SUPREME

MODEL 546 OSCILLOSCOPE

Stock No.7500

ELECTRICAL SPECIFICATIONS

Power Supply Requirements: (Unless otherwise specified on plate attached to case in rear of chassis)

Voltage.....110/120 A.C.
Frequency.....60 cycles
Power Consumption.....50 watts
Fuse Protection.....1 ampere

MECHANICAL SPECIFICATIONS

Over-all Dimensions:

Height.....11-1/2 inches
Width..... 7-1/4 inches
Depth.....13-1/4 inches

Weights:

Net.....22 pounds
Shipping.....25 pounds

STANDARD EQUIPMENT SUPPLIED WITH THE MODEL 546

QUANTITY INCLUDED	STOCK NUMBER	DESCRIPTION	PACKER'S CHECK
1	7500	Booklet, operating data	_____
1	6725	Card, return registration	_____

The above list has been checked by the undersigned who is responsible for the completion of this package.

Model 546, Serial Number_____ Signed_____
Mention above numbers in all correspondence. Shipping Dept.

SUPREME INSTRUMENTS CORPORATION
GREENWOOD, MISSISSIPPI
U. S. A.

MODEL 546
OPERATING DATA

INTRODUCTION

The SUPREME Model 546 is a complete oscilloscope incorporating a three-inch cathode-ray scope, vertical and horizontal amplifiers and a linear time base or sweep generator. This unit is essentially a super-sensitive voltmeter capable of indicating in two dimensions, namely, amplitude and time. This highly desirable feature makes it one of the most versatile instruments ever presented to the radio and electronic industry. It has an extremely wide range of utility, reaching into fields which are not directly associated with the electrical industry. Thus, an oscilloscope of this type has such innumerable possibilities of utilization that its applications can hardly be confined to this small book.

The scope section of the SUPREME Model 546 is designed around a three-inch cathode-ray type of the high vacuum tube with medium persistance screen. The deflecting plate terminals and image positioning controls are brought out to the front panel for easy accessability. A power supply of high regulation provides the necessary anode and control voltages of the proper magnitude and quality.

The vertical amplifier is of special design providing maximum gain with a wide range frequency response characteristic. The horizontal amplifier is so regulated as to amplify the internal or external sweep voltage with a minimum amount of distortion.

The internal sweep generator is of the thyratron gaseous-discharge type producing voltage impulses from approximately 15 to 30M cycles per second. Provisions are also incorporated for automatically switching from internal to external sweep without removing any connecting cables from the instrument. A special synchronization circuit is provided for stabilizing the sweep generator and holding the pattern stationary upon the screen of the cathode-ray tube .

DESCRIPTION OF PANEL AND COMPONENTS

PANEL:
Black "Cro-art" finish - Size 11-1/2 x 7-1/4 inches.

CATHODE RAY TUBE:
Upper center of panel - Three inch diameter, high vacuum, medium persistance type screen.

ROTARY CONTROLS:
Upper left and right side of panel - Equipped with hexagon knobs and labeled "INTENSITY", off-on power switch and "FOCUS". For adjusting the brilliance and definition of the image as shown on the screen of the cathode-ray tube.

ROTARY CONTROLS:
Upper left and right of panel - Equipped with hexagon knobs and labeled "VERT. POSITION" and "HOR. POSITION". For centering spot or image of the cathode-ray tube..

ROTARY CONTROL:
Left edge of panel - Equipped with bar pointer knob and labeled "VERT. GAIN". "0-100" scale: Gain control for vertical amplifier. "OFF": Amplifier off and "V-PLATE" terminal connected to vertical plate.

ROTARY CONTROL:
Right edge of panel - Equipped with bar pointer knob and labeled "HOR. GAIN". "0 - 100" scale: Gain Control for horizontal amplifier. "OFF": Amplifier off and "H-PLATE" terminal connected to horizontal plate.

ROTARY CONTROL:
Center of panel - labeled "SYNC.CONTROL" - Equipped with bar pointer knob. For adjusting amplitude of synchronizing voltage, stabilizing the image on the screen of the Cathode-ray tube.

ROTARY CONTROL:
Center of panel - Labeled "FINE FREQ." - Equipped with bar pointer knob. For vernier adjustment of saw-tooth generator.

ROTARY CONTROL:
Center of panel - Labeled "SWEEP FREQ." - Equipped with bar pointer knob. Range selector for saw-tooth generator. Rough frequency selection - 15/65/230/950/3M/10M/30M cycles.

PIN JACKS:
Four terminals at lower left of panel - Labeled "EXT.SYN." input for external synchronizing voltage; "VER" input for voltage under observation: "GND" return for "VER" and "EXT.SYN.": "V-PLATE" for connection to vertical deflecting plates.

PIN JACKS:
Four terminals at lower right of panel - Labeled "GHD","HOR" and "GHD", input for standard or external sweep; "H-PLATE" for connection to horizontal deflecting plates.

TOGGLE SWITCH:
Lower left side of panel - Labeled "EXT.SYN". - INT.SYN". Automatic connector for external or internal synchronizing voltage.

TOGGLE SWITCH:
Lower right side of panel - Labeled "EXT.SWEEP" - "INT.SWEEP". Automatic connector for horizontal sweep voltage.

MODEL NUMBER:
546- Printed in upper right hand corner of panel.

SERIAL NUMBER:
Number stamped in extreme upper center of panel.

PLEASE MENTION MODEL AND SERIAL NUMBERS IN ALL CORRESPONDENCE

PRELIMINARY INSTALLATION AND ADJUSTMENT

1 - Turn all rotary controls to the extreme counter-clockwise position and throw the toggle switches to the down position.

2 - Connect the power supply plug to a convenient a-c outlet, observing the frequency and voltage as given on the first page under "ELECTRICAL SPECIFICATIONS.

3 - Advance all rotary controls including the bar pointer knobs to approximately one-half normal rotation in a clockwise direction. Regulate the "INTENSITY"

control until a green flourescence appears on the screen of the cathode-ray tube. Adjust the "VERT. POSITION" and "HOR. POSITION" controls until the flourescent image is centered. Re-adjust the "FOCUS" and "INTENSITY" controls for a well defined horizontal line. Precaution must be taken not to burn the screen of the tube; therefore, the "INTENSITY" control must be kept as low as possible and yet maintain a clearly visible image.

GENERAL OPERATION

WAVEFORM OBSERVATION USING VERTICAL AMPLIFIERS

With all controls set atapproximately 50% rotation as given in the section "PRELIMINARY ADJUSTMENT" apply an A-C voltage to the "VER" and GND" terminals located in the extreme lower left hand corner. (If the resulting deflection from this test voltage does not provide the proper vertical amplitude for clear observation, advance the control if it is below normal and decrease the rotation if it exceeds the limits of the screen.) To adjust for more than one wave, turn the "SWEEP FREQ." control in the counter-clockwise direction until the desired number of cycles appear. For more accurate adjustment the "FINE FREQ." control acts as a vernier to the "SWEEP FREQ." control. Should the pattern fail to stand still, advance the "SYNC. CONTROL" in the clockwise direction just enough to stabilize the pattern. Over-synchronization may result in a distorted figure.

WAVEFORM OBSERVATION WITHOUT VERTICAL AMPLIFIER

Frequencies which are out of the amplifier range require provisions for connecting more directly to the deflecting plates. The vertical plate is accessible from the panel by attaching a lead to the "V-PLATE" and "GND" terminals with the "VERT. GAIN" in the extreme counter-clockwise or "OFF" position. The applied voltage should not exceed 500 volts (peak).

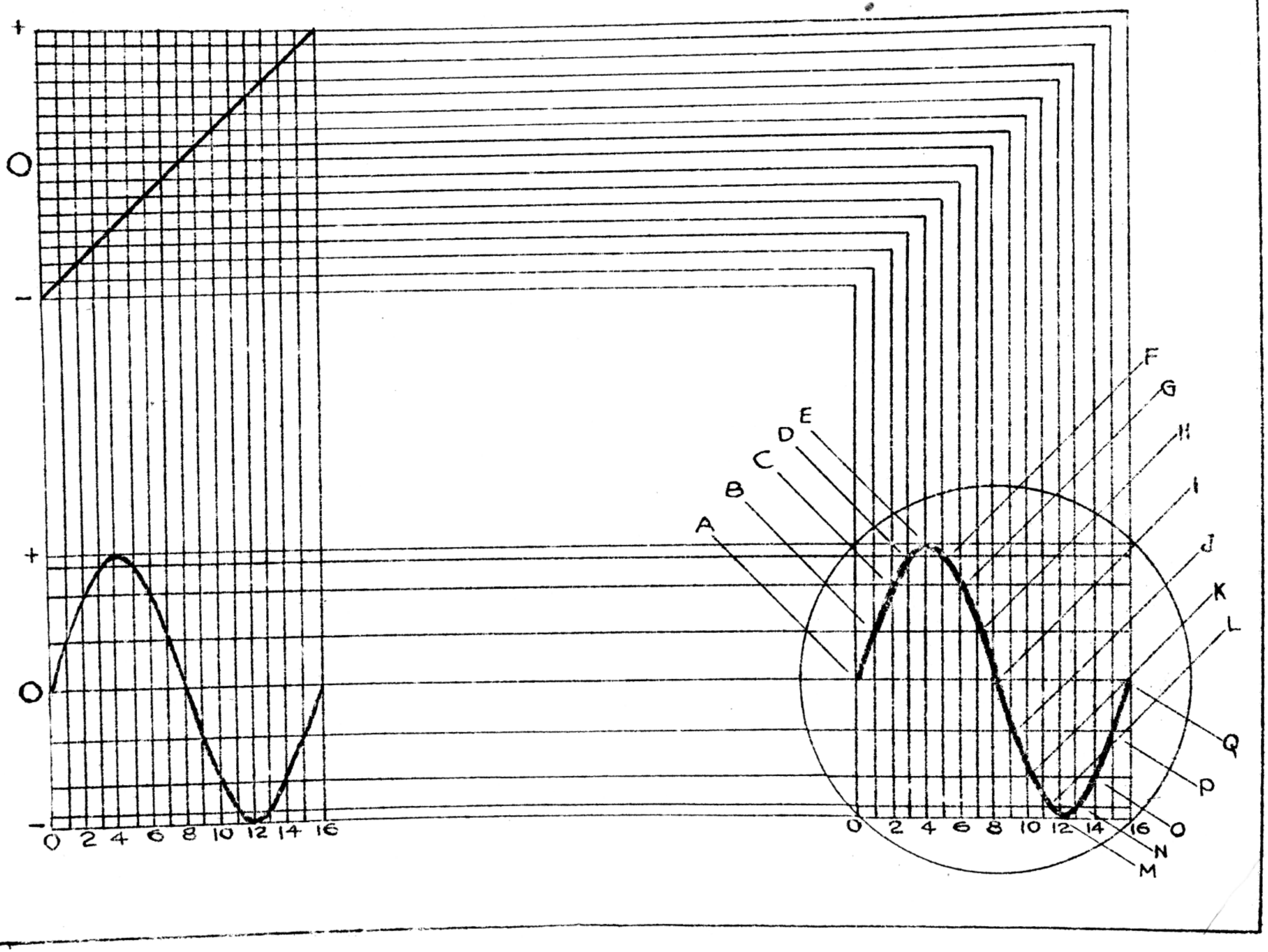
HORIZONTAL DEFLECTING SYSTEM

The "HOR. GAIN" operates in the same manner as the "VERT. GAIN" and controls the horizontal deflection caused by the output of the internal amplifier.

With the "EXT.-INT. SWEEP" in "INT. SWEEP" position a saw-tooth voltage is automatically applied to the horizontal amplifier input. With this toggle switch in "EXT. SWEEP" position, the operation is exactly the same as the vertical section using the amplifier except that the deflection will be on a horizontal plane. When the "HOR. GAIN" is in the "OFF" position the horizontal deflecting plate is accessible from the panel by connecting to the "H-PLATE" and "GND" terminals. The applied voltage should not exceed 500 volts (peak).

TIMING AXIS

The "SWEEP FREQ." is the main control for the internal saw-tooth oscillator with the "FINE FREQ." acting as a vernier. The lower limit of the saw-tooth oscillator is approximately 15 cycles with the "SWEEP FREQ." set at 15 and the "FINE FREQ." at 0. The next position will be approximately 65 cycles, 230, etc., if the "FINE FREQ." control remains at 0. Values between the division marks of the "SWEEP FREQ." may be obtained by rotating the "FINE FREQ." between 0 and 100. If more than one cycle appears upon the screen of the tube it means that the horizontal timing axis has a frequency below that of the test voltage. When the timing axis exceeds the frequency of the test voltage, a series of crossed waves or part cycles will be noted.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0 2 4 6 8 10 12 14 16
A
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INTERNAL SYNCHRONIZATION

The "SYNC. CONTROL" is located directly above the "FINE FREQ." control and is used to stabilize or lock the pattern upon the screen. This control works in conjunction with the "VERT. GAIN" and should be advanced just a sufficient amount to stop the image. Over-synchronization results in a distorted pattern and consequently should be avoided.

EXTERNAL SYNCHRONIZATION

When the "EXT. INT. SYN" toggle switch is in the down position, a part of the vertical amplifier output voltage is connected to the control grid of the thyratr on saw-tooth generator. When in the "EXT. SYN" p osition, the "EXT. SYN" terminal is connected to the control grid and external synchronization voltage may be applied to stabilize the pattern.

APPLICATION

The following notes list a few of the more popular applications of the cathode ray oscilloscope. For more information on the theory and uses of this equipment it is suggested that the operator consult any of the large number of publications on this subject. Data of this nature may be obtained from leading publishing houses, book stores, public libraries as well as periodicals sponsered by Radio Engineering Associations and those found on newsstands.

WAVEFORM OBSERVATION USING AMPLIFIERS AND LINEAR SWEEP

This is perhaps the most popular application of the oscilloscope since test signa ls are usually of very low magnitude and consequently will require the use of the vertical amp lifier. Furthermore, the use of a linear sweep produces a much more simple pattern to analyze than would a complex time base.

The instrument is set up in the same manner as given in the GENERAL OPERATION section "WAVEFORM OBSERVATION USING VERTICAL AMPLIFIER". The voltage under test should be applied to the "VER" and "GND" terminals and the "VERT. GAIN" control regulated for a pattern of approximately one inch amplitude. With the "EXT-INT" toggle switch in "INT" position, adjust the "HOR. GAIN" for a pattern of about two inches in length. If the figure on the screen resembles a large number of vertical lines, rotate the "SWEEP FREQ." selector clockwise which increases the frequency of the time base (see "TIMING AXIS" under GENERAL OPERATION). When the frequency of the test voltage is equal to the rate of the linear sweep one wave will appear (Fig. 1). To obtain a single wave it may be necessary to adjust the "FINE FREQ." control which acts as a vernier to the "SWEEP FREQ." control or range selector. To "lock" or stabilize the figure, advance the "SYN. CONTROL" just enough to stop the figure from moving. To obtain more than one wave, rotate the "SWEEP FREQ." control counter-clockwise or reduce the sweep frequency. The number of waves will be equal to the ratio of the test frequency to the rate of sweep. When the sweep rate is higher than the frequency of the test voltage, the pattern will look like a series of cross marks (Fig. 2). In this case it will be necessary to turn the "SWEEP FREQ." counter-clockwise.

WAVEFORM OBSERVATION USING AMPLIFIERS AND EXTERNAL SWEEP

For checking frequency and producing special patterns, an external time base is frequently employed. Lissajou figures, alignment curves, incremental permeability and tube characteristic curves use this arrangement.

In this case, the sweep voltage is applied to the "HOR" and "GND" terminals and the "EXT-INT. SWEEP" is thrown to the "EXT." position. The "SWEEP FREQ." control is placed in the "OFF" position. The operation is the same as described

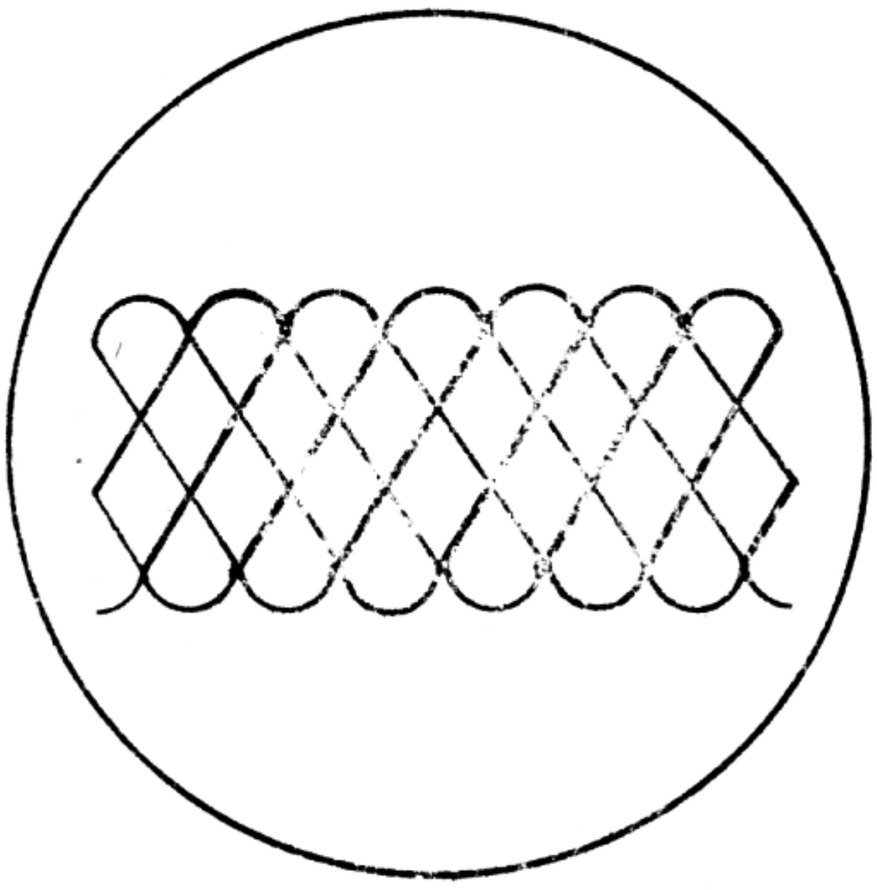


FIG. 2

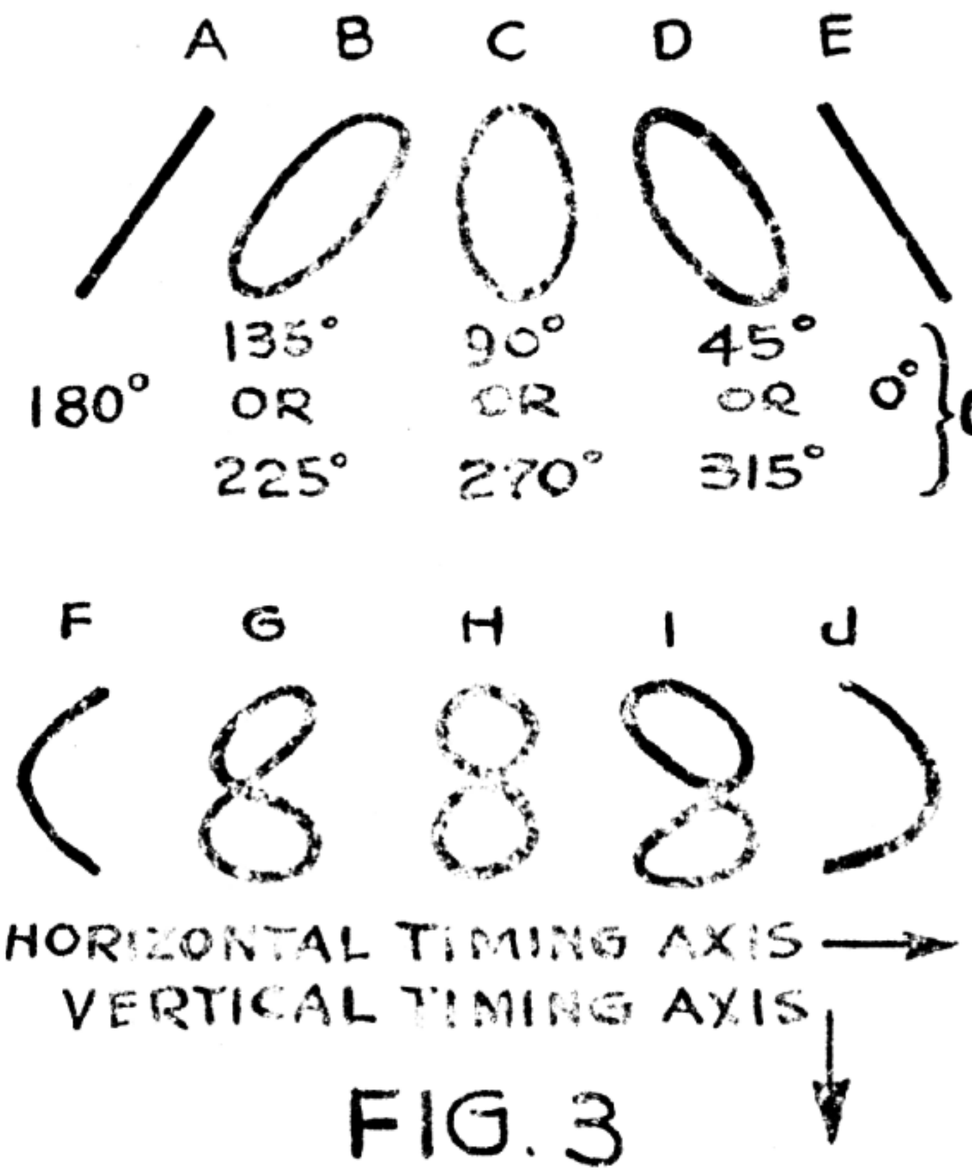


FIG. 3

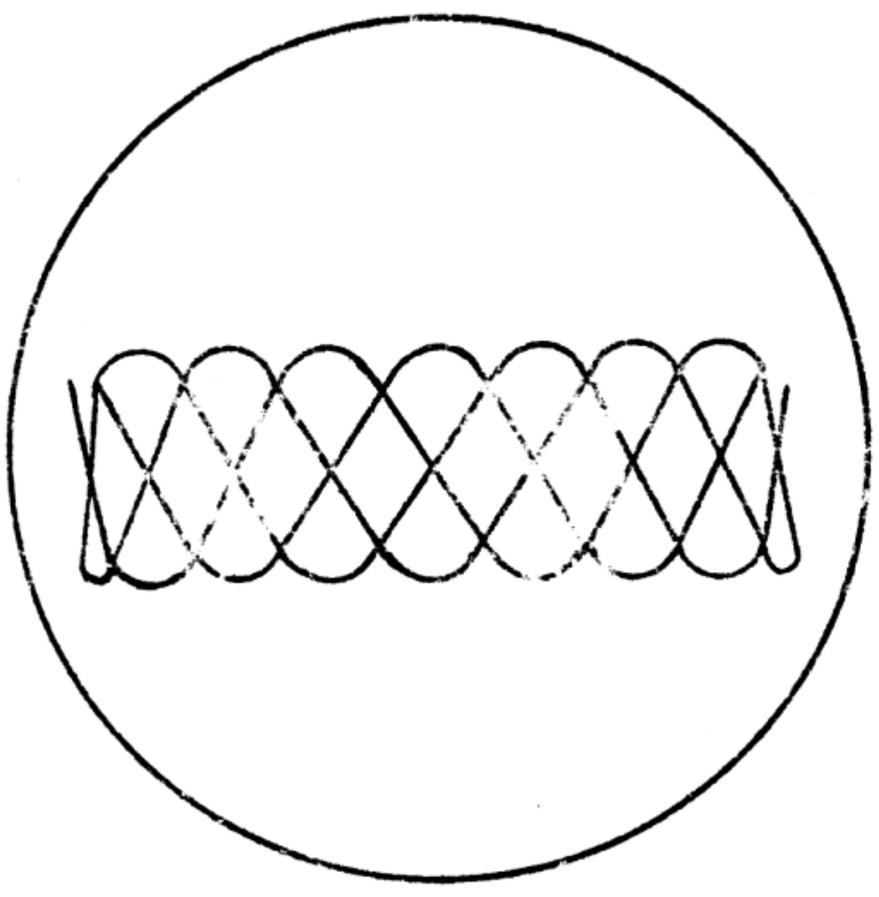


FIG. 4

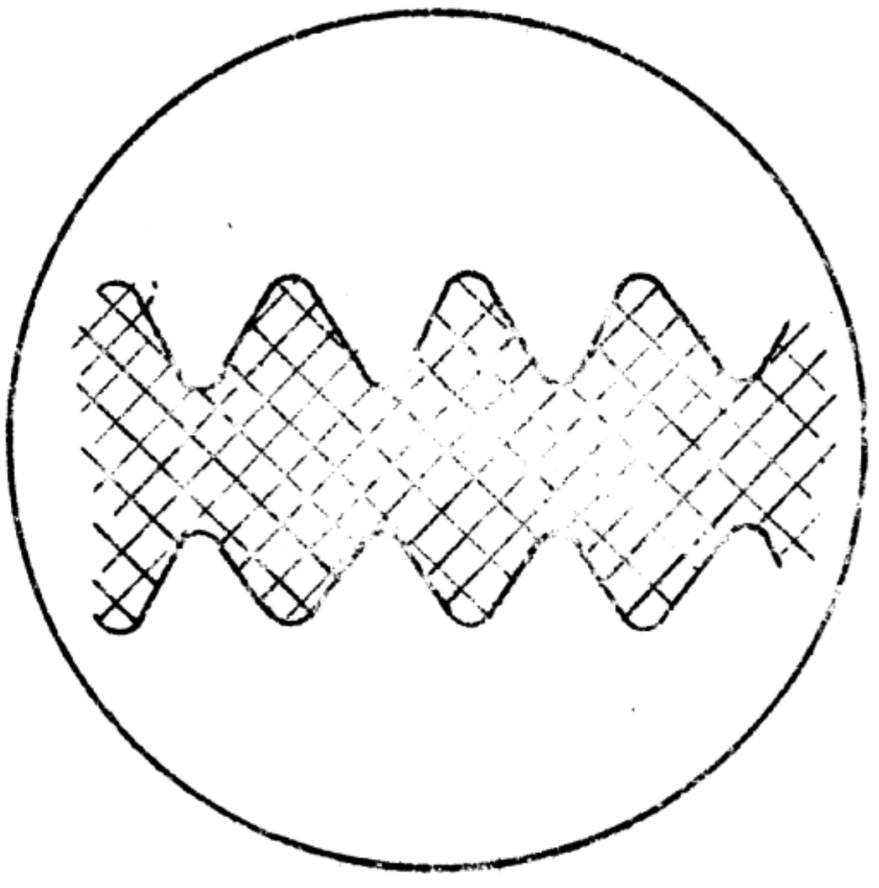


FIG. 5

previously except the rate of sweep is now controlled by the apparatus connected to the horizontal input.

Lissajous figures will result when the waveform of the sweep is similar to that of the test voltage. If the voltages applied to the horizontal and vertical inputs are sinusoidal and of the same frequency, but 90 degrees out of phase, an elliptical figure appears on the screen (Fig 3-C). If one of the frequencies is twice the value of the other, a figure "8" will indicate the ratio (Fig. 3-H). If a vertical and horizontal line are drawn tangent to the figure "8", it will touch it in two points on one side and one point on the other. This indicates a frequency ratio of 1:2. If one of the tangent lines had touched the figure in 9 points and the other in 2 points (Fig. 4) on the other side, the ratio would be 9:2. Thus, if the sweep voltage frequency was 60 cycles, Fig. 3-C indicates 60 cycles for the frequency of the test voltage. In Fig. 3-H the test voltage frequency would be one-half of 60 or 30 cycles. In Fig. 4 the result would be obtained by multiplying 60 times 9 and dividing by 2, making the vertical frequency 270 cycles. An orientation of the figure by 90 degrees would represent a reciprocal ratio.

PERCENTAGE OF MODULATION MEASUREMENTS

Although modulation measurements can be made by using the internal sweep of the instrument (Fig. 5), the most popular method is to use the modulation voltage as the time base. The latter method will produce trapezoidal patterns illustrated in Figures 6, 7, 8, 9, 10 and 11. To produce these patterns connect the vertical input of the scope to the output of the modulated R.F. tank circuit by means of a pick-up coil. Then feed the output of the modulator (A.F.) to the horizontal input. The degree of modulation (m) is equal to the difference of the vertical side of the trapezoid figure divided by their sum. For percentage of modulation, multiply m by 100. The voltage and frequency limit for this set-up is 500 volts peak and 100 kc., respectively. For frequencies higher than 100 kc. make the connections to the deflecting plates. Applications without the amplifiers will be explained further on.

ALIGNMENT OF RADIO RECEIVERS

By using a frequency modulated signal on the input of a radio frequency amplifier and connecting the vertical input of the scope to the output of the last detector, the frequency characteristic of the tuned circuit or circuits can be observed. If the internal sweep is used, it will be necessary to apply a synchronization voltage to the "EXT. SYN" and "GND" terminals. Even then sometimes the figure is unsteady and thus it is preferable to use a special external sweep. This is usually provided on frequency modulated generators and is applied directly to the horizontal amplifier input. If the time base employed has a frequency equal to the rate of frequency modulation, a single curve will result. If the ratio 1:2 with the time base frequency equal to one-half of the frequency modulating rate, the pattern will be a double trace. Some of these curves are illustrated in Figures 13, 14, and 15.

WAVEFORM OBSERVATION WITHOUT AMPLIFIERS

It is often desirable to observe voltages which have frequencies out of the limits of the amplifiers. Provisions are incorporated on this instrument for such occasions. To connect the test voltage to the vertical plates of the tubes without going through the amplifiers, turn the "VERT. GAIN" control to "OFF" and apply the voltage to "V-PLATE" terminal. To apply a voltage to the horizontal deflecting plates, turn "HOR. GAIN" to "OFF" and use the "H-PLATE" terminals. When the controls are in these respective positions, the input terminals are connected to the deflecting plates.

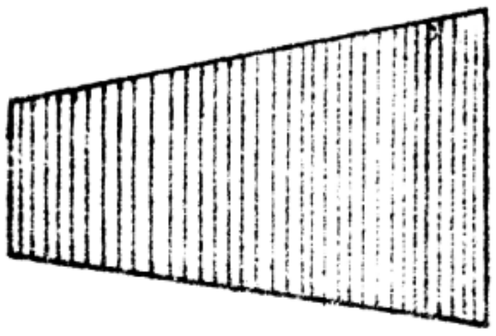


FIG. 6

50% Modulation

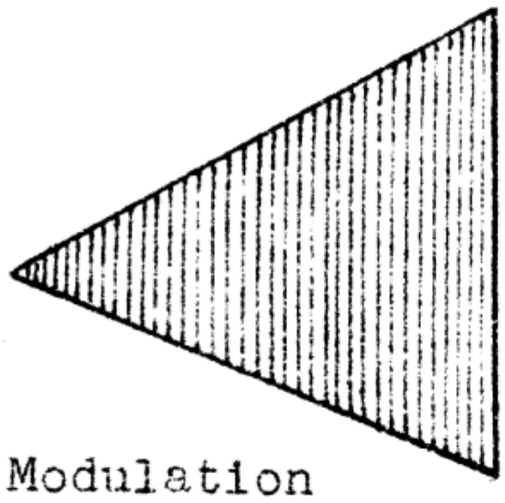
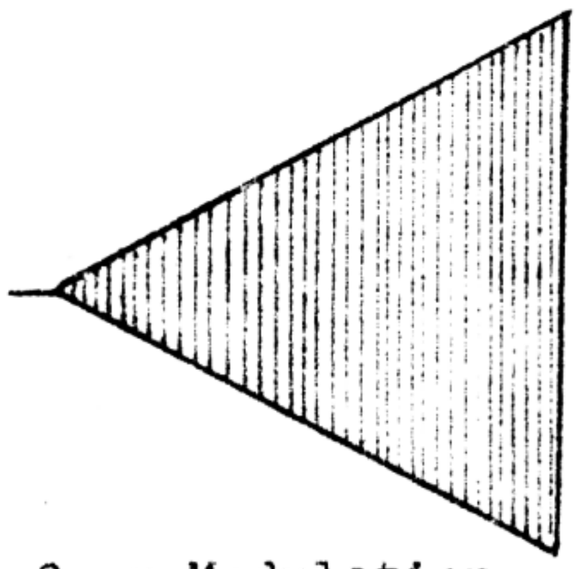


FIG. 7

100% Modulation



G

FIG. 8

Over Modulation

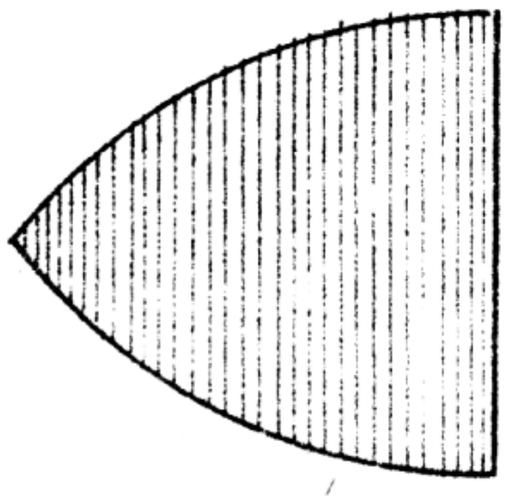


FIG. 9

Insufficient Excitation on
Class C State.

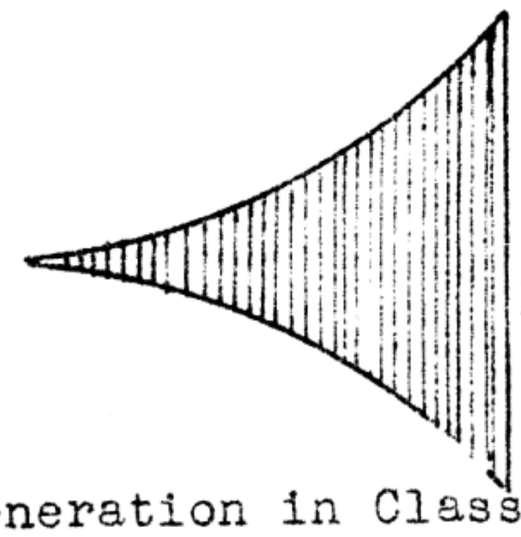


FIG. 10

Regeneration in Class C Amplifier

Brighter than balance of image

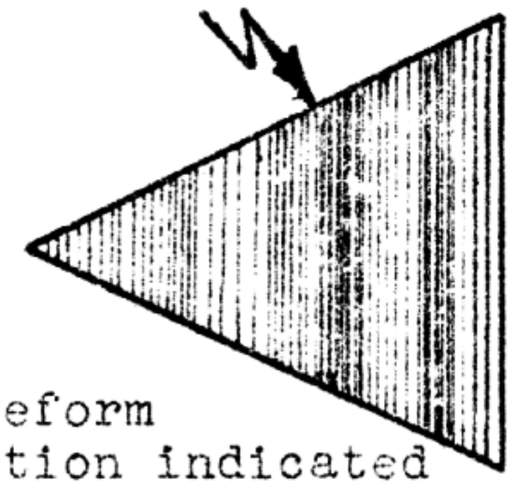
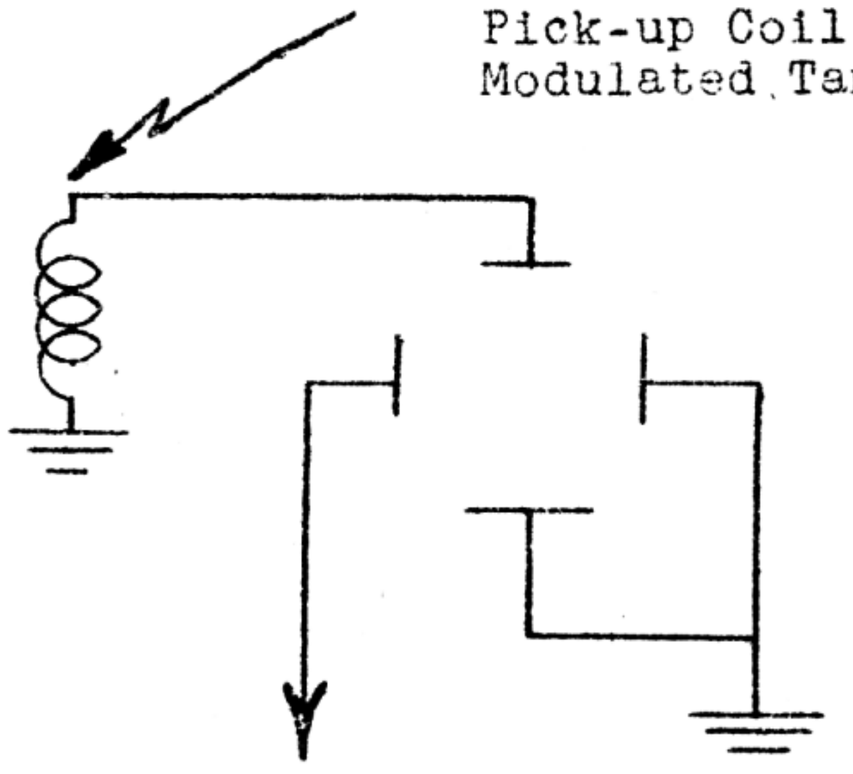


FIG. 11

AF Waveform
Distortion indicated
by bright band or bands

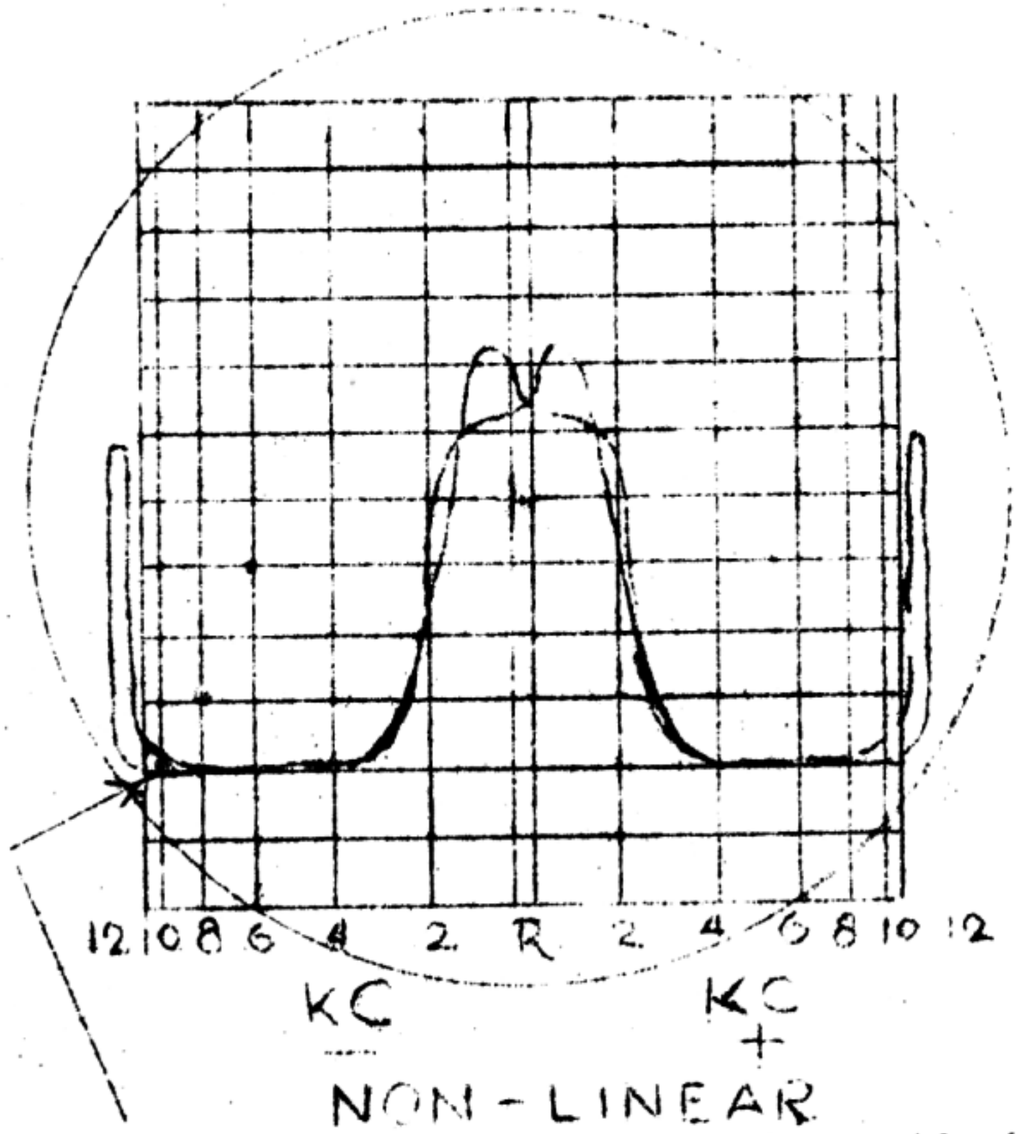


Pick-up Coil Placed Near R.F.
Modulated Tank Circuit.

To output of A.F. Modulator Tube Circuit

FIG. 12

DOUBLE-IMAGE RESPONSE CURVE

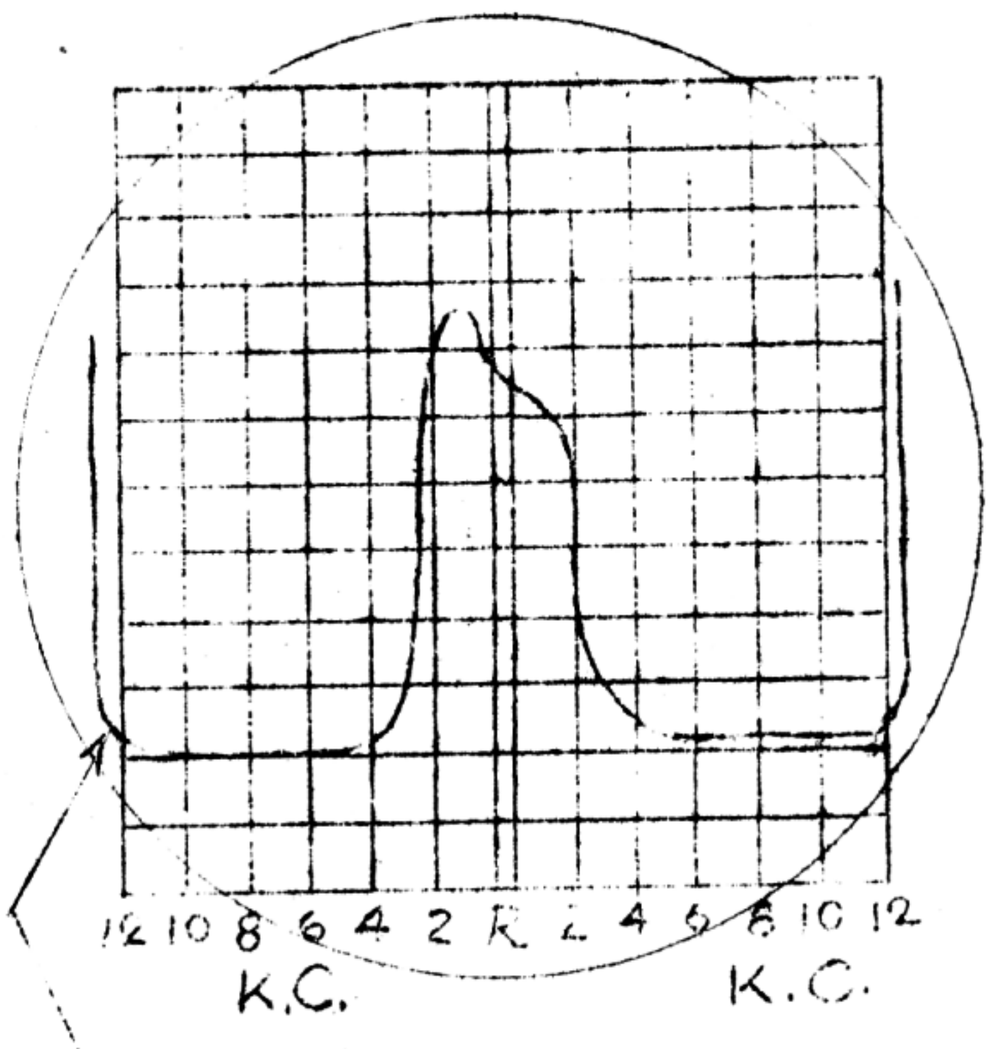


NON-LINEAR

Sweep should be adjusted so that the limiting brackets should appear $\frac{1}{4}$" beyond the outermost calibration

FIG. 13

SINGLE-IMAGE RESPONSE CURVE

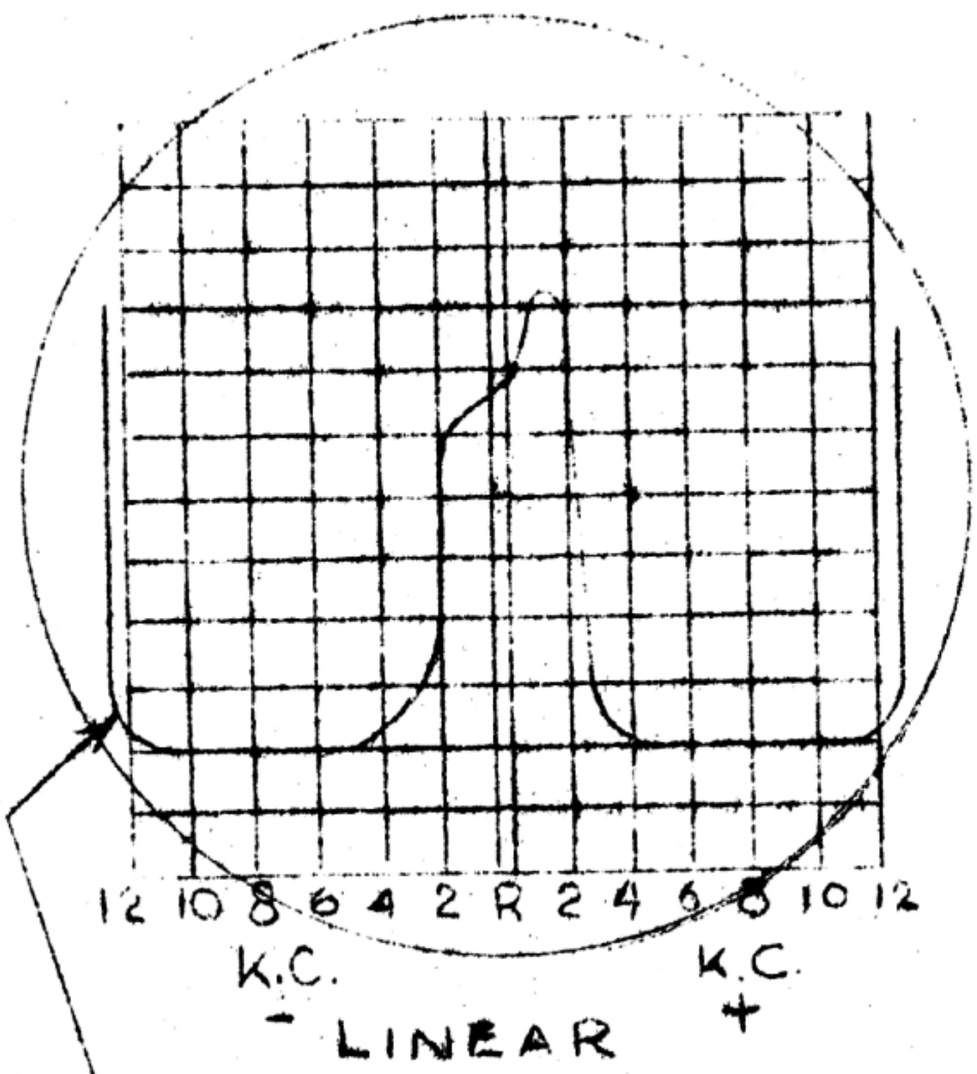


LINEAR

Sweep should be adjusted so that the limiting brackets appear along the outermost calibration lines.

FIG. 14

SINGLE IMAGE RESPONSE CURVE



LINEAR

Sweep should be adjusted so that the limiting brackets appear along the outermost calibration lines.

FIG. 15

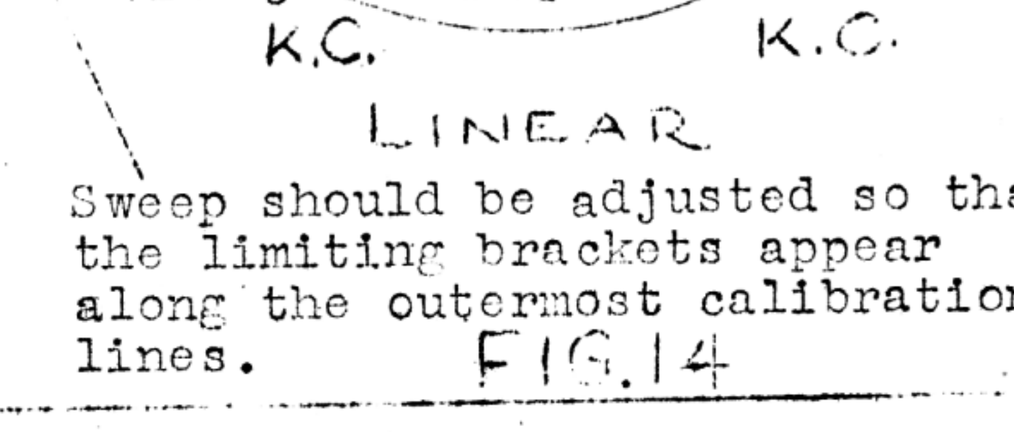


FIG. 16

With this set-up all of the above applications can be made; however, the applied voltages will have to be considerably higher. Off-screen deflection will occur in the vicinity of 60 volts and thus potentials of higher values should be reduced by external means. In addition to Lissajous figures, phase measurements may be made at the same time by referring to the Figures 3-A, B, C, etc. When the two voltages are in phase, a line 45 degrees slanting from left to right will indicate the 0 degrees phase displacement. 180 degrees will be represented by a 45 degree line from right to left. In between these two extremities various elliptical forms will appear with a circle representing a 90 degree phase angle.

REFERENCES ON THEORY AND APPLICATION OF THE OSCILLOGRAPH

Frederick E. Terman - Measurements in Radio Engineering
McGraw-Hill Book Company
New York City

R. A. Watson-Watt - The Cathode-ray Oscillograph in Radio Research
His Majesty's Stationery Office
London, England

John F. Rider - The Cathode-ray Tube at Work
John F. Rider, Publisher
New York City

SERVICE AND MAINTENANCE

If for any reason the Model 546 should fail to function properly, the following notes list information which may aid in locating the trouble.

CIRCUITS

There are six principal sections of the Model 546: namely, cathode-ray scope, power supply for scope, vertical amplifier, horizontal amplifier, low voltage power supply for amplifiers and internal sweep oscillator. Referring to the circuit diagram, the type 80 rectifier tube with filaments A-A have 350 volts applied to each plate. The common negative return for this section (low voltage power supply) is the chassis and the filament center tap is the positive output which connects to L_1. This supplies the voltage divider R_1, R_2, R_3, and R_4 which distributes the operating potentials to the amplifiers and sweep generator tubes. The type 80 rectifier tube with filaments B-B supplies voltage to the resistors R_5, R_6, R_8, and R_9 to provide the operating potentials to the cathode-ray tube type 906. This is a half-wave rectifier circuit with the tube (B) in series with the 800 volts winding (350 + 450) and the above mentioned voltage divider. R_9 regulates the bias voltage on the grid of the 906 and thus is the "INTENSITY" control. R_7 is connected to the second anode of the 906 and is indicated on the panel as the "FOCUS" control. R_{10} and R_{11} provide a variable potential which can be adjusted to provide either a negative or positive voltage with respect to the chassis. The common terminal connects to the deflecting plates through RR and controls the position of the image on the screen.

The vertical amplifier is of the fixed bias type using a 6C6 tube. The horizontal amplifier employs automatic bias by means of R_{21} in the cathode circuit. The input of these amplifiers are controlled by R_{17} and R_{18}. "VERT. GAIN" and "HOR. GAIN" respectively.

The sweep generator uses a type 885 thyratron oscillator and the frequency is adjusted by means of C_{13}, C_{14}, etc. - ("SWEEP FREQ.") and R_{25} ("FINE FREQ."). The switches connecting to V_{10} and H_{11} are located on the rear of the "VERT.GAIN" and

"HOR. GAIN" controls. The toggle switches which connect to C_8 and C_9 are the "EXT. INT. SWEEP" and "EXT. INT. SYNC." respectively.

INSTRUMENT TOTALLY INOPERATIVE

First check the fuse and if this is open, be sure that the voltage and frequency of the service outlet conform with the ELECTRICAL SPECIFICATIONS listed on the first page. If the trouble seems to be internal, disconnect the instrument from the service outlet and remove the chassis from the scope carrying case. Remove the two type 80 tubes and plug the instrument into the line. If the fuse does not open up, make the following test:

CAUTION - EXTREME CARE SHOULD BE EXERCISED IN MAKING MEASUREMENTS WITH THE INSTRUMENT CONNECTED TO THE LINE. THE VOLTAGES BETWEEN THE ELECTRODES OF THE CATHODE RAY TUBE AND RECTIFIERS ARE OF SUCH MAGNITUDE THAT SERIOUS BURNS WILL BE INFLICTED IF THE BODY SHOULD COME IN CONTACT WITH THESE POINTS AND THE CHASSIS. Using a pair of insulated test leads, measure the voltages on the secondaries of the power transformer. If these appear to be near the values shown on the circuit diagram, DISCONNECT THE INSTRUMENT and check C_1 and C_2. The resistance across C_2 should not be less than 25,000 ohms. It should be noted that C_1 and C_2 are electrolytic capacitors and thus will not read correctly on an ohmmeter unless the polarity is observed. With the type 80 tubes out of the sockets, if the instrument continues to blow fuses, check the power transformer for a possible short circuit between the windings and the laminations.

INSTRUMENT PARTIALLY INOPERATIVE

If either of the amplifiers should fail to function or the internal sweep generator is not working, replace the type 80 tube and check for voltages at the points listed. It is also advisable to check the merit of the tube and amplifier in a standard emission type checker or by substituting one of known condition.

VOLTAGE MEASUREMENTS

For the purpose of comparison, the following data lists the more important operating potentials which will aid in locating trouble. These notes are based on a line voltage of approximately 120 volts on the primary of the power transformer. A-C voltages are indicated on the circuit diagram in root mean square values. D-C voltages are indicated below as measured with a 1000 ohm per volt meter between the chassis and respective points. Reference to pin numbers on sockets are R.M.A., that is, looking at the base of the tube with the filament pins on the bottom, the left hand filament pin is 1, the next pin, counting clockwise is 2, etc. This applies to the tubes used in the Model 546.

Type 80 (full-wave rectifier)	Pin No. 1	400 volts positive
Type 80 (half-wave rectifier)	Pin No. 2 or 3	1050 volts negative
Type 6C6 (vertical amplifier)	Pin No. 2	250 volts positive
	3	80 volts positive
	4	2.2 volts positive
	5	2.2 volts positive
Type 6C6 (horizontal amplifier)	Pin No. 2	180 volts positive
	3	80 volts positive
	4	2.1 volts positive
	5	2.1 volts positive

Type 885 (sweep generator)	Pin No.	2	25 volts positive on 350 V range
		4	4.1 volts positive on 350 V range
Type 906 (cathode-ray tube)	Pin No.	2	0 to 85 volts negative
(Measurements made between		3	260 to 550 volts positive
Pin No. 7 and points indicated)		4	80 to 350 volts positive
Do not measure voltage from #2		5	200 to 400 volts positive
pin (grid) on 906 to chassis.		6	900 volts positive

THE CHASSIS IS POSITIVE WITH RESPECT TO CATHODE ON THE TYPE 906 ONLY.

REPLACEMENT PARTS

The parts used in the Model 546 were carefully inspected for mechanical and electrical defects before shipment from the factory. Under normal operating conditions, the tubes are the only parts which will require replacement. The average life of the amplifier and rectifier tubes is approximately 1500 hours and the life of the thyratron and cathode-ray tube approximately 1000 hours. The following list includes parts which may be easily replaced by the operator should the necessity arise.

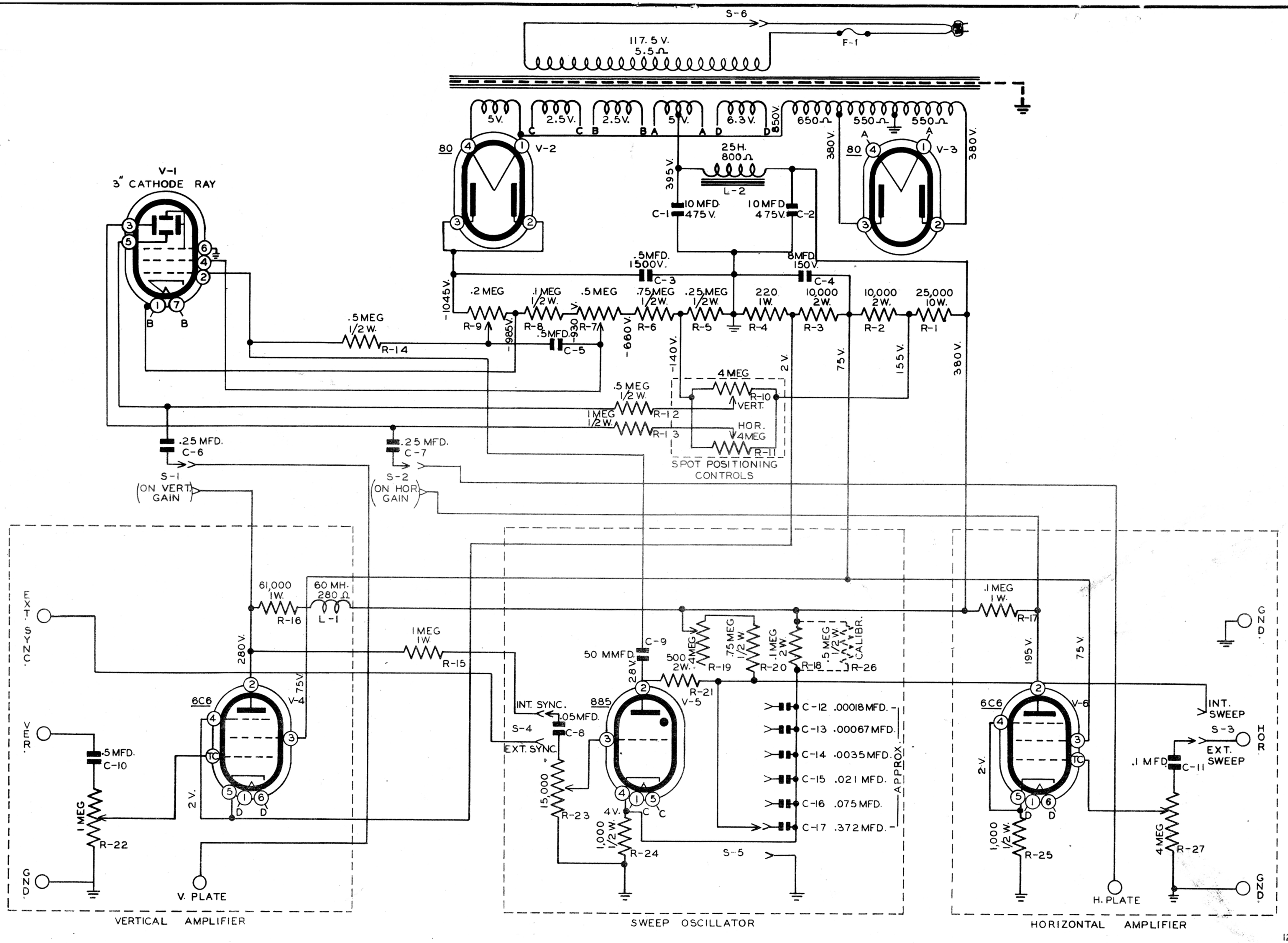
Stock Number	Description
5099	Filter choke
6986-87	Leads, pin plug to alligator
7276	Tube, type 6C6
8307	Tube, type 80
8305	Tube, type 885
7703	Tube, type 906
	Potentiometers, Resistors, Capacitors } Order by reference number stated on Circuit Diagram - C_1, R_1, etc.

Additional information concerning replacement parts may be obtained by writing to the Factory Service Department.

SUPREME INSTRUMENTS CORPORATION

GREENWOOD, MISSISSIPPI

U. S. A.



ALL VOLTAGES MEASURED WITH AN ELECTRONIC VOLTMETER

12-13-44

SUPERCEDES DWG. DATED 9-2-37

MATERIAL _____ FINISH _____

UNLESS OTHERWISE SPECIFIED DECIMAL DIMENSIONS TO BE ± _____ OTHER DIMENSIONS TO BE ± _____ SCALE _____

REV.	BY	WAS	DATE

SUPREME INSTRUMENTS CORPORATION
GREENWOOD, MISS., U.S.A.

SCHEMATIC DIAGRAM
MODEL 546

DRAWN	TRACED	DATE
C. J. Bouthell		4-17-45
CHECKED	APPROVED	SD.
	Raymond Howard	1641-C