

Power Technology Southeast Inc.  
Leesburg, Florida 34748

PTS MH-17.5  
PTS MH-20

Models:

# RV Generator Sets Operation and Installation Manual

**Power Tech**

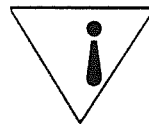
*generator auto  
1000 2 sheet*

*Ray 815-844-6163*

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## IMPORTANT NOTICE

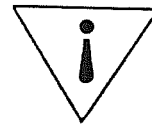


This is the industry's "Safety Alert Symbol." This symbol is used to call your attention to items or operations that could be dangerous to you or other persons using this equipment. Please read these messages carefully. It is essential that you read the instructions and safety regulations before you attempt to install or use this unit.

# INSTALLATION

## Introduction

Use this section as a guide when installing a generator set in the recreational vehicle, then refer to the appropriate operation section for specific service instructions. When installing an RV generator set, the installation must comply with CURRENT standards of (1) ANSI/RVIA RGS-1, (2) ANSI A 119.2/NRPA 501 C and (3) applicable articles of ANSI/NFPA 70, National Electrical Code. Generator set installation must also comply with state and local requirements.



## MARINE APPLICATION!

RV generator sets do not comply with United States Coast Guard (USCG) requirements and must not be used for marine applications. Use only generator sets specified for marine use in marine installations. USCG regulation 33CFR183 requires a generator set to be "ignition protected" when used in a gasoline-fueled environment.

## General Information

This information section covers the PTS RV generator set models listed below. To determine which model is involved, check the model number found on the nameplate attached to the frame of the generator being installed. Follow all instructions to ensure proper installation.

Model No.	Engine No.	Volts	Hz	KW	Phase
PTSMH-17.5	V2203BG	120/240	60	17.5	1
PTSMH-20	V2203BG	120/240	60	20	1

## Features

These generator sets feature Kubota diesel engines, rotating-field alternating current generator and relay controller. The generator is directly connected to the engine for permanent alignment. Each controller includes a Start/Stop switch for test operating the set at the controller. Also included is a Preheat/Prime switch to aid in cold weather starting or assist in bleeding air from the fuel

Fuel Consumption in GPH		
% Load	PTSMH-17.5	PTSMH-20
25%	.39	.44
50%	.78	.90
75%	1.18	1.30
100%	1.57	1.80

Generator		Total Radiator Air Requirements	
Model No.	In Line	Remote	
PTSMH 20	2120CFM	2120CFM	
PTSMH 17.5	2120CFM	2120CFM	
Fuel Inlet Connection		1/4 in. (6.4 mm)	
Battery Voltage		12 Volts	
Battery Recommended		Minimum 500	
Battery Cranking		Cold Cranking	
Current		170 Amps	
Battery Ground		Negative	
Fuel Recommendation		ASTM/D975 NO.1-D or NO.2-D Diesel Oil	

## Specifications

### NOTE

When using a radiator not supplied by Power Technology consult your radiator manufacturer to ensure that the heat rejection values listed on page 6 are met.

- \* Attach exhaust system.
- \* Add proper amount of radiator coolant.
- \* Add oil to crankcase until dipstick reads FULL.
- \* Connect fuel line, remote switch, load leads, and battery terminals.
- \* Consult the specification chart to aid in the installation.

After the set is attached to the frame of the vehicle, all that is usually required to make it operational is the following:

- \* Attach exhaust system.
- \* Add proper amount of radiator coolant.
- \* Add oil to crankcase until dipstick reads FULL.
- \* Connect fuel line, remote switch, load leads, and battery terminals.
- \* Consult the specification chart to aid in the installation.

When using a radiator not supplied by Power Technology consult your radiator manufacturer to ensure that the heat rejection values listed on page 6 are met.

**Installation Factors**

Each generator set is received as a unit except for the optional exhaust system components which are shipped loose for assembly after the set is installed in the vehicle. When preplanning the installation, the following factors must be considered:

1. **ELECTRICAL LOAD:** Does the set selected have adequate capacity to handle the load?
2. **COMPARTMENT SIZE:** Will there be sufficient room around the set to maintain minimum clearances?
3. **AIR REQUIREMENTS:** Are the compartment air inlets and outlets sized to allow adequate circulation of air for cooling and combustion?
4. **COMPARTMENT FLOOR:** Is the compartment floor strong enough to support the weight of the generator set?
5. **COOLING SYSTEM:** Is the cooling system large enough to adequately cool the generator set?
6. **FUEL SYSTEM:** Is the system properly designed to prevent fuel starvation of either the main engine or generator set engine?
7. **EXHAUST SYSTEM:** Will the system meet all safety requirements after installation?
8. **ELECTRICAL CONNECTIONS:** Will all systems, (battery, load, and remote switch) when connected, be compatible with vehicle system?

### Motor loads

When figuring generator set capacity requirements for installation involving motor loads, do not overlook the high current demanded by the motor during start-up. The "in-rush" or starting current may be 2 to 5 times higher than that required when the motor reaches normal operating speed. Reserve capacity must be allowed for in-rush demands plus other loads which could be on the line as the motor starts.

Air conditioning units are perhaps the most common type of motor loads for generator

sets in recreational vehicles. The starting characteristics of the different makes of air conditioning units vary greatly. One particular 12,000 BTU unit has, for example, lower starting requirements than a 10,000 BTU unit of another make. When only one unit is involved, there is usually no starting problem provided; of course, the lighting and appliance load is not too high when the unit is started.

The trend seems to be toward larger capacity air conditioners and the use of more than one unit in larger vehicles. Simultaneous starting of two units can present problems if the capacity is marginal. Because of the variation in starting characteristics of the various makes of air conditioners, no definite statements are made in this publication regarding multiple-motor starting capabilities of the mobile generator sets covered. Delayed starting or use of "easy starting" devices on air conditioner units should be considered whenever simultaneous starting of more than one motor is involved. The starting and running requirements of some motor loads common to mobile applications are listed in Table 2-1. Use this as a guide when selecting generator set capacity requirements involving motor loads. See Table 2-2 for generator set capabilities regarding air conditioners. Capabilities will vary according to "Kilowatt Derating".

### Electrical Load

While the electrical load of the vehicle should have been calculated prior to purchase of the generator set, you may want to recheck the load before installing the set to make sure that the capacity is ample to meet demands without possible overloading.

### Lighting Load

The lighting load is usually easiest to calculate. In most cases, simply add the wattage of each lamp to be operated off the generator set. Note that in many applications, not all of the lights or lamps are in the generator set AC circuit—some are DC powered by the 12-Volt battery in the vehicle. Make sure the total includes only lights actually on the generator set AC circuit. The lighting load is

usually not too heavy in mobile installations; however, it must be accurately calculated to prevent overloading which could occur (for example, if all lights happened to be on when the air conditioner or other motor loads start up).

ELECTRIC MOTOR	BASED ON CODE G ELECTRIC MOTOR	
	HORSE POWER	*STARTING WATTS
1/2	2000	1100
1	5800	1800
2	8000	2800
3	8000	4000
4	11000	5500
5	15000	6500

\*The size of generating set should be the same as starting watts.

Table 2-1. Motor Requirements

Generator Model	Wattage	of Size Indicated	Will Operate Air Conditioner	Wattage Remaining
PTSMH-17.5	17,500	Three, 13,500 Btu		12,820
PTSMH-20	20000	Three, 13,500 Btu		15,320

Table 2-2. Generator Capacity/Air Conditioner Ratings

DETERMINING ALTERNATOR LOAD REQUIREMENTS		Total Watts Checked
✓		
	VCR	70 (1)
	Light Bulb	100
	Radio	100
	Television	100 (1)
	Stereo	120 (1)
	Fry Pan	150
	Home Computer	150 (1)
	Vacuum Cleaner	250
	Attic Fan, 1/4 hp	400 (2)
	Sump Pump, 1/3 hp	500 (2)
	Refrigerator	600 (3)
	Furnace Fan, 1/3 hp	600 (2)
	Freezer	800 (3)
	Jet Water Pump, 3/4 hp	900 (2)
	Electric Stove Element	1000
	Submersible Water Pump, 1 hp (2)	1000
	Toaster	1000
	Coffee Maker	1200
	Dishwasher	1200
	Hair Dryer	1200
	Microwave Oven	1500
	Submersible Water Pump, 2 hp (2)	1600
	Water Heater	3000
	Oven	4500

Table 2-3. Appliance Ratings

### Appliance Loads

Generator sets in recreational vehicles are often used to furnish AC for appliances such as TV, stereo, electric water heaters, etc. With the exception of the resistance-type loads such as the water heater, requirements for appliances are usually low. Such loads must not, however, be overlooked when figuring total requirements. Reserve capacity should be available for anticipated appliance loads to avoid overloading of a set. The average power requirements of some common electrical appliances are listed in Table 2-3.

### EXTENSION CORDS

When electric power is to be provided to various loads at some distance from generator set, extension cords are normally used. These cords should be sized to allow for voltage drop between the set and point of use, is held to a minimum.

AMPS	LOAD IN WATTS		CORD LENGTH			
	120 Volts	240 Volts	#10 Wire	#12 Wire	#14 Wire	
5	600	1200	500 ft.	300 ft.	200 ft.	—
10	1200	2400	250 ft.	150 ft.	100 ft.	50 ft.
20	2400	4800	125 ft.	75 ft.	50 ft.	25 ft.
30	3600	7200	60 ft.	35 ft.	15 ft.	10 ft.
40	4800	9600	30 ft.	15 ft.	10 ft.	—
50	6000	12000	15 ft.	—	—	—

All units are rated at 1.0 power factor. The kilowatts of the generator set will decrease 3.5% per 1,000 ft. (305 m) above 500 ft. (152 m) above sea level. Derate 1% for every 10 degrees F (5.5 degrees C) above 68 degrees F.

### Kilowatt Derating

the correct direction and is of the proper voltage. To protect against overload and short circuits, it is recommended that fuses (adequate for the motor used) be installed between the fan motor and the L1/L2 connections.

**CAUTION**

The cooling system fill must be the highest point in the cooling system. If the cooling system fill is not located as directed, cooling water will not completely fill the engine and disablement of the high water temperature shutdown switch will occur. A close relationship exists between cooling system design and generator compartment size. Availability of space is often the determining factor in cooling system design. See "Compartment Size" section of this manual prior to designing and installing generator cooling system.

**NOTE**

Ambient temperature is defined as the temperature of the generator operating environment. In RV applications, ambient temperature is the temperature inside the generator compartment.

**COMPARTMENT SIZE**

When planning compartment size requirements, allow the minimum clearances for cooling of the generator set as shown in Table 2-4.

**NOTE**

Since the sets are flexibly mounted, the minimum clearances will assure that the sides of the compartment and the set will not rub while the set is in operation or while the vehicle is in transit.

Front	1-1/2 (38 mm)
Side	1-1/2 (38 mm)
Top	1-1/2 (38 mm)
Rear	3.0 (76 mm)

The thickness of insulating and sound deadening material used to line the compartment must be taken into consideration when planning clearances. If necessary, enlarge

Remote Radiator Cooling System  
Use the following data in designing and installing the generator set cooling system. To insure a safe effective installation, be sure the cooling system selected follows these parameters. Power Tech offers radiator assemblies which meet these requirements and adequately cool the generator. Select the radiator assembly appropriate for the generator installation.

Due to the multitude of coach manufacturers and the variety of generator installations, only general guidelines are provided. Adapt these recommendations to the installation. In a typical installation, the radiator assembly is installed in the same compartment as the generator. If the blower fan radiator assembly is used, cooling air is drawn across the generator and engine and then through the radiator. If the suction fan radiator assembly is used, the suction fan pulls cooling air through the radiator and then past the generator set. If the radiator assembly alone is used, the installer must supply an electric blower or suction fan to circulate the cooling air. See specifications Table for total air requirements. Depending on space limitations, the radiator can be located in front of, adjacent to, or in a ventilated location remote from the engine (maximum distance from generator is 10 ft.). To prevent recirculation of heated air, be sure to maintain a tight seal between the radiator and the discharge chute. Generally, the discharge chute opening should be approximately one and one-half times the size of the radiator core.

**NOTE**

If the radiator is to be located in a compartment separate from the engine, refer to the engine combustion air and heat rejection requirements of the alternator and engine block when designing the cooling system. A supplemental cooling fan capable of 1000 cfm (28.32 m<sup>3</sup>/min) should be installed to supply air to the generator compartment for these requirements.

Connect radiator fan motor to generator output leads L1 and L2 as shown in Figure 2-6. Be sure the radiator fan motor rotates in

the compartment so minimum clearance requirements are maintained. The generator set must be securely fastened to avoid unwanted movement from vibration and road shock. If the unit is equipped with a mounting tray, the tray is usually supported on the ends by angle iron and has a full door for service access. The same number of bolts as mounting holes in the tray must be used to secure the tray to the support structure. Units not equipped with mounting tray are secured by attaching genset mounts (two in front, two in rear) directly to the vehicle frame. Skid-mounted units can either be affixed to a tray for tray mounting or attached directly to the vehicle frame by the customer. The generator is easily removed from the coach if a carriage with rollers is incorporated into the support structure. Avoid road splash and the possibility of igniting combustible material beneath the coach by enclosing all unnecessary free space beneath the generator compartment.

When designing the compartment, allow sufficient room for the set to be easily re-moved when major service is required. See Figure 2-1. Also keep in mind that the compartment door must have air intake openings having a free area of equal to or greater than that specified under "Air Requirements."

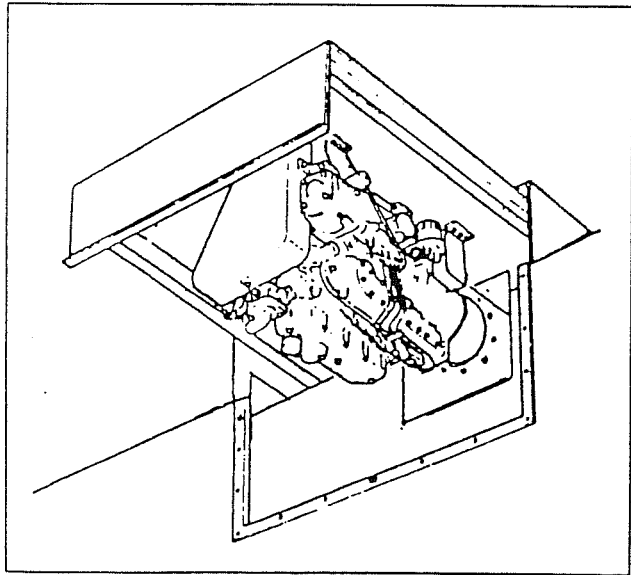
Make sure that the compartment is vapor tight and completely sealed off from the inside of the vehicle to prevent exhaust or other items from entering the vehicle.

Line the compartment with a good sound deadening material. The material selected must be fireproof or highly resistant to fire. An available type of 3-layer foam material does a very efficient job of absorbing sound. This type of material is easily cut to size with scissors and can be quickly installed using special fire retardant adhesive which bonds the material to almost any surface that is clean and dry. Other materials, such as fiberglass insulation with heat barrier, have also been used successfully in mobile installations.

**Air Requirements**

Each engine is equipped with a high water temperature shutdown switch which will automatically shut down the set, if operating temperatures climb too high. To prevent the generator set from shutdown, make sure the compartment openings are large enough to allow adequate circulation of cooling air. The minimum free air opening in the compartment door, for remote radiator models, is shown in Table 2-5. Remember, louvers, screens, and protective decorative grill work definitely restrict the effective air flow. Even a simple, relatively open mesh screen, as shown in Figure 2-2 will restrict air flow as much as 45%. The intake opening must be increased to compensate for such restrictions.

Figure 2-1. Slide Tray Mounting for Ease of Service

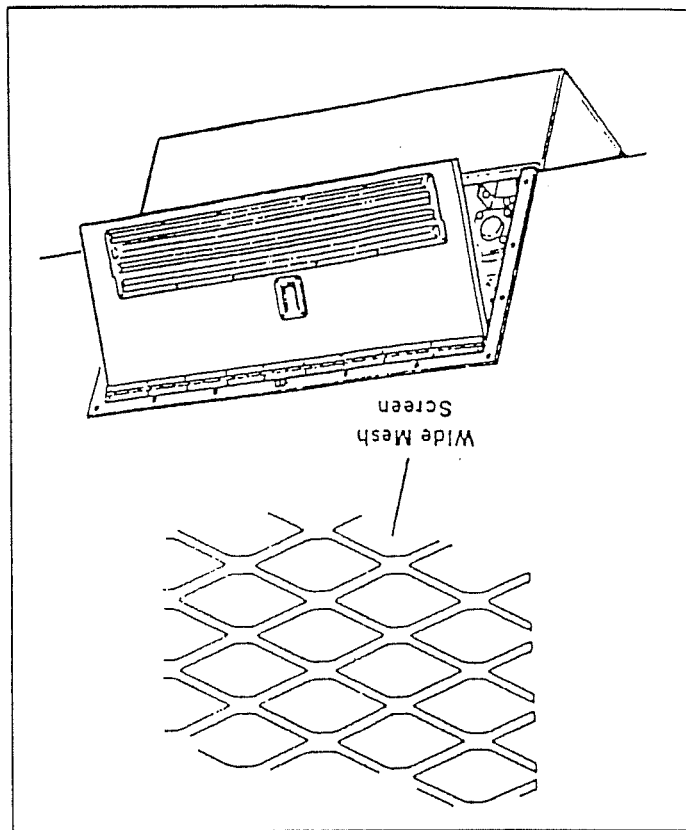


**Minimum Air Openings**

sq.in (sq.cm)	
Model 17.5/2Q Inlet	Outlet
PTS/MH	400
Remote Radiator	(2580)
Remote Radiator	(2580)

Table 2-5. Remote Radiator Compartment

Figure 2-2. Inlet Louvers & Screen



Air inlet and discharge openings for in-line radiator mounted models are shown in Figure 2-10. Also shown are required dimensions and positions for engine inlet, generator inlet and bottom discharge openings.

*Note*

The air inlet perimeter, at the engine radiator and generator end bracket must be sealed against the compartment wall. This is to make sure that only exterior air is drawn into the generator compartment.

The diesel fuel system for the generator set must be designed to operate independently of the system for vehicle engine if both engines are to be operated at the same time. The best way to do this is to have separate fuel tanks; however, this is usually impractical because of space restrictions. In most installations, both engines operate off a common tank with a separate dip tube arrangement. This prevents the smaller engine from being starved of fuel by the larger engine. The generator set dip tube is generally shorter than the vehicle dip tube. With this arrangement, fuel may not be available to the generator set when fuel supply is low. A simple tee fitting is sometimes used to provide fuel for both engines off a common tank; however, this usually prohibits simultaneous operation. There is also the possibility that operation of either engine could completely drain the fuel line of the other engine, thus making starting difficult if not impossible. The tee arrangement should be avoided or used only as a last resort.

**Other Pertinent Information**

- Thermostat Rating To ..... 180 F
- Full Open ..... 195 F
- High Water Temperature
- Switch Rating ..... 235 F (110 C)
- Maximum Distance Radiator to Generator Set ..... 10 ft. (9 m)
- Generator Set Dimensions ..... See Page 8

Notice: 1) There is no limit of combustion air temperature. However, output will decrease about 1% per 10°F above 68°F.

ENGINE SPEED	RPM	1800	1800
OUTPUT	HP	36.7	36.7
WATER FLOW	GPM	8.75	8.75
HEAT REJECTION	BTU/Min	99,000	99,000
AIR FLOW	CFM	2120	2120
ENGINE INLET WATER TEMPERATURE	MAX °F	N/A	N/A
ENGINE OUTLET WATER TEMPERATURE	MAX °F	235	235
ENGINE OIL TEMPERATURE	MAX °F	268	268
COMBUSTION AIR TEMPERATURE	MAX °F	N/A	N/A
THERMOSTAT RATING	°F	180	180
START TO OPEN			
PTS MH-17.5			
PTS MH-20			



Care must be taken when routing the fuel line from the main tank to the generator set. Keep fuel lines as short as possible but maintain adequate clearance from exhaust system. Fuel lines must be run along the frame or under carriage — never run fuel lines inside the coach. Locate fuel lines below the generator set compartment with entry point near fuel pump. The fuel line must be of adequate size to handle the flow of fuel and withstand road shock and year-round climate conditions. If steel tubing is used, it should be 1/4 in. (6.4 mm) I.P (minimum) with an 8 in. (203 mm) (minimum) flexible section to allow free movement of the generator set.



**WARNING**

**Fire Hazard!** Keep the compartment and generator set clean and free of debris and combustible material to minimize chance of fire. If sub-flooring exists beneath the set, an opening must be provided to allow fuel and/or oil that may leak from the system to drain out of the compartment. Make sure this opening is kept clear at all times.

**Compartment**

When installing the generator in a compartment, the air induction system or opening must be located in the bottom of the compartment. If it is to be located in the rear, care must be taken to insure that water can not enter the compartment causing possible electrical shorts.



**WARNING**

**DRIP PROOFING**

When installing a generator, the area directly under the generator portion of the set must incorporate, in the floor, a metal plate or barrier to prevent molten metal, burning insulation, flaming particles, or the like from

falling on flammable materials, including the surface upon which the generator is mounted.

**Exhaust Systems**

Because the length varies with most installations, a tail pipe is not furnished with the kits, however, a tail pipe must be installed to direct the exhaust gases beyond the perimeter of the vehicle. Use a tail pipe with as few gradual bends as possible to avoid excessive back pressure and face tail pipe away from normal air stream.



**WARNING**

**LETHAL EXHAUST GAS!** When installing exhaust system, position tail pipe end so that discharged exhaust gases may not be drawn into vehicle interior through windows, doors, air conditioners, etc. An engine discharges deadly carbon monoxide with its exhaust when operating. Carbon monoxide is particularly dangerous, since it is odorless, tasteless, non-irritating gas. It can cause death if inhaled for even a short period of time. Be especially careful if operating the generator set when parked under calm, windless conditions. Gases may accumulate in these circumstances. Park you vehicle so that the exhaust discharges downwind. Always be aware of others — make sure that your exhaust is directed away from vehicles and occupied buildings.

**CAUTION**

Make sure exhaust system components are positioned well away from drain opening beneath the set. Also, make sure the components are not blocking access to the oil drain plug.

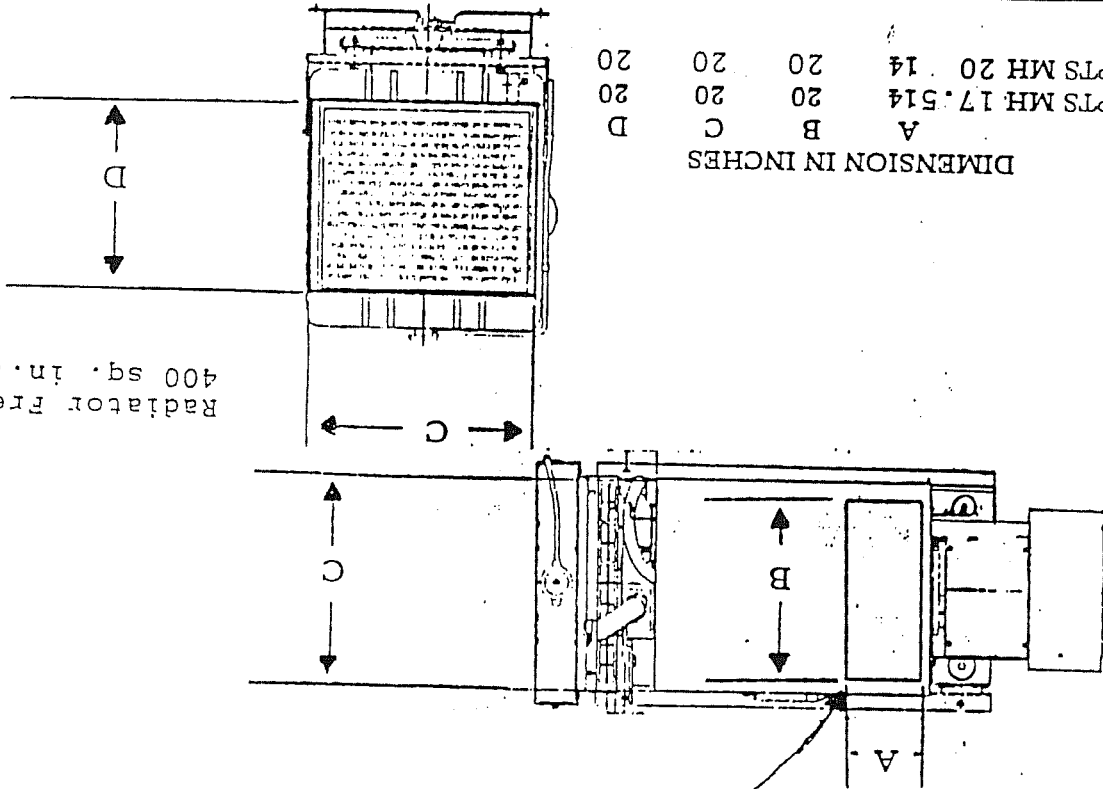
**SAFETY PRECAUTIONS**

A generator set can be dangerous if it is not properly maintained and operated. The best safeguards against accidents are to be aware of the potential dangers and to always use good common sense. Some general precautions concerning operation of a Generator Set are presented below. Keep these in mind.

FIG 2-10

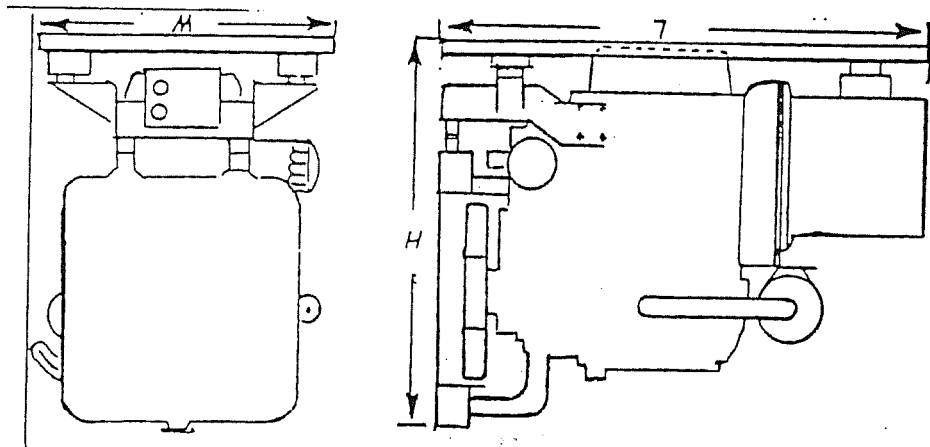
DIMENSION IN INCHES

PTS MH 20	14	20	20	20
PTS MH 17.514	20	20	20	20
A	B	C	D	



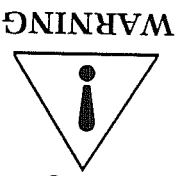
Generator Free-Air Opening  
288 sq. in.

Radiator Free-Air Opening  
400 sq. in.



MODEL LENGTH	WIDTH	HEIGHT	VAC	AMPS	RPM	WEIGHT
PTSMH-17.5 51.0	24.5	32.0	120/240	73/146	1800	750
PTSMH-20 51.0	24.5	32.0	120/240	83/166	1800	750

Jewelry before handling battery. Any compartment containing batteries should be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged. Always turn battery charger off before disconnecting.



**WARNING**

**ELECTROCUTION!** Failure to install a generator set with an electrical system consistent with governing Regulations and Standards is **UNLAWFUL**, and may cause **ELECTROCUTION** of vehicle occupants. Your generator set **MUST NOT** be used to "backfeed" by connecting it to building or outdoor electrical circuits. Backfeeding can cause serious injury or death to utility personnel working to repair a power outage, and may also seriously injure persons in your vehicle. Unauthorized connections are unlawful in some states and/or localities. A transfer switch must be installed to prevent interconnection of generator set power and outside power.



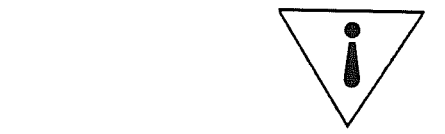
**WARNING**

**MOVING PARTS!** Keep hands, feet, and clothing away from belts and related pulleys when unit is running. Replace guards, covers, and screens (if used) before operating generator set.



**WARNING**

**HIGH VOLTAGE!** Remember that the function of a generator set is to produce electricity. Wherever electricity is present, there is the potential danger of electrocution. Take the same precautions with electrical appliances in your vehicle that you would observe in your home. Keep away from electrical



**WARNING**

**HOT PIPING!** An engine gets hot while running, and exhaust system components get extremely hot. Do not work on generator set until it has been allowed to cool.



**WARNING**

**DANGEROUS FUELS!** Use extreme caution when handling, storing, and using fuels—all fuels are highly explosive in a vapor state. Store fuel in a well-ventilated area away from spark producing equipment. Keep fuels out of the reach of children. Never add fuel to the tank while the engine is running. Spilled fuel may ignite on contact with hot parts, or from ignition spark. Always keep fuel lines and connections tight and in good condition. Don't replace flexible fuel lines with rigid lines. Should any fuel leakage, fuel accumulation, or electrical sparks be noted, **DO NOT OPERATE GENERATOR SET.** Systems should be repaired by qualified specialists before resuming generator set operation.



**WARNING**

**EXPLOSIVE BATTERY GASES!** The gases generated by a battery being charged are highly explosive. Do not smoke or permit flame or spark to occur near a battery at any time, especially when it is being charged. Avoid contacting terminals with tools, to prevent burns, and to prevent sparks. Always remove wristwatch, rings, and any other

circuits and wiring while the generator set is running. Have electrical service performed only by qualified electricians. Make sure that unqualified persons, especially children, cannot gain access to your generator set — keep the compartment door locked, or securely latched at all times. Be sure that the generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground.



**EXPLOSION!** Never connect negative (-) battery cable to positive (+) connection terminal of starter solenoid, or test battery by shorting terminals together. This could ignite fuel vapors, or cause battery to explode. To disconnect battery, remove negative cable first, and reconnect it last. Do not modify the fuel tank, or propulsion engine fuel system. Your vehicle must be equipped with a fuel tank allowing one of the two fuel pickup arrangements described. Fuel tank and installation must conform to applicable Regulations.



**HOT COOLANT!** Allow engine to cool and release pressure from cooling system before opening radiator pressure cap. To release pressure, cover the radiator cap with a thick cloth, then turn it slowly counterclockwise to the first stop. After pressure has been completely released, and engine has cooled, remove the cap.



**LETHAL EXHAUST GAS!** When installing exhaust system, position tail pipe end so that discharged exhaust gases may not be drawn into vehicle interior through windows, doors, air conditioners, etc.

**EXCESSIVE NOISE!** Never operate without adequate muffler or with a faulty exhaust system. Exposure to excessive noise can lead to impairment of hearing.



**ELECTRICAL SHOCK!** A battery can cause electrical burns and shocks. Use reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings, and any other jewelry.



**LETHAL EXHAUST GAS!** The engine power-ing your generator set discharges deadly carbon monoxide as part of the exhaust gas when operating. It is essential that the exhaust system be leak proof, and routinely inspected.



**BACKFIRE!** A sudden backfire can cause serious burns. Do not operate your generator set without its air/cleaner/flame arrestor.



**FLASH FIRE!** A sudden flash fire can cause serious burns. To avoid the possibility of a flash fire, do not smoke, or permit flame or spark to occur near carburetor, fuel lines, fuel filter, fuel pump, or other potential sources of spilled fuel, or fuel vapors.





**WARNING**

**LOOSE COMPONENTS!** When adjusting valves, do not use a ratchet wrench on crankshaft nut. Doing so can loosen nut and result in serious personal injury from nut or pulley flying off engine while unit is running.

**Electrical Connections**

Battery, load lead, and remote switch panel connections are needed to complete the installation. Make final connections to the battery only after all other connections have been made as this will prevent unintentional starting. Some specific details on each connection are stated in the following paragraphs. Refer to the wiring diagram for specific details — connections should be made only by qualified electricians. All wiring to the generator set shall be securely supported or harnessed to prevent abrasion. Additional support is required to prevent exposure to the exhaust system and drip of fuel, oil, or grease at least 2 in. (51 mm) clearance must be provided between electrical wiring and hot exhaust parts. Also, wiring must not be located directly below or in close proximity to fuel system parts or oil fill locations. If the coach is equipped with a mechanism for removing the generator from the compartment for servicing, be sure all wiring is long enough to allow free movement of the set. Some other points to consider when making AC load connections are covered in the following.

**NOTE**

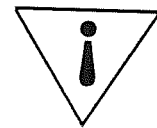
Wiring connections made at the time of installation should be accessible for inspection and servicing.

A separate 12-Volt battery is recommended for the generator set. With a separate battery, cables can be kept short which eliminates the problem of excessive voltage drop through long cables. See Table 2-6 for lengths



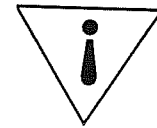
**WARNING**

**FIRE HAZARD!** Be careful when parking your RV to prevent grass fires started by hot exhaust gases and exhaust system. Keep away from hot engine and generator parts to avoid burning yourself.



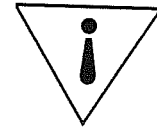
**WARNING**

**MARINE APPLICATION!** RV generator sets do not comply with United States Coast Guard (USCG) requirements. They must not be used for marine applications. Use only generator sets specified for marine use in marine installations. USCG regulation 33CFR183 requires a generator set to be "ignition protected" when used in a gasoline-fueled environment.



**WARNING**

**FIRE HAZARD!** Keep the generator set free of debris and combustible materials. Keep away from hot engine and generator parts to avoid burning yourself.



**WARNING**

**UNIT STARTS WITHOUT NOTICE!** To prevent accidental starting on units with a remote start/stop switch, always disconnect battery (remove negative lead first, and reconnect it last) to disable generator set before working on any equipment connected to generator.



**WARNING**

**EXPLOSIVE BATTERY GASES!** The gases generated by a battery being charged are highly explosive. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Any compartment containing batteries should be well ventilated to prevent accumulation of explosive gases. Do not mount battery in generator compartment.

### AC Load Lead Connections

Some sets have four color-coded load leads. The black leads (L1 and L3) are hot, the white or gray lead (L2) is neutral and the green lead is the hazard ground. The load leads can be routed directly from the junction box to the vehicle AC circuit or transfer switch connection. All installations require that the load leads be routed through flexible conduit from the generator end bracket to the junction box location. The load lead junction box must be accessible for servicing and inspection.

### NOTE

Keep load lead circuit away from the generator, specifically fuel and exhaust system components.

### NOTE

All field supplied wiring must be capable of withstanding temperatures of 90 C (167 F).

AC load lead L2 (white or gray) is always the neutral lead on PTS generator sets — make sure the neutral of the AC circuit in the vehicle is connected to the lead L2 (white or gray). If equipment ground-type plugs and receptacles (3-pronged) are used in the vehicle, the green wire must be connected to the chassis ground. On vehicles which also have provisions for using an outside AC power source, the neutral as well as the "hot" leads (or black) must be completely isolated from the generator set when power is switched to the outside source. See Figure 2-10.

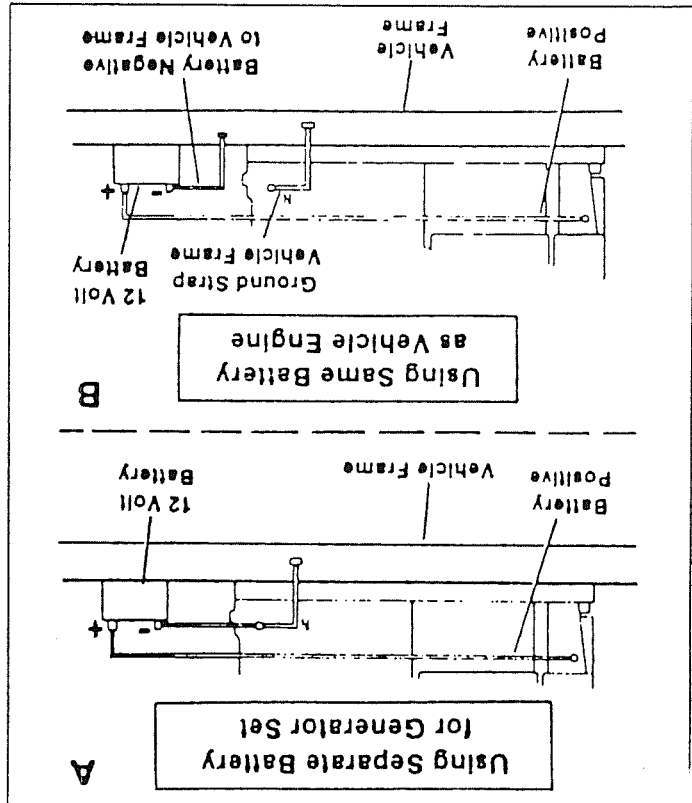


Figure 2-9. Battery Connection Details

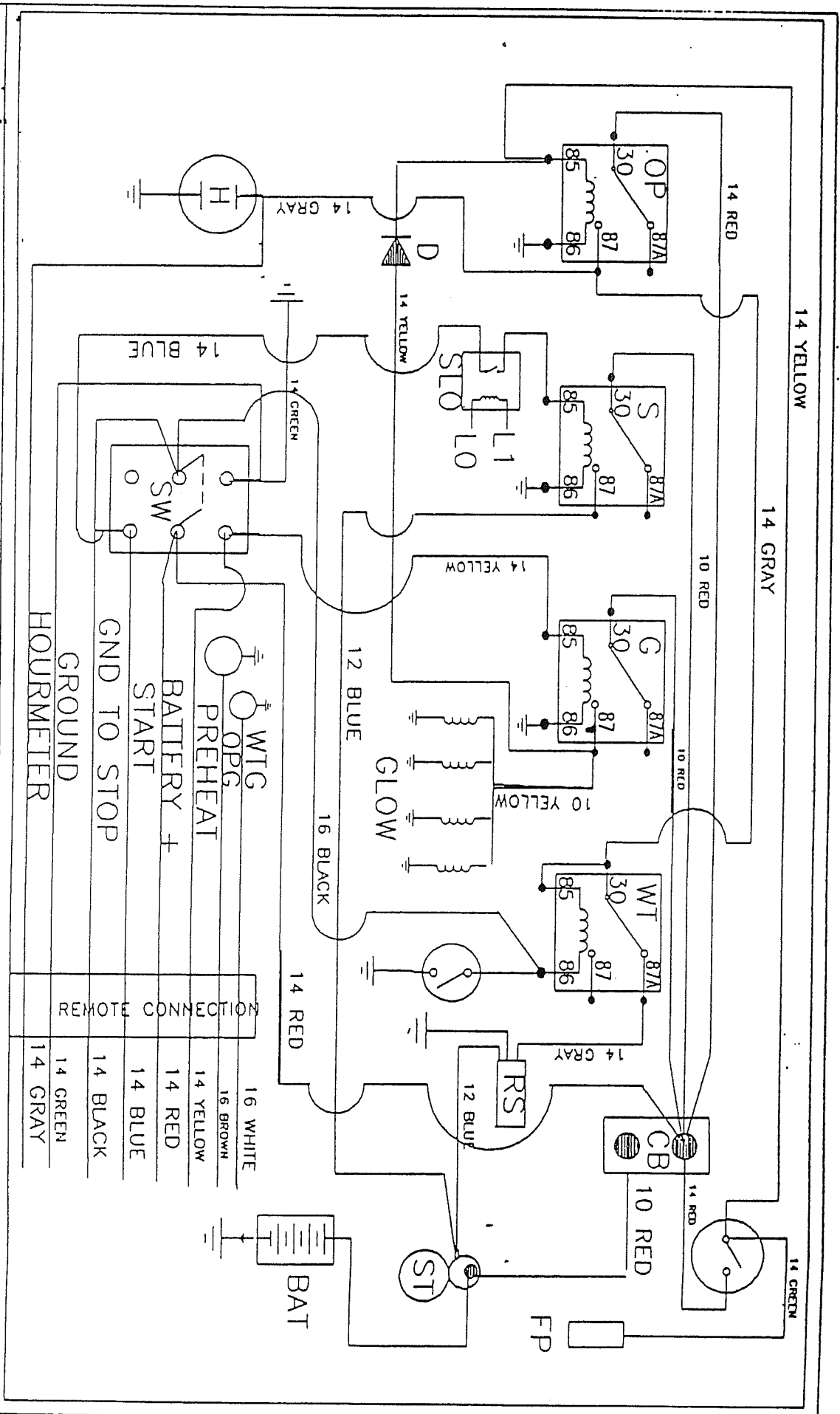
and sizes. Refer to Figure 2-9 (View A) for cable connections. Note that a grounding strap must be connected between the ground lug on the generator set and frame of the vehicle with this arrangement.

If the starting battery for the vehicle engine must also be used for starting the generator, the negative battery terminal must be grounded to the vehicle frame and heavy gauge (#4) ground strap must connect the ground lug on the generator set to the vehicle frame as illustrated in Figure 2-9.

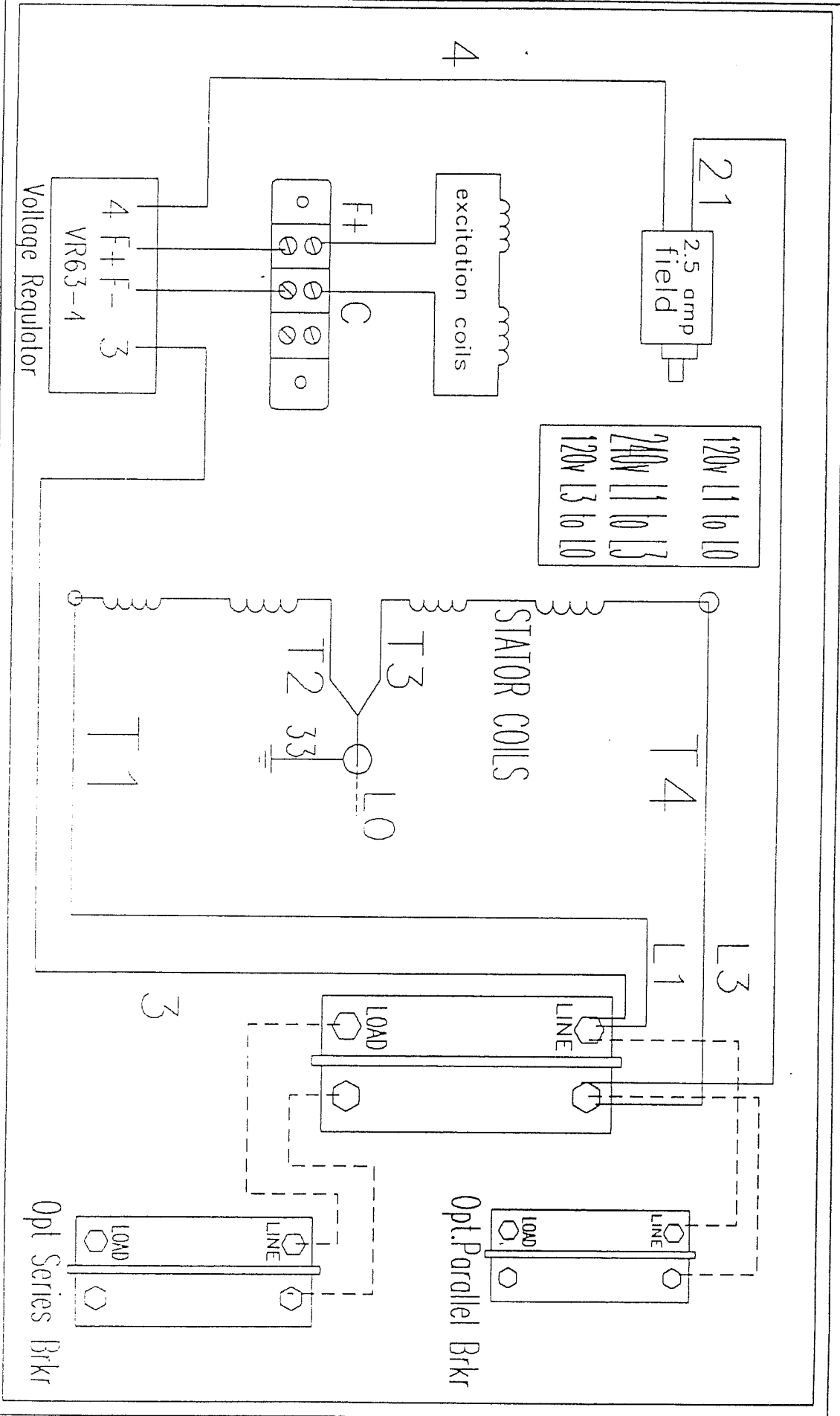
Distance Between Generator Set & Battery	Generator Set At 0° F At 32° F At 75° F	Generator Set At 180° C (100° C) (240° C)	Cable Size (AWG)
40 Feet (12.2 m)	00	0	1
30 Feet (9.2 m)	0	1	2
25 Feet (7.6 m)	1	2	4
20 Feet (6.1 m)	2	2	6
15 Feet (4.6 m)	2	4	6
10 Feet (3.0 m)	4	6	8
5 Feet (1.5 m)	6	6	8
2.5 Feet (0.8 m)	8	8	8

Table 2-6. Battery Cable Size

POWER TECHNOLOGY SOUTHEAST INC. 12V DC ENGINE CONTROLS 300/400 SERIES by J. EDDGE DATE 2/8/93



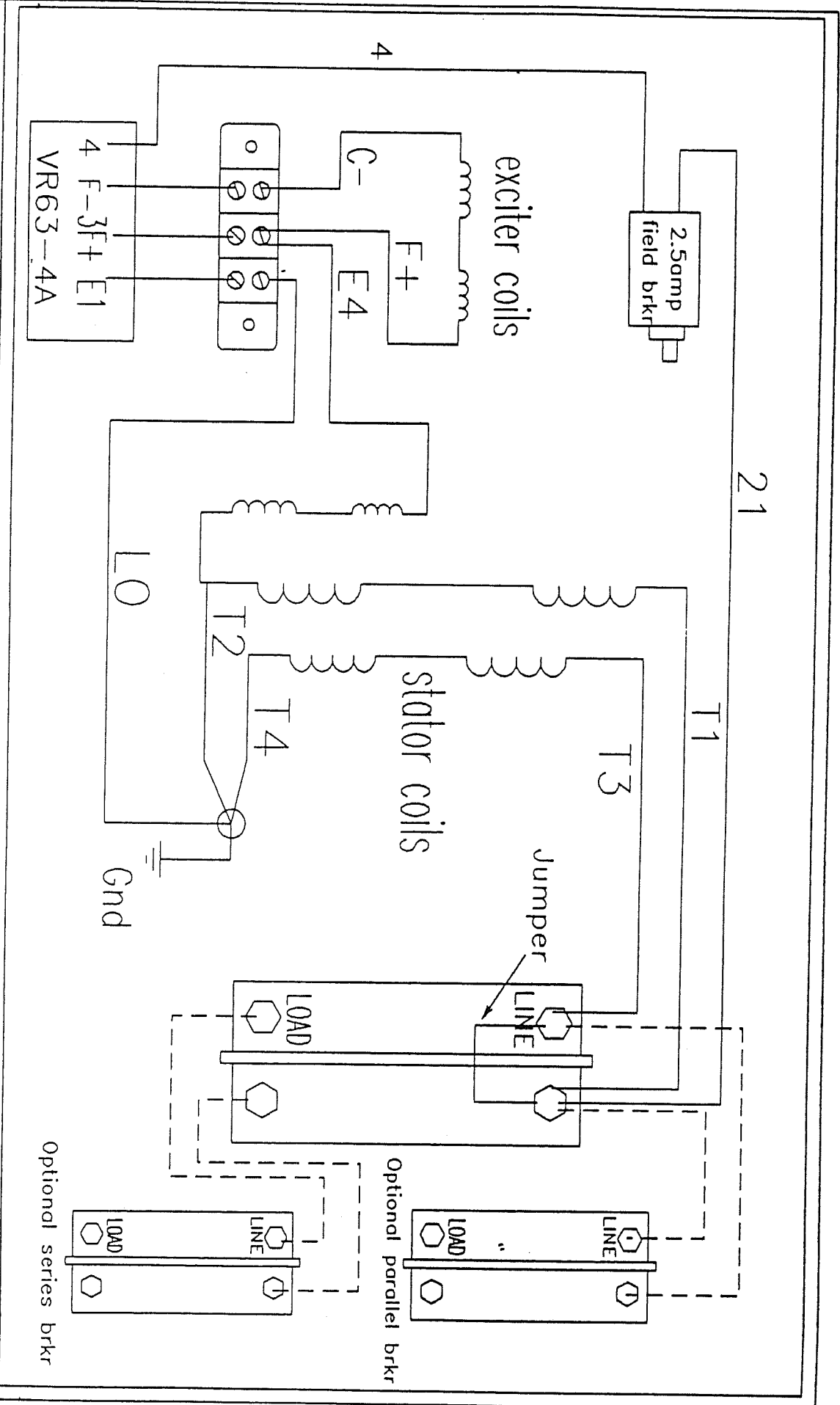
WIRING 12VDC



POWER TECHNOLOGY SOUTHEAST INC. 120/240 connection exciter generator

By J. Fudge DATE 1/12/93





POWER TECHNOLOGY SOUTHEAST INC. 120v connection exciter type

by J. Fudge  
DATE 1/11/93

# ENGINE SECTION

# FORWARD

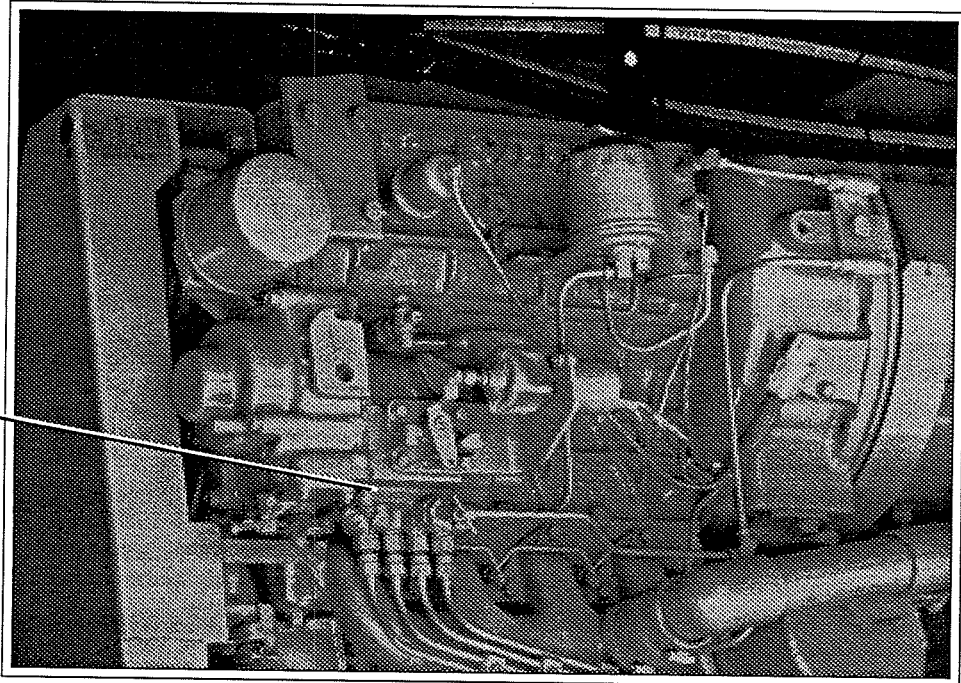
Kubota, Ltd. wishes to thank you for your purchase of the Kubota Diesel Engine. It has been designed and manufactured after many years of research and development. We are confident that the machine will give you the results you desire, but in order to get:

- \* higher efficiency,
- \* greater economy, and
- \* longer service,

we recommend that you read this Operator's Manual very thoroughly and see that the engine is handled and maintained in the proper manner. If the engine is handled and maintained in the proper way, you will find that in the long run, you have made a good investment. It should be added here that it is the policy of Kubota to utilize, as quickly as possible, all the progress made in our technical research so that the engine can be handled more easily and service life may be prolonged. The application of these new techniques may cause some small parts in the manual to differ slightly from those of the engine.

If your diesel engine should have trouble and need servicing, when you order parts, or if you have any questions, contact your Kubota dealer. Be sure to advise as to the following:

- (1) Engine model name and serial number.
- (2) Maker, model name and number of the generator.



Engine Model  
and Serial  
Number  
Location

113699  
113699

## IMPORTANT NOTICE

1. Engine exhaust fumes can be very harmful if allowed to accumulate. Be sure to run the engine in a well ventilated place and where there are no people or livestock near the engine.
2. Be sure to stop the engine when conducting daily and periodic maintenance, refueling, servicing and cleaning.
3. When allowing someone to use your machine, explain how to handle it carefully, and have him/her read this Operator's Manual thoroughly.

# FORWARD

Kubota, Ltd. wishes to thank you for your purchase of the Kubota Diesel Engine. It has been designed and manufactured after many years of research and development. We are confident that the machine will give you the results you desire, but in order to get:

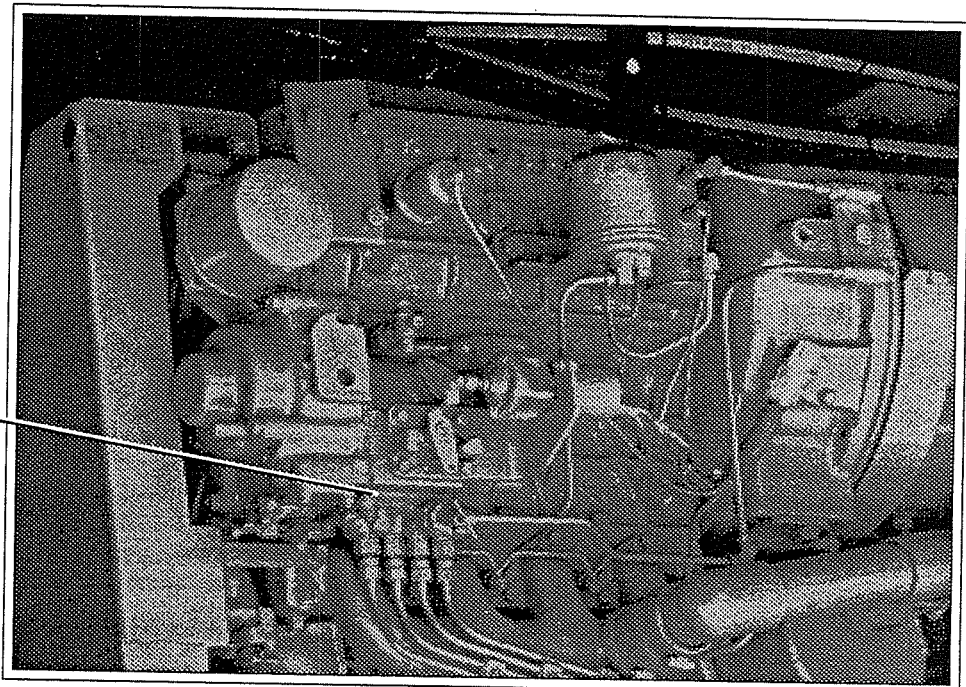
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Engine Model  
and Serial  
Number  
Location

1-1909  
113699

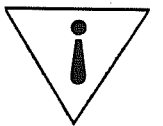
# IMPORTANT NOTICE

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3. When allowing someone to use your machine, explain how to handle it carefully, and have him/her read this Operator's Manual thoroughly.

# Operating the Engine

## 2.1 PREPARATORY CHECKS

Be sure to check the engine before starting it.



- (1) Be sure to install the machine on which the engine is installed, on a flat place.
- (2) Never run the engine on gradients.
- (3) Do not use the ether or any starting fluid with intake air of engine, or severe damage will be occurred.

## 2.2 STARTING AND STOPPING THE ENGINE

### \*Starting

- (1) Set the fuel cock to "ON".
- (2) Check that the engine stop lever is in the original position.
- (3) Place the speed control lever at "OPERATION".
- (4) Insert the key into the starter switch, and turn it to "ON".
- (5) Check to see that the oil pressure lamp and charge lamp are on.
- (6) Turn the starter switch counter-clockwise to "PREHEAT" to allow the glow lamp to redden. Shown below are the standard preheating times for various temperatures. This operation, however, is not required, when the engine is warmed up.
- (7) Return the key to "START", and the starter will begin turning, starting the engine. Release the key immediately.

Temperature	Preheating time
Over 0°C (32°F)	15 sec.
Below 0°C (32°F)	30 sec.

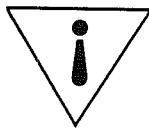
- (8) Check to see that the oil pressure lamp and charge lamp are off. If not, immediately stop the engine, and check the cause.
- (9) Warm up the engine at medium speed. Check to see that the oil pressure lamp is off. If it should stay on, immediately stop the engine and check.
- \* If there is enough engine oil.
- \* If the engine oil has dirt in it.
- \* If the wiring is faulty.

### IMPORTANT

If the glow lamp should redden too quickly or too slowly, immediately ask your Kubota dealer to check and repair it.

### IMPORTANT

- (1) Never turn the starter switch while the engine is running.
- (2) If the engine does not catch 10 seconds after the starter switch is set at "START", wait for another 30 seconds and then start the engine starting sequence over again. Do not allow the cell motor to run continuously for more than 30 seconds.
- (3) Be sure to warm up the engine not only in winter but also in other warmer seasons. An insufficiently warmed-up engine can shorten its service life.



- (1) Never start the engine in confined rooms. Exhaust fumes may poison people nearby.
- (2) Do not allow children to approach the machine while the engine is running.

### \*Stopping

- (1) Place the speed control lever at "STOP", and the engine will stop.
- (2) Turn the key switch to "OFF" and remove the key.

## 2.3 CHECKS DURING OPERATION

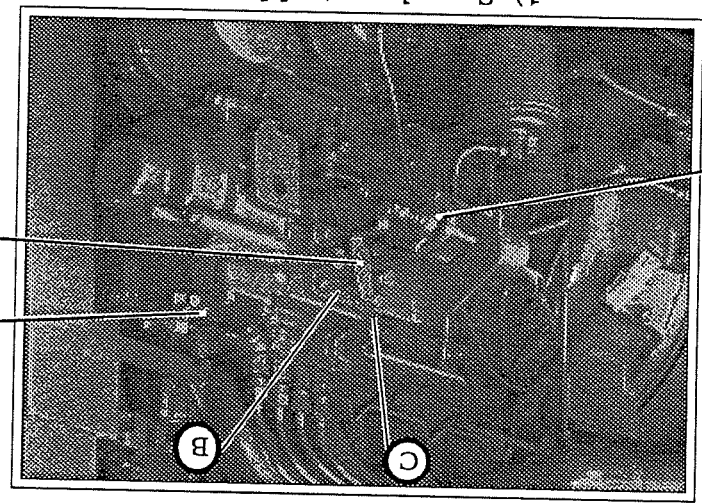
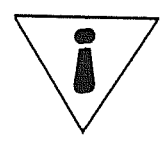
While the engine is running, constantly pay attention to see that every engine part is functioning smoothly and correctly.

### \*Cooling Water (Coolant)

- When the cooling water should boil up and steam and water overflow through the overflow pipe and cannot be stopped, stop the engine immediately, and do the following checks and remove the cause of trouble:
- (1) Check to see if there is any water leak;
  - (2) Check to see if there is any obstacle around the coolant inlet or outlet;
  - (3) Check to see if there is any dirt or dust between radiator fin and tube;
  - (4) Check to see if the fan belt is too loose;

- (5) Check to see if radiator water pipe is clogged; and
- (6) Check to see if anti-freeze is mixed into coolant in warm seasons.

When removing the radiator cap, wait at least ten minutes after the engine has stopped, and cooled down. Otherwise, hot water may gush out, scalding nearby people.



- 1) Speed control lever
- 2) Engine stop lever
- 3) Start-stop solenoid
- B) "Start"
- C) "Stop"

\*Oil Pressure Lamp (if used)

The lamp lights up to warn the operator that the engine oil pressure has dropped below the prescribed level. If the lamp should light up during engine operation or should not go off even after the engine speed has increased to more than 1000 rpm, immediately stop the engine and check the following:

- (1) Engine oil level, and
- (2) Lubricant system.

\*Fuel

Be careful not to allow the fuel tank to become completely empty, or air may enter the fuel system, requiring bleeding.

\*Color of Exhaust

While the engine is run within the rated output range, the color of exhaust remains

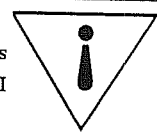
# Break-in and Checks

## 3.1 Daily Checks

To prevent trouble and accidents, it is important to keep the engine in top condition. Always check the following points before starting operation.

- (1) If the engine speed suddenly increases or decreases;
- (2) If a sudden unusual noise is heard;
- (3) If the color of exhaust suddenly darkens; or
- (4) If the oil pressure lamp or the water temperature alarm lamp lights up.

\*Immediately stop the engine: If the engine is run continuously with dark exhaust emission, it may lead to trouble.



Install the machine on a wide and flat place and stop the engine before checking.

Ref. Page	ITEM
NA	1. Parts which had trouble in previous operation.
28	(1) Oil or water leaks
27	(2) Engine oil level and contamination
NA	(3) Amount of fuel
28	(4) Amount of coolant
31	(5) Dust in air cleaner dust cup
ALL	(6) Damaged parts and nuts
24	(1) Proper functions of meters and pilot lamps; no stains on these parts
NA	(2) Proper function of glow lamp
25-35	(1) Color of exhaust fumes
25	(2) Unusual engine noise

2. By walking around the machine.

3. By inserting the key into the starter switch

4. By starting the engine

### 3.2 Break-In

During the engine break-in period, by all means observe the following:

- 1) Change engine oil and oil filter cartridge after the first 35 hours of operation.
- 2) When ambient temperature is low, operate the machine after the engine has been completely warmed up.

### 3.3 Periodic Checks

INTERVAL	ITEM	Ref. Page
Every 50 hours	Check of fuel pipes and clamp bands	28
Every 100 hours	Change of engine oil (depending on the oil sump)	28
Every 200 hours	Cleaning of air cleaner element	32
	Cleaning of fuel filter	NA
	Check of battery electrolyte level	NA
	Check of fan belt tightness	33
Every 150 hours	Check of radiator hoses and clamp bands	31
Every 200 hours	Replacement of oil filter cartridge	29
Every 400 hours	Replacement of fuel filter cartridge	
Every 500 hours	Removal of sediment in fuel tank	NA
Every one or two months	Cleaning of water jacket (radiator interior)	31
	Recharging of battery	NA
Every three months	Change of radiator cleaner and coolant	31
Every year or every six cleanings of air cleaners	Replacement of air cleaner element	32
Every two years	Replacement of battery	NA
Replacement of fuel pipes and clamp bands	Replacement of radiator hoses and clamp bands	31
	Replacement of fuel pipes and clamp bands	NA

### (SAE J313 JUN80) Grade of Diesel Fuel Oil According to ASTM D975

Carbon Residue on, 10 Percent	Water and Sediment, %	Flash Point, °C (°F)	Max	Viscosity at 100°F		Distillation 90% Point	Kinematic Viscosity at 40°C	Sulfur, %	Copper Strip Corrosion	Cetane Number
				52 (125)	Max					
Max	Max	Max	Max	32.6	4.1	338 (640)	1.9	4.1	Max	Min
0.01	0.05	52 (125)	0.05	40.1	0.50	282 (540)	32.6	40.1	0.50	40

4.1 FUEL

\* Fuel level check and refueling

(1) Check to see that the fuel level is above the lower limit of the fuel gauge.

(2) For fuel, always use diesel light oil. You are required not to use alternative fuel, because its quality is unknown or it may be inferior in quality, and kerosene, which is very low in cetane rating, adversely affects the engine. Diesel light oil differs in grades depending on the temperature.

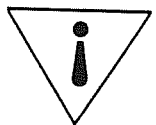
No. 2-D A distillate fuel oil of lower volatility for engines in industrial and heavy mobil service.

It is recommended to use No. 1-D fuel if ambient air temperature is expected to be less than 40°C or if use of the machine at an altitude exceeding 5,000 feet (1524 m) is expected.

Approved fuels for use with Kubota diesel engine are:

- Great Britain: BS2869 1967 Class A1 and A2
- USA: A.S.T.M/D975 No. 1-D and No. 2-D
- USA Federal: VV-F-800a Grades DF-A, DF-1 and DF-2.
- German: DIN51601
- France: J.O.14/9/57 gas oil
- Italy: CUNNA-gas oil NC-630-01
- Sweden: SIS 155432
- Switzerland: Federal military Spec. 9140-335-1404

Never fail to stop the engine before refueling. Keep the engine away from fire.



**IMPORTANT**

- (1) Be sure to use a strainer when filling the fuel tank, or dirt or sand in the fuel may cause trouble in the fuel injection pump.
- (2) Be careful not to let the fuel tank be come empty, or air can enter the fuel system, necessitating bleeding before next engine start.
- (3) Be careful not to spill oil during refueling. If oil should spill, wipe it off at once, or it may cause a fire.

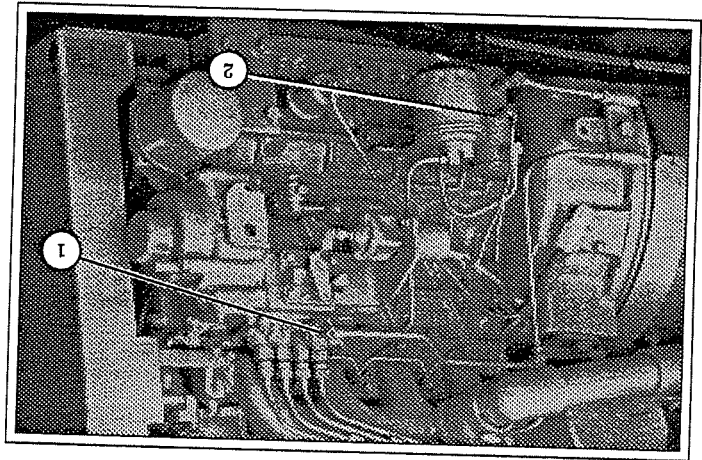
**Bleeding the fuel system**

Bleeding the fuel system is required;

- (1) after the fuel filter and pipes have been detached and refitted;
- (2) after the fuel tank has become empty; or
- (3) before the engine is to be used after long storage.

**PROCEDURE**

- (1) Open the air vent cock on top of the fuel injection pump.
- (2) Hold the prime switch down for about one minute, then release it.
- (3) Close the fuel injection pump cock.



1) Fuel vent cock  
2) Fuel feed pump

**IMPORTANT**

\* Always keep the air vent cock on the fuel injection pump closed except when air is vented, or it may cause the engine to stop.

**4.2 ENGINE OIL**

(1) \*

- (1) Check the engine oil level before starting the engine or more than five minutes after it has been stopped.
- (2) Detach the dipstick, wipe it clean, reinsert it, take it out again, and check the oil level.
- (3) If the oil level is too low, remove the oil port plug, and supply new oil to the prescribed level.

A:

Engine oil level within this range is proper. If the engine is operated with the oil level nearing the lower limit, however, oil may deteriorate quickly; keeping the oil level near the upper limit is this recommended.

Type of Engine	Quantity
V2203	2.38 gal (9.0 gal)

**IMPORTANT**

Engine oil should be of MIL-L-2140C or have properties of API classification CC/CD grades. Change the type of engine oil according to the ambient temperature.

above 77°F	SAE30
52°F to 77°F	SAE20
below 52°F	SAE10W or SAE10W-30

**NOTE**

Oil quantities shown are for standard oil pans.

(4)

When using oil different from the previous one, be sure to drain all the previous oil before supplying it into the crankcase.

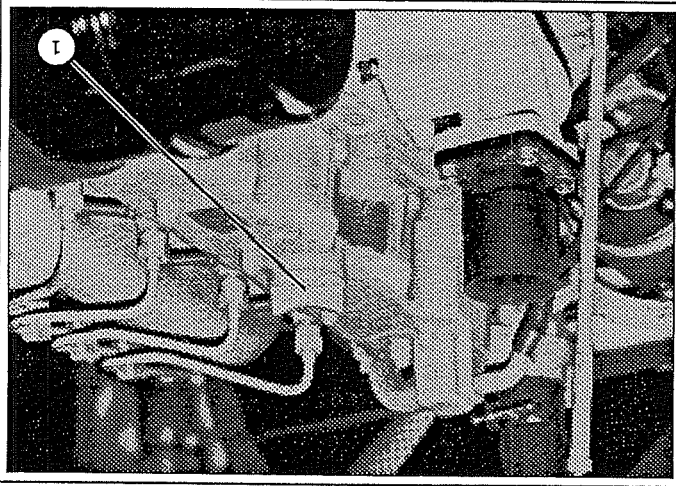
**IMPORTANT**

Be sure to inspect the engine, locating it on a horizontal place. If it is placed on gradients, an accurate oil quantity may not be measured.

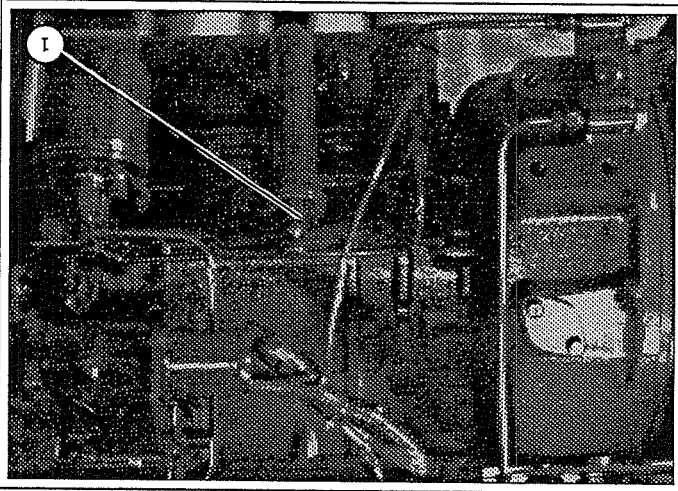




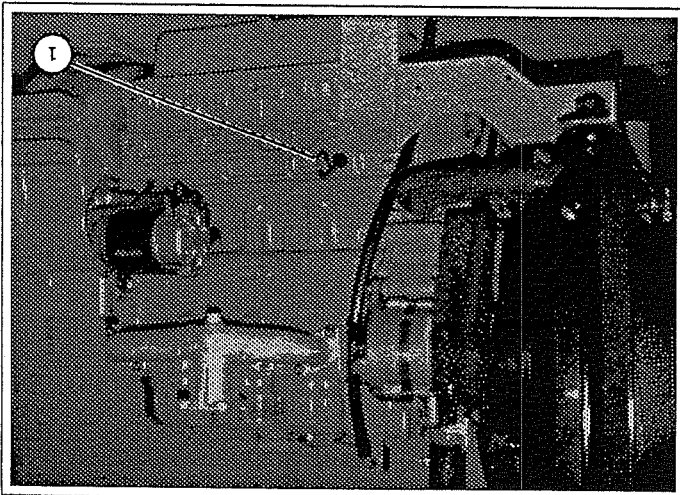
1) Oil fill plug



1) Dipstick



1) Dipstick

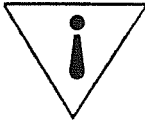


Though the radiator is built strongly, it may adversely affect the engine performance if handled in a wrong manner. Make it a rule to check the coolant level before every operation.

### 4.3 RADIATOR

Wipe off any oil sticking to the machine body completely.

### IMPORTANT



Stop the engine before replacing the oil filter cartridge.

oil if necessary. Add before checking the engine oil level.

that no oil leaks through the seal before checking the engine oil level. Add the engine oil level drops. Thus, run the engine for a while and check to see After the cartridge has been replaced, enough by hand.

seal surface, tighten the cartridge the gasket comes into contact with the

Screw in the cartridge by hand. When cartridge.

Apply a film of oil to the gasket for the filter wrench.

Detach the oil filter cartridge with a 200 hours of operation.

Replace the oil filter cartridge every

\* Replacing the oil filter cartridge

Change oil after the first 35 hours of operation, and every 100 hours thereafter.

### IMPORTANT



Change engine oil after stopping the engine.

Supply new engine oil up to the upper limit of the dipstick.

hot. Drain oil if done while the engine is still

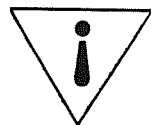
Draining oil will be easier and complete if done while the engine is still

Remove the drain plug at the bottom of the engine, and drain all the old oil. Changing engine oil

\* Checking the radiator hoses (water pipes)  
Check to see if the radiator hoses are properly fixed every 150 hours of operation or every six months, whichever comes first.

- (2) Re-tighten the fan belt if necessary.
- (1) Checks against excessive coolant overflow for net, or between radiator fin and tube.

Change coolant after stopping the engine.  
Never remove the radiator pressure cap while the engine is running under heavy load or immediately after it has been stopped, or hot water may gush out, scalding people nearby. Remove the radiator cap more than ten minutes after the engine has been stopped.

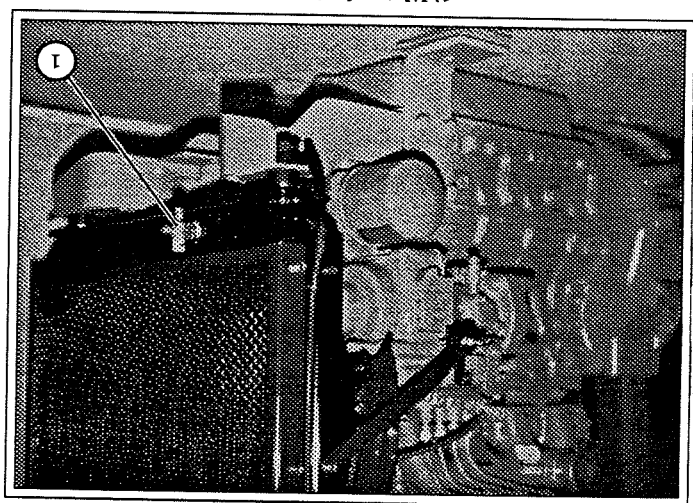


- (1)
- (2)

Summer
Winter (when temperature drops below 32°F (0°C))

**CAUTION**  
A solution of 50% antifreeze and 50% water must be used in this engine. (Freezing point about -34 F) Do not use 100% antifreeze, or severe damage will occur.

- (5) An improperly tightened radiator cap or a gap between the cap and the seat quickens loss of cooling water.
- (6) Radiator cleaner and anti-freeze



1) Water drain cock

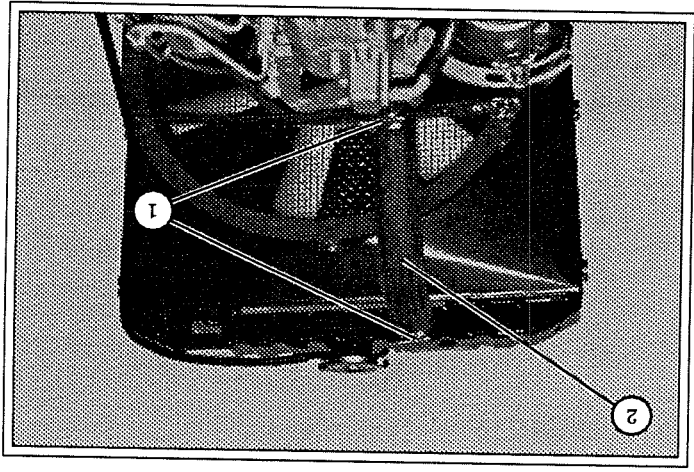
- (1) If the clamp band is loose, apply oil to the screw of the band, and tighten the band securely.
- (2) Made of rubber, the radiator hoses will wear out whether or not the engine has been used much. Replace the hoses and the clamp bands every two years, and secure them.

\* Cleaning the radiator core  
Should dirt collect between the radiator fin and the tube, wash it away with tap water.

\* Cleaning the radiator  
Clean the cooling system of the engine every 400 hours. In addition, clean it before adding anti-freeze.

**IMPORTANT**

Do not clean the radiator core with anything hard like a spatula or a screwdriver. It may damage the special radiator fin, impairing the radiator's operation.



1) Clamp band  
2) Radiator hose

\* Radiator cement  
As the radiator is solidly constructed, there is little possibility of water leakage. Should this happen, however, radiator cement can easily fix it. If leakage is serious, contact your dealer.

\* Anti-freeze

If it freezes, cooling water can damage the cylinders and radiator. It is thus necessary, if the ambient temperature falls below 32°C, to remove cooling water after operating to

will react with the radiator cleaning agent forming sludge which will affect the engine parts.

#### AIR CLEANER

4.4 (1) As the element of the air cleaner employed on this engine is a dry type, never apply oil to it.

(2) Remove and clean out the dust cup before it becomes half full with dust; usually once a week, or even every day if the working surroundings are dusty.

(3) Avoid touching the element except when cleaning.

(4) When dry dust adheres to the element, blow compressed air from the inside turning the element. Pressure of compressed air must be under 686kPa (7kgf/cm<sup>2</sup>, 99psi).

(5) When carbon or oil adheres to the element, soak the element in detergent for 15 minutes then wash it several times in water, rinse with clean water and dry it naturally.

After element is fully dried, inspect inside of the element with a light and check if it is damaged or not (referring to the instructions on the label attached to the element).

(6) Replace the element every year or every six cleanings.

#### IMPORTANT

Install the air cleaner dust cup with "TOP" indicated on the rear of the cup in the up-side. (However, it may be installed in either direction when the cover is placed at the lower part.)

If the dust cup is mounted incorrectly, dust or dirt does not collect in the cup, and direct attachments of the dust to the element will cause its lifetime to shorten to a great extent.

\* Dust indicator (optional)

If the red signal on the dust indicator attached to the air cleaner is visible, the air cleaner has reached the service level. Clean the element immediately, and reset the signal with the "RESET" button.

add anti-freeze to it.

(1) There are two types of anti-freeze available; use the permanent type (PT) for this engine.

(2) Before adding anti-freeze for the first time, clean the radiator interior by pouring fresh water and draining it a few times.

(3) The procedure for mixing of water and anti-freeze differs according to the make of the anti-freeze and the ambient temperature, basically it should be referred to SAE J1034 standard, more specifically also to SAE J814c.

(4) Mix the anti-freeze with water, and then fill in to the radiator.

#### IMPORTANT

When the anti-freeze is mixed with water, the anti-freeze mixing ratio must be less than 50%.

Vol % Antifreeze	Freezing Point			Boiling Point <sup>(a)</sup>
	°F	°C	°F	
40	-12	-24	-37	106
50	-34	-37	226	108

(a) At 760mm pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

#### NOTE

(1) The above data represent industry standards that necessitate a minimum glycol content in the concentrated anti-freeze.

(2) When the cooling water level drops due to evaporation, add water only. In case of leakage, add anti-freeze and water in the specified mixing ration. Anti-freeze absorbs moisture. Keep unused anti-freeze in a tightly sealed container.

(3) Do not use radiator cleaning agents when anti-freeze has been added to the cooling water. (Anti-freeze contains an anti-corrosive agent, which

## 4.6 ADJUSTMENT OF FAN BELT TIGHTNESS

\* Fan belt tension and damage  
An improperly adjusted fan belt can cause engine overheating and insufficient battery charging. Push on the fan belt at the middle with a finger, and check that it deflects about 0.28 in. (7mm). Also check the belt for cracks or tears.

### \* Tension adjustment

Loosen the two bolts holding the generator, and adjust until proper tension is obtained. Be sure to re-tighten the nuts and bolts after adjustment.

## 4.7 LONG STORAGE

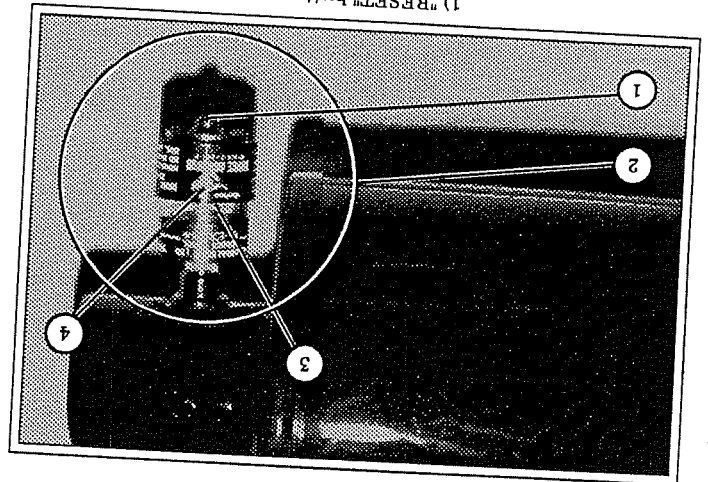
Before storing the engine for more than a few months, remove any dirt on the machine, and:

- (1) Drain the coolant in the radiator. Open the cock at the bottom of the radiator, and remove the pressure caps to drain water completely. Leave the cock open. Hang a note written "no water" on the pressure caps. Since water may freeze when the temperature drops below 32°C, it is very important that no water is left in the machine.

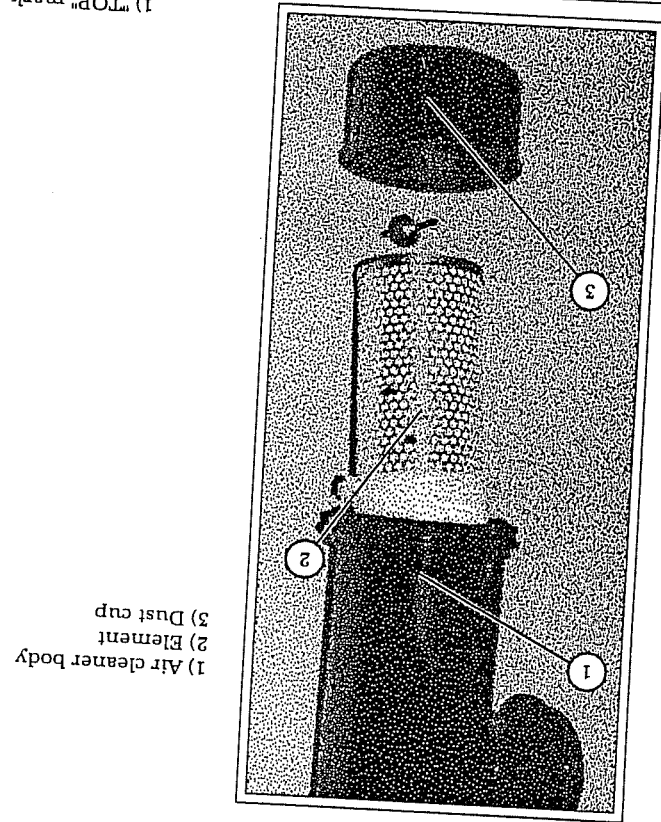
Always set the accelerator lever on "Stop". Should the decompression lever be pushed, and compression reduced while the engine stopped, starting the next time may be not only difficult, but impossible.

- (2) Remove dirty engine oil, fill with new oil and run the engine for about 5 minutes to let the oil penetrate to all the parts.

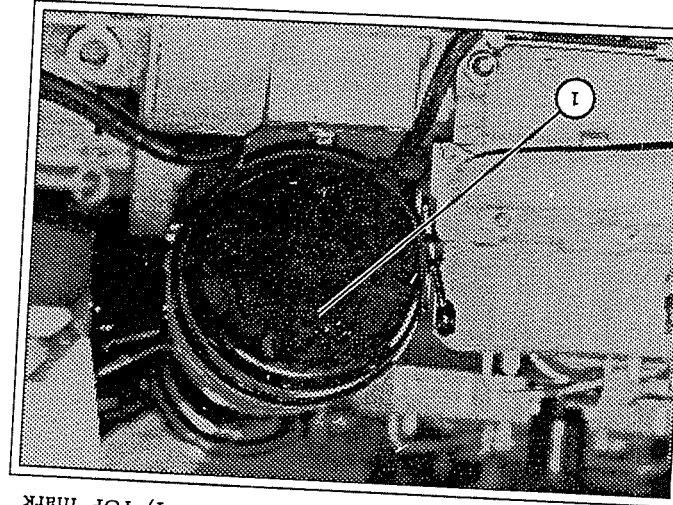
Check all the bolts and nuts, and tighten, if necessary.  
Remove the battery from the engine, recharge it, and adjust the electrolyte level. Store the battery in a dry and dark place.



1) "RESET" button  
2) Dust indicator  
3) Service level  
4) Signal



1) Air cleaner body  
2) Element  
3) Dust cup



1) "TOP" mark

## 4.6 ADJUSTMENT OF FAN BELT TIGHTNESS

\* Fan belt tension and damage  
An improperly adjusted fan belt can cause engine overheating and insufficient battery charging. Push on the fan belt at the middle with a finger, and check that it deflects about 0.28 in. (7mm). Also check the belt for cracks or tears.

\* Tension adjustment

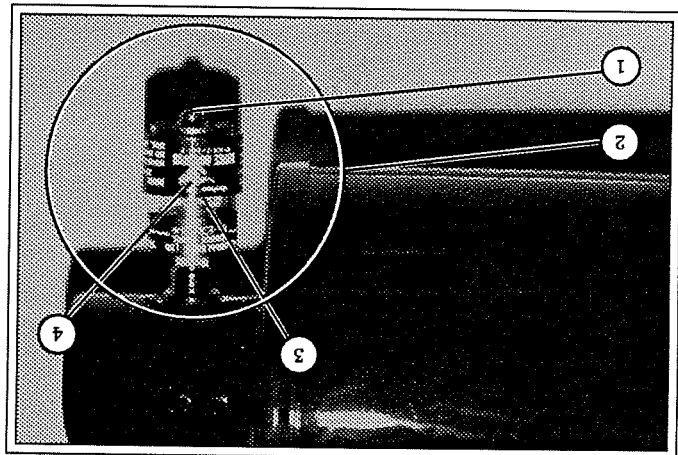
Loosen the two bolts holding the generator, and adjust until proper tension is obtained. Be sure to re-tighten the nuts and bolts after adjustment.

## 4.7 LONG STORAGE

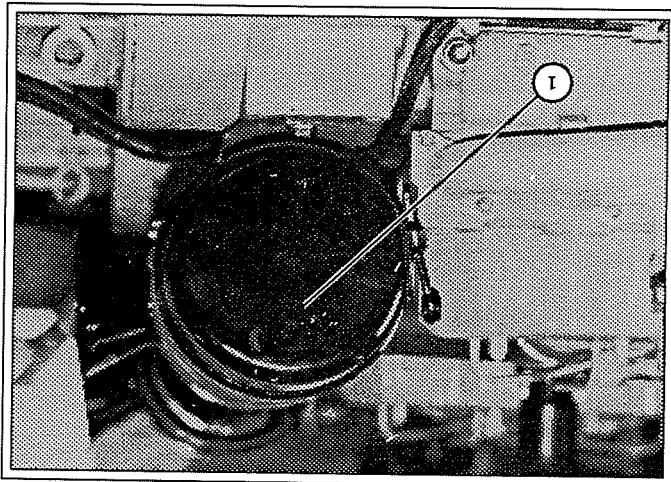
Before storing the engine for more than a few months, remove any dirt on the machine, and:

- (1) Drain the coolant in the radiator. Open the cock at the bottom of the radiator, and remove the pressure caps to drain water completely. Leave the cock open. Hang a note written "no water" on the pressure caps. Since water may freeze when the temperature drops below 32C, it is very important that no water is left in the machine.

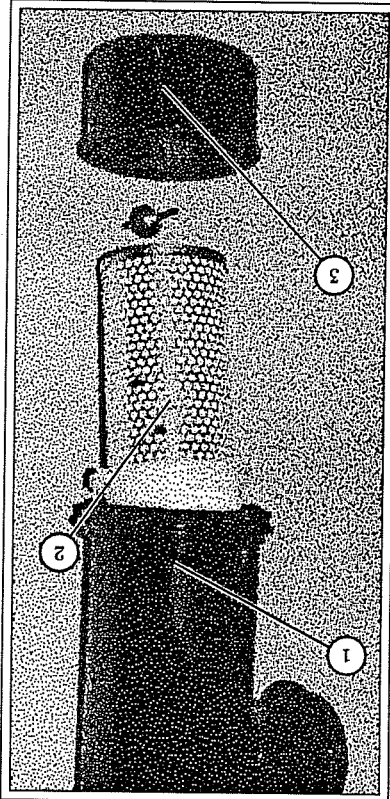
- (2) Always set the accelerator lever on "Stop". Should the decompression lever be pushed, and compression reduced while the engine stopped, starting the next time may be not only difficult, but impossible.  
Remove dirty engine oil, fill with new oil and run the engine for about 5 minutes to let the oil penetrate to all the parts.
- (4) Check all the bolts and nuts, and tighten, if necessary.
- (5) Remove the battery from the engine, recharge it, and adjust the electrolyte level. Store the battery in a dry and dark place.



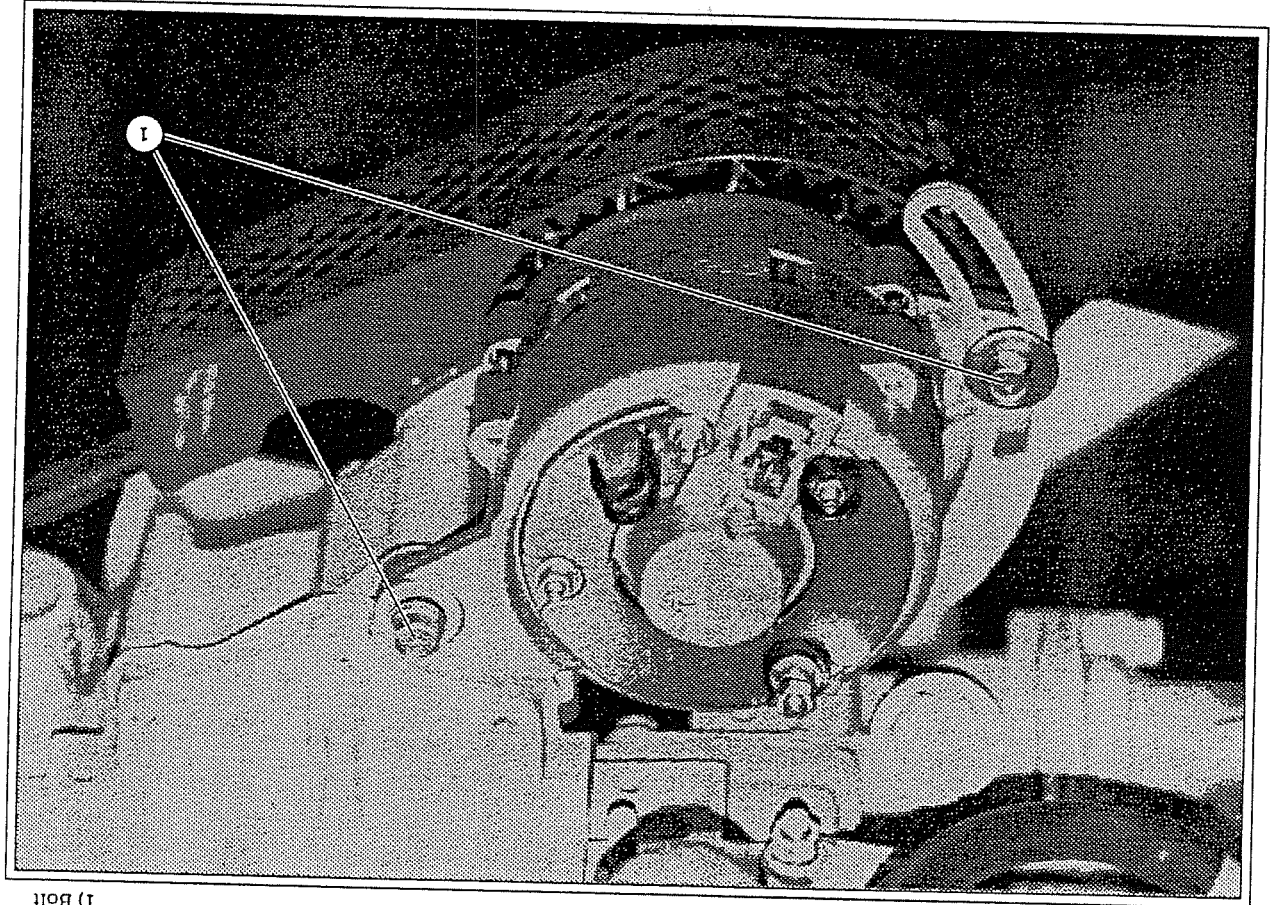
1) "RESET" button  
2) Dust indicator  
3) Service level  
4) Signal



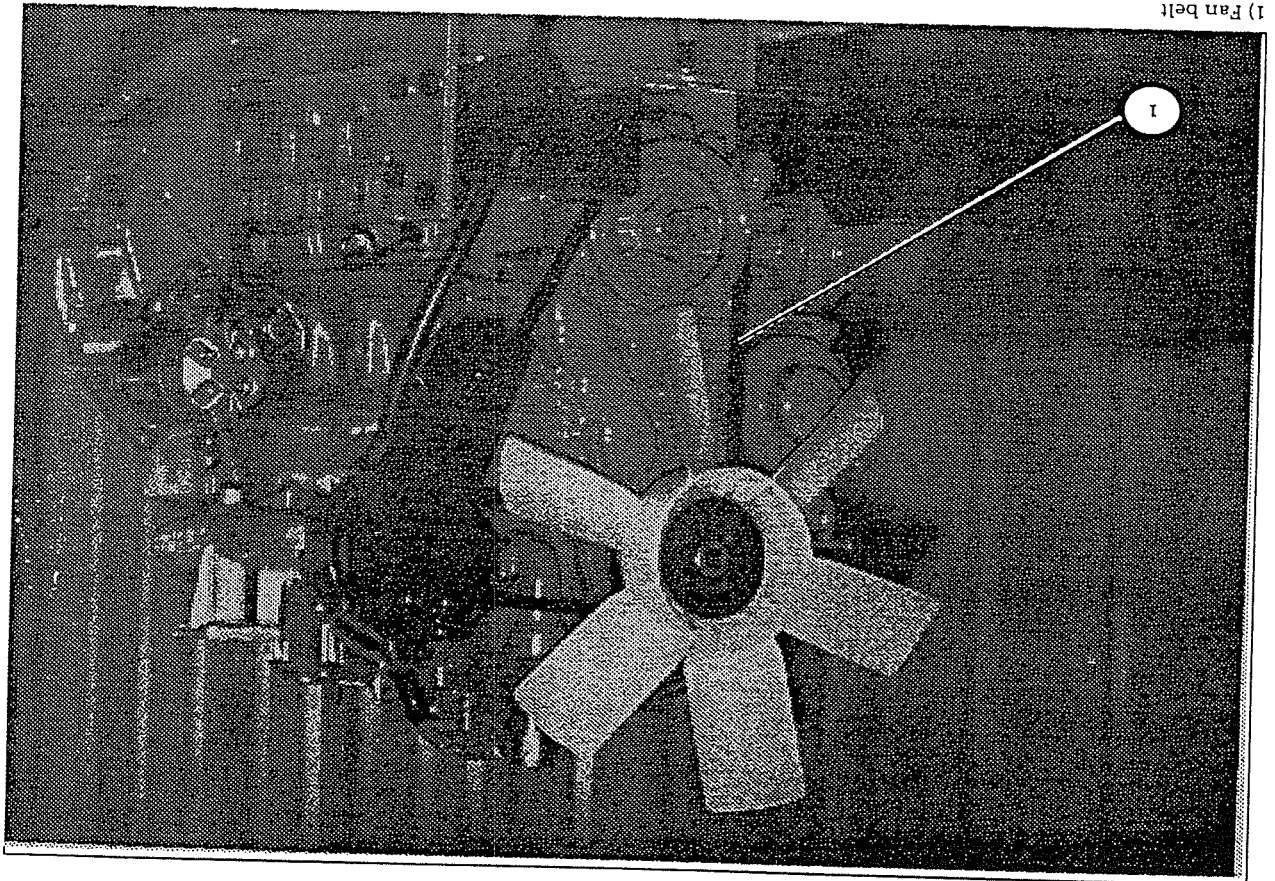
1) "POP" mark



1) Air cleaner body  
2) Element  
3) Dust cup



1) Bolt



1) Fan belt





# Specifications

Model	V2203-8G
Type	Vertical, water-cooled, 4-cycle diesel
Number of Cylinders	4
Bore x Stroke	87 x 92.4mm (3.43" x 3.64")
Total Displacement	2197 cc (134.07 cu. in.)
Combustion Chamber	Spherical type
Fuel Injection Pump	Bosch K type mini pump
Direction of Rotation	Counter-clockwise from flywheel side
Injection Nozzle	Bosch throttle type
Compression Ratio	22
Lubricating Oil Capacity	7.6l (2.01 gal.) Quality better than CC class (API)
Cooling System	Radiator (not included in the basic spec.) forced circulation (with water pump)
Starting System	Electric starting with cell starter (12V, 1.4kW)
Dynamo for Charging	12V, 420W
Fuel	Diesel fuel No. 2-D (ASTM D975)
Dry Weight	203 kg (447.5 lbs.)
SAE Net Cont. HP	270 HP/1800 rpm
DIN 6270-NA PS	270 PS/1800 rpm
Standby	325 PS/1800 rpm

Specifications subject to change without notice.

With SAE flywheel... possible

Problem	Possible Cause	Corrective Action
Generator		
No AC Output	AC current breaker(s) in OFF position	Return to ON position
	Faulty electronic regulator	Replace regulator
	Loss of excitation	See Generator Service Section
	Generator malfunction such as broken leads, or other internal fault	See Authorized Service Dealer
	Engine speed too low	Check governor operation
	Set overloaded	Make sure set capacity is not being exceeded. See "Wattage Requirements"
	Engine in poor condition	If routine services are performed and condition persists, see Authorized Service Dealer.

# Service Parts List

PTS MH 17.5 & 20

- Oil Filter
- Fuel Filter
- Air Filter
- Fan Belt
- Thermostat
- Fuel Pump
- Oil Capacity

- 70000-32091
- 70000-43081
- 70000-11080
- 15469-97010
- 15321-73010
- 476459
- 2.38 gal (9 qts.)

*Eng the V-1 1909 113699*

# POWER TECHNOLOGY SOUTHEAST INC.

## LIMITED WARRANTY ON POWER TECH. GENERATORS.

### OUR WARRANTY TO YOU

Power Technology Southeast Inc. warrants to you, the original purchaser, that each product of its manufacture, is free from defects in materials, and in workmanship; that each generator will deliver its rated output as indicated on the Power Tech. nameplate, if properly installed, serviced, and operated under normal conditions in accordance with Power Tech's instructions.

### THE WARRANTY SHALL BE IN EFFECT FOR THE FOLLOWING PERIODS:

1. U.L. listed units installed in a recreational vehicle 3 years or 2000 hours whichever comes first.
2. Non RV, Commercial or Marine use, 2 years or 2000 hours, whichever comes first.
3. Rental Units - 1 year or 2000 hours, whichever comes first.
4. Replacement parts for 90 days.

### WHAT POWER TECH WILL DO

Power Tech will, at our option, repair or replace any part covered by this warranty which becomes defective, malfunctions or otherwise fails to conform with this warranty under normal use and service during the term of this warranty at no charge for parts or labor.

### WHAT YOU MUST DO TO OBTAIN WARRANTY SERVICE

In order to obtain warranty repairs you must deliver the product, together with proof of purchase, to an authorized or recognized Power Tech. service facility or in the case of Kubota Engine Repairs you may use any authorized Kubota dealer or distributor, or any RV or Generator service facility considered competent by Power Technology.

### THIS WARRANTY DOES NOT COVER

1. Defects, malfunctions or failures resulting from accidents, abuse, misuse, improper servicing, lack of performance or required maintenance service, or normal wear.
2. Products which have been subjected to alteration, modification, neglect, unauthorized repairs.
3. Replacement of filters, belts, except 6.5kw drive belt, antifreeze or lubricants.
4. Electrical items damaged by welding or jump starting.
5. Damage caused by contaminated oil, bad fuel, USE OF OTHER OR ANY STARTING FLUID, USE OF MORE OR LESS THAN 50/50% SOLUTION OF ANTIFREEZE/H<sub>2</sub>O OR RUST CORROSION OF THE FUEL SYSTEM.
6. The replacement of complete assembly (unless prior approval has been granted by Power Tech) or components must be disassembled and repaired as necessary.
7. Overtime labor requested by customer.
8. Starting Batteries.
9. Damage caused by water entering the engine due to any cause.
10. Failure of fuel system components due to impurities in the fuel, routine fuel system maintenance and fuel filter replacement.
11. Any damage caused by overheating that is not a direct result of a defect in material or workmanship.
12. Any generator not application approved.
13. Any damage caused by failure to immediately correct a known or suspected engine, generator or accessories problem.
14. Travel time, mileage or labor for removal of a Power Tech. product from its application and reinstallation except as indicated below.

Power Tech. will pay the following stated labor at straight time only for warranty work requiring removal and reinstallation of Power Tech. products in the following applications. Provided such warranty work is performed by a Power Tech. authorized service center or designated service representative.  
1. On highway recreational and commercial vehicle applications - Up to a maximum of two (2) hours.

11. Marine generator installations (below deck) - Up to a maximum of four (4) hours.

B. Travel time and mileage  
Marine, industrial standby generators, Residential standby systems - Provided the set is permanently wired in a stationary installation. Power Tech. will, for 12 months after date of purchase, pay travel time up to five (5) hours and mileage up to 250 miles for related warranty repairs provided such travel and repairs are performed by a Power Tech. authorized service center or designated service representative.

15. Loss of generator excitation due to prolonged storage.

### GENERAL CONDITIONS

- A. This warranty is the sole property of the original owner-user. A transfer of ownership shall terminate this warranty.
- B. This warranty is valid only within the United States and Canada.
- C. This warranty does not cover any products or parts not purchased from Power Technology.
- D. Problems arising from improper installation are the responsibility of the installer and are not covered by the Power Tech. Warranty.
- E. Power Technology reserves the right to make design improvements and model changes without any obligation to change units or parts previously manufactured.
- F. Warranty registration card must be completed and mailed to Power Tech. to validate warranty.

### THIS IS THE ONLY EXPRESS WARRANTY ON POWER TECH. PRODUCTS

No person, agent or dealer is authorized to give any warranties on behalf of Power Technology Southeast Inc., not to assume for Power Technology Southeast Inc. any other liability in connection with any of its products unless made in writing and signed by an officer of Power Technology Southeast Inc.

### LIMITATIONS ON OUR RESPONSIBILITY WITH RESPECT TO PRODUCTS PURCHASED AND USED FOR PERSONAL, FAMILY OR HOUSEHOLD USE

Our responsibility is to repair or replace defective parts as stated above; we will not be responsible for any other expenses, losses or inconvenience which you may sustain as a result of the purchase, use, malfunction or defective condition of our products. ANY IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL BE LIMITED IN DURATION TO THE PERIOD SET FORTH ABOVE. Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

### LIMITATIONS ON OUR RESPONSIBILITY WITH RESPECT TO PRODUCTS USED FOR RENTAL OR FOR COMMERCIAL, INDUSTRIAL OR AGRICULTURAL PURPOSES

This warranty is in lieu of all other warranties, expressed or implied, and of any other obligations or liability on our part. WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED. Our responsibility for any and all losses and damages resulting from any cause whatsoever, including our negligence, alleged damaged or defective goods, whether such defects are discoverable or latent, shall be limited to the repair or replacement of defective parts as stated above. IN NO EVENT WILL WE BE LIABLE FOR LOSS OF USE, LOSS OF PROFITS, INCONVENIENCE, COMMERCIAL LOSS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER.



**PRINCIPLE OF OPERATION**

The exciter pole pieces contain residual magnetism, setting up lines of force across the air gap to the exciter armature. When the exciter armature begins to rotate a voltage is induced and current flow is initiated in the exciter armature AC windings. This voltage is fed to the rotating rectifier assembly, rectified and fed to the alternator field coils. This DC voltage is sufficient to magnetize the laminated alternator field which will set up lines of force across the air gap to the alternator stator. As the generator rotor rotates a voltage will be induced and current will flow in the alternator stator windings and to the output circuit.

A static type voltage regulator is connected to the generator output. The regulator will rectify part of the output voltage to provide a DC voltage to the exciter field coils. This will increase the density of the lines of force in the exciter increasing the voltage induced into the exciter armature windings, and therefore, to the rotating rectifiers.

The rotating rectifier output will be increased which will increase the alternator field strength and the generator output will build up to its rated voltage.

Adjustment of the generator output to the rated voltage level is accomplished by controlling the current fed to the exciter field coils.

Regulation is automatic with the static type voltage regulator. An additional voltage adjustment range is provided if desired by operating the voltage adjust rheostat.

**ROTATING FIELD ASSEMBLY (ROTOR)**  
The rotating field assembly consists basically of four members; the shaft assembly, the core assembly, field coil

dampner windings and balance lugs to provide a high degree of static and dynamic balance. The exciter rotor and rotating rectifier-hub assembly are separate units which are head shrunk onto the generator shaft.

**CORE ASSEMBLY**

The core assembly consists of once piece electrical steel laminations which are stacked on the shaft assembly.

**FIELD COIL**

Field coils of heavily insulated wire are "wet" wound directly onto the poles. Field coil leads are brought out to the rectifier assembly for connection to the source of DC excitation voltage.

**SHAFT**

Shaft is made of forged high strength steel, which is turned to close tolerance and then ground to a close tolerance.

**FOR OPERATION AT AMBIENT TEMP-ERATURES ABOVE 40° C DERATE KW RATING 1 PERCENT FOR EACH DEGREE C ABOVE 40° C. FOR OPERATION AT HIGH ALTITUDES ABOVE SEA LEVEL, RATINGS MUST BE DERATED 2 PERCENT FOR EACH 1000 FEET ABOVE SEA LEVEL**

**GENERAL DESCRIPTION**

The revolving field type generators have a DC field revolving within a stationary AC winding called the stator. AC power is distributed from the generator through leads connected to the stator windings. There are no sliding contacts between the AC winding and the load, therefore, great amounts of power by be drawn from this generator.

**VOLTAGE CONNECTIONS:**

Generator may be connected at the terminal board to deliver 120/240 volts to a 3-wire grounded neutral system, or 120

volts only to a 2-wire distribution system. If any equipment requires 240 volts, then the 120/240 volt connection must be used. If all equipment requires 120 volts, then the 120 volt connection is preferred, even if two lines leave the switch box. The two lines at the input to the switch box are both connected to the ungrounded 120 volt lines from generator. The 120 volt connection enables the EVR to hold the voltage very close the 115 or 120 volts (as initially adjusted) regardless of the power distribution among the different distribution lines. The 120 volt connection is recommended if all the electrical load requires only 115 or 120 volts.

Although the 120/240 volt connection may also be used when all load requires only 110 volts, it should be pointed out that with this connection the 240 volts is regulated and the lightly loaded phase (or line) will deliver a high line-to-neutral voltage and the heavily loaded phase will deliver a low line-to-neutral voltage. The heavily loaded line may have such a low voltage that air conditioning will have more difficulty in starting, and long starting time may over-load generator and trip circuit breakers.

**ELECTRONIC VOLTAGE REGULATION**  
Electronic Voltage Regulation (sometimes called automatic voltage regulation by many users) regulates the voltage by using a solid-state electronic circuit of transistors, integrated circuits, SCR's, resistors, capacitors, etc., to sense the generator voltage and feed a DC current into the exciter field of the proper average value to hold the generator voltage constant from no-load to full rated load and above. These electronic voltage regulators are very reliable devices which regulate the voltage to 2% or less.

**BRUSHLESS EXCITER**  
The brushless exciter consists of an

armature with a three phase AC winding and rotating rectifier assembly within a stationary field.

The stationary exciter field assembly is contained in the main generator frame. The exciter armature is bolted fit and keyed onto the shaft assembly. The rotating rectifier assembly slides over the bearing end of the generator rotor shaft.

### DC OUTPUT POWER FOR EXCITER

#### FIELD

The EVR rectifies the AC power input with a full wave rectifier to provide DC current (a series of half sine waves) with a high ripple content at a frequency of 120 Hz. This DC current is fed to the exciter field through one (or two) SCR's to provide a pulsed output in one direction only. The resistance and impedance within the regulator is very low and the peak value of the current into the exciter field is limited only by the impedance and resistance of the exciter field. For this reason exciter fields must have minimum specified resistance or the peak current delivered by the regulator will be so high that regulator components will be damaged. The regulators are commonly designed for a minimum exciter field resistance of 25 OHMS, although sometimes a slightly lower resistance can be tolerated. Connections to the exciter field are made of two DC output terminals, F + and C.

### ROTATING RECTIFIER BRIDGE

The rotating rectifier bridge consists basically of rectifying diodes mounted on a heat sink which is in turn mounted on an insulating ring. The entire assembly bolts to the adaptor on the generator shaft. Therefore, the rotating rectifier assembly will rotate with the exciter armature eliminating the need for any sliding contacts between the exciter output and the alternator field (see figure 1).

**BALANCE**  
The rotor assembly is precision balanced to a high degree of static and dynamic

The rectifier bridge is an integral part of the static regulator. The static regulator senses a change in the generator output and automatically regulates current flow in the exciter field circuit to increase or decrease the exciter field strength. An adjust rheostat sized to be compatible with the regulator is used to provide adjustment to the regulator sensing circuit.

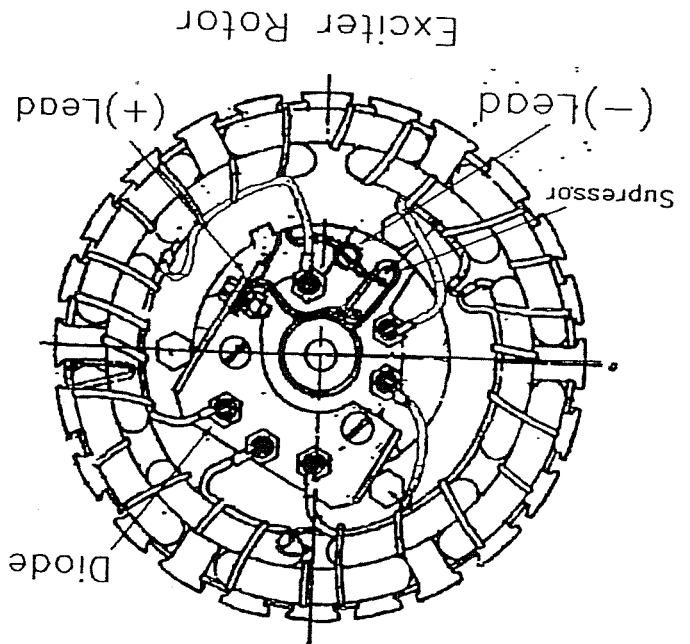
Field coil DC voltage is obtained by rectifying the voltage from phase to neutral line of the generator output, or other appropriate terminal to provide the needed voltage reference.

**SOURCE  
EXCITER FIELD COIL VOLTAGE**

The exciter field on the high frequency exciter consists of laminated segments of high carbon steel which are fitted together to make up the field poles. The field coils are placed into the slots of the field poles.

**EXCITER FIELD**

Figure 1



**BEARING**  
The generator rotor assembly is suspended on shielded, factory lubricated ball bearings. They are greased for life and should not require regreasing.

balance. Balance is achieved with the balance lugs on the field pole tips. Although the balance will remain dynamically stable at speed in excess of the design frequencies, the prime mover should be adequately governed to prevent excessive overspeed. High centrifugal forces at excessive overspeed can damage the damper windings and field coils.

**STATOR ASSEMBLY**  
The stator assembly consists of laminations of steel mounted in a rolled steel frame. Random wound stator coils are fitted into the insulated slots.

**STANDBY UNITS**  
Generators used as an auxiliary power source in case of commercial power failure must be isolated from the commercial line before being placed in operation.

**CAUTION: MAKE SURE UNIT IS COMPLETELY SHUT DOWN AND FREE OF ANY POWER SOURCE BEFORE ATTEMPTING ANY REPAIR OR MAINTENANCE ON THE UNIT.**

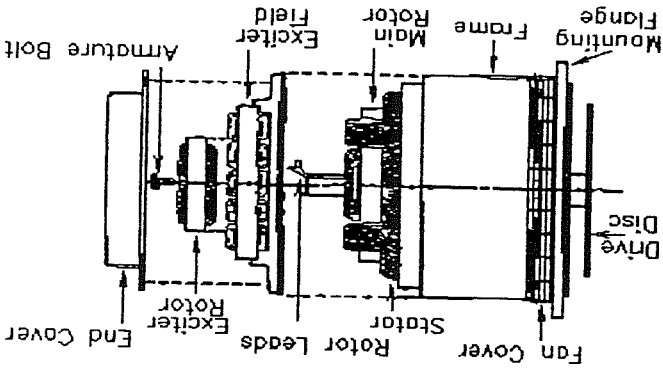


Figure 2

SECTION II  
SERVICE AND MAINTENANCE

PREVENTATIVE MAINTENANCE AND  
OPERATING PRECAUTIONS

Costly repairs and down time can usually be prevented by operating electrical equipment under conditions which are compatible with those at which the equipment was designed to operate. Follow the instructions outlined below to insure maximum efficiency of the electrical equipment.

COOLING

Keep all cooling parts clean and make certain sufficient room is left on all sides for a plentiful supply of fresh coolant air flow. DO NOT EXCEED AIR TEMPERATURE RISE AS SHOWN FOR 50°C ABOVE A 40°C AMBIENT. This ensures that the insulation NEMA Class "F" will not be damaged. DO NOT EXCEED RATED VOLTAGE OR LOAD, except as specified for the equipment. OPERATE GENERATOR AT RATED SPEED. KEEP REGULATING EQUIPMENT IN PROPER ADJUSTMENT. Failure to operate generators at rated voltages, load or speed will cause overheating and possibly damage to windings due to over voltage or current.

REGULATING EQUIPMENT

Regulating equipment should be kept in proper adjustment at all times. READ ALL INSTRUCTIONS CAREFULLY BEFORE ADJUSTING OR REPAIRING REGULATING EQUIPMENT.

BEARING REPLACEMENT

Factory lubricated shielded bearings will normally provide several years of trouble free service when operated under normal conditions. Excessive bearing load and adverse environment conditions will greatly shorten bearing life. should

bearing failure occur, bearings can be replaced. ALWAYS REPLACE WITH THE SAME TYPE BEARING AS INSTALLED AT THE FACTORY, CHECK PARTS LIST FOR PART NUMBER. Include generator serial number when ordering bearings.

ROTATING DIODE BRIDGE

The rotating diodes can be removed and replaced. Excessive overcurrent, overvoltage, overspeed, or reverse currents can cause damage to the assembly or any of the component parts.

All rotors are static and dynamically balanced to a high degree on precision machines to assure minimum vibration. They will therefore, remain dynamically stable at speed well beyond the synchronous speed of the generator. The rotors on generators are, however, subjected to extreme centrifugal forces which can increase beyond safe operating limits at excessive overspeed. Therefore, the prime mover should be adequately governed to prevent overspeed.

Damage to the rotor can also occur due to overheating which can be caused by:

1. Excessive field current due to failure of the regulator.
2. Exciter being operated below the rated speed which can result in excessive field current due to the regulator trying to maintain rated voltage.
3. The air flow is restricted from dust or other foreign objects collecting in the air passage.

If a rotor becomes defective, it should be returned to the factory with full nameplate data, because the rotor coils are enclosed in welded squirrel cage windings. Should a failure occur, the factory should be notified immediately and steps will be taken to get the generator back into



service with the least expense; and more important, to determine the cause of the failure and take steps to prevent a recurrence.

### PRECAUTIONS

#### GENERATOR WINDINGS (DRYING)

Generators that have been in transit or storage for long periods may be subjected to extreme temperature and moisture changes. This can cause excessive condensation, and the generator windings should be thoroughly dried out before bringing the generator up to full nameplate voltage. If this precaution is not taken, serious damage to the generator can result. The following steps should be taken to effectively dry the generator windings:

1. Short circuit the generator lead wires. Start the generator and separately excite the exciter with DC battery power of approximately 50 volts to produce rated AC nameplate current. To accomplish this excitation, the leads (F+ and C-) must be disconnected from the voltage regulator. Nameplate current can be measured with a clip-on ammeter at the generator leads. Make sure the AC current does not exceed the nameplate rating. Be sure to reconnect the leads F+ and C- to the proper terminals on voltage regulator after drying exercise.
2. Another procedure would be to put the generator in a hot room or to moderately heat with a heat source.

Experience has shown that it is necessary to take these precautions in locations such as seaboard installations and other highly humid areas. Some installations will be in atmospheres that are much more corrosive than others. A little precaution along the lines outlined here could eliminate an unnecessary repair job.

To restore the small amount of residual

Residual magnetism of the exciter field poles may be lost or weakened by a momentary reversal of the field connection, a strong neutralizing magnetic field from any source, or if the generator is not operated for a long period of time.

### FIELD FLASHING

The direct current (DC) necessary to magnetize the alternator field is obtained from the exciter. Initially, upon starting the generator, current flow and voltage are induced into the exciter armature by the magnetic lines of force set up by the residual magnetism of the exciter field poles.

### WARNING: HIGH VOLTAGE

(DIELECTRIC) TESTING MUST NOT BE PERFORMED TO THE MACHINE WITHOUT FIRST OBSERVING NEMA RULES. THE INSULATION OF THIS GENERATOR WINDING MAY BE SAFELY CHECKED BY USING A MEGGER. A HIGH MEGGER READING INDICATES LOW INSULATION LEAKAGE.

The finest insulation job can be very quickly broken down by carelessly applying high voltage to windings in a moisture saturated condition. Mishandling in this respect can easily cause a break-down, making it necessary to return the generator to the factory for repair, and consequent expense and loss of time.

The latest and newest in insulation and baking techniques are used.

Each generator was subjected to a standard NEMA insulation test, which means 1000 volts plus twice the highest voltage for which the generator is rated was impressed between the windings and frame. All machines are insulated with a high safety factor for the class of insulation used. The latest and newest in insulation and

magnetism necessary to begin the voltage build-up, connect a battery from 6 to 32 volts to the exciter field coil circuit. Normally, a battery of 6 or 12 volts is large enough.

### PROCEDURE FOR FIELD FLASHING TO RESTORE RESIDUAL MAGNETISM

1. Disconnect exciter field coil wire F+ at terminal F+.
2. Connect battery positive lead to field coil lead F+. Use 12 volt battery.
3. Connect battery negative lead to field coil circuit terminal C-.
4. Disconnect battery leads after approximately 3 to 5 seconds. If battery is connected for too long. Overheating and subsequent damage to the exciter can occur.
5. Reconnect field coil lead F+ to terminal F+.
6. Start unit and observe generator build-up.

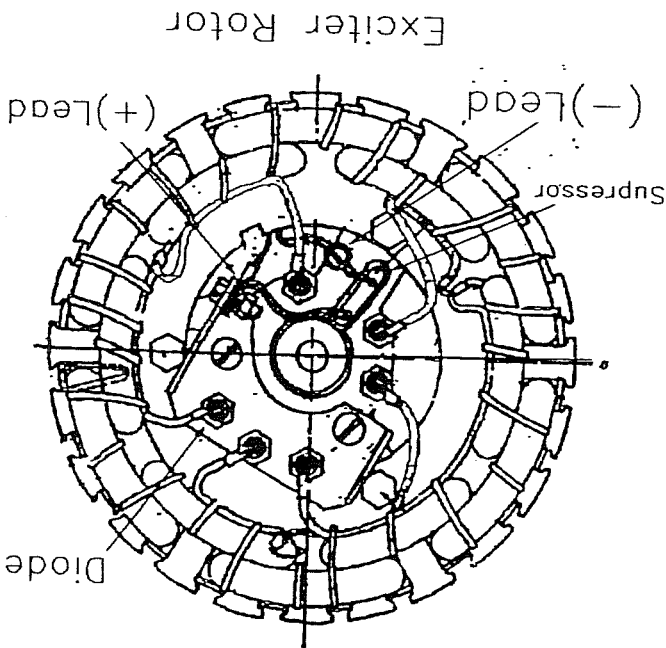
Reflash field (Steps 1 through 5 above) if generator output voltage does not build up. Reflash field if generator output voltage does not build up. This procedure Start generator and observe generator

### ALTERNATE PROCEDURE FOR FIELD FLASHING

Apply either an alternating current or a direct current voltage of approximately 12 volts to any two generator leads. Do not make a positive connection but rather touch the leads together until the generator voltage begins to rise and then remove. It is suggested that a 30 ampere fuse be inserted in the circuit to prevent any damage in case the build-up voltage is not removed quickly enough.

Start generator and observe generator build-up. Reflash field if generator output voltage does not build up. This procedure

should be performed by Trained Service Personnel only.



### TESTING DIODES WITH AN OHMMETER

Isolate the rectifier assembly by disconnecting the leads from the main rotor and three leads from the exciter rotor. Test each diode by applying the probes of an ohmmeter to the anode and cathode.

A good diode will produce a meter reading of only a few OHMS when the probes are applied in one direction, and a reading of near infinity when the probes are reversed. If both readings are high, or both are low, the diode is defective and must be replaced.

Diode failure after 25 hour "run-in" period is generally traceable to external causes such as overheating or a reverse current fed into the alternator. To save excessive service time and call-backs, it is a generally accepted practice to replace all diodes where failure can be traced to

external causes AFTER THE CAUSE OF THE DIODE FAILURE IS IDENTIFIED AND CORRECTED.

## TROUBLESHOOTING PROCEDURE AC BRUSHLESS GENERATOR

As with any machine, trouble may develop in electrical generators. It may be due to long service or neglect of regulator maintenance, servicing, and checking. Should trouble develop, the following instructions will be helpful in tracing the cause and making repairs.

Brushless generators are not complete units without added control equipment; therefore, reference will be made to control components.

## VOLTAGE DEVIATIONS

The generator output voltage should be kept as close as possible to the rated voltage shown on the generator nameplate. High voltage, low voltage and fluctuating voltage (hunting) may cause serious damage to the generator and its control equipment. A high voltage could damage sensitive equipment and low voltage could cause motors to burn out.

## SPEED DEVIATION

The generator speed should be maintained at rated nameplate speed. The frequency of the generator output depends on speed. If the generator runs slower than rated speed, the voltage may drop off. Automatic control equipment may burn out trying to maintain voltage by forcing the field.

## VISUAL EXAMINATION

The first step in investigating any generator failure or trouble should be to look for obvious evidence: burned areas, loose or open connections, wrong speed, incorrect reassembly and reconnection, etc.

## OBSERVE VOLTAGE OF DEFECTIVE GENERATOR

The next step is to carefully measure line-to-line voltage. A voltage about 10 percent of rated voltage (at rated RPM) is probably the residual voltage (determined by residual magnetism in exciter field). A normal residual voltage indicates exciter armature, rotor and stator are all good and that the trouble is probably in the excitation circuit. A very low voltage, or no voltage, indicates either that residual magnetism in the exciter field was lost (generally by disassembly or by sudden interruption of the exciter field current), or that a generator defect exists in the exciter armature, rotor or stator.

## BATTERY EXCITATION

The behaviour of the generator, when the exciter field is connected to a 12 volt battery for excitation current, is a useful guide for locating the generator fault. Disconnect F+ and C- from EVR and open CBI circuit breaker/switch in lead 3 or 4 to EVR (lead for power input to EVR). Connect F(+) to (+) of battery. Connect (-) of battery to C(-). Spin generator 1800 RPM.

A. If residual voltage is normal, 12 volts across lead F+ and C- should cause the generator to deliver a voltage near rated voltage with no load. If 12 volt excitation produces near normal voltage, failure of voltage regulator to provide voltage could mean a defective voltage regulator, or an open circuit in leads to terminals 3 or 4 of electronic regulator. Check switch or circuit breaker in these leads. With 12 volt excitation, connect voltmeter across terminals 3 and 4. Voltage should be 200 to 240 volts with CBI closed.

B. If 12 volt excitation produces no voltage, check exciter field resistance. It should normally be 25-28 OHMS at 77°F. If field is open or shorted, then the exciter field is defective. An open or short in the main rotor behaves similarly, but is also accompanied by a very low line-to-line voltage (residual voltage) without 12 volt battery excitation. If open or shorted rotors suspected, remove "R" lead from #10 base terminal on armature and measure resistance since "Q" lead is

4. RECTIFIER CHECKING

a. Each armature full-wave bridge rectifier has 5 terminals and 6 rectifying junctions. Rectifiers may be readily checked on the low range of an ohmmeter. From the "+" tab to "AC" tab, the ohmmeter should show a high resistance when polarity of the ohmmeter leads is reversed. The same conditions should be found from the "+" tab to any other "AC" tab and from "-" to "AC" tabs. If a ZERO resistance reading is found, this junction of the rectifier is shorted and the rectifier must be replaced. If a HIGH resistance is found with both polarities of the ohmmeter, this junction of the rectifier is "OPEN".

b. Armatures with 3-phase FULL-WAVE bridge rectifier.

The three-phase full-wave rectifier is now standard on most armatures used in generators. This 3-phase (full-wave rectifier) is a single unit with 6 diodes in a special case. The (+) terminal is identified by a red dot on the case and is connected by a short lead to the (+) terminal of armature to which the (+) rotor lead and suppressor lead are connected.

The other 3 terminals at the top of the rectifier are AC connections to each of the armature phase leads. The case is the (grounded) (-) lead to the rotor. To test the diodes disconnect the rectifier positive lead at the armature (+) terminal. Test between rectifier (+) lead and any AC terminal. Make the test also between rectifier (-) lead (ground or case) to any AC lead. The test determine that all diodes are good or that one or more is defective. Since a grounded armature winding gives the same test results as a bad diode, it is necessary to disconnect all AC rectifier connections and test armature windings

normally connected to ground. See "Resistance of Rotors".

c. If 12 volt excitation causes the engine to growl and load the engine with no or very low generator output voltage, the stator could be grounded or shorted. Or, a short or ground in the wiring of the generator power circuit could be the main fault. In either case, the stator will develop hot spots or could even smoke after running a few minutes. Run generator until a hot smell is detected, or stop in 5 minutes (whichever occurs first). Feel the stator winding. If it is hot, the stator or power wiring contains a short circuit. Examine the stator for burned (black) insulation which indicates a defective or damaged stator. Measure stator resistance T1 to T2 and T3 to T4 if possible. With 12 volt excitation measure voltage T1 to T2 and T3 to T4. If one of these voltages is very low while the other is close to normal, the low voltage winding has shorted turns.

d. If 12 volt excitation causes an increase in voltage but the output voltage is less than 60 percent of rated voltage, the rectifier (see 4) in the exciter armature could be defective or the exciter armature could have an open circuit. Also, one pole of the main field (rotor) could be shorted or grounded. If any of these defects exist, failure of the electronic regulator will occur. Re- placement of regulator alone will be followed by failure of the new regulator. If electronic regulator has failed, it is wise to check exciter current by placing a DC ammeter in the F(+) lead to exciter field. Normal exciter current at no-load rated voltage is 0.65 to 0.95 ampere. A higher current is another indication of a generator defect (described above), which could cause a new voltage regulator to fail.

for a short to ground before a fault can be positively identified. Also test each diode separately (-) to each AC terminal, and case to each AC terminal to positively identify which diode is bad. (See Figure 4).

c. Armature with two FULL-WAVE bridge rectifiers.

On some generator models an armature will be supplied with two full-wave bridge rectifiers very similar to the rectifiers used on armatures with one 3-phase FW rectifier.

To test these rectifiers, remove the two rectifier (-) leads at the R (rotor) + terminal and test each rectifier separately, first from + lead (rectifier #10 to any AC terminal, then case to any AC terminal. Then go to rectifier # 2 and test + to any AC terminal, then case to any AC terminal. A failure in the test "case to any AC terminal" could be as bad diode in either FW bridge rectifier. To determine which diode is bad, all AC terminals must be disconnected and each AC terminal of the rectifier tested to both + and to - (case) of that bridge rectifier.

**VOLTAGE SUPPRESSOR**

Voltage suppressor are similar to rectifiers in that they contain in effect a single semiconductor one-way junction. A suppressor should have a high resistance with one polarity of test leads and low but not zero resistance in the opposite direction. Resistance measurements sometimes fail to identify a defective suppressor. The best test is to remove suppressor from circuit. If an obvious improvement in generator is observed, suppressor is bad. Some suppressors have a high resistance in either polarity of applied voltage (if applied voltage is low), but have a low

resistance of voltages of 300 to 450 volts.

**RESISTANCE OF WINDINGS**

Frequently in troubleshooting a generator, a defective component can be identified by measuring the resistance of a winding.

Exciter field, armature, rotor and stator should withstand 1500 volts between winding and ground with less than 0.002 ampere of current between winding and ground. All electronic components such as rectifiers, suppressor and resistors must be disconnected.

**GENERATOR RESISTANCE VALUES**

Armature:	470-520 OHMs per phase,	5 - 10KW
	650-720 OHMs per phase,	12.5 - 50KW
Field:	18 - 22 OHMs	5 - 10KW
	23 - 28 OHMs	12.5 - 50KW
Stator:	OHMs vary with KW rating, but less than 1.0 OHM per phase.	
ROTOR:	8	10
	12.5	15
	17.5	20
	25	30 to 50
	30	to 50
	OHMs	1.47 1.58 1.73 1.84 2.00 2.1 2.2 2.5 to 3.8

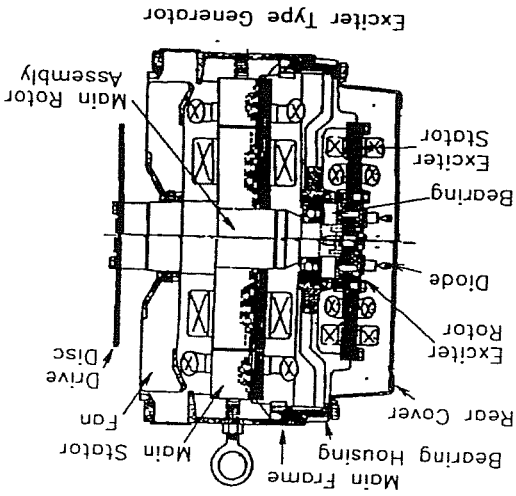


Figure 4

## ELECTRONIC REGULATION

An electronically regulated generator has superior voltage regulation than other types. (+/- 2%) within rated loads.

Power Technology SE, uses voltage regulators made by Basler Electric Co., Highland, Illinois.

The electronic voltage regulator, regulates the voltage using a solid-state electronic circuit of transistors, integrated circuits, SCR's, resistors etc. to sense the generator voltage and feed a DC

current into the exciter field of the proper average value to hold the generator voltage constant from no-load to full rated load and above.

### Characteristics of the Regulator

Overload Protection  
To prevent damage to devices receiving electrical power from the generator. The regulator provides both under load frequency and over load protection. The voltage regulator operates at 50 HZ or 60 HZ, or both. If frequency and engine speed, falls below the rated value, the generator voltage decreases to provide under frequency protection, but if the engine is over the speed required to give 50 HZ or 60 HZ, the voltage does not rise above that value set at the proper frequency (proper engine speed).

### AC Power Input

All EVR's must supply up to 4 amperes of DC output current into the exciter field at a voltage up to 70 volts DC. This voltage and current constitutes a power output of about 280 watts. This output power must come from the generator. The exciter field input power must be supplied at 190 to 240 volts AC at a volt-ampere burden of 500 VA maximum.

When the generator is operated at 208 volts to 240 volts this power comes from the generator load lines. When the generator is connected to deliver 120 volts, a separate winding in the stator provides 208 to 240 volts for the voltage regulator power input.

### DC Output Power for the Exciter Field

The EVR rectifies the AC power input with a full wave rectifier to provide DC current (a series of half sine waves) with a high ripple content at a frequency of 120 HZ. This DC current is fed to the exciter field through one or two SCR's to provide a pulsed output in one direction only. The resistance and impedance within the regulator is very low and the peak value of the current into the exciter field is limited only by the impedance and the resistance of the exciter field. For this reason the exciter fields must have a minimum specified resistance or the peak current delivered by the regulator will be so high that the regulator components will be damaged. The regulator is commonly designed for a minimum exciter field resistance of 20 OHMS 8-10KW & 25 OHMS 12-50KW, although sometimes a slightly lower resistance can be tolerated. Connections to the exciter field are made at two DC output terminals, F+ and F-.

# NO VOLTAGE

## CHECK AND REMEDY

## CAUSE

Check out continuity of field coils. If open in field coils, remove field assembly and return assembly to factory for repair. Flash field by making a flash connection of DC across terminals C- to F + to positive lead of DC source. (See previous instructions).

Check for continuity in windings. Return to factory for repair of open.

Check rectifiers per previous instructions, replace if faulty.

See troubleshooting of voltage regulator, replace if faulty.

Clear lead to restore build-up.

Check for continuity and return rotor to factory for repair if field coils are open.

Check for shorts and replace if faulty.

Check for short and replace if faulty. Measure resistance.

Test and Repair

Open circuit in exciter field.

Loss of residual magnetism in exciter field poles.

Open in stator windings.

\*Open in rotating rectifiers.

Malfunction of automatic voltage regulator.

Short circuited.

\*Open in generator field.

\*Shorted rotating rectifiers.

\*Shorted exciter armature.

\*Shorted leads between exciter armature and generator field.

NOTE: \*Designates rotating parts. Generator must be open to test.

# LOW VOLTAGE

## CAUSE

## CHECK AND REMEDY

Excessive load.

Reduce load. the load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.

Low speed.

Check engine for malfunction or system for overload.

Automatic voltage regulator defective.

See troubleshooting for automatic regulator. Replace if faulty.

Insufficient excitation.

Check regulator. Replace if faulty.

Line loss.

Increase size of line lead wire.

High resistance connection -- connection will be warm or hot.

Make better connection electronically and mechanically.

Shorted filed.

Test field coils for possible short by checking resistance with an ohmmeter. Return rotor assembly to factory for repair if alternator field coils are shorted.

Low power factor.

Reduce inductive (motor) load. Some AC motors draw approximately the same current regardless of load. Do not use motors of larger horsepower rating than is necessary to carry the mechanical load.



# FLUCTUATING VOLTAGE

(May be indicated by flickering lights)

## CAUSE

Irregular speed of engine.

Fluctuating speed.

Loose terminal or load connections.

Voltage regulator unstable.

Intermittent short in generator exciter field.

Test field coils for possible short by checking resistance with an ohmmeter. Return assembly to factory for repair if field coil is shorted.

Check regulator. Replace if faulty.

Make better connection mechanically and electronically.

overload.

Stabilize load. The addition of a lamp load (resistance load) may compensate partially for load changes caused by intermittent motor operation. Do not

Check engine for malfunction or load for fluctuation.

## CHECK AND REMEDY

Check engine for malfunction.

See troubleshooting for voltage regulator. Replace if necessary.

Excessive speed.

Voltage regulator defective.

# HIGH VOLTAGE

# OVERHEATING

## CAUSE

Generator overloaded.

Clogging ventilating screens.

High room temperature.

Insufficient circulation.

Operating with excessive voltage.

Low power factor.

Unbalanced load.

Dry bearing.

## CHECK AND REMEDY

Reduce load (Check with ammeter and compare with nameplate rating.)

Clean air passages.

Improve ventilation.

Provide cross-ventilation.

Check voltage drop in distribution lines and connections and adjust as described in voltage deviation instruction.

Reduce inductive loads or install power

factor improvement capacitors.

The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.

Replace bearing.

# MECHANICAL NOISE

Defective bearing.

Rotor scrubbing on stator.

Loose laminations.

Loose or misaligned coupling.

Tighten or align.

Return to factory for repair.

drive discs, tighten.

Bad bearing, replace. Bent shaft, return to factory. Loose endbell, tighten; loose

Replace bearing.

**GENERATOR FRAME PRODUCES  
SHOCK WHEN TOUCHED**

**CAUSE**

Static charge.

Grounded armature or field coil.

Ground generator frame.

Return to factory for repair.

**CHECK AND REMEDY**