Onan®

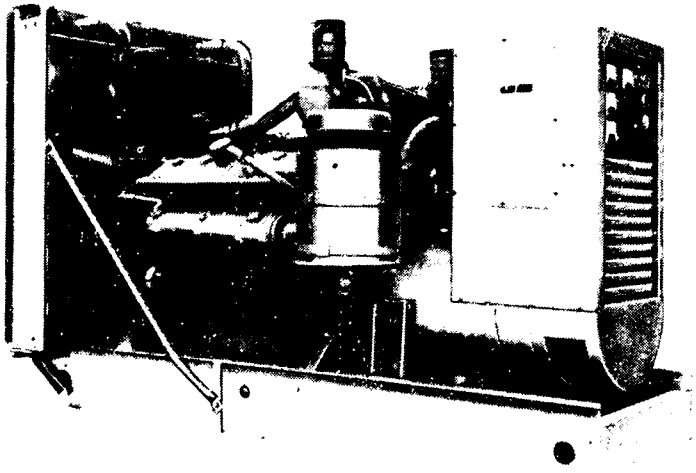
OPERATOR S MANUAL AND PARTS CATALOG

FOR

DHB

SERIES

ELECTRIC GENERATING SETS



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

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

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

To assist in familiarization, refer to the following terms.

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

The customary unit of Brake Horsepower (BHP) becomes kilowatts (kW) when converted to S1 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

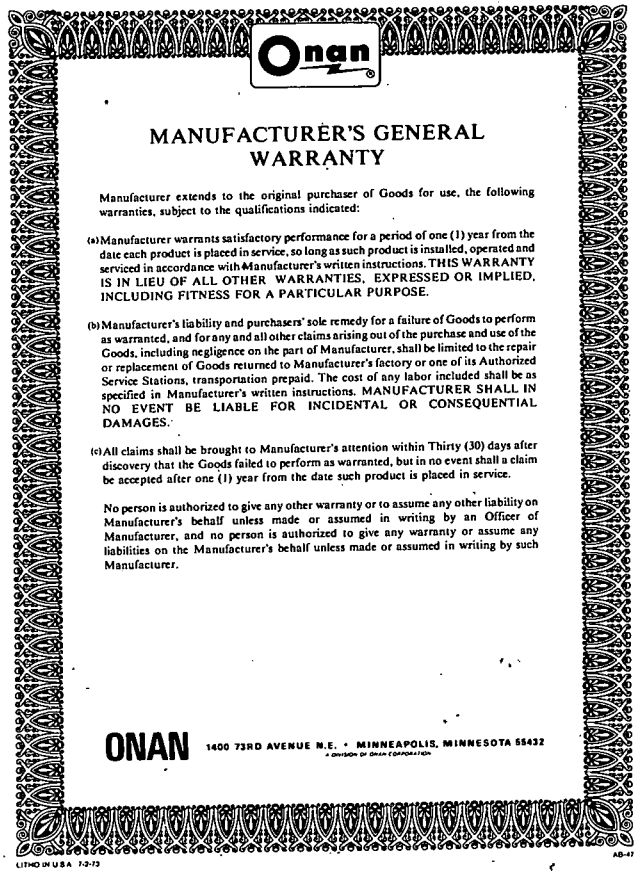
TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.

INTRODUCTION

FOREWORD

This manual is applicable to the DHB Series electric generating set, consisting of an ONAN YB, 350.0 kW generator, driven by a Detroit Diesel engine.

The manual is divided into two sections. Section 1 provides information on installation, operation and troubleshooting. Section 2 is a *Parts Catalog* for ONAN optional and standard equipment. The manual should be used in conjunction with the Detroit Diesel engine manual, as your specific engine may have variations due to optional equipment available.



Onan

MANUFACTURER'S GENERAL WARRANTY

Manufacturer extends to the original purchaser of Goods for use, the following warranties, subject to the qualifications indicated:

(a) Manufacturer warrants satisfactory performance for a period of one (1) year from the date each product is placed in service, so long as such product is installed, operated and serviced in accordance with Manufacturer's written instructions. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR A PARTICULAR PURPOSE.

(b) Manufacturer's liability and purchasers' sole remedy for a failure of Goods to perform as warranted, and for any and all other claims arising out of the purchase and use of the Goods, including negligence on the part of Manufacturer, shall be limited to the repair or replacement of Goods returned to Manufacturer's factory or one of its Authorized Service Stations, transportation prepaid. The cost of any labor included shall be as specified in Manufacturer's written instructions. MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

(c) All claims shall be brought to Manufacturer's attention within Thirty (30) days after discovery that the Goods failed to perform as warranted, but in no event shall a claim be accepted after one (1) year from the date such product is placed in service.

No person is authorized to give any other warranty or to assume any other liability on Manufacturer's behalf unless made or assumed in writing by an Officer of Manufacturer, and no person is authorized to give any warranty or assume any liabilities on the Manufacturer's behalf unless made or assumed in writing by such Manufacturer.

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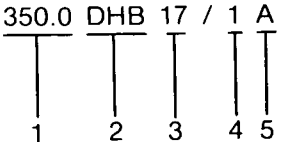
MODEL IDENTIFICATION

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



1. Indicates Kilowatt rating.
2. Factory code for SERIES identification.
3. Indicates voltage code.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

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

CAUTION **This symbol refers to possible equipment damage.**

If it is necessary to contact 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 types 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 Detroit Diesel nameplate is on the right hand side, on the cylinder block.

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

IMPORTANT! RETURN WARRANTY CARD ATTACHED TO UNIT.

SAFETY PRECAUTIONS

Throughout this manual you will find eye-catching flags containing Warnings and Cautions, alerting 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 generator 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 or carbon tetrachloride 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 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 generator set, disconnect batteries. This will prevent inadvertent starting of the set.

- Use extreme caution when making adjustments on the electrical components in the control panel while the engine is running. High voltages are present and could cause serious personal injury.

- DO NOT SMOKE while servicing batteries. Verify correct polarity of battery cables before connecting. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by electrical arcing or by smoking. When connecting batteries, connect the ground lead last.

SPECIFICATIONS

ENGINE DETAILS

Engine Manufacturer	Detroit Diesel
Engine Series	V12-71T
Number of Cylinders	V12
Displacement	852-inch³ (13.96 litre)
BHP @ 1800 RPM	575 (428.9 kW)
Compression Ratio	17.0:1
Bore	4.25-inches (107.95 mm)
Stroke	5.00-inches (127.0 mm)
Fuel	ASTM No. 2 Diesel
Battery Voltage	24VDC
Battery Group (Two 12-Volt, 225 A.H. [810 kC])	8D
Starting Method	Solenoid Shift
Governor Regulation	3-5 percent
Battery Charging Current	35 Amperes

GENERATOR DETAILS

Type	YB 17	60 Hz
	YB 517	50 Hz
Rating (Watts)		
60 Hertz Continuous Standby	350,000	437.5 kVA
50 Hertz Continuous Standby	290,000	362.5 kVA
AC Voltage Regulation	± 2 Percent	
60 Hertz RPM	1800	
50 Hertz RPM	1500	
Output Rating	0.8 PF	
AC Frequency Regulation	3.0 Hz No Load to Full Load	

CAPACITIES AND REQUIREMENTS

Cooling System	
Engine	13.75 Gallons (52 litres)
Engine and Radiator	36.50 Gallons (138 litres)
Engine Oil Capacity (Filter, Lines, Crankcase)	9.0 Gallons (34.1 litres)
Exhaust Connection (inches pipe thread)	5-inch pipe

AIR REQUIREMENTS (1800 RPM)

Engine Combustion	1800-CFM (0.85m³/sec)
Radiator Cooled Engine	33,500-CFM (15.8m³/sec)
Total for Radiator Cooled Model	35,300-CFM (16.7m³/sec)
Alternator Cooling Air (1800 RPM)	1,200-CFM (0.57m³/sec)
(1500 RPM)	1,000-CFM (0.5m³/sec)
Fuel Consumption at Rated Load ASTM No. 2 Diesel	28.7 GPH (109 litres/hr)

GENERAL

Height	75.0-inches (1.9 m)
Width	65.0-inches (1.65 m)
Length	114.0-inches (2.9 m)
Approximate Weight (Mass)	8050 pounds (3655 kg)

TABLE 1
YB GENERATOR VOLTAGE/CURRENT OPTIONS

350.0 kW 437.5 kVA 60 Hz
290.0 kW 362.5 kVA 50 Hz

VOLTAGE	PHASE	FREQUENCY	MAXIMUM CURRENT	PARALLEL WYE	SERIES WYE	CONNECT WIRE W12
(YB17) 120/208	3	60 Hz	1215A	x		H3
127/220	3	60 Hz	1148A	x		H4
139/240	3	60 Hz	1054A	x		H5
240/416	3	60 Hz	607A		x	H3
254/440	3	60 Hz	574A		x	H4
277/480	3	60 Hz	526A		x	H5
(YB517) 110/190	3	50 Hz	1102A	x		H3
115/200	3	50 Hz	1048A	x		H4
120/208	3	50 Hz	1007A	x		H4
127/220	3	50 Hz	951A	x		H5
220/380	3	50 Hz	551A		x	H3
230/400	3	50 Hz	524A		x	H4
240/416	3	50 Hz	503A		x	H4
254/440	3	50 Hz	475A		x	H5
9X 347/600	3	60 Hz	421A		x	*
5D 120/240	3	60 Hz	1054A	SERIES DELTA		*
6D 240/480	3	60 Hz	526A	SERIES DELTA		*

* - Factory wired, not reconnectible.

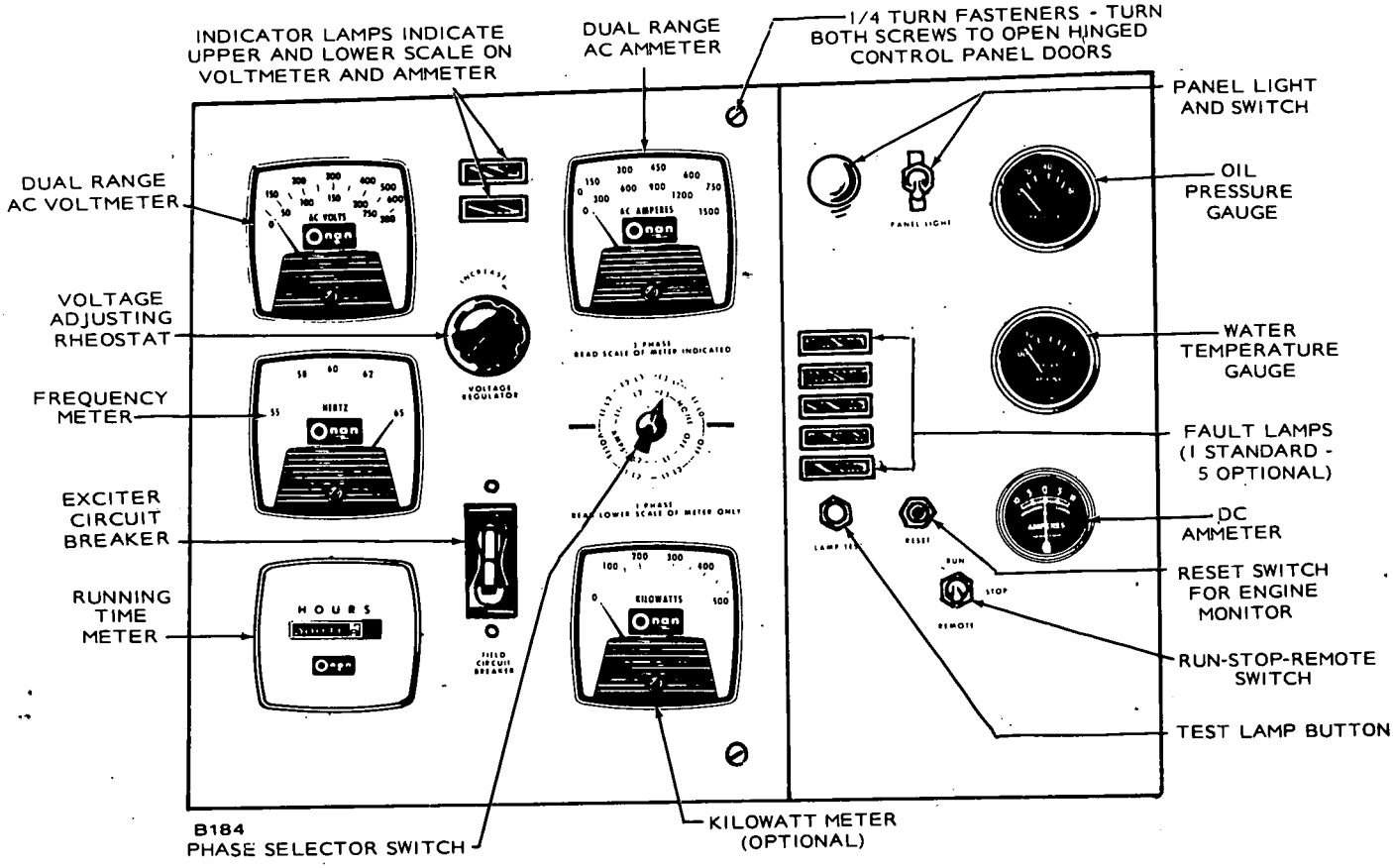


FIGURE 1. CONTROL PANEL

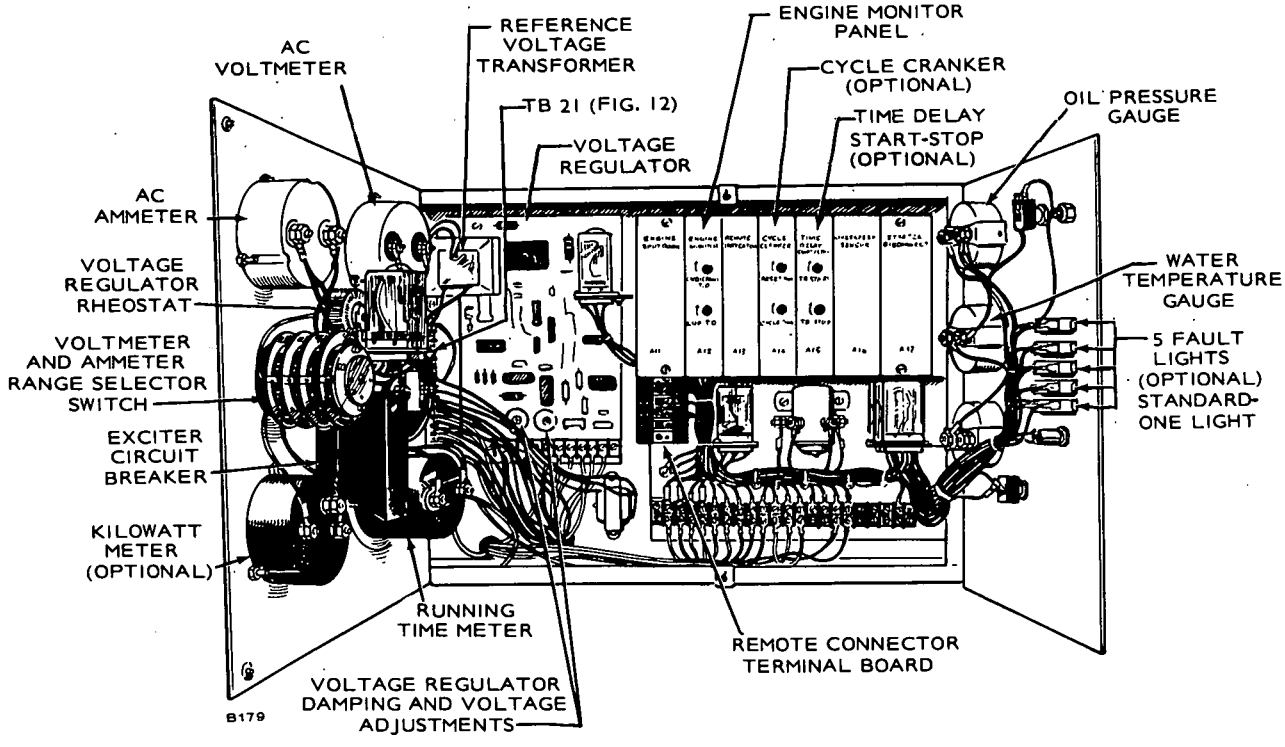


FIGURE 1A. CONTROL PANEL INTERIOR

DESCRIPTION

GENERAL

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

ENGINE

The engine on the DHB is a Detroit Diesel as described in engine manual. Basic measurements and requirements will be found under *Specifications.* However, the engine used for your unit may have variations due to optional equipment available, therefore the Detroit Diesel manual should be consulted.

AC GENERATOR

The generator is an ONAN Type YB, 12 lead, 4-pole revolving field, reconnectible bus-bar, 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 rpm, and the 50 Hz at 1500 rpm. Excitation is achieved as follows—

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

CONTROL PANEL

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

DC Panel

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 the battery charging current.

Run-Stop-Remote Switch: Starts and stops the unit locally or from a remote location.

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

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

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.

AC Ammeter: Indicates AC generator output current.

Dual range instrument: measurement range in use shown on indicator lights.

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

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.

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

OPTIONAL EQUIPMENT

DC Panel

Warning Lights: Eliminates the one "Fault" light and substitutes five indicator lights to give warning of—

a. Overcrank (failed to start)
b. Overspeed
c. Low oil pressure
d. High engine temperature
e. Low engine temperature

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

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. Refer to Figure 1A for location of units mentioned.

Terminal Board (TB) 21: Connection of wandering lead (W12) to terminals H3, H4, H5 is made at this point, to change voltage regulator tap when reconnecting generator for different voltages. Refer to Figure 12.

Voltage Regulator: Solid state unit controls AC output from generator at predetermined level regardless of load. Regulation plus or minus 2 percent from no load to full load, 0.8 P.F.

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

1. A 75 second cranking period.
2. Approximately a 12.5 second time delay for oil pressure buildup.
3. An external alarm contact to light a fault lamp and shut down the set for alarm conditions such as:
   a. Overcrank (failed to start after cranking 75 seconds).
   b. Overspeed (engine speed exceeds 2000 rpm).
   c. Low oil pressure 14 psi (96.5 kPa).
   d. High engine temperature 205° F (96° C).

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

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.

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.

Overspeed Shutdown: Shutdown occurs if engine speed exceeds 2010 rpm. A sensor mounted on the generator shaft (Figure 2) signals an overspeed condition which shuts down the engine through control module A16.

Failure of this system will allow a backup shutdown to function. A magnetic solenoid mounted on top of the engine will actuate to close the air intakes and starve the engine, thereby inducing shutdown. Reset air shut-off valve manually.

Start-Disconnect: Plug-in module. Operates at approximately 100 rpm above maximum cranking speed to prevent the starter from being energized while engine is running.

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.

Time Delay Start/Stop: Operative from remote location only. Provides 1-10 seconds time delay on starting and 30-seconds to 5-minutes delay on stopping. Delay period adjustable on engine monitor panel.

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

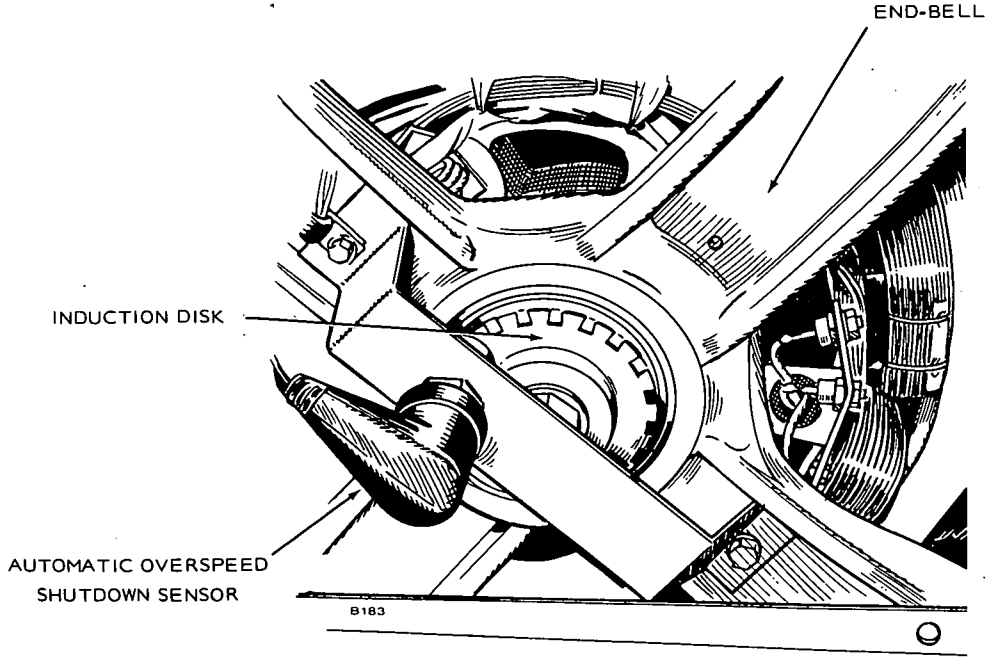


FIGURE 2. OVERSPEED SENSOR

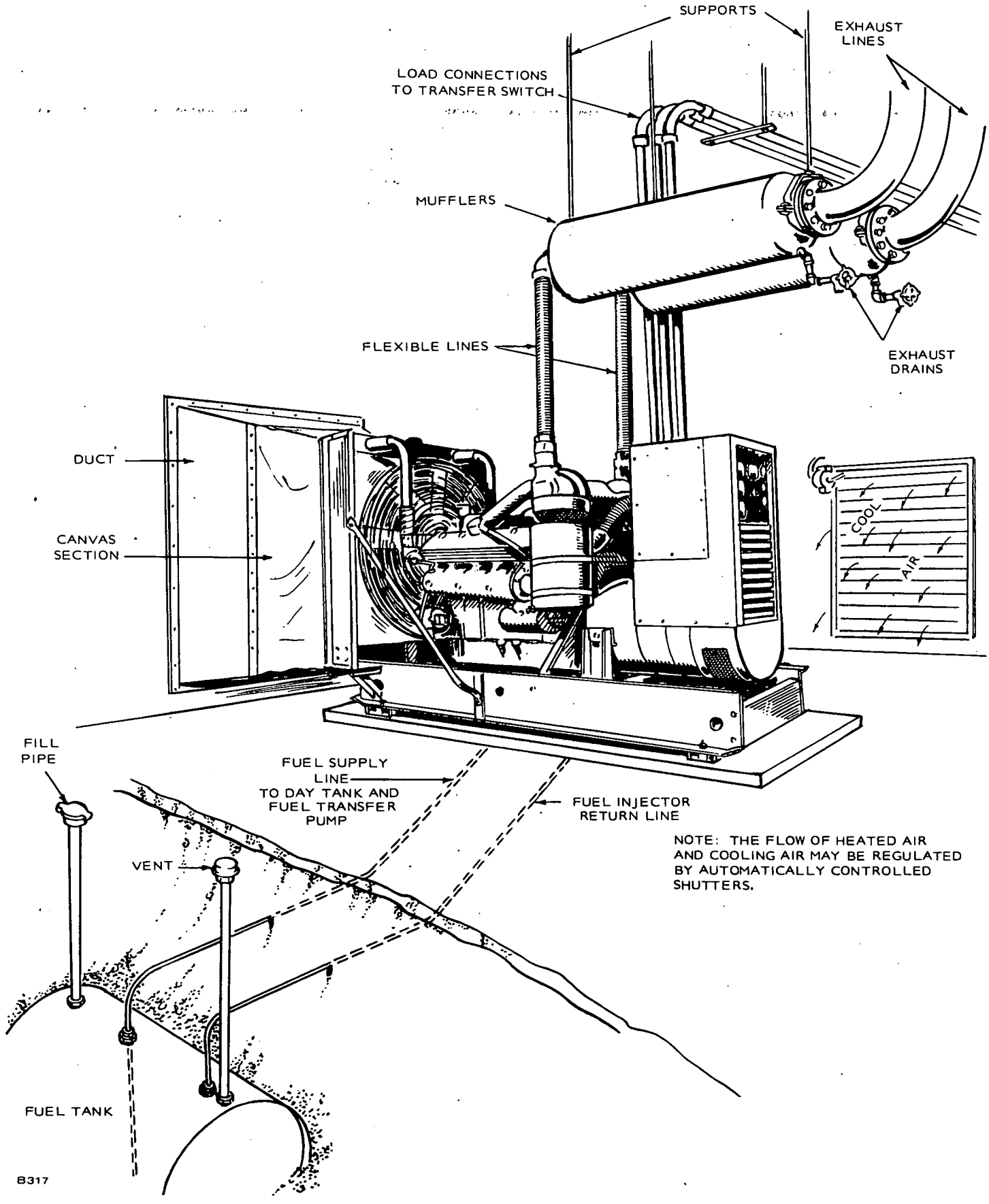


FIGURE 3. TYPICAL INSTALLATION

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 3.

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 connections.
8. Water connections.
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 extremes in weather conditions.

MOUNTING

Generator sets are mounted on a rigid skid base which provides proper support. Install vibration isolators between skid base and foundation. For convenience in draining crankcase oil and general servicing, mount set on raised pedestals (at least 6 inches high). Refer to ONAN Technical Bulletin T-030 for further installation information.

VENTILATION

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

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

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

Provide a means of restricting the air flow in cold weather to keep the room or compartment temperature at a normal point.

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

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

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

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

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

CITY WATER COOLING

An optional method of engine cooling, in place of the conventional radiator and fan, uses a constant pressure water supply. This is referred to as CITY WATER COOLING. There are two varieties of city water cooling: the HEAT EXCHANGER SYSTEM and STANDPIPE SYSTEM. See Figures 4 and 5.

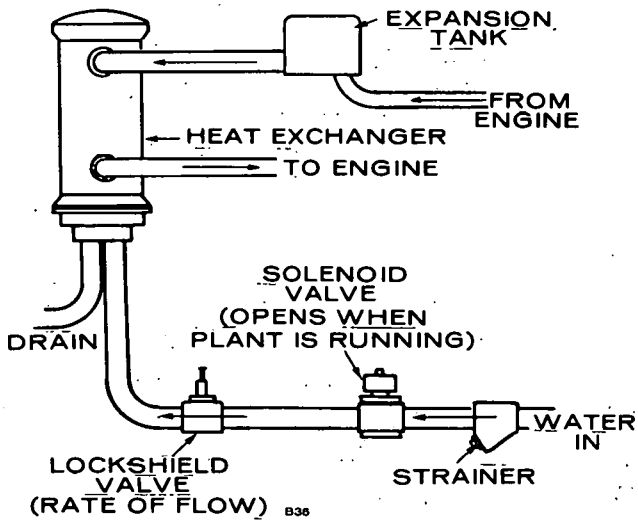


FIGURE 4. TYPICAL HEAT EXCHANGER SYSTEM

The HEAT EXCHANGER provides for a closed engine cooling system. Engine coolant flows through a tubed chamber, keeping the coolant separate from the cool "raw" water supply. The coolant chamber must be filled for operation, as for a radiator cooled set.

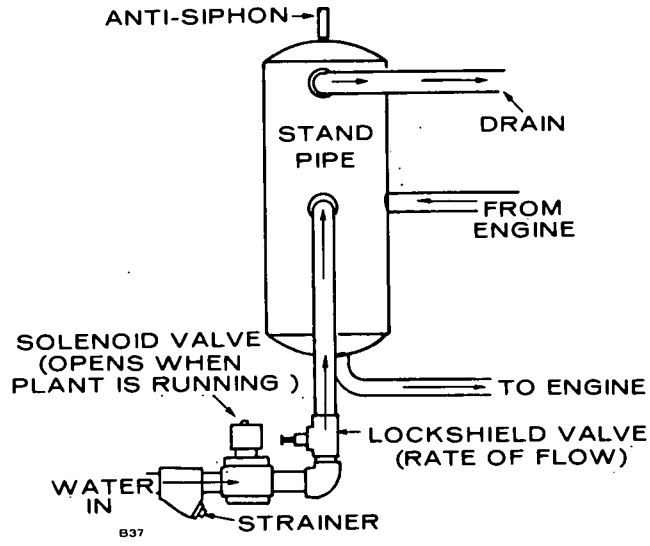


FIGURE 5. TYPICAL STANDPIPE SYSTEM

The STANDPIPE SYSTEM uses a mixing or tempering tank. Cooling water that circulates through the engine mixes with a source of cool "raw" water. The "raw" water supply must be free of scale forming lime or other impurities.

On both systems use flexible pipe for connecting water supply and outlet flow pipes to engine. Pipe the outlet flow to a convenient drain. Install an electric solenoid valve and a rate of flow valve in the water supply line. The electric solenoid valve opens and allows water flow through the system only when the unit operates. The rate of flow valve, either automatic or manual, provides for the proper flow rate to the engine. Adjust the flow to maintain water temperature between 165°F (74°C) and 195°F (91°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.

WATER JACKET HEATER (Optional)

This heater is installed to maintain an elevated engine temperature in lower ambient temperature application. It heats and circulates engine coolant, and is thermostatically controlled (Figure 19).

EXHAUST

WARNING **Inhalation of exhaust gases can result in serious injury or 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 6) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 7) 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 3 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9-inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 5-inch pipe size outlets of the engine with a flexible portion between the engine and muffler. Do not connect a flexible line to the exhaust manifold.

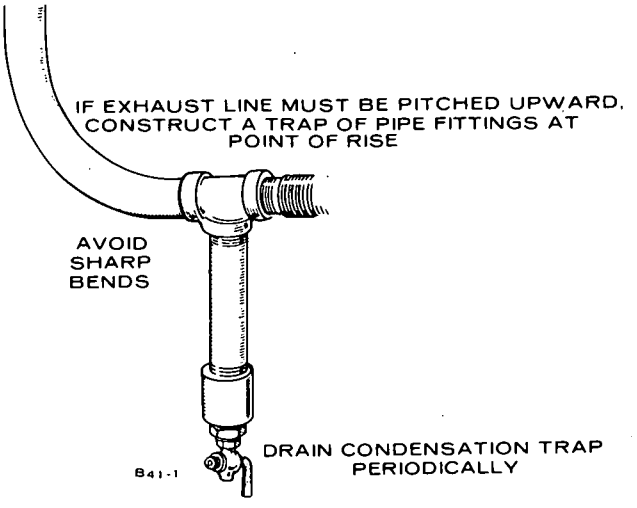


FIGURE 7. EXHAUST CONDENSATION TRAP

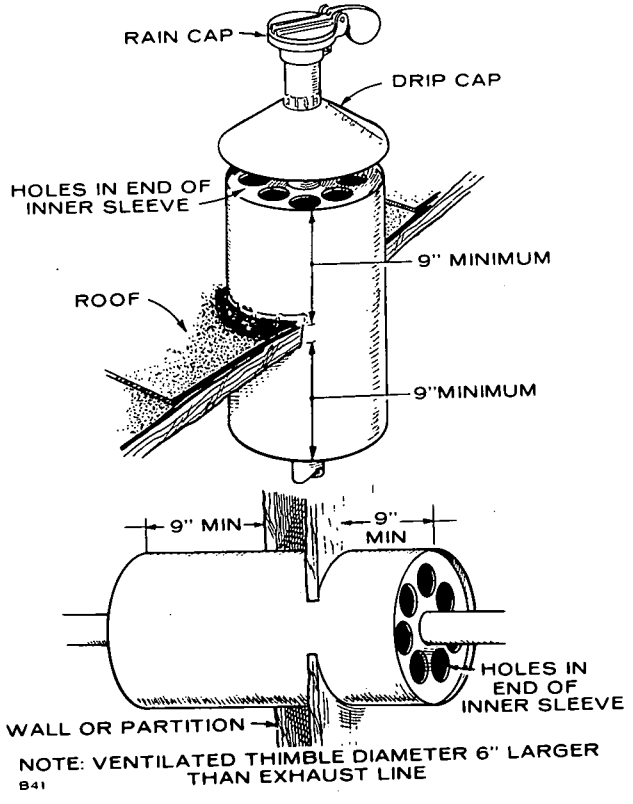


FIGURE 6. EXHAUST THIMBLE

Minimum diameters and maximum lengths of pipe (with critical muffler[s]) are as follows:

MAXIMUM EQUIVALENT EXHAUST LENGTH—FEET

6-inch	8-inch	10-inch	Pipe
	100	350	Single
59	387		Dual

Maximum permissable exhaust restriction (back pressure) is as follows:

60 Hz 27.0-inches H_2O (91.15 kPa)
50 Hz 18.9-inches H_2O (63.81 kPa)

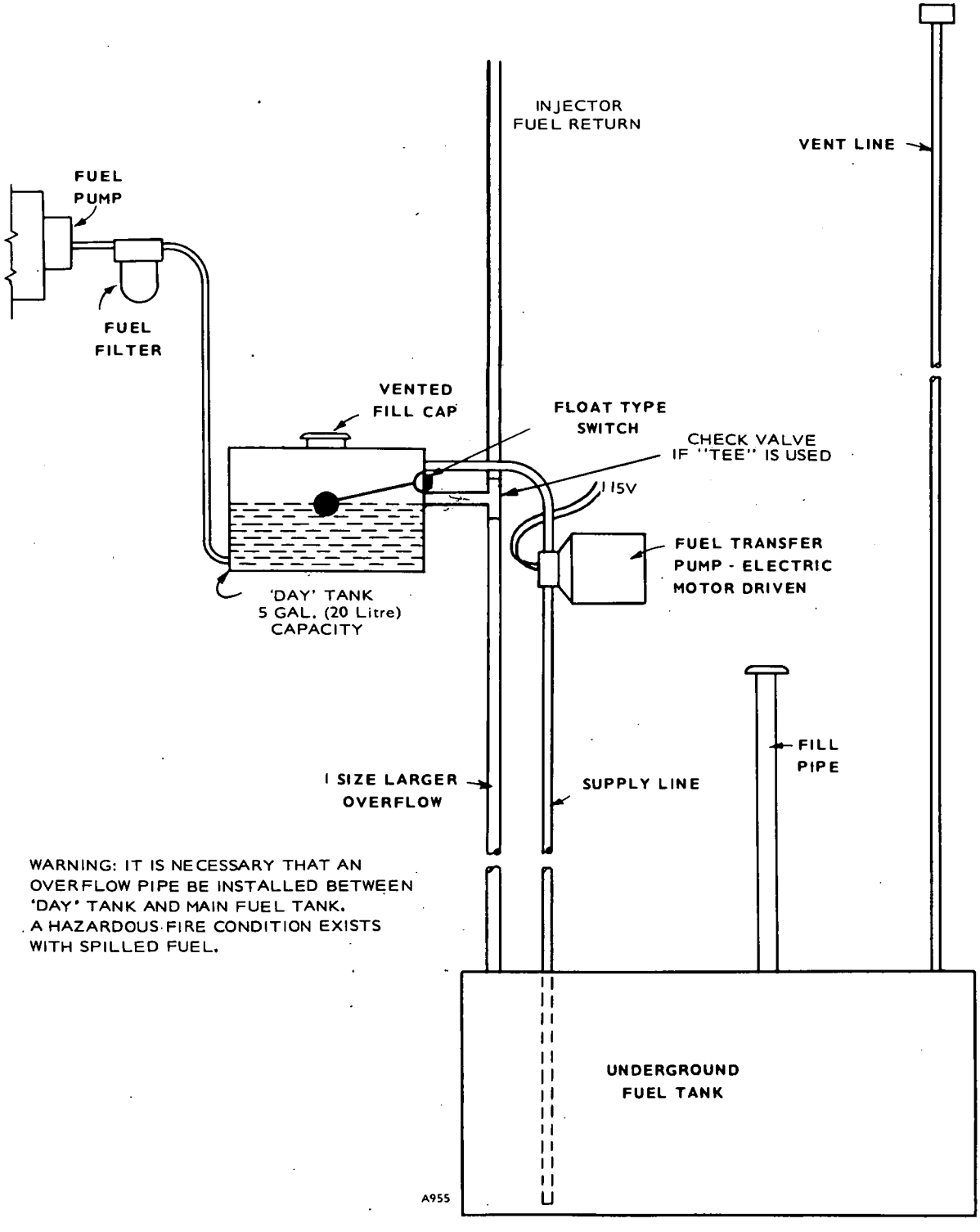


FIGURE 8. DAY TANK INSTALLATION (TYPICAL)

FUEL SYSTEM

Detroit Diesel engines used on ONAN DHB sets are designed for use with ASTM No 2 diesel fuels conforming to the specifications of the engine manual. Do not use fuels other than those specified.

INSTALLATION

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

CAUTION **Do not use any galvanized materials in the installation of a diesel fuel system. The fuel oil reacts chemically with the zinc coating to form powdery flakes which quickly clog fuel strainers and filters, and damage the fuel pump and injectors.**

In any diesel engine installation, fuel system cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture or contaminants of any kind.

FUEL TRANSFER PUMP

Pump delivery is above that required for combustion and injector cooling; the excess is returned to the tank. Fuel lift and restrictions in the system must not allow maximum suction to exceed 6-inches Hg (20.25 kPa); measurement to be made at the pump. If maximum suction does exceed that value, a day tank is then recommended. Do not return transfer pump fuel return line to the day tank. This will heat the fuel oil in the tank, thereby causing a loss of engine power. The return line should go to the main tank.

Pipe fittings to the filters and pump are threaded for 3/8 N.P.T.

FUEL FILTERS

There are two stages of filtration, primary (P) and secondary (S). The primary filter is a 30 micron unit, and is mounted on the suction side of the fuel transfer pump. This filter should be drained periodically to prevent water buildup. Should condensate level reach half the height of the element, it will be sucked into the system.

The secondary filter is connected between the fuel pump and the injectors. It is a 10 micron filter. This unit should be serviced at frequent intervals to prevent manifold pressure falling below 45 psi (310 kPa, measured at the filter outlet.

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the fuel tank. The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and the main fuel tank. Refer to the instructions included with the tank. See Figure 8 for an example of a day tank installation.

Add note per memo of D. Eichosz

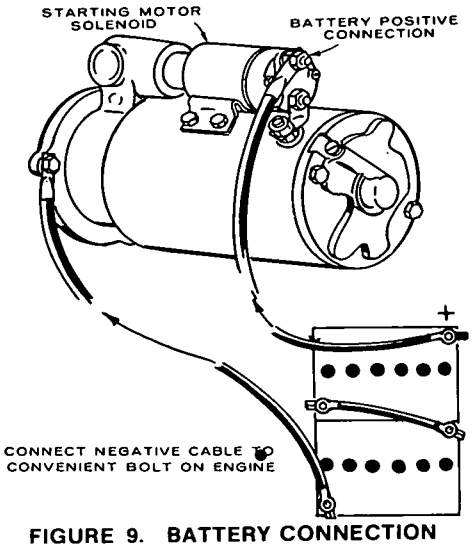


FIGURE 9. BATTERY CONNECTION

BATTERY

Starting the unit requires 24-volt battery current. Use two 12-volt (see *Specifications*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 9. Necessary battery cables are on unit. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Onan automatic transfer switches include such a battery charging circuit.

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

BATTERY, HOT LOCATION

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

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

REMOTE CONTROL CONNECTIONS

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated within the control box. Connect one or more remote switches across remote terminal and B+ terminal as shown in Figure 10. 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 (305-610 m), use No. 16 AWG wire.

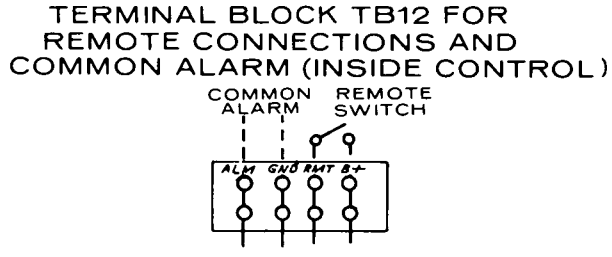


FIGURE 10. REMOTE STARTING

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.

If the installation is for standby service, a double throw transfer switch (Figure 11) must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator power to be connected to the load at the same time. Instructions for connecting an automatic transfer switch are included with such equipment.

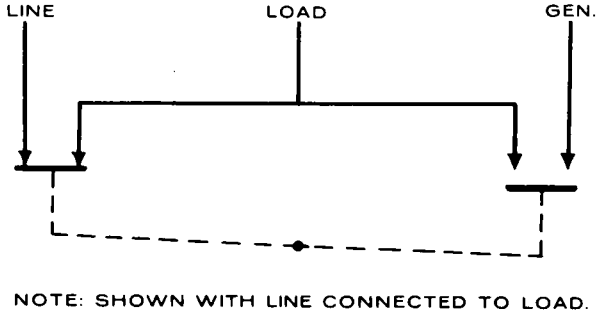


FIGURE 11. LOAD TRANSFER SWITCH

CONTROL BOX CONNECTION

Reconnection lead W12 on TB21 is a jumper which connects a single phase output from the generator to the appropriate tap on the voltage reference transformer. This lead is connected at one end to terminal 63 on the terminal board. The other end will be connected to a terminal marked H3, H4 or H5 (see Figure 12) depending upon the voltage option required. Refer to Table 1 and Figure 14 for voltages available and correct hookup.

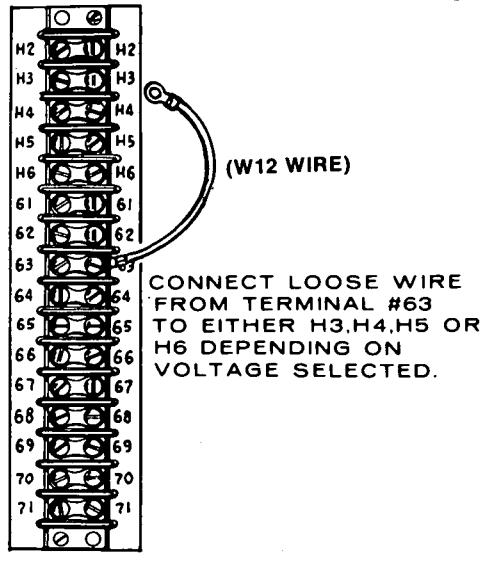


FIGURE 12. CONTROL BOX CONNECTION

GENERATOR CONNECTIONS

The model YB17 generator is a 3-phase 60 Hz (YB517 is 50 Hz) unit which can be bus-bar connected in either series wye or parallel wye configuration to give the line-to-neutral or line-to-line options referred to in Table 1 and Figure 14. Special models -9X, -5D and -6D are connected at the factory and cannot be changed without extensive modification. Line-to-neutral voltage is the lower voltage noted on the unit nameplate, line-to-line voltage is the higher nameplate rating.

Refer to Figure 13 for an example of 120/208 voltage connection.

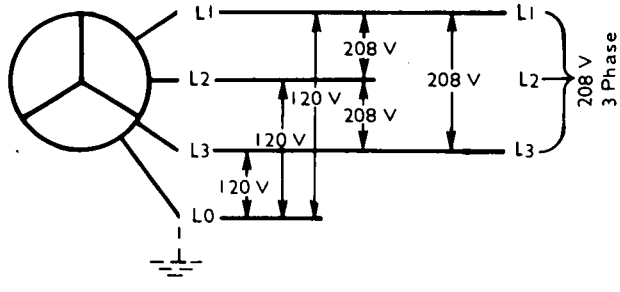
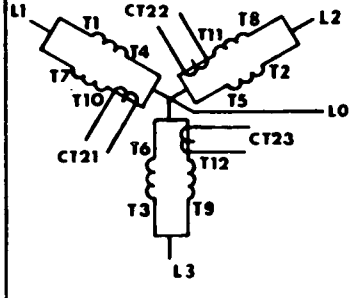
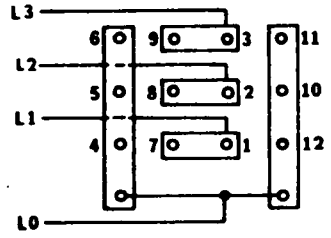
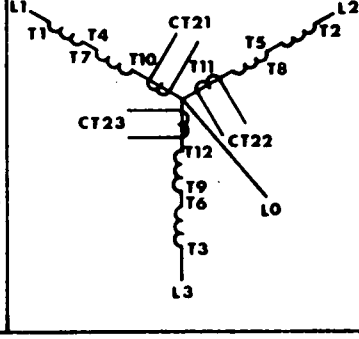
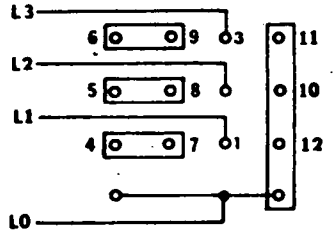


FIGURE 13. 3 PHASE WYE CONNECTION

THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASES	FREQUENCY	CONNECT LEAD FROM TERMINAL 63 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM
17 R	120/208	3	60	H3	PARALLEL WYE		
17 R	127/220	3	60	H4			
17 R	139/240	3	60	H5			
517 R	110/190	3	50	H3			
517 R	115/200	3	50	H4			
517 R	120/208	3	50	H4			
517 R	127/220	3	50	H5			
17 R	240/416	3	60	H3	SERIES WYE		
17 R	254/440	3	60	H4			
17 R	277/480	3	60	H5			
517 R	220/380	3	50	H3			
517 R	230/400	3	50	H4			
517 R	240/416	3	50	H4			
517 R	254/440	3	50	H5			

98C2579

FIGURE 14. VOLTAGE CONNECTIONS

For 3-phase loads connect separate load wires to each of the set terminals L1, L2 and L3 (Figure 14). For a large single phase load only, connect between terminals L1 and L2. Available capacity is 2/3 maximum output.

The terminal L0 can be grounded. For 1-phase loads connect the neutral wire to the L0 terminal. Connect the load wire to either terminal—L1, L2. Two separate single phase circuits are available with a total capacity of up to 2/3 of the generator rated 3-phase output.

If using 1-phase and 3-phase current at the same time, ensure the 1-phase load is properly balanced. Do not exceed rated line current.

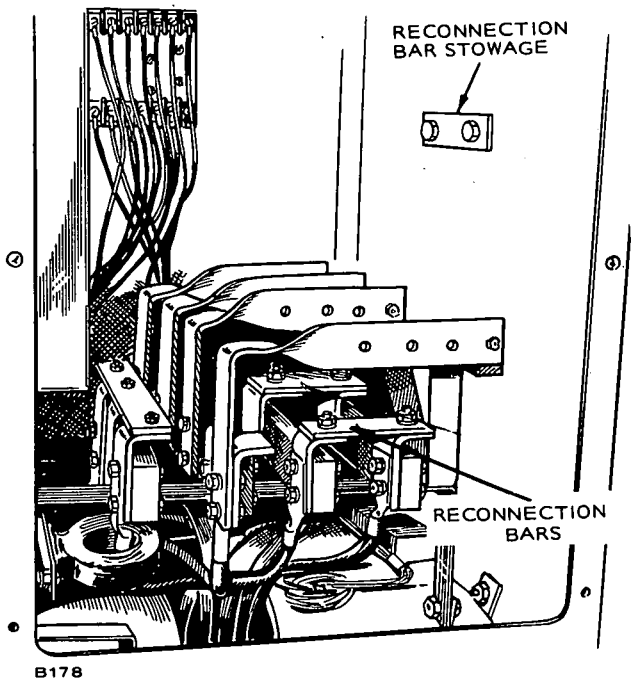


FIGURE 15. LOAD WIRE CONNECTIONS

Bus bars and reconnection bars are aluminum, plated with tin to retard electrolytic corrosion. Select connecting cables and terminal lugs with care, to keep dissimilar metals apart. Do not overtorque bolts.

Voltage code -5D and -6D Delta Connected sets. Available in 60 Hz series delta winding only. The -5D unit is 120/240 volt, the -6D is 240/480 volt. These sets supply single phase and three phase current. For three phase operation connect load wires to generator terminals L1, L2 and L3, one wire to each terminal. Terminal L0 is not used.

Single phase operation, terminals L1 and L2 are supply terminals; L0 is neutral which can be tied to ground if required. For 120 volt (-5D) or 240 volt (-6D) single phase, connect load wire to either L1 or L2 terminal and the return to L0.

See Figure 16 for a typical connection to a delta wound unit.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as no terminal current exceeds the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA.

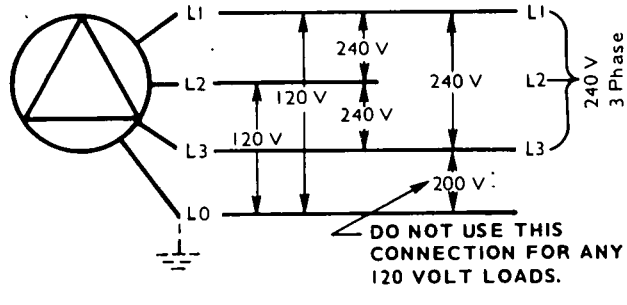


FIGURE 16. 3 PHASE, DELTA CONNECTION

OPERATION

GENERAL

ONAN DHB Series electric generating sets are given a complete running test under various load conditions and 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

Lubricating System: Engine oil was drained prior to shipment. After an extended period of inactivity, any lubricating oil in the upper parts of the engine will drain back into the lower galleries and crankcase. Prior to initial engine start after such a period, remove the valve rocker covers and pour two quarts (or two litres) of the same oil used in the crankcase over the rocker arms and push rods. Replace rocker covers and fill crankcase to capacities shown.

Refer to Detroit Diesel engine manual for engine oil recommendations. Note that for average operating conditions oil conforming to Military Specification Mil-L-2104B is recommended. Multigrade oils should not be used. Do not mix brands nor grades of oil.

Recommended oil viscosity is SAE 30, for all temperatures. Use a coolant heater for lower ambients. After engine has been run, check dipstick, add oil if necessary to bring level to FULL mark. Record total capacity for future oil changes.

Oil Capacities (nominal)

Oil Pan	34 quarts (32.2 litres)
Filter and Oil Lines	2 quarts (1.9 litres)
Total	36 quarts (34.1 litres)

CAUTION **After changing or filling engine crankcase, pre-fill oil filters. If this is not performed, the engine will be starved for oil until the filters fill up, and damage will result.**

CAUTION **Disconnect turbo charger oil inlet line and pump clean engine oil into the turbocharger and oil line. This will ensure that the bearings are oiled for the initial start. Failure to do so can cause irreparable damage to the turbocharger within five seconds of engine start.**

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Total capacity is 36.5 gallons (138 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean, soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures, use anti-freeze with an ethylene-glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to engine manual for additional information.

CAUTION **Verify that the electric solenoid valve used with city water cooled plants is open to allow coolant chambers to fill before initial starting of set. Overheating and damage to the engine could result from non-compliance.**

Ensure that water supply for city water cooling is turned ON.

Fuel System: Refer to the engine manual for fuel oil specifications. Check with fuel supplier and ensure that fuel supplied meets the specifications. Filter or strain fuel when filling tank.

Fuel supply tanks should be kept as nearly full as possible by topping up each time engine is used. Warm fuel returning from the injector pump heats the fuel in the supply tank. If the fuel level is low in cold weather, the upper portion of the tank not heated by returning fuel tends to increase condensation. In warm weather both the supply tank and fuel are warm. Cool night air lowers the temperature of the tank more rapidly than the temperature of the fuel. Again this tends to increase condensation.

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

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

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 petroleum based or non-conductive grease to retard formation of corrosive deposits.

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

STARTING

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

a. Crankcase filled.
b. Cooling system filled—input solenoid valve open.
c. Batteries charged and connected.
d. Fuel solenoid valve open.
e. Shut-off valves on air shutdown housings open.

To start, move the "run-stop-remote" switch to the "run" position. The engine should start after a few seconds of cranking.

Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 50 and 60 psi (345 and 414 kPa). Check the following gauges:

a. DC Ammeter—10 to 30 amperes.
b. AC Voltmeter—AC generator output voltage.
c. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 160° to 180° F (71° to 82° 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° to 195° F (74° to 91° C).

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

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

STOPPING

To reduce and stabilize temperatures within the engine and turbocharger run the engine at no load for 3-5 minutes before shutting down.

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

EXERCISE PERIOD

Generating sets on continuous standby service are required to be operative at essential load 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 pressure, 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 (305 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

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.

DUST AND DIRT

1. Keep set clean. Keep cooling system free of dirt, etc.
2. Service air cleaners regularly.
3. Change crankcase oil at proper intervals.
4. Ensure air inlet system is leak free.

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

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

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

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

***NOTE:** Not applicable on Pennsylvania State models.

OUT-OF-SERVICE PROTECTION

Refer to chapter on *Storage* in Detroit Diesel engine manual.

Run set at 1800 rpm with 50 percent load instead of 1200 rpm and no load.

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. Keep fuel system clean, and batteries in a well charged condition.
3. Partially restrict cool air flow but use care to avoid overheating.
4. Connect water jacket heater when set is not running.
5. Refer to engine manual for further information.

Engine Heater: The function of this optional heater is to keep the engine warm enough to assure starting under adverse weather conditions. Connect the heater to a source of power that will be ON during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating (Figure 17).

CAUTION **Do not energize heater until engine cooling system is filled with coolant.**

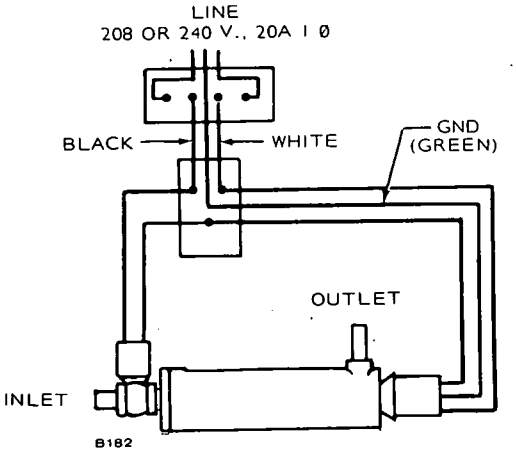


FIGURE 17. ENGINE HEATER (TYPICAL)

GENERAL MAINTENANCE

GENERAL

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

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.**

ENGINE SPEED

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

A Woodward governor is standard equipment on the DHB generator set. High speed and low speed limit stops are set at the ONAN testing facility and normally do not require further adjustment, therefore if your set is used on continuous standby service, the governor may never need to be touched. If however the unit is used frequently, adjustment may be required due to wear of internal components. This adjustment is achieved by backing off the high speed stop screw. Screw in the low speed adjusting screw until the generator output frequency meter reads 60 Hz (generator on rated load). Turn in the high speed adjusting screw until it bottoms; secure the locknuts. Refer to Figure 18.

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

Example: 30 x 61 (Hz) = 1830 rpm.

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

Engine crankcase oil flows through the governor. Dirty oil can degrade governor operation.

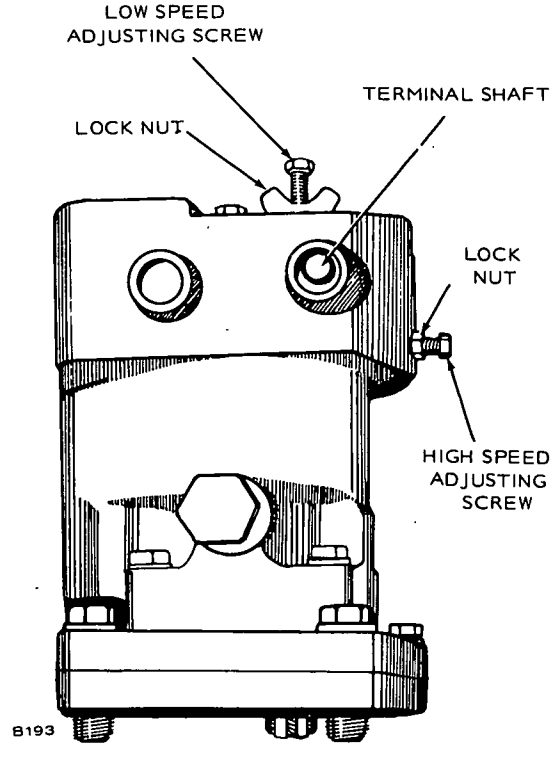


FIGURE 18. WOODWARD GOVERNOR

AC GENERATOR

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

Generator Bearing: Inspect the bearing every 1000 hours with the unit running.

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

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

INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly, make sure diodes are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure. Blow out the assembly periodically, with filtered, low pressure air. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 30 in. lb. or finger tight plus a quarter turn. Blow dust out of control panel.

BATTERIES

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

CONNECTIONS (Fuel, Exhaust, etc.)

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

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

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

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	8	50	100	200-250
Inspect Set	x			
Check Radiator Coolant	x			
Check Oil Level	x4			
Check Air Cleaner (Clean if Required)		x1		
Clean and Inspect Crankcase Breather			x	
Inspect Fan Belt			x2	
Check Cooling System			x3	
Clean and Inspect Battery Charging Alternator				x
Change Crankcase Oil			x1	
Replace Oil Filter Element			x1	
Check Batteries		x5		

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

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

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

x4 - For accurate readings, check oil level approximately 30 minutes after shutdown. Keep oil level as near "FULL" mark on dipstick as possible. See engine manual.

x5 - Or every month.

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

ADDITIONAL INFORMATIONAL LITERATURE

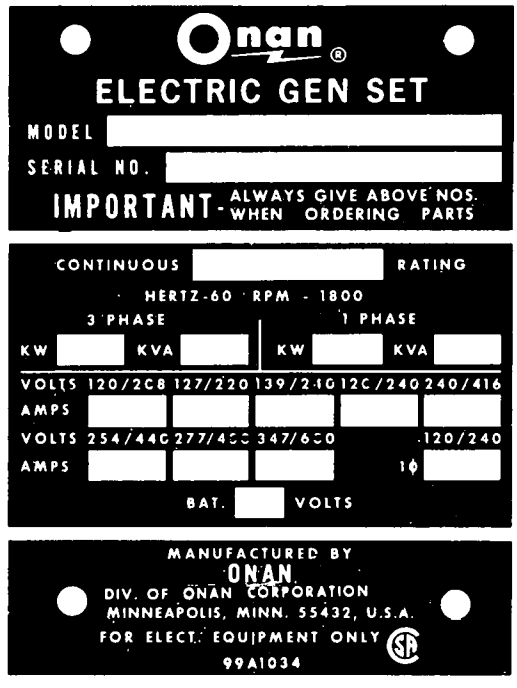
The following Technical Bulletins are available at no cost from ONAN office supplies department.

T-011	AUTOMATIC TRANSFER SWITCHES*
T-016	PARALLEL OPERATION OF ELECTRIC GENERATING SETS
T-017	RATING FACTORS FOR ELECTRIC GENERATING SETS
T-018	DIESEL FUEL SYSTEMS
T-030	INSTALLATION INFORMATION FOR LIQUID COOLED GENERATOR SETS

* A TECHNICAL BULLETIN FOR SERIES AT TRANSFER SWITCHES WILL BE AVAILABLE AT A LATER DATE.

PARTS CATALOG

This catalog applies to the DHB generator sets listed below. Engine parts modified or added by Onan will be in this list and have Onan part numbers. These supersede similar parts listed in the Detroit Diesel Allison manual. Onan parts are arranged in groups of related items and are identified by a reference. All part illustrations are typical. Using the Model and Specification from the Onan nameplate, select the parts from this catalog that apply to your set.



ONAN PARTS

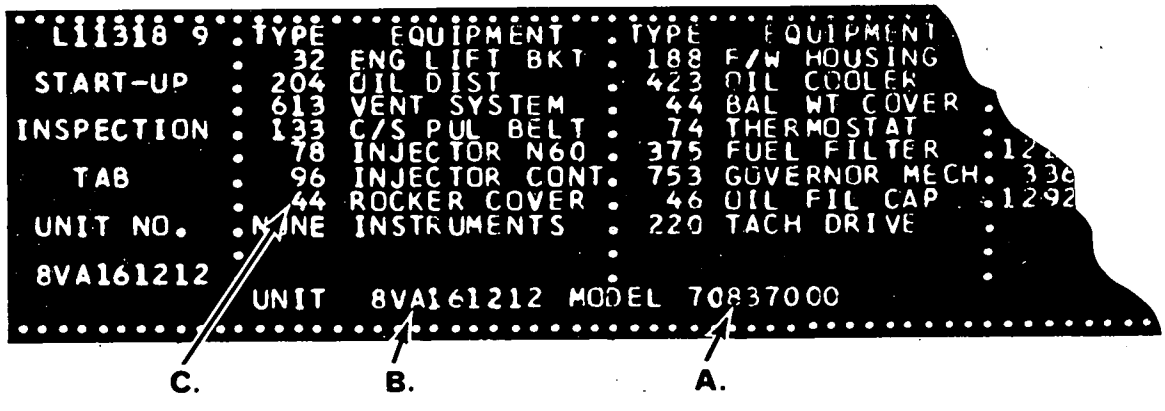
All parts in this list are Onan parts. For Onan parts or service, contact the dealer from whom you purchased this equipment or your nearest authorized service station. To avoid errors or delay in filling your order, please refer to the Onan nameplate and give the complete MODEL, SPECIFICATION and SERIAL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

MODEL AND SPECIFICATION**	WATTS
290.0 DHB - 517R/*	290,000
350.0 DHB - 17R/*	350,000

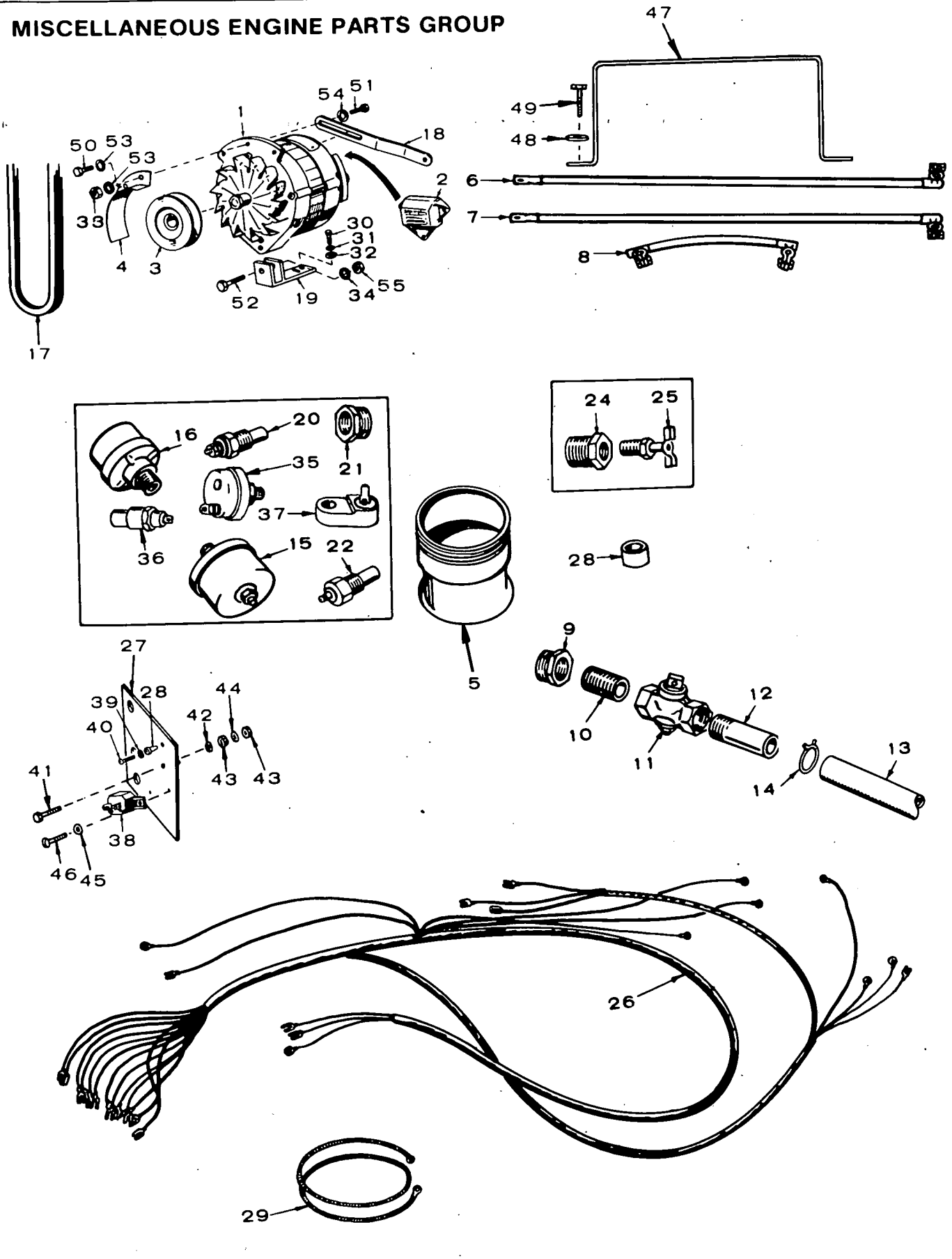
* The Specification Letter advances (A to B, B to C, etc.) with manufacturing changes.
** Refer to Specifications Section (Generator Details) in Operators Manual for Electrical Data.

DETROIT DIESEL ALLISON PARTS

All Detroit Diesel Allison parts must be ordered from the Detroit Diesel Allison Div., Detroit Michigan or their nearest authorized Detroit Diesel Allison distributor or dealer. When ordering parts, refer to the Detroit Diesel Allison option plate and supply: A. The "Model" number, B. the "Unit" number, and C. the "Type" number.



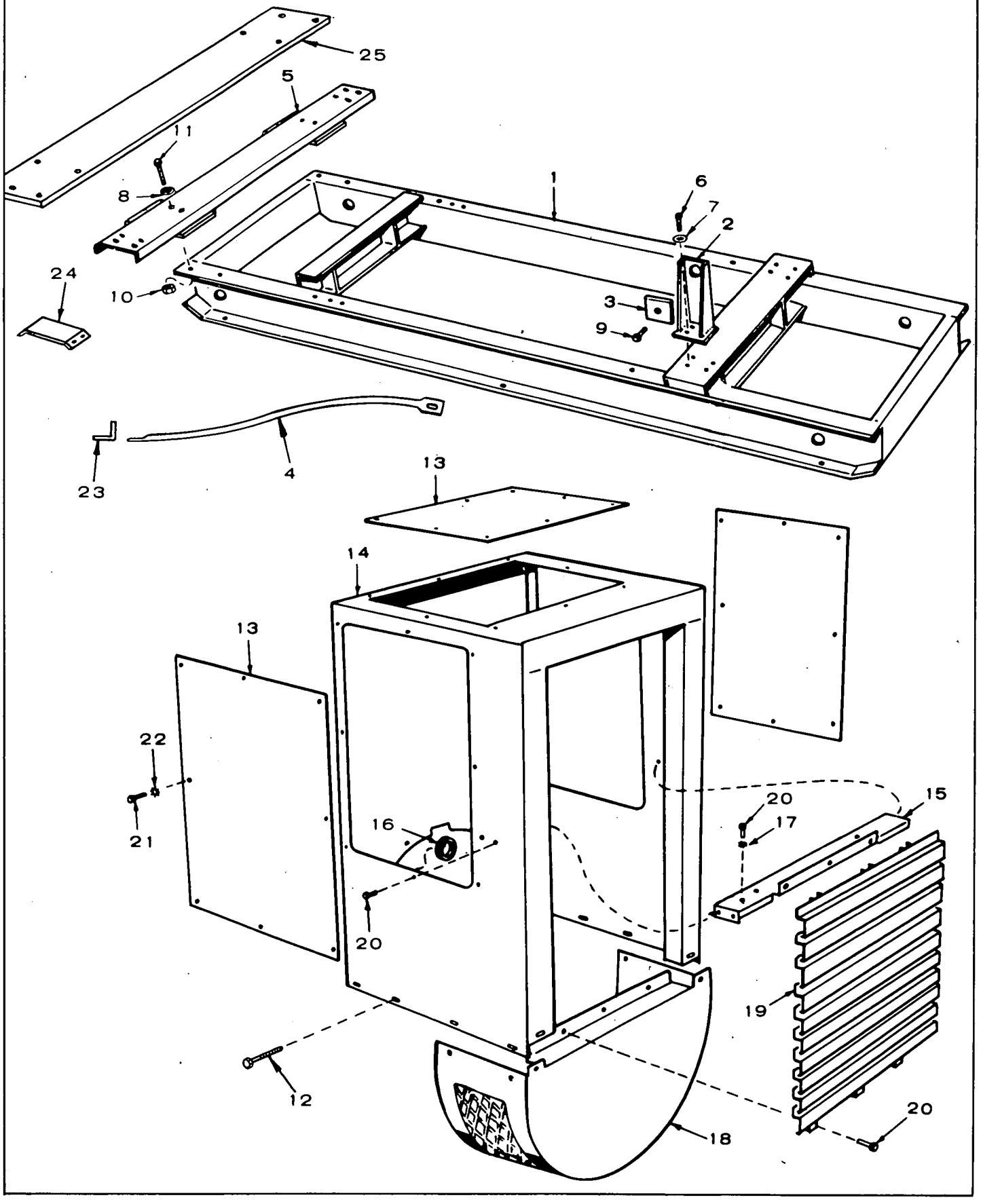
MISCELLANEOUS ENGINE PARTS GROUP



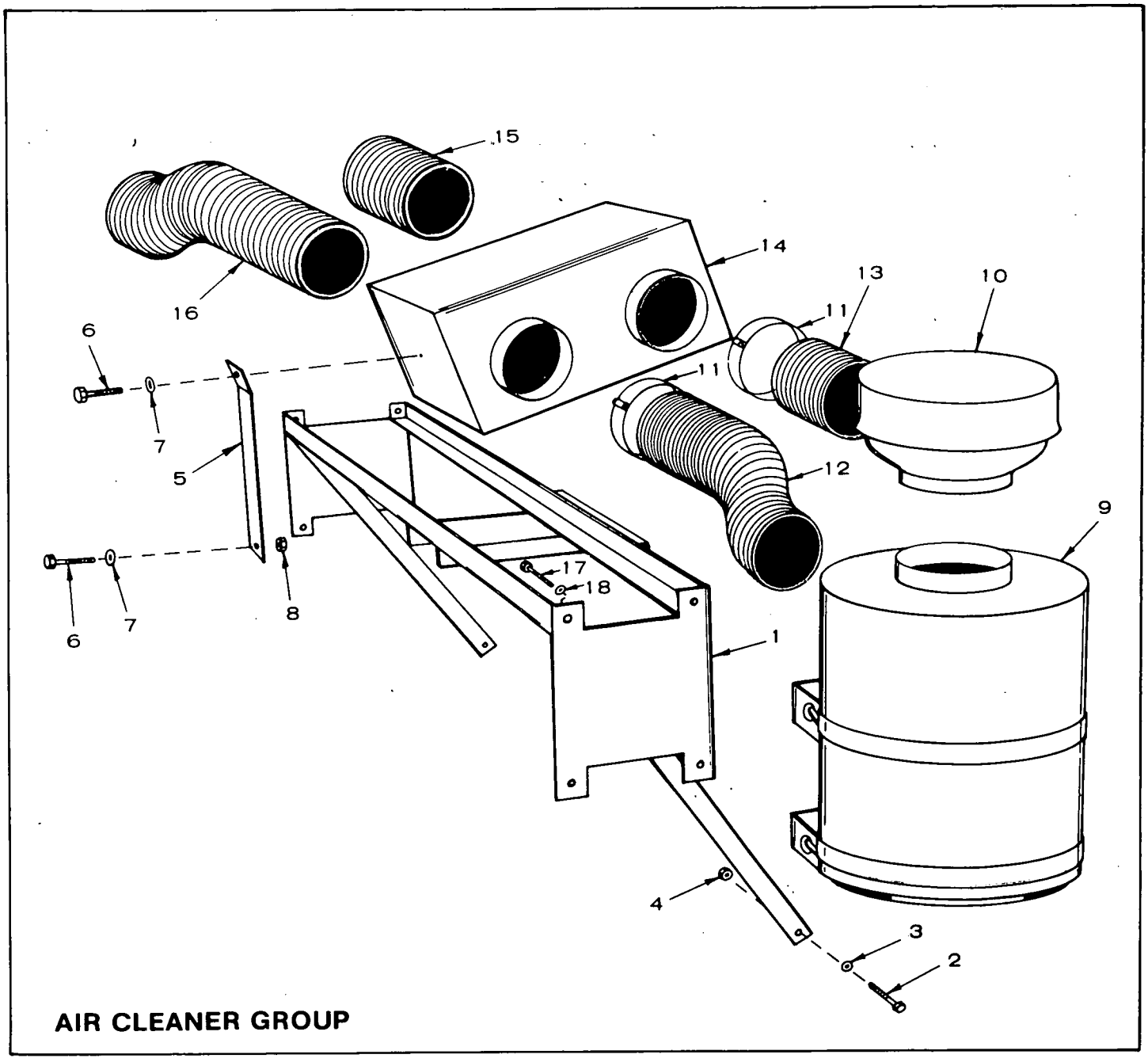
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191-0871	1	*Alternator, Charge - Includes Regulator and Fan (Motorola #70D44039B04 - Except: Specify #49A41756A01 Counterclockwise Fan)
2	191-0733	1	Regulator, Alternator (Part of Alternator)
3	191-0649	1	Pulley, Alternator
4	191-0725	1	Guard, Alternator Belt
5	155-1364	2	Adapter, Exhaust
6	416-0636	1	Cable, Battery - Positive
7	416-0445	1	Cable, Battery - Negative
8	416-0473	1	Cable, Jumper
9	505-0021	1	Bushing, Reducer (3/4 x 1/2") - Oil Drain
10	505-0100	1	Nipple, Close (1/2 x 1⅛") - Oil Drain
11	504-0011	1	Valve, Shutoff - Oil Drain
12	505-0185	1	Nipple, Half (1/2" x 1½") - Oil Drain
13		1	Hose, Oil Drain (Order 12" of Bulk Hose #503-0098)
14	503-0197	1	Clamp, Hose - Oil Drain
15	193-0195	1	Sender, Oil Pressure
16	309-0272	1	Switch, Oil Pressure Cutoff
17	511-0092	1	Belt, Alternator
18	191-0869	1	Strap, Alternator Adjusting
19	191-0870	1	Bracket, Alternator
20	193-0109	1	Sender, Water Temperature
21	505-0021	1	Bushing, Reducer - Water Temperature Sender Mtg. (3/4 x 1½")
22	309-0178	1	Switch, High Water Temperature
24	505-0131	1	Bushing, Reducer - Radiator Drain (3/4 x 3/8")
25	504-0028	1	Valve, Drain - Radiator Drain
26	338-0909	1	Harness, Wiring - Engine
27	332-1382	1	Bracket, Terminal Mounting
28	870-0196	1	Nut, Insulating
29	416-0632	1	Lead, Starter Ground
30	800-0048	2	Screw, Hex Cap - Steel (3/8-16 x 3/4")
31	850-0050	2	Washer, Spring Lock (3/8")
32	526-0183	2	Washer, Flat (25/64 I.D. x 5/8 O.D. x 3/32" Thick - Steel)
33	862-0015	1	Nut, Hex Steel (5/16-18)
34	856-0013	1	Washer, Lock - EIT (1/2")
35	309-0169	1	Switch, Oil Pressure (Pre-Alarm) - Optional
36	309-0179	1	Switch, High Engine Temperature (Pre-Alarm) - Optional
37	309-0269	1	Switch, Low Engine Temperature (Pre-Alarm) - Optional
38	320-0240	1	Breaker, Circuit - Starter (12.5 amp.)
39	508-0015	1	Washer, Fibre
40	809-0035	1	Screw, Round Head Sheet Metal (#8 x 3/4")
41	800-0007	1	Screw, Hex Cap - Steel (1/4-20 x 1")
42	850-0040	1	Washer, Spring Lock (1/4")
43	862-0001	2	Nut, Hex - Steel (1/4-20)
44	856-0006	1	Washer, Lock - EIT (1/4")
45	850-0030	2	Wahser, Spring Lock (#10)
46	811-0103	2	Screw, Round Head Brass (#10-32 x 3/4")
47	416-0635	1	Strap, Battery Holddown
48	850-0045	4	Washer, Spring Lock (5/16")
49	800-0035	4	Screw, Hex Cap - Steel (5/16-18 x 2½")
50	800-0025	1	Screw, Hex Cap - Steel (5/16-18 x 5/8")
51	800-0030	1	Screw, Hex Cap - Steel (5/16-18 x 1¼")
52	800-0094	1	Screw, Hex Cap - Steel (1/2-13 x 2")
53	850-0045	2	Washer, Spring Lock (5/16")
54	526-0022	1	Washer, Flat - Steel (21/64" I.D. x 9/16" O.D. x 1/16" Thick)
55	862-0005	1	Nut, Hex - Steel (1/2-13)

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

MOUNTING AND HOUSING GROUP

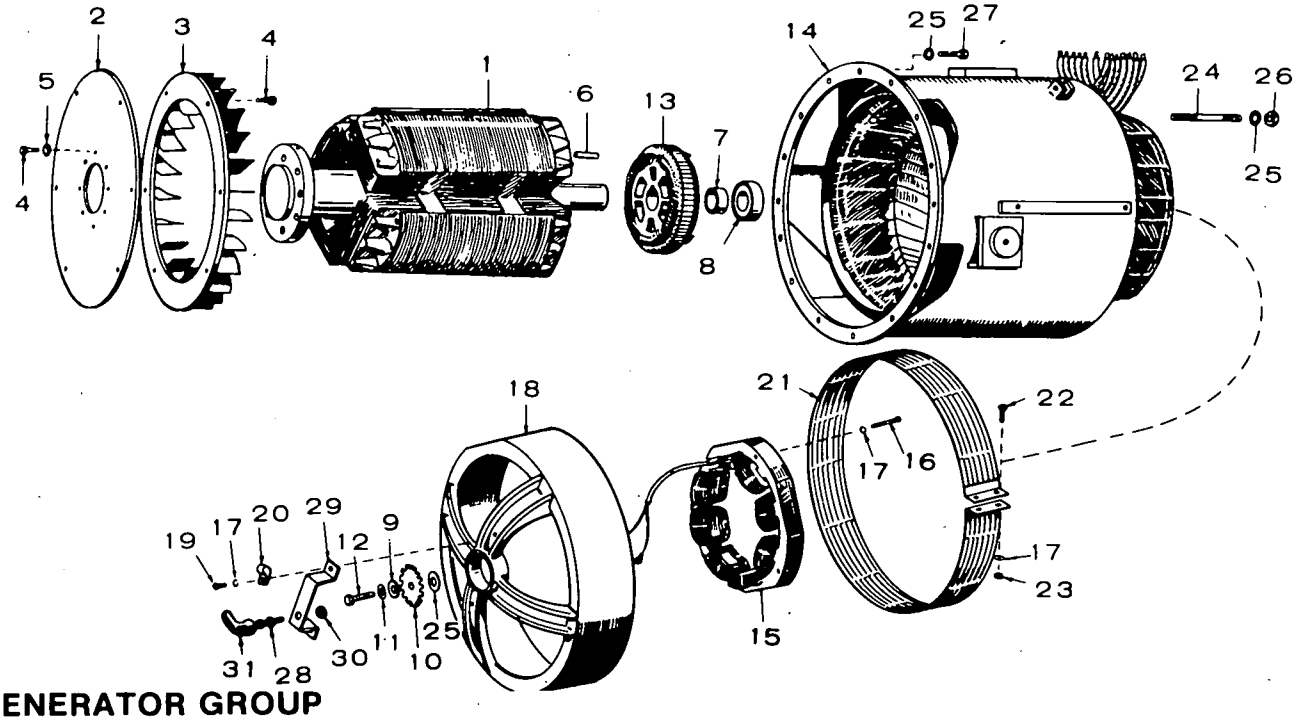


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403-1149	1	Base, Skid
2	232-2389	2	Bracket, Generator Mounting
3	232-2385	2	Plate, Generator Mtg. Retainer
4	130-0945	2	Brace, Radiator
5	130-0942	1	Support, Radiator
6	800-0156	6	Screw, Hex Cap - Steel (3/4-10 x 2¼")
7	850-0079	8	Washer, Spring Lock (3/4")
8	850-0079	8	Washer, Spring Lock (3/4")
9	800-0153	2	Screw, Hex Cap - Steel (3/4-10 x 1½")
10	862-0008	8	Nut, Hex - Steel (3/4-10)
11	800-0153	8	Screw, Hex Cap - Steel (3/4-10 x 1½")
12	821-0014	18	Screw, Flanged Hex Cap - Steel (5/16-18 x ½")
13	301-3731	3	Plate, Control Box
14	301-3605	1	Housing, Control Box
15	301-3604	1	Shelf, Control Box Housing
16	508-0001	1	Grommet, Rubber
17	856-0006	2	Washer, Lock - EIT (1/4")
18	234-0489	1	Cover, End Bell
19	234-0490	1	Grille, Generator Air Inlet
20	821-0010	9	Screw, Flanged Hex Cap - Steel (1/4-20 x 1/2")
21	815-0241	24	Screw, Truss Head (1/4-20 x ½")
22	853-0013	24	Washer, Lock - ET (1/4")
23	130-0944	2	Bracket, Radiator Brace
24	130-0951	2	Bracket, Radiator Mounting
25	130-0950	1	Plate, Radiator Mounting



AIR CLEANER GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	140-1314	1	Support, Air Cleaner Mounting
2	800-0090	2	Screw, Hex Head - Steel (1/2-13 x 1")
3	850-0060	2	Washer, Spring Lock (1/2")
4	862-0016	2	Nut, Hex - Steel (1/2-13)
5	140-1330	1	Bracket, Inlet Box Support
6	800-0005	2	Screw, Hex Head - Steel (1/4-20 x 3/4")
7	850-0040	2	Washer, Spring Lock (1/4")
8	862-0001	1	Nut, Hex - Steel (1/4-20)
9	140-1326	2	Cleaner, Air
10	140-1327	2	Cap, Weather
11	503-0059	16	Clamp, Hose
12		1	Hose, Flex (Order 14" of Bulk Hose #503-0641)
13		1	Hose, Flex (Order 4" of Bulk Hose #503-0641)
14	140-1328	1	Box, Air Inlet
15		1	Hose, Flex (Order 4" of Bulk Hose #503-0641)
16		1	Hose, Flex (Order 18" of Bulk Hose #503-0641)
17	801-0071	8	Screw, Hex Head - Steel (7/16-20 x 1")
18	850-0055	8	Washer, Spring Lock (7/16")
19	140-1331	2	Element, Air Cleaner (Not Illustrated)



GENERATOR GROUP

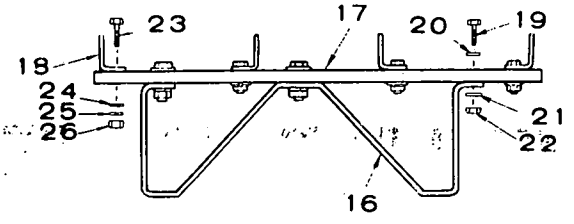
NOTE: See separate group for bus bar and exciter rotor parts.

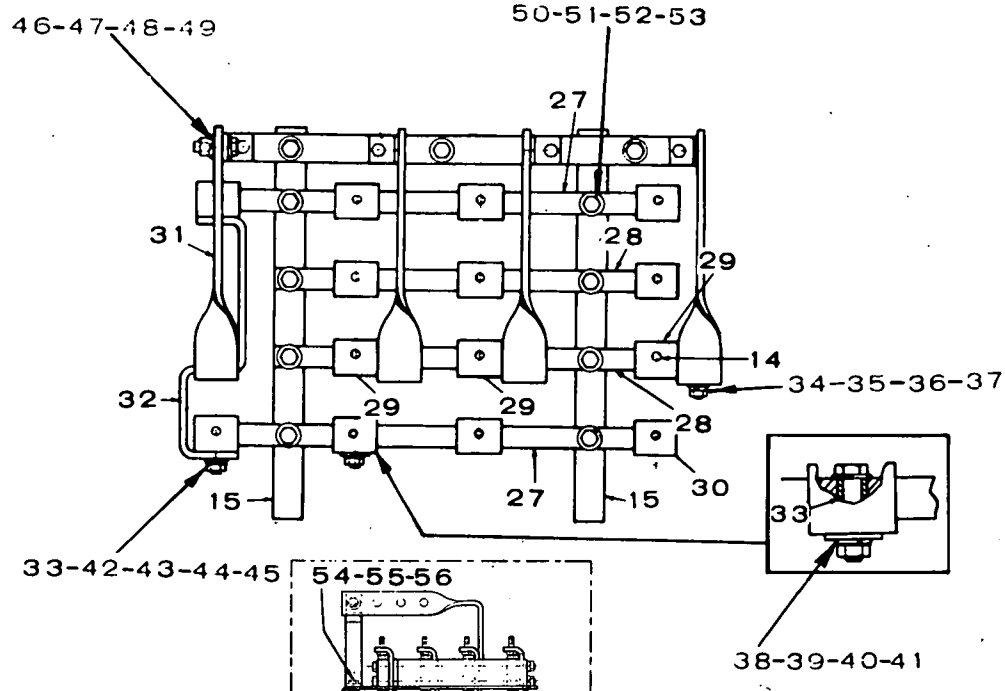
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	★	1	Rotor Assembly, Wound (Includes Parts Marked *)
2	232-2309	1	*Disc, Generator Drive
3	205-0103	1	*Fan, Generator
4	805-0035	14	*Bolt, Place (5/8-11 x 1½")
5	526-0259	8	*Washer, Flat - Steel (11/16" I.D. x 1-3/8" O.D. x 12 Ga.)
6	515-0145	1	*Key, Exciter Rotor
7	232-2317	1	*Spacer, Bearing
8	510-0106	1	*Bearing
9	526-0252	1	*Washer, Flat - Steel (13/16" I.D. x 2-3/8" O.D. x 5/32" Thick)
10	150-1405	1	*Wheel, Speed Sensor
11	850-0060	1	*Washer, Spring Lock (1/2")
12	800-0092	1	*Screw, Hex Cap - Steel (1/2-13 x 1½")
13	201-1902	1	*Rotor Assembly, Wound - Exciter (See Separate Group for Components)
14	★	1	Stator Assembly, Wound
15	220-1920	1	Stator Assembly, Wound - Exciter
16	800-0009	4	Screw, Hex Cap - Steel (1/4-20 x 1½")
17	850-0040	12	Washer, Spring Lock (1/4")
18	211-0214	1	Bell, End
19	800-0005	2	Screw, Hex Cap - Steel (1/4-20 x 3/4")
20	332-1554	1	Clamp, Loop
21	234-0455	1	Screen, Fan
22	800-0008	2	Screw, Hex Cap - Steel (1/4-20 x 1¼")
23	862-0001	2	Nut, Hex - Steel (1/4-20)
24	520-0780	4	Stud, End Bell Mounting (1/2 x 6½")
25	850-0060	20	Washer, Spring Lock (1/2")
26	862-0016	4	Nut, Hex - Steel (1/2-13)
27	800-0092	16	Screw, Hex Cap - Steel (1/2-13 x 1½")
28	150-1406	1	Sensor, Speed
29	150-1407	1	Bracket, Speed Sensor
30	870-0289	1	Nut, Hex - Steel (3/4-16)
31	150-1410	1	Cap, Insulator

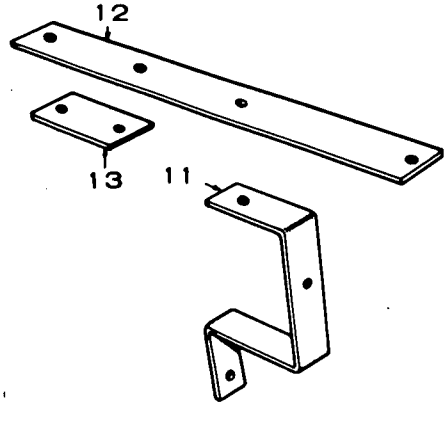
★ - Refer to factory giving complete Model, Spec and Serial Number from Onan nameplate.

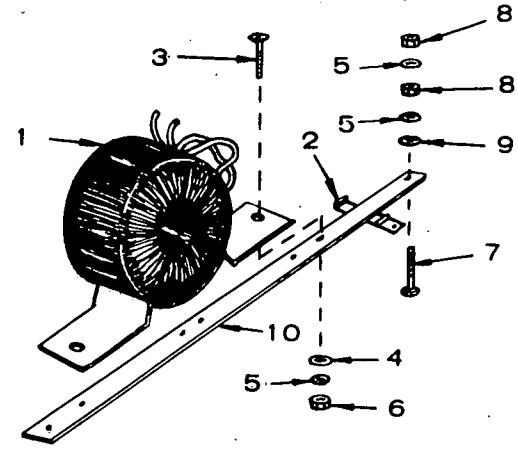
* - Parts included in the Rotor Assembly.

BUS BAR GROUP



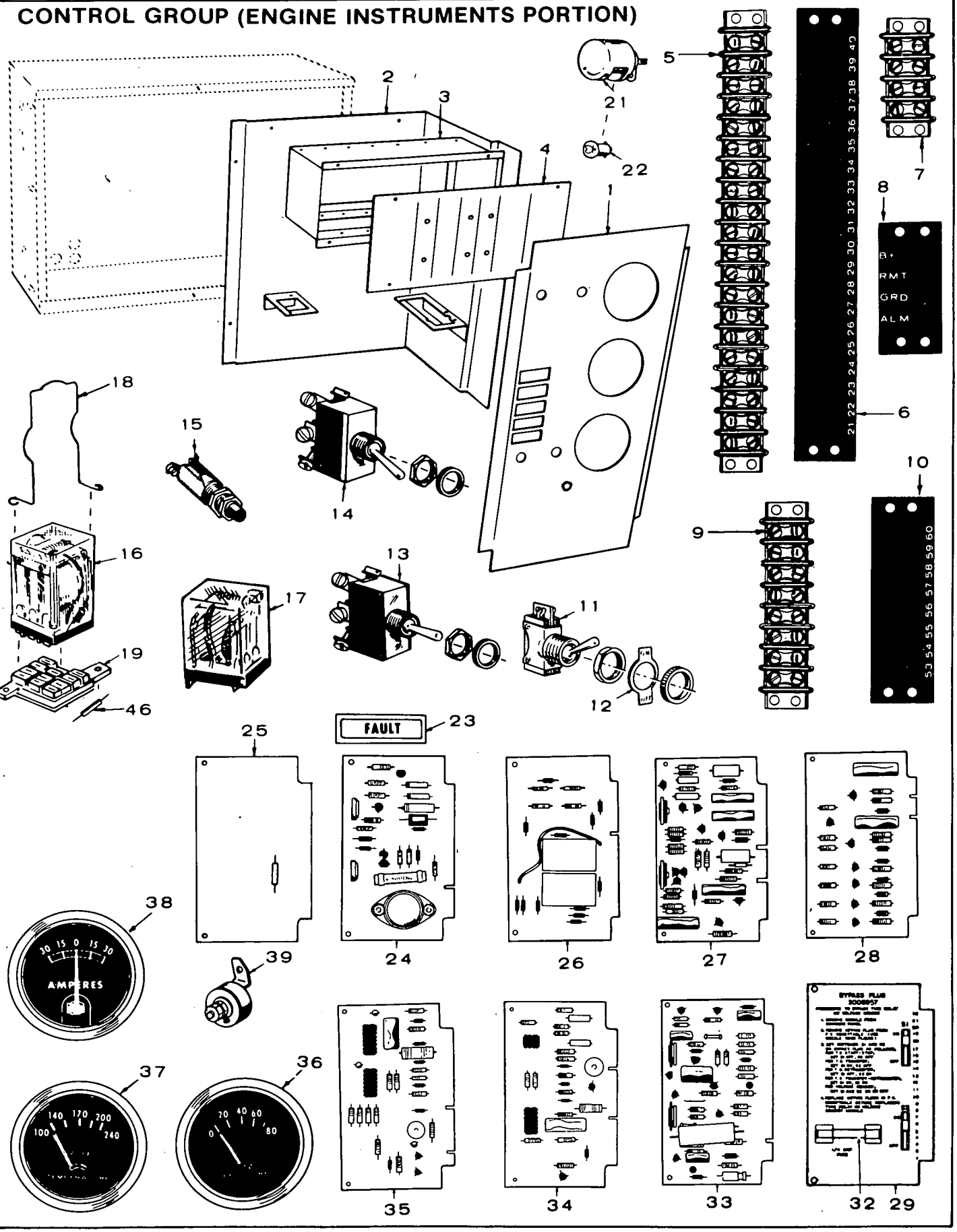


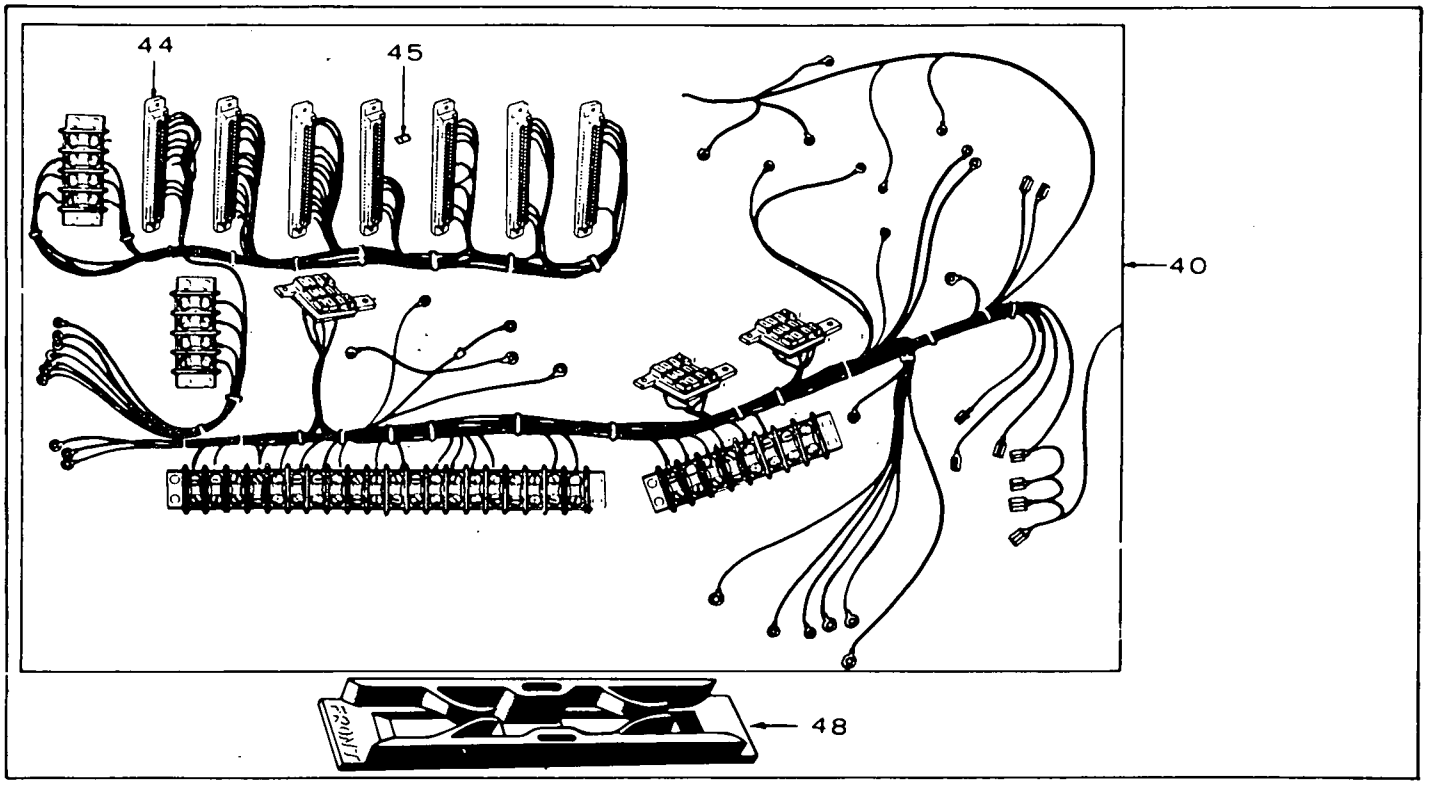




REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	302-0471	3	Transformer, Current
2	232-2342	2	Bracket, Terminal Board Mtg.
3	SCREW, ROUND STEEL HEAD MACHINE - TRANSFORMER MOUNTING		
	813-0100	4	#10-32 x 1/2"
	813-0103	2	#10-32 x 3/4"
4	526-0008	6	Washer, Flat - Steel (13/64" I.D. x 7/16" O.D. x 1/32" Thick)
5	856-0003	8	Washer, Lock - EIT (#10)
6	870-0053	6	Nut, Hex - Steel (#10-32)
7	815-0203	1	Screw, Round Head Brass Machine Screw (#10-32 x 7/8")
8	871-0010	2	Nut, Hex - Brass (#10-32)
9	526-0049	1	Washer, Flat - Brass (.200" I.D. x 7/16" O.D. x 1/32" Thick)
10	315-0389	1	Plate, Transformer Mounting
11	332-1402	1	Clamp
12	232-2246	2	Bar, Reconnection
13	232-2248	3	Bar, Reconnection
14	520-0142	14	Stud (5/16 x 1¼")
15	232-2249	2	Bracket, Terminal Board Mtg.
16	232-2237	1	Bracket, Bus Bar Support
17	232-2245	1	Board, Insulating - Bus Bar
18	232-2387	4	Bracket, Bus Bar
19	800-0051	3	Screw, Hex Cap - Steel (3/8-16 x 1¼")
20	526-0029	3	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
21	850-0050	3	Washer, Spring Lock (3/8")
22	862-0003	3	Nut, Hex - Steel (3/8-16)
23	800-0007	4	Screw, Hex Cap - Steel (1/4-20 x 1")
24	526-0018	4	Washer, Flat (21/64 I.D. x 3/4 O.D. x 1/16" Thick)
25	850-0040	4	Washer, Spring Lock (1/4")
26	862-0001	4	Nut, Hex - Steel (1/4-20)
27	232-2243	2	Board, Insulating
28	232-2242	2	Board, Insulating
29	232-2343	3	Bar, Bus
30	232-2241	11	Bar, Bus
31	232-2240	4	Bar, Bus
32	232-2238	1	Bracket, Bus Bar
33	232-2344	32	Spacer, Terminal Connection
34	800-0028	4	Screw, Hex Cap - Steel (5/16-18 x 1")
35	526-0115	8	Washer, Flat - Steel (11/32" I.D. x 11/16" O.D. x 1/16" Thick)
36	850-0045	4	Washer, Spring Lock (5/16")
37	862-0015	4	Nut, Hex - Steel (5/16-18)
38	800-0032	24	Screw, Hex Cap - Steel (5/16-18 x 1¾")
39	526-0115	24	Washer, Flat - Steel (11/32" I.D. x 11/16" O.D. x 1/16" Thick)
40	850-0045	24	Washer, Spring Lock (5/16")
41	862-0015	24	Nut, Hex - Steel (5/16-18)
42	800-0033	8	Screw, Hex Head - Steel (5/16-18 x 2")
43	526-0115	16	Washer, Flat - Steel (11/32 I.D. x 11/16 O.D. x 1/16" Thick)
44	850-0045	8	Washer, Spring Lock (5/16")
45	862-0015	8	Nut, Hex - Steel (5/16-18)
46	800-0051	4	Screw, Hex Cap - Steel (3/8-16 x 1¼")
47	526-0029	8	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
48	850-0050	4	Washer, Spring Lock (3/8")
49	862-0003	4	Nut, Hex - Steel (3/8-16)
50	800-0056	8	Screw, Hex Cap - Steel (3/8-16 x 2½")
51	526-0029	8	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
52	850-0050	8	Washer, Spring Lock (3/8")
53	862-0003	4	Nut, Hex - Steel (3/8-16 x 1")
54	800-0050	2	Screw, Hex Head - Steel (3/8-16 x 1")
55	850-0050	2	Washer, Spring Lock (3/8")
56	862-0003	2	Nut, Hex - Steel (3/8-16)
57	800-0050	2	Screw, Hex Head - Steel (3/8-16 x 1")
58	850-0050	2	Washer, Spring Lock (3/8")
59	862-0003	2	Nut, Hex - Steel (3/8-16)

CONTROL GROUP (ENGINE INSTRUMENTS PORTION)



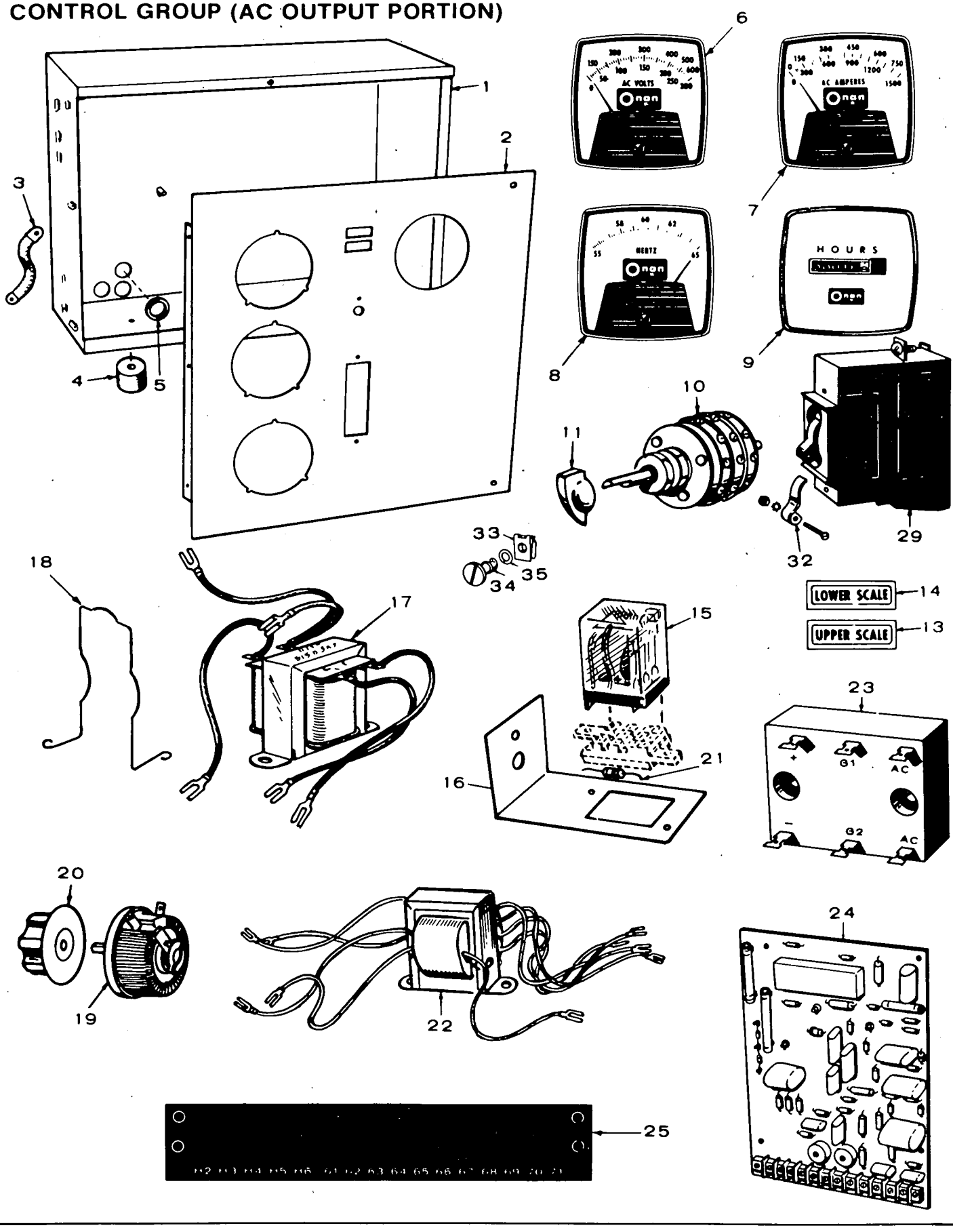


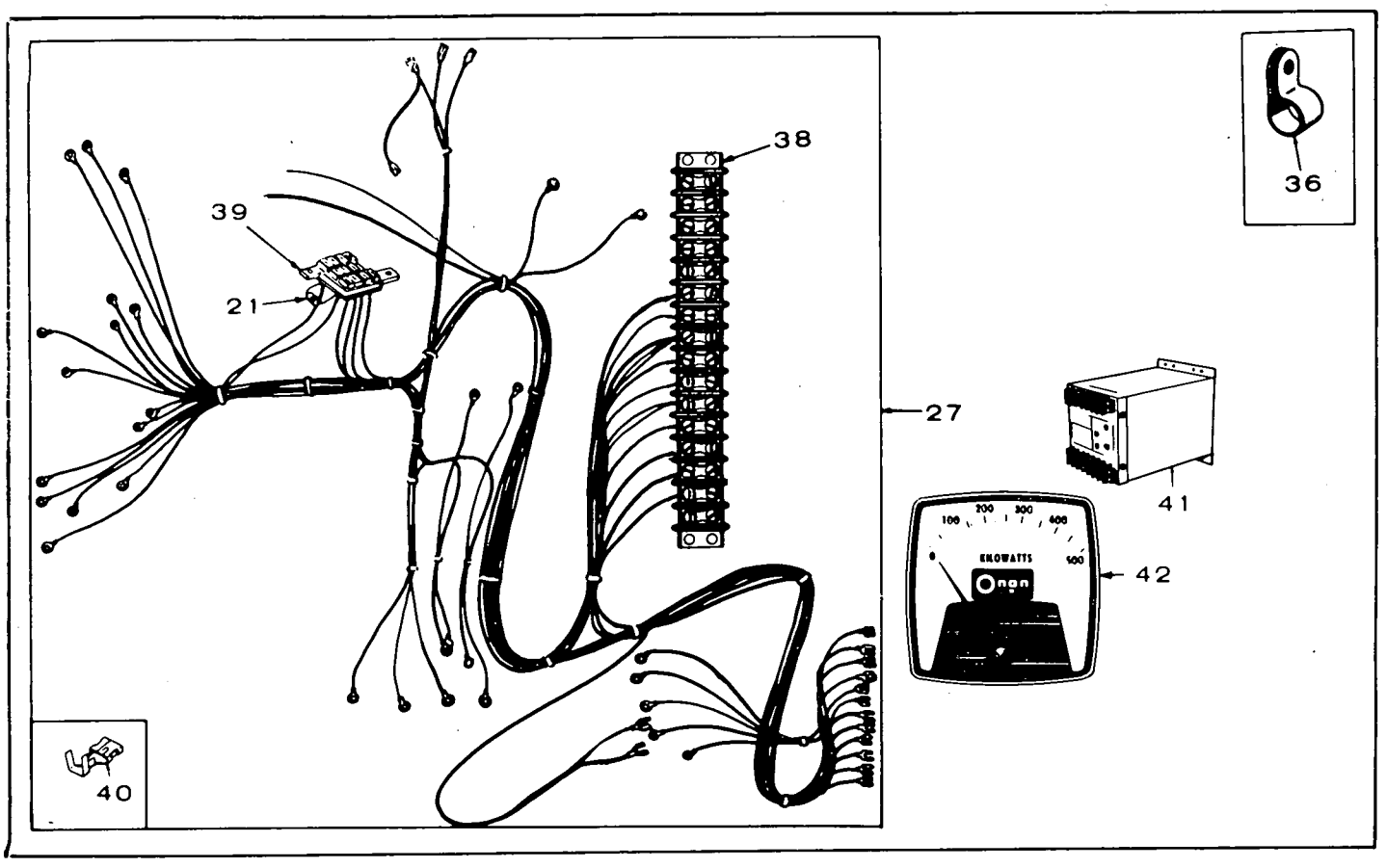
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL, ENGINE CONTROL		
	301-3661	1	Sets With One Fault Light
	301-3629	1	Sets With Five Fault Lights
2	301-3621	1	Bracket, Engine Control
3	301-3588	1	Rack, Module
4	301-3635	1	Cover Assembly, Rack
5	332-1005	1	*Block, Terminal - 20 Place
6	332-1559	1	Strip, Terminal Block Marker (21-40)
7	332-0537	2	*Block, Terminal - 4 Place
8	STRIP, TERMINAL BLOCK MARKER (4-Place)		
	332-1239	1	B+, Remote, Ground, Alarm
	332-1561	1	1-4
9	332-0699	1	*Block, Terminal - 8 Place - Set With Five Fault Lights
10	332-1560	1	Strip, Terminal Block Marker (53-60) - Sets With Five Fault Lights
11	308-0002	1	Switch, Panel Light
12	308-0003	1	Plate, On-Off Switch
13	SWITCH, SELECTOR		
	308-0220	1	Standard Control
	308-0347	1	Penn State Models
14	308-0337	1	Switch, Lamp Test
15	308-0091	1	Switch, Reset
16	307-1056	3	Relay (1) Start Disconnect (1) Ignition (1) Overspeed
17	307-1061	2	Relay, (1) Starter Protection, (1) Start Solenoid
18	307-1157	3	Spring, Relay Holddown
19	323-0765	3	*Socket, Relay - 11 Place
21	322-0149	1	Holder, Lamp
22	322-0017	1	Lamp, Panel
23	LAMP, FAULT		
	322-0129	1	Standard
	322-0119	1	Overcrank (Optional)
	322-0123	1	Overspeed (Optional)
	322-0120	1	Low Oil Pressure (Opt.)
	322-0121	1	High Engine Temperature (Optional)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
24	300-0956	1	Control Cycle Cranker (Opt.) (See Separate Group for Components)
25	300-0977	1	Control, Standard Cranker
26	300-0964	1	Control, Engine Shutdown (See Separate Group for Components)
27	300-0953	1	Control, Engine Monitor (See Separate Group for Components)
28	300-0955	1	Control, Remote Indicator - Sets With Five Fault Lights
29	300-0987	1	Module, Bypass Plug
32	321-0168	1	Fuse, 1/4 Amp (Part of 300-0987 Module)
33	300-0973	1	Module, Time Delay Start-Stop (Optional) See Separate Group for Components)
34	300-0957	1	Control, Overspeed Sensor (See Separate Group for Components)
35	300-0958	1	Control, Starter Disconnect (See Separate Group for Components)
36	193-0107	1	Gauge, Oil Pressure
37	193-0106	1	Gauge, Water Temperature
38	302-0061	1	Ammeter, Charge (30-0-30)
39	193-0189	2	Resistor, Gauge (1) Start Solenoid (1) Start Disconnect Relay
40	Harness, Wiring (Includes Parts Marked *)		
	338-0915	1	Sets With One Fault Light
	338-0705	1	Sets With Five Fault Lights
44	332-1271	6	*Housing, Printed Circuit Board Terminal (Seven on Sets With Five Fault Lights)
45	332-1276	As Req.	*Plug, Keying
46	357-0004	2	*Rectifier, Diode
48	323-0814	12	Guide, Printed Circuit Board (14 Used on Sets with Five Fault Lights)

* - Included in Wiring Harness Assembly.

CONTROL GROUP (AC OUTPUT PORTION)

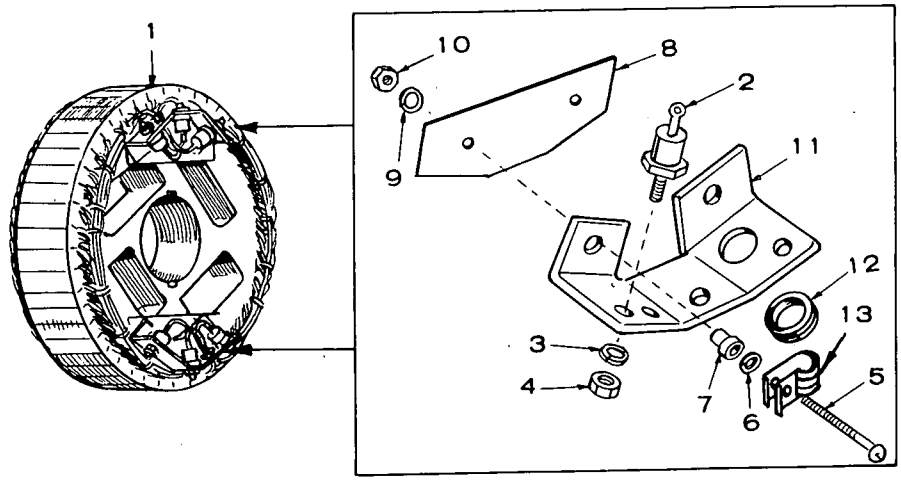




REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301-3158	1	Box, Control
2	PANEL, CONTROL BOX		
	301-3170	1	Standard Units
	301-3312	1	Units With Wattmeter
3	337-0049	1	Strap, Bond
4	402-0078	4	Dampener, Vibration
5	508-0001	4	Grommet (1-1/16"), Rubber
6	302-0718	1	Voltmeter, AC - Dual Scale 0-300, 0-600
7	AMMETER, AC		
	302-0879	1	290kW - Dual Scale 0-600, 0-1200
	302-0880	1	350 kW - Dual Scale 0-750, 0-1500
8	METER, FREQUENCY		
	302-0810	1	60 Hertz
	302-0894	1	50 Hertz
9	METER, RUNNING TIME		
	302-0466	1	60 Hertz
	302-0469	1	50 Hertz
10	308-0284	1	Switch, Voltage & Ammeter
11	303-0076	1	Knob
13	322-0131	1	Light, Upper Scale
14	322-0130	1	Light, Lower Scale
15	307-1061	1	Relay, Voltage Selector
16	301-3244	1	Bracket, Relay Mounting
17	315-0384	1	Reactor Assembly, Comm

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
18	307-1157	1	Spring, Relay Holddown
19	303-0170	1	Rheostat, Voltage Adj.
20	303-0032	1	Knob, Rheostat
21	350-0556	1	*Resistor
22	315-0342	1	Transformer, Voltage
23	305-0524	1	Bridge, Rectifier
24	332-1268	1	Board Assembly, Printed Circuit Voltage Regulator
25	332-1242	1	Strip, Marker (H2-H6, 61-71)
27	338-0730	1	Harness, Wiring - AC Control (Includes Parts Marked *)
29	320-0455	1	Circuit Breaker (3 Amp)
32	320-0307	1	Lock, Circuit Breaker Handle (Penn State Models) - Optional
33	406-0332	2	Receptacle, Fastener
34	406-0333	2	Stud, Fastener
35	406-0334	2	Washer, Stud Fastener
36	332-0050	1	Clip, Tinnerman
38	332-0795	1	*Block, Terminal - 16 Place
39	323-0764	1	*Socket, Relay
40	332-1280	As Req.	*Terminal, Crimp
41	302-0921	1	Transducer, Watt - Optional
42	WATTMETER, AC		
	302-0927	1	290 kW (Scale Reads 0-300)
	302-0928	1	350 kW (Scale Reads 0-500)

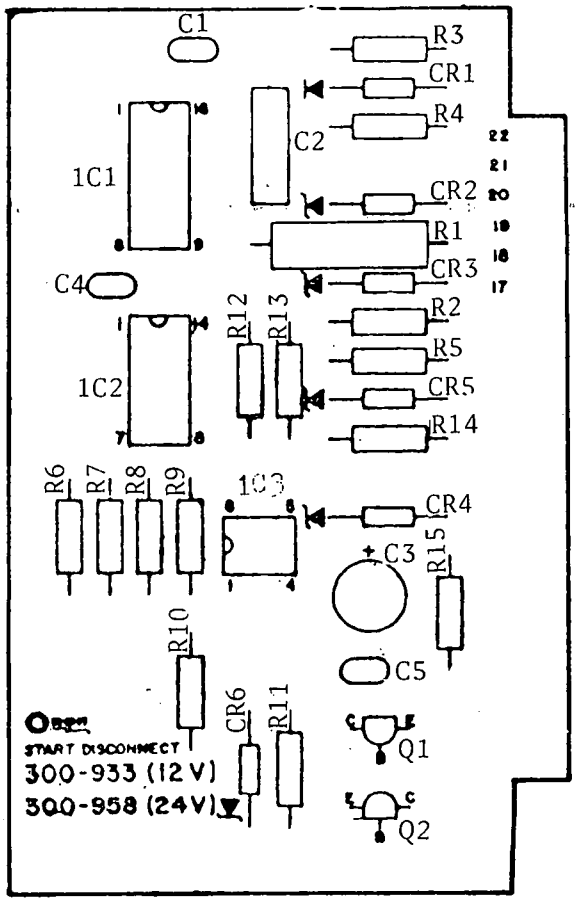
* - Included in Wiring Harness Assembly.



EXCITER ROTOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	201-1902	1	Rotor Assembly, Exciter - Complete (Also shown in Generator Group)
2	RECTIFIER, DIODE		
	358-0011	3	Positive Stud
	358-0012	3	Negative Stud
3	850-0040	6	Washer, Spring Lock (1/4")
4	868-0001	6	Nut, Hex - Stud (1/4-20)
5	813-0110	4	Screw, Round Head Steel (#10-32 x 2")
6	526-0009	4	Washer, Flat (7/32" I.D. x 1/2" O.D. x 1/16" Thick) Steel
7	508-0124	4	Bushing, Insulating
8	508-0156	4	Washer, Insulating
9	850-0030	4	Washer, Spring Lock (#10)
10	870-0053	4	Nut, Hex Steel (#10-32)
11	SINK, HEAT		
	363-0049	1	Positive
	363-0050	1	Negative
12	508-0093	2	Grommet, Rubber
13	332-0050	2	Clip, Wire

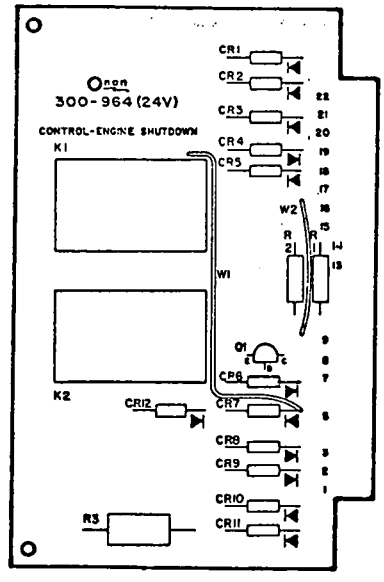
300-0958



STARTING MOTOR DISCONNECT MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0958	1	Module, Starter Motor Disconnect
1C1	367-0003	1	Integrated Circuit
1C2	367-0004	1	Integrated Circuit
1C3	367-0001	1	Integrated Circuit
C1,4	356-0051	2	Capacitor, Electrolytic (6.8 Mfd., 35 Volt)
C2	355-0028	1	Capacitor, Composition (.47 Mfd., 100 Volt)
C3	356-0038	1	Capacitor, Electrolytic (50 Mfd., 25 Volt)
Q1,2	362-0011	2	Transistor, Signal
CR1	357-0004	1	Rectifier, Diode (400 MA, 400 Volt)
CR2,3	359-0017	2	Diode, Zener (5.1 Volt, 400 MW)
CR4	359-0032	1	Diode, Zener (8.2 Volt, 400 MW)
CR5	359-0002	1	Diode, Zener (13 Volt, 400 MW)
CR6	359-0028	1	Diode, Zener (3.9 Volt, 500 MW)
R5	350-0383	1	Resistor (680-ohms, 1/2 Watt)
R2	350-0389	1	Resistor (1,200-ohms, 1/2 Watt)
R3,7,15	350-0422	3	Resistor (30,000-ohms, 1/2 Watt)
R6,11,12,13	350-0411	4	Resistor (10,000-ohms, 1/2 Watt)
R8,9	350-0418	2	Resistor (20,000-ohms, 1/2 Watt)
R10	350-0394	1	Resistor (2,000-ohms, 1/2 Watt)
R14	350-0404	1	Resistor (5,100-ohms, 1/2 Watt)
R1	350-0975	1	Resistor (330-ohms, 2 Watt)
R4	350-0420	1	Resistor (24,000-ohms, 1/2 Watt)
C5	356-0059	1	Capacitor, Electrolytic (2.2 Mfd., 35 Volt)

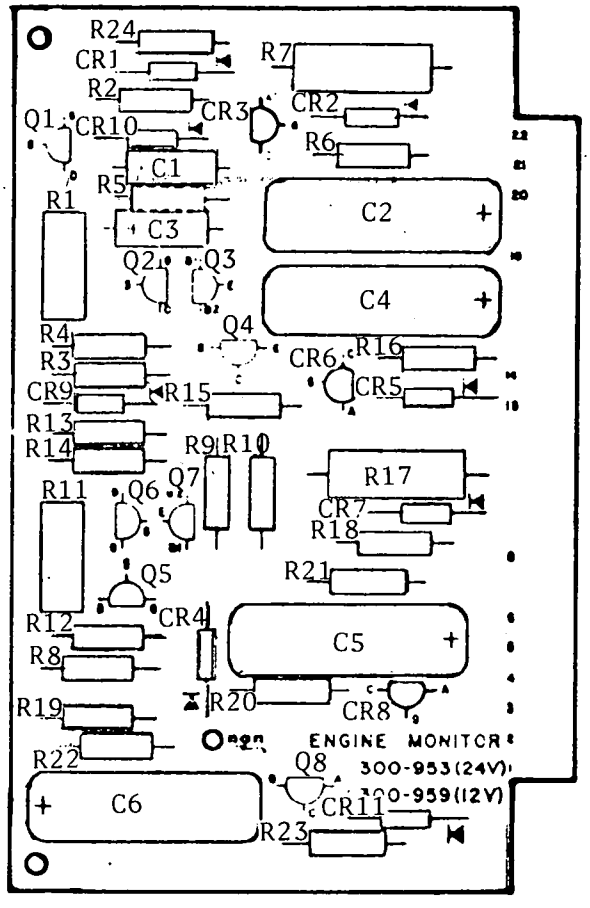
300-0964



ENGINE SHUTDOWN CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0964	1	Control, Engine Shutdown (Complete)
CR1 thru 12	357-0004	12	Rectifier, Diode
K1,2	307-1076	2	Relay
R1	350-0548	1	Resistor (10,000-Ohms, 1/2 Watt)
R2	350-0545	1	Resistor (5,600-ohms, 1/2 Watt)
R3	350-1128	1	Resistor (220-ohms, 2 Watt)
Q1	362-0026	1	Transistor, PNP

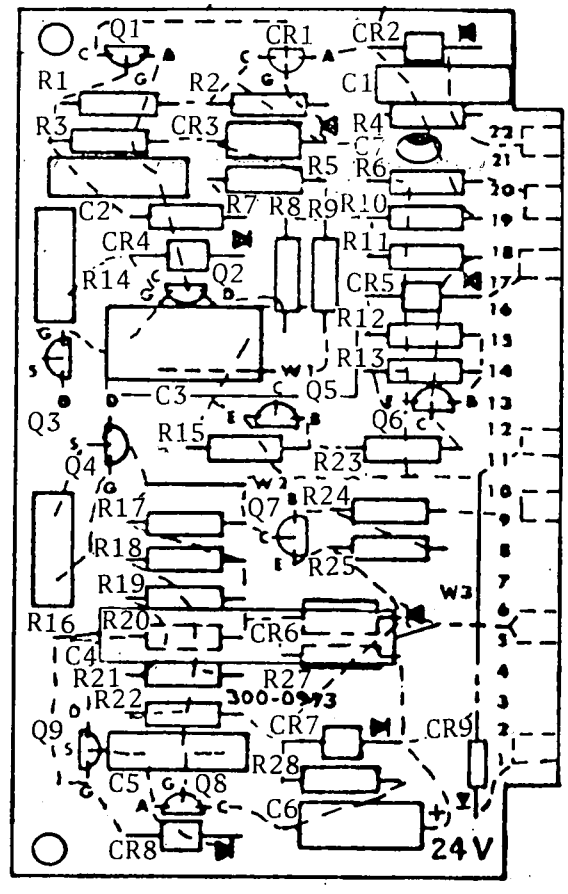
300-0953



ENGINE MONITOR CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0953	1	Control, Engine Monitor (Complete)
C1,3	356-0040	2	Capacitor, Electrolytic (10 Mfd., 20 Volt)
C2,4,5,6	355-0005	4	Capacitor, Composition (.22 Mfd., 200 Volt)
CR1,2,4,5 7,10,11	357-0004	6	Rectifier, Diode
CR3,6,8	364-0011	3	Rectifier, Gate Control
CR9	359-0027	1	Diode, Zener (1 Watt, 5 Volt)
Q1,5	362-0025	2	Transistor, Field Effect (30 MA)
Q3,7	361-0007	2	Transistor, Unijunction
Q4	362-0014	1	Transistor, NPN
Q8	362-0027	1	Transistor, PNP
R1,11	303-0169	2	Potentiometer (3.5 Megohm)
R2,3,12,13	350-0548	4	Resistor (10,000-ohms, 1/2 Watt)
R4,14,10,24	350-0536	4	Resistor (1,000-ohm, 1/2 Watt)
R5,15,21	350-0517	3	Resistor (27-ohms, 1/2 Watt)
R6,16,18	350-0505	3	Resistor (2.7-ohms, 1/2 Watt)
R7,17	350-0980	2	Resistor (510-ohms, 2 Watt)
R8	350-0403	1	Resistor (4,700-ohms, 1/2 Watt)
R9	350-0405	1	Resistor (5,600-ohms, 1/2 Watt)
R19	350-0534	1	Resistor (680-ohms, 1/2 Watt)
R20,22	350-0533	2	Resistor (560-ohms, 1/2 Watt)
R23	350-0395	1	Resistor (2,200-ohms, 1/2 Watt)
Q2,6	362-0031	2	Transistor, Field Effect (.05 MA)

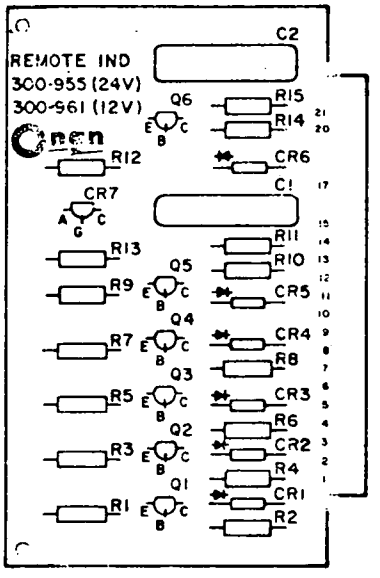
300-0973



TIME DELAY (START-STOP) MODULE—OPTIONAL

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0973	1	Mudule, Time Delay - Complete (Start-Stop) - Optional
C1,2,5	355-0025	3	Capacitor (.1 Mfd., 100 Volt)
C3	355-0028	1	Capacitor (.5 Mfd., 100 Volt)
C4	355-0027	1	Capacitor (10.0 Mfd., 50 Volt)
C6	356-0046	1	Capacitor (5 Mfd., 35 Volt)
C7	356-0053	1	Capacitor (1.0 Mfd., 35 Volt)
CR1	364-0011	1	Rectifier, Gate Control
CR2,4,5 7,8,9	357-0004	6	Rectifier, Diode (400 MA. 400 Volt)
CR3,6	359-0015	2	Diode, Zener (24 Volt)
Q1,8	361-0006	2	Transistor (2N6027)
Q2,3,4,9	362-0031	4	Transistor (2N5716)
Q5,6,7	362-0007	3	Transistor, Signal (2N2925)
R1,3,18,22	350-0411	4	Resistor (10,000-ohms, 1/2 Watt)
R2	350-0379	1	Resistor (470-ohms, 1/2 Watt)
R4	350-0524	1	Resistor (100-ohms, 1/2 Watt)
R5,19	352-0200	2	Thermistor (10,000-ohms)
R6	350-0537	1	Resistor (1,200-ohms, 1/2 Watt)
R7, R21	350-0391	2	Resistor (1,500-ohms, 1/2 Watt)
R8,12,20,24	350-0548	4	Resistor (10,000-ohms, 1/2 Watt)
R13,15,25,28	350-0536	4	Resistor (1,000-ohm, 1/2 Watt)
R10,27	350-0528	2	Resistor (220-ohms, 1/2 Watt)
R9,17	350-0540	2	Resistor (2200-ohms, 1/2 Watt)
R14,16	303-0169	2	Potentiometer (3.5 Megohm)
R23,11	350-0545	2	Resistor (5600-ohms, 1/2 Watt)

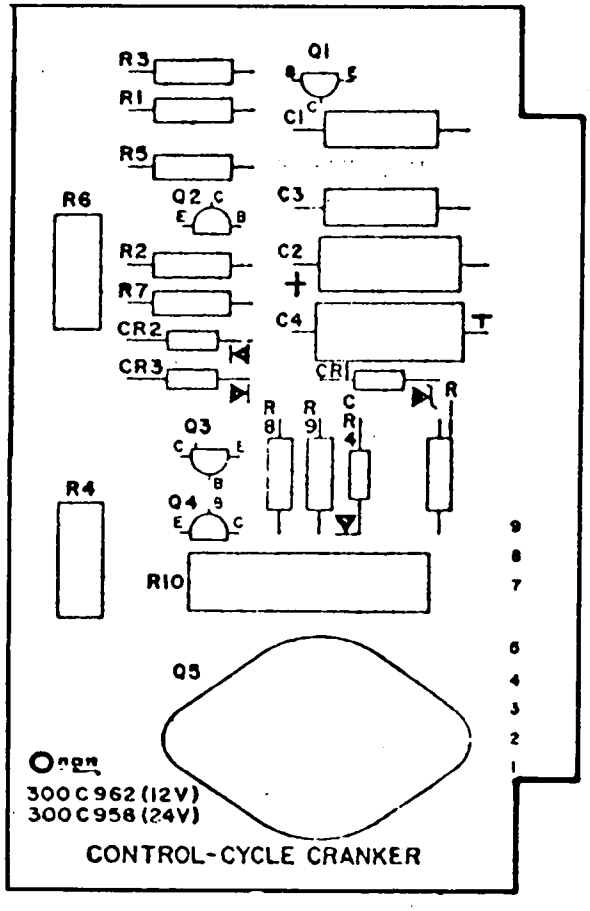
300-0955



REMOTE INDICATOR CONTROL MODULE (UNITS WITH 5 FAULT LIGHTS)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0955	1	Module, Remote Indicator
CR1 thru 6	357-0004	6	Rectifier, Diode (400 MA, 400 Volt)
CR7	364-0017	1	Rectifier, Gate Control
Q1 thru 6	362-0034	6	Transistor, PNP
R1,3,5,7 9,14	350-0529	6	Resistor (270-ohms, 1/2 Watt)
R2,6,8	350-0544	3	Resistor (4,700-ohms, 1/2 Watt)
R11	350-0505	1	Resistor (2,700-ohms, 1/2 Watt)
R12	350-0380	1	Resistor (510-ohms, 1/2 Watt)
R13	350-0517	1	Resistor (27-ohms, 1/2 Watt)
R15	350-0540	1	Resistor (2,200-ohms, 1/2 Watt)
C1,2	355-0005	2	Capacitor, Composition (.22 Mfd., 200 Volt)
R4,10	350-0389	2	Resistor (1,200-ohms, 1/2 Watt)

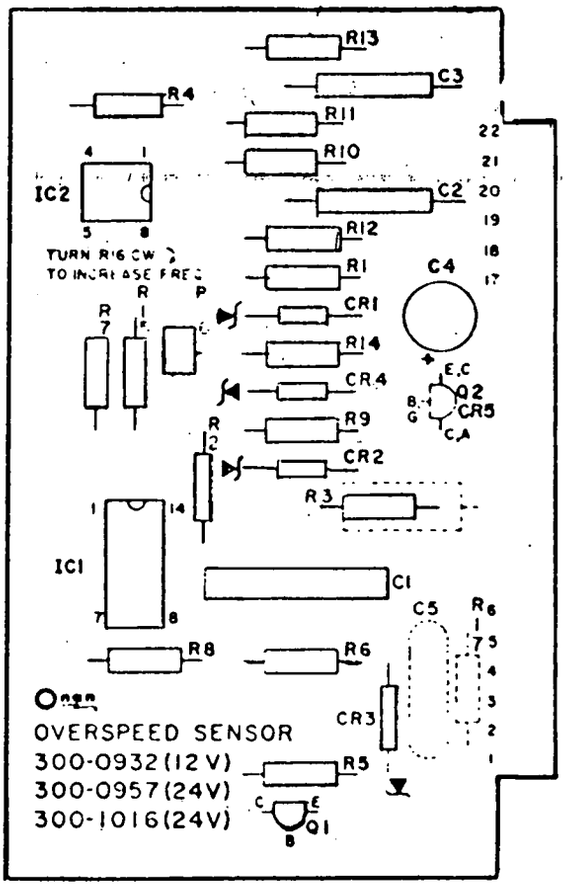
300-0956



CYCLE CRANKER MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0956	1	Module, Cycle Cranker
C3	355-0010		Capacitor, Composition (.0022 Mfd., 100 Volt)
C2	356-0039	1	Capacitor, Electrolytic (100 Mfd., 10 Volt)
C4	356-0045	1	Capacitor, Electrolytic (25 Mfd., 15 Volt)
CR1	359-0027	1	Diode, Zener (1.0 Watt, 7.5 Volt)
CR2,3,4	357-0004	3	Rectifier, Diode (400 MA 400 Volt)
Q1,2	362-0008	2	Transistors, Signal
Q3	362-0011	1	Transistor, Signal
Q4	362-0026	1	Transistor, Signal
Q5	362-0033	1	Transistor, Power
R1	350-0558	1	Resistor (68,000-ohms, 1/2 Watt)
R2	350-0546	1	Resistor (6,800-ohms, 1/2 Watt)
R3,8	350-0548	2	Resistor (10,000-ohms, 1/2 Watt)
R4,6	303-0171	2	Potentiometer (100,000-ohms)
R5	350-0560	1	Resistor (100,000-ohms, 1/2 Watt)
R7	350-0420	1	Resistor (24,000-ohms, 1/2 Watt)
R9	350-0500	1	Resistor (1-ohms, 1/2 Watt)
R10	352-0158	1	Resistor (50-ohms, 5 Watt)
R11	350-0534	1	Resistor (680-ohms, 1/2 Watt)
C1	355-0029	1	Capacitor, Composition (.015 Mfd., 100 Volt)

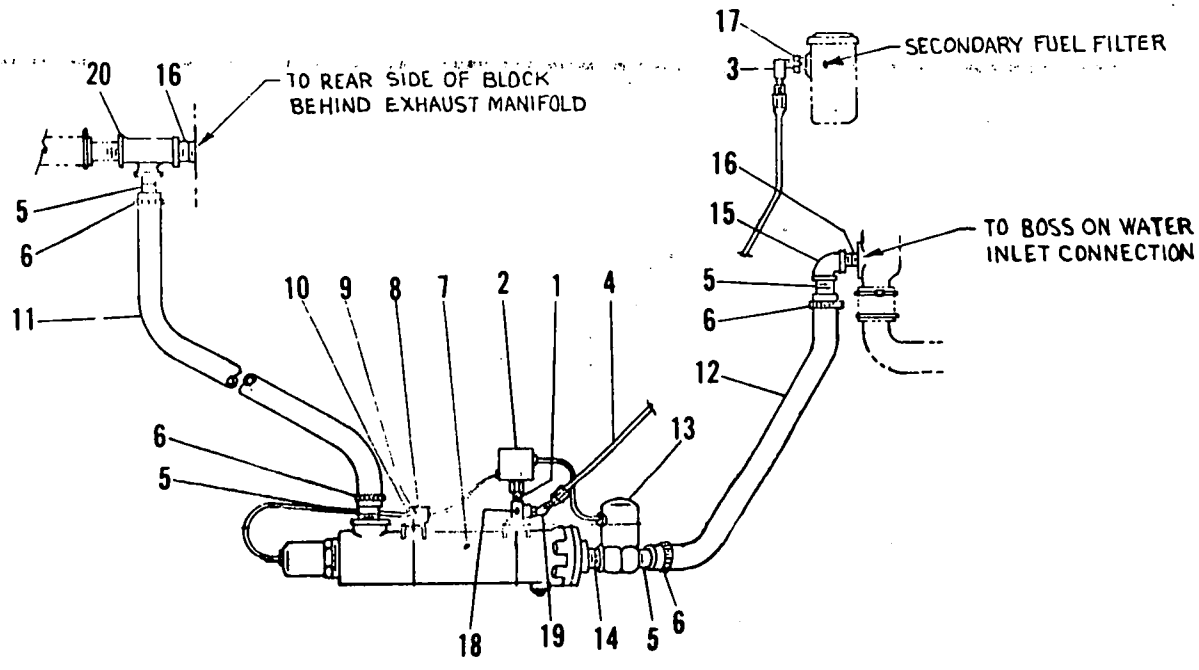
300-0957



OVERSPEED SENSOR CONTROL MODULE

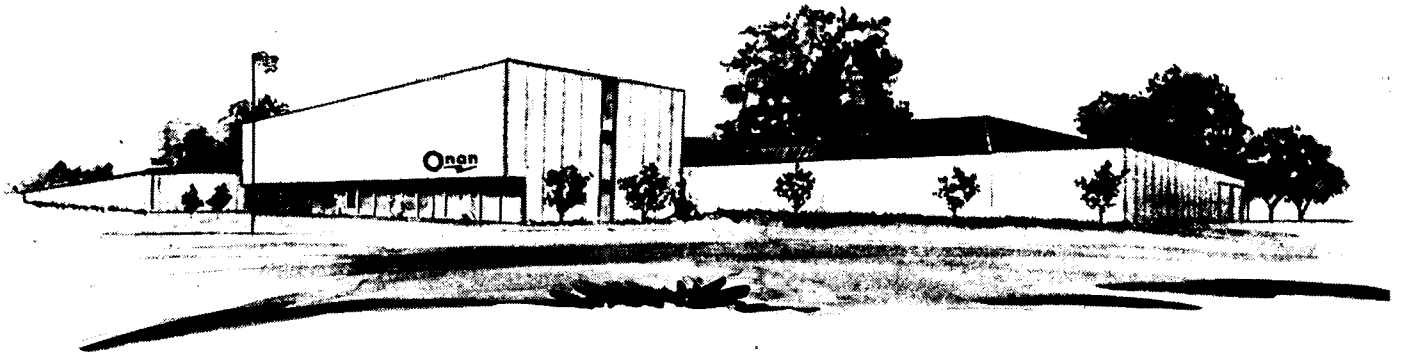
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0957	1	Control, Overspeed Sensor (Complete)
1C1	367-0002	1	Circuit, Integrated
1C2	367-0001	1	Circuit, Integrated
C1	355-0024	1	Capacitor, Composition (.22 Mfd., 200 Volt)
C2,3	355-0010	2	Capacitor, Composition (.0022 Mfd., 100 Volt)
C4	356-0038	1	Capacitor, Electrolytic (50 Mfd., 25 Volt)
CR1	359-0002	1	Diode, Zener (400 MW, 13 Volt)
CR2	359-0017	1	Diode, Zener (400 MW, 5.1 Volt)
CR3	359-0031	1	Diode, Zener (500 MW, 6.8 Volt)
CR4	359-0032	1	Diode, Zener (400 MW, 8.2 Volt)
Q1,2	362-0011	2	Transistor, Signal
R1	350-0382	1	Resistor (620-ohms, 1/2 Watt)
R15	350-0414	1	Resistor (13,000-ohms, 1/2 Watt)
R3	350-0683	1	Resistor (680-ohms, 1/2 Watt)
R4	350-0451	1	Resistor (.47 Megohm, 1/2 Watt)
R5,14	350-0394	2	Resistor (2000-ohms, 1/2 Watt)
R6,7,8,9,2, 10,11,12,13	350-0411	9	Resistor (10,000-ohms, 1/2 Watt)
R16	303-0191	1	Potentiometer (5,000-ohms, 1/4 Watt)

179-2030



WATER JACKET HEATER INSTALLATION (179-2030)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0099	1	Nipple, Pipe (1/4-Close)
2	309-0271	1	Switch, Pressure
3	502-0287	1	Elbow, Male (90°)
4	501-0188	1	Line, Flexible
5	505-0759	4	Adapter, Pipe to Hose
6	503-0429	4	Clamp, Hose
7	333-0138	1	Heater, Engine Water (4000 Watts, 240 Volt)
8	330-0004	1	Cover, Outlet Box
9	330-0005	1	Box, Outlet
10	503-0008	2	Grommet, Rubber
11		1	Hose, Rubber (Order 22" of Bulk Hose #503-0249)
12		1	Hose, Rubber (Order 18" of Bulk Hose #503-0249)
13	309-0253	1	Thermostat
14	505-0107	1	Nipple (1 x 2")
15	505-0041	1	Elbow, Pipe (1 x 90°)
16	505-0004	2	Nipple, Close (1 x 1½")
17	505-0281	1	Bushing, Reducer (1/2" x 1/4")
18	333-0142	1	Support, Pressure Switch
19	502-0284	1	Elbow, Male (45°)
20	505-0304	1	Tee, Pipe (1")



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

Onan®

PARTS AVAILABILITY NO LONGER GUARANTEED

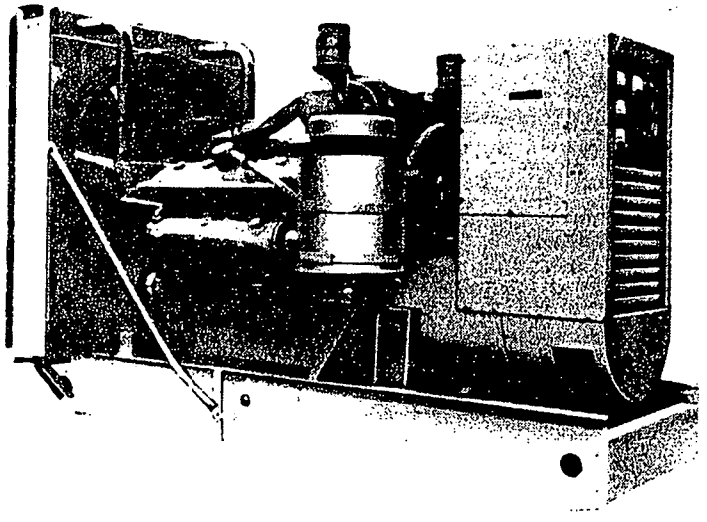
OPERATOR S MANUAL AND PARTS CATALOG

FOR

DHB

SERIES

ELECTRIC GENERATING SETS



Dear Customer

Onan has revised its warranty form in accordance with the recently enacted Magnuson-Moss Warranty Act. The revised warranty covering all Onan products has been inserted in this manual and replaces the warranty which is printed in the manual.

If you have any questions concerning this revision, please contact the Onan Service Department or a local Onan Authorized Service Distributor or Dealer.

Onan Corporation

945–0302

1A75

Printed in U.S.A.

TABLE OF CONTENTS

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

The customary unit of Brake Horsepower (BHP) becomes kilowatts (kW) when converted to S1 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.

Onan®

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
☐ Goods used in personal, family and household applications.	One (1) year from date of purchase.
☐ Goods used in commercial-industrial applications.	One (1) year from date of purchase.
☐ Commercial-industrial stationary generator sets.	One (1) year from date of initial start-up.
☐ 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.
☐ 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.
☐ 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

i. *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.

ii. *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

i. *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.

ii. *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.

LITHO IN U.S.A. 7-4-75 AB-355

INTRODUCTION

FOREWORD

This manual is applicable to the DHB Series electric generating set, consisting of an ONAN YB, 350.0 kW generator, driven by a Detroit Diesel engine.

The manual is divided into two sections. Section 1 provides information on installation, operation and troubleshooting. Section 2 is a *Parts Catalog* for ONAN optional and standard equipment. The manual should be used in conjunction with the Detroit Diesel engine manual, as your specific engine may have variations due to optional equipment available.

Onan

MANUFACTURER'S GENERAL WARRANTY

Manufacturer extends to the original purchaser of Goods for use, the following warranties, subject to the qualifications indicated:

(a) Manufacturer warrants satisfactory performance for a period of one (1) year from the date each product is placed in service, so long as such product is installed, operated and serviced in accordance with Manufacturer's written instructions. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR A PARTICULAR PURPOSE.

(b) Manufacturer's liability and purchasers' sole remedy for a failure of Goods to perform as warranted, and for any and all other claims arising out of the purchase and use of the Goods, including negligence on the part of Manufacturer, shall be limited to the repair or replacement of Goods returned to Manufacturer's factory or one of its Authorized Service Stations, transportation prepaid. The cost of any labor included shall be as specified in Manufacturer's written instructions. MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

(c) All claims shall be brought to Manufacturer's attention within Thirty (30) days after discovery that the Goods failed to perform as warranted, but in no event shall a claim be accepted after one (1) year from the date such product is placed in service.

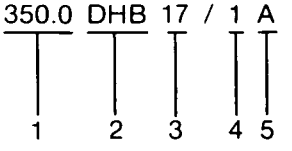
No person is authorized to give any other warranty or to assume any other liability on Manufacturer's behalf unless made or assumed in writing by an Officer of Manufacturer, and no person is authorized to give any warranty or assume any liabilities on the Manufacturer's behalf unless made or assumed in writing by such Manufacturer.

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

LITHO IN U.S.A. 7-3-73 AB-47

MODEL IDENTIFICATION

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



1. Indicates Kilowatt rating.
2. Factory code for SERIES identification.
3. Indicates voltage code.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

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

CAUTION **This symbol refers to possible equipment damage.**

If it is necessary to contact 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 types 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 Detroit Diesel nameplate is on the right hand side, on the cylinder block.

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

IMPORTANT! RETURN WARRANTY CARD ATTACHED TO UNIT.

SAFETY PRECAUTIONS

Throughout this manual you will find eye-catching flags containing Warnings and Cautions, alerting 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 generator 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 or carbon tetrachloride 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 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 generator set, disconnect batteries. This will prevent inadvertent starting of the set.

- Use extreme caution when making adjustments on the electrical components in the control panel while the engine is running. High voltages are present and could cause serious personal injury.

- DO NOT SMOKE while servicing batteries. Verify correct polarity of battery cables before connecting. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by electrical arcing or by smoking. When connecting batteries, connect the ground lead last.

SPECIFICATIONS

ENGINE DETAILS

Engine Manufacturer	Detroit Diesel
Engine Series	V12-71T
Number of Cylinders	V12
Displacement	852-inch^3 (13.96 litre)
BHP @ 1800 RPM	575 (428.9 kW)
Compression Ratio	17.0:1
Bore	4.25-inches (107.95 mm)
Stroke	5.00-inches (127.0 mm)
Fuel	ASTM No. 2 Diesel
Battery Voltage	24VDC
Battery Group (Two 12-Volt, 225 A.H. [810 kC])	8D
Starting Method	Solenoid Shift
Governor Regulation	3-5 percent
Battery Charging Current	35 Amperes

GENERATOR DETAILS

Type	YB 17 60 Hz YB 517 50 Hz
Rating (Watts)	
60 Hertz Continuous Standby	350,000 437.5 kVA
50 Hertz Continuous Standby	290,000 362.5 kVA
AC Voltage Regulation	± 2 Percent
60 Hertz RPM	1800
50 Hertz RPM	1500
Output Rating	0.8 PF
AC Frequency Regulation	3.0 Hz No Load to Full Load

CAPACITIES AND REQUIREMENTS

Cooling System	
Engine	13.75 Gallons (52 litres)
Engine and Radiator	36.50 Gallons (138 litres)
Engine Oil Capacity (Filter, Lines, Crankcase)	9.0 Gallons (34.1 litres)
Exhaust Connection (inches pipe thread)	5-inch pipe

AIR REQUIREMENTS (1800 RPM)

Engine Combustion	1800-CFM (0.85m^3/sec)
Radiator Cooled Engine	33,500-CFM (15.8m^3/sec)
Total for Radiator Cooled Model	35,300-CFM (16.7m^3/sec)
Alternator Cooling Air (1800 RPM)	1,200-CFM (0.57m^3/sec)
(1500 RPM)	1,000-CFM (0.5m^3/sec)
Fuel Consumption at Rated Load ASTM No. 2 Diesel	28.7 GPH (109 litres/hr)

GENERAL

Height	75.0-inches (1.9 m)
Width	65.0-inches (1.65 m)
Length	114.0-inches (2.9 m)
Approximate Weight (Mass)	8050 pounds (3655 kg)

TABLE 1
YB GENERATOR VOLTAGE/CURRENT OPTIONS

350.0 kW 437.5 kVA 60 Hz
290.0 kW 362.5 kVA 50 Hz

VOLTAGE	PHASE	FREQUENCY	MAXIMUM CURRENT	PARALLEL WYE	SERIES WYE	CONNECT WIRE W12
(YB17) 120/208	3	60 Hz	1215A	x		H3
127/220	3	60 Hz	1148A	x		H4
139/240	3	60 Hz	1054A	x		H5
240/416	3	60 Hz	607A		x	H3
254/440	3	60 Hz	574A		x	H4
277/480	3	60 Hz	526A		x	H5
(YB517) 110/190	3	50 Hz	1102A	x		H3
115/200	3	50 Hz	1048A	x		H4
120/208	3	50 Hz	1007A	x		H4
127/220	3	50 Hz	951A	x		H5
220/380	3	50 Hz	551A		x	H3
230/400	3	50 Hz	524A		x	H4
240/416	3	50 Hz	503A		x	H4
254/440	3	50 Hz	475A		x	H5
9X 347/600	3	60 Hz	421A		x	*
5D 120/240	3	60 Hz	1054A	SERIES DELTA		*
6D 240/480	3	60 Hz	526A	SERIES DELTA		*

* - Factory wired, not reconnectible.

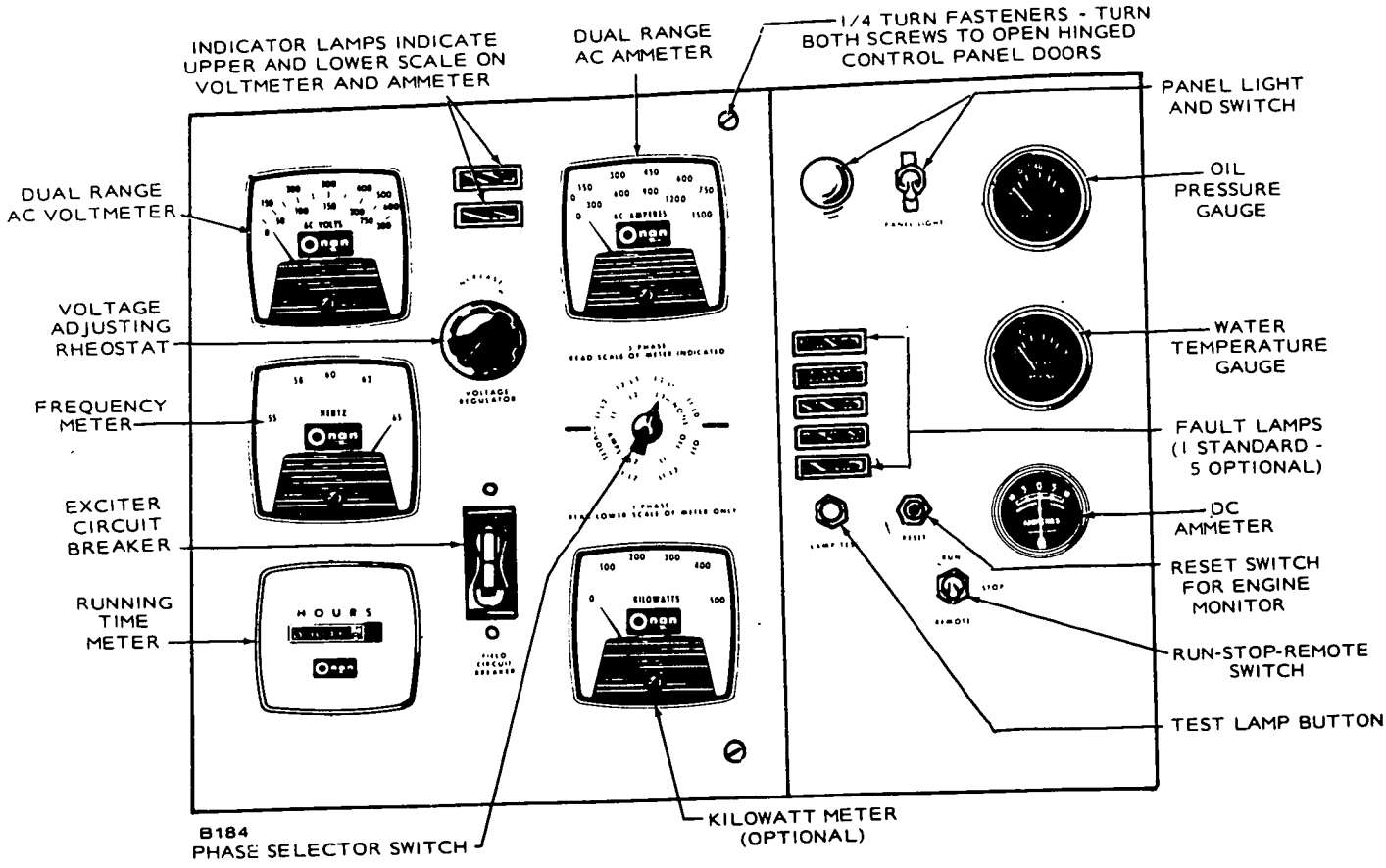


FIGURE 1. CONTROL PANEL

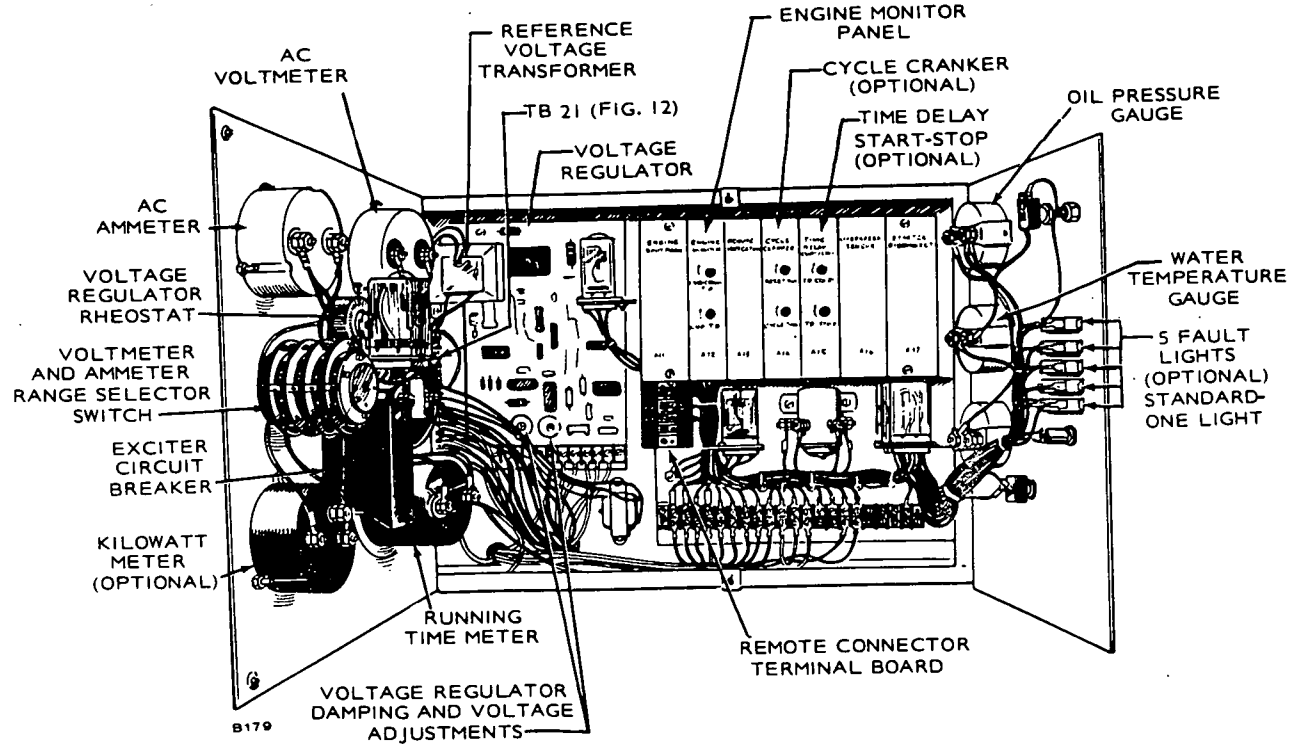


FIGURE 1A. CONTROL PANEL INTERIOR

DESCRIPTION

GENERAL

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

ENGINE

The engine on the DHB is a Detroit Diesel as described in engine manual. Basic measurements and requirements will be found under *Specifications.* However, the engine used for your unit may have variations due to optional equipment available, therefore the Detroit Diesel manual should be consulted.

AC GENERATOR

The generator is an ONAN Type YB, 12 lead, 4-pole revolving field, reconnectible bus-bar, 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 rpm, and the 50 Hz at 1500 rpm. Excitation is achieved as follows—

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

CONTROL PANEL

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

DC Panel

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 the battery charging current.

Run-Stop-Remote Switch: Starts and stops the unit locally or from a remote location.

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

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

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.

AC Ammeter: Indicates AC generator output current.

Dual range instrument: measurement range in use shown on indicator lights.

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

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.

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

OPTIONAL EQUIPMENT

DC Panel

Warning Lights: Eliminates the one "Fault" light and substitutes five indicator lights to give warning of—

a. Overcrank (failed to start)
b. Overspeed
c. Low oil pressure
d. High engine temperature
e. Low engine temperature

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

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. Refer to Figure 1A for location of units mentioned.

Terminal Board (TB) 21: Connection of wandering lead (W12) to terminals H3, H4, H5 is made at this point, to change voltage regulator tap when reconnecting generator for different voltages. Refer to Figure 12.

Voltage Regulator: Solid state unit controls AC output from generator at predetermined level regardless of load. Regulation plus or minus 2 percent from no load to full load, 0.8 P.F.

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

1. A 75 second cranking period.
2. Approximately a 12.5 second time delay for oil pressure buildup.
3. An external alarm contact to light a fault lamp and shut down the set for alarm conditions such as:
   a. Overcrank (failed to start after cranking 75 seconds).
   b. Overspeed (engine speed exceeds 2000 rpm).
   c. Low oil pressure 14 psi (96.5 kPa).
   d. High engine temperature 205° F (96° C).

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

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.

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.

Overspeed Shutdown: Shutdown occurs if engine speed exceeds 2010 rpm. A sensor mounted on the generator shaft (Figure 2) signals an overspeed condition which shuts down the engine through control module A16.

Failure of this system will allow a backup shutdown to function. A magnetic solenoid mounted on top of the engine will actuate to close the air intakes and starve the engine, thereby inducing shutdown. Reset air shut-off valve manually.

Start-Disconnect: Plug-in module. Operates at approximately 100 rpm above maximum cranking speed to prevent the starter from being energized while engine is running.

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.

Time Delay Start/Stop: Operative from remote location only. Provides 1-10 seconds time delay on starting and 30-seconds to 5-minutes delay on stopping. Delay period adjustable on engine monitor panel.

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

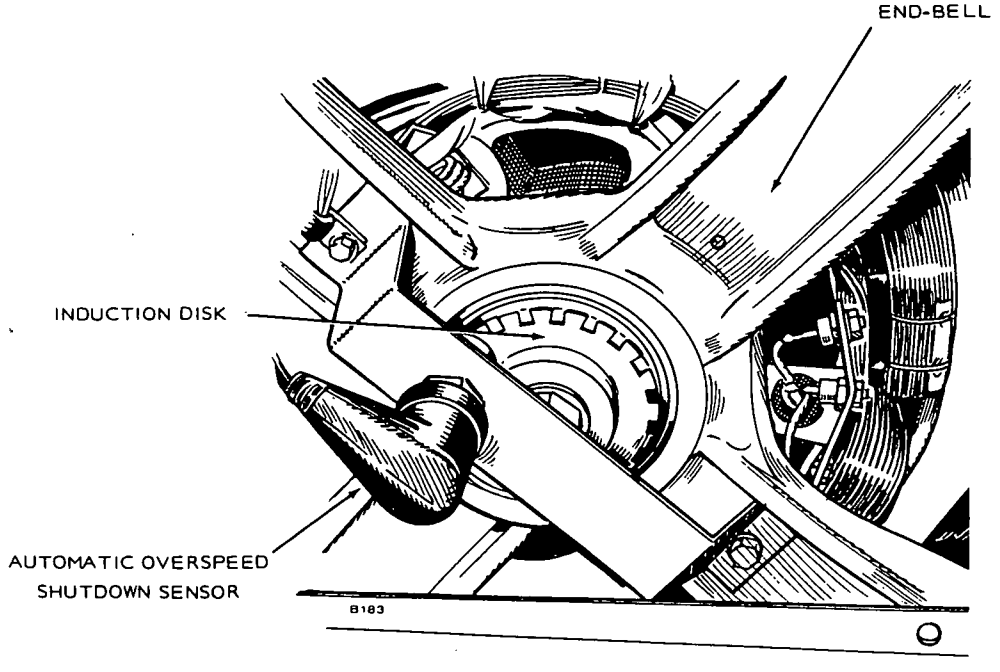


FIGURE 2. OVERSPEED SENSOR

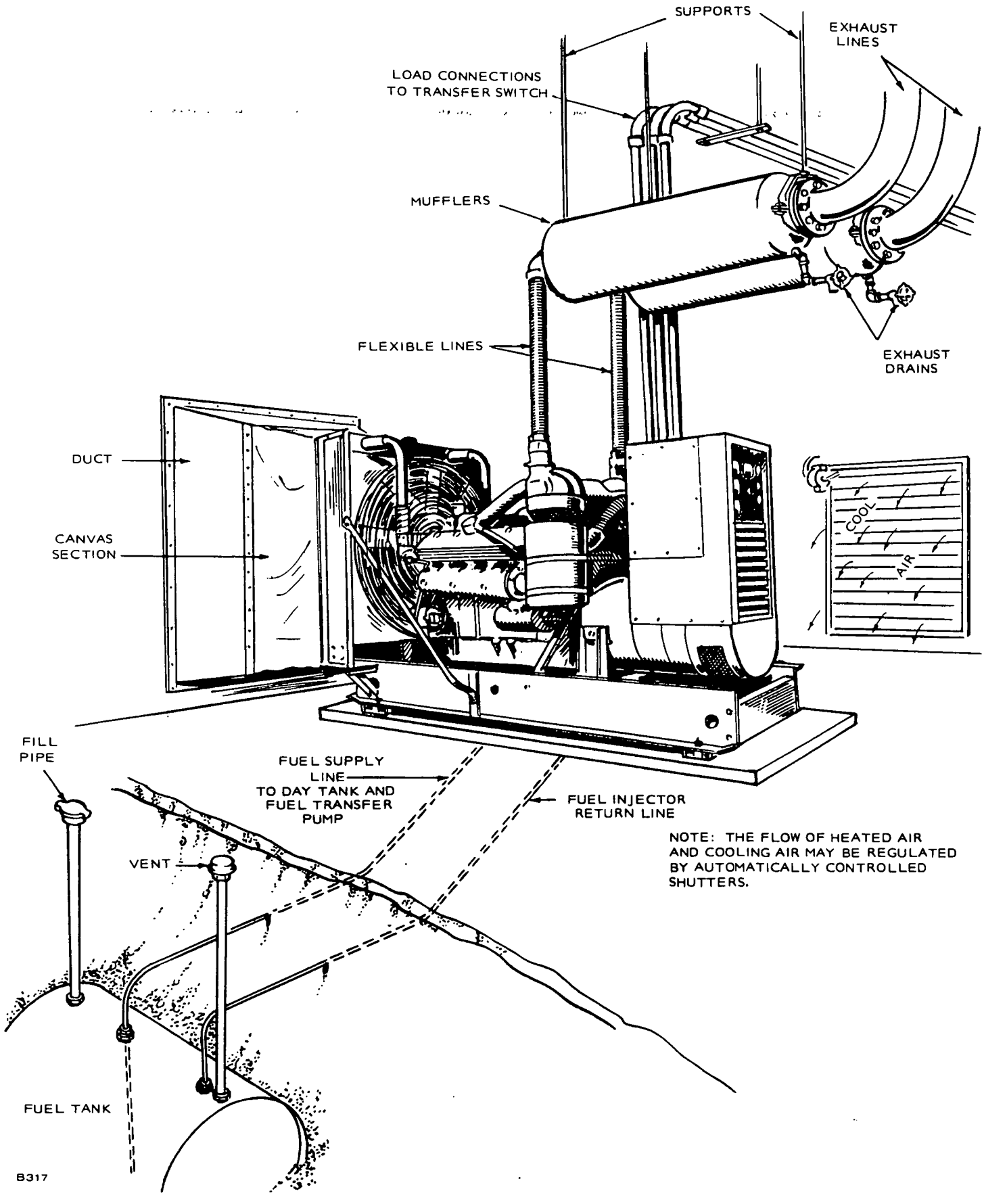


FIGURE 3. TYPICAL INSTALLATION

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 3.

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 connections.
8. Water connections.
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 extremes in weather conditions.

MOUNTING

Generator sets are mounted on a rigid skid base which provides proper support. Install vibration isolators between skid base and foundation. For convenience in draining crankcase oil and general servicing, mount set on raised pedestals (at least 6 inches high). Refer to ONAN Technical Bulletin T-030 for further installation information.

VENTILATION

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

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

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

Provide a means of restricting the air flow in cold weather to keep the room or compartment temperature at a normal point.

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

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

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

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

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

CITY WATER COOLING

An optional method of engine cooling, in place of the conventional radiator and fan, uses a constant pressure water supply. This is referred to as CITY WATER COOLING. There are two varieties of city water cooling: the HEAT EXCHANGER SYSTEM and STANDPIPE SYSTEM. See Figures 4 and 5.

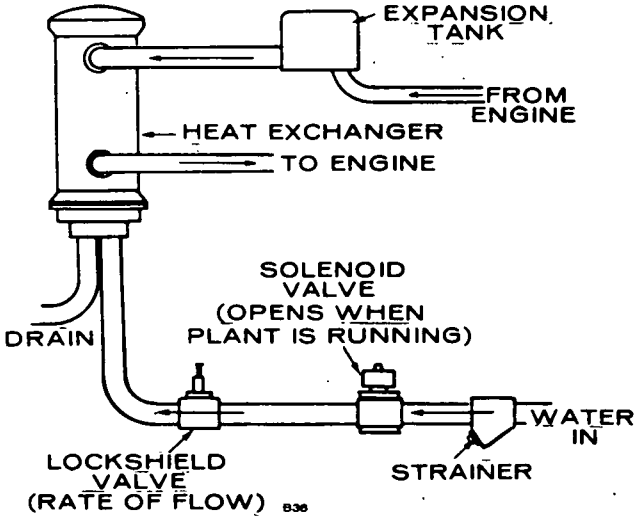


FIGURE 4. TYPICAL HEAT EXCHANGER SYSTEM

The HEAT EXCHANGER provides for a closed engine cooling system. Engine coolant flows through a tubed chamber, keeping the coolant separate from the cool "raw" water supply. The coolant chamber must be filled for operation, as for a radiator cooled set.

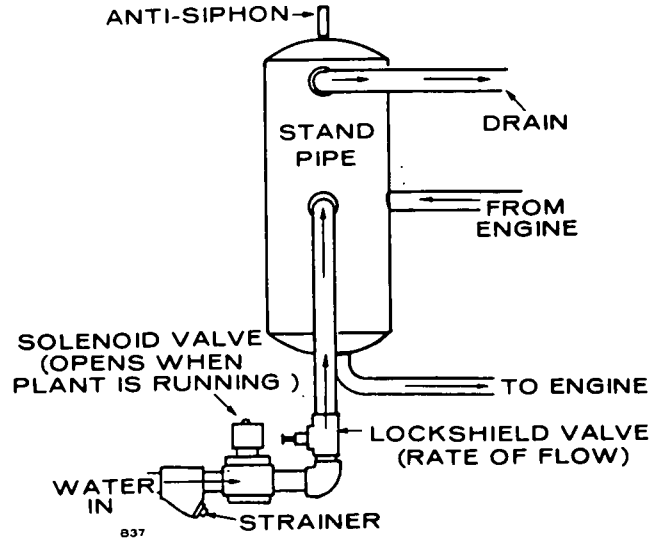


FIGURE 5. TYPICAL STANDPIPE SYSTEM

The STANDPIPE SYSTEM uses a mixing or tempering tank. Cooling water that circulates through the engine mixes with a source of cool "raw" water. The "raw" water supply must be free of scale forming lime or other impurities.

On both systems use flexible pipe for connecting water supply and outlet flow pipes to engine. Pipe the outlet flow to a convenient drain. Install an electric solenoid valve and a rate of flow valve in the water supply line. The electric solenoid valve opens and allows water flow through the system only when the unit operates. The rate of flow valve, either automatic or manual, provides for the proper flow rate to the engine. Adjust the flow to maintain water temperature between 165° F (74° C) and 195° F (91° 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.

WATER JACKET HEATER (Optional)

This heater is installed to maintain an elevated engine temperature in lower ambient temperature application. It heats and circulates engine coolant, and is thermostatically controlled (Figure 19).

EXHAUST

WARNING **Inhalation of exhaust gases can result in serious injury or 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 6) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 7) 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 3 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9-inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 5-inch pipe size outlets of the engine with a flexible portion between the engine and muffler. Do not connect a flexible line to the exhaust manifold.

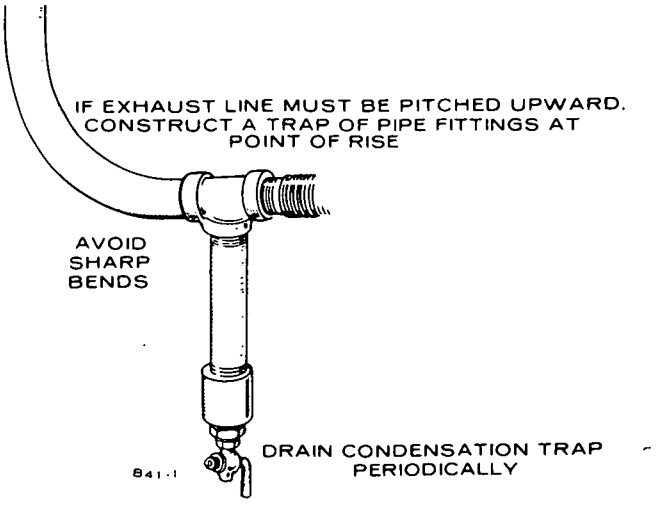


FIGURE 7. EXHAUST CONDENSATION TRAP

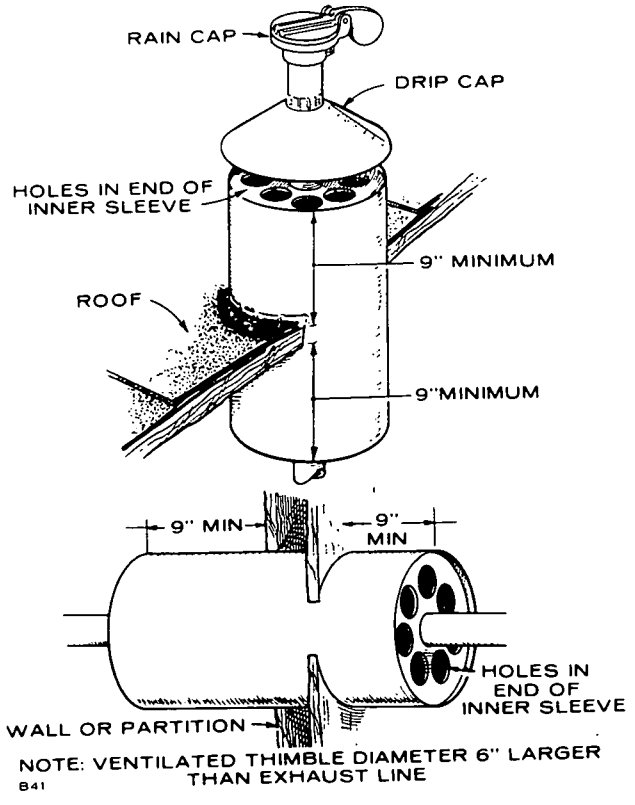


FIGURE 6. EXHAUST THIMBLE

Minimum diameters and maximum lengths of pipe (with critical muffler[s]) are as follows:

MAXIMUM EQUIVALENT EXHAUST LENGTH—FEET

6-inch	8-inch	10-inch	Pipe
	100	350	Single
59	387		Dual

Maximum permissable exhaust restriction (back pressure) is as follows:

60 Hz 27.0-inches H_2O (91.15 kPa)
50 Hz 18.9-inches H_2O (63.81 kPa)

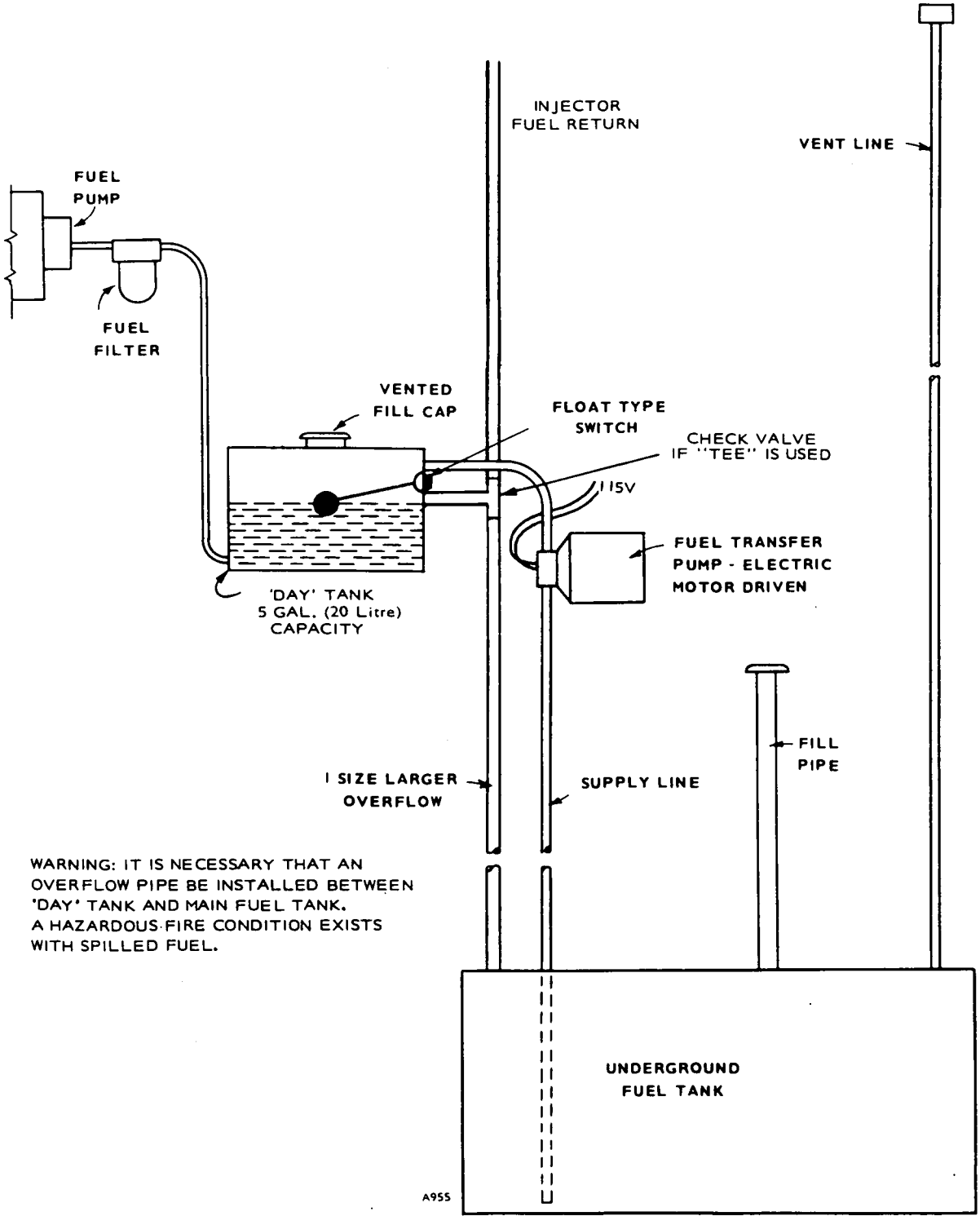


FIGURE 8. DAY TANK INSTALLATION (TYPICAL)

FUEL SYSTEM

Detroit Diesel engines used on ONAN DHB sets are designed for use with ASTM No 2 diesel fuels conforming to the specifications of the engine manual. Do not use fuels other than those specified.

INSTALLATION

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

CAUTION **Do not use any galvanized materials in the installation of a diesel fuel system. The fuel oil reacts chemically with the zinc coating to form powdery flakes which quickly clog fuel strainers and filters, and damage the fuel pump and injectors.**

In any diesel engine installation, fuel system cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture or contaminants of any kind.

FUEL TRANSFER PUMP

Pump delivery is above that required for combustion and injector cooling; the excess is returned to the tank. Fuel lift and restrictions in the system must not allow maximum suction to exceed 6-inches Hg (20.25 kPa); measurement to be made at the pump. If maximum suction does exceed that value, a day tank is then recommended. Do not return transfer pump fuel return line to the day tank. This will heat the fuel oil in the tank, thereby causing a loss of engine power. The return line should go to the main tank.

Pipe fittings to the filters and pump are threaded for 3/8 N.P.T.

FUEL FILTERS

There are two stages of filtration, primary (P) and secondary (S). The primary filter is a 30 micron unit, and is mounted on the suction side of the fuel transfer pump. This filter should be drained periodically to prevent water buildup. Should condensate level reach half the height of the element, it will be sucked into the system.

The secondary filter is connected between the fuel pump and the injectors. It is a 10 micron filter. This unit should be serviced at frequent intervals to prevent manifold pressure falling below 45 psi (310 kPa, measured at the filter outlet.

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the fuel tank. The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and the main fuel tank. Refer to the instructions included with the tank. See Figure 8 for an example of a day tank installation.

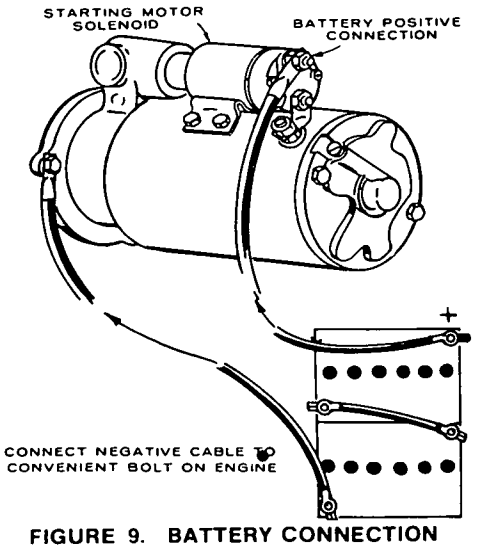


FIGURE 9. BATTERY CONNECTION

BATTERY

Starting the unit requires 24-volt battery current. Use two 12-volt (see *Specifications*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 9. Necessary battery cables are on unit. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Onan automatic transfer switches include such a battery charging circuit.

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

BATTERY, HOT LOCATION

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

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

REMOTE CONTROL CONNECTIONS

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated within the control box. Connect one or more remote switches across remote terminal and B+ terminal as shown in Figure 10. 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 (305-610 m), use No. 16 AWG wire.

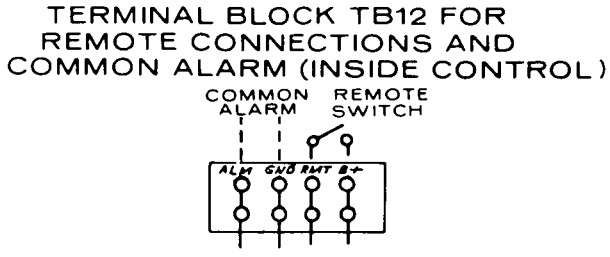


FIGURE 10. REMOTE STARTING

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.

If the installation is for standby service, a double throw transfer switch (Figure 11) must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator power to be connected to the load at the same time. Instructions for connecting an automatic transfer switch are included with such equipment.

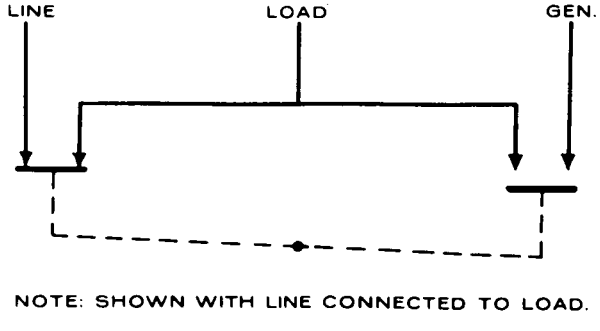


FIGURE 11. LOAD TRANSFER SWITCH

CONTROL BOX CONNECTION

Reconnection lead W12 on TB21 is a jumper which connects a single phase output from the generator to the appropriate tap on the voltage reference transformer. This lead is connected at one end to terminal 63 on the terminal board. The other end will be connected to a terminal marked H3, H4 or H5 (see Figure 12) depending upon the voltage option required. Refer to Table 1 and Figure 14 for voltages available and correct hookup.

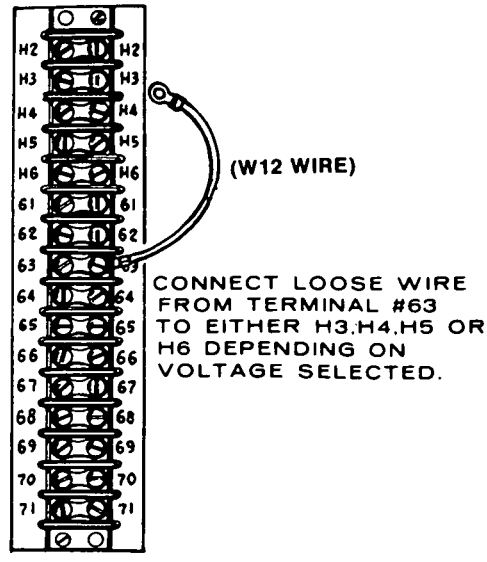


FIGURE 12. CONTROL BOX CONNECTION

GENERATOR CONNECTIONS

The model YB17 generator is a 3-phase 60 Hz (YB517 is 50 Hz) unit which can be bus-bar connected in either series wye or parallel wye configuration to give the line-to-neutral or line-to-line options referred to in Table 1 and Figure 14. Special models -9X, -5D and -6D are connected at the factory and cannot be changed without extensive modification. Line-to-neutral voltage is the lower voltage noted on the unit nameplate, line-to-line voltage is the higher nameplate rating.

Refer to Figure 13 for an example of 120/208 voltage connection.

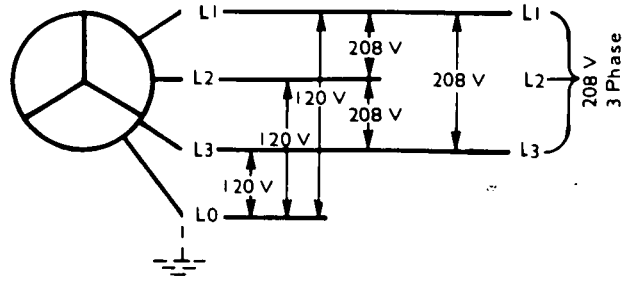
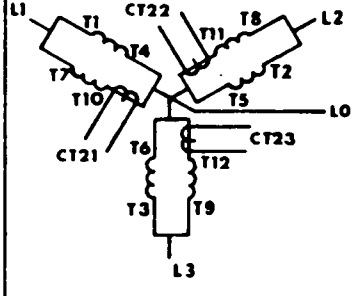
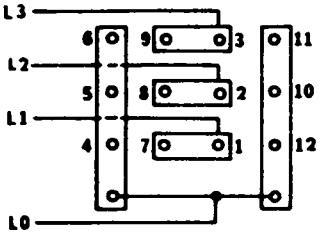
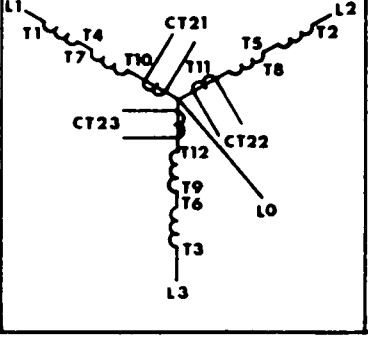
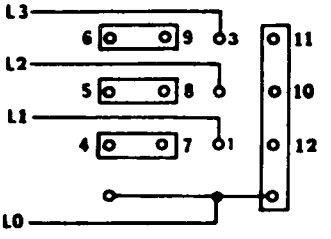


FIGURE 13. 3 PHASE WYE CONNECTION

THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASES	FREQUENCY	CONNECT LEAD FROM TERMINAL 63 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM
17 R	120/208	3	60	H3	PARALLEL WYE		
	127/220	3	60	H4			
	139/240	3	60	H5			
517 R	110/190	3	50	H3			
	115/200	3	50	H4			
	120/208	3	50	H4			
	127/220	3	50	H5			
17 R	240/416	3	60	H3	SERIES WYE		
	254/440	3	60	H4			
	277/480	3	60	H5			
517 R	220/380	3	50	H3			
	230/400	3	50	H4			
	240/416	3	50	H4			
	254/440	3	50	H5			

98C2579

FIGURE 14. VOLTAGE CONNECTIONS

For 3-phase loads connect separate load wires to each of the set terminals L1, L2 and L3 (Figure 14). For a large single phase load only, connect between terminals L1 and L2. Available capacity is 2/3 maximum output.

The terminal L0 can be grounded. For 1-phase loads connect the neutral wire to the L0 terminal. Connect the load wire to either terminal—L1, L2. Two separate single phase circuits are available with a total capacity of up to 2/3 of the generator rated 3-phase output.

If using 1-phase and 3-phase current at the same time, ensure the 1-phase load is properly balanced. Do not exceed rated line current.

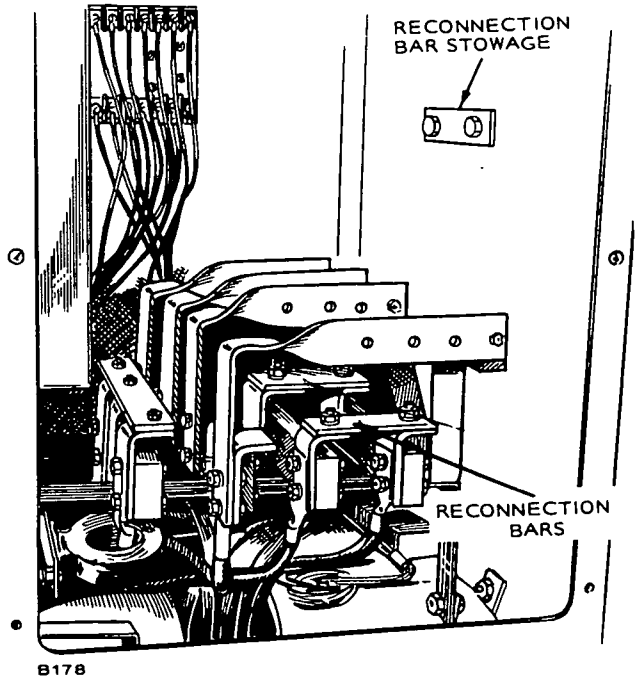


FIGURE 15. LOAD WIRE CONNECTIONS

Bus bars and reconnection bars are aluminum, plated with tin to retard electrolytic corrosion. Select connecting cables and terminal lugs with care, to keep dissimilar metals apart. Do not overtorque bolts.

Voltage code -5D and -6D Delta Connected sets. Available in 60 Hz series delta winding only. The -5D unit is 120/240 volt, the -6D is 240/480 volt. These sets supply single phase and three phase current. For three phase operation connect load wires to generator terminals L1, L2 and L3, one wire to each terminal. Terminal L0 is not used.

Single phase operation, terminals L1 and L2 are supply terminals; L0 is neutral which can be tied to ground if required. For 120 volt (-5D) or 240 volt (-6D) single phase, connect load wire to either L1 or L2 terminal and the return to L0.

See Figure 16 for a typical connection to a delta wound unit.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as no terminal current exceeds the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA.

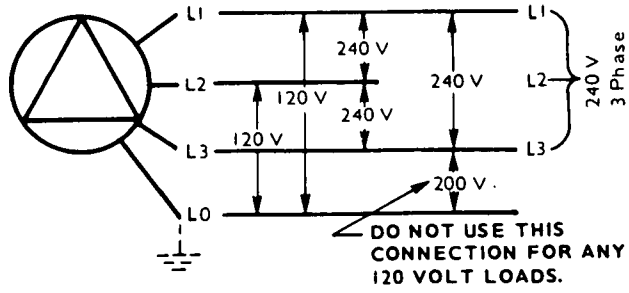


FIGURE 16. 3 PHASE, DELTA CONNECTION

OPERATION

GENERAL

ONAN DHB Series electric generating sets are given a complete running test under various load conditions and 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

Lubricating System: Engine oil was drained prior to shipment. After an extended period of inactivity, any lubricating oil in the upper parts of the engine will drain back into the lower galleries and crankcase. Prior to initial engine start after such a period, remove the valve rocker covers and pour two quarts (or two litres) of the same oil used in the crankcase over the rocker arms and push rods. Replace rocker covers and fill crankcase to capacities shown.

Refer to Detroit Diesel engine manual for engine oil recommendations. Note that for average operating conditions oil conforming to Military Specification Mil-L-2104B is recommended. Multigrade oils should not be used. Do not mix brands nor grades of oil.

Recommended oil viscosity is SAE 30, for all temperatures. Use a coolant heater for lower ambients. After engine has been run, check dipstick, add oil if necessary to bring level to FULL mark. Record total capacity for future oil changes.

Oil Capacities (nominal)

Oil Pan	34 quarts (32.2 litres)
Filter and Oil Lines	2 quarts (1.9 litres)
Total	36 quarts (34.1 litres)

CAUTION **After changing or filling engine crankcase, pre-fill oil filters. If this is not performed, the engine will be starved for oil until the filters fill up, and damage will result.**

CAUTION **Disconnect turbo charger oil inlet line and pump clean engine oil into the turbocharger and oil line. This will ensure that the bearings are oiled for the initial start. Failure to do so can cause irreparable damage to the turbocharger within five seconds of engine start.**

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Total capacity is 36.5 gallons (138 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean, soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures, use anti-freeze with an ethylene-glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to engine manual for additional information.

CAUTION **Verify that the electric solenoid valve used with city water cooled plants is open to allow coolant chambers to fill before initial starting of set. Overheating and damage to the engine could result from non-compliance.**

Ensure that water supply for city water cooling is turned ON.

Fuel System: Refer to the engine manual for fuel oil specifications. Check with fuel supplier and ensure that fuel supplied meets the specifications. Filter or strain fuel when filling tank.

Fuel supply tanks should be kept as nearly full as possible by topping up each time engine is used. Warm fuel returning from the injector pump heats the fuel in the supply tank. If the fuel level is low in cold weather, the upper portion of the tank not heated by returning fuel tends to increase condensation. In warm weather both the supply tank and fuel are warm. Cool night air lowers the temperature of the tank more rapidly than the temperature of the fuel. Again this tends to increase condensation.

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

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

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 petroleum based or non-conductive grease to retard formation of corrosive deposits.

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

STARTING

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

a. Crankcase filled.
b. Cooling system filled—input solenoid valve open.
c. Batteries charged and connected.
d. Fuel solenoid valve open.
e. Shut-off valves on air shutdown housings open.

To start, move the "run-stop-remote" switch to the "run" position. The engine should start after a few seconds of cranking.

Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 50 and 60 psi (345 and 414 kPa). Check the following gauges:

a. DC Ammeter—10 to 30 amperes.
b. AC Voltmeter—AC generator output voltage.
c. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 160° to 180° F (71° to 82° 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° to 195° F (74° to 91° C).

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

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

STOPPING

To reduce and stabilize temperatures within the engine and turbocharger run the engine at no load for 3-5 minutes before shutting down.

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

EXERCISE PERIOD

Generating sets on continuous standby service are required to be operative at essential load 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 pressure, 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 (305 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

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.

DUST AND DIRT

1. Keep set clean. Keep cooling system free of dirt, etc.
2. Service air cleaners regularly.
3. Change crankcase oil at proper intervals.
4. Ensure air inlet system is leak free.

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

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

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

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

*NOTE: Not applicable on Pennsylvania State models.

OUT-OF-SERVICE PROTECTION

Refer to chapter on *Storage* in Detroit Diesel engine manual.

Run set at 1800 rpm with 50 percent load instead of 1200 rpm and no load.

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. Keep fuel system clean, and batteries in a well charged condition.
3. Partially restrict cool air flow but use care to avoid overheating.
4. Connect water jacket heater when set is not running.
5. Refer to engine manual for further information.

Engine Heater: The function of this optional heater is to keep the engine warm enough to assure starting under adverse weather conditions. Connect the heater to a source of power that will be ON during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating (Figure 17).

CAUTION **Do not energize heater until engine cooling system is filled with coolant.**

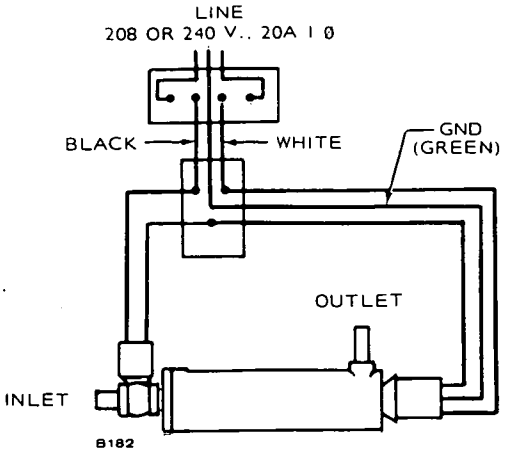


FIGURE 17. ENGINE HEATER (TYPICAL)

GENERAL MAINTENANCE

GENERAL

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

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.**

ENGINE SPEED

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

A Woodward governor is standard equipment on the DHB generator set. High speed and low speed limit stops are set at the ONAN testing facility and normally do not require further adjustment, therefore if your set is used on continuous standby service, the governor may never need to be touched. If however the unit is used frequently, adjustment may be required due to wear of internal components. This adjustment is achieved by backing off the high speed stop screw. Screw in the low speed adjusting screw until the generator output frequency meter reads 60 Hz (generator on rated load). Turn in the high speed adjusting screw until it bottoms; secure the locknuts. Refer to Figure 18.

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

Example: 30 x 61 (Hz) = 1830 rpm.

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

Engine crankcase oil flows through the governor. Dirty oil can degrade governor operation.

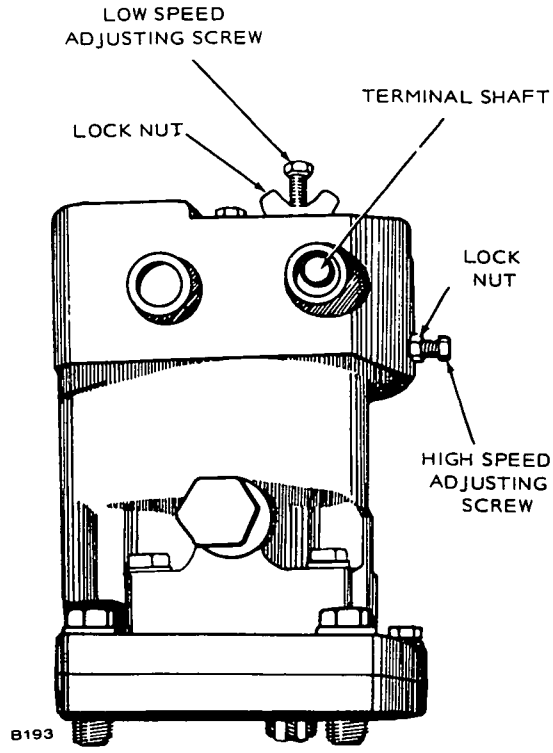


FIGURE 18. WOODWARD GOVERNOR

AC GENERATOR

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

Generator Bearing: Inspect the bearing every 1000 hours with the unit running.

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

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

INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly, make sure diodes are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure. Blow out the assembly periodically, with filtered, low pressure air. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 30 in. lb. or finger tight plus a quarter turn. Blow dust out of control panel.

BATTERIES

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

CONNECTIONS (Fuel, Exhaust, etc.)

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

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

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

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	8	50	100	200-250
Inspect Set	x			
Check Radiator Coolant	x			
Check Oil Level	x4			
Check Air Cleaner (Clean if Required)		x1		
Clean and Inspect Crankcase Breather			x	
Inspect Fan Belt			x2	
Check Cooling System			x3	
Clean and Inspect Battery Charging Alternator				x
Change Crankcase Oil			x1	
Replace Oil Filter Element			x1	
Check Batteries		x5		

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

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

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

x4 - For accurate readings, check oil level approximately 30 minutes after shutdown. Keep oil level as near "FULL" mark on dipstick as possible. See engine manual.

x5 - Or every month.

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

ADDITIONAL INFORMATIONAL LITERATURE

The following Technical Bulletins are available at no cost from ONAN office supplies department.

T-011	AUTOMATIC TRANSFER SWITCHES*
T-016	PARALLEL OPERATION OF ELECTRIC GENERATING SETS
T-017	RATING FACTORS FOR ELECTRIC GENERATING SETS
T-018	DIESEL FUEL SYSTEMS
T-030	INSTALLATION INFORMATION FOR LIQUID COOLED GENERATOR SETS

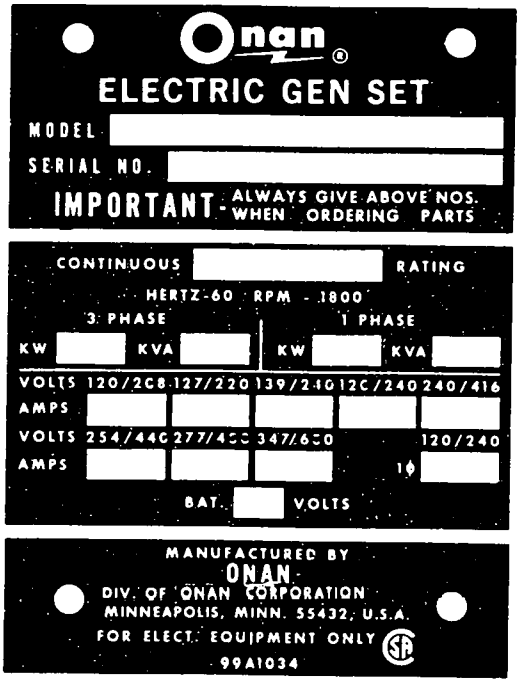
* A TECHNICAL BULLETIN FOR SERIES AT TRANSFER SWITCHES WILL BE AVAILABLE AT A LATER DATE.

PARTS CATALOG

This catalog applies to the DHB generator sets listed below. Engine parts modified or added by Onan will be in this list and have Onan part numbers. These supersede similar parts listed in the Detroit Diesel Allison manual. Onan parts are arranged in groups of related items and are identified by a reference. All part illustrations are typical. Using the Model and Specification from the Onan nameplate, select the parts from this catalog that apply to your set.

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.

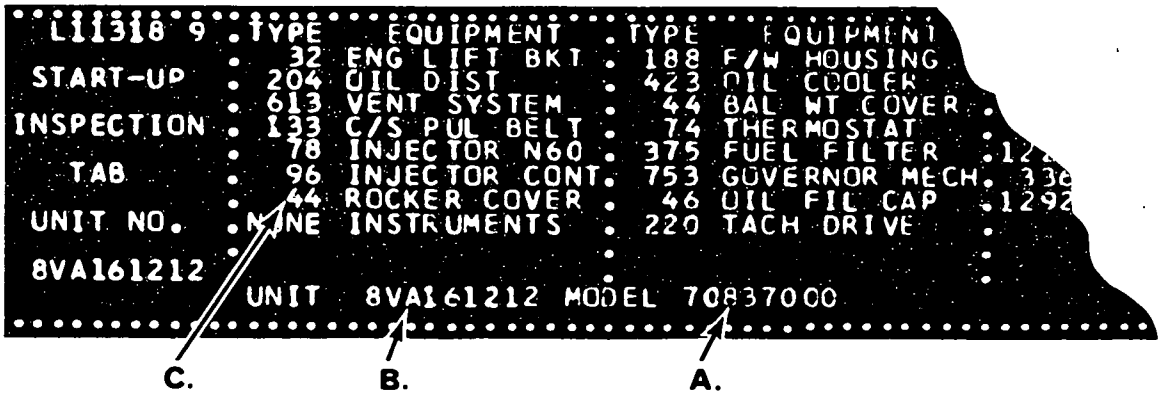


MODEL AND SPECIFICATION**	WATTS
290.0 DHB - 517R/*	290,000
350.0 DHB - 17R/*	350,000

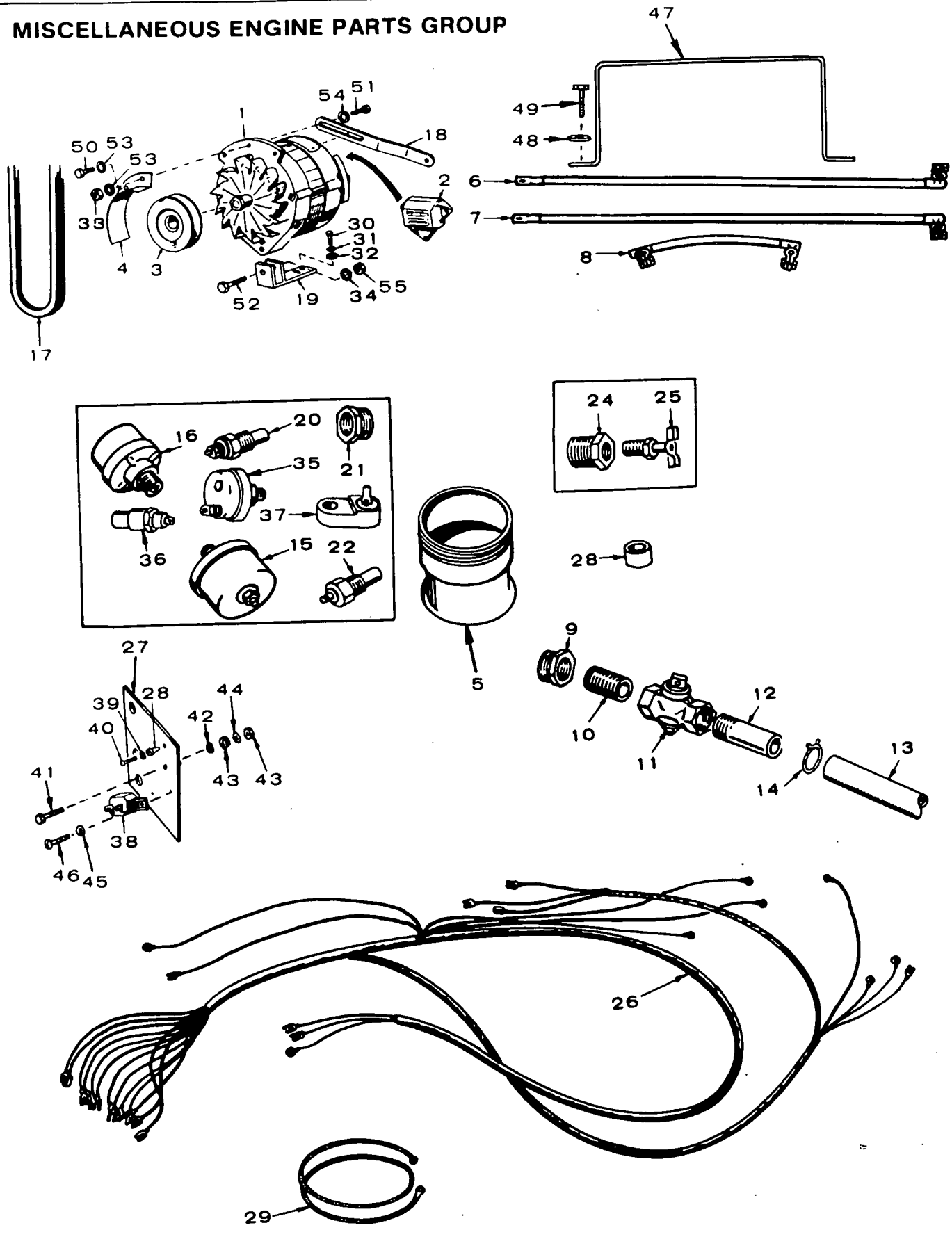
* The Specification Letter advances (A to B, B to C, etc.) with manufacturing changes.
** Refer to Specifications Section (Generator Details) in Operators Manual for Electrical Data.

DETROIT DIESEL ALLISON PARTS

All Detroit Diesel Allison parts must be ordered from the Detroit Diesel Allison Div., Detroit Michigan or their nearest authorized Detroit Diesel Allison distributor or dealer. When ordering parts, refer to the Detroit Diesel Allison option plate and supply: A. The "Model" number, B. the "Unit" number, and C. the "Type" number.



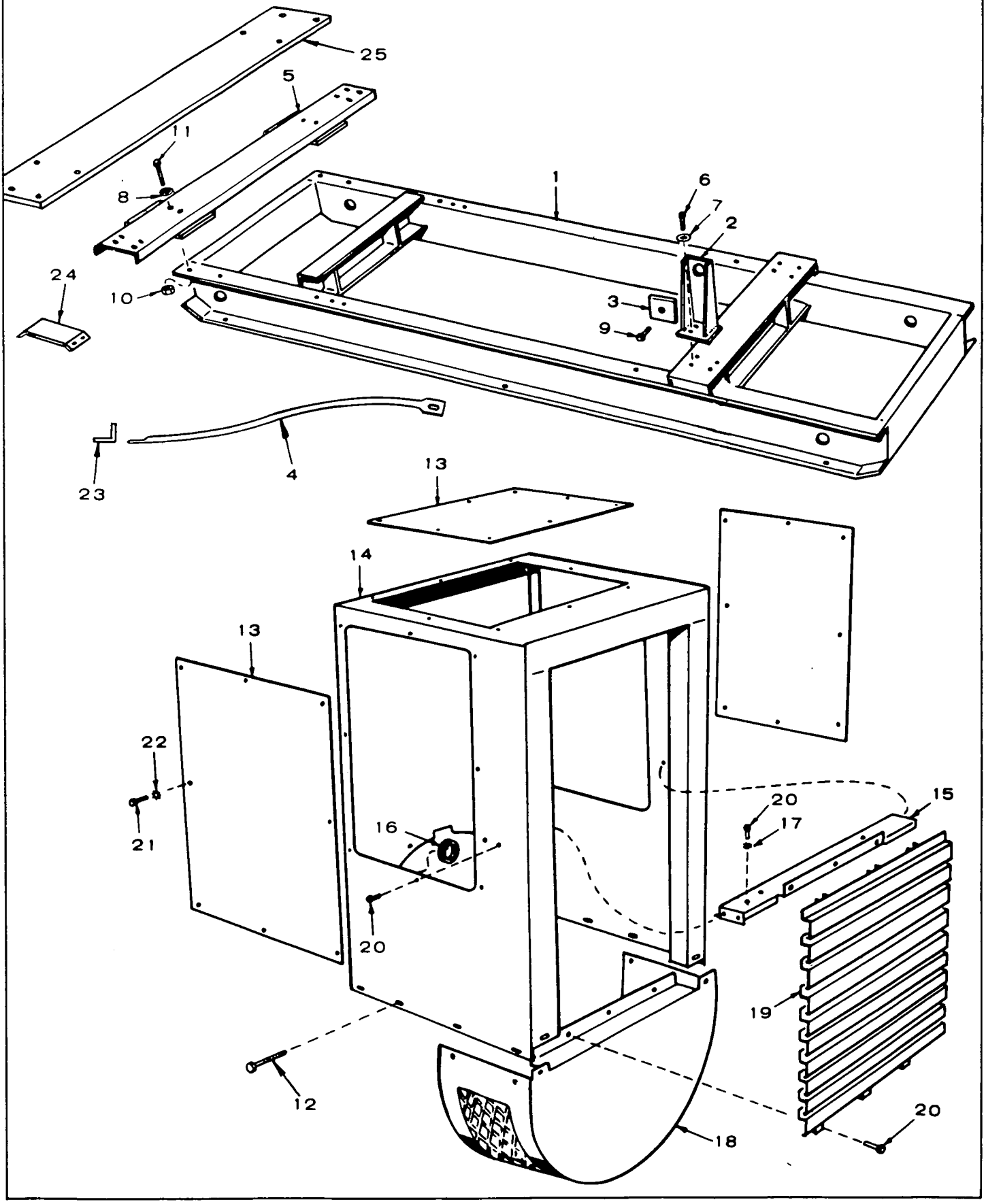
MISCELLANEOUS ENGINE PARTS GROUP



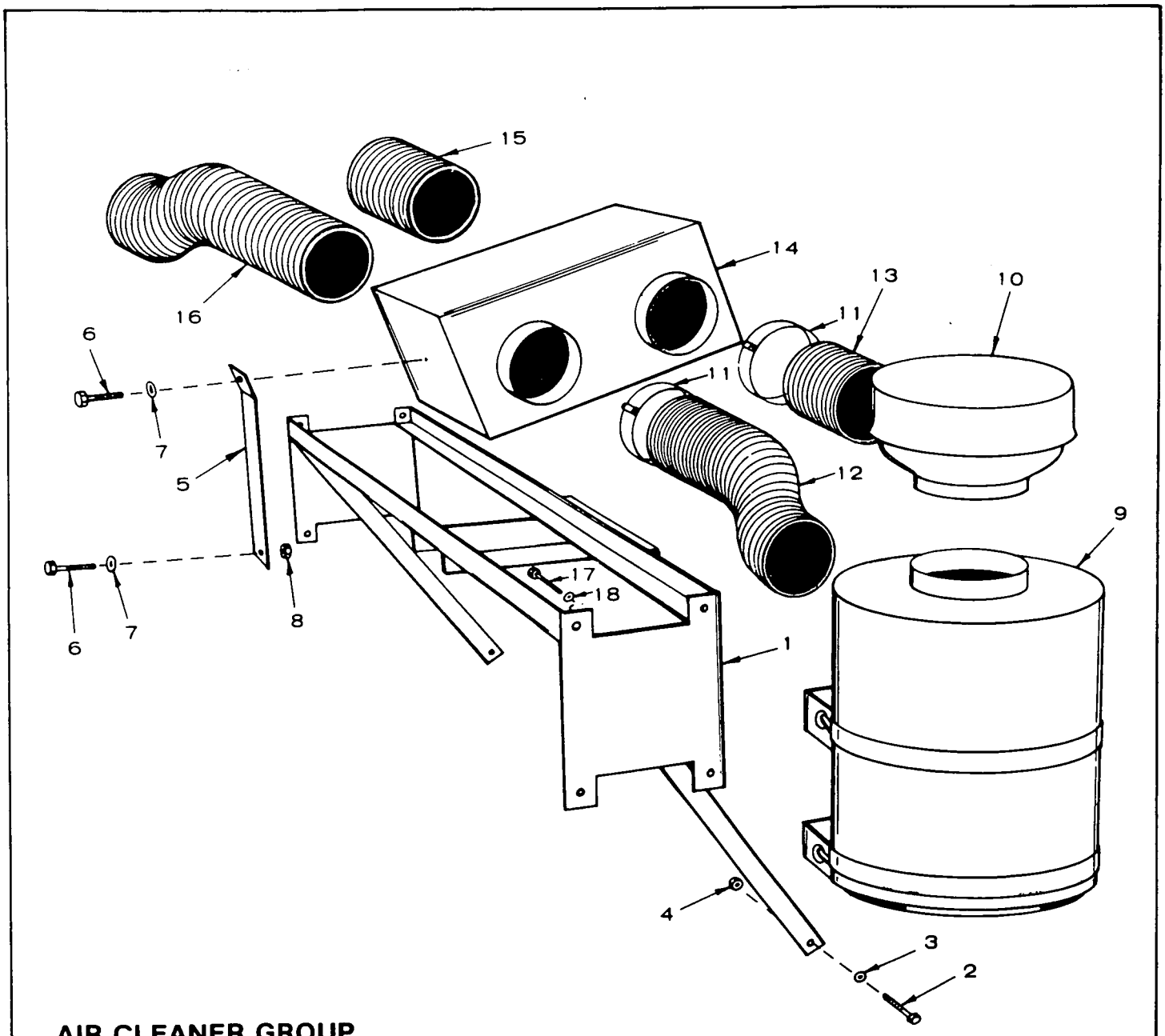
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191-0871	1	*Alternator, Charge - Includes Regulator and Fan (Motorola #70D44039B04 - Except: Specify #49A41756A01 Counterclockwise Fan)
2	191-0733	1	Regulator, Alternator (Part of Alternator)
3	191-0649	1	Pulley, Alternator
4	191-0725	1	Guard, Alternator Belt
5	155-1364	2	Adapter, Exhaust
6	416-0636	1	Cable, Battery - Positive
7	416-0445	1	Cable, Battery - Negative
8	416-0473	1	Cable, Jumper
9	505-0021	1	Bushing, Reducer (3/4 x 1/2") - Oil Drain
10	505-0100	1	Nipple, Close (1/2 x 1⅛") - Oil Drain
11	504-0011	1	Valve, Shutoff - Oil Drain
12	505-0185	1	Nipple, Half (1/2" x 1½") - Oil Drain
13		1	Hose, Oil Drain (Order 12" of Bulk Hose #503-0098)
14	503-0197	1	Clamp, Hose - Oil Drain
15	193-0195	1	Sender, Oil Pressure
16	309-0272	1	Switch, Oil Pressure Cutoff
17	511-0092	1	Belt, Alternator
18	191-0869	1	Strap, Alternator Adjusting
19	191-0870	1	Bracket, Alternator
20	193-0109	1	Sender, Water Temperature
21	505-0021	1	Bushing, Reducer - Water Temperature Sender Mtg. (3/4 x 1½")
22	309-0178	1	Switch, High Water Temperature
24	505-0131	1	Bushing, Reducer - Radiator Drain (3/4 x 3/8")
25	504-0028	1	Valve, Drain - Radiator Drain
26	338-0909	1	Harness, Wiring - Engine
27	332-1382	1	Bracket, Terminal Mounting
28	870-0196	1	Nut, Insulating
29	416-0632	1	Lead, Starter Ground
30	800-0048	2	Screw, Hex Cap - Steel (3/8-16 x 3/4")
31	850-0050	2	Washer, Spring Lock (3/8")
32	526-0183	2	Washer, Flat (25/64 I.D. x 5/8 O.D. x 3/32" Thick - Steel)
33	862-0015	1	Nut, Hex Steel (5/16-18)
34	856-0013	1	Washer, Lock - EIT (1/2")
35	309-0169	1	Switch, Oil Pressure (Pre-Alarm) - Optional
36	309-0179	1	Switch, High Engine Temperature (Pre-Alarm) - Optional
37	309-0269	1	Switch, Low Engine Temperature (Pre-Alarm) - Optional
38	320-0240	1	Breaker, Circuit - Starter (12.5 amp.)
39	508-0015	1	Washer, Fibre
40	809-0035	1	Screw, Round Head Sheet Metal (#8 x 3/4")
41	800-0007	1	Screw, Hex Cap - Steel (1/4-20 x 1")
42	850-0040	1	Washer, Spring Lock (1/4")
43	862-0001	2	Nut, Hex - Steel (1/4-20)
44	856-0006	1	Washer, Lock - EIT (1/4")
45	850-0030	2	Wahser, Spring Lock (#10)
46	811-0103	2	Screw, Round Head Brass (#10-32 x 3/4")
47	416-0635	1	Strap, Battery Holddown
48	850-0045	4	Washer, Spring Lock (5/16")
49	800-0035	4	Screw, Hex Cap - Steel (5/16-18 x 2½")
50	800-0025	1	Screw, Hex Cap - Steel (5/16-18 x 5/8")
51	800-0030	1	Screw, Hex Cap - Steel (5/16-18 x 1¼")
52	800-0094	1	Screw, Hex Cap - Steel (1/2-13 x 2")
53	850-0045	2	Washer, Spring Lock (5/16")
54	526-0022	1	Washer, Flat - Steel (21/64" I.D. x 9/16" O.D. x 1/16" Thick)
55	862-0005	1	Nut, Hex - Steel (1/2-13)

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

MOUNTING AND HOUSING GROUP

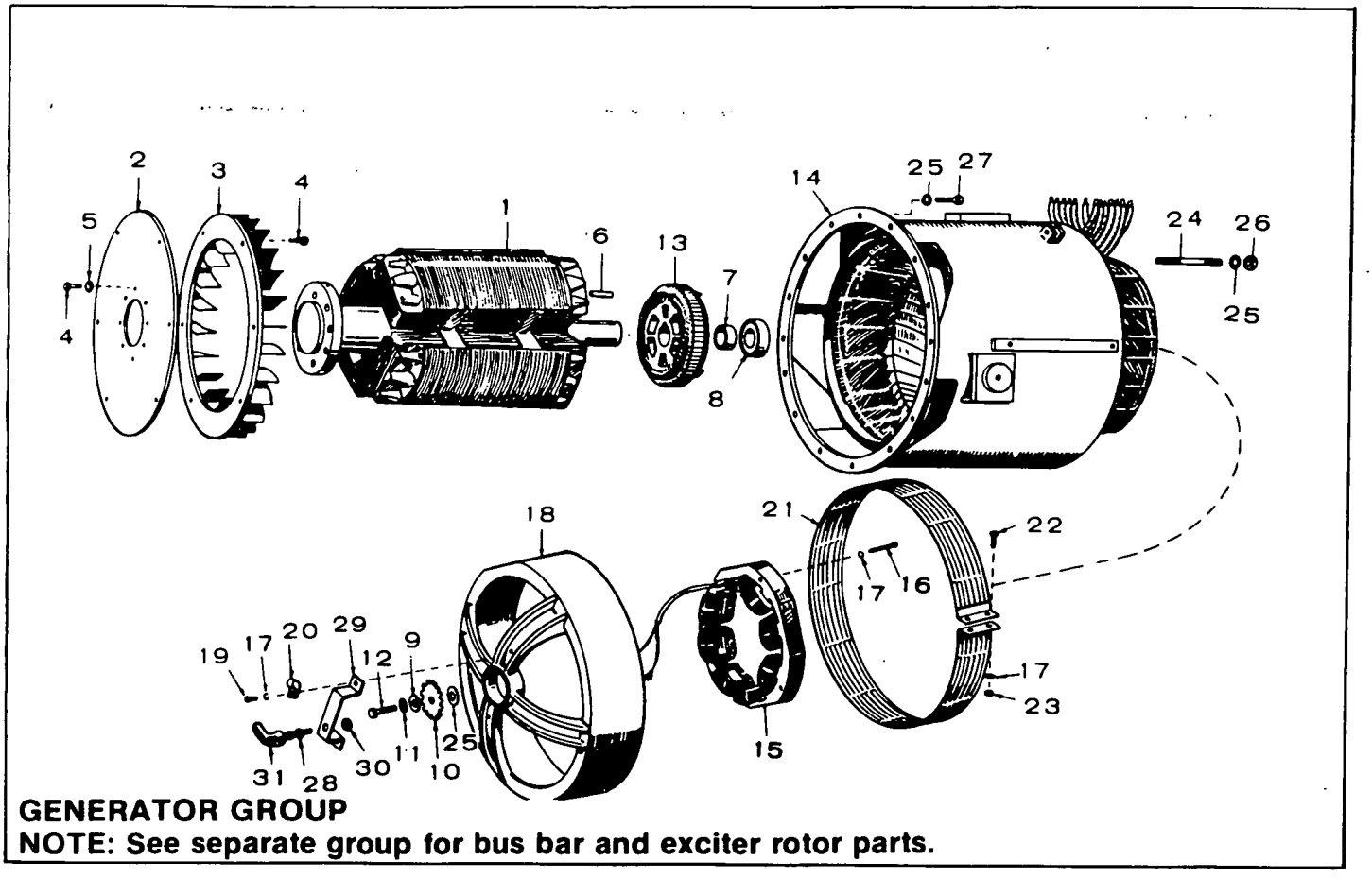


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403-1149	1	Base, Skid
2	232-2389	2	Bracket, Generator Mounting
3	232-2385	2	Plate, Generator Mtg. Retainer
4	130-0945	2	Brace, Radiator
5	130-0942	1	Support, Radiator
6	800-0156	6	Screw, Hex Cap - Steel (3/4-10 x 2¼")
7	850-0079	8	Washer, Spring Lock (3/4")
8	850-0079	8	Washer, Spring Lock (3/4")
9	800-0153	2	Screw, Hex Cap - Steel (3/4-10 x 1½")
10	862-0008	8	Nut, Hex - Steel (3/4-10)
11	800-0153	8	Screw, Hex Cap - Steel (3/4-10 x 1½")
12	821-0014	18	Screw, Flanged Hex Cap - Steel (5/16-18 x ½")
13	301-3731	3	Plate, Control Box
14	301-3605	1	Housing, Control Box
15	301-3604	1	Shelf, Control Box Housing
16	508-0001	1	Grommet, Rubber
17	856-0006	2	Washer, Lock - EIT (1/4")
18	234-0489	1	Cover, End Bell
19	234-0490	1	Grille, Generator Air Inlet
20	821-0010	9	Screw, Flanged Hex Cap - Steel (1/4-20 x 1/2")
21	815-0241	24	Screw, Truss Head (1/4-20 x ½")
22	853-0013	24	Washer, Lock - ET (1/4")
23	130-0944	2	Bracket, Radiator Brace
24	130-0951	2	Bracket, Radiator Mounting
25	130-0950	1	Plate, Radiator Mounting



AIR CLEANER GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	140-1314	1	Support, Air Cleaner Mounting
2	800-0090	2	Screw, Hex Head - Steel (1/2-13 x 1")
3	850-0060	2	Washer, Spring Lock (1/2")
4	862-0016	2	Nut, Hex - Steel (1/2-13)
5	140-1330	1	Bracket, Inlet Box Support
6	800-0005	2	Screw, Hex Head - Steel (1/4-20 x 3/4")
7	850-0040	2	Washer, Spring Lock (1/4")
8	862-0001	1	Nut, Hex - Steel (1/4-20)
9	140-1326	2	Cleaner, Air
10	140-1327	2	Cap, Weather
11	503-0059	16	Clamp, Hose
12		1	Hose, Flex (Order 14" of Bulk Hose #503-0641)
13		1	Hose, Flex (Order 4" of Bulk Hose #503-0641)
14	140-1328	1	Box, Air Inlet
15		1	Hose, Flex (Order 4" of Bulk Hose #503-0641)
16		1	Hose, Flex (Order 18" of Bulk Hose #503-0641)
17	801-0071	8	Screw, Hex Head - Steel (7/16-20 x 1")
18	850-0055	8	Washer, Spring Lock (7/16")
19	140-1331	2	Element, Air Cleaner (Not Illustrated)



GENERATOR GROUP

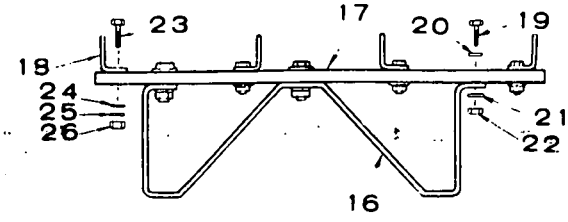
NOTE: See separate group for bus bar and exciter rotor parts.

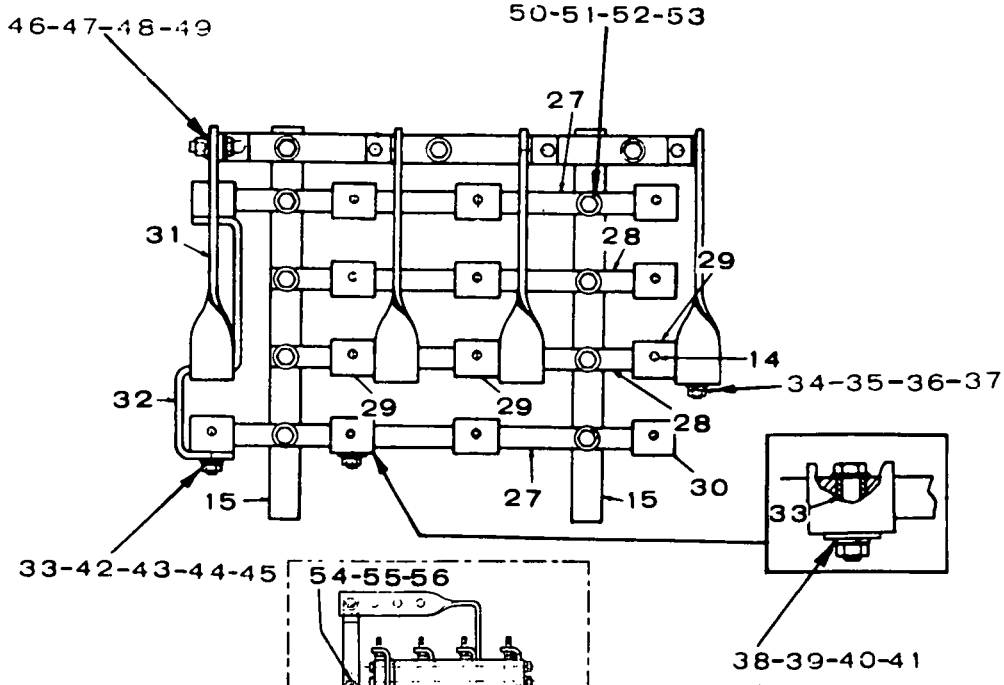
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	★	1	Rotor Assembly, Wound (Includes Parts Marked *)
2	232-2309	1	*Disc, Generator Drive
3	205-0103	1	*Fan, Generator
4	805-0035	14	*Bolt, Place (5/8-11 x 1½")
5	526-0259	8	*Washer, Flat - Steel (11/16" I.D. x 1-3/8" O.D. x 12 Ga.)
6	515-0145	1	*Key, Exciter Rotor
7	232-2317	1	*Spacer, Bearing
8	510-0106	1	*Bearing
9	526-0252	1	*Washer, Flat - Steel (13/16" I.D. x 2-3/8" O.D. x 5/32" Thick)
10	150-1405	1	*Wheel, Speed Sensor
11	850-0060	1	*Washer, Spring Lock (1/2")
12	800-0092	1	*Screw, Hex Cap - Steel (1/2-13 x 1½")
13	201-1902	1	*Rotor Assembly, Wound - Exciter (See Separate Group for Components)
14	★	1	Stator Assembly, Wound
15	220-1920	1	Stator Assembly, Wound - Exciter
16	800-0009	4	Screw, Hex Cap - Steel (1/4-20 x 1½")
17	850-0040	12	Washer, Spring Lock (1/4")
18	211-0214	1	Bell, End
19	800-0005	2	Screw, Hex Cap - Steel (1/4-20 x 3/4")
20	332-1554	1	Clamp, Loop
21	234-0455	1	Screen, Fan
22	800-0008	2	Screw, Hex Cap - Steel (1/4-20 x 1¼")
23	862-0001	2	Nut, Hex - Steel (1/4-20)
24	520-0780	4	Stud, End Bell Mounting (1/2 x 6½")
25	850-0060	20	Washer, Spring Lock (1/2")
26	862-0016	4	Nut, Hex - Steel (1/2-13)
27	800-0092	16	Screw, Hex Cap - Steel (1/2-13 x 1½")
28	150-1406	1	Sensor, Speed
29	150-1407	1	Bracket, Speed Sensor
30	870-0289	1	Nut, Hex - Steel (3/4-16)
31	150-1410	1	Cap, Insulator

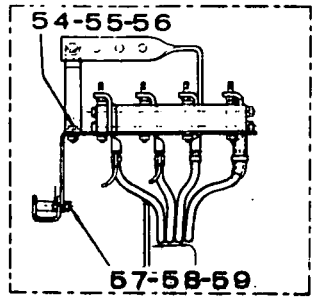
★ - Refer to factory giving complete Model, Spec and Serial Number from Onan nameplate.

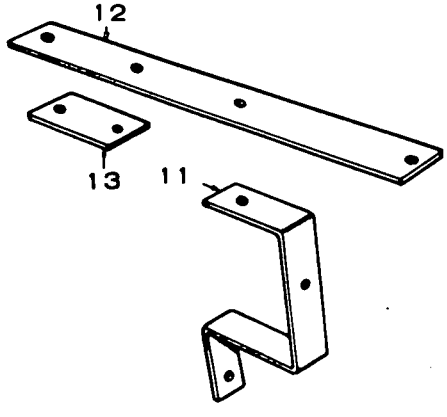
* - Parts included in the Rotor Assembly.

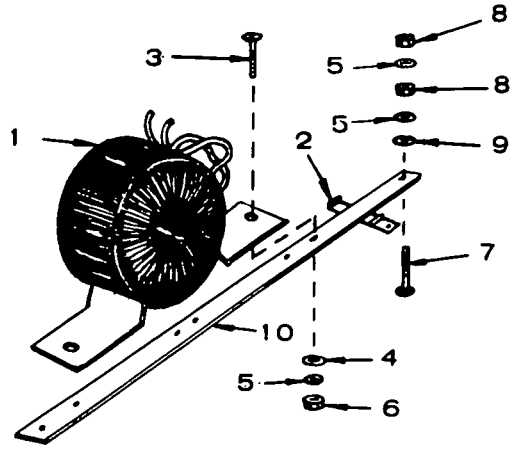
BUS BAR GROUP





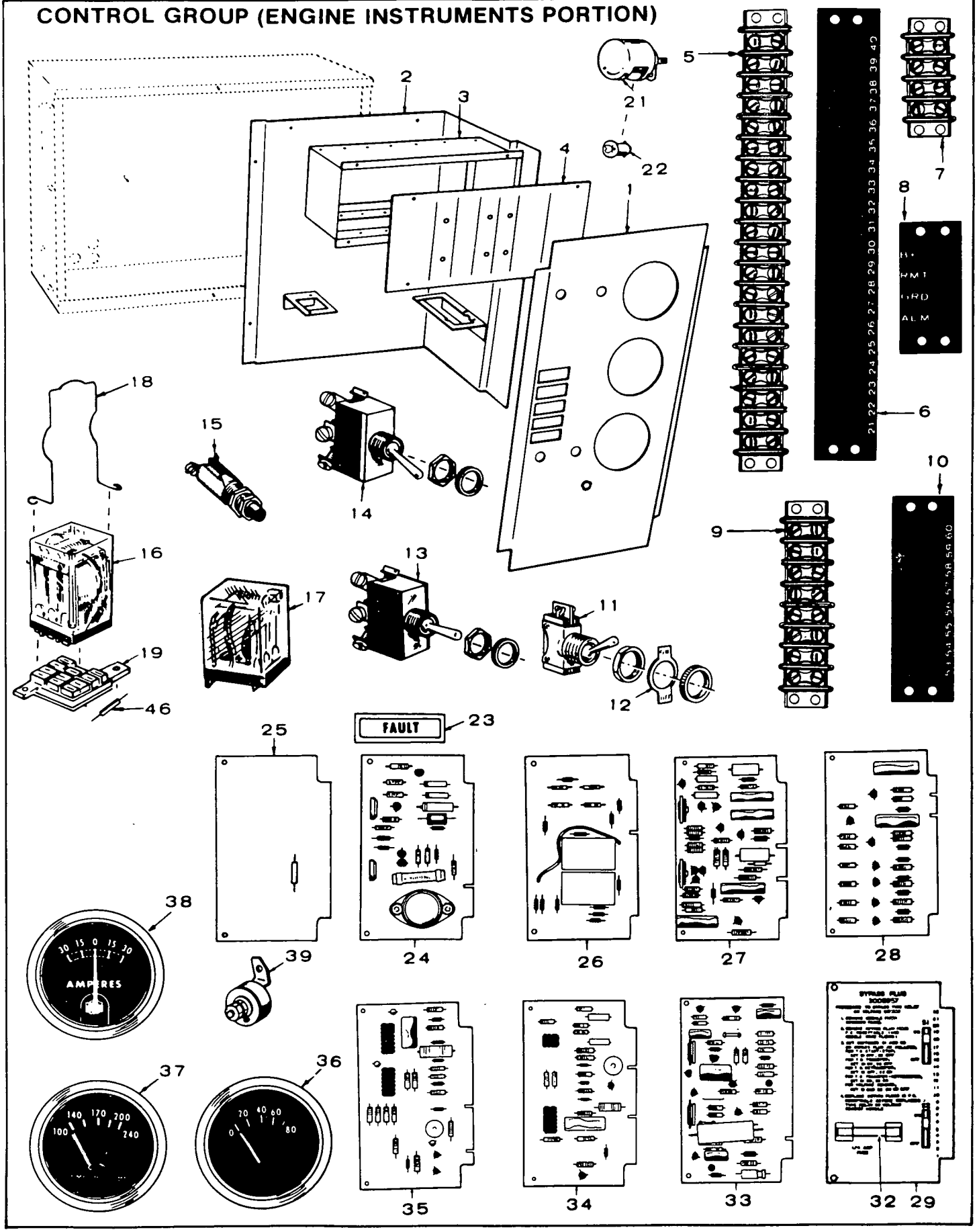


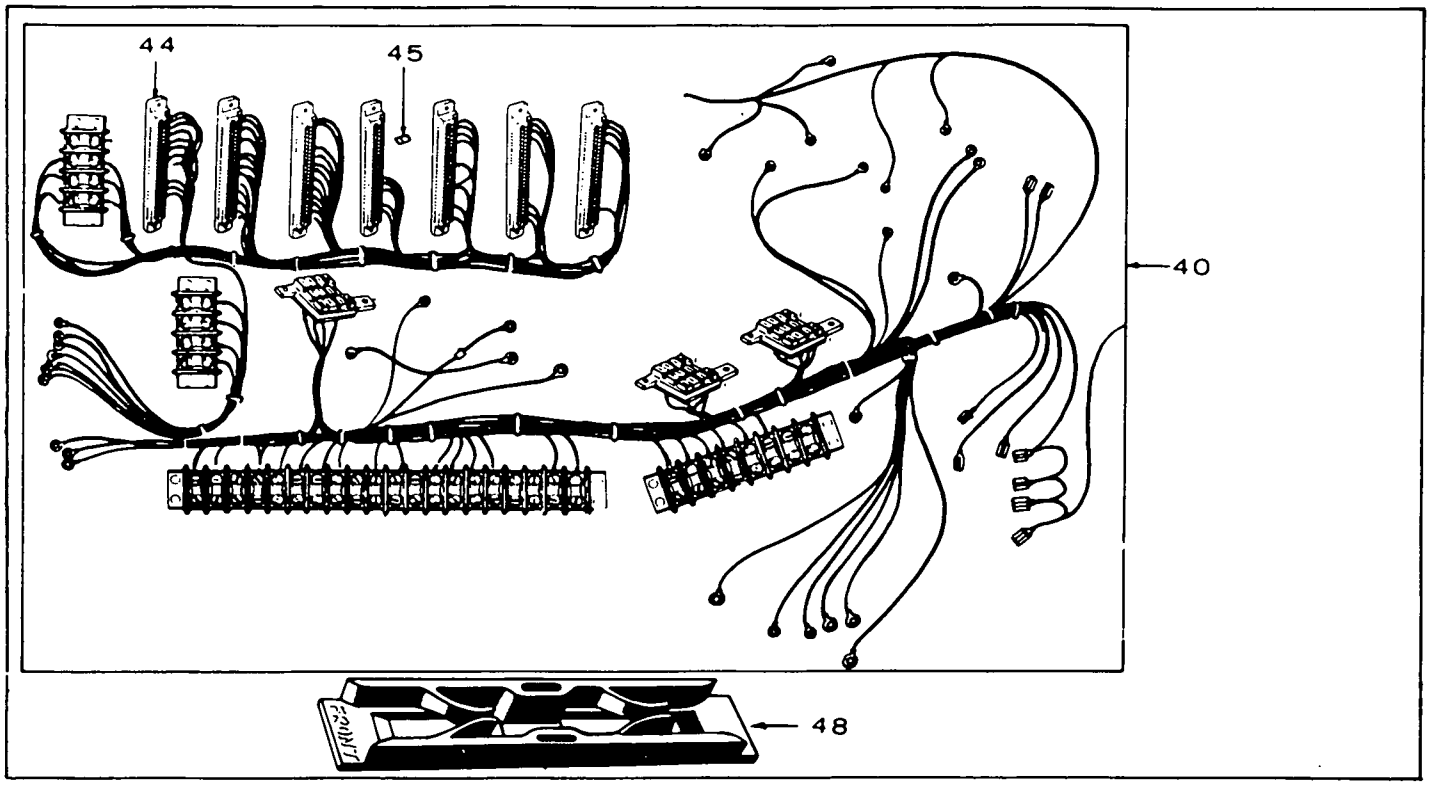




REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	302-0471	3	Transformer, Current
2	232-2342	2	Bracket, Terminal Board Mtg.
3	SCREW, ROUND STEEL HEAD MACHINE - TRANSFORMER MOUNTING		
	813-0100	4	#10-32 x 1/2"
	813-0103	2	#10-32 x 3/4"
4	526-0008	6	Washer, Flat - Steel (13/64" I.D. x 7/16" O.D. x 1/32" Thick)
5	856-0003	8	Washer, Lock - EIT (#10)
6	870-0053	6	Nut, Hex - Steel (#10-32)
7	815-0203	1	Screw, Round Head Brass Machine Screw (#10-32 x 7/8")
8	871-0010	2	Nut, Hex - Brass (#10-32)
9	526-0049	1	Washer, Flat - Brass (.200" I.D. x 7/16" O.D. x 1/32" Thick)
10	315-0389	1	Plate, Transformer Mounting
11	332-1402	1	Clamp
12	232-2246	2	Bar, Reconnection
13	232-2248	3	Bar, Reconnection
14	520-0142	14	Stud (5/16 x 1¼")
15	232-2249	2	Bracket, Terminal Board Mtg.
16	232-2237	1	Bracket, Bus Bar Support
17	232-2245	1	Board, Insulating - Bus Bar
18	232-2387	4	Bracket, Bus Bar
19	800-0051	3	Screw, Hex Cap - Steel (3/8-16 x 1¼")
20	526-0029	3	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
21	850-0050	3	Washer, Spring Lock (3/8")
22	862-0003	3	Nut, Hex - Steel (3/8-16)
23	800-0007	4	Screw, Hex Cap - Steel (1/4-20 x 1")
24	526-0018	4	Washer, Flat (21/64 I.D. x 3/4 O.D. x 1/16" Thick)
25	850-0040	4	Washer, Spring Lock (1/4")
26	862-0001	4	Nut, Hex - Steel (1/4-20)
27	232-2243	2	Board, Insulating
28	232-2242	2	Board, Insulating
29	232-2343	3	Bar, Bus
30	232-2241	11	Bar, Bus
31	232-2240	4	Bar, Bus
32	232-2238	1	Bracket, Bus Bar
33	232-2344	32	Spacer, Terminal Connection
34	800-0028	4	Screw, Hex Cap - Steel (5/16-18 x 1")
35	526-0115	8	Washer, Flat - Steel (11/32" I.D. x 11/16" O.D. x 1/16" Thick)
36	850-0045	4	Washer, Spring Lock (5/16")
37	862-0015	4	Nut, Hex - Steel (5/16-18)
38	800-0032	24	Screw, Hex Cap - Steel (5/16-18 x 1¾")
39	526-0115	24	Washer, Flat - Steel (11/32" I.D. x 11/16" O.D. x 1/16" Thick)
40	850-0045	24	Washer, Spring Lock (5/16")
41	862-0015	24	Nut, Hex - Steel (5/16-18)
42	800-0033	8	Screw, Hex Head - Steel (5/16-18 x 2")
43	526-0115	16	Washer, Flat - Steel (11/32 I.D. x 11/16 O.D. x 1/16" Thick)
44	850-0045	8	Washer, Spring Lock (5/16")
45	862-0015	8	Nut, Hex - Steel (5/16-18)
46	800-0051	4	Screw, Hex Cap - Steel (3/8-16 x 1¼")
47	526-0029	8	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
48	850-0050	4	Washer, Spring Lock (3/8")
49	862-0003	4	Nut, Hex - Steel (3/8-16)
50	800-0056	8	Screw, Hex Cap - Steel (3/8-16 x 2½")
51	526-0029	8	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
52	850-0050	8	Washer, Spring Lock (3/8")
53	862-0003	4	Nut, Hex - Steel (3/8-16 x 1")
54	800-0050	2	Screw, Hex Head - Steel (3/8-16 x 1")
55	850-0050	2	Washer, Spring Lock (3/8")
56	862-0003	2	Nut, Hex - Steel (3/8-16)
57	800-0050	2	Screw, Hex Head - Steel (3/8-16 x 1")
58	850-0050	2	Washer, Spring Lock (3/8")
59	862-0003	2	Nut, Hex - Steel (3/8-16)

CONTROL GROUP (ENGINE INSTRUMENTS PORTION)

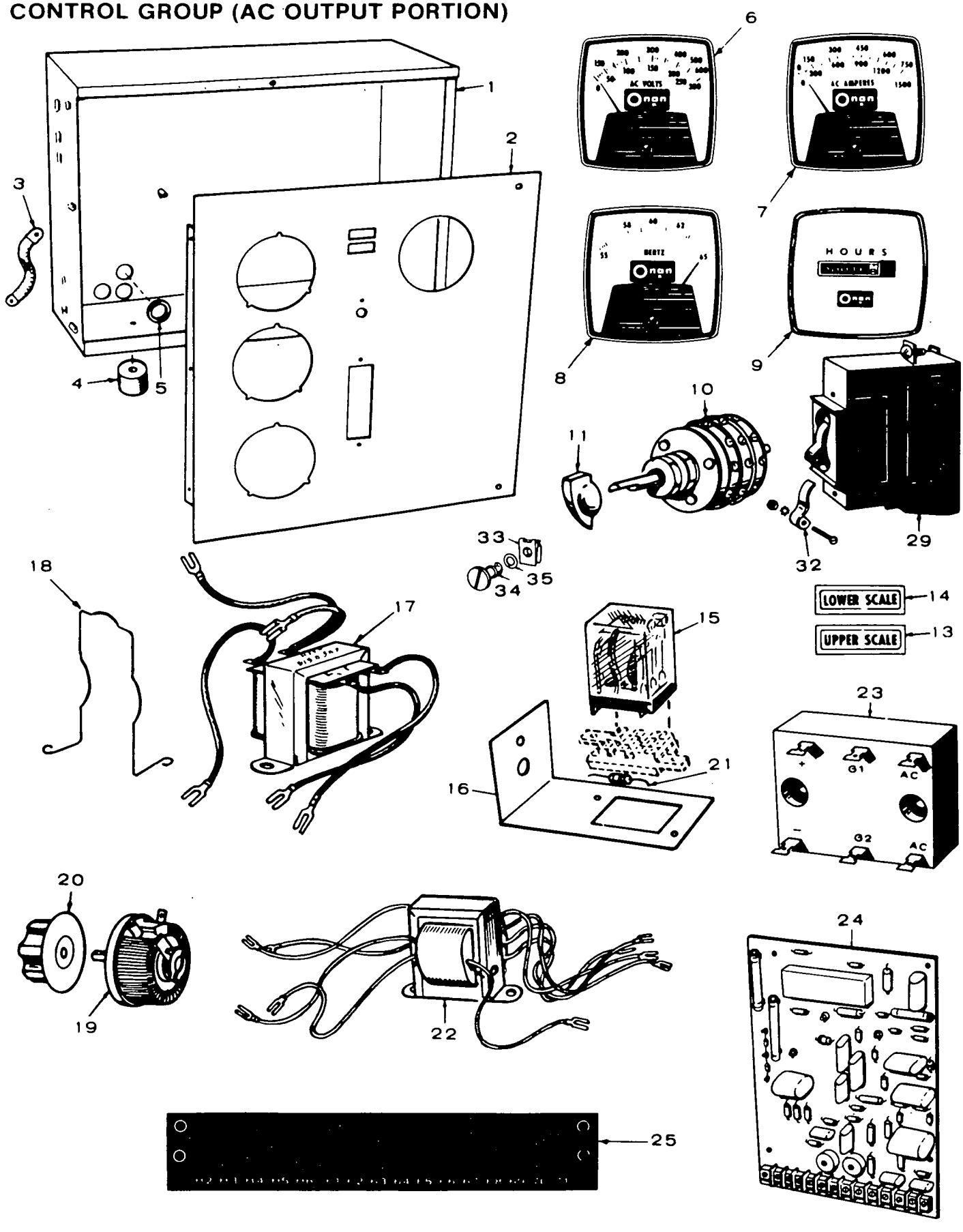


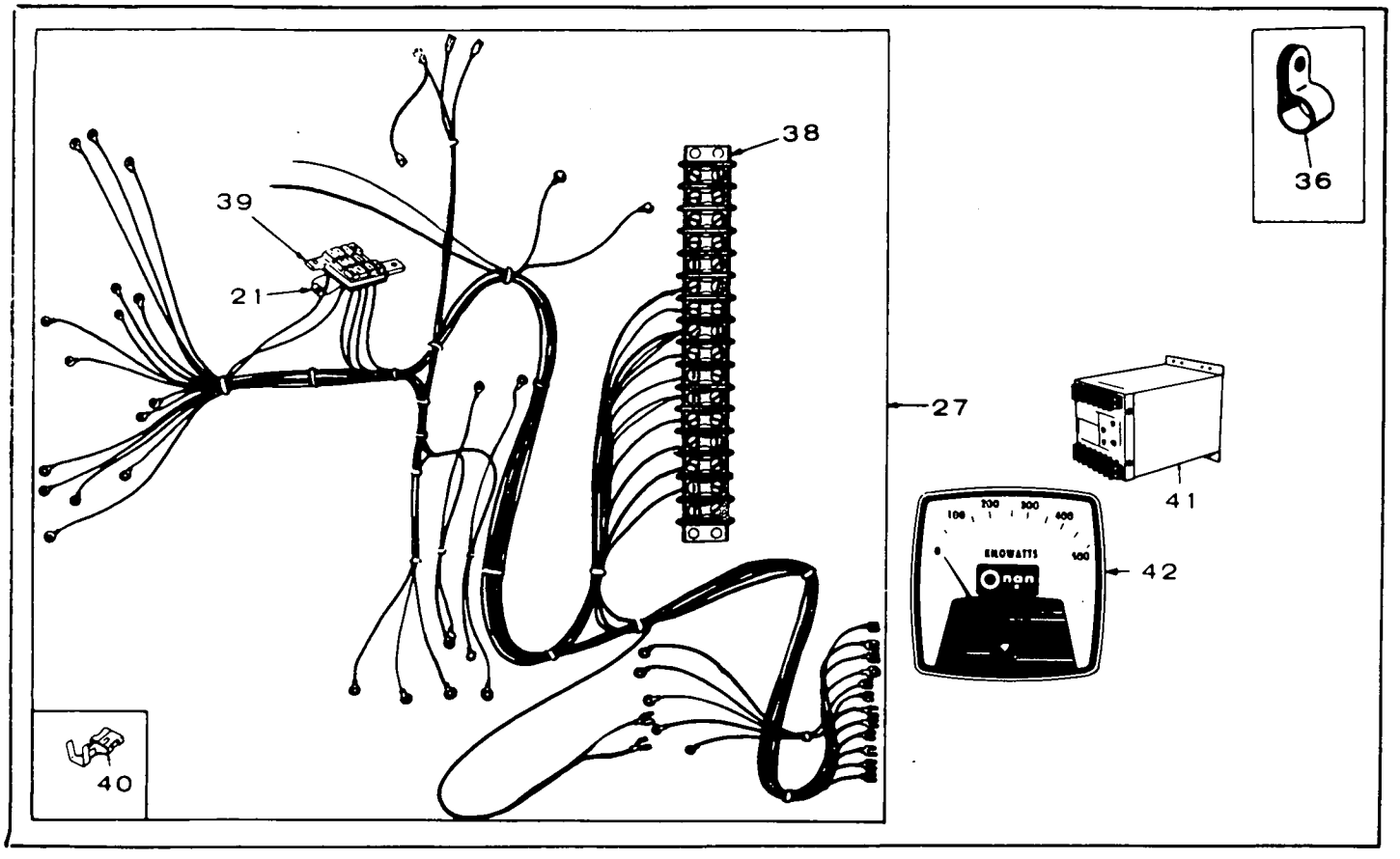


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL, ENGINE CONTROL		
	301-3661	1	Sets With One Fault Light
	301-3629	1	Sets With Five Fault Lights
2	301-3621	1	Bracket, Engine Control
3	301-3588	1	Rack, Module
4	301-3635	1	Cover Assembly, Rack
5	332-1005	1	*Block, Terminal - 20 Place
6	332-1559	1	Strip, Terminal Block Marker (21-40)
7	332-0537	2	*Block, Terminal - 4 Place
8	STRIP, TERMINAL BLOCK MARKER (4-Place)		
	332-1239	1	B+, Remote, Ground, Alarm
	332-1561	1	1-4
9	332-0699	1	*Block, Terminal - 8 Place - Set With Five Fault Lights
10	332-1560	1	Strip, Terminal Block Marker (53-60) - Sets With Five Fault Lights
11	308-0002	1	Switch, Panel Light
12	308-0003	1	Plate, On-Off Switch
13	SWITCH, SELECTOR		
	308-0220	1	Standard Control
	308-0347	1	Penn State Models
14	308-0337	1	Switch, Lamp Test
15	308-0091	1	Switch, Reset
16	307-1056	3	Relay (1) Start Disconnect (1) Ignition (1) Overspeed
17	307-1061	2	Relay, (1) Starter Protection, (1) Start Solenoid
18	307-1157	3	Spring, Relay Holddown
19	323-0765	3	*Socket, Relay - 11 Place
21	322-0149	1	Holder, Lamp
22	322-0017	1	Lamp, Panel
23	LAMP, FAULT		
	322-0129	1	Standard
	322-0119	1	Overcrank (Optional)
	322-0123	1	Overspeed (Optional)
	322-0120	1	Low Oil Pressure (Opt.)
	322-0121	1	High Engine Temperature (Optional)
24	300-0956	1	Control Cycle Cranker (Opt.) (See Separate Group for Components)
25	300-0977	1	Control, Standard Cranker
26	300-0964	1	Control, Engine Shutdown (See Separate Group for Components)
27	300-0953	1	Control, Engine Monitor (See Separate Group for Components)
28	300-0955	1	Control, Remote Indicator - Sets With Five Fault Lights
29	300-0987	1	Module, Bypass Plug
32	321-0168	1	Fuse, 1/4 Amp (Part of 300-0987 Module)
33	300-0973	1	Module, Time Delay Start-Stop (Optional) See Separate Group for Components)
34	300-0957	1	Control, Overspeed Sensor (See Separate Group for Components)
35	300-0958	1	Control, Starter Disconnect (See Separate Group for Components)
36	193-0107	1	Gauge, Oil Pressure
37	193-0106	1	Gauge, Water Temperature
38	302-0061	1	Ammeter, Charge (30-0-30)
39	193-0189	2	Resistor, Gauge (1) Start Solenoid (1) Start Disconnect Relay
40	Harness, Wiring (Includes Parts Marked *)		
	338-0915	1	Sets With One Fault Light
	338-0705	1	Sets With Five Fault Lights
44	332-1271	6	*Housing, Printed Circuit Board Terminal (Seven on Sets With Five Fault Lights)
45	332-1276	As Req.	*Plug, Keying
46	357-0004	2	*Rectifier, Diode
48	323-0814	12	Guide, Printed Circuit Board (14 Used on Sets with Five Fault Lights)

* - Included in Wiring Harness Assembly.

CONTROL GROUP (AC OUTPUT PORTION)

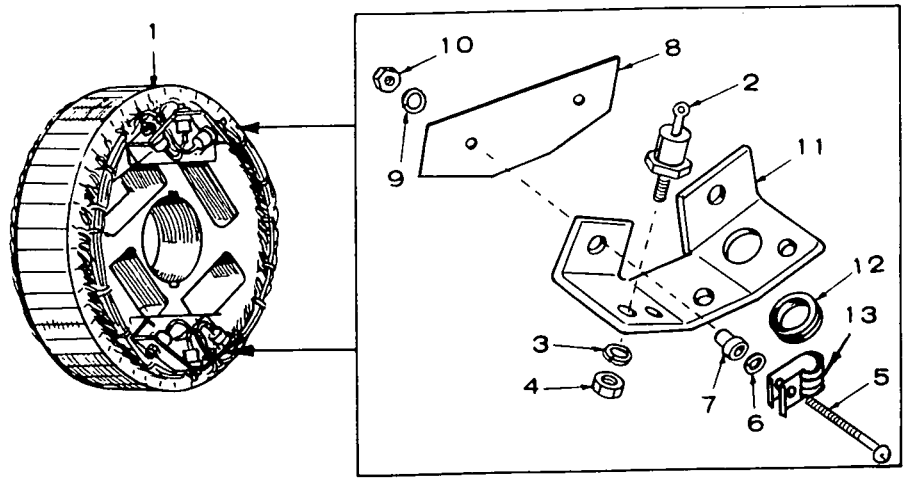




REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301-3158	1	Box, Control
2	PANEL, CONTROL BOX		
	301-3170	1	Standard Units
	301-3312	1	Units With Wattmeter
3	337-0049	1	Strap, Bond
4	402-0078	4	Dampener, Vibration
5	508-0001	4	Grommet (1-1/16"), Rubber
6	302-0718	1	Voltmeter, AC - Dual Scale 0-300, 0-600
7	AMMETER, AC		
	302-0879	1	290kW - Dual Scale 0-600, 0-1200
	302-0880	1	350 kW - Dual Scale 0-750, 0-1500
8	METER, FREQUENCY		
	302-0810	1	60 Hertz
	302-0894	1	50 Hertz
9	METER, RUNNING TIME		
	302-0466	1	60 Hertz
	302-0469	1	50 Hertz
10	308-0284	1	Switch, Voltage & Ammeter
11	303-0076	1	Knob
13	322-0131	1	Light, Upper Scale
14	322-0130	1	Light, Lower Scale
15	307-1061	1	Relay, Voltage Selector
16	301-3244	1	Bracket, Relay Mounting
17	315-0384	1	Reactor Assembly, Comm

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
18	307-1157	1	Spring, Relay Holddown
19	303-0170	1	Rheostat, Voltage Adj.
20	303-0032	1	Knob, Rheostat
21	350-0556	1	*Resistor
22	315-0342	1	Transformer, Voltage
23	305-0524	1	Bridge, Rectifier
24	332-1268	1	Board Assembly, Printed Circuit Voltage Regulator
25	332-1242	1	Strip, Marker (H2-H6, 61-71)
27	338-0730	1	Harness, Wiring - AC Control (Includes Parts Marked *)
29	320-0455	1	Circuit Breaker (3 Amp)
32	320-0307	1	Lock, Circuit Breaker Handle (Penn State Models) - Optional
33	406-0332	2	Receptacle, Fastener
34	406-0333	2	Stud, Fastener
35	406-0334	2	Washer, Stud Fastener
36	332-0050	1	Clip, Tinnerman
38	332-0795	1	*Block, Terminal - 16 Place
39	323-0764	1	*Socket, Relay
40	332-1280	As Req.	*Terminal, Crimp
41	302-0921	1	Transducer, Watt - Optional
42	WATTMETER, AC		
	302-0927	1	290 kW (Scale Reads 0-300)
	302-0928	1	350 kW (Scale Reads 0-500)

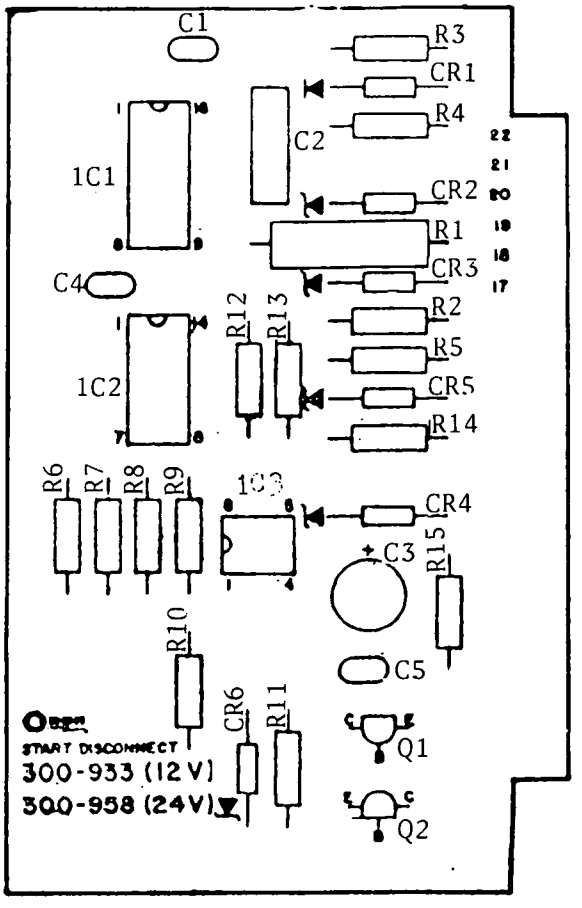
* - Included in Wiring Harness Assembly.



EXCITER ROTOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	201-1902	1	Rotor Assembly, Exciter - Complete (Also shown in Generator Group)
2	RECTIFIER, DIODE		
	358-0011	3	Positive Stud
	358-0012	3	Negative Stud
3	850-0040	6	Washer, Spring Lock (1/4")
4	868-0001	6	Nut, Hex - Stud (1/4-20)
5	813-0110	4	Screw, Round Head Steel (#10-32 x 2")
6	526-0009	4	Washer, Flat (7/32" I.D. x 1/2" O.D. x 1/16" Thick) Steel
7	508-0124	4	Bushing, Insulating
8	508-0156	4	Washer, Insulating
9	850-0030	4	Washer, Spring Lock (#10)
10	870-0053	4	Nut, Hex Steel (#10-32)
11	SINK, HEAT		
	363-0049	1	Positive
	363-0050	1	Negative
12	508-0093	2	Grommet, Rubber
13	332-0050	2	Clip, Wire

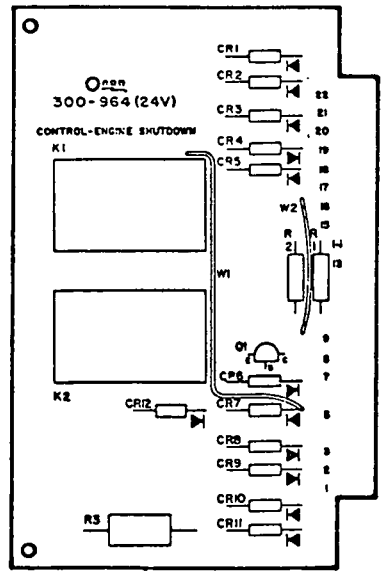
300-0958



STARTING MOTOR DISCONNECT MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0958	1	Module, Starter Motor Disconnect
1C1	367-0003	1	Integrated Circuit
1C2	367-0004	1	Integrated Circuit
1C3	367-0001	1	Integrated Circuit
C1,4	356-0051	2	Capacitor, Electrolytic (6.8 Mfd., 35 Volt)
C2	355-0028	1	Capacitor, Composition (.47 Mfd., 100 Volt)
C3	356-0038	1	Capacitor, Electrolytic (50 Mfd., 25 Volt)
Q1,2	362-0011	2	Transistor, Signal
CR1	357-0004	1	Rectifier, Diode (400 MA, 400 Volt)
CR2,3	359-0017	2	Diode, Zener (5.1 Volt, 400 MW)
CR4	359-0032	1	Diode, Zener (8.2 Volt, 400 MW)
CR5	359-0002	1	Diode, Zener (13 Volt, 400 MW)
CR6	359-0028	1	Diode, Zener (3.9 Volt, 500 MW)
R5	350-0383	1	Resistor (680-ohms, 1/2 Watt)
R2	350-0389	1	Resistor (1,200-ohms, 1/2 Watt)
R3,7,15	350-0422	3	Resistor (30,000-ohms, 1/2 Watt)
R6,11,12,13	350-0411	4	Resistor (10,000-ohms, 1/2 Watt)
R8,9	350-0418	2	Resistor (20,000-ohms, 1/2 Watt)
R10	350-0394	1	Resistor (2,000-ohms, 1/2 Watt)
R14	350-0404	1	Resistor (5,100-ohms, 1/2 Watt)
R1	350-0975	1	Resistor (330-ohms, 2 Watt)
R4	350-0420	1	Resistor (24,000-ohms, 1/2 Watt)
C5	356-0059	1	Capacitor, Electrolytic (2.2 Mfd., 35 Volt)

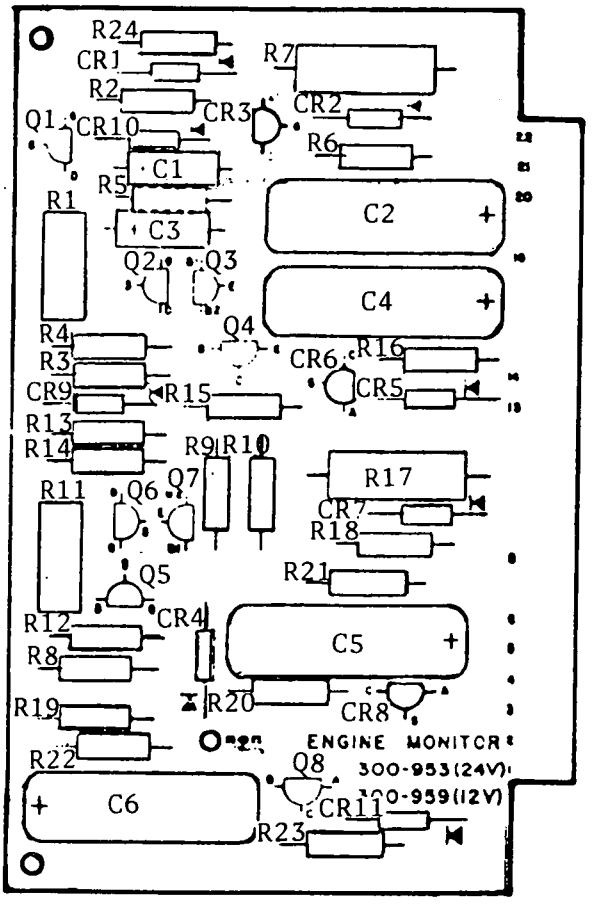
300-0964



ENGINE SHUTDOWN CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0964	1	Control, Engine Shutdown (Complete)
CR1 thru 12	357-0004	12	Rectifier, Diode
K1,2	307-1076	2	Relay
R1	350-0548	1	Resistor (10,000-Ohms, 1/2 Watt)
R2	350-0545	1	Resistor (5,600-ohms, 1/2 Watt)
R3	350-1128	1	Resistor (220-ohms, 2 Watt)
Q1	362-0026	1	Transistor, PNP

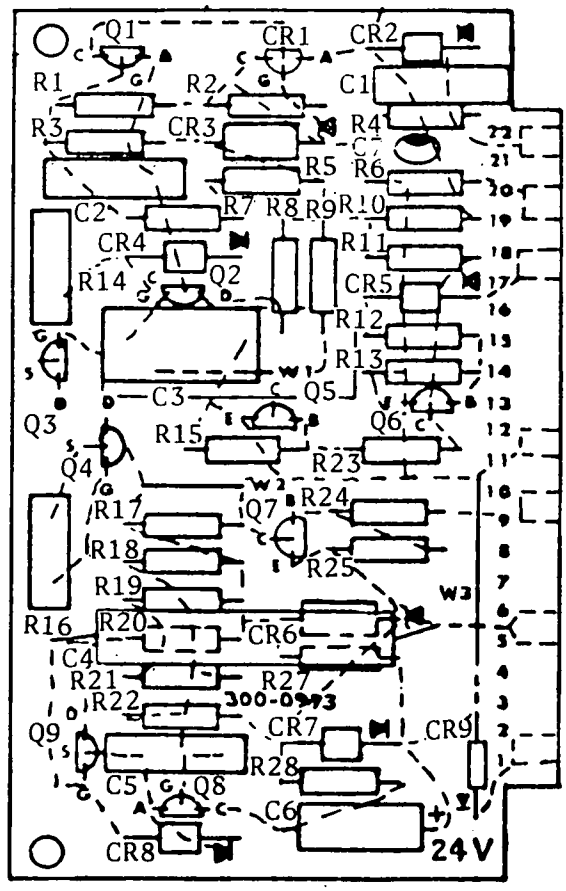
300-0953



ENGINE MONITOR CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0953	1	Control, Engine Monitor (Complete)
C1,3	356-0040	2	Capacitor, Electrolytic (10 Mfd., 20 Volt)
C2,4,5,6	355-0005	4	Capacitor, Composition (.22 Mfd., 200 Volt)
CR1,2,4,5 7,10,11	357-0004	6	Rectifier, Diode
CR3,6,8	364-0011	3	Rectifier, Gate Control
CR9	359-0027	1	Diode, Zener (1 Watt, 5 Volt)
Q1,5	362-0025	2	Transistor, Field Effect (30 MA)
Q3,7	361-0007	2	Transistor, Unijunction
Q4	362-0014	1	Transistor, NPN
Q8	362-0027	1	Transistor, PNP
R1,11	303-0169	2	Potentiometer (3.5 Megohm)
R2,3,12,13	350-0548	4	Resistor (10,000-ohms, 1/2 Watt)
R4,14,10,24	350-0536	4	Resistor (1,000-ohm, 1/2 Watt)
R5,15,21	350-0517	3	Resistor (27-ohms, 1/2 Watt)
R6,16,18	350-0505	3	Resistor (2.7-ohms, 1/2 Watt)
R7,17	350-0980	2	Resistor (510-ohms, 2 Watt)
R8	350-0403	1	Resistor (4,700-ohms, 1/2 Watt)
R9	350-0405	1	Resistor (5,600-ohms, 1/2 Watt)
R19	350-0534	1	Resistor (680-ohms, 1/2 Watt)
R20,22	350-0533	2	Resistor (560-ohms, 1/2 Watt)
R23	350-0395	1	Resistor (2,200-ohms, 1/2 Watt)
Q2,6	362-0031	2	Transistor, Field Effect (.05 MA)

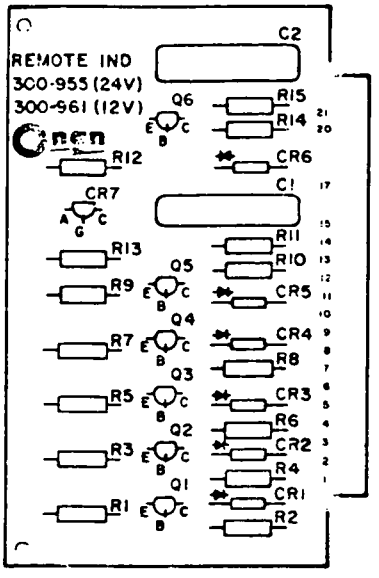
300-0973



TIME DELAY (START-STOP) MODULE—OPTIONAL

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0973	1	Mudule, Time Delay - Complete (Start-Stop) - Optional
C1,2,5	355-0025	3	Capacitor (.1 Mfd., 100 Volt)
C3	355-0028	1	Capacitor (.5 Mfd., 100 Volt)
C4	355-0027	1	Capacitor (10.0 Mfd., 50 Volt)
C6	356-0046	1	Capacitor (5 Mfd., 35 Volt)
C7	356-0053	1	Capacitor (1.0 Mfd., 35 Volt)
CR1	364-0011	1	Rectifier, Gate Control
CR2,4,5 7,8,9	357-0004	6	Rectifier, Diode (400 MA. 400 Volt)
CR3,6	359-0015	2	Diode, Zener (24 Volt)
Q1,8	361-0006	2	Transistor (2N6027)
Q2,3,4,9	362-0031	4	Transistor (2N5716)
Q5,6,7	362-0007	3	Transistor, Signal (2N2925)
R1,3,18,22	350-0411	4	Resistor (10,000-ohms, 1/2 Watt)
R2	350-0379	1	Resistor (470-ohms, 1/2 Watt)
R4	350-0524	1	Resistor (100-ohms, 1/2 Watt)
R5,19	352-0200	2	Thermistor (10,000-ohms)
R6	350-0537	1	Resistor (1,200-ohms, 1/2 Watt)
R7, R21	350-0391	2	Resistor (1,500-ohms, 1/2 Watt)
R8,12,20,24	350-0548	4	Resistor (10,000-ohms, 1/2 Watt)
R13,15,25,28	350-0536	4	Resistor (1,000-ohm, 1/2 Watt)
R10,27	350-0528	2	Resistor (220-ohms, 1/2 Watt)
R9,17	350-0540	2	Resistor (2200-ohms, 1/2 Watt)
R14,16	303-0169	2	Potentiometer (3.5 Megohm)
R23,11	350-0545	2	Resistor (5600-ohms, 1/2 Watt)

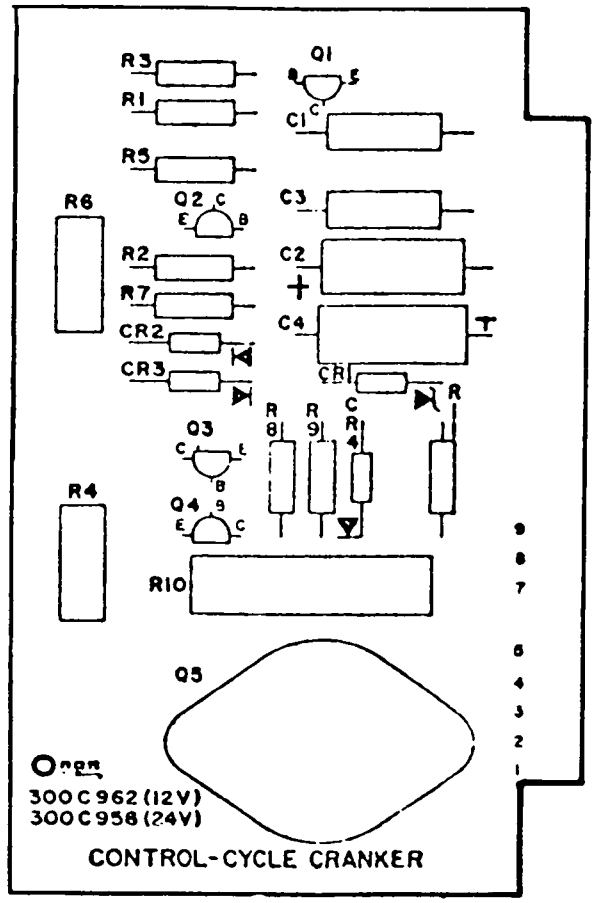
300-0955



REMOTE INDICATOR CONTROL MODULE (UNITS WITH 5 FAULT LIGHTS)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0955	1	Module, Remote Indicator
CR1 thru 6	357-0004	6	Rectifier, Diode (400 MA, 400 Volt)
CR7	364-0017	1	Rectifier, Gate Control
Q1 thru 6	362-0034	6	Transistor, PNP
R1,3,5,7 9,14	350-0529	6	Resistor (270-ohms, 1/2 Watt)
R2,6,8	350-0544	3	Resistor (4,700-ohms, 1/2 Watt)
R11	350-0505	1	Resistor (2,700-ohms, 1/2 Watt)
R12	350-0380	1	Resistor (510-ohms, 1/2 Watt)
R13	350-0517	1	Resistor (27-ohms, 1/2 Watt)
R15	350-0540	1	Resistor (2,200-ohms, 1/2 Watt)
C1,2	355-0005	2	Capacitor, Composition (.22 Mfd., 200 Volt)
R4,10	350-0389	2	Resistor (1,200-ohms, 1/2 Watt)

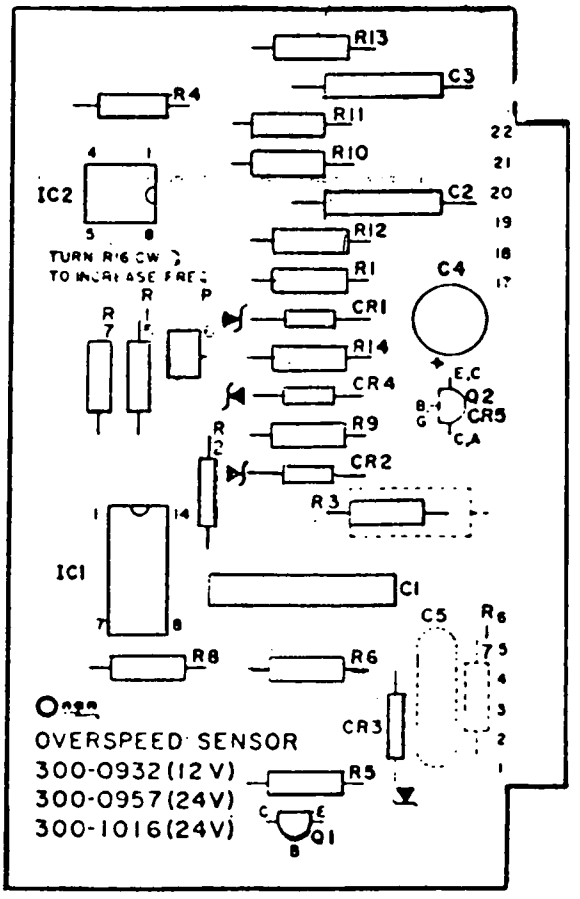
300-0956



CYCLE CRANKER MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0956	1	Module, Cycle Cranker
C3	355-0010		Capacitor, Composition (.0022 Mfd., 100 Volt)
C2	356-0039	1	Capacitor, Electrolytic (100 Mfd., 10 Volt)
C4	356-0045	1	Capacitor, Electrolytic (25 Mfd., 15 Volt)
CR1	359-0027	1	Diode, Zener (1.0 Watt, 7.5 Volt)
CR2,3,4	357-0004	3	Rectifier, Diode (400 MA 400 Volt)
Q1,2	362-0008	2	Transistors, Signal
Q3	362-0011	1	Transistor, Signal
Q4	362-0026	1	Transistor, Signal
Q5	362-0033	1	Transistor, Power
R1	350-0558	1	Resistor (68,000-ohms, 1/2 Watt)
R2	350-0546	1	Resistor (6,800-ohms, 1/2 Watt)
R3,8	350-0548	2	Resistor (10,000-ohms, 1/2 Watt)
R4,6	303-0171	2	Potentiometer (100,000-ohms)
R5	350-0560	1	Resistor (100,000-ohms, 1/2 Watt)
R7	350-0420	1	Resistor (24,000-ohms, 1/2 Watt)
R9	350-0500	1	Resistor (1-ohms, 1/2 Watt)
R10	352-0158	1	Resistor (50-ohms, 5 Watt)
R11	350-0534	1	Resistor (680-ohms, 1/2 Watt)
C1	355-0029	1	Capacitor, Composition (.015 Mfd., 100 Volt)

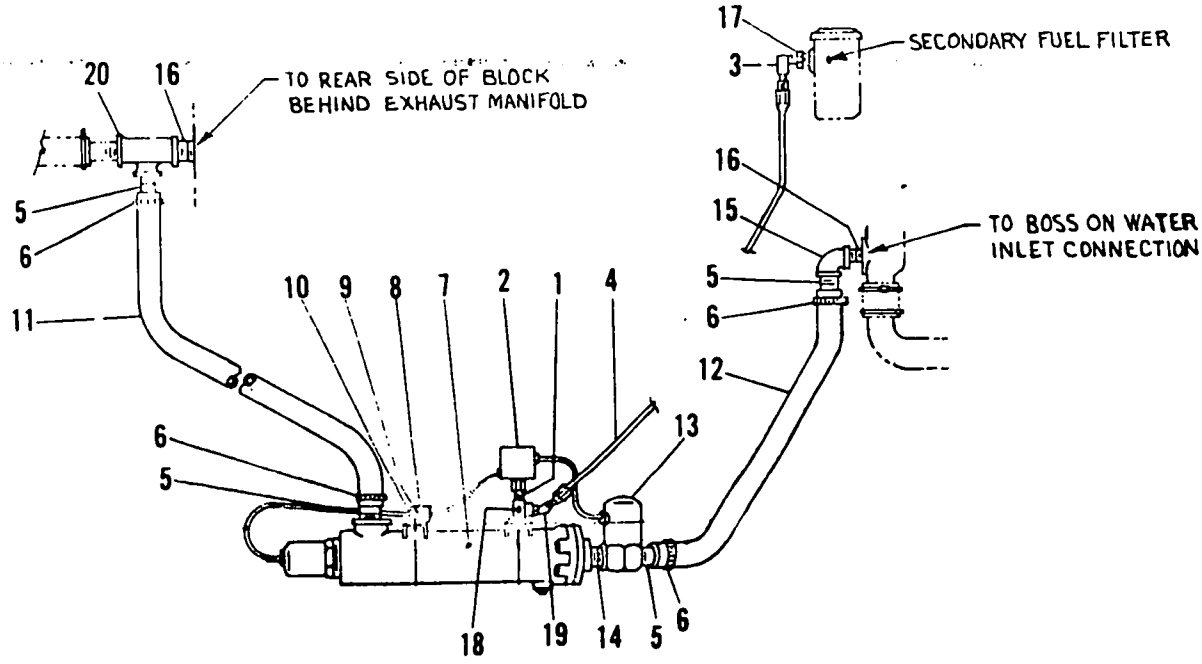
300-0957



OVERSPEED SENSOR CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0957	1	Control, Overspeed Sensor (Complete)
1C1	367-0002	1	Circuit, Integrated
1C2	367-0001	1	Circuit, Integrated
C1	355-0024	1	Capacitor, Composition (.22 Mfd., 200 Volt)
C2,3	355-0010	2	Capacitor, Composition (.0022 Mfd., 100 Volt)
C4	356-0038	1	Capacitor, Electrolytic (50 Mfd., 25 Volt)
CR1	359-0002	1	Diode, Zener (400 MW, 13 Volt)
CR2	359-0017	1	Diode, Zener (400 MW, 5.1 Volt)
CR3	359-0031	1	Diode, Zener (500 MW, 6.8 Volt)
CR4	359-0032	1	Diode, Zener (400 MW, 8.2 Volt)
Q1,2	362-0011	2	Transistor, Signal
R1	350-0382	1	Resistor (620-ohms, 1/2 Watt)
R15	350-0414	1	Resistor (13,000-ohms, 1/2 Watt)
R3	350-0683	1	Resistor (680-ohms, 1/2 Watt)
R4	350-0451	1	Resistor (.47 Megohm, 1/2 Watt)
R5,14	350-0394	2	Resistor (2000-ohms, 1/2 Watt)
R6,7,8,9,2, 10,11,12,13	350-0411	9	Resistor (10,000-ohms, 1/2 Watt)
R16	303-0191	1	Potentiometer (5,000-ohms, 1/4 Watt)

179-2030



WATER JACKET HEATER INSTALLATION (179-2030)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0099	1	Nipple, Pipe (1/4-Close)
2	309-0271	1	Switch, Pressure
3	502-0287	1	Elbow, Male (90°)
4	501-0188	1	Line, Flexible
5	505-0759	4	Adapter, Pipe to Hose
6	503-0429	4	Clamp, Hose
7	333-0138	1	Heater, Engine Water (4000 Watts, 240 Volt)
8	330-0004	1	Cover, Outlet Box
9	330-0005	1	Box, Outlet
10	503-0008	2	Grommet, Rubber
11		1	Hose, Rubber (Order 22" of Bulk Hose #503-0249)
12		1	Hose, Rubber (Order 18" of Bulk Hose #503-0249)
13	309-0253	1	Thermostat
14	505-0107	1	Nipple (1 x 2")
15	505-0041	1	Elbow, Pipe (1 x 90°)
16	505-0004	2	Nipple, Close (1 x 1½")
17	505-0281	1	Bushing, Reducer (1/2" x 1/4")
18	333-0142	1	Support, Pressure Switch
19	502-0284	1	Elbow, Male (45°)
20	505-0304	1	Tee, Pipe (1")

Onan®

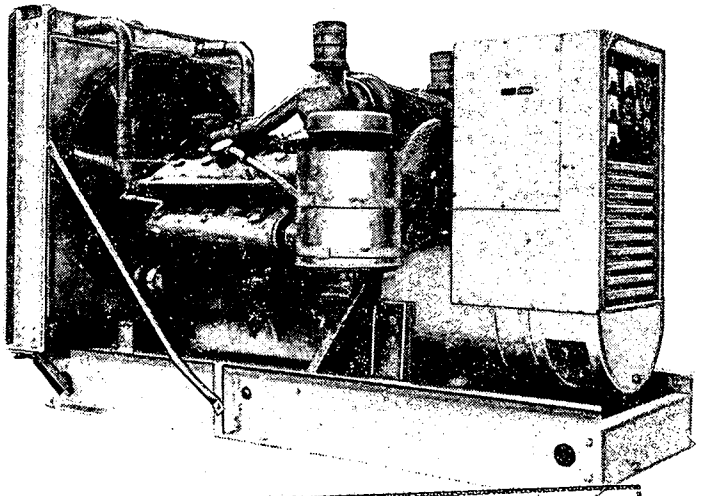
OPERATOR'S MANUAL AND PARTS CATALOG

FOR

DHB

SERIES

ELECTRIC GENERATING SETS



945–0302

1A75
Printed in U.S.A.

TABLE OF CONTENTS

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

The customary unit of Brake Horsepower (BHP) becomes kilowatts (kW) when converted to S1 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.

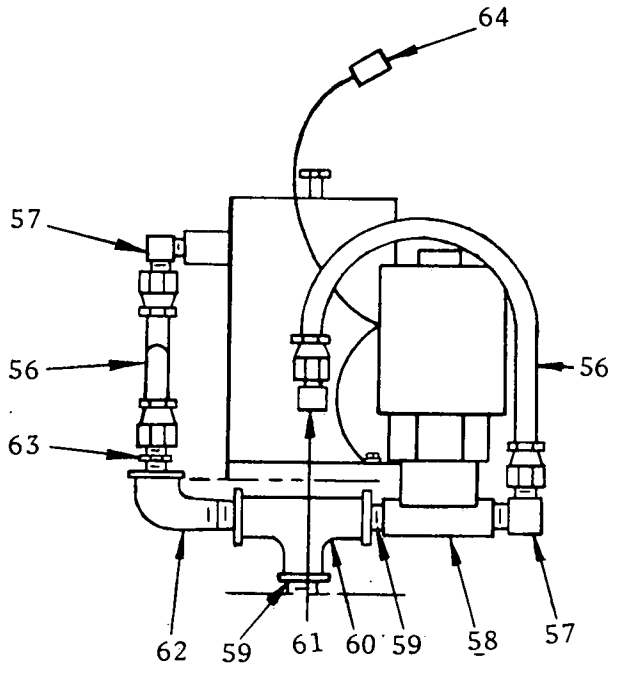
WARNING

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

945-1000
SUPPLEMENTARY PARTS LIST (10/75)

Parts in this list apply to 350.0 DHB Generating Sets Begin Spec B. Use these parts in addition to those shown in the Operators Manual and Parts Catalog 945-0302.

MISCELLANEOUS ENGINE PARTS GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
56	501-0210	2	Line, Flex Oil
57	502-0441	2	Elbow, Male - 90° (1/4"x1/2"-20)
58	307-1459	1	Valve, Solenoid Stop
59	505-0099	2	Nipple, Pipe (1/4" x 7/8")
60	505-0184	1	Tee, Pipe (1/4")
61	502-0443	1	Elbow, Male - 90° (1/8"x1/2"-20)
62	505-0011	1	Elbow, Street (1/4")
63	502-0442	1	Connector, Male (1/4"x1/2"-20)
4	332-0529	1	Terminal, Faston (1/4")

INTRODUCTION

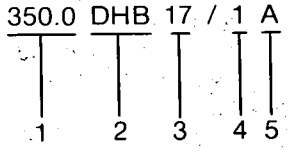
FOREWORD

This manual is applicable to the DHB Series electric generating set, consisting of an ONAN YB, 350.0 kW generator, driven by a Detroit Diesel engine.

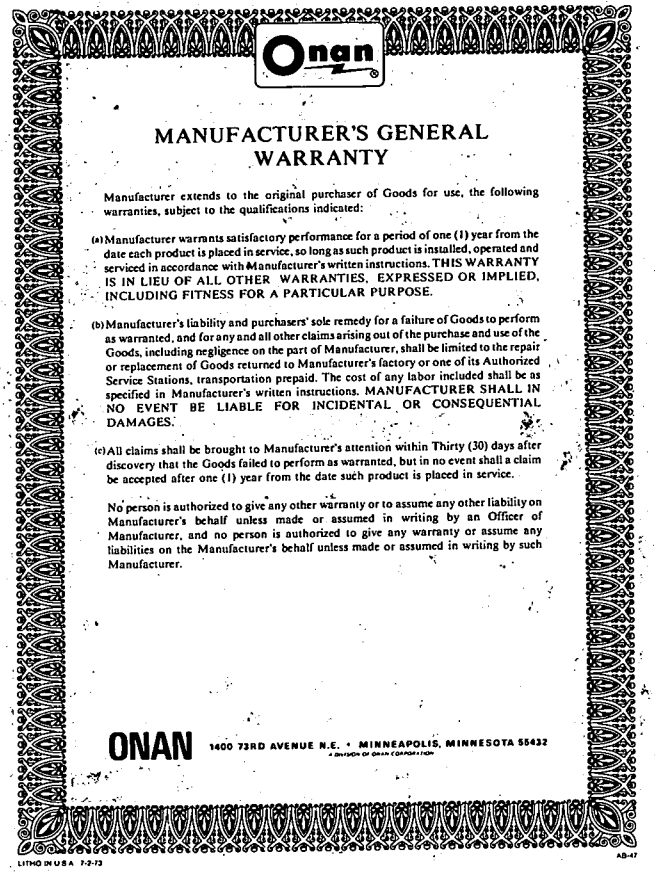
The manual is divided into two sections. Section 1 provides information on installation, operation and troubleshooting. Section 2 is a *Parts Catalog* for ONAN optional and standard equipment. The manual should be used in conjunction with the Detroit Diesel engine manual, as your specific engine may have variations due to optional equipment available.

MODEL IDENTIFICATION

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



1. Indicates Kilowatt rating.
2. Factory code for SERIES identification.
3. Indicates voltage code.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)



Onan

MANUFACTURER'S GENERAL WARRANTY

Manufacturer extends to the original purchaser of Goods for use, the following warranties, subject to the qualifications indicated:

(a) Manufacturer warrants satisfactory performance for a period of one (1) year from the date each product is placed in service, so long as such product is installed, operated and serviced in accordance with Manufacturer's written instructions. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR A PARTICULAR PURPOSE.

(b) Manufacturer's liability and purchasers' sole remedy for a failure of Goods to perform as warranted, and for any and all other claims arising out of the purchase and use of the Goods, including negligence on the part of Manufacturer, shall be limited to the repair or replacement of Goods returned to Manufacturer's factory or one of its Authorized Service Stations, transportation prepaid. The cost of any labor included shall be as specified in Manufacturer's written instructions. MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

(c) All claims shall be brought to Manufacturer's attention within Thirty (30) days after discovery that the Goods failed to perform as warranted, but in no event shall a claim be accepted after one (1) year from the date such product is placed in service.

No person is authorized to give any other warranty or to assume any other liability on Manufacturer's behalf unless made or assumed in writing by an Officer of Manufacturer, and no person is authorized to give any warranty or assume any liabilities on the Manufacturer's behalf unless made or assumed in writing by such Manufacturer.

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

A DIVISION OF ONAN CORPORATION

LITHO IN U.S.A. 7-2-73

AB-47

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

CAUTION **This symbol refers to possible equipment damage.**

If it is necessary to contact 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 types 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 Detroit Diesel nameplate is on the right hand side, on the cylinder block.

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

IMPORTANT! RETURN WARRANTY CARD ATTACHED TO UNIT.

SAFETY PRECAUTIONS

Throughout this manual you will find eye-catching flags containing Warnings and Cautions, alerting 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 generator 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 or carbon tetrachloride 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 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 generator set, disconnect batteries. This will prevent inadvertent starting of the set.

- Use extreme caution when making adjustments on the electrical components in the control panel while the engine is running. High voltages are present and could cause serious personal injury.

- DO NOT SMOKE while servicing batteries. Verify correct polarity of battery cables before connecting. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by electrical arcing or by smoking. When connecting batteries, connect the ground lead last.

SPECIFICATIONS

ENGINE DETAILS

Engine Manufacturer	Detroit Diesel
Engine Series	V12-71T
Number of Cylinders	V12
Displacement	852-inch³ (13.96 litre)
BHP @ 1800 RPM	575 (428.9 kW)
Compression Ratio	17.0:1
Bore	4.25-inches (107.95 mm)
Stroke	5.00-inches (127.0 mm)
Fuel	ASTM No. 2 Diesel
Battery Voltage	24VDC
Battery Group (Two 12-Volt, 225 A.H. [810 kC])	8D
Starting Method	Solenoid Shift
Governor Regulation	3-5 percent
Battery Charging Current	35 Amperes

GENERATOR DETAILS

Type	YB 17 60 Hz YB 517 50 Hz
Rating (Watts)	
60 Hertz Continuous Standby	350,000 437.5 kVA
50 Hertz Continuous Standby	290,000 362.5 kVA
AC Voltage Regulation	± 2 Percent
60 Hertz RPM	1800
50 Hertz RPM	1500
Output Rating	0.8 PF
AC Frequency Regulation	3.0 Hz No Load to Full Load

CAPACITIES AND REQUIREMENTS

Cooling System	
Engine	13.75 Gallons (52 litres)
Engine and Radiator	36.50 Gallons (138 litres)
Engine Oil Capacity (Filter, Lines, Crankcase)	9.0 Gallons (34.1 litres)
Exhaust Connection (inches pipe thread)	5-inch pipe

AIR REQUIREMENTS (1800 RPM)

Engine Combustion	1800-CFM (0.85m³/sec)
Radiator Cooled Engine	33,500-CFM (15.8m³/sec)
Total for Radiator Cooled Model	35,300-CFM (16.7m³/sec)
Alternator Cooling Air (1800 RPM)	1,200-CFM (0.57m³/sec)
(1500 RPM)	1,000-CFM (0.5m³/sec)
Fuel Consumption at Rated Load ASTM No. 2 Diesel	28.7 GPH (109 litres/hr)

GENERAL

Height	75.0-inches (1.9 m)
Width	65.0-inches (1.65 m)
Length	114.0-inches (2.9 m)
Approximate Weight (Mass)	8050 pounds (3655 kg)

TABLE 1
YB GENERATOR VOLTAGE/CURRENT OPTIONS

350.0 kW 437.5 kVA 60 Hz
290.0 kW 362.5 kVA 50 Hz

VOLTAGE	PHASE	FREQUENCY	MAXIMUM CURRENT	PARALLEL WYE	SERIES WYE	CONNECT WIRE W12
(YB17) 120/208	3	60 Hz	1215A	x		H3
127/220	3	60 Hz	1148A	x		H4
139/240	3	60 Hz	1054A	x		H5
240/416	3	60 Hz	607A		x	H3
254/440	3	60 Hz	574A		x	H4
277/480	3	60 Hz	526A		x	H5
(YB517) 110/190	3	50 Hz	1102A	x		H3
115/200	3	50 Hz	1048A	x		H4
120/208	3	50 Hz	1007A	x		H4
127/220	3	50 Hz	951A	x		H5
220/380	3	50 Hz	551A		x	H3
230/400	3	50 Hz	524A		x	H4
240/416	3	50 Hz	503A		x	H4
254/440	3	50 Hz	475A		x	H5
9X 347/600	3	60 Hz	421A		x	*
5D 120/240	3	60 Hz	1054A	SERIES DELTA		*
6D 240/480	3	60 Hz	526A	SERIES DELTA		*

* - Factory wired, not reconnectible.

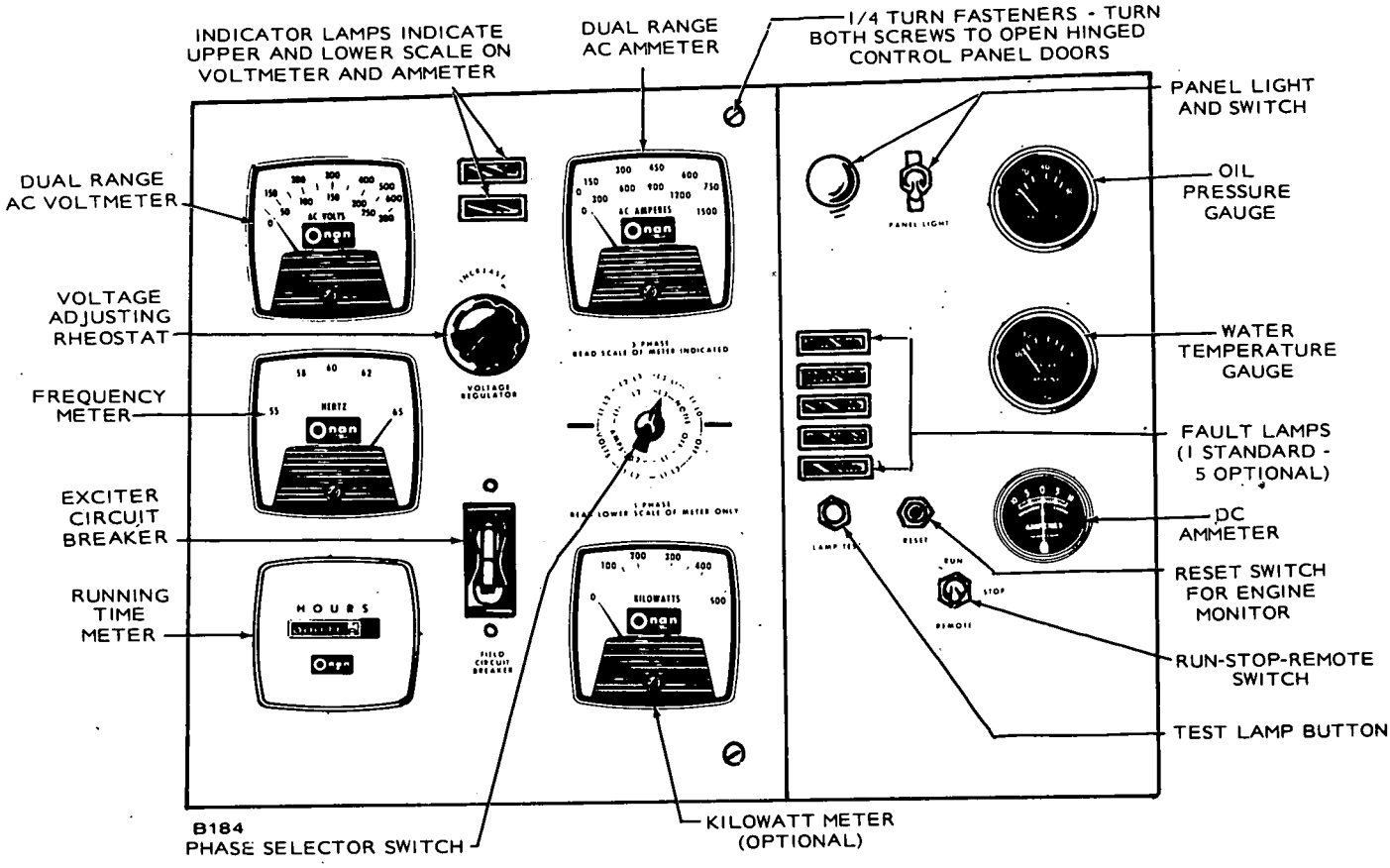


FIGURE 1. CONTROL PANEL

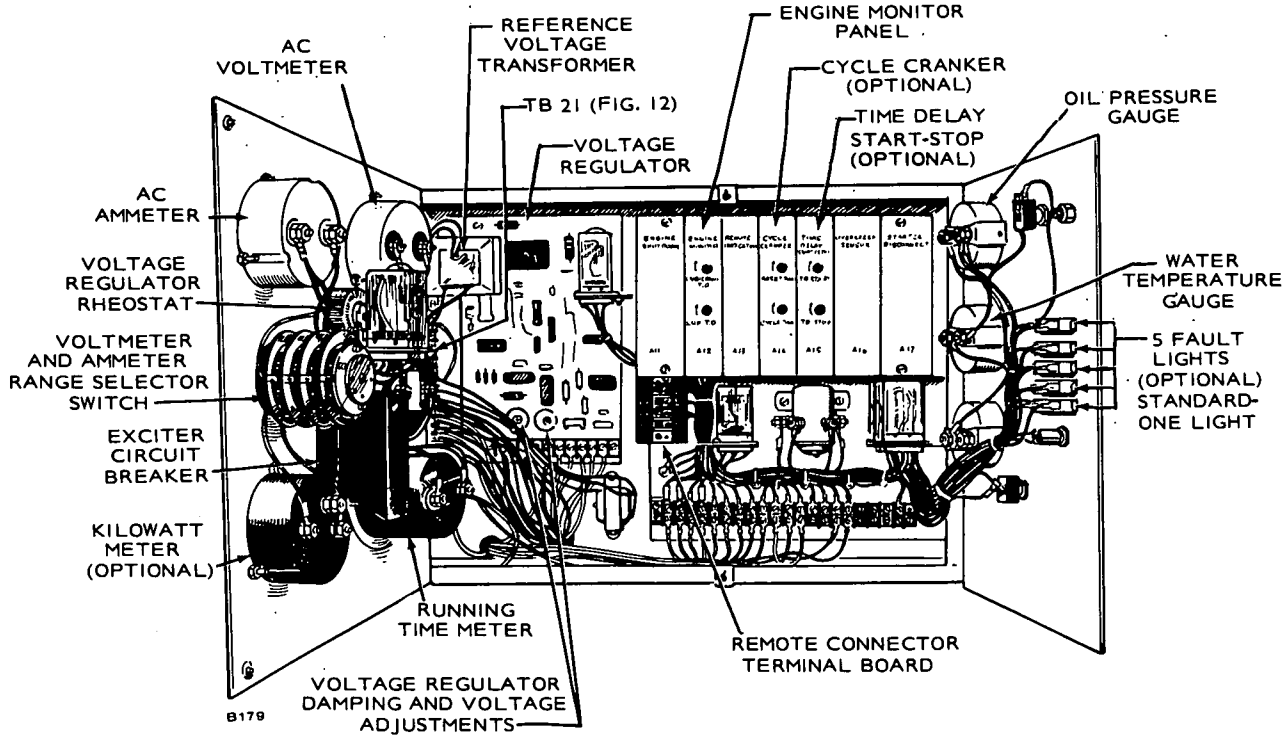


FIGURE 1A. CONTROL PANEL INTERIOR

DESCRIPTION

GENERAL

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

ENGINE

The engine on the DHB is a Detroit Diesel as described in engine manual. Basic measurements and requirements will be found under *Specifications*. However, the engine used for your unit may have variations due to optional equipment available, therefore the Detroit Diesel manual should be consulted.

AC GENERATOR

The generator is an ONAN Type YB, 12 lead, 4-pole revolving field, reconnectible bus-bar, 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 rpm, and the 50 Hz at 1500 rpm. Excitation is achieved as follows—

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

CONTROL PANEL

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

DC Panel

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 the battery charging current.

Run-Stop-Remote Switch: Starts and stops the unit locally or from a remote location.

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

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

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.

AC Ammeter: Indicates AC generator output current.

Dual range instrument: measurement range in use shown on indicator lights.

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

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.

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

OPTIONAL EQUIPMENT

DC Panel

Warning Lights: Eliminates the one "Fault" light and substitutes five indicator lights to give warning of—

a. Overcrank (failed to start)
b. Overspeed
c. Low oil pressure
d. High engine temperature
e. Low engine temperature

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

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. Refer to Figure 1A for location of units mentioned.

Terminal Board (TB) 21: Connection of wandering lead (W12) to terminals H3, H4, H5 is made at this point, to change voltage regulator tap when reconnecting generator for different voltages. Refer to Figure 12.

Voltage Regulator: Solid state unit controls AC output from generator at predetermined level regardless of load. Regulation plus or minus 2 percent from no load to full load, 0.8 P.F.

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

1. A 75 second cranking period.
2. Approximately a 12.5 second time delay for oil pressure buildup.
3. An external alarm contact to light a fault lamp and shut down the set for alarm conditions such as:
   a. Overcrank (failed to start after cranking 75 seconds).
   b. Overspeed (engine speed exceeds 2000 rpm).
   c. Low oil pressure 14 psi (96.5 kPa).
   d. High engine temperature 205° F (96° C).

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

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.

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.

Overspeed Shutdown: Shutdown occurs if engine speed exceeds 2010 rpm. A sensor mounted on the generator shaft (Figure 2) signals an overspeed condition which shuts down the engine through control module A16.

Failure of this system will allow a backup shutdown to function. A magnetic solenoid mounted on top of the engine will actuate to close the air intakes and starve the engine, thereby inducing shutdown. Reset air shut-off valve manually.

Start-Disconnect: Plug-in module. Operates at approximately 100 rpm above maximum cranking speed to prevent the starter from being energized while engine is running.

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.

Time Delay Start/Stop: Operative from remote location only. Provides 1-10 seconds time delay on starting and 30-seconds to 5-minutes delay on stopping. Delay period adjustable on engine monitor panel.

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

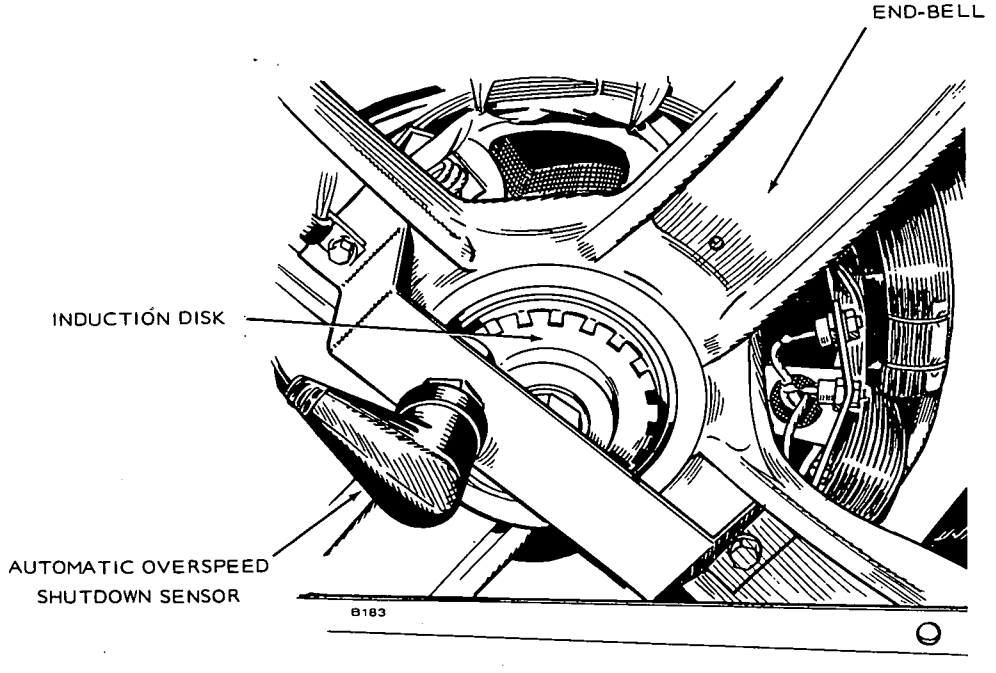


FIGURE 2. OVERSPEED SENSOR

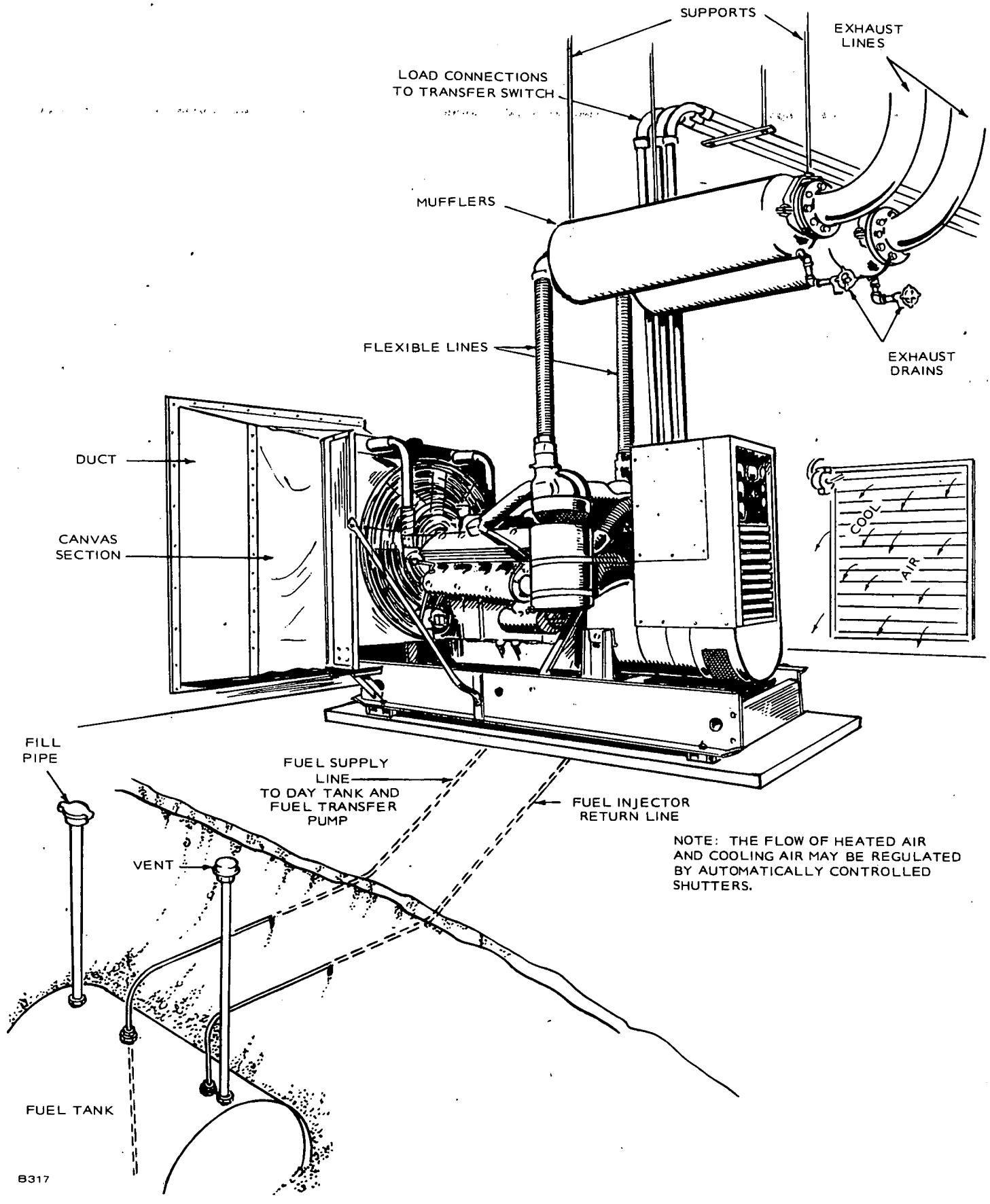


FIGURE 3. TYPICAL INSTALLATION

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 3.

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 connections.
8. Water connections.
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 extremes in weather conditions.

MOUNTING

Generator sets are mounted on a rigid skid base which provides proper support. Install vibration isolators between skid base and foundation. For convenience in draining crankcase oil and general servicing, mount set on raised pedestals (at least 6 inches high). Refer to ONAN Technical Bulletin T-030 for further installation information.

VENTILATION

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

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

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

Provide a means of restricting the air flow in cold weather to keep the room or compartment temperature at a normal point.

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

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

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

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

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

CITY WATER COOLING

An optional method of engine cooling, in place of the conventional radiator and fan, uses a constant pressure water supply. This is referred to as CITY WATER COOLING. There are two varieties of city water cooling: the HEAT EXCHANGER SYSTEM and STANDPIPE SYSTEM. See Figures 4 and 5.

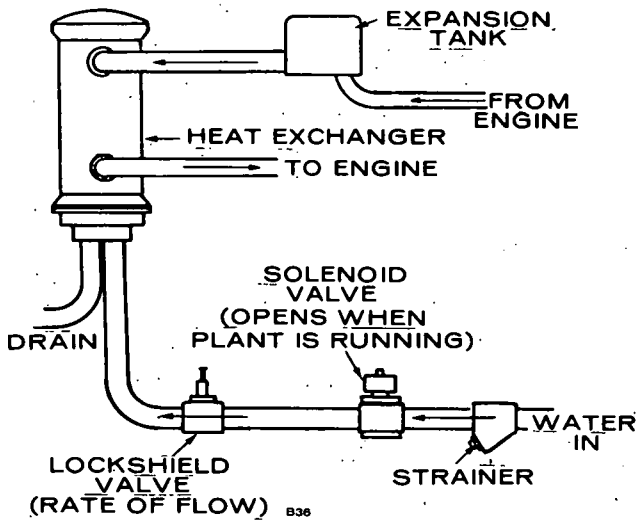


FIGURE 4. TYPICAL HEAT EXCHANGER SYSTEM

The HEAT EXCHANGER provides for a closed engine cooling system. Engine coolant flows through a tubed chamber, keeping the coolant separate from the cool "raw" water supply. The coolant chamber must be filled for operation, as for a radiator cooled set.

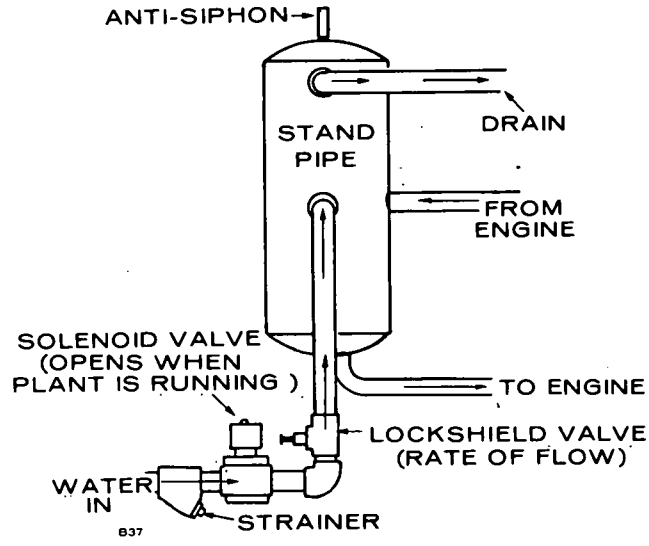


FIGURE 5. TYPICAL STANDPIPE SYSTEM

The STANDPIPE SYSTEM uses a mixing or tempering tank. Cooling water that circulates through the engine mixes with a source of cool "raw" water. The "raw" water supply must be free of scale forming lime or other impurities.

On both systems use flexible pipe for connecting water supply and outlet flow pipes to engine. Pipe the outlet flow to a convenient drain. Install an electric solenoid valve and a rate of flow valve in the water supply line. The electric solenoid valve opens and allows water flow through the system only when the unit operates. The rate of flow valve, either automatic or manual, provides for the proper flow rate to the engine. Adjust the flow to maintain water temperature between 165°F (74°C) and 195°F (91°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.

WATER JACKET HEATER (Optional)

This heater is installed to maintain an elevated engine temperature in lower ambient temperature application. It heats and circulates engine coolant, and is thermostatically controlled (Figure 19).

EXHAUST

WARNING **Inhalation of exhaust gases can result in serious injury or 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 6) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 7) 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 3 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9-inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 5-inch pipe size outlets of the engine with a flexible portion between the engine and muffler. Do not connect a flexible line to the exhaust manifold.

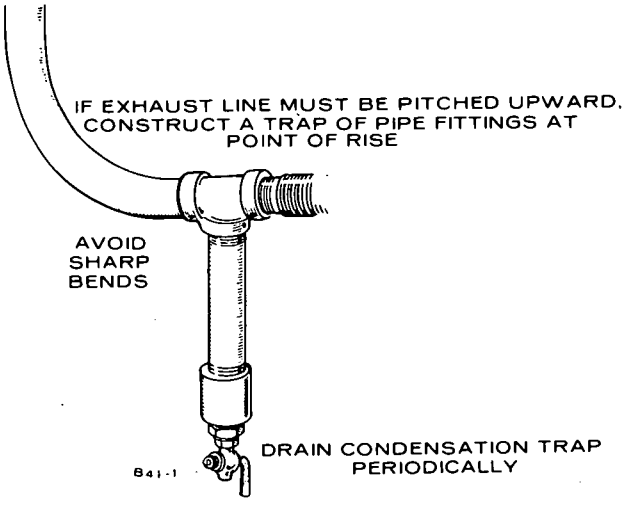


FIGURE 7. EXHAUST CONDENSATION TRAP

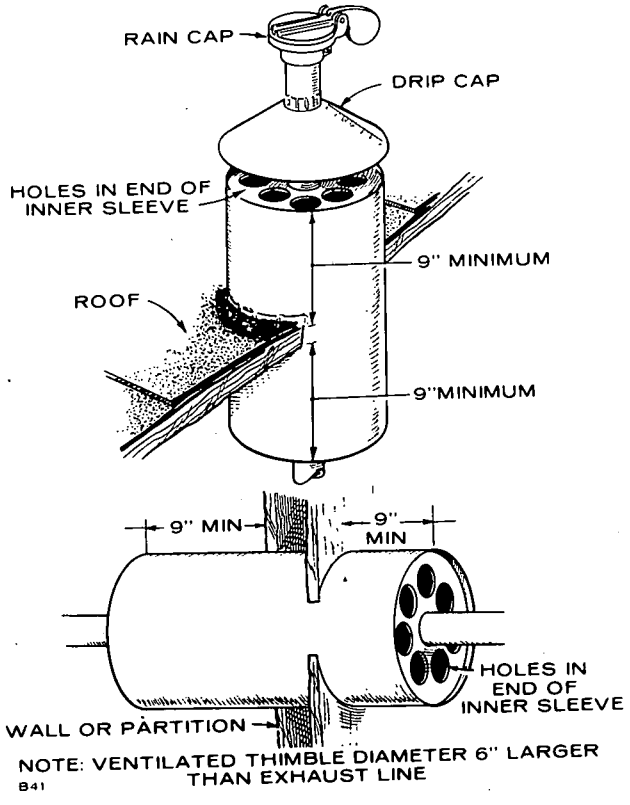


FIGURE 6. EXHAUST THIMBLE

Minimum diameters and maximum lengths of pipe (with critical muffler[s]) are as follows:

MAXIMUM EQUIVALENT EXHAUST LENGTH—FEET

6-inch	8-inch	10-inch	Pipe
	100	350	Single
59	387		Dual

Maximum permissable exhaust restriction (back pressure) is as follows:

60 Hz 27.0-inches H_2O (91.15 kPa)
50 Hz 18.9-inches H_2O (63.81 kPa)

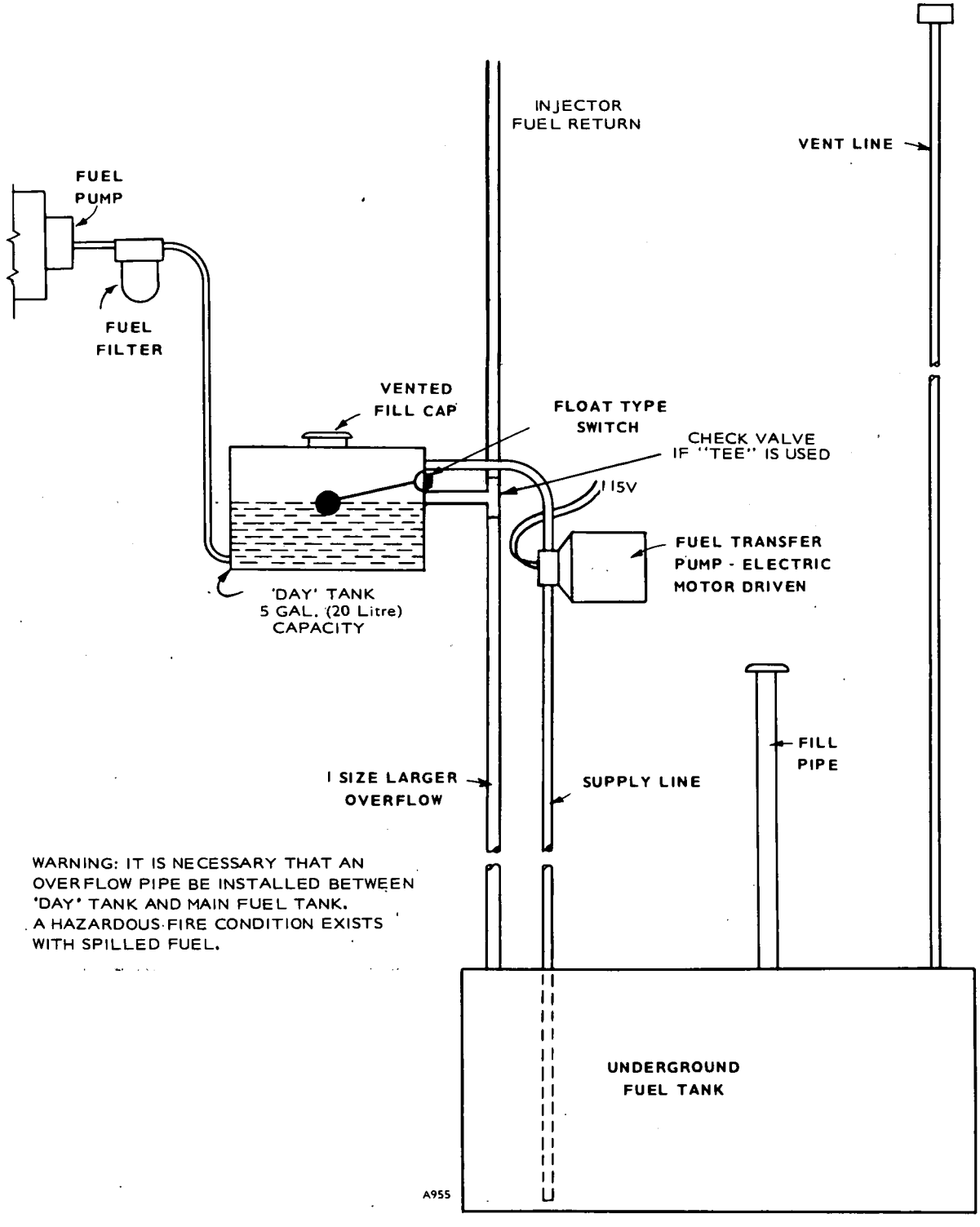


FIGURE 8. DAY TANK INSTALLATION (TYPICAL)

FUEL SYSTEM

Detroit Diesel engines used on ONAN DHB sets are designed for use with ASTM No 2 diesel fuels conforming to the specifications of the engine manual. Do not use fuels other than those specified.

INSTALLATION

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

CAUTION **Do not use any galvanized materials in the installation of a diesel fuel system. The fuel oil reacts chemically with the zinc coating to form powdery flakes which quickly clog fuel strainers and filters, and damage the fuel pump and injectors.**

In any diesel engine installation, fuel system cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture or contaminants of any kind.

FUEL TRANSFER PUMP

Pump delivery is above that required for combustion and injector cooling; the excess is returned to the tank. Fuel lift and restrictions in the system must not allow maximum suction to exceed 6-inches Hg (20.25 kPa); measurement to be made at the pump. If maximum suction does exceed that value, a day tank is then recommended. Do not return transfer pump fuel return line to the day tank. This will heat the fuel oil in the tank, thereby causing a loss of engine power. The return line should go to the main tank.

Pipe fittings to the filters and pump are threaded for 3/8 N.P.T.

FUEL FILTERS

There are two stages of filtration, primary (P) and secondary (S). The primary filter is a 30 micron unit, and is mounted on the suction side of the fuel transfer pump. This filter should be drained periodically to prevent water buildup. Should condensate level reach half the height of the element, it will be sucked into the system.

The secondary filter is connected between the fuel pump and the injectors. It is a 10 micron filter. This unit should be serviced at frequent intervals to prevent manifold pressure falling below 45 psi (310 kPa, measured at the filter outlet.

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the fuel tank. The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and the main fuel tank. Refer to the instructions included with the tank. See Figure 8 for an example of a day tank installation.

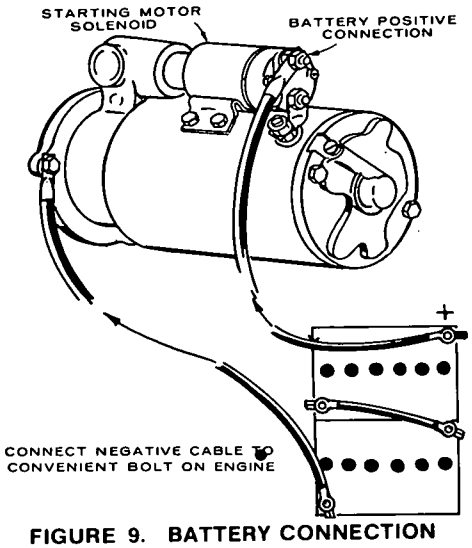


FIGURE 9. BATTERY CONNECTION

BATTERY

Starting the unit requires 24-volt battery current. Use two 12-volt (see *Specifications*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 9. Necessary battery cables are on unit. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Onan automatic transfer switches include such a battery charging circuit.

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

BATTERY, HOT LOCATION

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

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

REMOTE CONTROL CONNECTIONS

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated within the control box. Connect one or more remote switches across remote terminal and B+ terminal as shown in Figure 10. 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 (305-610 m), use No. 16 AWG wire.

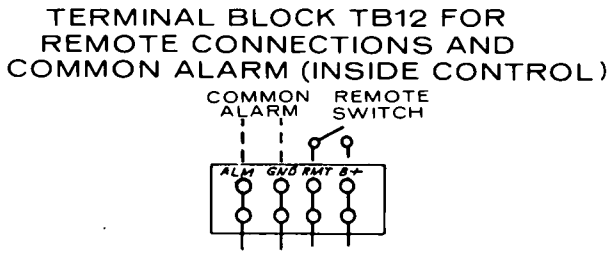


FIGURE 10. REMOTE STARTING

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.

If the installation is for standby service, a double throw transfer switch (Figure 11) must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator power to be connected to the load at the same time. Instructions for connecting an automatic transfer switch are included with such equipment.

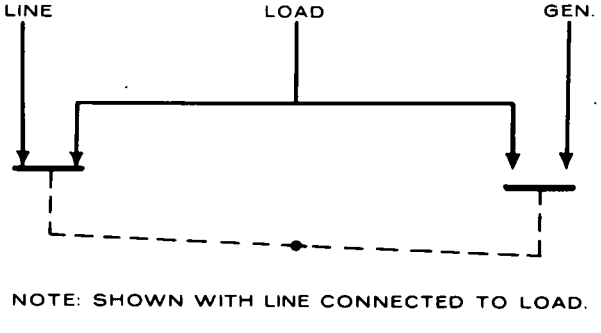


FIGURE 11. LOAD TRANSFER SWITCH

CONTROL BOX CONNECTION

Reconnection lead W12 on TB21 is a jumper which connects a single phase output from the generator to the appropriate tap on the voltage reference transformer. This lead is connected at one end to terminal 63 on the terminal board. The other end will be connected to a terminal marked H3, H4 or H5 (see Figure 12) depending upon the voltage option required. Refer to Table 1 and Figure 14 for voltages available and correct hookup.

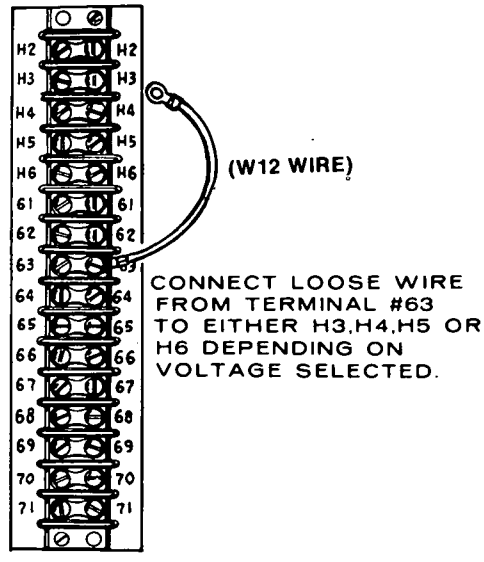


FIGURE 12. CONTROL BOX CONNECTION

GENERATOR CONNECTIONS

The model YB17 generator is a 3-phase 60 Hz (YB517 is 50 Hz) unit which can be bus-bar connected in either series wye or parallel wye configuration to give the line-to-neutral or line-to-line options referred to in Table 1 and Figure 14. Special models -9X, -5D and -6D are connected at the factory and cannot be changed without extensive modification. Line-to-neutral voltage is the lower voltage noted on the unit nameplate, line-to-line voltage is the higher nameplate rating.

Refer to Figure 13 for an example of 120/208 voltage connection.

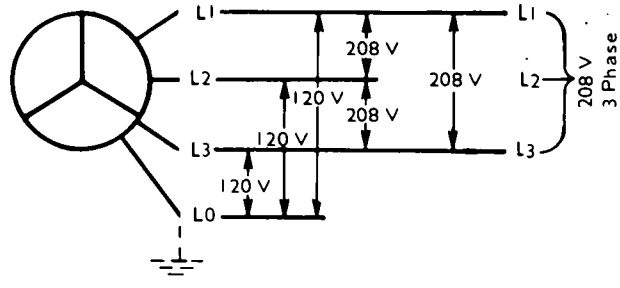
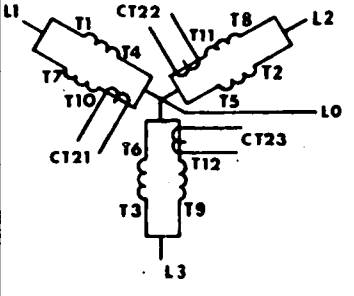
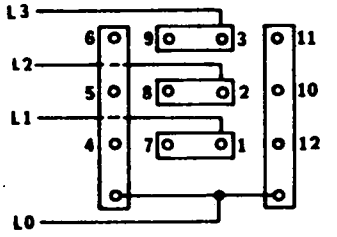
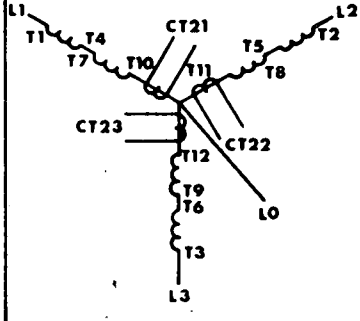
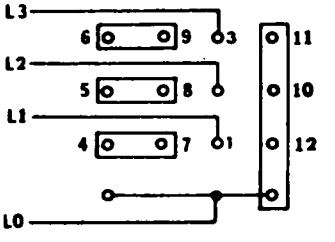


FIGURE 13. 3 PHASE WYE CONNECTION

THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASES	FREQUENCY	CONNECT LEAD FROM TERMINAL 63 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM
17 R	120/208	3	60	H3	PARALLEL WYE		
	127/220	3	60	H4			
	139/240	3	60	H5			
517 R	110/190	3	50	H3			
	115/200	3	50	H4			
	120/208	3	50	H4			
	127/220	3	50	H5			
17 R	240/416	3	60	H3	SERIES WYE		
	254/440	3	60	H4			
	277/480	3	60	H5			
517 R	220/380	3	50	H3			
	230/400	3	50	H4			
	240/416	3	50	H4			
	254/440	3	50	H5			

98C2579

FIGURE 14. VOLTAGE CONNECTIONS

For 3-phase loads connect separate load wires to each of the set terminals L1, L2 and L3 (Figure 14). For a large single phase load only, connect between terminals L1 and L2. Available capacity is 2/3 maximum output.

The terminal L0 can be grounded. For 1-phase loads connect the neutral wire to the L0 terminal. Connect the load wire to either terminal—L1, L2. Two separate single phase circuits are available with a total capacity of up to 2/3 of the generator rated 3-phase output.

If using 1-phase and 3-phase current at the same time, ensure the 1-phase load is properly balanced. Do not exceed rated line current.

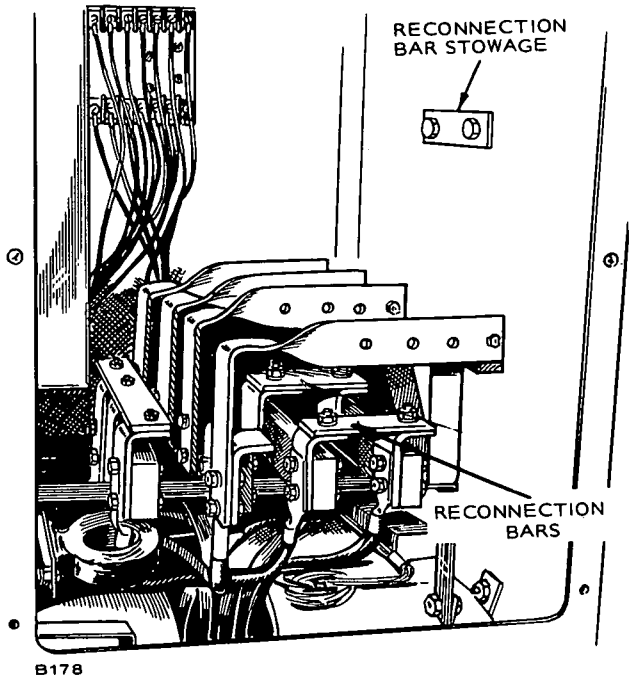


FIGURE 15. LOAD WIRE CONNECTIONS

Bus bars and reconnection bars are aluminum, plated with tin to retard electrolytic corrosion. Select connecting cables and terminal lugs with care, to keep dissimilar metals apart. Do not overtorque bolts.

Voltage code -5D and -6D Delta Connected sets. Available in 60 Hz series delta winding only. The -5D unit is 120/240 volt, the -6D is 240/480 volt. These sets supply single phase and three phase current. For three phase operation connect load wires to generator terminals L1, L2 and L3, one wire to each terminal. Terminal L0 is not used.

Single phase operation, terminals L1 and L2 are supply terminals; L0 is neutral which can be tied to ground if required. For 120 volt (-5D) or 240 volt (-6D) single phase, connect load wire to either L1 or L2 terminal and the return to L0.

See Figure 16 for a typical connection to a delta wound unit.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as no terminal current exceeds the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA.

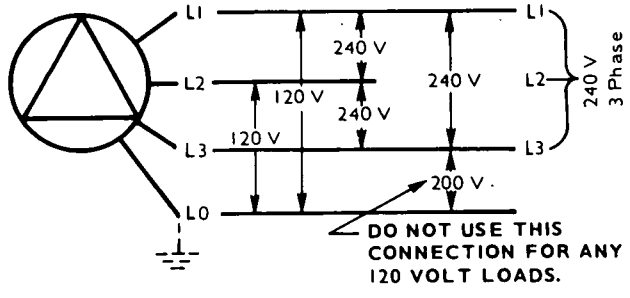


FIGURE 16. 3 PHASE, DELTA CONNECTION

OPERATION

GENERAL

ONAN DHB Series electric generating sets are given a complete running test under various load conditions and 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

Lubricating System: Engine oil was drained prior to shipment. After an extended period of inactivity, any lubricating oil in the upper parts of the engine will drain back into the lower galleries and crankcase. Prior to initial engine start after such a period, remove the valve rocker covers and pour two quarts (or two litres) of the same oil used in the crankcase over the rocker arms and push rods. Replace rocker covers and fill crankcase to capacities shown.

Refer to Detroit Diesel engine manual for engine oil recommendations. Note that for average operating conditions oil conforming to Military Specification Mil-L-2104B is recommended. Multigrade oils should not be used. Do not mix brands nor grades of oil.

Recommended oil viscosity is SAE 30, for all temperatures. Use a coolant heater for lower ambients. After engine has been run, check dipstick, add oil if necessary to bring level to FULL mark. Record total capacity for future oil changes.

Oil Capacities (nominal)

Oil Pan	34 quarts (32.2 litres)
Filter and Oil Lines	2 quarts (1.9 litres)
Total	36 quarts (34.1 litres)

CAUTION **After changing or filling engine crankcase, pre-fill oil filters. If this is not performed, the engine will be starved for oil until the filters fill up, and damage will result.**

CAUTION **Disconnect turbo charger oil inlet line and pump clean engine oil into the turbocharger and oil line. This will ensure that the bearings are oiled for the initial start. Failure to do so can cause irreparable damage to the turbocharger within five seconds of engine start.**

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Total capacity is 36.5 gallons (138 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean, soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures, use anti-freeze with an ethylene-glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to engine manual for additional information.

CAUTION **Verify that the electric solenoid valve used with city water cooled plants is open to allow coolant chambers to fill before initial starting of set. Overheating and damage to the engine could result from non-compliance.**

Ensure that water supply for city water cooling is turned ON.

Fuel System: Refer to the engine manual for fuel oil specifications. Check with fuel supplier and ensure that fuel supplied meets the specifications. Filter or strain fuel when filling tank.

Fuel supply tanks should be kept as nearly full as possible by topping up each time engine is used. Warm fuel returning from the injector pump heats the fuel in the supply tank. If the fuel level is low in cold weather, the upper portion of the tank not heated by returning fuel tends to increase condensation. In warm weather both the supply tank and fuel are warm. Cool night air lowers the temperature of the tank more rapidly than the temperature of the fuel. Again this tends to increase condensation.

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

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

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 petroleum based or non-conductive grease to retard formation of corrosive deposits.

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

STARTING

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

a. Crankcase filled.
b. Cooling system filled—input solenoid valve open.
c. Batteries charged and connected.
d. Fuel solenoid valve open.
e. Shut-off valves on air shutdown housings open.

To start, move the "run-stop-remote" switch to the "run" position. The engine should start after a few seconds of cranking.

Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 50 and 60 psi (345 and 414 kPa). Check the following gauges:

a. DC Ammeter—10 to 30 amperes.
b. AC Voltmeter—AC generator output voltage.
c. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 160° to 180° F (71° to 82° 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° to 195° F (74° to 91° C).

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

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

STOPPING

To reduce and stabilize temperatures within the engine and turbocharger run the engine at no load for 3-5 minutes before shutting down.

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

EXERCISE PERIOD

Generating sets on continuous standby service are required to be operative at essential load 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 pressure, 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 (305 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

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.

DUST AND DIRT

1. Keep set clean. Keep cooling system free of dirt, etc.
2. Service air cleaners regularly.
3. Change crankcase oil at proper intervals.
4. Ensure air inlet system is leak free.

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

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

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

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

*NOTE: Not applicable on Pennsylvania State models.

OUT-OF-SERVICE PROTECTION

Refer to chapter on *Storage* in Detroit Diesel engine manual.

Run set at 1800 rpm with 50 percent load instead of 1200 rpm and no load.

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. Keep fuel system clean, and batteries in a well charged condition.
3. Partially restrict cool air flow but use care to avoid overheating.
4. Connect water jacket heater when set is not running.
5. Refer to engine manual for further information.

Engine Heater: The function of this optional heater is to keep the engine warm enough to assure starting under adverse weather conditions. Connect the heater to a source of power that will be ON during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating (Figure 17).

CAUTION **Do not energize heater until engine cooling system is filled with coolant.**

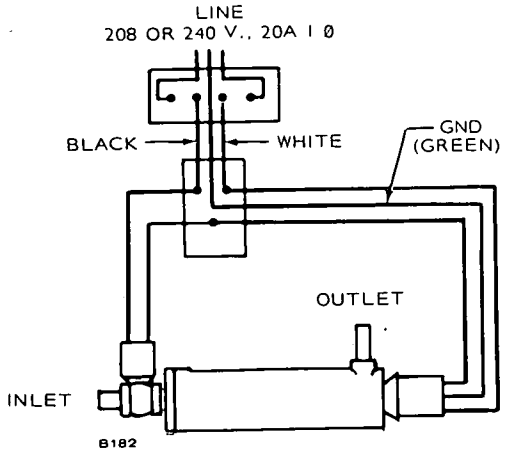


FIGURE 17. ENGINE HEATER (TYPICAL)

GENERAL MAINTENANCE

GENERAL

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

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.**

ENGINE SPEED

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

A Woodward governor is standard equipment on the DHB generator set. High speed and low speed limit stops are set at the ONAN testing facility and normally do not require further adjustment, therefore if your set is used on continuous standby service, the governor may never need to be touched. If however the unit is used frequently, adjustment may be required due to wear of internal components. This adjustment is achieved by backing off the high speed stop screw. Screw in the low speed adjusting screw until the generator output frequency meter reads 60 Hz (generator on rated load). Turn in the high speed adjusting screw until it bottoms; secure the locknuts. Refer to Figure 18.

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

Example: 30 x 61 (Hz) = 1830 rpm.

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

Engine crankcase oil flows through the governor. Dirty oil can degrade governor operation.

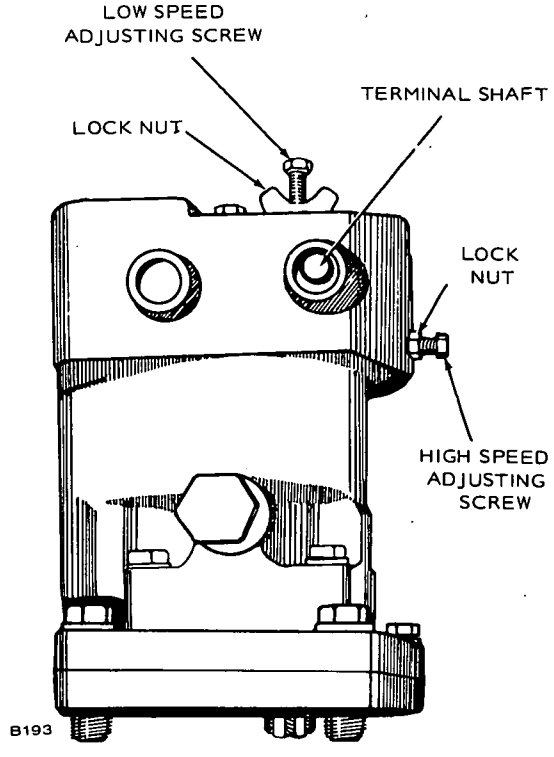


FIGURE 18. WOODWARD GOVERNOR

AC GENERATOR

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

Generator Bearing: Inspect the bearing every 1000 hours with the unit running.

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

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

INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly, make sure diodes are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure. Blow out the assembly periodically, with filtered, low pressure air. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 30 in. lb. or finger tight plus a quarter turn. Blow dust out of control panel.

BATTERIES

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

CONNECTIONS (Fuel, Exhaust, etc.)

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

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

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

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	8	50	100	200-250
Inspect Set	x			
Check Radiator Coolant	x			
Check Oil Level	x4			
Check Air Cleaner (Clean if Required)		x1		
Clean and Inspect Crankcase Breather			x	
Inspect Fan Belt			x2	
Check Cooling System			x3	
Clean and Inspect Battery Charging Alternator				x
Change Crankcase Oil			x1	
Replace Oil Filter Element			x1	
Check Batteries		x5		

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

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

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

x4 - For accurate readings, check oil level approximately 30 minutes after shutdown. Keep oil level as near "FULL" mark on dipstick as possible. See engine manual.

x5 - Or every month.

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

ADDITIONAL INFORMATIONAL LITERATURE

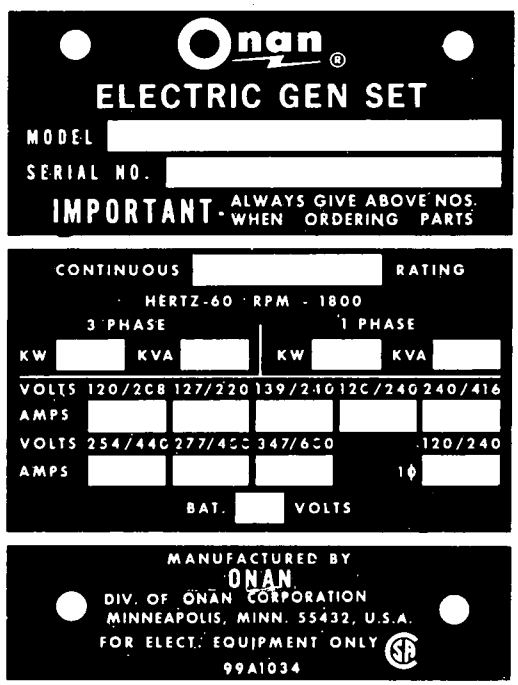
The following Technical Bulletins are available at no cost from ONAN office supplies department.

T-011	AUTOMATIC TRANSFER SWITCHES*
T-016	PARALLEL OPERATION OF ELECTRIC GENERATING SETS
T-017	RATING FACTORS FOR ELECTRIC GENERATING SETS
T-018	DIESEL FUEL SYSTEMS
T-030	INSTALLATION INFORMATION FOR LIQUID COOLED GENERATOR SETS

* A TECHNICAL BULLETIN FOR SERIES AT TRANSFER SWITCHES WILL BE AVAILABLE AT A LATER DATE.

PARTS CATALOG

This catalog applies to the DHB generator sets listed below. Engine parts modified or added by Onan will be in this list and have Onan part numbers. These supersede similar parts listed in the Detroit Diesel Allison manual. Onan parts are arranged in groups of related items and are identified by a reference. All part illustrations are typical. Using the Model and Specification from the Onan nameplate, select the parts from this catalog that apply to your set.



ONAN PARTS

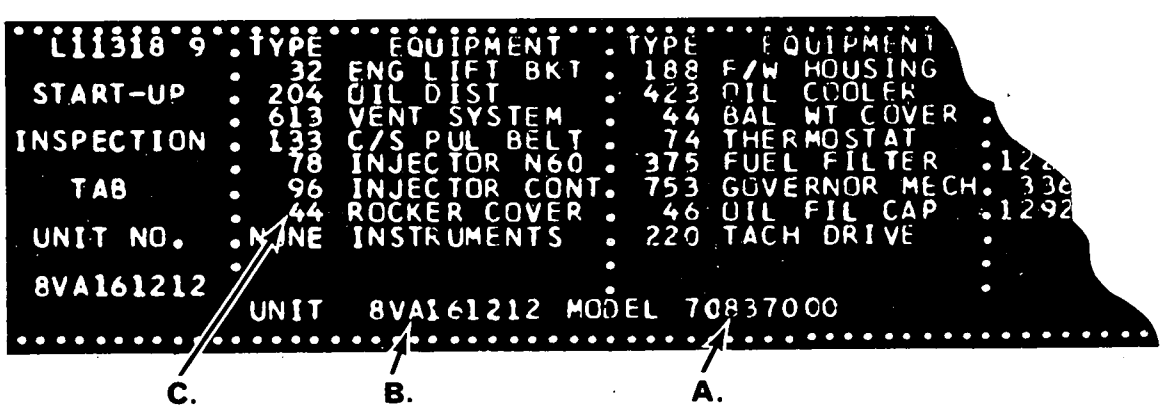
All parts in this list are Onan parts. For Onan parts or service, contact the dealer from whom you purchased this equipment or your nearest authorized service station. To avoid errors or delay in filling your order, please refer to the Onan nameplate and give the complete MODEL, SPECIFICATION and SERIAL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

MODEL AND SPECIFICATION**	WATTS
290.0 DHB - 517R/*	290,000
350.0 DHB - 17R/*	350,000

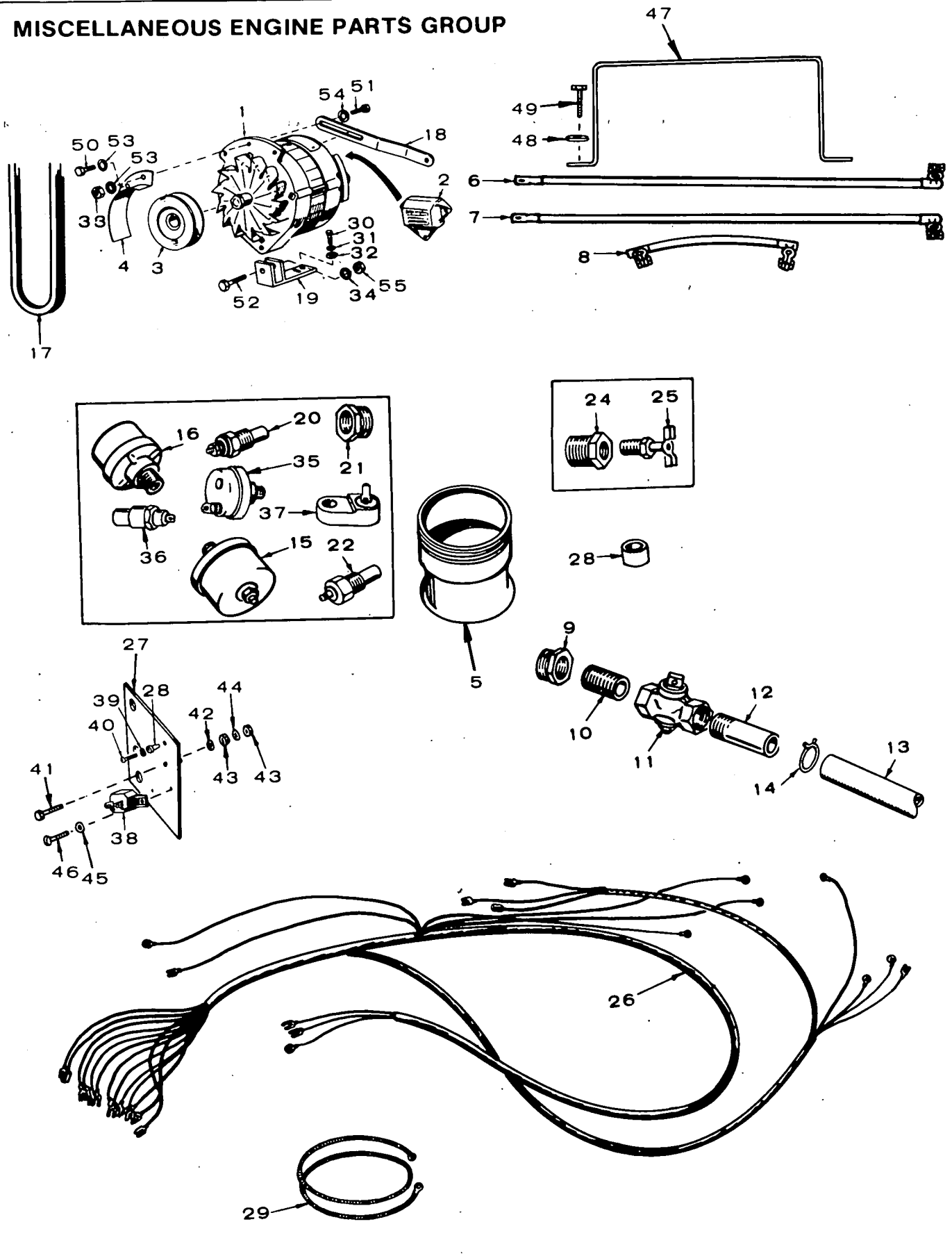
* The Specification Letter advances (A to B, B to C, etc.) with manufacturing changes.
** Refer to Specifications Section (Generator Details) in Operators Manual for Electrical Data.

DETROIT DIESEL ALLISON PARTS

All Detroit Diesel Allison parts must be ordered from the Detroit Diesel Allison Div., Detroit Michigan or their nearest authorized Detroit Diesel Allison distributor or dealer. When ordering parts, refer to the Detroit Diesel Allison option plate and supply: A. The "Model" number, B. the "Unit" number, and C. the "Type" number.



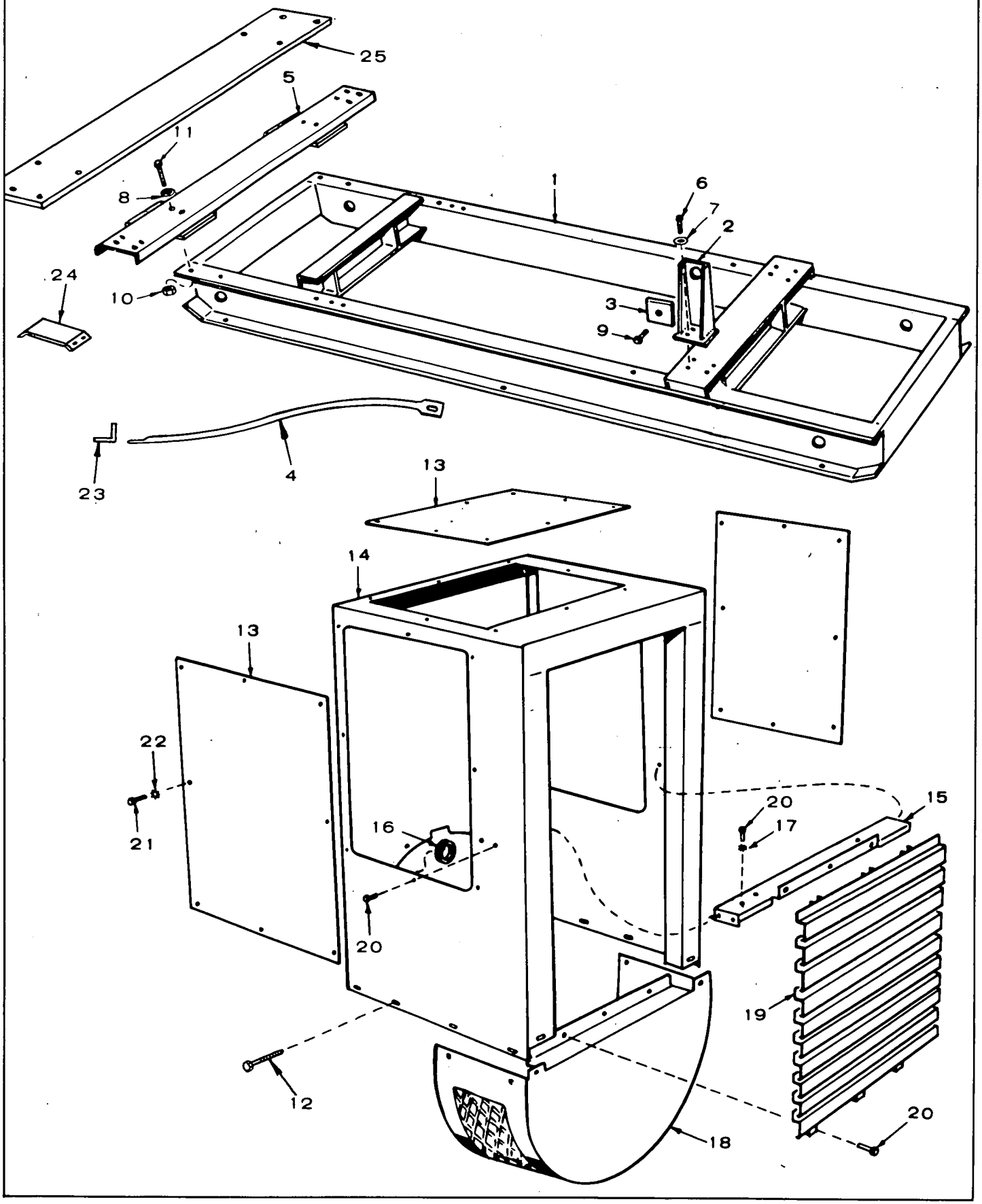
MISCELLANEOUS ENGINE PARTS GROUP



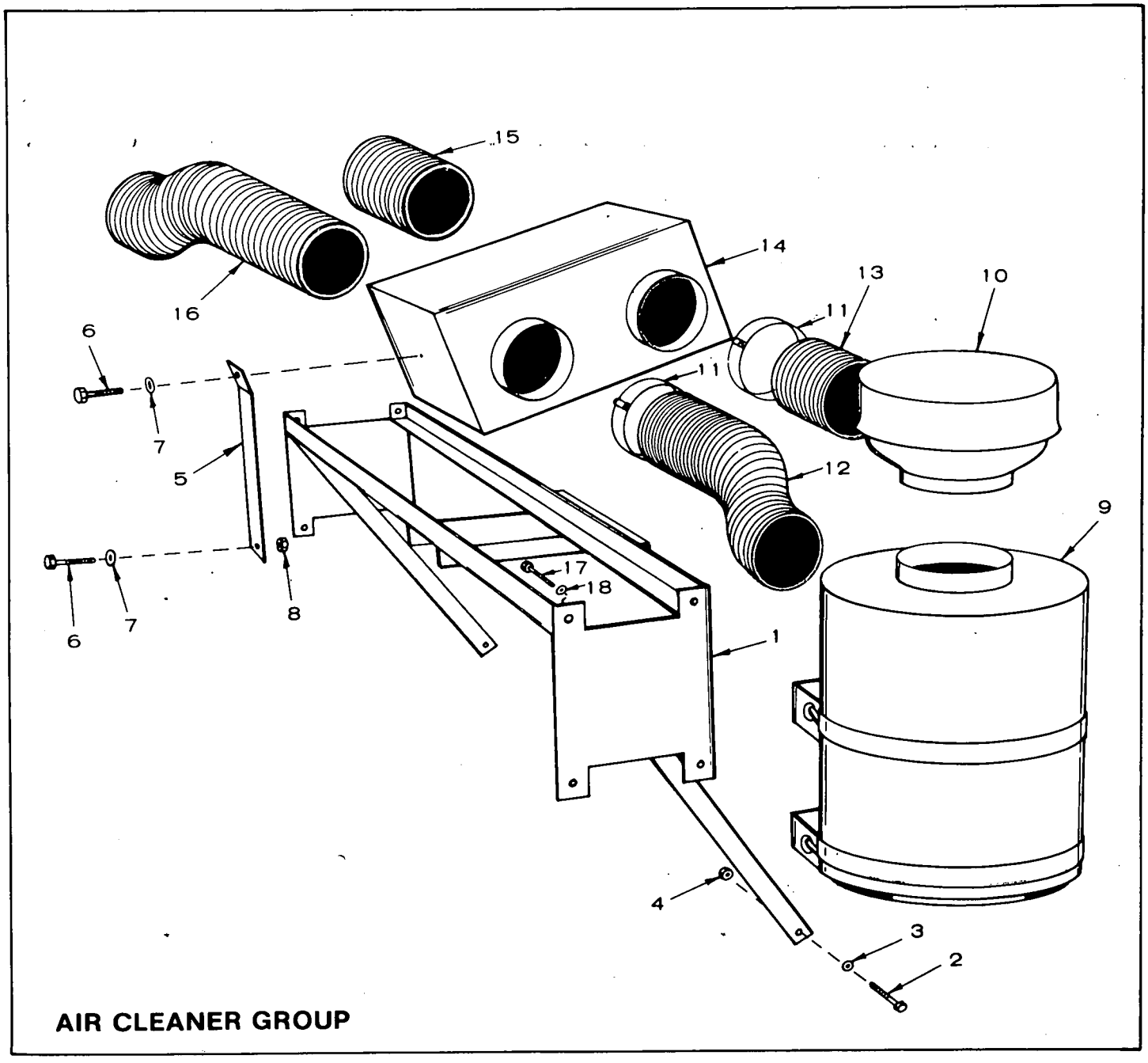
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191-0871	1	*Alternator, Charge - Includes Regulator and Fan (Motorola #70D44039B04 - Except: Specify #49A41756A01 Counterclockwise Fan)
2	191-0733	1	Regulator, Alternator (Part of Alternator)
3	191-0649	1	Pulley, Alternator
4	191-0725	1	Guard, Alternator Belt
5	155-1364	2	Adapter, Exhaust
6	416-0636	1	Cable, Battery - Positive
7	416-0445	1	Cable, Battery - Negative
8	416-0473	1	Cable, Jumper
9	505-0021	1	Bushing, Reducer (3/4 x 1/2") - Oil Drain
10	505-0100	1	Nipple, Close (1/2 x 1⅛") - Oil Drain
11	504-0011	1	Valve, Shutoff - Oil Drain
12	505-0185	1	Nipple, Half (1/2" x 1½") - Oil Drain
13		1	Hose, Oil Drain (Order 12" of Bulk Hose #503-0098)
14	503-0197	1	Clamp, Hose - Oil Drain
15	193-0195	1	Sender, Oil Pressure
16	309-0272	1	Switch, Oil Pressure Cutoff
17	511-0092	1	Belt, Alternator
18	191-0869	1	Strap, Alternator Adjusting
19	191-0870	1	Bracket, Alternator
20	193-0109	1	Sender, Water Temperature
21	505-0021	1	Bushing, Reducer - Water Temperature Sender Mtg. (3/4 x 1½")
22	309-0178	1	Switch, High Water Temperature
24	505-0131	1	Bushing, Reducer - Radiator Drain (3/4 x 3/8")
25	504-0028	1	Valve, Drain - Radiator Drain
26	338-0909	1	Harness, Wiring - Engine
27	332-1382	1	Bracket, Terminal Mounting
28	870-0196	1	Nut, Insulating
29	416-0632	1	Lead, Starter Ground
30	800-0048	2	Screw, Hex Cap - Steel (3/8-16 x 3/4")
31	850-0050	2	Washer, Spring Lock (3/8")
32	526-0183	2	Washer, Flat (25/64 I.D. x 5/8 O.D. x 3/32" Thick - Steel)
33	862-0015	1	Nut, Hex Steel (5/16-18)
34	856-0013	1	Washer, Lock - EIT (1/2")
35	309-0169	1	Switch, Oil Pressure (Pre-Alarm) - Optional
36	309-0179	1	Switch, High Engine Temperature (Pre-Alarm) - Optional
37	309-0269	1	Switch, Low Engine Temperature (Pre-Alarm) - Optional
38	320-0240	1	Breaker, Circuit - Starter (12.5 amp.)
39	508-0015	1	Washer, Fibre
40	809-0035	1	Screw, Round Head Sheet Metal (#8 x 3/4")
41	800-0007	1	Screw, Hex Cap - Steel (1/4-20 x 1")
42	850-0040	1	Washer, Spring Lock (1/4")
43	862-0001	2	Nut, Hex - Steel (1/4-20)
44	856-0006	1	Washer, Lock - EIT (1/4")
45	850-0030	2	Wahser, Spring Lock (#10)
46	811-0103	2	Screw, Round Head Brass (#10-32 x 3/4")
47	416-0635	1	Strap, Battery Holddown
48	850-0045	4	Washer, Spring Lock (5/16")
49	800-0035	4	Screw, Hex Cap - Steel (5/16-18 x 2½")
50	800-0025	1	Screw, Hex Cap - Steel (5/16-18 x 5/8")
51	800-0030	1	Screw, Hex Cap - Steel (5/16-18 x 1¼")
52	800-0094	1	Screw, Hex Cap - Steel (1/2-13 x 2")
53	850-0045	2	Washer, Spring Lock (5/16")
54	526-0022	1	Washer, Flat - Steel (21/64" I.D. x 9/16" O.D. x 1/16" Thick)
55	862-0005	1	Nut, Hex - Steel (1/2-13)

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

MOUNTING AND HOUSING GROUP

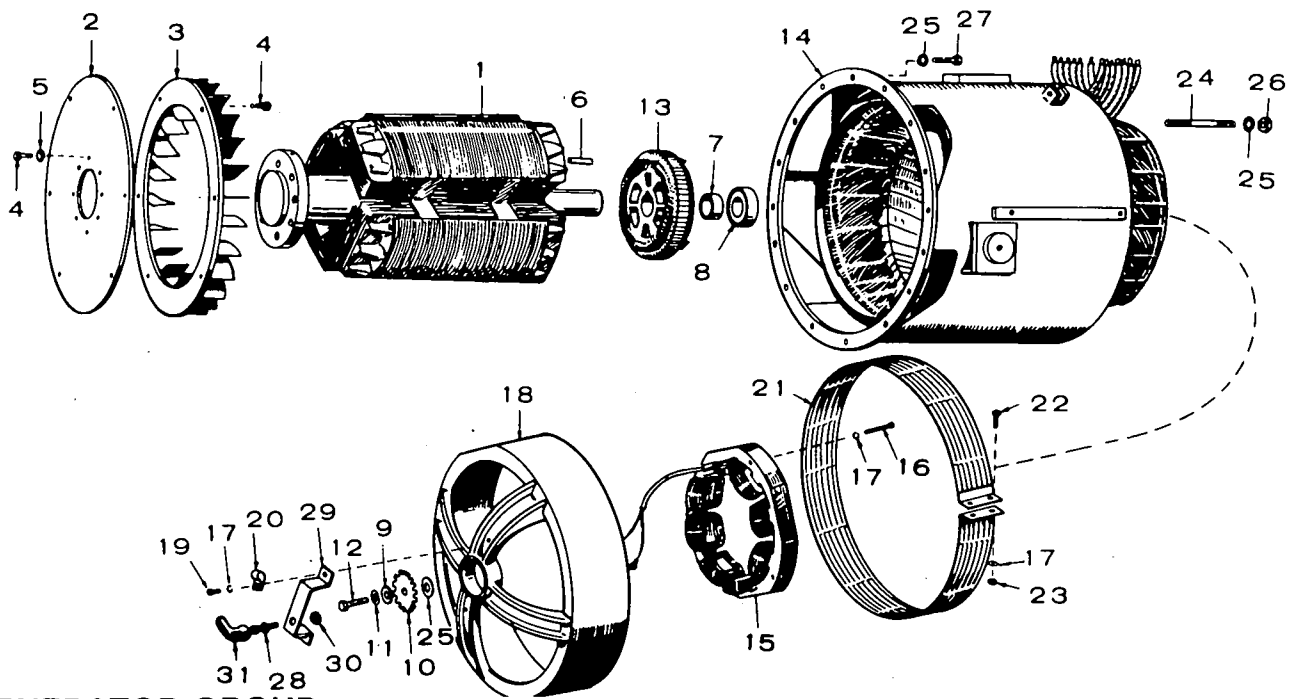


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403-1149	1	Base, Skid
2	232-2389	2	Bracket, Generator Mounting
3	232-2385	2	Plate, Generator Mtg. Retainer
4	130-0945	2	Brace, Radiator
5	130-0942	1	Support, Radiator
6	800-0156	6	Screw, Hex Cap - Steel (3/4-10 x 2¼")
7	850-0079	8	Washer, Spring Lock (3/4")
8	850-0079	8	Washer, Spring Lock (3/4")
9	800-0153	2	Screw, Hex Cap - Steel (3/4-10 x 1½")
10	862-0008	8	Nut, Hex - Steel (3/4-10)
11	800-0153	8	Screw, Hex Cap - Steel (3/4-10 x 1½")
12	821-0014	18	Screw, Flanged Hex Cap - Steel (5/16-18 x ½")
13	301-3731	3	Plate, Control Box
14	301-3605	1	Housing, Control Box
15	301-3604	1	Shelf, Control Box Housing
16	508-0001	1	Grommet, Rubber
17	856-0006	2	Washer, Lock - EIT (1/4")
18	234-0489	1	Cover, End Bell
19	234-0490	1	Grille, Generator Air Inlet
20	821-0010	9	Screw, Flanged Hex Cap - Steel (1/4-20 x 1/2")
21	815-0241	24	Screw, Truss Head (1/4-20 x ½")
22	853-0013	24	Washer, Lock - ET (1/4")
23	130-0944	2	Bracket, Radiator Brace
24	130-0951	2	Bracket, Radiator Mounting
25	130-0950	1	Plate, Radiator Mounting



AIR CLEANER GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	140-1314	1	Support, Air Cleaner Mounting
2	800-0090	2	Screw, Hex Head - Steel (1/2-13 x 1")
3	850-0060	2	Washer, Spring Lock (1/2")
4	862-0016	2	Nut, Hex - Steel (1/2-13)
5	140-1330	1	Bracket, Inlet Box Support
6	800-0005	2	Screw, Hex Head - Steel (1/4-20 x 3/4")
7	850-0040	2	Washer, Spring Lock (1/4")
8	862-0001	1	Nut, Hex - Steel (1/4-20)
9	140-1326	2	Cleaner, Air
10	140-1327	2	Cap, Weather
11	503-0059	16	Clamp, Hose
12		1	Hose, Flex (Order 14" of Bulk Hose #503-0641)
13		1	Hose, Flex (Order 4" of Bulk Hose #503-0641)
14	140-1328	1	Box, Air Inlet
15		1	Hose, Flex (Order 4" of Bulk Hose #503-0641)
16		1	Hose, Flex (Order 18" of Bulk Hose #503-0641)
17	801-0071	8	Screw, Hex Head - Steel (7/16-20 x 1")
18	850-0055	8	Washer, Spring Lock (7/16")
19	140-1331	2	Element, Air Cleaner (Not Illustrated)



GENERATOR GROUP

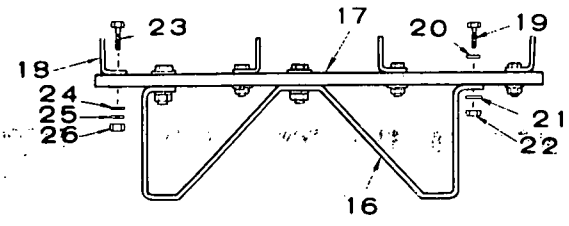
NOTE: See separate group for bus bar and exciter rotor parts.

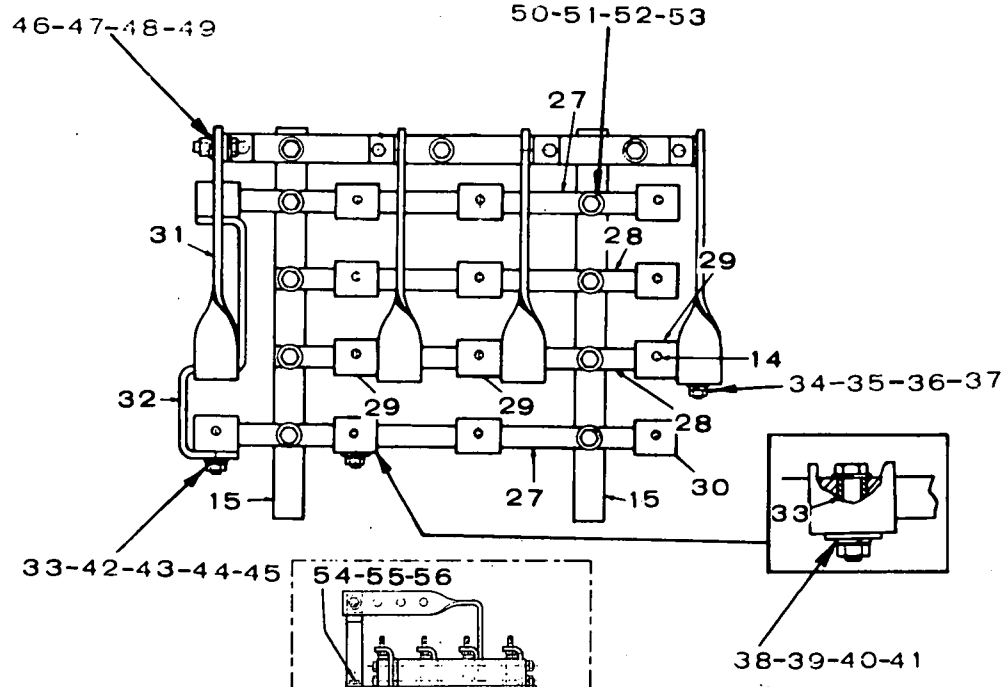
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	★	1	Rotor Assembly, Wound (Includes Parts Marked *)
2	232-2309	1	*Disc, Generator Drive
3	205-0103	1	*Fan, Generator
4	805-0035	14	*Bolt, Place (5/8-11 x 1½")
5	526-0259	8	*Washer, Flat - Steel (11/16" I.D. x 1-3/8" O.D. x 12 Ga.)
6	515-0145	1	*Key, Exciter Rotor
7	232-2317	1	*Spacer, Bearing
8	510-0106	1	*Bearing
9	526-0252	1	*Washer, Flat - Steel (13/16" I.D. x 2-3/8" O.D. x 5/32" Thick)
10	150-1405	1	*Wheel, Speed Sensor
11	850-0060	1	*Washer, Spring Lock (1/2")
12	800-0092	1	*Screw, Hex Cap - Steel (1/2-13 x 1½")
13	201-1902	1	*Rotor Assembly, Wound - Exciter (See Separate Group for Components)
14	★	1	Stator Assembly, Wound
15	220-1920	1	Stator Assembly, Wound - Exciter
16	800-0009	4	Screw, Hex Cap - Steel (1/4-20 x 1½")
17	850-0040	12	Washer, Spring Lock (1/4")
18	211-0214	1	Bell, End
19	800-0005	2	Screw, Hex Cap - Steel (1/4-20 x 3/4")
20	332-1554	1	Clamp, Loop
21	234-0455	1	Screen, Fan
22	800-0008	2	Screw, Hex Cap - Steel (1/4-20 x 1¼")
23	862-0001	2	Nut, Hex - Steel (1/4-20)
24	520-0780	4	Stud, End Bell Mounting (1/2 x 6½")
25	850-0060	20	Washer, Spring Lock (1/2")
26	862-0016	4	Nut, Hex - Steel (1/2-13)
27	800-0092	16	Screw, Hex Cap - Steel (1/2-13 x 1½")
28	150-1406	1	Sensor, Speed
29	150-1407	1	Bracket, Speed Sensor
30	870-0289	1	Nut, Hex - Steel (3/4-16)
31	150-1410	1	Cap, Insulator

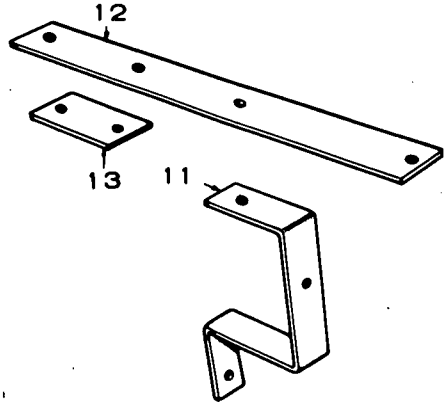
★ - Refer to factory giving complete Model, Spec and Serial Number from Onan nameplate.

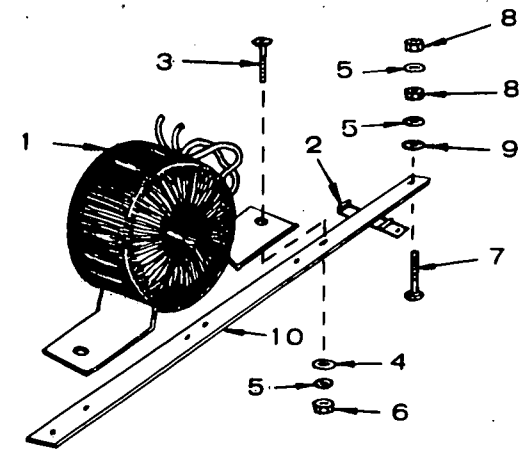
* - Parts included in the Rotor Assembly.

BUS BAR GROUP



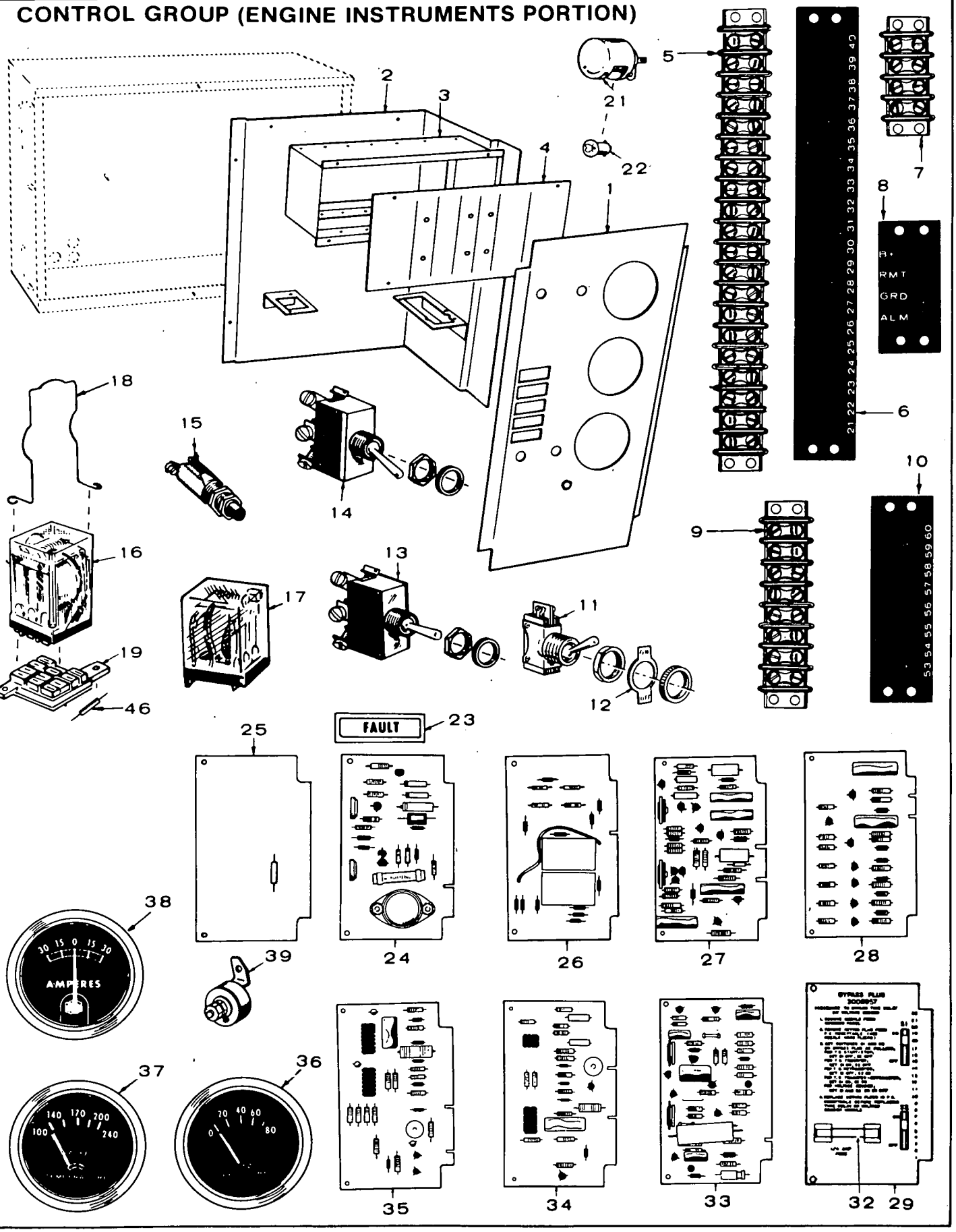


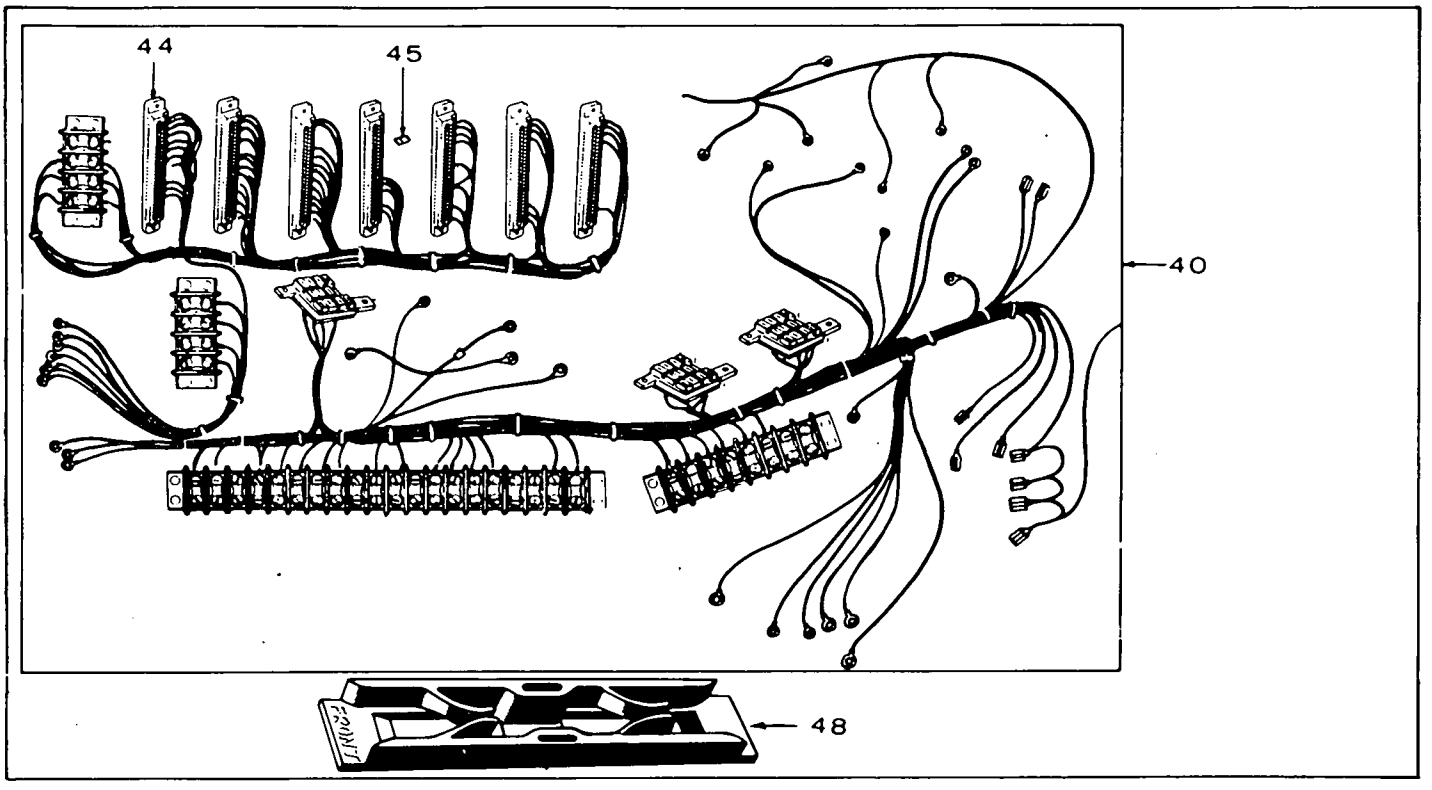




REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	302-0471	3	Transformer, Current
2	232-2342	2	Bracket, Terminal Board Mtg.
3	SCREW, ROUND STEEL HEAD MACHINE - TRANSFORMER MOUNTING		
	813-0100	4	#10-32 x 1/2"
	813-0103	2	#10-32 x 3/4"
4	526-0008	6	Washer, Flat - Steel (13/64" I.D. x 7/16" O.D. x 1/32" Thick)
5	856-0003	8	Washer, Lock - EIT (#10)
6	870-0053	6	Nut, Hex - Steel (#10-32)
7	815-0203	1	Screw, Round Head Brass Machine Screw (#10-32 x 7/8")
8	871-0010	2	Nut, Hex - Brass (#10-32)
9	526-0049	1	Washer, Flat - Brass (.200" I.D. x 7/16" O.D. x 1/32" Thick)
10	315-0389	1	Plate, Transformer Mounting
11	332-1402	1	Clamp
12	232-2246	2	Bar, Reconnection
13	232-2248	3	Bar, Reconnection
14	520-0142	14	Stud (5/16 x 1¼")
15	232-2249	2	Bracket, Terminal Board Mtg.
16	232-2237	1	Bracket, Bus Bar Support
17	232-2245	1	Board, Insulating - Bus Bar
18	232-2387	4	Bracket, Bus Bar
19	800-0051	3	Screw, Hex Cap - Steel (3/8-16 x 1¼")
20	526-0029	3	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
21	850-0050	3	Washer, Spring Lock (3/8")
22	862-0003	3	Nut, Hex - Steel (3/8-16)
23	800-0007	4	Screw, Hex Cap - Steel (1/4-20 x 1")
24	526-0018	4	Washer, Flat (21/64 I.D. x 3/4 O.D. x 1/16" Thick)
25	850-0040	4	Washer, Spring Lock (1/4")
26	862-0001	4	Nut, Hex - Steel (1/4-20)
27	232-2243	2	Board, Insulating
28	232-2242	2	Board, Insulating
29	232-2343	3	Bar, Bus
30	232-2241	11	Bar, Bus
31	232-2240	4	Bar, Bus
32	232-2238	1	Bracket, Bus Bar
33	232-2344	32	Spacer, Terminal Connection
34	800-0028	4	Screw, Hex Cap - Steel (5/16-18 x 1")
35	526-0115	8	Washer, Flat - Steel (11/32" I.D. x 11/16" O.D. x 1/16" Thick)
36	850-0045	4	Washer, Spring Lock (5/16")
37	862-0015	4	Nut, Hex - Steel (5/16-18)
38	800-0032	24	Screw, Hex Cap - Steel (5/16-18 x 1¾")
39	526-0115	24	Washer, Flat - Steel (11/32" I.D. x 11/16" O.D. x 1/16" Thick)
40	850-0045	24	Washer, Spring Lock (5/16")
41	862-0015	24	Nut, Hex - Steel (5/16-18)
42	800-0033	8	Screw, Hex Head - Steel (5/16-18 x 2")
43	526-0115	16	Washer, Flat - Steel (11/32 I.D. x 11/16 O.D. x 1/16" Thick)
44	850-0045	8	Washer, Spring Lock (5/16")
45	862-0015	8	Nut, Hex - Steel (5/16-18)
46	800-0051	4	Screw, Hex Cap - Steel (3/8-16 x 1¼")
47	526-0029	8	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
48	850-0050	4	Washer, Spring Lock (3/8")
49	862-0003	4	Nut, Hex - Steel (3/8-16)
50	800-0056	8	Screw, Hex Cap - Steel (3/8-16 x 2½")
51	526-0029	8	Washer, Flat - Steel (25/64" I.D. x 7/8" O.D. x 1/16" Thick)
52	850-0050	8	Washer, Spring Lock (3/8")
53	862-0003	4	Nut, Hex - Steel (3/8-16 x 1")
54	800-0050	2	Screw, Hex Head - Steel (3/8-16 x 1")
55	850-0050	2	Washer, Spring Lock (3/8")
56	862-0003	2	Nut, Hex - Steel (3/8-16)
57	800-0050	2	Screw, Hex Head - Steel (3/8-16 x 1")
58	850-0050	2	Washer, Spring Lock (3/8")
59	862-0003	2	Nut, Hex - Steel (3/8-16)

CONTROL GROUP (ENGINE INSTRUMENTS PORTION)



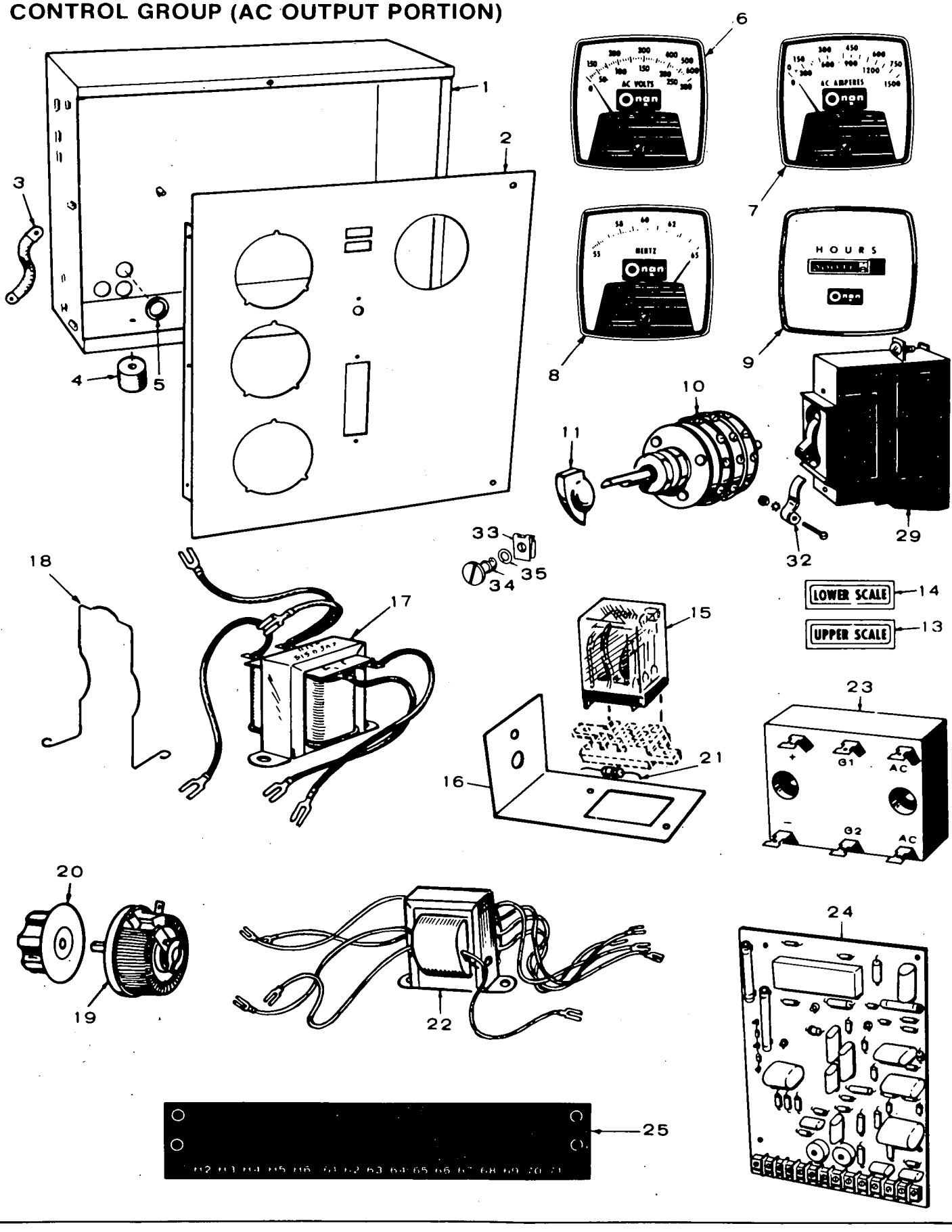


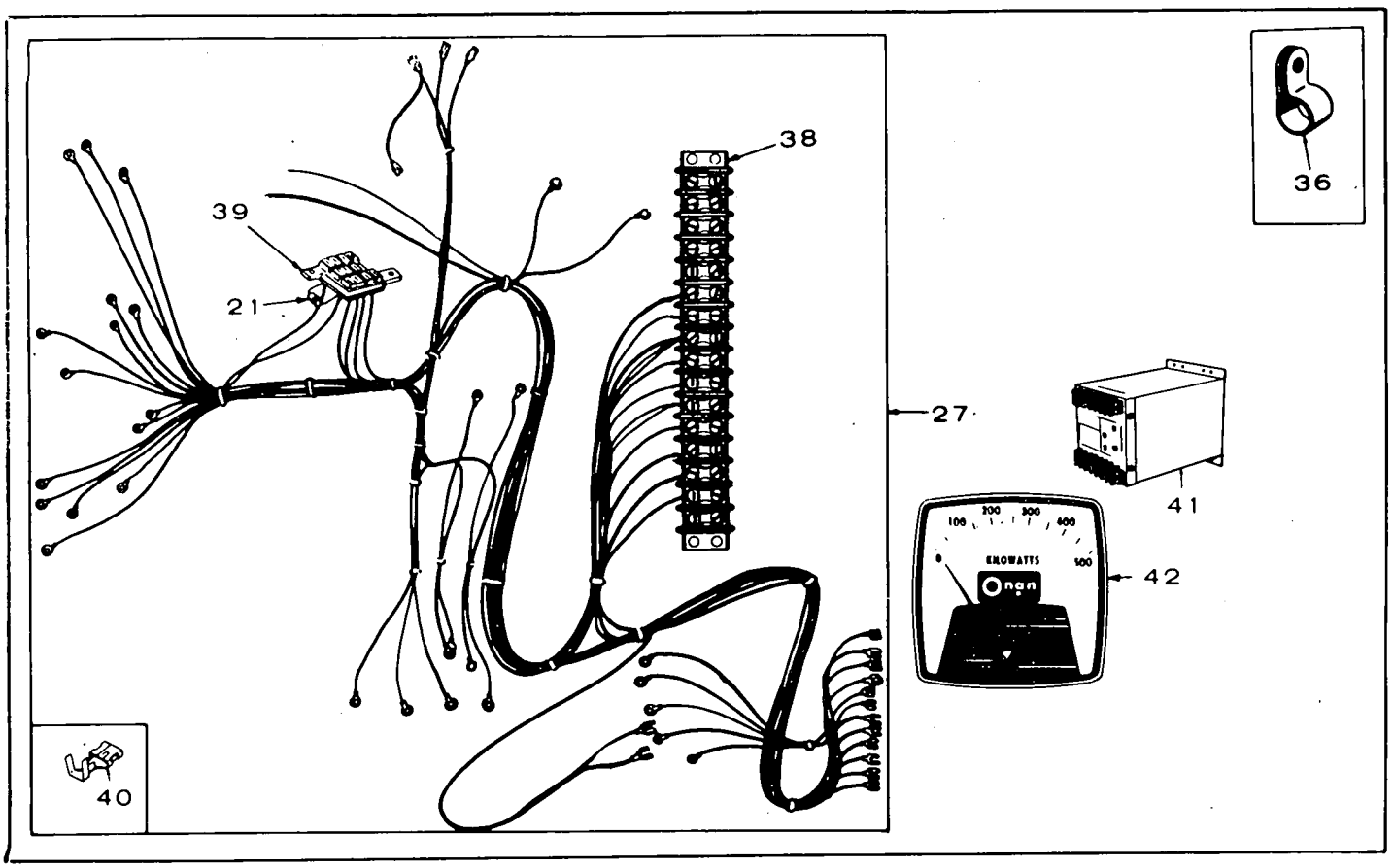
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL, ENGINE CONTROL		
	301-3661	1	Sets With One Fault Light
	301-3629	1	Sets With Five Fault Lights
2	301-3621	1	Bracket, Engine Control
3	301-3588	1	Rack, Module
4	301-3635	1	Cover Assembly, Rack
5	332-1005	1	*Block, Terminal - 20 Place
6	332-1559	1	Strip, Terminal Block Marker (21-40)
7	332-0537	2	*Block, Terminal - 4 Place
8	STRIP, TERMINAL BLOCK MARKER (4-Place)		
	332-1239	1	B+, Remote, Ground, Alarm
	332-1561	1	1-4
9	332-0699	1	*Block, Terminal - 8 Place - Set With Five Fault Lights
10	332-1560	1	Strip, Terminal Block Marker (53-60) - Sets With Five Fault Lights
11	308-0002	1	Switch, Panel Light
12	308-0003	1	Plate, On-Off Switch
13	SWITCH, SELECTOR		
	308-0220	1	Standard Control
	308-0347	1	Penn State Models
14	308-0337	1	Switch, Lamp Test
15	308-0091	1	Switch, Reset
16	307-1056	3	Relay (1) Start Disconnect (1) Ignition (1) Overspeed
17	307-1061	2	Relay, (1) Starter Protection, (1) Start Solenoid
18	307-1157	3	Spring, Relay Holddown
19	323-0765	3	*Socket, Relay - 11 Place
21	322-0149	1	Holder, Lamp
22	322-0017	1	Lamp, Panel
23	LAMP, FAULT		
	322-0129	1	Standard
	322-0119	1	Overcrank (Optional)
	322-0123	1	Overspeed (Optional)
	322-0120	1	Low Oil Pressure (Opt.)
	322-0121	1	High Engine Temperature (Optional)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
24	300-0956	1	Control Cycle Cranker (Opt.) (See Separate Group for Components)
25	300-0977	1	Control, Standard Cranker
26	300-0964	1	Control, Engine Shutdown (See Separate Group for Components)
27	300-0953	1	Control, Engine Monitor (See Separate Group for Components)
28	300-0955	1	Control, Remote Indicator - Sets With Five Fault Lights
29	300-0987	1	Module, Bypass Plug
32	321-0168	1	Fuse, 1/4 Amp (Part of 300-0987 Module)
33	300-0973	1	Module, Time Delay Start-Stop (Optional) See Separate Group for Components)
34	300-0957	1	Control, Overspeed Sensor (See Separate Group for Components)
35	300-0958	1	Control, Starter Disconnect (See Separate Group for Components)
36	193-0107	1	Gauge, Oil Pressure
37	193-0106	1	Gauge, Water Temperature
38	302-0061	1	Ammeter, Charge (30-0-30)
39	193-0189	2	Resistor, Gauge (1) Start Solenoid (1) Start Disconnect Relay
40	Harness, Wiring (Includes Parts Marked *)		
	338-0915	1	Sets With One Fault Light
	338-0705	1	Sets With Five Fault Lights
44	332-1271	6	*Housing, Printed Circuit Board Terminal (Seven on Sets With Five Fault Lights)
45	332-1276	As Req.	*Plug, Keying
46	357-0004	2	*Rectifier, Diode
48	323-0814	12	Guide, Printed Circuit Board (14 Used on Sets with Five Fault Lights)

* - Included in Wiring Harness Assembly.

CONTROL GROUP (AC OUTPUT PORTION)

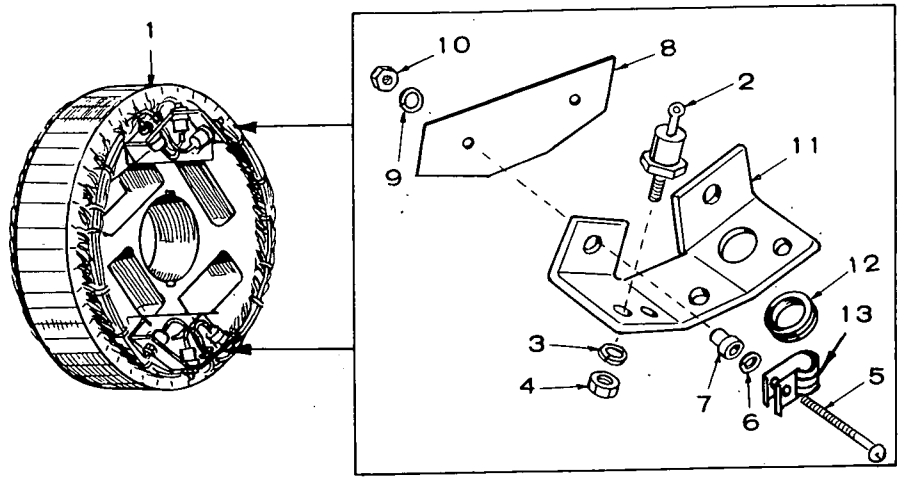




REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301-3158	1	Box, Control
2	PANEL, CONTROL BOX		
	301-3170	1	Standard Units
	301-3312	1	Units With Wattmeter
3	337-0049	1	Strap, Bond
4	402-0078	4	Dampener, Vibration
5	508-0001	4	Grommet (1-1/16"), Rubber
6	302-0718	1	Voltmeter, AC - Dual Scale 0-300, 0-600
7	AMMETER, AC		
	302-0879	1	290kW - Dual Scale 0-600, 0-1200
	302-0880	1	350 kW - Dual Scale 0-750, 0-1500
8	METER, FREQUENCY		
	302-0810	1	60 Hertz
	302-0894	1	50 Hertz
9	METER, RUNNING TIME		
	302-0466	1	60 Hertz
	302-0469	1	50 Hertz
10	308-0284	1	Switch, Voltage & Ammeter
11	303-0076	1	Knob
13	322-0131	1	Light, Upper Scale
14	322-0130	1	Light, Lower Scale
15	307-1061	1	Relay, Voltage Selector
16	301-3244	1	Bracket, Relay Mounting
17	315-0384	1	Reactor Assembly, Comm

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
18	307-1157	1	Spring, Relay Holddown
19	303-0170	1	Rheostat, Voltage Adj.
20	303-0032	1	Knob, Rheostat
21	350-0556	1	*Resistor
22	315-0342	1	Transformer, Voltage
23	305-0524	1	Bridge, Rectifier
24	332-1268	1	Board Assembly, Printed Circuit Voltage Regulator
25	332-1242	1	Strip, Marker (H2-H6, 61-71)
27	338-0730	1	Harness, Wiring - AC Control (Includes Parts Marked *)
29	320-0455	1	Circuit Breaker (3 Amp)
32	320-0307	1	Lock, Circuit Breaker Handle (Penn State Models) - Optional
33	406-0332	2	Receptacle, Fastener
34	406-0333	2	Stud, Fastener
35	406-0334	2	Washer, Stud Fastener
36	332-0050	1	Clip, Tinnerman
38	332-0795	1	*Block, Terminal - 16 Place
39	323-0764	1	*Socket, Relay
40	332-1280	As Req.	*Terminal, Crimp
41	302-0921	1	Transducer, Watt - Optional
42	WATTMETER, AC		
	302-0927	1	290 kW (Scale Reads 0-300)
	302-0928	1	350 kW (Scale Reads 0-500)

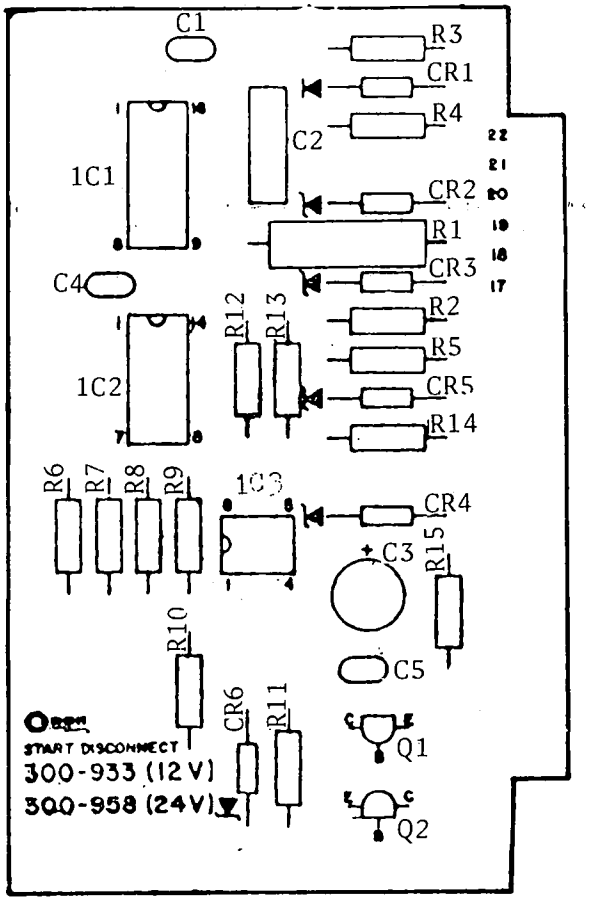
* - Included in Wiring Harness Assembly.



EXCITER ROTOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	201-1902	1	Rotor Assembly, Exciter - Complete (Also shown in Generator Group)
2	RECTIFIER, DIODE		
	358-0011	3	Positive Stud
	358-0012	3	Negative Stud
3	850-0040	6	Washer, Spring Lock (1/4")
4	868-0001	6	Nut, Hex - Stud (1/4-20)
5	813-0110	4	Screw, Round Head Steel (#10-32 x 2")
6	526-0009	4	Washer, Flat (7/32" I.D. x 1/2" O.D. x 1/16" Thick) Steel
7	508-0124	4	Bushing, Insulating
8	508-0156	4	Washer, Insulating
9	850-0030	4	Washer, Spring Lock (#10)
10	870-0053	4	Nut, Hex Steel (#10-32)
11	SINK, HEAT		
	363-0049	1	Positive
	363-0050	1	Negative
12	508-0093	2	Grommet, Rubber
13	332-0050	2	Clip, Wire

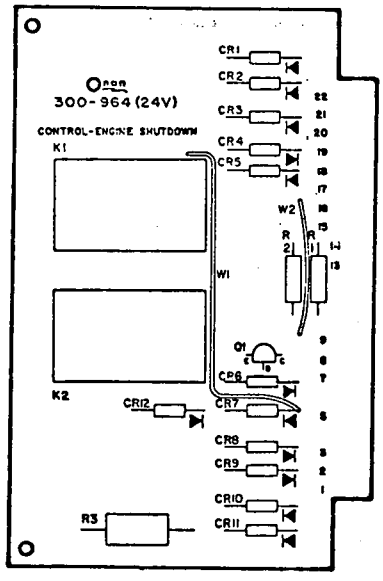
300-0958



STARTING MOTOR DISCONNECT MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0958	1	Module, Starter Motor Disconnect
1C1	367-0003	1	Integrated Circuit
1C2	367-0004	1	Integrated Circuit
1C3	367-0001	1	Integrated Circuit
C1,4	356-0051	2	Capacitor, Electrolytic (6.8 Mfd., 35 Volt)
C2	355-0028	1	Capacitor, Composition (.47 Mfd., 100 Volt)
C3	356-0038	1	Capacitor, Electrolytic (50 Mfd., 25 Volt)
Q1,2	362-0011	2	Transistor, Signal
CR1	357-0004	1	Rectifier, Diode (400 MA, 400 Volt)
CR2,3	359-0017	2	Diode, Zener (5.1 Volt, 400 MW)
CR4	359-0032	1	Diode, Zener (8.2 Volt, 400 MW)
CR5	359-0002	1	Diode, Zener (13 Volt, 400 MW)
CR6	359-0028	1	Diode, Zener (3.9 Volt, 500 MW)
R5	350-0383	1	Resistor (680-ohms, 1/2 Watt)
R2	350-0389	1	Resistor (1,200-ohms, 1/2 Watt)
R3,7,15	350-0422	3	Resistor (30,000-ohms, 1/2 Watt)
R6,11,12,13	350-0411	4	Resistor (10,000-ohms, 1/2 Watt)
R8,9	350-0418	2	Resistor (20,000-ohms, 1/2 Watt)
R10	350-0394	1	Resistor (2,000-ohms, 1/2 Watt)
R14	350-0404	1	Resistor (5,100-ohms, 1/2 Watt)
R1	350-0975	1	Resistor (330-ohms, 2 Watt)
R4	350-0420	1	Resistor (24,000-ohms, 1/2 Watt)
C5	356-0059	1	Capacitor, Electrolytic (2.2 Mfd., 35 Volt)

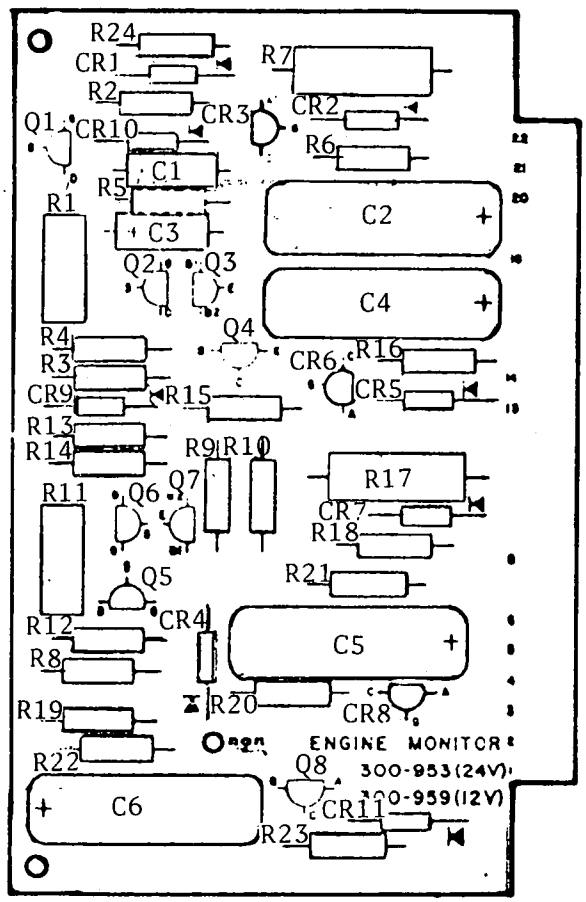
300-0964



ENGINE SHUTDOWN CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0964	1	Control, Engine Shutdown (Complete)
CR1 thru 12	357-0004	12	Rectifier, Diode
K1,2	307-1076	2	Relay
R1	350-0548	1	Resistor (10,000-Ohms, 1/2 Watt)
R2	350-0545	1	Resistor (5,600-ohms, 1/2 Watt)
R3	350-1128	1	Resistor (220-ohms, 2 Watt)
Q1	362-0026	1	Transistor, PNP

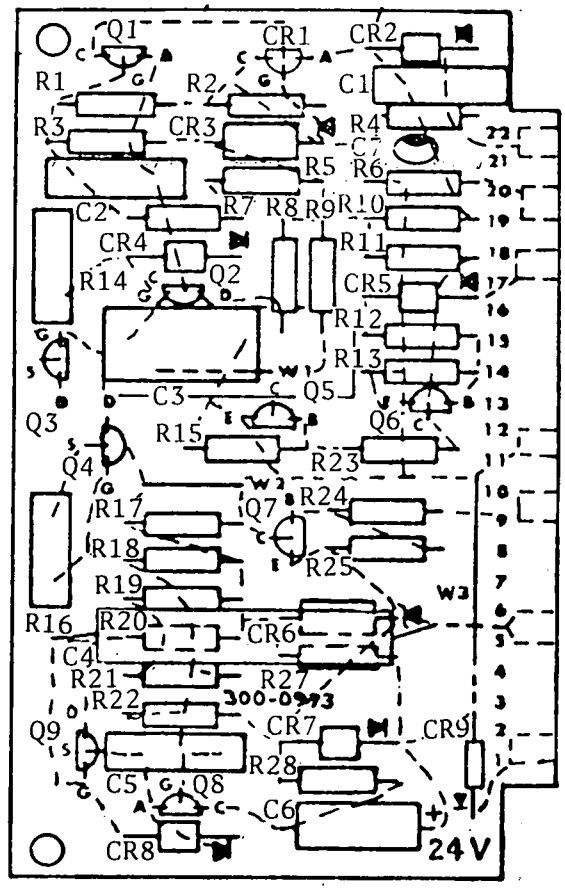
300-0953



ENGINE MONITOR CONTROL MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0953	1	Control, Engine Monitor (Complete)
C1,3	356-0040	2	Capacitor, Electrolytic (10 Mfd., 20 Volt)
C2,4,5,6	355-0005	4	Capacitor, Composition (.22 Mfd., 200 Volt)
CR1,2,4,5 7,10,11	357-0004	6	Rectifier, Diode
CR3,6,8	364-0011	3	Rectifier, Gate Control
CR9	359-0027	1	Diode, Zener (1 Watt, 5 Volt)
Q1,5	362-0025	2	Transistor, Field Effect (30 MA)
Q3,7	361-0007	2	Transistor, Unijunction
Q4	362-0014	1	Transistor, NPN
Q8	362-0027	1	Transistor, PNP
R1,11	303-0169	2	Potentiometer (3.5 Megohm)
R2,3,12,13	350-0548	4	Resistor (10,000-ohms, 1/2 Watt)
R4,14,10,24	350-0536	4	Resistor (1,000-ohm, 1/2 Watt)
R5,15,21	350-0517	3	Resistor (27-ohms, 1/2 Watt)
R6,16,18	350-0505	3	Resistor (2.7-ohms, 1/2 Watt)
R7,17	350-0980	2	Resistor (510-ohms, 2 Watt)
R8	350-0403	1	Resistor (4,700-ohms, 1/2 Watt)
R9	350-0405	1	Resistor (5,600-ohms, 1/2 Watt)
R19	350-0534	1	Resistor (680-ohms, 1/2 Watt)
R20,22	350-0533	2	Resistor (560-ohms, 1/2 Watt)
R23	350-0395	1	Resistor (2,200-ohms, 1/2 Watt)
Q2,6	362-0031	2	Transistor, Field Effect (.05 MA)

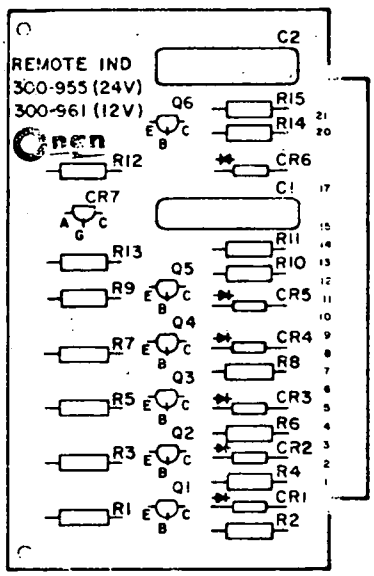
300-0973



TIME DELAY (START-STOP) MODULE—OPTIONAL

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0973	1	Mudule, Time Delay - Complete (Start-Stop) - Optional
C1,2,5	355-0025	3	Capacitor (.1 Mfd., 100 Volt)
C3	355-0028	1	Capacitor (.5 Mfd., 100 Volt)
C4	355-0027	1	Capacitor (10.0 Mfd., 50 Volt)
C6	356-0046	1	Capacitor (5 Mfd., 35 Volt)
C7	356-0053	1	Capacitor (1.0 Mfd., 35 Volt)
CR1	364-0011	1	Rectifier, Gate Control
CR2,4,5 7,8,9	357-0004	6	Rectifier, Diode (400 MA. 400 Volt)
CR3,6	359-0015	2	Diode, Zener (24 Volt)
Q1,8	361-0006	2	Transistor (2N6027)
Q2,3,4,9	362-0031	4	Transistor (2N5716)
Q5,6,7	362-0007	3	Transistor, Signal (2N2925)
R1,3,18,22	350-0411	4	Resistor (10,000-ohms, 1/2 Watt)
R2	350-0379	1	Resistor (470-ohms, 1/2 Watt)
R4	350-0524	1	Resistor (100-ohms, 1/2 Watt)
R5,19	352-0200	2	Thermistor (10,000-ohms)
R6	350-0537	1	Resistor (1,200-ohms, 1/2 Watt)
R7, R21	350-0391	2	Resistor (1,500-ohms, 1/2 Watt)
R8,12,20,24	350-0548	4	Resistor (10,000-ohms, 1/2 Watt)
R13,15,25,28	350-0536	4	Resistor (1,000-ohm, 1/2 Watt)
R10,27	350-0528	2	Resistor (220-ohms, 1/2 Watt)
R9,17	350-0540	2	Resistor (2200-ohms, 1/2 Watt)
R14,16	303-0169	2	Potentiometer (3.5 Megohm)
R23,11	350-0545	2	Resistor (5600-ohms, 1/2 Watt)

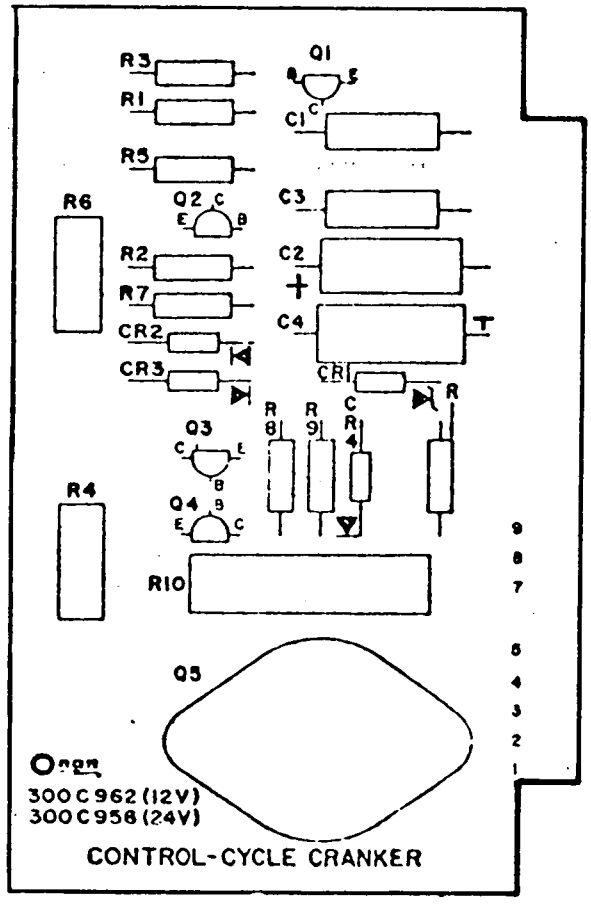
300-0955



REMOTE INDICATOR CONTROL MODULE (UNITS WITH 5 FAULT LIGHTS)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0955	1	Module, Remote Indicator
CR1 thru 6	357-0004	6	Rectifier, Diode (400 MA, 400 Volt)
CR7	364-0017	1	Rectifier, Gate Control
Q1 thru 6	362-0034	6	Transistor, PNP
R1,3,5,7 9,14	350-0529	6	Resistor (270-ohms, 1/2 Watt)
R2,6,8	350-0544	3	Resistor (4,700-ohms, 1/2 Watt)
R11	350-0505	1	Resistor (2,700-ohms, 1/2 Watt)
R12	350-0380	1	Resistor (510-ohms, 1/2 Watt)
R13	350-0517	1	Resistor (27-ohms, 1/2 Watt)
R15	350-0540	1	Resistor (2,200-ohms, 1/2 Watt)
C1,2	355-0005	2	Capacitor, Composition (.22 Mfd., 200 Volt)
R4,10	350-0389	2	Resistor (1,200-ohms, 1/2 Watt)

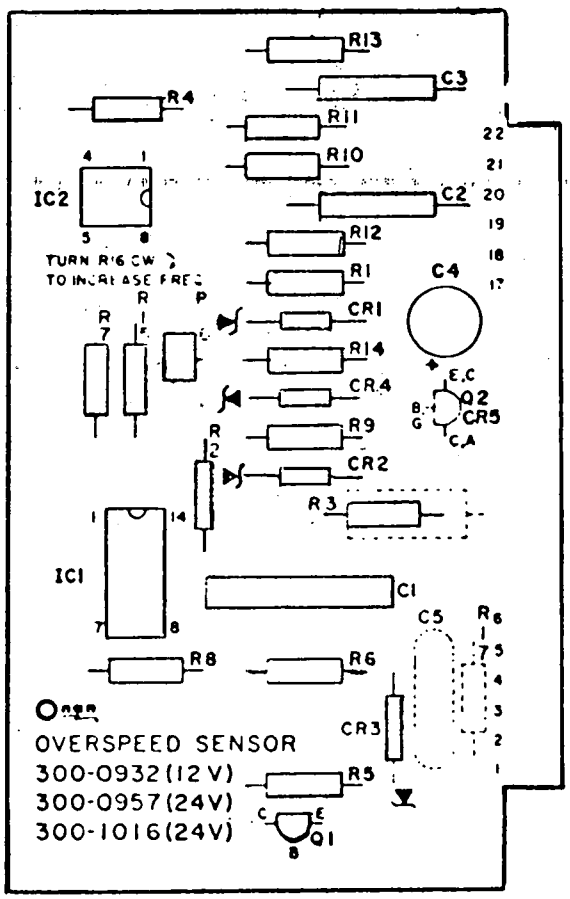
300-0956



CYCLE CRANKER MODULE

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0956	1	Module, Cycle Cranker
C3	355-0010		Capacitor, Composition (.0022 Mfd., 100 Volt)
C2	356-0039	1	Capacitor, Electrolytic (100 Mfd., 10 Volt)
C4	356-0045	1	Capacitor, Electrolytic (25 Mfd., 15 Volt)
CR1	359-0027	1	Diode, Zener (1.0 Watt, 7.5 Volt)
CR2,3,4	357-0004	3	Rectifier, Diode (400 MA 400 Volt)
Q1,2	362-0008	2	Transistors, Signal
Q3	362-0011	1	Transistor, Signal
Q4	362-0026	1	Transistor, Signal
Q5	362-0033	1	Transistor, Power
R1	350-0558	1	Resistor (68,000-ohms, 1/2 Watt)
R2	350-0546	1	Resistor (6,800-ohms, 1/2 Watt)
R3,8	350-0548	2	Resistor (10,000-ohms, 1/2 Watt)
R4,6	303-0171	2	Potentiometer (100,000-ohms)
R5	350-0560	1	Resistor (100,000-ohms, 1/2 Watt)
R7	350-0420	1	Resistor (24,000-ohms, 1/2 Watt)
R9	350-0500	1	Resistor (1-ohms, 1/2 Watt)
R10	352-0158	1	Resistor (50-ohms, 5 Watt)
R11	350-0534	1	Resistor (680-ohms, 1/2 Watt)
C1	355-0029	1	Capacitor, Composition (.015 Mfd., 100 Volt)

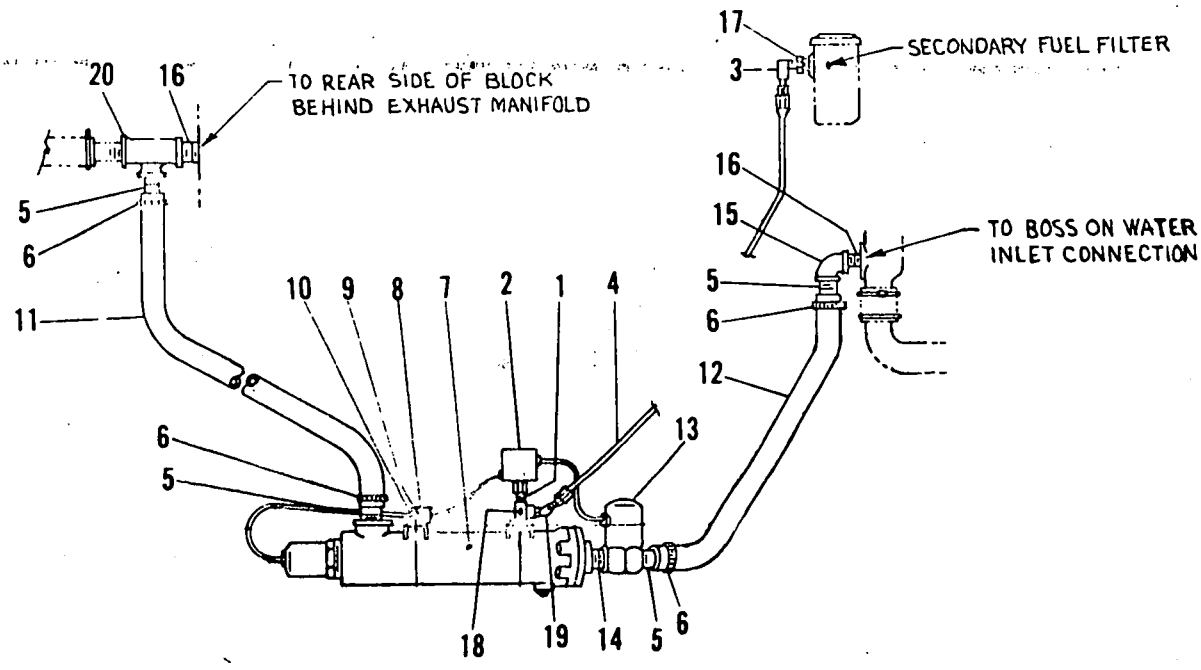
300-0957



OVERSPEED SENSOR CONTROL MODULE

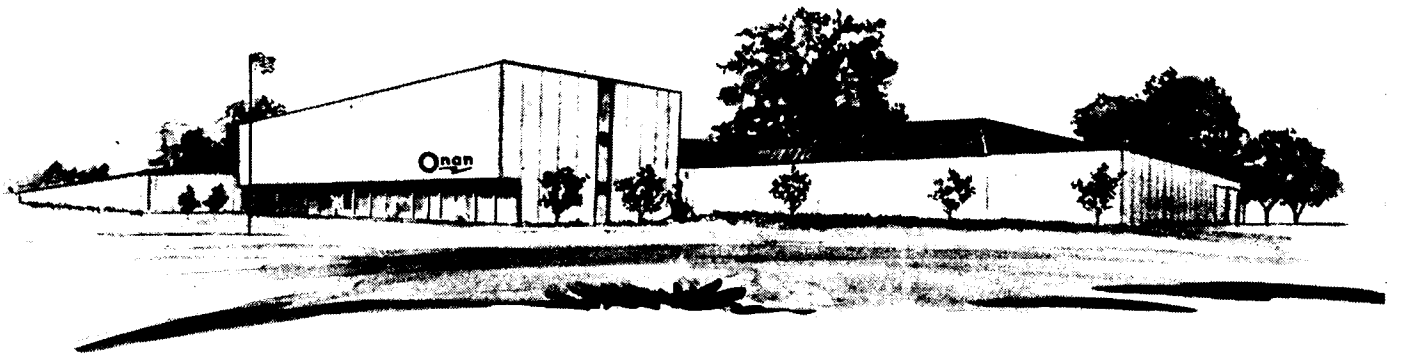
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0957	1	Control, Overspeed Sensor (Complete)
1C1	367-0002	1	Circuit, Integrated
1C2	367-0001	1	Circuit, Integrated
C1	355-0024	1	Capacitor, Composition (.22 Mfd., 200 Volt)
C2,3	355-0010	2	Capacitor, Composition (.0022 Mfd., 100 Volt)
C4	356-0038	1	Capacitor, Electrolytic (50 Mfd., 25 Volt)
CR1	359-0002	1	Diode, Zener (400 MW, 13 Volt)
CR2	359-0017	1	Diode, Zener (400 MW, 5.1 Volt)
CR3	359-0031	1	Diode, Zener (500 MW, 6.8 Volt)
CR4	359-0032	1	Diode, Zener (400 MW, 8.2 Volt)
Q1,2	362-0011	2	Transistor, Signal
R1	350-0382	1	Resistor (620-ohms, 1/2 Watt)
R15	350-0414	1	Resistor (13,000-ohms, 1/2 Watt)
R3	350-0683	1	Resistor (680-ohms, 1/2 Watt)
R4	350-0451	1	Resistor (.47 Megohm, 1/2 Watt)
R5,14	350-0394	2	Resistor (2000-ohms, 1/2 Watt)
R6,7,8,9,2, 10,11,12,13	350-0411	9	Resistor (10,000-ohms, 1/2 Watt)
R16	303-0191	1	Potentiometer (5,000-ohms, 1/4 Watt)

179-2030



WATER JACKET HEATER INSTALLATION (179-2030)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	505-0099	1	Nipple, Pipe (1/4-Close)
2	309-0271	1	Switch, Pressure
3	502-0287	1	Elbow, Male (90°)
4	501-0188	1	Line, Flexible
5	505-0759	4	Adapter, Pipe to Hose
6	503-0429	4	Clamp, Hose
7	333-0138	1	Heater, Engine Water (4000 Watts, 240 Volt)
8	330-0004	1	Cover, Outlet Box
9	330-0005	1	Box, Outlet
10	503-0008	2	Grommet, Rubber
11		1	Hose, Rubber (Order 22" of Bulk Hose #503-0249)
12		1	Hose, Rubber (Order 18" of Bulk Hose #503-0249)
13	309-0253	1	Thermostat
14	505-0107	1	Nipple (1 x 2")
15	505-0041	1	Elbow, Pipe (1 x 90°)
16	505-0004	2	Nipple, Close (1 x 1½")
17	505-0281	1	Bushing, Reducer (1/2" x 1/4")
18	333-0142	1	Support, Pressure Switch
19	502-0284	1	Elbow, Male (45°)
20	505-0304	1	Tee, Pipe (1")



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