J86250A VOLTAGE REGULATOR AND EXCITER OPERATING METHODS

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1. GENERAL

1.01 This section covers the operation of the J86250A voltage regulator and exciter.

1.02 This section is reissued to delete the information under the heading How the Voltage Regulator Works, to revise the List of Tools and Gauges, to delete the information for checking the droop setting, to delete the chart entitled Lead in Per Cent Versus CC Test Voltmeter Reading and the schematic, to delete the information covering the saturating current, and to amplify the information covering the replacement of rectifier stacks.

1.03 The J86250A voltage regulator and exciter is designed for use with the 302A and 301C← power plant and functions with the charging generators to maintain the central office battery voltage within closely predetermined limits regardless of any changes in the central office load on the battery. When properly connected to an appropriate dc generator which is floating or charging a 1000-ampere-hour or larger storage battery and which is connected to a load where the instantaneous demand does not exceed 30 per cent of the full-load rating of the generator, the instantaneous deviation from the floating or charging voltage measured at the point of regulation will not exceed ±1 per cent.

Caution: The voltages in this unit exceed 150 volts to ground. Operation of the AC contactor does not de-energize the whole unit. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time or destructive and dangerous short circuits may occur. Disconnect ac supply before working on regulator except when necessary to make tests.

1.04 When the voltage regulator is properly connected to an appropriate dc generator and is correctly adjusted, the generator will be automatically protected from overload by the constant current feature of the exciter circuit which provides a smooth transition from voltage regulation to current regulation at one of two preselected values of load current. These transition points may be chosen at any value of output current from 50 to 100 per cent of the full-load rating of the generator set.

1.05 On some early models, the front panel designation for the F1 fuse is marked as 1FN instead of F1. This is a reference to the size of the fuse contained, that is, 1-ampere Fusetron. Models so equipped will not have an F2 fuse. In this section, reference to F1 fuse will be understood to mean either the 1-ampere Fusetron or the 70A fuse contained in later models.

1.06 For more detailed information on the operation and maintenance of individual pieces of apparatus, refer to the appropriate Bell System Practice.

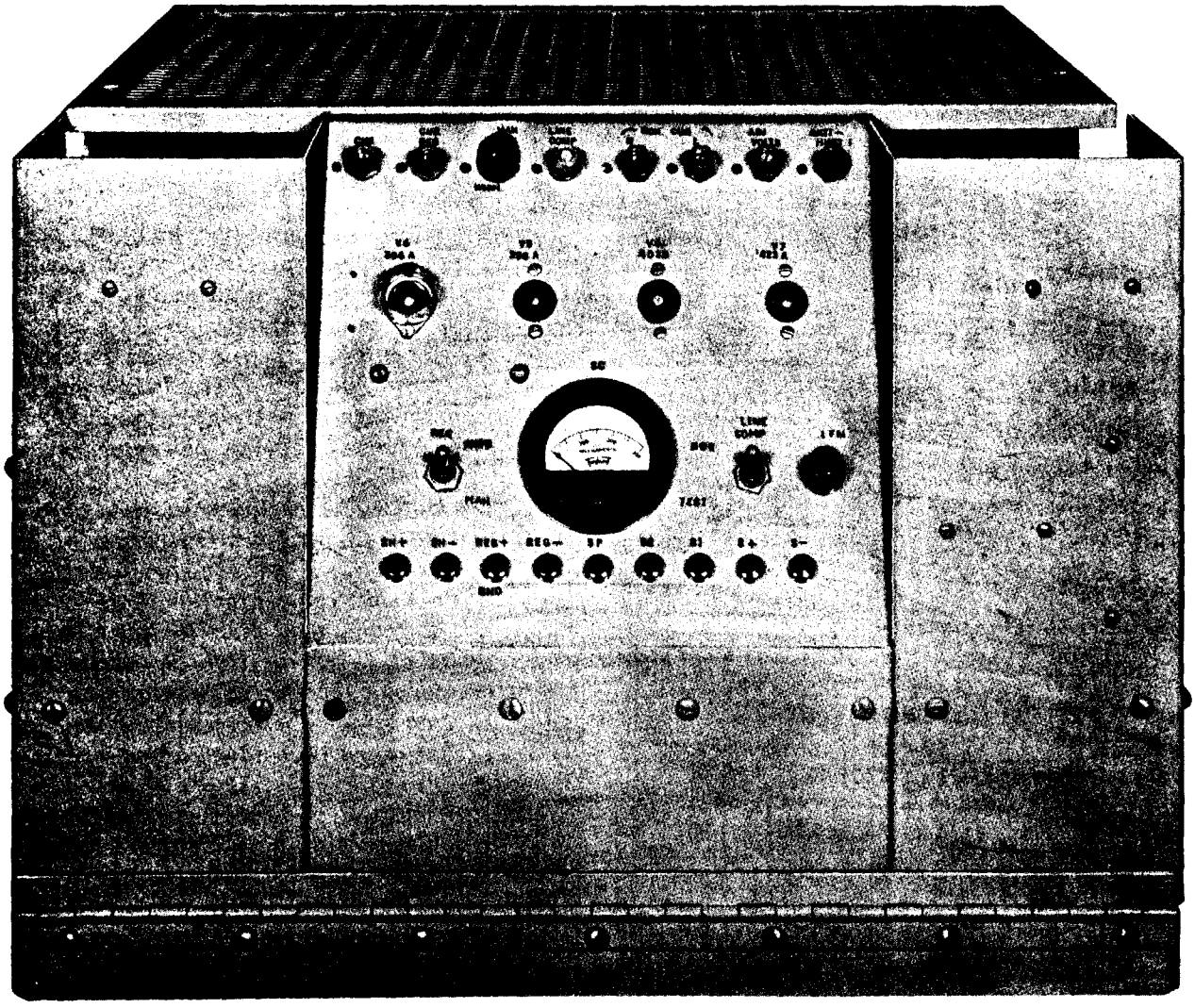

Fig. 1 — J86250A Voltage Regulator and Exciter (early model shown without tubes)

1.07 Routine checks are intended to detect defects, particularly in infrequently operated parts of the equipment, and, insofar as possible, to guard against circuit failures likely to interfere with service. Checks and adjustments, other than those required by trouble conditions, should be made during a period when they will cause the least unfavorable reaction to service.

1.08 The abbreviations cw and ccw used in this section stand for clockwise and counterclockwise, respectively.

1.09 The instructions in this section are based on drawing SD-81147-01. For detailed description of the operation of the circuit, see the corresponding circuit description.

2. TOOLS AND GAUGES

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
→ —	3-Inch C screwdriver (or the replaced 3-inch cabinet screwdriver)
GAUGES	
KS-14510 L1	Volt-Ohm-Milliammeter
R-1032, Detail 1	Thermometer
—	Electronic Voltmeter, Ballantine Laboratories, Inc Model 300U/3 or Equivalent

3. OPERATION

Preparing to Start Initially

3.01 When preparing to put the voltage regulator into service initially, check that:

(a) The REG key is in the AUTO position.

(b) T6 transformer is connected to input A and C leads when the local power service is 230 to 240 volts.

(c) All electron tubes are correct and in place.

(d) F1 and F2 fuses are in place.

(e) All external connections are made in accordance with the SD circuit diagram and other associated plant circuits.

(f) The CON CUR H, CON CUR L, and LINE COMP potentiometers are turned fully cw. The CHG, CUR REG, MAN, ADJ VOLTS, and ANTIHUNT 1 potentiometers are turned fully ccw. ANTIHUNT 2 potentiometer, mounted on the back of the control panel (see Fig. 2), is factory-set and should not be disturbed, except as specified in 4.14.

Initial Adjustments

3.02 After requirements of 3.01 have been satisfied, adjust the voltage regulator in accordance with the initial adjustments section of the associated plant.

Routine Adjustments (normal operation)

3.03 Under normal operation, the voltage regulator is completely automatic and receives all operating signals from the associated charging generator circuit. The current flowing in the dc coil of L1 saturable reactor will be indicated on SC milliammeter and will normally read between 40 and 170 milliamperes. This current will increase when load is applied to the generator and decrease when the generator load is removed.

4. TROUBLES

4.01 When any kind of trouble is encountered, it is first necessary to decide whether to locate the trouble with the equipment operating or de-energized. This voltage regulator has been designed to make some parts accessible for testing with the power connected. Test jacks are mounted in the face of the panel, which is accessible at all times. Trouble is easier to find if the equipment can be fully energized but, if the trouble is of a nature that causes excessive output from the equipment, it will be necessary to take the initial steps with the system de-energized, energizing it in subdivisions for short periods only, while electrical measurements are made. Also, operation for more than a few minutes at a time while trouble exists, even though the output may not be excessive, may result in overheating of some component. It is essential when testing to be alert for the need to quickly shut down the regulator at any time until the trouble is localized and cleared.

4.02 In general, the only items likely to become defective with use are the electron tubes and rectifier stacks.

4.03 Check the electron tubes when necessary using whatever electron tube tester is available.

4.04 Rectifier stacks will age with use so that after a period of years it may be necessary to change the connections to the associated transformer taps. T3 and T5 transformers have such aging adjustment taps available. Eventually, rectifier stacks and diodes may have to be replaced. When replacement is required, proceed as covered in 4.05 and 4.07.

Rectifier Stack Replacement

4.05 ***Selenium Rectifier Stacks:*** Selenium rectifier cells may fail due to aging, which is an increase in the resistance of the cells. The replacement of only the defective stack in the rectifying element that consists of more than one stack may result in an unbalanced condition in the rectifying element. To avoid unbalance, replace stacks as follows.

(a) When replacing a defective stack or stacks in a multiple stack element, replace all other stacks in the element that have been in service 2 years or longer.

(b) Do not combine stacks of different list numbers or different manufacturers.

(c) Never attempt to replace part of the rectifier cells in a stack or bolt assembly. Always replace the entire stack.

4.06 If the rectifier stacks seem warm, check the temperature with the R-1032 thermometer inserted between the radiating fins with

Fig. 2 — J86250A Voltage Regulator and Exciter (open)

the bulb near the bolt. If the temperature approaches 90 C, the stacks are probably nearing the end of their useful life and the supervisor should be notified so that replacement of stacks may be considered.

4.07 ***Silicon Diodes:*** When replacements are required, do not combine silicon diodes produced by different manufacturers.

4.08 The control potentiometers should be replaced if they become defective.

Trouble Chart

4.09 Should any of the following troubles develop, it is suggested that the possible causes be checked in the order given. See 4.10 through 4.14. If the trouble is not found, look for loose or open connections or short circuits due to foreign matter lying across wiring terminals. If a check of the possible causes listed in the following chart does not locate the trouble, it is advisable to make resistance measurements with the circuit completely de-energized, comparing the measured values with the values shown on the circuit drawing.

TROUBLE	POSSIBLE CAUSE
Rated output or field current not obtainable with saturating current maximum under MAN control	Poor connection in field circuit
	RV6 rectifying element has high resistance because of aging. Change taps on T5 transformer
	V1 or V2 electron tube failure or weak
Output excessively noisy	Harmonic filter circuit open
	C16 and C17 filter capacitors aged or defective
	L4 field inductor short-circuited
	Defective cells in RV6 rectifying element
No control with the ADJ VOLTS potentiometer, no output. Operation satisfactory under MAN control	V4 electron tube—no emission
	V6 electron tube—no emission
	V5 electron tube—no emission (2-3-4 half)
	V5 electron tube—shorted (6-7-8 half)
	CON CUR H potentiometer out of adjustment (too far ccw)
No control, high output. Operation satisfactory under MAN control	V7 electron tube failure
	REG fuse blown in associated plant
	Contacts of RT relay in associated plant dirty or open
No control, high output. Operation unsatisfactory under MAN or AUTO control	V3 electron tube failure
	V2 electron tube shorted (grid to cathode)
	Output of exciter too high due to high line voltage with light load
No control, no output. Operation unsatisfactory under MAN or AUTO control	V1 electron tube—no emission
	V2 electron tube—no emission
	F1 fuse operated ac failure
	F2 fuse operated ac regulator fuses operated

TROUBLE	POSSIBLE CAUSE
Poor regulation	RT relay not operated
	Leaky diode section of V5 electron tube
Regulator instability on constant current	AH1 or AH2 misadjusted
	Faulty V4 electron tube, machine operated on unstable portion of characteristic, LC misadjusted
No control with CON CUR H potentiometer for load in excess of 75 per cent rating, will not limit current, voltage regulation satisfactory	LINE COMP potentiometer out of adjustment (too far cw)
	V5 electron tube—no emission (6-7-8 side)
No control with CON CUR H potentiometer for load in excess of 75 per cent rating, current limited to zero at all times but removal of V5 tube results in normal voltage regulation	V5 electron tube — shorted (6-7-8 side)
	V6 electron tube—no emission
	LINE COMP potentiometer out of adjustment (too far ccw)
	Open circuit or high resistance in contacts of CRL relay or its equivalent in associated plant
Drop or droop not steep enough to make required adjustment	Failure of RV4A or RV4B diode
	V5 electron tube — low emission
	V6 electron tube — low emission

Trouble Analysis — Single Machine Operation

4.10 To isolate the trouble, perform the checks shown below with the associated generator bay control keys in the TEST position and the voltage regulator disconnected from the battery. To disconnect the voltage regulator from the battery, open the generator switch located in the generator bay when the generator voltage is below battery voltage.

(a) Operate the REG key of the voltage regulator to the MAN position and rotate the MAN potentiometer. If voltage control is possible, the saturating circuit is in proper operating condition.

(b) If the voltage is too low with the REG key in the AUTO position, check the adjustment of the ADJ VOLTS potentiometer. If there is no control, operate the ADJ VOLTS potentiometer fully ccw, remove the V5 electron tube, and recheck the ADJ VOLTS control. If proper control is obtained, the trouble is in the current control section.

(c) If the voltage is too high with the REG key in the AUTO position, check the adjustment of the ADJ VOLTS potentiometer. If there is no control, replace V7 tube.

4.11 Suspected trouble in the current control section of the voltage regulator can be checked by the following tests. With LINE COMP, CON CUR H, and CON CUR L potentiometers adjusted normally, a 1000-ohms/volt or a 20,000-ohms/volt voltmeter should indicate a dc voltage of 100 to 120 volts across C4 capacitor. If this voltage is not obtained, the settings of LINE COMP and CON CUR H potentiometers should be marked. Rotate either or both of the potentiometers. If the dc voltage across C4 capacitor does not vary, check for an open circuit in the pulse source circuit or failure of one or both of the RV4A and RV4B diodes. The contacts of CRL relay (or its equivalent), which connects CCL1 and CCL2 or CCL3 leads, should be checked. If an oscilloscope is available, it is possible to check RV4A and RV4B diodes by observing whether the unfiltered normally full-wave dc across C20 capacitor is only half wave. A half-wave indication or an otherwise distorted waveshape indicates that one or both diodes are damaged and must be replaced. To make a rapid check, bridge a spare diode across the suspected diode.

4.12 If the checks in 4.11 do not locate the trouble, proceed as follows.

(a) Using a high resistance voltmeter (at least 20,000 ohms/volt), measure the grid to cathode voltage of V4 electron tube. This voltage should be between −1 and −2 volts. If the grid voltage is correct and adjustment of the ADJ VOLTS potentiometer has no effect, take point-to-point readings across the circuit elements between the ADJ VOLTS potentiometer and V4 electron tube and check against the circuit drawing values.

(b) If appropriate equipment is available, the gain of the ac amplifier can be measured and should be about 1000. The gain is equal to the dc voltage across C4 capacitor divided by the ac voltage across C10 capacitor (measured by a Ballantine electronic voltmeter).

4.13 Both sections of V2 electron tube should carry their portion of the load current. The currents in the two sections of the electron tube can be measured by reading the voltage drops across R29 and R30 resistors and these readings should not differ by more than 50 per cent. If the voltage reading across one resistor is more than twice the reading across the other resistor, replace the electron tube as it will cause trouble in the near future.

Trouble Analysis — Two Machines Operating in Parallel (G1 on constant current and G2 on voltage regulation)

4.14 If the machine hunts only when connected in parallel, increase the resistance of ANTIHUNT 2 potentiometer, mounted on the back of the control panel (see Fig. 2), by turning the shaft ccw until the hunting is reduced to a minimum.

Note: This adjustment is very critical. With too little resistance, severe hunting will result at low battery voltage such as is encountered after a power failure. Too much resistance will not provide sufficient damping of hunt at moderately low voltages when the machine is operating under current regulation.

5. POINT-TO-POINT VOLTAGES

5.01 ***Point-to-point voltages*** are given on SD-81147-01. Point-to-point voltages are not to be checked on a routine basis but may be useful in locating a defective component. These voltages will be typical for a regulator in normal working condition. Voltages under trouble conditions may be higher and should be measured with the voltmeter on a high range first to avoid damage to the voltmeter.

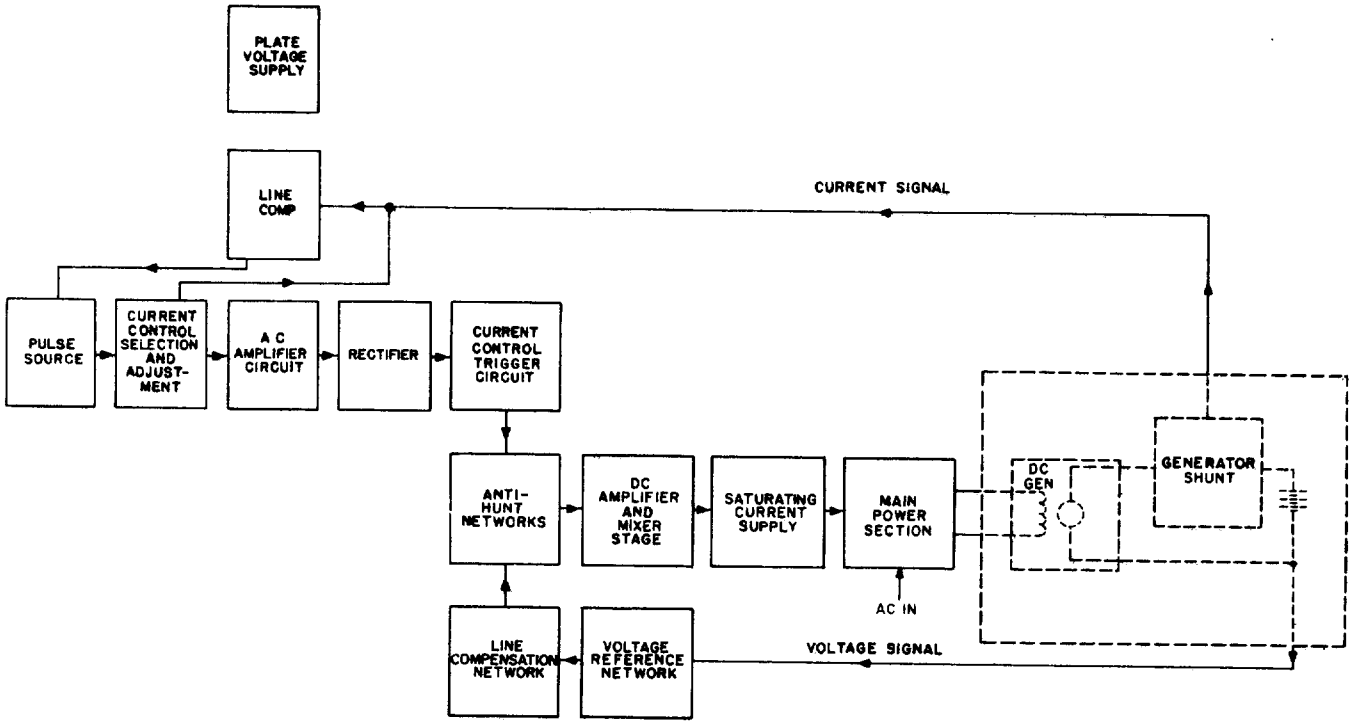

Fig. 3 — Block Diagram — J86250A Voltage Regulator and Exciter