

## Maintenance

### (1) Radiotrons

Under ordinary usage within the ratings specified for voltage supply, tube life will be consistent with that obtained in other applications. The rectifier, oscillator, and amplifier tubes will wear in accordance with loss of emission; whereas the determining factor in the life of the RCA-913 cathode-ray tube is the deterioration of the fluorescent screen.

**CAUTION. DO NOT ALLOW A SMALL SPOT OF HIGH BRILLIANCY TO REMAIN STATIONARY ON THE SCREEN FOR ANY LENGTH OF TIME, AS DISCOLORATION OR BURNING OF THE SCREEN WILL RESULT.**

It is not ordinarily possible to test the Radiotrons in their respective sockets, due to the likelihood of circuit effects causing error. Their removal and check with standard tube-testing apparatus is therefore desirable.

To remove the RCA-913, it is necessary to slide the tube toward the back of the chassis, then snap the tube out of its clip. Replacement is the reverse operation, sliding the tube into the panel opening.

To remove the RCA-902, it is necessary to loosen the clamp at the base of the tube, remove the tube escutcheon from the front panel and slide the tube out the front of the instrument. Replacement is the reverse operation.

### (2) Fuse Replacements

A small 1-ampere cartridge fuse is used in the primary circuit of the power transformer. This fuse is intended for protection of the entire power system of the Oscillograph, and should, therefore, not be replaced by one having a higher rating, nor be shorted out. A fuse failure should be carefully investigated before making a replacement, as usually in the use of fuses of accepted quality, there must be a definite cause for the fuse breakdown. The cause may originate from a surge in the power-supply line, but the greater percentage of causes may be centered in the apparatus protected, such as shorted rectifier elements, and so forth.

### (3) Resistance and Continuity Tests

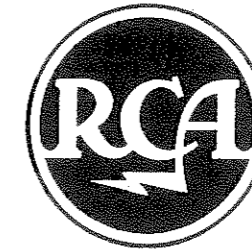
*In working on the chassis of the Oscillograph, care must be observed to have the power supply completely disconnected. The high voltages associated with the circuits of the cathode-ray tube make it dangerous to attempt to handle or work on the chassis while the power is "On."*

Care should be exercised in replacing any part that may be found faulty. All wiring associated with the part involved must be taken off, and especial attention given to possibility of damage to other wiring or parts. The relation of wiring and parts should be the same as in the original assembly.

## REPLACEMENT PARTS

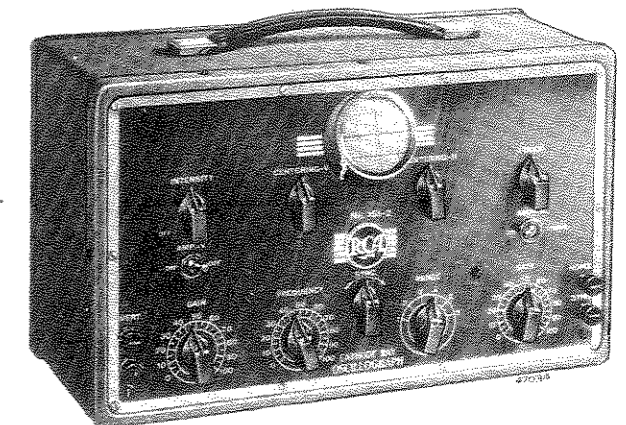
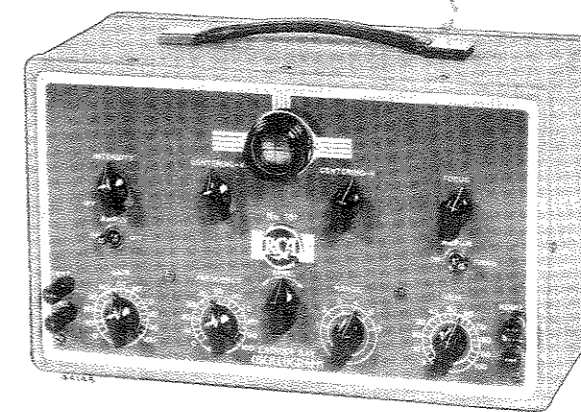
Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	Stock No.	Description
14118	Power Transformer—110-120 v, 50-60 cy. (T-1)	30436	Resistor—12,000 ohms, 1/2 watt (R-19) .....
14119	Synchronizing Transformer (T-2) .....	30866	Resistor—12,000 ohms, 1 watt (R-25) .....
13111	Filter Reactor (L-1) .....	5114	Resistor—15,000 ohms, 1 watt (R-26) .....
4839	Capacitor—0.1 mfd, 400 v (C-1, C-3, C-4, C-5, C-7, C-12) .....	12266	Resistor—39,000 ohms, 1/4 watt (R-15) .....
30303	Capacitor—0.0035 mfd (C-2, C-6) .....	13596	Resistor—47,000 ohms, 2 watts (R-20) .....
12536	Capacitor—820 mmfd (C-8) .....	14132	Resistor—150,000 ohms, 1 watt (R-12) .....
5107	Capacitor—0.0025 mfd (C-9) .....	12285	Resistor—470,000 ohms, 1/4 watt (R-2, R-8) .....
4858	Capacitor—0.01 mfd (C-10) .....	12679	Resistor—2.2 megohms, 1/4 watt (R-5, R-6) .....
5196	Capacitor—0.035 mfd (C-11) .....	4750	Switch—D.P.D.T. Toggle (S-1, S-2) .....
12484	Capacitor—0.25 mfd (C-13) .....	14127	Switch—Single gang, 6 position (S-3) .....
14121	Bypass Capacitor—4/10 mfd (C-14, C-15) .....	14133	Fuse—1 ampere (S-5) .....
14120	Filter Capacitor—4/4 mfd, 475 v (C-16, C-17) .....	4794	Tube Socket—4 prong .....
14126	Potentiometer—10,000 ohms with Switch (R-21, S-4) .....	4814	Tube Socket—5 prong .....
14125	Potentiometer—10,000 ohms (R-23) .....	4786	Tube Socket—6 prong .....
14124	Potentiometer—250,000 ohms (R-11) .....	31251	Tube Socket—(Octal) for RCA-902 .....
14123	Potentiometer—1 megohm (R-1, R-7, R-16, R-17) .....	31956	Tube Escutcheon—for RCA-902 .....
14122	Potentiometer—2 megohms (R-13) .....	31957	Tube Scanning Screen .....
14561	Resistor—220 ohms, 1/4 watt (R-10) .....	4857	Binding Post (HIGH) .....
14024	Resistor—2,700 ohms, 1/4 watt (R-3, R-24) .....	4607	Binding Post (0) .....
13714	Resistor—5,600 ohms, 1/4 watt (R-4, R-9) .....	7960	Bar Pointer Knob .....
12265	Resistor—6,800 ohms, 1/4 watt (R-14) .....	13210	Fuse Terminal Board Assembly .....
14250	Resistor—8,200 ohms, 1/2 watt (R-18) .....	14128	Tube Plug—Octal Base .....
3078	Resistor—1/2 W., 10,000 Ohms (R-22) .....	14129	Tube Support Bracket Ass'y .....
		14130	Eye Piece .....
		14131	Eye Piece Base .....
		14137	Screen .....
			□ 151-2 ONLY    * 151 & 151A ONLY
SFP-FHM 31245D			



## CATHODE-RAY OSCILLOGRAPH

STOCK NO. 151, 151A AND 151-2



RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION

CAMDEN, N.J., U.S.A.

# Cathode-Ray Oscillograph

## STOCK No. 151, 151A AND 151-2

### Electrical Specifications

Power Supply Rating.....	Voltage.....	110-120 Volts AC
	Frequency (Stock No. 151 and 151-2.....)	50-60 Cycles
	(Stock No. 151A).....	25-60 Cycles
	Wattage Consumption.....	35 Watts
	Fuse Protection.....	1 Amp.

STOCK NO. 151 & 151A	Deflection sensitivity at amplifier inputs.....	5 peak-to-peak volts per inch (max. "gain.")
	Deflection sensitivity at cathode-ray tube inputs.....	250 peak-to-peak volts per inch
Operating Limits.....	Input Characteristics:	
	(1) Through either amplifier.....	1 megohm, approximately 30 mmfd.
	(2) Without either amplifier.....	2 megohms, approximately 40 mmfd.
	Frequency response range of amplifiers.....	20-15,000 Cycles
	Maximum signal input (with amplifier).....	500 Volts (RMS)
Radiotrons Used and Functions.	Frequency range of timing axis.....	30-10,000 Cycles
	Maximum d-c voltage across input binding posts.....	100 Volts with amplifiers 200 Volts direct
	1 RCA-6C6.....	Signal amplifier for vertical deflection
	1 RCA-6C6.....	Signal amplifier for horizontal deflection
	1 RCA-885.....	"Saw-tooth" oscillator
	1 RCA-91B.....	Cathode-ray tube (1-inch)
	1 RCA-80.....	Full-wave rectifier

STOCK NO. 151-2	Deflection sensitivity at amplifier inputs.....	0.5 volt (r.m.s.) per inch (max. "gain.")
	Deflection sensitivity at cathode-ray tube inputs.....	30 volts (r.m.s.) per inch
Operating Limits.....	Input Characteristics:	
	(1) With amplifier.....	1 megohm, approximately 30 mmfd.
	(2) Without amplifier.....	2 megohms, approximately 40 mmfd.
	Frequency response range of amplifiers.....	20-15,000 cycles
	Maximum signal input (with amplifier).....	500 volts (r.m.s.)
Radiotrons Used and Functions.	Frequency range of timing axis.....	30-10,000 cycles
	Maximum d-c voltage across input binding posts.....	100 volts with amplifiers 200 volts direct
	1 RCA-6C6.....	Signal amplifier for vertical deflection
	1 RCA-6C6.....	Signal amplifier for horizontal deflection
	1 RCA-885.....	"Saw-tooth" oscillator
	1 RCA-902.....	Cathode-ray tube (2-inch)
	1 RCA-80.....	Half-wave rectifier

### Physical Specifications

Overall Dimensions.....	Height (including carrying-handle).....	9 1/2 inches
	Width.....	13 1/2 inches
	Depth.....	7 1/2 inches
Weight: 60 cycle.....		14 1/2 pounds
	25 cycle.....	16 pounds

For a comprehensive discussion of the fundamentals of cathode-ray tubes and an analysis of the figures which appear on the screen, see "A General Discussion of the Cathode-Ray Tube," RCA 1B-26453.

### Installation

Unpack the instrument from the shipping container and remove the screws securing the front panel to the case. Withdraw the chassis from the case, supporting the panel at the bottom, and feeding the power cable through the hole in the back. Make certain that all tubes are firmly in their sockets and all grid cap connections are in place. Should the deflecting plates in the cathode-ray tube not be in the proper plane it will be necessary to twist the tube to its proper position. However, do not correct its position with the set in operation.

Next replace the chassis in the case and replace the securing screws. With "Intensity" control in extreme counter-clockwise position ("Off"), plug the power supply cable into an electrical outlet supplying 110-120 volt, AC supply. The instrument is then ready for operation.

**NOTE: DO NOT ATTEMPT TO OPERATE THE EQUIPMENT WHEN WITHDRAWN FROM THE CASE AS THE HIGH POTENTIALS USED ARE DANGEROUS.**

### Controls

(Refer to the Schematic and Wiring Diagrams, Figures 4 and 5, for location of circuit units designated by symbols.)

1. "Intensity" control, R-23, is a potentiometer in the high side of the bleeder. Its position controls the bias on the grid of the cathode-ray tube, which in turn determines the quantity of electrons emanating from the "gun," thus controlling spot size. The power switch S<sub>1</sub> is located on this potentiometer. Initial clockwise rotation of this control turns on the power; additional rotation increases the spot intensity.

2. "Focus" control, R-21, is a potentiometer in the bleeder. Its position controls the anode No. 1 voltage, which (with constant A<sub>2</sub> voltage) determines the distance at which the electron beam focuses. In general, for a given "Intensity" setting, the "Focus" control should be set for maximum distinctness of spot or image.

3. "Ampl. V" switch, S<sub>1</sub>, connects the "Vertical" binding posts either straight through to the vertical deflecting plates on the cathode-ray tube or through an amplifier to these deflecting plates. In either case there is a condenser in the input circuit.

4. "Ampl. H" switch, S<sub>2</sub>, has two positions: "Timing" and "On." On "Timing" the "saw-tooth" or timing axis oscillator feeds through an amplifier to the horizontal deflecting plates on the cathode-ray tube and the "Horizontal" binding post is the synchronizing input terminal. When "On" the "Horizontal" binding post is connected through an amplifier to these deflecting plates.

5. "Ampl. V Gain" control, R<sub>1</sub>, is a potentiometer on the input circuit of the vertical amplifier. With "Amplifier V" switch "On," this potentiometer controls the vertical deflection.

6. "Ampl. H Gain" control, R<sub>2</sub>, is a potentiometer on the input circuit of the horizontal amplifier. With "Amplifier H" switch on "Timing" or "On" this potentiometer controls the horizontal deflection. Due to the capacity load on this

### Circuit Description

There is one usual feature to this circuit that causes surprising voltage distributions but doesn't affect the operating theory. Since the shell of the cathode-ray tube is connected to the second anode, which must be at a positive potential from the cathode, and since the shell must be grounded for safety, the positive side of the power supply has been connected to ground. This is common practice in Cathode-Ray Oscillographs, but in this case the power supply is common to the oscillograph and amplifier tubes, so the cathode, grid, suppressor and screen grids of the amplifiers are all at a high potential to ground and the plate is nearly at ground. It may be argued that no improvement has been made since the grid clips are at high voltage, but the grid clips cannot be

input potentiometer, when operating on "Timing" at the higher audio frequencies, linear sweep will not be obtained at all settings of this control.

7. "Range" switch, S<sub>3</sub>, selects one of six timing capacitor values. It thus changes the timing axis oscillator frequency in steps giving six ranges approximately as follows: No. 1, 20-130; No. 2, 50-300; No. 3, 100-900; No. 4, 350-3,000; No. 5, 1,100-10,000, and No. 6, 3,000-12,000 cycles.

8. "Freq." control, R<sub>12</sub>, is a rheostat in series with the timing condenser. It changes the timing axis oscillator frequency gradually as it is rotated, and in conjunction with "Range" switch above gives continuous range between the extremes of frequency.

9. "Sync." control, R<sub>11</sub>, is a potentiometer controlling the amount of synchronizing voltage fed to the grid of the RCA-885 tube. In general it should be set as far counter-clockwise as is consistent with a locked image, as over-synchronization causes poor wave-form from the timing axis oscillator.

10. "Centering V and H" are potentiometers to control the amount of d-c potential between the two deflecting plates of each pair, and thereby allow adjustment of the position of the spot or image.

11. There are two pairs of binding posts labeled "Vert. High," "Gnd. 0," "Horiz. High," and "Sync. High." As indicated by the word "High" on the posts, the Vert., Horiz., and Sync. posts all connect to internal circuits, the only ground posts being marked "Gnd. 0." To connect to the vertical amplifier, connect to Vert. and Gnd. To connect to the horizontal amplifier, connect to Horiz. and Gnd. To connect to the synchronizing circuit, connect to Horiz. and Gnd. The Horiz. binding post is controlled by the "Ampl. H" switch so that when the switch is "On" the post connects to the amplifier input and when the switch is on "Timing" the post connects to the synchronizing circuit. The Sync. post carries a fraction of the amplified vertical voltage and is to be connected to the "Horiz." post whenever it is desired to synchronize on the signal being examined.

reached when the equipment is in the case, and the resistance of the circuit is sufficiently high to limit the current to safe values at all but very low settings of the gain control.

While the voltage distribution, as shown in Figure 7 is quite unusual, the method of operating the amplifier tubes has not been affected. The grids are maintained about two volts negative from the cathode, the suppressor is connected to the cathode, the screen grid is about 35 volts positive from the cathode and the plate still more positive.

An amplifier consisting of a single RCA-6C6 constitutes the means of obtaining "gain" for the signal applied to the vertical deflecting system. The input to this stage is a high-resistance potentiometer connected to provide "gain" control. An isolation capacitor is made a part of the input circuit to exclude any d-c which may be associated

with the circuit being observed. The plate, or output circuit of the RCA-6C6 is a resistor whose value is so designed as to effect a broad and uniform frequency response in the amplifier stage. Coupling from the amplifier plate to the cathode-ray tube is made through a capacitor.

The amplifier for the signal applied to the horizontal deflecting plates is identical to that described above. A switch is provided to disconnect the vertical amplifier, thereby applying the voltage to be studied directly to the deflecting plates. There is an input switch to the horizontal amplifier for feeding in the timing or "saw-tooth" oscillator signal.

A synchronization system is included, as shown in the input circuit of the RCA-885. This is the "Synchronizing" circuit described under "Operation." The timing axis oscillator stage, using the RCA-885, is designed to have a frequency range of 30-10,000 cycles, controlled through the "Range" switch and "Frequency" control. The signal from

this oscillator has a "saw-tooth" wave-shape, obtained as follows: A d-c potential is applied across a capacitor and resistor in series in the plate circuit of the RCA-885 tube. This voltage charges the capacitor until the ionization potential (plate voltage at which the gas in the RCA-885 ionizes) is reached. When the RCA-885 ionizes the capacitor is short-circuited and the voltage across it drops nearly to zero. The RCA-885 immediately de-ionizes and allows the capacitor to start charging again. In this manner, the voltage across the capacitor has a "saw-tooth" characteristic. The capacitor referred to above is selected by the position of the "Range" switch as described in "Operation." With "Ampl. H" switch on "Timing," the voltage across this capacitor passes through the horizontal amplifier to the plates of the RCA-913 or 902

Power required for operation of the instrument is obtained through the power unit from a 110-120-volt, AC supply. Voltage rectification is accomplished by an RCA-80 connected in the secondary windings of the power transformer.

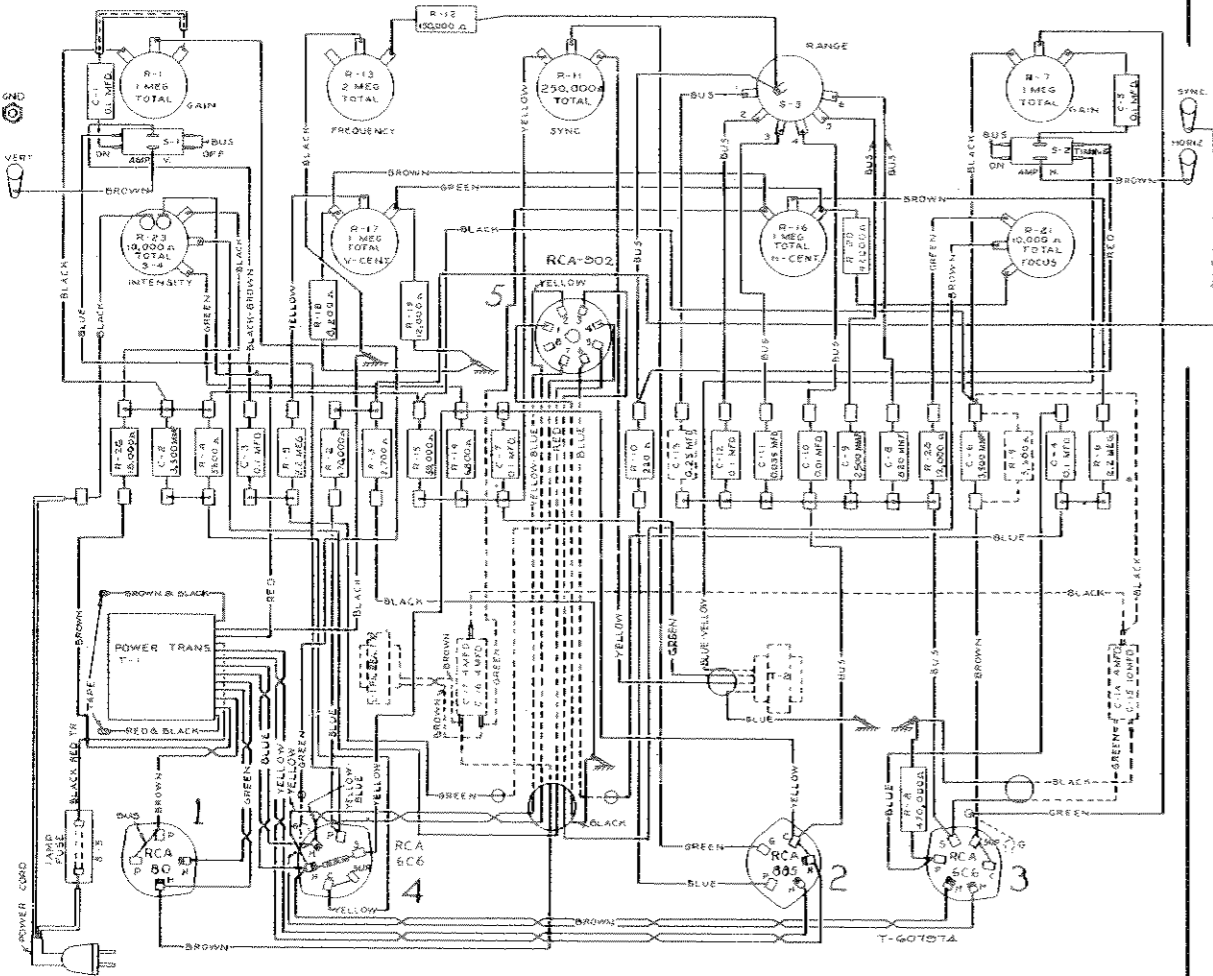


Figure 4 Chassis Connection Diagram, Stock No. 151-2

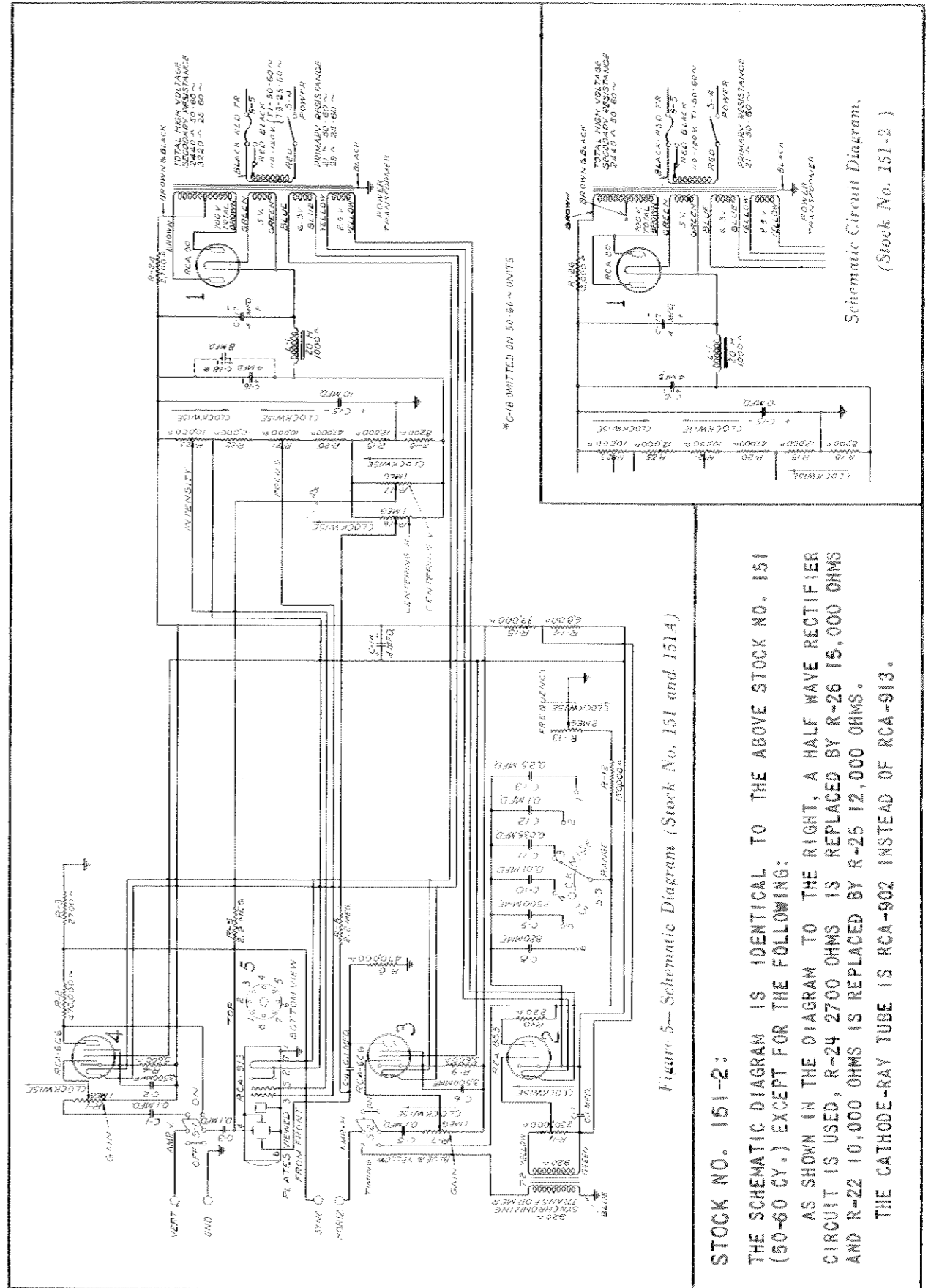


Figure 5—Schematic Diagram (Stock No. 151 and 151A)

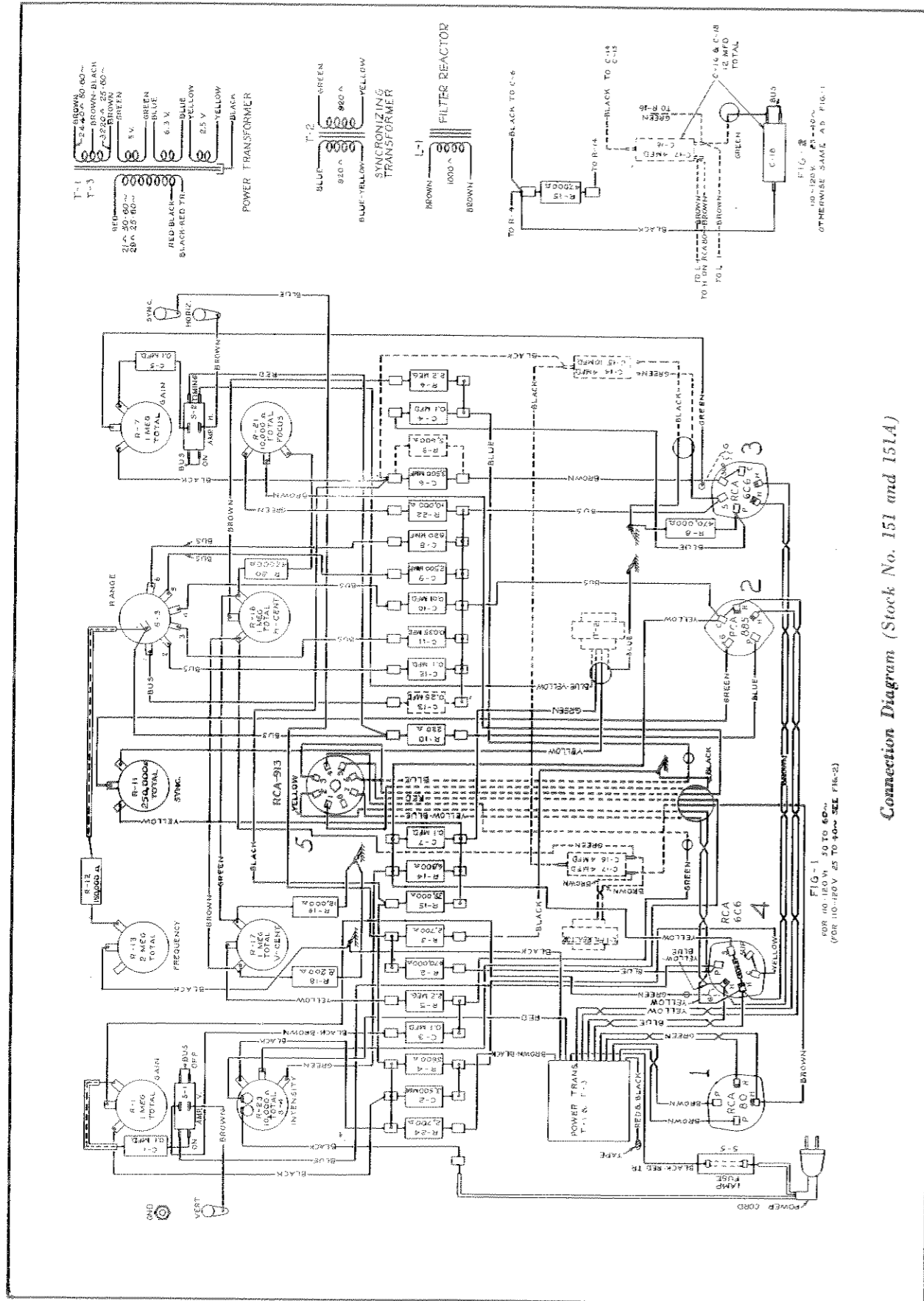
STOCK NO. 151-2:

THE SCHEMATIC DIAGRAM IS IDENTICAL TO THE ABOVE STOCK NO. 151 (50-60 CY.) EXCEPT FOR THE FOLLOWING:

AS SHOWN IN THE DIAGRAM TO THE RIGHT, A HALF WAVE RECTIFIER CIRCUIT IS USED, R-24 2700 OHMS IS REPLACED BY R-25 12,000 OHMS AND R-22 10,000 OHMS IS REPLACED BY R-23 12,000 OHMS.

THE CATHODE-RAY TUBE IS RCA-902 INSTEAD OF RCA-913.

Schematic Circuit Diagram,  
(Stock No. 151-2)



Connection Diagram (Stock No. 151 and 151A)

FIG. 1  
FOR 100-180V. 50 TO 60 Hz.  
FOR 110-120V. 25 TO 30 Hz. SEE FIG. 2

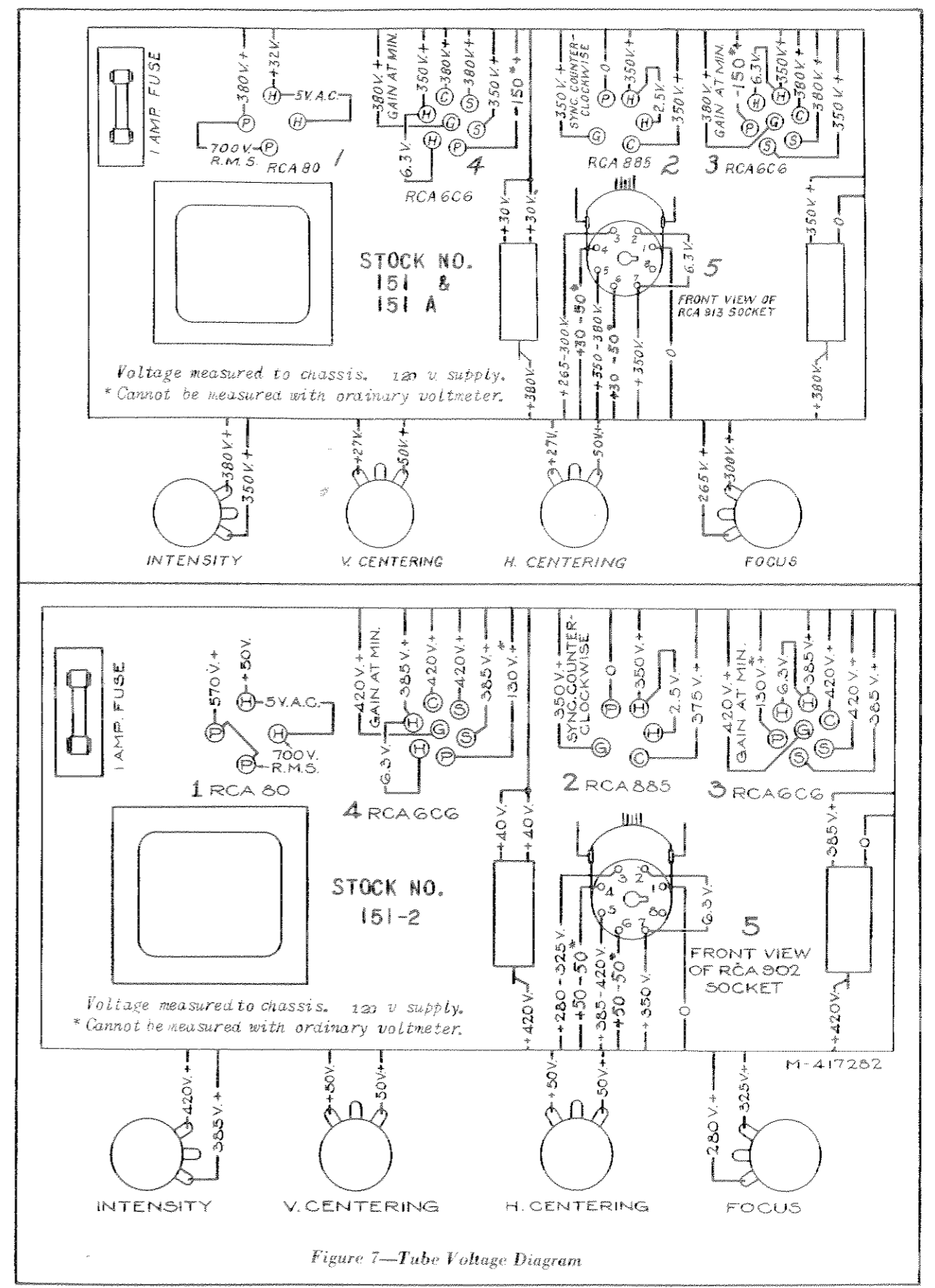


Figure 7—Tube Voltage Diagram