OPERATING INSTRUCTIONS

# DU MONT TYPE 164
# CATHODE-RAY OSCILLOGRAPH

DU MONT

ALLEN B. DU MONT LABORATORIES, INC.
PASSAIC, NEW JERSEY
U. S. A.

# DU MONT TYPE 164

# SERVICE OSCILLOGRAPH

## ELECTRICAL SPECIFICATIONS

### Power Supply Ratings

| | |
|---|---|
| Voltage . . . . . . . . . . . . . . . . . . . . . . . . . . | 110-120 Volts a.c. |
| Frequency . . . . . . . . . . . . . . . . . . . . . . . . | 60 Cycles |
| Wattage . . . . . . . . . . . . . . . . . . . . . . . . . . | 50 Watts |
| Fuse Protection . . . . . . . . . . . . . . . . . . . | 1 Ampere |

### Operating Limits

| | |
|---|---|
| Deflection sensitivity (max. amplifier input) . | ..48 r.m.s. volts/inch |
| Deflection sensitivity direct to plates. . . . . | 34 r.m.s. volts/inch |

Input Characteristics

1. Through vertical amplifier . . . . . . . . . . 1 megohm
2. Through horizontal amplifier . . . . . . . .0.8 megohm
3. Voltage gain vertical amplifier . . . . . . . 70
4. Voltage gain horizontal amplifier . . . . . . 40

Frequency range of amplifiers . . . . . . . . . . 15 to 30,000 cycles per sec
Frequency range of timing axis . . . . . . . . . . 15 tp 30,000 cycles per sec

Max. allowable a.c. volts input to amplifiers. . 300
Max. allowable d.c. volts input to amplifiers. . 400

D.C. volts delivered by high voltage section of power supply . . . . . . . . . . . . . . . . . . . . . 1125
D.C. volts delivered by low voltage section of power supply . . . . . . . . . . . . . . . . . . . . . 415

### Tubes and Functions

1 - Type 80 half-wave rectifier
1 - Type 80 full-wave rectifier
1 - 6C6 Vertical amplifier
1 - 6C6 Horizontal amplifier
1 - 885 Saw tooth oscillator
1 - 34-XH Cathode ray tube

### Physical Specifications

| | | |
|---|---|---|
| Height . . . . . . . . . . . . . . . . . . . . . . . . . | 11 3/8 | inches |
| Width . . . . . . . . . . . . . . . . . . . . . . . . . . | 7 1/2 | inches |
| Depth . . . . . . . . . . . . . . . . . . . . . . . . . . | 13 | inches |
| Weight . . . . . . . . . . . . . . . . . . . . . . . . . | 24 | pounds |

# OPERATING INSTRUCTIONS

## for

## DU MONT TYPE 164 SERVICE OSCILLOGRAPH

**1. SET UP** The Type 164 Oscillograph is shipped ready to operate. All tubes are in place and it is only necessary to plug into a line of the proper frequency and voltage.

**2. CONTROLS** All controls of the Type 164 Oscillograph are on the front panel and are plainly marked. The following description gives the location and use of the various controls. Because all the controls are on the front panel, it was deemed advisable to distinguish in some manner, the controls frequently adjusted from those more permanently set. Hence, the synchronizing, rough and fine frequency, and the horizontal and vertical amplifier controls have red bar knobs. In the upper left corner is the intensity control. It controls the intensity of the trace and also carries with it the off and on power switch. The "off" position being at the extreme counter-clockwise position. At the upper right is the focus control which needs no explanation. Just below the intensity control is the vertical positioning knob which controls the up and down movement of the spot or trace, while directly below the focus control is the horizontal positioning which controls the left to right movement of the pattern. The synchronizing control is in the center of the panel just below the cathode ray tube. Directly below the position controls are the amplifier gain controls, the vertical being on the left and the horizontal on the right. In the center of the panel under synchronizing is the vernier or fine frequency control of the linear sweep while directly below it is the rotary switch which controls the frequency in rough stops. The approximate range of these stops is as follows:

1 - Sweep off
2 - 15 to 60 cycles
3 - 60 to 220 cycles
4 - 220 to 900 cycles
5 - 900 to 3000 cycles
6 - 3000 to 10,000 cycles
7 - 10,000 to 30,000 cycles

At the bottom of the panel on the left side is the switch which permits either internal or external synchronization while on the right, a switch places the horizontal amplifier in operation with the sweep or connects it to the post for external use.

The controls are arranged so that the minimum setting is obtained when the knobs are turned counter-clockwise and maximum when turned clockwise.

**3. CONNECTIONS** The vertical input is to the binding posts on the left side of the panel, the lower post of the pair being the ground. The horizontal input is on the right side and as in the previous pair the bottom post is the ground.

On the back of the machine is a plate with five screw type binding posts. These permit the disconnecting of either or both circuits allowing direct connection to the deflection plates. This feature will be found a great convenience to amateurs or others working with d.c. or high frequency applications. The location of circuits on the panel will be found in figure L1 on page 12 of this pamphlet.

**CAUTIONS AND WARNING** 1. Do not operate this unit with the case removed as high voltages are employed.

2. Do not experiment with magnets around or near the case of the oscillograph. You may impair or render your oscillograph useless.
3. Do not place the unit over, under, or near a power transformer or reactance carrying a.c. as the field set up will cause distortion of the patterns to an extent that will make conclusions impossible.
4. Do not allow a small line or spot of high brilliancy to remain stationary on the screen for any length of time as the screen may be discolored or burnt.

## OPERATING INSTRUCTIONS FOR THE USE OF THE OSCILLOGRAPH

This procedure is included to acquaint the operator with the operation of the oscillograph. It is suggested that the operator follow these instructions and familiarize himself with the controls and their location before attempting any use or measurements.

Turn the two positioning controls, the focus, the synchronizing and the horizontal gain control to the half way point. Then turn the synchronizing switch to internal and the horizontal switch to the sweep position Place the frequency control switch on tap #1 and turn off the vertical amplifier. Insert plug in proper a.c. source and turn intensity control clockwise until a horizontal line appears. Now adjust both the intensity and focus controls until a sharp clear cut line is secured. Do not use greater brilliance than necessary to get a usable trace. This trace can now be positioned to the center of the screen and if a small source of a.c. is connected to the vertical posts a pattern will form on the screen as the vertical amplifier control is advanced. If one wave is secured it indicates that the sweep is the same frequency as the 60 cycles applied or if two waves appear, the sweep is at one half the frequency or 30 cycles and so on. The pattern can be caused to stand still or drift by turning of the synchronizing control. In some cases distortion can be caused by oversynchronizing so use only enough to lock the pattern.

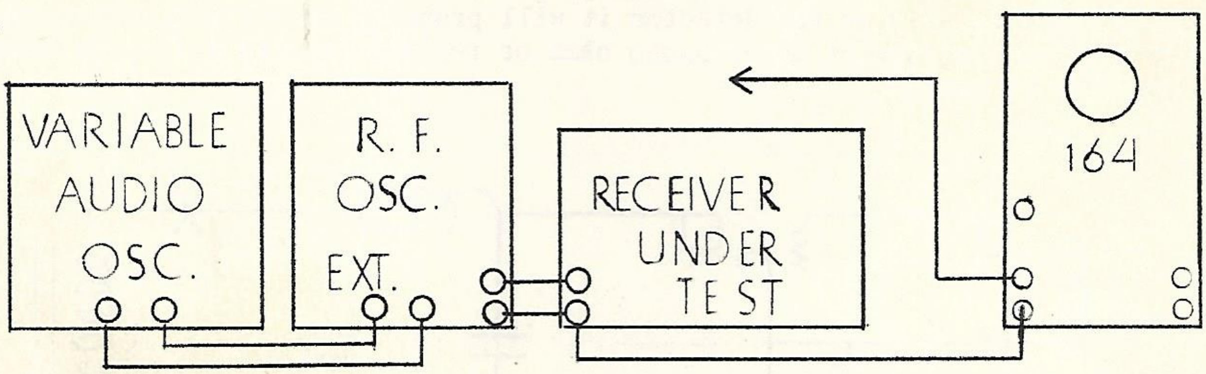
It is general practice to use several waves when examining wave forms especially on frequencies above 1000 cycles.

While the pattern given by an oscillograph shows peak voltages, it is a simple matter for the operator to acquaint himself with the deflection in inches secured at various settings of the gain control with T.M.S. (meter readings) voltages applied. If considerable use is made of this feature it may be advisable to plot a curve of the voltages required to give a certain deflection.

As this instruction book is intended for the radio service man it will not include miscellaneous applications, lissajou figures, photography, etc. We suggest that the service man acquaint himself with the theory and use of the instrument by studying in his spare time. The following texts will be of value: "The Cathode Ray Tube at Work", by John Rider, and "The Cathode Ray Oscillograph in Radio Research," by R.A. Watson Watt.

**VISUAL ALIGNMENT OF RADIO SETS** This was the first and simplest method of alignment and the oscillograph merely took the place of the output meter. It consisted of using a signal generator with some form of audio modulation which was applied to the receiver and the audio output was measured with an oscillograph. Unlike its predecessor the output meter, it not only showed the voltage output but also the shape of the wave, and enabled the study of the detector and audio systems permitting the locating of audio distortion, overloading, etc. While this method was not the most efficient and has now been supplanted by the modern frequency modulated oscillator of constant band width, which is undoubtedly better for pure alignment work, it is coming again to the fore this time under the title of overall frequency response.

In this case the old type audio oscillator is replaced by an adjustable or beat type oscillator capable of producing essentially sine waves of the same voltage output, from five cycles to fifteen thousand cycles. It is apparent that this setup will determine where the response of a receiver starts to fall off at either the high or low frequencies. Moving from the detector to the audio system and repeating the readings will show whether further loss is suffered.



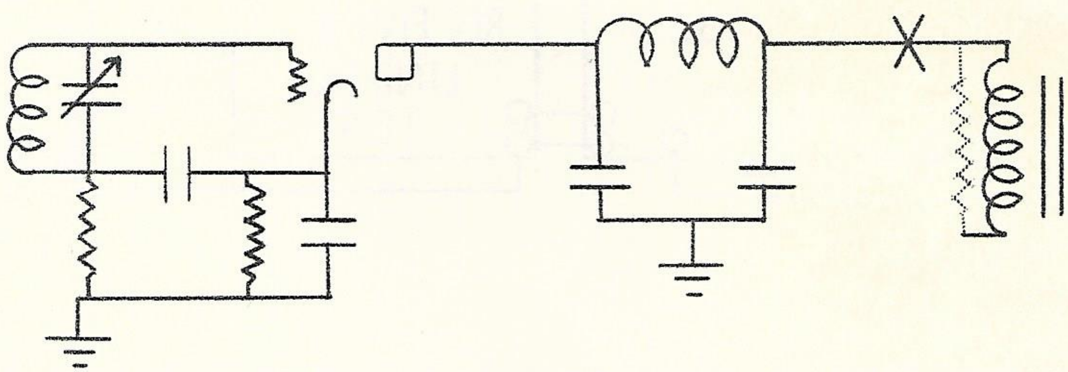

**VISUAL RESONANCE CURVES** The general procedure involved is as follows: An R.F. oscillator is provided with some means that will serve to vary its frequency a few kilocycles either side of the frequency to which it is tuned. In the older units it consisted of a motor driven vernier variable condenser, connected across the main tuning condenser of the oscillator. This process, known as frequency modulation, is often called "wobbulation" to distinguish it from audio modulation.

For IF alignment these older systems are nearly as good as the latest types but a little thought will disclose the fact that the width of the band swept will be determined by the position of the main condenser, so the trend has been to beat frequency oscillators which produce a constant band width.

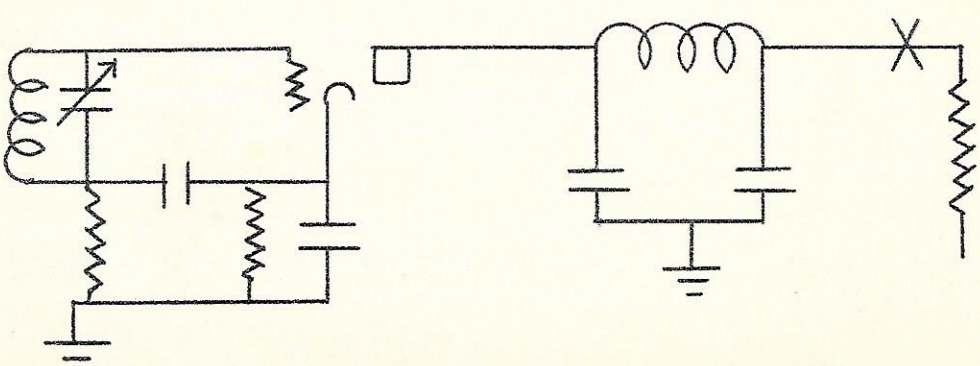
There are numerous methods of producing a frequency modulated signal. It can be effected by a motor driven condenser, a motor driven disc, vibrating reed or electronic means and, as previously stated, may or may not include the feature of constant band width. However, regardless of the method, the principle of operation is the same. The output of the generator in frequency plotted against time will appear as a pyramid for the 360 degrees of frequency modulation rotation. If the sweep is adjusted to twice this frequency of rotation, the spot will sweep from one side of the screen to the other in the length of time required for the oscillator to go from minimum to maximum and will then sweep a second time while the oscillator frequency goes from maximum to minimum. Thus during 180 degrees of frequency modulation rotation the oscillator frequency sweeps from minimum to maximum passing through the resonant point of the circuit tested and tracing this curve on the screen. During the next 180 degrees, the frequency goes from maximum to minimum and a second curve is traced. If the resonance curve of the circuit is symmetrical the two traces can be made to actually coincide.

In taking resonance curves it is advisable to take the A.V.C. action off the stage or stages being tuned. Intermediate frequency stages should always be tuned to peak at the frequency for which the set is designed

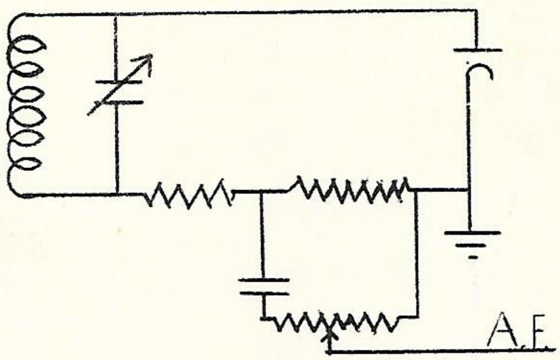
In connecting the oscillograph to the set under test; if there is a reactive load on the detector it will probably be advisable to shunt it with a resistor of about 25000 ohms or replace it with a 100,000 ohms resistor as shown.



In cases of resistive load this connection can be made as shown.



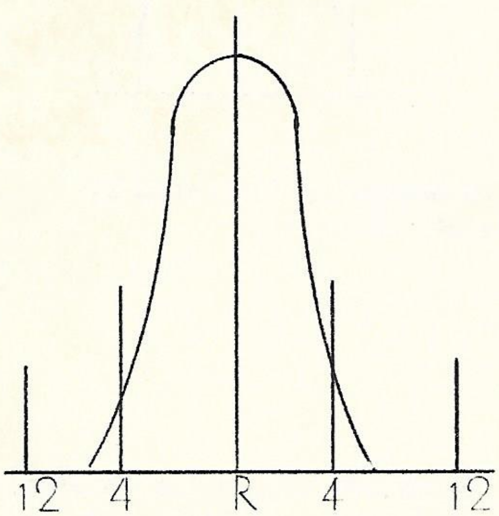
In case of diode connection across the diode load.



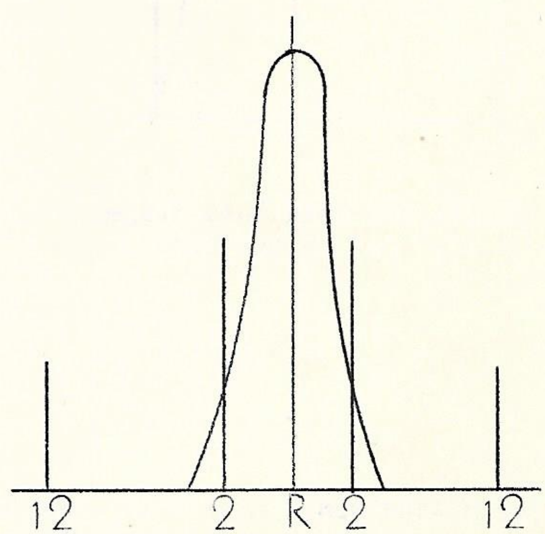

In general the ground circuit of the oscillograph is fastened to the ground of the receiver and the deflection plate to the point X in the drawings. Most receiver manufacturers give complete directions for connection to oscillographs in their service sheets, therefore, it would be confusing to attempt to cover all cases in this manual.

There may be cases where symmetry of curves cannot be secured. This is generally due to regeneration in the IF stages. It should be considered as an indication of trouble. The most common source being common coupling in the power supply due to too small or open bypass condensers. Of course, capacity coupling, poor shielding,etc.,can cause the same effect.

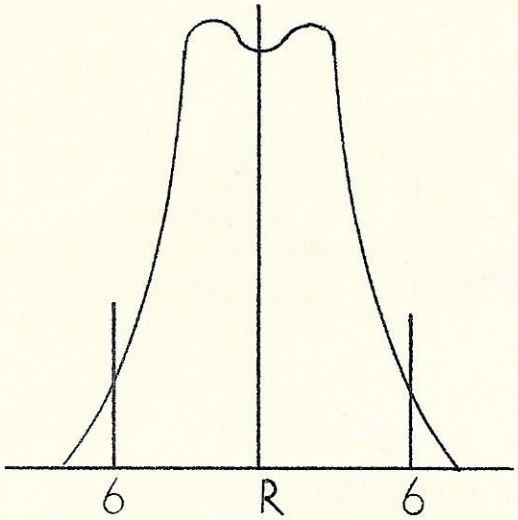
The following curves are shown to acquaint the operator with their general appearance.



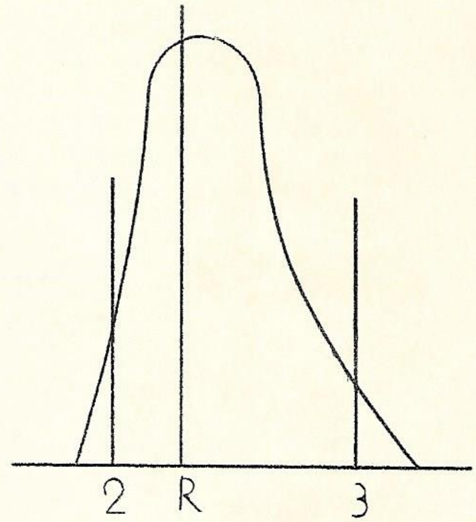

Good Curve Average Receiver



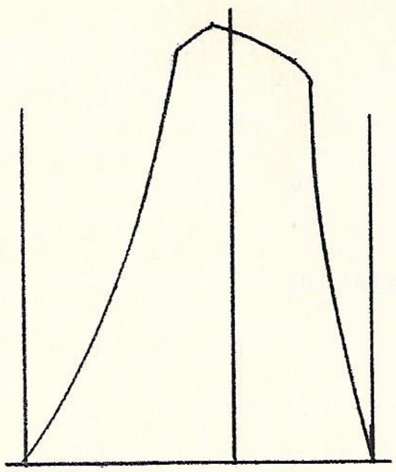

Good Curve Old Receiver Narrow Response



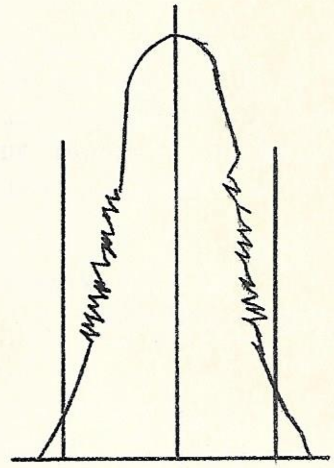

Good Curve Band Pass




Misaligned Stage - Cut Off One Side



Misaligned Band Pass Stage
Cut Off on One Side

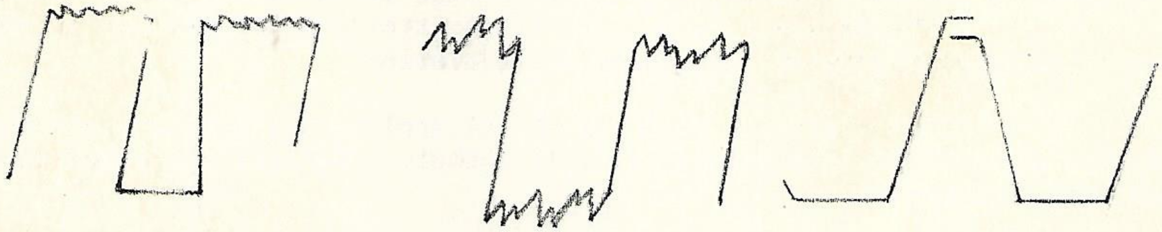


Oscillation Generally Indicated by
Jagged Slope

**HUM MEASUREMENTS** The sweep can be set to 60 cycles and, using internal synchronization, the pattern locked. A test prod then can be used for checking the entire circuit, the magnitude of the hum being indicated by the height of the waves. This enables the checking of the various points of the filter circuit and the effect of changes in chokes, condensers or alignment of parts readily seen and compared.

**OSCILLATION AND REGENERATION** With the oscillograph connected across the suspected circuit and no signal applied, only the straight horizontal trace of the sweep should appear. Oscillation will show by the widening of the sweep trace. Regeneration which is just short of oscillation can be seen by applying a radio signal modulated by an audio oscillator of good wave form. You will become familiar with the shape of this wave and since regeneration causes serious distortion its presence will be readily apparent.

**AUTO RADIO VIBRATORS** The vertical input can be connected several ways, directly across the contacts or between the center tap and either end of the high voltage windings. Internal synchronizing should be used and the waves made to stand still. Incorrect adjustments will cause peculiar rough patterns of many shapes. The following drawings give the general idea.



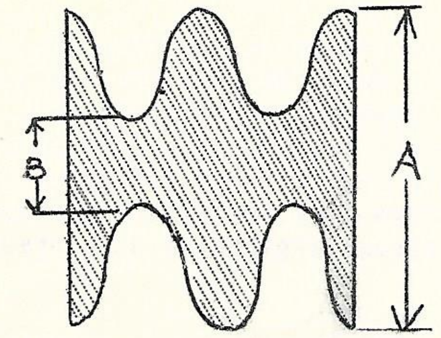
Spacing Too Great          Spacing Too Little          Spacing Correct

**PERCENTAGE OF MODULATION** The principle of this can be easily understood if we consider only one direction at a time. An unmodulated carrier is applied to the vertical plates and a certain length of trace measured. Then the modulation is applied and the length of the trace again measured. The percentage of modulation is then calculated as below:

$$\% \text{ Mod} = \frac{Lm - Lu}{Lu} \times 100$$

When Lm = Length modulated
Lu = Length unmodulated

Now add the sweep action and you get a band or block pattern for the carrier which will be what is called an envelope when modulated, the appearance of which will be as shown on the next page.



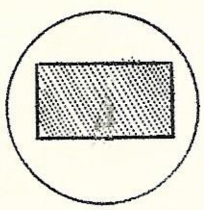

It is apparent that the sweep has merely allowed the visualizing of the wave form and no change in the formula is effected. We would merely substitute the new terms A and B and get

$$\% \text{ Mod.} = \frac{A - B}{A + B} \times 100$$

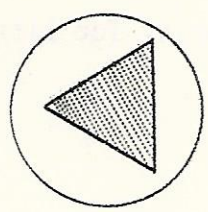
It is apparent that if sufficient voltage is available this could be applied to received signals as well as transmitters. On a transmitter it will usually be found that a few turns of wire connected to the vertical deflection plates and placed near the final tank circuit will pick up sufficient voltage. The size of the pattern will be controlled by varying the distance between the pickup coil and the transmitter. In case of very high frequencies or low power it may be found necessary to tune this pickup coil to the frequency of the transmitter.

**TRAPEZOIDAL PATTERNS** This method is considered better than the envelope for transmitter adjustment. This is because it lends itself better to complete analysis of the transmitter and not because it is better as an indicator of percentage of modulation.

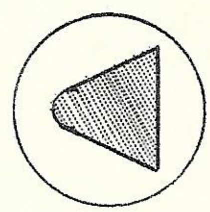
The articles on this particular application are so numerous that we will not go into details in this manual. The following drawings are self-explanatory.



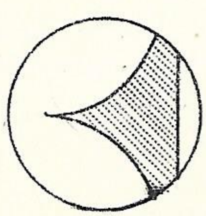
R.F. Carrier
No Modulation



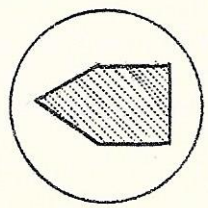
100% Modulation
No Distortion



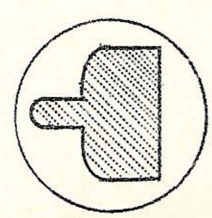
120% Modulation
Distortion Neg. Peaks



Regeneration
Class C Stage



Insufficient R.F.
Grid Input



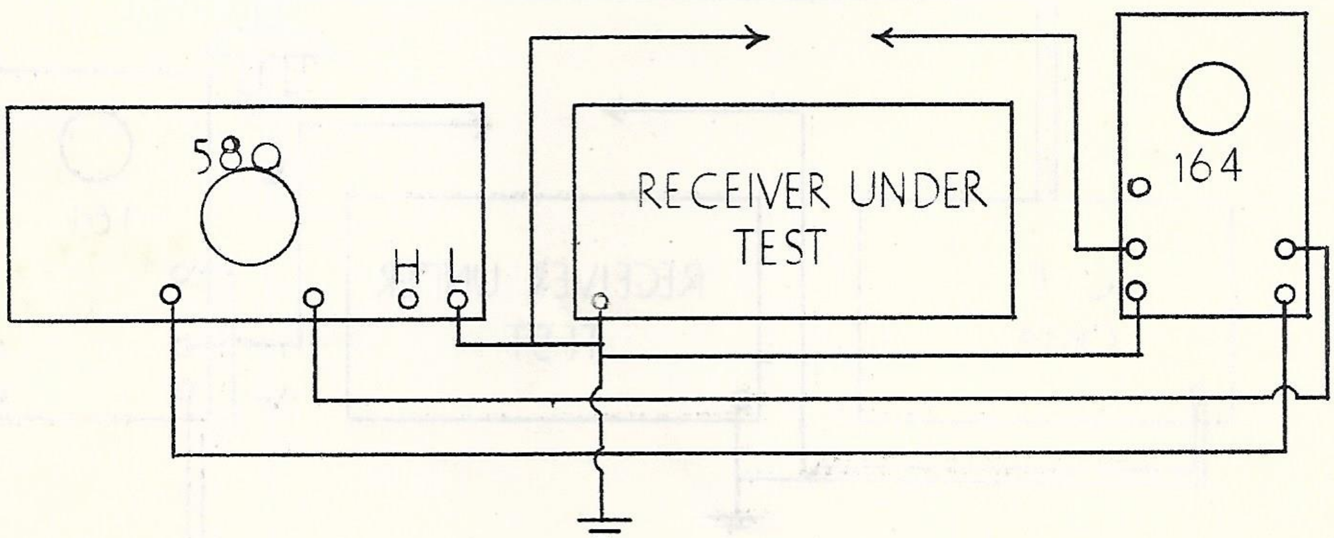
Highly
Regenerative

The Supreme Type 570 De Luxe Series Signal Generator is of the constant band width type with electronic wobbulation.

**CONNECTIONS** As shown in drawing below.

**OPERATION** No sweep or synchronizing are necessary as this generator provides its own sweep. The sweep should be turned off and the horizontal switch placed in the amplifier position. The horizontal amplifier control will then control the width of the sweep. The manufacturer states that the pin jack on the left of the dial be connected to the ground side of the oscillograph and that if the phase is incorrect change the plugs attaching the unit or the oscillograph to the a.c. line. The pattern secured is of the double type as it is actually a lissajou figure caused by 120 cycles on the vertical plates and 60 cycles on the horizontal.

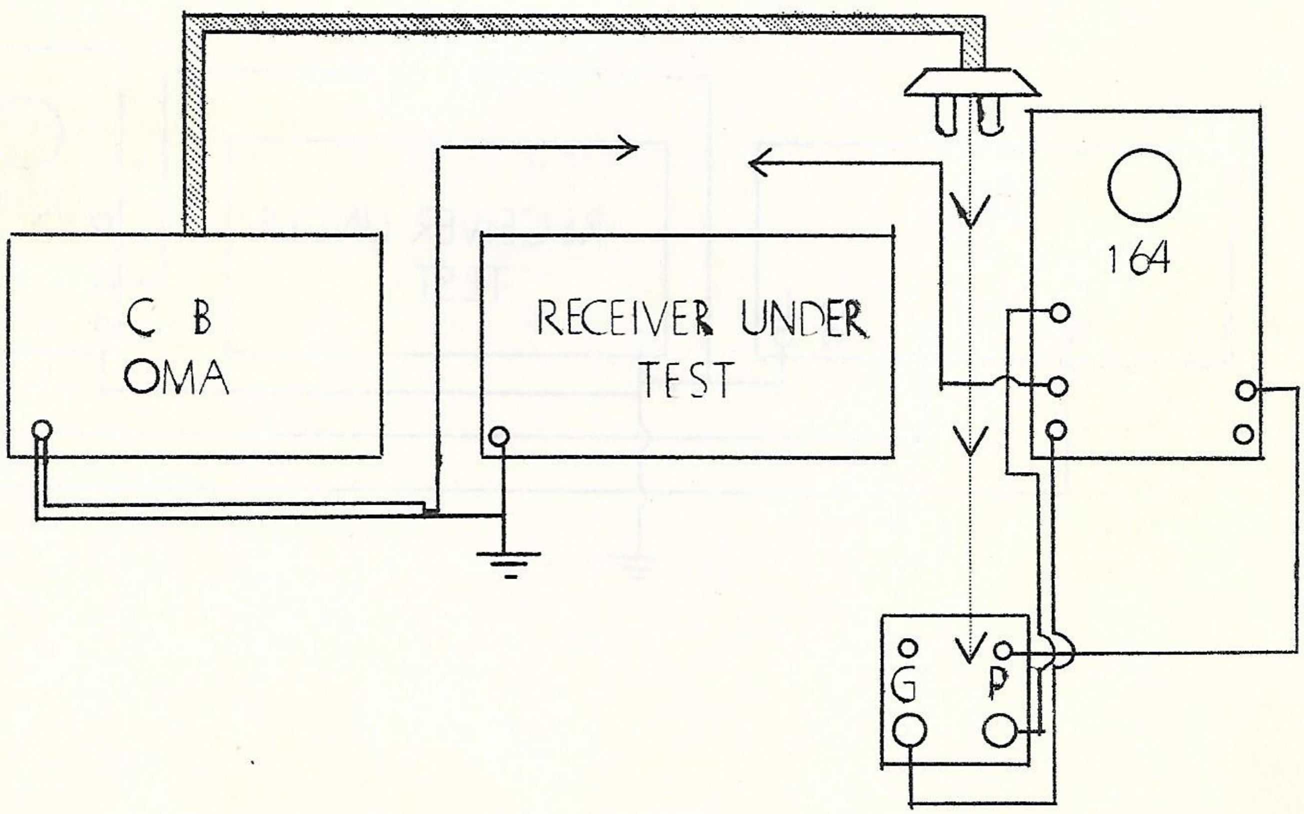
In use this unit is of the reset type, that is to say the frequency is direct reading at 400 cycles modulated and when frequency modulated, 600 kc should be added to the frequency desired. For example, if you desire 465 kc you should set the oscillator at 1065 kc.



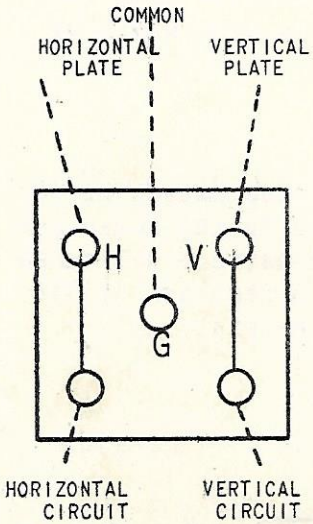
The Clough Brengle Type OM-A is distinguished from most signal generators by the fact that it permits both the double and the single trace curves to be used. It is of the constant band width type and is motor driven but works on a different principle from the old units as the wobbulation in this case is caused by a disc rotating in the field of the fixed oscillator.

**CONNECTIONS** The sweep source for single trace and the synchronizing pulse for double trace are secured from a cable at the back of the unit. The connections are quite simple as shown. It is not necessary to use a standard 4 plug socket as shown. A 4 prong female speaker plug makes a better appearing job.

**OPERATION** After connections are made place the synchronizing switch in the external position and the horizontal switch in the sweep position. With the sweep set at the correct frequency the regular double resonance pattern will be secured. Throwing this same switch to the amplifier position will result in the single pattern the phase of which is adjustable on the front of the oscillator while the amplitude can be controlled at either the oscillator or the horizontal amplifier control of the oscillograph.

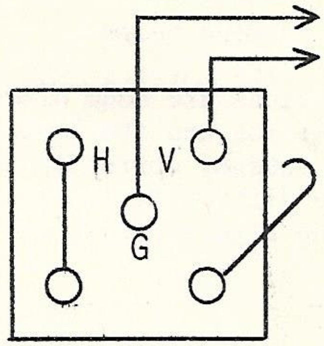


# FIGURE LI



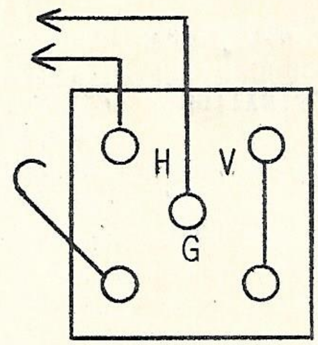

Rear View Panel

Fig. 2




Direct Connection To Vertical Plates

Fig. 3




Direct To Horizontal Plates

Fig. 4

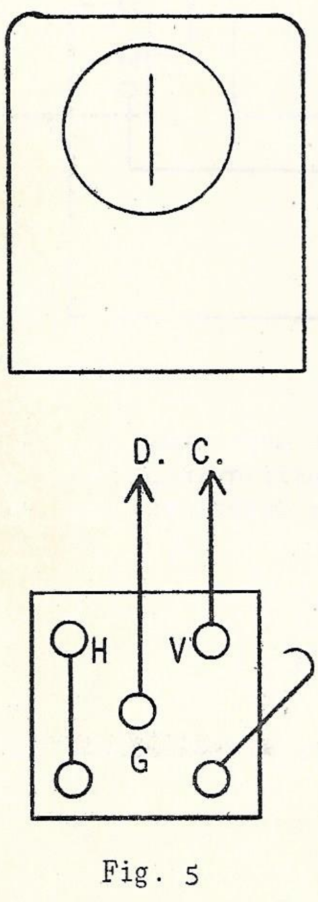



Fig. 5

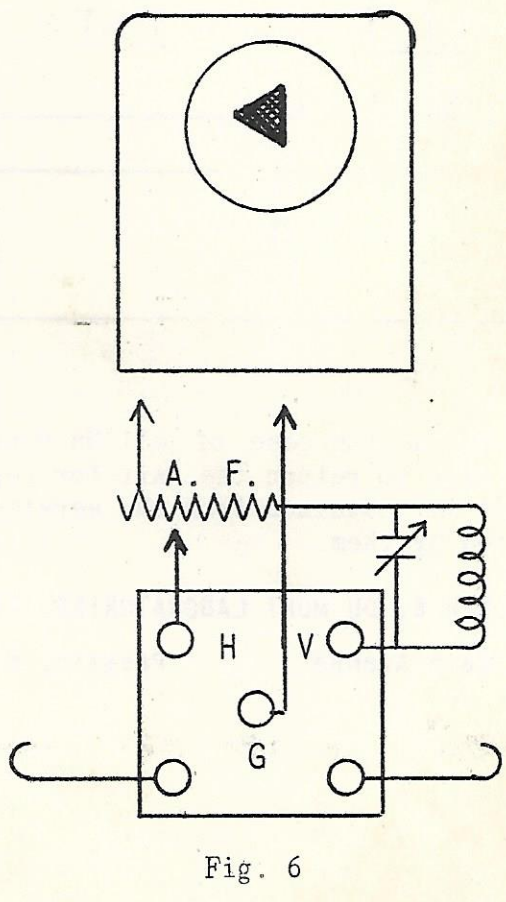



Fig. 6

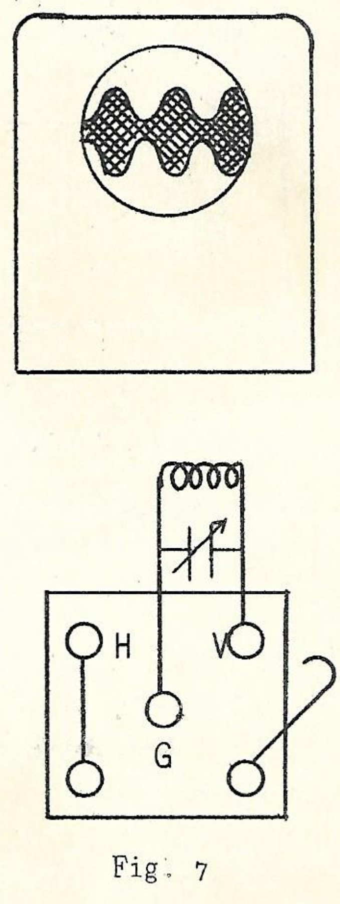
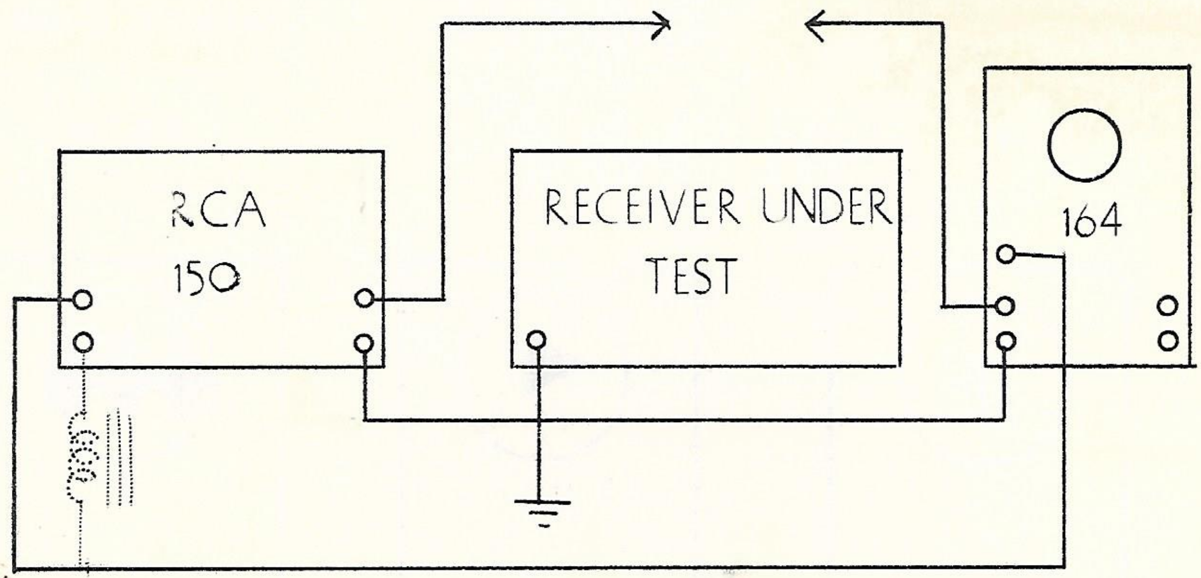



Fig. 7

The R.C.A. #150 Test Oscillator is of the constant band width type with electronic wobbulation. It features adjustable band width by a calibrated dial on the front panel.

**CONNECTIONS** As shown in drawing below.

**OPERATION** After connections are made place synchronizing switch in the external position and the horizontal switch in the sweep position. With the sweep frequency correctly set a double pattern will be secured. If there is phase difficulty in synchronizing, a regular filter choke connected across the #150 as shown will be found helpful.

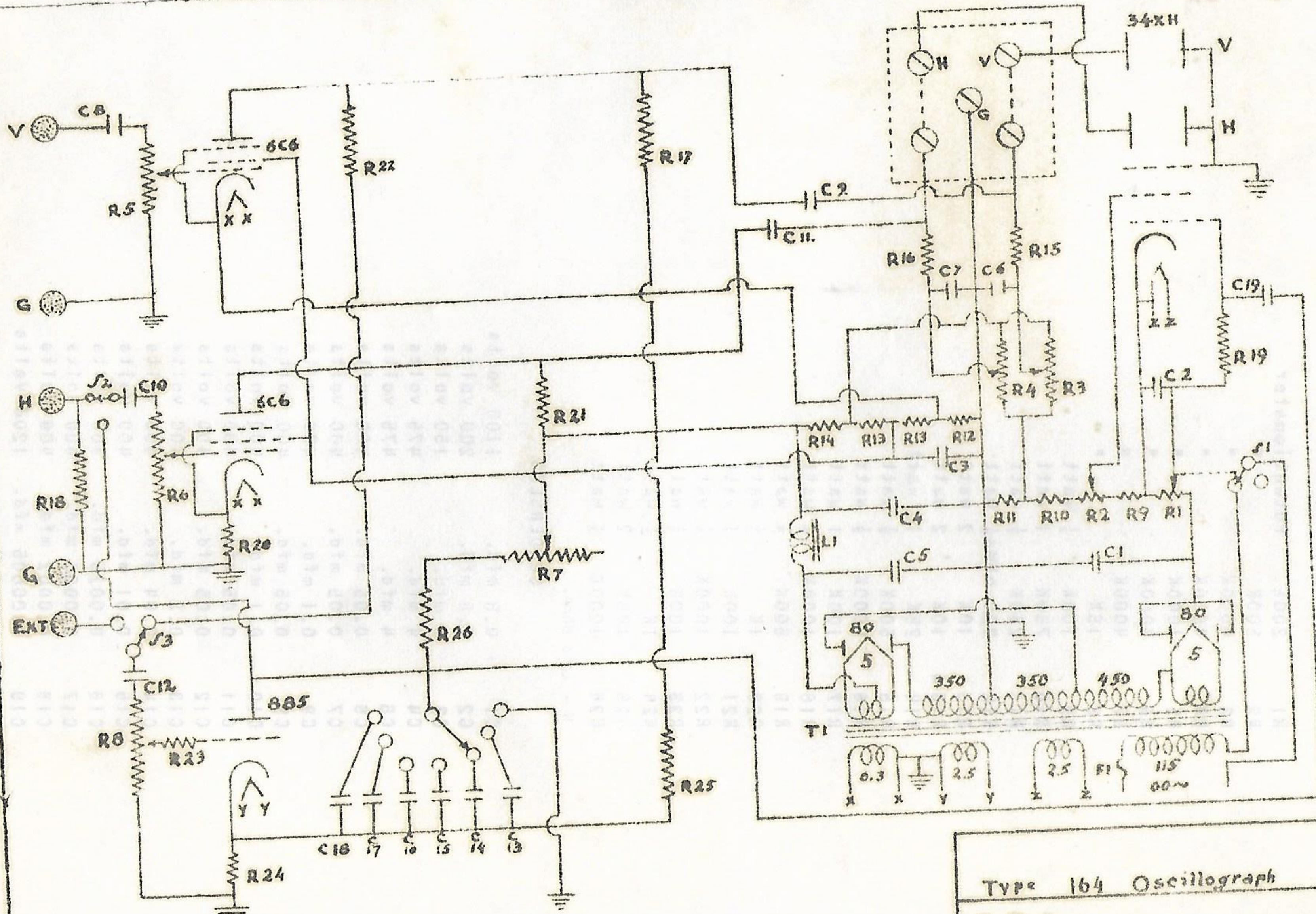



**RETURN TO FACTORY** As in the case of all Du Mont apparatus, if you desire to return the unit for repair or inspection, permission should first be obtained from our service department and shipment made as directed by them.

**ALLEN B. DU MONT LABORATORIES, INC.**

**2 Main Avenue Passaic, N.J.**

Printed in the U.S.A.




Type 164 Oscillograph

T. T. G.

Drawn by H.A.C.

DATE 3-23-37

ALLEN B. DU MONT LABORATORIES
UPPER MONTCLAIR, N. J.

# TYPE 164

# PARTS LIST

## RESISTORS

| | | | |
|---|---|---|---|
| R1 | 200K | Potentiometer | |
| R2 | 500K | " | |
| R3 | 4000K | " | |
| R4 | 4000K | " | |
| R5 | 1000K | " | |
| R6 | 4000K | " | |
| R7 | 4000K | " | |
| R8 | 15K | " | |
| R9 | 100K | ½ | watt |
| R10 | 750K | 1 | watt |
| R11 | 250K | ½ | watt |
| R12 | 220 ohms | ½ | watt |
| R13 | 10K | 2 | watt |
| R13A | 10K | 2 | watt |
| R14 | 25K | 10 | watt |
| R15 | 500K | ½ | watt |
| R16 | 5000K | ½ | watt |
| R17 | 100K | 1 | watt |
| R18 | 1000K | ½ | watt |
| R19 | 500K | ½ | watt |
| R20 | 1K | ½ | watt |
| R21 | 100K | 1 | watt |
| R22 | 1000K | ½ | watt |
| R23 | 100K | ½ | watt |
| R24 | 1K | ½ | watt |
| R25 | 100K | 2 | watt |
| R26 | 1000K | ½ | watt |

K - 1000 Ohms.

## CONDENSERS

| | | |
|---|---|---|
| C1 | 0.5 mfd. | 1100 volts |
| C2 | 0.5 mfd. | 200 volts |
| C3 | 8 mfd. | 150 volts |
| C4 | 4 mfd. | 475 volts |
| C5 | 4 mfd. | 475 volts |
| C6 | 0.05 mfd. | 400 volts |
| C7 | 0.05 mfd. | 400 volts |
| C8 | 0.1 mfd. | 400 volts |
| C9 | 0.05 mfd. | 400 volts |
| C10 | 0.1 mfd. | 400 volts |
| C11 | 0.05 mfd. | 400 volts |
| C12 | 0.05 mfd. | 400 volts |
| C13 | 0.2 mfd. | 400 volts |
| C14 | 0.04 mfd. | 400 volts |
| C15 | 0.01 mfd. | 400 volts |
| C16 | 0.0025 mfd. | 400 volts |
| C17 | 0.0006 mfd. | 400 volts |
| C18 | 0.0002 mfd. | 400 volts |
| C19 | 0.00005 mfd. | 1200 volts |