# RCC TELEVISION Service Manual

PUBLISHED BY RADIO COLLEGE OF CANADA, TORONTO

## 1957 Supplement No. 24



## INDEX

### ADMIRAL



### CANADIAN GENERAL ELECTRIC



### ELECTROHOME



### FLEETWOOD



### HALLICRAFTERS



### RCA-VICTOR



### SIMPSONS-SEARS



### SPARTON



### VIKING



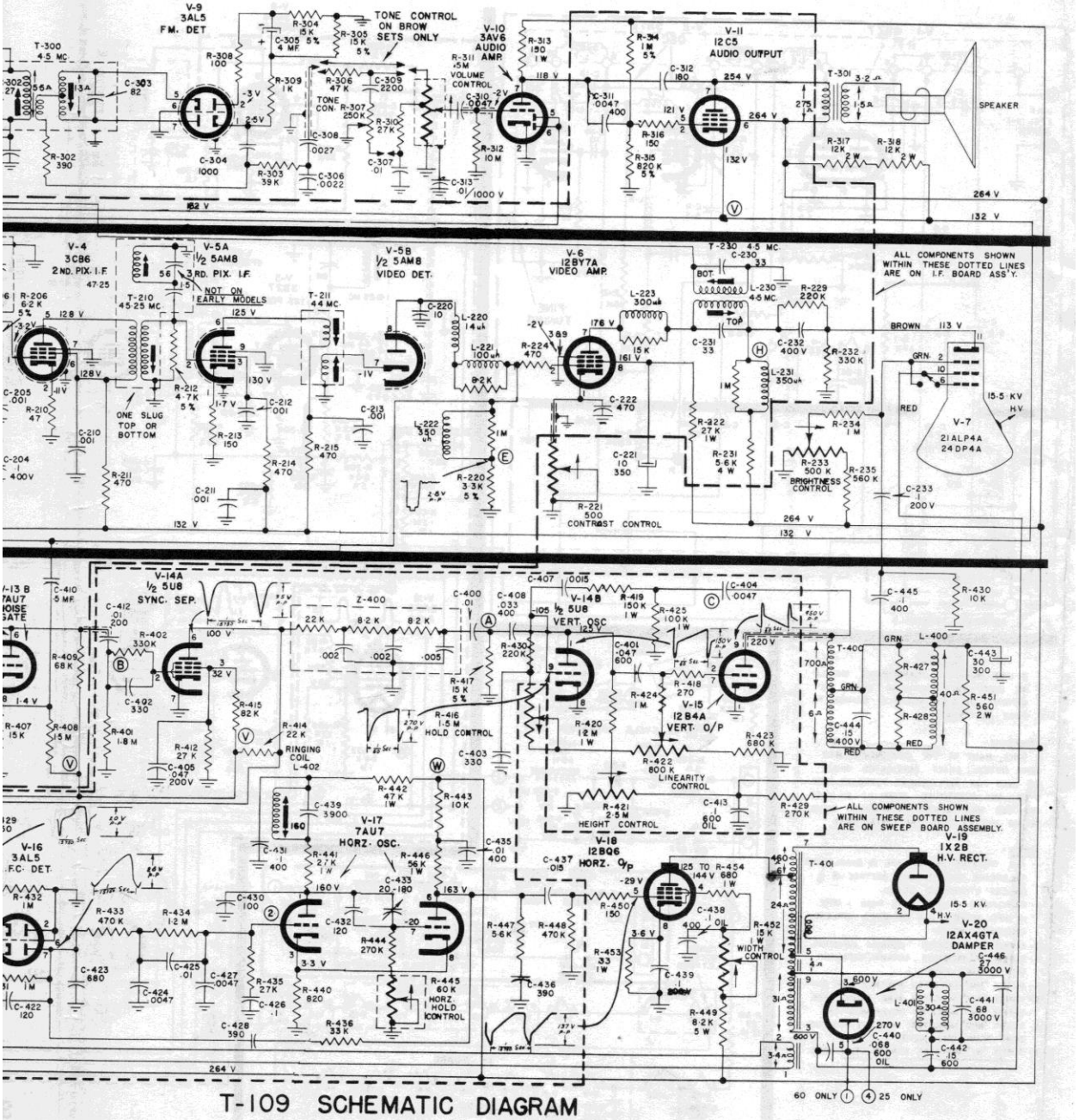
### WESTINGHOUSE



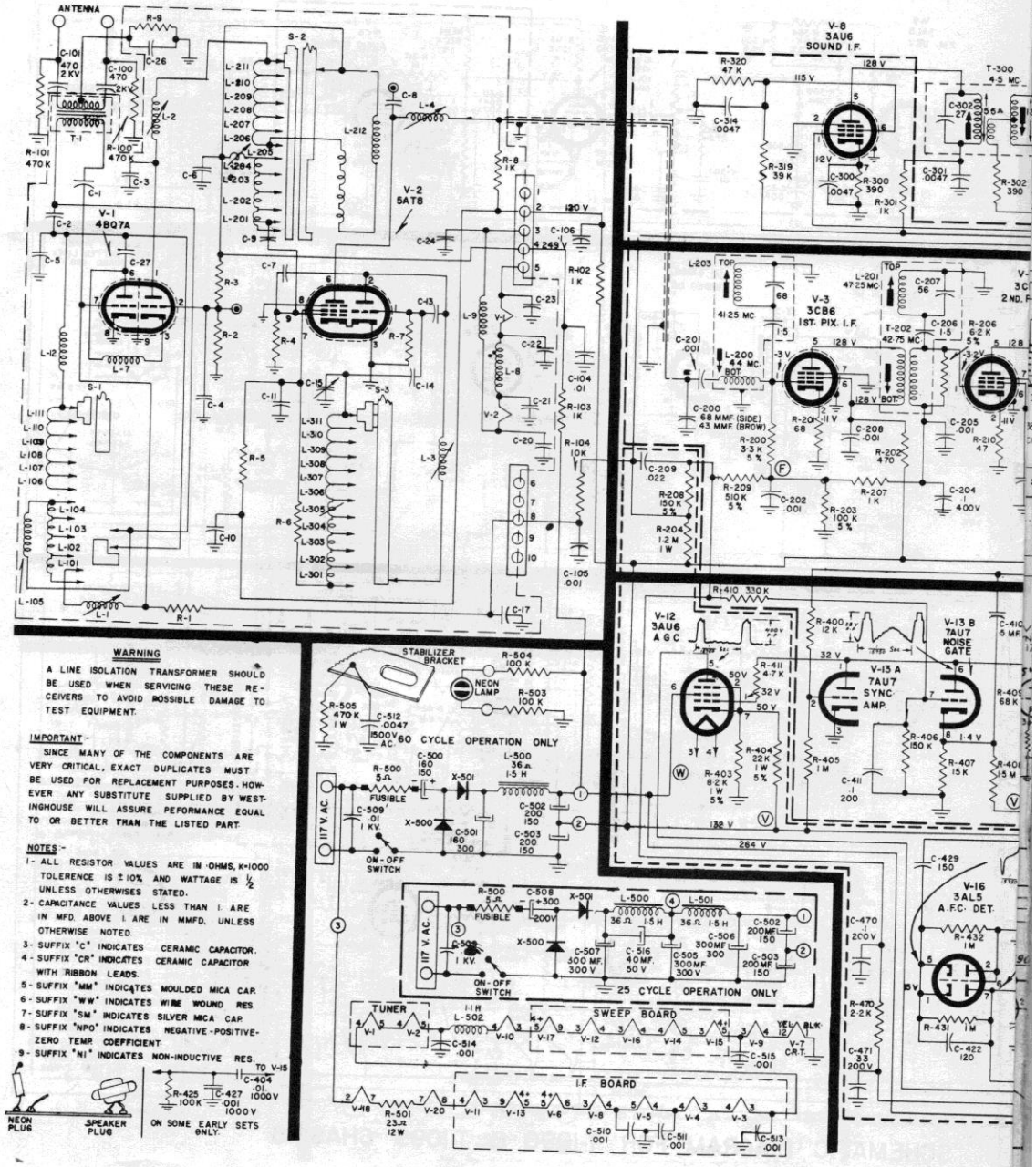
**RCC TELEVISION Supplement No. 24**

# WESTINGHOUSE
## T-109






T-109 SCHEMATIC DIAGRAM




**WARNING**

A LINE ISOLATION TRANSFORMER SHOULD BE USED WHEN SERVICING THESE RECEIVERS TO AVOID POSSIBLE DAMAGE TO TEST EQUIPMENT.

**IMPORTANT** -

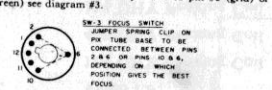
SINCE MANY OF THE COMPONENTS ARE VERY CRITICAL, EXACT DUPLICATES MUST BE USED FOR REPLACEMENT PURPOSES. HOWEVER ANY SUBSTITUTE SUPPLIED BY WESTINGHOUSE WILL ASSURE PEFORMANCE EQUAL TO OR BETTER THAN THE LISTED PART.

**NOTES** -

1- ALL RESISTOR VALUES ARE IN OHMS, K=1000 TOLERENCE IS ± 10% AND WATTAGE IS ½ UNLESS OTHERWISES STATED.
2- CAPACITANCE VALUES LESS THAN 1. ARE IN MFD. ABOVE 1. ARE IN MMFD. UNLESS OTHERWISE NOTED.
3- SUFFIX "C" INDICATES CERAMIC CAPACITOR.
4- SUFFIX "CR" INDICATES CERAMIC CAPACITOR WITH RIBBON LEADS.
5- SUFFIX "MM" INDICATES MOULDED MICA CAP.
6- SUFFIX "WW" INDICATES WIRE WOUND RES.
7- SUFFIX "SM" INDICATES SILVER MICA CAP.
8- SUFFIX "NPO" INDICATES NEGATIVE-POSITIVE-ZERO TEMP. COEFFICIENT.
9- SUFFIX "NI" INDICATES NON-INDUCTIVE RES.

## FOCUS

The focus control is a spring clip on the C. R. Tube base. Two positions are available. Pin #10 is the focus electrode and the spring clip can be connected from pin #10 to pin #2 (grid) or pin #6 (screen) see diagram #3.




## HORIZONTAL RINGING COIL

If the horizontal noise immunity is poor and/or the horizontal oscillator has a tendency to hunt (as evidence by a sine wave appearance of vertical lines, particularly at the top of the picture, the ringing coil L402 requires adjustment.

The procedure is as follows:

1. Short out the ringing coil with a short jumper wire.
2. Set the horizontal hold control in the center of its range.
3. Short out the A.F.C. voltage, pin #2 of horizontal oscillator to ground.
4. Tune in a fairly weak transmitted signal and adjust C433 until a picture just floats back and forth across the screen.
5. Remove short from across ringing coil L402 and adjust L402 until picture again just floats across screen. If two peaks occur, use slug position closest to bottom of coil.
6. Remove short from pin #2 of osc. and ground.
7. Check adjustment by switching to another channel and then back again. The receiver should pull into horizontal synchronization instantly.

NOTE: The ringing coil should always be adjusted for maximum stability as outlined above. It is never used as a means of adjusting the range of the horizontal hold control.

# FEATURES AND CIRCUIT DESCRIPTIONS

## PRINTED WIRING PLATE

**General Description:**

The major difference between conventionally wired circuits and the same circuits adapted to printed wiring is in the actual wiring disposition itself.

The printed wiring plate is a one unit assembly with the components mounted on one side and the printed wiring on the other. Convenient test points accessible from the under-side are located throughout, lettered from Ⓐ to Ⓦ and are shown on the accompanying schematic.

Because of the geometrical placement of all components and wiring, the usual lead dress and stray capacity factors are thereby held to a fixed tolerance, and for all practical purposes are non-existent as far as the technician is concerned.

Only a slight divergence from usual repair practices will be necessary.

**Component Removal:**

To remove a defective resistor or capacitor, first clip the pigtail leads close to the body of the component, thus leaving two stubs of wire protruding through the plate. These stubs should be used as junction points for the new component.

**Component Replacement:**

To install the new component, first clip the pigtail leads to the desired size, allowing sufficient length to make eyelets at the end of each pigtail. When the eyelets are made, insert over the stubs remaining from the defective component. Crimp securely and solder, using a small clean iron with a good grade of rosin core string solder. Care must be exercised not to overheat, otherwise crystalization of the junction point between the bottom end of the stub and the printed wiring will inevitably result. In some instances where the replacement of a component is made difficult due to the close proximity of the picture tube, it is quite permissable to insert the component on the under side of the printed wiring plate.

**Removal of Tube Sockets:**

The conventional tube socket pins have been replaced in the printed wiring circuit by special spring clips. These spring clips provide both mechanical support and electrical contact.

When removal of a socket is planned each spring clip should be freed independently by melting the solder at the point of contact between the printed wiring board and each spring clip. Use a fine brush to whisk away the surplus molten solder until the spring clip is freed. After each spring clip has been treated in this manner, the socket may be slipped free of the board by applying slight pressure upon the bottom side of the tube socket.

**Warning:**

The bond of metal foil is affected by excessive heating and repeated high temperature heating will create a destructive reaction that ultimately will destroy the bond between the laminated plate and the printed wiring entirely. Destruction of the bond appears only in extreme cases of repeated abuse, therefore extreme caution is recommended in order to prevent unnecessary damage. A good safety feature is to use the very lightest of soldering irons with just enough heat transferred to the wiring plate to melt the solder, and no more.

## THE NOISE GATE

The function of the noise gate circuit is to cancel all noise pulses in excess of the sync pulse tips that would normally cause premature triggering of the sweep oscillators.

V13B (½ 7AU7) performs this function, and its circuit action may be described as follows:

The Sync Amplifier (V13A) and the Noise Gate are connected in shunt through a common plate load resistor R409. Positive going sync pulses are capacity coupled to the grid of the Sync Separator (V14A) and direct coupled to the grid of the Keyed AGC tube (V-12). In the absence of noise pulses, the bias on the Noise Gate is such that it cannot conduct, and the sync information is permitted to pass on to the V12 and V14A intact.

This is accomplished by applying a fixed bias to the cathode, pin No. 8, from the 125 v. line through R408. However, that in itself is inadequate as the bias must be such that it adjusts itself automatically to any variations in signal strength, otherwise clipping would occur when the amplitude of the sync pulses increased, therefore an additional source of bias is needed that will vary in proportion to signal strength. AGC voltage serves this purpose well and is coupled directly to the grid, pin #7, via R410.

The bias is now such that the tube would normally remain at cut-off even on extreme noise pulses, therefore negative going sync information dervied from the detector load resistor is coupled to the cathode, pin #8, via C410. Under these conditions the tube is on the verge of conducting should a noise pulse exceed the sync pulse tips.

In the presence of a noise pulse, V13B will conduct. Because the noise pulse is negative going and is applied to the cathode of V13B, it will also be negative going in the plate circuit, which is what is required to cancel out its counterpart — the positive going portion that was developed in the output of the Sync. Amplifier.

Under these conditions, the input to the Sync. Separator and Keyed AGC will be relatively noise free and the AGC voltage developed will not be "set up" on noise as would normally be the case.

Secondly, during a noise pulse the cathode circuit of the Noise Gate acts as a shunt across the detector load resistor R220, thereby reducing the amplitude of the noise pulse fed to the Video Amplifier.

## AGC

The Automatic Gain Control System employs a conventional Keying Tube in conjunction with a Clamping Diode.

The operating of the Keying Tube (V12) will be omitted, as it has been covered thoroughly in RS-284, RS-289 and RS-293, however, the AGC distribution and the function of the Clamping Diode will be enlarged upon with the aid of the accompanying sketch. See Fig. No. 4.

The AGC voltage that is applied to the I.F. grids is developed across R203 (part of the divider network R209 and R203) and is a measure of the total AGC voltage developed by the Keying Tube (V12) at point "A". As the voltage at point "A" varies in proportion to signal strength, the gain of the I.F.'s will be made to vary correspondingly so that the output of the video detector will remain fairly constant.

In the early stages of signal amplification it is very important to keep the amplitude of the input signal high in comparison to the inherent circuit noise, therefore the AGC voltage to the R.F. amplifier is delayed a pre-determined amount by the application of a Clamping Diode. This delay will ensure that the R.F. amplifier is made to operate at its maximum permissiable gain, thereby maintaining a high signal to noise ratio.

The Clamping Diode consists of pins No. 5 and No. 6 of V10 (3AV6). To the plate, pin No. 6 are coupled two sources of voltage, (a) the AGC voltage developed by V12 via R208 and (b) a fixed value of B+ from the 125 volt line via R204. The grid of the R.F. amp ties back to pin No. 6 via R104. The values of R204 and R208 are so chosen as to maintain the diode at low impedance which in turn will keep the R.F. amp. grid at zero potential until the input signal reaches the prescribed level, at which point the R.F. bias will rise sharply to prevent the I.F.'s from being overloaded.

On a relatively weak signal input, the B+ effectively exceeds the AGC voltage at pin No. 6. The diode will conduct and due to its low internal resistance in comparison to the high resistance of R204, zero voltage will be applied to the R.F. amplifier grid over a considerable portion of its operating range.

As the input signal strength increases, a point is eventually reached where the corresponding AGC voltage developed exceeds the B+ at pin No. 6. The diode will cease to conduct and the voltage applied to the R.F. amplifier grid will swing negative, thereafter rising very sharply with any further increases in signal strength.

It becomes apparent that the AGC voltage to the I.F. grids will rise at a uniform rate, whereas the AGC voltage to the R.F. amplifier grid will then remain zero for weak and medium input signals and will rise sharply after the point is reached where the diode ceases to conduct. The cross-over point occurs at approximately −3 volts.

The circuit action is graphically illustrated in Fig. No. 4A.

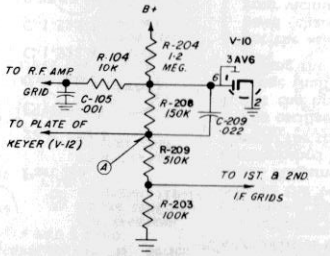



Fig. No. 4

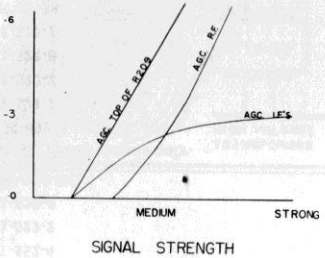



Fig. No. 4-A

## VERTICAL OSCILLATOR AND OUTPUT STAGE

This circuit is basically a plate to grid feedback multivibrator in which the signal developed by the output of the second tube is coupled to the input of the first tube and vice versa. Such an arrangement is self-oscillating because each tube inverts the signal 180°, thereby causing the input signal to the accompanying tube to be of the correct polarity to sustain oscillation.

The circuit operation can be better understood if it is broken down into the following groups of components. Refer to V14B and V15.

(a) The frequency determining components are C408-R430 and R416.
(b) The wave shaping components are C408-R417-R420 and R421.
(c) The feedback circuit consists of C404, R425, R419 and C407.

During the trace interval, V14B is held at cut-off and C408 is allowed to charge up to B+ potential via R421 and R420. V14B is maintained at cut-off due to the large negative voltage present at the grid which was acquired during the previous cycle. The charging of C408 will produce a positive going sawtooth pulse at the plate of V14B which is coupled to the grid of V15 via C401. During this interval, V15 conducts and produces the vertical trace on the screen.

The negative voltage present at the grid of V14B eventually leaks off to ground via R430, R416, R422 and R423. At a predetermined interval, depending on the setting of R416 this voltage will decrease to the point where V14B cannot be held at cut-off any longer. This condition occurs at retrace.

During the retrace interval, V14B conducts heavily, thereby providing a low impedance path to ground for the discharge of C408. As a result, a sharp negative going pulse is developed in the plate circuit of V14B, which in turn is coupled to the grid of V15, driving V15 to cut-off momentarily.

Due to inversion, a positive going pulse will appear in the plate circuit of V15 which is fed back to the grid of V14B via the feedback network. The presence of a positive pulse at the grid of V14B will cause the grid to draw current and charge the grid side of C407 to a high negative value, cutting V14B off.

C408 is now ready to assume a new charge and repeat another cycle of operation.

In effect, V15 performs two functions. First, it completes the oscillator circuit, and secondly, it acts as its own output stage in that the sawtooth voltage is amplified to a sufficient degree. Linearity is controlled by changing the bias on V15.

Synchronization is accomplished by feeding a negative sync pulse via C400 effectively to the grid of V15. After inversion in V15 it will be of the correct polarity to trigger 14B into conduction at the retrace interval.

A negative going pulse of the correct amplitude and shape is taken from the lower half of T-400, and coupled to the picture tube grid via C445 and C233. The CRT beam is thereby cut off during the retrace interval.

## HORIZONTAL AFC

The function of the AFC circuit is to develop a D.C. correction voltage that will control the frequency of the horizontal multivibrator. This voltage must be an exact measure of the phase difference between the incoming horizontal sync pulses and the horizontal sweep pulses.

V-16 (3AL5) the AFC tube, consists of two diodes coupled in series opposing. Negative going sync pulses are applied to the two cathodes via C429. A comparison sawtooth voltage derived from the output of the horizontal multivibrator is applied to plate pin No. 7 via C428 and effectively to plate pin No. 2.

When the sync pulses are in phase with the feedback voltage, both diodes conduct equally and the D.C. voltages developed across their individual load resistors R431 and R432 are equal and cancel out. Zero correction voltage is applied to pin No. 2 of the horizontal multivibrator.

When the feedback voltage either leads or lags the sync pulses, one diode will conduct more than the other, resulting in a D.C. correction voltage that will be either positive or negative depending on which diode is conduction the most. This D.C. voltage is applied to pin No. 2 of the horizontal multivibrator and will cause it to either speed up or slow down as the case may be, thereby restoring the original in-phase condition.

The manner in which this is accomplished is as follows. The sawtooth feedback voltage can in a sense be compared to an ordinary sine wave in that it will vary an equal amount in the positive and negative direction, and will go through zero value during each cycle.

If the sync pulses are applied at the instant the feedback voltage is going through zero, both diodes will conduct equally, the feedback voltage having no influence on either diode. Pin No. 5 will be positive in respect to ground and pin No. 7 will be negative by an equal amount in respect to pin No. 5. The resultant voltage between pin No. 7 and ground will therefore be zero.

If the phase of the horizontal oscillator shifts in respect to the sync pulses, the sync pulses will then be occurring at a time when the feedback voltage is going through a positive or negative portion of its cycle.

If this should occur when the feedback voltage is going through part of its positive cycle, the bottom diode (Pins No. 1 to No. 7) will conduct more than the top diode (pin No. 5 to No. 2), and as a result, the voltage between pin No. 7 and ground will be negative.

The opposite is true if this occurs during the time the feedback voltage is going through part of its negative cycle. The bottom diode (pin No. 1 to No. 7) conducts less than the top diode (pin No. 5 to No. 2) and the voltage between pin No. 7 and ground will be positive.

Because the output of V-16 is a pulsating D.C., it must be smoothed before it can be applied to the control grid of the horizontal oscillator, otherwise the horizontal oscillator would have a tendency to hunt above and below the correct frequency with changes in correction voltage. This is due to the fact that all AFC circuits are in principal inverse feedback networks, and therefore some damping must be employed to overcome this undesirable effect.

A long time constant circuit consisting of C423, R433, C424, R434, C425, C427, C426, R435, is incorporated for this purpose, thus giving partial immunity to random noise pulses as well as being a preventive measure against hunting.

## SOUND I.F. AND DETECTOR

Sound is taken off in the plate circuit of the video amplifier and transformer coupled to the grid of V8 (3AU6), the sound I.F. limiter. V8 is operated Class A with fairly low plate and screen voltages so that limiting will occur on extreme positive and negative swings of the input signal, thereby keeping the input to the ratio detector relatively amplitude and noise free.

The two diodes of the ratio detector (V9) are connected in series aiding across load resistors R304 and R305.

To the input, pins No. 5 and No. 7 are applied two signals of the same frequency. One being in phase to both diodes, the other 180° out of phase to the diodes.

The output is taken off effectively across the lower diode.

Before the FM signal may be detected, it is first converted into two signals that will vary in amplitude and phase with changes of frequency when combined. T300 performs this function. A voltage that is always in phase with the primary is inductively coupled over to the centre tap of the secondary by the winding directly positioned under the primary. A second voltage that is 90° out of phase with the primary at resonance, is induced into the secondary by the primary winding.

Reactances cancel at resonance in a series circuit. If the frequency deviates to either side of resonance, the circuit becomes either inductive or capacitive, therefore the phase shift will be greater or less than 90°.

These two voltages will add and subtract vectorially, depending on the phase relationships that exist at any one time or frequency.

At resonance, the two input voltages to each diode will be equal and 90° out of phase with each other. Both diodes will conduct equally, therefore the D.C. voltage drops across both diodes will be equal and no audio component will be developed.

Should the frequency deviate to either side of resonance, the phase relationship between the two input voltages changes to the extent that the voltages to one diode will be more in phase than the voltages to the other, causing one diode to conduct more than the other. The D.C. voltage drops across each diode will be in proportion to how much each diode is conducting.

Assuming the lower diode is conducting the most, the D.C. voltage drop across it will be small, whereas the D.C. voltage drop across the upper diode will be large, as a result a positive going audio component will be developed. When the upper diode conducts the most, the opposite will be true.

The greater the deviation, the greater the phase shift, the more audio signal that will be developed.

Below are shown the phase relationships that exist at, above and below resonance. See Fig. No. 5.

C305 and R304, and R305 form a long time constant. C305 being a short circuit to R.F. and A.F. frequencies, therefore a ratio detector is not usually sensitive to amplitude modulation caused by noise, etc.

C306 and R303 form a de-emphasis network to restore the high frequency components of the audio signal to normal.

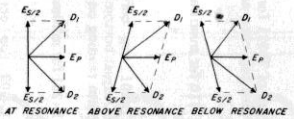



Fig. No. 5

## TUNER

The antenna input circuit is a constant 300 ohm balanced type.

The tuner itself is semi-incremental, having fixed coils and a selector switch type of construction. Channels are selected by mechanically shorting out a pre-determined portion of the coils in the R.F. and oscillator sections. It is only on Channel No. 2 that all the coils are utilized and as a higher channel is selected, a greater portion of the R.F. and oscillator coils will be shorted out.

The R.F. amplifier is a 4BQ7A dual-triode connected in "Cascode," the plate of the 1st triode being coupled directly to the cathode of the 2nd triode. The grid of the 2nd triode is held at ground potential for R.F. by the 470 mmf. capacitor connected from grid to ground. This arrangement has the low noise characteristics of a triode plus the effective high gain of a pentode, with variable MU characteristics thereby minimizing cross modulation at high signal levels.

The oscillator-mixer is a 5AT8, the pentode serving as the R.F. oscillator, and the triode as the mixer. A small variable capacitor in the tank circuit of the oscillator serves as the fine tuning control. Oscillator injection voltage is capacity coupled to the grid of the mixer.

The mixer output is bottom-capacity coupled to the grid of the first I.F., thereby reducing R.F. radiation into the I.F. strip.

The tuner used is an Sarkes-Tarzian cascode using a pentode mixer. A 4BQ7A is the R.F. amplifier and a 5AT8 is used with its pentode section as a mixer and its triode section as an R.F. oscillator. The use of a pentode mixer results in a noticable improvement in conversion gain with a negligible increase in noise.

Overcoupling in the mixer grid circuit is used only on the low band, 2-6 rather than on all bands as in previous tuners. Satisfactory band pass can be obtained from 7-13 with only a single tuned coil, thus simplifying the circuiting. The tuner output is coupled to the I.F. input by bottom C coupling (C200). Both tuner output coil L4 and I.F. input coil L200 are peaked to about 44 mcs. L200 is more broadly resonant than L4 and this combination results in having very good control over positioning picture and sound carriers. The value of C200, in combination with the capacitance of the shielded coupling cable (about 32 mmfd.) is the principle factor in determining the band-width of this circuit and its value is very critical. R200 is the loading resistor for L200. C201 is only a D.C. blocking capacitor and its value is not critical.

## VIDEO I.F. AMPLIFIER

This receiver uses a 3 stage 44 mcs. I.F. with a 3.8 mcs. bandwidth at the 50% point on the curve. The construction of the I.F. strip on a printed wiring board results in very good uniformity. The plate circuits of the first and second stages are stagger tuned bifilar wound coils. The last stage is overcoupled to take advantage of the broadening loading effects of the second detector.

Two traps, one each for adjacent — and accompanying — channel sound frequencies, are capacitive coupled to the grids of the first and second stages respectively. The values of the trap coupling capacitors are quite critical. A value too high will broaden the trap response, thus affecting the curve skirts, a value too low will result in too little attenuation at the trap frequency.

## AUDIO OUTPUT

Preceded by a driver stage, a stacked type audio output is employed, the cathode supplying B+ voltages to numerous other circuits. Some voltage regulation is thereby achieved.

Negative feedback is used to improve the quality of the audio signal.

# ALIGNMENT

## TEST EQUIPMENT

To service these chassis, the following test equipment should be available.

1. An R.F. sweep generator that is capable of producing a 10 mc. sweep at centre frequencies ranging from approximately 4.5 to 230 mcs. The output must be adjustable from at least 100,000 microvolts to a very low minimum, and must be flat at all positions of the attenuator.

2. A cathode ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low capacity input probe. The oscilloscope should have good low and high frequency characteristics.

3. If no provisions are available in the sweep generator for marker frequencies, an additional piece of equipment will be needed in the way of an R.F. signal generator. It must be capable of producing accurate unmodulated signal frequencies between 4.5 and 50 mc. and all picture and sound R.F. frequencies. Provisions for AM and FM modulation of the signal should be included. The accuracy of these frequencies is very important. If the signal generator does not include a crystal calibrator, a heterodyne frequency meter equipped with a crystal calibrator should be used to insure accuracy. The output level must be adjustable from at least 100,000 microvolts down to a very low minimum.

4. A vacuum tube voltmeter equipped with a high voltage probe for measurements up to 20,000 volts and an auxiliary R.F. probe for measuring R.F. voltages.

## GENERAL INFORMATION

The chassis and the test equipment should be bonded together by short lengths of heavy braided copper ribbon, and all interconnecting leads should be shielded and should be as short as possible consistent with ease in making connections. The effectiveness of the bonding can be checked during alignment by placing the hand on the chassis or test equipment. If the response curve or meter reading changes, the bonding must be improved before the circuits are aligned.

It is important that the coaxial cable used to couple the sweep generator output to the receiver be terminated at its output end in the characteristic impedance of the sweep generator output circuit. To accomplish this, connect the appropriate value of resistance across the output leads at the open end of the cable. See figures No. 11 and No. 12.

The oscilloscope vertical input cable and the generator input cables must be well separated from each other. The alignment equipment may be hooked up as shown in Fig. No. 12.

## R.F. OSCILLATOR ALIGNMENT PROCEDURE

If the 5AT8 R.F. oscillator tube is replaced, the different interelectrode capacitance of the new tube may change the oscillator frequency enough to necessitate re-alignment of the oscillator.

Alignment of the oscillator is accomplished by adjustment of the two brass slugs located adjacent to the vernier drive wheel of the fine tuning control on the front of the tuner.

A non-metallic screw driver should be used to make these adjustments, the procedure being as follows:

1. Set the fine tuning control at the middle of its range (half-capacity).

2. Set the channel selector to the highest of the low band (channels 2 through 6) stations operating in your vicinity.

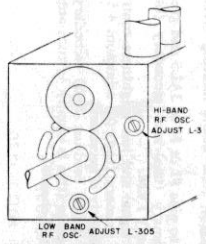
3. Peak the lower adjustment slug (L305) for the best picture detail.

4. Set the channel selector to the highest of the high band (channels 7 through 13) stations operating in your vicinity.

5. Peak the upper adjustment slug (L-3 for best picture detail.

6. Check the previously made low band adjustment, and if the tuning has changed, repeat steps 2 and 3.

The chassis does not have to be removed from the cabinet to make these adjustments.




TUNER ADJUSTMENTS

Fig. No. 6

# MISCELLANEOUS

## CATHODE RAY TUBE HANDLING

It is recommended that shatterproof goggles, heavy apron and heavy gloves should be worn at all times when handling the C. R. Tube. The tube should not be handled in the near vicinity of any person not so equipped.

The cathode ray tube, due to its large surface area and the high vacuum contained within, is subject to considerable air pressure. More than ordinary care should be taken to prevent shattering the tube. Never lift the tube by the neck, and when handling it, keep the viewing surface towards the body. The neck of the tube should not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during installation, **stop** and determine the cause of the trouble. **DO NOT FORCE THE TUBE.**

When returning picture tubes for credit or adjustment, do not mark the face or the aquadag coating with crayon, pencil or china marking pencil, as such marks may permanently deface the tube. Tubes so damaged are not subject to adjustment.

**NOTE:** The cathode ray tube is capable of retaining an electrical charge on anode No. 2 for a considerable length of time. Care should be taken to discharge the tube before handling.

## CRITICAL LEAD DRESS

1. When replacing parts in the R.F.-I.F. video circuits, care must be exercised that the replacement part is identically the same value, tolerance, physical size and dressed in exactly the same manner as the original component. All heater, B+, AGC leads must be kept as short as possible and dressed close to the chassis.

2. Video peaking coils should be dressed away from the chassis and clear of adjacent parts.

3. The shielded lead going from the mixer output to C201 must not be shortened or otherwise disturbed.

4. The spiral shield covering the lead going to the vertical output transformer must not be removed.

## TEST POINTS

Encircled letters on schematic indicate test points.

## D.C. VOLTAGE DATA

All D.C. voltages shown on the schematic were taken with a V.T.V.M. under the following conditions:

(a) All controls and adjustments set for normal receiver operation.
(b) Line voltage = 117 volts.
(c) Medium signal to give approximately —3V I.F. A.G.C.
(d) Beam current 200 uA.
(e) Contrast control 50 ohms above ground.
(f) All readings are subject ± 20% variation.

# ALIGNMENT

## SOUND I.F. ALIGNMENT

1. Set the contrast control at approximately the 50 ohm above ground point.
2. Inject 4.5 mcs. FM signal into grid of 3AU6 1st sound IF tube, pin #1.
3. Connect VTVM to pin #1 or #2 of 3AL5 and ground and adjust T300 primary (top) for maximum.
4. Connect VTVM to top of C306 and adjust T300 secondary (bottom) for centre zero.
5. Inject signal into junction of R224 and L221.
6. Use minimum signal (one below limiting level of 3AU6 limiter).
7. Connect VTVM to pins #1 or #2 of 3AL5 and ground.
8. Adjust L230 primary (top) and secondary (bottom) for maximum indication on VTVM.
9. Using strong air signal and low brightness control settings check tuning of T230 primary (top) for minimum 4.5 mcs. beat in picture. Readjust slightly if necessary.
10. Using weak air signal readjust T300 secondary (bottom) for minimum impulse noise (this is usually ¼ turn anti-clockwise viewed from underside of chassis).

## VIDEO I. F. ALIGNMENT PROCEDURE

**STEP**

1. With a short piece of Buss Wire short out the antenna input terminals.
2. Turn to channel #13.
3. Disable the Noise Gate (V13B) in one of three ways:
   (i) Connect a −12V bias battery to pin #7.
   (ii) Disconnect one end of C-410, .4 mfd.
   (iii) Use an old 7AU7 tube with the plate pin cut off.
4. Connect a −3V bias battery to the junction of R-200 and R-209 (F point on I.F. plate).
5. Connect a −1.5V bias battery to pin 5 and 6 of V-10 (AGC line).

**STEP**

6. Set the contrast control at approximately 50 ohms to ground.
7. Connect a scope through probe as shown in Fig. 10 across the diode load resistor R-220 (E point on I.F. plate to chassis ground), set to 3V peak-peak. Connect a VTVM across R-220, parallel to scope and set to −3V DC (USE CHASSIS GROUND — NOT PRINTED GROUND).
8. Couple a Marker Generator Output to the Sweep-Generator output so that the two signals are applied together for the procedure outlined in Step #9 and #15.
   Use the marker to check the response curve at the Frequencies indicated in Fig. 14.

   NOTE: For signal input use short leads and ground at center post of tube socket.

| STEP | GENERATOR SETUP | ADJUST |
|---|---|---|
| 9. | Set the sweep generator to 44 mcs. with 10 mcs. deviation, and couple to the 3rd I.F. Grid (Pin #2, V-5A). Adjust input to maintain an output of 3V Peak to Peak across Diode load. | Bottom core of T-211 for maximum response and top core as shown in Fig. 14A. |
| 10. | Set the R.F. signal generator to 45.25 mcs., couple to the 1st I.F. Grid Pin #1 of V-3 through the matching network as in Fig. 11. Adjust input to maintain output near −3V D.C. | Core of T-210 for maximum reading on VTVM. |
| 11. | Set the R.F. signal generator to 42.75 mcs., adjust input to maintain output near −3V D.C. | Detune T-201 top core counter-clockwise. Adjust bottom core T-202 for maximum reading on VTVM. |
| 12. | Set the R.F. signal generator to 47.25 mcs. Adjust input to maintain output approximately −3V D.C. | Top core L-201 for minimum reading on VTVM. |
| 13. | Set the R.F. signal generator to 44 mcs. Inject a signal through an isolated wire-loop attached to the matching network used above by inserting loop between bulb and shield of mixer tube (V-2). Adjust the input to maintain an output approximately −3V D.C. | Detune L-203 top core counter-clockwise. Adjust the bottom core of L-200 and core of L-4 on the tuner to read maximum on the VTVM. |
| 14. | Set the R.F. signal generator to 41.25 mcs. Adjust input to maintain an output near −3V D.C. | Adjust L-203 (top core) for minimum reading on the VTVM. |
| 15. | Remove buss wire from antenna terminal. Connect the sweep generator plus marker through a balanced matching network as shown in Fig. 13 to the antenna terminal. Set the sweep generator to 213 mcs. with a 10 mcs. deviation. Adjust input to maintain output of 3V peak-peak. | Readjust L-200 bottom core, L-4 core on tuner for curve as shown in Fig. 14D. |
| 16. | Set the sweep generator to different channels, also turn the channel selector to the same channel. | Check every channel for response to be within shaded area in Fig. 14D. If necessary, readjust L-200, L-4. |

NOTE: For viewing the reference responses Fig. 14B and C, the sweep generator set up as outlined in step 9 can be used, by connecting the sweep generator to the grid of the 2nd I.F. tube (Pin #1 of V-3) respectively. No readjustment should be necessary if alignment was followed carefully as outlined in steps 9 to 12 inclusive.

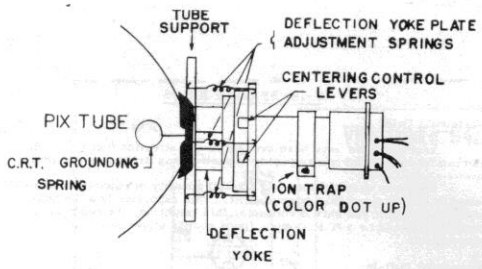
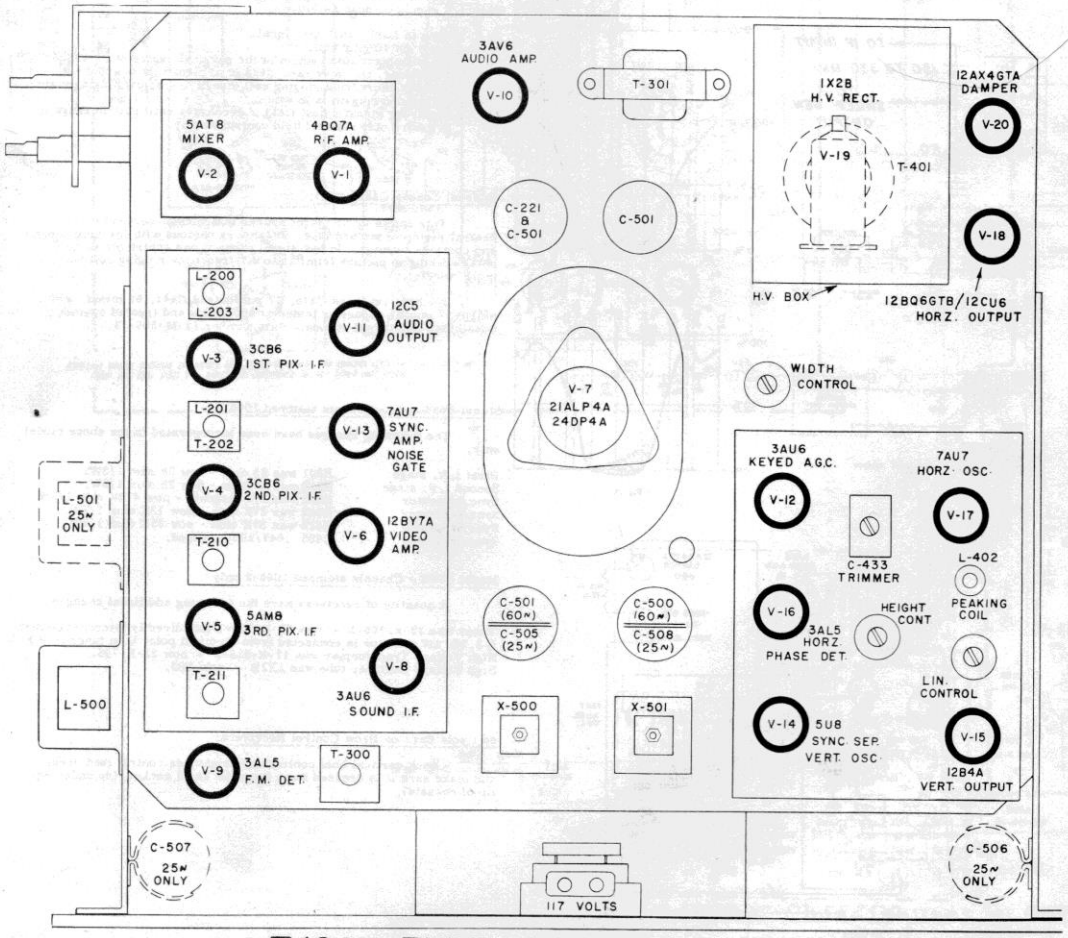



Fig. No. 2




T-109 TUBE LOCATION DIAGRAM

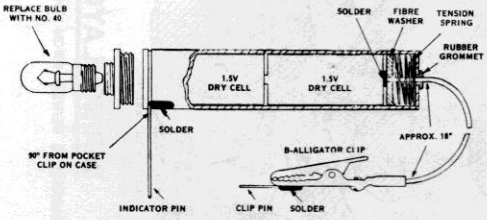
Fig. No. 1

## TROUBLE SHOOTING SERIES FILAMENT TUBES

In television receivers built with tube filaments connected in series, the same type of receiving tube failures may occur, as occur in receivers having their tube filaments connected in parallel operating from a filament transformer.

Defective tubes having such "troubles" as low emission, heater to cathode leakage, microphonism, etc., will produce the same symptoms in series connected tubes as in parallel tubes and the defective tube may be found in the same manner by observation of its effect on picture and/or sound.

However, in the event one tube filament opens in a series string, all tubes become inoperative and picture and sound disappear so a new approach must be found to locate the defective tube. Tube substitution is one way but a very long tedious task and unless the set is switched off after each new tube is tried, the technician is exposed to the hazard of shock from the chassis



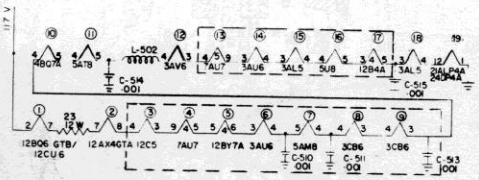

MODIFIED PEN LITE OR PENCIL LIGHT USED FOR CHECKING SERIES FILAMENT STRING

**Fig. 7**

The following information is given as a guide to solving this open filament problem easily. No A.C. power need be applied so no shock hazard exists and it is not necessary to have to wait for eash new tube to warm up, so the defective tube can be found in a matter of a few minutes.

Fig. #7 shows the construction of a modified pen light which can be used as an open filament tester. Of course, an ordinary ohmmeter can also be used if desired.

Figures #8 and 8A shows the filament wiring used in this chassis. Remove the line cord from the receiver and short across the 117v. line cord socket on the set. Remove V3, 3CB6 and use the test light or ohmmeter across filament connections 4 and 3. If you get continuity, V3 is the open filament, if not, a test from pin #3 of V3 or pin #4 of V3 to ground will isolate $\frac{1}{2}$ of the filament string. Whichever string does not show continuity it is quite easy to test from each filament connection to ground to isolate the open tube. It is not necessary to remove any tubes from the printed wiring plate because of the raised tube sockets employed. All tube socket pins are exposed for test purposes.

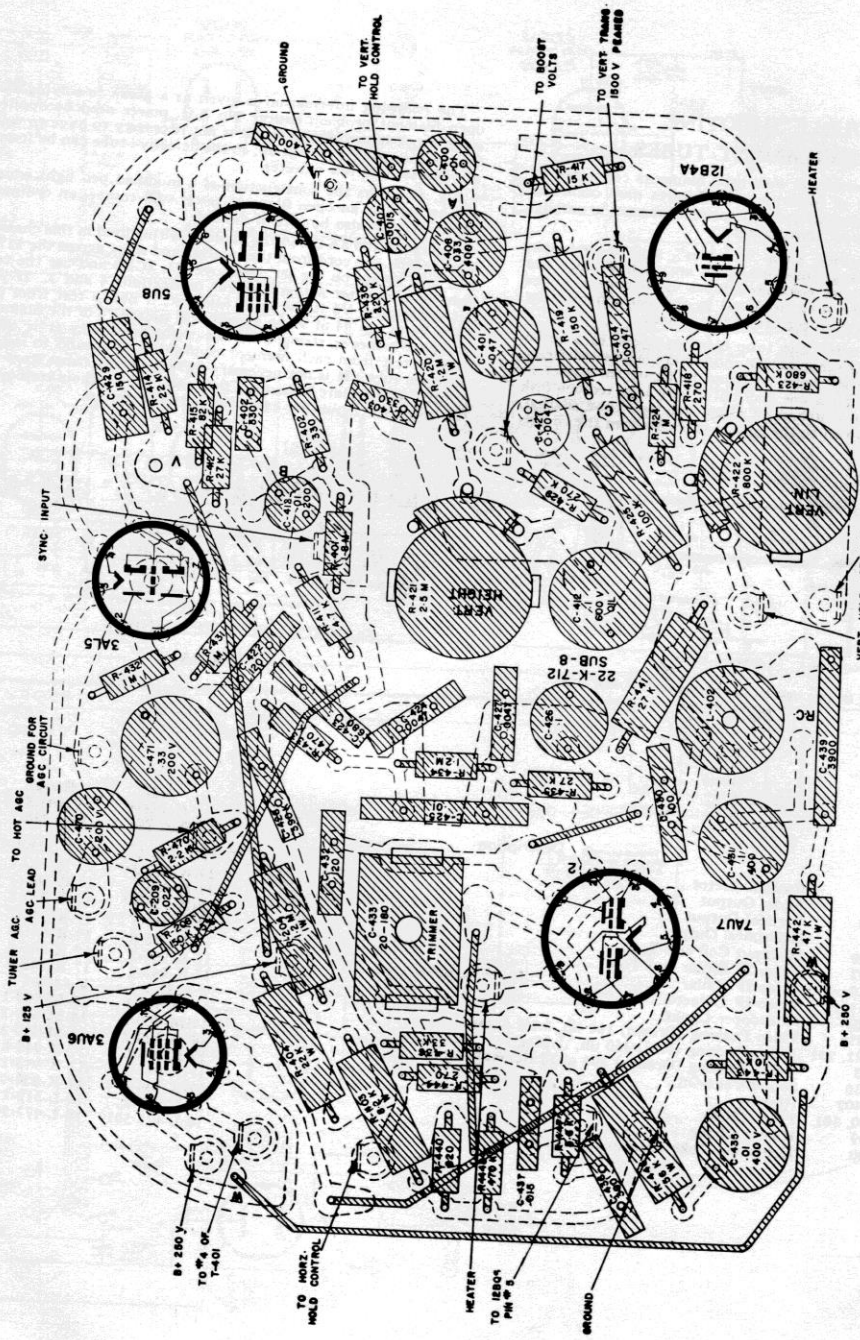



FILAMENT SEQUENCE (T-109)

**Fig. 8A**

| Code | Description | Side Control Part No. | Brow Control Part No. |
|---|---|---|---|
| T-300 | Ratio Detector | 18-L-523-1 | 18-L-523-1 |
| T-301 | Audio Output | 17-K-930-3 | 17-K-930-3 |
| T-400 | Vertical Output | 17-K-866-3 | 17-K-866-3 |
| T-401 | Horizontal Output | 17-K-936-2 | 17-K-936-2 |
| *L-200 | IF Input Coil and Trap | 17-K-945-7 | 17-K-945-7 |
| *L-202 | Video IF Bifilar and Trap | 17-K-945-8 | 17-K-945-8 |
| *L-210 | Video IF Bifilar | 17-K-945-2 | 17-K-945-2 |
| *L-211 | Video IF Detector | 17-K-945-9 | 17-K-945-9 |
| *L-220 | IF Stopper Choke | V-4886-1 | V-4886-1 |
| *L-221 | Video Peaking (Brown) 100 uh, 8.2K ohms | 14-M-500-1 | 14-M-500-1 |
| *L-222, 231 | Video Peaking (Red) 350 uh, .1 Meg | 14-M-500-2 | 14-M-500-2 |
| L-223 | Video Peaking (Orange) 300 uh, 15K ohms | 14-M-500-3 | 14-M-500-3 |
| *L-230 | Sound Take-Off | 17-K-945-6 | 17-K-945-6 |
| **L-402 | Ringing | 17-K-945-11 | 17-K-945-11 |
| L-500, 501 | Filter Choke | 17-K-934-4 | 17-K-934-4 |
| L-502 | Heater Choke | 18-L-512-2 | 18-L-512-2 |
| L-400 | Deflection Yoke Assembly | 18-L-477-501 | 18-L-477-501 |

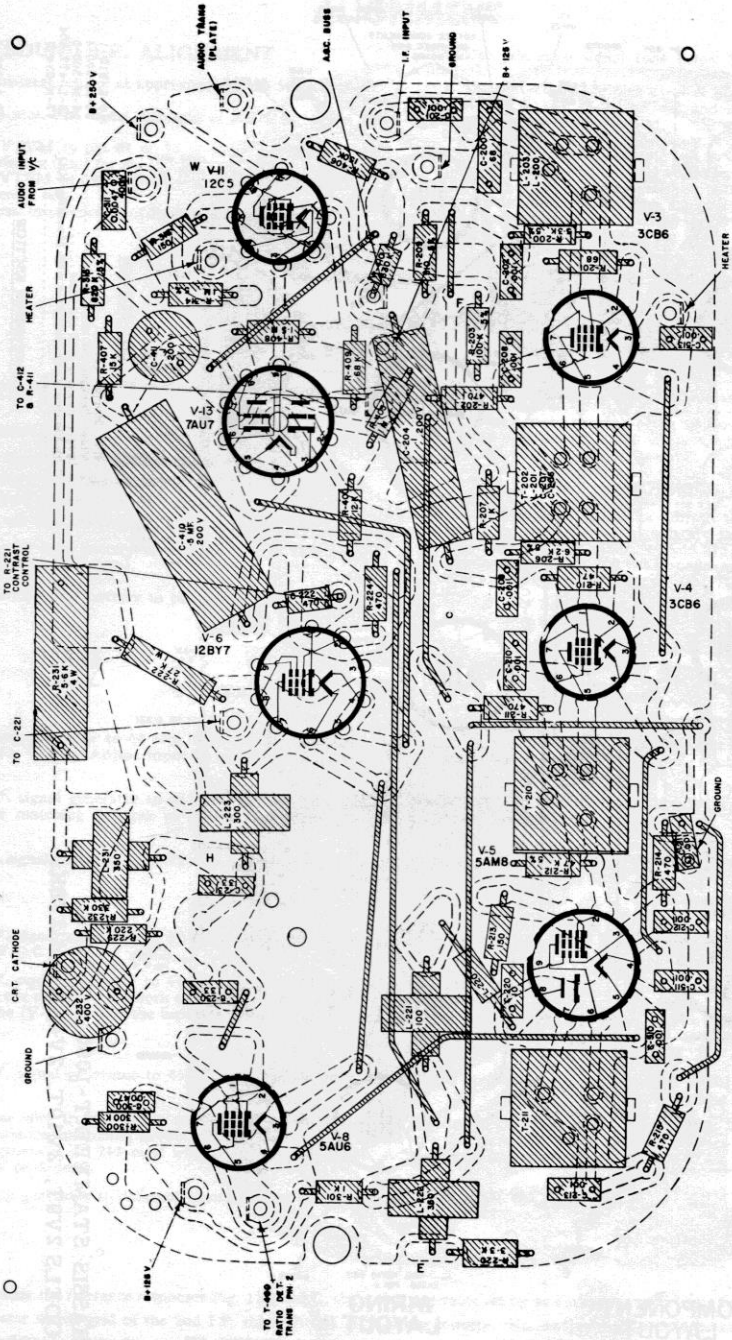
# WESTINGHOUSE
## T-109 etc.




## COMPONENT LAYOUT

## WIRING LAYOUT

NOTE :- THIS SWEEP BOARD DIAGRAM IS VEIWED FROM THE PRINTED SIDE.




## COMPONENT LAYOUT

## WIRING LAYOUT

NOTE - THIS I.F BOARD DIAGRAM IS VIEWED FROM THE PRINTED SIDE

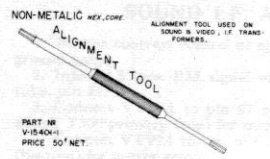



Fig. 9

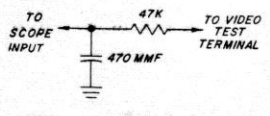



Fig. 10

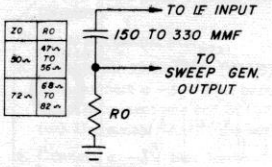



Fig. 11

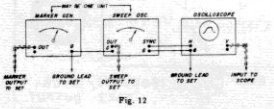



Fig. 12

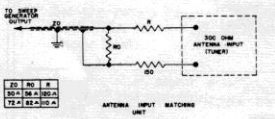



Fig. 13

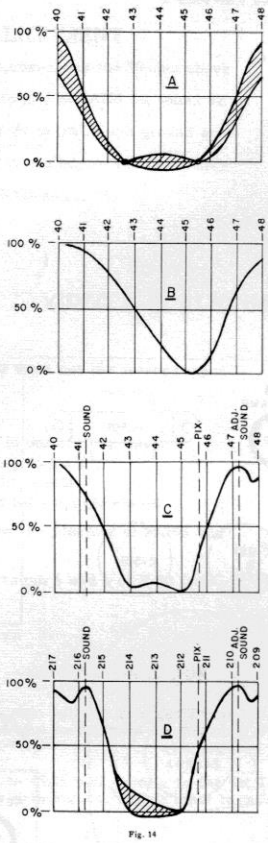



Fig. 14

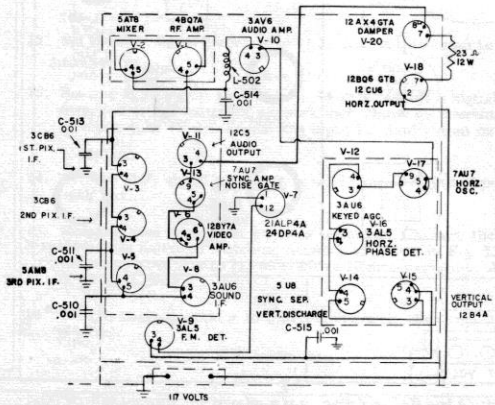



Fig. 8

## T-109 SERVICE HELPS

### Horizontal Drift:

Several cases have been brought to our attention that C436, the 390 mmfd. horizontal wave-shaping capacitor was drifting out of limits.

This was checked here and a small quantity of capacitors were found to exhibit more than normal drift. This capacitor is a thermally-stable type and if you shcuild encounter this condition, the replacement capacitor should be a N.P.O. type (good quality silver mica or equivalent).

### Horizontal Pull-In:

It has been found the horizontal pull-in range is more central on the control range if the horizontal oscillator circuit is set up correctly.

Just to review the ringing coil and horizontal oscillator procedure it should be done as follows:

1. Tune in fairly weak air signal.
2. Short out ringing coil.
3. Set horizontal hold control in the physical centre of its range.
4. Adjust osc. trimmer cap. C433 until picture is in sync.
5. Remove short from ringing coil circuit and adjust ringing coil until picture again is in sync.
6. On strong signal adjust C433 if necessary until pull-in range is in centre of horizontal hold control setting.

### Internal Corona C446, C441:

This shows up as bright sparks in a narrow vertical band in central region of picture tube. It is more obvious with low brightness and contrast settings. In low signal areas it can contribute to horizontal working in picture (similar to off-frequency ringing coil but much more minute).

We have replaced C446, 27 mmfd. and C441, 68 mmfd. with a single 82 mmfd. capacitor tested at 4000 volts and treated against the possibility of internal corona. Part number 12-M-506-13.

### Model 2V6T only - Chassis stamped 1096

The following changes have been incorporated in the above model only.

| | |
|---|---|
| First I.F. stage | R201 was 68 ohm - now 33 ohm 1/2W. |
| Second I.F. stage | R210 was 47 ohm - now 22 ohm 1/2W. |
| Sync Separator | R401 was 1.2 megohm - now 470K ohm 1/2W. |
| Sync Separator | R412 was 27K ohm - now 12K ohm 1/2W. |
| Sync Separator | R415 was 82K ohm - now 33K ohm 1/2W. |
| Sync Separator | C405 .047/200V deleted. |

### Model 2V6T - Chassis stamped 1096-2 only

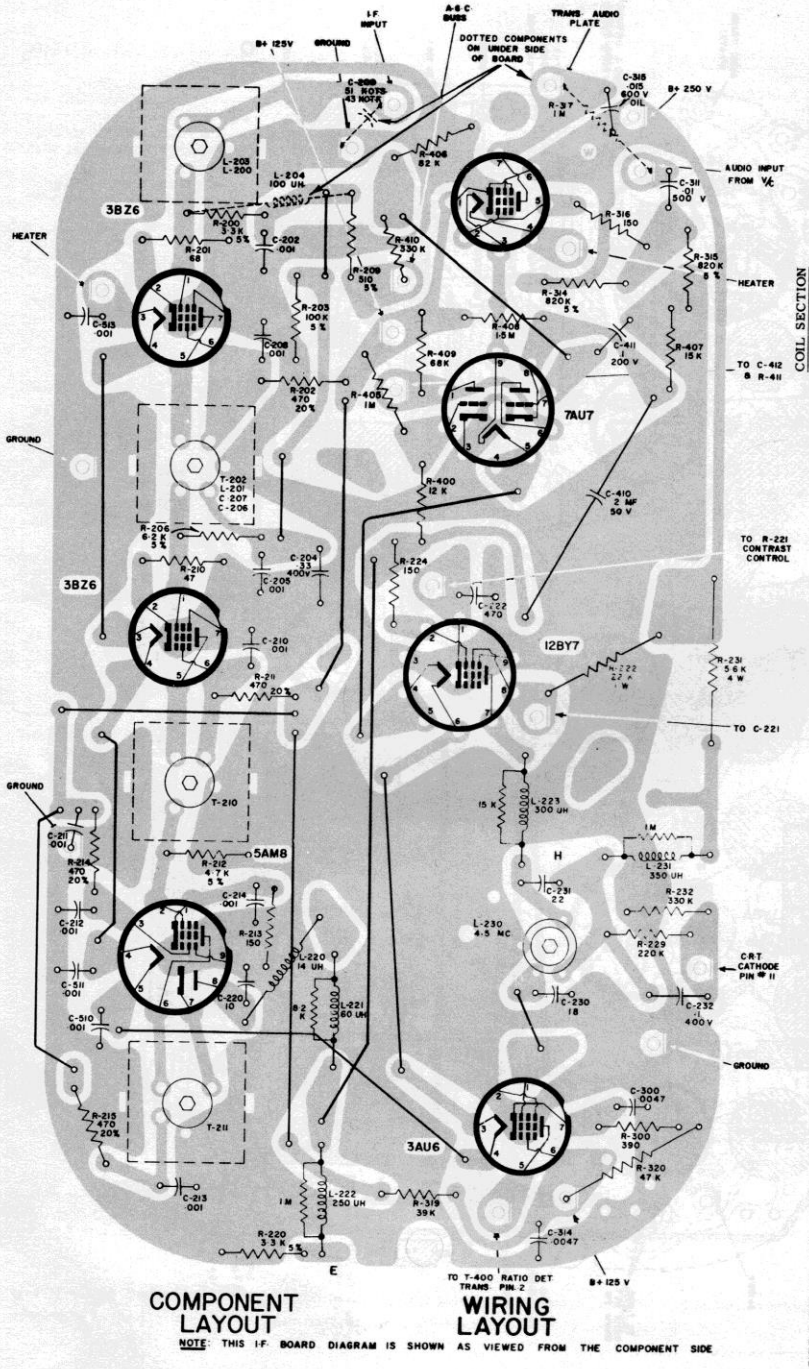
A quantity of receivers have the following additional changes.

Tuner was 22-K-706-1 - now 22-K-756-1 (not directly interchangeable).
A 2.7K 1W resistor is connected from terminal point E on tuner to B+.
High Voltage Transformer was 17-K-936-2 - now 22-K-785.
High Voltage Rectifier tube was 1X2B - now 1B3.

### 60 Cycle Buzz on Brow Control Receivers:

Check vertical hold control and brightness control lead dress and make sure it is dressed away from the 3AV6 socket, (up under top lip of chassis).

# WESTINGHOUSE
## T-1090, 1099




COMPONENT LAYOUT

WIRING LAYOUT

NOTE: THIS I-F BOARD DIAGRAM IS SHOWN AS VIEWED FROM THE COMPONENT SIDE

### COIL SECTION

| | |
|---|---|
| I.F. Stopper (14 uh) | 18-L-512-1 |
| Video Peaking (60 uh) Green | 14-M-500-4 |
| Video Peaking (250 uh) Blue | 14-M-500-5 |
| Deflection Yoke (complete with Mounting Kit) | 18-L-477-504 |
| Filter Choke | 17-K-934-5 |

### TRANSFORMER SECTION

| | |
|---|---|
| Ratio Detector | 18-L-567-1 |
| Audio Output | 17-K-930-5 |
| Sound Take-off | 17-K-945-13 |
| Horizontal Output (See note below) | 22-K-785-2 |

Note: A 22-K-785-1 Horizontal Output Transformer was used on some early production chassis. When replacing this transformer use 22-K-785-2 and add a 5.1 ohm resistor in 1B3 filament lead. (See schematic diagram).

| | |
|---|---|
| L-220 | T-300 |
| L-221 | T-301 |
| L-222 | T-230 |
| L-400 | T-401 |
| L-500 | |

CHASSIS STAMPED T-1090 & T-1099.
MODELS 2V9T, 2V10T, 2V4KR and 2V8K.

Note #1: Step 10 of video I.F. Alignment procedure, T210 is tuned to 45.35 mcs. on the above chassis only.