GENERAL RECEIVER ALIGNMENT

INTRODUCTION

For convenience and brevity, RCA Victor Alignment Procedure is being presented in tabular form as a part of the Service Data supplied in this manual for each radio receiver. It is essential that these instructions be rigidly adhered to and all adjustments made in the order listed. The brief instructions which are included with the schematic diagrams are supplemented in the following general discussion.

Part 1—Superheterodyne—I-F Alignment.

Every superheterodyne receiver uses an intermediate-frequency (i-f) amplifier having characteristics which largely govern the selectivity of the receiver. The i-f amplifier characteristics are determined principally by the design and adjustment of the i-f transformers. It is, therefore, necessary that the i-f amplifier be correctly adjusted to provide a symmetrical selectivity curve. These adjustments may be in the form of movable magnetite cores placed within the coils or adjustable trimmers connected across the coils. During alignment, it is necessary only to adjust these magnetite cores or trimmers, to obtain the best operation.

In some receivers, a quartz-crystal filter is included as part of the i-f amplifier system. In such designs, the crystal provides far greater selectivity than is otherwise available. During alignment of such an i-f amplifier, the most important point is to align the i-f amplifier transformers to exactly the natural periodic frequency of the crystal.

Some receivers use a double i-f amplifier. This consists of two i-f channels whose inputs are in parallel. One channel (usually the more selective of the two) amplifies the signal and feeds into the second detector. The other channel feeds the a-v-c tube. It is important that both channels be aligned to exactly the same frequency. The output indicator or Cathode Ray Oscillograph, as the case may be, must be connected to the channel under alignment.

Parts 19 and 20 describe the use of **RCA Stock No. 9595 Test Oscillator (TMV-97-C)** and **RCA Stock No. 9558 Frequency Modulator (TMV-128-A)** and tell how to find the correct Test Oscillator dial setting with Frequency Modulator plugged in, for any specified alignment frequency. This calibration, when made on an i-f amplifier, should always be made on one that does not have a flat-topped or double-peaked characteristic. Once this calibration is found, the test equipment will produce accurate results when used to align either flat-topped or double-peaked i-f amplifiers.

Some receivers employ automatic-frequency-control (a-f-c) circuits. Such receivers require very accurate alignment of these circuits before the a-f-c "pull-in" action will be correct and equal on both sides of the signal being received. The schematic diagram covering such receivers gives the procedure for making these adjustments.

Part 2—R-F Alignment. Image Response.

Every superheterodyne receiver incorporates a local oscillator, the output of which mixes with the incoming signal from the antenna. The local oscillator does not operate at the same frequency as the incoming signal which is to be received. The acceptance (resonant) frequency of the i-f amplifier establishes the difference frequency required; 175 kc and 460 kc are commonly used. In most RCA Victor receivers the local oscillator operates at a frequency higher than the incoming signal frequency. However, on certain bands of some receivers, the oscillator operates at a frequency lower than the incoming signal frequency. When the local oscillator output mixes with the incoming signal, the two predominating resultant frequencies produced are the *sum* and the *difference* of the two frequencies. Most superheterodyne receivers are designed in such a way that the *difference* frequency is the same as the i-f amplifier resonant frequency. Modulation of the incoming signal will be present as modulation of input to the i-f amplifier.

Figure 1 shows the frequency-range chart for the RCA Victor Model 5T5 receiver. The intermediate frequency is 460 kc. The A band range is 530 kc to 1,900 kc. The C band range is 5,800 kc to 21,600 kc. The design is such that the local oscillator in the receiver operates at a frequency higher than the incoming signal frequency. Let us consider the case of an incoming signal at a frequency of 10,000 kc with the receiver tuned to this frequency. The local oscillator is now operating at 10,460 kc to produce a difference frequency of 460 kc, which is the resonant frequency of the i-f amplifier. An unwanted signal at 10,920 kc will also be accepted by the i-f amplifier since this particular frequency also differs from the frequency of the local oscillator by 460 kc. Thus, it is possible to receive two signals of different frequencies at the same dial setting. Likewise, if the radio receiver is tuned to a frequency of 9,080 kc, the local oscillator will produce a 460 kc beat with the original wanted signal which was at 10,000 kc. Therefore, it is possible to receive a given signal at two different settings of the receiver dial. This unwanted signal is known as the image, and in all superheterodyne receivers exists at a frequency which differs from the wanted signal frequency by twice the intermediate frequency. Image response depends upon many things in-

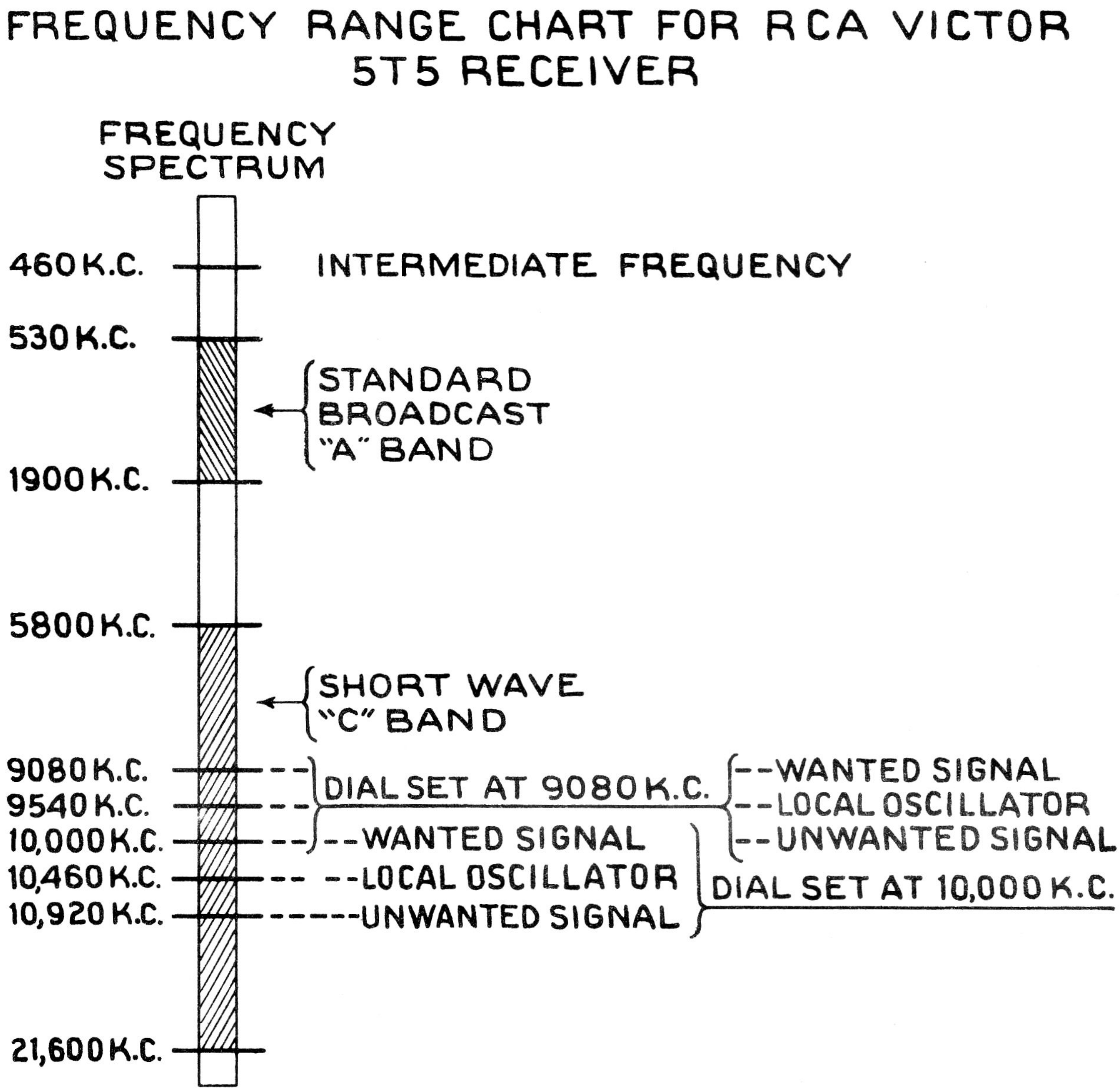


Figure 1

herent in the receiver design such as number of tuned circuits, degree of coupling, shielding, etc.

When aligning the short-wave band of a receiver, the oscillator trimmer usually has sufficient range so the local oscillator can be tuned over rather wide limits. It is thus often possible to tune the local oscillator to either a higher or lower frequency than the incoming signal. The receiver alignment information supplied with the schematic diagram specifies which of these settings to use. It is important that the correct oscillator-trimmer setting be employed; otherwise the receiver sensitivity will be below normal over some portions of that particular band since the tuned circuits will not track.

Some receivers employ "band-spread" circuits as an aid to short-wave reception. Such circuits spread short-wave stations further apart on the dial than is usual for the standard-broadcast band. Because of this fact, a slight error in dial calibration will be very noticeable and may result in a portion of the short-wave broadcast band not falling within the tuning range of the receiver. Alignment of such short-wave bands requires greater accuracy of calibration than can usually be obtained with test equipment now in general use for radio service work. Sufficient accuracy for alignment of such bands requires special alignment procedure which is covered in the Service Data for these receivers. Where reception conditions permit, it is satisfactory to tune in a short-wave station of known frequency falling within the frequency range of the particular band under alignment, and then make alignment adjustments to that particular band until the receiver has maximum sensitivity and correct dial calibration.

Part 3—Usual Effects of Misalignment of R-F or I-F Stages.

The most commonly observed effects of misaligned r-f or i-f stages are loss of sensitivity; either over the entire receiver range, or on certain bands, or a portion of certain bands; loss of selectivity, often characterized by the selectivity being noticeably unequal on the two sides of the point of best reception; inaccurate dial readings; and change in fidelity of the receiver. Loss of fidelity will be apparent as change of audio-characteristic balance with either high- or low-audio frequencies being reduced. If the i-f amplifier is not tuned to the specified frequency, the oscillator and other tuned circuits will not track. The dial readings will then be incorrect and portions of all bands will have low sensitivity. Misaligned i-f amplifiers in receivers using a-f-c circuits will usually result in incorrect or unequal "pull-in" action.

Part 4—Preliminaries to Alignment.

Before the various aligning adjustments are made, the radio receiver should be functioning normally in all other respects. Trouble-shooting, if necessary, should precede the final alignment.

Receiving signals at the correct setting of the dial scale depends upon having the proper relation between tuning condenser setting and dial scale. There will usually be a mark at the low-frequency end of the scale for pointer setting with the condenser fully meshed. The adjustment is made by rotating the pointer to the desired position with the shaft stationary, or in some cases by moving the scale, shifting a stationary index, or other relative change. It is important that this be checked before alignment of the separate bands. Pointer or dial setting is necessary because the scales are not linear with frequency and all scales are pre-calibrated for maximum accuracy.

Part 5—Connection of Test Oscillator to Radio Receiver. Use of Dummy Antenna.

The radio receiver ground terminal should usually be connected to the "o" or "Gnd." terminal of the Test Oscillator and preferably also connected to an external ground. The "Ant." or "High" terminal of the Test Oscillator output must be connected to the antenna post or other points in the radio receiver as specified in Alignment Procedure. The use of a fixed condenser, or resistor, in series with this Test Oscillator lead, is specified in some instances. Such a condenser or resistor, known as a "Dummy Antenna," provides the proper input loading to the receiver. The condenser or resistor, as the case may be, should be connected at the point where the Test Oscillator lead joins the radio set, and should not be connected at the Test Oscillator. Grid caps should be left connected to the tubes to provide d-c bias unless otherwise specified. In any case that requires removal of the grid cap, the "Dummy Antenna" will consist of a resistor. Shielded leads should be used; **RCA Stock No. 9797 Cable Assembly** is a convenient set of such leads for all these connections.

When the Test Oscillator is connected to the grid circuit of the first-detector tube (usually for alignment of the first i-f transformer) it is often necessary to set the receiver range switch to the "A band" (standard broadcast) position in order to get sufficient signal from the Test Oscillator into the i-f amplifier to permit proper alignment.

RCA Test Oscillators have rather low-impedance output circuits. When using some other types of Oscillators, which have high-impedance output circuits, to align high-gain i-f amplifiers, there is a possibility of i-f regeneration. If such is the case, the resonance curve will be unusually narrow in width and high in amplitude. This condition can be eliminated by shunting a 200-ohm resistor directly across the Oscillator output terminals. If the Oscillator output controls are calibrated in terms of voltage output, this resistor will, of course, change the calibration.

Part 6—Connections of Output Meter to Radio Receiver.

The **RCA Stock No. 4317 (TMV-121-A) Neon Output Indicator** or any one of many different types of Output Meters can be employed during alignment. Such indicators, or meters, should be connected across either the primary or secondary of the output transformer. It is best to leave the loudspeaker voice coil connected to the radio receiver when using an Output Meter. In general, the RCA Output Indicator gives best results when connected across the voice coil of the loudspeaker, although on some types of receivers it will give satisfactory results when connected to the primary of the output transformer.

Part 7—Connections of Cathode Ray Oscillograph to Different Types of Second-Detector Circuits.

Figures 2, 3, and 4 show, in simplified form, the three most commonly used second-detector circuits. Figure 2 shows a diode-detector circuit. Figure 3 shows a power detector resistance-capacitance coupled to the audio amplifier. Figure 4 shows a power detector using impedance-capacitance or transformer coupling to the audio amplifier. For simplicity, only the essential elements in these circuits are shown. On

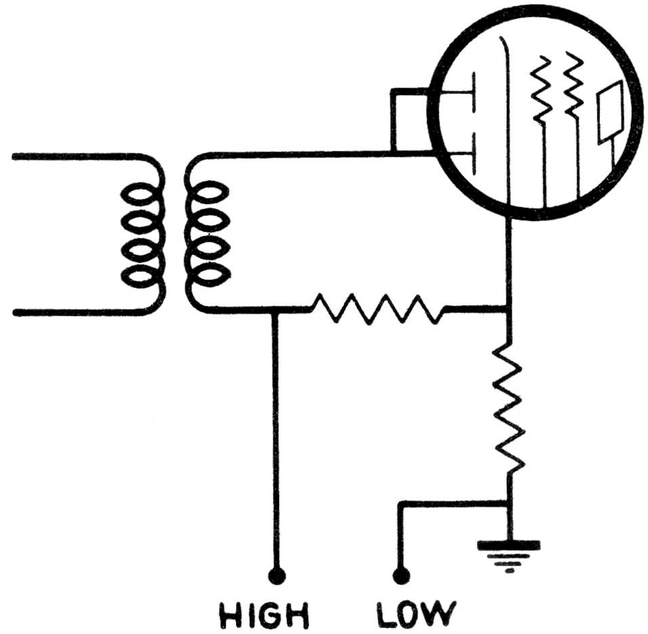


Figure 2

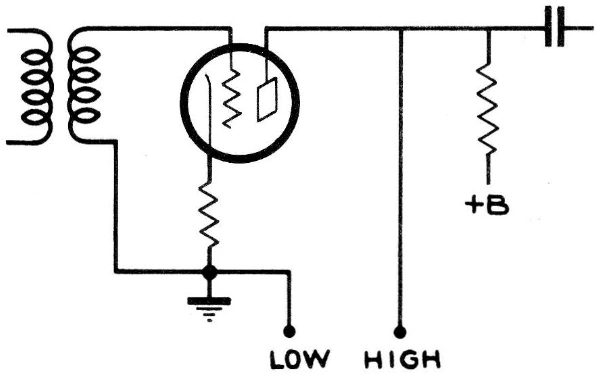
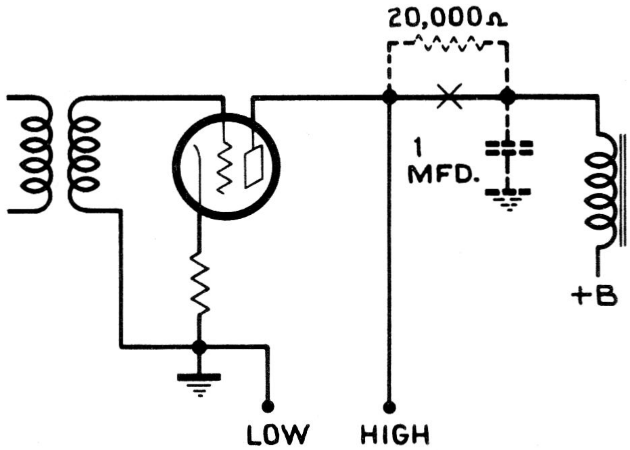


Figure 3



Open plate circuit at point marked "X". Connect resistor and condenser as shown by dotted lines

Figure 4

each of the three diagrams, points of connection are indicated by "Low" and "High." The "Low" point should be connected to the "0" or "Gnd" Cathode Ray Oscillograph terminal; the "High" point should be connected to the vertical "High" terminal.

Part 8—Aligning the Tuned Circuits.

Tuning adjustment with trimmers or adjustable magnetite cores is accomplished while applying a modulated signal, of the specified frequency, to the input of the stage being adjusted. Either Oscillograph or Output Meter indication, of the amplitude of audio-frequency output, of the radio receiver, shows when tuning is correct. In some cases, the Oscillograph also shows the selectivity characteristic. The various tuned circuits are aligned by adjusting each in this manner. During all alignment adjustments, the output of the Test Oscillator must be kept as low as possible to prevent a-v-c action from taking place and making all adjustments seem very broad.

The tool used for tuning must have a minimum of metal so it will cause little or no tuning reaction. If removing the tool, after making an adjustment, reduces the output appreciably, a slight compensating mistuning will correct the error and produce maximum output when the tool is removed. Sometimes fine adjustments of mica compression trimmers can be made easily by tapping the trimmer screw with a wooden rod.

Part 9—Rocking Adjustments in Alignment.

Provision is usually made in the oscillator circuits of superheterodynes for a tracking adjustment at the low-frequency end of X and A bands. This consists of a variable oscillator-trimming condenser or magnetite core. Tuning frequencies specified in the Alignment Procedure Table for making these adjustments should be followed carefully because the design of the tuned circuits is such that only this procedure will produce correct dial calibration. For maximum sensitivity at the low-frequency end of the band, this should be a rocking adjustment. To make a rocking adjustment, change the setting of the specified oscillator trimmer slightly, then tune the gang condenser for maximum output regardless of dial setting, and note the exact reading of the output indicator. Next, repeat this procedure and note if the output reading so obtained is greater, or less, than the first one. If the second reading is greater than the first, continue this process while changing the oscillator-trimmer adjustment in the same direction until the highest possible output reading is obtained. If the second reading is less than the first, continue this process while changing the oscillator-trimmer adjustment in the opposite direction until the highest possible output reading is obtained.

When using a frequency-sweeping device and Cathode Ray Oscillograph connected to show the resonance curve of the circuit being aligned, rocking is unnecessary because the final result is the same regardless of whether a receiver is sweep-tuned about a fixed Test Oscillator frequency or a Test Oscillator sweep-tuned about a fixed receiver frequency.

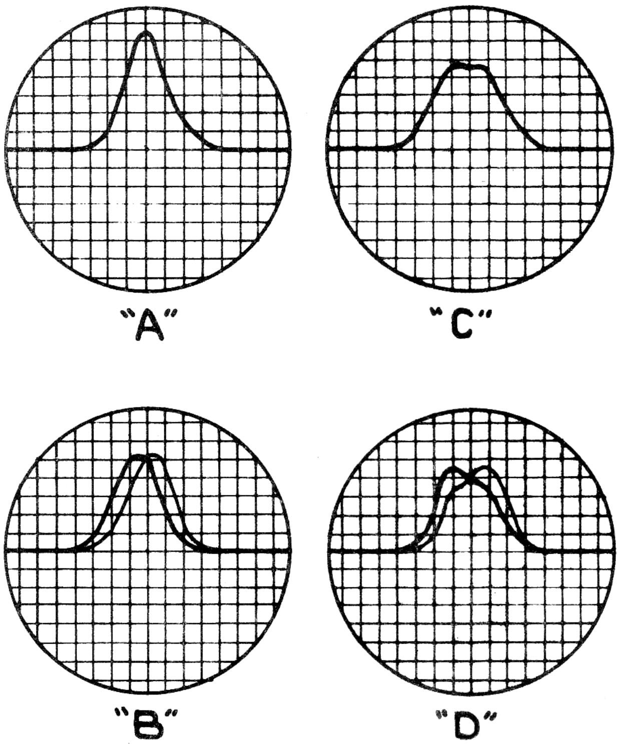
In such cases, adjustment should be made for maximum amplitude of the resonance curves. In some receivers, the same maximum amplitude is obtainable throughout part of the trimmer adjustment range. When such is the case, the maximum amplitude setting which produces most accurate dial calibration should be used.

The dial setting so obtained will ordinarily be close to correct. This procedure increases the receiver sensitivity by effectively tuning the local oscillator circuit simultaneously with the r-f and first-detector stages at the low-frequency end of the band. Simultaneous adjustment is necessary to maintain correct tracking. An adjustment at the low-frequency end of a band should be followed by readjustment at the high-frequency end because each tuning adjustment affects the other.

Alignment at high frequencies (above broadcast-band frequencies) can sometimes be improved by similar rocking. This becomes effective when there is interaction among the various tuned circuits. In such cases, it is preferable to adjust the local-oscillator trimmer first, and then adjust the r-f and first detector trimmers while rocking. When the interaction is particularly bad, repeating these adjustments several times will often produce an increase in sensitivity.

Part 10—Frequency Sweeping in I-F Amplifier Alignment.

Many i-f amplifiers have a sharp, single-peak selectivity characteristic because i-f coupling transformers are under-coupled. When improved fidelity is desired, i-f coupling transformers may be over-coupled with the result of a flat-topped selectivity characteristic and extended high-frequency audio range. Some i-f amplifiers do employ over-coupling and have, therefore, a double-peaked or flat-topped selectivity characteristic. Any amplitude indicating device such as **RCA Stock No. 4317 Neon Output Indicator (TMV-121-A)** or any conventional output meter can be used when aligning i-f amplifiers having single-peaked characteristics. *A more satisfactory method using a frequency-sweeping device and Cathode Ray Oscillograph is desirable in any case and necessary for double-peaked or flat-topped characteristics.* The frequency-sweeping alignment method makes it possible to tune the mid-frequency point of the flat-topped or double-peaked characteristic to the desired alignment frequency, and maintain practically symmetrical side-bands. It is also of great value in checking an i-f amplifier having a variable-width selectivity characteristic. If the intermediate frequency is 460 kc and the sweep range 20 kc, the sweeping device varies



A—Correct pattern showing a sharp selectivity curve with proper i-f alignment.

B—Incorrect pattern showing result of i-f alignment at a frequency slightly different from the Test Oscillator output frequency.

C—Correct pattern showing a broad selectivity curve with proper i-f alignment.

D—Incorrect pattern showing result of slight misalignment of i-f transformers.

Figure 5

the Test Oscillator output frequency from 450 kc to 470 kc and back to 450 kc linearly with time. The cycle is repeated so rapidly that a Cathode Ray Oscillograph connected to the second detector of the receiver, when properly synchronized, shows two selectivity curves—one like the mirror image of the other. Figure 5 shows these patterns as they appear on the oscillograph screen. The i-f amplifier alignment is correct when the two images are made to coincide throughout and have maximum amplitude.

Part 11—Use of Crystal Calibrator to Check Calibration of Test Oscillators.

One of the easiest methods of checking the calibration of a Test Oscillator against the **RCA Stock No. 9572 Crystal Calibrator (TMV-133-A)** requires the use of an all-wave radio receiver which will tune to the frequencies at which it is desired to check calibration. A few turns of wire should be wrapped around the case of the Crystal Calibrator and connected to the antenna and ground posts of the radio receiver. The Crystal Calibrator may be used, as supplied by the factory, without external B batteries, and is simply plugged into the power line in the usual way. Hum signals will now be heard in the radio receiver at dial settings 100 kc or 1,000 kc apart, depending on the position of the "Hi-Lo" switch on the Crystal Calibrator. If, for example, it is desired to check a calibration at 5,000 kc, set the "Hi-Lo" switch to the "Hi" position and tune the radio-receiver dial exactly to its fifth harmonic (5,000 kc) signal. Next, remove the Crystal Calibrator and connect the Test Oscillator to the radio receiver, and tune the Test Oscillator dial in the region of 5,000 kc until its signal is heard with maximum intensity in the receiver. At this point the Test Oscillator is delivering a signal of exactly 5,000 kc. A notation should now be made of the dial scale reading on the Test Oscillator and marked that this particular reading represents exactly 5,000 kc. This same procedure may be followed to find exact calibration for any frequency which is a multiple of 100 or 1,000 kc.

To check the Test Oscillator at frequencies which are not multiples of 100 or 1,000 kc, tune the receiver to a frequency which is a harmonic of the wanted check point on the Test Oscillator and which falls on some multiple of 100 or 1,000 kc. Suppose it is desired to check at 175 kc. The Test Oscillator dial is set to 175 kc and its fourth harmonic, which is 700 kc, is checked—using the Crystal Calibrator and radio receiver as outlined above.

Part 12—Wave-Trap Adjustment.

Wave-traps may consist of either a parallel-resonant circuit in series with the antenna of the receiver, or a series-resonant circuit connected from antenna to ground. They will be found in many RCA Victor receivers, especially following the models of 1935. The resonant frequency of the wave-trap is adjusted during manufacture to the same frequency as the i-f amplifier, to prevent signals at or near this frequency from causing interference.

When aligning a receiver, the wave-trap should always be adjusted to the same frequency as the i-f amplifier unless the exact frequency of the local interfering signal is known. In this case the wave-trap should be adjusted exactly to this interfering frequency. To make this adjustment, it is necessary to increase the Test Oscillator output considerably, since the wave-trap attenuates the signal. However, care must be taken not to use too strong a signal as this would cause a-v-c action in the receiver and make the wave-trap appear to tune broadly.

Part 13—Tuning Wand.

The **RCA Stock No. 6679 Tuning Wand** is very useful in checking any tuned circuit during alignment. When the test equipment is connected ready for aligning, insert first one end and then the other, of the tuning wand, inside the coil to be checked and observe the effects of each on the receiver output. If each end of the tuning wand produces a decrease in output, the circuit is correctly tuned and needs no further adjustment. If the brass sleeve end of the tuning wand produces an increase of output, the circuit must be retuned to a higher frequency; and if the iron core end of the tuning wand produces an increase of output, the circuit must be retuned to a lower frequency.

Both r-f and i-f circuits are usually tuned by either magnetite cores or trimming condensers.

Part 14—RCA Alignment Equipment.

Stock No. 9595 Test Oscillator—TMV-97-C.
Stock No. 9558 Frequency Modulator—TMV-128-A.
Stock No. 9545 Cathode Ray Oscillograph—TMV-122-B.
Stock No. 9572 Crystal Calibrator—TMV-133-A.
Stock No. 150 Test Oscillator.
Stock No. 151 Cathode Ray Oscillograph.
Stock No. 4317 Neon Output Indicator—TMV-121-A.
Stock No. 9797 Cable Assembly.
Stock No. 12636 Air-Trimmer Wrench.
Stock No. 11890 Fibre Screw Driver.
Stock No. 6679 Tuning Wand.
Stock No. 4160 Aligning Wrench.
Stock No. 3792 Resistor, 300 ohms.
Stock No. 12635 Capacitor, .001 mf.
Stock No. 12694 Capacitor, 220 mmf.
(This capacitor is suitable for use wherever a capacitor of 200 mmf. is specified in alignment procedure.)
Stock No. 12270 Capacitor, 80 mmf.

NOTE: When using the **RCA Stock No. 12636 Air-Trimmer Wrench,** care must be taken not to disturb the adjustment of the Air-Trimmer Capacitor while tightening its lock nut. The lock nut should be tightened while the test equipment is still connected to the radio receiver, so that any change in capacity which might result from the tightening will be immediately observed. The chassis should not be moved until the lock nuts are tightened.

The instruction books supplied with RCA test equipment such as Cathode Ray Oscillographs, Test Oscillators, Frequency Modulators, Crystal Calibrators, etc., describe the construction and operation of these instruments and will be found very helpful.

The following publications contain valuable information relative to receiver alignment and will be found helpful. Obviously, the list is not inclusive, but it will guide the reader to other references.

GHIRARDI, ALFRED A., *Modern Radio Servicing.* Radio and Technical Publishing Co., New York.

RIDER, JOHN F., *The Cathode-Ray Tube at Work.* John F. Rider, Publisher, New York.

Part 15—Connecting and Operating Different Combinations of RCA Test Equipment for Aligning.

Below are shown connection diagrams for different combinations of RCA Test Equipment, any of which can be used to align RCA Victor receivers (and also other types). In using any of these combinations, connect the test equipment as shown in the diagram and adjust it to the frequency specified with the schematic diagram in this manual, then adjust the receiver trimmers or magnetite cores, as the case may be, in the manner prescribed.

Below each of the following connection diagrams will be found data on how to adjust and operate the test equipment.

Part 16—Use of RCA Stock No. 150 or RCA Stock No. 9595 Test Oscillator (TMV-97-C) and RCA Stock No. 4317 Neon Output Indicator.

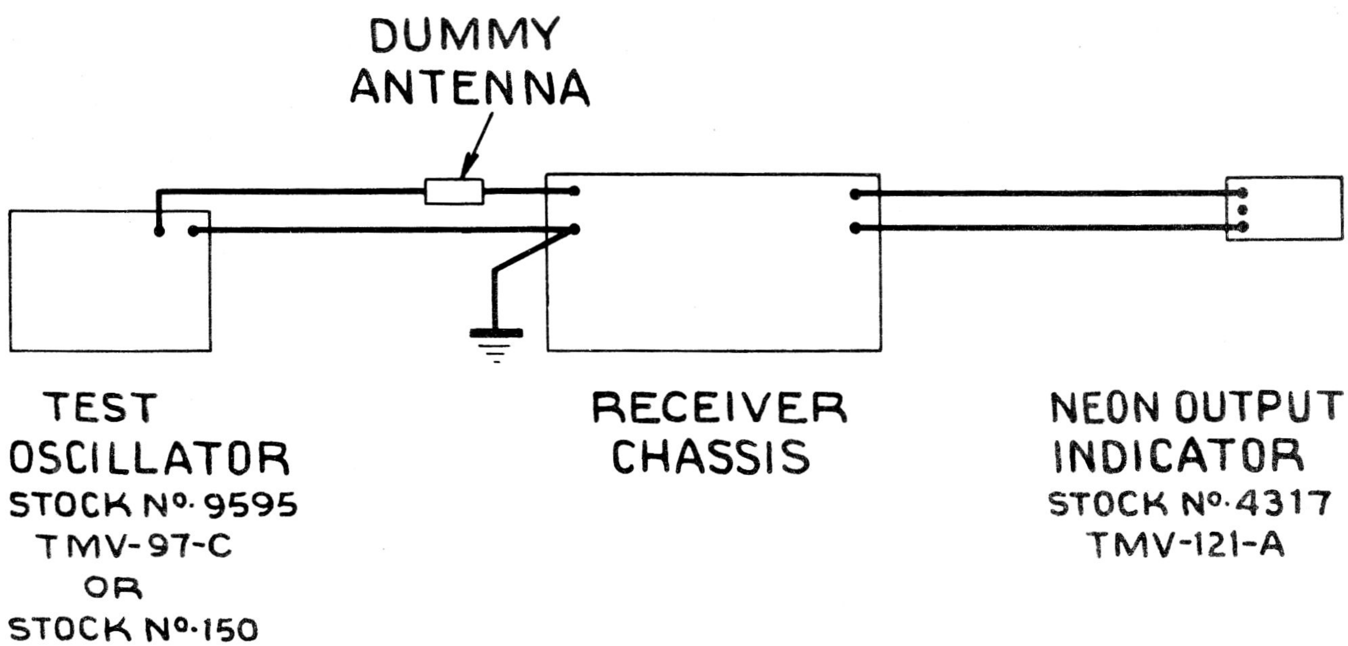


Figure 6

When using the **RCA Stock No. 9595 Test Oscillator (TMV-97-C),** or **RCA Stock No. 150 Test Oscillator,** and **RCA Stock No. 4317 Neon Output Indicator (TMV-121-A),** make connections to receiver chassis and Dummy Antenna.

Such connections are shown in figure 6 and described in Parts 5 and 6 above.

Part 17—Use of RCA Stock No. 150 Test Oscillator and RCA Stock No. 151 Cathode Ray Oscillograph.

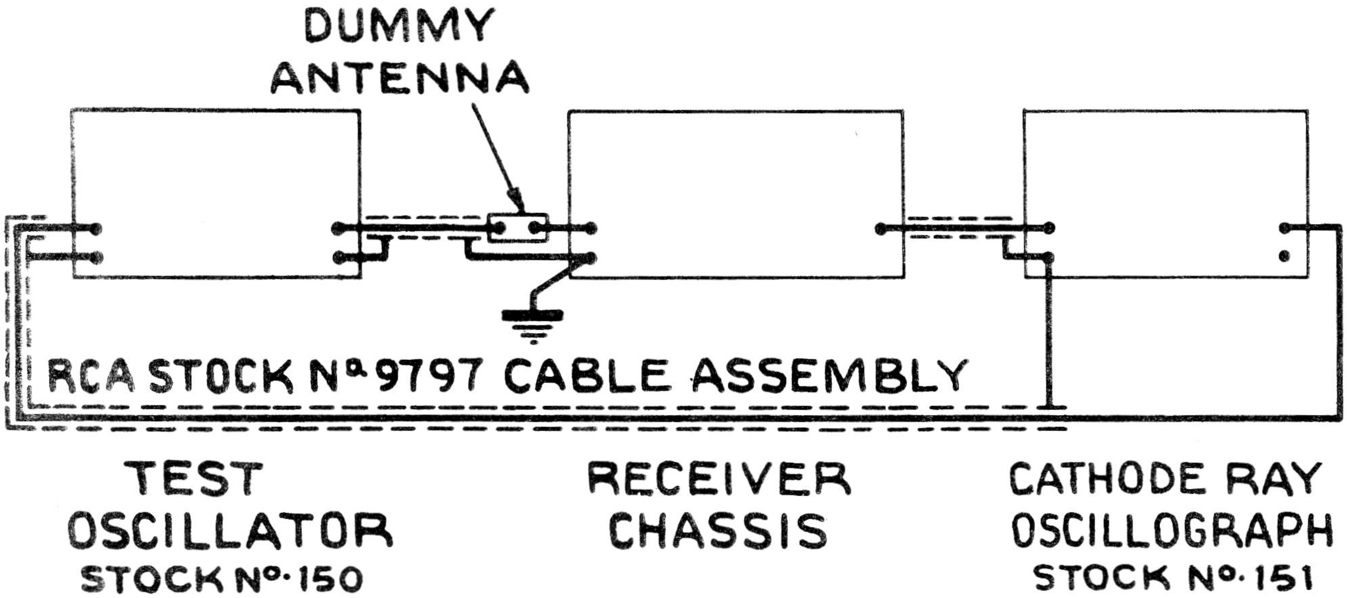


Figure 7

When using the **RCA Stock No. 150 Test Oscillator** and **RCA Stock No. 151 Cathode Ray Oscillograph,** make connections to receiver chassis and Dummy Antenna. Connect the test equipment as shown in figure 7, and adjust it as follows:

Test Oscillator:

SWEEP KC—Between 20 and 40.

DIAL—Specified alignment frequency.

RANGE KC—Range within which specified frequency falls.

POWER switch—ON.

MODULATION switch—FREQ.

Output controls FINE and COURSE—Low as possible and still keep screen filled with image.

Cathode Ray Oscillograph:

INTENSITY / FOCUS — Adjust to give clear, sharply defined image on screen.

CENTERING—V / CENTERING—H — Adjust to center image on screen.

AMP. V switch—ON.

AMP. H switch—TIMING.

GAIN (under intensity control)—Maximum clockwise.

FREQUENCY—Approximately 55.

SYNC. control—Approximately two-thirds clockwise.

RANGE—1.

GAIN (under focus control)—Approximately 65.

Two separate, distinct, and similar waves should now appear on the screen. If only one wave appears, increase the "Frequency" control on the Oscillograph to obtain two waves. These waves will be identical in shape, totally disconnected, and appear in reversed positions. They will have a common base line which is discontinuous. Adjust the "Frequency" and "Sync." controls of the Oscillograph to make them remain motionless on the screen. Turning the Test Oscillator dial slightly should cause them to move back and forth across the screen. However, before making any alignment adjustments, the Test Oscillator dial must be adjusted to the specified alignment frequency.

The circuit being aligned (to which the Test Oscillator output was originally connected) must now have its trimmers or magnetite cores adjusted so that the two waves on the Oscillograph screen coincide throughout and have maximum amplitude.

In most receivers, the trimmer which tunes the local oscillator for the high-frequency band (usually around 12,000 kc and higher) has sufficient capacity to tune it over a rather wide range of frequencies. The **RCA Stock No. 150 Test Oscillator,** because of its beat-frequency principle, produces on the two high-frequency bands (frequencies from 7,000 kc to 32,000 kc) the frequency to which the dial is calibrated and also another frequency 1,600 kc lower. Thus, it is sometimes possible to produce the desired resonance curve on the screen at four different settings of the receiver's local-oscillator trimmer. Two of these points represent the correct tuning, and the image, for the frequency of the Test Oscillator shown on its dial. The other two represent the correct tuning, and the image for the additional frequency coming from the Test Oscillator which is 1,600 kc lower than the one shown on its dial. When this condition exists, the local-oscillator trimmer in the receiver must be set to one of the two highest frequencies. If the alignment information specifies adjustment to the highest-frequency (minimum-capacity) peak, use the highest-frequency peak obtainable on the trimmer. If it specifies adjustment to the lowest-frequency (maximum-capacity) peak, use the peak next lower in frequency to the highest-frequency one obtainable. This is the correct procedure in all cases where the intermediate frequency used in the receiver is less than 800 kc, and when the fundamental (not a harmonic) frequency delivered by the Test Oscillator is being used.

When using this Test Oscillator, it is important to keep its output controls at the lowest possible setting in order to avoid unwanted beat notes and harmonics which may otherwise be present.

Part 18—Use of RCA Stock No. 9595 Test Oscillator (TMV-97-C), RCA Stock No. 9558 Frequency Modulator (TMV-128-A), and RCA Stock No. 9545 Cathode Ray Oscillograph.

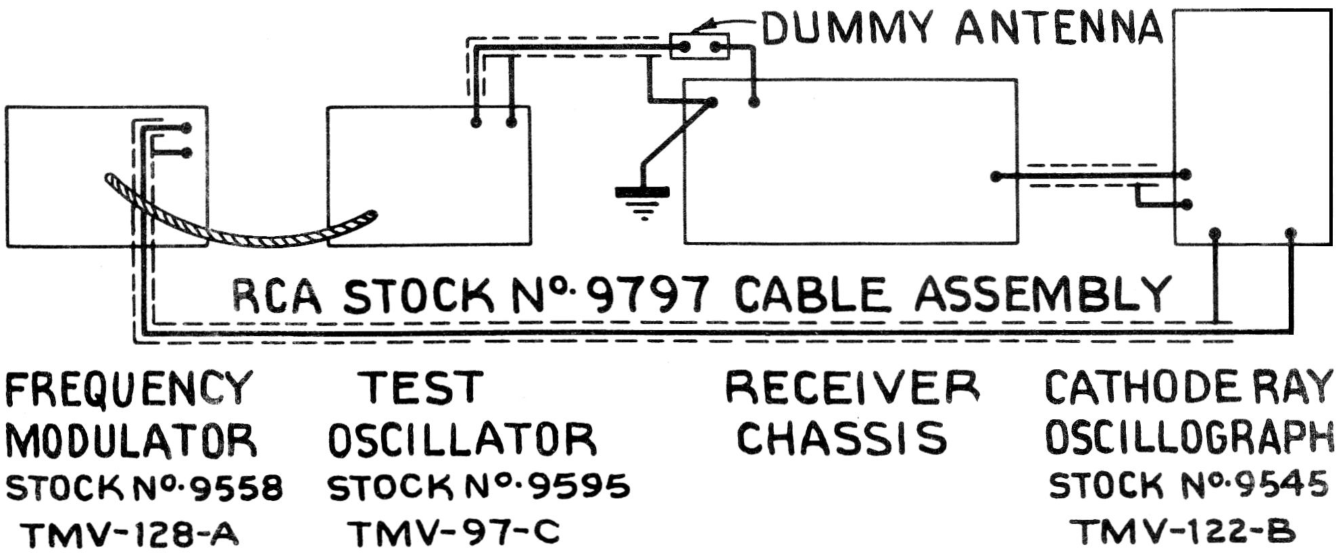


Figure 8

When using the **RCA Stock No. 9595 Test Oscillator (TMV-97-C)**, and **RCA Stock No. 9558 Frequency Modulator (TMV-128-A)**, and **RCA Stock No. 9545 Cathode Ray Oscillograph (TMV-122-B)**, it is necessary to determine the correct Test Oscillator dial setting with Frequency Modulator plugged in, for any given frequency, in order that the sweep range will center about that particular frequency. Make connections to receiver chassis and Dummy Antenna. Connect the test equipment as shown in figure 8, and adjust it as follows:

Frequency Modulator:

Disconnect by removing plug-in cable from Test Oscillator (not from Frequency Modulator).

Test Oscillator:

RANGE KC—Range within which specified frequency falls.

DIAL—Specified alignment frequency.

HI-LO control switch, OUTPUT control knob } Low as possible and still keep screen filled with image.

Modulation switch—MOD.

Power switch—ON.

Cathode Ray Oscillograph:

INTENSITY, FOCUS } Adjust to give clear, sharply defined image on screen.

AMPL. A—ON.

RANGE switch—2.

AMPL. B—TIMING.

SYNC. control—Approximately 5.

FREQ. control—Approximately 7.

VERTICAL GAIN—Maximum clockwise.

SYNC. switch—INT.

HORIZONTAL GAIN—Approximately 5.

With the test equipment controls adjusted as indicated above, align the circuit in question for maximum (peak) amplitude as indicated on the Oscillograph screen. Then change only the test equipment settings noted below leaving the other controls as they were:

Frequency Modulator:

Power switch—ON.

HI-LO switch—HI. See text below.

Cable—Plugged into Test Oscillator.

Test Oscillator:

RANGE KC, DIAL } See text below.

Modulation switch—OFF.

Cathode Ray Oscillograph:

FREQ. control—Approximately 8.

SYNC. switch—EXT.

Increase the frequency of the Test Oscillator by slowly turning its tuning control until two separate, distinct, and similar waves appear on the screen. If only one wave appears, increase the "Freq." control on the Oscillograph to obtain two waves. These waves will be identical in shape, totally disconnected, and appear in reversed positions. They will have a common base line which is discontinuous. Adjust the "Freq." and "Sync." controls of the Oscillograph to make them remain motionless on the screen. Continue increasing the Test Oscillator frequency until these forward and reverse curves move together and overlap, *with their highest points exactly coincident.* For some frequencies, this will necessitate moving the "Range-kc" switch on the Test Oscillator to the next higher-frequency position, and may also necessitate throwing the "Hi-Lo" switch on the Frequency Modulator to the "Lo" position. In still other cases, it may be necessary to tune the Test Oscillator to a lower frequency and increase its output, thereby using one of its harmonics instead of the fundamental frequency. The equipment is now producing a test signal which is sweeping around the specified alignment frequency to which the Test Oscillator was originally adjusted, and this specified frequency is exactly in the middle of the range of sweep.

The circuit being aligned (to which the Test Oscillator output was originally connected) must now have its trimmers or magnetite cores adjusted so that the *two curves on the Oscillograph screen coincide throughout and have maximum amplitude.*

It is desirable to write down the final switch and dial settings of the Frequency Modulator and Test Oscillator for future reference. If this is done, much future work can be eliminated since then it will only be necessary to adjust the test equipment to these final settings, and it will be ready for use in aligning any circuit which must be aligned to that particular frequency.

The Frequency Modulator method of sweeping is generally used only for frequencies below 2,000 kc. At higher frequencies, the Frequency Modulator is not used and alignment adjustments are made for peak amplitude only as shown on the Oscillograph screen.

Part 19—Use of RCA Stock No. 9595 Test Oscillator (TMV-97-C), RCA Stock No. 9558 Frequency Modulator (TMV-128-A), and RCA Stock No. 151 Cathode Ray Oscillograph.

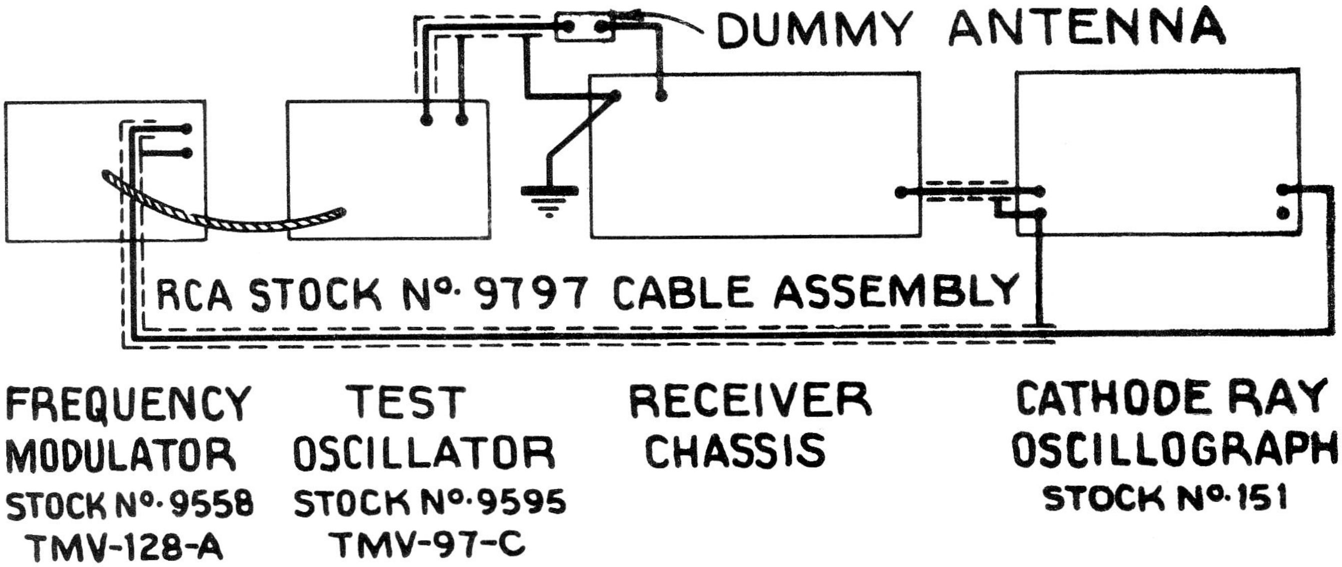


Figure 9

When using the **RCA Stock No. 9595 Test Oscillator (TMV-97-C)**, and **RCA Stock No. 9558 Frequency Modulator (TMV-128-A)**, and **RCA Stock No. 151 Cathode Ray Oscillograph**, it is necessary to determine the correct Test Oscillator dial setting with Frequency Modulator plugged in, for any given frequency, in order that the sweep range will center about that particular frequency. Make connections to receiver chassis and Dummy Antenna. Connect the test equipment as shown in figure 9, and adjust it as follows:

Frequency Modulator:

Disconnect by removing plug-in cable from Test Oscillator (not from Frequency Modulator).

Test Oscillator:

RANGE KC—Range within which specified frequency falls.
DIAL—Specified alignment frequency.
HI-LO control switch / OUTPUT control knob } Low as possible and still keep screen filled with image.
Modulation switch—MOD.
Power switch—ON.

Cathode Ray Oscillograph:

INTENSITY / FOCUS } Adjust to give clear, sharply defined image on screen.
CENTERING—V / CENTERING—H } Adjust to center image on screen.
AMP. V switch—ON.
AMP. H switch—TIMING.
GAIN (under intensity control)—Maximum clockwise.
FREQUENCY—Approximately 15.
SYNC. control—Maximum clockwise.
RANGE—1.
GAIN (under focus control)—70.
Wire from Frequency Modulator disconnected from HORIZ.-HIGH binding post.
Connect jumper between HORIZ.-HIGH and SYNC. HIGH binding posts.

With the test equipment controls adjusted as indicated above, align the circuit in question for maximum (peak) amplitude as indicated on the Oscillograph screen. Then change only the test equipment settings noted below leaving the other controls as they were:

Frequency Modulator:

Power switch—ON.
HI-LO switch—HI. See text below.
Cable—Plugged into Test Oscillator.

Test Oscillator:

RANGE KC / DIAL } See text below.
Modulation switch—OFF.

Cathode Ray Oscillograph:

SYNC. control—Approximately one-half clockwise.
Remove jumper between HORIZ.-HIGH and SYNC.-HIGH binding posts.
Connect wire from HORIZ.-HIGH binding post to Frequency Modulator.

Increase the frequency of the Test Oscillator by slowly turning its tuning control until two separate, distinct, and similar waves appear on the screen. If only one wave appears, increase the "Frequency" control on the Oscillograph to obtain two waves. These waves will be identical in shape, totally disconnected, and appear in reversed positions. They will have a common base line which is discontinuous. Adjust the "Frequency" and "Sync." controls of the Oscillograph to make them remain motionless on the screen. Continue increasing the Test Oscillator frequency until these forward and reverse curves move together and overlap, *with their highest points exactly coincident.* For some frequencies, this will necessitate moving the "Range-kc" switch on the Test Oscillator to the next higher-frequency position, and may also necessitate throwing the "Hi-Lo" switch on the Frequency Modulator to the "Lo" position. In still other cases, it may be necessary to tune the Test Oscillator to a lower frequency and increase its output, thereby using one of its harmonics instead of the fundamental frequency. The equipment is now producing a test signal which is sweeping around the specified alignment frequency to which the Test Oscillator was originally adjusted, and this specified frequency is exactly in the middle of the range of sweep.

The circuit being aligned (to which the Test Oscillator output was originally connected) must now have its trimmers or magnetite cores adjusted so that the *two curves on the Oscillograph screen coincide throughout and have maximum amplitude.*

It is desirable to write down the final switch and dial settings of the Frequency Modulator and Test Oscillator for future reference. If this is done, much future work can be eliminated since then it will only be necessary to adjust the test equipment to these final settings, and it will be ready for use in aligning any circuit which must be aligned to that particular frequency.

The Frequency Modulator method of sweeping is generally used only for frequencies below 2,000 kc. At higher frequencies, the Frequency Modulator is not used and alignment adjustments are made for peak amplitude only as shown on the Oscillograph screen.

Part 20—Use of RCA Stock No. 150 Test Oscillator and RCA Stock No. 9545 Cathode Ray Oscillograph (TMV-122-B).

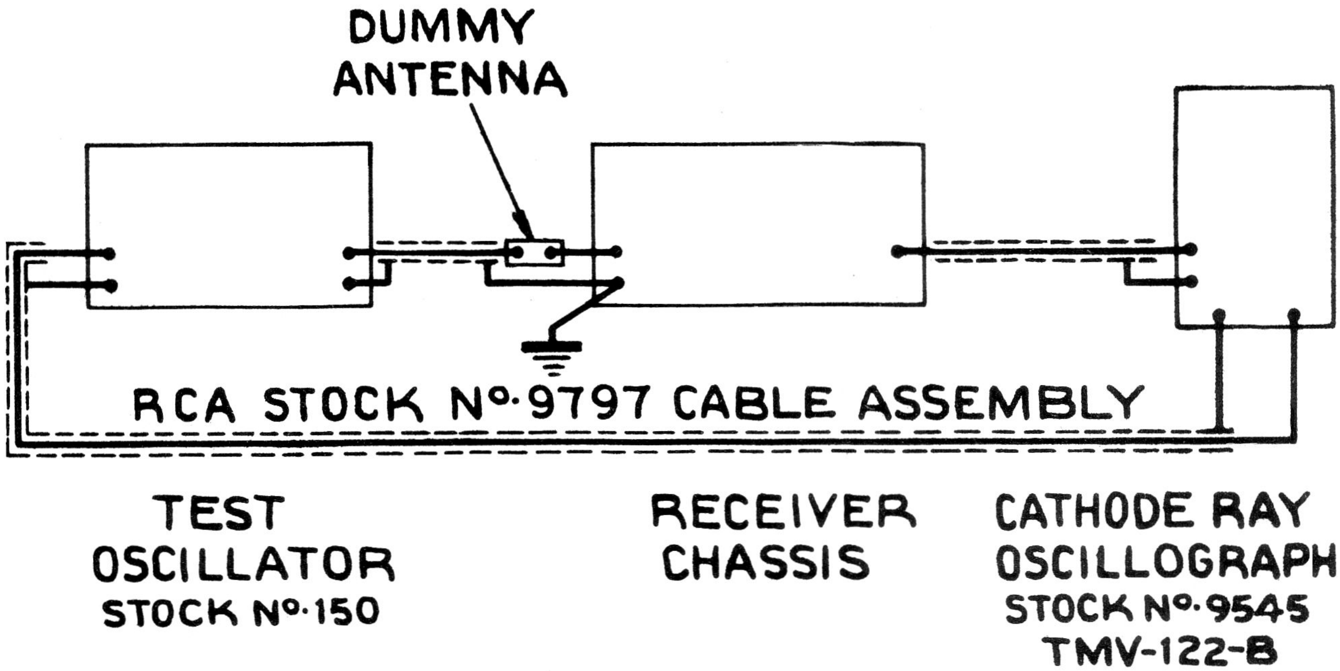


Figure 10

When using the **RCA Stock No. 150 Test Oscillator** and **RCA Stock No. 9545 Cathode Ray Oscillograph (TMV-122-B)**, make connections to receiver chassis and Dummy Antenna. Connect the equipment as shown in figure 10, and adjust it as follows:

Test Oscillator:

SWEEP KC—Between 20 and 40.
DIAL—Specified alignment frequency.
RANGE KC—Range within which specified frequency falls.
POWER switch—ON.
MODULATION switch—FREQ.
Output controls FINE and COURSE—Low as possible and still keep screen filled with image.

Cathode Ray Oscillograph:

INTENSITY } Adjust to give clear, sharply
FOCUS } defined image on screen.
AMPL. A—ON.
RANGE switch—3.
AMPL. B—TIMING.
SYNC. control—Maximum clockwise.
FREQ. control—Approximately 8.
VERTICAL GAIN—Maximum clockwise.
SYNC. switch—EXT.
HORIZONTAL GAIN—Approximately 4.

Two separate, distinct, and similar waves should now appear on the screen. If only one wave appears, increase the "Freq." control on the Oscillograph to obtain two waves. These waves will be identical in shape, totally disconnected, and appear in reversed positions. They will have a common base line which is discontinuous. Adjust the "Freq." and "Sync." controls of the Oscillograph to make them remain motionless on the screen. Turning the Test Oscillator dial slightly should cause them to move back and forth across the screen. However, before making any alignment adjustments, the Test Oscillator dial must be adjusted to the specified alignment frequency.

The circuit being aligned (to which the Test Oscillator output was originally connected) must now have its trimmers or magnetite cores adjusted so that the two waves on the Oscillograph screen coincide throughout and have maximum amplitude.

In most receivers, the trimmer which tunes the local oscillator for the high-frequency band (usually around 12,000 kc and higher) has sufficient capacity to tune it over a rather wide range of frequencies. The **RCA Stock No. 150 Test Oscillator**, because of its beat-frequency principle, produces on the two high-frequency bands (frequencies from 7,000 kc to 32,000 kc) the frequency to which the dial is calibrated and also another frequency 1,600 kc lower. Thus, it is sometimes possible to produce the desired resonance curve on the screen at four different settings of the receiver's local-oscillator trimmer. Two of these points represent the correct tuning, and the image, for the frequency of the Test Oscillator shown on its dial. The other two represent the correct tuning, and the image, for the additional frequency coming from the Test Oscillator which is 1,600 kc lower than the one shown on its dial. When this condition exists, the local-oscillator trimmer in the receiver must be set to one of the two highest frequencies. If the alignment information specifies adjustment to the highest-frequency (minimum-capacity) peak, use the highest-frequency peak obtainable on the trimmer. If it specifies adjustment to the lowest-frequency (maximum-capacity) peak, use the peak next lower in frequency to the highest-frequency one obtainable. This is the correct procedure in all cases where the intermediate frequency used in the receiver is less than 800 kc, and when the fundamental (not a harmonic) frequency delivered by the Test Oscillator is being used.

When using this Test Oscillator it is important to keep its output controls at the lowest possible setting in order to avoid unwanted beat notes and harmonics which may otherwise be present.

"CONDENSED ALIGNMENT PROCEDURE"

Model 150 — Electronic Sweep Oscillator.

Adjustment of Fixed Frequency Oscillator - The 6F7 oscillator stage must be adjusted to operate exactly at 800 KC in all positions of the "CW-AMP-FREQ." switch.

(1) Adjust tap of resistor R-10 to give 2.75 volts between the cathode of the Frequency Control tube (6C6) and ground.

(2) Advance "Range KC" Control to #6 position and set variable capacitor to its minimum capacitance position (full out of mesh).

(3) Tune in the 8th harmonic (800 KC) of an RCA Stock #9572 Crystal Calibrator on a broadcast receiver.

(4) Connect the test oscillator output to receiver antenna-ground terminals.

(5) Set oscillator "Modulation" Control on "FREQ". and reduce the "Sweep KC" (R-1) Control to its zero position or turned completely counter-clockwise.

(6) Adjust trimmer C-28 to produce zero beat signal in receiver output.

(7) Without otherwise disturbing oscillator or receiver, shift "Modulation" Control to "CW", and adjust compensating capacitor C-17 to restore the zero beat. If proper zero beat adjustment is not within the range of C-17, it will be necessary to slightly re-adjust the bias resistor R-10 - see (1). If zero beat requires less indicated capacitance in C-17, then the bias voltage should be increased slightly. If more indicated capacitance is required on C-17, the bias voltage must be decreased slightly. The alignment steps (2), (3), (4), (5), (6) and (7) must then be repeated.

Adjustment of Variable Frequency Oscillator - Trimmers are provided in the variable oscillator circuits for alignment at the high frequency end of each tuning range. These must be properly adjusted in respect to frequency and correct dial setting. The following procedure will establish correct alignment of the variable oscillator at the proper points; while the 800 KC oscillator is kept in-operative so as to avoid beat signals and harmonics that may be confusing otherwise. The oscillator and crystal calibrator must be operating into a receiver which will tune to 1100 KC, 1800 KC, 3300 KC, 7800 KC, 13000 KC, and 31000 KC.

(1) Adjust the dial so that the index mark is exactly opposite the continuous radial line at the low frequency end of the scales when the capacitor is in full mesh.

(2) Ground the top control grid of the 6A7 variable oscillator. This removes the 800 KC signal from the Mixer Stage leaving only the variable oscillator signal in the output.

(3) Band #1 - Tune the receiver to the 11th harmonic of the Crystal Calibrator at 1100 KC. Set the oscillator to the 300 KC dial reading. Adjust trimmer C-36 to produce zero beat.

(4) Band #2 - Tune the receiver to the 18th harmonic of the Crystal Calibrator at 1800 KC. Set the oscillator to a reading of 1000 KC. Adjust trimmer C-35 to give zero beat.

(5) Band #3 - Tune the receiver to the 33rd harmonic of the Crystal Calibrator at 3300 KC. Set the oscillator to 2500 KC on the dial. Adjust trimmer C-34 to give zero beat.

(6) Band #4 - Tune the receiver to the 78th harmonic of the Crystal Calibrator at 7800 KC. Set the oscillator to 7000 KC on the dial. Adjust C-33 to give zero beat.

(7) Band #5 - Tune the receiver to the 13th harmonic of the Crystal Calibrator at 13,000 KC. Set the oscillator to 13,800 KC on the dial. Adjust C-32 to give zero beat.

(8) Band #6 - Tune the receiver to the 31st harmonic of the Crystal Calibrator at 31,000 KC. Set the oscillator to 31,800 KC on the dial. Adjust C-31 to give zero beat.

Adjustment of Sweep Control - The bias adjustment R-10 determines the symmetry of frequency sweep and also affects the tuning of the 800 KC fixed frequency oscillator. The correct setting of this adjustment is to a value of 2.75 volts, however, due to slight variations in characteristics of the 6C6 tubes a slightly lower or higher value may be required to give:- (a) equal range of sweep above and below the normal frequency, and (b) proper control range for capacitor C-17.

Check of the symmetry can be made by placing the Oscillator in operation at 580 KC (or some other frequency where the receiver dial is graduated in 5 KC. markings) with "Modulation" in the "Freq." position. The signal should be tuned on a broadcast receiver with an oscillograph connected and adjusted to show the typical forward and reverse curves. Tuning the receiver above and below 580 KC will cause the curves to disappear or merge into a straight horizontal line. The points on the receiver dial at which the curve disappears should be at approximate equal KC. from the 580 KC reference point. If seriously poor symmetry is indicated, R-10 should be readjusted, and if necessary, exchange the 6C6 Frequency Control tube. If R-10 is varied, it is imperative to re-check the alignment of the Fixed Frequency Oscillator as in A.