Western Electric

1126C PROGRAM OPERATED LEVEL GOVERNING AMPLIFIER

20B RECTIFIER

INSTRUCTION BULLETIN NO. 1199, ISSUE NO. 1

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1126C PROGRAM OPERATED LEVEL GOVERNING AMPLIFIER

Research and design by Bell Telephone Laboratories

INSTRUCTION BULLETIN NO. 1145 ISSUE NO. 1

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Typical Electrical Characteristics

Gain 52 ± 2 db maximum with all input and output fixed attenuators omitted (35.5 ± 2 db as shipped with 10 db input and 6.5 db output attenuators connected) when working from 600 ohms and into 600 ohms, both adjustable attenuators at zero attenuation.

Input Level Range— −30 dbm* to +20 dbm

Output Level Range— −7 dbm to +18.5 dbm

Program Level Range—Deduct 6 to 10 db from above values to allow for peak factor.

Operates from 600 ohms (circuit not balanced to ground)

Operates into 600 ohms (circuit not balanced to ground)

Output Power +18.5 dbm (as shipped and with adjustable output attenuator at zero) when gain reduction starts. (+25 dbm maximum with all output fixed attenuators omitted).

Output Noise— −45 dbm (unweighted) with input terminated. 63 db below output level available when gain reduction starts.

Output Distortion — For Program: Less than 1% for all operating conditions up to 5 db compression. For single audio frequency tone: (a) Below compression; less than 1%. (b) For 5 db compression less than 1% for frequencies above 200 cycles and not more than 2% for frequencies as low as 50 cycles. (c) For 15 db compression, less than 2% for frequencies above 200 cycles, and not more than 5% for frequencies as low as 50 cycles. The distortion under conditions of compression occurs only during the short intervals of time the compression is in effect.

Frequency Characteristic—Flat within 1 db of the 1000 cycle value over the range 30 to 15,000 cycles.

Compression Ratio (Single frequency audio tone)—10:1 (10 db input increase results in 1 db output increase above point at which gain reduction starts.)

Recovery Time—Variable in 5 steps of 0.2 seconds each from 0.2 second to 1 second. Optional adjustment permits variation from 0.1 to 0.5 second.

Power Supply—105 to 125 volts, .7 amperes, 50 to 60 cycle a-c.

Dimensions—Panel 19$\frac{5}{32}$" wide by 19$\frac{1}{4}$" high (approximately) 126C Amplifier — 7 inches of rack space 298A Control Panel —5$\frac{1}{4}$ inches of rack space 20B Rectifier —7 inches of rack space

Weight—Approximately 49 pounds.

Mounting—All units are recessed panel type primarily intended for relay rack or equipment cabinet mounting.

The three units are furnished assembled and wired together as a unit but may be separated if desired for other types of installation.

Finish—Mats: Dark Aluminum Gray (designated 1126C-15) or Black Japan (designated 1126C-3). The 1126C-15 will be furnished if not otherwise specified.

Chassis: Bright Aluminum Lacquer.

*dbm—level referred to .001 watt.

General Description

The Western Electric 1126C Program Operated Level Governing Amplified was designed primarily for use in AM and FM broadcasting system installations. It has been successfully applied in other systems such as recording and sound systems where automatic regulation of program level is desired. The gain of this amplifier, above a certain predetermined level, is controlled by the amplitude of the program, with the result that high peaks of the program are kept below a predetermined level. In broadcasting installations this permits an increase in the average modulation of the transmitter. The automatic level governing action of the amplifier reduces the probability of overloading by program peaks and thus eliminates (1) splash or short interval adjacent channel interference due to instantaneous over-modulation of an AM transmitter, (2) overswing in FM transmitters which may cause over-riding of the guard band as well as distortion in the receiver, (3) instantaneous overload and consequent distortion in other transmission systems.

The amount of level governing which can be employed depends on the program material being transmitted and the degree of dynamic fidelity desired. While it is recommended that 5 db of compression not be exceeded on programs which require transmission over a wide dynamic range, this equipment is capable of operating with as much as 15 db compression; it, therefore, imposes no limitations on operation in such a manner. However, peak limiting of this amount cannot generally be employed because the esthetic character of the program is seriously impaired by this amount of reduction in dynamic range. This is discussed further under the section on "Operation". The amount of level governing action and the level at which it begins are controllable by means of fixed and adjustable input and output attenuators.

The 1126C Amplifier consists of three units which may be mounted as one integral unit, or mounted separately as three units for convience of operation. They are: 126C Amplifier, 298A Control Panel, and a 20B Rectifier.

The 126C Amplifier is a three stage push-pull amplifier with which is associated a d-c biased program operated rectifier for automatically limiting the gain of the amplifier when the rectified audio voltage overcomes the d-c bias. The rectifier may be disabled by means of a "LIMITER ON-OFF" switch.

The 126C Amplifier differs essentially from its predecessor the 126B Amplifier in that the 6J5 tubes in the output stage of the B have been replaced by 6SN7 twin triode tubes in the 126C. One section of each of the 6SN7 tubes functions in the 126C as did the 6J5 tubes in the 126B. The second section of each of the 6SN7 tubes functions as a push-pull cathode follower stage whose purpose is to supply audio frequency voltage to the limiter rectifier, at a low impedance for maximum speed of operation of the limiter circuit. The cathode follower stage also serves to isolate the limiting function from the audio frequency channel of the amplifier.

The 298A Control Panel contains the input and output adjustable attenuators, a meter for indicating the condition of the vacuum tubes and for indicating the amount of compression, and a tapped switch for adjusting the Limiter recovery time.

The 20B Rectifier is a regulated rectifier supplying a nominal output of 275 volts direct current for the plates and screens of the amplifier tubes and 6.3 volts a-c for the amplifier filament supply. The rectifier has a very short time constant and a very low internal impedance.

Detailed operating instructions for the 20B Rectifier are contained in Instruction Bulletin No. 1103.

Mounting

The complete assembly requires 19¼ inches relay rack or equipment cabinet

space. The chassis of each unit should be secured to the relay rack with screws furnished with the equipment. The mats are secured separately to the relay rack with cross slotted head screws which are also furnished, but the mats should not be mounted until the internal circuit adjustments have been completed.

Mounting Precautions

Avoid exposure to magnetic fields which might induce noise in the 126C Amplifier. Any equipment with self contained a-c power supply mounted on the same bay should be separated at least 5¼ inches from the 126C Amplifier. Hum caused by pickup in the input transformer may be reduced by loosening the clamping ring and rotating the transformer to the position of minimum hum. Do not rotate the transformer more than 180 degrees in either direction from its original position or the leads may be damaged.

If the unit is mounted in an enclosed equipment cabinet, no equipment which would materially affect the free circulation of air past the 1126C Amplifier should be mounted immediately above or below it. In any event, the 1126C Amplifier should not be mounted in an enclosed equipment cabinet if the total power dissipation in the cabinet is such that the air temperature behind the power transformer of the 20B Rectifier and approximately four inches from it is higher than 140 degrees Fahrenheit at any time.

External Conditions

The audio connections are made to the terminals of the 298A Control Panel as follows:

Terminal Numbers	*Circuits*
13 and 14	Input
3 and 4	Output
5 or 7	Audio Ground
27	Filament Transformer Ground

Input and output circuits of the amplifier are of the type unbalanced with respect to ground. When the connecting circuits are of the balanced type a repeating coil such as the Western Electric 119C or 111C Repeating Coil should be used to isolate the balanced from the unbalanced circuits, otherwise grounding difficulties may produce frequency discrimination and other undesirable effects.

The primary power connections are made to terminals 15 and 16 (15 is the ground side) of the 20B Rectifier.

NOTE: The strapping of the power transformer of the 20B Rectifier should be checked to insure proper connections in accordance with the instruction bulletin of the 20B Rectifier.

The input and output connections should be made with shielded twisted pair copper wire with insulation over the shields, and all the joints should be securely soldered. The shields should be electrically continuous and the shield on the input leads should be grounded at the 298A Control Panel only (Terminal 5 or 7). The shield on the output leads should be grounded at its destination.

If the units are separately mounted they should be interwired as shown on Figure 4 using shielded twisted pair for all audio circuits and twisted pair in conduit for power wiring.

After all external connections have been completed the meter of the 298A Control Panel should be connected (the white wire is positive), the 298A mat should be screwed on and the knobs replaced.

Grounding

The 1126C Amplifier should have only one external ground connection except for the grounding on one side of the primary a-c power supply, (terminal 15 on the 20B Rectifier) and the filament transformer ground (terminal 27 on the 298A Control Panel). As noted this external ground will ordinarily be connected to terminal 5 or 7 on the 298A Control Panel. However, it may be connected to terminal 16 or 17 of the 126C Amplifier if this is more convenient.

Vacuum Tubes

Vacuum tubes of the type indicated adjacent to the sockets of the 126C Amplifier and the 20B Rectifier should be inserted in the sockets. Each push-pull stage of the 126C Amplifier should use tubes of the same type.

ADJUSTMENT

Input Attenuators

The single frequency level required at the input terminals of the 1126C Amplifier (terminals 13 and 14 on the 298A Control Panel) for compression to start when the adjustable attenuator (A1 on 298A Panel) is set at zero attenuation and all fixed input pads (A1, A2 or A3 on 126C Amplifier) out of circuit is approximately −25 dbm (See Figure 6). Three fixed input attenuators A1, A2 and A3 are included in the 126C Amplifier (See Figures 1 and 5). It may be necessary to connect one or more of these attenuators, depending on the level obtainable at the point of the system where the 1126C Amplifier is to be connected. The 10 db unit A2, is connected in the equipment during manufacture. The following table gives the fixed attenuators normally required for different single frequency input level ranges obtained at the input of the 1126C Amplifier. One or more of these fixed input attenuators should be connected, depending on the anticipated level in accordance with this table:

Single Frequency Input Level	*Fixed Attenuators*
−30 to −20	None
−25 to −15	5 db
−20 to −10	10 db
−15 to −5	10 db and 5 db
−10 to 0	20 db
−5 to +5	20 db and 5 db
0 to +10	20 db and 10 db
+5 to +20	20 db, 10 db and 5 db

The finer input adjustment is provided by Attenuator A1 on the 298A Control Panel. This attenuator has a range of 15 db in 0.5 db steps.

Ordinarily the program level in vu at the input may be as much as 6 to 10 db lower than the single frequency level to allow for the peak factor in the program material.

The peak factor depends on the grade of transmission desired and the dynamic range of program material.

Output Attenuators

The single frequency output level at the output terminals of the output transformer of the 126C Amplifier available when compression starts is approximately +25 dbm (See Figure 6). The adjustable output attenuator A2 on the 298A Control Panel has a zero insertion loss; it has a range of adjustment of 3 db in steps of 0.1 db. Five fixed output attenuators A4, A5, A6, A7 and A8 are included in the 126C Amplifier (See Figures 1 and 5). It is recommended that the 6.5 db fixed attenuator or an external Impedance Stabilizing Pad of at least this value be used between the output transformer and the succeeding circuits as indicated on the schematic of the 126C Amplifier and 298A Control Panel (Figure 1), since the adjustable output attenuator A2 is not of itself a suitable termination for the output transformer.

This 6.5 db unit, A4, is connected in the equipment during manufacture. The maximum single frequency output level then available, before limiting starts, with the output attenuator, A2, set at zero is +18.5 dbm. For lower output levels it will be necessary during installation to connect one or more of the fixed output attenuators depending upon the level required at the output of the 1126C Amplifier. The following table gives single frequency output levels

obtainable with various combinations of these fixed output attenuators.

Single Frequency Output Level in dbm	*Fixed Attenuators**
+18.5 to +15.5	None
+16.5 to +14.5	1.5 db
+15 to +13	3 db
+13.5 to +11.5	1.5 db and 3 db
+12 to +10	6 db
+10.5 to +8.5	6 db and 1.5 db
+9 to +7	6 db and 3 db
+7.5 to +5.5	6 db, 3 db and 1.5 db
+6 to +4	12 db
+4.5 to +2.5	12 db and 1.5 db
+3 to +1	12 db and 3 db
+1.5 to −.5	12 db, 3 db and 1.5 db
0 to −2	12 db and 6 db
−1.5 to −3.5	12 db, 6 db and 1.5 db
−3 to −5	12 db, 6 db and 3 db
−4.5 to −6.5	12 db, 6 db, 3 db and 1.5 db

*In addition the 6.5 db pad or equivalent should always remain connected. (See text).

As at the input, the program level in vu at the output will ordinarily be 6 to 10 db lower than the single frequency level to allow for the peak-factor in the program material.

ALIGNMENT

First remove the front mats from the 126C Amplifier and the 20B Rectifier and connect the proper fixed attenuators (see tables in text for input and output attenuators for various levels) in the input and output circuits of the 126C Amplifier to give the desired range of operating levels.

Then connect input terminals 13 and 14 on the 298A Control Panel to a 600 ohm source of 1000 cycle tone, and the output terminals 3 and 4 to a 600 ohm terminating resistance across which is bridged a volume indicator with the range switch set for the expected output level. The Western Electric 754B Volume Indicator, with the termination key in the 600 ohm position will provide both the termination and the volume indicator with range switch.

CAUTION: THE PLATE VOLTAGE IS EXPOSED IN THE 20B RECTIFIER AND THE 126C AMPLIFIER WHEN THE MATS ARE NOT ON THESE UNITS. IN ADDITION, IF THE MAT IS REMOVED AFTER POWER HAS BEEN APPLIED, THE MAIN FILTER CONDENSERS SHOULD BE DISCHARGED TO GROUND.

Set the controls on the 126C Amplifier and the 298A Control Panel as follows:

P1 (under mat of 126C Amplifier in upper left section) mid-scale } 126C
P2 (under mat of 126C Amplifier in upper left section) mid-scale } Amplifier
S1 (rear of 126C Amplifier)—On
A1 and A2 (input and output attenuators)—mid-scale } 298A
D1 (recovery time)—position 3. } Panel
D2 (plate current)—position 0. } Panel

The potentiometer with the screwdriver slot (P1) in the lower left hand corner of the front of the 20B Rectifier (See instruction book on 20B Rectifier) should be turned to the extreme counterclockwise position.

With the 1000 cycle input to the 126C Amplifier turned off and with input ter-

minals 13 and 14 short circuited, apply power to the 20B Rectifier. After allowing five minutes to warm up, set the plate current switch D2 on the 298A Control Panel to position B and adjust P1 on the 20B Rectifier so that M1 on the 298A Control Panel reads 100% on the lower scale. Now check the plate currents of all the amplifying tubes in the 126C Amplifier by turning D2 through its various positions. In positions 3 to 6, inclusive M1 should read 100 ±20% on the lower scale. With D2 in position 1, adjust P1 on the 126C Amplifier so that M1 reads 0 db on the upper scale. (Note: If 0 db reading is not obtained interchange V1 and V2 or select another vacuum tube for V1.) Now turn D2 to position 2 and the meter should read between 115 and 150 on the lower scale.

NOTE: The use of tubes other than the 1612 Type for V1 and V2 may change the level governing action of the amplifier and increase its noise level. The level at which gain reduction begins and the slope of the input versus output curve may differ considerably from that shown on Figure 6. In addition it may also be necessary to increase the value of R1 so that M1 reads 0 db on the upper scale when P1 of the 126C amplifier is adjusted with Switch D2 in position 1. If it is impossible to reduce the readng of M1 to the correct value by adjustment of P1, the Resistor R1 should be increased to 500 ohms.

Readings observed during operation with program may vary considerably with the degree of gain reduction, particularly with V5 and V6. These changes are of no practical significance and do not indicate faulty operation.

Remove the short circuit from terminals 13 and 14 and apply 1000 cycle tone to the input at a level 10 db higher than that indicated by a volume indicator on average program at that point in the circuit. This margin provides for the peak factor in program material for highest grade transmission. Adjust the input attenuator on the 298A Control Panel so that with this input level the Meter M1 with D2 in position 1 reads 5 db compression. Adjust the output attenuator on the 298A Control Panel so that the output 1000 cycle tone will give an output level reading on the volume indicator connected to the output terminals corresponding to that required for 85% modulation of the associated transmitter.

To allow for future operating adjustments, if necessary, it is desirable that both the input and output adjustable attenuators on the 298A Panel should be left as near to mid-scale as possible. Therefore it may be necessary to repeat this alignment with different values of fixed input and output attenuators connected to obtain settings on the input and output adjustable attenuators more nearly at mid-range. After final adjustment of the fixed attenuators the equipment is ready for use and the mats may be replaced on the 126C Amplifier and the 20B Rectifier.

The purpose of potentiometer P2 on the 126C Amplifier is to permit adjustments to minimize very low frequency (20 cycles or less) shock disturbances, known as "thumps", sometimes produced in level governing type amplifiers by sudden abnormally wide variations in average program level which causes the control circut to "pop" in and out of deep compression. The optimum adjustment may be obtained by one of the following methods.

1. Apply 1000 cycle tone across the insulated terminal of the 126C Amplifier or the 298A Control Panel, and ground (See Figure 1). Approximately 2 volts from an impedance of less than 500 ohms should be obtained from the oscillator for this adjustment. Potentiometer P2 on the 126C Amplifier should then be adjusted to give minimum reading of the output volume indicator meter.
2. Apply 10,000 cycle tone to the input terminals 13 and 14 of the 298A

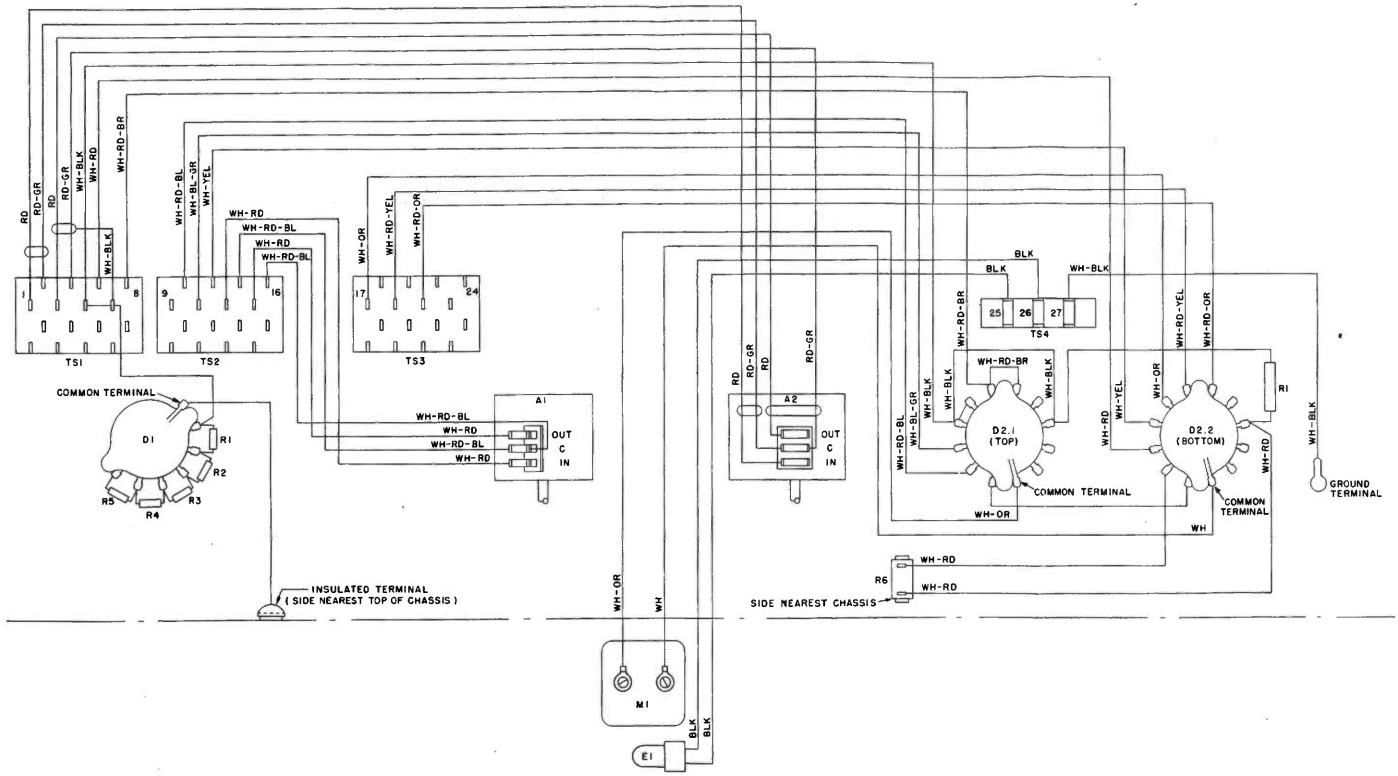

Figure 3—298A Control Panel Wiring Diagram

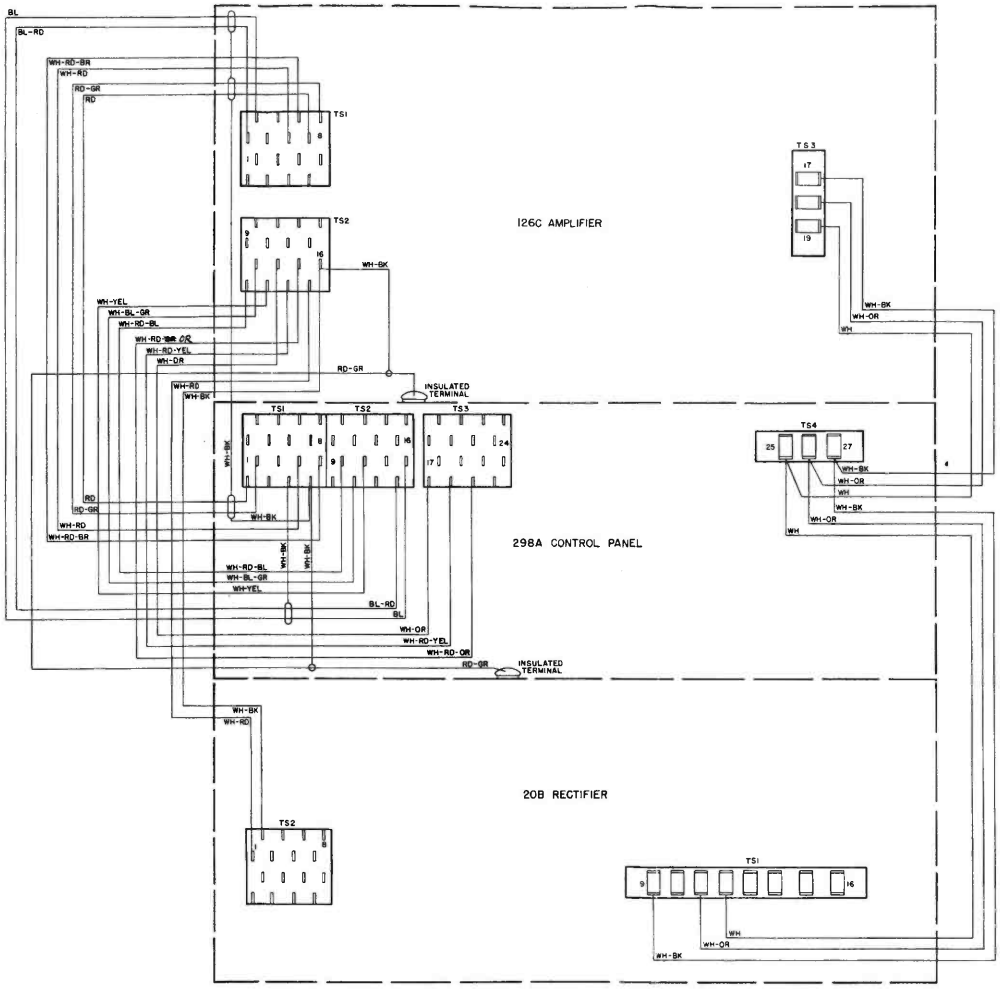

Figure 4—**1126C Amplifier Interconnections**

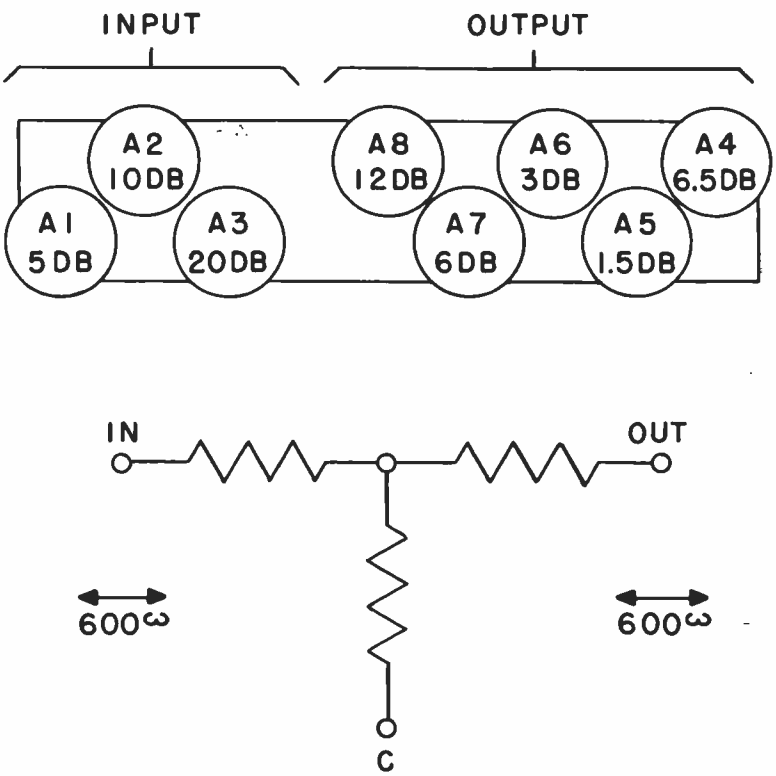

Figure 5—1126C Amplifier Schematic Input & Output Pads

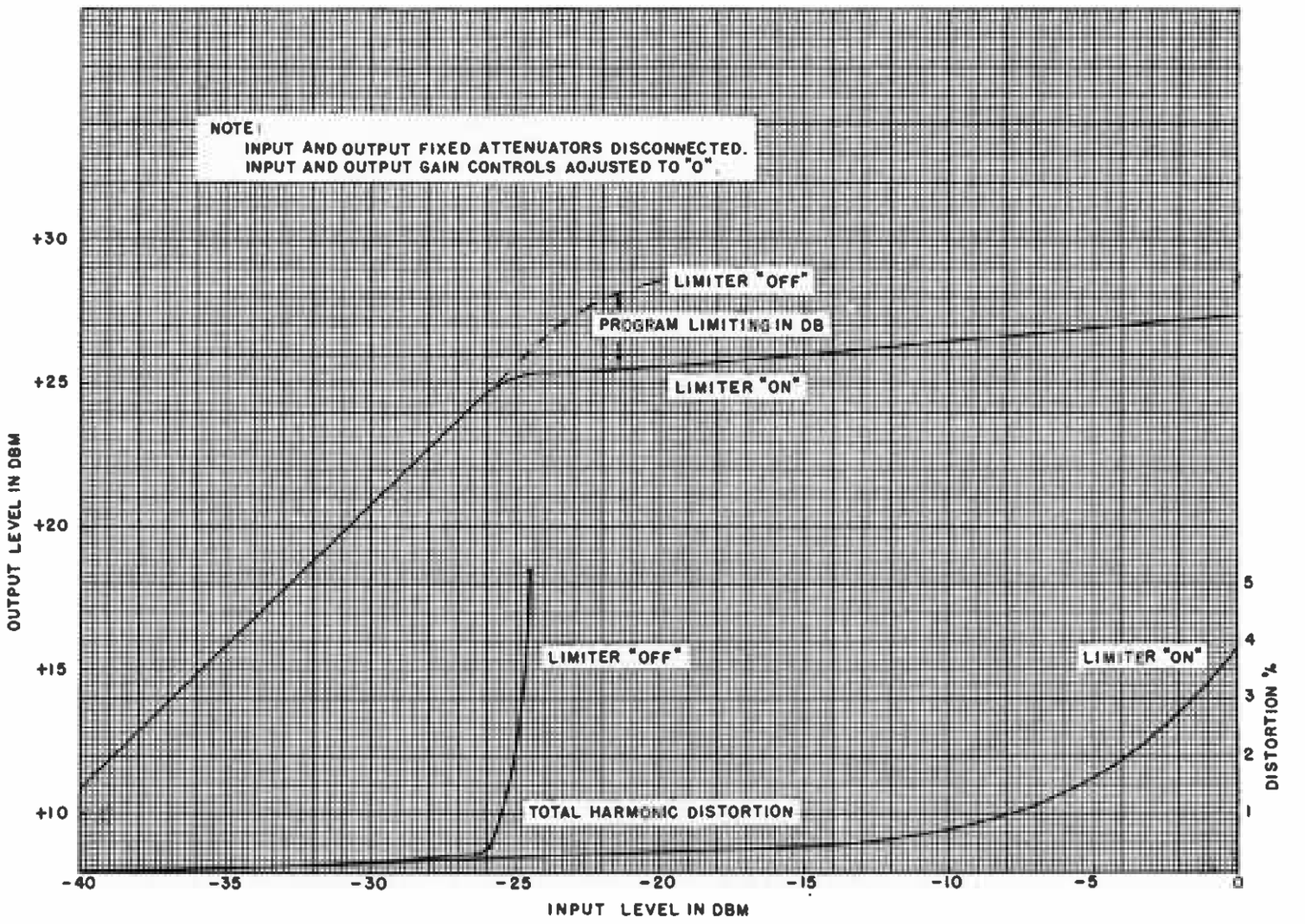

Figure 6—1126C Amplifier Output vs. Input and Distortion at 1 kc.

No. 1126-A AMPLIFIER

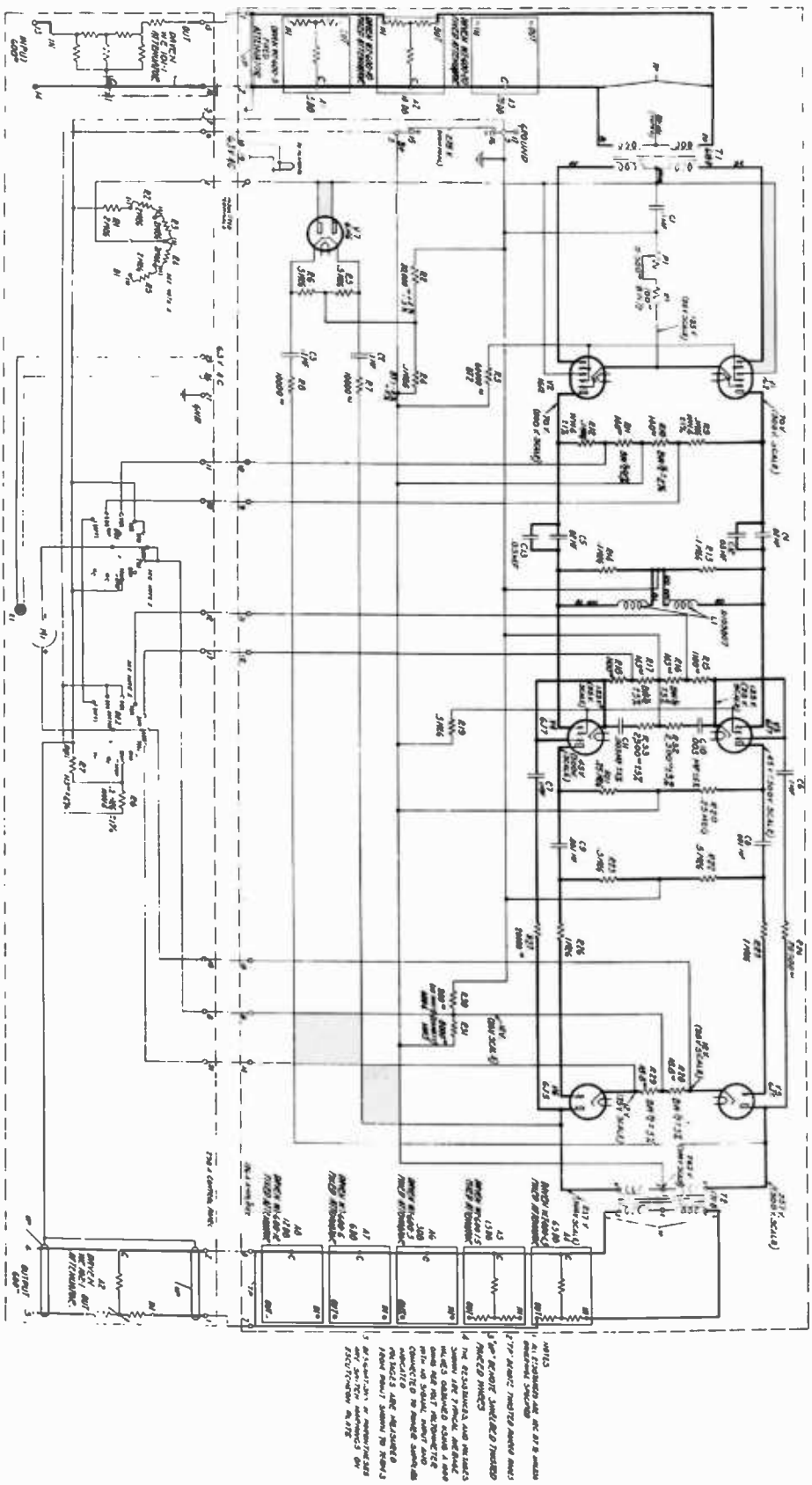

Figure 1 – Schematic – 126A Amplifier and 298A Control Panel

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20B RECTIFIER

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—$19\frac{5}{32}$ x $6\frac{31}{32}$ inches.

Chassis — Overall including mounting flanges, $18\frac{15}{16}$ x $6\frac{1}{16}$ x 2 inches. Width of recessed section, 17 inches.

Maximum Depth of Apparatus—$6\frac{7}{8}$ 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.

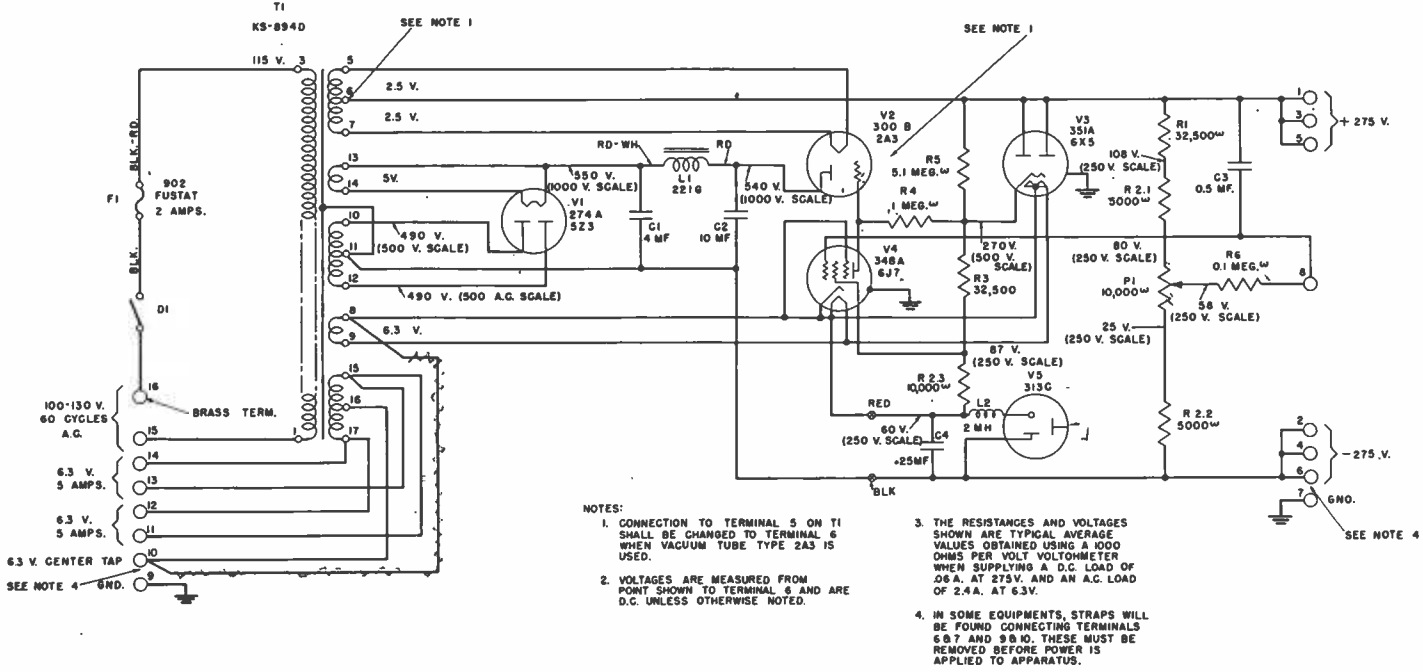
In this connection, it should be noted that P1 is provided primarily to adjust for aging of the gas tube V5 and for commercial variations in the resistors used in the regulator circuits. However, output voltages higher or lower than 275 volts may be obtained by adjustment of P1 with the following limita-

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.

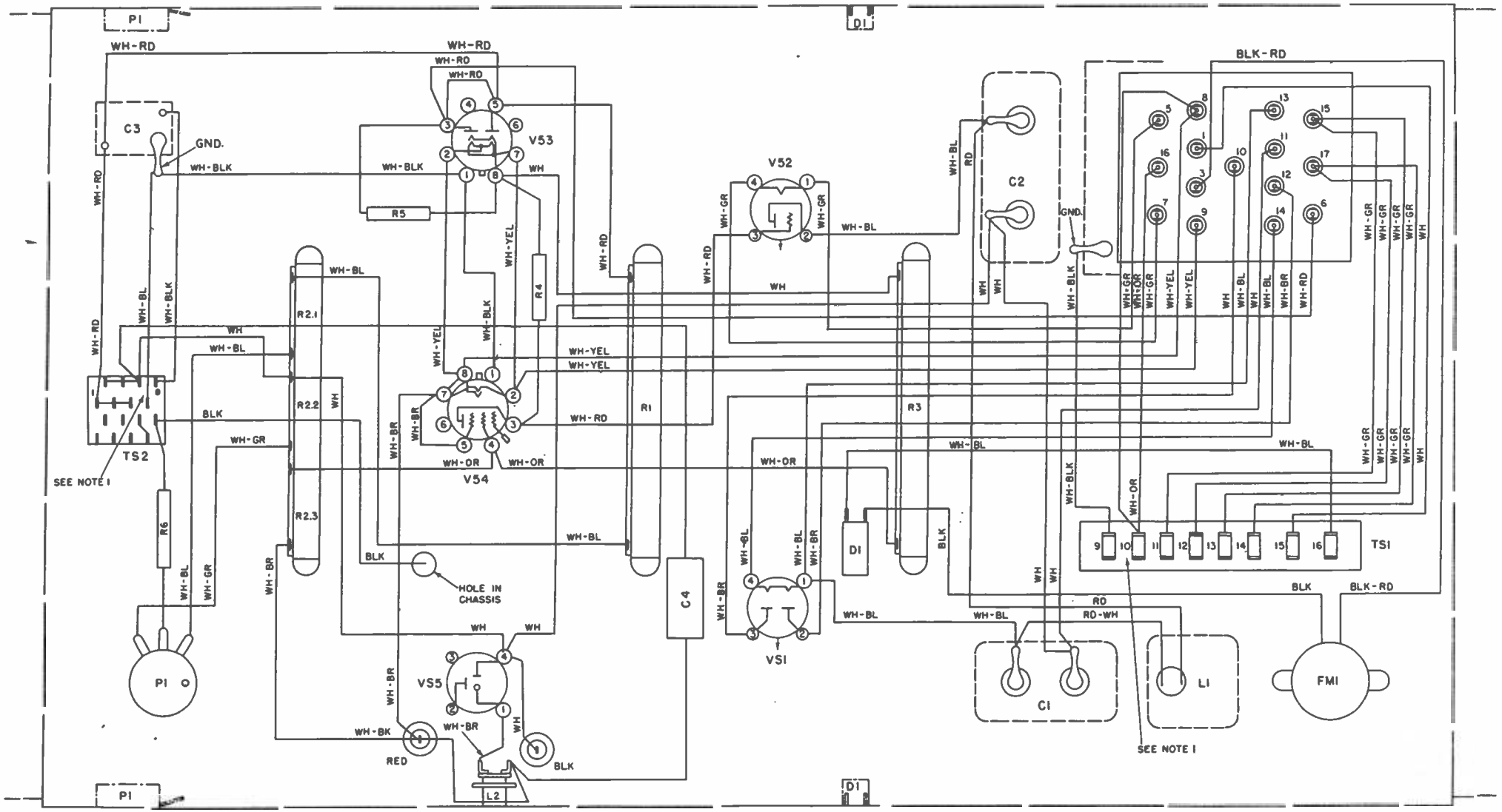
If replacement parts are required for the 20B rectifier they may be procured through the nearest distributor.



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:
1. 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. 2—Wiring Diagram

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