Onan®

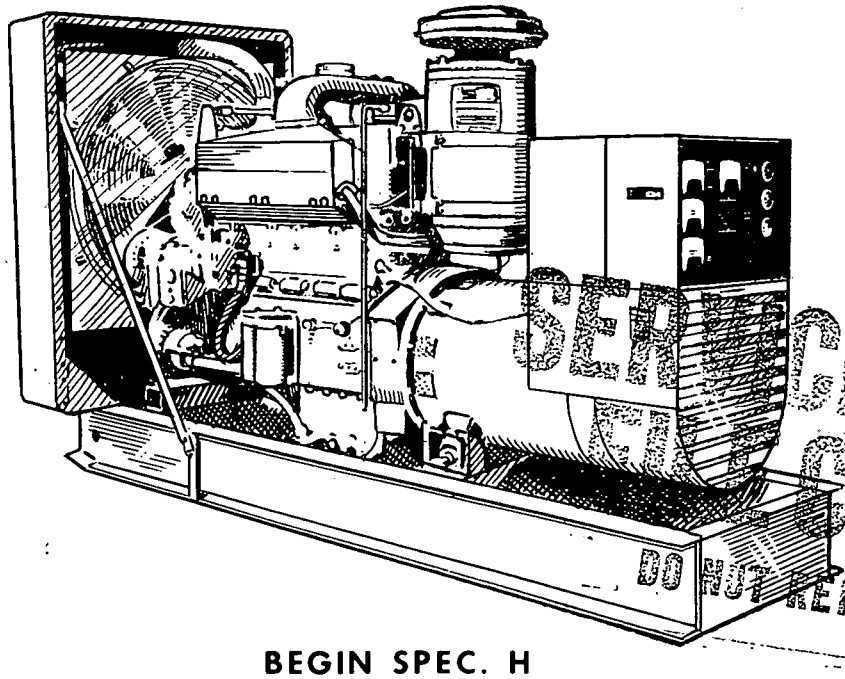
OPERATOR'S MANUAL AND PARTS CATALOG

FOR

DFM

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)
Revolutions per Minute	r/min	rpm
Temperature	Celsius (°C)	Fahrenheit (°F)

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

WARNING

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

INTRODUCTION

FOREWORD

This manual is applicable to the DFM Series electric generating set, consisting of an ONAN YB generator, driven by a Cummins NTA855-G Diesel Engine. See *SPECIFICATIONS* for generator sizes.

The manual is divided into two sections.

Section 1 provides information on installation, operation and troubleshooting.

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

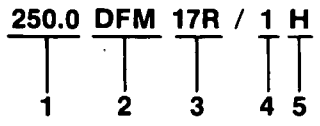
The manual should be used in conjunction with the Cummins engine manual, for specific engine information.

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

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

MODEL IDENTIFICATION

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



1. Indicates Kilowatt rating (250.0 kW).
2. Factory code for SERIES identification.
3. 17 = 60 Hz. Reconnectible
   517 = 50 Hz. Reconnectible
   R—Indicates remote starting feature.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

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

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

SAFETY PRECAUTIONS

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

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

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

Most accidents can be prevented!

KNOW YOUR MANUAL—KNOW YOUR EQUIPMENT

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

General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove all oil deposits; keep the floor clean and dry.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the generating set are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- Do not wear loose clothing in the vicinity of moving parts, or jewelry while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts; cause shock or burning.
- If necessary to make adjustments while the unit is running, use extreme caution when close to hot exhausts, moving parts, etc.
- Do not stand on a wet floor while working on electrical equipment. Use rubber insulative mats placed on dry wood platforms.

Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME in the vicinity of the generator set or fuel tank. Internal combustion engine fuels are highly flammable.

  REMEMBER—IF YOU CAN SMELL FUMES—A POSSIBLE EXPLOSION AND FIRE CONDITION EXISTS!
- Make sure that oily rags are not left on or near the engine. Oil soaked rags are combustible and present hazardous walking conditions.
- Fuel lines must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Your engine installation should be equipped with a means of positive fuel shutoff in applications when fuel is conducted from a remote source. Fuels under pressure (e.g. natural gas or liquefied petroleum gas) should be controlled by a positive shutoff valve, preferably automatic, in addition to any valve integral with the carburetor or gas regulator equipment.

Exhaust System

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

Coolant System

- Coolants under pressure have a higher boiling point than that of water. DO NOT open a radiator or heat exchanger pressure cap or break a system while the engine is running, and in no case until the system pressure has been bled off.

- Radiator fan belts are guarded for your protection. DO NOT remove covers or guards.

- Keep your hands away from moving parts.

Ventilation System

- Check remote radiators frequently. Remove any dirt, debris, bird nests, etc.

- Check ventilation louvres frequently. Make sure that free-fall louvres and motor operated louvres open and close properly and that there is no restriction in the free-air flow.

Electrical System

- The electrical installation exterior to your generator should have been performed by qualified licensed electricians. All local and state codes should have been consulted and complied with. It is essential that all load circuit breakers adequately protect electrical functions, all circuits are properly grounded and wiring is correct capacity.

- Tag open switches.

- DON'T tamper with interlocks.

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

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

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

SPECIFICATIONS

ENGINE DETAILS

Engine Manufacturer	CUMMINS
Engine Series	NTA 855 G
Number of Cylinders	6
Displacement	855-in³ (14.0 litres)
BHP @ 1800 r/min	400 (298.4 kW)
Compression Ratio	13.5:1
Bore	5.50-inch (139.7 mm)
Stroke	6.00-inch (152.4 mm)
Fuel	Diesel
Battery Voltage	24
Battery Group (Two 12-Volt, 225 A.H. [810 kC])	8D
Starting Method	Solenoid Shift
Governor Regulation	5% Max No Load—Full Load
Battery Charging Current	35-Amperes

GENERATOR DETAILS

Type	YB 17 60 Hz YB 517 50 Hz
Rating (Watts)	
60 Hertz Continuous Standby	250 000 (312.5 kVA)
50 Hertz Continuous Standby	210 000 (262.5 kVA)
AC Voltage Regulation	± 2%
60 Hertz r/min	1800
50 Hertz r/min	1500
Output Rating	0.8 PF
AC Frequency Regulation	3%

CAPACITIES AND REQUIREMENTS

Cooling System (Engine, Radiator and Aftercooler)	14.5 Gallons (55 litres)
Engine Oil Capacity (Filter, Lines, Crankcase)	10.5 Gallons (40 litres)
Exhaust Connection (inches pipe thread)	5.0 OD male

AIR REQUIREMENTS (1800 r/min)

Engine Combustion	950-cfm (0.45 m³/s)
Radiator Cooled Engine	19 000-cfm (8.97 m³/s)
Total for Radiator Cooled Model	19 950-cfm (9.42 m³/s)
Alternator Cooling Air (1800 r/min)	1,200-cfm (0.6 m³/s)
(1500 r/min)	1,000-cfm (0.5 m³/s)
Fuel Consumption at Rated Load ASTM No. 2 Diesel	
60 Hz	18.4 g/h (19.4 cm³/s)
50 Hz	15.8 g/h (16.6 cm³/s)

GENERAL

Height	71.5 inches (1.82 m)
Width	44 inches (1.12 m)
Length	114 inches (2.90 m)
Approximate Weight (Mass)	6320 lb. (2867 kg)

TABLE 1. YB GENERATOR VOLTAGE/CURRENT OPTIONS

250 kW 312.5 kVA 60 Hz
210 kW 262.5 kVA 50 Hz

VOLTAGE	FREQ	PHASE	AMPERES	PARALLEL WYE	SERIES WYE	SERIES DELTA	REF XFMP TAP
CODE 17							
120/208	60 Hz	3	867	x			H3
127/220	60 Hz	3	820	x			H4
139/240	60 Hz	3	752	x			H5
240/416	60 Hz	3	434		x		H3
254/440	60 Hz	3	410		x		H4
277/480	60 Hz	3	376		x		H5
CODE 517							
110/190	50 Hz	3	798	x			H3
115/200	50 Hz	3	758	x			H4
120/208	50 Hz	3	729	x			H4
127/220	50 Hz	3	689	x			H5
220/380	50 Hz	3	399		x		H3
230/400	50 Hz	3	379		x		H4
240/416	50 Hz	3	364		x		H4
254/440	50 Hz	3	344		x		H5
CODE 5D**							
120/240	60 Hz	3	752			x	H5
CODE 6D**							
240/480	60 Hz	3	376			x	H5
CODE 7**							
220/380	60 Hz	3	475		x		H3
CODE 9X**							
347/600	60 Hz	3	301		x		H5

* - Adjust voltage transformer on TB21 in Control Cabinet.
** - Not reconnectible.

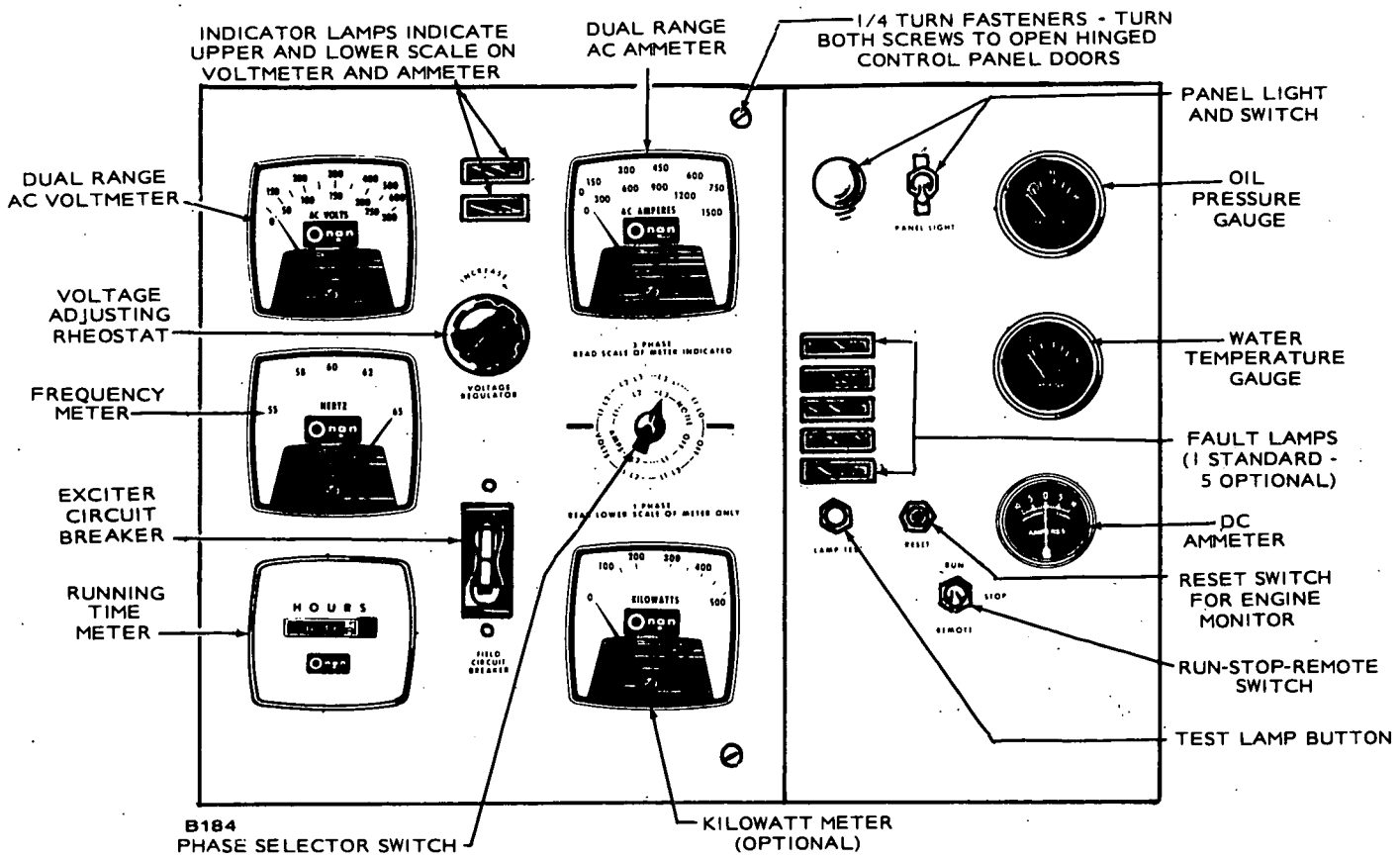


FIGURE 1. CONTROL PANEL

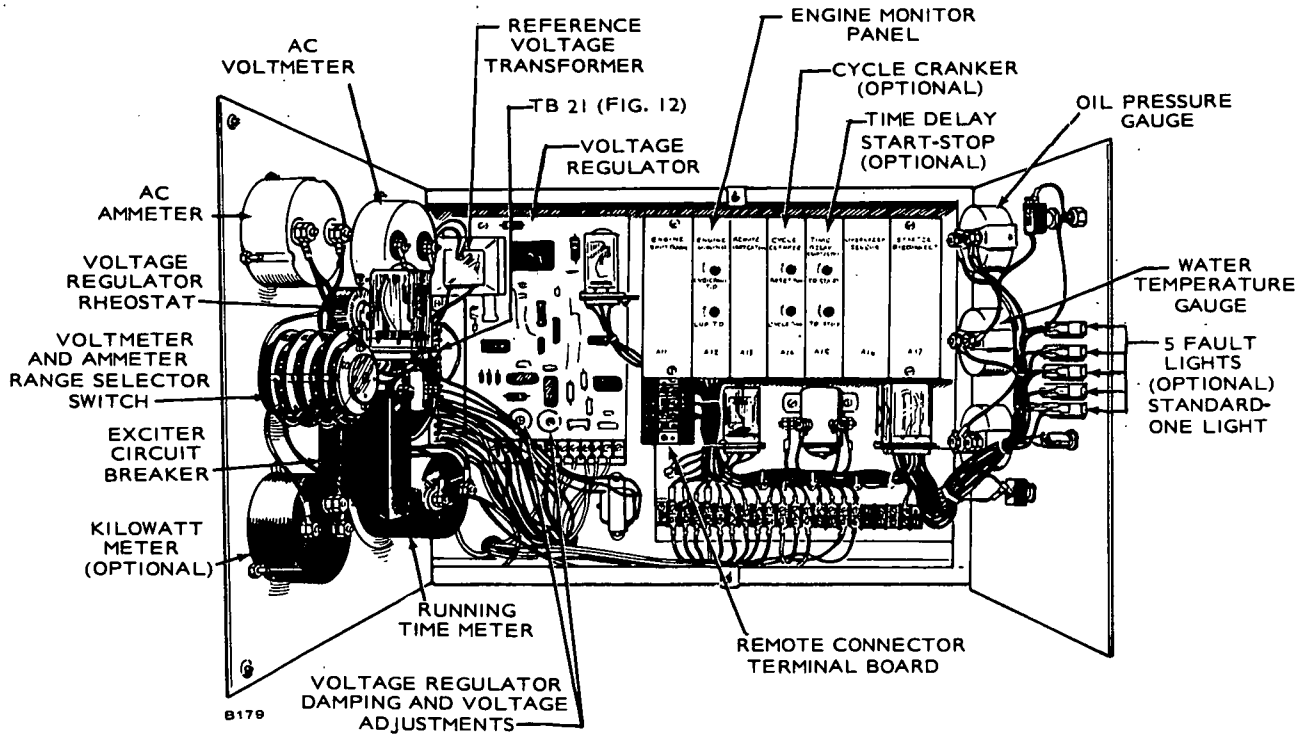


FIGURE 1A. CONTROL PANEL INTERIOR

DESCRIPTION

GENERAL

An ONAN DFM 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 DFM is a Cummins NTA855-G as described in the engine manual. Basic measurements and requirements will be found under *SPECIFICATIONS.* For operation, maintenance and service information, consult the Cummins manual.

AC GENERATOR

The generator is an ONAN Type 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 r/min, and the 50 Hz at 1500 r/min. Excitation is achieved as follows—

Residual alternating current from the stator winding is applied to the voltage regulator, where it is compared with a reference voltage, rectified and returned to the field 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 r/min.)

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 wire W22 to terminals H3, H4, H5, and H6 is made at this point, to change reference voltage when reconnecting generator for different voltages. Refer to Figure 16.

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

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

1. A 75 second cranking period.
2. Approximately 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 r/min.
   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.

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 r/min. A sensor mounted on the generator shaft (Figure 2) signals an overspeed condition which shuts down the engine through control module A16.

Start-Disconnect: Plug-in module. Operates at approximately 100 r/min 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.

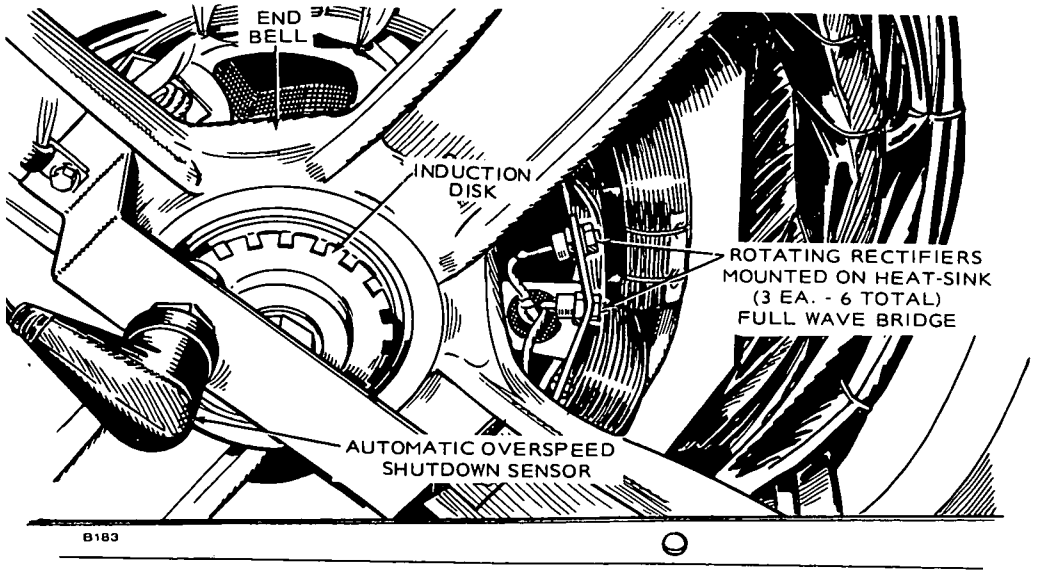


FIGURE 2. OVERSPEED SENSOR

TABLE 2. FAULT LAMP OPTIONS

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

* - With additional optional sensors.

ENGINE SENSORS

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

For location, refer to Figures 3 and 4. When changing a sensor, do not substitute, use recommended replacement parts. Resistance units are matched to the gauge they supply, and cut-off switches are close-tolerance actuation parts, made for a specific application.

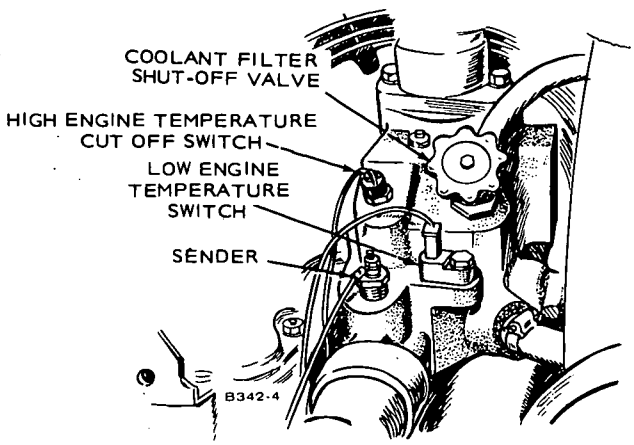


FIGURE 3. WATER TEMPERATURE MONITORS

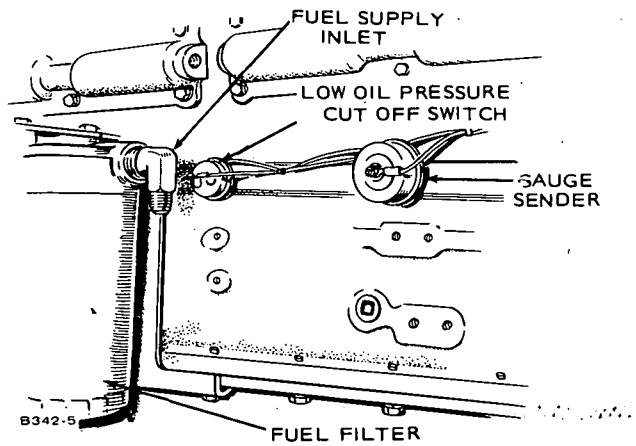


FIGURE 4. OIL PRESSURE MONITORS

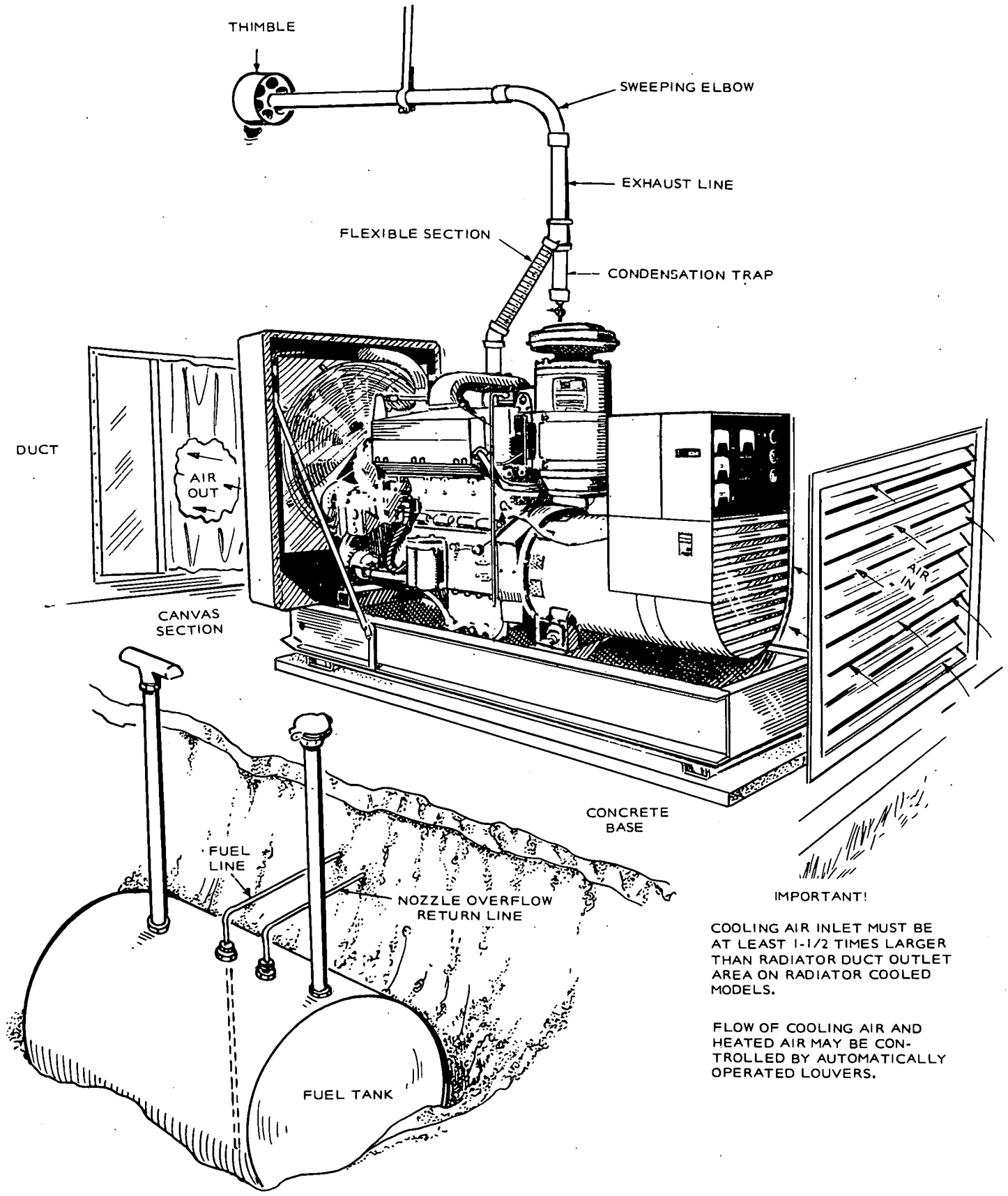


FIGURE 5. TYPICAL DFM INSTALLATION

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 5.

Requirements to be considered prior to installation:

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

LOCATION

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

MOUNTING

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

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

VENTILATION

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

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

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

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

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

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

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

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

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

COOLING SYSTEM

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

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

This system reduces set enclosure airflow and noise levels. Proper operation depends upon a constant supply of raw water for heat removal. The engine coolant side of the system may be protected from freezing the raw water side cannot. See Figure 6 for typical installation.

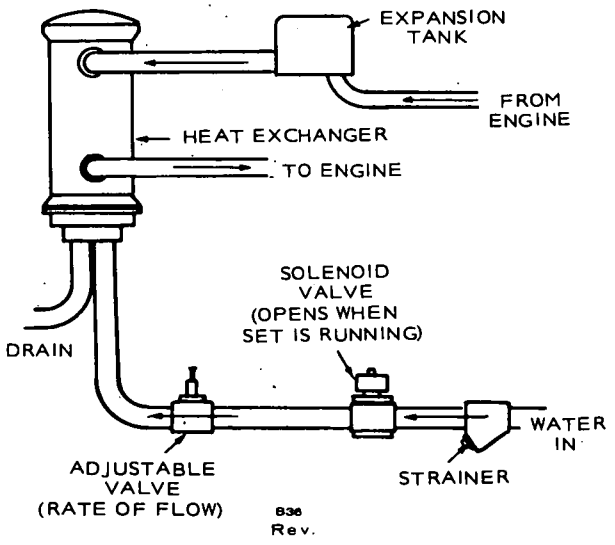


FIGURE 6. TYPICAL HEAT EXCHANGER SYSTEM

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

This system reduces set enclosure airflow requirements and noise levels. Proper operation is dependent on a constant supply of cooling water. The system cannot be protected from freezing. See Figure 7.

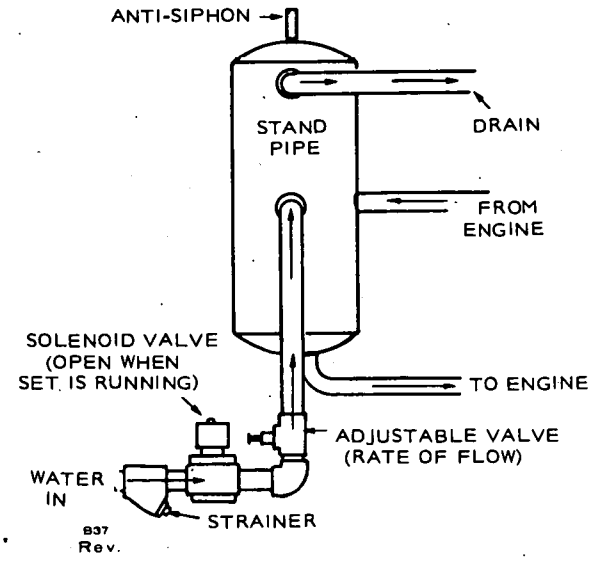


FIGURE 7. TYPICAL STANDPIPE SYSTEM

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

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

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

COOLING CONNECTIONS

The radiator cooled (standard) set does not require any external connections except as discussed under *Ventilation*. Allow clearance around the set for access to service the radiator and fan belts. See Figure 5.

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

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

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

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

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

COOLANT FILTER

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

Do not use any type of antifreeze with a stop-leak additive. The filter will remove the additive (usually a particulate) and become clogged and ineffective. Replace filter periodically as recommended in *GENERAL MAINTENANCE* section. A shut-off valve is installed at each end of the bypass filter line to facilitate filter changing (see Figure 8).

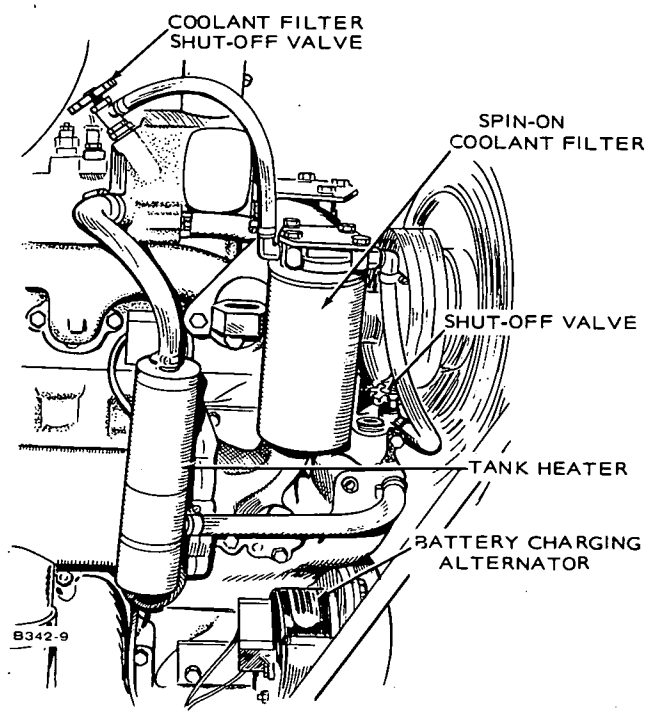


FIGURE 8. COOLANT FILTER INSTALLATION

WATER JACKET HEATER (Optional)

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

EXHAUST

WARNING **Inhalation of exhaust gases can result in death.**

Engine exhaust gas must be piped outside building or enclosure. Do not terminate exhaust pipe near inlet vents or combustible materials. An approved thimble (Figure 9) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 10) 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 5 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9-inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 5-inch (127 mm) pipe size outlet of the engine with a flexible portion between the engine and the muffler.

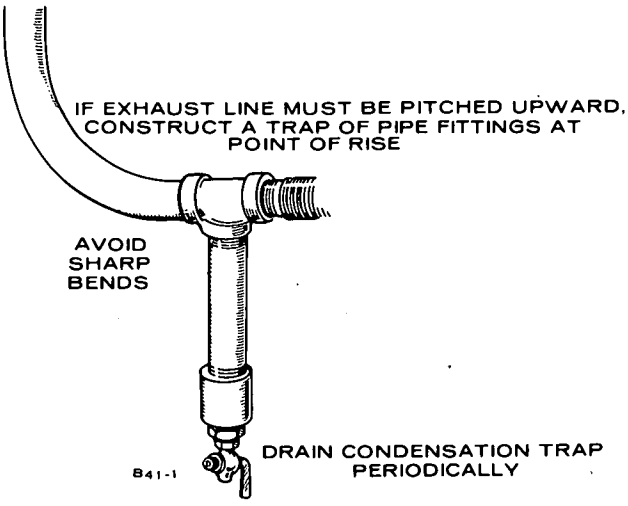


FIGURE 10. EXHAUST CONDENSATION TRAP

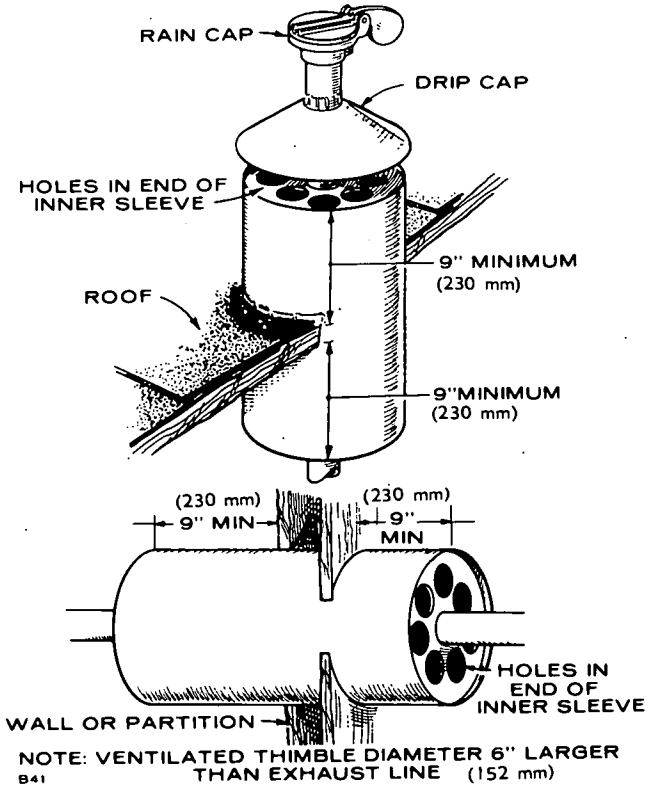


FIGURE 9. EXHAUST THIMBLE

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

Single Exhaust system:

6-inch diam..... 100 Feet (30 m)

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

FUEL SYSTEM

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

FUEL CONNECTIONS

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

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

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

Fuel inlet connection is to the filter and is threaded for 7/8-inch 14 UNF fitting. Injector's return to the tank is threaded for 3/4-inch 16 UNF fitting. See Figure 11 for fuel system installation.

Maximum return line restriction, 4-inches Hg (13.5 kPa).

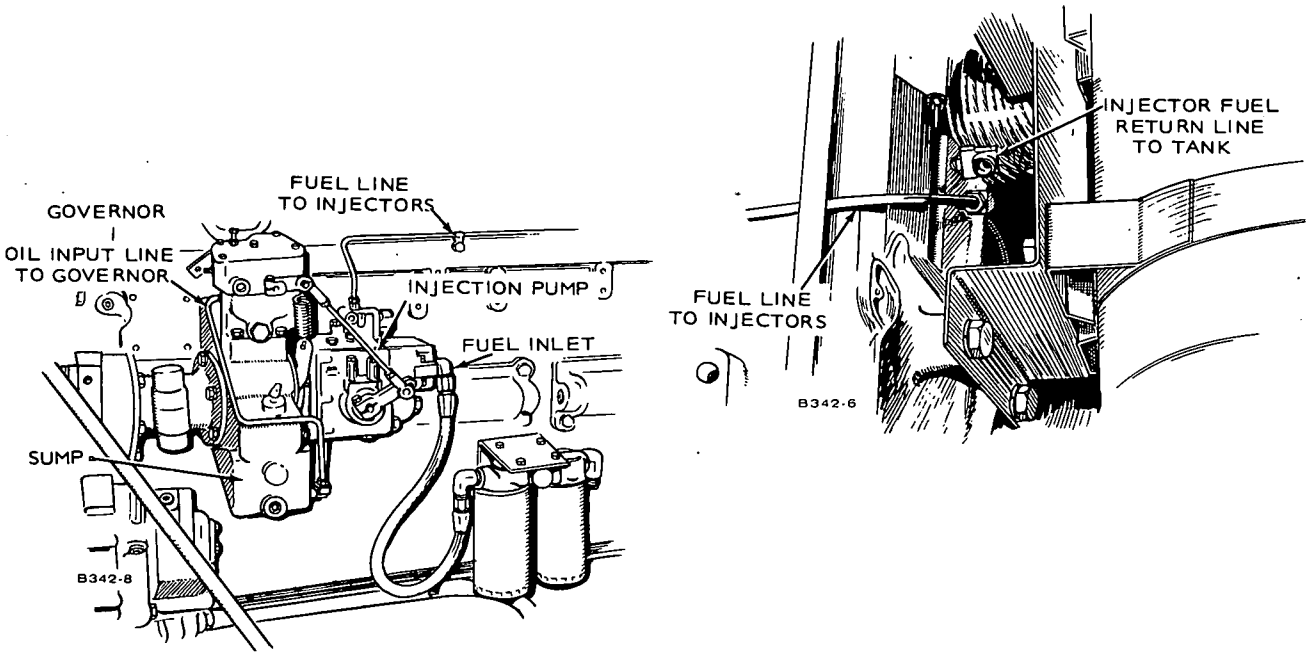


FIGURE 11. FUEL SYSTEM

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the fuel tank. The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and main fuel tank. Refer to the installations included with the tank. See Figure 12 for an example of a day tank installation. Tank and lines must be below level of injector pump return outlet.

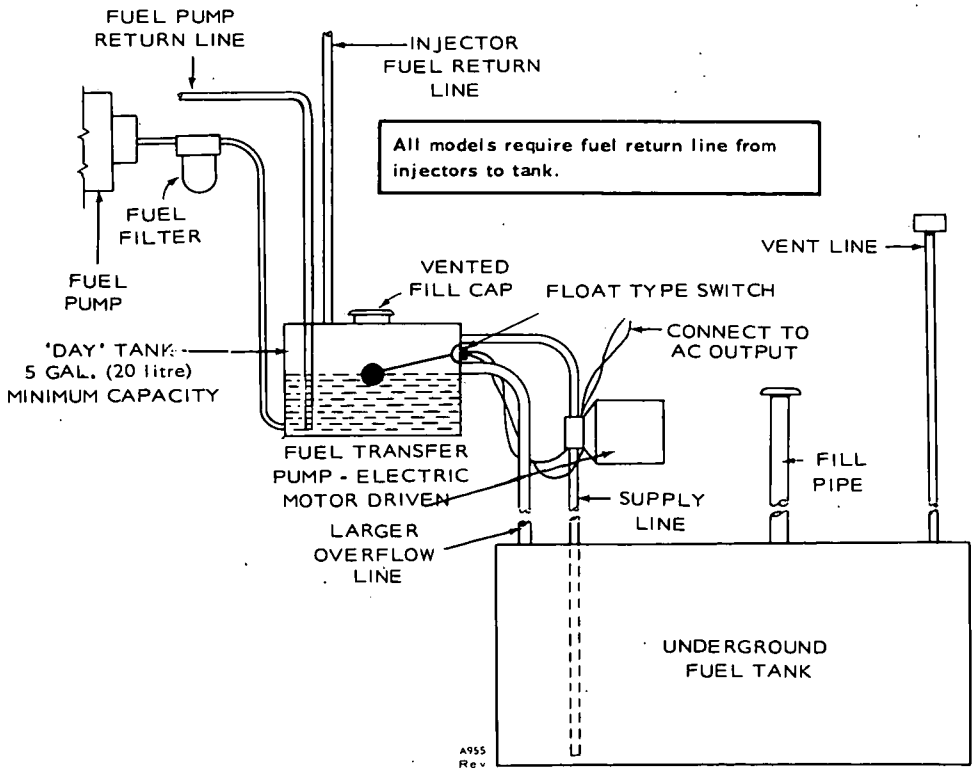


FIGURE 12. DAY TANK (TYPICAL)

BATTERY

Starting the unit requires 24-volt battery current. Use two 12-volt (see *SPECIFICATIONS*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 13. 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 (32.3° C) such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.275 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90° F (32.2° C), this should not be noticed. The lengthened battery life will be worth the effort.

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

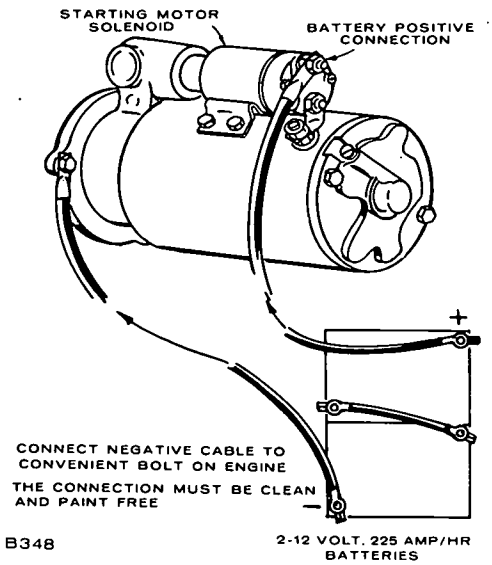


FIGURE 13. BATTERY CONNECTION

REMOTE CONTROL CONNECTIONS

Provision is made for additon 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 14. If the distance between the set and remote station is less than 1000-feet (305 m), use No. 18 AWG wire; between 100- and 2000-feet (305 and 610 m), use No. 16 AWG wire.

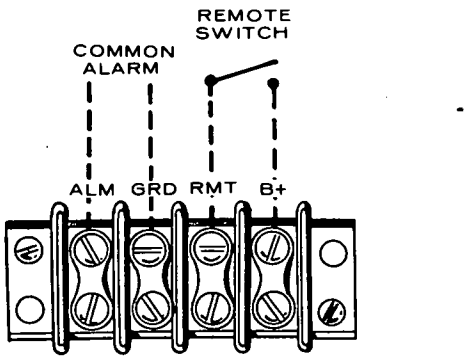


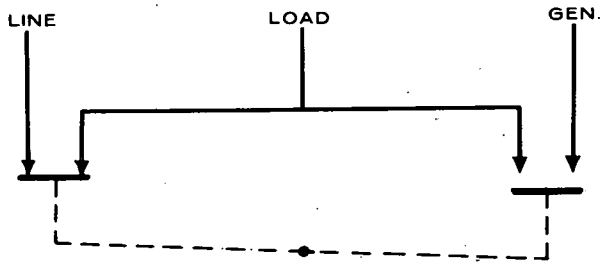
FIGURE 14. REMOTE START CONNECTION (TB12)

WIRING CONNECTIONS

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

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

If the installation is for standby service, a double throw transfer switch must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator current to be connected to the load at the same time. See Figure 15. Instructions for connecting an automatic load transfer control are included with such equipment.



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.

FIGURE 15. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

CONTROL BOX CONNECTION

Reconnection lead W22 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 16) depending upon the voltage option required. Refer to Table 1 and Figure 20 for voltages available and correct hookup.

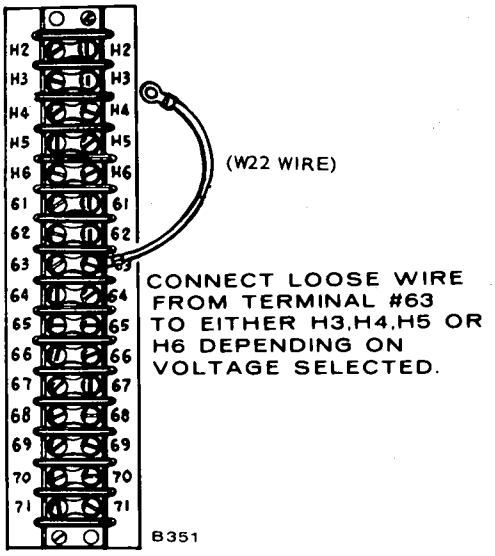


FIGURE 16. CONTROL BOX CONNECTION

GENERATOR CONNECTIONS

The model YB17 generator is a 3-phase 60 Hz (YB517 is 50 Hz) unit which can be bus-bar connected (see Figure 18) 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 20. 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 17 for an example of 120/208 voltage connection.

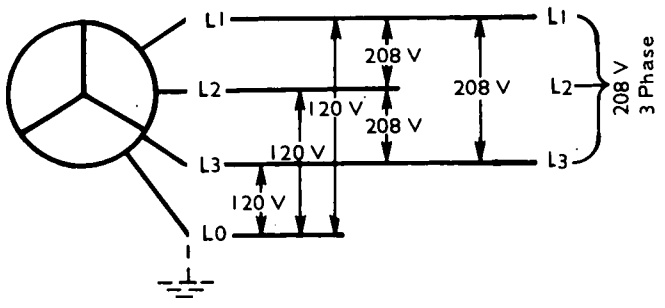


FIGURE 17. 3 PHASE WYE CONNECTION

For 3-phase loads connect separate load wires to each of the set terminals L1, L2 and L3 (Figure 17). 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.

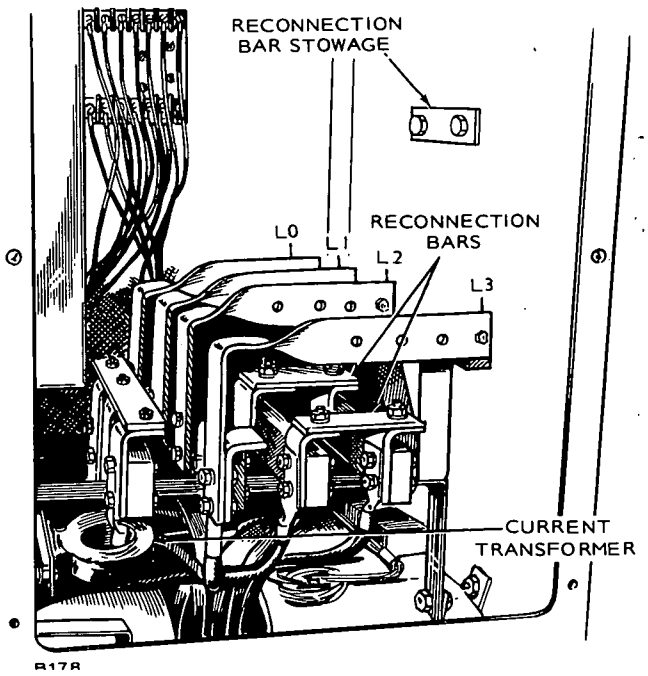


FIGURE 18. LOAD WIRE CONNECTIONS

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. See Figure 18.

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.

For 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 19 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.

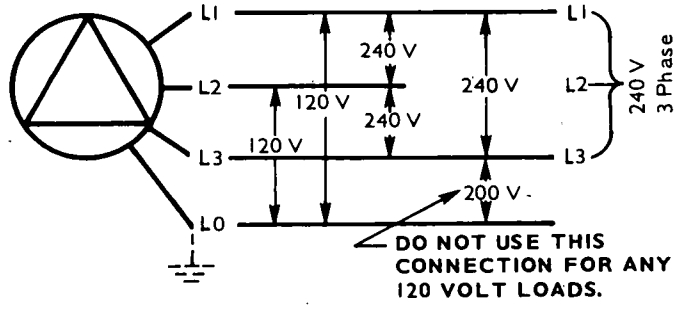
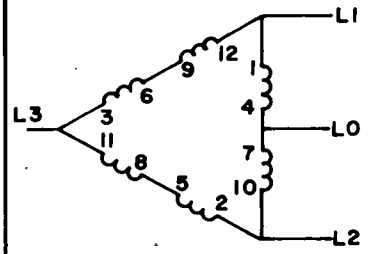
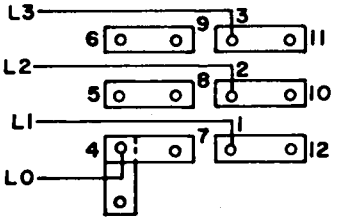
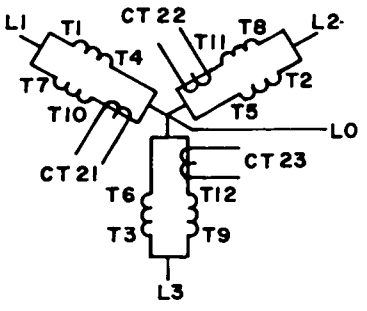
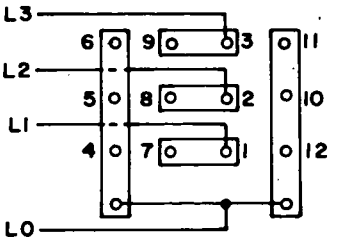
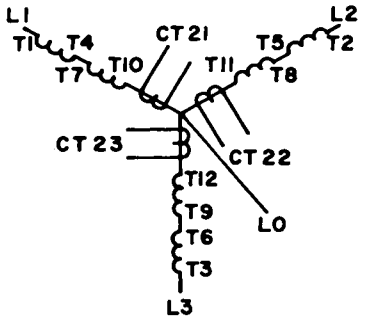
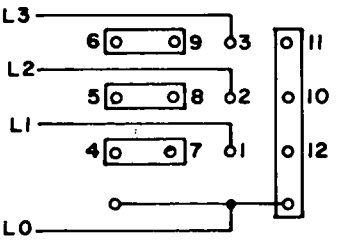
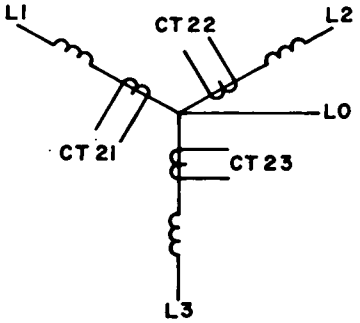
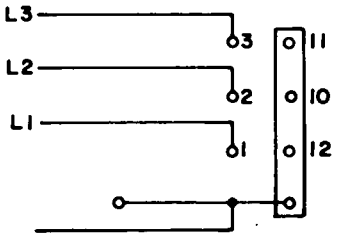


FIGURE 19. 3 PHASE, DELTA CONNECTION

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASE	FREQUENCY	CONNECT LEADS FROM TERMINAL 63 TO: GENERATOR CONNECTION		GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM
5D	120/240	3	60	H5	SERIES DELTA		
6D	240/480	3	60	H5			
	120/208	3	60	H3	PARALLEL WYE		
17	127/220	3	60	H4			
	139/240	3	60	H5			
	110/190	3	50	H3			
517	115/200	3	50	H4			
	120/208	3	50	H4			
	127/220	3	50	H5			
7	220/380	3	60	H3	SERIES WYE		
	240/416	3	60	H3			
17	254/440	3	60	H4			
	277/480	3	60	H5			
	220/380	3	50	H3			
517	230/400	3	50	H4			
	240/416	3	50	H4			
	254/440	3	50	H5			
9X	347/600	3	60	H5	SERIES WYE		

SINGLE PHASE NOTE NOT AVAILABLE YB SERIES GENERATORS 98-2579(C)

FIGURE 20. OPTIONAL VOLTAGE CONNECTIONS

OPERATION

GENERAL

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

PRESTART SERVICING

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

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

- new grade SE/CD

Oil viscosity should be as follows:

AMBIENT TEMPERATURES	VISCOSITY
-10° F (-23° C) and below	See engine manual.
-10 to 30° F (-23 to -1° C)	10W
20 to 60° F (-7 to 16° C)	20-20W
40° F (4° C) and above	30

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

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 14.5-gallons (55 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures use anti-freeze with an ethylene glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to Cummins engine manual for additional information.

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

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

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

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

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

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

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

1. Remove oil inlet line from turbo-charger housing (Figure 21), fill bearing housing with clean engine lubricating oil; replace line, secure.
2. Fill crankcase to "L" (low) mark on dipstick (Figure 22).
3. Remove plug from head of oil filter housing (Figure 21) and connect a hand or motor-driven priming pump from a source of clean lubricating oil to the plug boss in filter housing.
4. Prime until a 30 psi (207 kPa) pressure is obtained.
5. Disconnect wire from fuel solenoid valve (Figure 23), close throttle and crank engine while maintaining an external prime pressure of 15 psi (103 kPa), for 15 seconds.
6. Remove external priming equipment, replace plug in filter housing, torque 15 to 20 lb-ft (20 to 27 N.m).
7. Reconnect wire to fuel shut-off valve.
8. Complete oil fill to "H" (high) mark on dipstick.

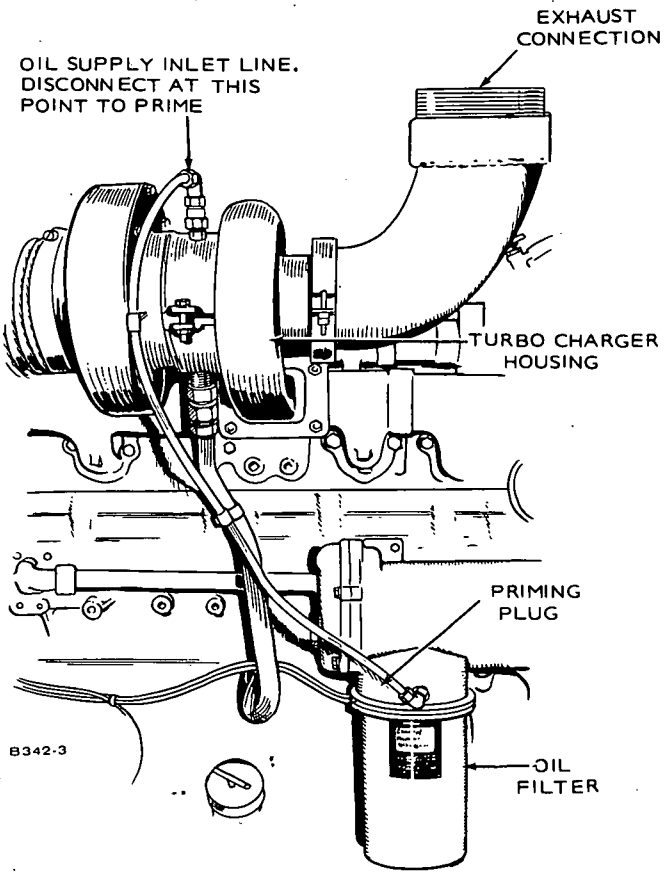


FIGURE 21. PRIMING TURBOCHARGER

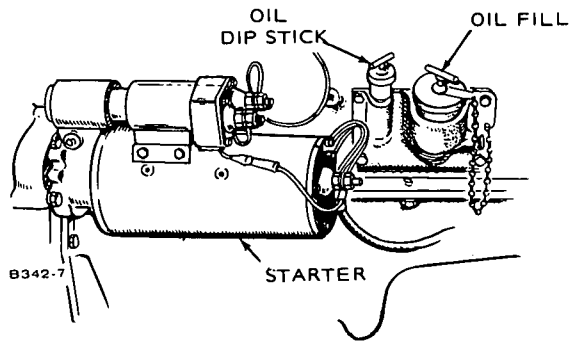


FIGURE 22. OIL FILL AND DIPSTICK LOCATIONS

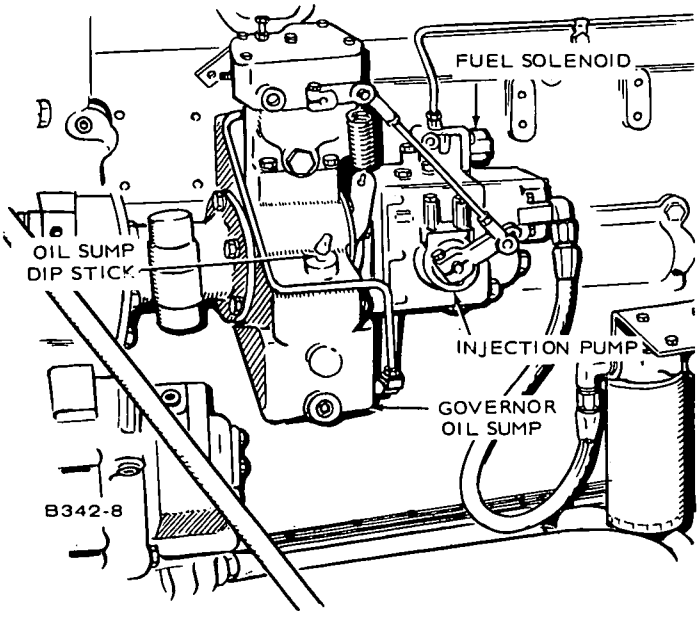


FIGURE 23. FUEL SOLENOID VALVE LOCATION

Priming Fuel System: Priming should not be necessary as the set was checked out before shipping. If however it is desired to verify and reprime system, remove each fuel filter and fill with clean fuel oil. Replace filters and make sure that all connections are secure (see Figure 27).

BATTERIES

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

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

STARTING

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

1. Crankcase filled.
2. Governor sump filled (Figure 24).
3. Cooling system filled—input solenoid valve open.
4. Batteries charged and connected.
5. Fuel solenoid valve open.

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

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

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

STOPPING

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

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

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

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

NO LOAD OPERATION

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

EXERCISE PERIOD

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

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

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

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

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

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

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

*NOTE: Not applicable on Pennsylvania State models.

OUT-OF-SERVICE PROTECTION

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

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

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

PREPARING A STORED ENGINE FOR SERVICE

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

Clean Engine

1. Clean accumulated dirt from exterior of engine. Remove covers, tape and wrappings.
2. Use suitable cleaner to remove rust preventive compound from unpainted surfaces.
3. Refill crankcase with clean lubricating oil. Flush and fill cooling system.

Inspection

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

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

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

HIGH ALTITUDE

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

HIGH TEMPERATURES

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

LOW TEMPERATURES

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

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

GENERAL MAINTENANCE

GENERAL

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

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

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

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

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

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	8	50	100	200-250
Inspect Set	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		
Replace Fuel Filter				x
Check all hardware, fittings, clamps, fasteners, etc.			x6	

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

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

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

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

x5 - Or every two weeks.

x6 - Or every 3 months.

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

ENGINE SPEED

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

A Woodward governor is standard equipment on the DFM 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 24.

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

Example: 30 x 61 (Hz) = 1830 r/min

Adjust engine speed to 1800 r/min for 60 Hz sets and 1500 r/min for 50 Hz sets.

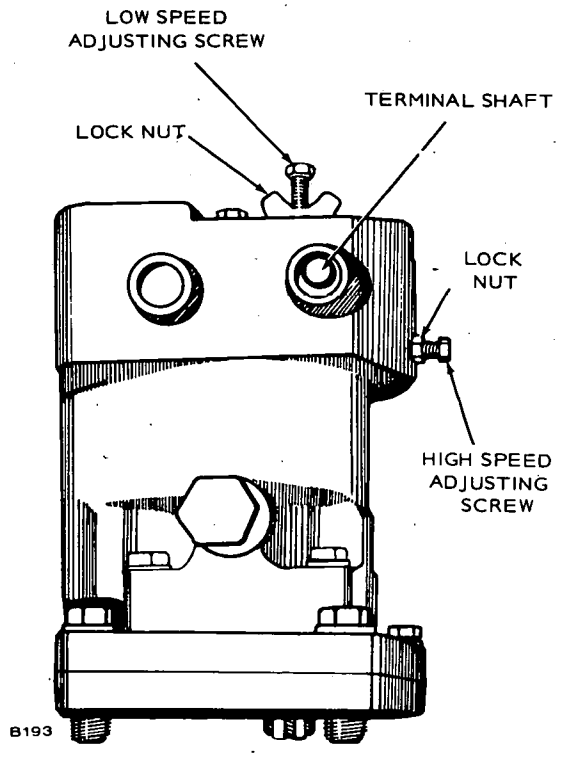


FIGURE 24. WOODWARD GOVERNOR

BATTERIES

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

CONNECTIONS (Fuel, Exhaust, etc.)

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

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

AC GENERATOR

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

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

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

INSPECTION AND CLEANING

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

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

FILTERS

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

Air Filter: Replace or clean when plugged, or in accordance with service maintenance instructions. To remove filter element loosen eight nuts holding head, lift off head and remove filter element (see Figure 25).

Recommended clean method for element:

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

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

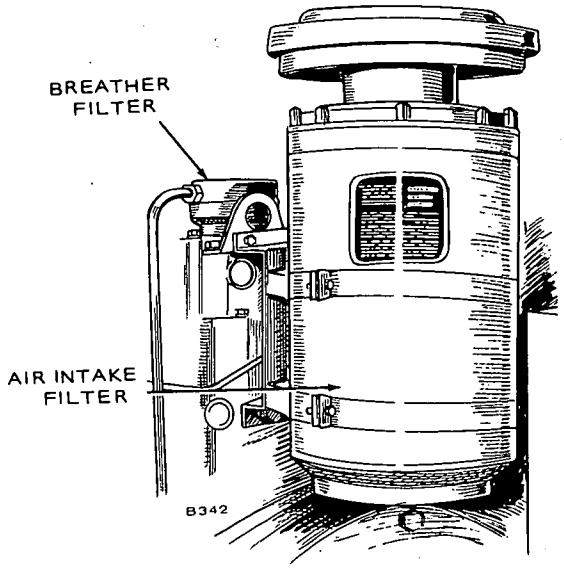


FIGURE 25. AIR FILTER

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

To change filter, proceed as follows—

1. Remove drain plug (see Figure 26) and allow oil to drain.

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

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

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

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

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

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

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

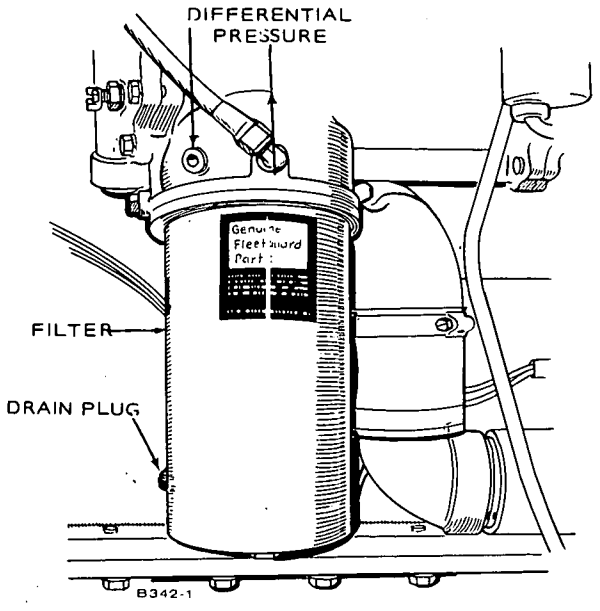


FIGURE 26. LUBRICATION OIL FILTER

Fuel Filter: Spin-off throw-away unit. A water drain is situated at the bottom of the filter case. This should be used to drain off moisture either daily or at the end of every exercise period, depending on unit application. When replacing filter, fill with clean fuel before installation (see Figure 27).

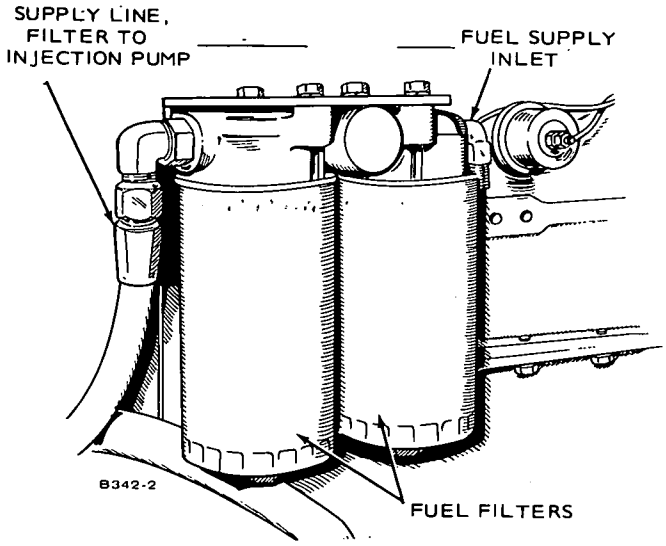


FIGURE 27. FUEL FILTERS

Coolant Filter: A shut off valve (see Figure 28) is installed in the inlet and outlet line to the coolant filter to be closed, for minimum coolant loss when the filter is removed. Refer to engine manufacturer's manual for coolant filter replacement information.

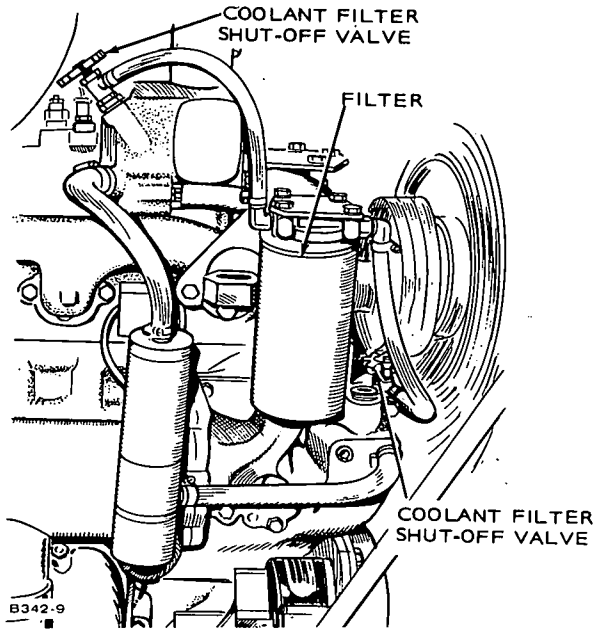


FIGURE 28. COOLANT FILTER

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

1. Remove wing nut, flat-washer and rubber washer holding cover, lift cover and swing away from filter assembly (see Figure 29).
2. Lift out breather element, vapor element and gasket.
3. Clean all parts with approved solvent. Dry with compressed air (30 psi maximum [OSHA]).
4. Inspect all parts, replace if necessary.
5. Reassemble filter assembly, replace cover and secure.

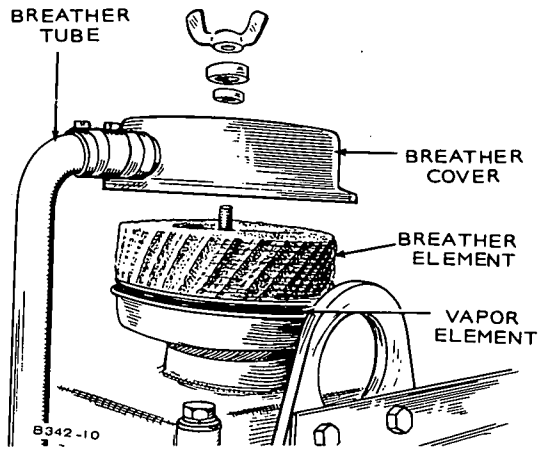


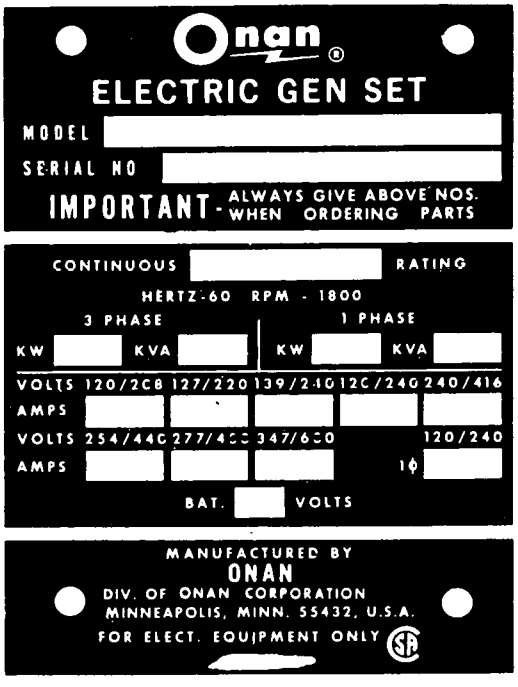
FIGURE 29. CRANKCASE BREATHER FILTER

PARTS CATALOG

INSTRUCTIONS FOR ORDERING REPAIR PARTS

ONAN PARTS

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



CUMMINS PARTS

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

CUMMINS

CUMMINS ENGINE COMPANY, INC.
COLUMBUS, INDIANA, U.S.A.

SBM NO. | MODEL | ENG NO. | OTHER REF.NO.

This catalog applies to the standard DFM generator sets as listed below, powered by a Cummins NTA855G engine (see Cummins manual). Engine parts modified or added by Onan will be in this list and have Onan part numbers. These supersede similar parts listed in the Cummins manual. Onan parts are arranged in groups of related items and are identified by a reference number. All parts illustrated are typical. Unless otherwise mentioned, parts are interchangeable. Right and left generator set sides are determined by *facing* the front end of the engine.

ELECTRIC GENERATING SET DATA

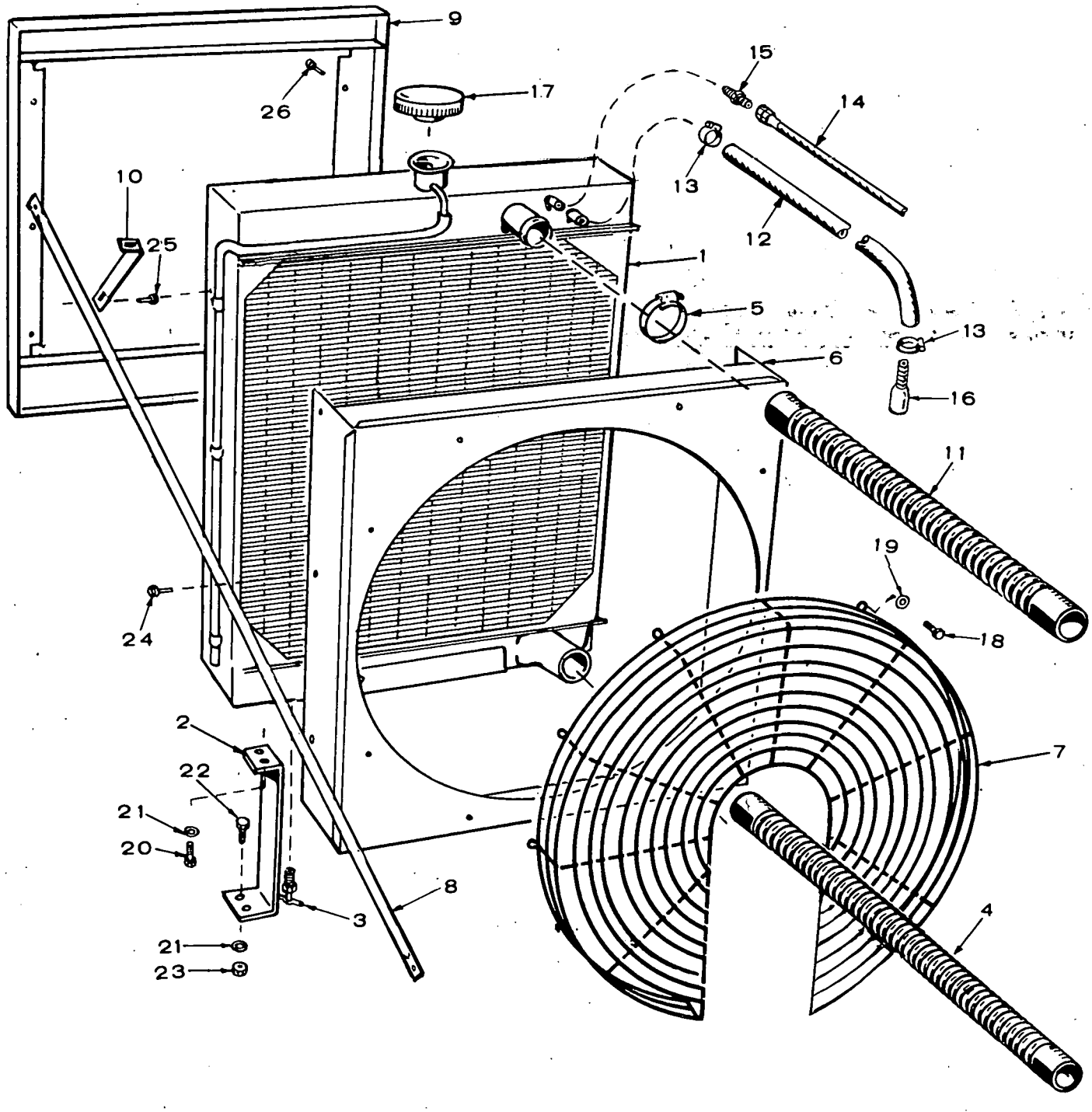
Model and Spec No.*	Watts†	Wire	Hertz	Phase
250 DFM 17R/	250,000	12	60	3

* - The Specification letter advances (A to B to C, etc.) with manufacturing changes.
† - These sets are reconnectible; refer to Specifications (generator details).

REPLACEMENT ENGINE

100-1359	1	Engine, Replacement (Cummins NTA855G). General Description: Includes: Complete Cylinder Block, Fuel Pump, Fuel Filters, Oil Filter, Governor, Fan Blades (Pusher Type), Flywheel, Fan Belt, Water Pump, Turbo Charger and After Cooler, 90° Turbo Exhaust Connector, 90° Water Outlet. Excludes: Alternator, Starter, Water Temperature Sender, Oil Pressure Sender, Radiator, Ammeter. **NOTE:** Replacement engine is for standard Spec 1 generator sets. For all other Specs refer to factory.

COOLING SYSTEM GROUP



140 - 1346 | DWG SIZE P

1. Name AIR CLEANER ASSY

2. Mfrd. by DONALDSON COMPANY, INC.
   Address MPLS, MINN 55440

3. Manufacturer's No.;
   [X] Mfr. standard no. EBA13-0018 which describes it fully. It is a standard commercial item.
   [ ] Mfr. style no. _____ which is an incomplete description. Also necessary to specify _____

4. Government Spec: The part described
   [X] is not required to meet a Gov't Spec.
   [ ] must meet Gov't Specs as follows: _____

5. Or Equal
   [X] Only the brand detailed above is acceptable.
   [ ] An equal in another brand is acceptable.

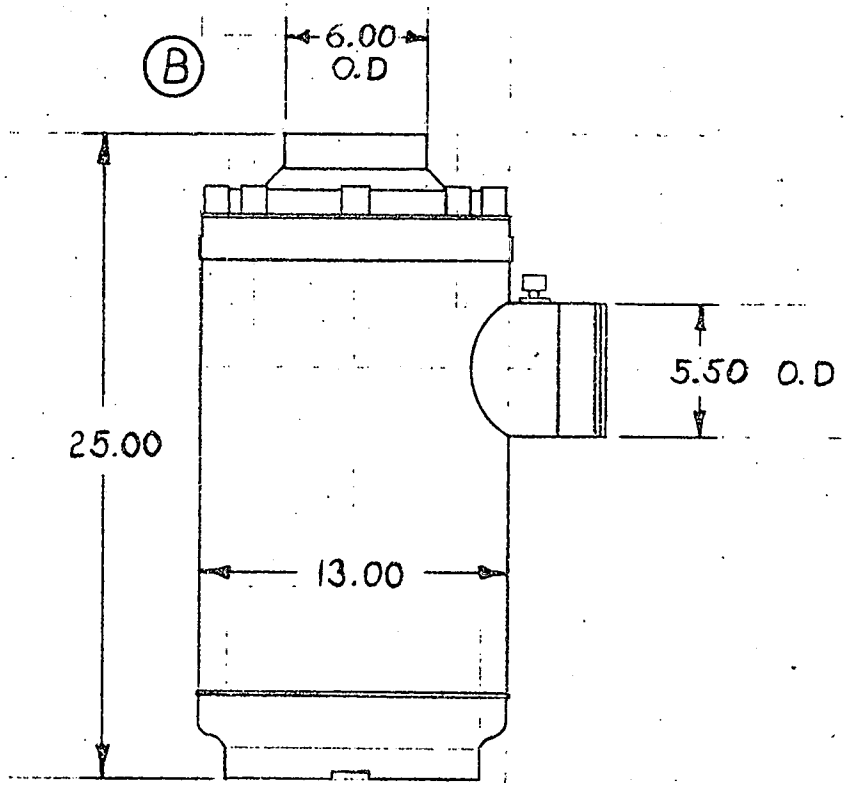
6. Same as Onan No. _____ except _____

7. After Receipt by Onan:
   [X] Used as is
   [ ] Modified becomes Onan No. _____

8. First Used on Model DFE, DFP

9. Data Furnished by R. HANSEN

NOTES:
(A) 1. FOR SPARE PARTS, ELEMENT PART NO. 140-1376, DONALDSON NO. P11-7797
(C) 2. ALTERNATE SOURCE: FRAM AUTOMOTIVE DIV; PROVIDENCE, R.I. 02916
2.1 MFR STD NO: 266402



LET	REVISION	ENG	CKR	DATE
C	ADDED NOTE 2	WCB	HP	11-9-76
B	PICTURE ADDED	WC	WB	7-25-75
A	NOTE ADDED	WC	WB	7-25-75

DR VL | SC
CKR WJB
ENGR R.R. Hansen 5-1-75
DATE 3-27-75

DIVISION OF ONAN CORPORATION
Minneapolis, Minnesota

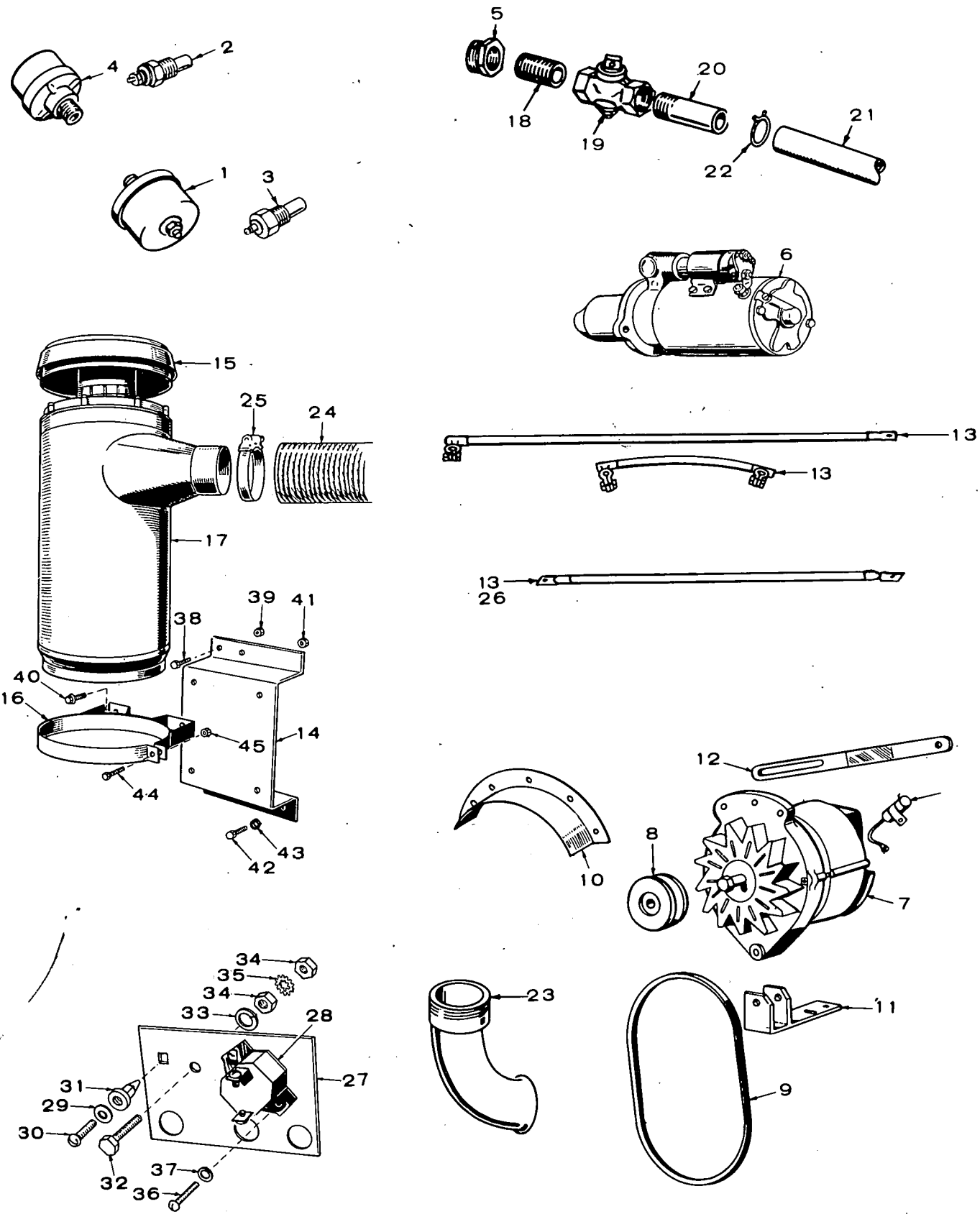
TITLE: AIR CLEANER ASSY

PUR.	TP	COST	RELAY	QC	PO	SAMP REL	PROD REL
X(2)				X	X		TOA 5-22-75

MODEL: DFE, DFP
DWG NO.: 140 - 1346
DWG SIZE P

FORM 8C003

MISCELLANEOUS ENGINE PARTS GROUP



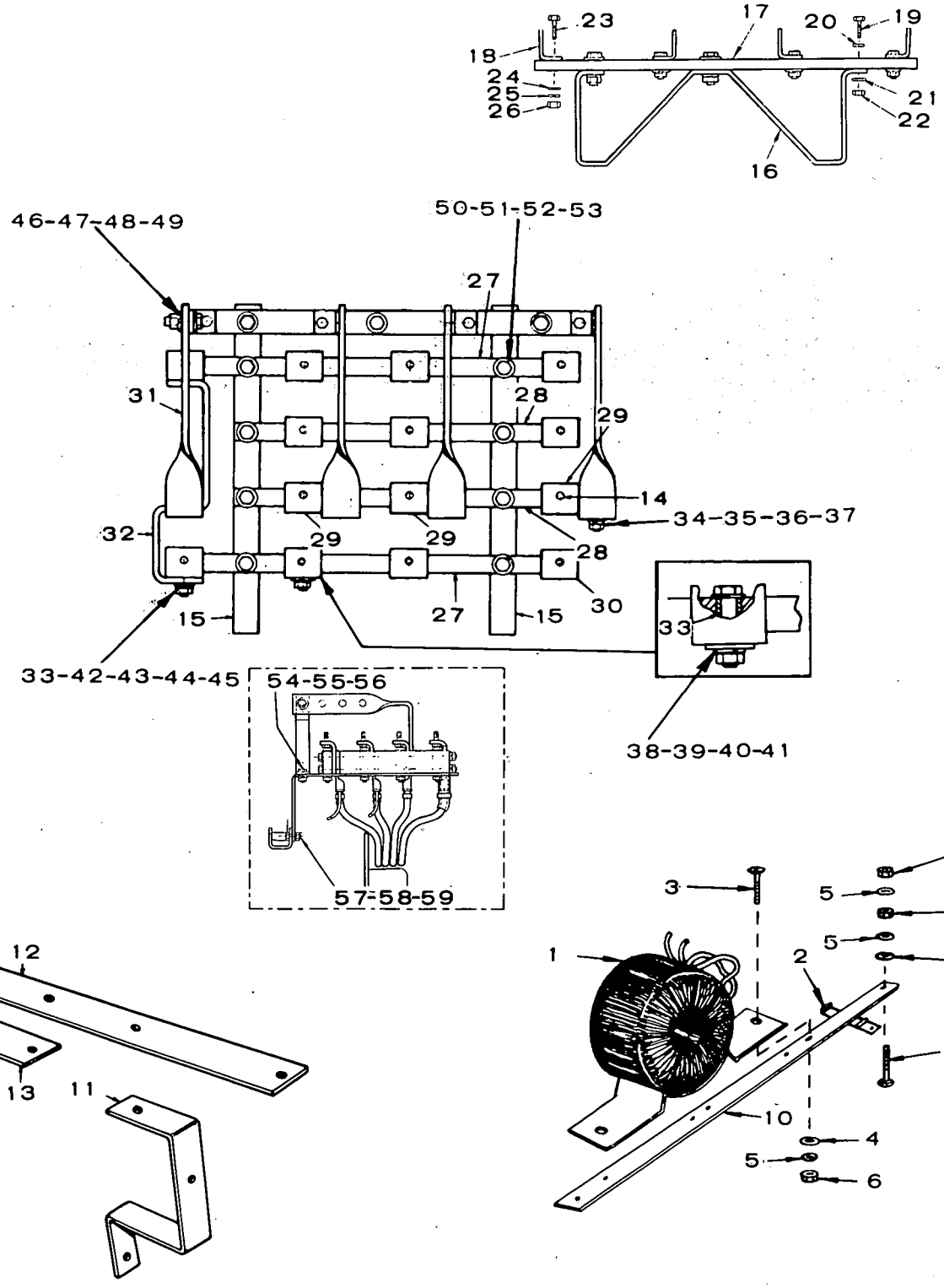
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	130-0992	1	Radiator
2	130-0917	1	Bracket, Radiator Support
3	504-0028	1	Cock, Radiator Drain
4	503-0756	1	Hose, Radiator (Lower)
5	503-0354	4	Clamp, Radiator Hose
6	130-1017	1	Shroud, Radiator Fan
7	130-0924	1	Guard, Radiator Fan
8	405-1888	2	Brace, Radiator Support
9	130-0842	1	Shroud, Radiator
10	130-0848	2	Brace, Radiator Support
11	503-0752	1	Hose, Radiator
12		1	Hose, Deration (34" of Bulk Hose 503-0249)
13	503-0429	2	Clamp, Hose
14	501-0087	1	Hose, Vent
15	502-0184	1	Connector
16	505-0759	1	Adapter, Pipe (1")
17	130-0449	1	Cap, Radiator
18	821-0018	8	Screw, Cap (Lockhead) Radiator Fan Guard Mounting (1/4-20 x 5/8)
19	526-0018	8	Washer, Flat - Radiator Fan Guard Mounting (17/64" ID x 5/8" OD x 1/16" THK)
20	800-0130	4	Screw, Cap (Hexhead) Radiator Support Mounting (5/8-11 x 1")
21	850-0070	4	Washer, Lock (Spring) Radiator Support Mounting (5/8)
22	821-0016	4	Screw, Cap (Lockhead) - Radiator Brace Mounting (5/16-18 x 3/4")
23	870-0257	2	Nut, Self Locking Hex - Radiator Brace Mounting (5/16-18)
24	821-0014	8	Screw, Cap (Lockhead) Radiator for Shroud Mounting (5/16-18 x 1/2")
25	821-0029	2	Screw, Cap (Lockhead) Radiator Support Brace Mounting (3/8-16 x 3/4")
26	821-0014	8	Screw, Cap (Lockhead) Radiator Shroud Mounting (5/16-18 x 1/2")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	193-0108	1	Sender, Oil Pressure Gauge
2	193-0109	1	Sender, Water Temperature Gauge
3	309-0178	1	Switch, High Temperature
4	309-0169	1	Switch, Low Oil Pressure
5	505-0117	1	Bushing, Reducer
6	191-0852	1	†Starter (24 Volt)
7	191-0688	1	Alternator (24 Volt)
8	191-0781	1	*Pulley, Alternator
9	511-0084	1	Belt, Alternator Drive
10	191-0725	1	Guard, Alternator Belt
11	191-1141	1	Bracket, Alternator Mounting
12	191-0869	1	Bracket, Alternator Adjusting
13	CABLE, BATTERY		
	416-0444	1	Positive
	416-0445	1	Negative
	416-0473	1	Jumper, Battery
14	140-1349	1	Bracket, Air Cleaner Mounting
15	140-1347	1	Cap, Air Cleaner
16	140-1345	2	Band, Air Cleaner Mounting
17	140-1346	1	Cleaner, Air
18	505-0100	1	Nipple, Pipe - Oil Drain
19	504-0011	1	Valve, Shut-off - Oil Drain
20	505-0185	1	Nipple, Half - Oil Drain
21		1	Hose, Rubber - Oil Drain (Order 8" of 503-0098 Bulk Rubber Hose)
22	503-0197	1	Clamp, Oil Drain Hose
23	155-1035	1	Outlet, Exhaust
24	503-0641	1	Hose, Flexible Air Cleaner
25	503-0748	2	Clamp, Hose - Air Cleaner
26	416-0632	1	Cable Assembly, Starter
27	332-1382	1	Bracket, Terminal Mounting
28	320-0240	1	Breaker, Circuit
29	508-0015	1	Washer, Fibre
30	809-0035	1	Screw, Tapping - Roundhead (#8 x 3/4")
31	870-0196	1	Nut, Insulated
32	800-0007	1	Screw, Cap - Hexhead (1/4-20 x 1")
33	850-0040	1	Washer, Lock - Spring (1/4)
34	862-0001	2	Nut, Hex (1/4-20)
35	856-0006	1	Washer, Lock - External/ Internal (1/4")
36	811-0103	2	Screw, Tapping - Roundhead (10-32 x 3/4")
37	850-0030	2	Washer, Lock - Spring (#10)
38	800-0050	2	Screw, Cap (Hexhead) - Air Cleaner Bracket Mounting (3/8-16 x 1)
39	870-0281	2	Nut, Hex (Self Lock) - Air Cleaner Bracket Mounting (3/8-16)
40	821-0029	4	Screw, Cap (Lockhead) - Air Cleaner Band Mounting (3/8-16 x 3/4)
41	870-0281	4	Nut, Hex (Self Lock) - Air Cleaner Band Mounting (3/8-16)
42	801-0097	2	Screw, Cap (Hexhead) - Air Cleaner Bracket Mounting (5/8-18 x 1-1/4")
43	850-0070	2	Washer, Lock (Spring) - Air Cleaner Bracket Mounting (5/8)
44	800-0032	2	Screw, Cap (Hexhead) - Air Cleaner Band (5/16-18 x 1-3/4")
45	870-0257	2	Nut, Hex (Self Lock) - Air Cleaner Band (5/16-18)
46	800-0048	2	Screw, Hex Cap - Steel (3/8-16 x 3/4")
47	850-0050	2	Washer, Spring Lock (3/8")
48	526-0183	2	Washer, Flat (25/64 I.D. x 5/8 O.D. x 3/32" Thick-Steel)
49	862-0015	1	Nut, Hex Steel (5/16-18)
50	856-0013	1	Washer, Lock - EIT (1/2")
51	800-0025	1	Screw, Hex Cap - Steel (5/16-18 x 5/8")
52	800-0030	1	Screw, Hex Cap - Steel (5/16-18 x 1-1/4")
53	800-0094	1	Screw, Hex Cap - Steel (1/2-13 x 2")
54	850-0045	2	Washer, Spring Lock (5/16")
55	526-0022	1	Washer, Flat - Steel (21/64" I.D. x 9/16" O.D. x 1/16" Thick)
56	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.

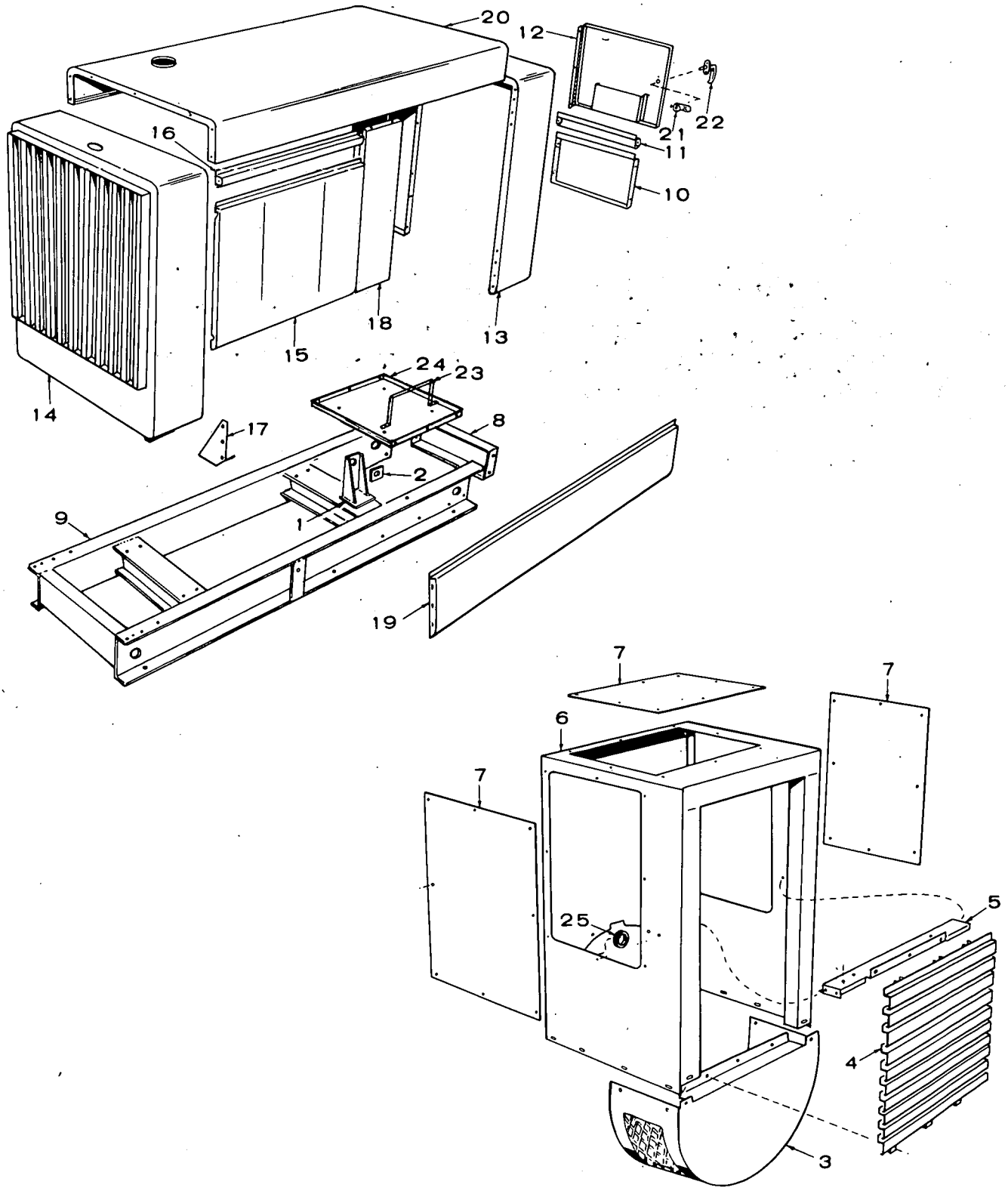
† - For components contact your nearest Delco Remy Division of General Motors Corporation, Anderson, Indiana 46011.

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)

MOUNTING AND HOUSING GROUP



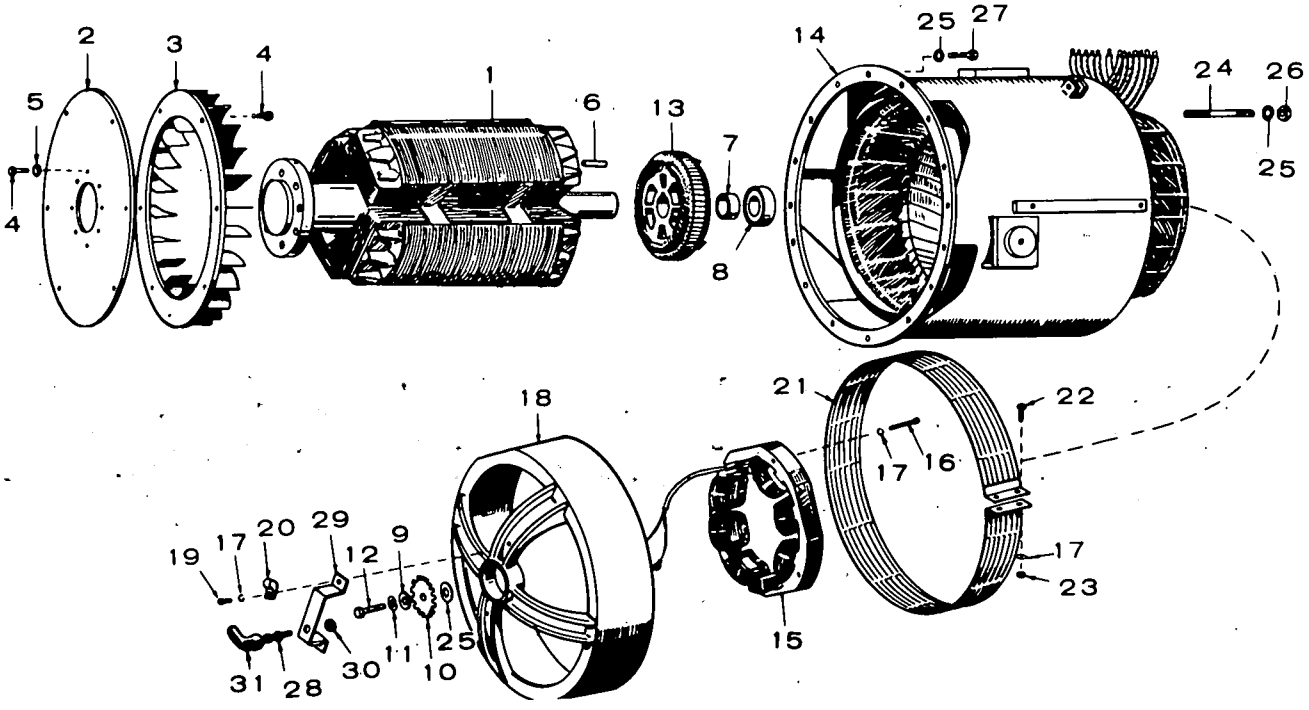
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	232-2385	2	Plate, Generator Mounting
2	232-2389	2	Bracket, Generator Mounting
3	234-0489	1	Cover, End Bell
4	234-0490	1	Grille, Generator Air Inlet
5	301-3604	1	Shelf, Control Box Housing
6	301-3605	1	Housing, Control Box
7	301-3731	3	Plate, Control Box Side
8	403-1200	1	Panel, Base—
9	403-1203	1	Skid, Base
10	405-1856	1	Panel, Lower Rear Housing (Housed Sets Only)
11	405-1858	2	Panel, Rear Louvered (Housed Sets Only)
12	405-1880	1	Door, Rear Housing
13	405-1883	1	Panel, Rear End (Housed Sets Only)
14	405-1884	1	Panel, Front End Housing
15	405-2011	4	Door, Removable (Housed Sets Only)
16	405-2014	8	Panel, Louvered (Housed Sets Only)
17	405-2016	2	Bracket, Panel Mounting
18	405-2220	2	Panel, Center (Housed Sets Only)
19	405-2221	2	Panel, Base (Housed Sets Only)
20	405-2222	1	Panel, Top Housing (Housed Sets Only)
21	406-0089	1	Catch, Lock Handle (Housed Sets Only)
22	406-0159	1	Handle, Lock (Housed Sets Only)
23	416-0635	2	Strap, Battery Hold-down
24	416-0674	1	Tray, Battery
25	508-0001	1	Grommet, Rubber

ASSOCIATED MOUNTING HARDWARE (Not Illustrated)

800-0153	2	Screw, Cap - Hexhead - Generator Mounting (3/4-10 x 1-1/2")
850-0079	2	Washer, Lock - Spring - Generator Mounting (3/4")
800-0156	4	Screw, Cap - Hexhead - Generator Bracket Mounting (3/4-10 x 2-1/4")
850-0079	4	Washer, Lock - Spring - Generator Bracket Mounting (3/4")
862-0020	4	Nut, Hex - Generator Bracket Mounting (3/4-10)
800-0035	4	Screw, Cap - Hexhead - Battery Hold-down Mounting (5/16-18 x 2-1/2")
850-0045	4	Washer, Lock - Spring - Battery Hold-down Mounting (5/16")
821-0010	As Req.	Screw, Cap - Lock Head - Panel Mounting (1/4-20 x 1/2")
821-0010	As Req.	Screw, Cap - Lock Head - Grille Mounting (1/4-20 x 1/2")
821-0014	As Req.	Screw, Cap - Lock Head - Control Box Mounting (5/16-18 x 1/2")
821-0016	As Req.	Screw, Cap - Lock Head - Base Panel Mounting (5/16-18 x 3/4")
870-0257	As Req.	Nut, Hex - Self Locking - Base Panel Mounting 5/16-18)
821-0016	As Req.	Screw, Cap - Lock Head - Battery Tray Mounting (5/16-18 x 3/4")
870-0257	As Req.	Nut, Hex - Self Locking - Battery Tray Mounting (5/16-18)
800-0138	2	Screw, Cap - Hex Head - Front Engine Mount - (5/8-11 x 3")
850-0070	2	Washer, Lock - Spring - Front Engine Mount (5/8")
862-0007	2	Nut, Hex - Front Engine Mount (5/8-11)

GENERATOR GROUP

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

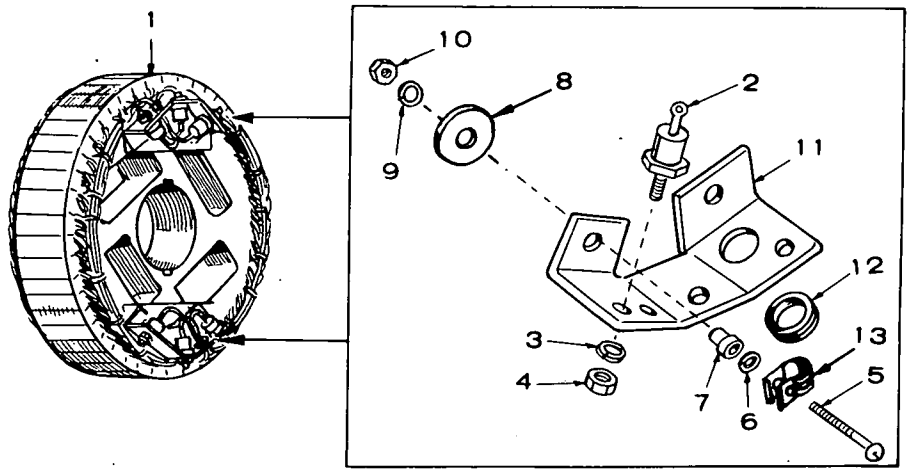


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	★	1	Rotor Assembly, Wound (Includes Parts Marked *)
2	232-2309	1	*Disc, Generator Drive
3	205-0103	1	*Fan, Generator
4	805-0035	14	*Bolt, Place (5/8-11 x 1½")
5	526-0259	8	*Washer, Flat - Steel (11/16" I.D. x 1-3/8" O.D. x 12 Ga.)
6	515-0145	1	*Key, Exciter 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.

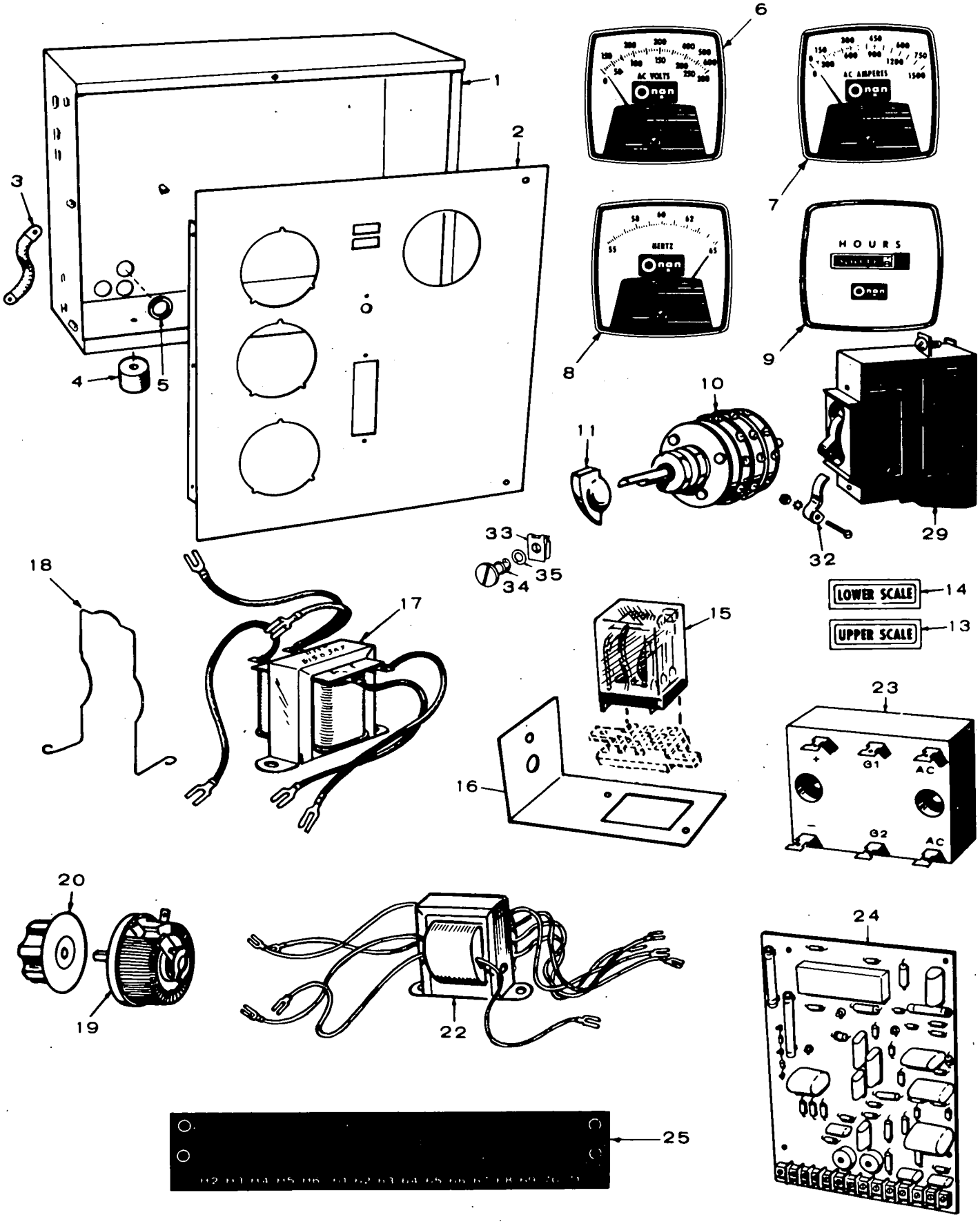
* - Parts included in the Rotor Assembly.

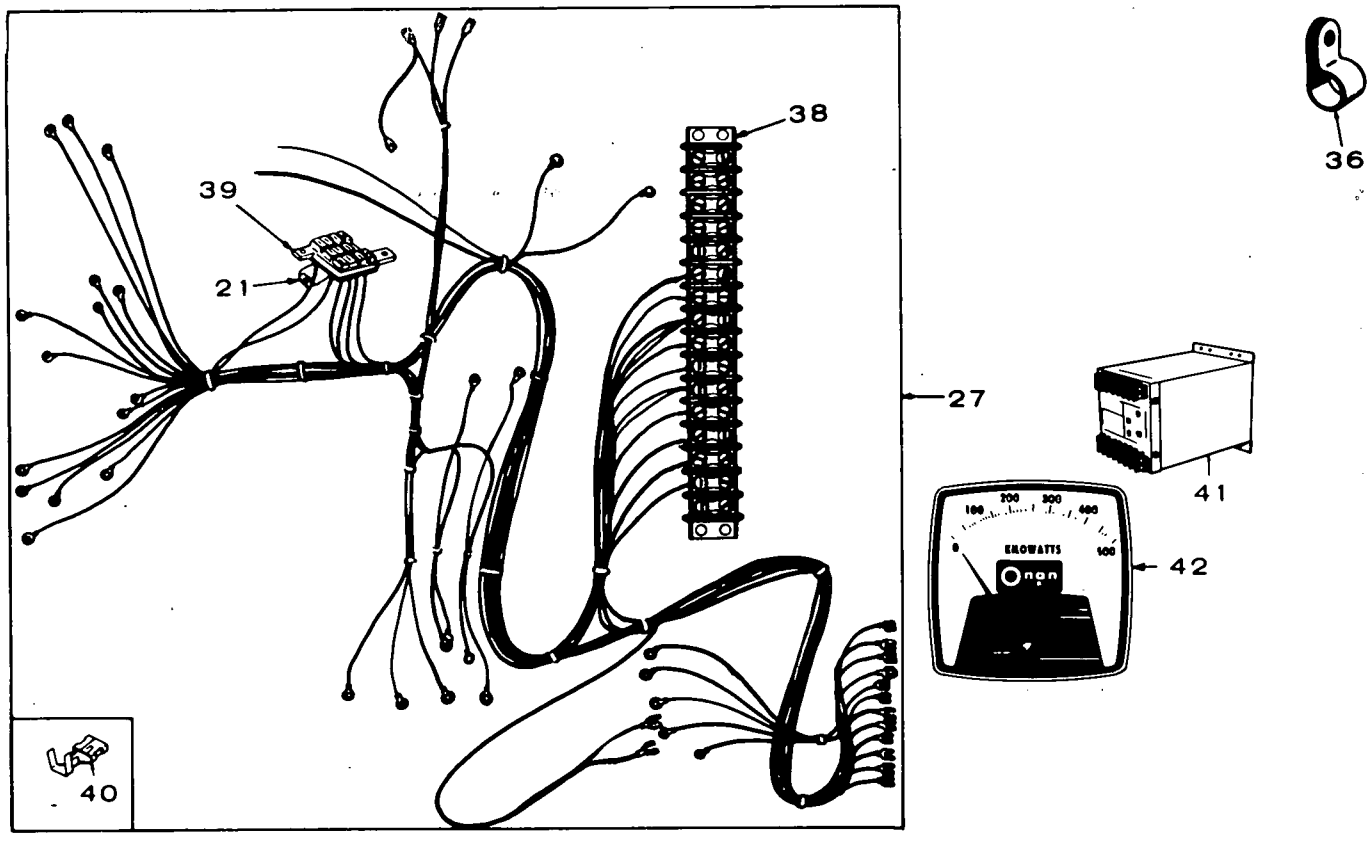
EXCITER ROTOR GROUP



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

CONTROL GROUP (AC Portion)

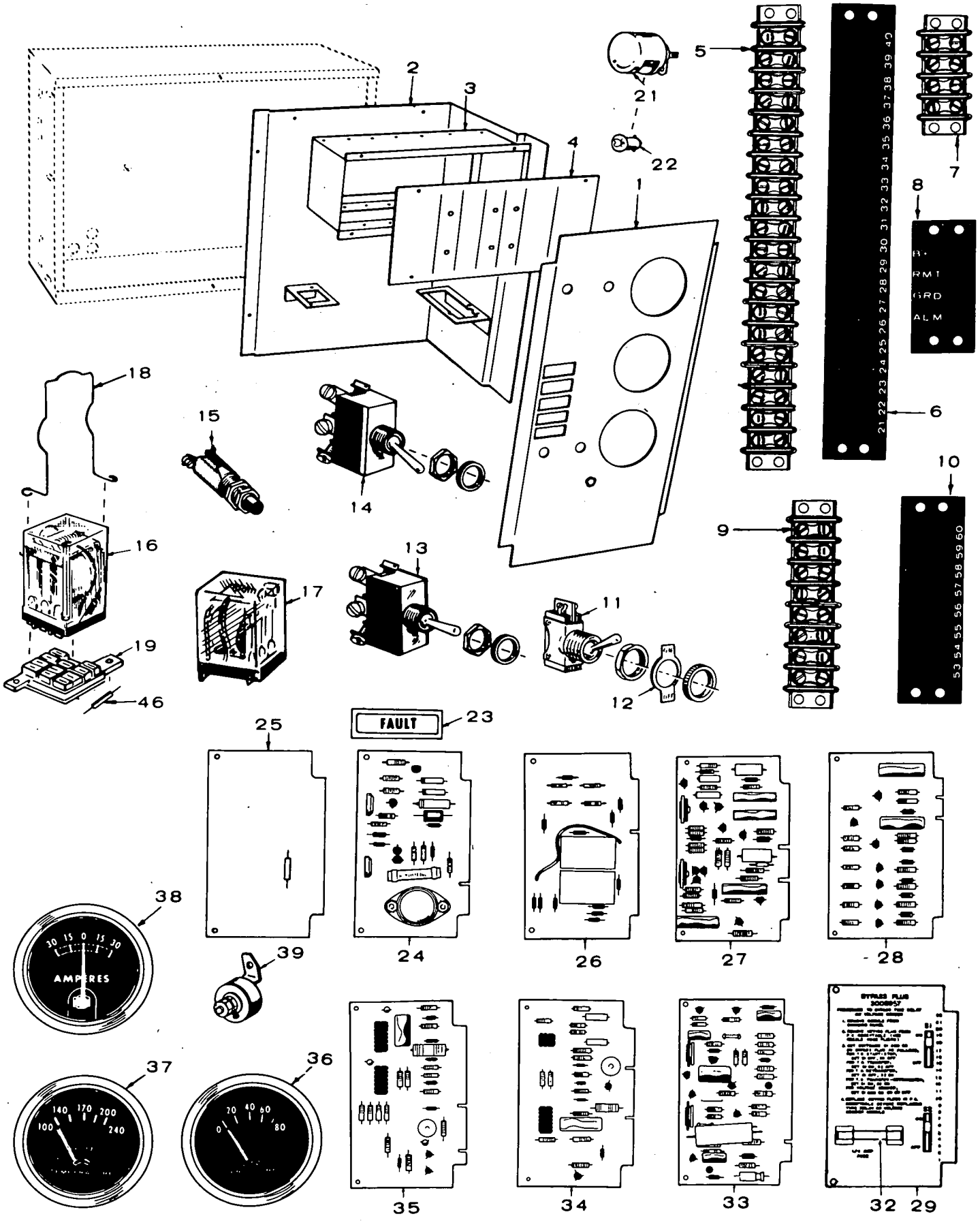


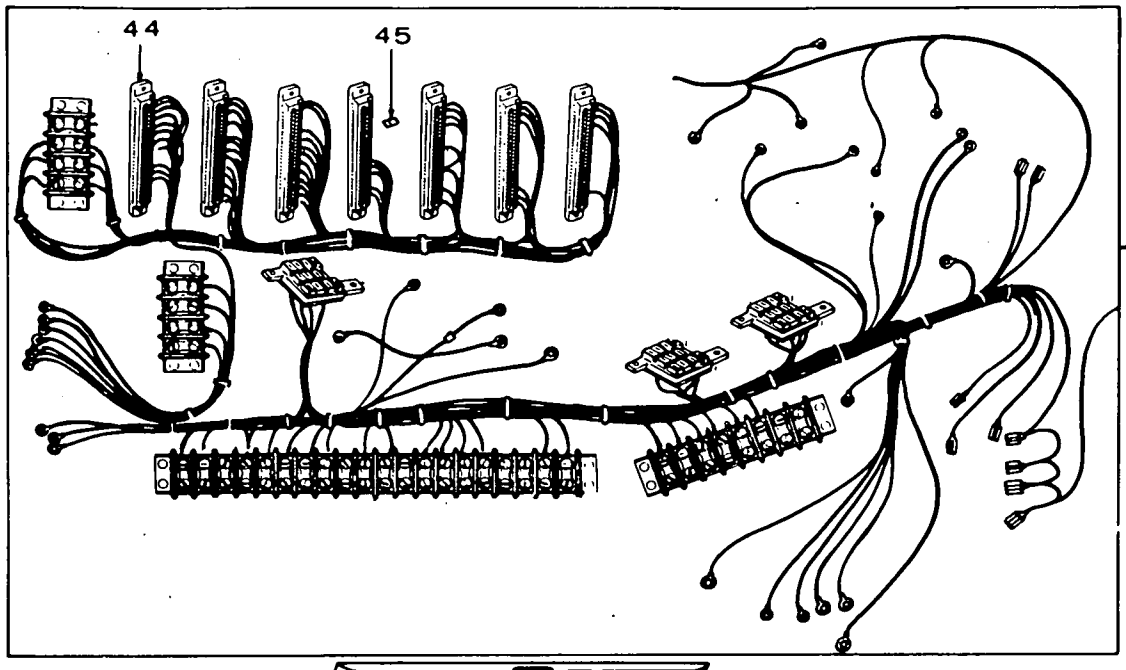


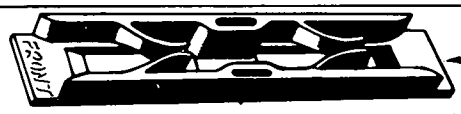
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301-3158	1	Box, Control
2	PANEL, CONTROL BOX		
	301-3170	1	Standard Units
	301-3312	1	Units With Wattmeter
3	337-0049	1	Strap, Bond
4	402-0078	4	Dampener, Vibration
5	508-0001	4	Grommet (1-1/16"), Rubber
6	302-0718	1	Voltmeter, AC - Dual Scale 0-300, 0-600
7	AMMETER, AC		
	302-0878	1	250 kW - Dual Scale 0-500, 0-1000
	302-0879	1	300 kW - Dual Scale 0-600, 0-1200
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
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	250 kW (Scale Reads 0-300)
	302-0928	1	300 kW (Scale Reads 0-500)

* - Included in Wiring Harness Assembly.

CONTROL GROUP (Engine Portion)







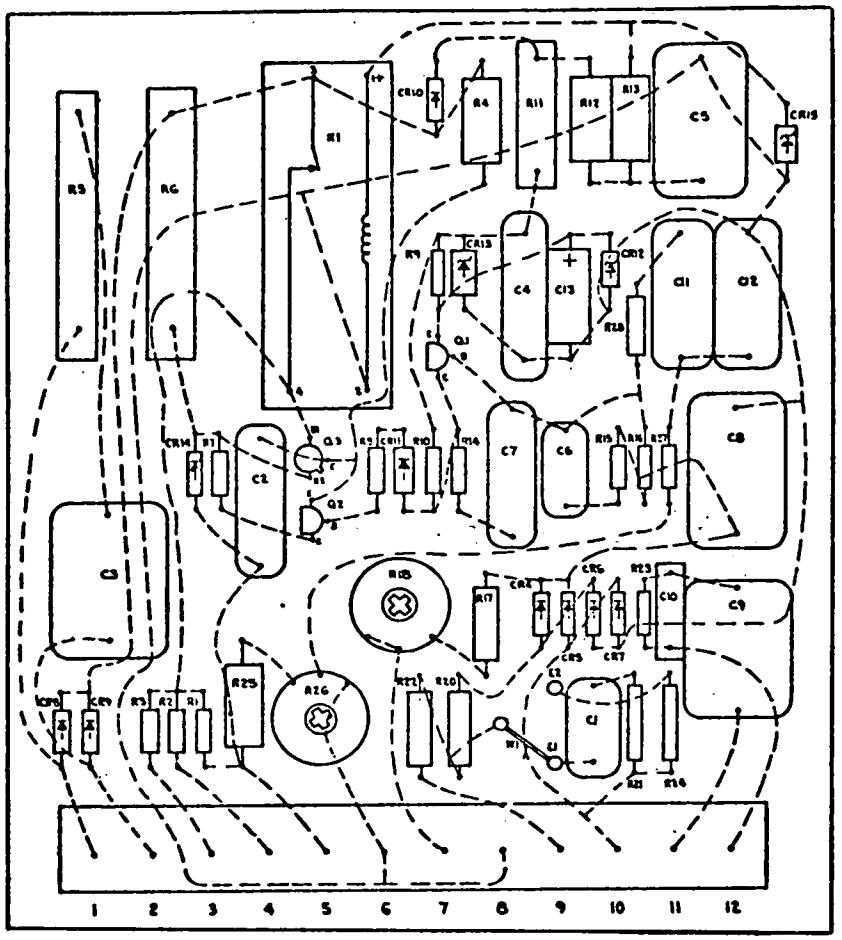
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL, ENGINE CONTROL		
	301-3661	1	Sets With One Fault Light
	301-3629	1	Sets With Five Fault Lights
2	301-3621	1	Bracket, Engine Control
3	301-3588	1	Rack, Module
4	301-3635	1	Cover Assembly, Rack
5	332-1005	1	*Block, Terminal - 20 Place
6	332-1559	1	Strip, 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.

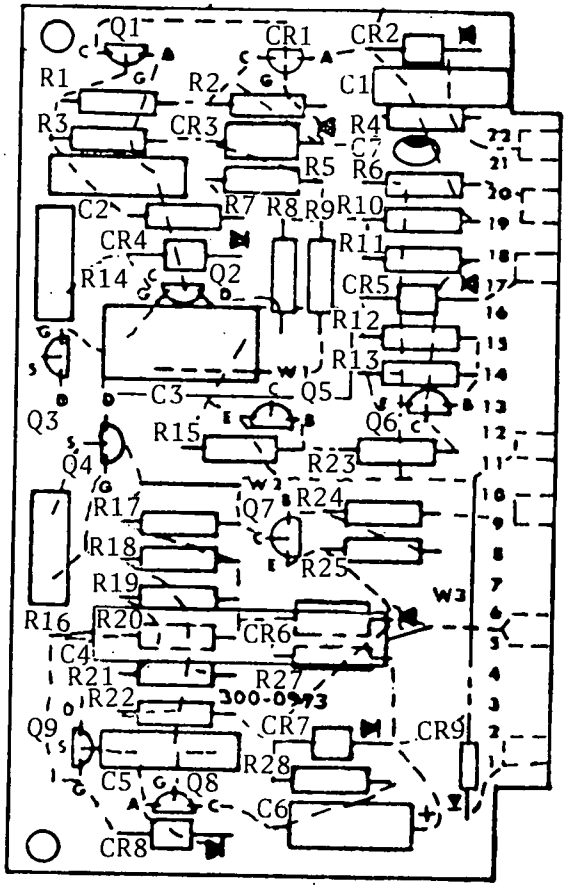
PRINTED CIRCUIT BOARD ASSEMBLY GROUP (AC)

332-1268 - Printed Circuit Board, Complete



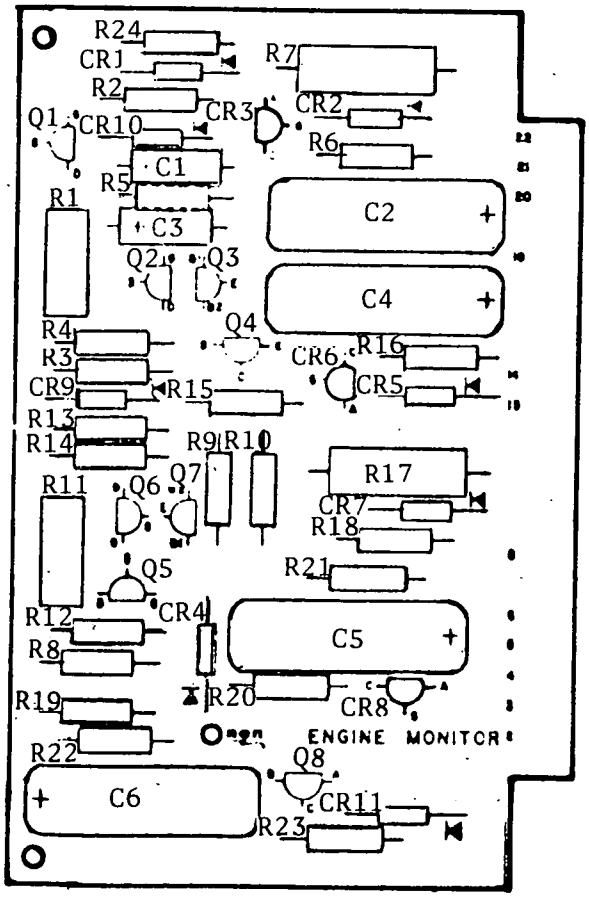
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
TB1	332-1252	1	Terminal Block
C1	355-0018	1	Capacitor (.47., 100 Volt)
C2, C7	355-0005	2	Capacitor (.22 Mfd., 200 Volt)
C3, C9	355-0017	2	Capacitor (.47 Mfd., 400 Volt)
C4, C12	355-0006	2	Capacitor (.47 Mfd., 200 Volt)
C5, C8	355-0016	2	Capacitor (1 Mfd.,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

TIME DELAY (START-STOP) MODULE—OPTIONAL



300-0973

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)

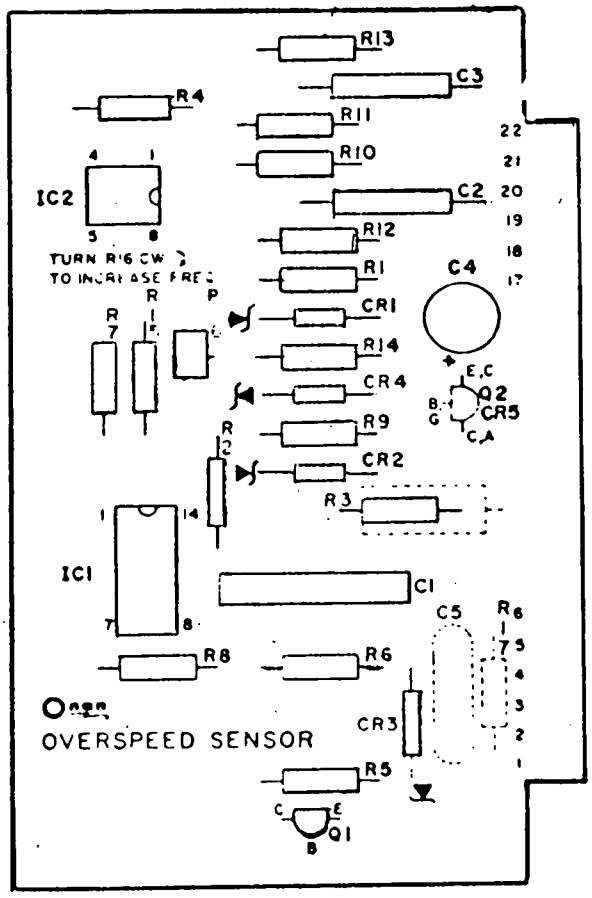


ENGINE MONITOR CONTROL MODULE

300-0953

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)

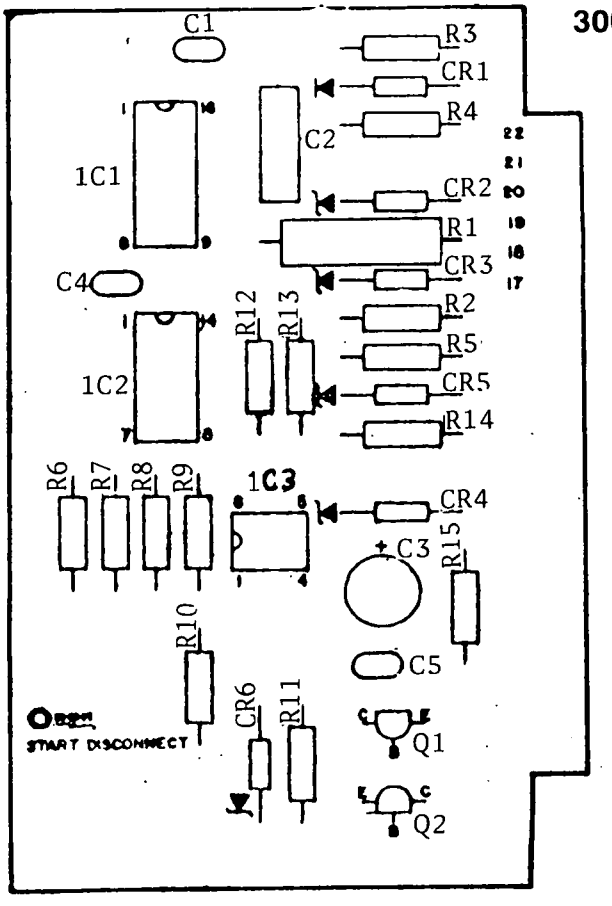
OVERSPEED SENSOR CONTROL MODULE



300-0957

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)

STARTING MOTOR DISCONNECT MODULE

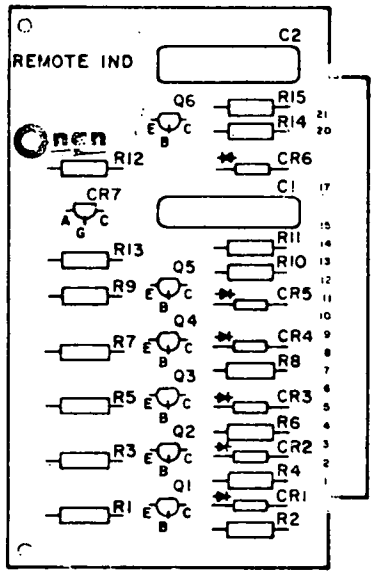


300-0958

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)

REMOTE INDICATOR CONTROL MODULE
(UNITS WITH 5 FAULT LIGHTS)

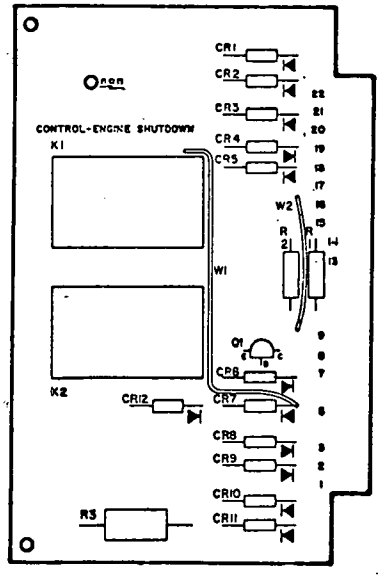
300-0955



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)

ENGINE SHUTDOWN CONTROL MODULE

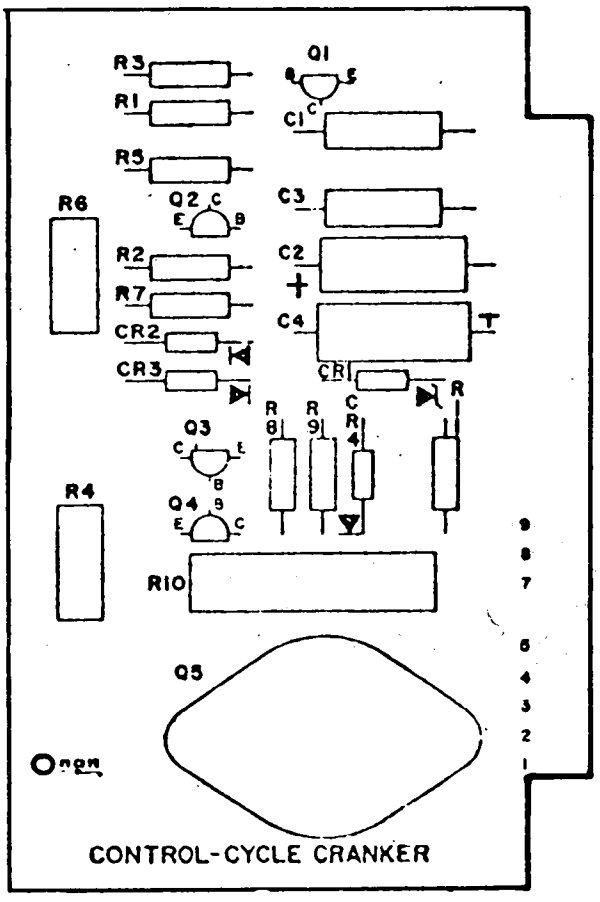
300-0964



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

CYCLE CRANKER MODULE

300-0956



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)

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.

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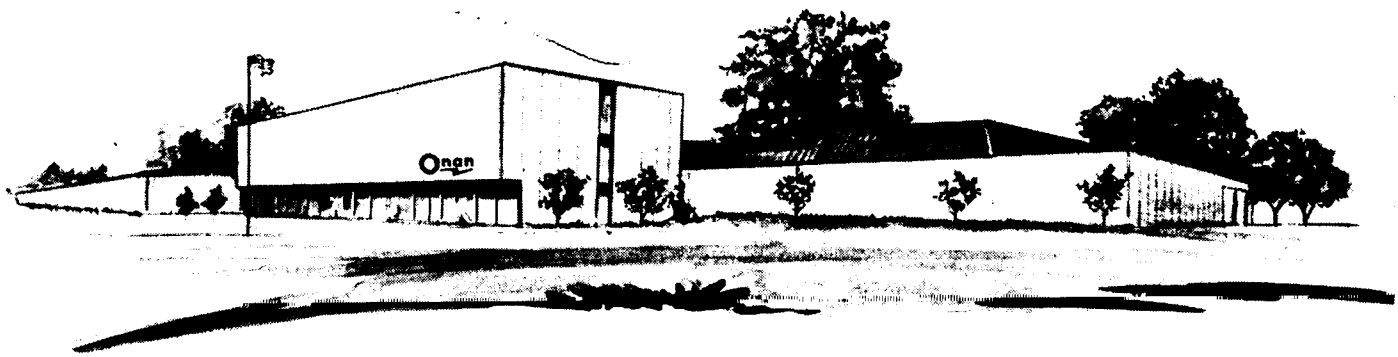

ONAN **1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432**
A DIVISION OF ONAN CORPORATION