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Caterpillar

Service Manual

Electric Set

Generators

Diesel

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CT-S-GENERATOR

Service Manual

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SERVICE MANUAL

for

CATERPILLAR

GENERATOR

STATICALLY REGULATED CONTROLLED RECTIFIER

for

DIESEL ELECTRIC SETS

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GENERATOR PRINCIPLES OF OPERATION

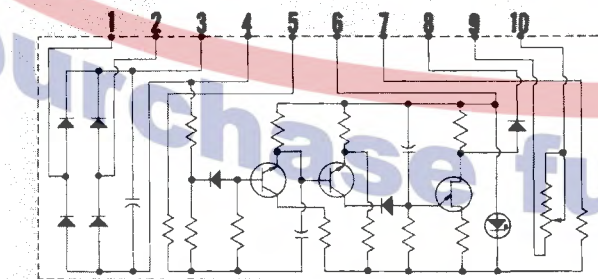
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desirable. To reduce these high frequency harmonics, noise suppression assembly (V), mounted on the generator frame, is utilized in conjunction with noise suppression capacitor (W). Choke coils (7) in the noise suppression assembly, in series with the excitation power supply, help impede these high frequencies and capacitors (8) bypass these high frequencies to ground at the generator frame. To make good use of noise suppression assembly, always ground the generator frame.

REGULATOR ASSEMBLY

After the generator voltage builds up enough to open the contact points of the build-up relay, the relay has accomplished its function. When the build-up relay contact points are open, the regulator assembly supplies the controlled rectifier "gate" with electric impulses.

The regulator assembly contains resistors, rectifiers, capacitors and transistors in circuits connected to terminals (1 through 10) on the side of the regulator assembly. Because of many components and the complexity of the circuits, the complete assembly is sealed in non-conductive synthetic resin and is serviced as a unit.

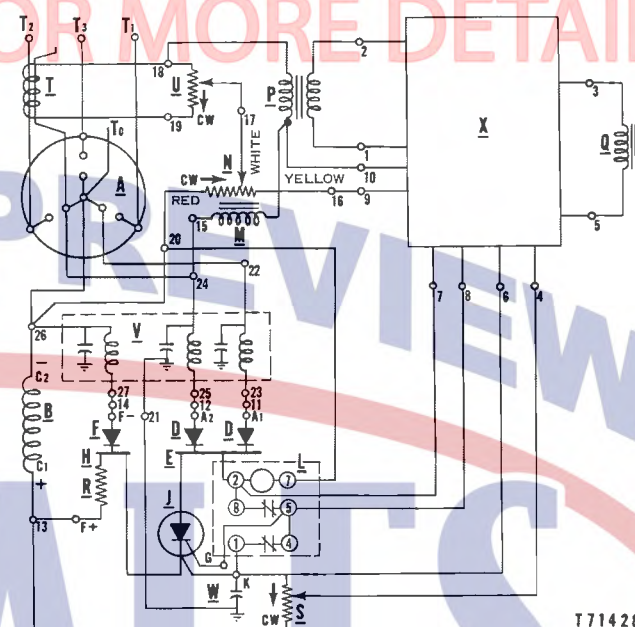


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REGULATOR ASSEMBLY WIRING DIAGRAM (SCHEMATIC)

From stator (A) of the generator, a circuit (connected from both phase 2 and the stator neutral) including sensing reactor (M) and voltage level potentiometer (N) leads to terminals 10 and 9 on regulator assembly (X). This circuit from the generator stator will establish an alternating current voltage reference. Here the AC voltage is divided in direct proportion to the reactance of the sensing reactor and the combined resistance in the regulator assembly and the potentiometer. Because frequency varies the reactance of the sensing reactor, the voltage applied to the arm of the potentiometer is independent of engine speed or frequency change. This AC voltage reference also connects to isolation transformer (P) primary winding. The transformer isolates the regulating circuit and also prevents the

voltage divider sensing circuit and the regulator circuit from becoming parallel circuits.



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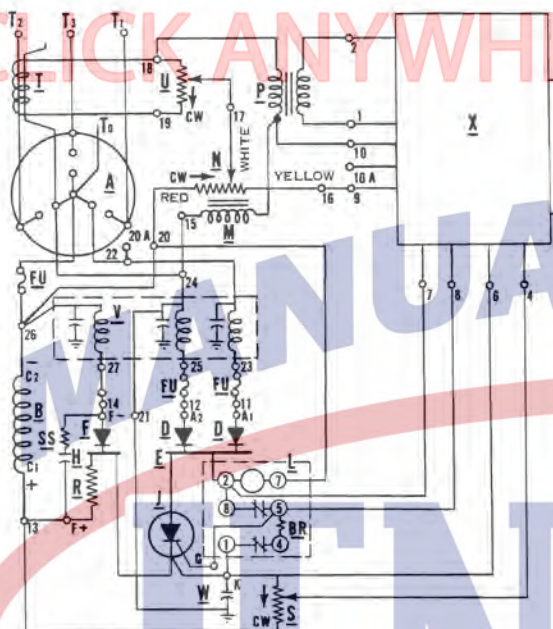
SRCR GENERATOR WIRING DIAGRAM
(Same Nomenclature as Previous Illustration)

The AC voltage from the secondary winding of the isolation transformer enters the regulator assembly through terminals 1 and 2. Terminals 1 and 2 lead to four diodes that make up a full wave rectifier which changes AC voltage to DC. This DC voltage is filtered by filter choke (Q) connected to terminals 3 and 5. The filtered DC voltage supplies a network of transistors, resistors, capacitors and diodes. The transistors in this network amplify any voltage variations in the input from the isolation transformer. This amplified voltage controls a timing circuit in the regulator assembly. A signal from the timing circuit, through terminal 8, supplies the "gate" of controlled rectifier (J) with an electric impulse which causes the controlled rectifier to "turn on" the excitation circuit to rotating field (B) [as required] to maintain constant generator output voltage.

GENERATOR TROUBLE SHOOTING GUIDE

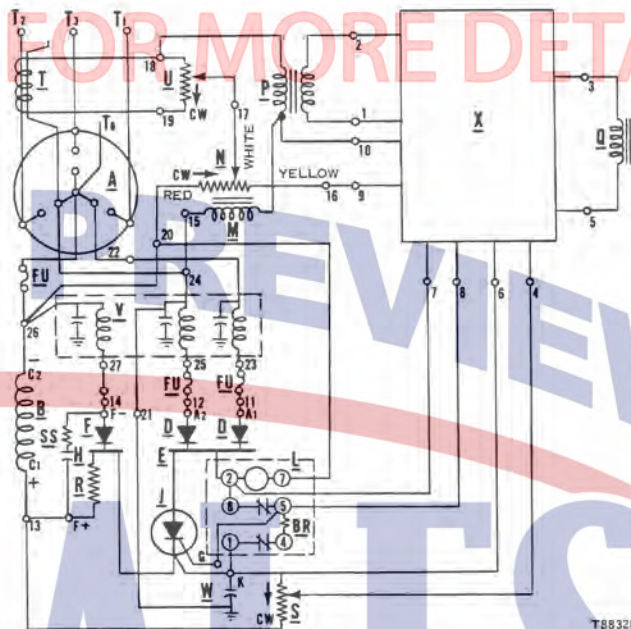
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Generators up to Serial No. 199



**SRCR GENERATOR
WIRING DIAGRAM**

*Reconnect red wire at terminal 20 to 20A and wire at terminal 10 to 10A for 125/250 volt single phase operation.



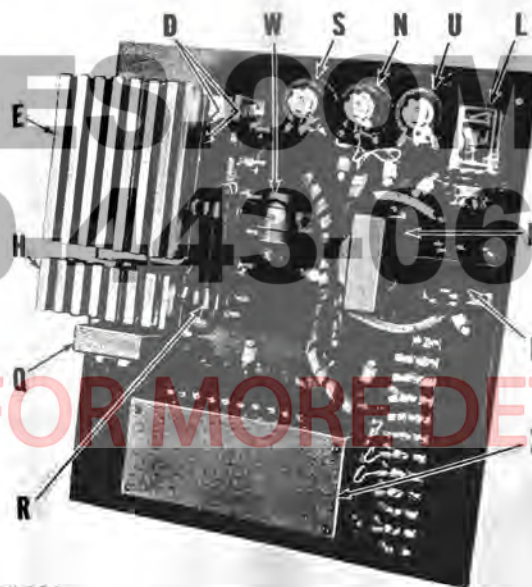
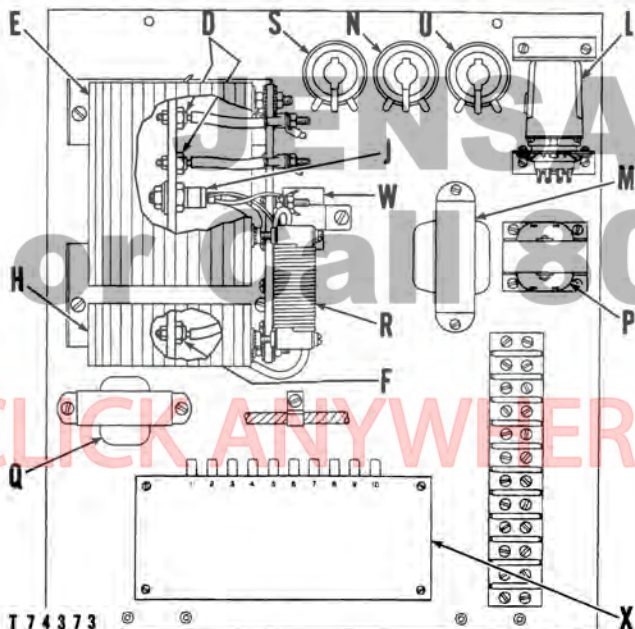
**115-230 VOLT SRCR GENERATOR*
WIRING DIAGRAM**

A-Stator.
B-Rotating field.
D-Power rectifier.
E-Main heat sink.
F-Field rectifier.
H-Auxiliary heat sink.
J-Controlled rectifier.
L-Build-up relay.

M-Sensing reactor.
N-Voltage level potentiometer.
P-Isolation transformer.
Q-Voltage control choke.
R-Regulator gain resistor.
S-Regulator gain potentiometer.
T-Voltage droop transformer.
U-Voltage droop potentiometer.

V-Noise suppression unit.
W-Noise suppression capacitor.
X-Regulator assembly.
BR-Build-up resistor.
FU-Fuse.**
SS-Surge suppressor**

**If not equipped with fuses and a surge suppressor these units can be installed if necessary.

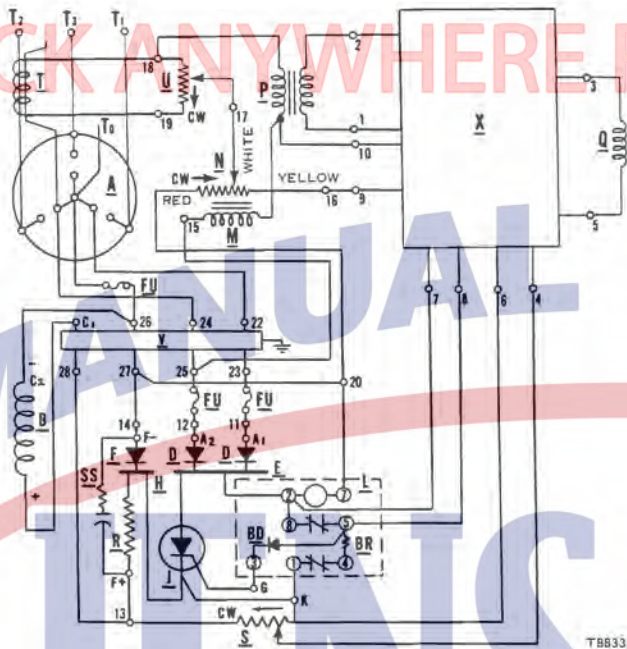
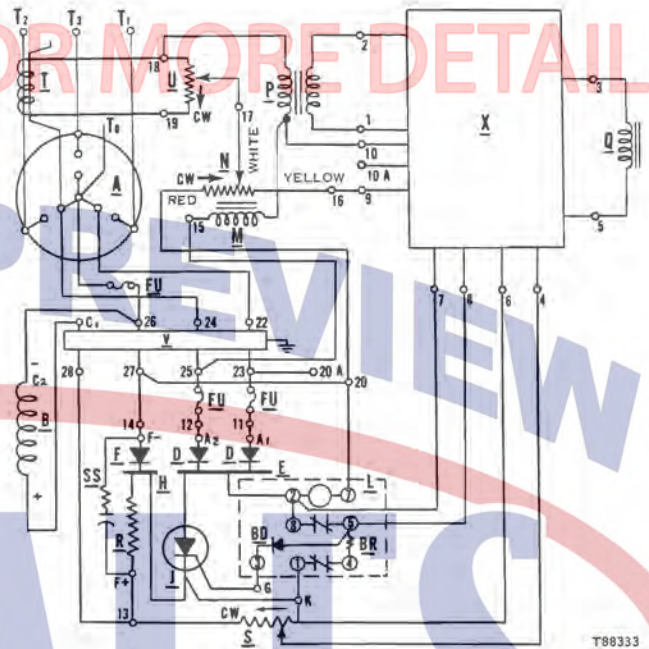


GENERATOR STATIC EXCITER AND REGULATOR ASSEMBLY
D311 and D320 SRCR Generators Illustrated.

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GENERATOR TROUBLE SHOOTING GUIDE

Generators above Serial No. 200

SRCR GENERATOR
WIRING DIAGRAM115-230 VOLT SRCR GENERATOR*
WIRING DIAGRAM

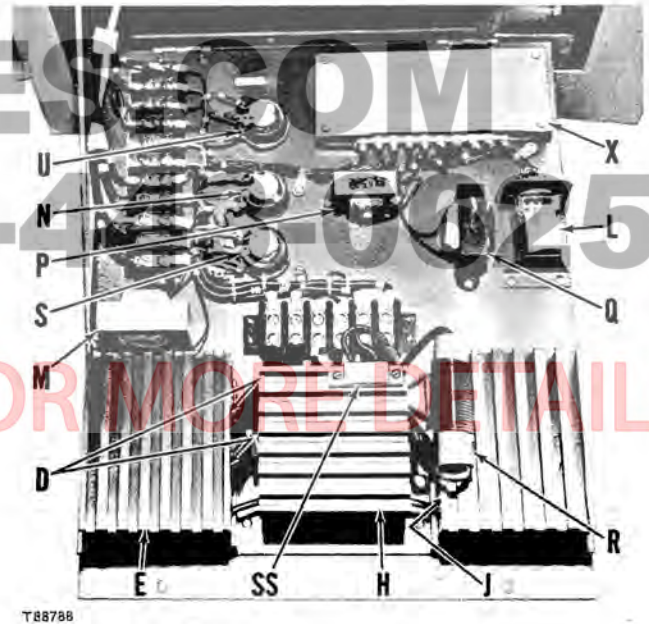
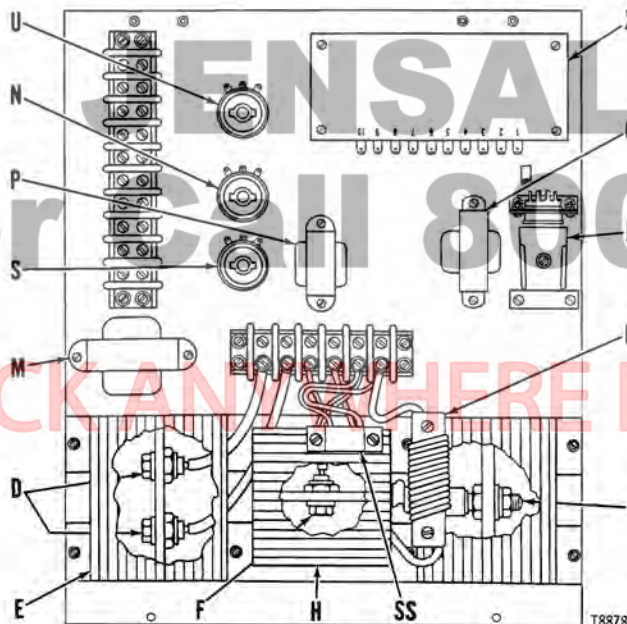
*Reconnect red wire at terminal 20 to 20A and wire at terminal 10 to 10A for 125/250 volt single phase operation.

A-Stator.
B-Revolving field.
D-Power rectifier.
E-Main heat sink.
F-Field rectifier.
H-Auxiliary heat sink.
J-Controlled rectifier.
L-Build-up relay.

M-Sensing reactor.
N-Voltage level potentiometer.
P-Isolation transformer.
Q-Filter choke.
R-Regulator gain resistor.
S-Regulator gain potentiometer.
T-Voltage droop transformer.
U-Voltage droop potentiometer.

V-Noise suppression unit.
X-Regulator assembly.
BD-Blocking rectifier.
BR-Build-up relay resistor.
FU-Fuses.
SS-Surge suppressor**

**If not equipped with a surge suppressor, it can be installed.



GENERATOR STATIC EXCITER AND REGULATOR ASSEMBLY

GENERATOR

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TROUBLE SHOOTING GUIDE

FAULT CONDITION	POSSIBLE CAUSE
II. AC Voltage too Low	A. Faulty Voltmeter B. Engine Speed Too Low C. Voltage Level Adjustment Too Low D. Voltage Droop Too High E. Regulator Gain Too Low F. Incorrect Generator or Exciter Connections G. Overload or Unbalanced Load H. Open Power Rectifier (Phase Diode) I. Open Regulator Gain Potentiometer J. Open Noise Suppression Unit K. Defective Voltage Regulator Assembly L. Isolation Transformer (Incorrectly Connected)
FAULT CONDITION	POSSIBLE CAUSE
III. AC Voltage too High	A. Faulty Voltmeter B. Engine Speed Too High C. Voltage Level Adjustment Too High D. Voltage Droop Control Polarity Reversed E. Regulator Gain Too High F. Incorrect Generator or Exciter Connections G. Unbalanced Load H. Open Power Rectifier (Field Diode) I. Shorted Controlled Rectifier J. Open Noise Suppression Unit K. Open Voltage Reference Circuit L. Open Isolation Transformer M. Open Filter Choke N. Open Regulator Gain Potentiometer O. Defective Build-Up Relay P. Regenerative Load Power Too High Q. Defective Voltage Regulator Assembly R. Isolation Transformer (Incorrectly Connected)
FAULT CONDITION	POSSIBLE CAUSE
IV. AC Voltage Unstable	A. Faulty Voltmeter B. Engine Speed Unstable C. Load Fluctuations D. Loose Connections E. Defective Voltage Build-Up Relay F. Engine Low Idle Speed Too Low G. Defective Brushes or Poor Brush Seating H. Regulator Gain Adjustment Too High I. Noise Suppression Capacitors Leaky J. Excessive Vibration of Exciter Components K. Defective Voltage Regulator Assembly

INITIAL OPERATING PROCEDURE AFTER REPAIR

The engine should not be operated at rated RPM immediately after the cause for the fault condition has been repaired. The following procedure may prevent additional failures if the **actual cause** of the fault condition was not detected.

1. Remove build-up relay **L** and disconnect wire **8** from regulator assembly **X**.
2. Start the engine and operate it at low RPM. The residual magnetism in the field should produce approximately 2 to 10 volts (generator output). A shorted controlled rectifier **J** will allow the field to produce higher output voltage.
3. Stop the engine and install build-up relay **L**.
4. Start the engine and operate it at low idle RPM. The output voltage will vary (up and down) when the points in the build-up relay are properly operating. If the output voltage is 2 to 10 volts and steady either the build-up relay points are open or the controlled rectifier is open (or the blocking rectifier **BD** is open, if the generator is so equipped). If the build-up relay points remain closed, generator voltage will be higher and steady.
5. Stop the engine and reconnect the wire to terminal **8**.
6. Start the engine and operate it at low RPM. The output voltage should be approximately 66% of generator rated voltage. If the output voltage is either too high or is not steady the reference circuit may be open or the regulator assembly may be defective.
7. With the engine operating at low idle RPM and the generator producing a steady voltage (approximately 66% of rated voltage), slowly increase the RPM to rated RPM. Adjust the voltage level control to generator rated voltage. The generator is now ready to use.

TROUBLE SHOOTING DETAILED GUIDE

I. No AC Voltage

WARNING

Refer to the warning on Page 1 before proceeding with any of the following checks.

NOTE

NO AC VOLTAGE could have been preceded by a transient condition of high AC voltage. If the excitation circuit is equipped with fuses, this high voltage could have "blown" a fuse. Installing a new fuse will not correct the condition of high transient AC voltage. A substitute fuse must not be used. See topic III. AC VOLTAGE TOO HIGH.

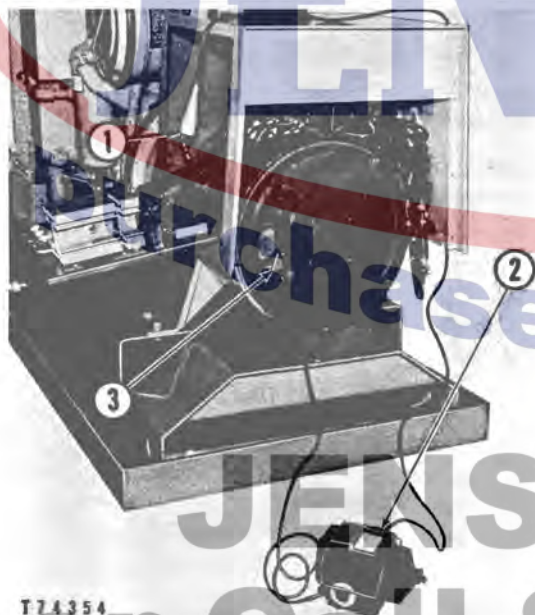
A. Faulty Voltmeter

1. Check voltage with a meter known to be accurate.
2. Check fuses and connections in switch-gear voltmeter circuit.

B. Open or Short Circuit

1. Disconnect lead **C2** from terminal **26** and **C1** from terminal **13** (disconnect **C1** from the noise suppression unit if the generator is so equipped). Check the continuity of the rotating field through these disconnected leads. Measure the resistance using a Kelvin or Wheatstone Bridge across the slip rings. Resistance should measure between .5 and 1.5 ohms on high voltage generators and between .25 and .5 ohms on low voltage generators.
2. Disconnect the generator leads from the load. Disconnect the stator from terminals **22**, **24** and **26**. Check the continuity of the stator through terminal leads **T1**, **T2** and **T3**. Use a Kelvin or Wheatstone Bridge to measure the resistance of the stator. Resistance should measure less than .1 ohm.

C. Grounded Circuits



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FIG. 2. ROTATING FIELD INSULATION TEST
1-Positive lead. 2-Megohmmeter. 3-Rear fan.

1. See Fig. 2. Disconnect leads **C2** from terminal **26** and **C1** from terminal **13** (disconnect **C1** from the noise suppression unit if the generator is so equipped). With positive lead (1) of megohmmeter (2) connected to either **C1** or **C2** and the negative lead connected to a blade of rear fan (3), measure the insulation of the rotating field. The insulation should measure no less than 1 megohm.

NOTE

Insulation resistance measures should be taken with the windings above ambient temperature. Moisture and/or foreign materials in the windings will affect the measures. Generator drying procedures are covered in the Operation and Maintenance Instructions.

2. See Fig. 3. Disconnect the generator leads from the load and insulate the neutral (if the generator is a 10 lead wire generator, connect leads **T1** to **T7**, **T2** to **T8**, **T3** to **T9** and **T4**, **T5**, **T6** to **T0** — these four connected leads are neutral). Disconnect the stator from terminals **22**, **24** and **26**. With positive lead (1) of megohmmeter (2) connected to either **T1**, **T2** or **T3** and the negative lead connected to generator cover, measure the insulation of the stator winding. The insulation should measure no less than 1 megohm for generators rated under 600 volts and no less than 3 megohms for generators rated up to 2400 volts.

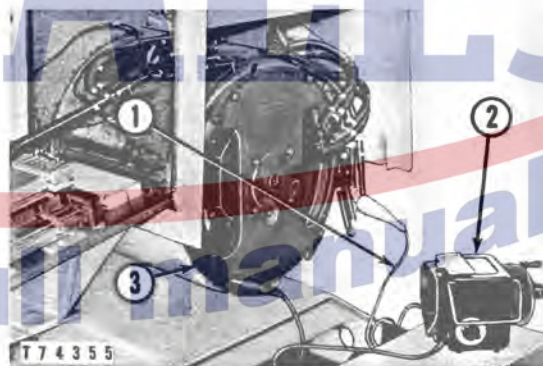


FIG. 3. STATOR WINDING INSULATION TEST
1-Positive lead. 2-Megohmmeter. 3-Generator cover.

D. Shorted Power Rectifiers (Phase Diodes)

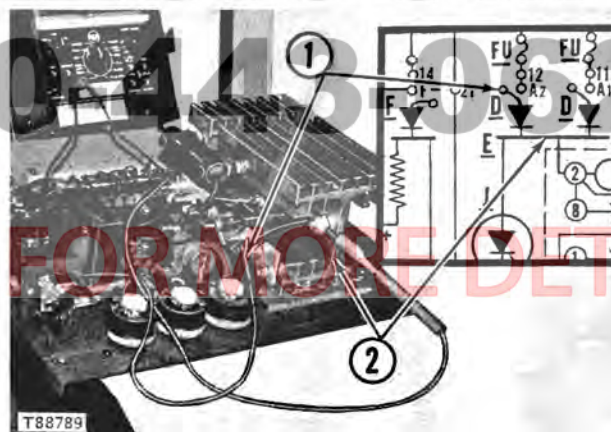


FIG. 4. POWER RECTIFIER REVERSE RESISTANCE TEST
1-Negative lead. 2-Main heat sink.