

Panoramic
Radio Spectroscope Adaptor
Model SA-1 Type 100
Instruction Manual

dated late 1941 (approx)

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INSTRUCTION BOOK

PANORAMIC RADIO-SPECTROSCOPE ADAPTOR

Pat. Nos. 1,878,737 and 1,994,232. Other patents pending.

1. GENERAL CHARACTERISTICS

The Panoramic Radio-Spectroscope Adaptor operates in conjunction with an ordinary radio receiver of the super-heterodyne type, having an intermediate frequency between 450 - 480 kilocycles.

Upon connecting the adaptor to such a receiver, the operator will be enabled to observe the characteristics of all signals present over a band of the frequency spectrum which is adjustable in width, and which extends equally on each side of the frequency to which the receiver is tuned.

This observation is made visually on the screen of a cathode ray tube, without in any way disturbing the normal aural reception from the receiver.

As the receiver is manually tuned through its tuning range, a constant bandwidth of the spectrum passes in view of the operator and all signals contained therein appear simultaneously on a cathode ray screen, as deflections indicative of the frequency and amplitude of each signal encountered.

The operator listening to the aural output of the receiver will hear only that signal which is visible in the center of the screen, as determined by the normal aural selectivity of the receiver and the selectivity of the adaptor.

II. THEORY OF OPERATION

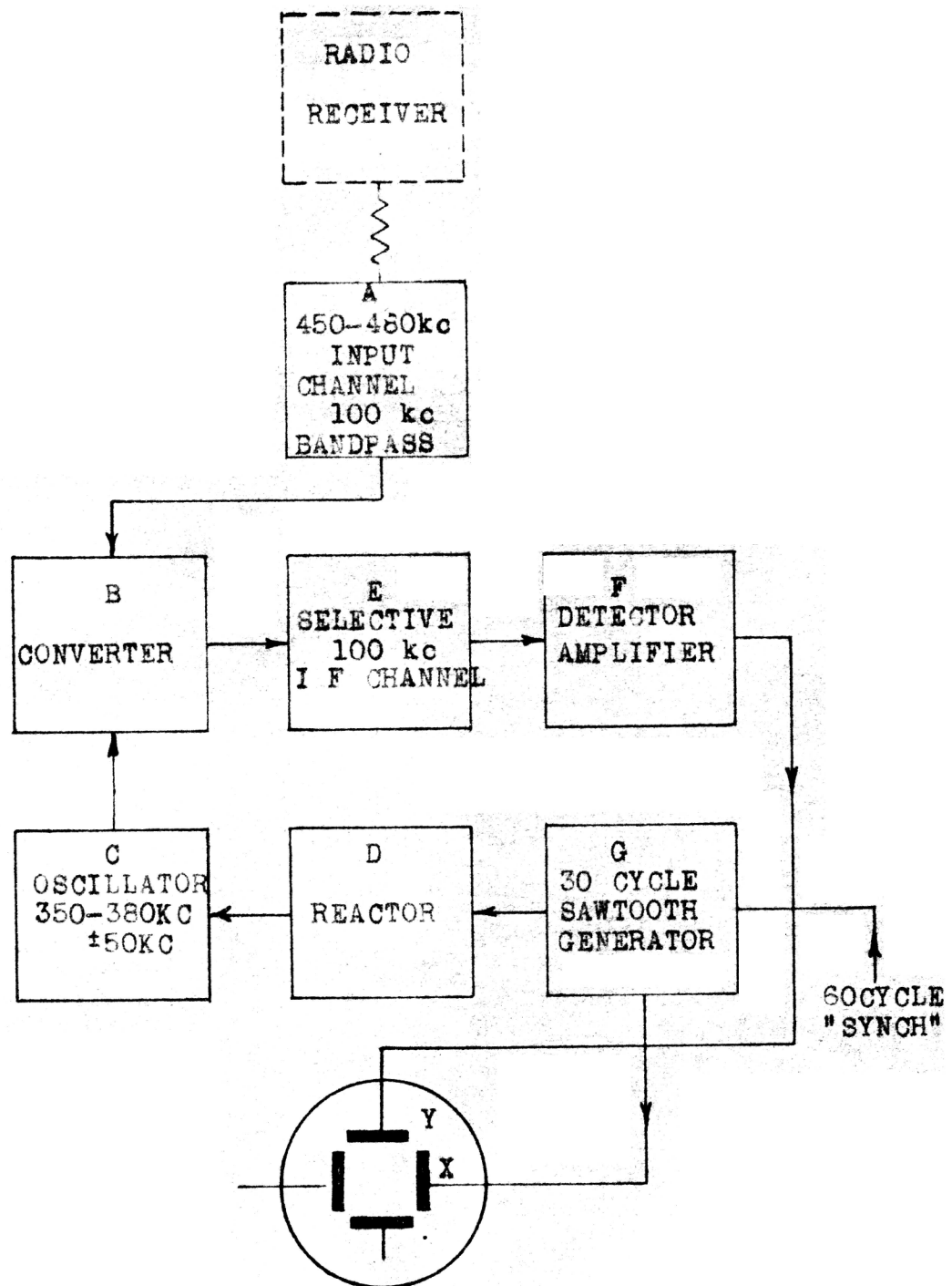
This will be best understood by referring to block diagram, Fig. 1 and to additional Figs. 2, 3 and 4.

The input stage (A) of the PANORAMIC Adaptor is connected to the plate of the mixer of an ordinary super-heterodyne receiver, whose I.F. is tuned somewhere in the range of 450 - 480KC. This connection is made through a high value resistor, so that the operation of the receiver is practically unaffected. This input stage A is, in effect, an R.F. amplifying stage, which has a bandpass characteristic 100KC wide, or 50KC on each side of a mean frequency which is tunable over the range of 450 to 480KC.

It is necessary to adjust this mean frequency so as to make it equal to that of the intermediate frequency F_I of the radio receiver with which the PANORAMIC adaptor must operate.

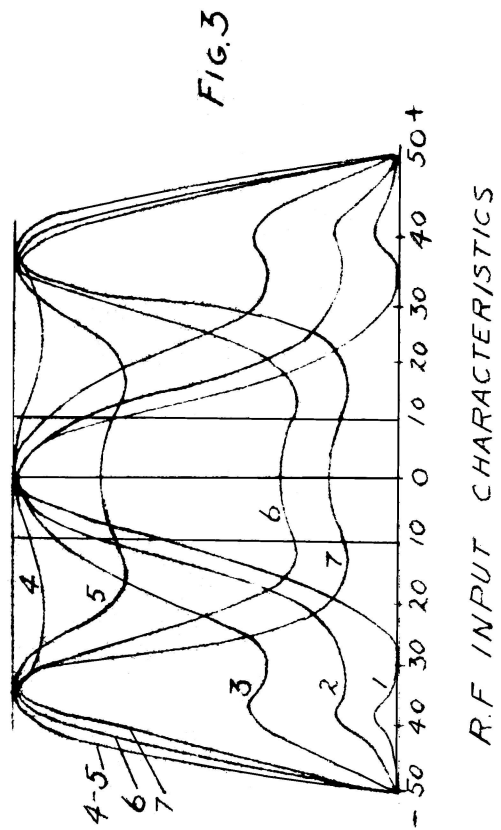
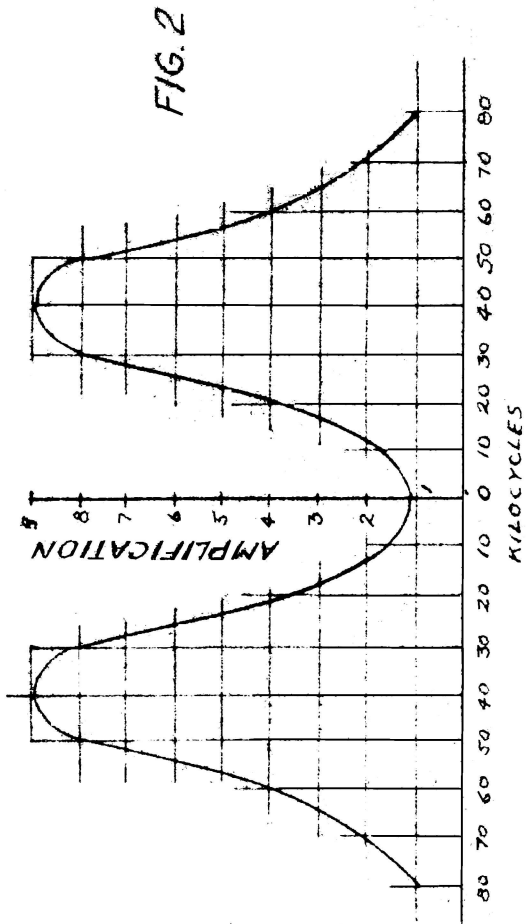
The bandpass characteristics of this input stage A are such as to amplify signals 40KC on each side of the mean frequency about nine times more than the signals at the mean frequency F_I (Fig. 2). This tends to compensate for the tuned R.F. stage and tuned plate circuit of the receiver with which the radio adaptor must operate, and to allow reception of signals over the band of 100KC.

The compensation cannot be perfect for all frequencies: most receivers are much more selective on the lower frequency ranges than on the higher ones and the above ratio of peak to center bandpass amplification will give partial compensation on the low frequency range of such a receiver, gradually improving until perfect compensation is reached at a given frequency. There will be over-compensation, however, at higher frequency ranges. Fig. 3



CATHODE RAY TUBE

FIGURE 1



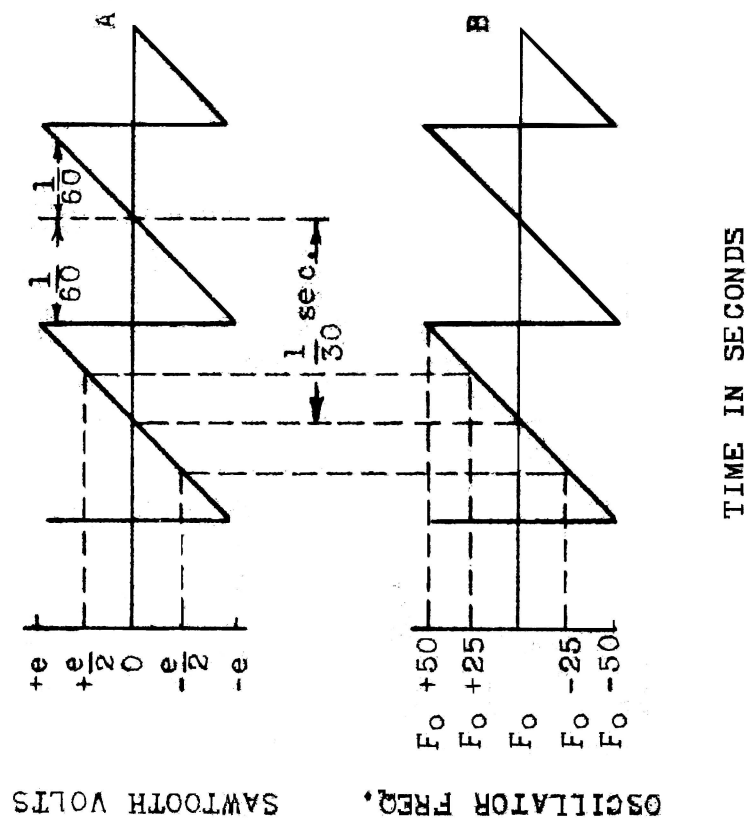


FIGURE 4
SA 1

shows a family of curves representing the variation of amplitude of a given signal as it passes from one extremity to the other on the screen, covering a 100KC tuning range at various frequencies, through a hypothetical radio receiver.

In this figure, curves 1, 2 and 3 show various degrees of partial compensation, curve 4 shows complete compensation, curves 5, 6 and 7 show various degrees of over-compensation.

By again referring to Fig. 1: the signal received and amplified through the input stage A, are fed into the converter stage B, where they are mixed with the signals from oscillator C. This oscillator is periodically and automatically varying in frequency up to 50KC above and below a fixed mean frequency F_0 . This mean frequency can be adjusted between 350 and 380KC and must also be made to correspond to the particular set with which the adaptor is intended to operate.

It should be equal to the frequency of the receiver's intermediate frequency (F_I), less one hundred kilocycles: $F_0 = F_I - 100$ (1)

The periodic tuning of the oscillator C is effected by purely electronic means. A reactor tube (D) is connected to this oscillator through proper phase shifting circuits in such a manner as to become part of the tuning elements of the oscillator. By varying a controlling voltage applied to the grid of this tube, the reactance between the plate and cathode changes in such a manner as to vary the frequency of the oscillator proportionally to that voltage. Such a controlling voltage variation is applied periodically, thirty times per second, by feeding into the reactor tube part of the output of the sawtooth voltage generator G.

The sawtooth voltage is in effect an A.C. voltage (Fig. 4A) which, starting from zero volts, rises linearly (proportionally to time) up to a maximum value $+e$ within $1/60$ second, then drops to $-e$ practically instantaneously, and then rises again linearly, within $1/60$ second to zero voltage. This represents a complete cycle lasting $1/30$ second.

The oscillator frequency varies in the same manner: (see Fig. 4B). When the sawtooth voltage is equal to zero, the oscillator frequency is at its mean frequency F_0 ; as the sawtooth voltage rises to its maximum positive value $+e$ the oscillator frequency rises to its maximum frequency of $F_0 + 50\text{KC}$. As the sawtooth voltage instantaneously drops to maximum negative value $-e$, the oscillator frequency instantaneously drops to $F_0 - 50\text{KC}$ and as the voltage again rises to zero volts, the oscillator frequency increases to the mean frequency F_0 .

It can be seen, therefore, that the maximum limits of frequency sweep, $\pm 50\text{KC}$ in the above example, are determined by the peak sawtooth voltage $\pm e$ applied to the reactor tube.

By controlling this peak voltage to any value below $\pm e$ volts, the limits of frequency/^{sweep} can be controlled to any value below $\pm 50\text{KC}$.

If only half of the above peak voltages are applied to the reactor tube, the oscillator will vary only over a band half as wide: $F_0 \pm 25\text{KC}$. In other words, the total bandwidth of the oscillator frequency sweep is proportional to the sawtooth voltage applied.

Referring again to Fig. 1:

The variable frequency signal output of the oscillator C and the mixed signals of various frequencies coming from input A, are mixed in the converter B. The output of this converter is passed in the I.F. channel E.

This channel is sharply tuned to 100KC and will successively select and amplify each of the signals coming through the input A, at a given time only. To be specific: each signal will pass through E only during the moment when the difference between the signal frequency F_{IX} and the oscillator frequency F_{Ox} is one hundred kilocycles.

$$F_{IX} - F_{Ox} = 100 \quad (2)$$

When the variable oscillator frequency value F_{Ox} passes through the specific value F_0 , the variable signal frequency value F_{IX} becomes the specific value F_I . This is evident from relationship (1). However, the signals F_I are those which are produced in the radio receiver mixer, when tuned to a given signal of frequency F_g , generally readable on its dial. Therefore, it can be said that when the oscillator of the adaptor passes through its mean value F_0 , we shall receive the signals F_g to which the radio receiver is tuned and which are audible in its phones or speaker. By the same reasoning, it can be seen that when the oscillator frequency becomes F_0+50KC we shall receive signals F_g+50KC and when the oscillator frequency becomes F_0-50KC we shall receive the signals F_g-50KC .

After amplifying the successively received signals through channel E, they are fed into a detector and a video-amplifier. They are then applied to the Y-plates (vertical deflection plates) of a

cathode ray tube (C.R.T.).

Part of the output of the sawtooth voltage generator is fed to the X-plates (horizontal deflection plates) of the C.R.T. Before doing so, however, the cathode ray spot must be positioned, by means of a horizontal positioning control, on the center of the screen, at the position marked zero. Upon applying sawtooth voltage, the spot will sweep the screen equally on each side of the zero mark. If the amplitude of this voltage is properly adjusted by means of the Horizontal gain control, the spot will reach the extreme right of the screen scale, corresponding to calibration point +50KC, when the sawtooth voltage reaches maximum positive value +e, at which time any signals perceived on the C.R. screen must correspond to the maximum frequency value $F_g + 50KC$. The spot will be at the extreme left when the sawtooth voltage reaches maximum negative value -e and when the signals perceived on the screen correspond to the maximum frequency value $F_g - 50KC$. The spot will pass through the center of the screen marked 0 when the signal received on the receiver is of F_g kilocycles. This will hold true no matter what the actual frequency of F_g is.

III. TERMS AND DEFINITIONS

In order to avoid confusion in the descriptions which follow, and considering the fact that the PANORAMIC adaptor fulfills certain particular functions which are not obtained in ordinary reception, it becomes necessary to establish certain terms and definitions which apply particularly to such type of radio equipment.

Panoramic Reception is the simultaneous visual reception of several radio signalling stations whose frequencies are distributed over a continuous portion of the frequency spectrum. This defin-

ition distinguishes "panoramic reception" from the ordinary reception which can be called: "uni-signal reception" and which can be either aural or visual, or both.

Sweepwidth (W) is the total band, measured in cycles, kilocycles or megacycles, which can be observed by panoramic reception and which corresponds to the range of frequency sweep of the oscillator in the panoramic radio adaptor.

Frequency Sweep Axis is the line along which the signal deflections are produced and which can be calibrated in frequency according to a given frequency scale. This axis is measured in inches (See Fig. 5).

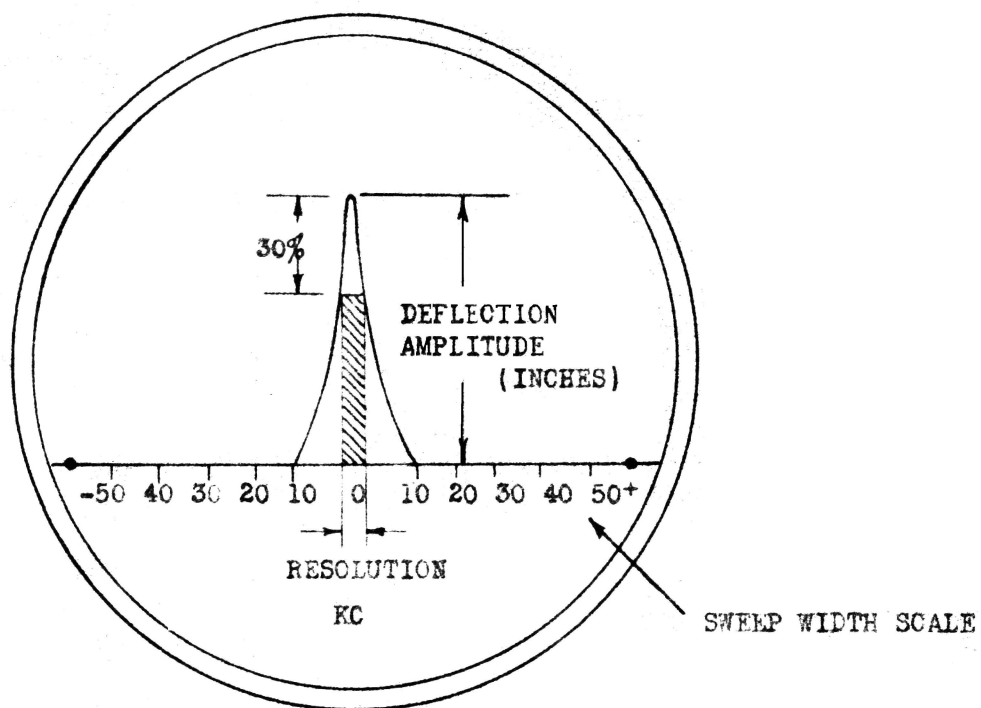
Sweepwidth Scale is the scale adjacent the frequency sweep axis. It is calibrated either in arbitrary units or in cycles, kilocycles or megacycles (See Fig. 5).

Center Frequency is the frequency of the signal receivable on that part of the frequency sweep axis corresponding to zero sweep voltage applied to the cathode ray tube.

Deflection Amplitude is the height of a given signal deflection measured from the frequency sweep axis to the tip of the deflection. It is measured in inches (See Fig. 5).

Visual Signal Strength is the product of the deflection amplitude value and the deflection sensitivity of the C.R.T. (voltage required for producing a one inch deflection on the screen of the cathode ray tube). It is measured in volts.

Visual Gain is the ratio between a given visual signal strength and the input signal voltage. It can be measured in decibels.



RESOLUTION PATTERN SA1

FIG. 5

Resolution (S) of a given signal is the frequency difference measured along the sweepwidth scale between the points where its deflection is 30% down from its peak value. This value corresponds to "selectivity" in ordinary receivers. It can be said that the resolution is "better" as its value decreases (See Fig. 5).

Frequency velocity (V) of a frequency swept oscillator is the variation of frequency (dF) divided with the time period (dt) during which it takes place $V = \frac{dF}{dt}$ The value may, or may not, be constant throughout the entire frequency sweep cycle.

As it will be shown below, the resolution of the panoramic adaptor is dependent on the frequency velocity and, therefore, where this frequency velocity is variable, the resolution also is variable.

Mean Frequency Velocity (V_m) is the sweepwidth divided by the time period during which a sweep cycle takes place $V_m = \frac{W}{t} = Wf$ It is measured in megacycles per second.

Sweep Frequency (f) is the number of frequency sweep cycles during a period of one second ($f = \frac{1}{t}$) ($f = \frac{V_m}{W}$)

IV. GENERAL DESCRIPTION

Cabinet. The PANORAMIC radio-spectroscope adaptor is mounted in a metal cabinet, gray crackled, with ventilating louvres extending 1/4" on each side. (See Fig. 6, page 13).

Dimensions: Front: 17" wide (without louvres) Height: 9 1/8"
Depth: 10 3/4" plus a 2" projection in the rear for the cathode ray tube.

Net Weight: 41 lbs.

Power Source: The adaptor operates from a source of 105 to 125V A.C. 60 cycle single-phase power supply. The power required is 95 watts.

Cathode Ray Tube. This is on the left side of the panel. A circular aperture 5 1/2" in diameter covers its 5 inch screen. On the lower part of this aperture there is the sweepwidth scale, which is calibrated in kilocycles, in steps of 10KC. This scale is marked 0 in the center and runs up to +50KC on the right side on -50KC on the left side. The calibration is linear.

Panel Controls: On the lower part of the panel there is a row of four knobs marked as follows:

H. POS. This is the horizontal positioning control, and permits the adjustment of the origin frequency to correspond to the 0 mark on the sweepwidth calibration. It seldom needs adjustment, but it permits a rapid correction for a slight horizontal drift of the frequency sweep axis (horizontal luminous line).

VERT. POS. This is a vertical positioning control of the frequency sweep axis. It is adjusted to bring this axis adjacent to, or slightly below, the edge of the frequency sweepwidth scale on the aperture.

SWEEP. This controls the sweepwidth of the adaptor by controlling the sawtooth voltage applied to the reactor tube. When the knob is turned fully to the right, up to the 100 mark, the PANORAMIC adaptor covers a band of 100KC. As the knob is turned left the sweepwidth gradually decreases, until it becomes zero. The numbers 50, 20 and 0 indicate the approximate sweepwidth in kilocycles for various intermediate positions.

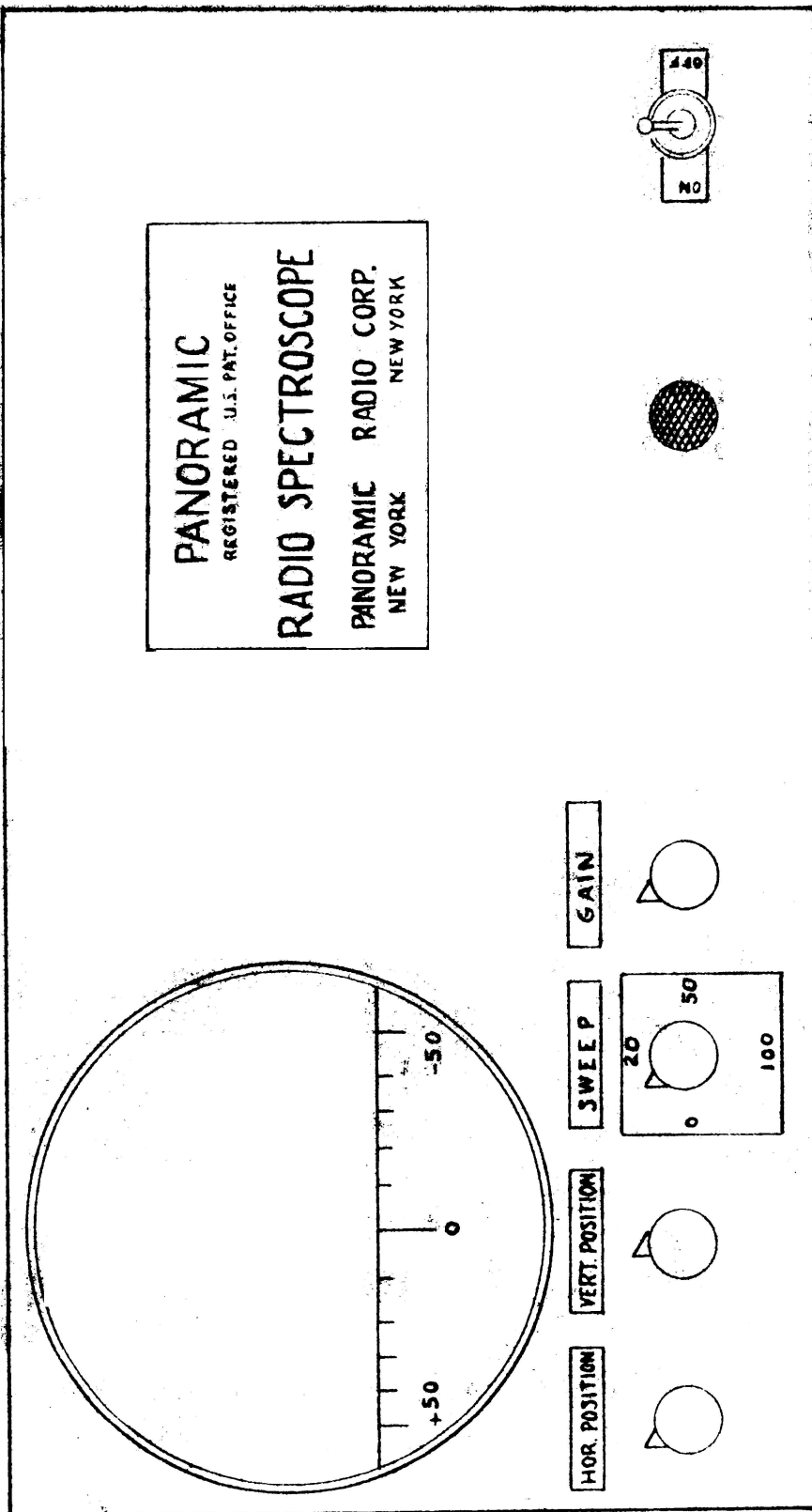


FIG. 6

This control is useful when two or more signals are so close together as to almost merge into each other. By reducing the sweepwidth, stations which are too close in frequency to be separated from each other, spread apart and separate linearly. Even modulation sidebands can be seen. In other words, the resolution becomes better, for decreased sweepwidths. It is of the order of 4KC for a sweepwidth of 100KC and it becomes about 2KC for a sweepwidth of 20KC.

GAIN. This controls the visual gain of all signals on the screen, by controlling the gain of the input amplifying stage.

It is generally desirable to adjust this gain control to the lowest point which will give a distinguishable deflection for the weakest signal that can be received aurally in the receiver.

Receivers having high gain R.F. stages require less gain in the adaptor than those having low gain.

By reducing the GAIN of the adaptor to the minimum, it will be possible to best compare weak signals close to strong ones, without overloading any circuits. The noise level as well as the spurious signal level will be the lowest at low gain.

PILOT LIGHT. A green pilot light is provided to show when the PANORAMIC adaptor is turned on.

SWITCH. A toggle switch is provided on the extreme right, marked ON and OFF.

Rear View:

FUSE. This is situated at the extreme left. It can be taken out of its holder, for replacement purposes, with the aid of a screw-

driver.

INTENSITY. This is a semi-adjustable control requiring a screw-driver for adjustment. It controls the intensity brilliancy of the cathode ray line on the screen.

FOCUS. This semi-adjustable control must be adjusted for clearness of the image.

INPUT. The signal input line, is a single conductor, low-loss cable, having a fixed capacity which is part of the input transformer tuned circuit.

The other end of the inner conductor is connected to a 250,000 ohm resistor which, in turn, is connected to a special spring clip. This clip can be slipped tightly around the plate prong of the mixer tube of the receiver, with which the PANORAMIC adaptor will operate.

Another clip is connected to the outer conductor of the cable for grounding it to the chassis.

SWEEP FREQ. This controls the sweep frequency of the adaptor and can be adjusted from 15 to 30 cycles.

A certain amount of A.C. line voltage is fed into the grid of the sawtooth generator for synchronizing the sweep frequency with the line frequency. By proper adjustment of this control, the sweep can be "locked" in synchronism with a 60 cycle line at 15 cycles, 20 cycles or 30 cycles. The standard sweep frequency of the PANORAMIC adaptor is 30 cycles. The procedure for determining the exact sweep frequency will be explained below. This control is covered, so as to render it less accessible after adjustment.

PHONES. The jack marked "Phones" is for the purpose of aurally monitoring the Panoramic Adaptor. Only high-impedance crystal headphones should be inserted into this jack so as not to short-circuit the input to the vertical plates of the cathode ray tube. If any signal within a range of 50KC above or below the frequency to which the receiver is tuned, appears on the screen, a 30 cycle note will be heard in the headphones. This is caused by the signal appearing once every sweep-cycle and hence at a rate of 30 times per second.

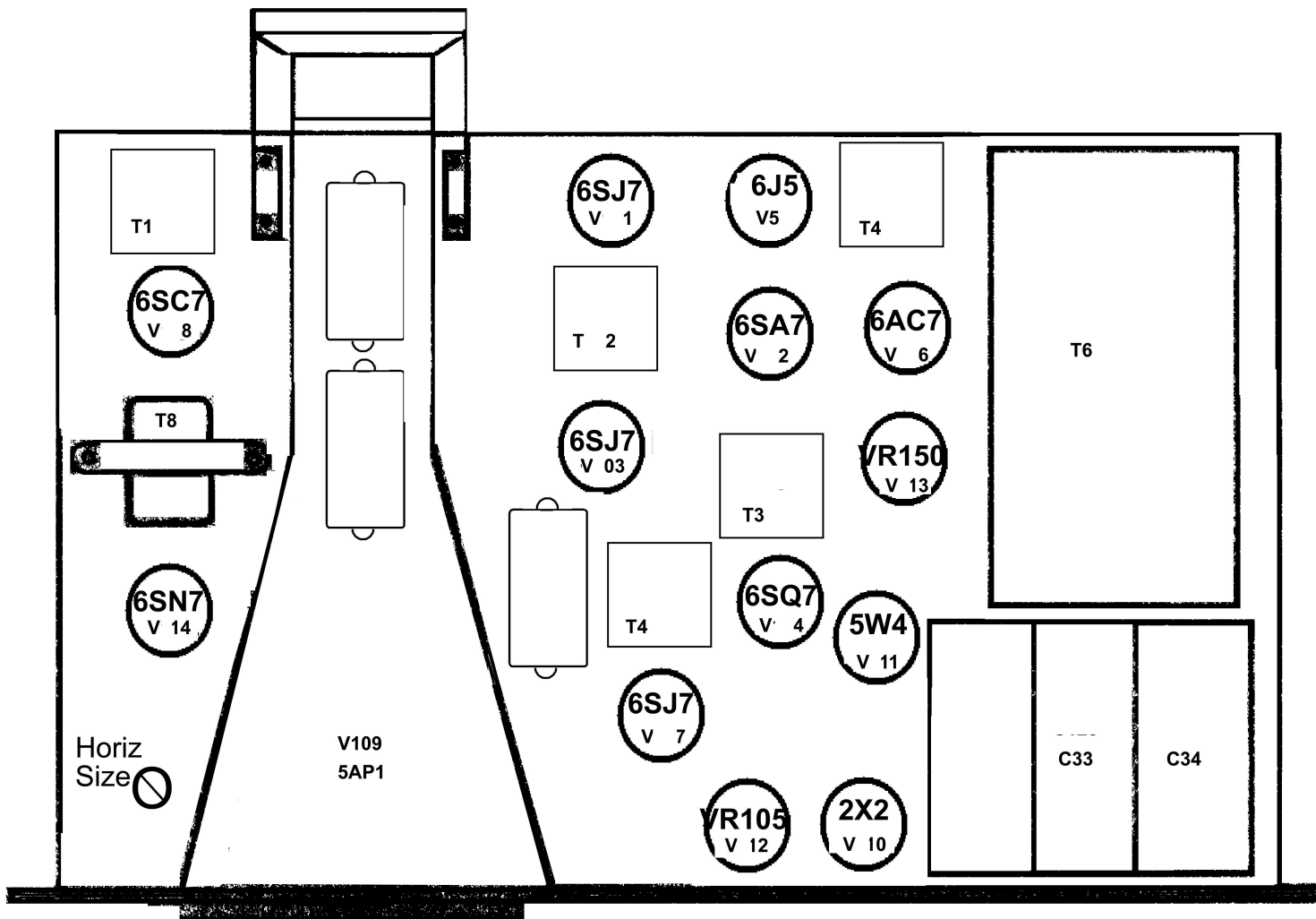
However, if the sweep width control is reduced to zero, a station tuned exactly into the center frequency will be heard in the phones as normal modulation. No BFO is provided in the adaptor, but sometimes the BFO in the receiver feeds a stray signal into the adaptor in which case CW signals can be read.

Top View: See Fig. 8

H. SIZE. This is a semi-adjustable control (R67) for adjusting the size of the frequency control for the sawtooth voltage amplifying stage as used for the cathode ray sweep. This is a push-pull stage, using the tube V8 (6SC7). The H. SIZE control seldom needs any adjustment. The sawtooth voltage generator is the tube V14 (6SN7-GT).

T1 tunable between 450 - 470KC. Its input is connected, through a condenser and resistance, to the input line. Its output is connected to the input amplifying tube V1 (6SJ7).

T2 is the interstage transformer which is identical in electrical characteristics to T1. It serves to couple the input amplifying stage to the mixer tube V2 (6SA7).



Editor's note:
Part numbers correspond to 1941 schematic.

T8 is the plate power supply and filament transformer for the various tubes. It operates in conjunction with rectifier tube V12 (5W4).

The maximum plate voltage supplied by the 5W4-GT is 350V. Two regulator tubes are also used: V12 (VR105) and V13 (VR150) for maintaining constant plate and screen voltages to the various tubes.

Blanking voltage generator. In practical applications, it is rather difficult to lead a pure sawtooth voltage amplifier, without a certain amount of distortion of the sawtooth wave.

The distortion generally consists in the fact that the voltage drop from maximum to minimum is not any longer instantaneous, but represents a fraction of the total cycle. The actual shape of the sawtooth wave in the adaptor is shown in Fig. 9. In order to eliminate the return trace on the screen, it is necessary to "blank out" a small portion of the total sweep cycle. This is obtained by generating a periodic negative pulse voltage synchronized with the sawtooth voltage (Fig. 10), and by applying this negative pulse to the grid of the cathode ray tube for blanking out the image during the return of the spot, and a short time thereafter. The V-7 (6SJ7) is the blanking wave generator.

V. INSTALLATION

The PANORAMIC adaptor is adjusted, when leaving the factory, for operating with a receiver having an I.F. frequency of 455KC. If it will be operated with such type of receiver, there will be very few adjustments to make.

The installation procedure is the following:

1.- The PANORAMIC adaptor is installed very close to the receiver with which it must operate so as to permit the connection of the input line (which is 2 1/2 feet long) to the receiver. A 3/4" hole may be required in the back of the receiver cabinet.

The converter, or mixer tube, of the receiver is removed from its socket and the special prong-fitting spring clip is secured to the plate prong of the tube. The tube is replaced in its socket, carefully avoiding the possibility of shorting the clip to other prongs or to any parts grounded to the chassis. If the receiver is using glass tubes in metal shields, it may be necessary to cut a small notch in the shield and shield base, to clear the clip.

These Adaptors are wired for use with a power supply of 110-225V 50 cycles single phase A.C. The transformers are wound with double primaries, so that operation of 220-250V, 50-60 cycles A.C. is also possible. Consult Fig. A2 in Appendix for the transformer connections for such change in primary power source.

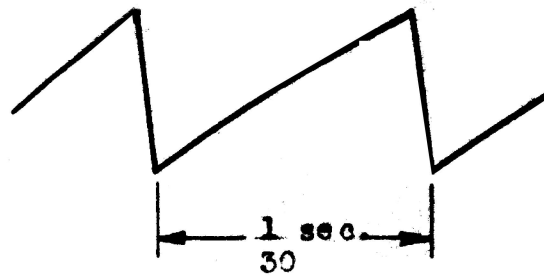
The power cord is next connected to a source of 115V 60 cycle single-phase current. The toggle switch on the front panel is turned "ON."

After a short interval a horizontal line appears on the screen. This line takes a few more seconds to become stabilized.

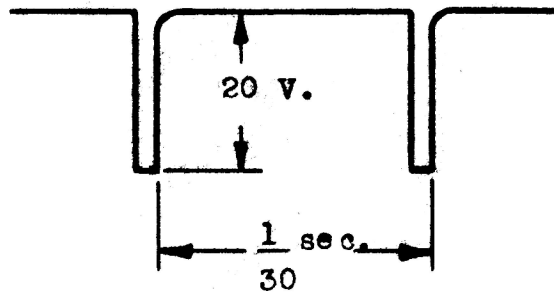
2.- The first adjustments required are of the Intensity and Focus control, followed by the Vertical Positioning Control. The function and position of each of these controls has been explained above.

3.- The HOR. SIZE is next adjusted (control on top of chassis,

FIGURE 9



SAW TOOTH



BLANKING WAVE

FIGURE 10

Sawtooth & Blanking Wave		
SA-1		
DR.	PANORAMIC	CH.
M.K.	RADIO CORP.	M.P.
6-10	New York City	6/43
DWG.	P1-287	

under C.R.T.) until the size of the frequency sweep axis is $4 \frac{1}{4}$ ". The sweepwidth scale is exactly 4" long. Therefore, the frequency sweep axis extends $\frac{1}{8}$ " on each side of the scale. Two dots have been provided at the end of the scale, indicating the exact size of the axis. This is next centered with respect to the scale with the aid of the HOR. POS. control on the front panel. The final accurate adjustment of this control will be made later.

4.- The receiver is next turned on and accurately tuned to a weak signal, preferably in the high frequency range. If the receiver has an A.V.C. switch, this should preferably be turned off during all the adjustments which follow. With the SWEEP control of the Panoramic Spectroscope adaptor turned to 100, this signal received on the radio receiver, should appear somewhere on the screen of the adaptor, very close to the center of the sweepwidth scale.

This assumes that the sweep frequency has remained adjusted to 30 cycles per second (factory adjustment). A marker line beside the control has been provided to indicate, approximately, the correct setting for 30 cycles.

If, for any reason, this adaptor has been disadjusted, or if operated on other than a 60 cycle line, the sweep frequency may not be synchronized with the A.C. line and the result will be an instability of the frequency sweep axis. The entire horizontal line may jump right and left, with the signal doing the same. If this is the case, before proceeding with any further adjustments, the proper frequency sweep must be obtained.

The procedure is described under "Miscellaneous Adjustments", on a following page. It should be borne in mind that only at a

sweep frequency of $1/2$ the A.C. line frequency is the sweepwidth scale, on the screen of the adaptor, accurately calibrated.

5.- The SWEEP control is next slowly rotated to the left. The deflection begins to widen at its base and may have a tendency to run off the screen to one side or the other. This indicates the necessity of adjusting the mean frequency of the adaptor's oscillator.

This adjustment can be made by lifting the lid of the adaptor, and rotating the trimmer condenser marked ZERO, located on the oscillator transformer T-5, until the peak of the deflection comes over the zero mark.

6.- The SWEEP control is next rotated fully to the right and the HOR. POS. control is re-adjusted to maintain the peak of the deflection over the zero mark.

These adjustments should be made in all cases, previous to the bandpass adjustment described below.

Band-Pass Adjustment. If the receiver I.F. is tuned to a frequency quite different from 455KC, it may be necessary to retune the input transformers T_1 and T_2 .

Recommended Procedure. 1.- The best procedure for doing this is with the use of a signal generator capable of supplying a signal of controllable frequency over a band of 100KC centered at the frequency of the receiver's I.F.

The signal generator is coupled directly to the input of the adaptor which was previously tuned as directed hereinabove. With the Sweep Control set for 100KC, the frequency of the signal generator is manually varied so as to move the deflection from

one extremity to the other on the screen. The signal amplitude (Gain) of the adaptor should be adjusted so that the maximum deflection or amplitude does not exceed about 1 1/2 inch. The peak should appear near the two extremities of the screen, approximately over $\pm 45\text{KC}$ on the sweepwidth scale, and should be of equal amplitude on both sides.

If the amplitudes are not equal on both sides, this indicates that either one or both transformers T1 and T2 are incorrectly aligned.

If the amplitude on the right side (+) is greater than on the left side (-), this signifies that the mean frequency of one of the bandpass transformers is tuned for too low a frequency. The opposite is true if this peak is higher on the left side. By adjusting the trimmers on top of transformers T1 and T2 the desired condition can be brought about. By turning the trimmers clockwise (increasing capacity) the peak increases to the right side, and vice-versa. The adjustments should be made gradually and in rotation from one trimmer to another by swinging the signal generator frequency control back and forth, and the operation should be repeated until the signals are quite equal in amplitude at equal distance from the center frequency. The original amplitude ratio between signals at approximately $\pm 40\text{KC}$ and center frequency should be from about 5:1 to 9:1.

With this adjustment completed, the adaptor is ready to be operated with the receiver.

Alternate Procedure. 2.- If there is no signal generator available, the bandpass adjustment can be made with the aid of the receiver alone. In order to do so, however, it is important that

the R.F. stage of the receiver should be accurately tuned, at least at those frequencies at which the receiver will serve for lining up the input of the adaptor. The following procedure should be followed: The receiver is tuned to a given signal, preferably one of steady strength, in a band above 4.5mc.

The tuning control of the receiver is next rocked back and forth so as to move the deflection on the screen of the adaptor from one end of the scale to the other. The signal should pass through three peaks. The relative amplitude of these peaks depends on the frequency of the signal and on the selectivity of the receiver's R.F. stages. One of these peaks should be in the center; the other two should be at about $\pm 45\text{KC}$. The latter peaks should be of equal amplitude. If they are not, the center frequency of the adaptor requires adjustment and the same procedure should be used as described above, until the side peaks are of equal amplitude. The receiver A.V.C. and the adaptor A.V.C. must be turned off during these adjustments.

Note: Some of the receivers using a crystal in the I.F. stages have a selectivity control which actually varies the tuned frequency of the first I.F. transformer in the receiver. This control should be set to a position which brings the center peak in the center of the scale, and should not be touched again during the adjustments which follow.

The first of the above two methods is preferable because the R.F. stage of the receiver is seldom very accurately adjusted to peak and this may lead to error of adjustments.

Miscellaneous Adjustments

Sweep Frequency. The sweepwidth scale is calibrated to be accurate

for a sweep frequency of 30 cycles. The sweep frequency control in the back of the receiver, however, may be adjusted for any sweep frequency between 15 and 30 cycles.

In order to check up this adjustment, proceed as follows:

Remove the V4 tube (68Q7) and connect to its grid (prong #2) a short piece of wire. Re-insert the tube in its socket.

Touch the end of the wire and observe the screen. By touching that wire, some A.C. (60 cycle) hum is introduced. If the sweep frequency control is properly adjusted, two peaks will appear on the screen. If the sweep frequency is adjusted to 60 cycles only one peak will appear. If the sweep frequency is 20 cycles, three peaks will appear. Some adaptors may be adjusted to a sweep frequency as low as 15 cycles, and in this case four peaks will appear. However, the desired frequency is 30 cycles, which shows two peaks.

Aligning I.F. Transformers. These are tuned to 100KC. In case of misalignment the sensitivity will drop and the signal deflections may appear distorted, each having a double peak or being asymmetric.

In practically all cases the following simple procedure will give excellent results. Tune the receiver to an audible signal which appears on the center of the screen. Be sure that the gain of the receiver (or adaptor) is at all times low enough to avoid any overload condition (see below). Tune the 100KC I.F. transformer trimmers for highest deflection amplitude and symmetry of deflection.

In those rare cases where the transformers have been totally dis-

adjusted, a 100KC signal should be fed into the grid of the mixer tube V-2 and the trimmers adjusted for highest deflection amplitude.

Sweepwidth. This should seldom, if ever, require adjustment. If, for some reason, the adaptor does not cover the proper sweepwidth of 100KC (when the SWEEP control is turned fully to the right), check up first to see if the sawtooth voltage is normal. The quickest indication can be had by making sure that the frequency sweep axis is 4 1/4 inch. If it is too short, it might indicate that the voltage output of the sawtooth wave generator is too low. This would cause a reduced sweepwidth. If, for some reason, the phasing network trimmer condensers (C33 and C34) have been disadjusted, this would cause an incorrect sweepwidth.

It should be borne in mind that: decreasing their capacities increases the sweepwidth, and vice-versa. In order to adjust them, proceed as follows: With the "SWEEP" control turned fully to the right, reduce the capacity of both condensers to the lowest and measure (with the aid of a frequency calibrated signal generator, or a calibrated receiver), the sweepwidth. Increase gradually, and about equally, the capacity of both trimmers until the desired sweepwidth of 100KC is obtained.

VI. CHARACTER OF SIGNALS and their visual interpretation

With a little experience, the operator will be able to visually recognize the character of various types of signals, without the need of listening to them. It must be remembered, however, that the Panoramic radio adaptor can show only what the radio receiver is able to receive and no more. A poorly adjusted

receiver cannot be expected to give good results even in a perfectly adjusted receiver.

A constant carrier appears as a deflection of fixed amplitude.

An amplitude modulated carrier appears as a deflection of variable amplitude. Voice or music modulation causes the carrier to vary irregularly in amplitude. A constant tone modulation of low frequency will produce a series of convolutions varying in amplitude, their number being determined by the modulation frequency.

As the modulation frequency increases the convolutions move toward the two sides of the deflection, as the side-bands tend to become visible. When the modulation frequency is increased to above 2000 cycles, it becomes possible to separate the two side-bands by reducing the sweepwidth of the adaptor. The higher the frequency of modulations, the further away these side-bands will move from the center deflection, representing the carrier. One should remember that due to possible non-linear amplification of the receiver, or of the adaptor, or both, over a wide band, the two side-bands may appear unequal in amplitude, even if they are of equal strength. Their relative amplitude may vary as the receiver is tuned and as the deflection moves from one end to the other on the screen.

Single Side-band Modulation appears as two carriers of slightly different frequency. (See below: "Signal Interference").

A Frequency Modulated Carrier appears as a carrier which is "wobbling" sideways.

A Speech or Music Modulation FM Signal appears as a multiplicity

of silence a single carrier appears.

A CW signal appears and disappears in step with the keying of the transmitter. During the moments when the signal is off, the frequency sweep axis closes at the base of the signal. A radio operator used to reading CW signals on phones can, with a little practice, read such signals directly off the screen. In very rapidly keyed signals the deflection and the axis are seen simultaneously.

A MCW signal appears like a CW signal of periodically varying amplitude. If the modulation rate is high, sidebands will appear as explained below.

Signal Interference. Two signals which are so close in frequency as to cause aural interference (beat), may appear on the screen as a single deflection, varying in amplitude similarly to a modulated signal. As the frequency separation is decreased, visible slow beats will be seen. As the frequency separation is increased, the deflection appears as if modulated on one side only. Further increase of frequency will cause a "break" in the apex of the deflection. By reducing the sweepwidth of the adaptor, the respective deflections will gradually separate.

Transient disturbances, generally received as noises in the receiver, are of two types: periodic and aperiodic transients.

Periodic transients, such as produced by automobile ignition, motors, vibrators, buzzers, etc., appear as signals moving along the frequency sweep axis in one direction or another. Thus, an automobile which is accelerating will produce a set of deflections which may

move first in one direction, slow down, stop, and then move in an opposite direction. This is caused by the fact that the adaptor is sweeping at a fixed rate (30 times per second), whereas the transient occurs at a variable rate. The images stop on the screen when there is synchronism between the two. If the transient disturbance is synchronized with the 60 cycle line the "noise" appears as a fixed signal, which, however, does not move on the screen when the receiver is tuned, but only varies in amplitude. Such deflections may appear like amplitude modulated signals or like steady carriers. (See below: "Diathermy apparatus").

Aperiodic transients, such as "static" appear as irregular deflections and flashes along the whole frequency sweep axis.

Tube noises, due to too great an amplification of the receiver, or adaptor, or both, appear as varying irregularities along the frequency sweep axis. Proper adjustment of the gain controls should reduce or eliminate this disturbance.

Images. If the receiver will allow "images" to pass (due to poor image rejection of the R.F. circuits) these will be distinguishable from normal signals by the fact that they will move on the screen of the PANORAMIC adaptor in opposite direction with respect to the normal signals. Such images are more apt to appear on the higher frequency ranges of the receiver.

Harmonic Spurious Signals produced in the receiver by the beat of very strong signals with harmonics of the oscillator, will be distinguishable from other signals by the fact that they are moving on the screen more rapidly than the normal signals (twice as fast for second harmonic spurious, three times as fast for third harmonic spurious signals). Generally, a reduction in the

gain of the receiver will eliminate this type of spurious signal. Diathermy apparatus using an unfiltered power supply will produce a periodic disturbance which will cause a deflection to appear on certain portions of the screen and disappear on other portions. This is due to the fact that such equipment emits a signal pulsating in synchronism with the power line. On the other hand, the adaptor too is sweeping the spectrum in synchronism with the line, at a lower frequency (30 cycles) and only when certain phase relationship exists, is it possible for the adaptor to receive those periodic pulses.

Deflection limiting action.(overload). Upon increasing the strength of any signal, its deflection amplitude will increase up to about $2 \frac{1}{8}$ inches ($\pm 1/8"$). A voltage limiting action takes place at that amplitude (in the vertical deflection amplifier) and further increase in signal strength will cause only a flattening of the deflection along an imaginary amplitude limiting line. The deflection takes a truncated shape which corresponds to the normal shape of a deflection of higher amplitude from which the top has been lopped off.

This can be seen on the oscillograms No. 9, 10, 11, shown further below. It should be noticed that an increase in signal strength causes a deflection of wider base. The operator can, therefore, judge the relative amplitude of two signals by the relative width of their respective deflections on the screen.

Harmonic Spurious Signals. If the signal strength exceeds a certain value, the deflection caused by any signal breaks up into a series of parallel deflections, somewhat similar to side-bands. (See oscillogram No. 13). These spurious signals can take place either

in the receiver or adaptor on extremely strong signals. This will be explained further below. A reduction in the gain of the adaptor will eliminate this type of distortion.

Use of the A.V.C. of the receiver. When the receiver is using A.V.C., the signal appearing in the center of the screen will control the amplitude of all other signals. If the receiver is tuned to a strong signal, the weaker adjacent signals will be reduced in amplitude or may not appear at all. It may be found convenient, in many applications, to operate the receiver with the A.V.C. cut off.

VII. APPLICATIONS

Once the PANORAMIC radio adaptor has been properly installed in connection with a good communication receiver, it will be found useful in many types of applications.

A. RADIO RECEPTION

The rapid checking up of the desired ranges of the frequency spectrum is rendered possible with the aid of the adaptor.

For the experienced operator, capable of interpreting the character of each station, the entire band under investigation becomes integrated into a continuity which he can easily visualize as a whole. The "traffic density" at certain points can be noted; characteristic signals are recognizable from among others and upon re-tuning over the same portion of the spectrum, he will easily note any changes which may have occurred. The station which he may have already identified will be recognized from new stations which have just come in.

Few stations can escape his observation. The use of the PANORAMIC

adaptor, therefore, speeds up the work of radio communication. In amateur and professional radio work, shorter calls can be made and the replies can be picked up sooner.

The operator can constantly watch a series of channels of communication and quickly tune his receiver to any station which may appear on one of these channels.

In case of interference from other stations, he can recognize the character of the interference and its position in the spectrum with respect to the station to which he wishes to listen. He can, therefore, intelligently and quickly use the means at his disposal for reducing or eliminating the interference, by properly re-tuning the receiver to a higher or lower frequency, using crystal filter, etc. One of the best methods for eliminating certain types of interference is in the use of directional receiving antennae. The operator should rotate such antennae until he obtains the highest ratio between desired and undesired signals, as shown on the screen of the adaptor.

Direction Finding. The PANORAMIC adaptor can be used as an accurate signal strength indicator for several stations simultaneously. If the receiver uses a loop, or any other type of directional antennae, either the null method or maximum signal method can be used. The null method is, generally, the more accurate of the two.

The direction of a series of stations on adjacent frequencies can thus be taken in rapid succession without re-tuning the receiver. It should be noted that if the operator is located on a line connecting two stations, he will read the same bearing (or two

bearings differing by 180°) for those two stations.

Therefore, if a loop is rotated, and any two stations pass through the null point at the same time, the operator will know that he is on a line connecting those stations.

B. RECEIVER CHECK-UP AND ALIGNMENT. The PANORAMIC radio adaptor provides an excellent and very accurate method of checking up the alignment of radio receivers.

If the adaptor has been properly adjusted for a given I.F. frequency, and if the R.F. stages of a radio receiver are properly aligned, any signal deflection moving from one end of the screen to the other, will pass through amplitude variations which must be symmetrical with respect to the zero mark. If, however, any deflection appears of greater amplitude on one side than on the other, this indicates that the R.F. stage, or stages, of that receiver are improperly tuned at that particular point of its receiving range. An experienced operator will be able to judge very rapidly what adjustments must be made for proper tracking and aligning.

Reduced sensitivity or complete insensitivity at certain frequencies, may sometimes be due to reduced power of the receiver's oscillator, or to its failure to oscillate. This can be easily checked with another receiver and PANORAMIC adaptor, by tuning that receiver to the frequency of the oscillator and checking its amplitude over its entire range. This operation provides also a very excellent method of checking up the tracking of the oscillator over the entire range of any given band.

C. TRANSMITTER ADJUSTMENTS. The PANORAMIC adaptor will be very useful in many ways around a transmitter.

Frequency adjustments of a master oscillator with respect to a standard frequency are easily and quickly made.

The operator can check up the frequency spectrum and select the channel which is free from interference.

He can easily adjust his transmitter frequency at any desired frequency difference from a given standard or station. Rapid checks can be made as to frequency.

The proper adjustments of multiplier or buffer stages can be made. The adjustments giving the greatest signal output and which do not tend to "pull" the signal off frequency, are generally made.

Spurious oscillations caused by improper neutralizing can quickly be detected.

The percentage of modulation of a transmitter can be checked best by reducing the sweepwidth of the adaptor to zero. The frequency sweep axis will then move vertically according to percentage of modulation. An overload condition should be avoided, working with signal strengths below the point where the limiter action takes place. Undesired frequency modulation can be easily detected.

The PANORAMIC adaptor serving as a visual strength indicator can be used for taking field strength measurements around the transmitter. It can then be used in conjunction with a standard signal generator tuned to a slightly different frequency, to measure the variations of field strength for determining antenna radiation patterns.

D. ELECTRICAL TEST. The PANORAMIC radio adaptor is well suited for carrying out many rapid tests for production or control of materials.

Being a frequency measuring, or comparing device, the test methods are based on the generation of a signal frequency and comparing that frequency to one or several standard frequencies. If the generated frequency is lower, or higher, than the standard, within certain given tolerances, the product tested does not possess the desired electrical characteristics.

Such tests can be well applied to ganged, identical elements for checking up tracking, such as variable condensers, I.F. transformers, etc. The sections of a variable condenser can thus be rapidly checked point by point and properly balanced for identical capacity.

VIII. CHARACTERISTIC OSCILLOGRAMS

A. MODULATION SIDEBANDS VERSUS SWEEPWIDTH

#1. Signal modulated at 3000 cycles. Sweepwidth 100KC.

The sidebands are too close to the fundamental to be resolved. Some irregularity at the base is the only indication of their presence.

#2. Same signal as in #1. Sweepwidth reduced to 70KC. The resolution is better and the sidebands are clearly separated on each side of the carrier.

#3. Same signal as in #1. Sweepwidth reduced to 50KC. The sidebands separate still more. The amplitude of the deflection has increased. Slight amount of overload is apparent by the flattening of the apex of the deflection.

#4. Same signal as in #1. Sweepwidth reduced to 25KC. The sidebands are still further away. (The gain of the adaptor was somewhat reduced, to avoid overload).

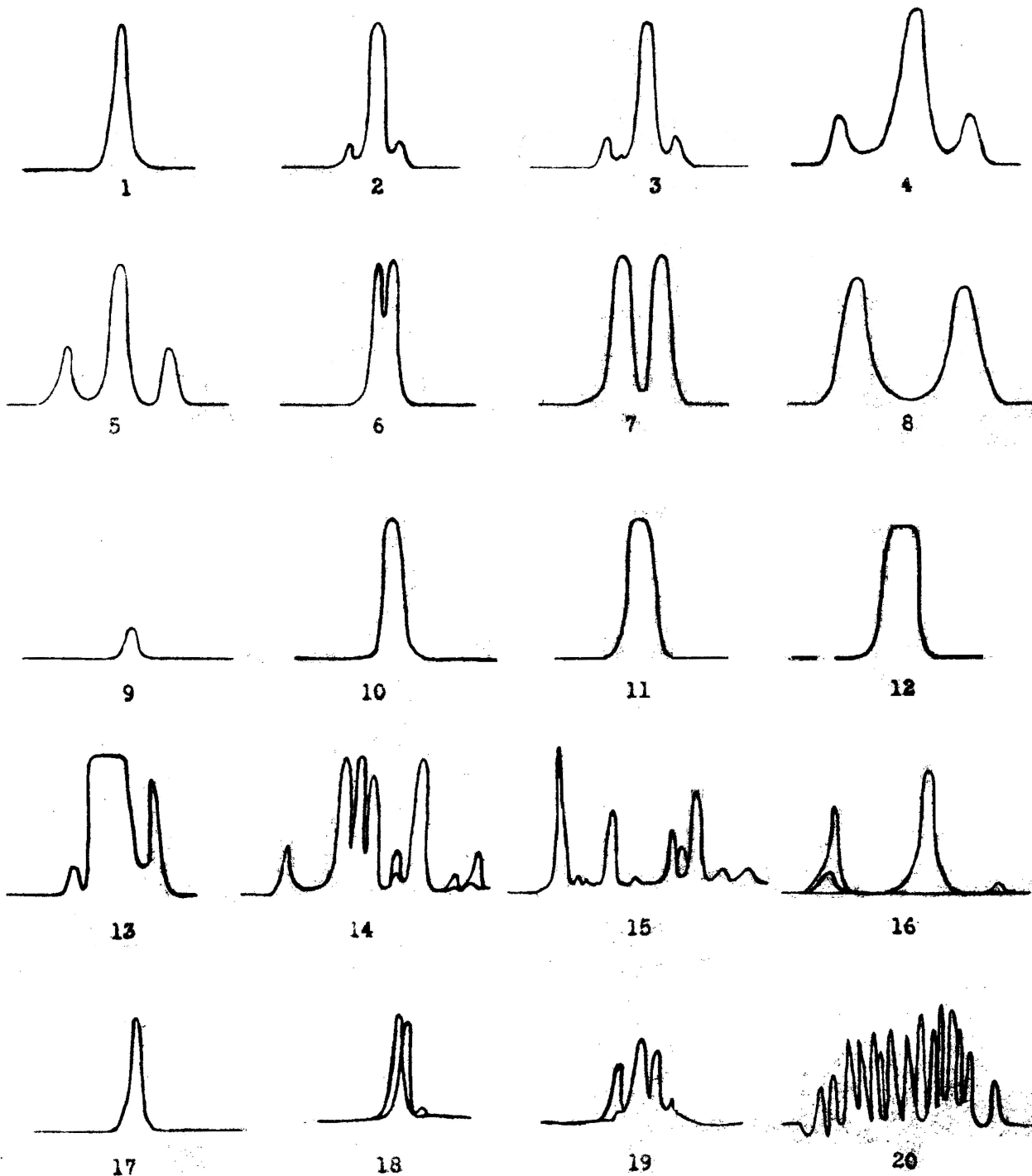
#5. Signal modulated at 15,000 cycles. Sweepwidth 100KC. The sidebands are quite distinct from the carrier.

B. RESOLUTION VERSUS SWEEPWIDTH.

#6. Two carriers 5KC apart at full sweepwidth of 100KC.

#7. Same carrier as in #6 with sweepwidth reduced to 50KC.

#8. Same signals as #6 with sweepwidth reduced to 20KC. (Gain slightly reduced to avoid overload).



CHARACTERISTIC OSCILLOGRAMS - SA-1

C. DEFLECTION AMPLITUDE VERSUS SIGNAL STRENGTH

(100KC sweepwidth, no AVC control, fixed gain control).

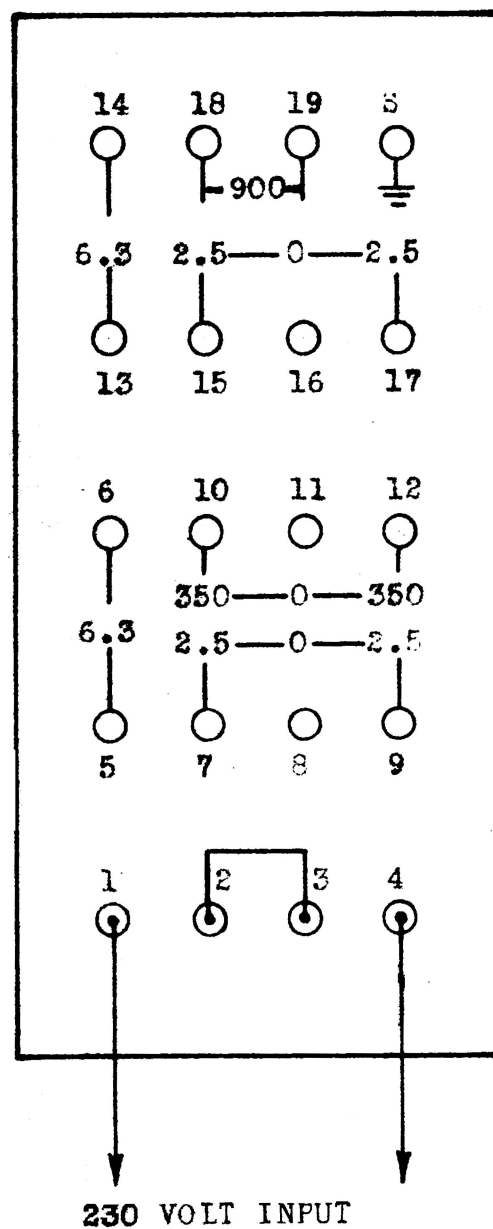
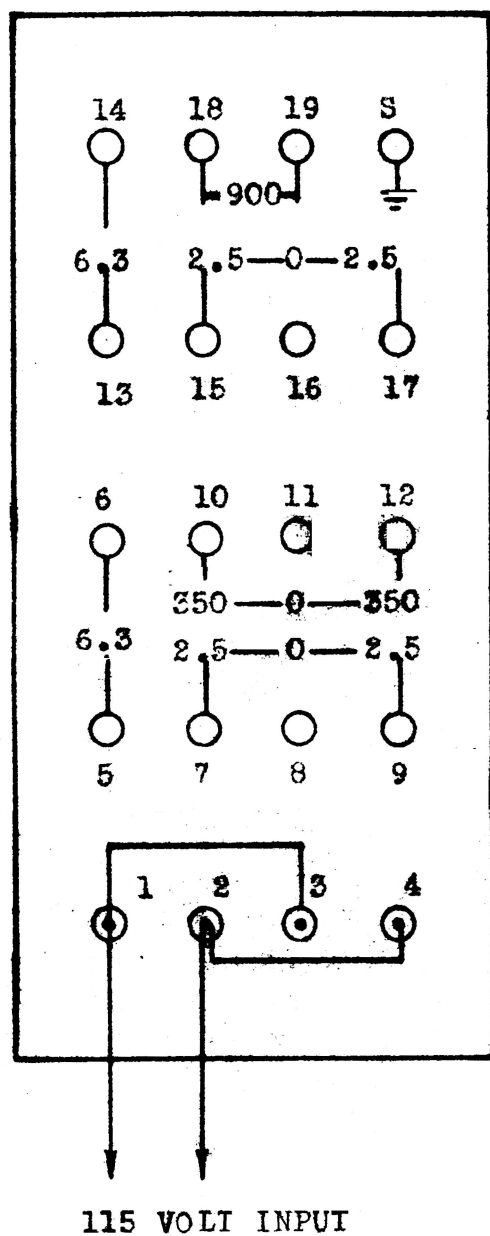
- #9. 10 microvolt signal.
- #10. 100 " " Limit amplitude has been reached.
- #11. 1000 " " Base widens up. Limiting action causes square top.
- #12. 10,000 microvolt signal. Small spurious signal visible on the left.
- #13. 100,000 microvolt signal. The deflection breaks up into three portions: one central portion flattened on the top and two "harmonic spurious".

D. EXAMPLE OF ACTUAL RECEIVING CONDITIONS

- #14. 14mc. Amateur phone band. About six modulated phone stations are visible.
- #15. A portion of the broadcast band. Stations are distributed at every 10KC.
- #16. Three automatic telegraph stations. Due to the rapid keying the deflections appear closed at the bottom. On the left side a "key click" appears.

E. FM SIGNAL. (100KC SWEEPWIDTH)

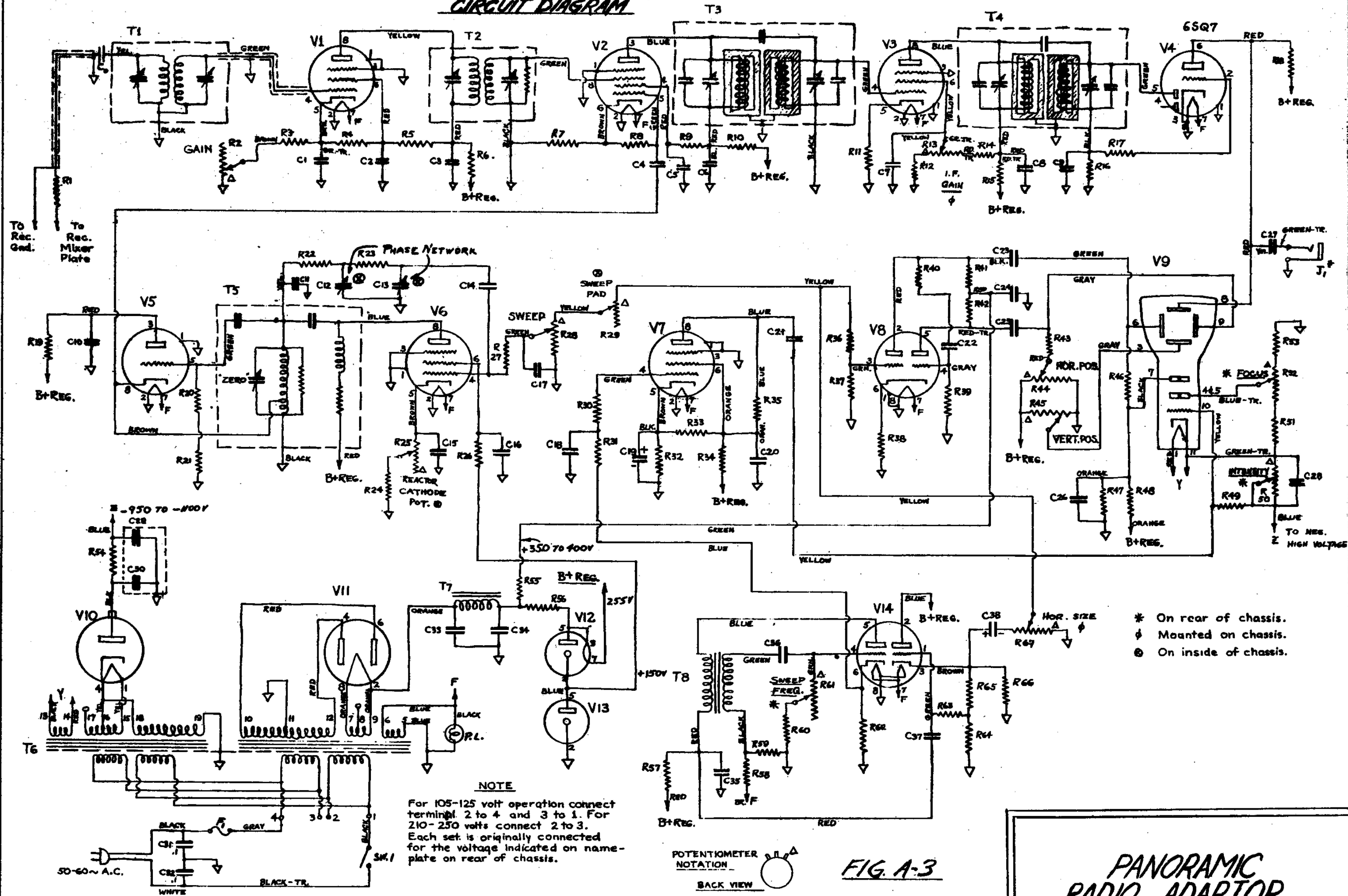
- #17. Carrier during period of silence.
- #18. Very little modulation.
- #19. Increased modulation.
- #20. Heavy modulation.



- Fig. A-2

Power Transformer		
Terminal Board - SA-1		
Ex.	PANORAMIC	Ch.
P.L.	RADIO CORP.	M.P.
6-9-43	N.Y. CITY	6-9-43
Pl - 238		

CIRCUIT DIAGRAM



**PANORAMIC
RADIO ADAPTOR**

**NORRADIO CORP.
NEW YORK CITY.**

SERVICE NOTES
FOR MODEL SA1 PANORAMIC ADAPTOR

CAUTION - HIGH VOLTAGE!

The voltages used in this equipment are high, therefore dangerous to life. Always be certain that the power plug has been disconnected before attempting to remove the set from the cabinet.

Equipment required for servicing Panoramic Adaptors

In order to service the SA1 Adaptor, the following equipment should be available:

- (a) Volt-ohmmeter (at least 1000 ohms per volt).
- (b) Signal Generator to cover a range of 100 to 700KC
- (c) Cathode ray oscillograph.

Operational Tests

A.- Sweep Circuits

1.- Sawtooth Sweep. V14 (6SN7GT) is the sawtooth generator, and V8 (6SC7) is the sawtooth amplifier. If no horizontal sweep is observed on the screen, check to see that these tubes are operating properly. An oscillograph connected to the cathode of V14 (pin #3) should indicate a linear sawtooth wave of 30 c.p.s. If not, V14 is inoperative. Connecting oscillograph to the plates of V8 should similarly show a sawtooth wave indicating whether V8 is operating properly. The H. Size control adjusts the amplitude of sawtooth voltage being supplied to V8. The amplitude of the sawtooth (in volts peak to peak) at various circuit points should be approximately as follows:

(Service Notes)

<u>Point</u>	<u>Volts peak to peak</u> <u>(measured above chassis)</u>
High side of Sweep Width Control Pot	8
Grid of V14 (pin #1)	20
Cathode of V14 (pin #3)	18
Grid of V8 (pin #3)	4
Plate of V8 (pin #2)	110
Plate of V8 (pin #5)	110

Refer to Fig. 9 in instruction book for proper sawtooth waveform.

2.- Blanking Pulse Generator. V7 (6SJ7) is the blanking tube.

If this tube is operating properly, little or no back trace will be seen when a signal appears at the low frequency end of the screen. An oscillograph connected to the plate of V7 (oscillograph connected for direct operation to its horizontal plates) should indicate the blanking pulse. This should be approximately rectangular, and should measure at least 40 volts peak to peak. See Fig. 10 in instruction book.

3.- Reactor Tube. V6 (6AC7) is the reactor tube, which sweeps the frequency of the oscillator (V5), in accordance with the sawtooth voltage being applied to its grid through the sweep control and sweep pad resistance.

If signals do not appear as pulses when the sweep control is set at maximum, but instead the line moves upward, it is an indication that the oscillator frequency is not being swept. Check with oscillograph connected to the grid of V6 to see whether sawtooth voltage appears at this point. If so, check all D.C. voltages at the socket of this tube (V6) to see that they are correct. Check for defective tube by replacing with another tube.

DO NOT ATTEMPT TO ADJUST THE PHASE NETWORK TRIMMERS OR THE REACTOR CATHODE RESISTANCE UNLESS ABSOLUTELY CERTAIN THAT THESE REQUIRE ADJUSTMENT.

(Service Notes)

Little or no adjustment of the phase trimmers and cathode resistor is required when inserting a new reactor tube (See instruction book for adjustment procedure). It will probably be necessary to adjust the ZERO trimmer.

B.- Sensitivity and Selectivity

1.- The overall sensitivity of the Model 8A1 Panoramic adaptor should be 200 microvolts or less for a 1/2" deflection at the center frequency with the signal being fed into the input cable, the gain control at maximum, and the sweep control at maximum.

The I.F. Gain control, R13 (located inside the chassis) can be made to adjust the sensitivity. In order to prevent too much noise pickup, the I.F. gain control should be so adjusted that the sensitivity is not better than 100 microvolts. With the panel gain control set at maximum, any noise created within the adaptor itself should not appear. If it does, adjust the I.F. gain control until it disappears.

The following table indicates the correct sensitivity per stage. Input signal levels, with gain control at maximum, and sweepwidth at zero should be approximately as shown:

<u>Point of Input</u>	<u>Frequency of Signal Input</u>	<u>Signal Input for 1/4" steady deflection</u>
I.F. grid (pin #4 of V3)	100KC	7500 microvolts
Mixer grid (pin #8 of V2)	100KC	125 "
Mixer grid (pin #8 of V2)	455KC (or center of band)	300 "
Input tube grid (pin #4 of V1)	455KC (" ")	15 "

2.- The bandpass characteristics of the Panoramic Adaptor should be so adjusted that the overall response of the adaptor and the receiver with which it is used is fairly flat. This can best be done by connecting the adaptor to the receiver and tuning in a

(Service Notes)

signal on the receiver, turning the receiver dial back and forth so that the signal pulse moves back and forth over the screen. If the amplitude of the signal does not remain constant over the entire range, adjust the trimmers on T1 and T2 until it is fairly so. It is impossible to maintain a flat response on all bands of the receiver unless the receiver has perfect tracking on all bands, hence this adjustment should be made with the receiver set on that band which will be most used.

3.- The I.F. stage is tuned to 100KC. The sensitivity of the Model SA1 Panoramic adaptor will depend to a large degree on the alignment of this stage. If it is too sharply aligned, however, the adaptor will be too sensitive to noise, and the signal pulses will have kinks in them. Proper alignment can be determined by reducing the sweepwidth to approximately 5KC with a signal at the center of the screen. The gain should be adjusted so as to maintain the peak of the signal below the cut-off point. The picture on the screen should appear symmetrical, with no kinks in its sides. Now observe the exact frequency of the signal input and place a thumbnail on the screen, at a point on one side of the curve about $1/3$ down from the top (keeping the gain control down to prevent overloading). Now shift the frequency of the signal so that a point on the other side of the curve coincides with the thumbnail and note the new frequency. The overall change in frequency should be about 2KC. If it is very much less than 2KC, slightly detune the trimmers on T3 and T4, at the same time observing that the shape of the curve is kept symmetrical.

C. D.C. Voltage Tests

The D.C. voltage on the tube socket terminal (measured from chassis)

(Service Notes)

should be approximately as follows, using a 1000 ohm-per-volt meter:

Refer to pages 2, 4 and 5 and Fig. 3 in the instruction book for correct bandpass characteristics. Note that with a "flat" response there are still three peaks to be observed.

<u>Tube</u>	<u>Plate</u>	<u>Screen</u>	<u>Cathode</u>
V1 (gain control at max.)	220	75	1.5
V1 (" " " ")	235	120	25
V2	240	60	2
V3	210	100	1.4
V4	90 #	---	0
V5	95	---	0
V6	255	150	4
V7	25 #	50 #	5
V8 (input section)	105 #	---	1.0
V8 (output ")	110 #	---	1.0
V10	-1100	---	---
V11	---	---	400
V12	260 volts on pin #5		
V13	155 " " " #5		
V14 (osc. section)	30 #	---	0.7 ##
V14 (coupling section)	260 #	---	25

#These values were obtained when using the 300 volt range of a 1000 ohm-per-volt meter. Using a higher range with such a meter or a meter with a higher ohm-per-volt sensitivity will result in higher values.

##This value was obtained using the 12 volt range of a 1000 ohm-per-volt meter.

On the cathode ray tube socket the following D.C. voltages should appear (above chassis):

<u>Pin #</u>	<u>Element</u>	<u>Potential</u>
7	2nd Anode	+130
5	Focus Anode	-300 to -520
11	Cathode	-720

The drop across the intensity rheostat varies from 0 to 110 volts.

The drop across the H. position potentiometer, and similarly the

(Service Notes)

V. position potentiometer, varies from 0 to 255 volts.

Miscellaneous Servicing Data

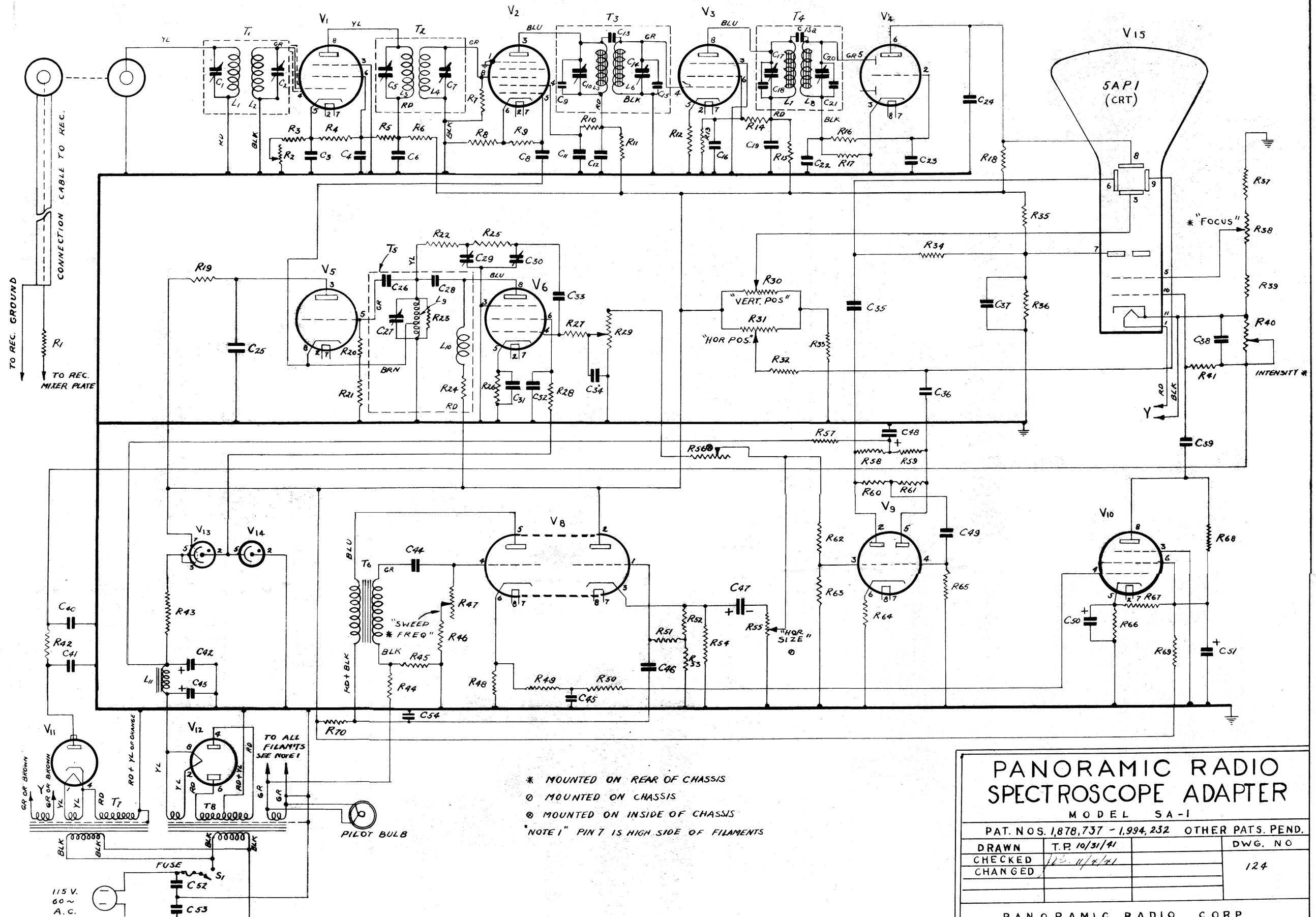
A.- To mount C.R. tube, first remove the 4-36 screw inside bottom of hood, and remove the scale. Push tube through hood into socket, and replace scale so that "0" is in the center of the screen.

When removing a cathode ray tube it is advisable to pry tube from socket with a screwdriver so as not to pull off clip ring at back of socket.

B.- To remove set from cabinet, remove the five self-tapping screws on the front panel, and also the self-tapping screw at the rear bottom of the cabinet.

C.- If stationary spots are seen along the base line (unaffected by tuning of the receiver) it is probable that the line voltage is below normal causing the voltage regulator tubes to oscillate.

D.- If the frequency sweep axis is not steady on the screen and starts to flutter sideways, it is an indication that the sweep frequency is not properly synchronized. See instruction book for proper adjustment.



PANORAMIC RADIO SPECTROSCOPE ADAPTER

MODEL SA-1

PAT. NOS. 1,878,737 - 1,994,232 OTHER PATS. PEND.

DRAWN	T.P. 10/31/41	DWG. NO.
CHECKED	12-11/4/41	124
CHANGED		

PANORAMIC RADIO CORP.
NEW YORK CITY