Western Electric

20B RECTIFIER

Instruction Bulletin No. 1103

Issue 2

Western Electric

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Type

Full-wave vacuum-tube rectifier incorporating a vacuum-tube voltage-regulating circuit with provision for preventing the plate voltage from rising above its final value during the warm-up period of the voltage-regulator tube.

Typical Characteristics

Input — 105-130 volts, 50 to 60 cycles. Power consumption approximately 55W.-.7A at 115 volts for no load and 196W.-1.7A for rated load.

Output—Rated load-plate supply 110 milliamperes at 275 volts d-c and filament supply 10 amperes at 6.3 volts a-c.

Plate Supply Regulation—3 volts max. voltage change from no load and +10 per cent line voltage to rated load and −10 per cent line voltage.

Plate Supply Ripple—Approximately 5 millivolts rms at rated load.

Equipment Characteristics

Dimensions—Mat—19 5/32 x 6 31/32 inches.

Chassis — Overall including mounting flanges, 18 15/16 x 6 11/16 x 2 inches. Width of recessed section, 17 inches.

Maximum Depth of Apparatus—6 7/8 inches, from front edge of chassis.

Weight—26 pounds.

Mounting—Recessed panel type designed to mount vertically on standard relay rack or speech-input cabinet where it occupies 7 inches of panel space. May also be mounted horizontally on a flat surface by moving the power switch and potentiometer to either side wall of the chassis utilizing knock-outs provided.

Mat Finish—Aluminum gray (20B-15 Rectifier); black japan (20B-3 Rectifier). Aluminum gray furnished unles sotherwise specified.

Chassis Finish—Bright gray enamel.

Protection

A 2-ampere No. 902 Fustat (which is furnished) accessible from the rear of the chassis provides protection in the power input circuit for rated output load plus allowance for 10 per cent high line voltage. The fustat socket is arranged to prevent the use of higher amperage Fustats, but will accommodate one other Fustat of lower rating, the 1.8 ampere No. 9018 Fustat, which will permit somewhat closer adjustment for loads less than rated output.

> **NOTE**—Fustats must be screwed in with appreciable pressure to insure circuit continuity.

Mounting

Ten .216-24 x ½ inch Phillips recessed binding head screws are furnished with each rectifier. A corresponding Phillips No. 2 Point screwdriver will be required for use with these screws in mounting the rectifier. The chassis, less the mat, should first be mounted with four of the screws. The mat may then be mounted over the chassis and fastened directly to the cabinet using four more of the screws. The remaining two screws are spares. However, the mat should not be mounted until the adjustments described under "Operation" are completed.

If desired, the rectifier may be mounted

horizontally on a flat surface. This necessitates moving the power switch D1 and the adjustment potentiometer P1 to one or the other of the long side walls of the chassis. Knockouts are provided at these alternate positions for mounting the switch and the potentiometer. The bracket on which the potentiometer is mounted must be removed if the nearby alternate position in the side wall is used. After mounting the controls in the new positions, the wiring (which is of sufficient length to reach these positions) should be reconnected in accordance with the wiring diagram.

Connections-External

Terminals	Circuits
15-16	A-C power, 15 to grounded side of line
13-14	6.3 volt amplifier filaments, max. 5 amperes
11-12	6.3 volt amplifier filaments, max. 5 amperes
7-9	Ground terminals—connect one to a good ground
1-3-5	Plate supply, positive
2-4-6	Plate supply, negative

NOTE — Negative plate supply is grounded at the rectifier by a strap to terminal 7. In some cases, quieter operation may be obtained by grounding the negative at one of the amplifiers being supplied by the rectifier, in which case disconnect the strap from terminal 6 to 7.

Use 14-gauge twisted-pair copper wire for a-c power. Use shielded twisted-pair copper wire for amplifier filaments and plate supply-22 gauge or larger for plate supply.

If individual pairs are used for the filament of each amplifier the wire may be as small as No. 18 gauge if the length is such that the voltage drop in the wire does not exceed 0.2 volt. If one pair of wires is used for more than one amplifier, its size should be such that the current-carrying capacity of the wire is not exceeded and the voltage drop in the wire is not more than 0.2 volt. When the total filament load is taken on a number of pairs, the connections of these pairs should be distributed between the two sets of filament supply terminals so as not to exceed approximately 5 amperes per set.

Vacuum Tubes

The following vacuum tubes are required for operation of this rectifier and must be ordered separately.

1 Western Electric 274A or type 5Z3

1 Western Electric 300B or type 2A3

1 Western Electric 351A or type 6X5 or type 6X5G

1 Western Electric 348A or type 6J7 or type 6J7G

1 Western Electric 313C

NOTE—Special instructions when Type 2A3 tube is used:

1. Limit 275 volts output load to 75 milliamperes for optimum tube life.
2. Make sure filament voltage at socket VS2 is 2.5 volts instead of 5 volts as furnished. 2.5 volts are obtained by moving the WHITE-GREEN wire, normally on terminal 5 of transformer T1, to terminal 6. The WHITE-RED wire normally connected to terminal 6 should remain connected.

CAUTION—High voltages are exposed to the operator's touch whenever the mat is removed. High voltages may be present even with the a-c power off or disconnected. For example, across the filter condensers C1 and C2 after failure or removal of the 300B or 2A3 tube during operation. Exercise extreme care at all times when mat is not in place to avoid contact with dangerous voltages.

Operation

After the rectifier has been installed and connected it should be equipped with vacuum tubes as listed above. The locations of the tubes in their respective sockets can be ascertained by the tube markings stamped beside each vacuum-tube socket.

WARNING—Before operating the power switch to turn on the rectifier for the first time, be sure that the potentiometer P1 has been turned to the extreme counterclockwise (min. voltage) position, to avoid delivering a higher voltage at the output than the external apparatus connected to the output can stand.

To place the rectifier and associated amplifiers in operation, connect a 1000 ohms per volt voltmeter across the d-c output and operate the power switch to the "ON" position. After allowing 10 or 15 minutes for the rectifier to reach stable operating temperature, adjust the potentiometer P1 until 275 volts is obtained at the output. Turn off power switch, disconnect the voltmeter, replace the mat over the chassis, and the equipment is ready for use.

Circuit Description

A brief description of the functions of the more important elements in this rectifier will clarify the manner in which it operates. Referring to the schematic Figure 1, V1, C1, L1 and C2 comprise a conventional full-wave rectifier with filter delivering approximately 700 volts to the 300B tube, V2, which acts as a variable impedance in series with the positive output circuit reducing this voltage to the value determined by the setting of P1, normally 275 volts. During operation, a fraction of the output voltage is taken by the voltage divider, R1, R2.1, P1 and R2.2, amplified by the 348A tube, V4, and applied to the grid of V2 where it varies the plate impedance of this tube in accordance with small changes in output voltage, thus compensating for the change and maintaining the output voltage constant.

The 313C tube, V5, is a cold-cathode gas-filled tube whose function is to establish a reference voltage against which variations in the a-c line and output voltages can be corrected. This tube requires about 70 volts for initial ionization, after which the voltage sustained across the control gap is approximately 60 volts independent of the current.

The function of V3, the 351A tube, is to limit the output voltage at terminal 1 during the warm-up period of V4. This prevents excessive voltage on the plates of the vacuum tubes in the associated amplifiers while the filaments are heating. When the rectifier is first turned on and V1 and V2 become operative the gas tube V5 is ignited at once by voltage applied through V2, R5, R3 and R2.3, and a potential of approximately 60 volts is established across V5. The resistance of R3 and R2.3 combined is low relative to the resistance of R5 so that the cathode and plate of V4, and the grid of V2 are also at a potential of approximately 60 volts. Under these conditions V4 is inoperative and the grid of V2 is highly negative in respect to its filament, consequently its plate resistance is high, limiting the voltage on output terminal 1. During this period V3, being a heater type tube, is non-conducting. As V3 warms up simultaneously with V4 and passes current, R5 is effectively shorted out; current flows through R4 to the plate of V4 creating a potential difference between the plate and cathode of this tube so it can function normally. At the same time this increase of voltage on the plate of V4 is equivalent to a reduction in bias between the filament and plate of V2 which lowers the plate resistance and increases the output voltage until equilibrium is established by the regulator circuit at the voltage determined by the setting of P1.

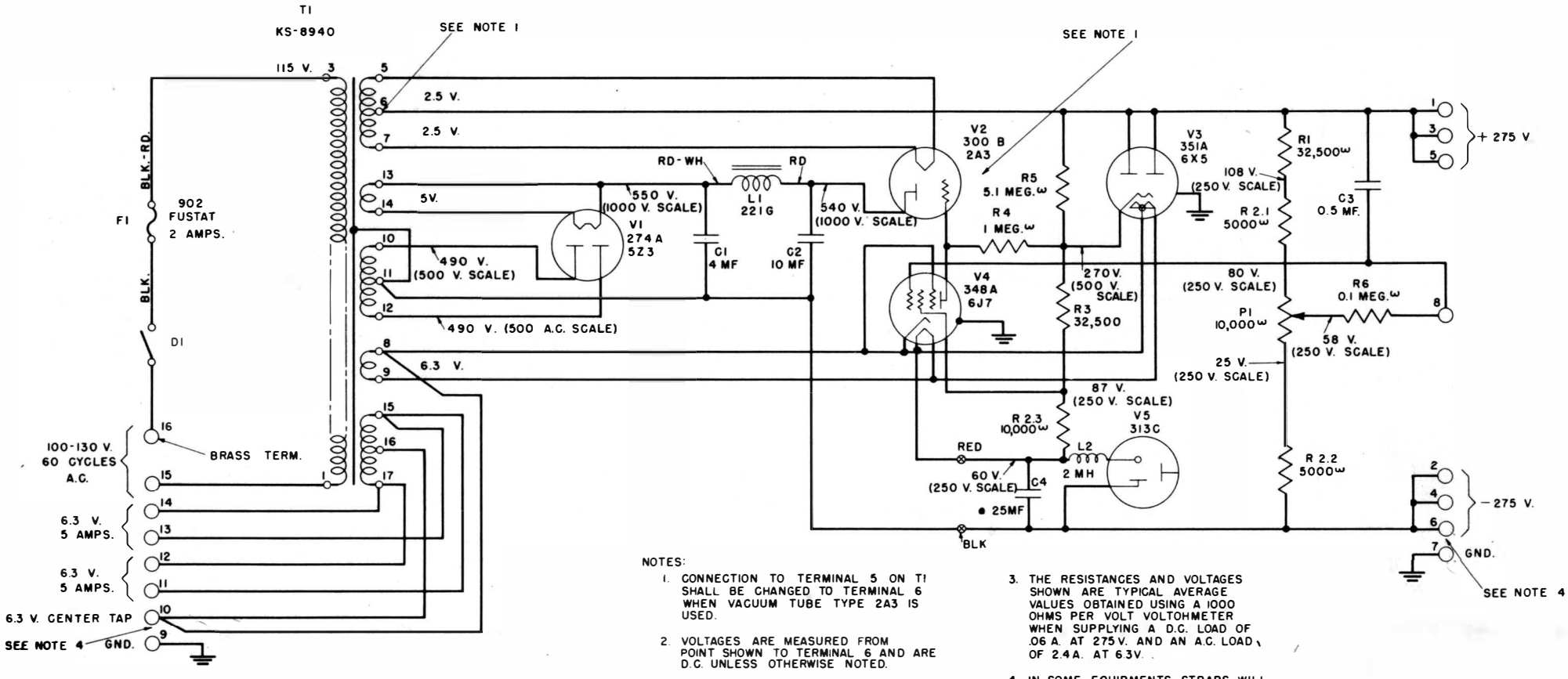
In this connection, it should be noted that P1 is provided primarily to adjust for aging of the gas tube V5 and for commercial variations in the resistors used in the regulator circuits. However, output voltages higher or lower than 275 volts may be obtained by adjustment of P1 with the following limita-

tions. As the output voltage is increased the load current which can be obtained without loss of regulation will be reduced. Typical maximum load current values are 20 milliamperes at 450 volts and 70 milliamperes at 375 volts. The output voltage should not be adjusted to more than 450 volts otherwise the current through the 313C tube will exceed its rated value of 10 milliamperes. As the output voltage is decreased the load which must be absorbed by the 300B tube V2 increases and the output current capacity must correspondingly be reduced to avoid overloading the 300B tube. Typical limiting values of output current for several output voltages below 275 volts which will give the same dissipation in the 300B tube as at rated load are 90 milliamperes at 250 volts and 72 milliamperes at 204 volts. At very low output currents and low output voltage some loss in regulation will result. On a typical rectifier supplying a load at 225 volts, 5 milliamperes, the output voltage varied only 0.4 volt for a change in line voltage from 100 to 130 volts. At 210 volts, 5 m.a., the d-c output followed a-c line voltage fluctuations above 122 volts with variations as much as 2 volts.

Maintenance

Test points are provided for determining the operating characteristics of V5. The voltage across this tube when measured with a voltmeter of at least 1000 ohms per volt should not exceed 65. While the tube may function when the voltage drop across it is in excess of 65, the noise level of the rectified voltage will become excessive and the regulating circuit may oscillate. Consequently, the tube should be replaced.

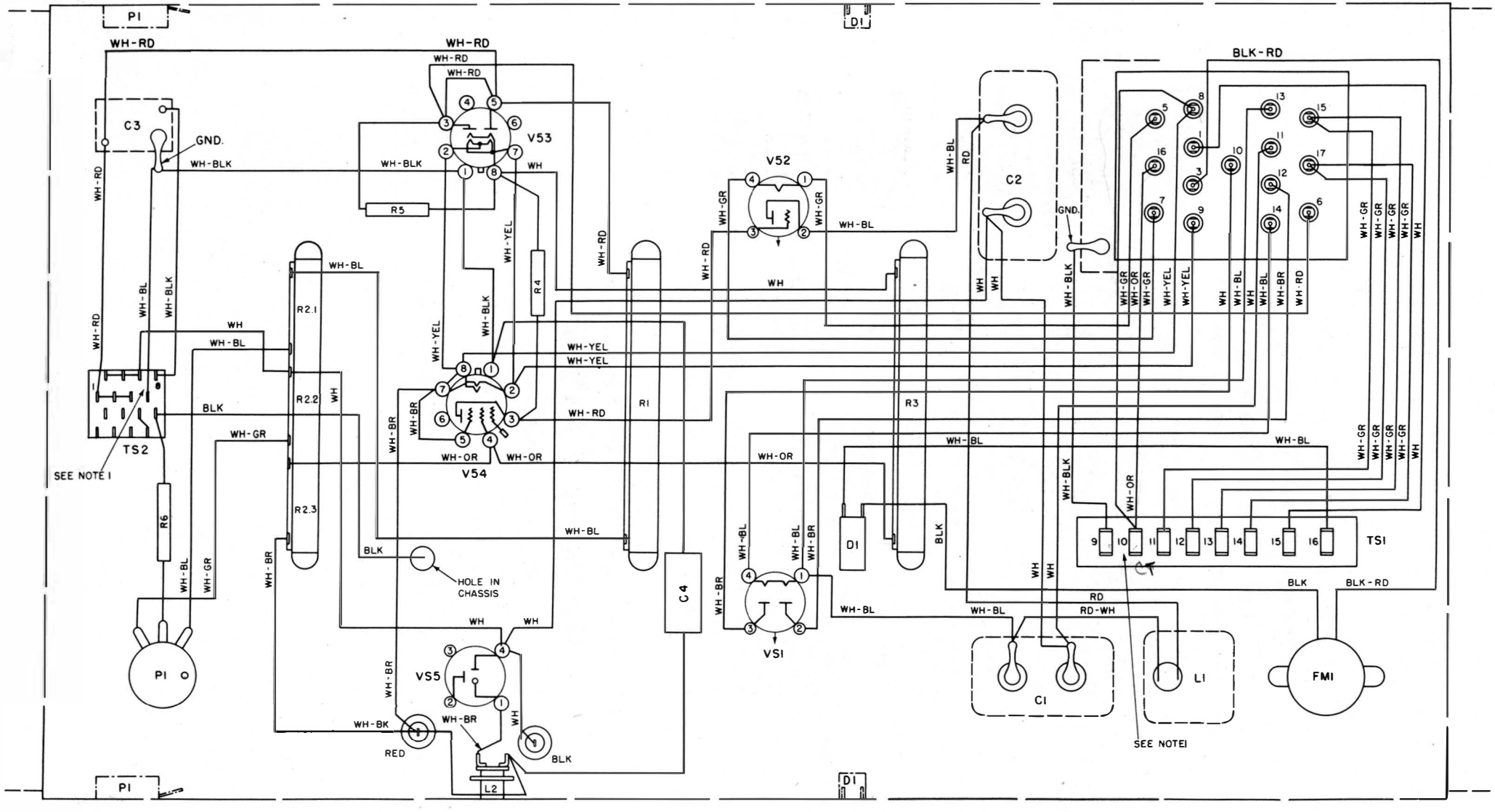
If replacement parts are required for the 20B rectifier they may be procured through the nearest distributor.



NOTES:

1. CONNECTION TO TERMINAL 5 ON T1 SHALL BE CHANGED TO TERMINAL 6 WHEN VACUUM TUBE TYPE 2A3 IS USED.
2. VOLTAGES ARE MEASURED FROM POINT SHOWN TO TERMINAL 6 AND ARE D.C. UNLESS OTHERWISE NOTED.
3. THE RESISTANCES AND VOLTAGES SHOWN ARE TYPICAL AVERAGE VALUES OBTAINED USING A 1000 OHMS PER VOLT VOLTOHMETER WHEN SUPPLYING A D.C. LOAD OF .06 A. AT 275 V. AND AN A.C. LOAD OF 2.4 A. AT 6.3 V.
4. IN SOME EQUIPMENTS, STRAPS WILL BE FOUND CONNECTING TERMINALS 6 & 7 AND 9 & 10. THESE MUST BE REMOVED BEFORE POWER IS APPLIED TO APPARATUS.

Fig. 1—Schematic



NOTE:
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Fig. 2—Wiring Diagram

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