BT TROUBLESHOOTING
&
ADJUSTMENT GUIDE
(12 Stud AC Terminal Block)

The following trouble shooting guide is designed to give insight into problems which may be encountered with the BT Westerbeke brushless generators. Owing to the simplicity of the equipment and controls, troubleshooting is relatively easy, once the relationship between cause and effect is understood.

Most potential problems are covered in the text of this guide; however, should an omission or an error be found, we would greatly appreciate your notifying us of it.

Keep in mind that a basic fundamental knowledge of electricity is required for this troubleshooting, and always remember that lethal voltages are present in the circuitry; therefore, extreme caution is essential when working on or troubleshooting a generator.

Only a few basic tools are necessary for diagnosis and repair. These are hand tools: an amp probe and a quality volt-ohmmeter capable of reading less than one ohm due to the precision required in reading component winding resistances.

NOTE: Do not always rely on the vessel's instruments for accurate readings; try to bring your own.

Before attempting any repairs, get as clear an explanation of the problem as possible, preferably from an individual witnessing the problem. In some cases, this may bring to light a problem which is related to the method of operation rather than equipment fault.

Bring basic repair parts with you on the initial trip to the problem equipment, such as a regulator board when installed, diodes and bridge rectifier, so that if the problem should be found in one of these easily replaceable parts, the problem can be remedied early and efficiently.

The Internal and external wiring diagrams are important tools in troubleshooting this generator or any generator model.

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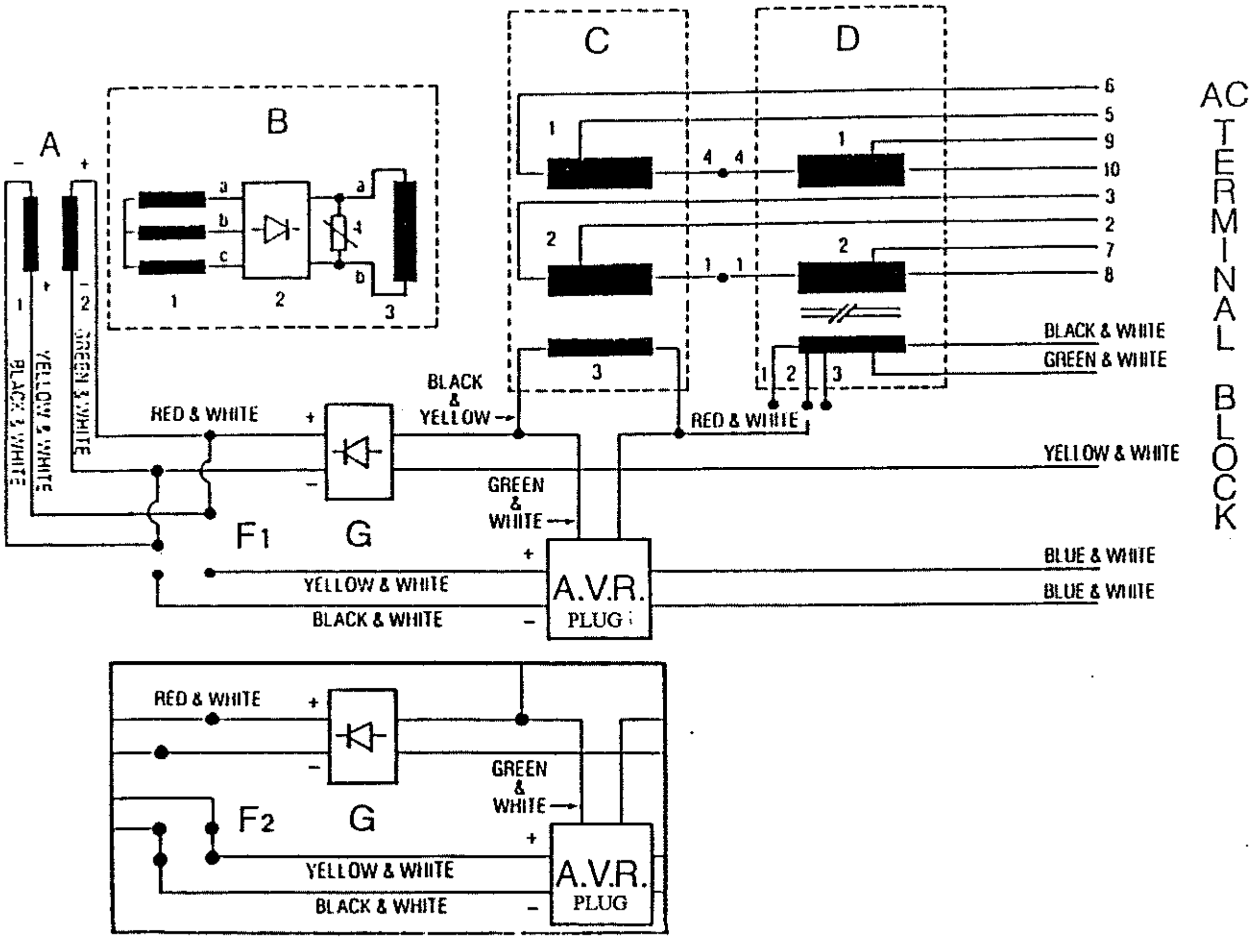


INTERNAL WIRING SCHEMATIC

A. EXCITER STATOR WINDINGS 1 & 2
- F1. Exciter Stator Windings (Selector in Compound)
- F2. Exciter Stator Windings (Selector in Electronic)

B. EXCITER ROTOR
1. Auxiliary Windings (a - b - c)
2. Diodes (6)
3. Rotating Field Windings
4. Pozi Resistor

C. MAIN STATOR
1. Main Stator Windings
2. Main Stator Windings
3. Main Stator Auxiliary Windings

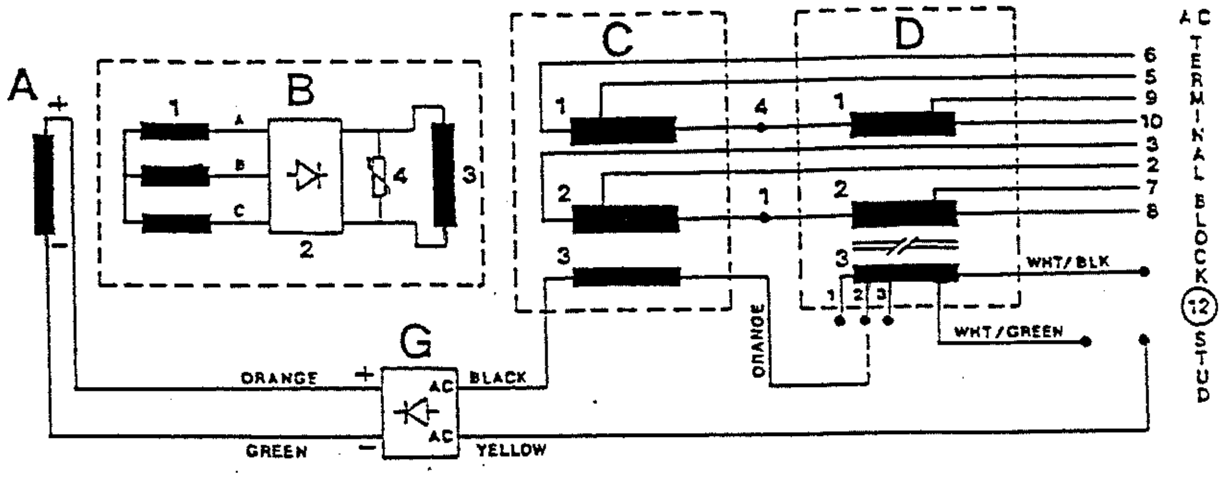
D. COMPOUND TRANSFORMER
1. Compound Transformer Windings
2. Compound Transformer Windings
3. Compound Transformer Auxiliary Windings

F. SELECTOR SWITCH
1. Compound
2. Electronic and Compound

G. BRIDGE RECTIFIER

A.V.R. - Automatic Voltage Regulator

INTERNAL WIRING SCHEMATIC
FOR 12 STUD BT MODEL
WITH VOLTAGE REGUALTOR CIRCUIT REMOVED



A. EXCITER STATOR WINDING
Resistance Valve 10.0 Ohms

B. EXCITER ROTOR & FIELD
1. Auxiliary Windings (a-b-c)
2. Diodes (6)
3. Rotating Field Windings
4. Pozi Resistor

C. MAIN STATOR
1. Main Stator Windings
2. Main Stator Windings
3. Main Stator Auxiliary Windings

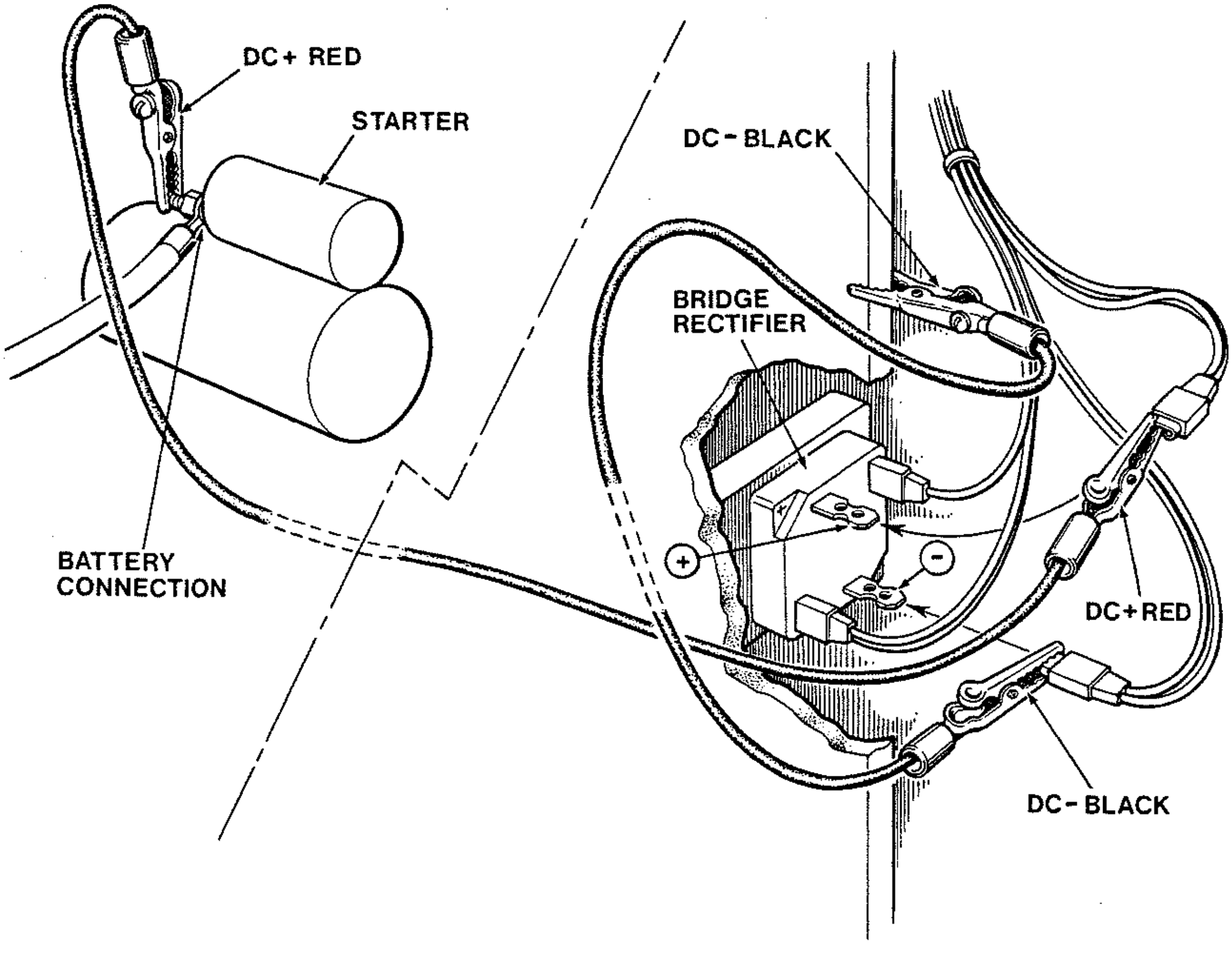
D. COMPOUND TRANSFORMER
1. Compound Transformer Windings
2. Compound Transformer Windings
3. Compound Transformer Auxiliary Windings

G. BRIDGE RECTIFIER

The removal of the voltage regulator circuit simplifies the wiring circuitry in the 12 stud BT generator's exciter circuit. Resistance readings and voltage checks can be easily gotten for the components in the exciter circuit A, G, C-3 and D-3 by locating the color coded wires at the connection points shown on the above schematic. When checking winding resistance valve be sure to lift both of the component's electrical connections.

EXCITING THE GENERATOR WITH 12VDC

NOTE - KEEP EXCITER CIRCUIT POLARITY CORRECT. DC + TO + LED
AND DC - TO THE CASE GROUND.



1. The amount of No Load voltage produced by the generator can be an indicator of where in the generator the problem/fault may lie.

Residual Voltage 18 - 22 Volts AC

This voltage is the AC voltage produced by the generator from magnetism in the exciter stator field. This voltage is measured between the Neutral and Hot leg(s) with no load on the generator, with it running at rated rpm.

The presence of residual voltage is an indication that the following generator components are O.K.

1. Exciter Rotor (B-1 and B-2)
2. Rotating Field (B-3)
3. Main Stator (C-1 & 2)
4. Compound Transformer (D-1 & 2)

The fault lies in one or more of the following components in the exciter circuit:

A. Exciter Stator (A-1 & 2)
B. Bridge Rectifier (G)
C. Selector Switch (F)
D. Main Stator Auxiliary Windings (C-3)
E. Compound Transformer Auxiliary Winding (D-3)

2. Twelve (12) volt DC excitation of the exciter stator windings should cause the generator to produce between 125 - 135 volts AC between each hot lead and the neutral. (Twelve volts DC is applied between the lifted (+) and (-) leads of the bridge rectifier, + to + and - to - .) Correct voltage produced with twelve volts DC excitation indicates the fault is in one or more of the above listed components B, D or E. If the generator does not produce 125 - 135 volts AC, then include A and C.

TROUBLESHOOTING CHART

*REFER TO THE **INTERNAL WIRING DIAGRAMS** WHEN PERFORMING THE FOLLOWING TESTS.*

TROUBLESHOOT THE COMPONENTS IN THE FOLLOWING ORDER:

1. **LOW VOLTAGE** 60-100 VOLTS AC

COMPONENT CHECKS:

F SELECTOR SWITCH
B ROTOR COMPONENTS
- B2. EXCITER ROTOR DIODES
- B3. ROTOR FIELD WINDING
- B1. EXCITER ROTOR WINDING(S) **a,b,c.**

A 1-1+2 EXCITER STATOR WINDING(S).

2. **NO AC VOLTAGE OUTPUT**

MAIN STATOR, ROTOR COMPONENTS, TRANSFORMER

COMPONENT CHECKS:

C 1+2 MAIN STATOR WINDING
B 4 POSI RESISTOR
B 2 DIODES (4-6 OPEN/SHORTED)
D 1+2 COMPOUND TRANSFORMER WINDING
B 3 ROTOR FIELD WINDING

3. **RESIDUAL VOLTAGE** EXCITER CIRCUIT FAULTY

COMPONENT CHECKS:

A 1-1+2 EXCITER STATOR WINDING(S)
G BRIDGE RECTIFIER
D 3 TRANSFORMER AUX. WINDING
C 3 MAIN STATOR AUX. WINDING
F SELECTOR SWITCH

CIRCUIT CONNECTIONS (from the Transformer Aux. winding to the connections on the Bridge Rectifier)

PAGES 5 AND 6 REMOVED

Bridge Rectifier

The bridge rectifier is supplied AC voltage from the auxiliary windings in the generator stator (C-3) and the compound transformer (D-3). The AC voltage measured across the AC terminals of the rectifier during engine operation is listed below.

120 Volts	120/240
N/L F/L	N/L F/L
11 - 21 Volts AC	11 - 21 Volts AC

Diodes in the rectifier convert this AC voltage to DC and supply it to the windings (A-1 and A-2) of the exciter stator to induce a field through which the exciter rotor revolves. The DC voltage measured across the (+) and (-) terminals of the bridge rectifier during engine operation is listed below.

120 Volts	120/240
N/L F/L	N/L F/L
8 - 17 Volts DC	8 - 17 Volts DC

Failure of the bridge rectifier will result in no strong field being produced by the exciter stator windings. A weak field is present, due to the magnetism in the exciter stator, which will cause the generator to produce residual voltage as discussed earlier in this text, page 3.

Testing the Bridge Rectifier for Fault(s) with an Ohmmeter

(1) Set ohmmeter scale on RX1 (+DC). Zero the meter.

(2) Connect the (+) lead from the meter to point #4. With the (-) lead from the meter, momentarily contact points #1, #2, #3 and #5. No deflection of the needle should occur showing no continuity.

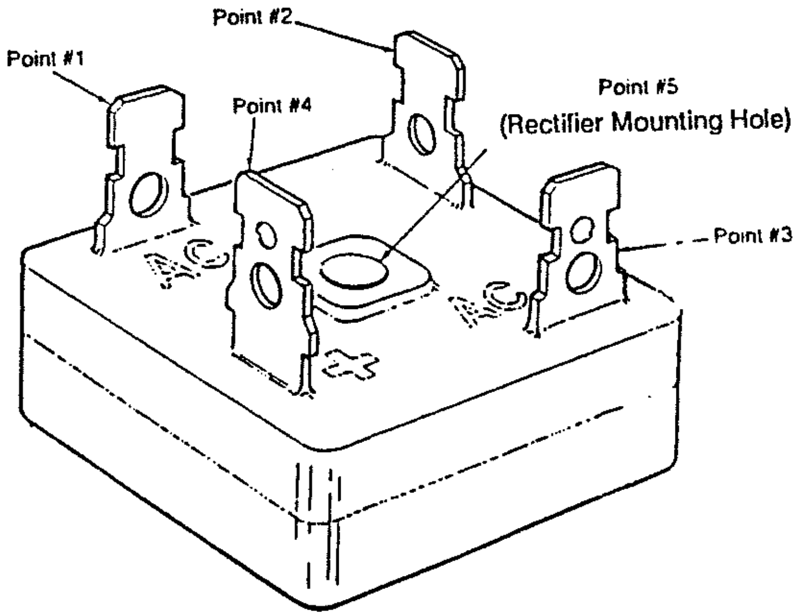
(3) Remove the (+) lead from point #4 and connect the (-) lead to point #4 and, with the (+) lead, momentarily touch points #1, #2 and #3. The needle of the meter should deflect showing a passage of meter voltage through the diodes in the rectifier.

(4) Touch point #5 with the (+) lead. No deflection of the needle should occur.

(5) Place the (+) lead of the meter on point #1 and the (-) on point #3. No deflection of the needle should occur (infinite resistance). Reverse the connections and the same should occur.

Should the rectifier fail any of the above tests, it is defective and should be replaced.

RESISTANCE VALUES - at 70° F (21° C)
(Simpson Meter 260 Model)

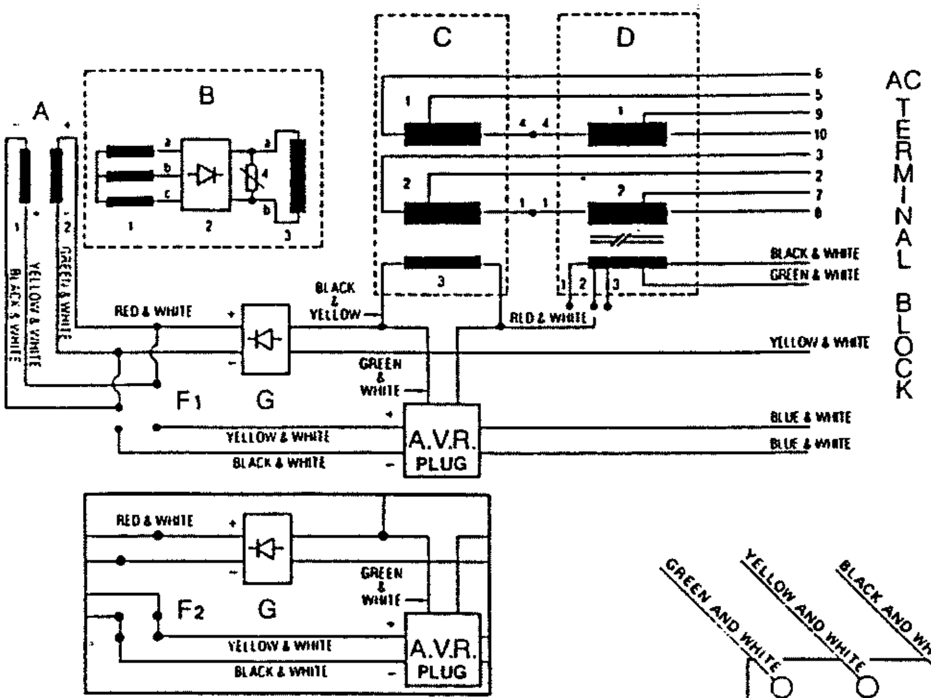


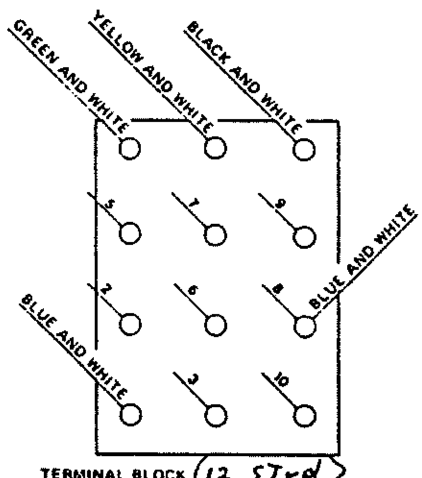
A. EXCITER STATOR WINDINGS

(A Windings, 1 & 2)
Exciter windings A 1 & 2 (Compound F1) 8.5 - 9.0 Ohm. (Reading taken between positive (+) and negative (-) leads lifted off the bridge rectifier with the selector switch in the **COMP** position.) Either of the two leads should have no continuity to the case/ground.

(A Winding, 1)
Exciter windings A-1 (Elec - F2) 30.0 - 30.5 Ohm. (Selector switch in the **ELEC** position, with readings taken between the yellow and white and black and white-striped wire leads at the regulator plug).

(A Winding, 2)
Exciter windings A-1 (Elec - F2) 12.5 - 13.0 Ohm. (Reading taken between positive (+) and negative (-) leads lifted off the bridge rectifier.)





TERMINAL BLOCK (12 Stud)
(Showing Electrical Connections from Generator)

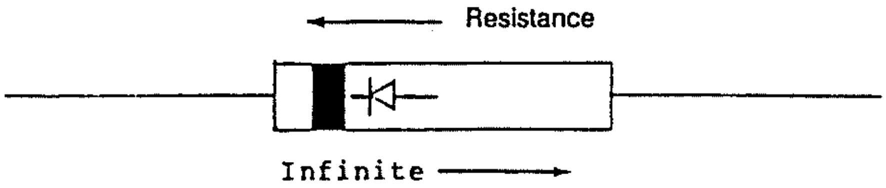
B. EXCITER ROTOR

1. Auxiliary windings 1.0 - 1.2 Ohm. (Readings taken between each pair of windings - a + b, b + c, c + a.) Winding connections can be left soldered at their connection points. If the readings are believed to be incorrect, unsolder the connections and recheck for resistance readings.

2. Diodes (six diodes are mounted on the exciter rotor; they rectify the AC voltage produced by the three groups of auxiliary windings to DC voltages and supply this DC voltage to the rotating field windings.)

Resistance Value

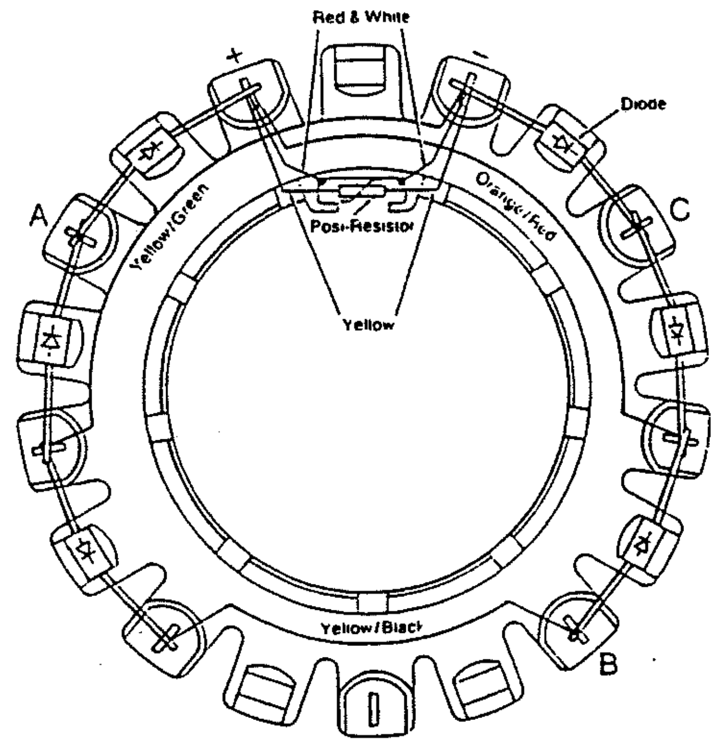
11 Ohms through the diode
Infinite blocking



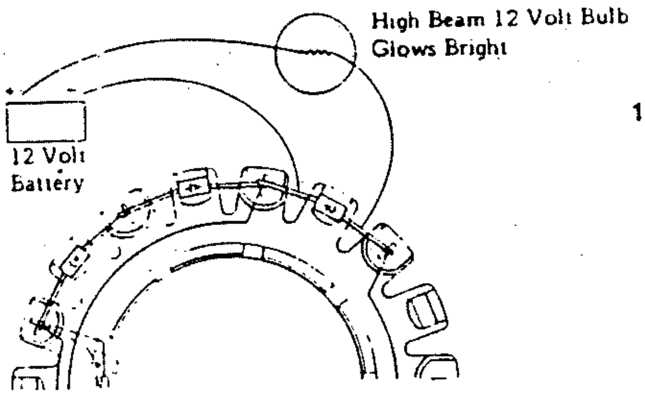
The diodes can be easily checked in place with the use of a common automotive 12-Volt high beam headlight bulb, some jumper leads and the generator's 12-Volt starting battery. (See the next page.)

A short or an open in a diode can easily be found with the above without having to unsolder and isolate each diode to check it with an Ohmmeter.

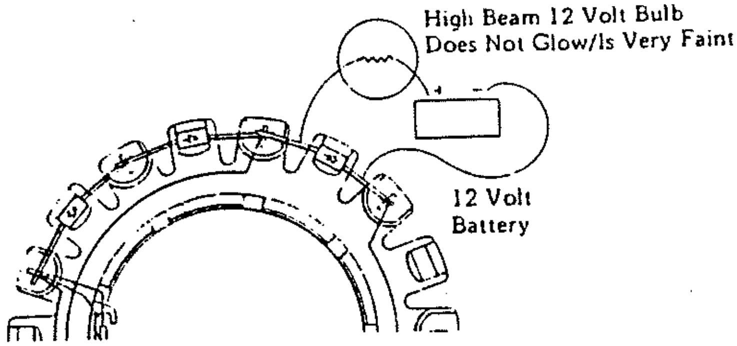
NOTE: Attempting to check diodes in place with an Ohmmeter will give erroneous readings on the diodes due to the auxiliary windings connections.



Exciter Rotor



1. When leads are put across the diode, as illustrated, voltage passes through the diode allowing the head light to glow brightly.



2. Reverse the leads across the diode. The diode should block voltage passing through it and the head light should not glow, or it may glow faintly.

   A. Should the bulb not glow with leads connected in both directions, the diode is open internally.

   B. Should the bulb glow bright with the leads connected in both directions, the diode is shorted internally.

   In both A and B above, the diode should be replaced. Check resistance values of rotating field windings and the integrity of the posi resistor connected between field windings.

3. Rotating Field Windings 7.0 - 8.0 Ohms. (Readings taken between the two red and white wires connected to the (+) and (-) terminals of the exciter rotor as shown on the illustration on the previous page.)

   NOTE: These terminals are not marked (+) and (-); there should be no continuity to thr rotor's shaft.

4. Posi-Resistor. (Infinite readings between both yellow leads lifted from terminals (+) and (-) on the exciter rotor.)

   NOTE: A SHORTED POSI-RESISTOR WILL DESTROY THE ROTATING FIELD AND CAUSE THE AC OUTPUT VOLTAGETO DROP TO ZERO.

C. MAIN STATOR WINDINGS

1 & 2. Main stator windings .20 - .22 ohms

Group 1 - measured between Lead #6 at the AC terminal block and Lead #4 at the junction block. Lift both leads along with lead #5 at the terminal block to totally isolate group #1.

Group 2 - measured between Lead #3 at the AC terminal block and Lead #1 at the junction block. Lift both leads along with lead #2 at the terminal block to totally isolate group #2.

NOTE: The *Junction Block* for connections #4 and #1 from the main stator windings and to the transformer windings is found just below and to the left of the compound transformer.

3. Main Stator Auxiliary Windings 1.5 - 1.8 ohms. (Measured between the double leads on the AC terminal of the bridge rectifier, unplugged from the rectifier and the double lead central prong connection of the regulator plug.)

No continuity should be found between either of these three winding groups or to the generator's case.

D. COMPOUND TRANSFORMER

1 & 2. - Compound Transformer Windings: .019 - .021 Ohm

Group 1 measured between Lead #10 at the AC terminal block and Lead #4 at the junction box. Lift both leads along with lead #9 at the terminal block.

Group 2 measured between Lead #8 at the AC terminal block and Lead #1 at the junction block. Lift both leads along with lead #7 at the terminal block.

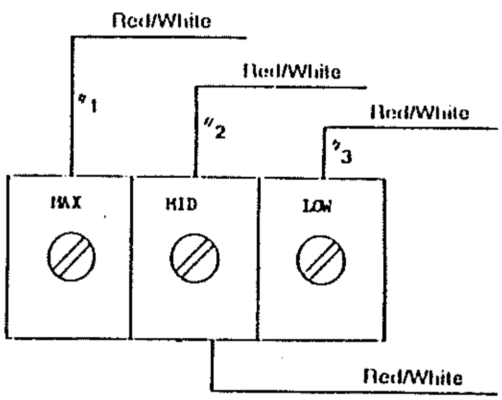
3. Transformer Auxiliary Windings: 4.0 - 4.5 Ohm.

A. Serial # 1001 - 1040: These very early models units transformer auxiliary windings resistance value is measured between the black and white wire, lifted from the AC terminal block, and the red and white-striped wire at the regulator plug. To totally isolate these windings for the above measurement, lift also from the AC terminal block the green and white-striped wire.

B. Serial # 1041 and up: A three connection terminal strip was added to this circuit located just below the AC terminal block at the lower left. Isolate the three numbered #1, #2, and #3 red and white-striped wires coming onto each of the three terminals. Lift the black and white and green and white leads off their connections on the AC terminal block. Measure the resistance value between the #1 red and white lead lifted from the terminal strip and the black and white lead lifted from the AC terminal block.

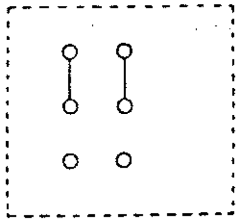
NOTE: The addition of the three connection terminal strip is for the increase or decrease of full-load voltage output. Should full-load voltage fall below 108 volts, selecting a higher number terminal strip lead to connect the lead (red and white) that is routed to the regulator plug and the exciter circuit will supply a higher AC voltage to the exciter circuit during full-load conditions, bringing the output voltage of the generator up.

No-load voltage should be properly adjusted by shimming the compound transformer: 121 - 124 Volts at 61.5 - 62.0 Hertz. Note that the above should not be used as a means of compensating for incorrectly adjusting the generator's no-load voltage.

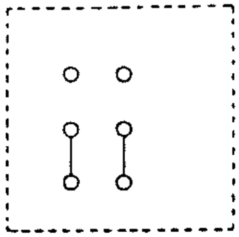


E. SELECTOR SWITCH

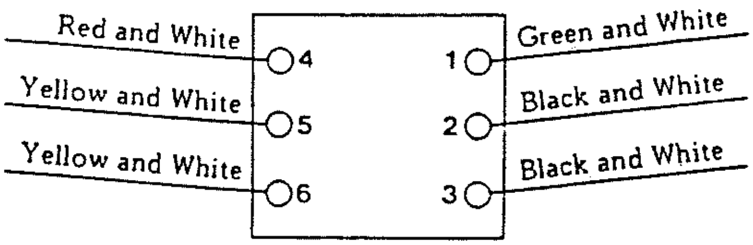
1. Selector Switch in Compound



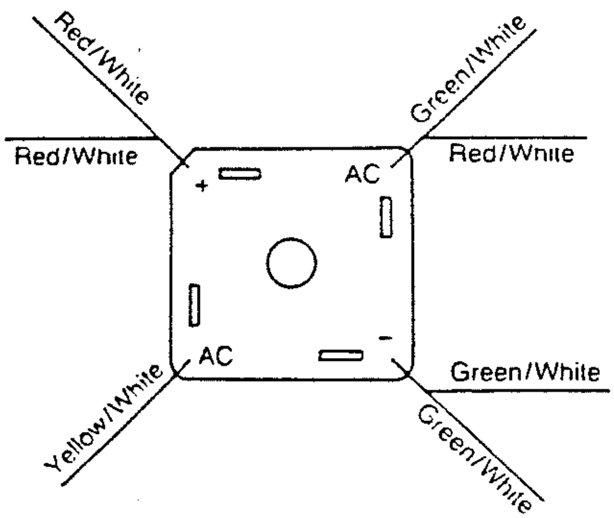
2. Selector Switch in Compound with A.V.R.



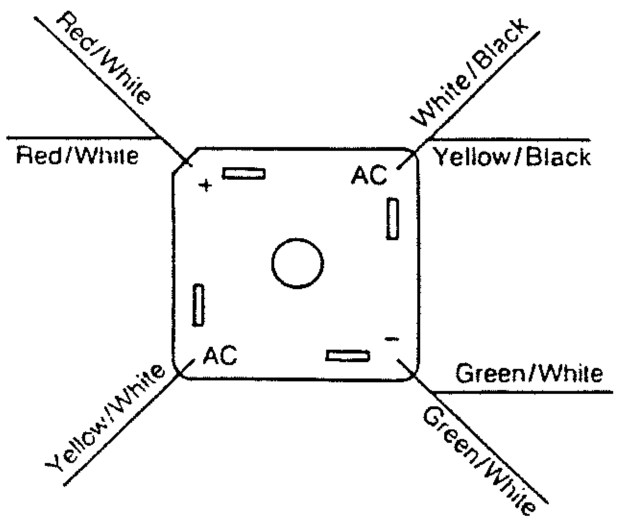
SELECTOR SWITCH WIRING



G. BRIDGE RECTIFIER WIRING



GENERATORS #1001 - 1040



GENERATORS 1041 - UP

No-Load Voltage Adjustment

Voltage adjustment is made with the generator regulation being governed by the compound transformer.

1. The selector switch must be in the **COMP** position.

2. Operate the generator and apply a moderate load momentarily and remove it. Note the voltage output from the generator's 120 volt leg(s) (110 volt 50 Hertz). The no-Load voltage should be between 121 - 124 volts at 61.5 - 62 Hertz (111 - 113 volts at 51.5 - 52 Hertz).

   NOTE: The No Load voltage should be adjusted to the voltage produced by the generator once started and a momentary load applied to excite the transformer and then removed. The voltage produced by the generator after this momentary load is removed is no-Load voltage.

3. To raise or lower the voltage, shims of varying thickness (non-conductive material) are placed or removed from under the steel laminated bar on top of the compound transformer. The material used for shimming should not soften at temperatures in the 176° F (80° C) range. A small reduction in no-Load voltage (1 to 3 volts) can sometimes be accomplished by gently tapping the top of the laminated steel bar to reduce the air gap between the existing shims and the transformer core.

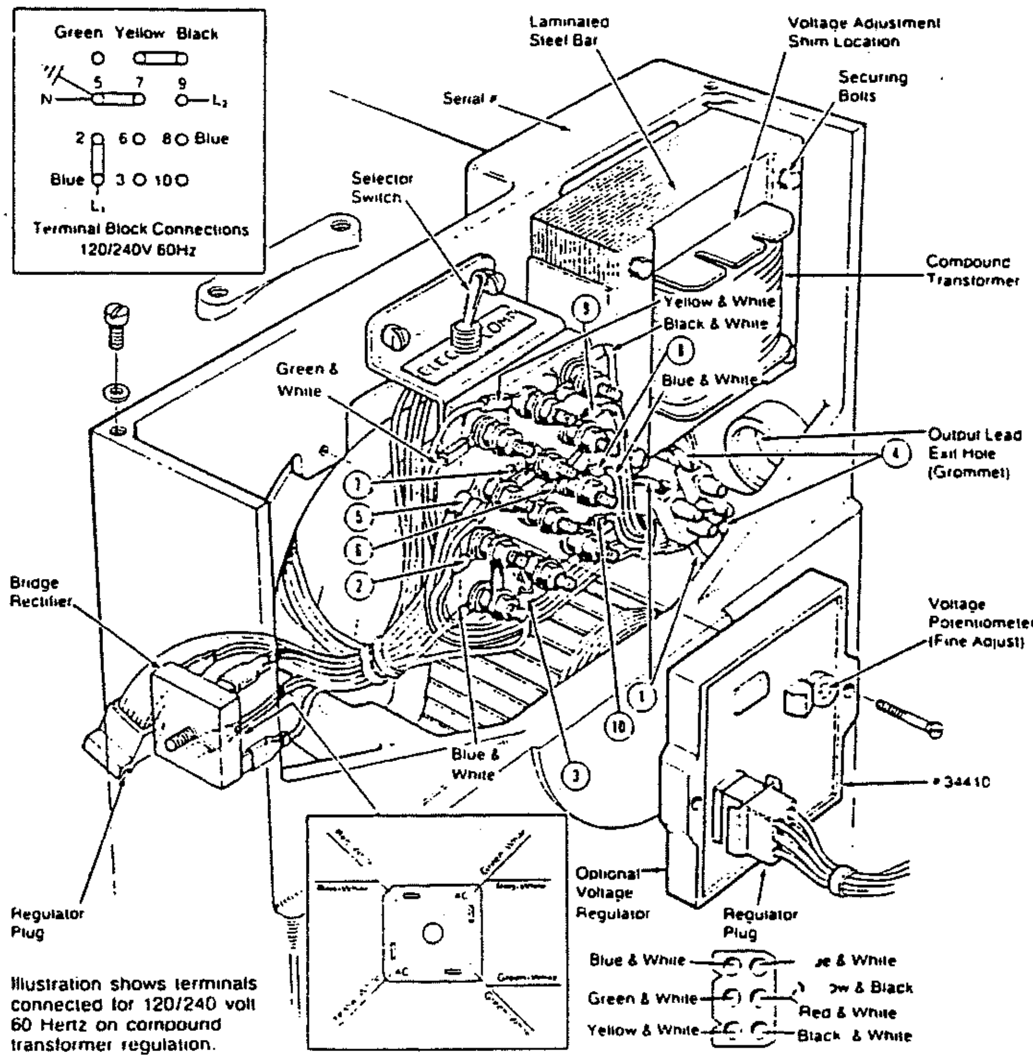


Illustration shows terminals connected for 120/240 volt 60 Hertz on compound transformer regulation.

CAUTION

Under no circumstances attempt to increase the no-Load voltage by increasing the gap between the laminated steel bar and the transformer core without the use of shims. Magnetic forces created within the transformer during generator operation may close the air gap and reduce no-Load voltage output.

4. To remove the laminated steel bar, remove the two upper securing bolts from the compound transformer and lift the bar from the transformer. The addition of shim thickness will raise the no-Load voltage and, conversely, the removal of shim thickness will lower the no-Load Voltage.

Varying shim thickness by .001 inch (0.025 mm) will change the No Load voltage by 4 to 6 volts.

Optional Voltage Regulator

An optional solid state voltage regulator board #34410 is available for use with the BT generator. When this board is installed and the regulation switch is moved to the ELEC position, the regulator works together with the standard compound transformer regulator to regulate generator voltage output. Refer to the wiring diagram on page 2.

Installation

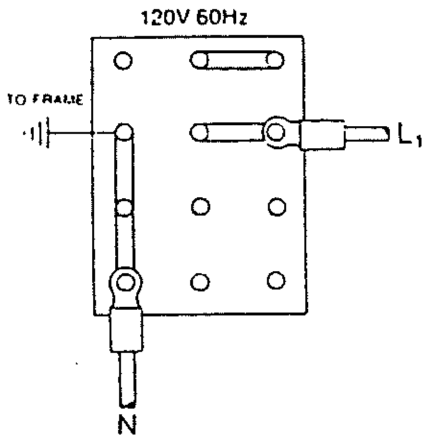
1. The regulator is mounted using existing tapped holes in generator case. Use (2) M4 x 0.7 millimeter screws, each 15 mm long, with lock washers to mount the regulator board.

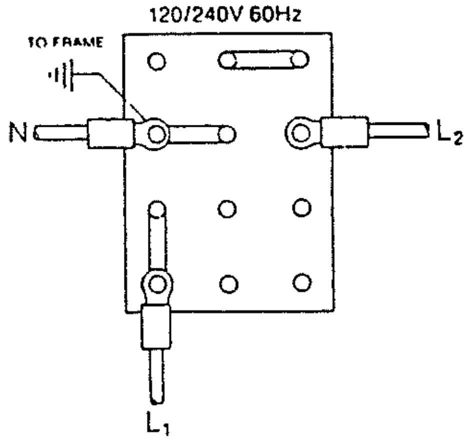
2. Take the 6-prong generator plug and plug it into the receptacle on the regulator board.

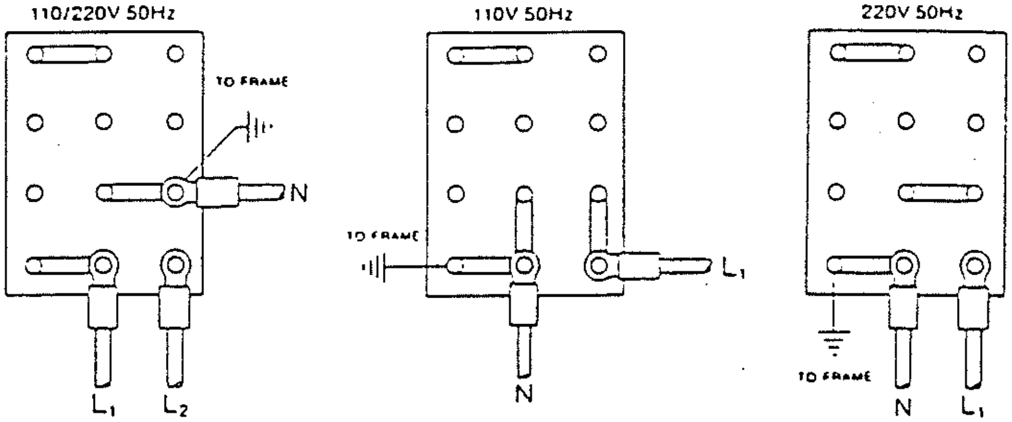
   NOTE: The plug is shaped so it will only engage in the regulator's receptacle in one direction. Check this and insert correctly.

3. Before moving the selector switch to ELEC, make sure the no-Load voltage produced by the generator is properly adjusted with the selector in COMP position, following procedures for No-Load Voltage Adjustment.

4. With generator no-Load voltage adjusted to 116 - 118 VOLTS move the selector switch into the ELEC position. Adjust the regulator board potentiometer to set no-load voltage at 120 volts, 61.5 - 62 Hertz (110 volts, 51.5 - 52 Hertz). Generator voltage output should be within ±5 percent from no-Load to full-rated generator output.







NOTE 1 - The frame ground wire must be moved when changing from 110 volts 50 Hertz to 110/220 volts 50 Hertz. For making connections to the AC terminal block, use terminal ends for #10 studs that will accept #6 multi-strand wire when the generator is wired for 120 volts, or use #8 when the generator is wired for 120/240 volts. Use an approved cable clamp to protect and secure the wire from chafing where it exits the generator housing.

NOTE2 - The neutral and frame ground (⏚), which are normally combined, can be separated for thos systems requiring a separate neutral from common ground. The generator's frame *must* be connected to the vessel's common ground for safety reasons.

Generator Frequency

1. Frequency is a direct result of engine/generator speed: 1800 rpm = 60 Hertz; 1500 rpm = 50 Hertz.

2. To change generator frequency follow the steps below.

   A. Connect the AC output leads to the AC terminal block, following the illustrations on this page or on the preceding page.

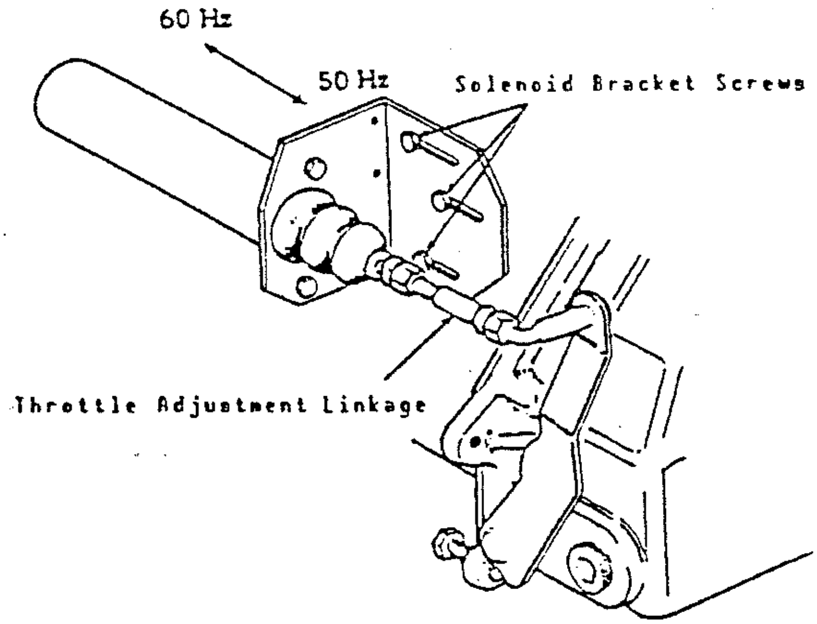
   B. Adjust the engine's speed to obtain the frequency corresponding to the voltage selected.

   C. Adjust the no-load voltage if it is needed by the compound transformer.

   D. Load the generator to the new amperage rating and reposition the loaded voltage tap to position X, Y or Z as needed to maintain exceptable voltage output at full rated amperage output.

   NOTE: Volts x Amperage = Kilowatts

Engine speed is increased or decreased by adjusting the length of the linkage between the throttle arm an solenoid plunger with the plunger completely bottomed in the solenoid.



Solenoid and Throttle with Linkage

CAUTION

Failure of the solenoid plunger to bottom in the solenoid will result in a failed solenoid.

To avoid failure of the solenoid, make sure the solenoid plunger bottoms in the solenoid. Check the solenoid's operation at the initial start-up. Periodically lubricated linkage joints between the solenoid plunger and the throttle arm will eliminate binding.

NOTE: The solenoid plunger *must* move smoothly and rapidly into the solenoid when the solenoid is electrically energized, drawing the engine's throttle arm into the Set Speed/Run position.

Gasoline Model Governor Adjustments

Operate the generator set to bring the unit up to its operating temperature before attempting an adjustment.

NOTE: If the governor is severely out of adjustment, manually adjust the linkage without any load on the generator to obtain a safe output voltage before proceeding with the adjustment.

Three adjusting points are on the governor.

1. Bumper Screw This screw is used to remove a no-load surge ONLY. NEVER turn the bumper screw into the governor far enough so that it increases the no-load speed. To adjust the governor, turn the bumper screw in until the engine stops surging. Now bring the Increase/Decrease Screw (on the governor) up until the generator runs between 61.5 to 62.0 cycles no-load. Apply a 1/4, a 1/2 and a 3/4 load to the generator and ensure the generator does not surge under these three load intervals.

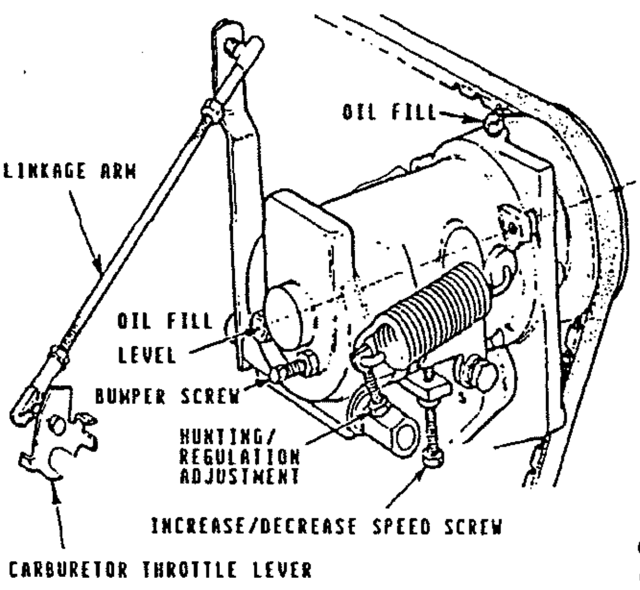
   NOTE: Only if the generator surges at any of these load intervals are you to follow steps #2 and #3 below.

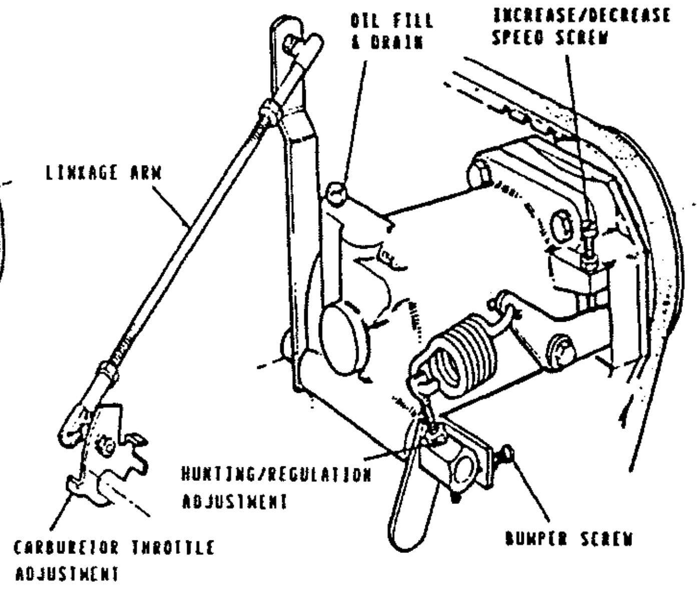
2. Increase/Decrease Speed This adjusting bolt sets the no-load speed of the engine. (The linkage arm between the governor arm and throttle lever should be adjusted to hold the throttle full open when the engine is not running.) Make sure this linkage moves freely and that the ball joint connectors are properly lubricated. Use graphite lubricant at this connection. Disconnect the ball joint and apply a graphite lubricant to the inside of the joint.

3. Hunting/Regulation If the variation in engine speed between no-load and full-load is too great, adjust this eye bolt to draw the spring closer to the lever hub. The increase/decrease speed bolt may need to be adjusted as well.

If the governor surges while under a load, adjust this eye bolt to move the spring away from the lever hub. (Check the speed adjustment.)

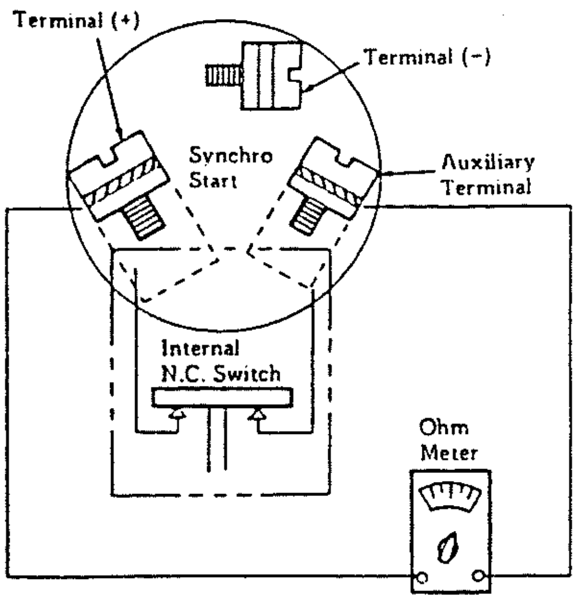
To increase or decrease the speed of a diesel engine-driven generator, adjust the linkage between the throttle arm and the solenoid plunger with the plunger completely bottomed in the solenoid.





1. Manual Check

Check the operation and bottoming of the fuel solenoid plunger by manually doing the following:



A. Connect an Ohmmeter across the positive (+) terminal and vacant auxiliary terminal of the back of the fuel solenoid (see the illustration to the right).

B. With the fuel solenoid in the STOP position, 0 - 1 Ohms resistance should be found across these two terminals.

C. Manually moving the throttle arm into the RUN position and bottoming the fuel solenoid plunger, a resistance of about 15 - 30 Ohms should register on the meter, indicating that the plunger has bottomed against the internal switch de-energizing the pull of the windings.

Failure to manually make sure that the fuel solenoid operates as described above will result in the failure of the solenoid when operated electrically. (The fuel solenoid may fail within 30 seconds if the plunger does not bottom when electrically energized.)

2. ELECTRICAL CHECK

When operated electrically by use of the PREHEAT switch on the instrument panel, the fuel solenoid plunger should move smoothly and rapidly into the solenoid with no binding or hesitation, drawing the throttle arm into the RUN position with the plunger bottoming in the solenoid.

Slow or hesitant movement of the solenoid plunger into the solenoid when energized can be the result of linkage binding, misalignment, and/or a possible voltage loss at the solenoid.

Remote start/stop panels ,when wired into the generator panel with inadequate wire size for the distance run, can produce this effect. Check voltage at the solenoid's positive (+) terminal.

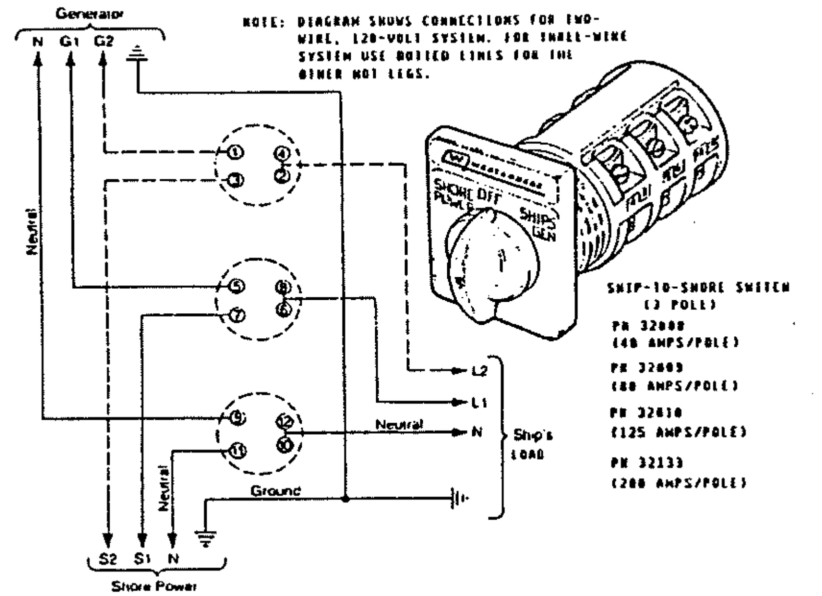
With the solenoid operating properly, when energized by the PREHEAT switch, the generator can then be started and the linkage adjusted so the engine's speed will have the generator producing the correct no-load voltage and Hertz. The linkage can then be secured.

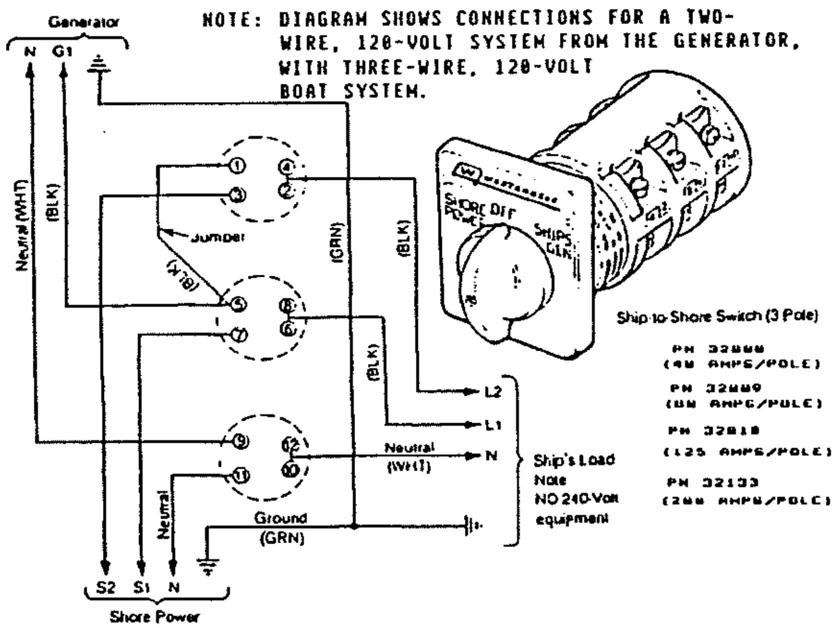
Shore Power Connections

If the installer connects shore power to the vessel's AC circuit, this must be done by means of the SHORE POWER/OFF/SHIPS GEN., center position-off transfer switch shown below. Use of this switch prevents simultaneous connection of shore power to generator output.

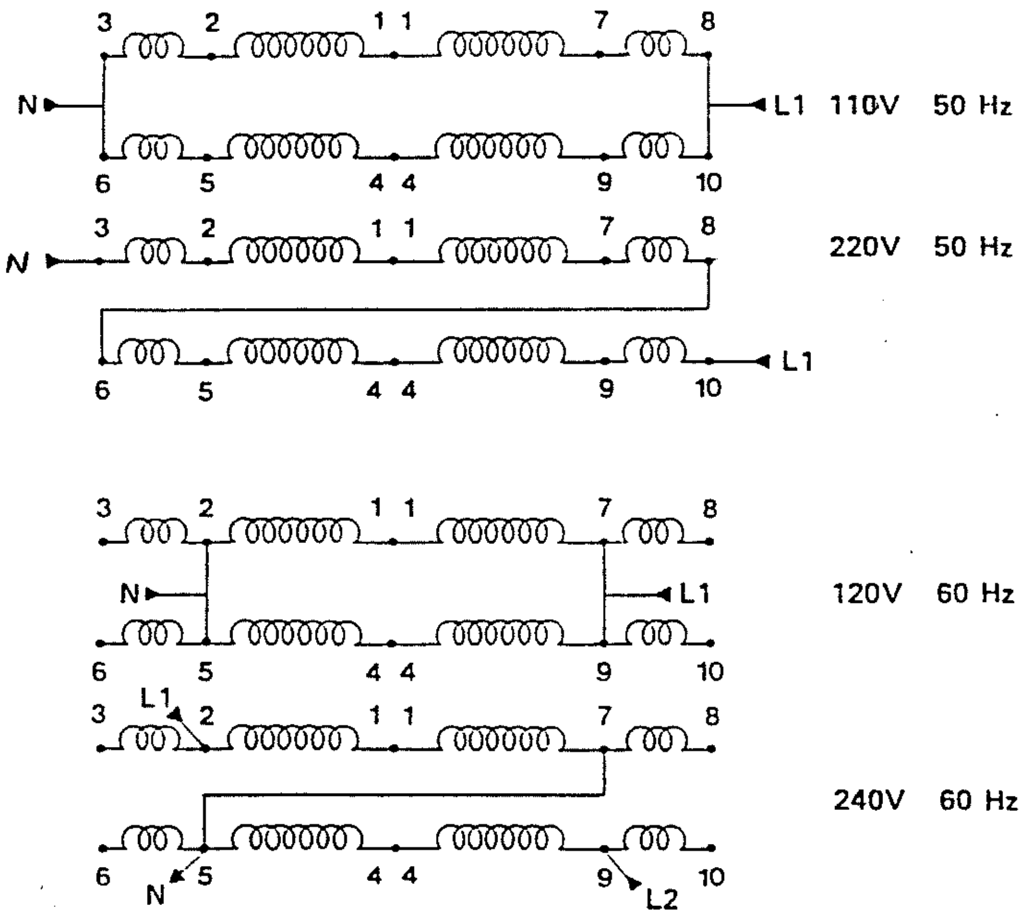
CAUTION

Damage to the generator can result if utility shore power and generator output are connected at the same time. This type of generator damage is not covered under the warranty; it is the installer's responsibility to make sure all AC connections are correct.





Shore Power Switch Connection Diagrams



Winding Connection to Obtain the
Voltage and Related Frequency