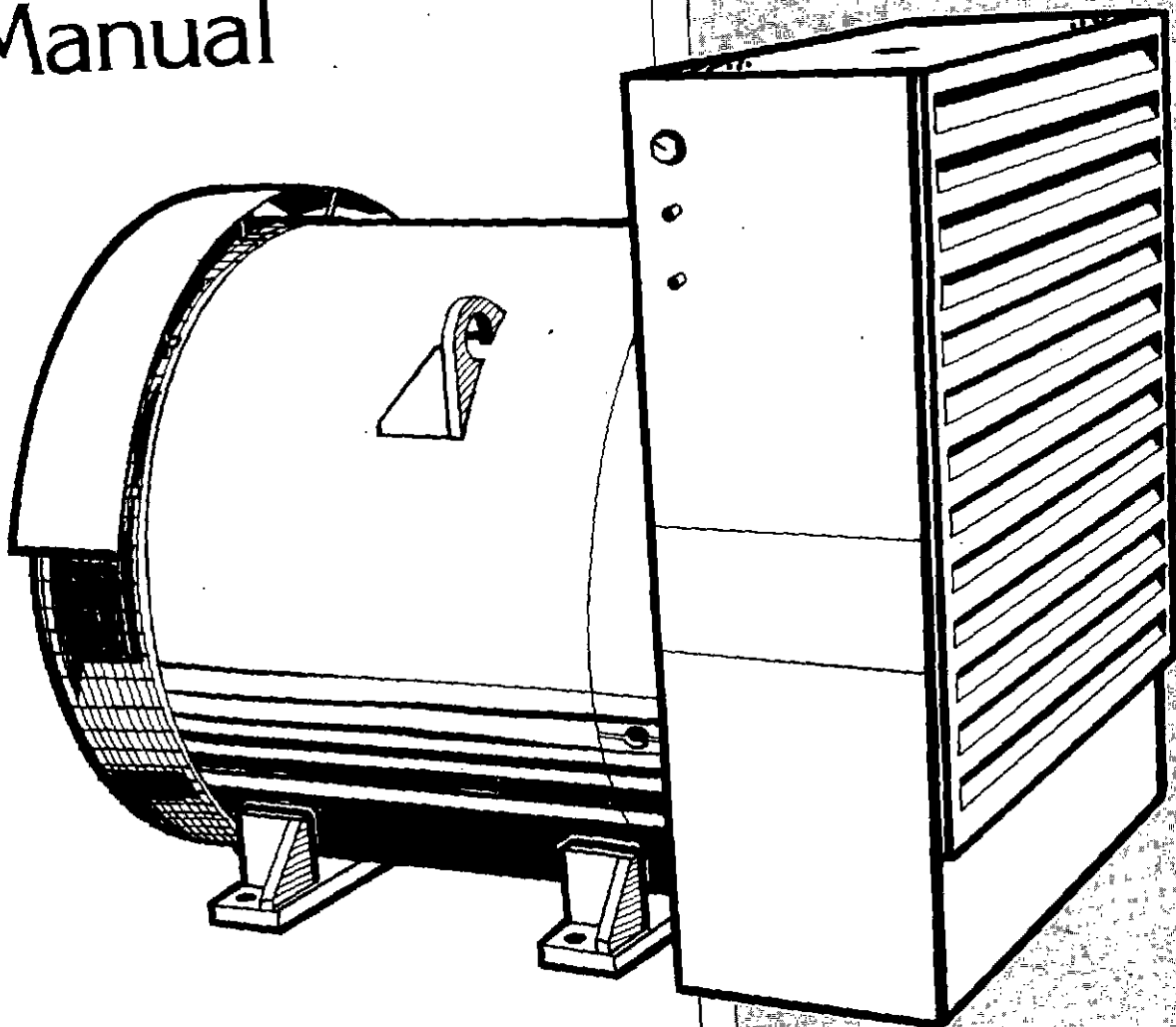


Magna One[®] Generator Installation, Operation and Maintenance Manual



**MARATHON
ELECTRIC**
WAUSAU, WISCONSIN 54401

FOREWORD

This service manual applies to Magna One brushless ac generators manufactured by Marathon Electric Manufacturing Corporation. It contains instructions for installation, operation, and maintenance of these generators. Also included is a Parts List Section, a Trouble Shooting Section, Shipping Instructions and a Sales and Service Listing.

WARNING

These instructions must be followed to insure safe and proper installation, operation and maintenance of the generator. They should be brought to the attention of all persons who install, operate or maintain this equipment.

Disconnect all power before servicing. Failure to follow all safety information can result in serious personal injury or death. Install and ground per local and national codes. Consult qualified personnel with any questions.

TORSIONAL VIBRATION

The factors which are most critical to torsional vibration are contained in the design of the engine.

The engine-generator set manufacturer, his representative or buyer shall be responsible for the torsional analysis and approval of the engine-generator combination. Marathon Electric will submit to the above for approval rotor weight and WK² information, along with such other data as is deemed necessary when requested to do so.

Marathon Electric will proceed with the manufacture of generators prior to the receipt of torsional approval unless specifically requested in writing to delay production for receipt of such approval from the buyer. The buyer will be responsible for manufacturing charges incurred as a result of manufacturing prior to torsional approval.

Marathon Electric will not be responsible for the torsional vibrational characteristics of an installation when the engine vibrates on its base or steel bed and such vibration is transmitted to the supporting structure, or when the construction of the base is such that the engine-generator-mount natural frequency approaches that of the floor or sub-base resulting in magnification of vibration, or where the engine-generator combination has been found torsionally compatible, yet develops vibration due to a base of insufficient strength or inadequate sway-bracing.

INDEX

GENERAL INFORMATION

General	1
Mechanical Construction	1
Unirotor™ Construction	2
Stator	2
Ventilation System	2
Electrical Connections	2

INSTALLATION

Receiving your Magna One Generator	3
Moisture Removal	4
Generator Insulation Testing	5
Preparation for Use	6
Generator Mounting	6
Electrical Connections	7-12
Paralleling Operations	13, 14
Thyristor or Silicon Controlled Rectifier Loading	14

OPERATION

Pre-start Inspection	15
Starting-up the Generator	15
Field Flashing	15
Preventive Maintenance	16, 17
Cleaning Methods	16
Lubrication	17, 18

SERVICE

Disassembly	19-23
Removal from Prime Mover	19
Exciter Removal	19, 20
Main Rotor Removal	20, 21
Conduit Box and Front End Removal	22, 23

SERVICE (Continued)

Inspection	24-28
Exciter Inspection	24
Main Rotor Inspection	24-27
Front End Bracket Inspection	27
Drive End Bracket or SAE Adaptor Inspection	27
Main Stator Inspection	28
Conduit Box and Voltage Regulator Inspection	28
Assembly	29-35
Conduit Box and Front End Bracket Installation	29, 30
Main Rotor Installation	30-32
Exciter Installation	32, 33
Assembly to Prime Mover	33-35
Capscrew Torque Values	34

TROUBLE SHOOTING

Generator Does Not Produce Voltage	36
Generator Produces Low Voltage	37
Generator Produces High Voltage	38
Generator Voltage is Fluctuating	38

PARTS LIST

Single Bearing Generator Parts List	39
Exciter (rotor) Armature Stator and Rectifier Assembly	40
Recommended Spare Parts	41

SHIPPING INSTRUCTIONS

Shipping Instructions	42
-----------------------------	----

SALES AND SERVICE

Back Cover

GENERAL INFORMATION

GENERAL MECHANICAL CONSTRUCTION

GENERAL

A generator is a device which transforms mechanical energy into electrical energy. Magna One Generators are brushless, 4-pole machines producing 60 Hz power at 1800 rpm, or 50 Hz power at 1500 rpm (Hz = Hertz = cycles per second). All standard units are rated at 0.8 power factor.

Single bearing generators are supplied with an SAE adaptor and flexible drive discs on the drive end as standard. Alignment of the generator and engine is assured by the concentricity of the flywheel housing and the generator adaptor. Flexible drive discs are piloted in a rabbet in the flywheel itself, again assuring alignment. It may be necessary to shim the generator feet on the base for solid support. Two bearing units come standard with two brackets and a shaft extension for a drive coupling.

Ac generators require direct current flowing through the rotor winding to set up the magnetic flux which allows the unit to generate. A small ac exciter, which actually is a miniature replica of the main generator, provides this direct current. The exciter is mounted on the same shaft as the generator rotor. While the main generator field rotates and the armature is stationary, the exciter field is stationary and the armature rotates. The output from this exciter is fed into the rectifying elements mounted on a heat sink. This rectifier assembly is located on the end of the main shaft, opposite the drive end (see figure below).

The ac exciter itself requires direct current for its excitation. This excitation is supplied by rectifying a portion of the output of the main generator by means of a static voltage regulator. The amount of

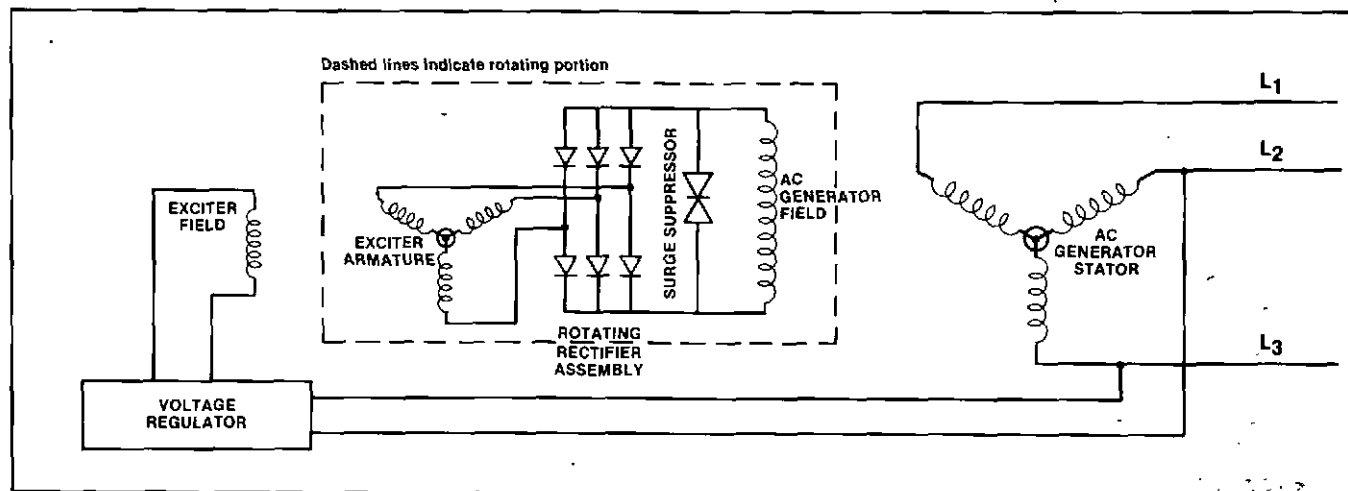
current going into the field of the exciter will determine the output voltage of the exciter, and this in turn will control the output voltage of the main generator. Meters, controls, or other features needed to satisfy installation requirements are available as optional extras.

MECHANICAL CONSTRUCTION

Magna One brushless generators are designed and manufactured with the same engineering precision and craftsmanship that has, for years, gained Marathon Electric an outstanding reputation in this field. Precision machine parts, together with careful hand assembly, give the Magna One durability and reliability.

A solid, rolled steel frame, results in rigid support for the stator core and end brackets. The stator core is firmly anchored to the frame by the welding of bar steel core supports to the core and frame.

The end brackets and adaptors are made of cast iron for the ultimate rigidity required to support the heavy duty shielded bearings. A front bracket supports the stationary exciter field structure. For single bearing units, the frame is fitted with a rugged cast iron SAE adaptor, precision rabbeted to insure alignment with the prime mover. A nodular iron hub is keyed and heat shrunk to the shaft. This hub carries a number of flexible steel drive discs which have holes for fastening to the flywheel (for some adaptor-disc combinations a spacer is used between the hub and discs to maintain the proper distance between the discs and SAE adaptor face). This affords flexibility, in the axial direction, while in the radial direction it acts as a rigid coupling providing a uniform air gap.



GENERAL INFORMATION

UNIROTOR™ CONSTRUCTION STATOR

For two bearing generators, a second bracket and standard shaft extension is substituted for the adaptor and flexible drive discs. The 360 and 440 Frames are available with long shaft extensions for belt drive applications while all frame sizes are suitable for coupled drive. When selecting a belt driven generator, refer to the chart on Page 6 for the drive details under which these units will operate successfully.

UNIROTOR™ CONSTRUCTION

A unique feature of the Magna One generator is that the amortisseur winding and coil supports are die cast as an integral part of the rotor. The 4 poles which carry the field windings are one piece laminations die cast with aluminum providing high mechanical integrity, and low vibration at operating speeds. This method has been time proven to be far superior to separate pole pieces which must be dovetailed to a spider or fastened by screws to the shaft.

The rotor pole assembly is heat shrunk and keyed to the shaft, forming a very rigid rotating element.

A thermo-setting bonding epoxy is applied between layers of the field winding and is applied to the finished rotor. The completed rotor is baked under a controlled cycle to ensure a solid, mechanically stable rotor. All rotors are dynamically balanced and then tested at a speed of 125% of the operating speed.

The ac exciter armature and the heat sink which carries the diodes are mounted on an assembly which is placed on the generator shaft outboard of the front generator bearing.

STATOR

The stator laminations are composed of thin, low-loss steel, notched on precision presses. The cores are reinforced by rugged steel stack rings and supporting bars which are welded around the core. Up to 600 volts, random-wound coils are placed in slots insulated with Class F materials. Once the properly insulated coils have been inserted in the stator core, the entire core is then given multiple dips and bakes in a thermo-setting varnish by a special process which ensures complete coverage. This premium insulation system utilizes all synthetic and non-

VENTILATION SYSTEM ELECTRICAL CONNECTIONS

hygroscopic materials making the standard windings fungus resistant and suitable for operation in high humidity and abrasive environments. Subsequently, the wound core is placed into and welded to the frame.

VENTILATION SYSTEM

Magna One generators employ an advanced flow-through ventilation system. The cast aluminum alloy ventilating fan draws air through louvers in the conduit box, over the main stator and exciter windings and exhausts it through ventilation screens in the adaptor. This exclusive design provides efficient cooling as air is distributed evenly throughout the generator, effectively reducing the recirculation of hot air. Since there is only one air intake, mounting of air filtration systems is easily accomplished.

ELECTRICAL CONNECTIONS

The large front end mounted conduit box is constructed of formed sheet steel with ample room inside for the voltage regulator, most circuit breakers and other options. A hole-saw or any suitable tool can be used to provide a hole for the conduit entrance. An approved connector must be used in conjunction with the conduit. The regulator can be moved from the left to the right side with relative ease if the entrance of the conduit is needed in this location.

IMPORTANT: To minimize the transmission of vibration, it is essential that flexible conduit be used for all electrical connections to the generator. Refer to the connection diagrams supplied with the generator and install all intercomponent and external wiring in accordance with the regulations of the national and local regulatory bodies. Be sure the generator frame is grounded to all the other components of this system with the ground wire complying with national and local codes. Terminal lugs^① are provided on all low voltage (below 600 volts) generators except 682 frames where buss bars are used. Above 600 volts, terminal lugs^① are used exclusively. Clean all contact surfaces to assure good electrical bonding with the generator lugs or buss bars. Use heavy duty terminal lugs or good quality clamps for making all connections. Tape all connections in accordance with national and local regulations.

^①CSA certified terminal lugs are used.

INSTALLATION

RECEIVING YOUR MAGNA ONE GENERATOR

RECEIVING YOUR MAGNA ONE GENERATOR

Upon receipt of the generator, it is recommended that it be carefully examined to determine if any shipping damage has occurred before accepting the shipment from the transportation company.

UNPACKING AND HANDLING

Read all instruction cards carefully. When lifting, attach an overhead crane to the lifting lugs on the generator frame. Apply lifting forces in a vertical direction, if possible.

WARNING

DO NOT LIFT COMPLETE GENERATOR SET BY MEANS OF LIFTING LUGS ON GENERATOR. PERSONAL INJURY OR EQUIPMENT DAMAGE MAY RESULT.

WARNING

DO NOT APPLY ANY FORCE TO GENERATOR FAN FOR LIFTING OR ROTATING GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

STORAGE

In the event that the generator is not to be installed on the prime mover immediately, it is recommended that it be stored in a clean, dry area which is not subject to rapid changes in temperature and humidity.

INSPECTION

It is recommended that the insulation resistance of the generator stator be checked with a megohmmeter prior to initial operation. In order to do this, all stator leads must be connected together and the insulation resistance measured from the lead terminals to the stator frame. Make certain the stator leads are not touching the frame. A megohm reading should be obtained that is equal to or greater than the following formula:

$$\text{Minimum Megohms} = \frac{\text{Rated Voltage}}{1000} + 1$$

An insulation resistance greater than the minimum indicates the insulation is in good condition. (NOTE: 1 megohm = 1,000,000 ohms.) A record should be kept of the resistance readings for comparison with future data. A drop in resistance values indicates wet, dirty or grounded insulation. In this case, clean and dry the winding using one of the listed methods on the following pages and check for grounds following the instructions in the "GENERATOR INSULATION TESTING" section.

CAUTION: READ THE "GENERATOR INSULATION TESTING" SECTION THOROUGHLY BEFORE USING A MEGGER ON THE ROTOR OR EXCITER FIELD. EXTENSIVE EQUIPMENT DAMAGE CAN RESULT FROM IMPROPER TESTING.

INSTALLATION

MOISTURE REMOVAL

MOISTURE REMOVAL

Machines that have been idle for sometime in unheated and damp locations, may have "sweated" as a result of sudden changes in temperature or may have become wet by accident. These should be dried out thoroughly before being put into service. The following are recommended drying methods.

Oven

Place the machine in an oven and bake it at a temperature not to exceed 90 degrees C or 194 degrees F. The voltage regulator and any electronic component accessories must be removed from the generator when using this method.

Space Heaters

Enclose the generator with a covering and insert heating units (space heaters, lamps or coils of steam pipe) to raise the temperature. Leave a hole at the top of the enclosure to permit the escape of moisture.

Forced Air

A portable forced air heater can be used by directing heat to the end of the generator opposite the coupling and running the generator with no load and without excitation (this can be accomplished by removing the regulator fuses). Heat at point of entry should not exceed 66 degrees C (150 degrees F) at the bearing hub.

"Short Circuit" Method

The Generator can be dried out quickly and thoroughly by using this method. NOTE: Be sure that all of the following steps are performed and all precautions taken as personal injury or serious damage to the generator could result.

1. Disconnect exciter leads F1 and F2 from the terminal block.

2. Connect a dc battery or other dc power source of approximately 20-35 volts (depending on the kW of your unit) to the exciter leads F1 and F2. An adjustable voltage source is desirable, however a voltage adjust rheostat (rated approximately 2 amps) in series with the dc power source will accomplish the same result.
3. Short circuit the generator lead wires to each other (L1 to L2 to L3).
4. Start the generator and measure the current through the leads with a clip-on ammeter.
5. Adjust the voltage source to produce approximately 80% of the rated ac nameplate current, but in no case exceed nameplate amps. If an adjustable source is not available and current is excessive, use a small dc source or a large resistor in series with the source.

Running time will be determined by the amount of moisture present in the machine. Insulation resistance checks should be taken every one to four hours until a fairly constant value is obtained, equal to or greater than the following formula:

$$\text{Megohms} = \frac{\text{Rated Voltage}}{1000} + 1$$

6. After machine has achieved a constant resistance value, disconnect the dc power source and reconnect F1 from the exciter to F(+) on the terminal block, and F2 to F(-). Make sure that all leads are reconnected properly.

If it is necessary to dry out the generator, it is recommended that the unit be thoroughly tested using the "Generator Insulation Testing" procedures found on the next page.

INSTALLATION

GENERATOR INSULATION TESTING

GENERATOR INSULATION TESTING

The following tests can be used to check minimum insulation resistance. Minimum insulation resistance can be tested using a megohmmeter.

CAUTION: MEGOHMMETER MUST NEVER BE APPLIED TO VOLTAGE REGULATOR OR DIODES - EQUIPMENT DAMAGE WILL RESULT.

$$\text{Minimum insulation resistance in megohms} = \frac{\text{Machine Voltage}}{1000} + 1$$

Example: 480 volt line to line generator:

$$\text{Minimum Insulation Resistance} = \frac{480}{1000} + 1 = 1.48 \text{ Megohms}$$

MAIN STATOR (ARMATURE)

1. All stator leads must be connected together. Connect one megohmmeter lead to stator leads and the other megohmmeter lead to the generator frame. Make sure the other stator leads are not touching the frame.
 - a. A reading lower than the calculated minimum indicates an unacceptably low generator insulation resistance.

Clean, dry and/or repair stator, replace if necessary.

MAIN ROTOR (MAIN FIELD)

1. Disconnect the two generator main field leads which come out through the end of the rotor shaft. These wires connect to each of the two diode heat sinks.

NOTE: Make sure neither of the two leads touch any other part.

2. Apply one megohmmeter lead to one generator field lead and the other megohmmeter lead to the aluminum standoff casting (behind insulation plate on exciter rotor).

- a. A reading of less than the calculated minimum indicates an unacceptably low main field insulation resistance.

Clean, dry and/or repair generator rotor, replace if necessary.

EXCITER STATOR (FIELD)

1. Disconnect exciter field leads from F+ and F- on terminal strip next to opening inside regulator box.

NOTE: Location and markings on wires.

2. Connect one megohmmeter lead to exciter field lead and the other to the exciter frame.

- a. A reading lower than the calculated minimum indicates an unacceptably low exciter field insulation resistance.

Clean, dry and/or repair the exciter stator, replace if necessary.

EXCITER ROTOR (ARMATURE)

1. Remove diode leads from studs, being certain to note the proper location for reconnection.
2. Apply one megohmmeter lead to one of the exciter rotor leads and the other lead to the aluminum standoff casting (behind insulation plate on exciter rotor).

- a. A reading of less than the calculated minimum indicates an unacceptably low exciter rotor insulation resistance.

Clean, dry and/or repair the exciter rotor, replace if necessary.

INSTALLATION

PREPARATION FOR USE GENERATOR MOUNTING

PREPARATION FOR USE

Although the generator is carefully inspected and tested in operation before it leaves the factory, it is recommended that the unit be thoroughly inspected. The insulation on the wire should be inspected and all bolts should be checked for tightness.

Remove all shipping tapes, bags, blocks and skids which are used to prevent vibration and rotor movement during shipment. Dry, low-pressure compressed air of approximately 30 PSI (206 KPA) can be used to blow out the interior of the generator. In the case of two bearing machines, it is possible to turn the rotor by hand to make sure that it rotates smoothly without binding.

If the machine has been in storage for a year or longer, it is recommended that it be lubricated according to the lubrication instructions and chart found in the "Lubrication" section of this manual.

GENERATOR MOUNTING

Single bearing generators are provided with an SAE flywheel adaptor and flexible drive discs. Very close tolerances are maintained in the manufacture of the generator so that the alignment procedure is extremely simple. A coupling hub of nodular iron is shrunk on the shaft and special steel drive discs are bolted to the hub. Holes are provided in the periphery of the coupling disc which correspond to tapped holes in the flywheel. The outside diameter of the discs fits in a rabbet in the flywheel so that concentricity is assured in all cases.

CAUTION: GRADE 8 CAPSCREWS AND HEAVY SERIES LOCKWASHERS OR GRADE 8 PLACE-BOLTS AND HARDENED WASHERS ARE RECOMMENDED TO MOUNT THE DRIVE DISCS TO THE FLYWHEEL.

The SAE adaptor and the flywheel housing are designed to match each other with no further alignment necessary. Shims may be necessary under the feet of the generator to insure a solid mounting.

TWO BEARING GENERATOR MOUNTING

Two bearing generators are provided with a shaft extension and keyway. For direct-coupled units, the assembler furnishes a flexible coupling which is installed between the driver and the generator shaft.

IMPORTANT: Aligning the two machines as accurately as possible will reduce vibration and insure minimum coupling wear. It may be necessary to shim the generator feet for proper support.

BELT DRIVE

360 and 440 frame, two bearing generators can be belt driven. Please refer to Marathon Electric for application assistance involving belt driven installations. Sheave diameters should be chosen according to the table below.

Magna One Sheave Application for
Two Bearing Units^①

Model	Min. Sheave Dia. in Inches @ 10,000 Hr. B-10 Life ^②		Min. Sheave Dia. in Inches @ 20,000 Hr. B-10 Life ^②		Max. Sheave Width Inches
	60 Hz	50 Hz	60 Hz	50 Hz	
360FDR8500	7.1	6.0	9.5	8.1	5.88
360FDR8504	7.9	6.7	10.4	8.7	5.88
362FDR8508	8.7	7.7	11.8	10.3	5.88
362FDR8512	12.2	10.0	16.8 ^③	13.7	5.88
440FDR8016	10.2	8.5	13.7 ^③	11.3	8.50
440FDR8020	12.7	11.2	17.2 ^③	15.1	8.50
440FDR8024	14.4	12.4	19.6 ^③	16.9 ^③	8.50

① Assumptions:

- Belting factor is 1.3.
- The drive and the driven sheaves are the same diameter.
- The sheave load is located at the center of the shaft extension.
- Based upon continuous kW ratings.

② These sheave diameters exceed the maximum recommended belt speed of 6000 ft/min.

③ B-10 Life means 90% of the bearings will last this long or longer.

INSTALLATION

ELECTRICAL CONNECTIONS

GENERATOR LEAD CONNECTIONS

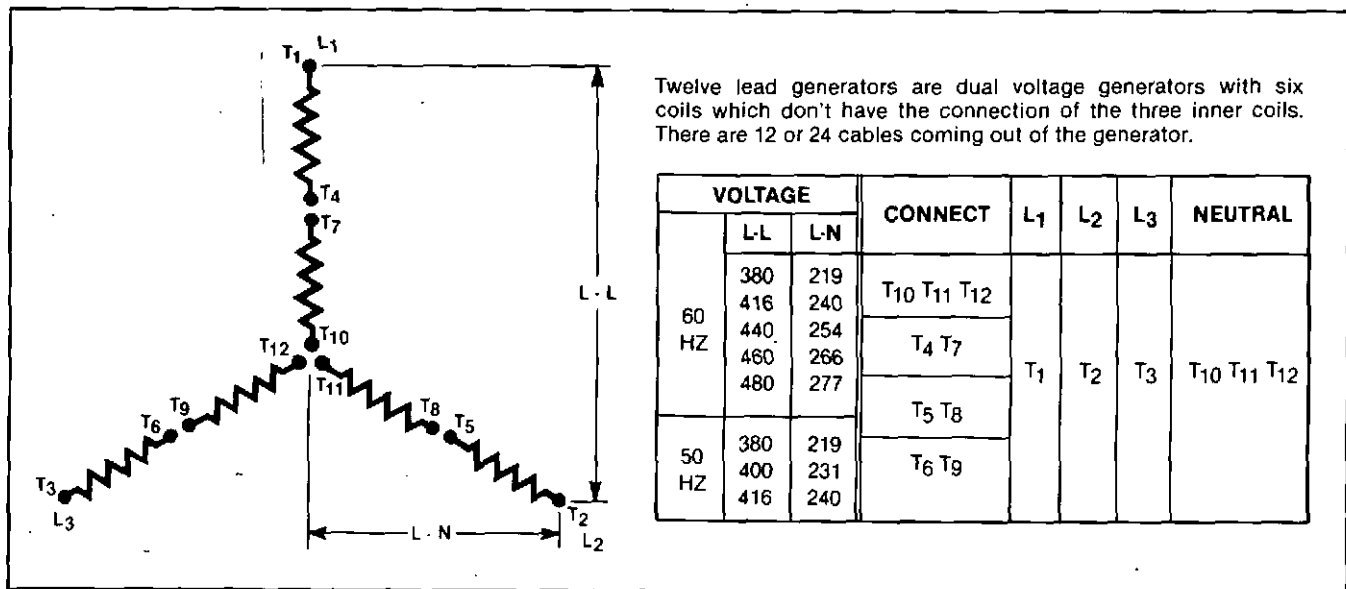
The electrical connections in the conduit box should be made in accordance with the appropriate "connection diagram." Use the diagram appropriate for the number of leads and voltage range required.

The final voltage setting is established within the selected range by an adjustment of the voltage regulator.

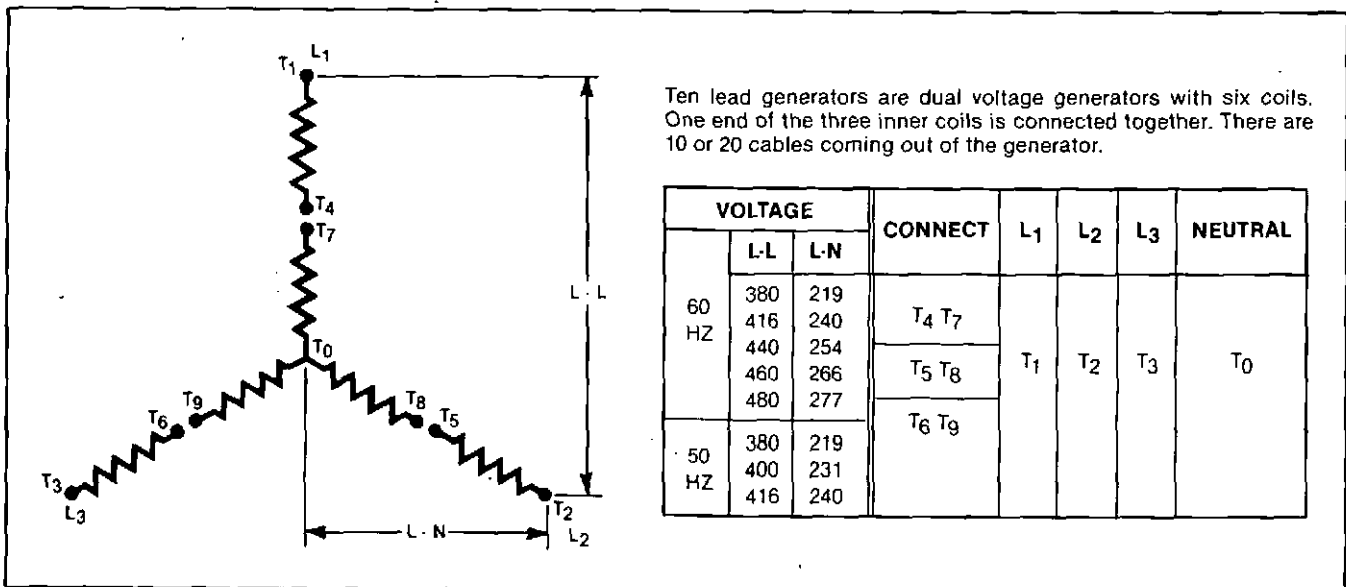
The use of flexible conduit is required to minimize the effect of the engine vibrations.

CAUTION: SOME GENERATORS HAVE MULTIPLE, IDENTICALLY MARKED, CABLES FOR EACH LEAD. CONNECT ALL IDENTICALLY MARKED CABLES TOGETHER WHEN MAKING CONNECTION TO LOAD.

12 LEAD HI WYE



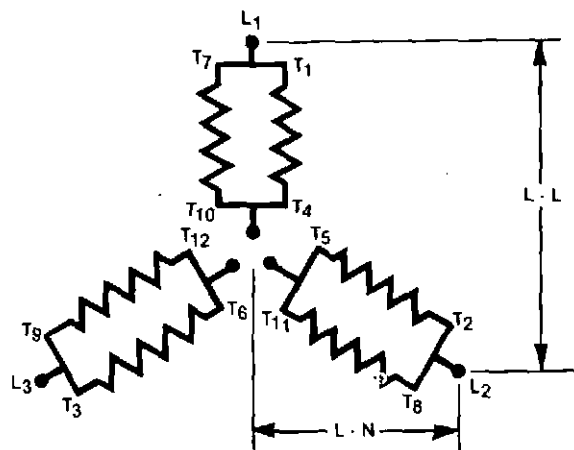
10 LEAD HI WYE



INSTALLATION

ELECTRICAL CONNECTIONS

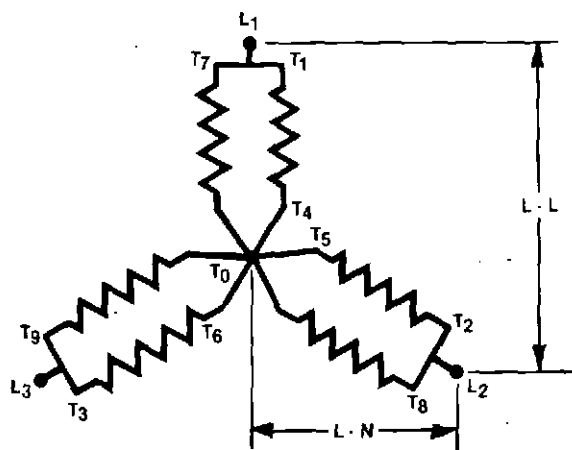
12 LEAD LOW WYE



Twelve lead generators are dual voltage generators with six coils which don't have the connection of the three inner coils. There are 12 or 24 cables coming out of the generator.

	VOLTAGE		CONNECT	L ₁	L ₂	L ₃	NEUTRAL
	L-L	L-N					
60 HZ	190	110	T ₁₀ T ₁₁ T ₁₂	T ₁	T ₂	T ₃	T ₁₀ T ₁₁ T ₁₂ T ₄ T ₅ T ₆
	208	120	T ₄ T ₅ T ₆				
	220	127	T ₁ T ₇				
	230	133	T ₂ T ₈				
	240	139	T ₃ T ₉				
50 HZ	190	110	T ₁₀ T ₁₁ T ₁₂	T ₁	T ₂	T ₃	T ₁₀ T ₁₁ T ₁₂ T ₄ T ₅ T ₆
	200	115	T ₄ T ₅ T ₆				
	208	120	T ₁ T ₇				

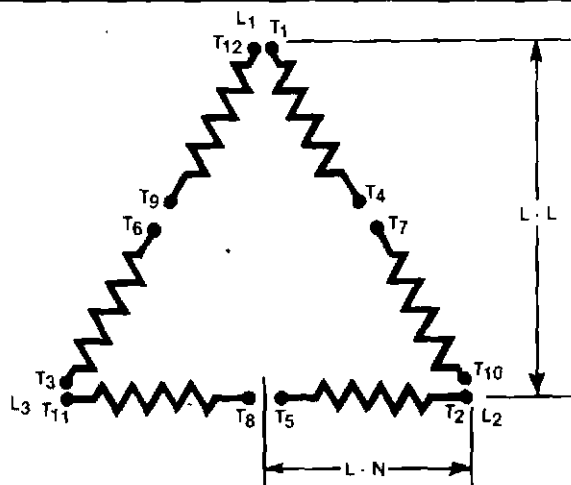
10 LEAD LOW WYE



Ten lead generators are dual voltage generators with six coils. One end of the three inner coils is connected together. There are 10 or 20 cables coming out of the generator.

	VOLTAGE		CONNECT	L ₁	L ₂	L ₃	NEUTRAL
	L-L	L-N					
60 HZ	190	110	T ₁ T ₇	T ₁	T ₂	T ₃	T ₄ T ₅ T ₆ T ₁₀
	208	120	T ₂ T ₈				
	220	127	T ₃ T ₉				
	230	133	T ₄ T ₅ T ₆ T ₁₀				
	240	139	T ₁ T ₇				
50 HZ	190	110	T ₄ T ₅ T ₆ T ₁₀	T ₁	T ₂	T ₃	T ₄ T ₅ T ₆ T ₁₀
	200	115	T ₁ T ₇				
	208	120	T ₂ T ₈				

12 LEAD HI DELTA



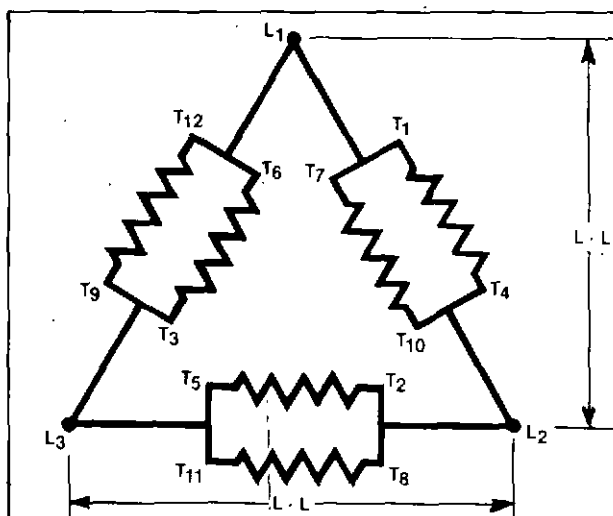
Delta connection with 12 lead generators only.

	VOLTAGE		CONNECT	L ₁	L ₂	L ₃
	L-L	L-N				
60 HZ	240	120	T ₄ T ₇	T ₁	T ₂	T ₃
	277	139	T ₅ T ₈			
			T ₆ T ₉			
50 HZ	200	100	T ₁ T ₁₂	T ₁	T ₂	T ₃
	220	110	T ₂ T ₁₀			
	240	220	T ₃ T ₁₁			
			T ₄ T ₇			

INSTALLATION

ELECTRICAL CONNECTIONS

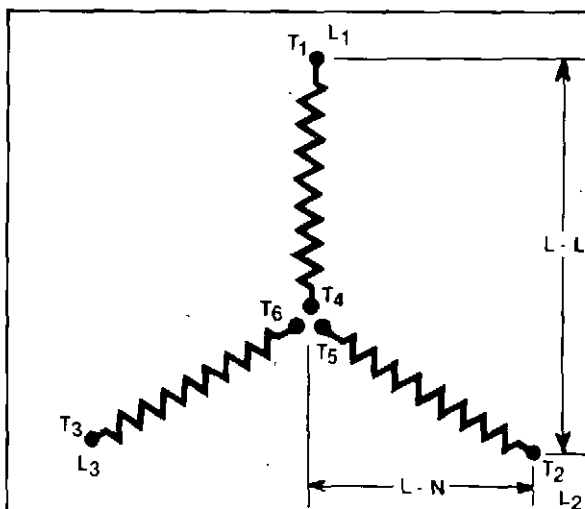
12 LEAD LOW DELTA



Delta connection with 12 lead generators only.

VOLTAGE		CONNECT	L ₁	L ₂	L ₃
	L-L				
60 HZ	120	T ₁ T ₇ T ₆ T ₁₂	T ₁	T ₂	T ₃
	139	T ₂ T ₈ T ₄ T ₁₀			
50 HZ	100	T ₃ T ₉ T ₅ T ₁₁			
	120				

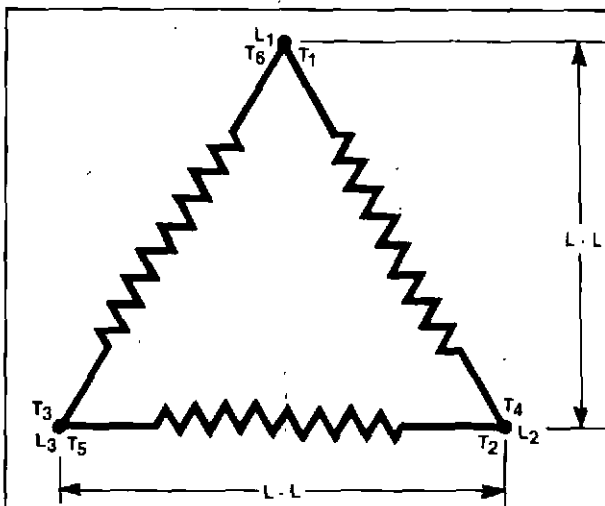
6 LEAD WYE



Six lead generators have 3 coil groups with 6 or 12 cables or bus bars coming out of the generator.

VOLTAGE			CONNECT	L ₁	L ₂	L ₃	NEUTRAL
	L-L	L-N					
60 HZ	190	110	T ₄ T ₅ T ₆	T ₁	T ₂	T ₃	T ₄ T ₅ T ₆
	203	120					
	220	127					
	230	133					
	240	139					
	3300	1905					
50 HZ	190	110					
	200	115					
	208	120					
	3300	1905					

6 LEAD DELTA



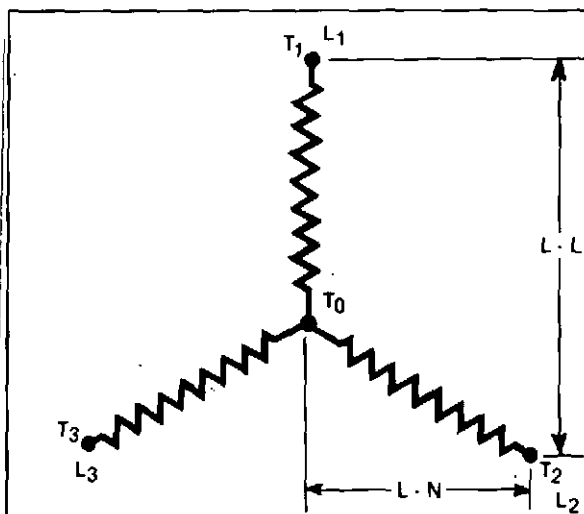
Six lead generators have 3 coil groups with 6 or 12 cables coming out of the generator.

VOLTAGE		CONNECT	L ₁	L ₂	L ₃
	L-L				
60 HZ	2400	T ₁ T ₆	T ₁	T ₂	T ₃
		T ₂ T ₄			
50 HZ	1905	T ₃ T ₅			

INSTALLATION

ELECTRICAL CONNECTIONS

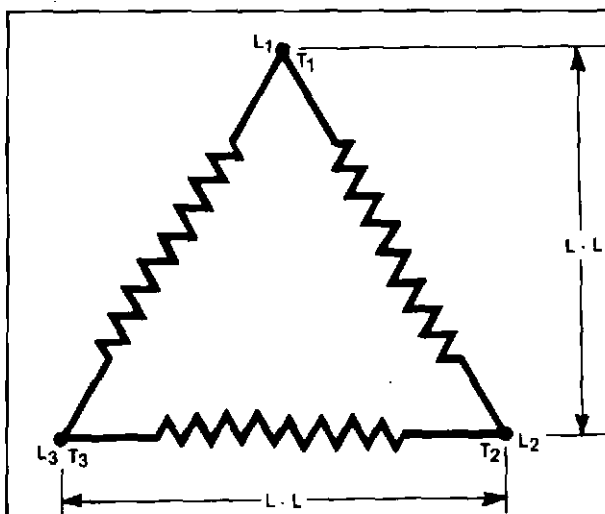
4 LEAD WYE



Four lead generators have 3 coil groups with one end of each group connected together. There are 4, 8 or 16 cables or 4 bus bars coming out of the generator.

VOLTAGE		L ₁	L ₂	L ₃	NEUTRAL
	L-L				
60 HZ	380	T ₁	T ₂	T ₃	T ₀
	416				
	440				
	460				
	480				
50 HZ	600				
	380	T ₁	T ₂	T ₃	T ₀
	400				
	416				
	480				

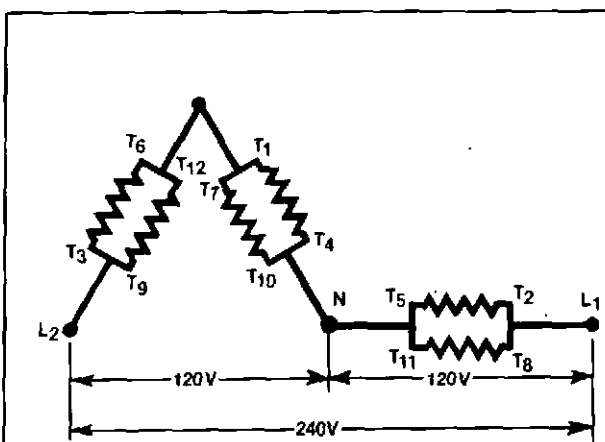
3 LEAD DELTA



Three lead generators have 3 coil groups with one end of each group connected into a Delta internally. There are 3, 6, or 12 cables or 3 bus bars coming out of the generator.

VOLTAGE		L ₁	L ₂	L ₃
	L-L			
60 HZ	480	T ₁	T ₂	T ₃

12 LEAD ZIG-ZAG



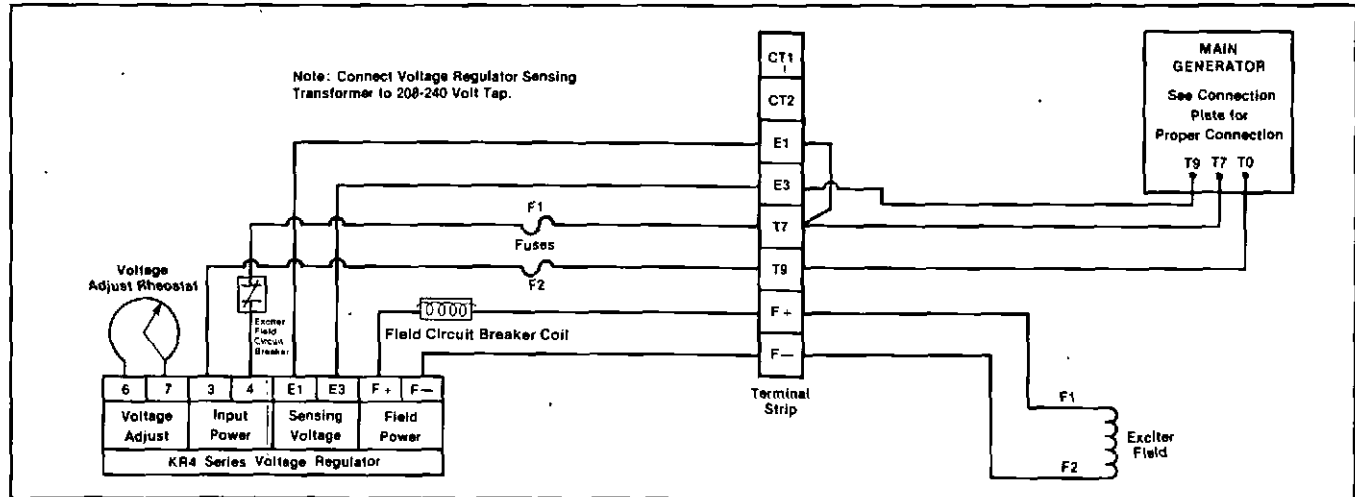
ZIG-ZAG connection with 12 lead machine only.

VOLTAGE		CONNECT	L ₁	L ₂	NEUTRAL
	L-L				
60 HZ	120/240	T ₃ T ₉	T ₂	T ₃	T ₄
		T ₂ T ₈			
		T ₁ T ₆ T ₇ T ₁₂			
		T ₄ T ₁₀ T ₅ T ₁₁			

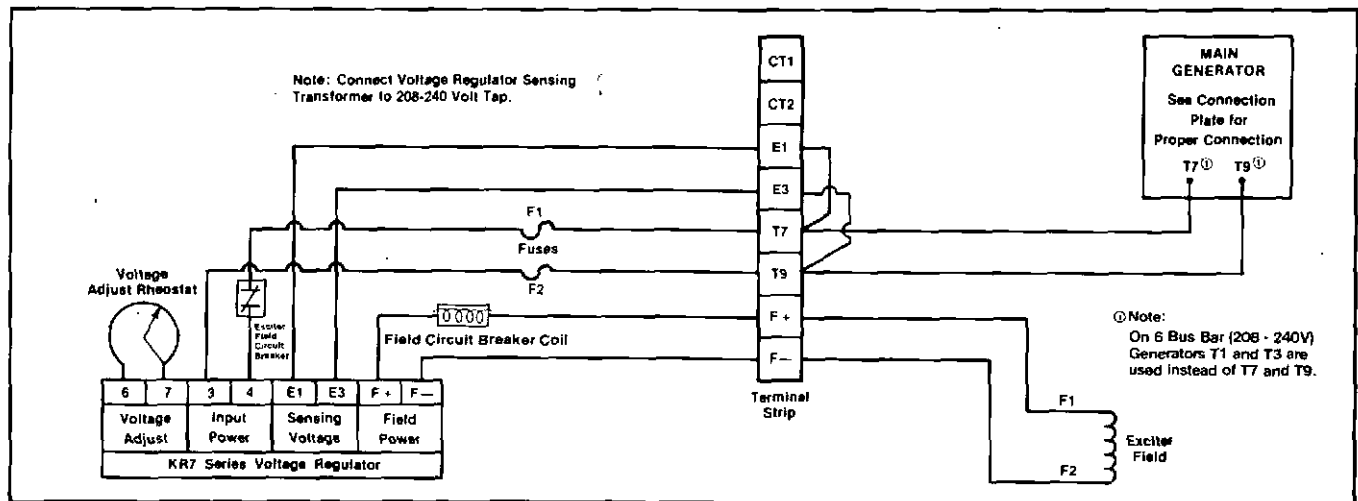
INSTALLATION

ELECTRICAL CONNECTIONS

VOLTAGE REGULATOR CONNECTION DIAGRAM - KR4 SERIES (208-240 VOLT TAP)



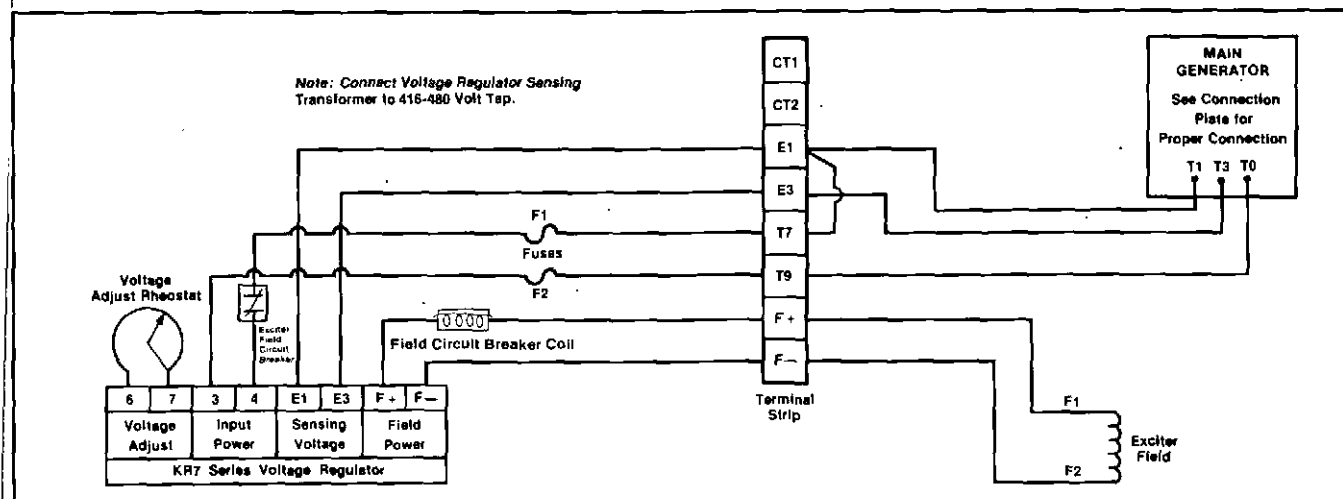
VOLTAGE REGULATOR CONNECTION DIAGRAM - KR7 SERIES (208-240 VOLT TAP)



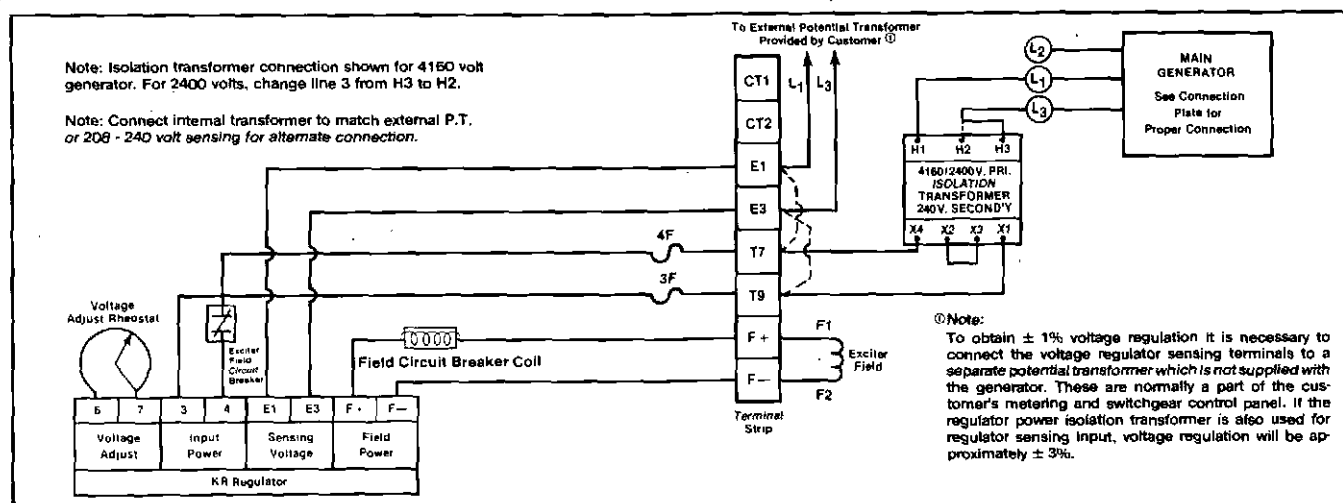
INSTALLATION

ELECTRICAL CONNECTIONS

VOLTAGE REGULATOR CONNECTION DIAGRAM - KR7 SERIES(416-480 VOLT TAP)



VOLTAGE REGULATOR CONNECTION DIAGRAM - KR7F SERIES (4160/2400 VOLT)



INSTALLATION

PARALLELING OPERATIONS

PARALLELING OPERATIONS

Magna One generators come standard with amortisseur windings die cast as an integral part of the rotor. This exclusive Unirotor construction makes all Magna One generators suitable for paralleling operations when the proper control equipment is added. Paralleling with other generator sets and/or with the utility power grid offers a number of advantages. Multiple unit installations increase power capacity; they can be added or removed from the load depending on the load required; they can be better maintained and repaired (since single source breakdown would mean total loss of power) and they often provide more reliable, efficient and economical operation.

Successful parallel operation means that the generators deliver power to the external system without delivering power to each other, or accepting power from the load buss or power grid. Additional equipment is necessary to insure safe and successful operation.

PRIME MOVER

The prime mover provides the speed and torque which will be necessary to keep the machines in synchronized operation. The speed will directly control the watt or kW load and frequency of the unit. The prime mover speed is controlled by a governor. The governor must have special paralleling and droop provisions to permit parallel operation with other machines.

VOLTAGE REGULATOR

The voltage regulator controls the generator output voltage and the reactive power supplied by the generator. When two or more ac generators operate in parallel, the voltage regulator must have paralleling provisions (either internally or external to the regulator) to permit it to control the reactive or VAR load while it is in parallel operation. A separate paralleling current transformer is required to sense the reactive current and signal the voltage regulator. This additional paralleling circuitry is absolutely necessary to control the reactive current flowing between the generator sets.

SWITCHGEAR

There are additional relays and breaker controls which are necessary to insure safe, trouble free operation of paralleled units. Reverse power relays monitor the direction of power flow to insure that the generator is delivering power, not accepting it. These power relays control breakers, which are a means of connecting and disconnecting the generator from the load. The total system can include over-voltage, over-current protection, under frequency protection, power factor correction provision and various associated control equipment from manual switchgear to micro-processors. The amount of control gear and level of sophistication will be determined by the needs and requirements of the particular application.

PARALLELING BASICS

The following points are basic criteria which must be met before two units can be paralleled. THIS IS NOT MEANT TO BE SPECIFIC INSTRUCTIONS FOR PARALLELING OPERATION.

1. Additional paralleling circuitry
 - A. Voltage regulator - paralleling provisions
 - B. Paralleling current transformers(s)
 - C. Paralleling provisions on governor controls
 - D. Switchgear
2. The voltage and frequency must be the same for all sets with voltages in phase.
3. The voltage regulation characteristics of the individual generators should be similar.
4. The generators must have the same phase rotation.
5. The driving engines should have the same speed regulation characteristics and the governors should be adjusted to give the same speed regulation.

Before operating generator sets in parallel, each set should be checked by starting, operating and adjusting the sets as individual units before attempting paralleling.

INSTALLATION

PARALLELING OPERATIONS THYRISTOR OR SILICON CONTROLLED RECTIFIER LOADING

REACTIVE LOAD CONTROL

When two identical generators are operating together in parallel and an unbalance occurs in field excitation, circulating currents begin to flow between the generators. This current will appear as a lagging power factor or inductive load to the highly excited generator, and as a leading power factor or capacitive load to the generator with the lower field current. This is known as the reactive circulating current and there are two methods of controlling it in parallel operation:

1. *Reactive droop compensation.* (Formerly known as parallel droop compensation.)

The bus voltage droops, or decreases, as the reactive lagging power factor load is increased.

2. *Reactive differential compensation.* (Formerly known as cross current compensation.)

The reactive differential compensation circuit allows parallel generators to share reactive loads with no decrease or droop in generator voltage. The RDC circuit must meet the following criteria:

- A. All paralleling current transformers for all the generators being paralleled must be included in the secondary interconnection loop.
- B. When different size generators are paralleled, all paralleling current transformers must have the same or proportional ratios that give approximately the same secondary current.
- C. Voltage regulator paralleling circuitry must be the same.
- D. Current transformer secondaries and the generator lines must be isolated electrically.

Because of the above criteria, reactive differential compensation cannot be used when paralleling with the utility power grid. There is no limit, however, in the number of generators that can be included in this type of circuit.

- E. It is also desirable to have an auxiliary contact on the main generator breaker to short the parallel CT secondary when that breaker is open (not connected to the load buss).

PARALLELING CIRCUITRY

Because of the number of variables involved in paralleling generator sets, every installation will have its own circuitry and methods or procedures of bringing paralleled units on line. There are numerous ways of connecting paralleled units and an almost unlimited variety of applications and associated equipment.

When parallel operation is desired, it is important that the control manufacturer, the generator manufacturer and the systems engineer work together to insure the proper selection of all components. Please refer to Marathon Electric for application assistance.

THYRISTOR OR SILICON CONTROLLED RECTIFIER LOADING

Solid state electronic control devices which utilize thyristors or SCR firing circuits (such as variable frequency induction motor controls, precision motor speed controls, no-break powered battery chargers, etc.) can introduce high frequency harmonics which adversely affect or distort the normal waveform of the generator. This creates additional heat in the generator stator and rotor, and can cause overheating. These devices can and do present problems to non-utility power generating equipment or any limited power buss system. The problems which can occur are not limited to the generator itself, but can effect the solid state control devices, the equipment it controls, other associated loads, monitoring devices or a number of combinations over the entire system.

Magna One generators can supply some thyristor and SCR loads when properly applied. For a single thyristor (SCR) load, the maximum KVA load on the generator should be limited to about 60% of the generator rating. Where thyristor (SCR) loading is less than 30% of the total loading, derating of the generator is not normally required. It is important that the control manufacturer, the generator manufacturer and the systems engineer work together to insure the proper selection of all components. Please refer to Marathon Electric for application assistance.

OPERATION

PRE-START INSPECTION STARTING-UP THE GENERATOR FIELD FLASHING

PRE-START INSPECTION

Before operating the generator for the first time, the following checks are recommended.

1. Check all wiring against the proper connection diagrams and make sure all connections are properly insulated.
2. Inspect for any remaining packing materials and remove loose clothes and all tools.
3. Check that all covers and guards are installed and tight.

IDLING

Permanent equipment damage can be caused by idling the engine between 650 and 1400 generator rpm. If engine adjustments require idling at these speeds, the **REGULATOR FUSES MUST BE REMOVED** before engine start-up and adjustment.

WARNING

RESIDUAL VOLTAGE IS PRESENT AT THE GENERATOR LEADS AND AT THE REGULATOR PANEL CONNECTIONS, EVEN WITH THE REGULATOR FUSES REMOVED. CAUTION MUST BE OBSERVED OR SERIOUS PERSONAL INJURY OR DEATH CAN RESULT. CONSULT QUALIFIED PERSONNEL WITH ANY QUESTIONS.

If generator is supplied with the optional regulator power "off-on" switch, simply turn the switch to the "off" position; or if supplied with the optional under-frequency module, the regulator is protected. **WHEN IN DOUBT, REMOVE THE FUSES.** After engine adjustment, the regulator fuses should be replaced. The engine should be brought through the 650-1400 rpm range in less than 45 seconds.

VOLTAGE ADJUSTMENTS

A means for adjusting the voltage is incorporated in the regulator. For details refer to the Voltage Regulator Manual applicable to this unit.

STARTING-UP THE GENERATOR

The following procedure should be followed for starting-up the generator set:

1. The generator output must be disconnected from the load. Be certain that the main circuit breaker is open.
2. Start the prime mover and adjust it for the proper speed. If unit is not frequency protected, remove the fuses.
3. If fuses have been removed, replace the fuses and adjust the voltage to the required value by means of the voltage adjust rheostat.
4. Close the main circuit breaker and apply the load.
5. Adjust engine speed at full load to 1800 rpm for 60 hertz, 1500 rpm for 50 hertz.
6. Before stopping the engine, remove the load by tripping the main circuit breaker.

FIELD FLASHING

The generator relies on residual voltage to start the generator action which in turn produces the rated voltage. If the generator fails to produce a voltage after it has come up to rated speed, it may be necessary to flash the field. This procedure must be done while the generator is at a standstill. See the Field Flashing Procedure for further information.

FIELD FLASHING PROCEDURE

With the generator set shut down, apply a 12 volt dc flashing source (battery) across terminals F+ and F- on the voltage regulator. The positive terminal of the battery must be connected to F+ and the negative terminal to F-. **CAUTION:** If these leads are reversed, the voltage regulator will be destroyed. A diode in the voltage regulator allows the flashing source to be removed from the field without the danger of inductive arcing. This action re-magnetizes the exciter field and allows build-up when the system is restarted.

OPERATION

PREVENTATIVE MAINTENANCE CLEANING METHODS

PREVENTATIVE MAINTENANCE

Dirt and heat are common enemies of a generator. Keeping the generator clean, preventing overloads, and proper alignment of the generator and its prime mover will result in efficient operation.

Accumulations of dust and dirt not only contribute to insulation breakdown, but they can also increase temperature by restricting ventilation and by blocking the dissipation of heat from the winding and frame surfaces. Some machines are exposed to accumulations of materials such as talc, lint, or cement dust, which may obstruct the ventilation. The most harmful types of foreign materials include carbon black, metallic dust and chips, and similar substances which not only impede the ventilation, but also form a conductive film over the insulation, increasing the possibility of insulation failure. Machines operating in dirty places should be disassembled and cleaned periodically.

Dirt and dust will conduct electricity between points of different electrical potential. The regulator must be kept free of excessive amounts of dust and dirt. Low pressure, moisture-free compressed air may be used to blow out any dust and dirt.

CLEANING METHODS

When electrical components get dirty, the insulation must be cleaned. There are a number of acceptable methods for cleaning the generator, each of which will necessitate disassembly of the unit. The method of cleaning will be determined by the kind of dirt, and when the unit must be returned to service. Drying after cleaning is necessary.

Whenever the generator is disassembled, the windings should be given a thorough inspection and the insulation cleaned, if necessary. The inspection should cover the condition of the windings and insulation, and the effectiveness of the supporting ties as evidenced by the rigidity of the coil end turns.

SOLVENTS

It is recommended that only petroleum distillates be used for cleaning electrical components.

A solvent is usually required to remove accumulated soil containing oil or grease. A wet rag with solvent is suitable for wiping.

Dry components thoroughly with moisture-free, low pressure compressed air.

CAUTION: CARE MUST BE TAKEN NOT TO GET SOLVENT ON INSULATING VARNISHES OR DETERIORATION OF VARNISH WILL OCCUR.

Petroleum solvents of the safety type should be used. The flash point of these solvents should be greater than 100° F (38° C).

WARNING

ADEQUATE VENTILATION MUST BE AVAILABLE TO AVOID FIRE, EXPLOSION AND HEALTH HAZARDS WHERE SOLVENTS ARE USED. AVOID BREATHING SOLVENT VAPORS. RUBBER GLOVES OR OTHER SUITABLE PROTECTION FOR THE HANDS SHOULD BE USED.

CLOTH AND COMPRESSED AIR

Cleaning with a dry cloth may be satisfactory when components are small, the surfaces are accessible and only dry dirt is to be removed.

Blowing dirt out with compressed air is usually effective particularly when the dirt has collected in places which cannot be reached with a cloth. Use clean dry air at 30 PSI (206 KPA).

BRUSHING AND VACUUM CLEANING

Dry dust and dirt may be removed by brushing with bristle brushes followed by vacuum cleaning. Do not use wire brushes. Vacuum cleaning is an effective and desirable method of removing dry and loose dirt.

SHELL BLASTING

Air blasting with ground nut shells may be satisfactory for removal of hard dirt deposits from insulation. Use mild abrasives such as 12-20 mesh ground walnut shells.

DRYING ELECTRICAL INSULATION

Electrical components, after cleaning, storing or shipping must be dried before placing in operation if tests indicate that the insulation resistance is below a safe value. See approved drying procedures in the "Installation Section" of the manual.

OPERATION

PREVENTATIVE MAINTENANCE LUBRICATION

DRYING ELECTRICAL INSULATION

Electrical components, after cleaning, storing or shipping must be dried before placing in operation if tests indicate that the insulation resistance is below a safe value. See approved drying procedures in the "Installation Section" of the manual.

AIR INTAKE AND EXHAUST

Check the area around the air intake and exhaust openings to be sure they are clean and unobstructed. Remove all foreign material and clean all screens.

ELECTRICAL CONNECTIONS AND WINDINGS

Inspect for loose or contaminated connections. Check wires for cracked or frayed insulation. Tighten connections and replace defective or oil soaked insulation.

If inspection shows that varnish coatings on the windings have deteriorated, they should be re-coated with insulating varnish. Please refer to Marathon Electric for insulation system requirements.

LUBRICATION

All generators are lubricated before leaving the factory and are ready for operation. As a general rule, bearings should be relubricated annually or at the indicated intervals in table 1, whichever occurs first. Unusually severe operating conditions, such as high ambient or dusty environments, require more frequent lubrication (every six months or one half the table intervals, whichever occurs first). 360 Frame generators are permanently lubricated, and therefore regreasing is not necessary.

Use Chevron SRI #2 or equivalent anti-friction type, high quality, grease with a lubrication temperature range of lowest ambient temperature expected to +260°F.

During an overhaul, the grease reservoir should be thoroughly cleaned and new grease added. The reservoir should be 1/3 to 1/2 filled with new grease.

To add or renew grease, proceed as follows:

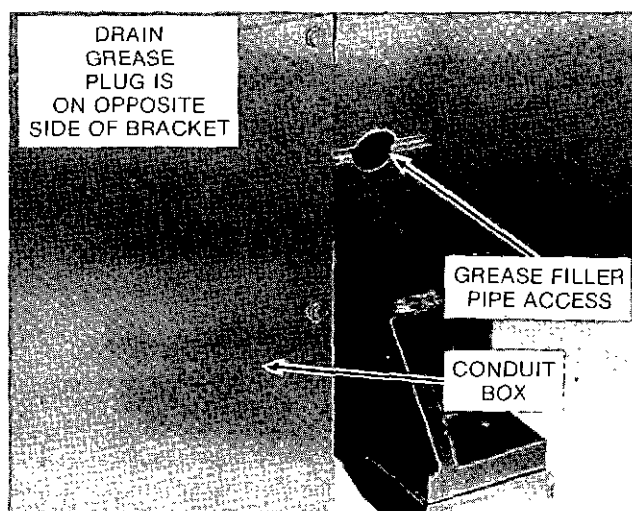
1. Stop unit.

2. Wipe clean the grease plugs and surrounding parts.
3. Remove filler and drain plugs (see figure to right).
4. Insert 1/8" N.P.T. grease fitting or appropriate fitting in filler pipe.
5. Free drain hole of any hard grease, using a piece of wire if necessary.
6. Using a low pressure grease gun, add grease according to the amounts in table 1:
7. Start unit with drain plug removed - filler pipe may be open or closed. Allow unit to run 15 minutes to allow excess grease to drain.
8. Stop unit, wipe off any drained grease, and replace filler and drain plugs.

CAUTION: USE ONLY CLEAN GREASE FROM CLEAN, CLOSED CONTAINERS AND KEEP IT FROM BEING CONTAMINATED WHILE REGREASING.

The amount of grease added is very important! Only enough grease should be added to replace the grease used by the bearing.

CAUTION: TOO MUCH GREASE CAN BE AS HARMFUL AS INSUFFICIENT GREASE - USE THE PROPER AMOUNT.



OPERATION

LUBRICATION

TABLE 1: RELUBRICATION AMOUNTS AND INTERVALS

	FRAME SIZE	BEARING SIZE	AMOUNT OF GREASE			INTERVALS ^①	
			OUNCES	CUBIC INCHES	TEASPOONS	60 HZ	50 HZ
SINGLE BEARING UNITS	440	312	1.0	1.8	5.8	7600	8800
	500, 502	314	1.2	2.1	7.0	6500	8400
	680, 682, 683	320	2.1	3.7	12.2	3800	5300
DOUBLE BEARING UNITS (SHAFT END BEARING ONLY)	440	318	1.7	3.0	9.9	4600	6200
	500, 502	318	1.7	3.0	9.9	4600	6200
	680, 682, 683	322	2.4	4.2	14.0	3000	4500

^①HOURS OF RUNNING TIME

SERVICE

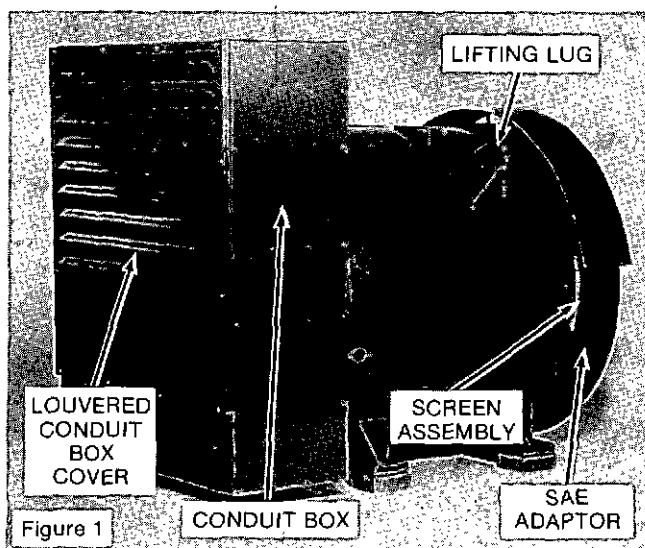
DISASSEMBLY

REMOVAL FROM PRIME MOVER

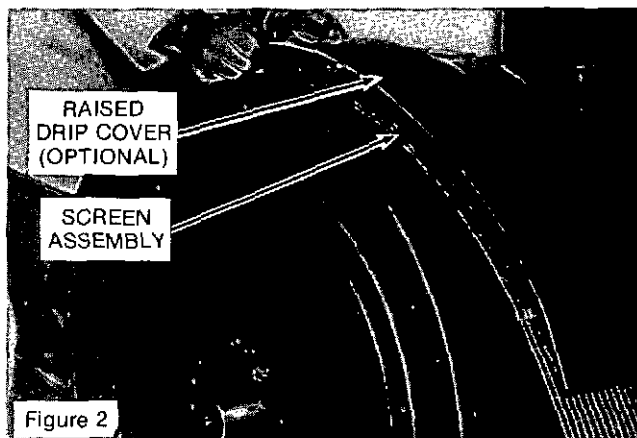
WARNING

DISCONNECT ALL POWER BEFORE SERVICING. FAILURE TO FOLLOW ALL SAFETY INSTRUCTIONS CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

1. Remove louvered conduit box cover. (See Figure 1).



2. Disconnect all electrical load leads from the generator leads (or buss bars) inside the conduit box.
3. Remove all conduit or ducting from the conduit box.
4. Attach a suitable hoist to the generator lifting lugs.
5.
 - a. For two-bearing generators, disconnect the coupling or sheave and belts between the generator and prime mover. (Follow the coupling manufacturer's instructions for disconnection.)
 - b. For single bearing generators, remove the bolts mounting the screen assembly to the SAE adaptor and remove the screen. (See Figure 2.) (NOTE: Do not remove the drip-cover from the screen assembly if so equipped.) Remove the capscrews attaching the drive discs to the flywheel and remove the capscrews attaching the SAE adaptor to the flywheel housing.



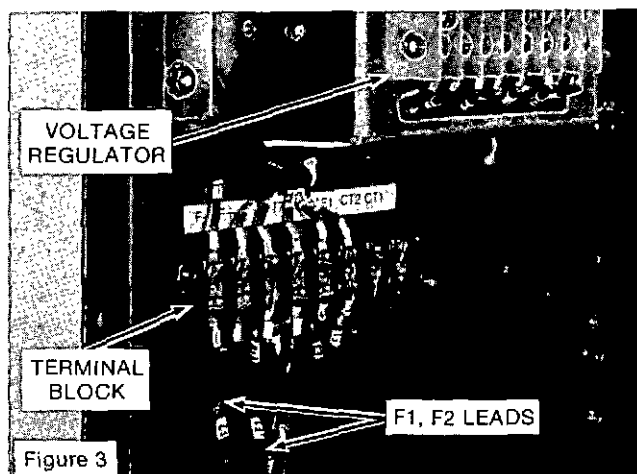
WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

6. Remove the mounting bolts which secure the generator to the base.
7. Raise the generator slightly and move the generator away from the prime mover.
8. On single bearing generators, if generator is to be shipped, see Shipping Instructions Section for proper rotor support.

EXCITER REMOVAL

1. Remove regulator enclosure and disconnect F1 and F2 leads from the corresponding F+ and F- terminals on the terminal block on the regulator panel. (See Figure 3).



SERVICE

DISASSEMBLY

2. Remove all lead fasteners connecting F1 and F2 leads to the front end bracket or conduit box. Remove the four capscrews and belleville washers holding the exciter stator and lead shield in place. (See Figure 4.) Remove the lead shield. Mark the exciter stator "top front" for reference. (See Figure 5.) Remove the exciter stator.

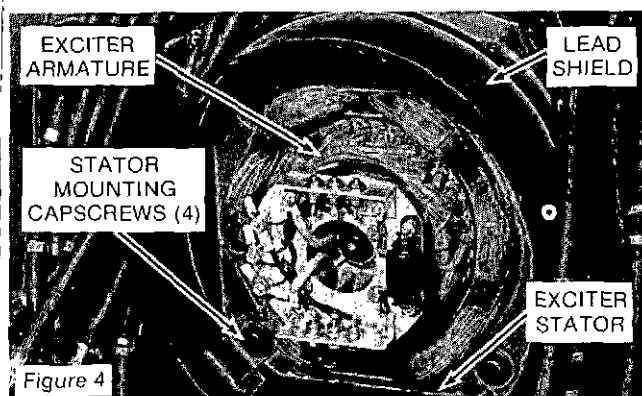


Figure 4

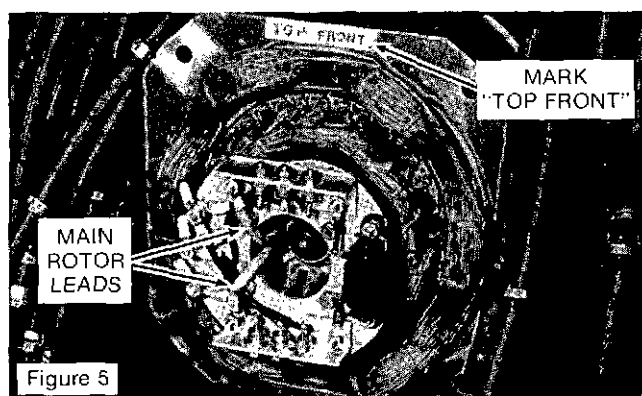


Figure 5

3. Disconnect both main rotor leads coming out of the aluminum standoff plate lead hole from the rectifier aluminum angle. (See Figure 6.)

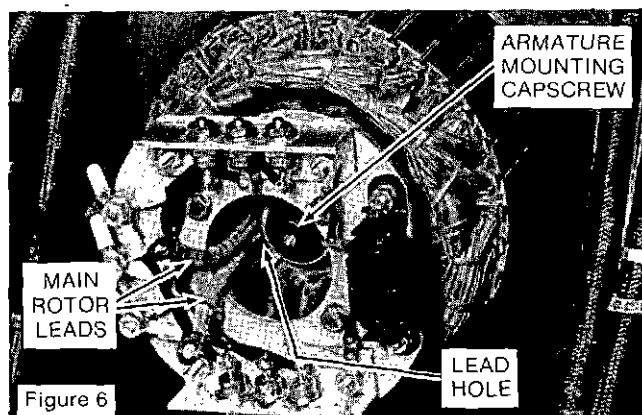


Figure 6

4. Remove the capscrew and belleville washer which holds the exciter (rotor) armature to the generator shaft. Use a six inch, 3/4 - 16NF capscrew threaded into the aluminum standoff plate to push against the end of the shaft. (See Figure 7.) Carefully feed the leads through the lead hole in the aluminum standoff plate as the armature is removed.

CAUTION: DO NOT TIGHTEN THE ARMATURE REMOVAL CAPSCREW BEYOND THE END OF THE THREADS. IF THE THREAD LENGTH IS NOT SUFFICIENT TO REMOVE THE EXCITER ARMATURE, USE A PIECE OF THREADED ROD WITH A NUT WELDED ON THE END.

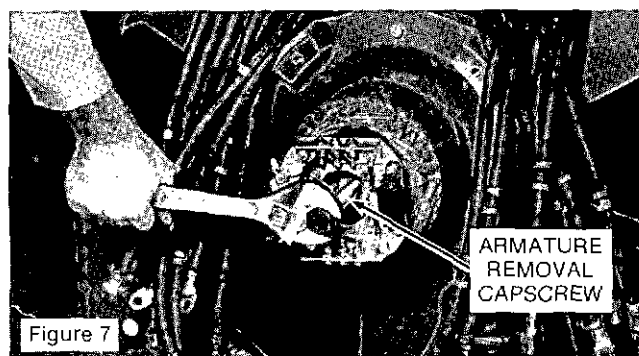


Figure 7

MAIN ROTOR REMOVAL

1. a. For two bearing generators, remove the two capscrews and lockwashers holding the bearing lock to the drive end bracket. On 680, 682 Frame generators, remove the two capscrews holding the bearing cap to the front end bracket. (See Figure 8.)

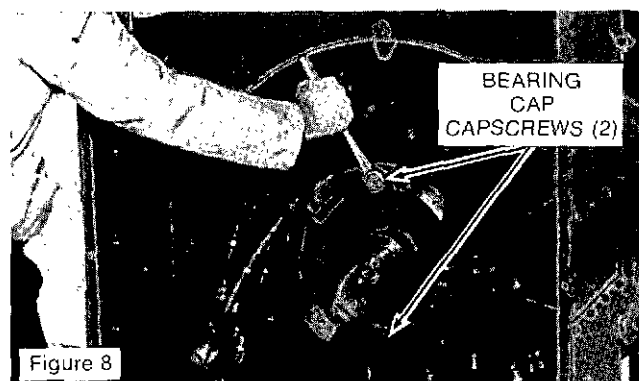
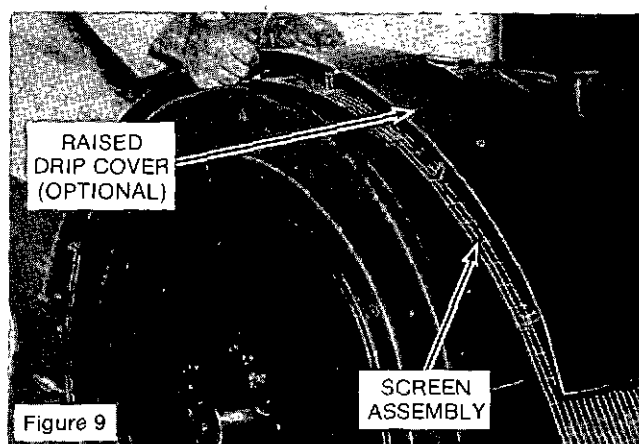


Figure 8

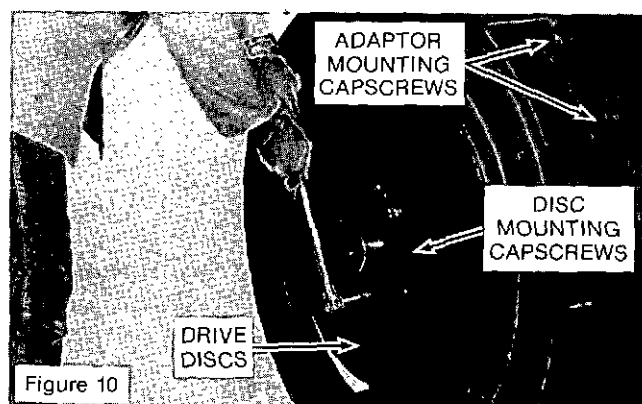
SERVICE

DISASSEMBLY

- b. For single bearing 680, 682 Frame generators, remove the two capscrews holding the bearing cap to the front end bracket. (See Figure 8.)
2. If the screen assembly is still mounted, remove the bolts securing the screen assembly to the drive end bracket or the SAE adaptor and remove the screen assembly. (See Figure 9.) (NOTE: Do not remove the drip cover from the screen assembly if so equipped.)

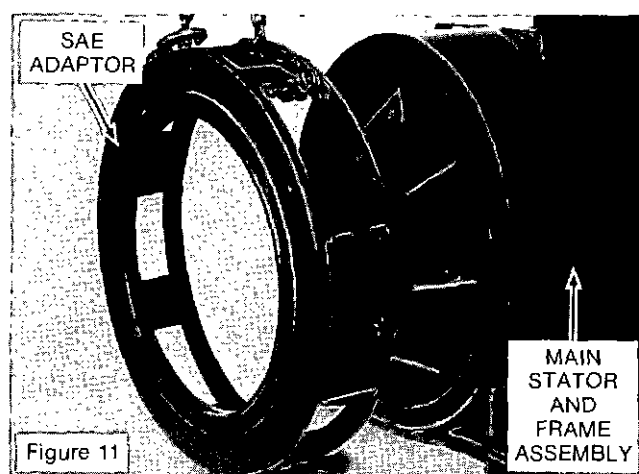


3. a. For two bearing generators, remove the drive coupling half or sheave from the shaft extension.
- b. For single bearing generators, remove the capscrews and hardened washers holding the drive discs to the drive hub. (See Figure 10.) (NOTE: Capscrew removal can most easily be accomplished by starting at the bottom and removing the capscrews in a clockwise sequence.) Remove all drive discs (and spacers if any).



4. a. For two bearing generators, remove the capscrews holding the drive end bracket to the generator and remove the bracket.
- b. For single bearing generators, remove the capscrews holding the SAE adaptor to the generator and remove the adaptor. (See Figure 11.)

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN DRIVE END BRACKET OR SAE ADAPTOR REMOVAL.



5. Using a rotor lifting fixture and a suitable hoist, carefully remove the rotor assembly from the main stator and frame assembly through the drive end. (See Figure 12.)

CAUTION: SPECIAL CARE SHOULD BE USED IN THE ROTOR ASSEMBLY REMOVAL, OR WINDING DAMAGE COULD RESULT.

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

SERVICE

DISASSEMBLY

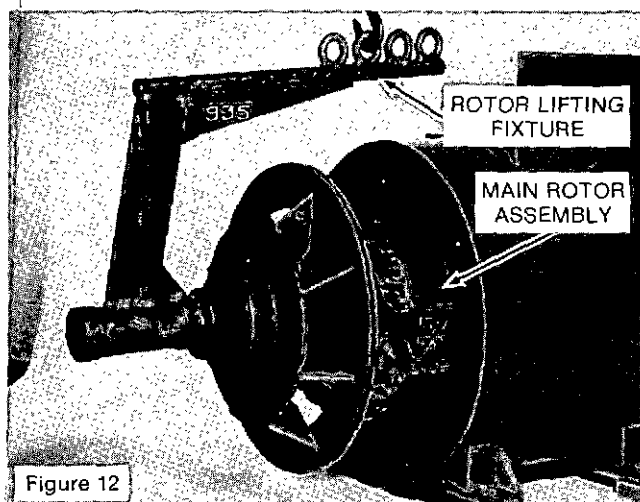


Figure 12

CONDUIT BOX AND FRONT END BRACKET REMOVAL

1. Disconnect the following leads from the corresponding points on the terminal strip on the regulator panel: (See Figure 13.)

Frame Size	Leads to be Disconnected
360, 440, 500	T0, T7, E3, [CT-1, CT-2 if used]
502, 680	T7, T9, [CT-1, CT-2 if used]
682	T0, T7 E1, E3, [CT-1, CT-2 if used]

NOTE: The above lead combinations are used on the standard generators; other leads may have to be removed depending on the particular application.

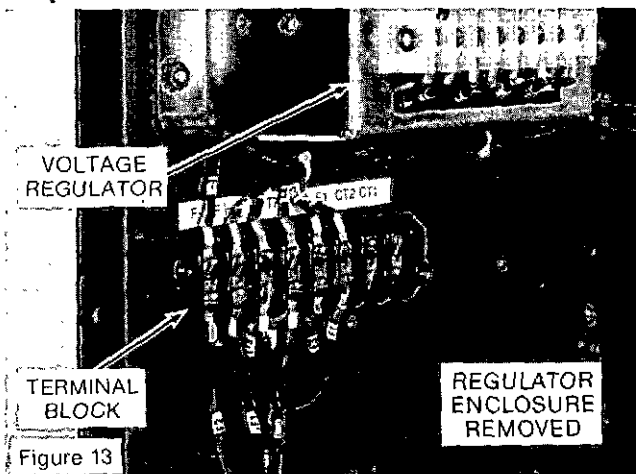


Figure 13

2. On generators with buss bars, disconnect all main stator leads bolted to the buss bar assembly, making sure all leads are marked for identification before removal. (See Figure 14.)
3. a. On generators with four buss bars (T1, T2, T3, T0), remove the capscrew, flat washer and lockwasher mounting the red insulating channel to the front end bracket. Remove the buss bar support mounting capscrews and lockwashers. Remove the buss bar assembly. Remove the capscrews and lockwashers mounting the neutral buss bar to the support.
- b. On generators with six buss bars (T1, T2, T3, T4, T5, T6), remove the capscrews and lockwashers mounting the buss bar support to the front end bracket. Remove the buss bar assembly (T1, T2 and T3). The neutral buss bar assembly (T4, T5 and T6) can remain in the bottom of the conduit box.

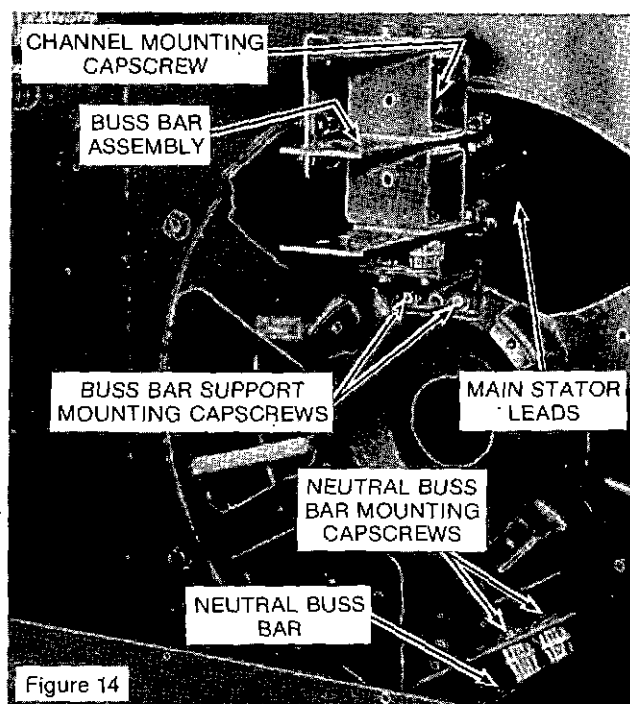
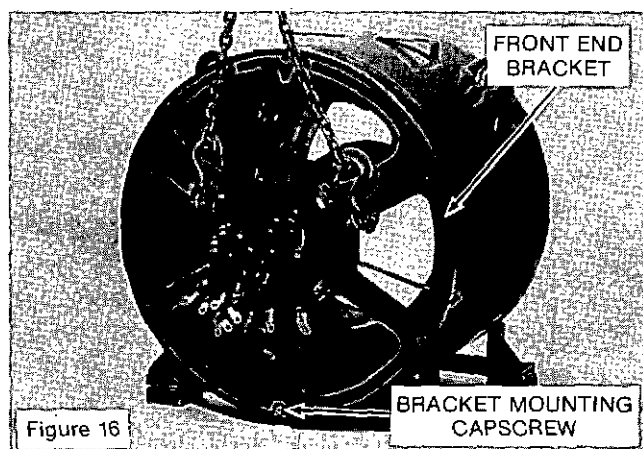
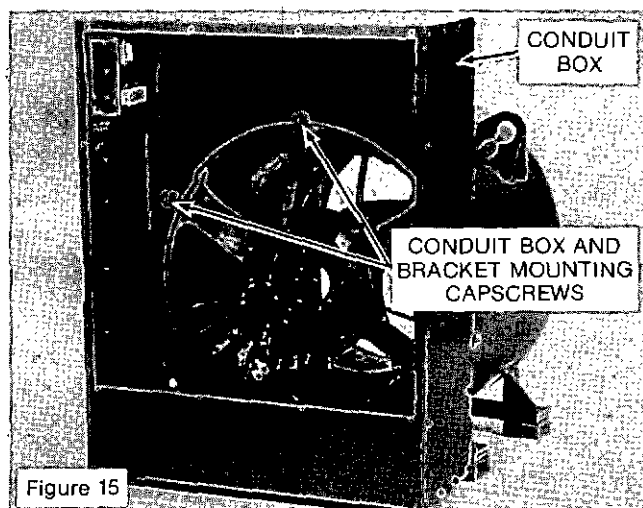


Figure 14

SERVICE

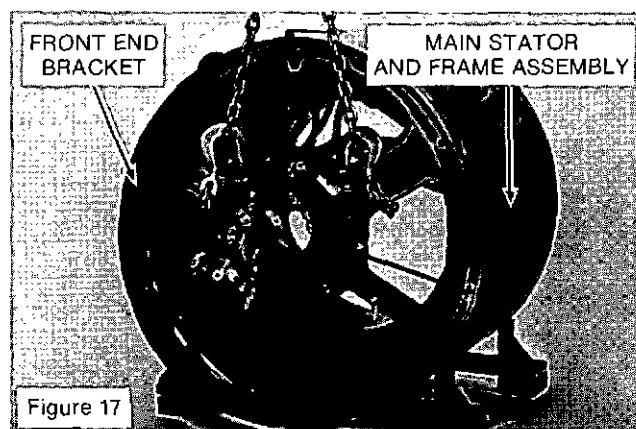
DISASSEMBLY

4. Remove the capscrews and starwashers holding the conduit box and front end bracket to the main stator assembly. (See Figure 15.) Lift off the conduit box.
5. On 680, 682 Frame generators, remove the one additional mounting capscrew at the bottom of the front end bracket. (See Figure 16.)



6. Remove the front end bracket from the main stator assembly. (See Figure 17.)

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN THE FRONT END BRACKET REMOVAL.



SERVICE

INSPECTION

EXCITER INSPECTION

A. Exciter Stator

1. Clean dust and dirt from the stator winding with a soft cloth or brush. (See Figure 18.) (See *cleaning methods under Preventative Maintenance.*)
2. Check the exciter stator winding for a loose, frayed, or burnt winding. Repair or replace as necessary. If field repair of the winding is necessary, contact Marathon Electric for special winding procedures and materials.
3. Look for score marks in the bore of the exciter core caused by rubbing.

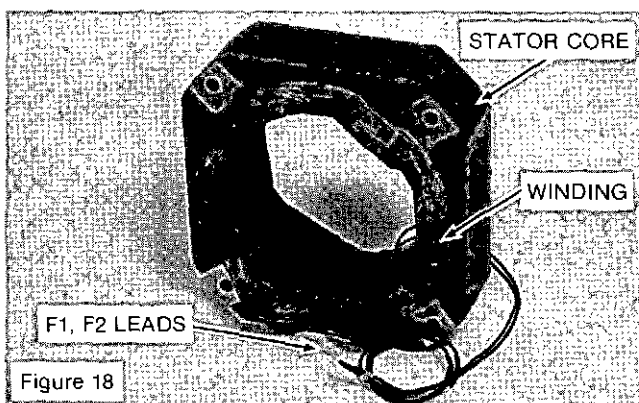


Figure 18

B. Exciter (Rotor) Armature

1. Clean all metal parts with an approved cleaning solvent.
2. Clean dust and dirt from the exciter armature and rectifier assembly with a soft cloth or brush. (See Figure 19.) (See *cleaning methods.*)
3. Check the exciter armature for burrs on the mating surfaces.
4. Check the rectifiers and surge protector for proper operation. (See Troubleshooting Section.) Replace defective parts.
5. Check the exciter armature and rectifier assembly for a loose, frayed, or burnt winding or loose connections. Repair or replace as necessary. If field repair of the winding is necessary, contact Marathon Electric for special winding procedures and materials.

6. Look for score marks on the outside diameter of the armature core caused by rubbing.

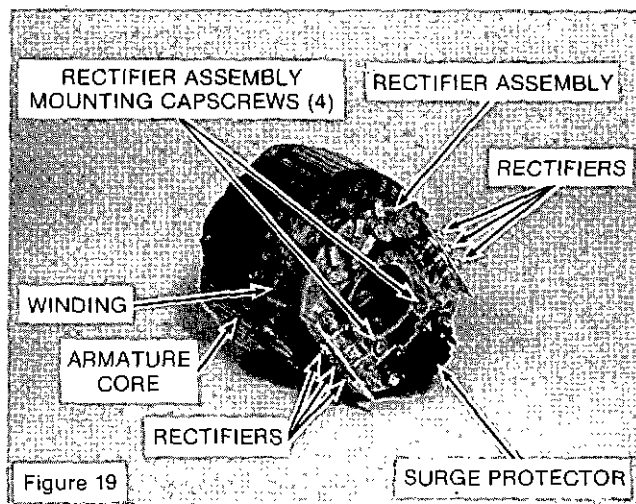


Figure 19

MAIN ROTOR INSPECTION

A. Bearing

1. Check the bearing for damage or wear. On 680-684 Frame generators, clean the old grease from the bearing cap, and fill the bearing cap grease cavity 1/3 to 1/2 full of new multipurpose lithium based grease.

NOTE: If the bearing needs to be removed, for any reason, always install a new bearing.

2. If the bearing is to be replaced, remove with a suitable puller. (See Figure 20.) On 680-684 Frame generators and two bearing generators, be sure the bearing cap is on the shaft before installing the new bearing.

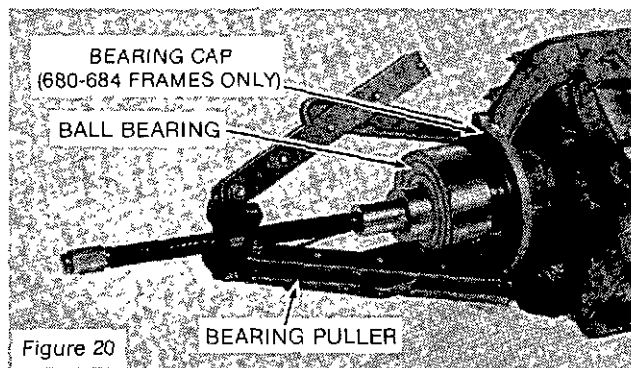


Figure 20

SERVICE

INSPECTION

Heat the new bearing in an oven to a maximum temperature of 212° F (100° C). Apply a thin coat of clean lubricating oil to the press-fit area of the rotor shaft. Using asbestos gloves, install the bearing over the end of the shaft until it seats against the shaft shoulder. (See Figure 21.) The bearing should slide on the shaft and be seated without excessive force. If the bearing binds on the shaft before being fully seated, a piece of tubing, slightly larger than the press-fit area, can be used to drive the bearing into place. Using light taps with a soft mallet, apply pressure to the inner race only.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD PRESSURE BE APPLIED TO THE OUTER RACE OF THE BEARING, AS PERMANENT BEARING DAMAGE COULD RESULT.

Allow the bearing to cool for one hour before attempting to assemble the generator.

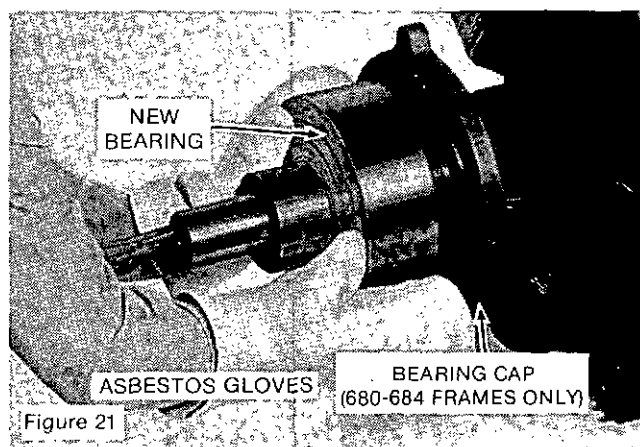


Figure 21

B. Drive Hub (Single Bearing Generators Only)

1. Check the drive hub for cracks or stripped drive disc mounting holes. Replace the hub if defective.
2. If the hub is to be replaced, mark the fan and hub for alignment to ensure proper balance after reassembly. Remove the fan mounting capscrews and belleville washers and move the fan back away from hub. (See Figure 22.) Install a suitable puller to the hub. Remove the setscrew in the hub over the key. Using a torch, rapidly heat the hub at the outer diameter while tightening the puller. (This must

be done rapidly before the heat can expand the shaft.) Remove the hub. (Check the fan for defects according to Section C.)

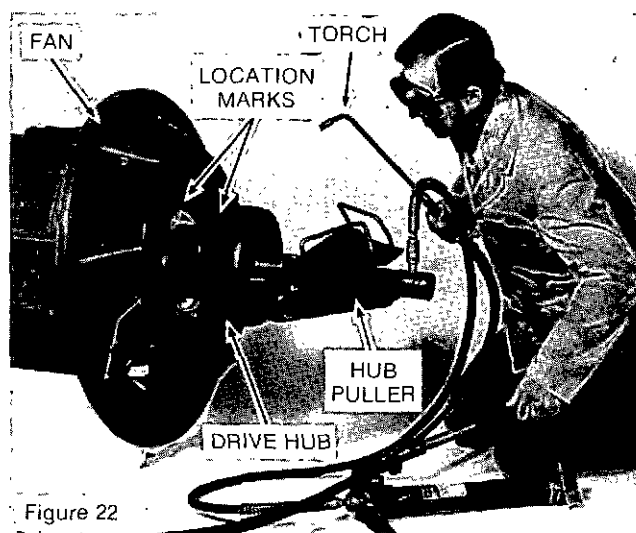


Figure 22

Mark the new hub in the same place as the old hub relative to the keyway. Heat the new hub in an oven to 500°-600° F (260°-316° C). Be sure that the fan is still on the shaft. Using asbestos gloves, slide the hub over the key in the shaft until it seats against the shaft shoulder. (See Figure 23.)

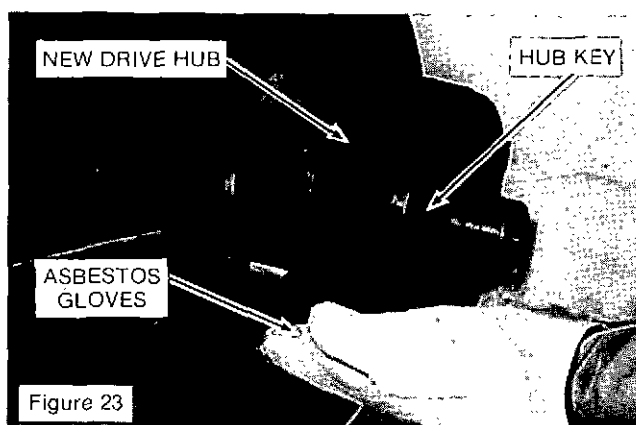


Figure 23

Allow the hub to cool for one hour. After the hub has cooled, tighten the setscrew in the hub to 50 ft-lbs (68 N.m) torque. Match the alignment marks on the fan and hub and mount the fan with the capscrews and belleville washers. (See Figure 24.) Torque the capscrews per Figure 49. (See Figure 25.)

SERVICE

INSPECTION

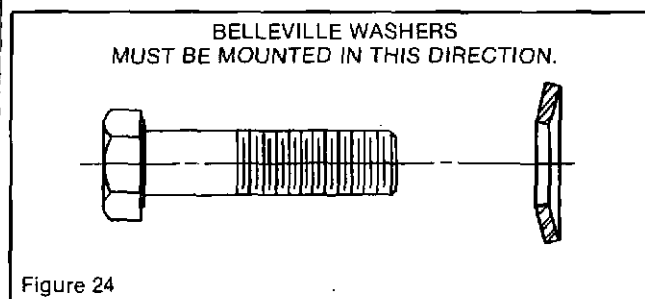


Figure 24

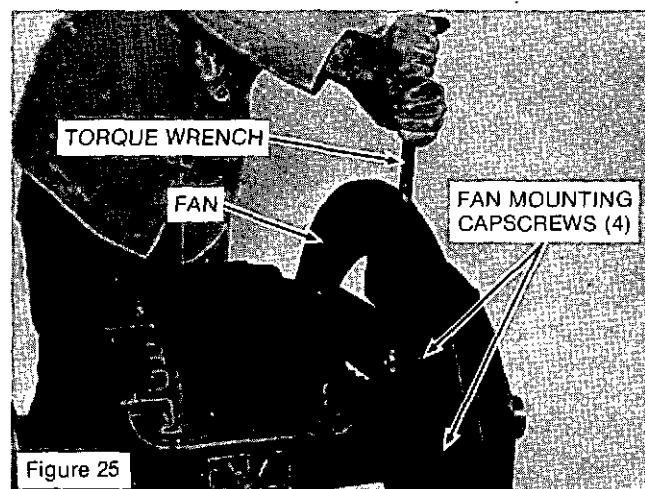


Figure 25

Rebalancing of the rotor assembly is not necessary if only the hub is replaced and the fan is mounted in the same location relative to the hub.

C. Fan

1. Check the fan for cracks or broken blades. Replace the fan if defective.
2. a. For two-bearing generators, remove the drive end bearing cap. (See bearing removal instructions above.) Remove the fan setscrews. Using a torch, rapidly heat the backside of the fan.

CAUTION: DO NOT HEAT THE FAN ABOVE 400-500° F (204-260° C) AS THIS WILL REMOVE THE TEMPER FROM THE FAN.

Using asbestos gloves, slide the fan off the shaft. Heat the new fan in an oven to 400°-500° F (204°-260° C). Using asbestos gloves, slide the fan over the key in the shaft until it seats against the shaft shoulder. Allow the fan to cool for one-half hour. After the fan has cooled, tighten the

setscrews in the fan to 17 ft-lbs (23 N.m) torque. Install the bearing cap and a new bearing according to the bearing assembly instructions above.

- b. For single bearing generators, remove the hub according to the above drive hub removal instructions. Slide the fan off the shaft. Slide the new fan on the shaft making sure the fan mounting surface is toward the drive hub. Mount the hub according to the drive hub assembly instructions above. Mount the fan to the drive hub with the capscrews and belleville washers (see Figure 24). Torque the capscrews per Figure 49. (See Figure 25.)

3. The rotor assembly must be rebalanced if a new fan has been installed.

D. Main Rotor Core and Windings

1. Clean all metal parts with an approved cleaning solvent. Remove dust and dirt from the rotor windings with a soft cloth or brush. (See Figure 26.) (See cleaning methods.)

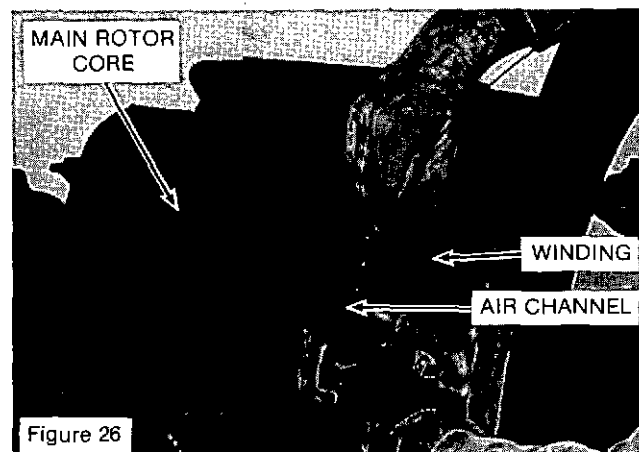


Figure 26

Remove any accumulated dust or dirt in the winding air channels with a piece of wire or with low-pressure, moisture-free air.

CAUTION: IF A PIECE OF WIRE IS USED FOR CLEANING THE AIR CHANNELS, CARE MUST BE TAKEN NOT TO SCRATCH THE WINDING AS THIS COULD CAUSE AN INSULATION FAILURE.

2. Check the rotor for loose, frayed, or burnt windings. A defective rotor winding must be rewound by Marathon Electric. The rotor assembly must be rebalanced after any rework or repair has been completed.

SERVICE

INSPECTION

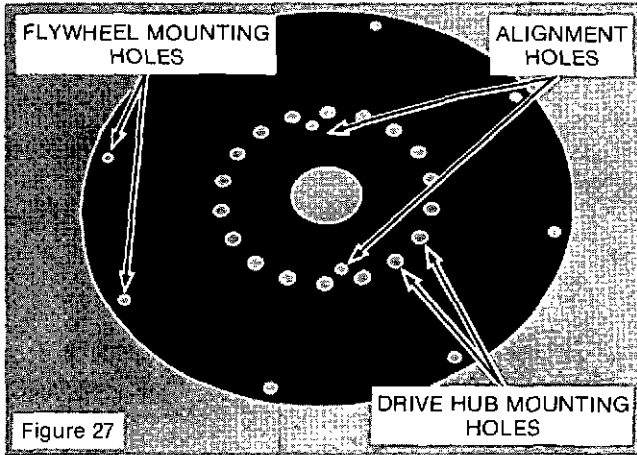


Figure 27

F. Drive Discs (Single Bearing Generators Only)

1. Inspect the drive discs for distorted or bent edges. (See Figure 27.) Inspect for worn mounting holes. Replace all defective discs as necessary.
2. Inspect the drive disc mounting capscrews for damaged threads. Replace capscrews if damaged.

FRONT END BRACKET INSPECTION

1. Remove the filler and drain grease pipes and the grease plugs from the bracket. (See Figure 28.)
2. Clean the end bracket, grease pipes, and capscrews in an approved solvent to remove all dust, dirt, and grease. Dry the parts thoroughly with compressed air.
3. Inspect the capscrews for stripped threads and replace if defective.
4. Inspect the end bracket for cracks and burred or rough mating surfaces. Inspect the bearing bore for burrs or wear. If the bracket shows excessive bearing bore wear, it should be replaced.

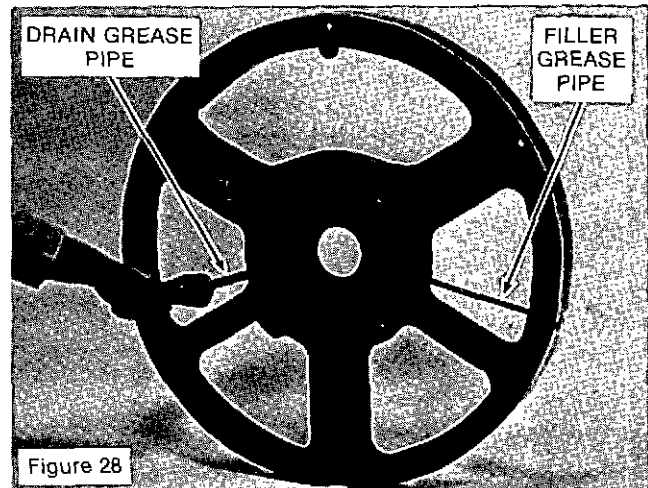


Figure 28

DRIVE END BRACKET OR SAE ADAPTOR INSPECTION

1. For two-bearing generators, remove the grease plugs from the bracket.
2. Clean the bracket or adaptor, capscrews and screen assembly in an approved solvent to remove all dust, dirt, and grease. (See Figure 29.) Dry the parts thoroughly with compressed air.
3. Inspect the capscrews for stripped threads and replace if defective.
4. Inspect the bracket or adaptor for cracks and burred or rough mating surfaces.
5. For two-bearing generators, inspect the bearing bore for burrs or wear. If the drive end bracket shows excessive bearing bore wear, it should be replaced.

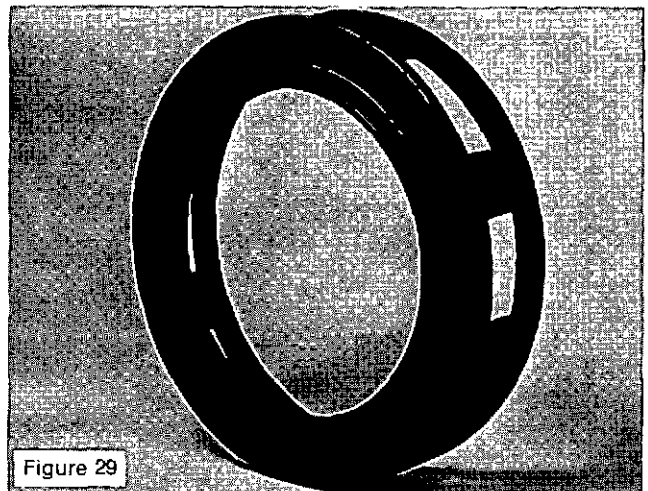


Figure 29

SERVICE

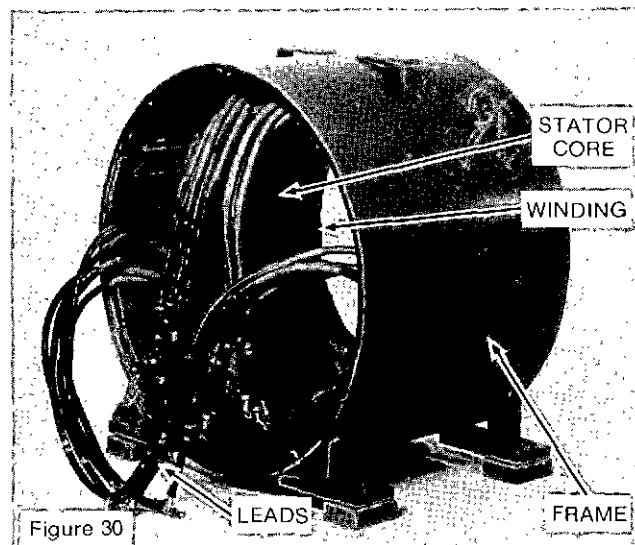
INSPECTION

MAIN STATOR INSPECTION

1. Clean dust and dirt from the stator frame and winding with a clean cloth, brush, or low-pressure, moisture-free air. (See Figure 30.) (See cleaning methods.)
2. Inspect the frame for cracks, burred mating surfaces, or other damage.
3. Inspect the stator for a loose, frayed, or burnt winding. Repair or replace as necessary. If field repair of the winding is necessary, contact Marathon Electric for special winding procedures and materials.

CONDUIT BOX AND VOLTAGE REGULATOR INSPECTION

1. Clean dust from the conduit box and the louvered cover with a clean cloth, brush, or low-pressure, moisture-free air. (See cleaning methods.)
2. Clean dust and dirt from the voltage regulator with a clean cloth, brush, or low-pressure, moisture-free air. (See cleaning methods.) Check all electrical connections for loose or broken wires.



SERVICE

ASSEMBLY

CONDUIT BOX AND FRONT END BRACKET INSTALLATION

1. Fill the grease cavity of the front end bracket 1/3 to 1/2 full of new multipurpose lithium based grease. See "Lubrication Instructions" in this manual. Assemble all grease pipes and plugs in the bracket.
2. Install two guide pins in the main stator assembly frame. Align the bracket mounting holes to the guide pins and slide the bracket over the pins. (See Figure 31.) On 680, 682 Frame generators, install the bottom cap-screw. (See Figure 32.)

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN THE FRONT END BRACKET INSTALLATION.

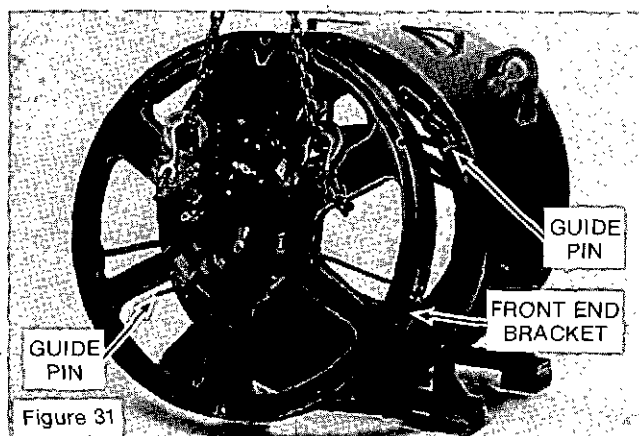


Figure 31

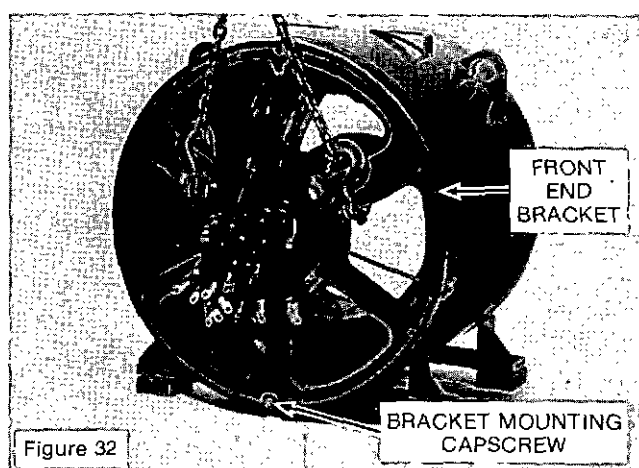


Figure 32

3. Insert two capscrows and starwashers through the conduit box and mount the conduit box to the bracket and main stator and frame assembly. (See Figure 33.)

Remove the two guide pins and insert the remaining capscrows and starwashers.

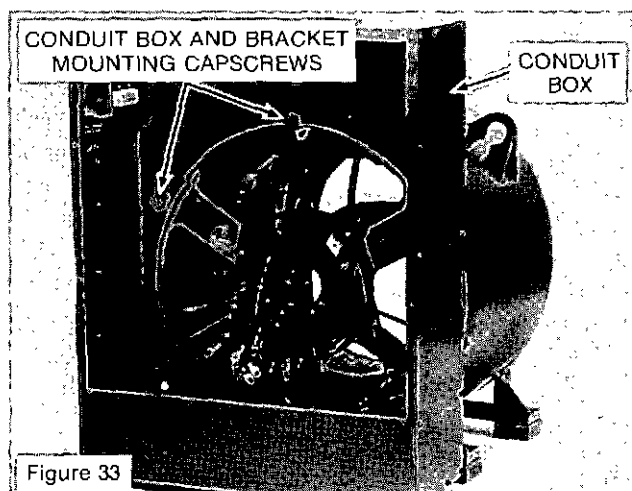


Figure 33

4.
 - a. On generators with four buss bars (T1, T2, T3, T0), mount the neutral buss bar to the support with the capscrows and lockwashers. (See Figure 34.) Mount the buss bar assembly to the front end bracket with the capscrows and lockwashers. Assemble the capscrow, flat washer, and lockwasher through the red insulating channel into the front end bracket.
 - b. On generators with six buss bars (T1, T2, T3, T4, T5, T6), mount the buss bar assembly support to the front end bracket with the capscrows and lockwashers.

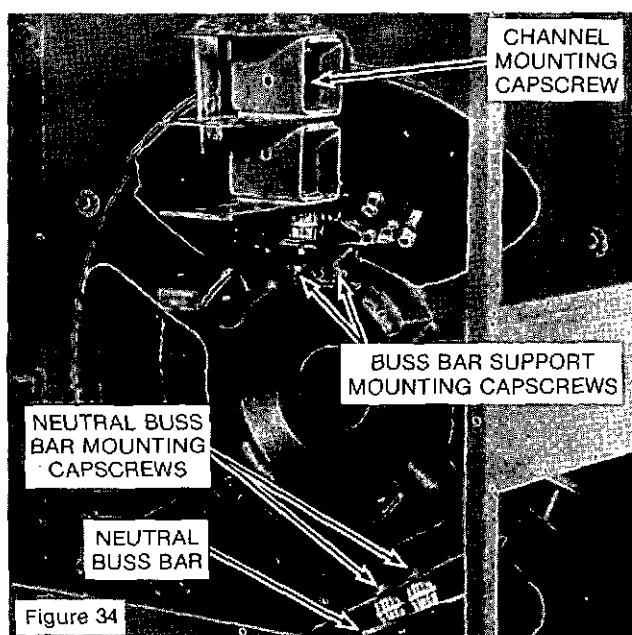


Figure 34

SERVICE

ASSEMBLY

- On generators with buss bars, connect the main stator leads to the appropriate buss bar according to the lead markings. Insert a flat washer on the bolt, then assemble one terminal to the buss bar with the bolt and flat washer. (See Figure 35.) Insert a second lead on the bolt on the other side of the buss bar, then a flat washer, lockwasher, and locknut.

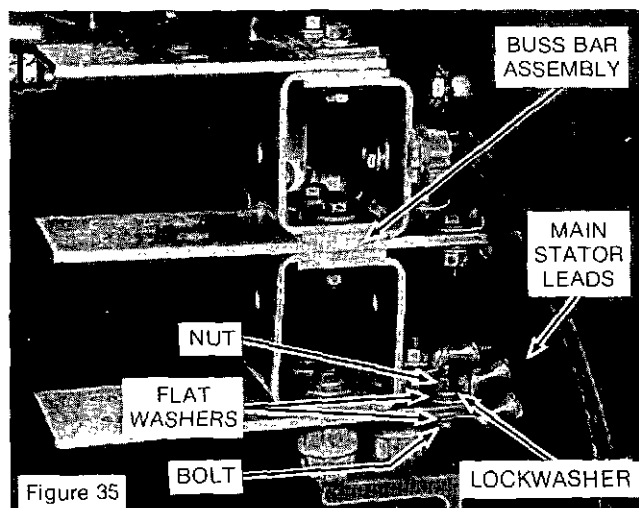


Figure 35

- Connect the following leads to the corresponding points on the terminal strip on the regulator panel: (See Figure 36).

Frame Size	Leads to be Connected
360, 440, 500	T0, T7, E3, [CT-1, CT-2 if used]
502, 680	T7, T9, [CT-1, CT-2 if used]
682	T0, T7, E1, E3, [CT-1, CT-2 if used]

- Install regulator enclosure.

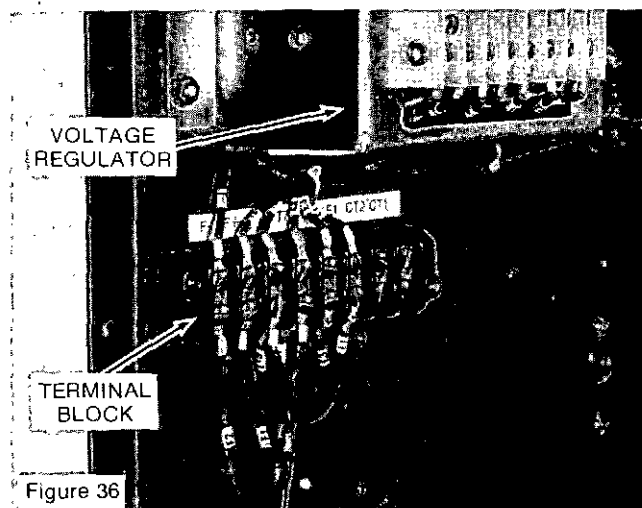


Figure 36

NOTE: These lead combinations are used on the standard generator; other leads may have to be reconnected depending on the particular application.

MAIN ROTOR INSTALLATION

- Using a rotor lifting fixture and a suitable hoist, carefully install the rotor assembly into the main stator assembly through the drive end. (See Figure 37.) Carefully feed the rotor leads through the front end bracket shaft hole as the rotor is installed.

CAUTION: SPECIAL CARE SHOULD BE USED IN THE ROTOR ASSEMBLY INSTALLATION, OR WINDING DAMAGE COULD RESULT.

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

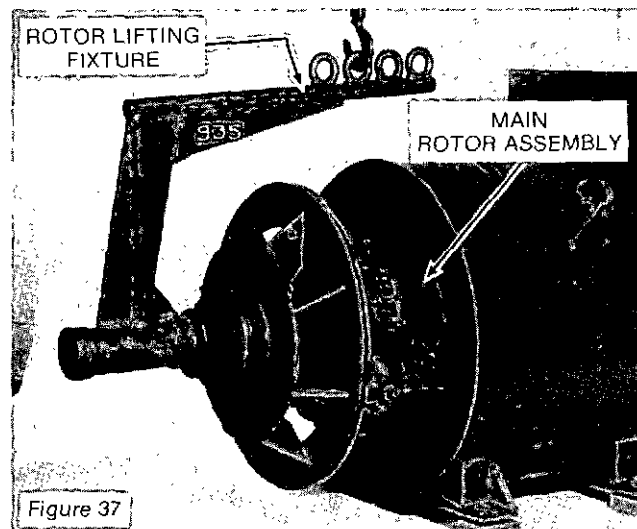


Figure 37

SERVICE

ASSEMBLY

2. a. For two bearing generators, insert guide pins in the rear bearing lock holes. Fill the grease cavity of the drive end bracket 1/3 to 1/2 full of new multipurpose lithium based grease. Assemble all grease plugs in the bracket. Mount the bracket on the bearing and guide the bearing lock pins through the bracket holes. Align the drive end bracket and mount with the capscrews. Remove one bearing lock guide pin and insert a capscrew and lockwasher into the bearing lock and tighten. Remove the remaining guide pin and replace with the remaining capscrew and lockwasher.
- b. For single bearing generators, pilot the SAE adaptor to the fan and secure to the main stator and frame assembly with capscrews torqued per Figure 49. (See Figure 38.) It may be necessary to raise the rotor assembly slightly to allow the mounting of the SAE adaptor.

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN THE DRIVE END BRACKET OR THE SAE ADAPTOR ASSEMBLY.

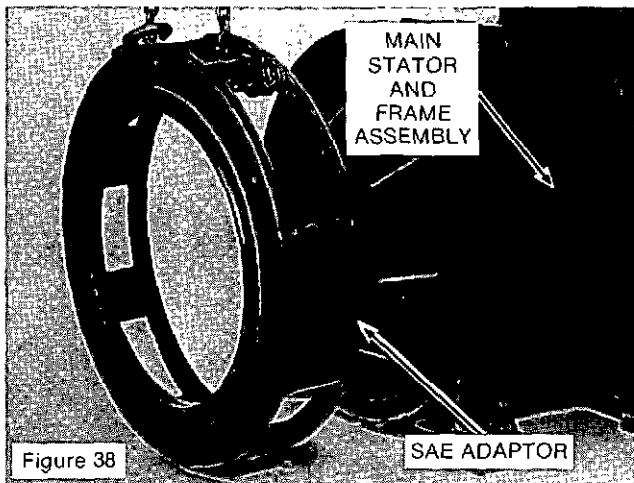


Figure 38

3. a. For two-bearing generators, install the drive coupling half or sheave on the shaft extension.
- b. For single bearing generators, insert a guide stud into the drive hub. Position all spacers (if any), then all drive discs, one at a time until all discs are installed. (See Figure 39.) Make sure that all disc mounting holes at the inner and outer diameter are properly aligned. Secure the

discs with the capscrews and hardened washers torqued per Figure 49. (See Figure 40 for torquing sequence.)



Figure 39

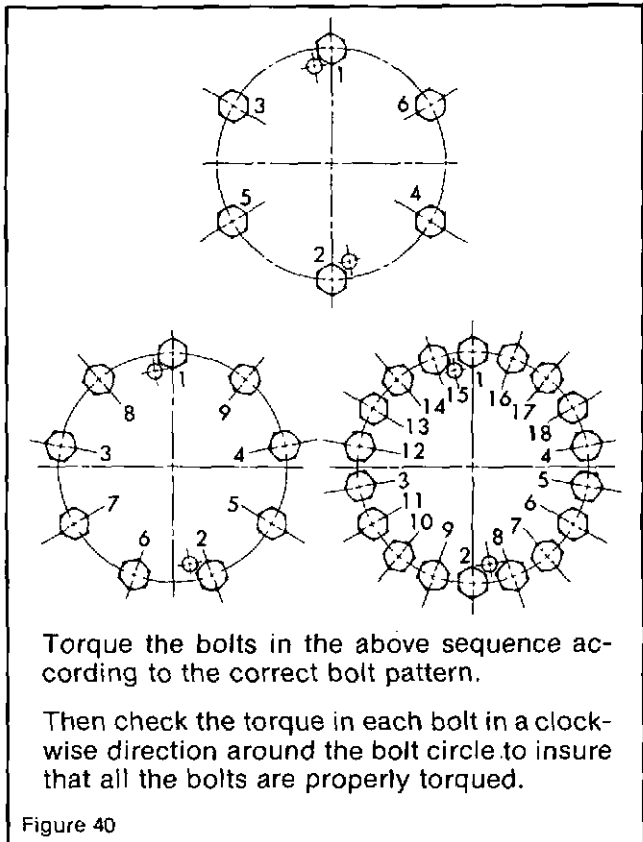
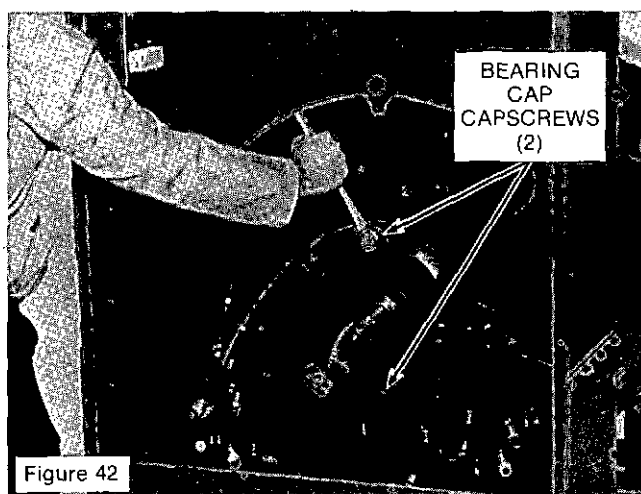
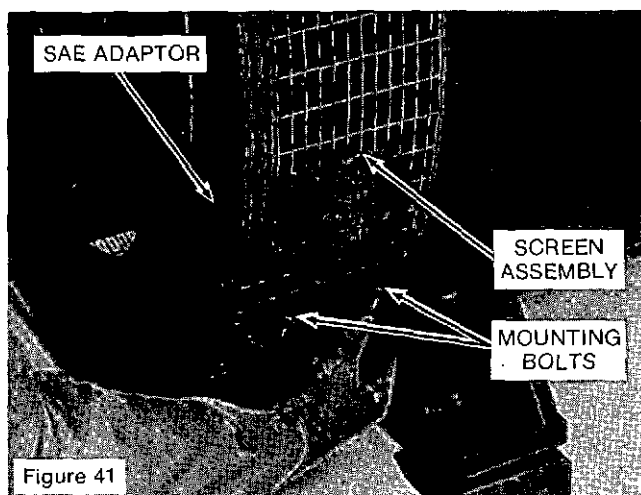


Figure 40

SERVICE

ASSEMBLY

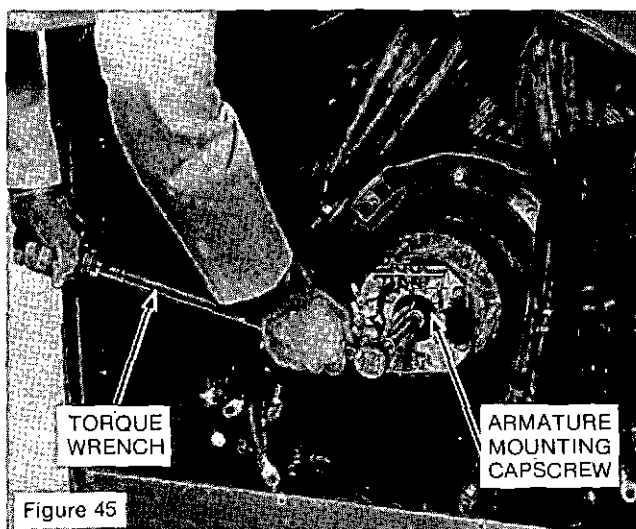
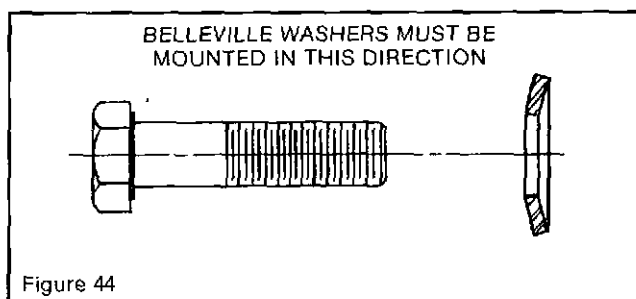
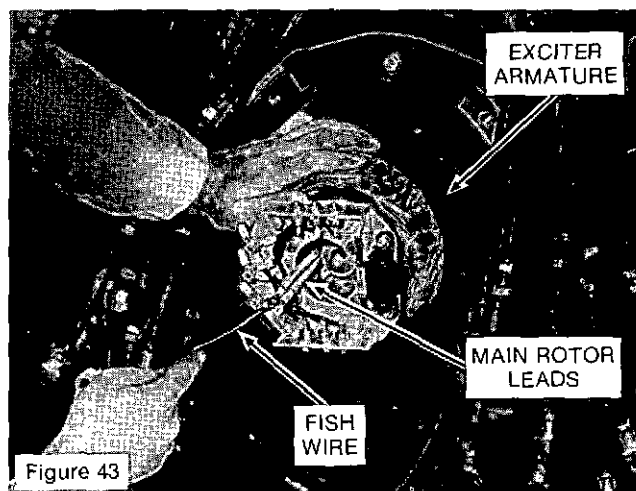
4. Mount the screen assembly on the drive end bracket or the SAE adaptor and tighten the bolts. (See Figure 41.)
5. On 680, 682 Frame generators, insert the two capscrows and lockwashers into the front end bracket and secure the bearing cap. (See Figure 42.)



EXCITER INSTALLATION

1. Install the exciter key in the armature bore keyway. Attach a wire to the main rotor leads and feed the wire through the armature bore and out the lead hole in the aluminum standoff plate. Mount the armature on the end of the shaft and align the key in the armature bore to the keyway in the shaft. Slide the armature on the shaft while feeding the main rotor leads through the lead hole in the aluminum standoff plate. (See Figure 43.)

Insert the capscrow and belleville washer (see Figure 44) through the mounting hole in the aluminum standoff plate and secure to the shaft (see Figure 45). Tighten the capscrow until the armature seats on the shaft. Torque the capscrow per Figure 49.



SERVICE

ASSEMBLY

2. Connect both main rotor leads coming out of the aluminum standoff plate to the rectifier aluminum angle; one to each angle. (See Figure 46.)
3. Mount the exciter stator on the front end bracket mounting pads and align the mounting holes, noting the position of "top front" previously marked for reference (field leads at inside bottom). (See Figure 47.) Align the lead shield on the exciter stator and mount with the capscrews and belleville washers (see Figure 44). Torque the capscrews per Figure 49. Install new lead fasteners to secure F1 and F2 to the front end bracket and conduit box.

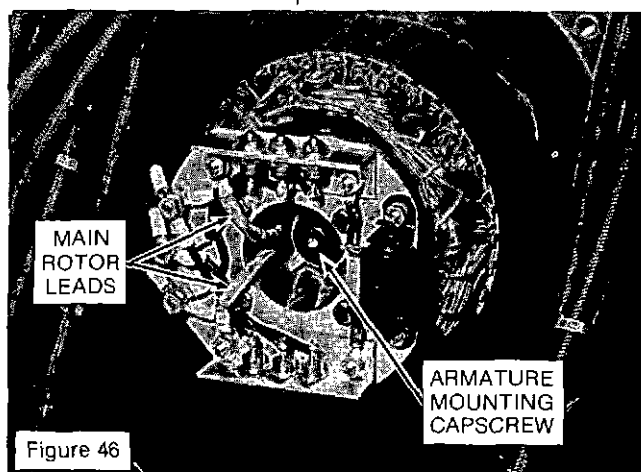


Figure 46

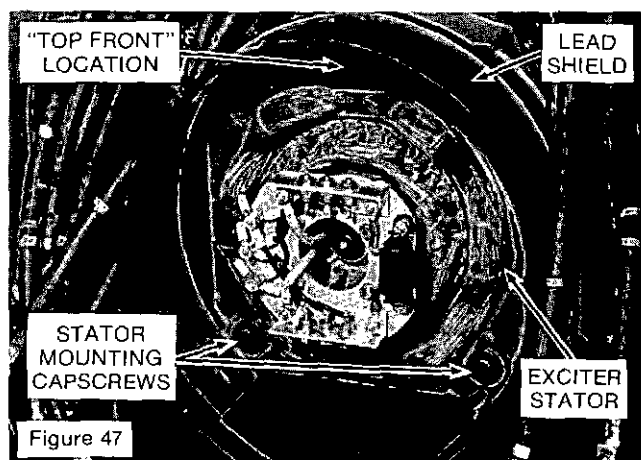


Figure 47

4. Connect the F1 and F2 leads to the corresponding F+ and F- terminals on the terminal block on the regulator panel and install the regulator enclosure. (See Figure 48).

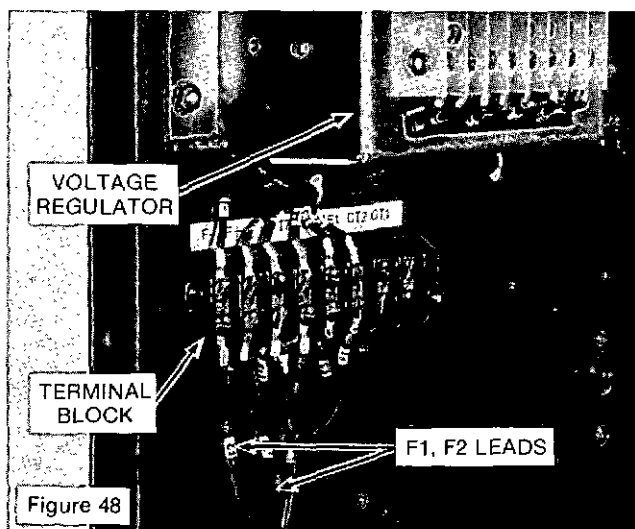


Figure 48

ASSEMBLY TO PRIME MOVER

1. Attach a suitable hoist to the generator lifting lugs, and move the generator until the generator foot mounting holes are aligned with the base and slightly above.
2.
 - a. For two-bearing generators, align the coupling halves or sheaves between the generator and the prime mover by adding shims under the feet.
 - b. For single bearing generators, if the screen assembly is mounted on the adaptor, remove the mounting bolts and remove the screen (see Figure 50). (NOTE: Do not remove the drip cover from the screen assembly if so equipped.) Insert two guide pins in the flywheel and two in the flywheel housing. Adjust the generator position until the drive discs are piloted in the flywheel. Remove the guide pins and secure the discs with Grade 8 place bolts and hardened washers or Grade 8 capscrews and heavy series lockwashers. (Torque per Figure 49.)

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

SERVICE

ASSEMBLY

FIGURE 49: CAPSCREW TORQUE VALUES

Capscrew Diameter and Ultimate Tensile Strength (PSI) ⁴	To 1/2 - 69,000 PSI To 3/4 - 64,000 PSI To 1 - 55,000 PSI			To 3/4 - 120,000 PSI To 1 - 115,000 PSI			150,000 PSI		
SAE Grade Number	1 or 2			5			8		
Capscrew Head Markings									
Capscrew Body Size (Inches) - (Thread)	Torque Ft-Lb (N-m)			Torque Ft-Lb (N-m)			Torque Ft-Lb (N-m)		
	Dry ¹	Oiled ²	Plated ³	Dry ¹	Oiled ²	Plated ³	Dry ¹	Oiled ²	Plated ³
1/4 - 20	5 (7)	4.5 (6)	4 (5)	8 (11)	7 (9)	6 (8)	12 (16)	11 (15)	10 (14)
- 28	6 (8)	5.4 (7)	4.8 (6)	10 (14)	9 (12)	8 (11)	14 (19)	13 (18)	11 (15)
5/16 - 18	11 (15)	10 (14)	9 (12)	17 (23)	15 (20)	14 (19)	24 (33)	22 (30)	19 (26)
- 24	13 (18)	12 (16)	10 (14)	19 (26)	17 (23)	15 (20)	27 (37)	24 (33)	22 (30)
3/8 - 16	18 (24)	16 (22)	14 (19)	31 (42)	28 (38)	25 (34)	44 (60)	40 (54)	35 (47)
- 24	20 (27)	18 (24)	16 (22)	35 (47)	32 (43)	28 (38)	49 (66)	44 (60)	39 (53)
7/16 - 14	28 (38)	25 (34)	22 (30)	49 (66)	44 (60)	39 (53)	70 (95)	63 (85)	56 (76)
- 20	30 (41)	27 (37)	24 (33)	55 (75)	50 (68)	44 (60)	78 (106)	70 (95)	62 (84)
1/2 - 13	39 (53)	35 (47)	31 (42)	75 (102)	68 (92)	60 (81)	105 (142)	95 (129)	84 (114)
- 20	41 (56)	37 (50)	33 (45)	85 (115)	77 (104)	68 (92)	120 (163)	108 (146)	96 (130)
9/16 - 12	51 (69)	46 (62)	41 (56)	110 (149)	99 (134)	88 (119)	155 (210)	140 (190)	124 (168)
- 18	55 (75)	50 (68)	44 (60)	120 (163)	108 (146)	96 (130)	170 (230)	153 (207)	136 (184)
5/8 - 11	83 (113)	75 (102)	66 (89)	150 (203)	135 (183)	120 (163)	210 (285)	189 (256)	168 (228)
- 18	95 (129)	86 (117)	76 (103)	170 (230)	153 (207)	136 (184)	240 (325)	216 (293)	192 (260)
3/4 - 10	105 (142)	95 (130)	84 (114)	270 (366)	243 (329)	216 (293)	375 (508)	338 (458)	300 (407)
- 16	115 (156)	104 (141)	92 (125)	295 (400)	266 (361)	236 (320)	420 (569)	378 (513)	336 (456)
7/8 - 9	160 (217)	144 (195)	128 (174)	395 (535)	356 (483)	316 (428)	605 (820)	545 (739)	484 (656)
- 14	175 (237)	158 (214)	140 (190)	435 (590)	392 (531)	348 (472)	675 (915)	608 (824)	540 (732)
1 - 8	235 (319)	212 (287)	188 (255)	590 (800)	531 (720)	472 (640)	910 (1234)	819 (1110)	728 (987)
- 14	250 (339)	225 (305)	200 (271)	660 (895)	594 (805)	528 (716)	990 (1342)	891 (1208)	792 (1074)

NOTES:

1. Based on use of clean, dry threads.
2. Torque reduced by 10% when engine oil is used as a lubricant.
3. Torque reduced by 20% if new plated capscrews are used.
4. Capscrews threaded into aluminum may require reductions in torque of 30% or more.

SERVICE

ASSEMBLY

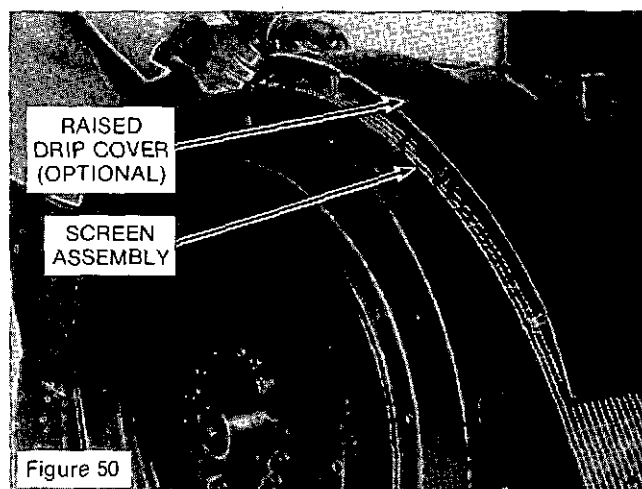


Figure 50

Position the generator so that the SAE adaptor mates with the flywheel housing.

CAUTION: DO NOT FORCE THE ALIGNMENT OF THE UNITS. SHIFT THE GENERATOR FROM SIDE TO SIDE OR RAISE OR LOWER WITH A LIFTING DEVICE AS NECESSARY.

It may be necessary to use shims under the mounting feet of either the generator or the prime mover to obtain proper alignment; use the same shims as removed under disassembly or proceed as follows: Using the extreme bottom four capscrews, mount the SAE adaptor to the flywheel housing. With a .0015 to .002 inch feeler gauge at the extreme top adaptor to flywheel housing to fit, raise the generator or lower the prime mover until the gauge is snug. Relieve just enough to release the feeler gauge and torque the remaining SAE adaptor capscrews to the flywheel housing.

Mount the screen assembly and tighten the mounting bolts.

3. Shim under the generator feet for proper support, ensuring that the generator mounting surfaces are level.
4. Install the mounting bolts which secure the generator to the mounting base.
5. For two bearing generators, assemble the coupling halves or sheave belts between the generator and the prime mover. (Follow the coupling manufacturer's instructions for assembly.)

6. Connect all existing conduit or ducting to the conduit box.
7. Connect all electrical load leads to the generator leads (or buss bars) inside the conduit box.
8. Check the exciter air gap (gap between the exciter armature and stator) by inserting a .010 inch feeler gauge in the gap and rotating it around the armature diameter to ensure that a minimum air gap is available. (See Figure 51.) If the feeler gauge cannot be rotated one full revolution, then check for a "cocked" exciter stator or loose stator mounting capscrews.

NOTE: On single bearing units, the exciter air gap cannot be checked properly until the generator is mounted to the prime mover.

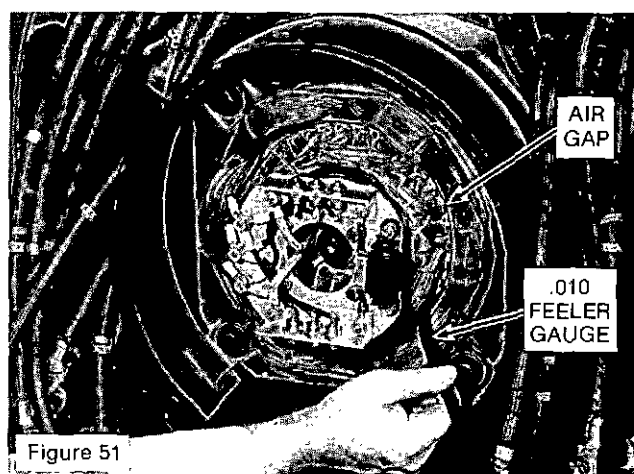


Figure 51

9. Mount the louvered conduit box cover.
10. Relubricate the bearing according to the lubrication instructions. (See Figure 52.)



Figure 52

TROUBLE SHOOTING

GENERATOR PRODUCES NO VOLTAGE

THIS SECTION IS DIVIDED BY SYMPTOMS:

GENERATOR PRODUCES NO VOLTAGE

GENERATOR PRODUCES LOW VOLTAGE

GENERATOR PRODUCES HIGH VOLTAGE

GENERATOR VOLTAGE IS FLUCTUATING

WARNING

RESIDUAL VOLTAGE IS PRESENT AT THE GENERATOR LEADS AND AT THE REGULATOR PANEL CONNECTIONS, EVEN WITH THE REGULATOR FUSES REMOVED. CAUTION MUST BE OBSERVED OR SERIOUS PERSONAL INJURY OR DEATH CAN RESULT. CONSULT QUALIFIED PERSONNEL WITH ANY QUESTIONS.

NOTE: Always include the Model Number and Serial Number of your generator when corresponding with Marathon Electric

GENERATOR DOES NOT PRODUCE VOLTAGE

- STEP 1** SHUT DOWN THE GENERATOR SET and remove conduit box cover. Check main generator leads for loose or broken connections.
- STEP 2** Check regulator fuses with ohmmeter. If defective, replace.
- STEP 3** Start up generator. Measure voltage at voltage regulator terminals 3 and 4. The voltmeter reading should exceed 5V ac. If it does, proceed to Step 4. If it does not, check continuity of wiring from connections 3 and 4 to the voltage source. If wiring is okay, — flashing is required. See the section on Field Flashing, page 15.
- STEP 4** SHUT DOWN THE GENERATOR SET. Disconnect voltage regulator by removing the connections to terminals F+ and F- on the regulator. Connect a common 12 volt storage battery to the disconnected wires keeping polarity the same. Start up the generator set. With the generator at rated speed, read the voltage output of the unit on a voltmeter. Following these steps, if the reading is one-half or greater of the

rated output when there is no load on the generator, the problem is in the voltage regulator. Consult your voltage regulator owner's manual for further information. If the reading remains near zero, the voltage regulator is okay, and the problem is further on. **SHUT DOWN THE GENERATOR.** Reconnect the voltage regulator. Proceed to Step 5.

- STEP 5** Examine the rotating exciter for loose or broken lead wires. Be sure to check that all six rectifier connections are secure as well as all other wires on the exciter. Repair, replace or tighten as necessary. Proceed to Step 6.
- STEP 6** Test each rectifier with an ohmmeter. Remove the bolted leadwire from one rectifier at the terminal stud. Test the resistance between the disconnected leadwire and the rectifier base. Make sure you have a good connection. Note the reading and reverse the ohmmeter probes. One reading should be high and the other low if the rectifier is good. If this is the case, reconnect that rectifier and proceed to the next, repeating the procedure until all six rectifiers have been checked. If the high and low readings are not achieved, the rectifier is defective and must be replaced. Torque the new rectifier to 20-30 in-lbs. Please note that two different types of rectifiers (with different polarities) are used on your unit. If all rectifiers are good, proceed to Step 7.
- STEP 7** Locate the surge protector and disconnect one of the two bolted surge protector leads. With an ohmmeter, measure the resistance between the disconnected lead and the other surge protector terminal. Reverse the ohmmeter probes and repeat the test. If a high resistance is measured in both directions, proceed to Step 8. If resistance is low in one or both directions, replace the surge protector.
- STEP 8** Check windings for continuity. If opens or shorts are found in the exciter armature or stator, replace the necessary component. If the condition is found in the main generator stator or rotor, major repair or generator replacement is probably required.

TROUBLE SHOOTING

GENERATOR PRODUCES LOW VOLTAGE

NOTE: Always include the Model Number and Serial Number of your generator when corresponding with Marathon Electric

GENERATOR PRODUCES LOW VOLTAGE

STEP 1 Low voltage condition should be verified at the generator load leads with an auxiliary voltmeter.

STEP 2 SHUT DOWN THE GENERATOR SET and remove conduit box cover. Check main generator leads for correct connection.

STEP 3 Start up the generator set. Verify correct speed (1800 rpm at 60 Hertz and 1500 rpm at 50 Hertz) with a tachometer.

STEP 4 Make sure generator load does not exceed nameplate capacity. Verify this with a "clamp-on" ammeter on the main load leads. Current in any line must not exceed nameplate amps.

STEP 5 Adjust the range pot on the voltage regulator in the extreme clockwise direction to increase generator voltage as necessary.

STEP 6 Be sure the voltage adjust rheostat is adjusted, as necessary, to increase generator voltage.

STEP 7 SHUT DOWN THE GENERATOR SET. Check the sensing tap on the voltage regulator to be sure it is correct. On some applications, full line voltage is not used for regulatory sensing. Refer to the generator connection diagram.

STEP 8 Disconnect the voltage regulator by removing the connections to terminals F+ and F- on the regulator. Connect a common 12-volt storage battery to the disconnected wires keeping the polarity the same. Start up the generator set. With the generator at rated speed, read the voltage output of the unit on a voltmeter. Following these steps, if the reading is one-half or greater of the rated output when there is no load on the generator, the problem is in the voltage regulator. Consult your voltage regulator owners'

manual for further information. If the reading remains near zero, the voltage regulator is okay and the problem is further on. SHUT DOWN THE GENERATOR SET. Reconnect the voltage regulator.

STEP 9 Test each rectifier with an ohmmeter. Remove the bolted leadwire from one rectifier at the terminal stud. Test the resistance between the disconnected leadwire and the rectifier base. Make sure you have a good connection. Note the reading and reverse the ohmmeter probes. One reading should be high and the other low if the rectifier is good. If this is the case, reconnect that rectifier and proceed to the next, repeating the procedure until all six rectifiers have been checked. If the high and low reading is not achieved, the rectifier is defective and must be replaced. Torque the new rectifier to 20-30 in-lbs. Please note that two different types of rectifiers (with different polarities) are used on your unit. If the rectifiers are good, proceed to Step 10.

STEP 10 Locate the surge protector and disconnect one of the two bolted surge protector leads. With an ohmmeter, measure the resistance between the disconnected lead and the other surge protector terminal. Reverse the ohmmeter probes and repeat the test. If a high resistance is measured in both directions proceed to Step 11. If resistance is low in one or both directions, replace the surge protector.

STEP 11 Check the windings for continuity. If opens or shorts are found in the exciter armature or stator, replace the necessary component. If the condition is found in the main generator stator or rotor, major repair or generator replacement is probably required.

TROUBLE SHOOTING

GENERATOR PRODUCES HIGH VOLTAGE GENERATOR VOLTAGE IS FLUCTUATING

NOTE: Always include the Model Number and Serial Number of your generator when corresponding with Marathon Electric

GENERATOR PRODUCES HIGH VOLTAGE

- STEP 1 High voltage condition should be verified at the generator load leads with an auxiliary voltmeter.
- STEP 2 SHUT DOWN THE GENERATOR SET and remove conduit box cover. Check main generator leads for correct connection.
- STEP 3 Start up the generator set. Verify correct speed (1800 rpm at 60 Hertz and 1500 rpm at 50 Hertz) with a tachometer.
- STEP 4 Adjust the range pot on the voltage regulator in the counterclockwise direction to decrease generator voltage as necessary.
- STEP 5 Be sure the voltage adjust rheostat is adjusted as necessary, to reduce generator voltage.
- STEP 6 SHUT DOWN THE GENERATOR SET. Check the sensing tap on the voltage regulator to be sure it is correct. On some applications, full line voltage is not used for regulator sensing. Refer to the generator connection diagram.
- STEP 7 Check the polarity of the rectifiers on the rotating rectifier. All three rectifiers on each aluminum standoff should have the identical part number. Note, however, that two different types of rectifiers (with different polarities and different part numbers) are used on each aluminum angle.
- STEP 8 Disconnect the voltage regulator by removing the connections to terminals F+ and F- on the regulator. Connect a common 12 volt storage battery to the disconnected wires keeping the polarity the same. Start up the generator set. With the generator at rated speed, read the voltage output of the

unit on a voltmeter. If the reading is one-half or greater of the rated output when there is no load on the generator, the problem is in the voltage regulator. Consult the voltage regulator owners' manual for further information. Shut down the generator. Reconnect the voltage regulator.

GENERATOR VOLTAGE IS FLUCTUATING

- STEP 1 Adjust voltage regulator stability clockwise for increased stability.
- STEP 2 Verify engine governor performance with a tachometer to insure stable engine speed.
- STEP 3 SHUT DOWN THE GENERATOR SET and remove conduit box cover. Check all wiring for loose connections. Be sure that voltage adjust rheostat is properly connected and working.
- STEP 4 Disconnect voltage regulator by removing the connections to terminals F+ and F- on the regulator. Connect a common 12 volt storage battery to the disconnected wires keeping polarity the same. Start up the generator set. With the generator at rated speed, read the voltage output of the unit on a voltmeter. Following these steps, if the reading is one-half or greater of the rated output and does not fluctuate when there is no load on the generator, the problem is in the voltage regulator. Consult your regulator owners' manual for further information. If the reading continues to fluctuate, the problem is further on. Shut down the generator. Reconnect the voltage regulator. Proceed to Step 5.
- STEP 5 Check windings for continuity. If opens or shorts are found in the exciter armature or stator, replace the necessary component. If the condition is found in the main generator stator or rotor, major repair or generator replacement is probably required.

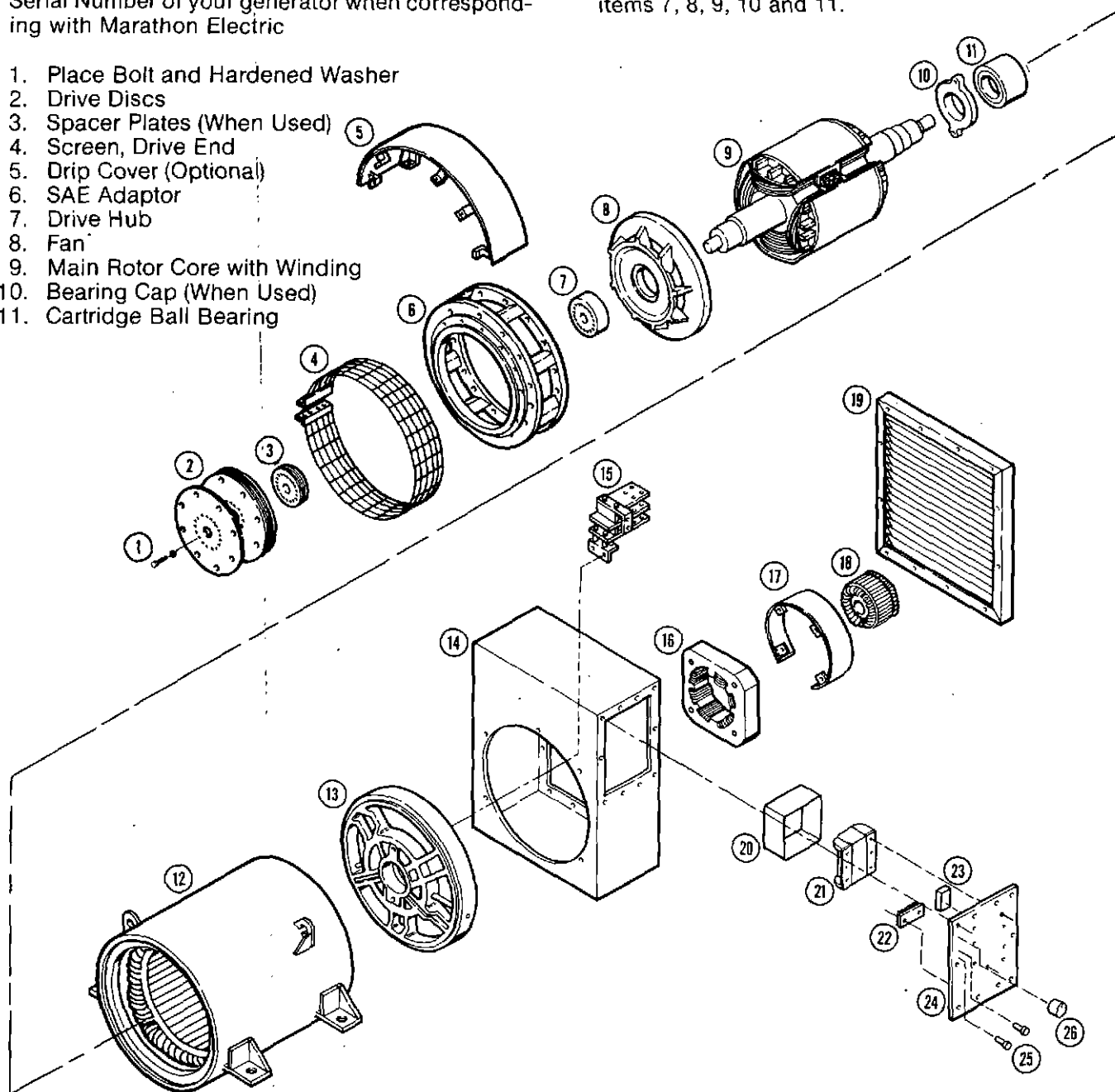
PARTS LIST

SINGLE BEARING GENERATOR PARTS LIST

NOTE: Always include the Model Number and Serial Number of your generator when corresponding with Marathon Electric

NOTE: Complete Main Rotor Assembly consists of items 7, 8, 9, 10 and 11.

1. Place Bolt and Hardened Washer
2. Drive Discs
3. Spacer Plates (When Used)
4. Screen, Drive End
5. Drip Cover (Optional)
6. SAE Adaptor
7. Drive Hub
8. Fan
9. Main Rotor Core with Winding
10. Bearing Cap (When Used)
11. Cartridge Ball Bearing



12. Main Stator and Frame Assembly with Winding
13. Front End Bracket
14. Conduit Box
15. Buss Bar Assembly (When Used)
16. Exciter Stator Assembly with Winding
17. Lead Shield

18. Exciter (Rotor) Armature and Rectifier Assembly with Winding
19. Louvered Conduit Box Cover
20. Regulator Enclosure
21. Voltage Regulator
22. Terminal Block
23. Exciter Field Circuit Breaker
24. Regulator Panel
25. Fuses and Fuse Holders
26. Voltage Adjust Rheostat

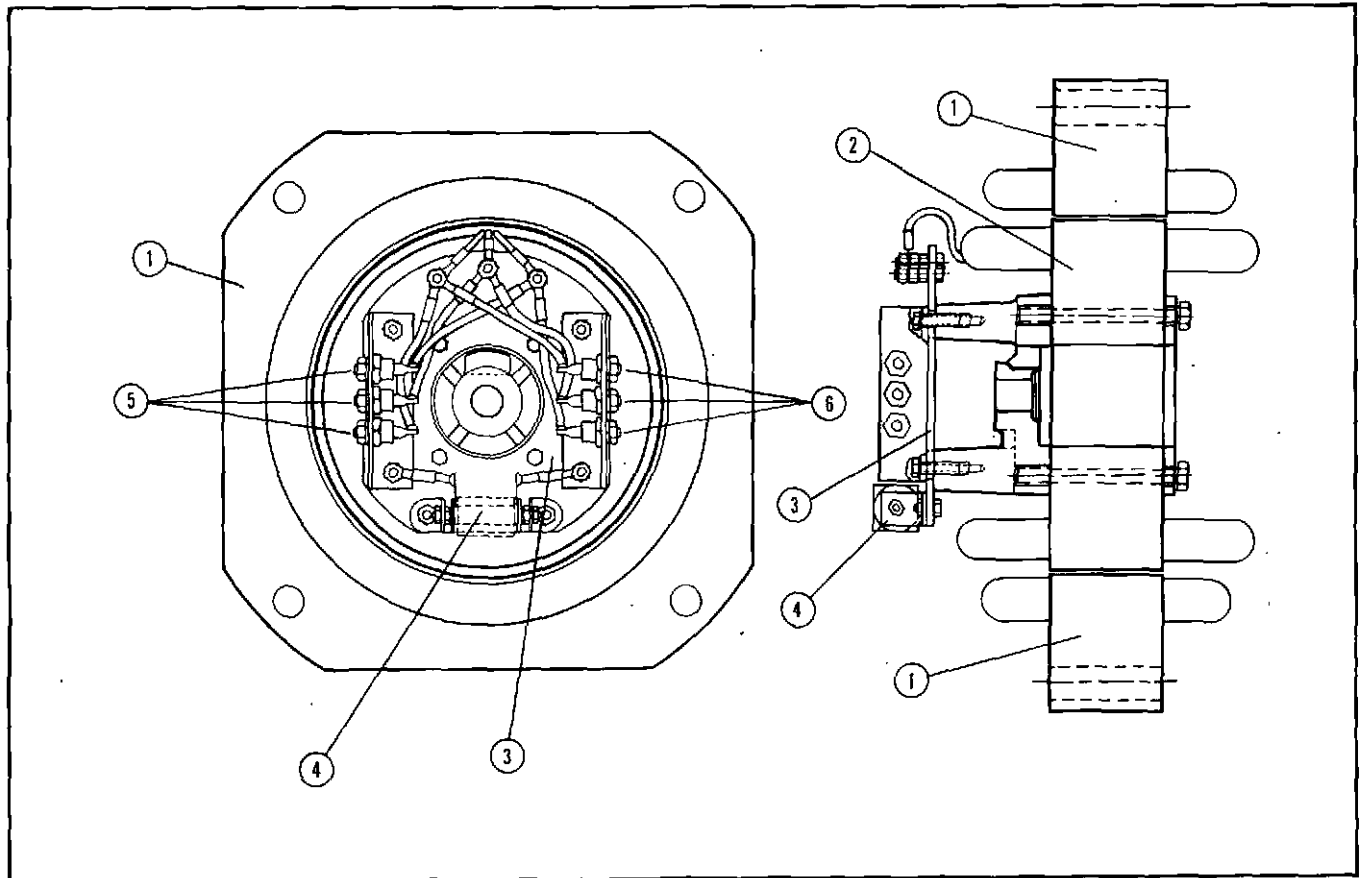
PARTS LIST

EXCITER (ROTOR) ARMATURE, STATOR AND RECTIFIER ASSEMBLY

Rectifier Mounting Torque 20-30 inch-pounds.

NOTE: Diodes have distinct polarity and can not be interchanged.

NOTE: Always include the Model Number and Serial Number of your generator when corresponding with Marathon Electric



1. Exciter Stator Assembly with Winding
2. Exciter (Rotor) Armature & Rectifier Assembly with Winding
3. Rectifier Assembly
4. Surge Protector
5. Rectifiers (Standard Polarity)
6. Rectifiers (Reverse Polarity)

PARTS LIST

RECOMMENDED SPARE PARTS

Marathon Electric recommends the following spare parts to minimize inconvenience. Always include the Model Number and Serial Number of your generator when corresponding with Marathon Electric.

Refer to factory for other voltage regulators.

Parts may be ordered direct from:

Marathon Electric Mfg. Corp.
P.O. Box 1407
Wausau, Wis. 54401

Phone (715) 675-3311

<u>ITEM</u>	<u>QTY.</u>	<u>PART NUMBER</u>
Voltage Regulator	1	
KR-4F		A-505156
KR-4FM		A-510632
KR-4FFX		A-511682
KR-4FFMX		A-511683
KR-7F		A-505308
KR-7FM		A-510633
KR-7FFX		A-511684
KR-7FFMX		A-511685
Bearing	1	Refer to factory
Surge Protector	1	A-A509431-1
Rectifier (Standard Polarity)	3	A-A9589-6
Rectifier (Reverse Polarity)	3	A-A9681-2
Fuse	6	A-505369
Fuse Holder	2	A-505310
Voltage Adjust Rheostat	1	A-508445
Exciter Field Circuit Breaker		
For KR-4 Regulators	1	A-511162-1
For KR-7 Regulators	1	A-511162-3
Exciter Assembly (In remote areas)	1	Refer to factory

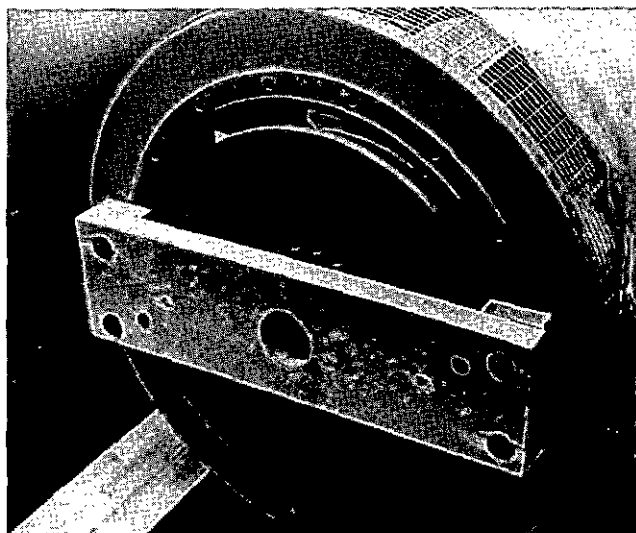
SHIPPING INSTRUCTIONS

SHIPPING INSTRUCTIONS

When installed, single bearing generator rotors are supported on the drive end by the drive discs bolted to the engine flywheel. When the engine is removed, the rotor must be supported by an appropriate fixture to prevent main rotor, main stator or exciter damage (see photo). Before shipping any generator, the main rotor must be supported by the adaptor using an appropriate fixture.

WARNING

DO NOT ATTEMPT TO TRANSPORT ANY GENERATOR WITHOUT PROPER ROTOR SUPPORT, OR EXTENSIVE EQUIPMENT DAMAGE CAN OCCUR.



Sales and Service Assistance

California

ANAHEIM
625 South Euclid Suite 15
Anaheim, CA 92802
Phone: (714) 956-7111

CASTRO VALLEY
20835 Chester Street, Suite B
Castro Valley, CA 94546
Phone: (415) 889-1393

Florida

MIAMI
Alvan C. Chaney & Assoc.
117 N.E. 54th St.
Miami, FL 33137
Phone: (305) 754-8857

Illinois

CHICAGO
655 Central Ave., Unit E
Wood Dale, IL 60191
Phone: (312) 350-1800

Indiana

INDIANAPOLIS
6520 E. 82nd Street
Indianapolis, IN 46250
Phone: (317) 842-4652

Louisiana

NEW ORLEANS
5622 Perrier Street
New Orleans, LA 70115
Phone: (504) 889-5426

Minnesota

MINNEAPOLIS
8700 West 36th Street
Minneapolis, MN 55426
Phone: (612) 935-8424

New York

SYRACUSE
Room 173 Pickard Building
5858 East Molloy Road
Syracuse, NY 13211
Phone: (315) 454-0994
454-3130

Ohio

CINCINNATI
1313 E. Kemper Rd., Suite 104
Cincinnati, OH 45246
Phone: (513) 671-1677

CLEVELAND
20800 Center Ridge Rd-Suite 400
Cleveland, OH 44116
Phone: (216) 331-2910

Oklahoma

TULSA
2227 S. Garnett Road, Suite 106
P.O. Box 690115
Tulsa, OK 74169
Phone: (918) 438-3391

Pennsylvania

BRIDGEVILLE
Foster-McClinton, Inc.
2867 Washington Road
Bridgeville, PA 15017
Phone: (412) 941-4800

FOGELSVILLE
55 Snowdrift Road
Fogelsville, PA 18051
Phone: (215) 395-6880

South Carolina

GREENVILLE
100 Executive Center Drive
Greenville, SC 29615
Phone: (803) 288-8990

Tennessee

NASHVILLE
1040 Murfreesboro Road
Suite 207
Nashville, TN 37217
Phone: (615) 366-4262

Texas

DALLAS
1366 Exchange Drive
Richardson, TX 75081
Phone: (214) 699-0251

HOUSTON
13201 Northwest Freeway
Suite 202, #1
Houston, TX 77040
Phone: (713) 462-4445

Utah

SANDY
E.L. Pack & Associates
1830 East 9800 South
Sandy, UT 84092
Phone: (801) 571-4484

Washington

SPOKANE
Electro-Power Corp.
N. 104 Madelia
P.O. Box 2983
Spokane, WA 99202
Phone: (509) 535-2931

Australia

E.A. Marr & Sons
32 Regent Crescent
Moorebank, NSW 2170
Australia

England

Cranfold Electrical Drives
28 Nightingales
Cranleigh, Surrey GU6 8DE
England



100 E. Randolph Street
Wausau, WI 54401
Phone: (715) 675-3311
TWX: (910) 281-1521
TLX: 26-0175 ME WAS