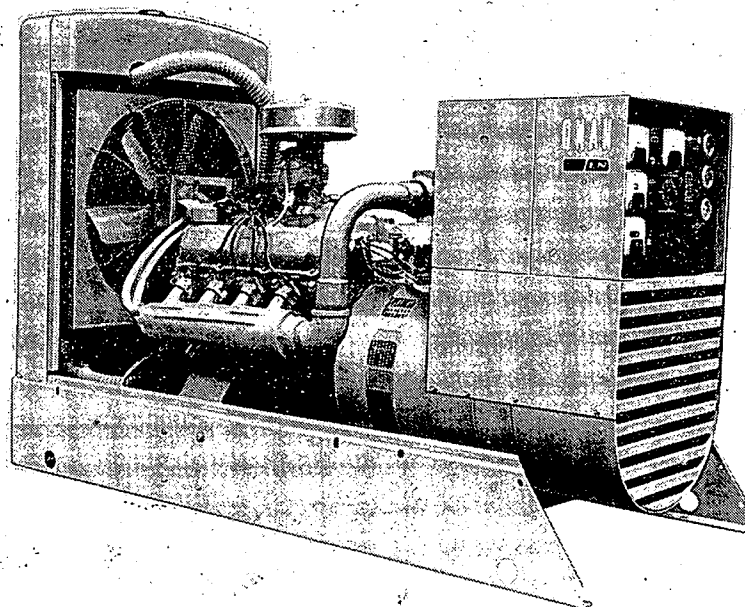


OPERATOR'S MANUAL AND PARTS CATALOG

FOR
EN
SERIES

ELECTRIC GENERATING SETS



FILE COPY
<i>EN</i> SECTION
RETURN TO FILE
ENGINEERING DEPT.

FORM NUMBER

g28-0303

ISSUE DATE

1A76

TABLE OF CONTENTS

TITLE	PAGE
Introduction	1
Safety Precautions	2
Specifications	4
Description	9
Installation	13
Operation	20
General Maintenance	25
Parts Catalog	32

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 EN Series electric generating sets each consisting of an ONAN UR generator, driven by a Ford GP-6005 A Engine. See *SPECIFICATIONS* for generator sizes.

The manual is divided into two sections.

Section 1 provides information on installation, operation and troubleshooting.

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

The manual should be used in conjunction with the 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.

70.0	EN	15R	/	1	A
1	2	3		4	5

1. Indicates Kilowatt rating (70 kW).
2. Factory code for SERIES identification.
3. 15 = 60 Hz. Reconnectible
515 = 50 Hz. Reconnectible
R—Indicates remote starting feature.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

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

Left side and right side are considered when viewed from the engine or front end of the generator 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

55 kW

ENGINE DETAILS

Engine Manufacturer	FORD
Engine Series	460 GP-6005 A
Number of Cylinders.....	V8
Displacement.....	460-in ³ (7.5 litre)
BHP @ 1800 r/min.....	111.5 (83.18 kW)
Compression Ratio	8.5:1
Bore	4.36-inch (110.74 mm)
Stroke	3.85-inch (97.79 mm)
Fuel	Gasoline
Battery Voltage	12V
Battery Group (one 12-Volt, 72 A.H. [259 kC]).....	3EE
Starting Method	Solenoid Shift
Governor Regulation.....	5% No Load—Full Load
Battery Charging Current	35-Amperes

GENERATOR DETAILS

Type.....	UR 15 60 Hz
Rating (Watts)	
60 Hertz Continuous Standby	55 000 (68.75 kVA)
AC Voltage Regulation.....	± 2%
60 Hertz r/min	1800
Output Rating	0.8 PF
AC Frequency Regulation.....	3 Hz

CAPACITIES AND REQUIREMENTS

Cooling System, Engine and Radiator	30-quarts (28 litres)
Engine Oil Capacity (Filter, Lines, Crankcase).....	7-quarts (6.6 litres)
Exhaust Connection (inches pipe thread)	3 (Female)

AIR REQUIREMENTS (1800 r/min)

Engine Combustion.....	190 ft ³ /min (0.09 m ³ /s)
Radiator Cooled Engine.....	8500 ft ³ /min (4.0 m ³ /s)
Total for Radiator Cooled Model	8690 ft ³ /min (4.1 m ³ /s)
Alternator Cooling Air	1000 ft ³ /min (0.5 m ³ /s)
Fuel Consumption at Rated Load	
Regular Gasoline	7.8 gal/hr (8.2 cm ³ /s)
Natural Gas	1000 BTU/ft ³ (37.25 MJ/m ³) 888 ft ³ /hr (0.42 m ³ /s)
Liquid Petroleum	2500 BTU/ft ³ (93.1 MJ/m ³) 355 ft ³ /hr (13.2 m ³ /s)

GENERAL

Height	52.5 inches (1.33 m)
Width	33.0 inches (0.88 m)
Length	76.31 inches (1.94 m)
Approximate Weight (Mass)	1881 lb (853 kg)

SPECIFICATIONS

70.0 kW

ENGINE DETAILS

Engine Manufacturer	FORD
Engine Series	460 GP-6005 A
Number of Cylinders.....	V8
Displacement.....	460-in ³ (7.5 litre)
BHP @ 1800 r/min.....	111.5 (83.18 kW)
Compression Ratio	8.5:1
Bore	4.36-inch (110.744 mm)
Stroke	3.85-inch (97.79 mm)
Fuel	Gasoline
Battery Voltage.....	12 VDC
Battery Group (one 12-Volt, 72 A.H. [259 kC]).....	3EE
Starting Method	Solenoid Shift
Governor Regulation.....	5% No Load—Full Load
Battery Charging Current	35-Amperes

GENERATOR DETAILS

Type.....	UR 15 60 Hz
Rating (Watts)	
60 Hertz Continuous Standby	70 000 (87.5 kVA)
AC Voltage Regulation.....	± 2%
60 Hertz r/min	1800
Output Rating	0.8 PF
AC Frequency Regulation	3 Hz

CAPACITIES AND REQUIREMENTS

Cooling System, Engine and Radiator	30-quarts (28 litres)
Engine Oil Capacity (Filter, Lines, Crankcase).....	7-quarts (6.6 litres)
Exhaust Connection (inches pipe thread)	3 (Female)

AIR REQUIREMENTS (1800 r/min)

Engine Combustion.....	190-ft ³ /min (0.09 m ³ /s)
Radiator Cooled Engine.....	8500-ft ³ /min (4.0 m ³ /s)
Total for Radiator Cooled Model	8690-ft ³ /min (4.1 m ³ /s)
Alternator Cooling Air	1000-ft ³ /min (0.5 m ³ /s)
Fuel Consumption at Rated Load (Regular Gasoline).....	9.0-gal/hr. (9.5 cm ³ /s)

GENERAL

Height	52.5-inches (1.33 m)
Width	33.0-inches (0.88 m)
Length	76.31-inches (1.94 m)
Approximate Weight (Mass)	1986-lb (901 kg)

TABLE 1.
UR GENERATOR VOLTAGE OPTIONS

55 kW 68.75 kVA 60 Hz

VOLTS	FREQ	PHASE	AMPERES	DOUBLE DELTA	SERIES DELTA	PARALLEL WYE	SERIES WYE	REF. VOLTAGE WIRE (W12) TAP
120/240	60 Hz	1	286*	x				H5
120/240	60 Hz	3	165		x			H5
120/208	60 Hz	3	191			x		H3
127/220	60 Hz	3	180			x		H4
139/240	60 Hz	3	165			x		H5
240/416	60 Hz	3	95				x	H3
254/440	60 Hz	3	90				x	H4
277/480	60 Hz	3	83				x	H5
9XR 347/600	60 Hz	3	66					H3—Not Reconnectible

* This current value is available only from special long stack unit (option B125). A standard 3-phase generator connected into a Double Delta configuration will deliver 2/3 current value shown (286 x .66 = 190-Amperes).

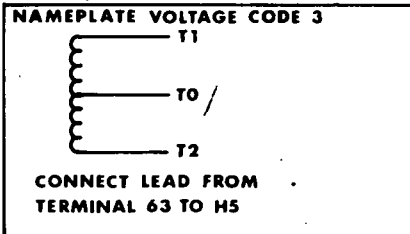
TABLE 1A.
UR GENERATOR VOLTAGE OPTIONS

70 kW 87.5 kVA 60 Hz

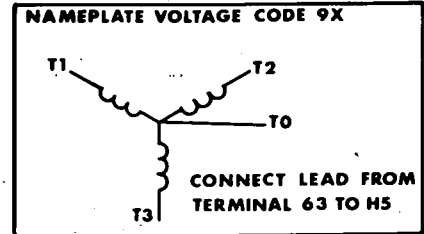
VOLTS	FREQ	PHASE	AMPERES	DOUBLE DELTA	SERIES DELTA	PARALLEL WYE	SERIES WYE	REF. VOLTAGE WIRE (W12) TAP
120/240	60 Hz	1	365*	x				H5
120/240	60 Hz	3	210		x			H5
120/208	60 Hz	3	243			x		H3
127/220	60 Hz	3	230			x		H4
139/240	60 Hz	3	210			x		H5
240/416	60 Hz	3	121				x	H3
254/440	60 Hz	3	115				x	H4
277/480	60 Hz	3	105				x	H5
9XR 347/600	60 Hz	3	84					H3—Not Reconnectible

* This current value is available only from special long stack unit (option B125). A standard 3-phase generator connected into a Double Delta configuration will deliver 2/3 current value shown (365 x .66 = 242 amperes).

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

98C2193

FIGURE 1. OPTIONAL VOLTAGE CONNECTIONS

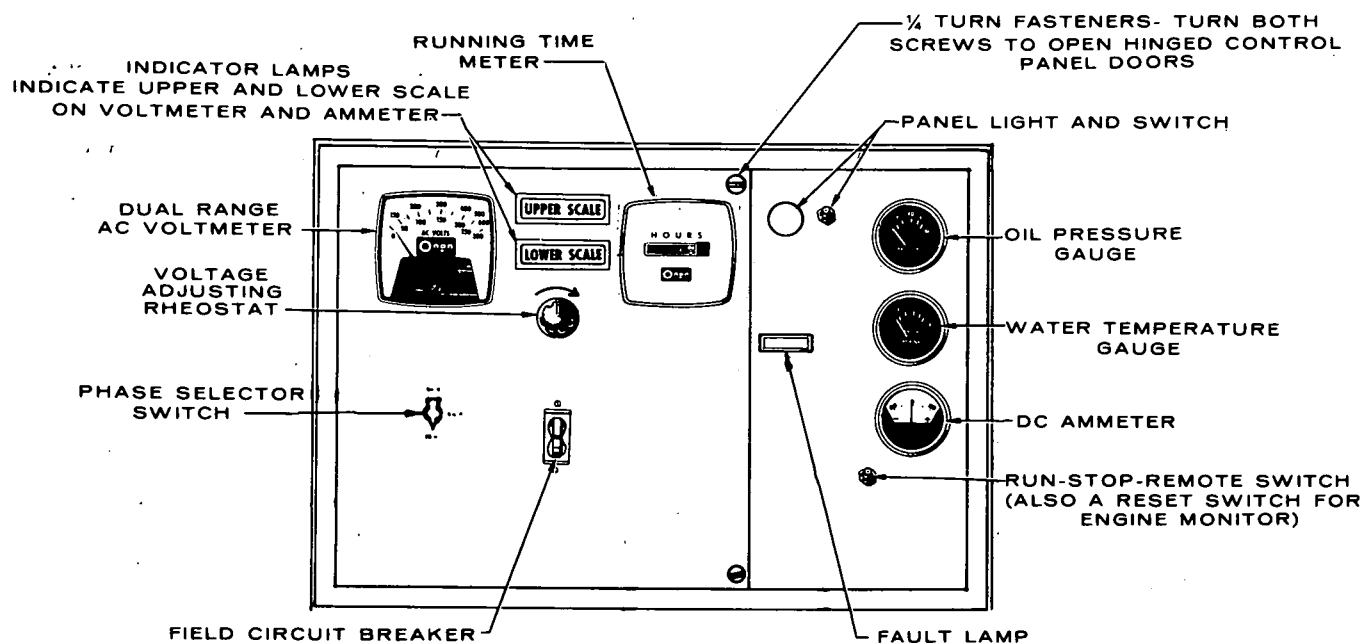


FIGURE 2. STANDARD CONTROL PANEL (ONE FAULT LAMP)

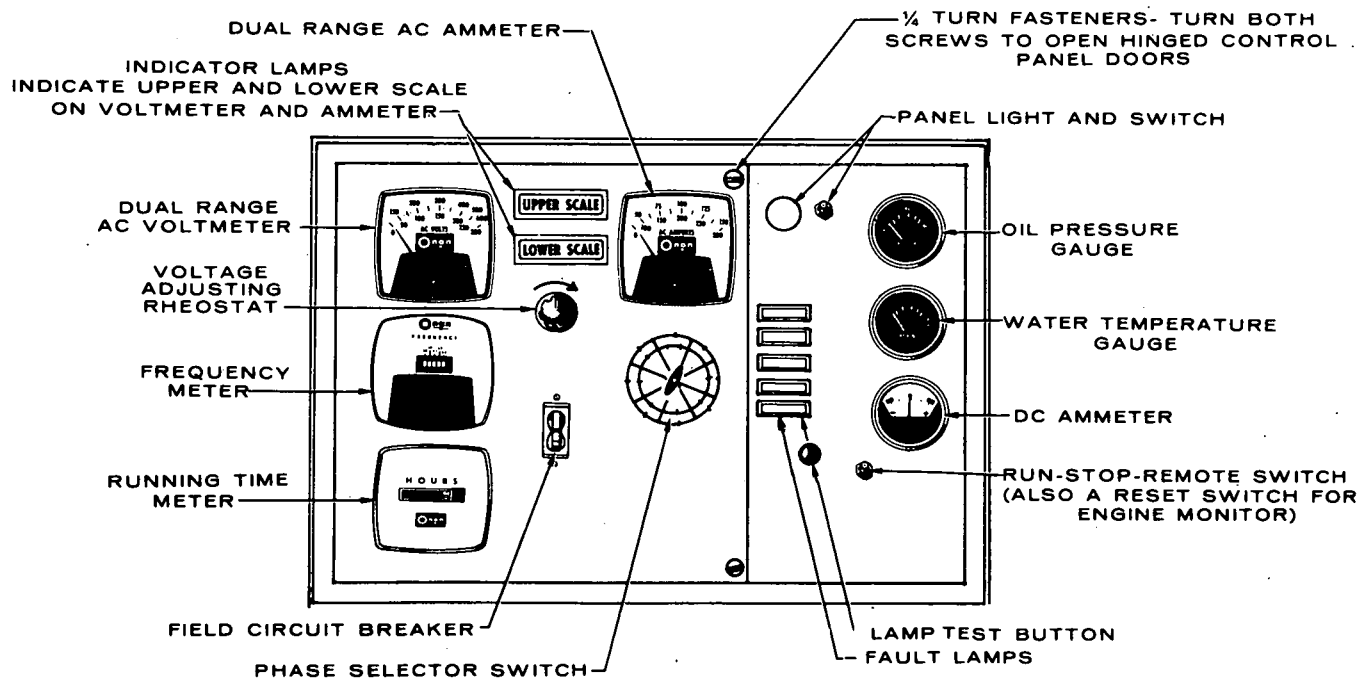


FIGURE 3. OPTIONAL CONTROL PANEL (FIVE FAULT LAMPS)

DESCRIPTION

GENERAL

An Onan EN 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 this unit is a Ford GP-6005A as described in the engine manual. Basic measurements and requirements will be found under *SPECIFICATIONS*. For operation, maintenance and service information, consult the Ford 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. Excitation is achieved as follows—

Residual alternating voltage 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 transfers control to 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 percent 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 shutdown.

Lamp Test: Press to test warning lamp bulbs (when engine is running only), on five light panels.

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.)

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

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 percent from no load to full load, at 0.8 PF.

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). See Figure 4.
 - c. Low oil pressure 14 psi (96.5 kPa).
 - d. High engine temperature 215° F (102° C).

CAUTION

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

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.

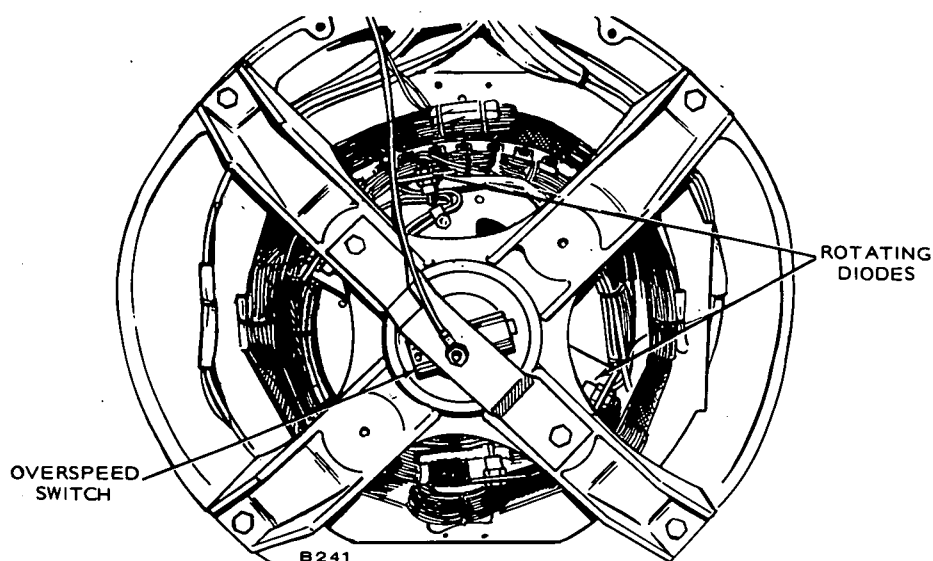


FIGURE 4. OVERSPEED SWITCH

TABLE 2. FAULT LAMP OPTIONS

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

* - With additional optional sensors.

ENGINE SENSORS

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

For location, refer to Figures 5 and 6. When changing a sensor, do not substitute, use recommended replacement parts. Resistance units are matched to the gauge they supply, and cut-off switches are close-tolerance actuation parts, made for a specific application.

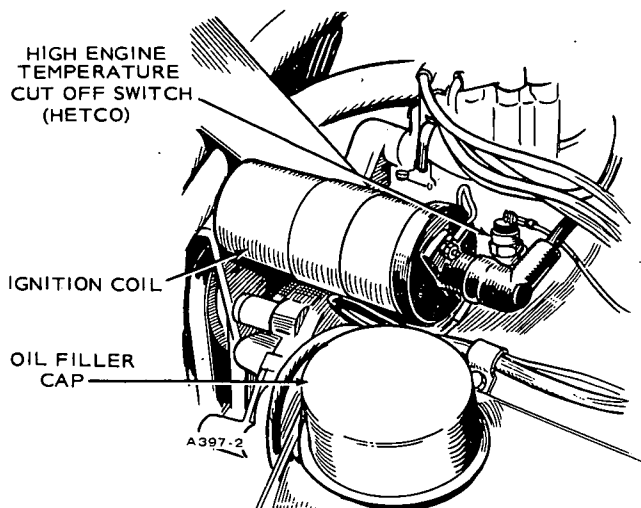


FIGURE 5. WATER TEMPERATURE MONITORS

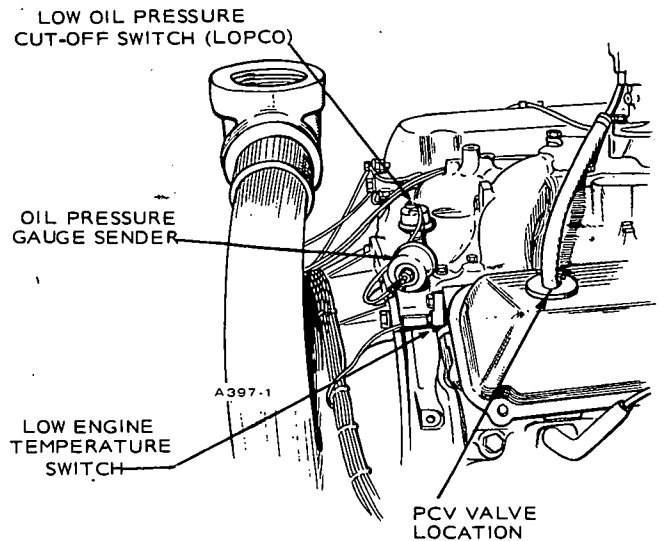
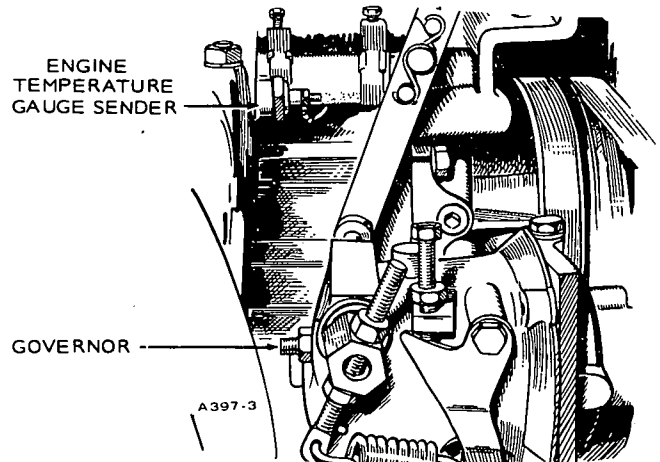


FIGURE 6. OIL PRESSURE MONITORS



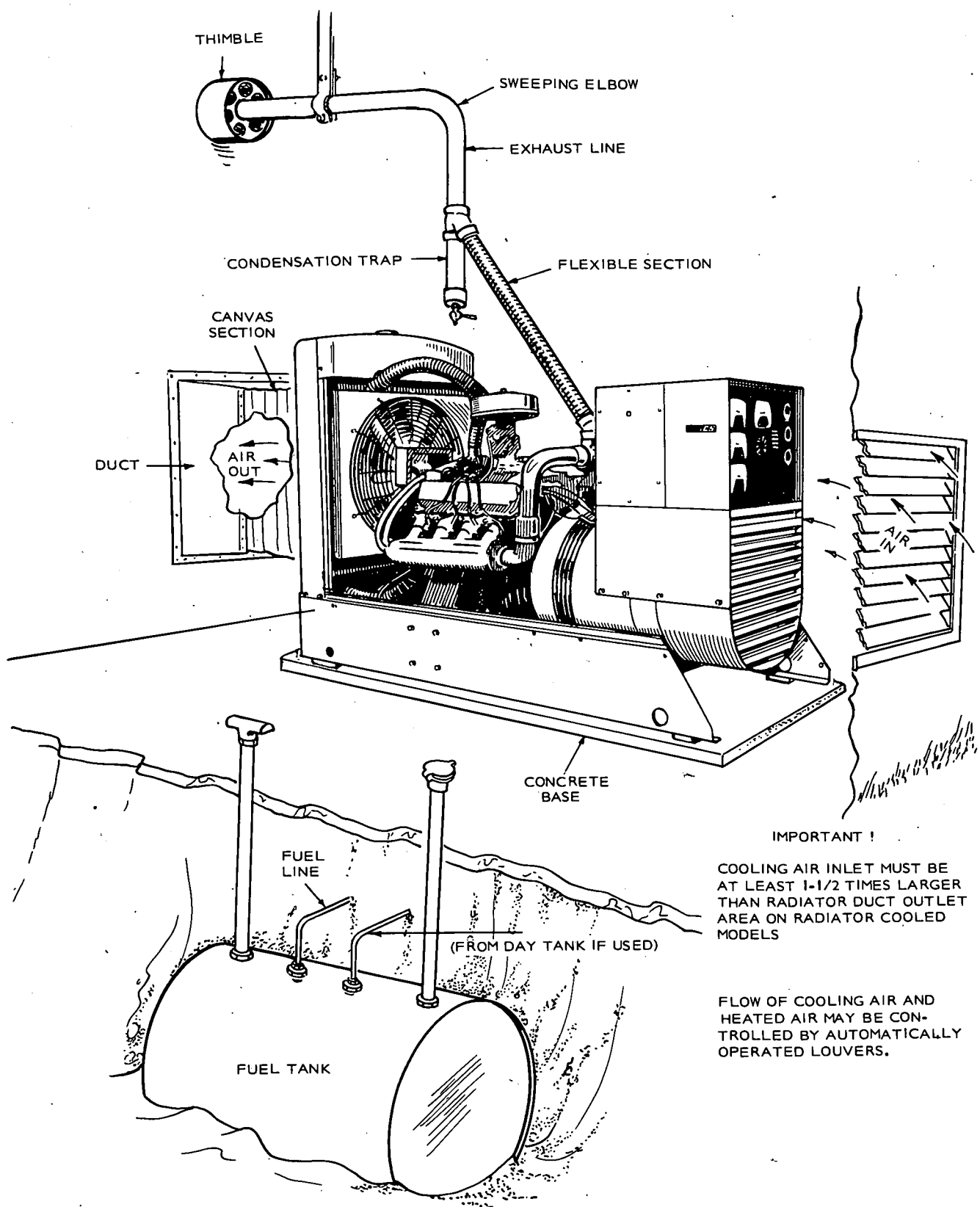


FIGURE 7. TYPICAL EN INSTALLATION

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). Refer to *ONAN Technical Bulletin T-030* for further installation information.

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.

VENTILATION

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

Radiator set cooling air travels from the rear of the set and is removed by a pusher fan which blows out through the radiator. Locate the air inlet to the rear of the set.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The opening free area must 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.

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. 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.

Installations require 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 lime, or other impurities.

This system reduces set enclosure airflow requirements 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.

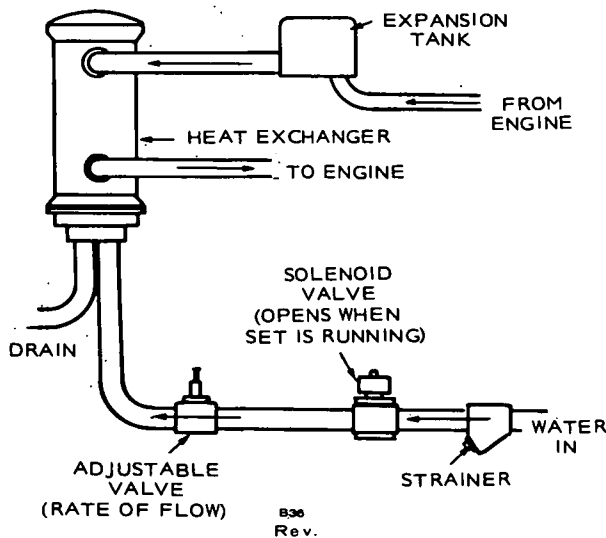


FIGURE 8. TYPICAL HEAT EXCHANGER SYSTEM

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 passages 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.

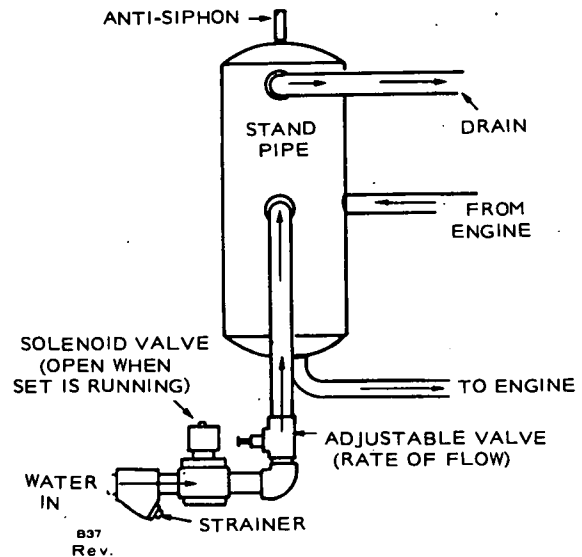


FIGURE 9. TYPICAL STANDPIPE SYSTEM

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.

Direct Flow Installation

With this system, a city or raw water cooling supply under pressure forces water directly into the engine, through the engine and to the outlet. An adjustable valve controls the incoming water flow rate to obtain correct engine water temperature, as measured at engine coolant water outlet while the generator set is operating under full load. A solenoid valve is coordinated with the generator set system to open during set operation.

CAUTION

Restrict inlet water pressure to a maximum of 7 psi or 48.3 kPa, otherwise engine gaskets and seals will leak.

Raw water cooling is often undesirable because:

1. The water supply must be very clean or engine deposits will result.
2. A high temperature differential between the cold incoming water into the engine and warm discharged water can put damaging stresses on engine components (no overall uniform engine temperature).

Water Cooled Manifolds

CAUTION

Severe damage will occur to water cooled manifolds if size or routing of water pipe is deviated from that of factory installation. This has been designed to allow maximum cooling of manifolds (see Figure 10).

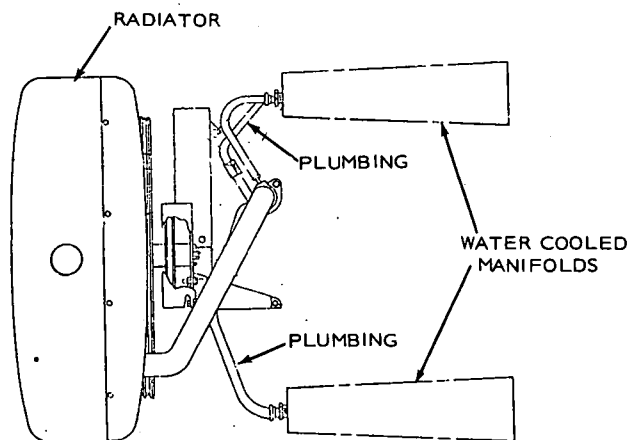


FIGURE 10. WATER COOLED MANIFOLDS

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 and applied load.

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.

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 3-inch (76.2 mm) pipe size outlet of the engine.

Suspend the pipe from the enclosure structure and attach to engine with a flexible section. Place muffler as close to engine as possible to reduce condensation damage and carbon fouling.

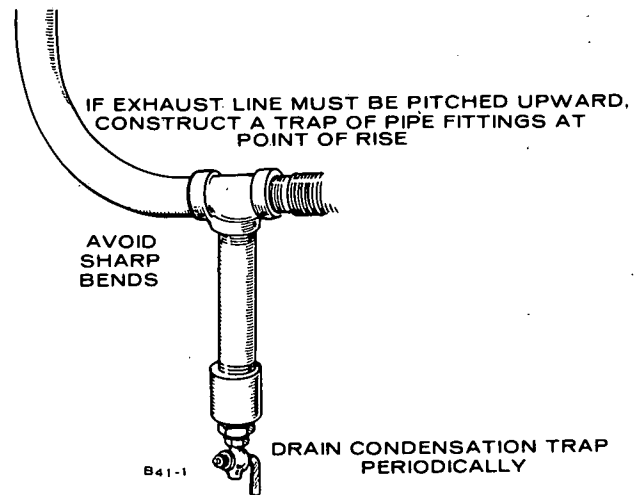


FIGURE 12. EXHAUST CONDENSATION TRAP

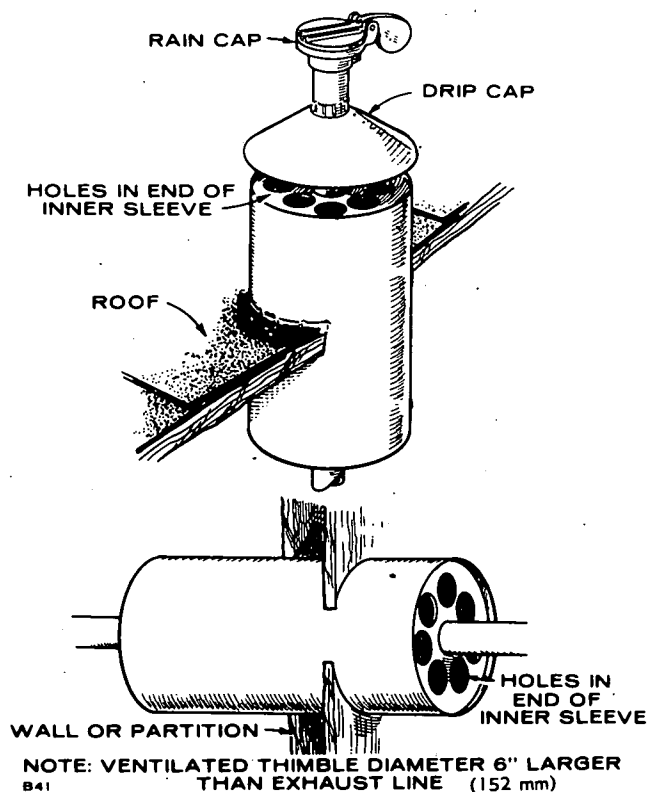


FIGURE 11. TYPICAL EXHAUST THIMBLE

A critical muffler recommended for this unit is sized for a 3½-inch (89 mm) exhaust pipe. Maximum allowable length of pipe for this diameter is 145-feet (44 m).

Maximum permissible exhaust restriction (back pressure) is 1.5-inches (38.0 mm) Hg.

FUEL SYSTEM

Ford engines used on EN sets are designed to operate on gasoline with an average regular grade of 90 octane.

FUEL CONNECTIONS

Before starting any type of fuel installation, ONAN recommends that the regulations described in Pamphlet 58 of the National Fire Prevention Association (NFPA) be studied. All pertinent state and local codes, most of which are governed by NFPA 58, must be complied with, and the installation must be inspected before the unit is put in service.

Fuels under pressure (e.g. natural gas or LPG) must be controlled by a positive shut off valve, preferably automatic, in addition to any valve integral with the carburetor or gas regulator equipment.

Connection of gasoline fuel inlet line requires a 1/8-inch pipe fitting to an adapter on skid base.

Lift to fuel pump should not exceed 6 feet (2 m), horizontal distance between set and fuel tank should not exceed 50 feet (15 m). Use 3/8-inch tubing up to 25 feet (12.5 m), 1/2-inch up to 50 feet (15 m).

Optional Day Tank

The engine may be equipped with a one quart reservoir tank to replenish fuel lost from the carburetor by evaporation during shutdown. See Figure 13. Connect a 5/16-inch return line between the reservoir upper side fitting (this fitting has a restricted orifice and must be used) and the main supply tank. Be sure the return line has a continuous drop to the main supply tank with no dip-and-rise where fuel could collect and form a vent seal. See that the top center opening of the tank is tightly plugged.

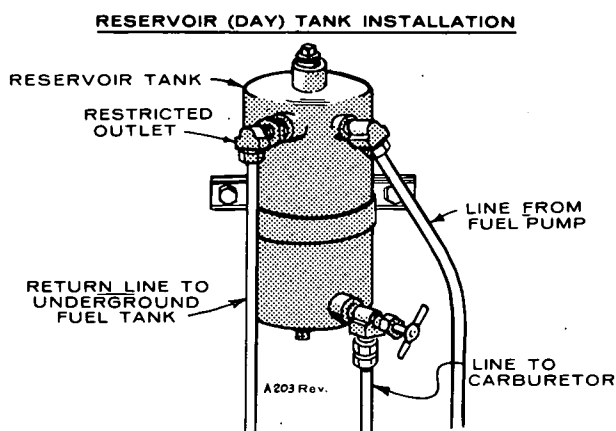


FIGURE 13. DAY TANK INSTALLATION

Natural or Manufactured Gas

On sets equipped with an Impco carburetor, gas pressure at the carburetor must be set at 3-ounces (1.3 kPa) gauge, or 5-inch (127 mm) water column, manometer, with the engine running at 1800 r/min on no load.

Thermac regulator is designed for a maximum line pressure of 6 ounces (2.6 kPa) gauge, or 10.38-inches (263.6 mm) water column, manometer.

If line pressure is excessive, install a suitable pressure reducing regulator. Be sure to comply with all local regulations such as:

- Recommended electric shutoff valve.
- Hand shutoff valve at the fuel source.
- Supply line filter.

Use a short length of approved flexible connection between the supply pipe and the set regulator inlet.

Combination Gas-Gasoline

Combination gas-gasoline sets are designed for normal operation on gas fuel, with provision for emergency operation on gasoline. Both gas and gasoline procedures must be followed. A reservoir tank is sometimes provided, so a fuel return line may be necessary as described for gasoline fuel.

BATTERY

Starting the unit requires 12-volt battery current. Use one 12-volt (see specification) battery for a normal installation. Connect the battery as in Figure 14. Necessary battery cables are on unit. Service battery as necessary. Infrequent set use (as in emergency standby service) may allow battery to self-discharge to the point where it 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.

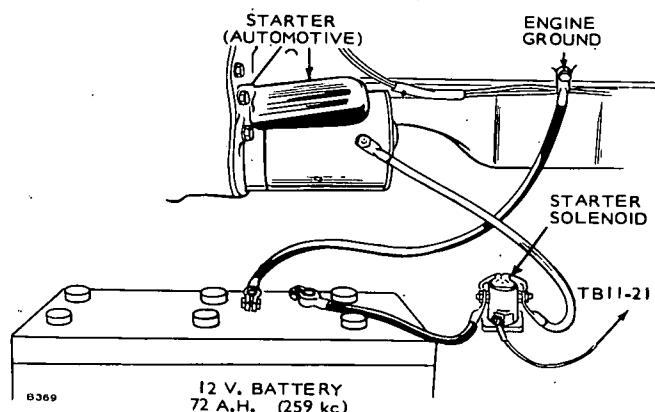


FIGURE 14. BATTERY CONNECTION

REMOTE CONTROL CONNECTIONS

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

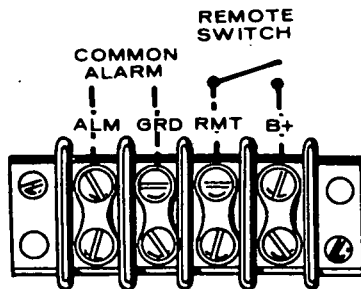


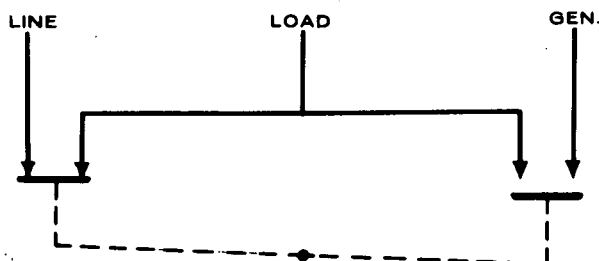
FIGURE 15. REMOTE START CONNECTION (TB12)

WIRING CONNECTIONS

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

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

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



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.

FIGURE 16. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

Control Box Connections

The factory ships these 12 lead generators with load 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 17.
2. Connect wires together as shown on panel drawing and in Figure 1 according to voltage desired.
3. Identify leads connected together, appropriately as L0, L1, L2 or L3 before making load connections.
4. 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 Figures 1 and 18.

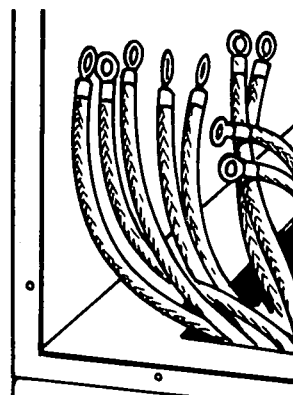


FIGURE 17. CONTROL BOX (SIDE PANEL REMOVED)

5. Close front panel and secure with 1/4 turn fasteners.
6. Connect load wires to generator leads through current transformers (see Figure 1).
7. Insulate connections as needed.

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

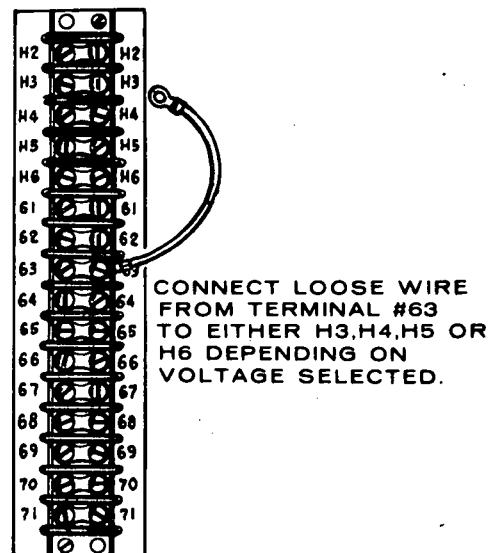


FIGURE 18. REFERENCE VOLTAGE CONNECTION (TB21)

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 19. 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.

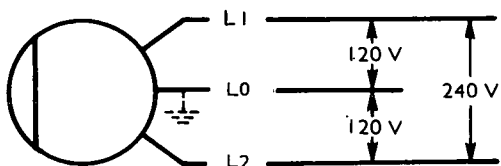


FIGURE 19. 120/240 V. 1-PHASE DOUBLE DELTA

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 20. 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.

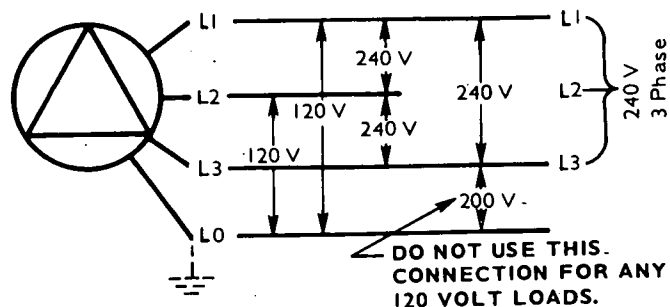


FIGURE 20. 120/240 V. 3-PHASE DELTA

3 Phase, Wye Connected Set: The 3 phase, 12 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 21.

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

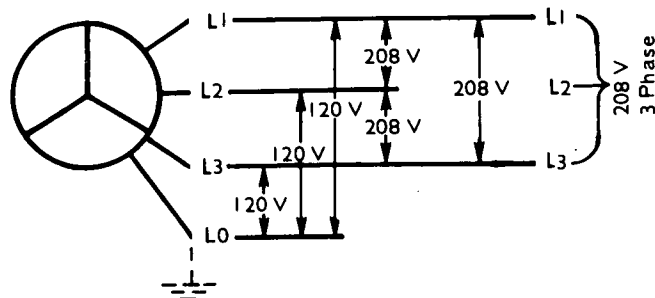


FIGURE 21. 120/208 V. 3-PHASE WYE

OPERATION

GENERAL

ONAN EN 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 safe mark (see Figure 23). Record total capacity for future oil changes. Do not mix brands nor grades of lubricating oils.

ENGINE OIL LEVEL DIPSTICK



FIGURE 22. OIL LEVEL DIPSTICK

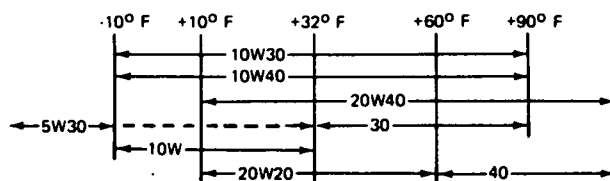


FIGURE 23. OIL VISCOSITIES

Oil capacities (nominal)

Oil Pan and Filter — 7-quarts (6.6 litres)

Cooling System

Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 30-quarts (28 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean soft water, and a permanent anti-freeze equal to 0°F (-17°C) protection, to guard against corrosion and coolant boiling. 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 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 set to allow coolant chambers to fill. Overheating and damage to the engine could result from non-compliance.

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

If the set uses gasoline fuel, see that the fuel supply tank is properly filled with automotive "regular" gasoline. Do not use highly leaded premium grade gasoline. Check with the fuel supplier for assurance that the fuel supplied meets the specifications. Make every effort to keep the fuel supply clean.

If the set is equipped for gas fuel, see that the fuel supply is turned on. Observe all safety precautions regarding the use of gas fuel.

Combination Gas-Gasoline

A set designed for normal operation on gas fuel with provision for emergency operation on gasoline fuel, is equipped with a gas-gasoline toggle switch. Throw the switch to the appropriate position according to the type of fuel in use.

Check all connections in fuel system for security, to ensure that pressure will not bleed off when engine is not in use. Pressure should be maintained for immediate starting if unit is on standby service.

BATTERIES

Ensure that the cable connections to the batteries are secure. Coat connections with 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.
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- and 55-psi (207- and 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° to 195° F (82° to 90° C). On city water cooled units an adjustable valve is connected in the water supply line. Adjust the hand wheel valve to provide a water flow that will keep the water temperature gauge reading within the range of 165° F to 195° F (74° C to 90° C).

Break-In Note

Run set at 50 percent 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.

If a restart attempt is made within two minutes of shutdown, engine will crank approximately 15-seconds before start.

STOPPING

To reduce and stabilize 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.

NO LOAD OPERATION

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

EXERCISE PERIOD

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

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

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

HIGH ALTITUDE

Ratings apply to altitudes up to 1000 feet (304 m) standard cooling, normal ambients and specified fuels. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

Engine horsepower loss is approximately 3 percent for each 1000 feet (304 m) of altitude above sea level for a naturally aspirated engine. 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 manual for further information.

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

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

*NOTE: Not applicable on Pennsylvania State models.

OUT-OF-SERVICE PROTECTION

Generator sets removed from service for extended periods of time should be protected from rust and corrosion. Onan recommends the following protective procedure—

For One Month

1. Run the engine at 1800 r/min and treat the upper cylinders by spraying an engine preservative oil (SAE 10) into the carburetor air intake for about two minutes. Shut off the ignition and allow the engine to come to a stop while continuing to spray the oil into the carburetor air intake. Disconnect and remove battery. Follow standard battery storage procedure. Apply film of non-conductive grease to terminal lugs.
2. Leave spark plugs installed and cover all engine openings with dust-proof caps or shields.
3. Drain oil, water and gasoline.

For Indefinite Period

1. Drain crankcase completely and refill with an engine preservative oil (SAE 10).
2. Run engine until it is completely out of gasoline, then restart and run it on an unleaded, undyed gasoline for at least 10 minutes. Run engine at 1800 r/min and treat upper cylinders by spraying an engine preservative oil (SAE 10) into the carburetor air intake for about two minutes. Shut off the ignition and allow the engine to come to a stop while continuing to spray the oil into the carburetor air intake.
3. Disconnect and remove battery. Follow standard battery storage procedure. Apply film of non-conductive grease to terminal lugs.
4. Drain oil and gasoline. Drain water at the bottom of the radiator and side of block.
5. Service air cleaner.
6. Remove all grease and oil from the exterior surfaces of the engine.
7. Leave spark plugs installed.
8. Clean throttle and governor linkage. Protect by wrapping with clean cloth.
9. Seal all engine openings and accessories with water resistant adhesive tape. Mask off all areas to be used for electrical contact.
10. Make sure all surfaces are dry, then spray all taped openings, all engine accessories including ignition wiring, and all exterior surfaces of the engine with an ignition insulation compound.
11. Fill fuel tank to prevent condensate contamination.
12. Provide suitable cover for entire unit.

RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping.
2. Perform *PRESTART SERVICING* section in entirety.
3. Verify that no loads are connected to the generator.
4. Start engine.

After engine has started, excessive blue smoke will be exhausted and the engine will run rough until the rust inhibitor or oil has burned away.

5. After start, apply load to at least 50 percent of rated capacity.
6. Check all gauges to be reading correctly. Unit is ready for service.

BATTERY, HOT LOCATION

Batteries will self discharge very quickly when installed where the ambient temperature is consistently above 90°F (32.3°C), such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.275 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90°F (32.3°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 an 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.

GENERAL MAINTENANCE

GENERAL

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

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

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

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

WARNING

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

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	10	50	200	400
Inspect Complete Set for Leaks, etc.	x1			
Check Engine Oil Level	x1			
Check Radiator Coolant Level	x1			
Check Fuel	x1			
Check Governor Oil Level* (Pierce only)		x		
Check Air Cleaner (Clean or Replace as Necessary)		x2		
Check Electrolyte Level of Battery		x6		
Stop-Solenoid Linkage, Lubricate Governor Linkage*		x2		
Change Engine Oil & Filter		x2		
Check all Hardware, Fittings, Clamps, Fasteners, etc.		x4		
Adjust Drive Belt Tension			x3	
Change Governor Oil* (Pierce only)			x	
Clean Fuel Lift Pump			x	
Clean Sediment Bowl & Filter			x	
Check Starter			x5	
Clean & Inspect Battery Charging (DC) Alternator			x	
Check AC Generator			x	
Inspect Spark Plugs, Replace if Necessary			x	
Replace Fuel Filter Element				x2
Adjust Valve Clearances				x
Inspect Ignition Points, Replace if Necessary*				x

x1 - As noted or 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 - Or every 3 months.

x5 - Oil front bearing sparingly; check brushes.

x6 - Or every two weeks.

* - See Figure 34.

NOTE: The above schedule is a minimum requirement.

ENGINE

General

Basic maintenance procedures are contained within the Ford manual, which should be used in conjunction with the set manual, except in such cases where instructions state otherwise. Then, the new information unique to the EN set shall take precedence.

Air Filter

Remove wing nut in center of filter cover. See Figure 24. Remove cover and filter. Tap filter on a flat surface to remove adherent dirt. Place a light source inside the filter and inspect for free air passage. If necessary, apply a low pressure air source (30-psi [207 kPa] OSHA) to the inside of the filter to remove as much dirt as possible. Inspect interior housing. Vacuum clean if dirty, or remove housing and wipe clean.

CAUTION Do not clean filter housing while still installed. Loose dirt entering intake could damage carburetor or engine.

Replace air filter every 50 hours of operational time, more often in extremely dusty conditions.

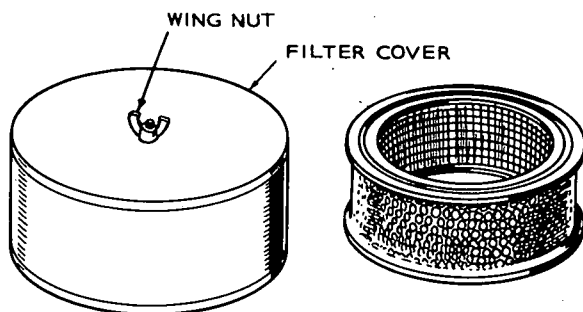


FIGURE 24. AIR CLEANER

Engine Oil Filter

Spin-off type, should be replaced with every oil change, at 50 hours of operational time.

Remove and discard old filter, wipe oil from exposed adapter recess. See Figure 25. Coat gasket of new filter with clean lubricating oil and place in position on adapter. Hand-tighten filter until gasket contacts adapter face, then advance one-half turn. DO NOT OVERTIGHTEN.

Clean all oil residues from engine, then fill crankcase. Refer to *Prestart Servicing*. Run engine and check for oil leaks; make necessary repairs. Note oil change in engine logbook.

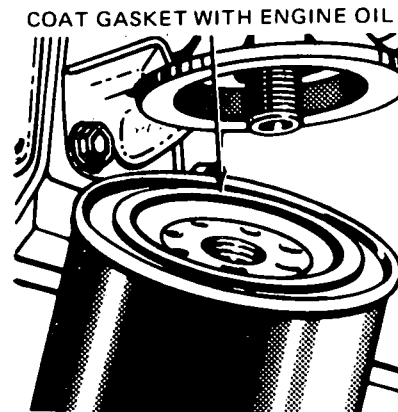


FIGURE 25. OIL FILTER ASSEMBLY

Fuel Filter

Replace filter every 200 operational hours or as conditions require. Unscrew the filter housing from the fuel pump (Figure 26) and remove the filter element and gasket. Discard the element and gasket. Clean the filter housing in a petroleum cleaning solvent.

Place a new filter element over the spout in the fuel pump valve housing cover.

Be sure to use the proper type element for the installation.

Coat a new gasket with a light engine oil and position the gasket on the filter housing. Screw the filter housing onto the fuel pump. Hand tighten the filter housing until the gasket contacts the pump, and then advance it 1/8 turn. Start the engine and check for leaks.

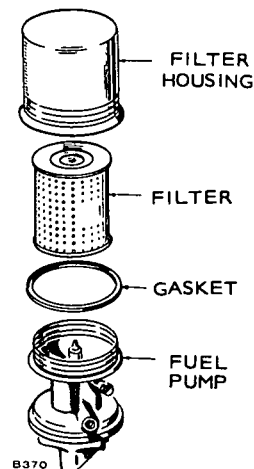


FIGURE 26. FUEL FILTER ASSEMBLY

Crankcase Ventilation (PCV) Valve

Push fit in valve rocker cover. Remove and clean at every oil change. After cleaning, shake valve to ensure ball is free, then reinstall.

CARBURETORS

The following carburetors were installed by ONAN for a specific application and engine output. Use these instructions and adjustment procedures in preference to those given in the Ford engine manual.

Carburetor, Gasoline

Carburetors have main and idle adjusting needle valves. The main adjusting needle, at the bottom of the carburetor, affects operation at heavier load conditions. The idle adjusting needle, at the side of the carburetor, affects operation at light and no load conditions. For location of adjustments, see Figure 27.

Under normal circumstances, factory carburetor adjustments should not be disturbed. If adjustments have been changed, an approximate setting of 1-1/2 turn open for idle needle and one turn open for main needle will permit starting. Adjust temporarily for smoothest running. Allow engine to thoroughly warm up before making final adjustment.

To adjust "idle" (no load) needle, see that no loads are connected to the generator. Slowly turn idle adjusting needle out until engine speed drops slightly. Turn needle in just to the point where speed returns to normal.

To adjust main needle, apply a full electrical load. Turn the main needle in until engine speed begins to drop. Slowly turn needle out until speed no longer rises. Try various electrical loads. If engine speed

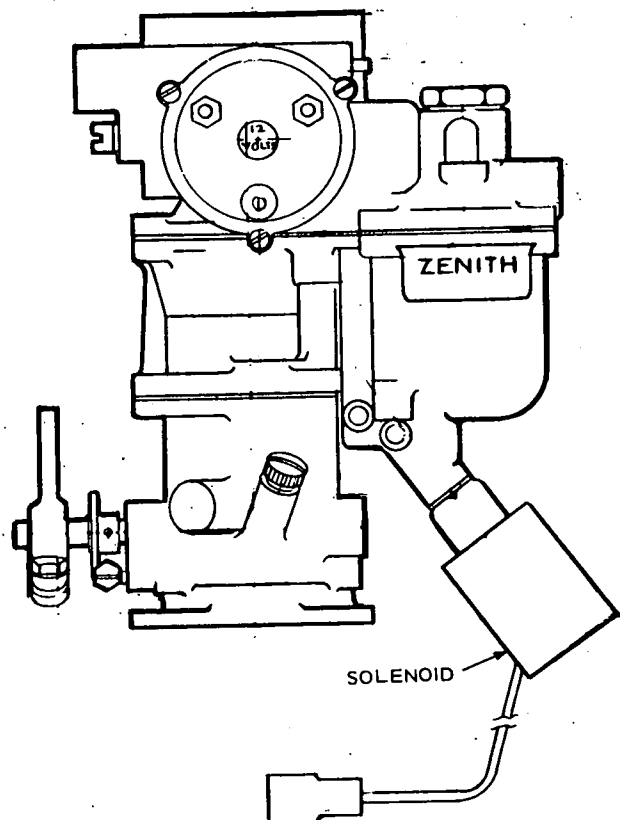


FIGURE 27. GASOLINE CARBURETOR

fluctuates at any load, turn main adjusting needle out slightly. Do not turn out more than 1/2 turn beyond original full load setting. If stable speed cannot be obtained by such carburetor adjustment, a change in governor sensitivity adjustment will probably be necessary.

Combination Carburetor, Gas Operation

If the engine is equipped with a combination carburetor (Figure 28), see that the gasoline shut-off valve is closed. The electric choke must be adjusted so that the adjustable cover is turned 10 to 12 notches counterclockwise from the "*" mark. When properly adjusted, the electric choke will be completely open even at very low temperatures.

Gas fuel main adjustment should be made at full load only.

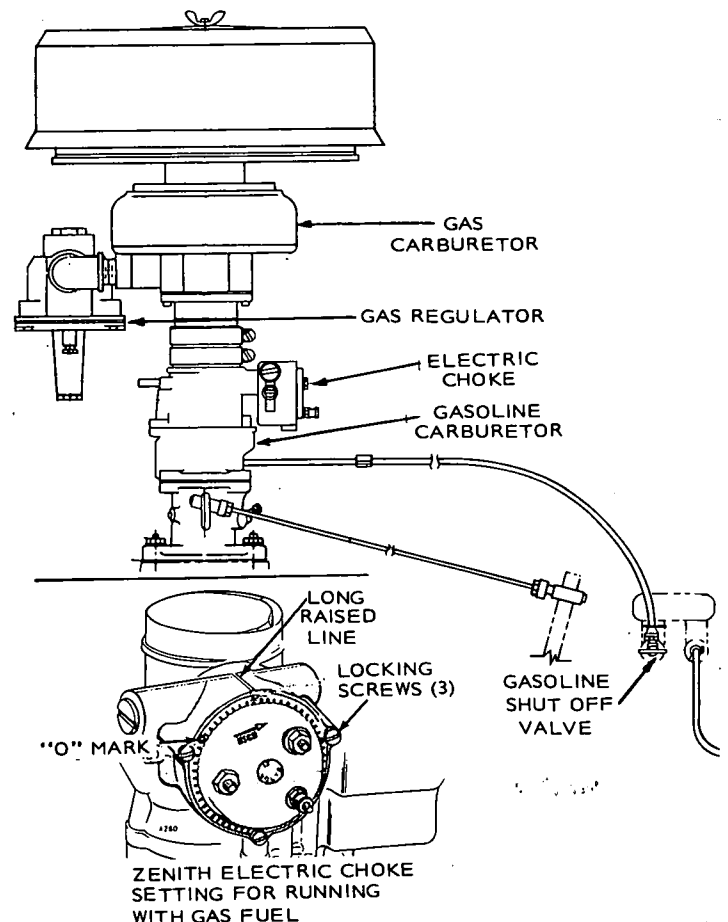


FIGURE 28. COMBINATION CARBURETOR

Carburetor, Gas

Engines equipped for natural gas operation use a gas carburetor with combined regulator. Carburetor adjustments are the same as the combination gas-gasoline carburetor.

Electric Choke

A 12 volt electric choke (Figure 29) with vacuum booster is used on all engines. The adjustable choke cover is held in place by three screws. Perimeter of the cover is divided into sections by small raised marks. One mark is labeled zero and the twelfth mark from zero is labeled with an asterisk (*), which indicates normal adjustment setting. A long raised line on top of the choke housing is used as the reference mark. Normal setting for the choke is made when the asterisk mark lines up with reference line.

If overchoking occurs, loosen three locking screws and turn choke cover slightly to the left (counterclockwise). Do not turn very far. One or two notches will usually be sufficient. Tighten locking screws. To increase choking action, turn choke cover slightly to the right (clockwise). Retighten cover screws.

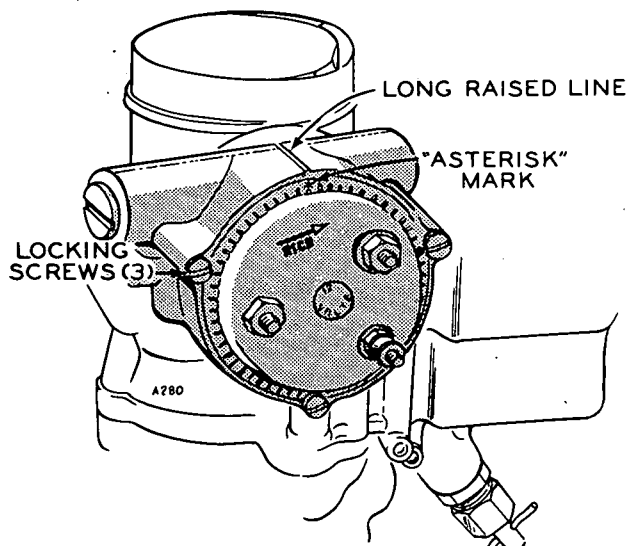


FIGURE 29. ELECTRIC CHOKE

Governor

The governor controls the speed of the engine, and therefore the frequency of the voltage. Engine speed affects AC output voltage. Use either a tachometer or frequency meter to check engine speed for proper governor adjustment.

1. **Governor linkage**—With engine stopped, throttle held wide open, and tension on governor spring, adjust the governor linkage length by rotating the ball joint on the link so that the throttle stop lever clears the stop pin by not less than 1/32-inch.
2. **Warm up**—Start the engine and allow it to reach operating temperature.
3. **Speed**—With no electrical load connected, adjust the speed adjusting screw to obtain 1890 r/min (63 hertz). Apply a full electrical load. The speed drop from the no load figure should be no more than 90 r/min (3 hertz) and no less than 45 r/min (1-1/2 hertz). An incorrect speed drop from no load to full load necessitates a sensitivity adjustment.
4. **Sensitivity**—If engine tends to hunt (alternately increase and decrease speed) under load conditions, increase sensitivity screw on which the spring link pivots.
Any change in the setting of the sensitivity screw will require correcting the speed screw adjustment. Turning the sensitivity screw clockwise causes a slight speed increase which can be corrected by turning the speed screw slightly counterclockwise to decrease spring tension.
5. **General**—Be sure that all lock nuts are tightened as adjustments are completed. Governors cannot operate properly if there is any binding, sticking, or excessive looseness in the connecting linkage or carburetor throttle assembly. A lean fuel mixture, or a cold engine may cause hunting.
6. **Output**—Check the AC output voltage.

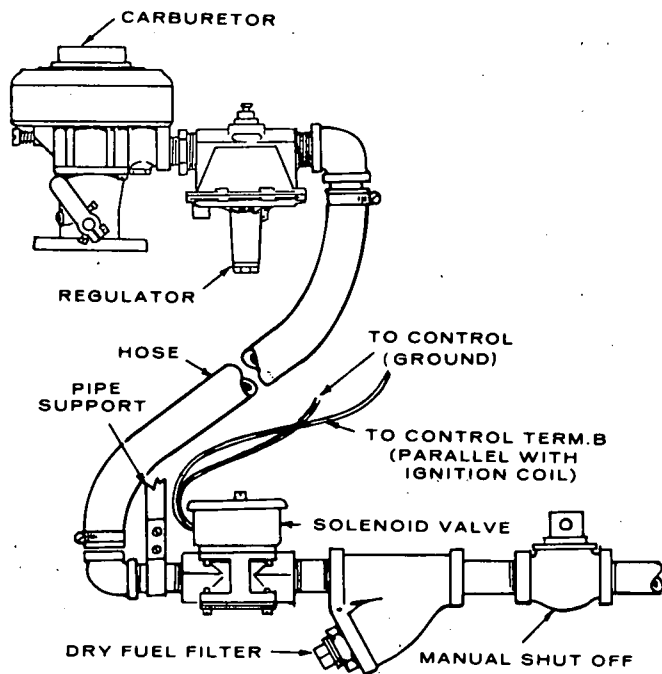


FIGURE 30. LPG VAPOR WITHDRAWAL

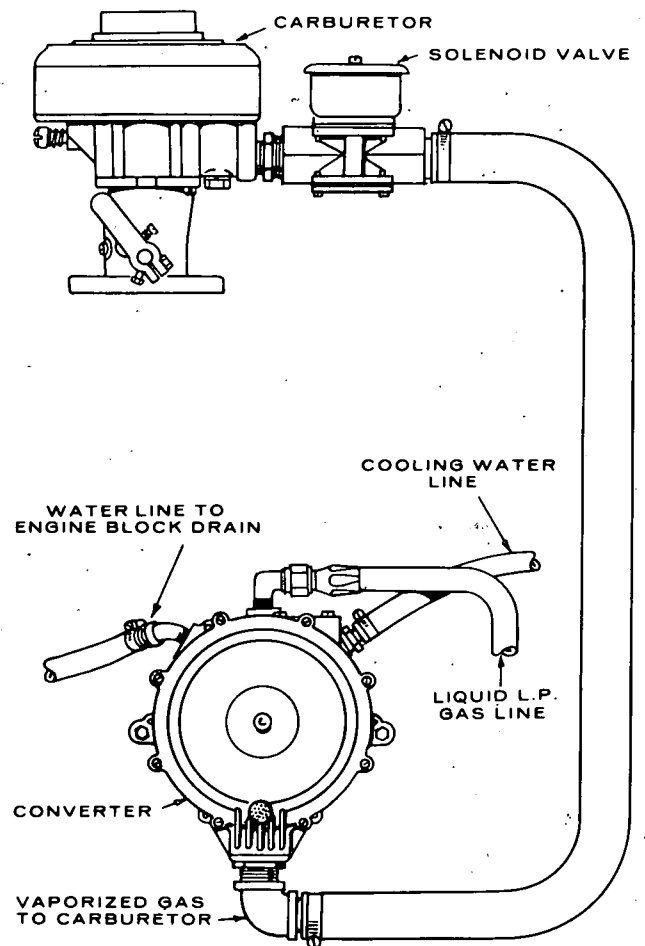


FIGURE 31. LPG LIQUID WITHDRAWAL

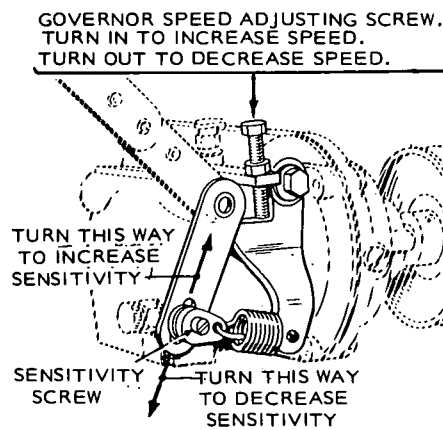


FIGURE 32. GOVERNOR ADJUSTMENT

Drive Belt Adjustment

Separate belts are used to drive fan, governor and alternator (Figure 33). Maintain correct adjustment of these belts to provide proper engine cooling and alternator output. Check belts for cracks and wear occasionally, and replace when necessary.

To adjust fan belt, loosen fan bracket screws, then move bracket up or down until a deflection of 1/2 inch (13 mm) is obtained between crankshaft pulley and fan pulley, with light thumb pressure on the belt.

To adjust alternator or governor belt, loosen link clamp screw and the mounting bolts, move alternator or governor toward or away from engine until a deflection of 1/2 inch (13 mm) is obtained between pulleys, with light thumb pressure on belt.

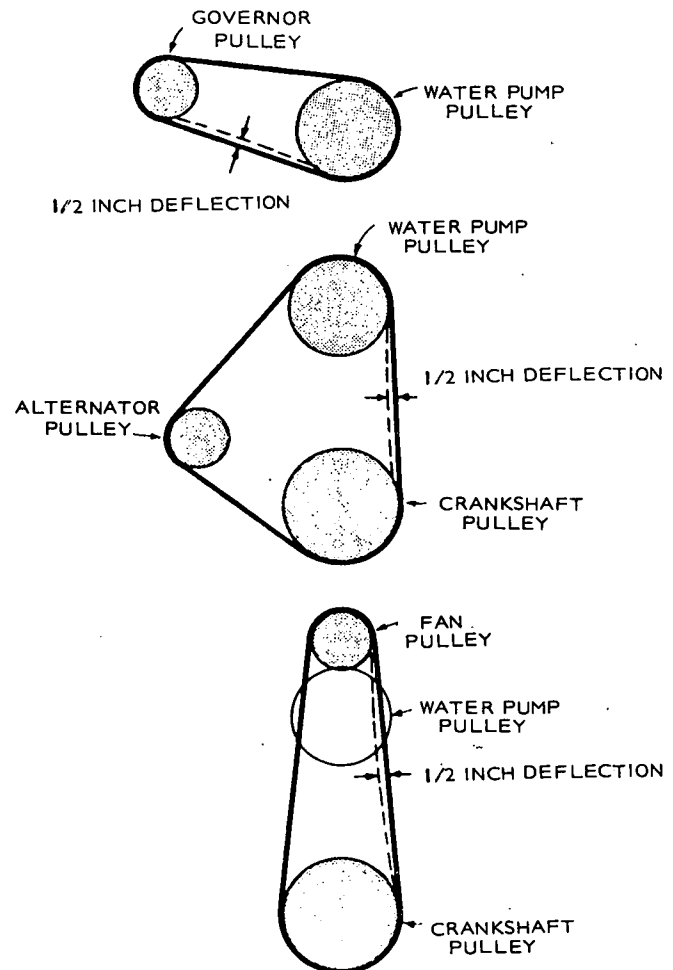


FIGURE 33. DRIVE BELT ADJUSTMENT

BATTERIES

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water.

TUNE UP

ONAN suggests that the following specifications for tune up be used in preference to those given in the Ford manual. This is due to a difference in r/min (no idle speed) and removal of automatic vacuum advance.

TABLE 6. TUNE-UP SPECIFICATIONS

ADJUSTMENTS	
Spark Plug Gap	0.035-inch (0.889 mm)
Spark Plug Torque	10-15 lbs-ft (13.56-20.34 N•m)
Ignition Points—Gap Setting	0.017-inch (0.431 mm)
Dwell Angle	24° - 30°
Valve Clearance Setting	Zero Lash

CONNECTIONS (Fuel, Exhaust, etc.)

Operator should periodically make a complete visual inspection of the unit while running at rated load.

Some of the things to check for are as follows:

1. Check 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 for security.

MAINTENANCE

Refer to Table 5 for *Operator Maintenance Schedule*.

Governor oil level should be even with bottom of the oil level plug. When adding oil to the governor, the oil should just start to flow out of the oil level plug hole. Do not overfill.

AC GENERATOR

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

Inspection

Inspect generator and control box for loose or broken wires and parts. Check diodes and printed circuit boards for excessive dust, greast or moisture. Blow these assemblies out periodically with filtered, low pressure, compressed air.

CAUTION

Excessive foreign matter on diodes and heat sinks will cause overheating and possible failure.

Generator Bearing

Inspect the bearing for evidence of outer case rotation every 1000 hours while the unit is running.

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

Deterioration of the bearing grease due to oxidation makes this replacement necessary.

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

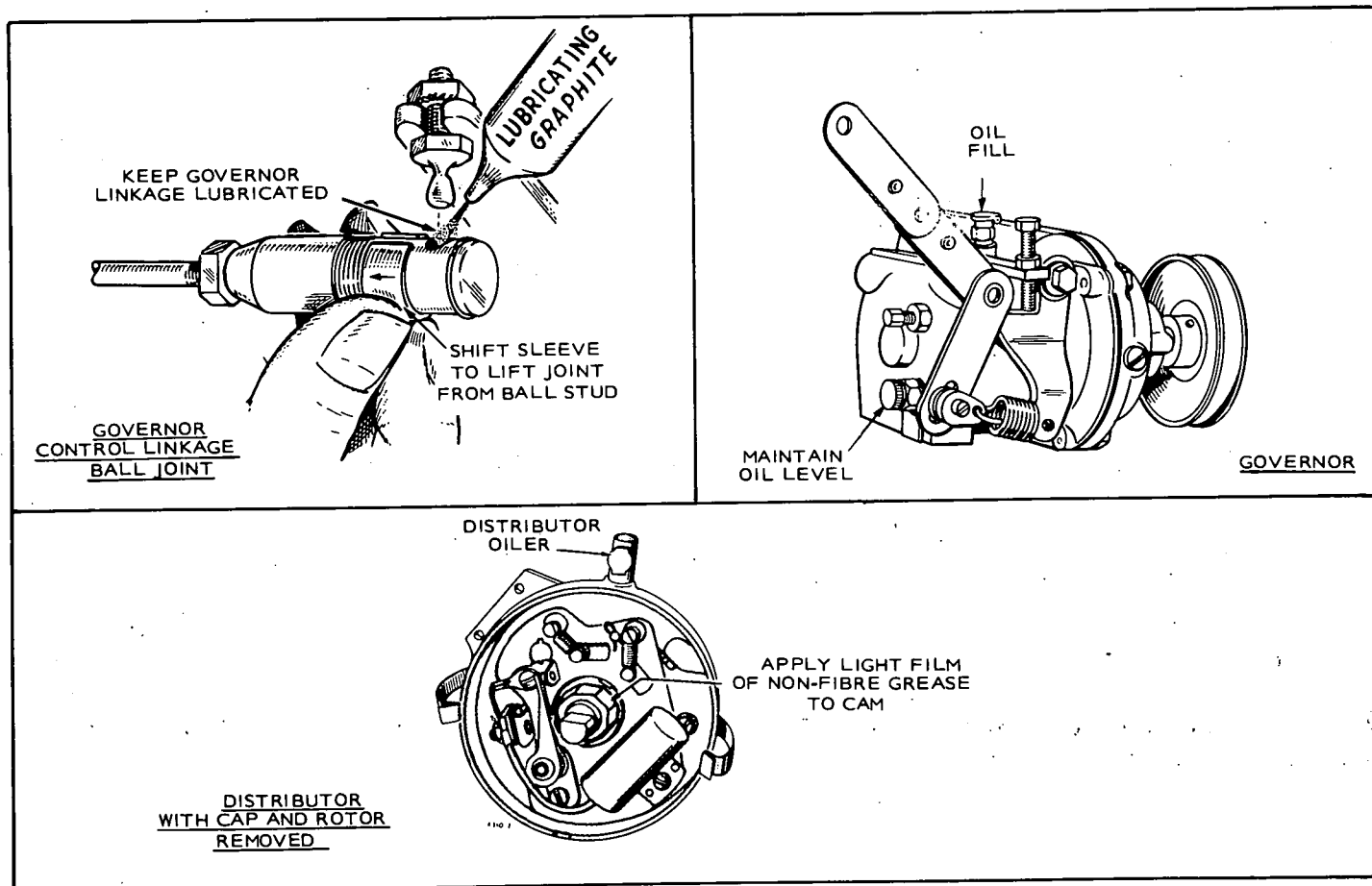


FIGURE 34. MAINTENANCE

PARTS CATALOG

INSTRUCTIONS FOR ORDERING REPAIR PARTS


ONAN PARTS

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

Onan ELECTRIC GEN SET																																																					
MODEL																																																					
SERIAL NO.																																																					
IMPORTANT - ALWAYS GIVE ABOVE NOS. WHEN ORDERING PARTS																																																					
<table border="1"> <tr> <td colspan="2">CONTINUOUS</td> <td colspan="2">RATING</td> </tr> <tr> <td colspan="4">HERTZ - 60 RPM - 1800</td> </tr> <tr> <td colspan="2">3 PHASE</td> <td colspan="2">1 PHASE</td> </tr> <tr> <td>KW</td> <td>KVA</td> <td>KW</td> <td>KVA</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="4">VOLTS 120/208 127/220 139/240 120/240/416</td> </tr> <tr> <td colspan="4">AMPS</td> </tr> <tr> <td colspan="4"></td> </tr> <tr> <td colspan="4">VOLTS 254/440 277/480 347/600 120/240</td> </tr> <tr> <td colspan="4">AMPS</td> </tr> <tr> <td colspan="4"></td> </tr> <tr> <td colspan="4">BAT. VOLTS</td> </tr> <tr> <td colspan="4"></td> </tr> </table>		CONTINUOUS		RATING		HERTZ - 60 RPM - 1800				3 PHASE		1 PHASE		KW	KVA	KW	KVA					VOLTS 120/208 127/220 139/240 120/240/416				AMPS								VOLTS 254/440 277/480 347/600 120/240				AMPS								BAT. VOLTS							
CONTINUOUS		RATING																																																			
HERTZ - 60 RPM - 1800																																																					
3 PHASE		1 PHASE																																																			
KW	KVA	KW	KVA																																																		
VOLTS 120/208 127/220 139/240 120/240/416																																																					
AMPS																																																					
VOLTS 254/440 277/480 347/600 120/240																																																					
AMPS																																																					
BAT. VOLTS																																																					
MANUFACTURED BY ONAN DIV. OF ONAN CORPORATION MINNEAPOLIS, MINN. 55432, U.S.A. FOR ELECT. EQUIPMENT ONLY																																																					

FORD PARTS

All Ford parts must be ordered from the Ford Motor Company of Dearborn, Michigan, or their nearest authorized distributor. When ordering parts, refer to the Ford nameplate and give the complete SERIAL, TYPE and OPTIONS NUMBER.

 REG. U.S. PAT. OFF. INDUSTRIAL ENGINE SERIAL	
<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	
TYPE	OPTIONS
<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

This catalog applies to the standard EN generator sets as listed below. These sets are powered by a Ford engine (see Ford Manual). Engine parts modified or added by Onan will be in this list and have Onan part numbers. These supersede similar parts listed in the Ford manual. Onan parts are arranged in groups of related items and are identified by a reference. All parts illustrations are typical. Using the Model and Spec No. from the ONAN nameplate, select the Parts Key No. (1, 2, etc., in the last column) that applies to your set. This Parts Key No. represents parts that differ between models. Unless otherwise mentioned, parts are interchangeable. Right and left sides are determined by facing the front end of the engine.

GENERATOR SET DATA TABLE

MODEL AND SPEC NO.*	ELECTRICAL DATA				PARTS KEY NO.
	WATTS	HERTZ	PHASE	WIRE	
55.0 EN-53R/	55,000	60	1	3	1
55.0 EN-515R/	55,000	60	£	12	
55.0 EN-9XR/	55,000	60	3	4	
70.0 EN-3R/	70,000	60	1	3	2
70.0 EN-15R/	70,000	60	£	12	
70.0 EN-9XR/	70,000	60	3	4	

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

£ - These sets are reconnectible; refer to Specifications (Generator Details).

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

REPLACEMENT ENGINE

100-1334

1

Ford Motor Company Model 460 GP6005A5030B

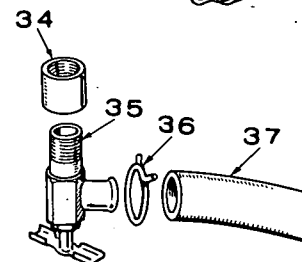
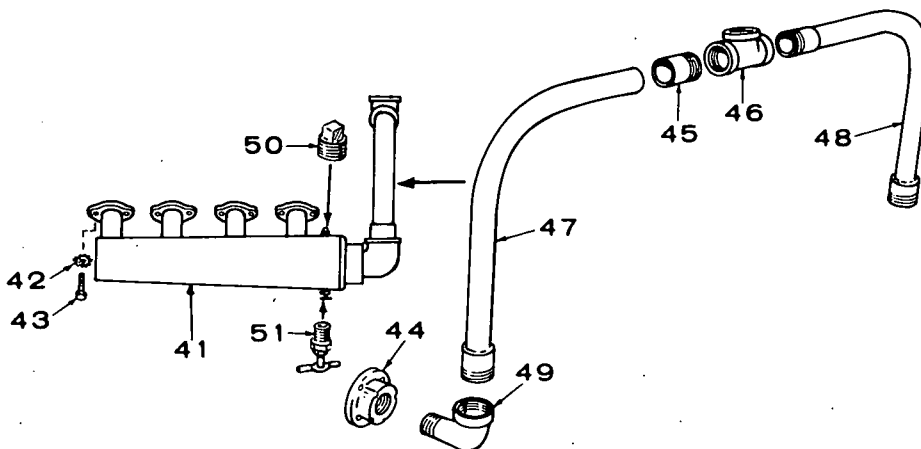
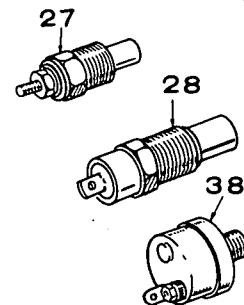
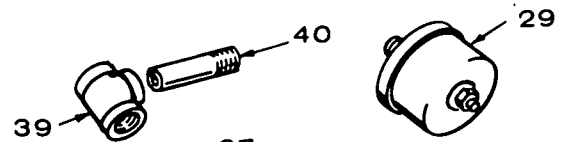
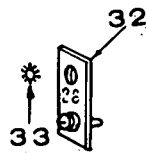
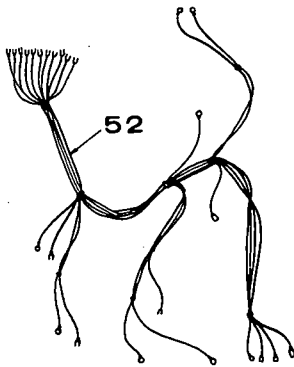
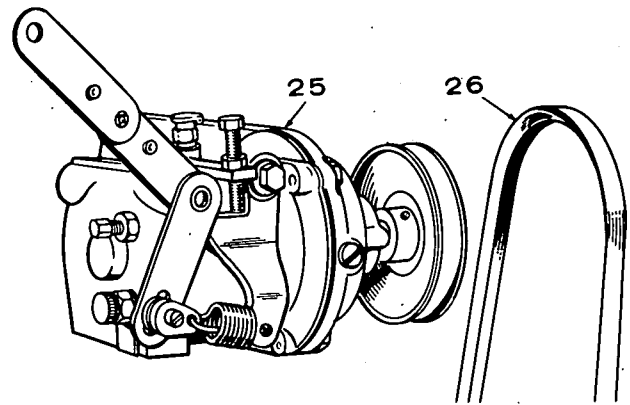
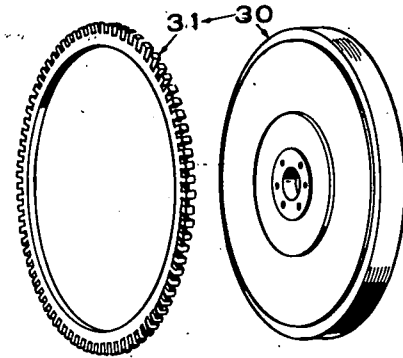
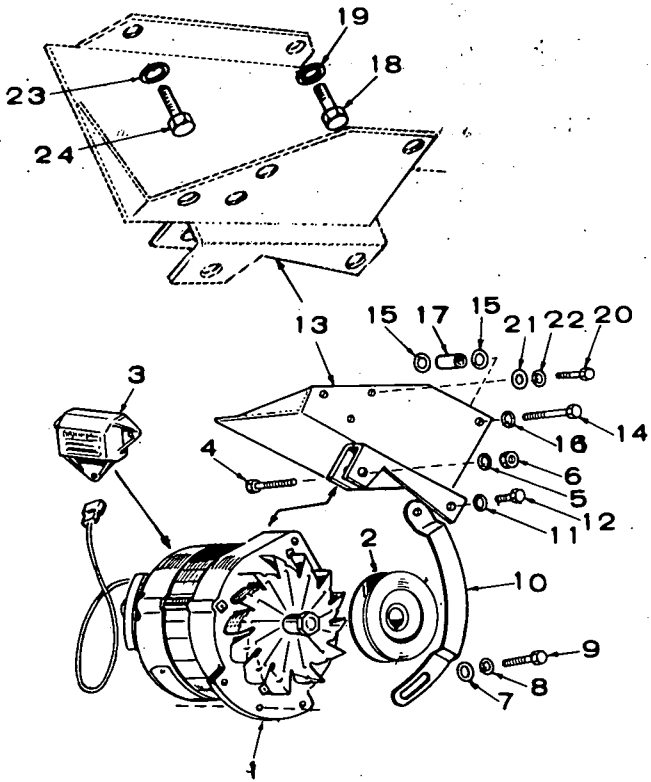
General Description:

Includes—Complete Cylinder Block, Oil Pan, Water Pump, Oil Filter, Fuel Pump, Starter Motor, Spark Plugs, Flywheel Housing Plate, Thermostat, Alternator Mounting Brackets, Intake Manifolds and PC Valve.

Excludes—Carburetor, Air Cleaner, Charge Alternator, Oil Pressure, Water Temperature Gauge Senders, Oil Pressure Switch, High Water Temperature Cut Off Switch, Radiator, Fan Blades & Belt, Muffler and Exhaust Tube.

NOTE: Standard Spec 1 engine listed, for all other models refer to factory.

MISCELLANEOUS ENGINE PARTS

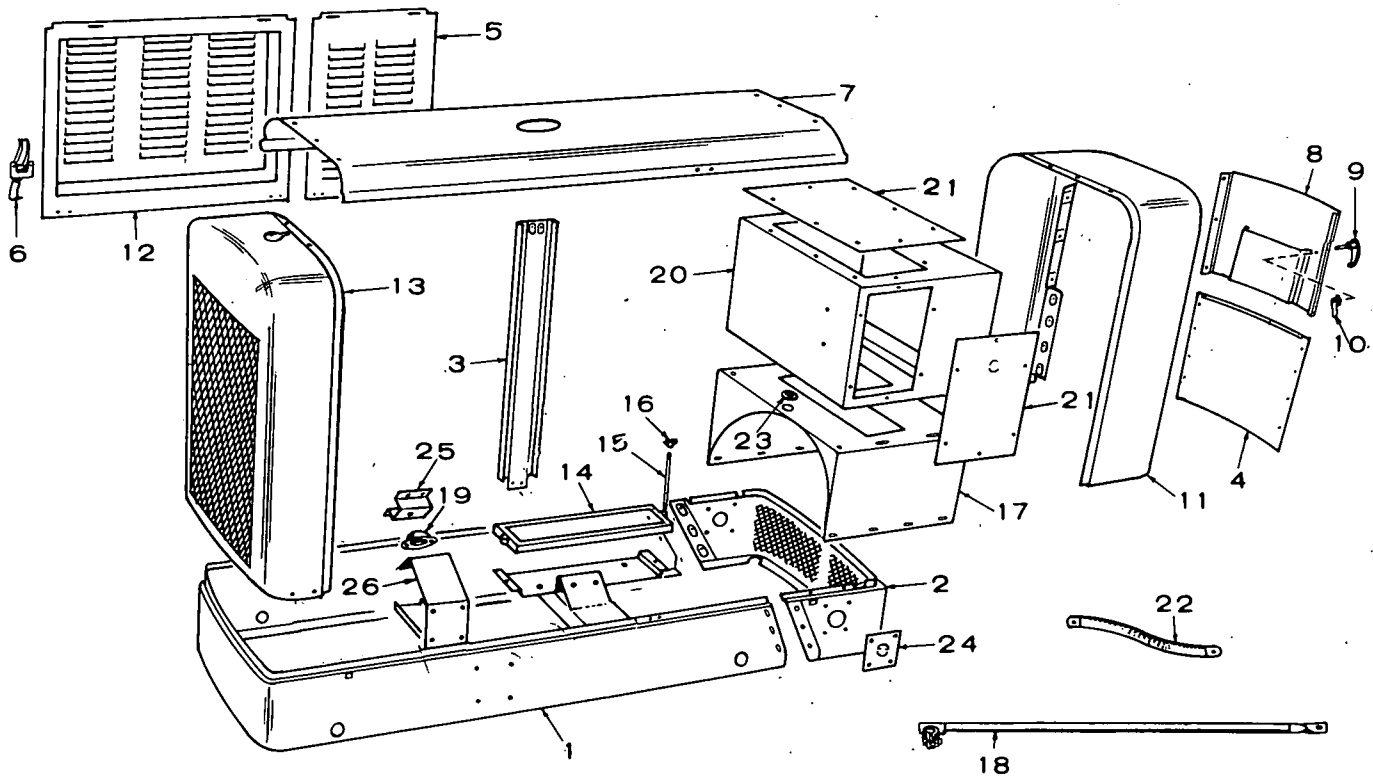


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191-0665	1	*Alternator, Charge (Motorola #70D44039B)	27	193-0104	1	Sender, Water Temperature
2	191-0649	1	Pulley, Alternator	28	309-0178	1	Switch, High Water Temperature
3	191-0732	1	Regulator, Alternator	29	193-0108	1	Sender, Oil Pressure
4	800-0095	1	Screw, Cap - Hex Head (1/2-13 x 2-1/2")	30	104-0925	1	Flywheel, Includes Ring Gear
5	850-0060	1	Washer, Lock - Spring (1/2")	31	104-0723	1	Gear, Ring
6	862-0005	1	Nut, Hex (1/2-13)	32	332-1292	1	Bracket and Terminal Assembly
7	526-0115	1	Washer, Flat (11/32" ID x 11/16" OD x 11/16" Thk)	33	853-0016	1	Washer, Lock - ET (5/16")
8	850-0045	1	Washer, Lock - Spring (5/16")	34	505-0028	1	Coupling (3/8") Oil Drain
9	800-0027	1	Screw, Cap - Hex Head (5/16-18 x 7/8")	35	504-0092	1	Valve (3/8") Oil Drain
10	191-0535	1	Bracket, Alternator Adjusting	36	503-0131	1	Clamp, Hose - Oil Drain
11	850-0050	1	Washer, Lock - Spring (3/8")	37		1	Hose, Oil Drain (Order 30" of Bulk Hose #503-0227)
12	821-0029	1	Screw, Cap - Hex Head Locking (3/8-16 x 3/4")	38	309-0169	1	Switch, Low Oil Pressure
13	150-1521	1	Bracket, Governor and Alternator	39	505-0059	1	Tee, Pipe (1/8")
14	800-0052	1	Screw, Cap - Hex Head (3/8-16 x 1-1/2")	40	505-0104	1	Nipple, Pipe (1/8 x 1-1/2")
15	526-0026	2	Washer, Flat (13/32" ID x 3/4 OD x 1/16 Thk)	41	154-1766	2	Manifold, Exhaust
16	850-0050	1	Washer, Lock - Spring (3/8")	42	854-0020	16	Washer, Lock - IT (3/8")
17	130-0988	1	Spacer, Governor and Alternator Bracket Mounting	43	800-0051	16	Screw, Cap - Hex Head (3/8-16 x 1-1/4")
18	800-0047	1	Screw, Cap - Hex Head (3/8-16 x 5/8")	44	154-1739	2	Flange, Exhaust Manifold Outlet
19	850-0050	1	Washer, Lock - Spring (3/8")	45	155-0615	1	Nipple, Half (2-1/2") - Exhaust
20	821-0030	2	Screw, Cap - Hex Head Locking (3/8-16 x 1")	46	505-0373	1	Tee, Reducer - Exhaust (2-1/2 x 2-1/2 x 3")
21	526-0026	2	Washer, Flat (13/32" ID x 3/4 OD x 1/16 Thk)	47	155-1373	1	Tube, Exhaust
22	850-0050	2	Washer, Lock - Spring (3/8")	48	155-1372	1	Tube, Exhaust
23	850-0055	1	Washer, Lock - Spring (7/16")	49	505-0216	2	Elbow, Street - Exhaust (2-1/2" x 90°)
24	800-0069	1	Screw, Cap - Hex Head (7/16-14 x 3/4")	50	505-0057	2	Plug, Pipe - Exhaust Manifold
25	151-0415	1	**Governor (Hoof #BD766B)	51	504-0005	2	Valve, Drain - Exhaust Manifold
26	BELT, V			52	338-0942	1	Harness, Engine
	511-0098	1	Governor Drive				
	511-0099	1	Alternator Drive				

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

** - Check Governor nameplate and order components from your nearest Hoof Products Company dealer.

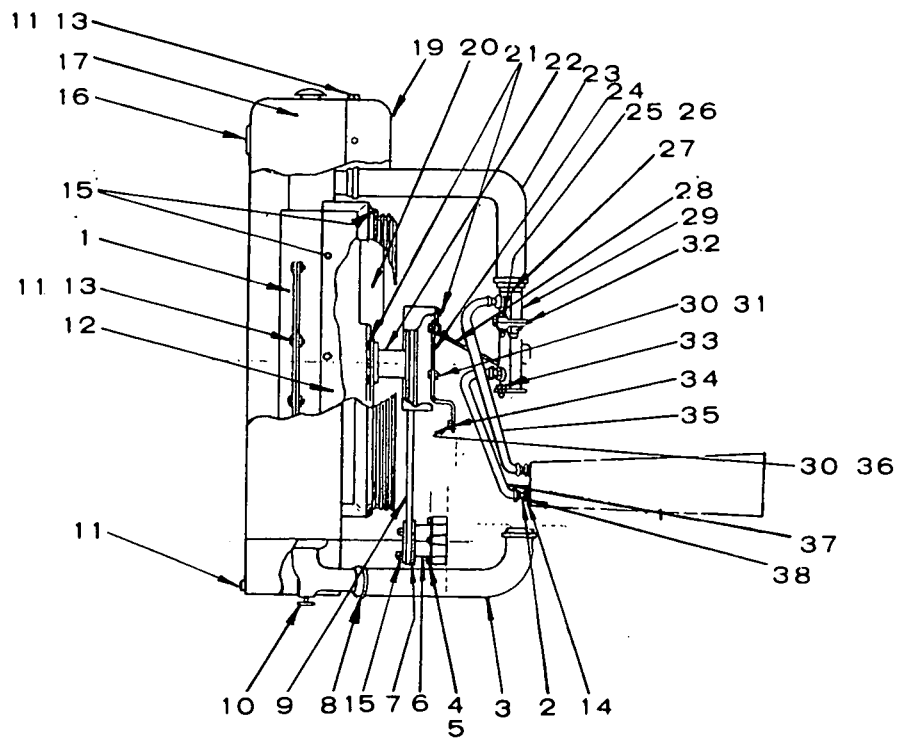
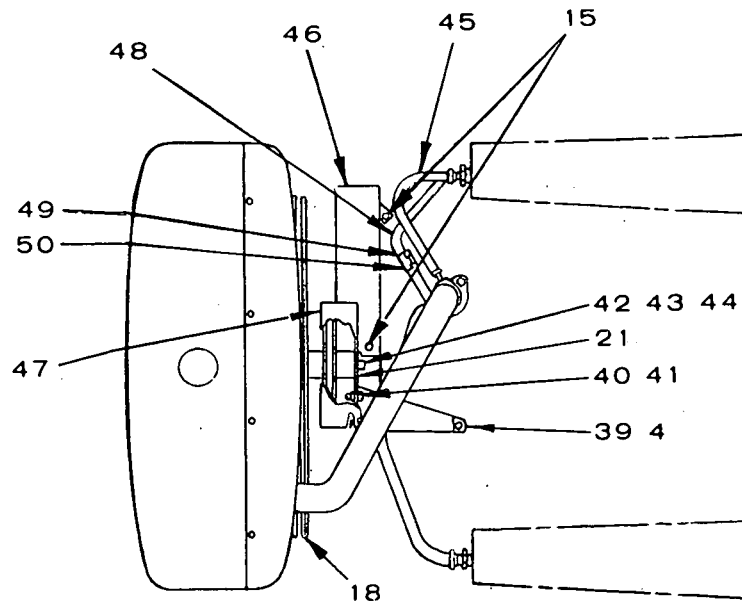
MOUNTING AND HOUSING GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403-1191	1	Chassis, Front
2	403-0894	1	Chassis, Rear (Housed Sets)
3	405-1776	2	Support, Center Housing (Housed Sets)
4	405-1780	1	Panel, Rear Housing Access (Housed Sets)
5	405-1778	2	Panel, Door-Side (Housed Sets)
6	406-0105	8	Clamp, Door (Housed Sets)
7	405-1813	1	Panel, Top (Housed Sets)
8	405-1777	1	Panel, Rear Door (Housed Sets)
9	406-0157	1	Handle, Door (Housed Sets)
10	406-0089	1	Catch, Door (Housed Sets)
11	405-1775	1	Panel, Rear (Housed Sets)
12	405-1774	2	Door, Removable Housing (Housed Sets)
13	405-1836	1	Panel, Front (Also shown in Radiator Installation Group)
14	416-0338	1	Frame, Battery Hold-down
15	520-0231	2	Stud, Battery Hold-down
16	865-0007	2	Nut, Wing - Battery Hold-down
17	301-3154	1	Saddle, Control Box Housing
18	CABLE, BATTERY		
	416-0021	1	20-1/2" Long
	416-0672	1	28-1/4" Long
19	402-0371	4	Mount, Vibration
20	301-3155	1	Housing, Control Box
21	301-3156	2	Panel, Control Box Housing (NOTE: Unhoused sets use qty. of three)
22	337-0090	1	Strap, Ground
23	508-0001	1	Grommet, Control Box Saddle
24	403-0895	2	Cover, Conduit Opening

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
25	403-1193	2	Support, Engine
26	403-1194	2	Bracket, Engine Mounting
ASSOCIATED MOUNTING HARDWARE (Not Illustrated)			
SCREW, CAP - HEX HEAD - SELFLOCKING			
821-0014	As Req.	5/16-18 x 1/2"	(Control Box Panel & Saddle and Housing)
821-0010	As Req.	1/4-20 x 1/2"	(Control Box & Saddle and Conduit Opening Cover)
821-0016	As Req.	5/16-18 x 3/4"	(Top Panel)
SCREW, CAP - HEX HEAD			
800-0069	7	7/16-14 x 3/4"	(Engine Support and Rear Chassis)
800-0520	4	3/4-10 x 1"	(Vibration Mounts)
800-0071	16	7/16-14 x 1"	(Vibration Mounts and Engine Bracket)
800-0046	1	3/8-16 x 1/2"	(Ground Strap to Engine)
SCREW, ROUND HEAD			
812-0146	4	1/4-20 x 3/8"	(Control Box)
813-0098	22	#10-32 x 3/8"	(Hold-down Clamp and Rear Panel) (Housed Sets)
815-0350	18	Screw, Cap - Hex Head - Slotted (#10-32 x 3/8")	(Control Box)
809-0059	3	Screw, Pan Head Tapping (#14 x 1/2")	(Rear Housing Door) (Housed Sets)
WASHER, LOCK - SPRING			
850-0040	4	1/4"	(Control Box)
850-0050	As Req.	3/8"	(Chassis & Battery Cable ground)

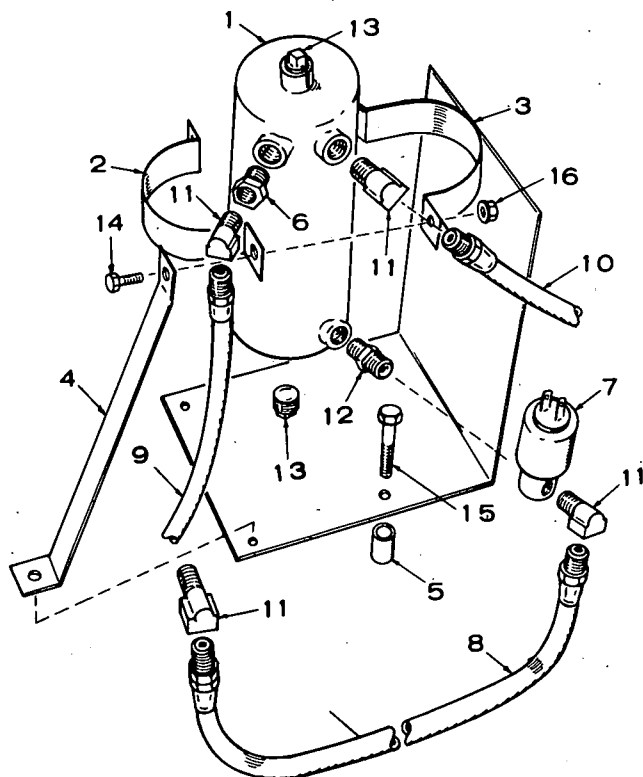
RADIATOR INSTALLATION (179-2036)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	130-0961	1	Radiator
2	505-0135	8	Nipple, Pipe - Half (3/8 x 1-1/2")
3	503-0635	1	Hose, Radiator - Lower
4	850-0050	5	Washer, Lock - Spring (3/8")
5	800-0055	4	Screw, Cap - Hex Head (3/8-16 x 2-1/4")
6	130-0968	1	Adapter, Pulley
7	512-0059	1	Pulley
8	503-0274	4	Clamp, Hose
9	511-0100	1	Belt, Fan
10	504-0028	1	Valve, Drain
11	821-0014	22	Screw, Cap - Hex Head Locking (5/16-18 x 1-1/2")
12	130-0975	1	Shroud, Radiator
13	870-0113	14	Nut, Retaining (5/16-18)
14	505-0019	4	Bushing, Reducer (1/2 x 3/8")
15	821-0010	20	Screw, Cap - Hex Head Locking (1/4-20 x 1/2")
16	99-0885	1	Nameplate (ONAN)
17	405-1836	1	Panel, Front Housing (Also shown in Mounting and Housing Group)
18	130-0986	1	Guard, Fan
19	405-1837	1	Extension, Radiator Hood
20	130-0428	1	Blade, Fan
21	821-0016	10	Screw, Cap - Hex Head Locking (5/16-18 x 3/4")
22	130-0981	1	Hub & Pulley Assembly
23	503-0753	1	Hose, Radiator - Upper
24	130-0971	1	Bracket, Fan Drive
25	821-0023	2	Screw, Cap - Hex Head Locking (5/16-18 x 1-1/2")

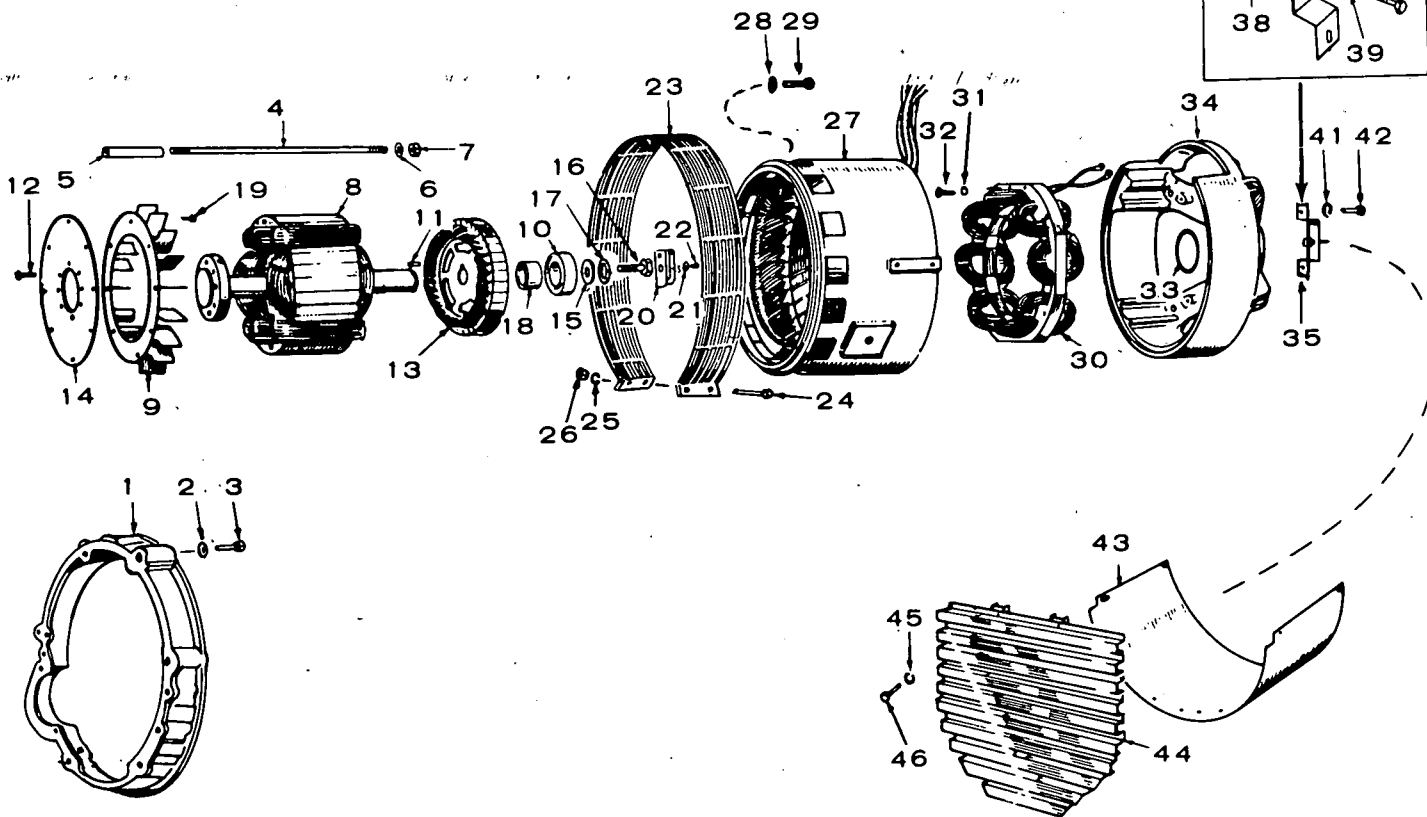
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
26	870-0048	4	Nut, Hex - Locking (5/16-18)
27	130-1019	1	Outlet, Water
28	130-0973	1	Brace, Fan Drive Bracket
29	130-1018	1	Adapter, Thermostat
30	800-0051	3	Screw, Cap - Hex Head (3/8-16 x 1-1/4")
31	870-0133	1	Nut, Hex - Locking (3/8")
32	130-1024	1	Gasket, Water Outlet
33	821-0023	2	Screw, Cap - Hex Head Locking (5/16-18 x 1")
34	191-0864	1	Spacer
35	503-0712	1	Hose (5/8" ID x 28")
36	850-0050	2	Washer, Lock - Spring (3/8")
37		1	Hose (Order 23" of Bulk Hose #503-0386)
38	503-0183	8	Clamp, Hose
39	800-0048	1	Screw, Cap - Hex Head (3/8-16 x 3/4")
40	821-0025	2	Screw, Cap - Hex Head Locking (5/16-18 x 5/8")
41	870-0048	4	Nut, Hex - Locking (5/16-18)
42	862-0016	1	Nut, Hex (1/2-13)
43	850-0060	1	Washer, Lock - Spring (1/2")
44	526-0035	1	Washer, Flat (17/32" ID x 7/8 OD x 1/8 Thk)
45	503-0712	1	Hose (5/8" ID x 28")
46	130-0991	1	Guard, Belt
47	130-0989	1	Guard, Belt
48		1	Hose (Order 23" of Bulk Hose #503-0386)
49	148-0274	1	Bracket, Hose
50	800-0069	1	Screw, Cap - Hex Head (7/16-14 x 3/8")

RESERVOIR (DAY) TANK GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	159-0294	1	Tank, Reservoir
2	159-0253	1	Band, Tank Mounting
3	159-1038	1	Bracket, Tank Mounting
4	159-1037	2	Bracket, Tank Mounting
5	159-1039	1	Spacer, Tank Mounting
6	159-0705	1	Reducer, Restricted (3/8 x 1/8")
7	307-0565	1	Valve, Solenoid (12 Volt)
8	501-0032	1	Line, Flexible (9")
9	501-0037	1	Line, Flexible (56-1/4" with 1/4" with Male Flared Union Both Ends)
10	501-0117	1	Line, Flexible (56" with 1/4" Male Flared Union Fitting One End and 1/8" Pipe Thread One End)
11	502-0002	4	Elbow, Inverted Male
12	502-0082	1	Nipple, Hex
13	505-0057	2	Plug, Pipe - Square Head (1/8")
14	821-0011	2	Screw, Cap - Hex Head - Self Locking (1/4-20 x 7/8")
15	821-0023	1	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1-1/2")
16	870-0212	2	Nut, Self Locking (1/4-20)

GENERATOR GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	231-0205	1	Adapter, Generator
2	850-0055	8	Washer, Lock - Spring (7/16")
3	800-0072	8	Screw, Cap - Hex Head (7/16-14 x 1-1/4")
4	STUD, GENERATOR THROUGH		
	520-0722	4	55 kW Sets
	520-0724	4	70 kW Sets
5	503-0611	4	Hose, Insulating
6	850-0055	4	Washer, Lock - Spring (3/8")
7	862-0011	4	Nut, Hex - Machine (3/8-16)
8		1	Rotor Assembly, Wound (Includes Parts Marked §)
9	205-0089	1	§Blower, Generator Cooling
10	510-0101	1	§Bearing, Rotor Shaft
11	515-0145	1	§Key, Exciter Rotor
12	805-0033	8	§Bolt, Place (5/8-11 x 1")
13	201-1739	1	§Rotor Assembly, Wound - Exciter (See Separate Group for Components)
14	232-2078	1	§Disc, Generator Drive
15	526-0238	1	§Washer, Bearing Retainer
16	800-0513	1	§Screw, Cap - Hex Head (3/4-10 x 1-1/2")
17	850-0079	1	§Washer, Lock - Spring (3/4")
18	232-2102	1	§Spacer, Bearing
19	805-0018	8	Bolt, Place (3/8-16 x 1")
20	150-0717	1	Switch Assembly, Overspeed
21	856-0010	1	Washer, Lock EIT (3/8")
22	812-0189	1	Screw, Machine - Round Head (3/8-16 x 3/4")
23	234-0368	1	Screen, Generator
24	800-0008	2	Screw, Cap - Hex Head (1/4-20 x 1-1/4")
25	850-0040	2	Washer, Lock - Spring (1/4")
26	862-0001	2	Nut, Hex (1/4-20)

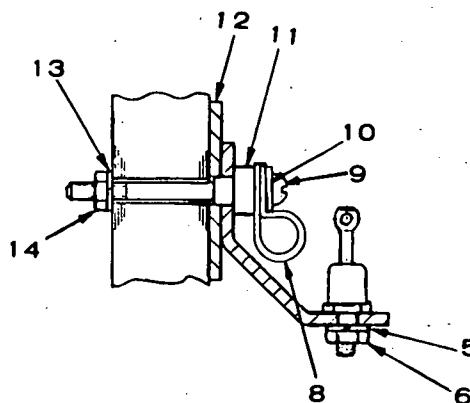
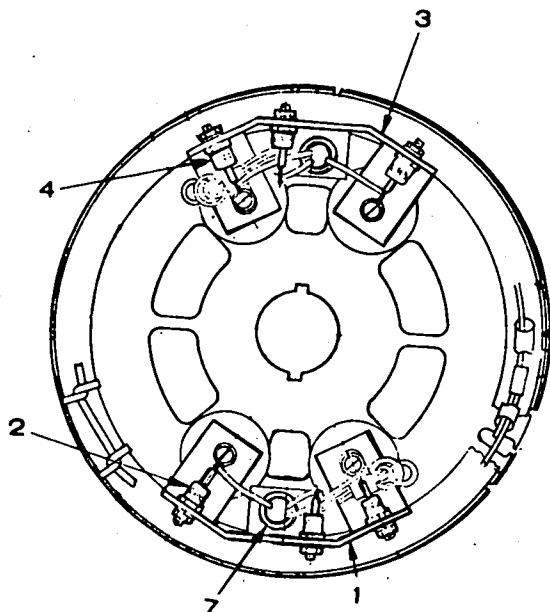
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
27		1	Stator Assembly, Wound
28	850-0050	8	Washer, Lock - Spring (5/8")
29	800-0051	8	Screw, Cap - Hex Head (3/8-16 x 1-1/4")
30	220-2353	1	Stator Assembly, Wound - Exciter
31	850-0040	4	Washer, Lock - Spring (1/4")
32	800-0009	4	Screw, Cap - Hex Head (1/4-20 x 1-1/2")
33	509-0125	1	Seal, "O" Ring - Bearing
34	211-0185	1	Bell, End
35	150-1456	1	Bracket and Control Assembly, Overspeed (Includes Parts Marked †)
36	150-1356	1	†Bracket, Overspeed Switch
37	862-0001	2	†Nut, Hex (1/4-20)
38	853-0013	1	†Washer, Lock - ET (1/4")
39	870-0250	1	†Nut, Insulation - Overspeed Switch
40	150-0723	1	†Point, Overspeed Switch
41	850-0040	2	Washer, Lock - Spring (1/4")
42	800-0003	2	Screw, Cap - Hex Head (1/4-20 x 1/2")
43	234-0361	1	Wrapper, Generator End Bell
44	234-0370	1	Grille, Generator Air Inlet
45	850-0040	4	Washer, Lock - Spring (1/4")
46	812-0146	4	Screw, Machine - Round Head (1/4-20 x 3/8")

* - Order by description giving complete Model, Spec and Serial Number.

§ - Parts included in Wound Rotor Assembly.

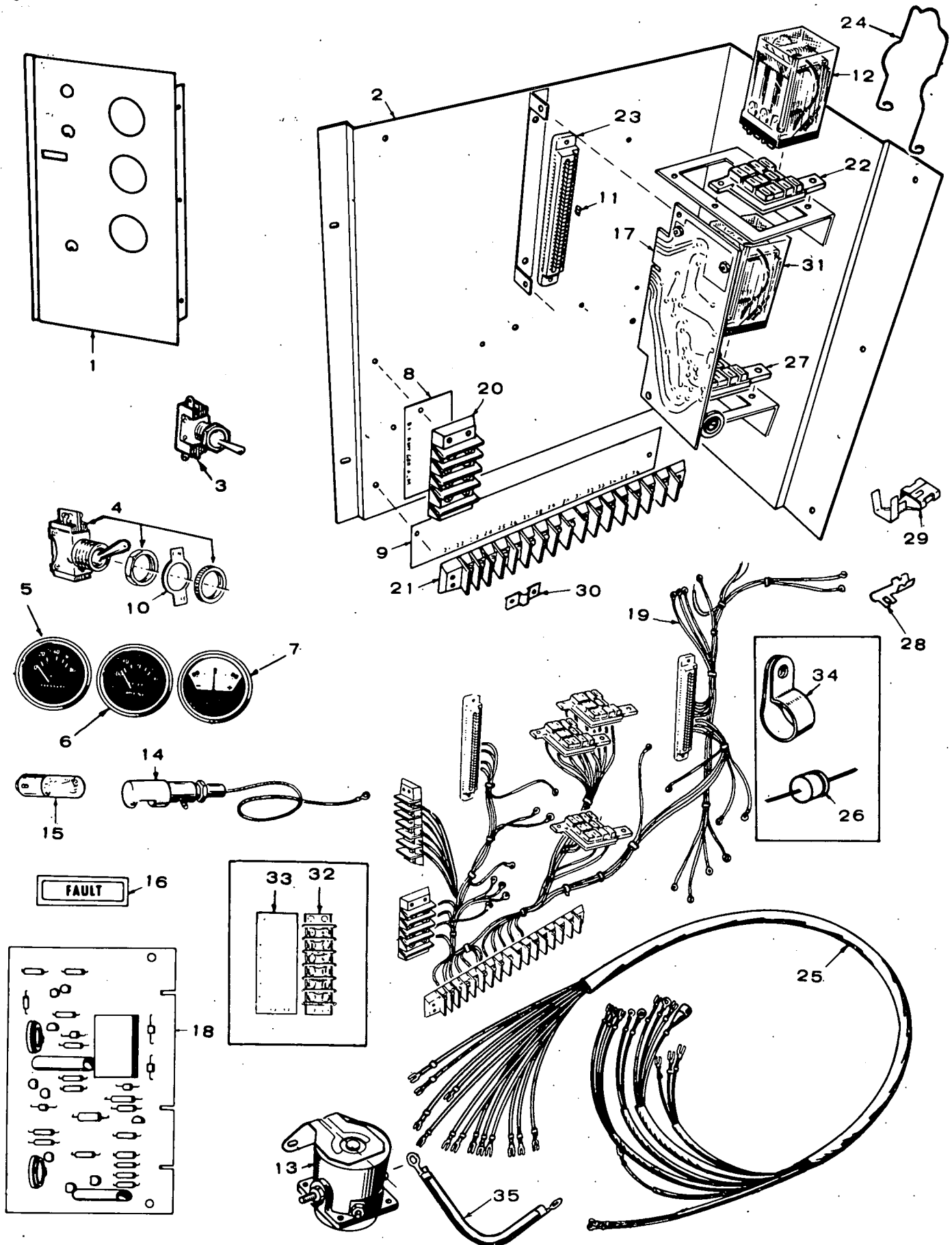
† - Parts included in 150-1456 Overspeed Bracket and Control Assembly.

EXCITER ROTOR GROUP (BRUSHLESS GENERATOR)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	201-1739	1	Rotor Assembly, Wound - Exciter (Complete)
1	363-0055	1	Heat Sink, Rectifier - Negative
2	358-0015	3	Rectifier, Diode - Negative (CR4, CR5 & CR6)
3	363-0054	1	Heat Sink, Rectifier - Positive
4	358-0016	3	Rectifier, Diode - Positive (CR1, CR2 & CR3)
5	850-0030	6	Washer, Lock Spring (#10) Diode Mounting
6	870-0053	6	Nut, Hex - Diode Mounting (10-32)
7	508-0093	2	Grommet, Rubber
8	332-0050	2	Clip, Wire
9	813-0110	4	Screw, Roundhead - Heat Sink Mounting (10-32 x 2")
10	526-0009	4	Washer, Flat - Heat Sink Mounting (#10)
11	508-0124	4	Bushing, Insulating - Heat Sink Mounting
12	508-0156	4	Washer, Insulating - Heat Sink Mounting
13	850-0030	4	Washer, Lock Spring - Heat Sink Mounting (#10)
14	870-0053	4	Nut, Hex - Heat Sink Mtg. (10-32)

CONTROL GROUP (ENGINE INSTRUMENTS PORTION)

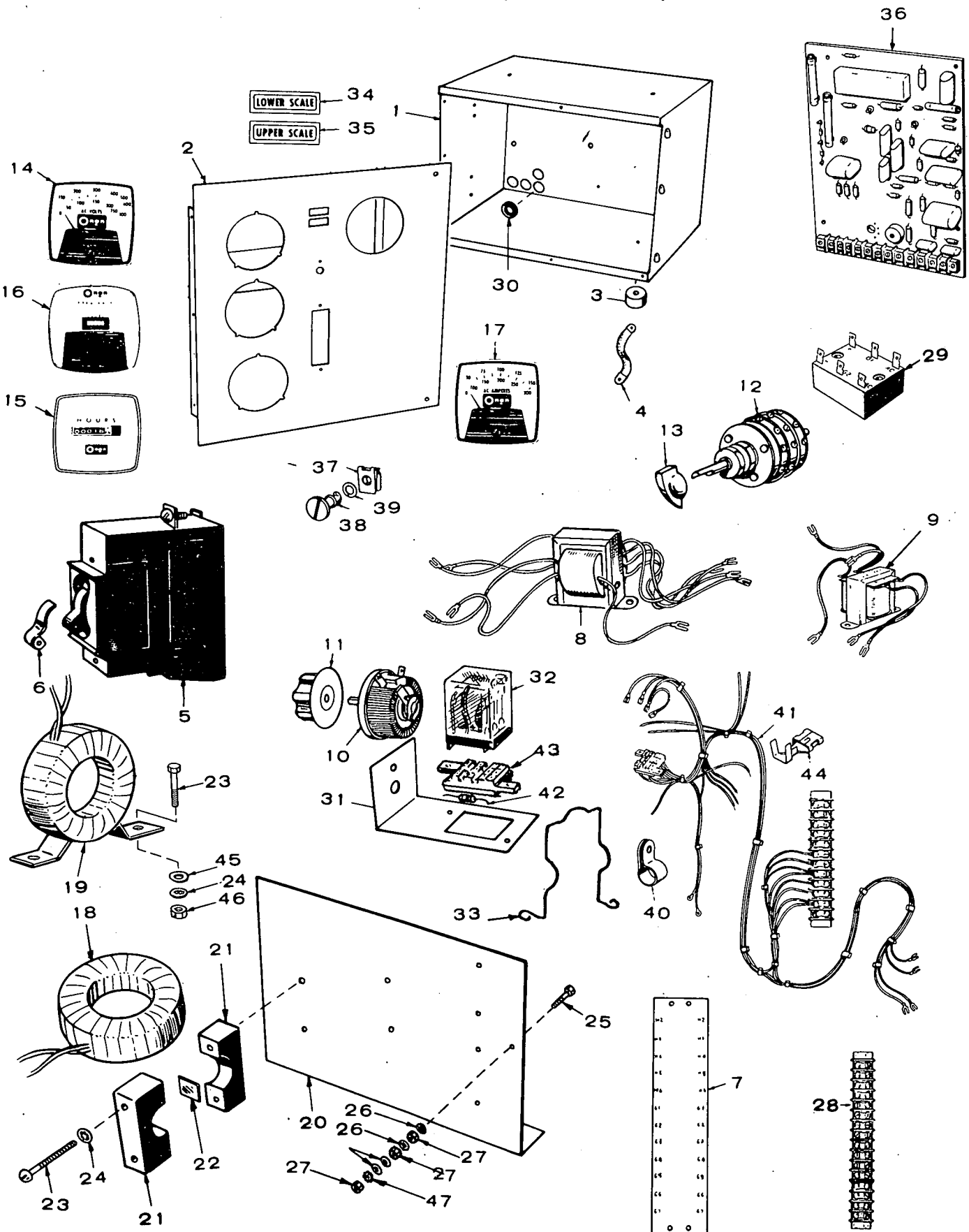


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL ONLY, ENGINE CONTROL		
	301-3165	1	Sets with One Fault Light
	301-3267	1	Sets with Five Fault Lights - Optional
2	301-3253	1	Bracket, Engine Control
3	SWITCH, SELECTOR		
	308-0138	1	Standard Generator Sets
	308-0327	1	Penn State Generator Sets
4	308-0002	1	Switch, Panel Light
5	193-0107	1	Gauge, Oil Pressure
6	193-0106	1	Gauge, Water Temperature
7	302-0061	1	Ammeter, Charge (30-0-30)
8	332-1239	1	Strip, Marker (B+, Remote, Ground, Alarm)
9	332-1241	1	Strip, Marker (21 through 36)
10	308-0003	1	Plate, Switch (on-off)
11	332-1276	2	Plug, Keying (Sets with Five Fault Lights use qty. of 1)
12	307-1058	2	Relay (1) Start Disconnect (1) Ignition
13	307-1031	1	Relay, Start Solenoid (Not Mounted in Control Box)
14	322-0149	1	Holder, Lamp
15	322-0074	1	Lamp, Panel
16	LAMP, FAULT		
	322-0128	1	Standard Generator Sets
	322-0107	1	Overcrank (Optional)
	322-0111	1	Overspeed (Optional)
	322-0108	1	Low Oil Pressure (Optional)
	322-0109	1	High Engine Temperature (Optional)
	322-0110	1	Low Engine Temperature (Optional)
17	CONTROL, CRANKER		
	300-0733	1	Standard Cranker
	300-0714	1	Cycle Cranker (Optional) - See Separate Group for Components)
18	MONITOR, ENGINE CONTROL (See Separate Group for Components)		
	300-0679	1	Sets with One Fault Light - Standard
	300-0681	1	Sets with Five Fault Lights - Optional
	300-0730	1	Penn State Sets with One Fault Light
19	HARNESS ASSEMBLY, WIRING - CONTROL (Includes Parts Marked *)		
	338-0527	1	Sets with One Fault Light - Standard
	338-0535	1	Sets with Five Fault Lights - Optional
20	332-0537	1	*Block, Terminal - 4 Place
21	332-0795	1	*Block, Terminal - 16 Place
22	323-0765	2	*Socket, Relay - 11 Place

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
23	332-1271	2	*Housing, Printed Circuit Board Terminal
24	307-1157	3	Spring, Relay Hold-down
25	338-0521	1	Harness Assembly, Wiring - Engine to Control
26	357-0004	1	Rectifier, Diode (Part of Standard Cranker Control)
27	323-0764	1	*Socket, Relay - 8 Place
28	332-1269	As Req.	*Terminal, PC Board
29	332-1280	As Req.	*Terminal, Crimp
30	332-1043	1	*Jumper, Terminal - Sets with One Fault Light
31	307-1061	1	Relay, Starter Protection - Begin Spec D
32	332-0699	1	*Block, Terminal (6 Place) - Sets with Five Fault Lights
33	332-1240	1	*Strip, Marker (53 through 58) - Sets with Five Fault Lights
34	332-0051	1	Clip, Harness
35	336-2377	1	Cable, Start Solenoid to Starter Motor
ASSOCIATED HARDWARE (Not Illustrated)			
	821-0010	2	Screw, Cap - Hex Head Self Locking (1/4-20 x 1/2") - Start Solenoid Mounting
	870-0212	2	Nut, Hex - Self Locking (1/4-20) - Start Solenoid Mounting
	815-0026	1	Screw, Machine - Truss Head (#10-32 x 3/8")
	812-0077	4	Screw, Machine - Round Head (#8-32 x 3/8")
	812-0066	4	Screw, Machine - Round Head (#6-32 x 3/4")
	815-0203	1	Screw, Machine - Brass - Round Head W/ET (#10-32 x 7/8")
WASHER, LOCK - SPRING			
	850-0030	1	#10
	850-0025	4	#8
WASHER, LOCK - TOOTH			
	853-0003	8	#6 ET
	853-0008	1	#10 ET
	856-0003	1	#10 EIT
	856-0013	2	1/2" EIT
NUT, HEX			
	870-0053	2	#10-32
	860-0008	4	#8-32
	860-0006	4	#6-32
	871-0010	2	#10-32 Brass
	526-0049	2	Washer, Flat - Brass (.200 ID x 7/16 OD x 1/32 Thk)
	518-0295	4	Fastener - Snap In

* - Parts included in Control Wiring Harness Assembly.

CONTROL GROUP (AC PORTION)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301-3158	1	Box Only, Control
2	PANEL ONLY, CONTROL		
	301-3274	1	Sets Without Meter Panel
	301-3170	1	Sets With Meter Panel
3	402-0078	4	Mount, Rubber - Control Box
4	337-0049	1	Strap, Ground
5	320-0431	1	Breaker, Circuit
6	320-0307	1	Lock, Circuit Breaker Handle (Penn State)
7	STRIP, MARKER		
	332-1248	1	Sets Without Meter Panel
	332-1242	1	Sets With Meter Panel
8	315-0342	1	Transformer, Voltage
9	REACTOR, COMMUTATOR		
	315-0384	1	With Leads and Terminals
	315-0343	1	Reactor Only, Less Leads and Terminals
10	303-0170	1	Rheostat
11	303-0032	1	Knob, Rheostat
12	SWITCH, SELECTOR		
	308-0012	1	Sets Without Meter Panel
	308-0284	1	Sets With Meter Panel
13	303-0076	1	Knob, Selector Switch
14	302-0718	1	Voltmeter
15	302-0466	1	Meter, Running Time
16	302-0221	1	Meter, Frequency (Sets With Meter Panel)
17	AMMETER (Sets With Meter Panel)		
	302-0721	1	55 kW Sets
	302-0722	1	70 kW Sets
18	302-0107	3	Transformer, Current (55 kW Sets With Meter Panel)
19	302-0608	3	Transformer, Current (70 kW Sets With Meter Panel)
20	BRACKET, TRANSFORMER MOUNTING		
	302-0729	1	55 kW Sets
	302-0764	1	70 kW Sets
21	CLAMP, TRANSFORMER MOUNTING (55 kW Sets With Meter Panel)		
	302-0235	3	Upper
	302-0236	3	Lower
22	302-0253	As Req.	Shim, Transformer Mounting (55 kW Sets With Meter Panel)
23	SCREW, MACHINE - ROUND HEAD		
	813-0110	6	55 kW Sets (#10-32 x 2")
	813-0100	6	70 kW Sets (#10-32 x 1/2")
24	WASHER, LOCK		
	854-0010	6	55 kW Sets (#10 IT)
	856-0003	6	70 kW Sets (#10 EIT)
25	815-0203	1	Screw, Machine - Round Head (#10-32 x 7/8")
26	854-0010	2	Washer, Lock - IT (#10)
27	871-0010	3	Nut, Machine - Hex (#10-32)
28	*BLOCK, TERMINAL		
	332-0607	1	Sets Without Meter Panel (12 Place)
	332-0795	1	Sets With Meter Panel (16 Place)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
29	305-0524	1	Bridge, Rectifier
30	508-0001	4	Grommet, Rubber
31	301-3244	1	Bracket, Relay Mounting
32	307-1061	1	Relay, Voltage Selector
33	307-1157	1	Spring, Relay Hold-down
34	322-0130	1	Light, Lower Scale
35	322-0131	1	Light, Upper Scale
36	332-1268	1	Board Assembly, Printed Circuit (See Separate Group for Components)
37	406-0332	2	Fastener
38	406-0333	2	Stud, Fastener
39	406-0334	2	Washer, Stud Fastener
40	332-0050	1	Clip, Tinnerman
41	HARNESS, WIRING - AC CONTROL (Includes Parts Marked *)		
	338-0764	1	Generator Sets Without Meter Panel
	338-0730	1	Generator Sets With Meter Panel
42	350-0556	1	Resistor (47,000-Ohm, 1/2 Watt)
43	323-0764	1	*Socket, Relay
44	332-1280	As Req.	*Terminal, Crimp
45	526-0008	12	Washer, Flat (13/64" ID x 7/16 OD x 1/32") - 70 kW Sets
46	870-0053	6	Nut, Hex (#10-32) - 70 kW Sets
47	856-0003	1	Washer, Lock - EIT (#10)

ASSOCIATED HARDWARE (Not Illustrated)

815-0026 7 Screw, Machine Truss Head (#10-32 x 3/8")

SCREW, MACHINE - ROUND HEAD

812-0059 2 #6-32 x 1/4"
812-0061 7 #6-32 x 3/8"
812-0066 2 #6-32 x 3/4"
812-0077 2 #8-32 x 3/8"
815-0203 1 #10-32 x 7/8" Brass W/ET

WASHER, LOCK - SPRING

850-0020 2 #6
850-0025 2 #8
850-0045 5 5/16"

WASHER, LOCK - EXTERNAL TOOTH

853-0003 9 #6
853-0008 1 #10
856-0008 1 Washer, Lock - EIT (5/16")

NUT, HEX - MACHINE

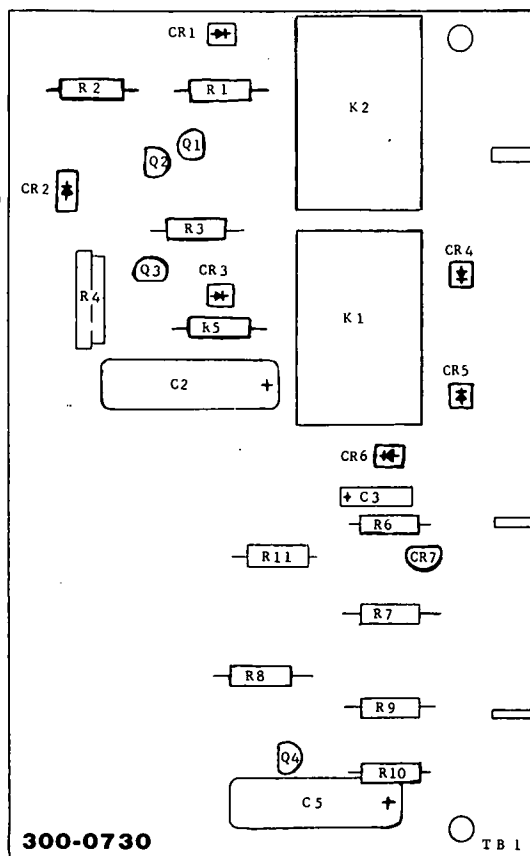
860-0008 2 #8-32
871-0010 2 #10-32 - Brass
862-0015 1 5/16-18
870-0053 1 #10-32
526-0049 1 Washer, Flat (.200 ID x 7/16 OD x 1/32 Thk)

SCREW, CAP - HEX HEAD

800-0045 4 5/16-18 x 3/8"
800-0046 1 3/8-16 x 1/2"

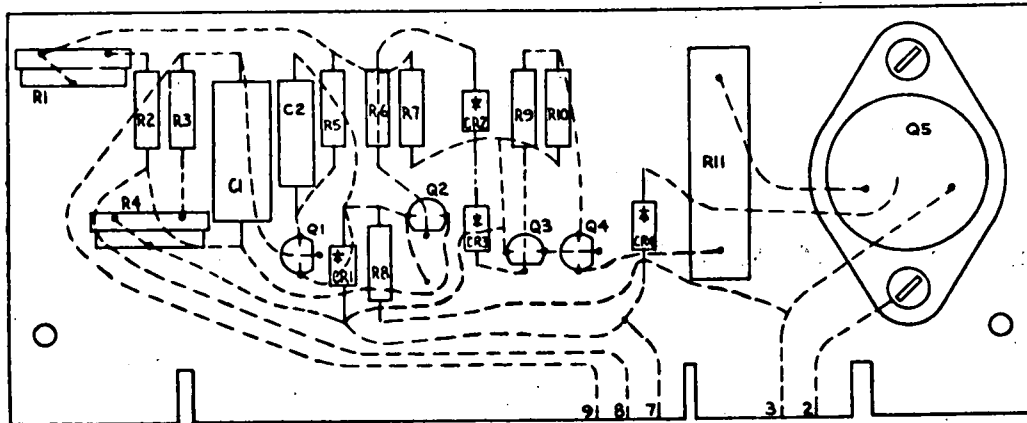
* - Parts included in AC Control Wiring Harness.

ENGINE CONTROL MONITOR GROUP - 12 VOLT PENN STATE (1 Fault Light)



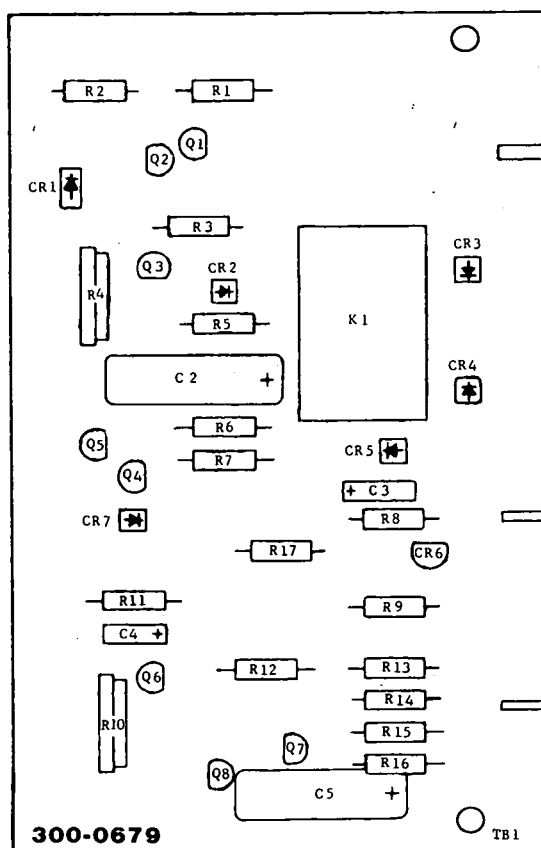
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0730		Monitor, Engine Control - 12 Volt (Penn State)	Q2	362-0025	1	Transistor
C1			Not used	Q3	362-0025	1	Transistor
C2	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	Q4	362-0008	1	Transistor
C3	356-0040	1	Capacitor, Electrolytic (10 Mfd, 20 Volt)	R1	350-0536	1	Resistor, Composition (1000-Ohm, 1/2 Watt, 10%)
C4			Not used	R2	350-0526	1	Resistor, Composition (100-Ohm, 1/2 Watt, 10%)
C5	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R3	350-0552	1	Resistor, Composition (22,000-Ohm, 1/2 Watt, 10%)
CR1	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R4	303-0169	1	Potentiometer (3.5 Megohm, 1/4 Watt, 30%)
CR2	359-0027	1	Diode, Zener (1 Watt, 7.5 Volt, 5%)	R5	350-0572	1	Resistor, Composition (1 Megohm, 1/2 Watt, 10%)
CR3	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R6	350-0505	1	Resistor, Composition (2.7-Ohm, 1/2 Watt, 10%)
CR4	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R7	350-0517	1	Resistor, Composition (27-Ohm, 1/2 Watt, 10%)
CR5	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R8	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR6	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R9	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR7	364-0017	1	Diode, Rectifier (8 Amp, 30 Volt)	R10	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
K1	307-1039	1	Relay, Armature (12 Volt)	R11	350-0971	1	Resistor, Composition (220-Ohm, 2 Watt, 5%)
K2	307-1039	1	Relay, Armature (12 Volt)	TB1	332-1246	1	Printed Wiring Board
Q1	361-0003	1	Transistor				

CRANKER CYCLE CONTROL GROUP - 12 VOLT **(Optional Equipment)**



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

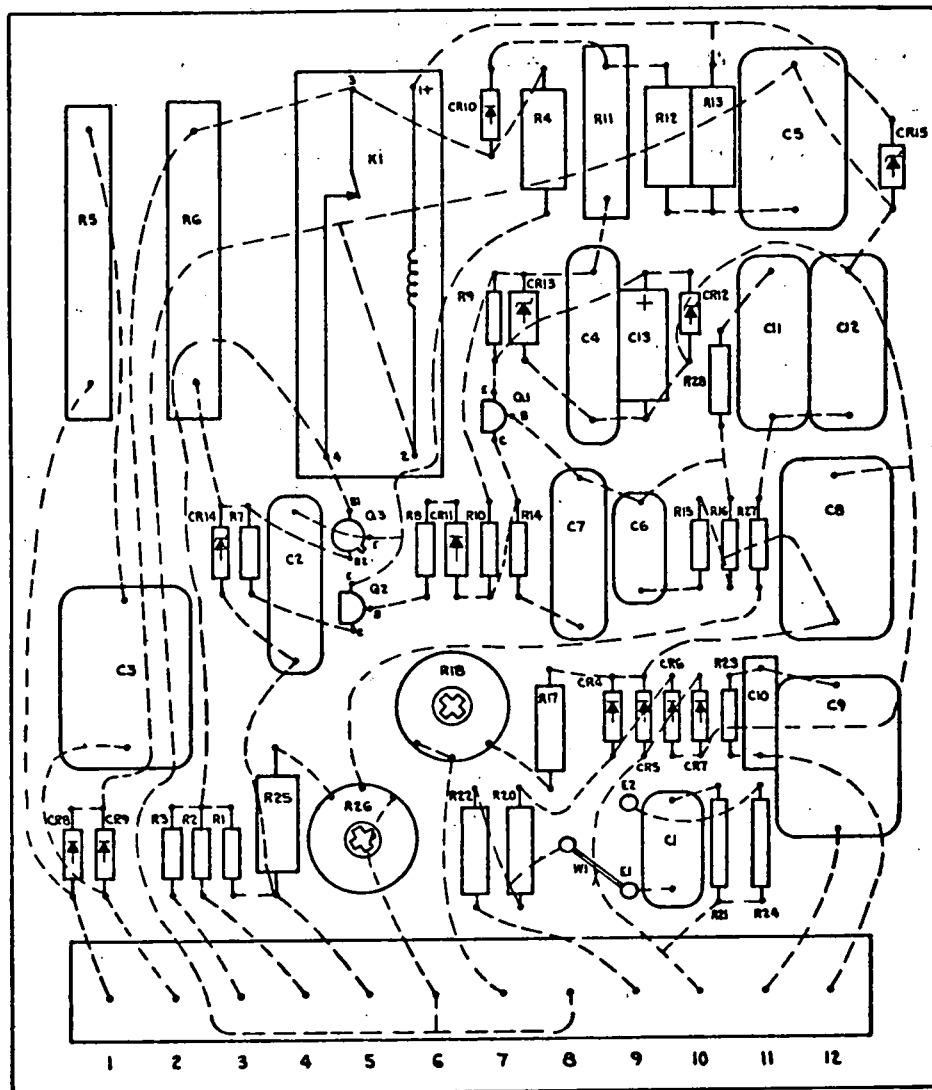
ENGINE CONTROL MONITOR GROUP - 12 VOLT



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				

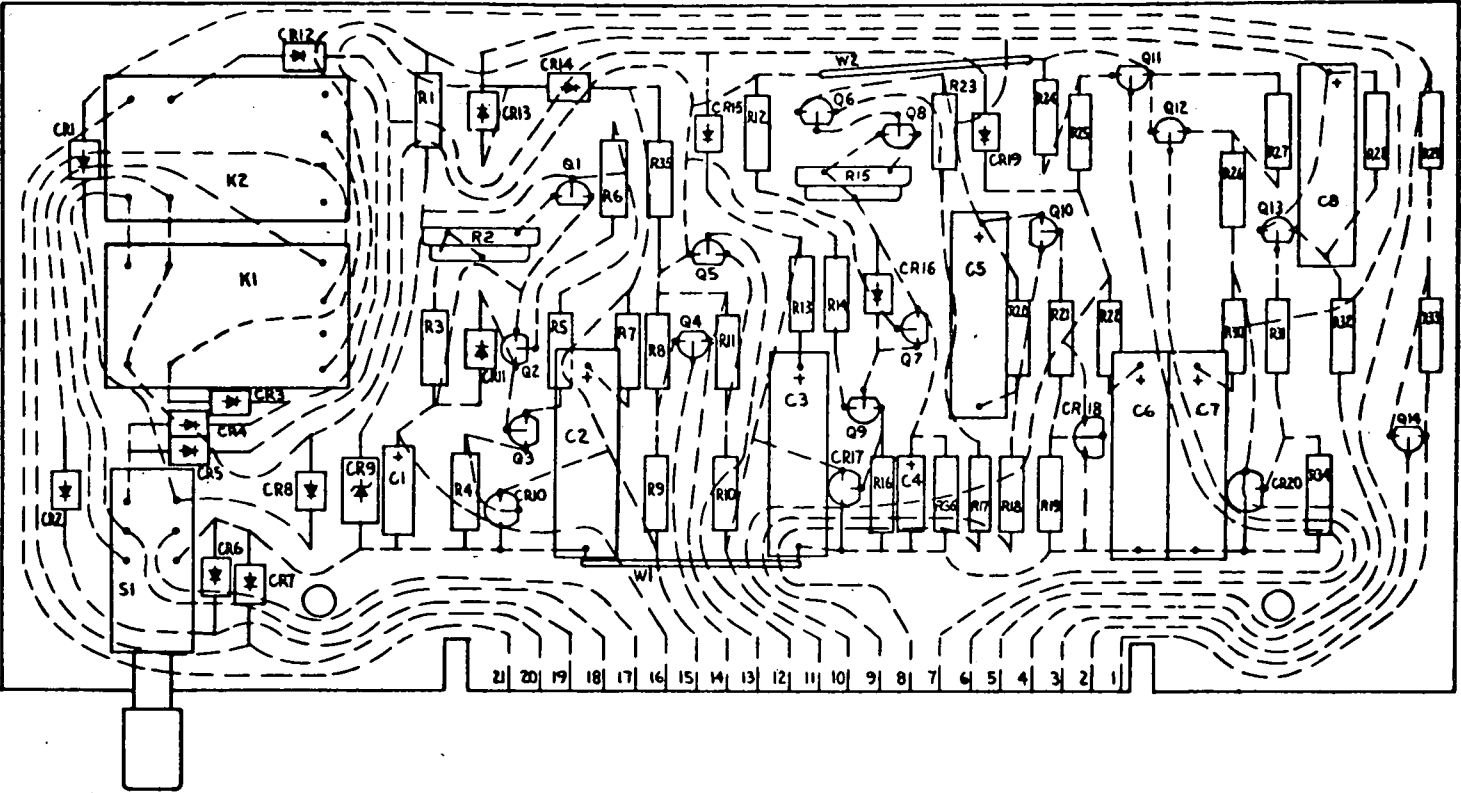
PRINTED CIRCUIT BOARD ASSEMBLY GROUP (AC,

332-1268 - Printed Circuit Board, Complete



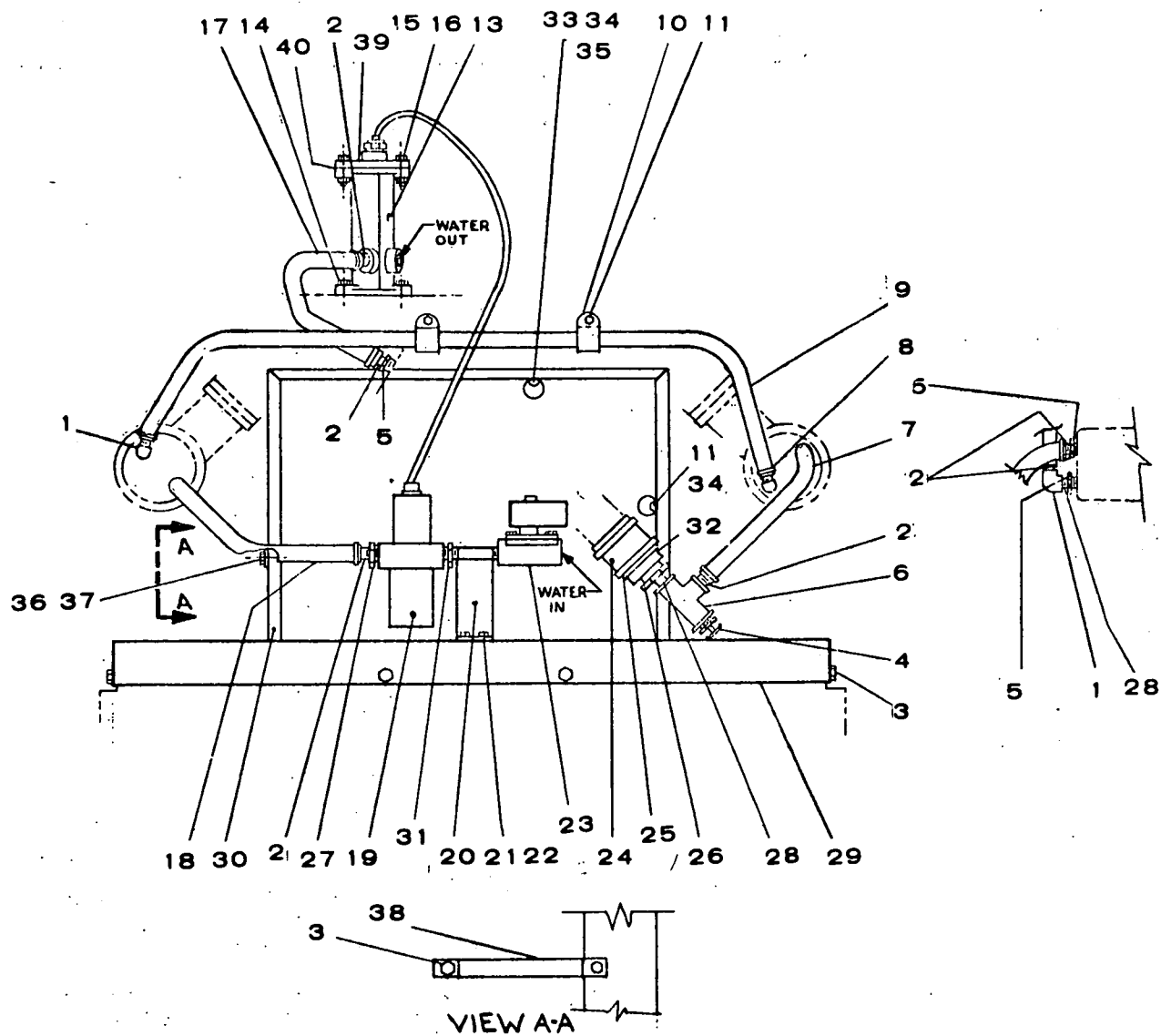
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
TB1	332-1252	1	Terminal Block	R6	353-0039	1	Resistor, Fixed (5,000-Ohm, 15 Watt)
C1	355-0018	1	Capacitor (.47 Mfd., 100 Volt)	R7	350-0398	1	Resistor (3,000-Ohm, 1/2 Watt)
C2, C7	355-0005	2	Capacitor (.22 Mfd., 200 Volt)	R8, R16	350-0447	2	Resistor (330,000-Ohm, 1/2 Watt)
C3, C9	355-0017	2	Capacitor (.47 Mfd., 400 Volt)	R9, R10	350-0423	2	Resistor (33,000-Ohm, 1/2 Watt)
C4, C12	355-0006	2	Capacitor (.47 Mfd., 200 Volt)	R11, R12	352-0151	2	Resistor, Fixed (15,000-Ohm, 5 Watt)
C5, C8	355-0016	2	Capacitor (1 Mfd., 100 Volt)	R13	350-1007	1	Resistor (6,800-Ohm, 2 Watt)
C6	355-0015	1	Capacitor (.1 Mfd., 200 Volt)	R14	350-0443	1	Resistor (220,000-Ohm, 2 Watt)
C10	355-0014	1	Capacitor (.047 Mfd., 200 Volt)	R15, R27	350-0435	2	Resistor (100,000-Ohm, 1/2 Watt)
C11	355-0020	1	Capacitor (.1 Mfd., 400 Volt)	R17	351-0521	1	Resistor, Metal Film (12,100 Ohm, 1/4 Watt)
C13	356-0039	1	Capacitor (100 Mfd., 10 Volt)	R18	303-0168	1	Potentiometer
CR4 thru 11	357-0014	8	Rectifier, Silicon	R20, R22	351-0520	2	Resistor, Metal Film (28,000-Ohm, 1/4 Watt)
CR12	359-0016	1	Diode, Zener (6.8 Volt)	R21	351-0522	1	Resistor, Metal Film (5,110-Ohm, 1/4 Watt)
CR13	359-0025	1	Diode, Zener (20 Volt)	R24	351-0523	1	Resistor, Metal Film (8,870-Ohm, 1/4 Watt)
CR14	359-0026	1	Diode, Zener (18 Volt)	R25	350-1011	1	Resistor (10,000-Ohm, 2 Watt)
CR15	359-0015	1	Diode, Zener (24 Volt)	R26	303-0164	1	Potentiometer
K1	307-1063	1	Relay, Magnetic Reed	R28	350-0459	1	Resistor (1.0 Megohm, 1 Watt)
Q1, Q2	362-0017	2	Transistor, Silicon (NPN)		517-0127	2	Cover, Potentiometer (Not Illustrated)
Q3	361-0004	1	Transistor, Unijunction				
R1, R23	350-0355	2	Resistor (47-Ohm, 1/2 Watt)				
R2, R3	350-0351	2	Resistor (33-Ohm, 1/2 Watt)				
R4	350-1075	1	Resistor (4.7 Megohm, 2 Watt)				
R5	353-0040	1	Resistor, Fixed (270-Ohm, 10 Watt)				

ENGINE CONTROL MONITOR GROUP - 12 VOLT
OPTIONAL (5 Fault Lights)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0681		Monitor, Engine Control - 12 Volt - Optional	R2	303-0169	1	Potentiometer (3.5 Megohm, 1/4 Watt, 30%)
C1	356-0040	1	Capacitor, Electrolytic (10 Mfd, 20 Volt)	R3	350-0572	1	Resistor, Composition (1 Megohm, 1/2 Watt, 10%)
C2	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R4	350-0517	1	Resistor, Composition (27-Ohm, 1/2 Watt, 10%)
C3	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R5	350-0536	1	Resistor, Composition (1000-Ohm, 1/2 Watt, 10%)
C4	356-0030	1	Capacitor, Electrolytic (1 Mfd, 35 Volt)	R6	350-0548	1	Resistor, Composition (10,000-Ohm, 1/2 Watt, 10%)
C5	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R7	350-0505	1	Resistor, Composition (2.7-Ohm, 1/2 Watt, 10%)
C6	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R8	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
C7	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R9	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
C8	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R10	350-0380	1	Resistor, Composition (510-Ohm, 1/2 Watt, 5%)
CR1	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R11	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR2	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R12	350-0552	1	Resistor, Composition (22,000-Ohm, 1/2 Watt, 10%)
CR3	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R13	350-0505	1	Resistor, Composition (2.7-Ohm, 1/2 Watt, 10%)
CR4	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R14	350-0536	1	Resistor, Composition (1000-Ohm, 1/2 Watt, 10%)
CR5	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R15	303-0169	1	Potentiometer (3.5 Megohm, 1/4 Watt, 30%)
CR6	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R16	350-0517	1	Resistor, Composition (27-Ohm, 1/2 Watt, 10%)
CR7	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R17	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
CR8	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R18	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
CR9	359-0027	1	Diode, Zener (1 Watt, 7.5 Volt, 5%)	R19	350-0517	1	Resistor, Composition (27-Ohm, 1/2 Watt, 10%)
CR10	364-0017	1	Diode, Rectifier (8 Amp, 30 Volt)	R20	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR11	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R21	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR12	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R22	350-0505	1	Resistor, Composition (2.7-Ohm, 1/2 Watt, 10%)
CR13	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R23	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR14	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R24	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR15	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R25	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
CR16	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R21	350-0380	1	Resistor, Composition (510-Ohm, 1/2 Watt, 5%)
CR17	364-0017	1	Diode, Rectifier (8 Amp, 30 Volt)	R27	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR18	364-0017	1	Diode, Rectifier (8 Amp, 30 Volt)	R28	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR19	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R29	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
CR20	364-0017	1	Diode, Rectifier (8 Amp, 30 Volt)	R30	350-0505	1	Resistor, Composition (2.7-Ohm, 1/2 Watt, 10%)
CR21	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R31	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
K1	307-1039	1	Relay, Armature (12 Volt)	R32	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
K2	307-1039	1	Relay, Armature (12 Volt)	R33	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
Q1	362-0025	1	Transistor	R34	350-0517	1	Resistor, Composition (27-Ohm, 1/2 Watt, 10%)
Q2	362-0025	1	Transistor	R35	350-1128	1	Resistor, Composition (220-Ohm, 2 Watt, 10%)
Q3	361-0003	1	Transistor	R36	350-0584	1	Resistor, Composition (10 Megohm, 1/2 Watt, 10%)
Q4	362-0008	1	Transistor	S1	308-0280	1	Switch, Push - DPDT (1A, 28 VDC/45A, 115 VAC)
Q5	362-0008	1	Transistor	TB1	332-1231	1	Printed Wiring Board
Q6	362-0008	1	Transistor				
Q7	362-0031	1	Transistor				
Q8	362-0031	1	Transistor				
Q9	361-0003	1	Transistor				
Q10	362-0008	1	Transistor				
Q11	362-0008	1	Transistor				
Q12	362-0008	1	Transistor				
Q13	362-0008	1	Transistor				
Q14	362-0008	1	Transistor				
R1	350-0526	1	Resistor, Composition (100-Ohm, 1/2 Watt, 10%)				

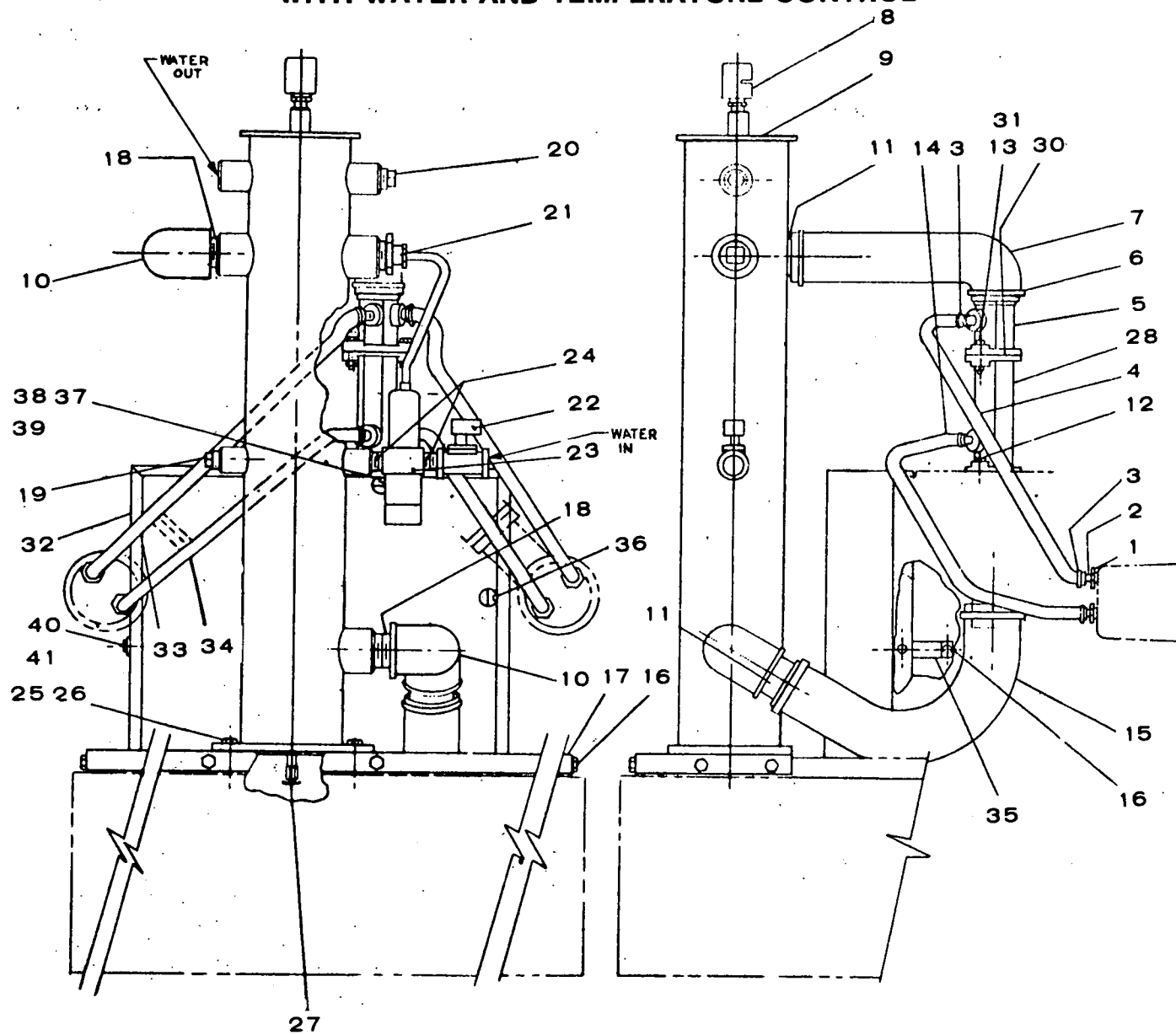
DIRECT FLOW (CITY WATER) COOLING INSTALLATION (179-1031) - WITH WATER AND TEMPERATURE CONTROL VALVE



DIRECT FLOW (CITY WATER) COOLING INSTALLATION (179-1031) - WITH WATER AND TEMPERATURE CONTROL VALVE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0120	2	Elbow (90° x 3/8")
2	505-0135	8	Nipple, Half (3/8 x 1-1/2")
3	821-0014	7	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1/2")
4	505-0028	1	Cock, Drain (3/8")
5	505-0019	6	Bushing, Reducer (1/2 x 3/8")
6	505-0060	1	Tee, Pipe (3/8")
7	503-0386	As Req.	Hose (5/8" Bulk) Order Length Required
8	503-0183	8	Clamp, Hose
9	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
10	148-0274	2	Bracket, Carb. to Reg. Hose
11	800-0046	3	Screw, Cap - Hex Head (3/8-16 x 1/2")
13	130-1019	1	Adapter, Thermostat
14	821-0021	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1")
15	870-0048	2	Nut, Hex - Self Locking (5/16-18)
16	821-0023	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1-1/2")
17	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
18	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
19	309-0241	1	Valve, Water & Temp. Control
20	110-0526	1	Nipple & Bracket Assy.
21	821-0013	2	Screw, Cap - Hex Head - Self Locking (1/4-20 x 1")
22	870-0065	2	Nut, Hex Self Locking (1/4-20)
23	307-0833	1	Valve, Solenoid
24	503-0357	3	Hose (2-5/8" ID)
25	503-0465	2	Clamp, Hose
26	505-0028	1	Bushing, Reducer (1-1/4 x 3/8")
27	505-0131	1	Bushing, Reducer (3/4 x 3/8")
28	505-0101	3	Nipple, Close (3/8 x 1")
29	130-0499	1	Bracket, Heat Exchanger
30	130-1050	1	Guard, Belt
31	505-0021	1	Bushing, Reducer (3/4 x 1/2")
32	505-0031	1	Coupling, Pipe (1-1/4")
33	800-0054	1	Screw, Cap - Hex Head (3/8-16 x 2")
34	850-0050	4	Washer, Lock (3/8")
35	130-1009	1	Spacer, Belt Guard
36	821-0010	1	Screw, Cap - Hex Head - Self Locking (1/4-20 x 5/16")
37	870-0212	1	Nut, Hex Locking (1/4-20)
38	130-1008	1	Strap, Belt Guard
39	130-1021	1	Plate, Water Outlet
40	130-1024	1	Gasket, Water Outlet

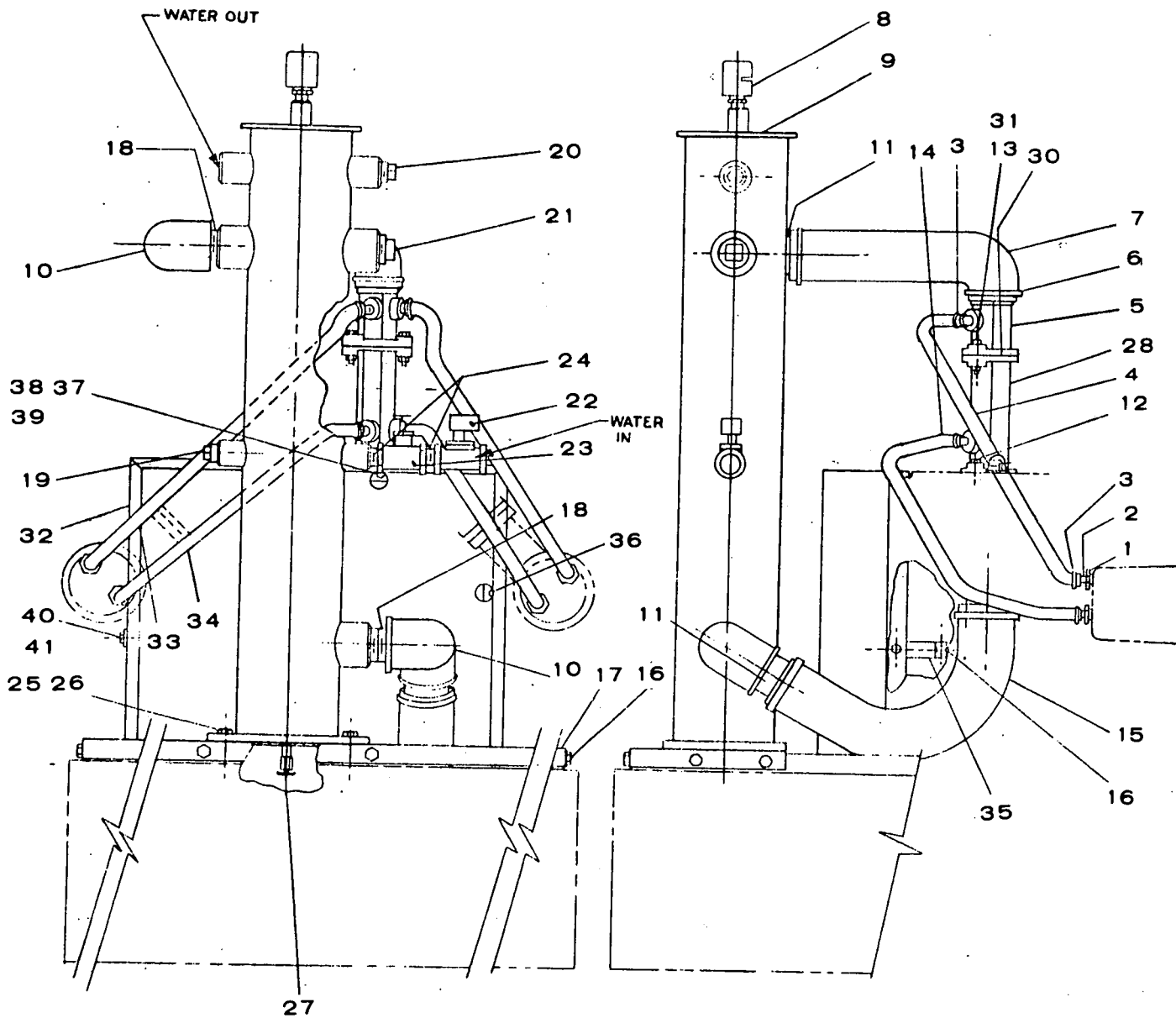
STANDPIPE INSTALLATION (179-1033) - WITH WATER AND TEMPERATURE CONTROL



STANDPIPE INSTALLATION (179-1033) - WITH WATER AND TEMPERATURE CONTROL

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0019	4	Bushing, Reducer (1/2 x 3/8")
2	505-0135	8	Nipple, Half (3/8 x 1-1/2")
3	503-0183	8	Clamp, Hose
4	503-0386	As Req.	Hose (5/8" ID Bulk) Order Length Required
5	130-1018	1	Outlet, Water
6	503-0274	4	Clamp, Hose
7	503-0635	1	Hose, Flexible
8	504-0062	1	Valve, Vacuum Relief
9	130-0635	1	Standpipe
10	505-0043	2	Elbow (90° x 1-1/2")
11	505-0385	2	Nipple, Half (1-1/2 x 2")
12	821-0021	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1")
13	821-0023	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1-1/2")
14	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
15	503-0635	1	Hose, Flexible
16	821-0014	7	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1/2")
17	130-1023	1	Bracket, Standpipe Mtg.
18	505-0220	2	Nipple, Close (1-1/2" x 1-3/4")
19	505-0130	1	Plug, Square Head (3/4")
20	505-0140	1	Plug, Square Head (1")
21	505-0289	1	Bushing, Reducer (1-1/2 x 3/4")
22	307-0835	1	Valve, Solenoid (3/4")
23	309-0241	1	Valve, Water & Temp Control
24	505-0102	2	Nipple, Close (3/4 x 1-3/8")
25	821-0030	4	Screw, Cap - Hex Head - Self Locking - (3/8-16 x 1")
26	870-0133	4	Nut, Lock (3/8")
27	504-0028	1	Cock, Drain
28	130-1019	1	Adapter, Thermostat
30	130-1024	1	Gasket, Water Outlet
31	870-0048	2	Nut, Hex - Self Locking (5/16-18)
32	130-1050	1	Guard, Belt
33	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
34	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
35	130-1008	1	Strap, Belt Guard
36	821-0029	1	Screw, Cap - Hex Head - Self Locking (3/8-16 x 3/4")
37	800-0054	1	Screw, Cap - Hex Head (3/8-16 x 2")
38	850-0050	1	Washer, Lock - Spring (3/8)
39	130-1009	1	Spacer
40	821-0010	1	Screw, Cap - Hex Head - Self Locking (1/4-20 x 5/16")
41	870-0212	1	Nut, Hex - Self Locking (1/4-20)

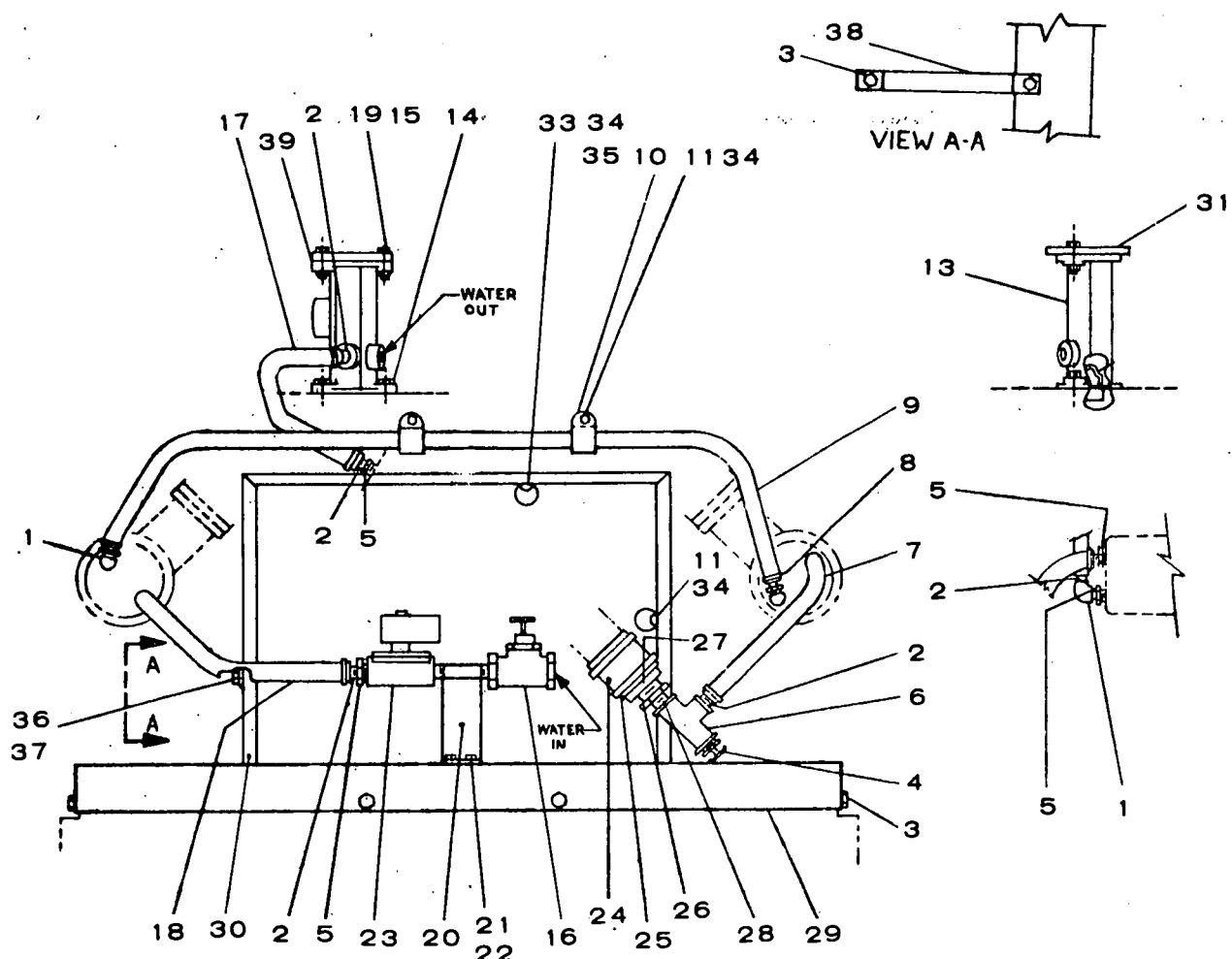
STANDPIPE INSTALLATION (179-1030)



STANDPIPE INSTALLATION (179-1030)

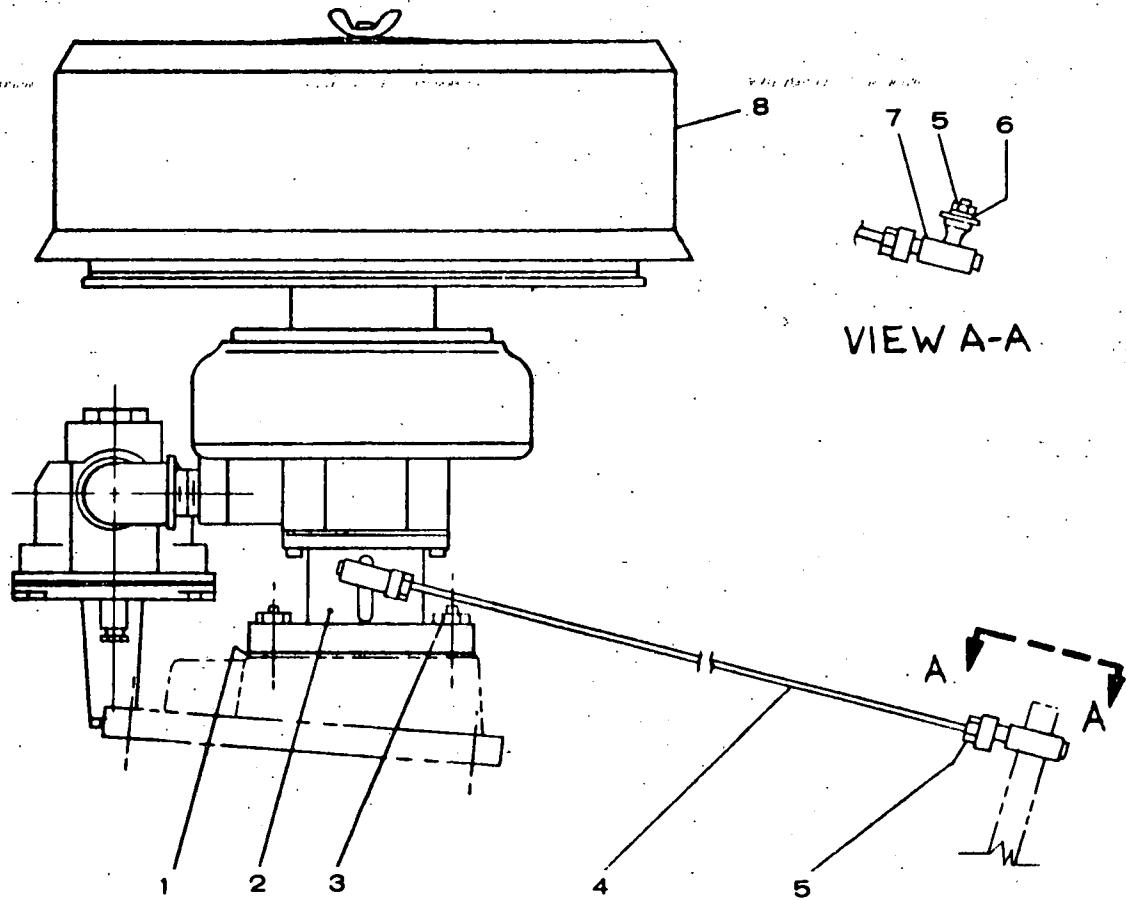
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0019	4	Bushing, Reducer (1/2 x 3/8")
2	505-0135	8	Nipple, Half (3/8 x 1-1/2")
3	503-0183	8	Clamp, Hose
4	503-0386	As Req.	Hose (5/8" ID Bulk) - Order length required
5	130-1018	1	Outlet, Water
6	503-0274	4	Clamp, Hose
7	503-0635	1	Hose, Flexible
8	504-0062	1	Valve, Vacuum Relief
9	130-0635	1	Standpipe
10	505-0043	2	Elbow (90° x 1-1/2")
11	505-0385	2	Nipple, Half (1-1/2 x 2")
12	821-0021	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1")
13	821-0023	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1-1/2")
14	503-0386	As Req.	Hose (5/8" ID Bulk) - Order length required
15	503-0635	1	Hose, Flexible
16	821-0014	7	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1/2")
17	130-1023	1	Bracket, Standpipe Mtg.
18	505-0220	2	Nipple, Close (1-1/2" x 1-3/4")
19	505-0130	1	Plug, Square Head (3/4")
20	505-0140	1	Plug, Square Head (1")
21	505-0402	1	Plug, Square Head (1-1/2")
22	307-0835	1	Valve, Solenoid (3/4")
23	504-0046	1	Valve, Lockshield (3/4")
24	505-0102	2	Nipple, Close (3/4 x 1-3/8")
25	821-0030	4	Screw, Cap - Hex Head - Self Locking (3/8-16 x 1")
26	870-0133	4	Nut, Hex - Locking (3/8")
27	504-0028	1	Cock, Drain
28	130-1019	1	Cock, Drain
30	130-1024	1	Gasket, Water Outlet
31	870-0048	2	Nut, Hex Self Lock (5/16-18)
32	130-1050	1	Guard, Belt
33	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
34	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required
35	130-1008	1	Strap, Belt Guard
36	821-0029	1	Screw, Cap - Hex Head - Self Locking (3/8-16 x 3/4")
37	800-0054	1	Screw, Cap - Hex Head (3/8-16 x 2")
38	850-0050	1	Washer - Lock - Spring (3/8")
39	130-1009	1	Spacer
40	821-0010	1	Screw, Cap - Hex Head - Self Locking (1/4-20 x 5/16")
41	870-0212	1	Nut, Hex - Self-Locking (1/4-20)

DIRECT FLOW (CITY WATER) COOLING INSTALLATION (179-1032)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0120	2	Elbow (90° x 3/8")	19	821-0023	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1-1/2")
2	505-0135	8	Nipple, Half (3/8 x 1-1/2")	20	110-0526	1	Nipple & Bracket Assy.
3	821-0014	7	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1/2")	21	821-0013	2	Screw, Cap - Hex Head - Self Locking (1/4-20 x 1")
4	505-0028	1	Cock, Drain (3/8")	22	870-0065	2	Nut, Hex - Self Locking (1/4-20)
5	505-0019	6	Bushing, Reducer (1/2 x 3/8")	23	307-0833	1	Valve, Solenoid
6	505-0060	1	Tee, Pipe (3/8")	24	503-0357	3	Hose (2-5/8" ID)
7	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required	25	503-0354	2	Clamp, Hose
8	503-0183	8	Clamp, Hose	26	505-0028	1	Bushing, Reducer (1-1/4 x 3/8")
9	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required	27	505-0031	1	Coupling, Pipe (1-1/4")
10	148-0274	2	Bracket, Carb. to Regulator Hose	28	505-0101	1	Nipple, Close (3/8 x 1")
11	800-0046	3	Screw, Cap - Hex Head (3/8-16 x 1/2")	29	130-0499	1	Bracket, Heat Exchanger
13	130-1019	1	Adapter, Thermostat	30	130-1050	1	Guard, Belt
14	821-0021	2	Screw, Cap - Hex Head - Self Locking (5/16-18 x 1")	31	130-1022	1	Plate, Water Outlet
15	870-0048	2	Nut, Hex - Self Locking (5/16-18)	33	800-0054	1	Screw, Cap - Hex Head (3/8-16 x 2")
16	504-0019	1	Valve, Lockshield	34	850-0050	4	Washer, Lock - Spring (3/8")
17	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required	35	130-1009	1	Spacer, Belt Guard
18	503-0386	As Req.	Hose (5/8" ID Bulk) - Order Length Required	36	821-0010	1	Screw, Cap - Hex Head - (1/4-20 x 5/16")
				37	870-0212	1	Nut, Hex - Self Locking (1/4-20)
				38	130-1008	1	Strap, Belt Guard
				39	130-1024	1	Gasket, Water Outlet

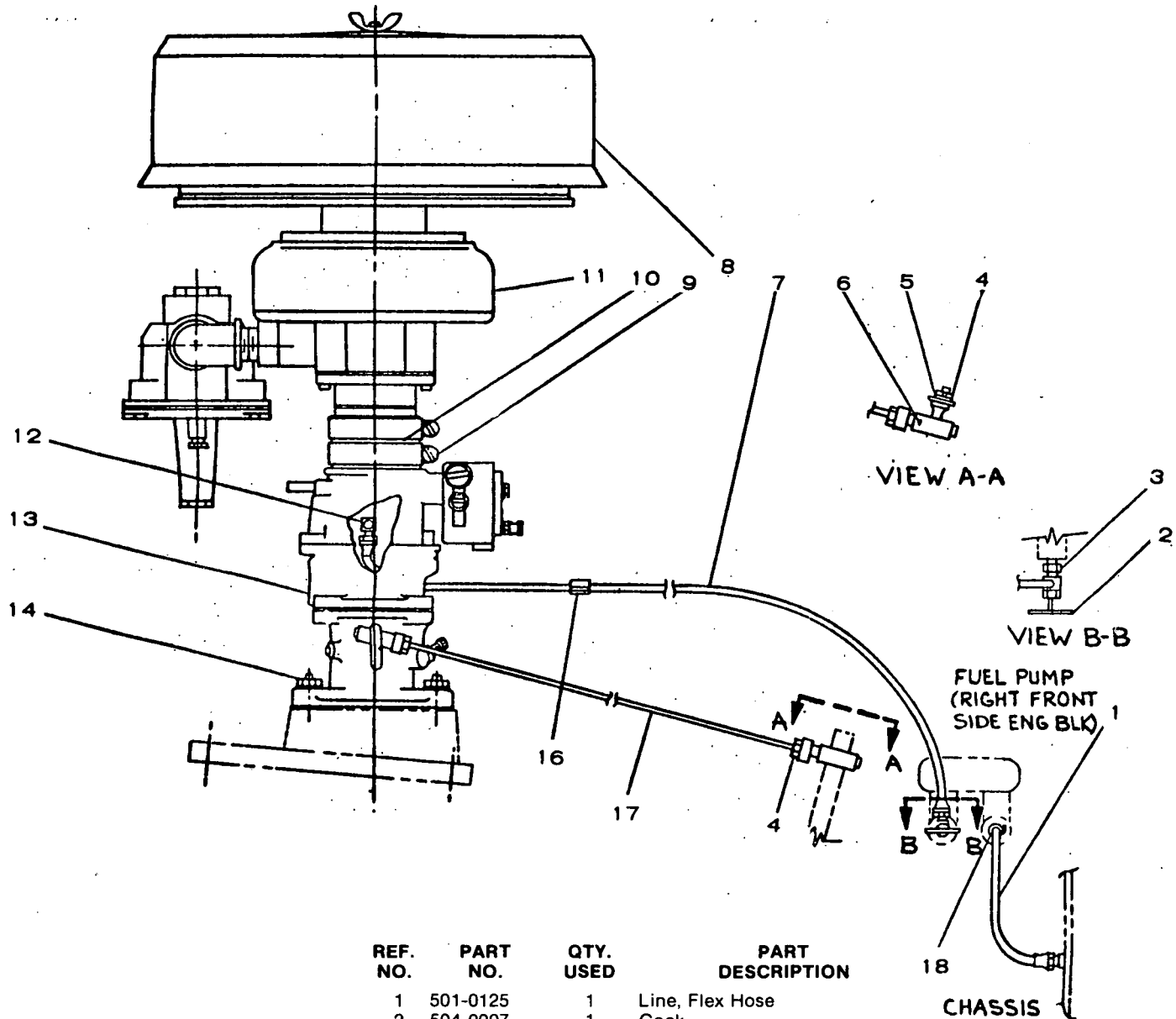
LIQUID PETROLEUM GAS VAPOR CARBURETOR INSTALLATION **(179-0453)**



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
2	145-0488	1	Carburetor, Nat. Gas
3	870-0281	1	Nut, Hex - Self Locking (3/8-16)
4	520-0855	1	Stud, Governor (1/4-28 x 14-1/2")
5	115-0025	4	Nut, Hex (1/4-28)
6	850-0040	2	Washer, Lock Spring (1/4")
7	150-0638	2	Joint, Ball
8	140-1083	1	Air Cleaner

148-636 LP

GAS-GASOLINE CARBURETOR INSTALLATION (179-0452)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	501-0125	1	Line, Flex Hose
2	504-0007	1	Cock
3	502-0354	1	Adapter, Fuel Line
4	115-0025	4	Nut, Hex (1/4-28)
5	850-0040	2	Washer, Lock Spring (1/4")
6	150-0638	2	Joint, Ball (1/4-28)
7	501-0008	1	Line, Flex Fuel
8	140-1083	1	Air Cleaner
9	503-0465	2	Clamp, Hose
10	503-0542	1	Hose, Adapter (2-1/4 x 1-1/4)
11	145-0487	1	Carb. & Reg. Assy. (Gas)
12	502-0020	1	Elbow, Street
13	141-0841	1	Carburetor (Gas)
14	870-0281	2	Nut, Hex - Self Locking (3/8-16)
16	332-1554	1	Clamp, Loop
17	520-0855	1	Stud, Gov. (1/4-28 x 14-1/2")
18	503-0373	1	Clamp, Hose

Req 148-597
n Gas



**MANUFACTURER'S
LIMITED
WARRANTY**

Onan extends to the original purchaser of goods for use, the following warranty covering goods manufactured or supplied by Onan, subject to the qualifications indicated.

- (1) Onan warrants to original purchaser for the periods set forth below that goods manufactured or supplied by it will be free from defects in workmanship and material, provided such goods are installed, operated, and maintained in accordance with Onan's written instructions, and further provided, that installation inspection and initial start-up on commercial-industrial generator set or power system installations are conducted by an Onan Authorized Distributor or its designated service representative.

PRODUCT APPLICATION	PERIOD OF WARRANTY
<input type="checkbox"/> Goods used in personal, family and household applications.	One (1) year from date of purchase.
<input type="checkbox"/> Goods used in commercial-industrial applications.	One (1) year from date of purchase.
<input type="checkbox"/> Commercial-industrial stationary generator sets.	One (1) year from date of initial start-up.
<input type="checkbox"/> Commercial-industrial, standby power systems with nominal operating speeds of 1800 rpms or less which are installed in the U.S. or Canada (must include Onan supplied generator sets, automatic transfer switch, exerciser and running time meter).	* Five (5) years or 1500 hours, whichever occurs first from the date of initial start-up. Labor allowance for the first two (2) years or 1500 hours, whichever occurs first from the date of initial start-up.
<input type="checkbox"/> Commercial-industrial, standby power systems with nominal operating speeds of 1800 rpms or less which are installed outside the U.S. or Canada (must include Onan supplied generator set, automatic transfer switch, exerciser and running time meter).	* Two (2) years or 1500 hours, whichever occurs first from the date of initial start-up.
<input type="checkbox"/> Repair or replacement parts.	Ninety (90) days from date of purchase, excludes labor.

* Must be registered on Form No. 23C065, to be provided and completed by seller.

- (2) Onan's sole liability and Purchaser's sole remedy for a failure of goods to perform as warranted shall be limited to the repair or replacement of goods returned to Onan's factory at 1400 73rd Avenue N.E., Minneapolis, Minnesota 55432, or to an Onan Authorized Distributor or its designated service representative, transportation prepaid.

Except as indicated below, this warranty does not include travel time and mileage labor for removal of Onan product from its application and reinstallation.

a) Removal and Reinstallation

- Garden Tractor Engines*—Onan will pay up to a maximum of two (2) hours labor for warranty work requiring removal and reinstallation of Onan industrial engines in garden tractor applications performed by an Onan Authorized Distributor or its designated service representative.
- Vehicles*—Onan will pay one (1) hour labor for warranty work requiring removal and reinstallation performed by an Onan Authorized Distributor or its designated service representative on vehicle applications utilizing a POWER DRAWER® and Onan supplied sliding tray generator set installations.

b) Travel Time and Mileage

- Marine Generator Set Installations*—Onan will, for six (6) months after date of purchase, pay travel time up to four (4) hours and mileage costs up to one hundred fifty (150) miles related to warranty repairs, provided, such travel and repairs are performed by an Onan Authorized Distributor or its designated service representative.
- Commercial-Industrial Standby Generator Set and System Installations*—Provided the generator set or system is permanently wired in a stationary installation, Onan will, for six (6) months after initial start-up, pay travel time up to four (4) hours and mileage costs up to one hundred fifty (150) miles for warranty repairs performed by an Onan Authorized Distributor or its designated service representative.

(3) THERE IS NO OTHER EXPRESS WARRANTY.

IMPLIED WARRANTIES INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO PERIODS OF WARRANTY SET FORTH ABOVE AND TO THE EXTENT PERMITTED BY LAW, ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED.

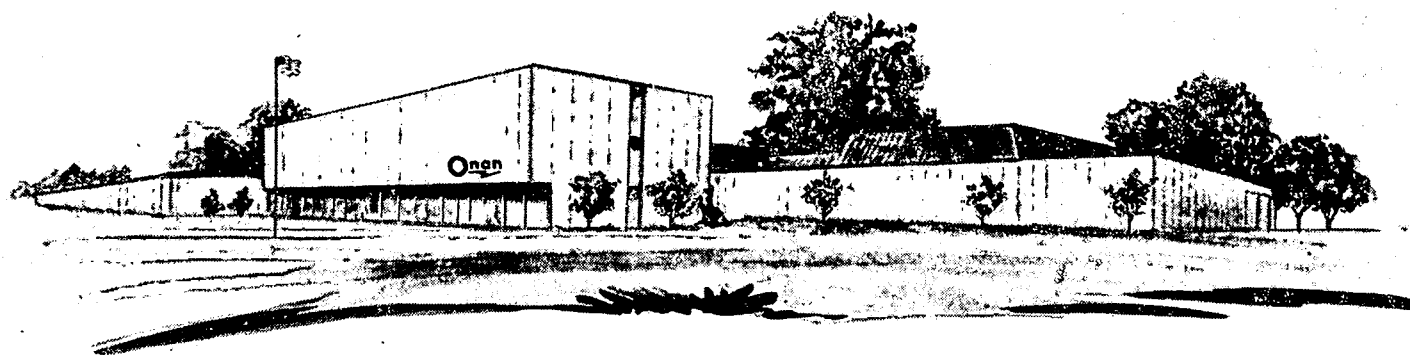
IN NO EVENT IS ONAN LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

(4) All claims must be brought to the attention of Onan or an Onan Authorized Distributor or its designated service representative within thirty (30) days after discovery that goods or parts fail to perform as warranted.

(5) THIS WARRANTY SHALL NOT APPLY TO:

- a) Cost of maintenance, adjustments, installation and start-up.
- b) Failures due to normal wear, accident, misuse, abuse, negligence or improper installation.
- c) Products which are altered or modified in manner not authorized by manufacturer in writing.
- d) Failure of goods caused by defects in the system or application in which the goods are installed.
- e) Telephone, telegraph, teletype or other communication expenses.
- f) Living and travel expenses of persons performing service, except as specifically included in Section 2.
- g) Rental equipment used while warranty repairs are being performed.
- h) Overtime labor requested by purchaser.
- i) Starting batteries.

(6) No person is authorized to give any other warranties or to assume any other liabilities on Onan's behalf, unless made or assumed in writing by an officer of Onan, and no person is authorized to give any warranties or assume any other liability on behalf of Seller unless made or assumed in writing by Seller.



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

