Zonge ZMG-30DL Motor-Generator
uses generator model 360SSL1311

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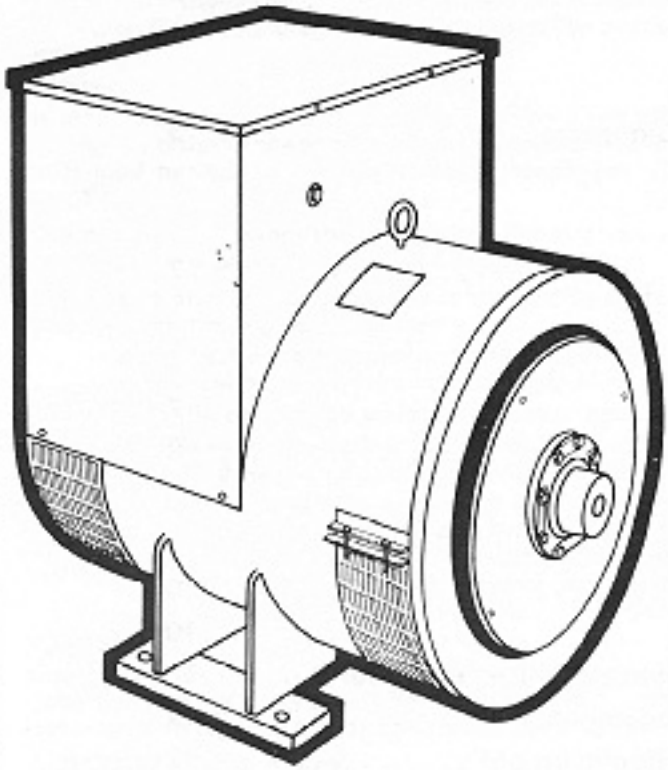
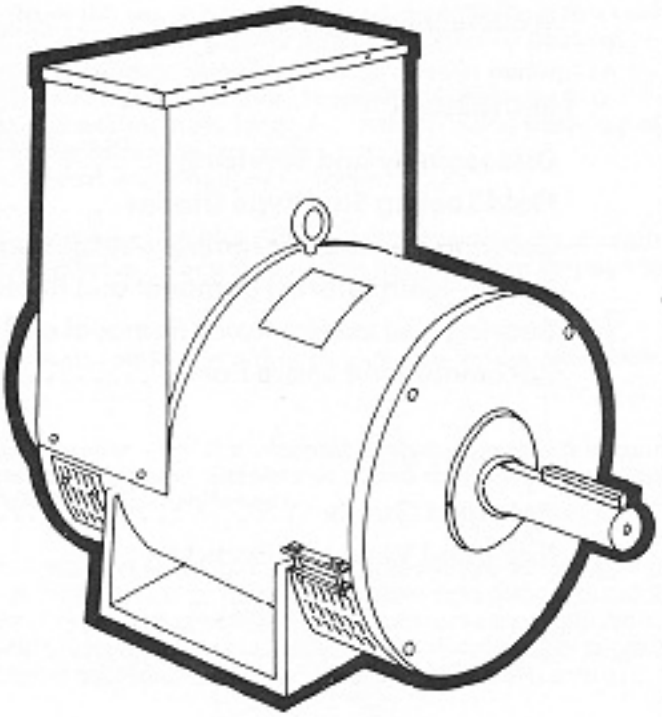
MARATHON® ELECTRIC

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

# TYPE SER Brushless AC Synchronous, Externally Regulated Alternator
# Frame 361, 441—1200/1000 RPM
# Frame 360, 440, 580, 680, 680x—1800/1500 RPM





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Making Energy Work for You

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# THE LIMA ELECTRIC CO., INC.
# TYPE SER INSTRUCTION MANUAL — FRAMES 360 THROUGH 680X

**NOTICE**
The following instructions are essential to assure the proper installation, operation, and maintenance of the alternator, and for the safety of operating and service personnel. Installation and maintenance should be performed only by qualified personnel in strict observance of procedures and safety measures set forth in this manual.

All electrical connections should be made in accordance with current government, industry, association codes and standards. Grounding (earthing) of this alternator should be in strict accordance with the National Electrical Code (NFPA 70), or the appropriate electrical code or standard having jurisdiction at the installation site.

Mechanical connections and assembly should be made with grade 5 or better hardware and fasteners.

## SECTION I
## GENERAL INFORMATION

**INCOMING INSPECTION**
Immediately upon receipt of your SER Alternator check for damage to housing, windings and mechanical parts. Shipping damage claims must be instituted through the carrier, and must be made within the time limit specified by ICCregulations.

**STORAGE**
Alternators should be stored in a clean, dry place, not subject to rapid and severe changes in temperature and humidity. If humid storage conditions cannot be avoided, the unit should be warmed and dried prior to installation and test.

**DRYING**
It may be necessary to thoroughly dry the alternator windings prior to placing into service at full nameplate voltage in order to prevent damage to the unit. This is especially true if the unit has been: (1) Stored or left idle for extended periods of time in humid atmospheres; (2) subjected to wide temperature variations in storage or transit.

Drying can be accomplished by putting the alternator in a hot, dry room, or by circulating hot, dry air across the windings for a period of at least 4 hours.

Drying can also be accomplished more quickly by following the "Short Circuit" method after the unit has been installed on the engine as follows:

A. Short the alternator output leads L1, L2, L3. Apply a clamp-on ammeter to these leads. The ammeter must have a minimum range equal to the full load nameplate current of the alternator.
B. Disconnect the voltage regulator input power leads.
C. Remove the exciter field leads F+ and F− from the voltage regulator, and connect them to a variable DC power source of approximately 35VDC, 2 amperes or greater capacity. Observe polarity.
D. Start the engine and adjust the DC voltage source to an amperage not to exceed nameplate current rating at any time. Drying time will vary with moisture conditions. Properly dried windings will be indicated by megohmmeter readings across the exciter field leads F+ and F−, and each leg of the alternator L1, L2, L3 to neutral according to the following formula:
(Nameplate Voltage ÷ 1000) + 1 = Min. Acceptable Megohm Reading.

**CAUTION**
Completely disconnect the automatic voltage regulator and output wiring prior to taking any megohm readings. Take all readings across the alternator and field leads themselves. Failure to do this may result in damage to the automatic voltage regulator or connected equipment.

**DIRECTION OF ROTATION**
The units covered by this manual may be operated with shaft rotation in either a clockwise, or counter-clockwise direction.

**PHASE ROTATION**
All LIMA three phase alternators have "A B C" phase rotation with the alternator shaft turning in a counter-clockwise direction when viewed from the end opposite the drive end. Should this phase rotation be improper for the application, reverse output load leads "L1" and "L2" at the circuit breaker.

**PARRALLEL OPERATION**
All TYPE SER alternators are built with shorted damper (Amortisseur) windings for good paralleling and transient performance and are designed with a two thirds pitch in the main stator winding. For proper parallel operation, the automatic voltage regulator must be equipped with paralleling circuitry such as a paralleling module, and a paralleling current transformer (C/T) installed in one phase lead - usually the "B" phase of three phase alternators. Paralleling of single phase units require special considerations. Consult with the factory prior to attempting to parallel units connected for single phase operation.

**NOTE**
When attempting to parallel this unit with one built by some other manufacturer, especially if the units are connected in a Wye (Star) connection with grounded neutrals, consult with the manufacturer of the other machine to assure compatability. Failure to do this could lead to high "third harminic' currents in the neutral, and possible over heating of both units.

## SECTION II
## ASSEMBLY OF THE ALTERNATOR TO THE PRIME MOVER

**CAUTION:** DISABLE OR RENDER INOPERATIVE ANY ENGINE CRANKING DEVICES BEFORE ATTEMPTING TO INSTALL OR SERVICE THIS ALTERNATOR. FOR ELECTRIC START SETS, DISCONNECT THE CRANKING BATTERY. FOR AIR START, DISCONNECT AIR SUPPLY. FAILURE TO COMPLY WITH THESE SAFETY PROCEDURES COULD RESULT IN SEVERE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

**CAUTION:** LIFT THE UNIT ONLY BY THE PROPER LIFTING LUGS. FRAME 360 UNITS ARE PROVIDED WITH A SINGLE "EYE BOLT" LIFTING EYE. INSURE THAT THE EYE BOLT IS TIGHTLY THREADED IN THE FRAME PRIOR TO ATTEMPTING TO LIFT THE UNIT. 440 AND LARGER FRAMES ARE PROVIDED WITH TWO LIFTING LUGS WELDED TO THE FRAME. INSURE THAT LIFTING DEVICES HAVE ADEQUATE CAPACITY. SAFE PRACTICE CALLS FOR CAPACITY TO BE AT LEAST ONE AND ONE HALF TIMES THE LOAD TO BE LIFTED. IF IN DOUBT, CONSULT THE FACTORY FOR UNIT WEIGHT.

**CAUTION:** NEVER "BAR OVER" THE ENGINE-GENERATOR SET USING THE GENERATOR'S FAN AS A FULCRUM. FAN MATERIAL IS LIGHT WEIGHT ALUMINUM AND NOT DESIGNED FOR THIS PURPOSE. BARRING OVER THE SET WITH THE FAN COULD DAMAGE THE FAN AND RESULT IN SERIOUS INJURY TO PERSONNEL AND POSSIBLE SEVERE DAMAGE TO EQUIPMENT.

**TORSINAL VIBRATION**
Torsional vibrations will be generated in all engine driven shaft systems to some degree. In some cases the magnitude of these vibrations at certain critical speeds may cause damage to either the alternator or its driver, or both. It is therefore necessary to examine the torsional vibration effect on the entire rotating system. It is the responsibility of the generator set manufacturer/assembler to assure the torisonal compatability of the alternator and its driver. The Marathon Electric Mfg., Corp. will make available drawings showing all pertinent shaft dimensions, coupling details, rotor weights, locations, and inertias for the customer to forward to the engine manufacturer for analysis.

**SINGLE BEARING UNITS**

A. The flexible disc couplings supplied with your alternator are sized and drilled to match standard SAE industrial engine flywheels. The frame engine ring is machined and drilled to match standard SAE industrial engine flywheel housings.
B. Loosely bolt the disc coupling to the engine flywheel using flat washers. **DO NOT USE LOCK WASHERS** for this purpose.
C. Loosely bolt the alternator frame engine ring to the engine flywheel housing. Insure that the alternator's engine ring register (lip) is properly seated inside the engine flywheel housing.
D. Insure that the flex discs are properly seated in the flywheel pilot bore. Tighten all bolts in rotation, making sure that the bolts are of the proper length so that they will not "Bottom Out" and prevent a secure coupling. Torque bolts to tension proper for the size, type and grade being used.
E. Shim under the alternator feet as necessary to assure proper alignment of the alternator frame with the engine so that tightening the alternator foot bolts will not result in placing a prestress on either the alternator engine ring, or the engine flywheel housing.

**TWO BEARING UNITS**

A. The shaft extension and keyway on two bearing units can be used with either a direct coupling adaptor, or belt driven with sheaves. For the latter, it is important that both the drive and driven sheave diameters are matched to assure proper running speed of the alternator.

**ENDPLAY TEST PROCEDURE (ALL UNITS)**

A. After the alternator is installed with the prime mover, check for proper endplay. Using a suitable lever, force the engine flywheel forward so that the crankshaft is pressed against its thrust bearing. When force is released, the engine crankshaft should remain in this position.
B. Apply force in the opposite direction and observe that the crankshaft again remains stationary.
C. If the crankshaft springs away from either thrust bearing when force is removed, it is an indication that the alternator shaft is not moving freely in the assembly, and normal life of the engine thrust bearings could be impaired.
D. Probable causes are:
   (1) Improper "G" dimension on either the alternator or the engine;
   (2) Improper seating of the drive discs in the engine flywheel;
   (3) Improper mating of the alternator and flywheel housings, or;
   (4) The alternator bearing is bottoming out in the bearing bracket.
E. Refer to the engine manual for recommended end play. Frequently, it will be in the range of 0.007" to 0.015".

# SECTION III
# ELECTRICAL WIRING PROCEDURES — WIRING DIAGRAMS

## CAUTION

Wiring of the alternator should be done in accordance with good electrical practices. Follow government, association and industry standards. In some wiring arrangements, groups of terminals are connected together with no further termination. These terminals must be properly insulated to avoid a hazard to personnel and potential equipment damage.

**SER** alternators are supplied in 4-lead, 10-lead, or 12-lead configurations. From the nameplate information and system voltage requirements, select the appropriate wiring diagram from the information that follows.

**Note C-1:** Some models intended for 4-wire WYE connection may be equipped with bus bar termination. Diagram "A" applies to these units.

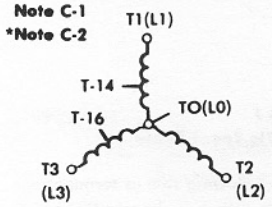
***Note C-2:** Certain 480 V, 4-lead units are supplied with two winding legs centertapped (T-14, T-16) to provide 240 V, 1-phase input power to the automatic voltage regulator. All other 4-lead, WYE connected units will require the addition of a power isolation transformer to obtain 240 V, 1-phase power for AVR operation.

## WIRING REFERENCE CHART

| | CONFIGURATION | SER TYPE ADJUSTABLE VOLTAGE RANGE (60 HZ) | REF. DIAG |
|---|---|---|---|
| 3 PHASE | 4-Lead Unit, Wye Connected | 416-480 V | A |
| | 4-Lead Unit, Wye Connected | 575-600 V | A |
| | 4-Lead Unit, 480 Volt Delta Connected | 440-480 V | B |
| | 12-Lead Unit, 4-Wire 240 Volt Delta Connected | 220-240 V | C |
| | 12-Lead Unit, High Voltage Wye Connected | 416-480 V | D |
| | 12-Lead Unit, Low Voltage Wye Connected | 208-240 V | E |
| | 10-Lead Unit, High Voltage Wye Connected | 416-480 V | F |
| | 10-Lead Unit, Low Voltage Wye Connected | 208-240 V | G |
| 1 PHASE | 12-Lead Unit, Low Voltage Delta | 110-120 V | H |
| | 12-Lead Unit, 240 Volt, Zig Zag | 220-240 V | I |
| | 12-Lead Unit, 480 Volt, Zig Zag | 416-480 V | J |

### DIAGRAM A

**4-Lead Unit, 480 or 600 Volt, Wye Connected, 3 Phase**

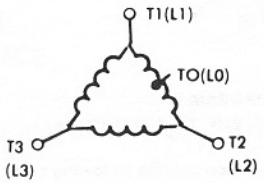



| OUTPUTS: | 480 V | 600 V |
|---|---|---|
| L1 to L2 | 480 V, 3Ø | 600 V, 3Ø |
| L2 to L3 | 480 V, 3Ø | 600 V, 3Ø |
| L1 to L3 | 480 V, 3Ø | 600 V, 3Ø |
| L1 to L0 | 277 V, 1Ø | 346 V, 1Ø |
| L2 to L0 | 277 V, 1Ø | 346 V, 1Ø |
| L3 to L0 | 277 V, 1Ø | 346 V, 1Ø |

**CAUTION:** Properly insulate all unused terminations

### DIAGRAM B

**4-Lead Unit, 480 Volt, Delta Connected, 3 Phase**




| OUTPUTS: | 240 V, 1Ø | 480 V, 3Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | L2 to L3 |
| | | L1 to L3 |

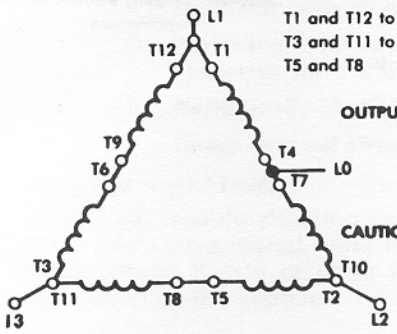
**CAUTION:** Properly insulate all unused terminations

### DIAGRAM C

**12-Lead Unit, 240 Volt, Delta Connected, 3 Phase**

Connect the following sets of terminations:

T1 and T12 to form L1 T2 and T10 to form L2
T3 and T11 to form L3 T4 and T7 to form L0
T5 and T8 T6 and T9




| OUTPUTS: | 120 V, 1Ø | 240 V, 3Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | L2 to L3 |
| | | L1 to L3 |

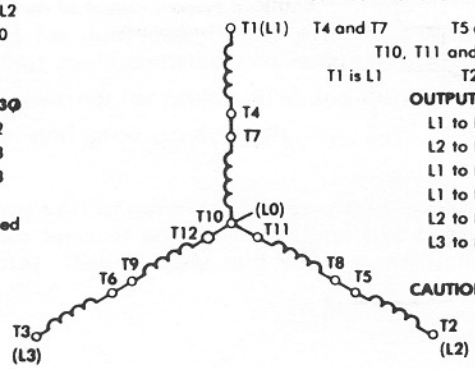
**CAUTION:** Properly insulate all unused terminations

### DIAGRAM D

**12-Lead Unit, High Voltage, Wye Connected, 3 Phase**

Connect the following sets of terminations:

T1(L1) T4 and T7 T5 and T8 T6 and T9
T10, T11 and T12 to form L0
T1 is L1 T2 is L2 T3 is L3



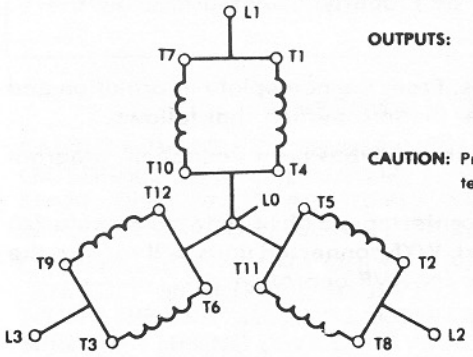

| OUTPUTS: | 416 V | 480 V |
|---|---|---|
| L1 to L2 | 416 V, 3Ø | 480 V, 3Ø |
| L2 to L3 | 416 V, 3Ø | 480 V, 3Ø |
| L1 to L3 | 416 V, 3Ø | 480 V, 3Ø |
| L1 to L0 | 240 V, 1Ø | 277 V, 1Ø |
| L2 to L0 | 240 V, 1Ø | 277 V, 1Ø |
| L3 to L0 | 240 V, 1Ø | 277 V, 1Ø |

**CAUTION:** Properly insulate all unused terminations

**DIAGRAM E**
**12-Lead Unit, Low Voltage, Wye Connected, 3 Phase**

Connect the following sets of terminations:

T1 and T7 to form L1 T2 and T8 to form L2
T3 and T9 to form L3
T4, T5, T6, T10, T11 and T12 to form L0




| OUTPUTS: | 120 V, 1Ø | 208 V, 3Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | L2 to L3 |
| | L3 to L0 | L1 to L3 |

**CAUTION:** Properly insulate all unused terminations

**DIAGRAM F**
**10-Lead Unit, High Voltage, Wye Connected, 3 Phase**

Connect the following sets of terminations:

T4 and T7 T5 and T8 T6 and T9
T1 is L1 T2 is L2 T3 is L3

| OUTPUTS: | 277 V,1Ø | 480 V, 3Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | L2 to L3 |
| | L3 to L0 | L1 to L3 |

**CAUTION:** Properly insulate all unused terminations

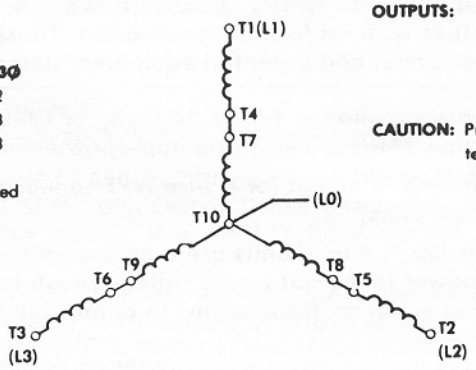
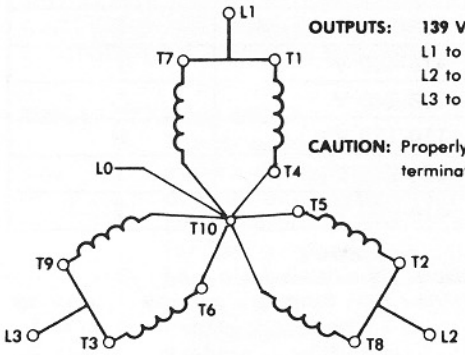



**DIAGRAM G**
**10-Lead Unit, Low Voltage, Wye Connected, 3 Phase**

Connect the following sets of terminations:

T1 and T7 to form L1 T2 and T8 to form L2
T3 and T9 to form L3
T4, T5, T6 and T10 to form L0




| OUTPUTS: | 139 V, 1Ø | 240 V, 3Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | L2 to L3 |
| | L3 to L0 | L1 to L3 |

**CAUTION:** Properly insulate all unused terminations

**DIAGRAM H**
**12-Lead Unit, Low Voltage, Delta Connected, 1 Phase**

Connect the following sets of terminations:

T2, T8, T6, T12 and Insulate
T1, T5, T7, T11 to form L1
T3, T4, T9, T10 to form L2

**OUTPUTS:** 120 V, 1Ø
L1 to L2

**CAUTION:** Properly insulate all unused terminations

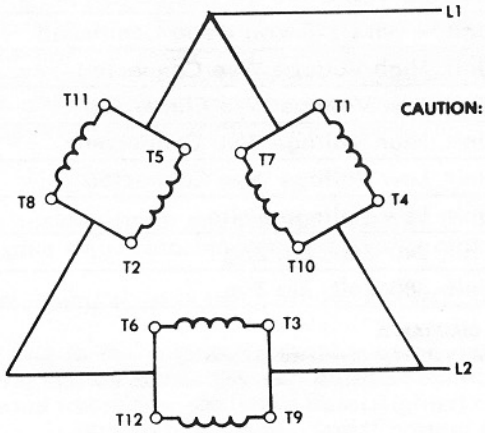



**DIAGRAM I**
**12-Lead Unit, 240 Volt, Zig Zag, 1 Phase**

Connect the following sets of terminations:

T2, T8, T6, T12 and Insulate
T1, T7, to form L1
T3, T9, to form L2
T4, T10, T5, T11 to form L0

| OUTPUTS: | 120 V, 1Ø | 240 V, 1Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | |

**CAUTION:** Properly insulate all unused terminations

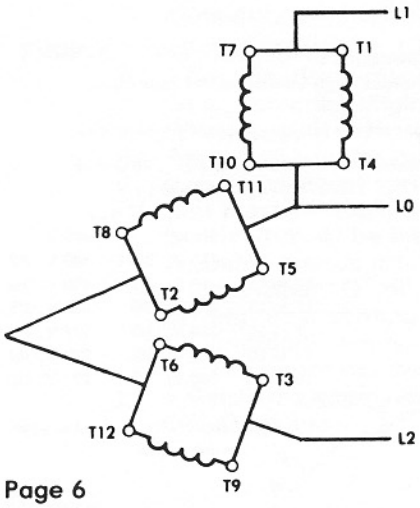


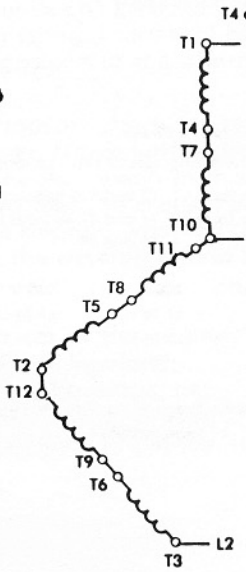

**DIAGRAM J**
**12-Lead Unit, 480 Volt, Zig Zag, 1 Phase**

Connect the following sets of terminations:

T4 and T7 T2 and T12 T6 and T9 T5 and T8
T10, T11 to form L0
T1 is L1 T3 is L2

| OUTPUTS: | 240 V, 1Ø | 480 V, 1Ø |
|---|---|---|
| | L1 to L0 | L1 to L2 |
| | L2 to L0 | |

**CAUTION:** Properly insulate all unused terminations



## SECTION IV
## START-UP AND SHUT-DOWN PROCEDURES

**START-UP — IMPORTANT**

Review alternator wiring diagrams for proper connection. Review voltage regulator and accessory manuals to insure that these devices are properly installed and connected. Make sure exciter field leads (F+ and F−) are connected in proper polarity at the voltage regulator.

A. Insure that the main line circuit protector is **OPEN** and that no external load is on the machine. If the voltage regulator is equipped with an ON/OFF switch or a FIELD CIRCUIT BREAKER, set the device to its OFF or OPEN position.

B. Reconnect and energize starting power to the prime mover. Adjust running speed and governor so the alternator is running at nameplate RPM.

C. With the regulator "off" output voltage will be approximately ¼ normal. This "residual voltage" is provided by the residual magnetism of the exciter stator. Read all voltages — line to line and line to neutral to check for equal and balanced values. If the unit has been improperly connected, unbalanced voltages will result. In this case, shut the unit down and correct any improper connections. **Energizing the regulator with the unit improperly connected could result in damage to the unit.**

D. Once checks listed in sub-paragraph C above are satisfactorily completed indicating proper connections, turn the regulator switch to the "ON" position and adjust the alternator's output voltage to the desired level according to the regulator manufacturer's operating manual.

**NOTE**

It is quite possible to observe a "no voltage" condition upon start-up due to a loss of residual magnetism in the exciter field during transit, storage or under certain electro-mechanical conditions. If no output is observed, shutdown the system and refer to the PROCEDURE FOR FLASHING FIELD (Sec. VI 1.) of the Disassembling and Servicing section of this manual.

**SHUT-DOWN**

There are no specific instructions for alternator shut-down, but several practices should be observed to prolong equipment life.

A. It is advisable to disconnect all loads prior to shut-down. This is especially important if loads can be damaged by low voltage and frequency conditions during alternator "wind down."

B. If at all possible, shut off the voltage regulator before shut-down.

C. Isolate any conditions that would cause the alternator to see an input voltage at its terminals. Failure to do this could result in rectifier damage.

## SECTION V
## MAINTENANCE

**GENERAL**

A. SER alternators use "lubricated for life" bearings and do not require maintenance beyond the good housekeeping practices that follow.

**CAUTION:** PRIOR TO CONDUCTING ANY MAINTENANCE OR SERVICE, OPEN MAIN DISCONNECT SWITCH. LOCK IT IN THE "OFF" POSITION IF POSSIBLE. PREVENT INADVERTENT START-UP OF THE PRIME MOVER, LOCALLY OR BY REMOTE CONTROL. SAFE PRACTICE CALLS FOR DISCONNECTING THE BATTERY, OR DISABLING ALTERNATE STARTING CIRCUITS OR DEVICES.

B. Periodically inspect ventilating screens for dust and dirt accumulation. Keep vents clear.

C. Periodically inspect windings for accumulation of dust, dirt, oil or moisture. Oil deposits should be removed with an approved solvent.

D. Periodically inspect terminal connections for tightness. Check terminals, voltage regulator and accessories for dirt and other conditions that could contribute to leakage or arcing.

E. Periodically check the prime mover and governor for proper RPM and the alternator for rated output.

F. Check ground straps for tight connection and good conductivity.

**TROUBLE SHOOTING**

Most field trouble shooting can be performed with a volt-ohmmeter, battery/light continuity tester, soldering iron, and conventional hand tools. Note that certain tests of shorted windings can only be performed with a Wheatstone, Kelvin or other bridge resistance tester. Disassembly and service instructions are contained in Section VI of this manual.

## TROUBLESHOOTING

Most troubleshooting in the field can be performed with a multimeter, soldering iron and conventional hand tools. Note that certain tests for open or shorted windings can only be verified with a megohmmeter or bridge resistance tester. Disassembly and service instructions follow the troubleshooting chart.

### TROUBLESHOOTING CHART

| CAUSE | CHECK AND REMEDY |
|---|---|
| **NO VOLTAGE OUTPUT** | |
| Loss of residual magnetism in the exciter. | Flash the exciter field. See next section. |
| Open circuit in exciter field. | Check continuity. If open, return to factory for repair. |
| Open stator windings. | Check continuity. If open, return to factory for repair. |
| Faulty rectifiers. | Check per instructions that follow. Replace if faulty. |
| Malfunction of automatic voltage regulator. | See AVR manual. Replace if faulty. |
| Short circuit. | Check all leads and clear fault. |
| Open in main field coil. | Check continuity. If open, return to factory for repair. |
| Shorted exciter rotor. | Check for short with bridge-type resistance meter. |
| Grounded exciter rotor. | Check insulation to ground with megohmmeter after disconnecting AVR and rectifier assembly. |
| Shorted leads between exciter rotor and main field. | Test and repair. |
| **LOW VOLTAGE OUTPUT** | |
| Low rheostat setting. | Adjust to rated output. |
| Excessive load. | Reduce load. Balance all loads to as near equal as possible. Do not exceed rated current on any leg. |
| Low RPM. | Check engine and governor. Check system for overload. |
| Automatic Voltage Regulator. | See AVR manual. Replace if faulty. |
| Insufficient excitation. | Check regulator. Replace if faulty. |
| Line losses. | Use larger line wiring. |
| High resitance connections. | Check for warm or hot connections. Restore good connections. |
| Shorted main or exciter field. | Check main field with a bridge-type meter. Check exciter field with ohmmeter for approximately 17 ohms for parallel field and 35 ohms for series field. Return to factory for repair. |
| Low power factor. | Redue inductive (motor) load. (Some AC motors draw nearly the same current regardless of load. Do not use motors rated larger than necessary to carry the mechanical load.) |

## TROUBLESHOOTING CHART (Continued)

| CAUSE | CHECK AND REMEDY |
|---|---|
| **HIGH VOLTAGE OUTPUT** | |
| High rheostat setting. | Adjust to rated output. |
| High RPM. | Check engine and governor. |
| Automatic Voltage Regulator. | See AVR manual. Replace if faulty. |
| **FLUCTUATING VOLTAGE** | |
| Irregular engine speed. | Check engine and governor. |
| Fluctuating load. | Stabilize load. |
| Loose connections. | Check alternator and load connections. Restore good connections. |
| Unstable voltage regulator. | See AVR manual. Replace if faulty. |
| Intermittent short in exciter field. | Check with ohmmeter for approximately 17 ohms for parallel field and 35 ohms for series fields. Return to factory for repair. |
| Uneven air gap. | Measure stator/rotor clearance at several points. Suspect bearing(s) drive discs, flywheel, flywheel housing or alternator frame if clearances are uneven. |
| **OVERHEATING** | |
| Excessive load. | Check with ammeter and compare with nameplate. Reduce load. |
| Clogged vent openings. | Clear air passages. |
| Environmental conditions. | Improve ventilation and air circulation. |
| Low power factor. | Reduce inductive loads or install capacitors to improve power factor. |
| Unbalanced load. | Strive for balanced load on each leg. Do not exceed rated current on any leg. |
| Dry bearing. | Replace bearing. |
| **MECHANICAL NOISE** | |
| Defective bearing(s). | Replace. |
| Rotor rubbing on stator. | Bad bearing(s); replace. Bent shaft; return to factory. Loose endbell; tighten. Loose drive discs; tighten. |
| Loose or misaligned coupling. | Align and tighten. |
| **ALTERNATOR PRODUCES SHOCK WHEN TOUCHED** | |
| Static charge. | Ground alternator frame. |
| Grounded stator or field coil. | Check with megohmmeter AFTER DISCONNECTING AVR. Return to factory for repair. |

## SECTION VI
## DISASSEMBLY AND SERVICING

**CAUTION: BEFORE SERVICING, MAKE CERTAIN THAT THE ALTERNATOR IS ISOLATED FROM ANY OTHER VOLTAGE SOURCE, AND THAT THE ENGINE OR OTHER PRIME MOVER CANNOT BE STARTED, EITHER LOCALLY OR REMOTELY. IT IS URGED THAT THE BATTERY OR STARTING SOURCE BE REMOVED FROM THE PRIME MOVER, OR AT LEAST RENDERED INOPERABLE.**

**RESTORING RESIDUAL MAGNETISM (FLASHING THE EXCITER FIELD).**
To restore the small amount of residual magnetism necessary to begin the voltage build-up, connect a 6 to 32 volt battery to the exciter field circuit. Normally a 6 to 12 volt DC source will be adequate to restore the excited field's residual magnetism.

A. Remove exciter leads F+ and F− from F+ and F− terminals of the voltage regulator. CAUTION: Failure to remove these leads may destroy the voltage regulator if the battery connections are reversed.
B. Connect the positive battery pole to lead F+.
C. Connect the negative battery pole to the negative (F−) terminal on the voltage regulator FOR APPROXIMATELY THREE TO FIVE SECONDS.
D. Reconnect the (F+) and (F−) leads to the automatic voltage regulator.
E. Start the unit and observe voltage build-up. Repeat the flashing procedure if build-up fails to develop.

**NOTE:** Inadvertent polarity reversal may be corrected by interchanging the battery leads.

**FIELD TESTING STUD TYPE DIODES**
Refer to Figure 1 below for reference to diode polarity and part identification.

A. Stud type diodes may be tested in the field without unsoldering and removing the load lead from the diode terminal. Remove the diode load lead terminal lug from its terminal post and insure that it is not making contact with any adjacent metalic part. An ohmmeter or a battery-light continuity tester may be used to find a short or open condition in the diode. Connect the positive test lead to the anode and the negative lead to the cathode, take a reading, and then reverse the leads and take a reading. These checks should indicate one of three conditions:
   (1) Good diode: Will have a much greater reverse resistance (positive lead on cathode) than forward resistance (negative lead on anode). Typical reverse resistance will be 30,000 - 300,000 ohms or greater, while typical forward resistance will be less than 10 ohms. The continuity tester will have the light "on" in one direction, and "off" in the other.
   (2) Shorted condition: Ohmmeter reading will be zero, or very low in both directions. Continuity tester light will be "on" in both directions.
   (3) Open condition: Ohmmeter will have a maximum (infinity) reading in both directions. Continuity tester light will be dark (off) in both directions.

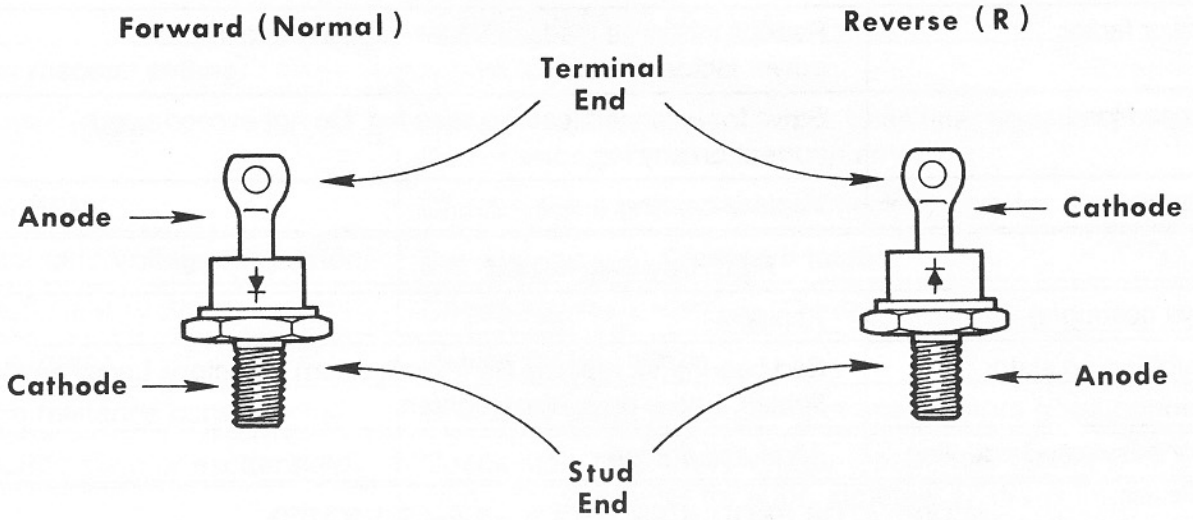



**FIGURE 1**

**ROTATING RECTIFIER ASSEMBLY MAINTENANCE AND TEST PROCEDURE.**

A. Individual rectifiers, or complete heat sink assemblies with both diodes still installed can be removed and replaced through the access port located on the top of the endbell opposite the drive end of the

unit (See Fig. 2). Remove the 4 inspection port cover plate retaining cap screws and the cover plate. The assembly is now available for inspection, test, and/or service. See Figure 3 for the rotating rectifier assembly parts identification and location. The individual diodes are "stud type", retained by 1/4 - 28 hex head nuts and star washers. To test the individual diodes, disconnect the diode's lead wire terminal lug from the main rotor terminal post. Since each diode stud is secured to a heat sink; use the heat sink and the diode terminal or output lead terminal lug as the two testing points, and proceed with testing as in paragraph 2 above. If the diode tests good, reinstall the load lead terminal lug on the main rotor post. If the diode tests bad, replace the device following the procedures given in sub paragraph B below.

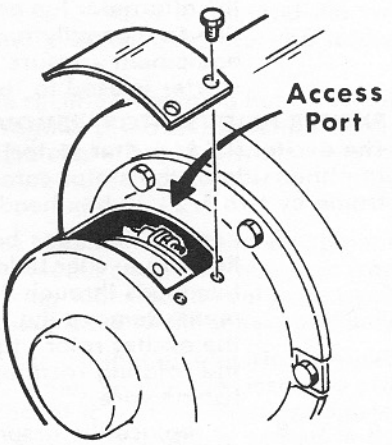
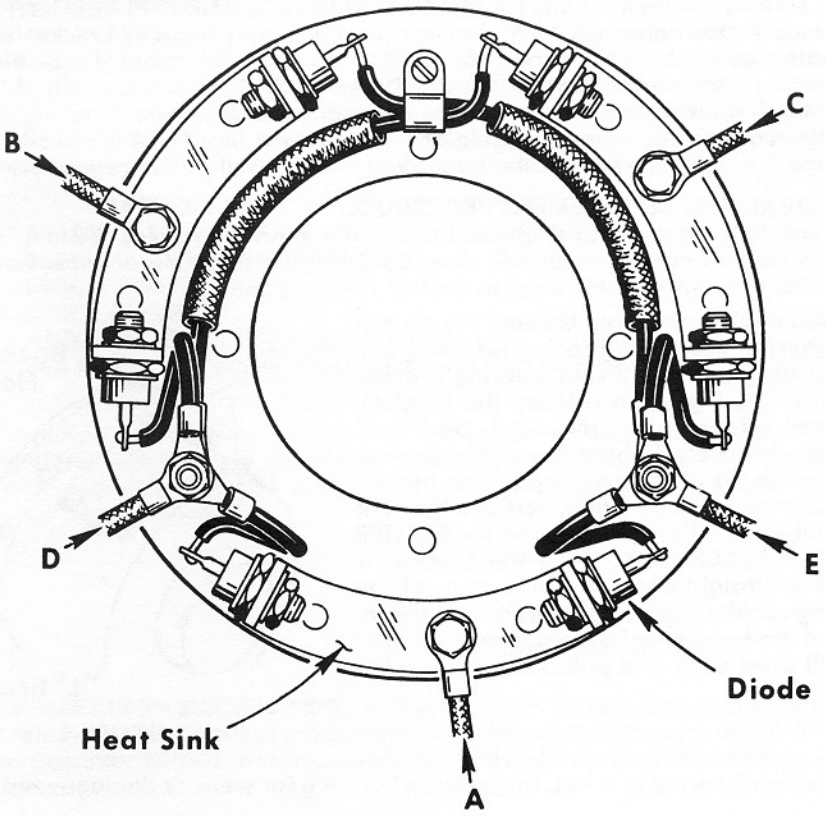



FIGURE 2

B. Prior to installing a replacement diode on the heat sink, run a bead of thermal-electrical contact compound such as the Brundy Company's Penetrox "A" around the base of the diode (do not coat the threads). When installing a diode on the heat sink, care should be taken not to over-torque the retaining nut which could cause damage to the device. Torque to 28 to 30 pounds-inches. If not damaged, the existing diode load lead may be unsoldered from the failed diode and resoldered on the replacement.




A - Exciter Rotor Lead
B - Exciter Rotor Lead
C - Exciter Rotor Lead
D - Main Rotor Lead
E - Main Rotor Lead

FIGURE 3

C. Should it be necessary to remove one or more heat sink assemblies, it will first be necessary to remove the two diode lead terminals from their respective main rotor posts. Next remove the exciter rotor lead, and the plastic lead wire clamp if it is retaining either of the two diode leads involved. Now remove the two 1/4 - 20 hex head cap screws which secure the heat sink to the insulating plate, and carefully pull the assembly out the inspection port. Reverse this procedure when reinstalling the heat sink assembly.

D. If the alternator is close coupled to an engine, it may well be necessary to "bar-over" the engine in order to position any specific area of the rectifier assembly directly under the access port. NEVER use

the alternator fan as a fulcrum to accomplish this. Use the engine manufacturer's recommended practice to manually turn over the engine. To prevent possible injury to personnel and damage to the equipment - insure that the engine cannot start during this procedure, especially if the engine's starter is used to "bump-over" the engine.

**EXCITER FIELD (STATOR) REMOVAL AND REPLACEMENT.**

The exciter field (exciter stator) is retained in position by the rear bearing bracket, and two "L" brackets welded to either side of the stator core. The "L" brackets are secured to the outside of the rear end plate of the main frame by two 1/2 - 13 hex head cap screws.

A. Remove the rear bearing bracket per instructions for BEARING AND EXCITER ROTOR REMOVAL. Remove exciter field leads F(+) (F−) from the voltage regulator. Attach a fish wire or cable to these two leads through the terminal lugs to assist in pulling these leads back into position during replacement. Remove the two "L" bracket retaining screws. Gently pull the core straight back and clear of the exciter rotor - taking care not to let it drop or cock and knick the end turns of the exciter rotor or the rotating rectifier assembly. When the assembly is clear set it down and remove the lead wire fishing wire.

B. To replace the assembly, position it close to the rear of the machine, and attach the fishing wire to the two exciter field lead terminals. Lift the assembly into position and gently slide it on over the exciter rotor. An assistant should be pulling gently on the exciter lead fish wire during this operation to assure the leads are clear and do not get hung up. When the assembly is in position, install the two "L" bracket retaining cap screws but do not torque them at this time. The inside ears of the rear bearing bracket provide alignment of the exciter core assembly. Re-install the rear bearing bracket and torque the retaining cap screws per instructions for BEARING REMOVAL AND REPLACEMENT. Torque the "L" bracket cap screws to the same (59 to 61 lb./in.) torque as the bearing bracket retaining screws. Remove the exciter lead fishing wire from the exciter leads. At this point it may be well to flash the exciter field per instructions for RESTORING RESIDUAL MAGNETISM, especially if the field has been rewound, or if the field is a replacement for the original assembly. After flashing the field, re-install the exciter field leads to the voltage regulator - taking care that F(+) is installed on the positive (+) terminal, and F(−) is installed on the negative (−) terminal of the regulator.

**BEARING AND EXCITER ROTOR REMOVAL AND REPLACEMENT PROCEDURE.**

Prior to commencing this operation, rotate the alternator shaft until two of the main rotor poles are in a "vertical" position. Once the bearing bracket is backed out the rotor will drop down on the main stator core. Having the main rotor in this position will limit the amount of rotor drop to that of the air gap.

A. Rear Bearing Bracket Removal Procedure. Loosen but do not remove the two 1/2 - 13 exciter stator "L" bracket retaining cap screws (Fig. 4). Remove the four 12 - 13 rear bearing bracket hex head cap screws (Item A, Fig. 4) to release the bracket. Rethread two of these cap screws in the threaded "back-out" holes in the flange of the bracket. Tighten these two screws together to back the bracket off of the bearing. If the exciter stator is to be removed during this operation, remove the rear bearing bracket first, and then follow procedures for EXCITER STATOR REMOVAL AND REPLACEMENT. Once the bracket is free of the bearing, pull it straight back until it is clear of the exciter stator and rotating rectifier assembly. As soon as the internal aligning register of the bracket is free of the rear plate of the frame, the rotor will drop until one pole is resting in the main stator core.

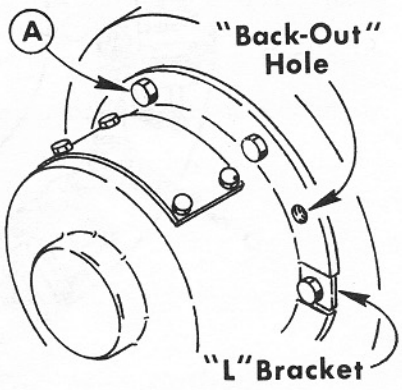



FIGURE 4

**NOTE:**
On 360, 361, 440, and 441 frames there is an "O" ring installed in the bearing bore of the rear bearing bracket. Inspect this "O" ring for wear or damage, and replace if necessary.

B. Front Bearing Bracket Removal (2-bearing units only). Remove the drive arrangement from the alternator shaft extension.

**NOTE:**
The shaft extension must be supported before proceeding further. A hoist and sling, jack, or some other means of support with a capacity of TWO TONS should be used.

Remove the six hexhead cap screws holding the bearing bracket to the frame. Rethread two of these screws in the threaded "back-out" holes provided and proceed as described above for the rear bearing bracket.

C. Bearing Removal Procedure. Using a bearing puller remove the bearing. Be sure that the puller is against the Inner Race of the bearing to prevent damage to the bearing. Prior to removal visually inspect the bearing for obvious wear and damage.

D. Rotating rectifier assembly removal procedure. Remove the three exciter rotor leads, and the two main rotor leads (Fig. 3 Items a, b, c, and d) from the rectifier assembly. Remove the four cap screws holding the rectifier asssembly to the rectifier hub.

E. Exciter rotor removal procedure. Using a bearing puller, remove the rectifier mounting hub. This hub is heat shrunk onto the shaft and may require the use of heat during the removal operation. When reassembling, this hub must be heated prior to being installed on the shaft. Pull the two main rotor load leads out of the holes in the exciter rotor. These two holes may be used to remove the exciter rotor with a hub puller.

F. Bearing replacement. **ALWAYS** install the same type bearing that was supplied as original equipment. Order by part number from the parts list, and include the alternator model and serial numbers from the unit's nameplate. Install the bearing with a conventional bearing tool. When replacing **avoid damage to the bearing outer race** and bearing shields. **Apply pressing force to the inner race only.**

G. Reasssembly. For reassembly, reverse the above procedures being careful that all electrical connections are clean and tight. When reinstalling either bearing bracket, it may well be necessary to provide a lifting device such as a sling and hoist or a jack to raise the bracket so that the aligning register will fit into the alternator frame. Insure that the bearing bracket register is properly seated in the frame prior to torqueing the retaining cap screws. Failure to do this may result in damage to the bearing bracket. Torque the four retaining cap screws to 59 to 61 lb./in. of torque. After the bracket is secure, torque the two exciter stator "L" bracket cap screws to the same values as for the bearing bracket screws.

**RECOMMENDED SPARE PARTS**

The table below lists spare parts which could be kept by the alternator owner to meet maintenance and service requirements. This list of parts and quantities should be adequate to support several like units located at the same operating site, especially if stocks of spare parts are replaced as they are consumed. For "critical" units, or those in service in extremely remote sites, it is strongly recommended that a complete set of the below listed parts be maintained for each unit at the site. For major repairs consult the factory for availability of replacement parts such as complete wound components and major sub-assemblies.

| PART DESCRIPTION | QUANTITY |
|---|---|
| BEARING, DRIVE END (2 BEARING UNITS ONLY) | 1 |
| BEARING, OPPOSITE DRIVE END | 1 |
| DIODE, FORWARD | 3 |
| DIODE,REVERSE | 3 |
| AUTOMATIC VOLTAGE REGULATOR | 1 |

See Pages 14 & 15 for Illustration and Part Numbers

**NOTE:**

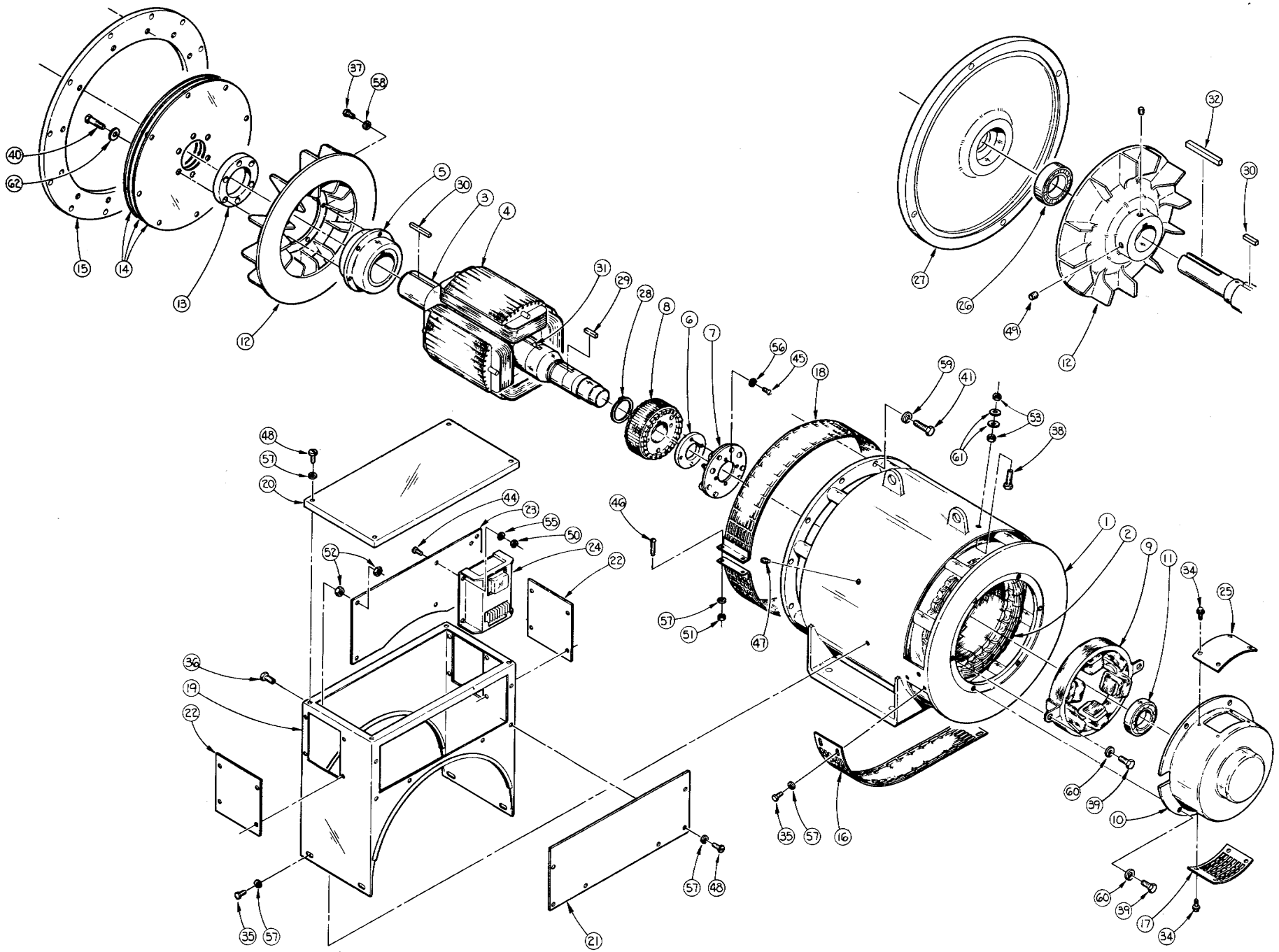
When ordering spare parts, include the unit serial number, model/part number, and adaption kit p/n -if single bearing along with the part description from the parts list. Since Lima provides a number of different regulators, when ordering either a replacement AVR, or AVR accessories, indicate the manufacturer and model number of the device being replaced.

## SECTION VII
## RETURNED GOODS

Contact **MARATHON ELECTRIC MFG., CORP.** by letter, telex or telephone for a "RETURNED MATERIAL AUTHORIZATION" before returning either parts or a complete unit. We will take steps to return your unit to service quickly, and at the least expense possible. At the same time, we will analyze the cause of failure and recommend steps to prevent a recurrence of the failure.

**CAUTION: SINGLE BEARING ALTERNATORS MUST HAVE THE ROTOR ASSEMBLY PROPERLY SECURED TO PREVENT DAMAGE DURING TRANSIT TO THE FACTORY OR AUTHORIZED SERVICE STATION.**

**MARATHON ELECTRIC MFG., CORP.**
100 EAST RANDOLPH STREET
P.O. BOX 8003
WAUSAU, WI 54402-8003
TELEX: 910-281-1521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**PARTS LIST**
**FRAME 360, 440, 580, 680**
**SINGLE BEARING**

| Part No. | Part Name |
|---|---|
| 1 | Frame |
| 2 | Main Stator |
| 3 | Shaft |
| 4 | Main Rotor |
| 5 | Drive Hub |
| 6 | Rectifier Hub |
| 7 | Rectifier Ass'y. |
| 8 | Exciter Rotor |
| 9 | Exciter Stator |
| 10 | Endbell |
| 11 | Bearing |
| 12 | Fan |
| 13 | Hub Spacer |
| 14 | Disc Coupling |
| 15 | Adaptor Ring |
| 16 | Intake Screen |
| 17 | Endbell Screen |
| 18 | Screen & Cover Band |
| 19 | Connection Box |
| 20 | Cover |

| Part No. | Part Name |
|---|---|
| 21 | Front Panel |
| 22 | Side Panel |
| 23 | Mounting Panel |
| 24 | Regulator |
| 25 | Cover Plate |
| 26 | Bearing |
| 27 | Endbell |
| 28 | Retaining Ring |
| 29 | Key |
| 30 | Key |
| 31 | Key |
| 32 | Key |
| 34 | Capscrew |
| 35 | Capscrew |
| 36 | Capscrew |
| 37 | Capscrew |
| 38 | Capscrew |
| 39 | Capscrew |
| 40 | Capscrew |
| 41 | Capscrew |

| Part No. | Part Name |
|---|---|
| 44 | Screw - Rd. Hd. |
| 45 | Screw - Rd. Hd. |
| 46 | Screw - Rd. Hd. |
| 47 | Screw - Socket Set |
| 48 | Screw - Pan Hd. |
| 49 | Screw - Socket Set |
| 50 | Nut |
| 51 | Nut |
| 52 | Nut |
| 53 | Nut |
| 55 | Washer - Split Lock |
| 56 | Washer - Shakeproof |
| 57 | Washer - Split Lock |
| 58 | Washer - Split Lock |
| 59 | Washer - Split Lock |
| 60 | Washer - Split Lock |
| 61 | Washer - Flat |
| 62 | Washer - Flat |