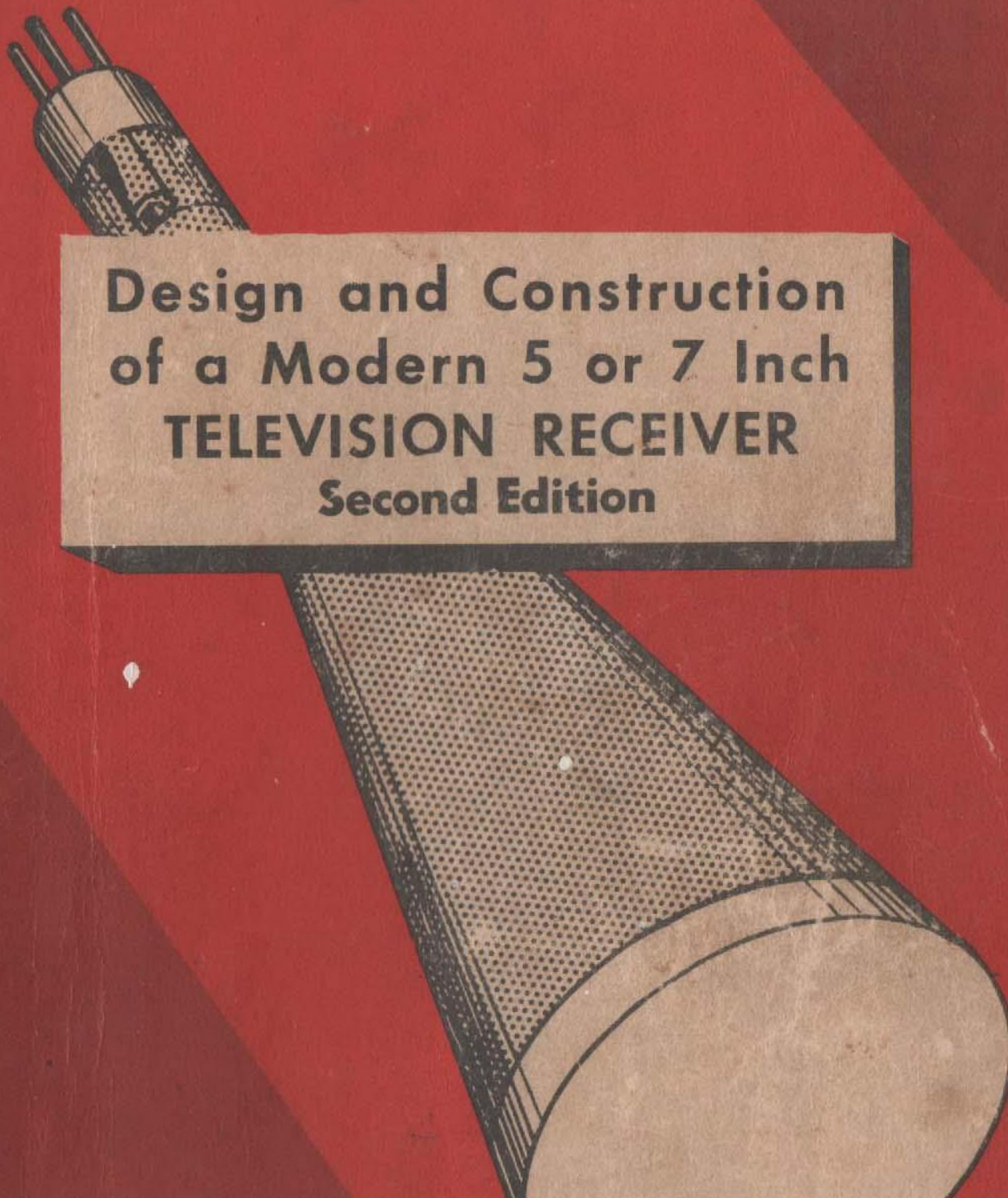
Design and Construction of a Modern 5 or 7 Inch TELEVISION RECEIVER

Second Edition



VISION RESEARCH LABORATORIES

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by

M. H. Kronenberg

VISION RESEARCH LABORATORIES
Kew Gardens, New York

PRINTED IN THE UNITED STATES OF AMERICA

Preface

Now that regular scheduled television broadcasts are available in many of the larger cities, and component parts are becoming plentiful and less expensive, there are many experimenters, radio servicemen and technicians who are anxious to build their own television receivers. Just as in the early days of Radio, there are those who prefer to build and align their own equipment so that they may have first hand experience in this new and intriguing field.

This booklet has been prepared to supply the technician with just the information that is required for the construction of an inexpensive television receiver. The author has endeavored to present a design which is as simple as possible, yet sound, and which does not necessitate the fabrication of any complicated parts.

M. H. Kronenberg

May 1947

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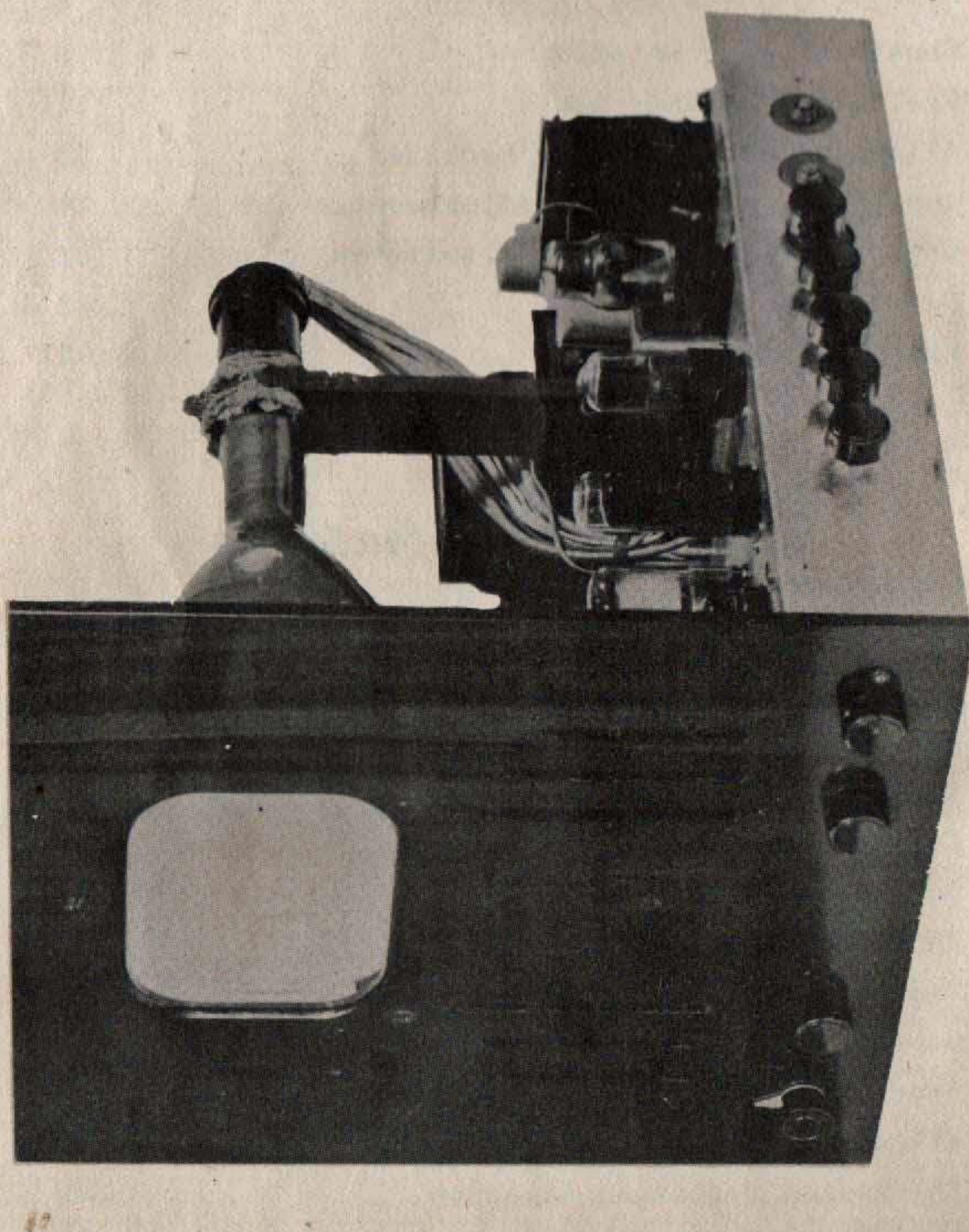


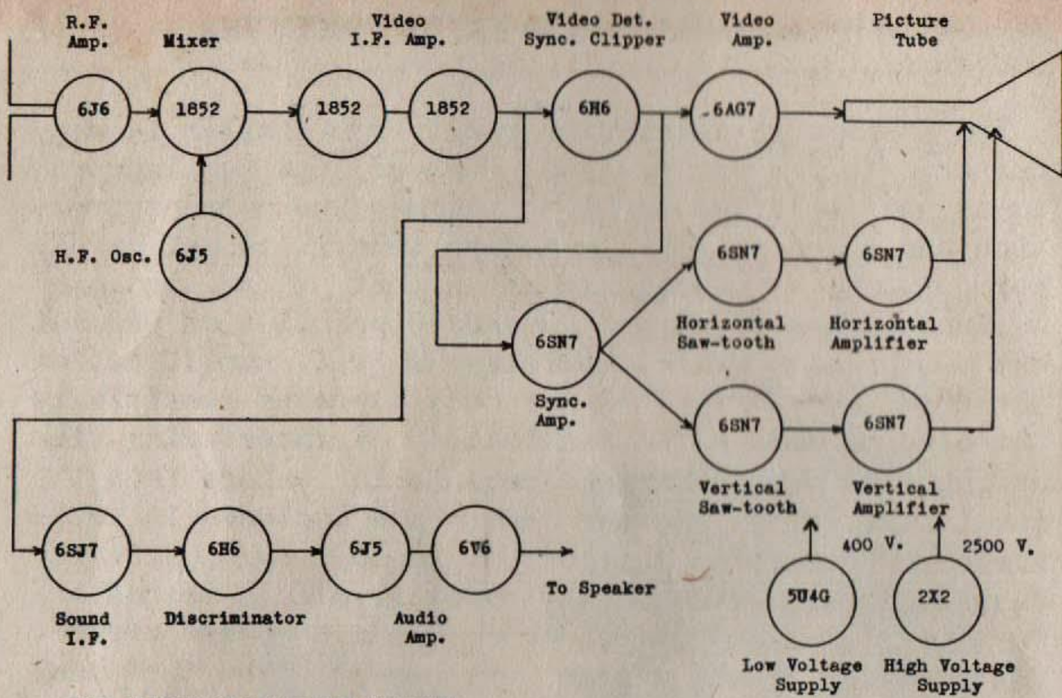
A PRACTICAL TELEVISION RECEIVER.

The present day television receiver is similar in many respects to pre-war designs. However, new and improved tubes and simplified design techniques have made construction and adjustment of the modern television set hardly more costly or complicated than that of an ordinary communications receiver. Standard practice of present day receivers is to include a stage of r.f. amplification ahead of the mixer. This not only improves sensitivity but also minimizes the possibility of interfering with neighboring television receivers due to leakage from the local oscillator. Another feature now included in television receivers is that of FM sound reception which results in improved quality over the old AM method. As for circuit details the reader may compare modern circuit design with pre-war design and he will find that many simplifications have been effected. The only portions of the set which may be totally unfamiliar to one not acquainted with television circuits are those relating to scanning and synchronization.

Three main considerations determine the design of the television receiver about to be described: cost, simplicity and foolproof operation. To keep costs down, the design incorporates inexpensive and readily available components. Simplicity and foolproof operation are closely related to each other and toward this end, the number of tubes and necessary adjustments consistent with satisfactory performance is kept at a minimum.

Figure 1 shows a block diagram of the basic circuit and the function of each tube in the set. There are nineteen tubes required to perform all functions necessary to provide simultaneous picture and sound reception. Front panel controls (Refer to parts layout and photograph) are: tuning, volume control, brightness, and contrast. Other controls, not on the front panel only require occasional adjustment and therefore do not complicate operation of the receiver.

Two power supplies are included, one, the low voltage supply which should deliver about + 400 volts, 150 ma,



BLOCK DIAGRAM OF TELEVISION RECEIVER

Fig. 1

the other, a high voltage, low current unit capable of supplying + 2500 volts, 2 ma. The 'front end' consists of an RF amplifier (grounded grid type), mixer, and separate local oscillator. A two gang tuning condenser is used for station selection. This method of tuning was selected for simplicity in construction, adjustment and operation. Experimenters who prefer channel selection by means of a band switch may easily substitute this type of tuning as shown on page 35. The picture or video I.F. channel consists of two stages of I.F. amplification which differ from any conventional I.F. amplifier only in the degree of coupling used in the transformers. Figure 2 shows a response curve of the picture I.F. amplifier and from this curve can be seen the correct position of the sound and picture carriers. At the output of the sound I.F. amplifier a discriminator and an audio amplifier produce sound reception. A double diode is used at the output of the video I.F. amplifier to perform a dual function, namely as a detector for the picture (video) components of the signal and to separate the synchronization pulse from this signal (clipping). The output of the video detector is amplified and then applied to the picture tube control grid where the rapid fluctuations in voltage are translated to variations of light intensity on the face of the cathode ray tube. The synchronization pulses which are literally sheared off the composite television signal by the clipper detector are applied to the sweep circuits. The horizontal sweep circuit uses a multi-vibrator saw-tooth generator and the vertical sweep circuit consists of a blocking oscillator type of saw-tooth generator. Following the vertical and horizontal saw-tooth scanning generators are push-pull horizontal and vertical amplifiers which produce the relatively large voltage needed for full cathode ray tube deflection.

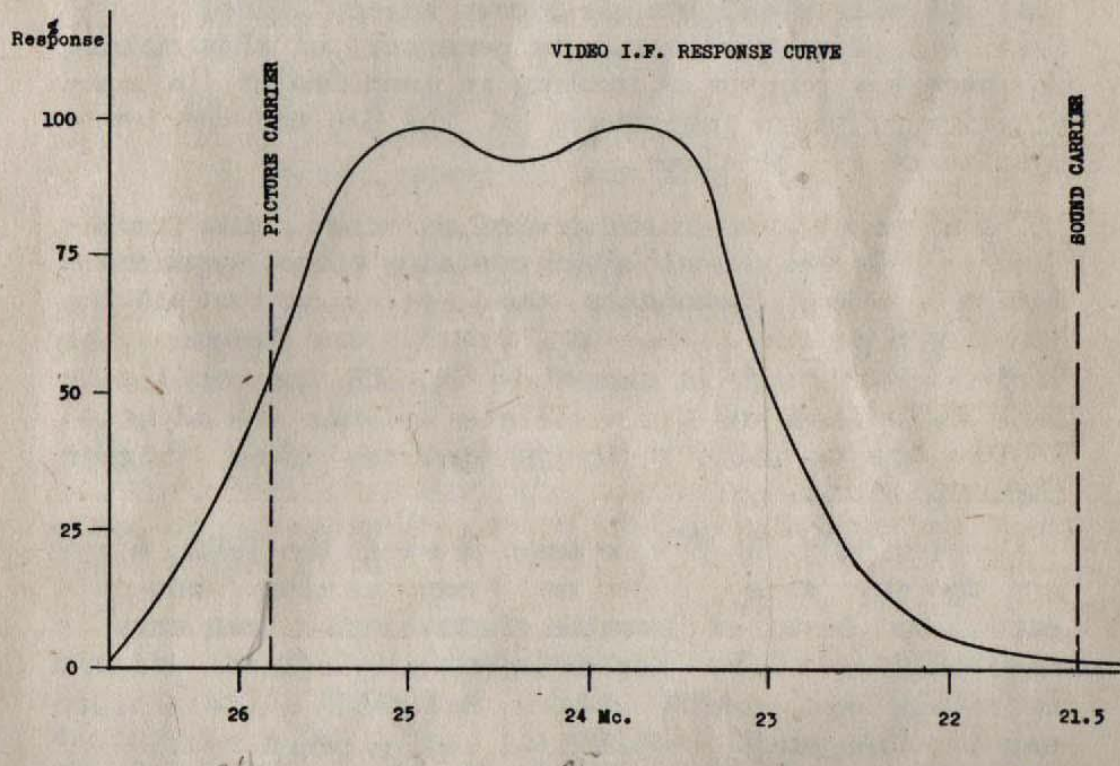


Fig. 2

CIRCUIT DETAILS AND OPERATION

The circuit and the way in which it functions may best be described by referring to the circuit diagram and tracing the television signal from the antenna on through the various stages up to the cathode ray tube.

The antenna is coupled to the input of a 6J6 (single-section) grounded grid amplifier by T1. This input transformer, 1 : 1 ratio, is necessary so that antenna feeder balance is maintained. The input resistance that the antenna 'sees' is approximately 200 - 300 ohms and thus will match quite accurately a standard 'twin-lead' 300 ohm transmission line.

The plate circuit of the 6J6 amplifier is tuned by means of a variable condenser, C4 and inductance L1. The tuning of L1 must be rather broad, (about 6 mc.) so that the entire television channel is amplified, therefore, a loading resistance is necessary at this point. The necessary degree of loading is supplied by the combination of plate resistance of the 6J6 and the input resistance of the mixer.

Two signals appear at the grid of the mixer, the amplified television signal, which contains video, synchronization and sound components, the other being that of the local oscillator. The local oscillator frequency is varied by C3 which is ganged to C4. L2, the oscillator tank inductance and C1, oscillator trimmer are adjusted so that the oscillator always operates 26 mc. higher than the RF tuning.

Conversion to the IF band takes place in the 1852 mixer and the same video, sound and synchronizing components appear at the mixer plate but their carrier frequency is now reduced to I.F. For example, a television station operating in channel 2 (54 - 60 mc) sends out a picture carrier frequency of 55.25 mc., and a sound carrier on 59.75 mc.. When the receiver is tuned correctly for reception on channel 2, then the local oscillator frequency will be 81.25 mc. and will beat with the incoming television signal to produce the IF frequencies in the plate circuit of the mixer.

The video IF amplifier consists of two stages utilizing double tuned band-pass transformers as the coupling elements. Transformers T2, T3 and T4 are adjusted so that they will pass a band of frequencies approximately 3 mc. wide, from 23 to 26 mc. The bandwidth of the IF amplifier is made no wider than is necessary for good definition on small picture tubes (such as 5BP4 and 7EP4, etc.) so that the maximum amount of gain is possible. The output of the video IF amplifier is applied to the detector-clipper circuit by T4. At this point, a link is provided to couple the sound IF component (21.5 mc) to L5, the input transformer for the sound IF amplifier.

The detector-clipper circuit consists of a 6H6 double diode, one section used to rectify the video or picture signal and the other section separates synchronizing pulses from the composite video signal for amplification. Components C30 and R19 in conjunction with the lower half of the 6H6 develops a steady bias voltage for the diode clipper which prevents it from drawing any current except when the applied signal exceeds the bias voltage. This occurs only at the peaks of the composite signal, which are actually the synchronizing pulses. Thus only synchronizing pulses appear across R21.

The video signal appears across R23 and is amplified by the 6AG7 video stage. In order to minimize the effects of circuit capacitance on picture resolution and to obtain maximum amplification, coils L3 and L4 are used in a series peaking circuit.

It now remains to be shown how the picture components as they appear on the cathode ray tube face are synchronized or put in their correct positions with respect to the original scene.

The process of scanning in the television pickup camera and also in the picture tube of the television receiver is similar to that of a person reading a newspaper. The picture is broken up into many lines, 525 by present day standards and each group of these lines makes up a page or frame of the picture. A fine cathode ray beam scans those 525 lines from left to right, each line separately, and moving down the page or frame until it reaches the bottom and then starts out on the next frame etc. The eye interprets the resultant pattern as a rectangular area of light called the scanning raster. Thus two sweep circuits are operating simultaneously, one to sweep 525 lines * and the other sweep circuit to turn the pages or change the frame. This latter sweep circuit operates at a rate of 60 c.p.s. and produces a scanning raster that consists of 525 lines recurring 30 times each second. While the cathode ray tube spot is scanning the face of the cathode ray tube its intensity is being modulated by the video signal and if the scanning generators are in exact synchronism with the scanning generators associated with the pickup camera at the transmitter, then a picture will be reproduced that is very much like the original scene. The horizontal scanning generator generates a saw-tooth wave-form operating at a frequency of 15750 c.p.s. and the vertical scanning generator a frequency of 60 c.p.s. The synchronization of the scanning generators is accomplished by applying the synchronization pulses after they have been amplified at the synchronization amplifier (see figure 1) to control a local oscillator which in turn initiates the saw-tooth sweep. The output of the synchronization amplifier consists of positive pulses which are applied to the vertical blocking oscillator and negative pulses which are applied to the horizontal multivibrator. Filters consisting of components R31, R32, C38, C39 and C50, C51, R49 (see schematic) are for the purpose of filtering the synchronizing pulses so that only 60 c.p.s. pulses appear at the vertical blocking oscillator and 15750 c.p.s. pulses appear at the horizontal multivibrator. The multivibrator and the blocking oscillator produce strong synchronized pulses which are converted into a saw-tooth wave which is then amplified and applied to the cathode ray tube deflection plates.

Power supply requirements for the receiver are somewhat different than in ordinary broadcast receivers. A relatively heavy duty low voltage supply capable of delivering about 400V at 150 Ma., and a high voltage cathode ray tube supply, 2500V at about 2 Ma., are required.

* *This explanation is purposely simplified to illustrate the method of scanning and, therefore, does explain the present day system of interlaced scanning. For further explanation the reader is referred to a bibliography at the end of this booklet.*

Referring to the schematic diagram, it is well to note the manner in which these supply voltages are distributed, particularly the low voltage section. The + 400V tap connects only to the vertical and horizontal deflection amplifiers and to the output section of each sawtooth generator. All other stages utilize + 280V, except the 6AG7 screen which is tapped at + 150V.

CONSTRUCTIONAL DETAILS.

General

Before construction is started it is well to study carefully the parts layout and photographs presented herein. The actual construction and appearance of the completed set will depend somewhat upon the components that are available. For example, the type of transformers, capacitors, etc., may vary considerably from one set to another.

The Chassis

Since the constructor may select components that are not of standard design, mounting holes may vary considerably in size and location on the chassis. On page 12 and 13 are shown a photograph of a specially designed chassis, and sub-chassis parts layout sketch. Reference to these will aid in planning a suitable layout. Recommended minimum size for the chassis is 17" x 13" x 3", and at least #18 gauge steel.

Mounting of Major Parts.

Mounting of major components such as transformers, potentiometers, capacitors should present no unusual problems. The mounting of such capacitors as C47, C48, C56, C57 should be made by means of standoff insulators as shown in the parts layout diagram, since this portion of the circuit is + 2500V with respect to the chassis.

A bakelite or polysterene strip should be used to insulate the focus (R84), horizontal centering (R79), and vertical centering controls (R80). (See page 16). All other potentiometers are mounted in the conventional manner as shown.

All coils with the exception of the discriminator coil should be mounted below the chassis, situated as closely as possible to their associated tube sockets. The RF and oscillator coils may be soldered directly to the socket. Winding data and constructional details of the coils are shown on page 11. Reference to the parts layout will show approximate position of all trimmers. The actual placement and mounting of the trimmers will depend somewhat upon the type of trimmers used. The mica compression type trimmer, commonly used, may be mounted simply by soldering one end to a terminal strip which is secured to the chassis, and the other end connected to the appropriate tube socket pin by means of a heavy piece of bus bar. In this way rigid mechanical construction and short leads will result. It is convenient for alignment purposes to mount trimmers with their adjustment screws facing the chassis and to drill holes directly above each trimmer so that adjustment may be made from the top of the chassis.

Mounting of Cathode Ray Tube

It is *not* recommended that the cathode ray tube be mounted until after the set has been placed into operation and the initial tests and adjustments to be described later are made. During the adjustments that follow completion of the set, it is well to keep the cathode ray tube in its original container just opening front and back of the container so that connection to the set may be made and the tube face observed. When mounting the cathode ray tube it is advisable to keep it as far as possible from transformers, filter chokes, etc. In a compact arrangement it may be necessary to shield the tube from stray magnetic fields which may cause picture distortion, or difficulty in centering. Such a shield is available commercially and is designed to fit the particular cathode ray tube that is used.

The manner in which the cathode ray tube is mounted may be seen in the photograph and sketch on pages 14 and 16. In the panel shown, the tube front rests on blocks of wood secured to the panel. A bracket made of metal or wood is used on the base to hold the cathode ray tube in place.

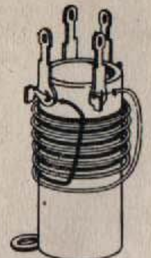
Wiring

All wiring with the exception of those wires carrying high potential (+2500V) may be done with ordinary push-back #18 or #20 gauge. The high voltage wires, such as those used to wire in the centering potentiometers, deflection plates, etc. should be well insulated preferably a 5000V covering. Shielded cable is desirable in the audio volume control circuit.

Procedure

The following procedure in construction has been found satisfactory and each step is listed in order:

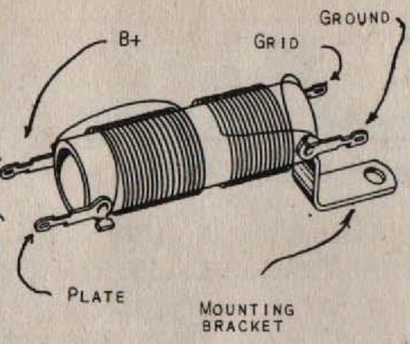
1. Lay out parts on chassis and drill necessary mounting holes.
2. Mount tube sockets. Arrows shown in parts layout diagram indicate direction of octal-pin key for most convenient wiring.
3. Mount transformers, choke, filter condensers and potentiometers.
4. Wire in complete heater system making ground connections to tube sockets wherever indicated in diagram.
5. Wire up power supplies.
6. Mount IF and RF components and coils. Wire up front end, i.e. RF amplifier, mixer, video and sound IF's, detectors, video and sound amplifiers.
7. Wire remaining stages, (synchronization and deflection section) and potentiometers.
8. Connect external cables such as: speaker leads, AC cable, and multi-wired cable leading to the cathode ray tube socket.



(T1) ANTENNA INPUT TRANSFORMER

PRI. AND SEC.:

6 TURNS EACH, #33 D.C.C. INTERWOUND CLOSE SPACED, ON 5/8" DIAMETER FORM



T2, T3

PRI:
11 TURNS, #33 D.C.C., CLOSE SPACED

SEC:
9 TURNS, #33 D.C.C., CLOSE SPACED

SPACING BETWEEN PRI. AND SEC: 1/4"

COIL FORM: PAPER OR BAKELITE
5/8" DIAMETER, 1-1/2" LONG
(WAX IMPREGNATED)

(L1, L2) R.F AND OSC. COILS

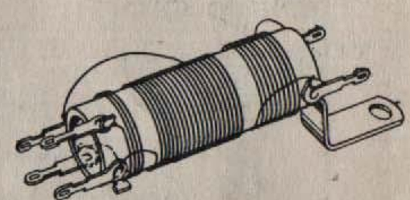
L1; 3 TURNS, #12 BUS BAR, 1/2" DIA., 1/2" LONG, SELF-SUPPORTING

L2: 3 TURNS, #12, 1/2" DIA. 3/4" LONG

T4

PRI. AND SEC: SAME AS T2, T3

LINK: 2 TURNS, #33 D.C.C. SPACED 1/8" FROM PRI.



(T2, T3, T4) VIDEO I.F. TRANSFORMERS

SEC.: 10 TURNS, #33 D.C.C.

LINK: 2 TURNS, #33 D.C.C. CLOSE SPACED

COIL FORM: 5/8" DIAMETER – SAME AS FOR T2, T3.

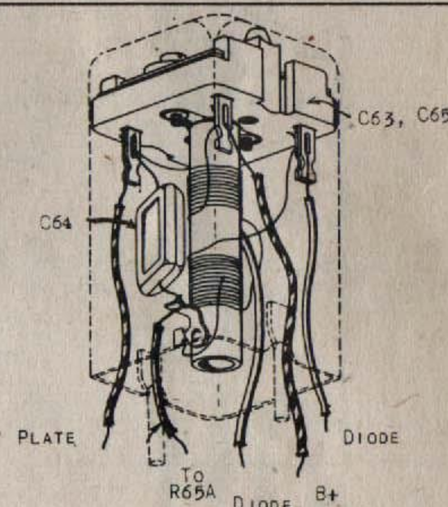
(T5) SOUND I.F. INPUT COIL

L3: 150 TURNS #35 ENAMEL, 1" LONG, 170 UH

L4: 110 TURNS, #35 ENAMEL, 3/4" LONG, 120 UH

COIL FORM: 5/8" DIAMETER SAME AS FOR T2, T3.

(L3, L4) DETECTOR AND VIDEO PEAKING COILS



PRI: 13 TURNS, #33 D.C.C.

SEC: 15 TURNS, #33 D.C.C., CENTER TAPPED

SPACING BETWEEN PRI. AND SEC: 5/16"

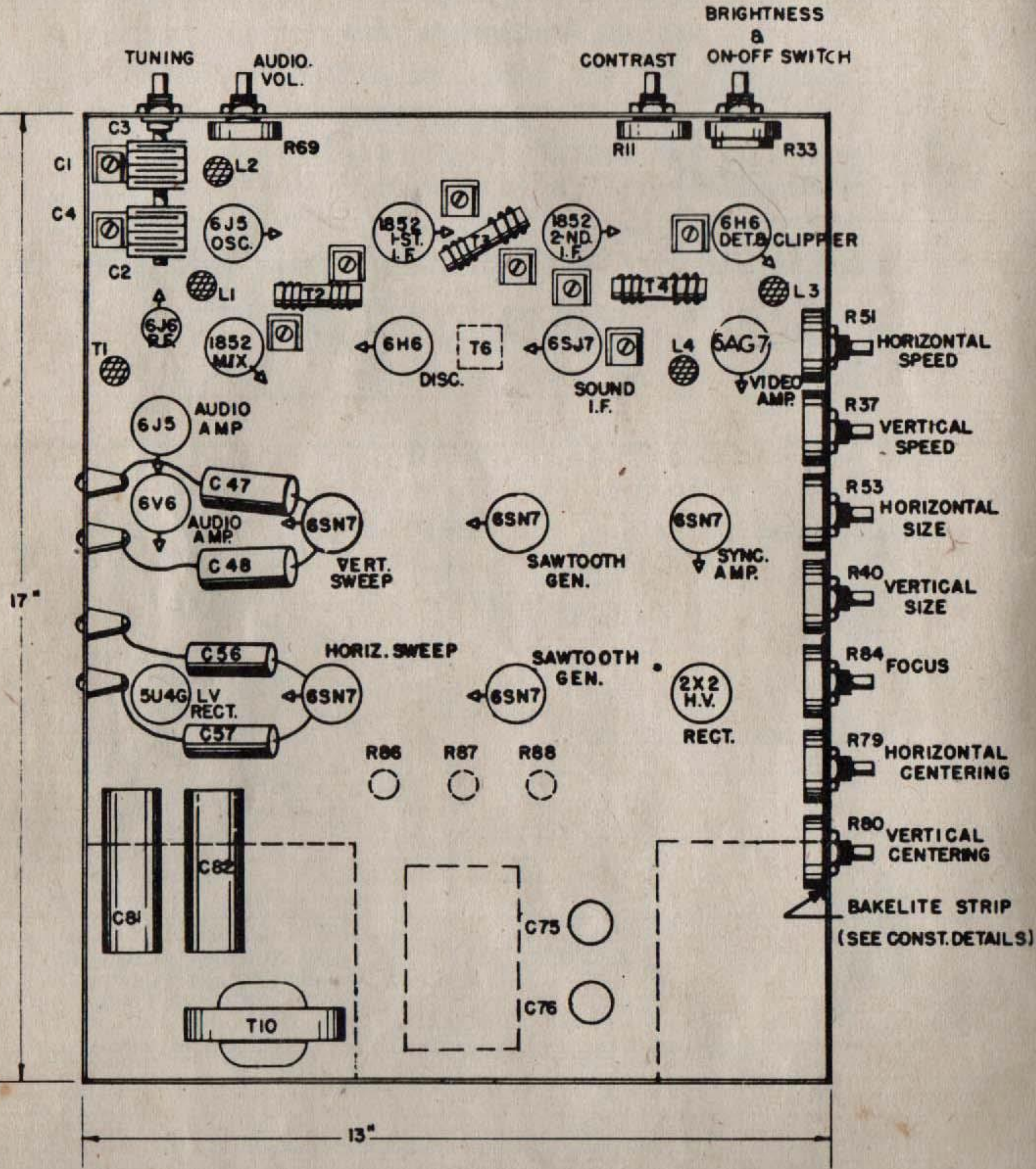
COIL FORM: 3/8" DIAMETER, 2" LONG

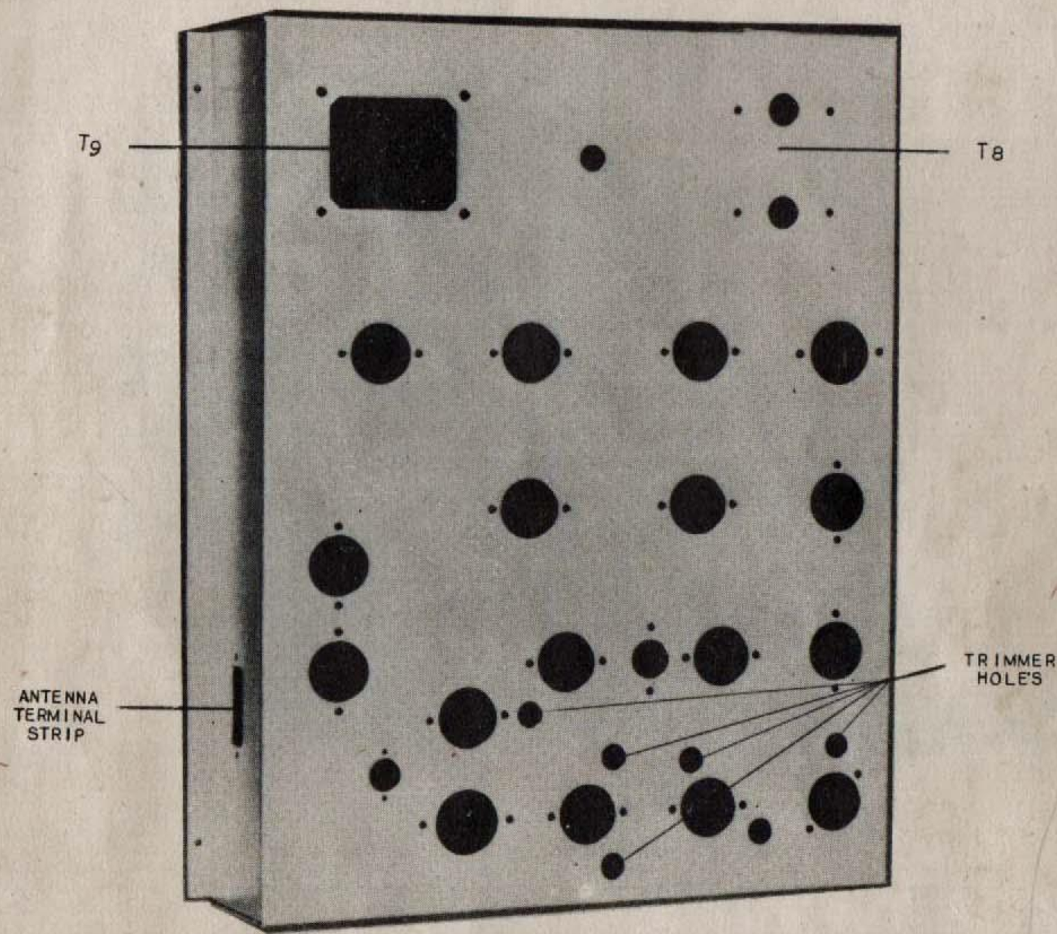
SHIELD: 2-3/8" x 1-1/4" x 1-1/4"

(T6) DISCRIMINATOR TRANSFORMER

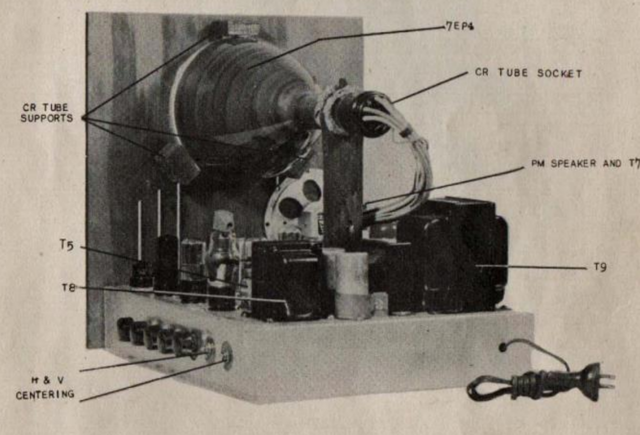
SUB CHASSIS PARTS LAYOUT

(MAJOR COMPONENTS)



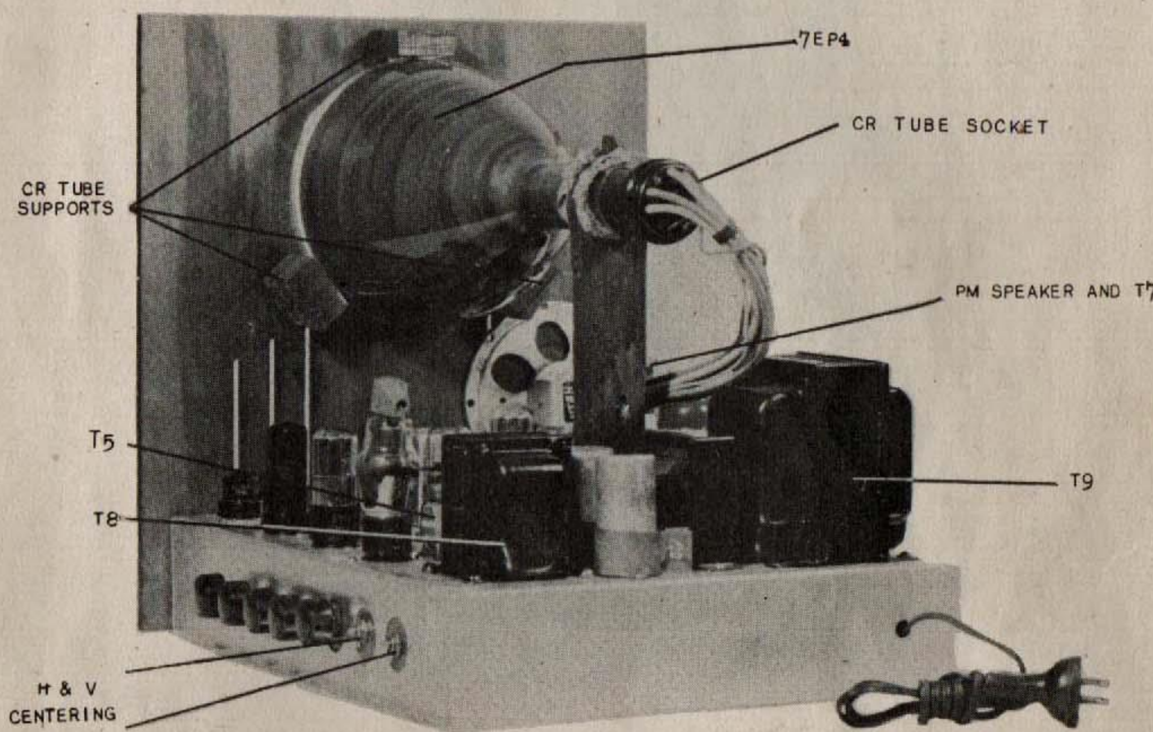


TOP VIEW OF CHASSIS
Showing Socket, Transformer Holes, etc.



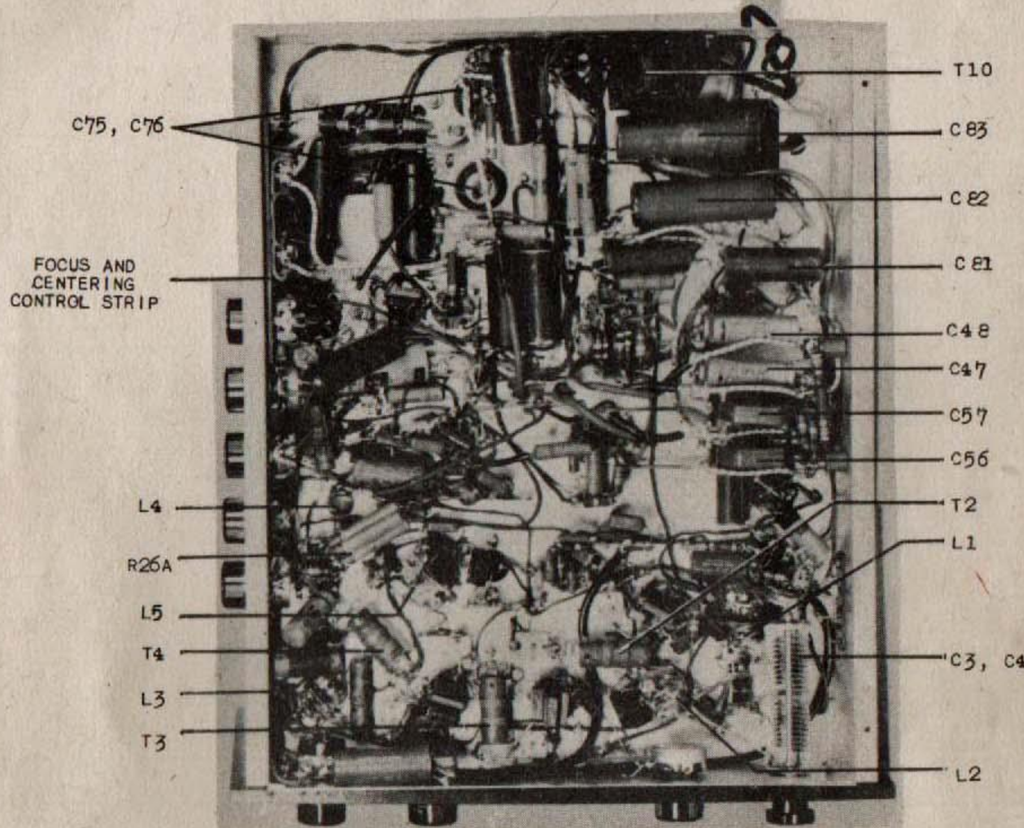
REAR VIEW

Showing CR Tube Mounting and Components on Top of Chassis



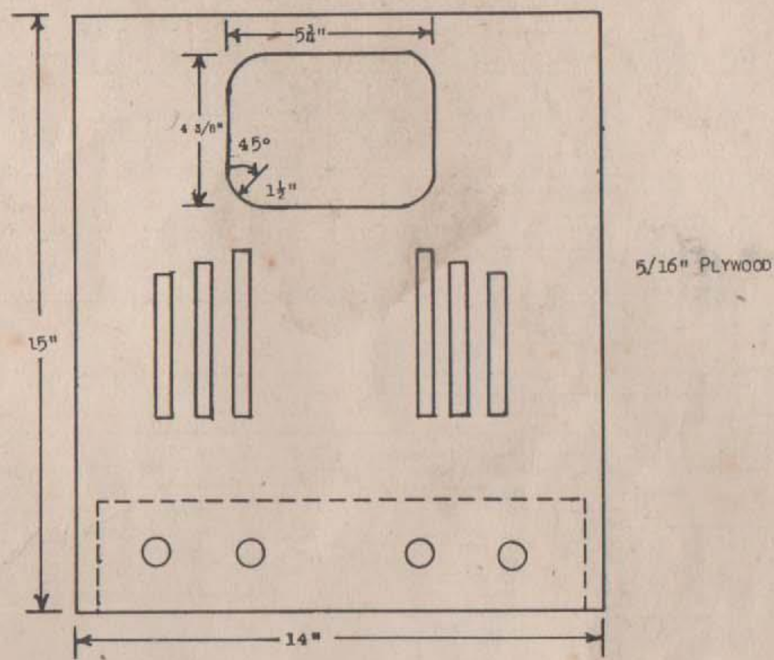
REAR VIEW

Showing CR Tube Mounting and Components on Top of Chassis

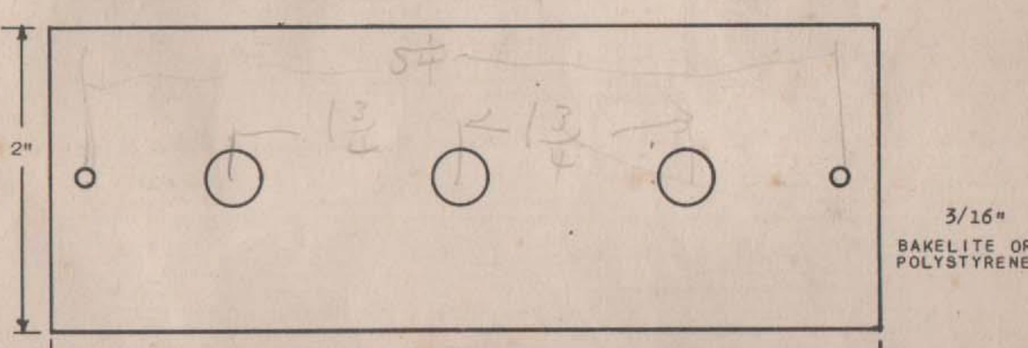


BOTTOM VIEW

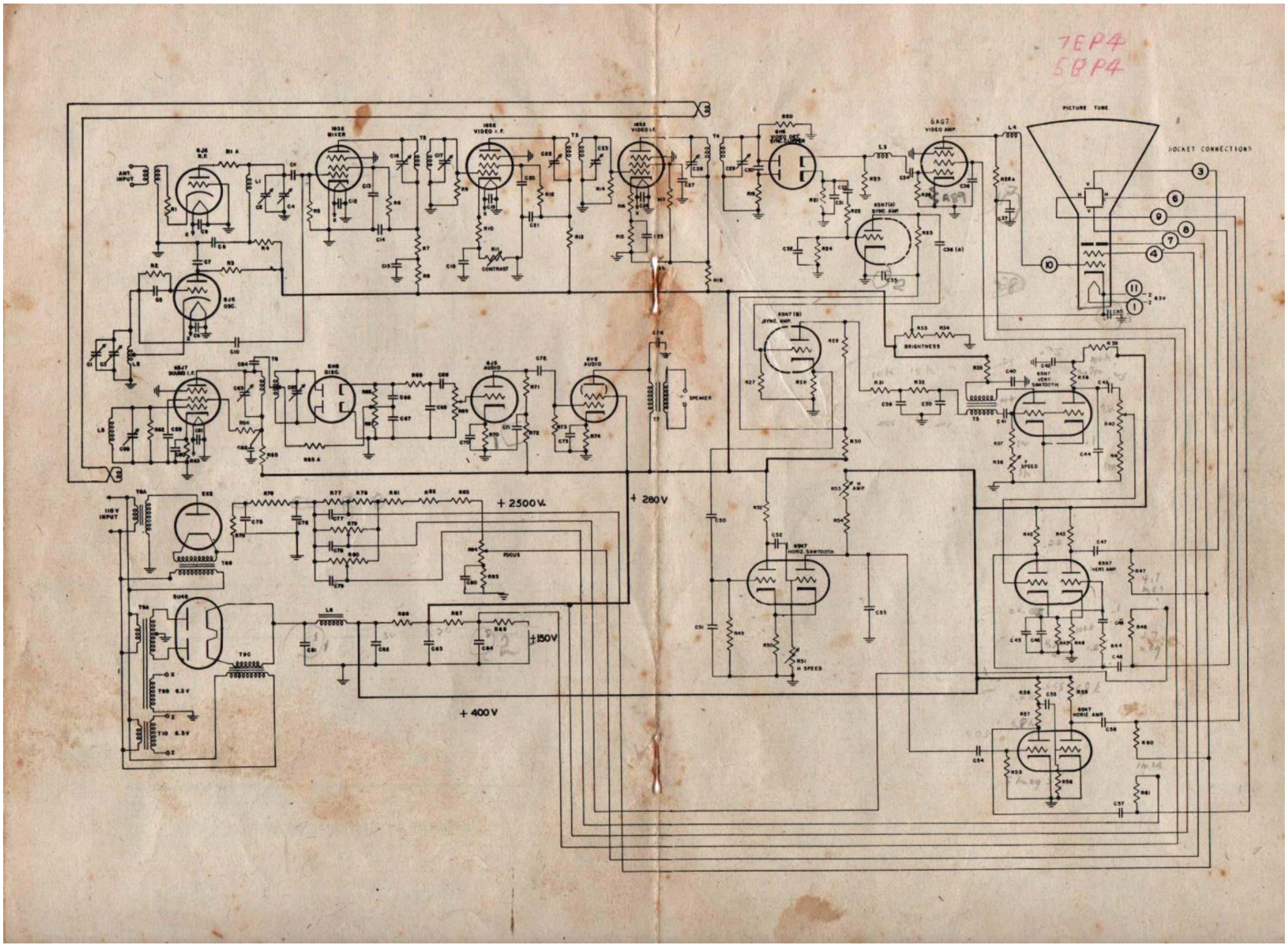
Showing Sub-Chassis Wiring



FRONT PANEL FOR USE WITH 7" PICTURE TUBE



INSULATING STRIP FOR·CENTERING AND FOCUS CONTROLS



7EP4
5BP4
PICTURE TUBE
SOCKET CONNECTIONS
ANT. INPUT
6AG7
VIDEO AMP
BRIGHTNESS
CONTRAST
FOCUS
SPEAKER
110V INPUT
+ 2500V
+ 280V
+ 400V
+150V
H SPEED

PRELIMINARY MEASUREMENTS.

First be sure that all wiring has been carefully checked against the schematic diagram. Then turn on set to make preliminary measurements. When set is first placed in use do not advance brightness control any further than is necessary for switching set on. This will prevent a bright spot from appearing on the tube first before the sweep circuits have warmed up. A bright concentrated spot such as this may impair the life of the picture tube or burn small areas on the tube face.

After the set is allowed to warm up for a few minutes, it is important to measure voltages at various points in the circuit as a double check on wiring and also on component parts ratings. Table 1 below, shows *approximate*

TABLE OF VOLTAGE MEASUREMENTS

CIRCUIT		DC VOLTS APPROX.
R86	TO CHASSIS	+ 400
R87	TO CHASSIS	+ 280
R88	TO CHASSIS	+ 150
6J6	CATHODE (AT TUBE SOCKET)	+ .5
*6AC7	MIXER GRID (AT TUBE SOCKET)	-2 to -4
6AC7	MIXER PLATE (AT TUBE SOCKET)	+ 240
6AC7	I.F., CATHODE (AT TUBE SOCKET)	+ 1.5
6AG7	CATHODE (AT TUBE SOCKET)	+ 2.0
6J5	OSCILLATOR, PLATE (AT TUBE SOCKET)	+ 125
*6J5	OSCILLATOR, GRID (AT TUBE SOCKET)	-10 to -20
6SJ7	SOUND I.F., CATHODE (AT TUBE SOCKET)	+ 2.5
6J5	AUDIO, CATHODE (AT TUBE SOCKET)	+ 4
6V6	AUDIO, CATHODE (AT TUBE SOCKET)	+ 12
6SN7	VERTICAL AMPLIFIER CATHODE (AT TUBE SOCKET)	+ 10
*6SN7	HORIZ. AMP. GRID (1 & 2) (AT TUBE SOCKET)	-8
R84	TO CHASSIS (SLIDING ARM)	+ 500 to + 700
** *CR	TUBE GRID TO CATHODE	-10 to -70
*CR	TUBE 2ND ANODE TO CHASSIS	+ 2500

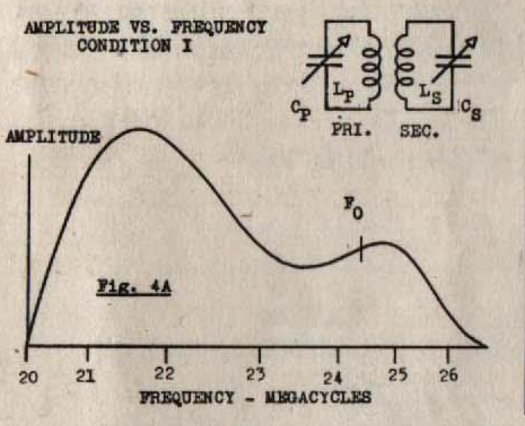
* *Measured with Vacuum Tube Voltmeter.*
** *Picture tube grid should never be positive with respect to control grid.*

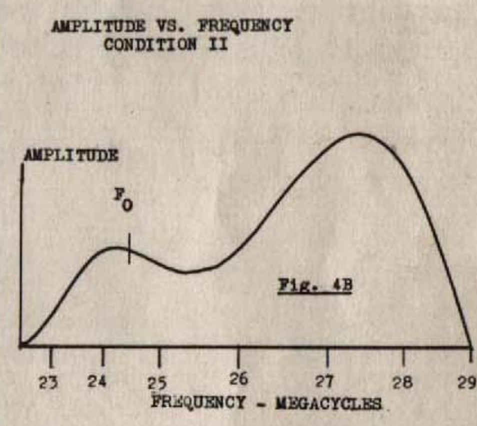
voltages to be expected at the indicated points in the circuit. Measurements may be made with a 20,000 ohm/volt meter except where indicated otherwise.

After the voltage measurements have been made, advance the brightness control until the picture tube face becomes lighted (moderate intensity). Then adjust focus control until the scanning lines are discernable. It should now be possible to set the size of the scanning raster with the horizontal and vertical size controls. The correct size setting is approximately 4 1/2" wide x 3 3/8" high, when a 5" picture tube is used, or 6" wide x 4 1/2" high for a 7" tube. This setting will result in cutting off the corners of the picture. Not much of the average scene is lost, however, and an increase in picture size is thus obtained. If it is found that the raster is not centered on the tube, adjustment of the horizontal and vertical centering controls will rectify this. Further 'touching up' adjustment on these controls may be necessary when the television picture is received, but once the picture has been properly focused, centered and 'sized' these controls will not require any adjustment over long periods of time.

ALIGNMENT OF TELEVISION RECEIVER.

The process of alignment of a television receiver is different than that prescribed in adjusting narrow band receivers such as broadcast superhetrodynes. It is very important that the alignment of the television set be done correctly if best results are to be obtained. Improper alignment may cause poor definition or blurring of the picture, poor synchronization which is evidenced by the tendency for the picture to tear horizontally or drift vertically or in pictures that either lack contrast or are too contrasty. This is particularly true in aligning the I.F amplifier, since the overall response curve is determined mainly in this portion of the receiver.

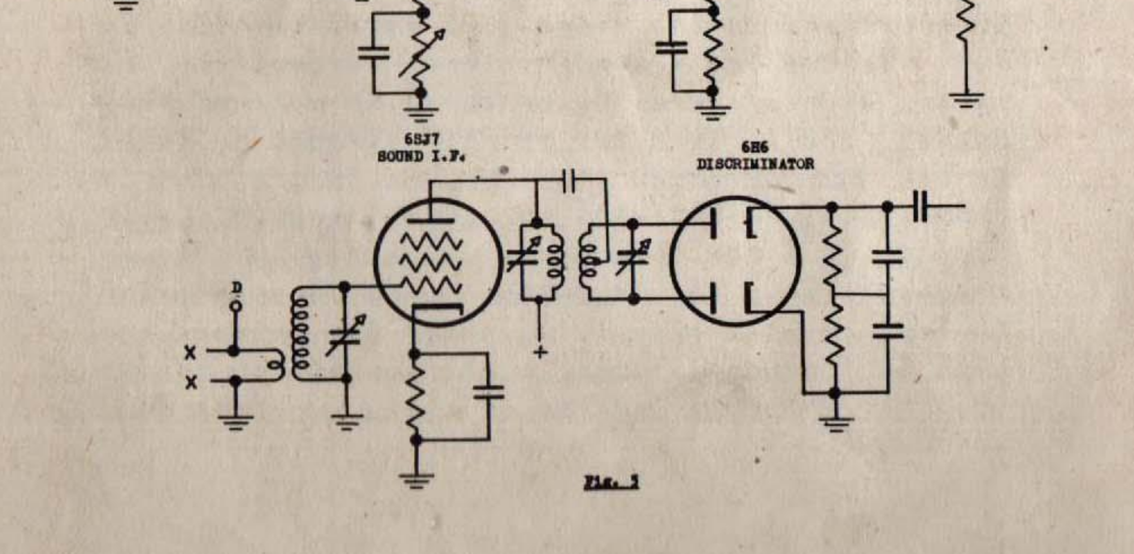




NOTE: Fig. 4 illustrates the effect of improper tuning of an overcoupled tuned transformer, such as that used in the video I.F. amplifier (T_2, T_3 T_4). Assume the secondary tuned circuit (Ls, Cs in the above figure) to be tuned to a fixed frequency, (Fo). When the primary circuit is tuned to the same frequency as the secondary then a symmetrical selectivity curve will result, as in Fig. 2. If the primary is resonated to a lower frequency than the secondary then a curve similar to Fig. 4A will result. Tuning the primary too high in frequency causes a similar effect except that the greater peak is on the high frequency side of Fo.

Over coupled transformers such as that used in a television receiver IF amplifier must be aligned so that a symmetrical response curve is obtained. This procedure is in contrast with that used to align narrow band amplifiers, where each transformer is tuned for peak response and selectivity is of paramount importance. To align a television I.F. amplifier, it is necessary to know the selectivity requirements and also to understand the behavior of the I.F. circuits that are used. The explanation that follows will enable the experimenter to realize the optimum performance of this receiver with a minimum of time and equipment. The equipment required will be a ordinary serviceman's signal generator and a D.C. Voltmeter of the 20,000 ohm per volt variety. Figure 2 shows how the response or gain of the I.F. amplifier varies within the required band of frequencies. This curve is obtained when alignment has been correctly made. The important points to note are that the response curve is tuned to 50% of maximum amplification at 26 and at 23 mc.

ALIGNMENT PROCEDURE DIAGRAM



[illegible]

There may be irregularities between those two points but they will not be troublesome if they are never less than 70% of the highest peak. This is the condition to strive for and if coil specifications have been closely adhered to, there should be no difficulty experienced in this design. The test set-up for I.F. alignment is illustrated in Figure 5. The first step is to carry out tuning adjustments with the generator connected to point A (Figure .). The generator is set for maximum output on 24.5 m.c. Trimmer C28 (see schematic diagram) is tuned to highest capacity and trimmer C29 is tuned for maximum response as indicated on voltmeter. Then the capacity of trimmer C28 is reduced to about the same setting as trimmer C29 and the response characteristics of the last I.F. stage may then be checked by tuning generator from 20 mc. to 28 mc.. If trimmer C28 is incorrectly set then either of two conditions may exist. These conditions are illustrated in Figure 4A and 4B. Comparison of Figure 4A and 4B with results obtained will indicate whether C28 should be increased or decreased in capacity. (Once the tuning of T4 is completed C28 and C29 should not be touched.)

Before proceeding any further with alignment, study Figures 4A and 4B carefully as it will provide a clue to incorrect adjustments that may occur later. Repeat the same process, moving generator to point B, (tuning C22 to maximum capacity and C23 for maximum output, then returning C22 for the proper response) and then to point C, each time checking the overall response curve to assure that trimmers are correctly set. In carrying out this procedure, it is well to adjust the signal generator attenuator so that the maximum voltage indication (on the output voltmeter) is always about 1 to 3 volts. This will assure that no stage is being overloaded. Always have the output voltmeter connected at point Y.

Adjustment of the R-F and oscillator circuit is similar to a tracking adjustment on any conventional superhet receiver. The idea being to adjust the RF and oscillator tuning capacitances and inductances so that the proper range of variation in oscillator frequency is obtained and the RF amplifier is always resonant approximately 23 mc. lower in frequency than the oscillator.

The first step in tracking the RF and Oscillator circuits is to correct the tuning range of the oscillator. For example, if it is desired, to tune from 50 mc. to 90 mc. then the local oscillator frequency must vary from 50+26 to 90+26 or 76 to 116 mc., for full variation of the tuning condenser. First check the oscillator frequency with the tuning condenser plates fully meshed, with a calibrated wave-meter, adjust L2 so that 76 mc. oscillation is obtained. Tune the dual tuning condenser to minimum capacity and check the frequency. Variation of trimmer C1 will affect the frequency as well as the tuning range. If C1 is too large then the tuning range will be small and conversely if C1 is too small then the oscillator may tune over a wider range of frequencies than desired.

After the oscillator has been adjusted, check the RF tuning. This may be done with the aid of a tuning "wand", which is merely an iron dust core slug and a brass slug of diameter small enough to fit into the coil L1. First check the 50 mc. end by tuning to maximum capacity and feeding a signal of about 55 mc. in at the antenna terminals. The tuning wand may then be used to determine whether L1 is too large or too small. If the brass slug causes the receiver sensitivity to increase then L1 is too large and the turns must be separated. The opposite is true if the iron slug causes the sensitivity to increase. Adjust the inductance L1 for maximum sensitivity.

The next step is to tune to minimum capacitance and feed a signal of about 85 mc. into the antenna terminals. Note carefully the effect of the tuning wand on receiver sensitivity. If the iron core, for example, causes the signal to increase, this means that the tuning capacity is too small and the RF tuning range is too great for the oscillator. In this case, C2 must be increased and L1 readjusted. After some experimentation with this circuit, the technician should find it easy to correct the front end tuning and to expand or contract the tuning range to meet his requirements.

Alignment of the sound IF channel is the same as for any FM receiver. The signal generator (modulated) tuned to 21.5 mc. is connected at point D (in figure 5). Trimmers C58 and C63 are then tuned for maximum speaker output, then tuned C65 to a minimum or null in the output. The loudspeaker is used as output indicator.

After these initial adjustments have been made the receiver is ready for operation. Some further "touching up" will be required after the television signal is tuned in, but this should not be attempted until a satisfactory antenna installation has been made. Before the received picture is discernible, it will be necessary to adjust both horizontal and vertical speed controls until the picture is correctly synchronized. Proper synchronization will be evidenced by a "locking in" of the picture so that it is stationary on the screen and does not drift vertically or tear horizontally.

THE INSTALLATION AND FINAL ADJUSTMENT.

One of the most important parts of your television receiver is its antenna. The requirements as in alignment and circuit design are much more exacting and subject to difficulties than in the ordinary broadcast receiver. The eye is more sensitive in discrepancies in what it sees than the ear is about what it hears. Therefore, care must be taken in the antenna installation to minimize reception of unwanted interference such as reflection from buildings, man made noise and poor sensitivity. Reflection of the television signal from surrounding buildings will manifest itself as a double or blurred image on the television screen. Excessive noise and poor sensitivity will result in loss of picture detail as well as tearing or drifting of the picture. The type of antenna required depends a lot upon the location of the receiver. In the average location not too far distant from the television transmitter, an antenna of the type illustrated in Figure 6A will serve admirably. This antenna is called the Folded Dipole and is used with the 300 ohm ribbon type .transmission line. In order to balance the feeder system so that it doesn't pick up man made noises, the feed line may be twisted or transposed at random points as it is fed into the house. The antenna illustrated in Fig. 6B may be used where higher sensitivity is required as in locations near the end of the service range of the local television broadcast station. Performance of the two general types of antennae illustrated may be improved by adding reflector or director elements. A simple and efficient antenna-reflector type of array is available as a standard item of many antenna manufacturers. This array consists of a simple half-wave dipole and reflector (or director) spaced approximately .2 wavelength apart and arranged so that the plane of the elements is horizontal. This type of directional array is useful in eliminating reception of unwanted noise or reflections that may occur in directions other than that of the television transmitter.

An antenna of extremely high sensitivity for operation in areas where the received signal may be weak can be constructed by using the array illustrated in Figure 6B and placing a similar array of elements (slightly longer than 80") directly behind the antenna, to form a reflector system. Some experimentation on the length of the reflector elements as well as spacing between reflector and antenna may be necessary if optimum signal pickup must be attained.

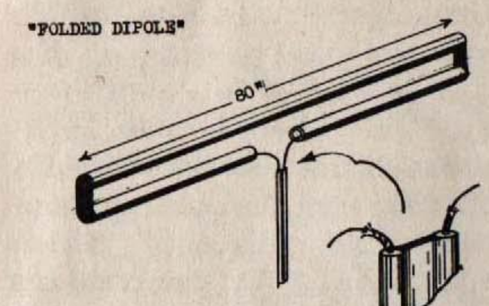


Fig. 6A

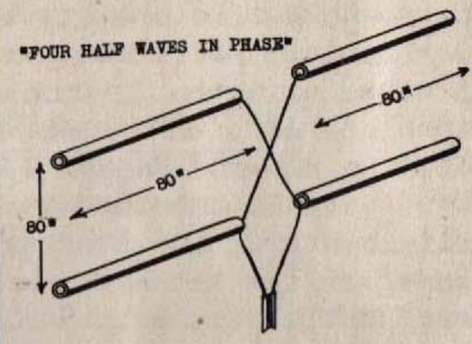


Fig. 6B

After the installation has been completed, a local television station should be tuned in and "touch up" adjustments then made. First, be sure a local station is operating at the time you tune in (this can be ascertained by consulting your newspaper or a local station). Turn on receiver, remembering not to advance the Brightness - AC switch control too far. As the tuning control is turned, starting from the high frequency end of the band, reception of the television signal will be evidenced by a loud buzz in the speaker. When this "buzz" is received the dial should be turned carefully until the sound is heard clearly. The tuning control should be set where the sound is strongest and the buzz disappears. Increase Brightness until light is visible on the cathode ray tube screen. The un-synchronized picture will then appear as a pattern of light streaks on the screen. Tune the horizontal speed control until the picture becomes discernible. If the picture is drifting rapidly upward or downward, adjust the vertical speed control until stationary. The picture may then require re-focusing and also adjustment of contrast. Adjustment of the contrast control should be carried out in conjunction with the brightness control. For increasing picture contrast, the contrast control should be increased and brightness reduced. The reverse is true when a less contrasty picture is desired.

RESISTORS, cont'd.

Legend	Value
R45	4.7K 1/2 W
R46	100 K 1/2 W
R47	4.7 meg 1 W
R48	4.7 meg 1 W
R49	470 ohms 1/2 W
R50	470 ohms 1/2 W
R51	100K pot
R52	250K 1/2 W
R53	250K pot
R54	500K 1/2 W
R55	1 meg 1/2 W
R56	1 meg 1/2 W
R57	68K 1/2 W
R58	6.2K 1/2 W
R59	68K 1/2 W
R60	1 meg 1 W
R61	1 meg 1 W
R62	20K 1/2 W
R63	1K 1/2 W
R64	100K 1/2 W
R65	2,2K 1/2 W
R65A	50K 1/2 W
R66	100K 1/4 W
R67	100K 1/4 W
R68	100K 1/4 W
R69	1 meg pot.
R70	24K 1/2 W
R71	100K 1/2 W
R72	50K 1/2 W
R73	220K 1/2 W
R74	220 ohms 2 W
R75	33K 1/2 W
R76	330K 1 W
R77	68K 1/2 W
R78	68K 1/2 W
R79	470K pot.
R80	470K pot.
R81	470K 1 W
R82	470K 1 W
R83	470K 1 W
R84	470K pot.
R85	470K 1 W
R86	880 ohms 25 W
R87	5K 10 W
R88	15K 10 W
R89	R5 ohms ½ W

COILS & TRANSFORMERS

Legend	Value
T1, T2, T3, T4, T6, L1, L2, L3, L4, L5,	- See Page **11**.
T5 Vertical Blocking Oscillator	3:1 Ratio interstage audio coupling transformer. (Low impedance winding connected to plate circuit.)
T7 Audio Output	Output transformer to match 6V6 Plate to Speaker Voice Coil.
T8 High Voltage Power Trans.	2200V. Oscilloscope type power Transformer (1 to 2 ma.) with 2.5V, 2 amp. (H.V. insulation) rectifier winding.
T9 Low Voltage Power Transformer	770V. C.T., 150 ma., with 5V., 3amp., 6.3V 7.5 amp., windings. (Separate filament transformers may be used instead.)
T10 Filament Transformer	6.3V 2 amp.
L6	5 to 10 henry 150 ma. filter choke

TUBES

H.F. Osc.	6J5
R.F. Amp.	6J6
Mixer	1852/6AC7
Video IF (1)	1852/6AC7
Video IF (2)	1852/6AC7
Detector	6H6
Video Amp.	6AG7
Picture tube	5BP4 or 7EP4
Sync. Amp.	6SN7
Vert. Sawtooth	6SN7
Horiz. Sawtooth	6SN7
Vert. Amp.	6SN7
Horiz. Amp.	6SN7
Sound IF	6SJ7
Discriminator	6H6

TUBES - cont'd.

Sound Audio	6J5 or 6SF5
	6V6
High Voltage Rect.	2X2/879
Low Voltage Rect.	5U4G

TUBE SOCKETS

- 1 Octal, Ceramic (For oscillator)
- 13 Octal, Bakelite
- 1 7 Prong Miniature
- 1 4 Prong, Ceramic (For 2X2)
- 1 11 Pin Magnal (Cathode Ray Tube)

SPEAKER

5" or 6" PM Type with output transformer

* *1 to 2 inch length of 150 ohms "twin-lead antenna cable".*

** *Two .06 uf, 1600 W.V. condensers in series may be used.*

*** *Two .06 uf, 1600 W.V. condensers in series, such as generator filters (paper) may be used.*

ABBREVIATIONS

W.V.	-	Working Voltage
K	-	one-thousand ohms
meg	-	one-million ohms
W	-	Wattage rating
ww	-	wire wound
elect.	-	electrolytic (dry) type capacitor
Paper	-	paper tubular type capacitor
mica	-	molded mica type capacitor

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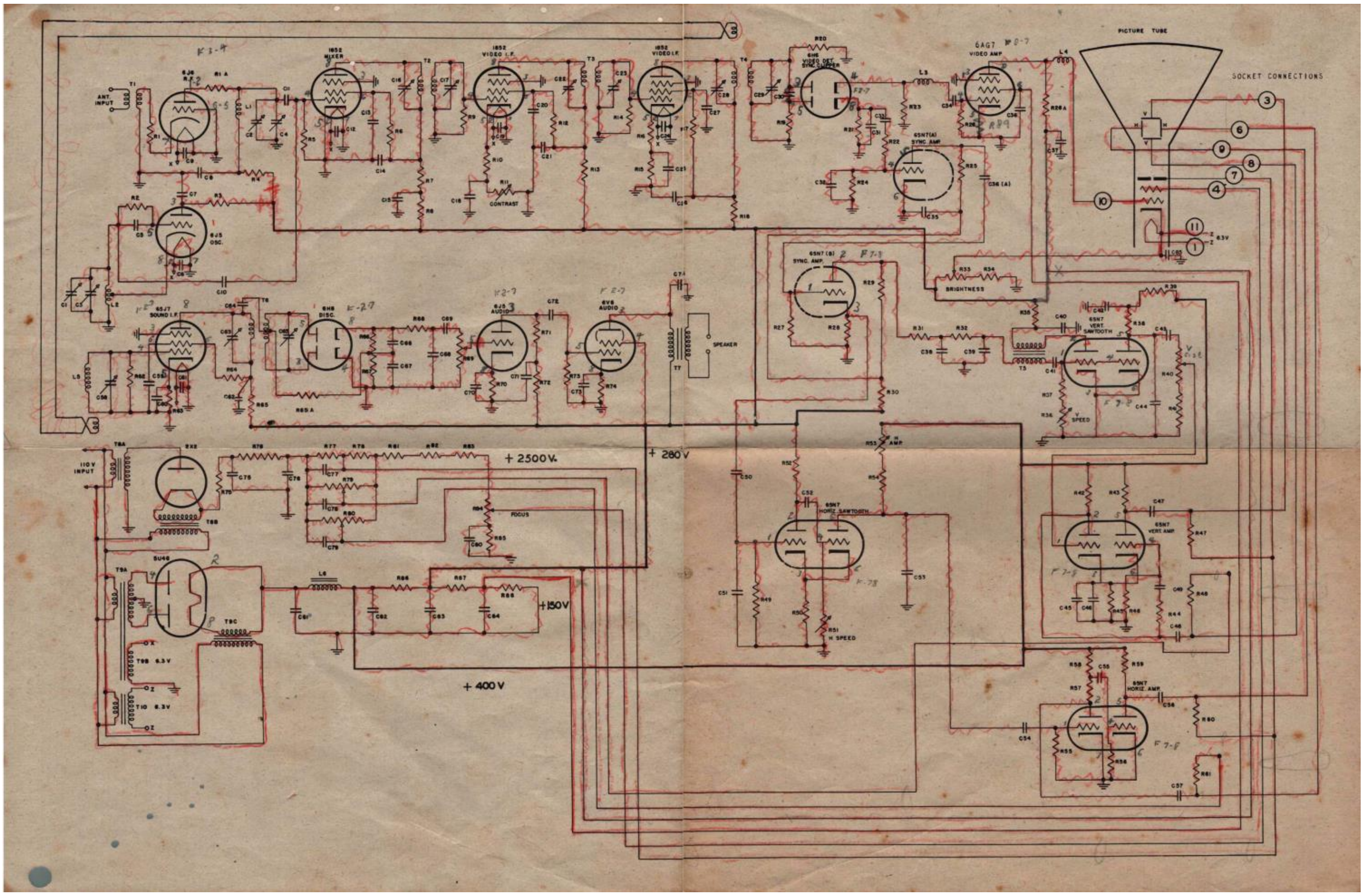

PICTURE TUBE
SOCKET CONNECTIONS
ANT. INPUT
6J6 R.F.
1852 MIXER
1852 VIDEO I.F.
1852 VIDEO I.F.
6H6 VIDEO DET.
6AG7 VIDEO AMP
6SN7(A) SYNC. AMP
CONTRAST
6J5 OSC.
BRIGHTNESS
6SN7(B) SYNC. AMP.
6SJ7 SOUND I.F.
6H6 DISC.
6J5 AUDIO
6V6 AUDIO
SPEAKER
6SN7 VERT SAWTOOTH
SPEED
110V INPUT
2X2
+ 2500V.
+ 280V
FOCUS
6SN7 HORIZ. SAWTOOTH
H AMP
H SPEED
6SN7 VERT AMP
5U4G
+150V
6.3V
6.3V
+ 400V
6SN7 HORIZ. AMP

VISION
Research Laboratories

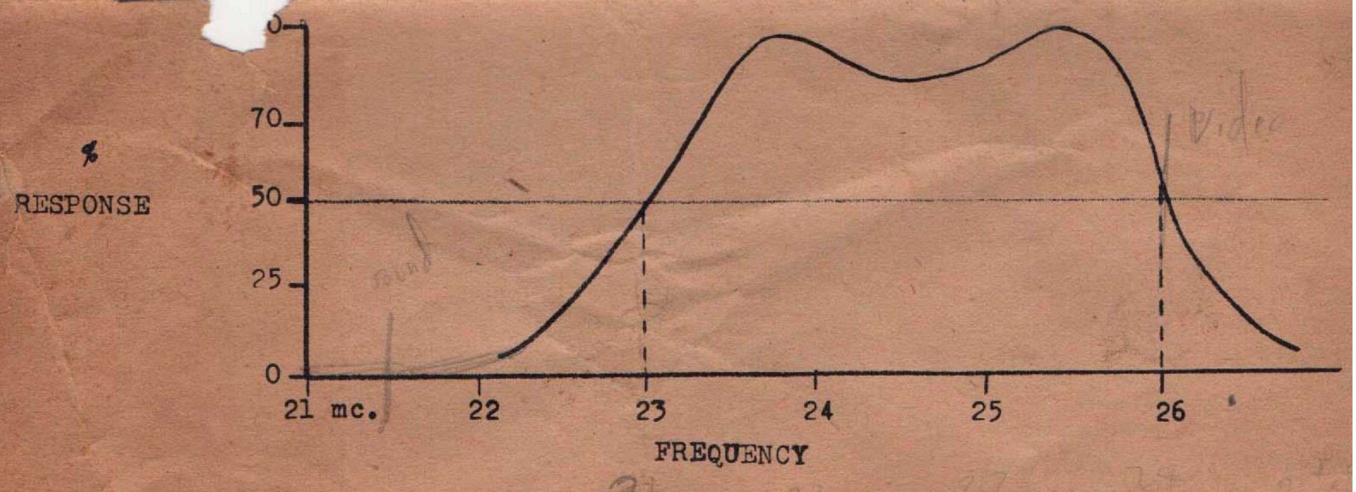
P.O. Box #52, Kew Gardens 15, N.Y.

SPECIFICATION SHEET

COIL KIT 500A

In order to conform with the new RMA standards for television receivers, Coil Kit 500 has been revised to operate in the 21.5 to 26 mc. Video I.F. band, and is now designated as Coil Kit 500A.

Coil Kit 500A contains the same components and alignment procedure, is the same except for frequency. The Sound I.F. Discriminator and Input Transformer (previously 8.25 mc.) are aligned at 21.5 mc., and the Video I.F. Transformers are adjusted to the 23-26 mc. band. The 50% response points of the video I.F. response curve should occur approximately at 23 and 26 mc. The graph shows average amplitude vs. frequency characteristic of the video I.F. amplifier using C[illegible]A.



VISION

TELEVISION RECEIVER COIL KIT NO. 500A

1. Ant. Input Trans.
2. Osc. Coil
3. RF Amp. Coil
4. Video IF Input Trans.
5. Video IF Interstage
6. Video IF Output Trans.
7. Sound Input Trans.
8. Discriminator Trans.
9. Video Det. Peaking Coil
10. Video Amp. Peaking Coil

INSTRUCTIONS WRAPPED AROUND EACH COIL