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"HIS MASTER'S VOICE" SERVICE MANUAL

for

TELEVISION RECEIVER CHASSIS TYPE E 2

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THE GRAMOPHONE COMPANY LIMITED
(Incorporated in England)
HOMEBUSH - - - N.S.W.

PART No. 682 - 5261

TV Receiver — Chassis Type E2

SPECIFICATION

POWER SUPPLY:
200, 230, 240V. A.C., 50 cycles per second.

CONSUMPTION:
190 watts.

CARRIER FREQUENCIES:

Channel	*Vision Carrier*	*Sound Carrier*
1.	50.25 mc/s	55.75 mc/s
2.	64.25	69.75
3.	86.25	91.75
4.	133.25	138.75
5.	140.25	145.75
6.	175.25	180.75
7.	182.25	187.75
8.	189.25	194.75
9.	196.25	201.75
10.	210.25	215.75

In two of the switch positions marked with dots between Channel 10 and Channel 1, a straight-through I.F. connection is provided from the aerial input socket. This is to provide for the future attachment of a U.H.F. adaptor, if required, and to facilitate servicing.

AERIAL INPUT:
Provision for 300 ohm balanced twin, or 75 ohm coaxial feeder.

INTERMEDIATE FREQUENCIES:
Vision I.F. — Carrier .... 36.0 mc/s.
Sound I.F. — Carrier .... 30.5 mc/s.

FUSE TYPES:
2 amp. — Mains.
250 mA — H.T.
500 mA — H.T.

VALVE COMPLEMENT

V1	6CW7	R.F. Amplifier.
V2	6BL8	Frequency Changer
V3	6BX6	1st I.F. Amplifier
V4	6BX6	2nd I.F. Amplifier
V5	6BX6	3rd I.F. Amplifier
V6	6CK6	Video Amplifier
V7	6N3	Power Rectifier
V8	6N3	Power Rectifier
V9	6BL8	Gated A.G.C. and Noise Inverter
V10	6BL8	Vert. Sync. Separator and Horizontal Sync. Separator
V11	6BX6	Intercarrier Amp.
V12	6BX6	Limiter
V13	6AL5	Ratio Detector
V14	6BM8	Audio Amplifier and Audio Output
V15	6BM8	Blocking Oscillator and Vertical Output
V16	6BX6	Reactance Valve
V17	6AL5	Phase Discriminator
V18	6BL8	Horizontal Oscillator and Horizontal Driver
V19	6CM5	Horizontal Output
V20	6W2	E.H.T. Rectifier
V21	6R3	Damping Diode
MR1	0A70	Vision Detector
MR2	0A81	Horizontal Sync. Damping Diode
MR3	39K2	Tuner A.G.C. Clamp
C.R.T.	17HP4-B	Picture Tube

Caution

The normal B+ voltages in this receiver are dangerous. Use extreme caution when servicing this receiver. The high voltage at the picture tube anode (16,000 Volts) will give an unpleasant shock but does not supply enough current to give a fatal burn or shock. However, secondary human reactions to otherwise harmless shocks have been known to cause injury.

Always discharge the picture tube anode to the chassis before handling the tube.

The picture tube is highly evacuated and if broken it will violently expel glass fragments. When handling the picture tube, always wear goggles.

FEATURES

(1) 21 valves and three metal rectifiers.
(2) Aluminised electrostic focus picture tube type 17HP4B, with correct aspect ratio to avoid loss of picture at top and bottom. Important with film titles.
(3) Phase linear treatment of three stage I.F. amplifier to make tuning position non-critical.
(4) Genuine D.C. coupling from video detector through the video amplifier to the picture tube maintains correct levels of intensity from black to white. This ensures that the picture viewed on the screen is a true reproduction of the picture transmitted, especially in dark scenes, or very light scenes.
(5) Low noise level ensured by cascode connection of R.F. amplifier and delay on the A.G.C. applied to it.
(6) High gain gated A.G.C. gives fast action to cope with aircraft flutter and has immunity from impulse interference.
(7) Separate vertical and horizontal sync. separators and a noise inverter maintain efficient synchronisation in all useful operating conditions.
(8) Both amplitude limiter and ratio detector combine to prevent impulse noise and "sync. buzz" from being present in the sound even in the weakest areas.
(9) Ample feedback and compensated volume control make full use of the high fidelity capabilities of the F.M. transmission.
(10) Laminated safety glass protects against possible picture tube implosion, and is tinted to form an optical filter which improves the contrast of the picture under high lighting conditions.

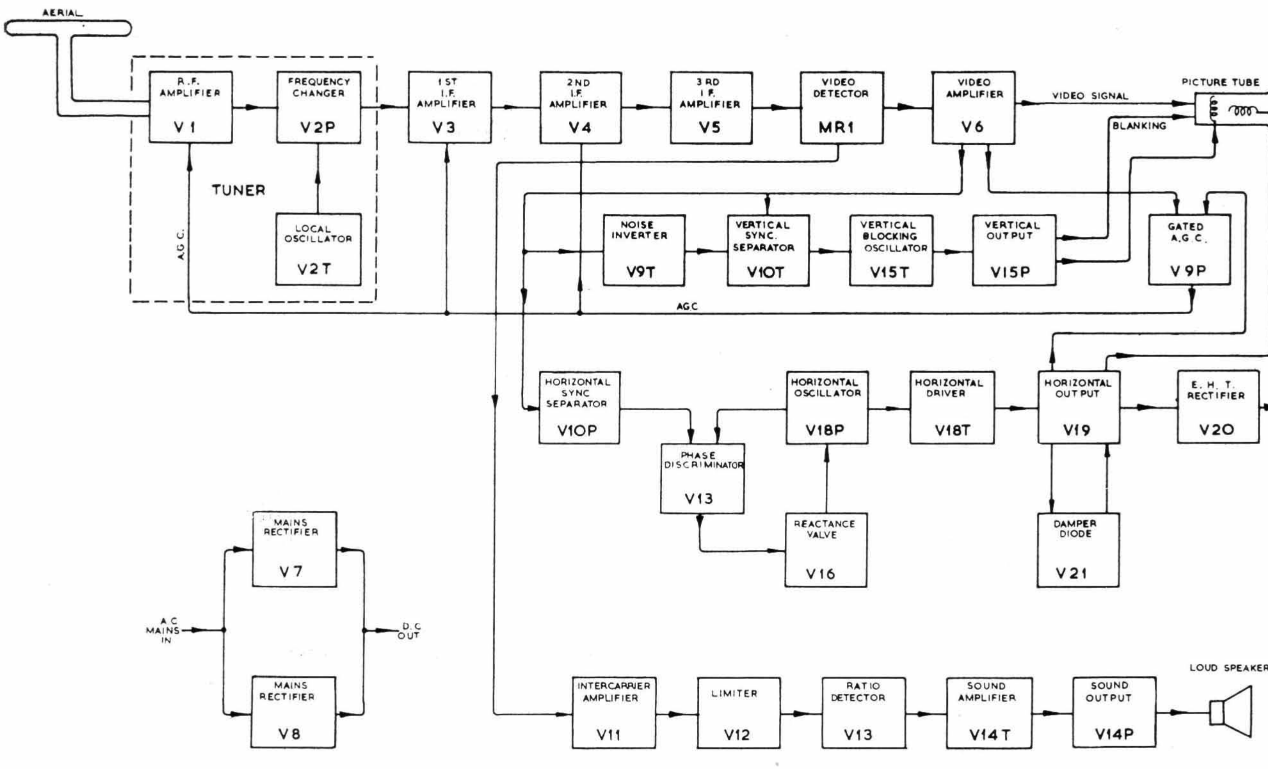


FIG. 1

CIRCUIT DESCRIPTION

R.F. UNIT

The tuner section contains two valves. The two halves of the first valve (V1) in "cascode" connection form the R.F. Amplifier. Tuning of the input circuit between channels is accomplished by switching increments of inductance on the rear card (Card 4) of the switch-tuner. The input to this circuit is matched for 75 ohms. An aerial coupling unit which is, in effect, a balance-to-unbalance transformer, enables a 300 ohm feeder to be used if required. The alternative inputs, 300 ohm and 75 ohm, are provided on the rear of the chassis.

A peaking inductance couples the anode of V1A to the cathode of V1B. This is fixed-tuned to maintain performance in the high frequency channels.

Coupling between the R.F. Amplifier V1 and the Frequency Changer V2 is through a two-section band-pass circuit. The two inductance legs of this circuit have increments switched by Card 3 and Card 2 of the switch. The pentode section of V2 acts as mixer, while the triode is the local oscillator. Tuning (channel selection) of the oscillator is by means of switched inductance increments on Card 1 (front card). In addition, a small variable capacitor provides fine tuning, and the control shaft for this capacitor is concentric with the control shaft for the switch.

Intermediate frequency output from the mixer is via the first I.F. transformer mounted on the tuner and a short 75 ohm cable which forms part of the bottom capacity coupling to the I.F. Amplifier.

In two of the three switch positions not numbered (the two positions adjacent to Channel 1) the oscillator H.T. is removed, and an additional inductance, L16, switched into the input circuit on Card 4. This gives a straight-through connection for intermediate-frequency signals fed into the aerial socket to facilitate servicing, and to provide for the possibility of a U.H.F. adaptor being attached.

I.F. AMPLIFIER

The tuner I.F. output is coupled to the grid of the first I.F. Amplifier V3 and tuned by coil L52. There are three stages of I.F. Amplification using double-tuned inter-stage coupling circuits. Top capacity coupling is used between the two inductance elements of each circuit which are wound on separate formers. Trap circuits are coupled to I.F. coils L52 and L56, the former (L53 and C25) tuned to the sound I.F. and the latter (L57, C35 and C36) to the sound I.F. of the adjacent sound channel. The first two I.F. valves, V3 and V4, have A.G.C. applied to them and consequently have small unbypassed resistors in their cathode circuits to minimise detuning of their grid circuits by A.G.C. bias.

Coupling the last I.F. stage to the vision detector diode is a further double-tuned circuit IFT2 coupled by an inductive link with L59.

VIDEO AMPLIFIER

The detected video output from germanium diode MR1 is amplified in V6 and fed to the picture-tube cathode. L60, L61, L62 are peaking chokes to maintain high frequency response. IFT3 with R35 is a 5.5 Mc/s trap to eliminate the intercarrier component from the vision signal.

INTERCARRIER AMPLIFIER AND SOUND OUTPUT

The frequency-modulated 5.5 mc/s component from the video detector is applied via transformer IFT3 in the output from the diode MR1 to the intercarrier amplifier V11. A single-tuned circuit couples V11 to the limiter V12.

Output from the limiter is demodulated by ratio-detector V13 to provide the audio signal which passes through the tone control network and volume control, is amplified by the triode section and drives the output pentode section of V14. Feedback is derived from the output transformer secondary and is applied to the cathode of both sections of V14.

The tone control provides normal flat response at mid position. Full anti-clockwise rotation cuts high frequencies, as may be needed when excessive sibilance or high frequency noise is transmitted. Full clockwise rotation cuts low frequencies. This facility may be needed in "live" reverberant locations such as halls, or schools, or when low frequency noise such as hum is transmitted.

A margin of sound gain is provided so that the full 3 watts output is obtained from sound signals which are not fully modulated. Moreover, the sound output stage has a controlled overload characteristic which ensures that, when overdriven, it does not "paralyse" but merely clips the peaks and so remains comparatively free from audible distortion.

SYNC SEPARATORS

Separate vertical and horizontal sync. separators are employed (V10 triode and pentode sections). Video signal with sync tips positive is taken from the video amplifier anode and applied to the grids of both sections of V10. Differentiation in C56 and R72 occurs in the pentode grid. Grid leak bias on these valves ensures that they conduct only on sync tips and hence the sync output at their anodes is free of picture information. Since differentiation has occurred at the grid of the pentode section, its output is essentially horizontal sync pulses only. The triode section output is followed by a three-stage integrator and only vertical sync pulses pass out of this circuit.

NOISE INVERTER

Anode current in the triode section of V9 is normally cut off by the steady bias between its grid and cathode. Video signal with sync tips positive is fed to the grid of this valve from the video amplifier and the valve is biased so that under normal conditions this signal will not drive it into conduction. However, if impulse interference with amplitude greater than sync pulse height is present, the valve will conduct during the interfering pulse and amplified, inverted interference pulses will appear at the valve anode. Since the anode load of this valve (R69) is also in the path through which video signal is fed to the vertical sync separator then the interfering pulses cancel out across this resistor and the vertical sync separator thereby has good immunity to the effects of impulse noise.

GATED A.G.C.

The same video waveform that feeds the noise inverter is fed to the grid of the A.G.C. amplifier (Pentode section V9). The polarity of this waveform is with sync tips positive, and the valve is biased so that it can conduct during sync pulses. However, it can only do this if there is a positive pulse applied to its anode via

C52 from the line output transformer during line flyback. This overcomes the possibility of the valve conducting on impulse interference occurring during the period between line sync pulses, and makes the A.G.C. operation immune to impulse interference.

The current through the valve depends on the height of the sync pulses and the setting of the contrast control. This current flows from chassis through R25, R27, R55, R54 and R53 to the anode of the valve. The current pulses in the anode of the valve are smoothed by C50, so that a steady DC potential is developed across R27 and R25, which is the A.G.C. bias for the I.F. valves, V3 and V4. Note that this potential is negative with respect to chassis. Fixed cathode bias for the A.G.C. valve is obtained from the voltage divider R57, R58 and the cathode resistor network R60, R61, and VR2B.

The grid voltage is obtained from the CONTRAST control and is applied to the A.G.C. valve grid via R63 and R67. Because the A.G.C. valve has a small grid base (about —2V.) compared with the voltage from its cathode to earth (+50V.), the voltage from its grid to earth during conduction remains substantially constant (+48 to 49 volts) as long as any A.G.C. voltage is produced. Thus an increase of voltage at its grid due to the CONTRAST control produces an equal *decrease* of grid voltage due to sync. tips from the video output. In this way the CONTRAST control voltage sets the video output voltage, and automatic control of the A.G.C. voltage and hence I.F. gain. At the same time, the CONTRAST control varies the bias of the noise inverter grid so that sync. tips are always held just below cut-off independent of the height of the video signal.

VR2B is a pre-set adjustment of the A.G.C. cathode bias and this is set in the factory for +50V.

A.G.C. voltage is also applied to the R.F. amplifier from the junction of R51 and R52. This latter resistor, together with C49, form a smoothing filter for the pulses appearing at V9 anode. The junction of these two resistors is clamped to —0.8V. by the selenium rectifier MR3 acting as a clamping diode and not until the anode of V9 falls to a value fixed by the H.T. voltage divided by the ratio of R50 and R51 to R52 does this point become unclamped. A "delayed" bias is therefore provided to the R.F. stage, ensuring that maximum R.F. stage gain is available with low signal levels to minimise noise from the frequency converter.

The division ratio of the voltage divider supplying I.F. bias is important. If the ratio is too small, the tuner will start to receive bias before converter noise has disappeared from the picture. As a result, noise will be visible even at high signal levels. If the ratio is too large, an excessive degree of control will be demanded of the I.F. amplifier before the tuner starts to receive bias. This can cause overloading of the I.F. amplifier. Therefore the ratio is adjusted for optimum in the factory by setting the resistor chain R53, R54, R55.

VERTICAL DEFLECTION CIRCUITS

Vertical sync pulses from the sync separator via the integrator are used to synchronise the blocking oscillator comprised of transformer TR3 and triode portion of V15. "Height" is varied by adjustment of the D.C. potential fed to the blocking oscillator anode and "Vertical Hold" is adjusted by varying the time constant of the blocking oscillator grid circuit. The Vertical Hold control VR6 is returned to the slider of the Height Control potentiometer VR5 so that the blocking oscillator frequency is unaffected when Height is adjusted. This makes the Vertical Hold almost independent of Height Adjustment.

The pentode section of V15 is the vertical output stage. The sawtooth waveform from the blocking oscillator is applied to the grid of the output amplifier and a sawtooth current waveform appears in the vertical output transformer TR4.

A feedback voltage is developed across R114 from the current in the deflection coils. This voltage is stepped up to the input grid of the frame output valve. Additional resistors, R112, A, B and C, are provided in series with the primary of the feedback transformer for factory adjustment of linearity to take up transformer inductance tolerances.

HORIZONTAL OSCILLATOR AND AUTOMATIC PHASE CONTROL

Automatic frequency and phase control is obtained by means of a sine wave type of "flywheel" circuit. Incoming horizontal sync pulses from the horizontal sync separator are fed via a transformer (damped by diode MR2) into the discriminator V17 where they are compared in phase with a sine waveform taken from the horizontal oscillator transformer TR6. In this circuit the sync pulse is applied in the same phase to both diodes of the discriminator. From the oscillator a balanced winding on the transformer feeds equal and opposite sine-wave voltages to the cathodes of the diodes. These pulse and sine waveforms are added together and detected by the diodes so that the voltage developed across R117 is equal to the peak negative voltage applied to the top diode and is negative with respect to the centre tap of the sine wave winding. Similarly, the voltage across R119 is equal to the peak negative voltage applied to the bottom diode and is negative with respect to the centre tap of the winding.

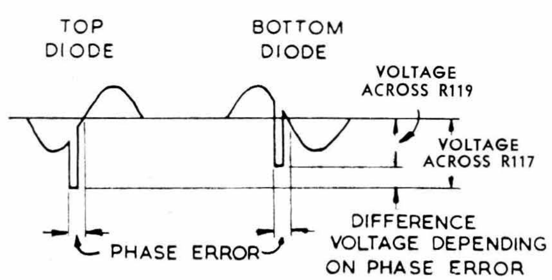
Since the two peak rectified voltages are in the same sense, negative with respect to the transformer centre tap, the discriminator output voltage, taken across the two load resistors, R117 and R119, will be their difference.

Fig. 2 shows how the sine wave applied to the diodes in opposite sense and the pulse applied in the same sense are added together.

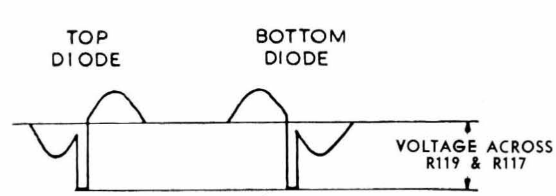
In Fig. 2 (*a*) there is a phase error between the incoming sync pulse and the receiver horizontal oscillator, the sync pulse arriving before the sine-wave crosses the zero axis. Then the voltage across R117 is greater than the voltage across R119 and the discriminator output (the difference between the above two voltages) is negative with respect to the bottom of the discriminator. If the phase error had been in the opposite sense, i.e., the sync pulse arriving *after* the sine-wave had crossed the zero axis, the discriminator output would be in the opposite direction, i.e., positive with respect to the bottom of the discriminator. When the phase error is zero, as in Fig. 2 (*b*), the voltages across R117 and R119 are equal and the resulting output is zero.

The discriminator output is connected in series with a fixed negative bias voltage of approximately —3.4 volts derived from the Reactance Bias potentiometer which taps off part of the grid leak bias developed in the horizontal driver grid circuit. Thus the D.C. voltage on the reactance valve (V16) grid is approximately —3.4 volts when there is zero phase error, more negative when the sync pulse leads in phase and less negative when the sync pulse lags.

The reactance valve V16 is essentially a capacitance shunted across the oscillator tank circuit and the effective value of its capacitance is varied by the control bias on its grid, developed by the discriminator, and is varied in such a direction as to correct for any change of phase which develops a correcting voltage.



(a) WAVEFORMS APPLIED TO PHASE DISCRIMINATOR DIODES WITH PHASE ERROR.



(b) WAVEFORMS APPLIED TO PHASE DISCRIMINATOR PHASE ERROR ZERO.

Fig. 2

HORIZONTAL DEFLECTION CIRCUITS

Negative voltage pulses from the anode of the horizontal oscillator (V18 pentode) are applied via a differentiating circuit C97 and R125 to the Horizontal Driver valve (V18 triode).

The horizontal driver valve (V18 triode) produces a negative pulse output which is timed to cut off the horizontal output valve V19 at end of a scan. When V19 is cut off sharply, the magnetic field that has been established in the horizontal output transformer during the scan collapses and the oscillatory circuit comprised of the transformer inductance and stray capacitances tends to "ring." However, after one-half cycle of oscillation the damping diode V21 starts to conduct. During the "flyback" time the magnetic energy has established itself in the reverse direction, and the picture tube spot has returned to the left-hand side of the screen.

When the damping diode conducts it permits current to flow at a controlled rate through part of the transformer. This current, passed by the auto-transformer into the deflection coils, forms the initial part of the horizontal scan. As the damper ceases to conduct the line output valve takes over and supplies the necessary current to complete the scan, at which point a further negative pulse on the grid of V19 starts the cycle over again.

During flyback a high voltage pulse is produced at the anode of the E.H.T. rectifier V20, which is peak-rectified, and then smoothed by the capacitance between inner and outer bulb coatings of the picture tube, and supplies E.H.T. of approximately 16,000 volts.

Energy recovered by the damping diode produces a boosted H.T. voltage of 550 volts which is used, if required, for focus voltage and also is divided down to 350 volts for supplying the G2 electrode voltage of the picture tube.

REMOTE CONTROL

By plugging into socket SK4, the octal socket in the rear of the chassis, volume and contrast can be controlled from the Remote Control Unit.

The remote volume control VR4A adds a variable resistance across the supply voltage of the sound limiter. Since this control can only *reduce* volume, the main volume control should be set for the maximum volume desired.

The remote contrast control VR2A feeds a variable D.C. voltage into the contrast control line, junction R63, R64A and R65. It varies contrast either side of a middle (normal) value which is set by the main contrast control.

Note that connection of the Remote Control Unit does not affect operation of the normal receiver volume and contrast controls.

INSTALLATION

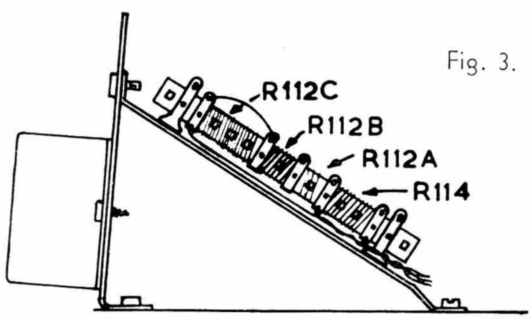
The receiver is shipped from the factory with the picture tube installed and all controls pre-adjusted for normal operation. It should only be necessary to ensure that the mains tapping is correctly adjusted for the mains voltage existing in the particular area and a suitable aerial connected to the aerial input socket. Either 75 ohm or 300 ohm feeder may be used. In very strong signal areas it may be necessary to use an attenuator in the aerial lead to avoid overloading the receiver. The various operating controls should be checked for proper operation, *and their use demonstrated to the purchaser* as described in the installation manual. It is necessary to remove the back of the cabinet to gain access to the mains adjustment panel.

LINEARITY

Apart from the normal and pre-set operating controls available on the front panel, there are two adjustments at the rear of the receiver for vertical and horizontal linearity. Normally these should only need adjustment if a component change is made in the deflection amplifiers.

(A factory adjustment of the linearity of the vertical scan is carried out by means of the jumper wire connecting to a junction of the resistors R112A, R112B, R112C. It should not be necessary to alter this setting unless component changes are made in the feedback circuit of the vertical output valve, V15. If this is done, then the jumper on this resistor chain should be connected in the way which produces best linearity of the vertical scan.

Fig. 3.



RESISTOR PANEL FOR VERTICAL LINEARITY ADJUSTMENT.

The "Line Linearity" control should be adjusted only with the aid of a meter connected across the horizontal output valve (V19) cathode resistor. With the meter set to a suitable current range, the linearity control should be set to produce a minimum current indication.

50V. ADJUST AND CONTRAST RANGE

Both of these controls have been accurately set in the factory and should not require readjusting unless one or more of the circuit elements have been changed. The procedure for adjustment is as follows: Display a normal picture on the screen and adjust the 50V. ADJUST control until there is a potential of +50V. at the cathode of V9. This 50V. reading should be made with a V.T.V. or a voltmeter of 100 Ohms/Volt, on the 300V. range. Next, turn the contrast control to its maximum anti-clockwise position and adjust the CONTRAST RANGE control until a very weak picture is displayed. Check that with this setting of the control the contrast available with the contrast control turned to its maximum clockwise position is in excess of normal requirements.

ION TRAP

If ion trap adjustment is necessary, set brightness control at normal brightness or if no raster is evident at all set brightness control at the centre of its range. Check that iron trap magnet is placed on the neck of the tube in the region of the bend in the gun. (This position is shown in Fig. 4). Rotate magnet around the tube neck and move it backwards or forwards along the neck until the position for maximum brightness of raster is obtained. Readjust brightness setting if necessary to keep raster brightness at that of a reasonably bright picture, but not excessively so.

Check also that the position found for the magnet by the above procedure produces good overall focus.

It is most important that the ion trap be accurately set because misadjustment not only produces astigmation, but can damage the picture tube.

PICTURE SHIFT

The electrostatically focused picture tube in this receiver may require only one adjustment on installing the receiver in a new location, and that is to centre the picture. Small shifts in position of picture may occur due to the effect of the earth's magnetic field in different locations. The picture may be re-centred by rotating the two wire-ring shift magnets on the rear of the deflection yoke.

PICTURE TILT

If the picture is not square with the edges of the mask, the deflection coils should be rotated by gripping the rotating plate on the rear of the deflection assembly by its finger-grips, and turning the coils until the picture is squared up. It may be necessary after this operation to centre the picture by means of the shift magnets.

LINE BALANCING TRIMMER

This adjustment is located on the back of the deflection yoke assembly and balances the capacities between deflection coils. The control should be adjusted to minimise the amount of vertical deflection of horizontal lines on the left-hand side of the picture. This deflection appears as a waviness in the horizontal lines.

FUSES

Three fuses are provided, one in the mains circuit and two in the H.T. circuits. The H.T. fuses should only be replaced with similar types.

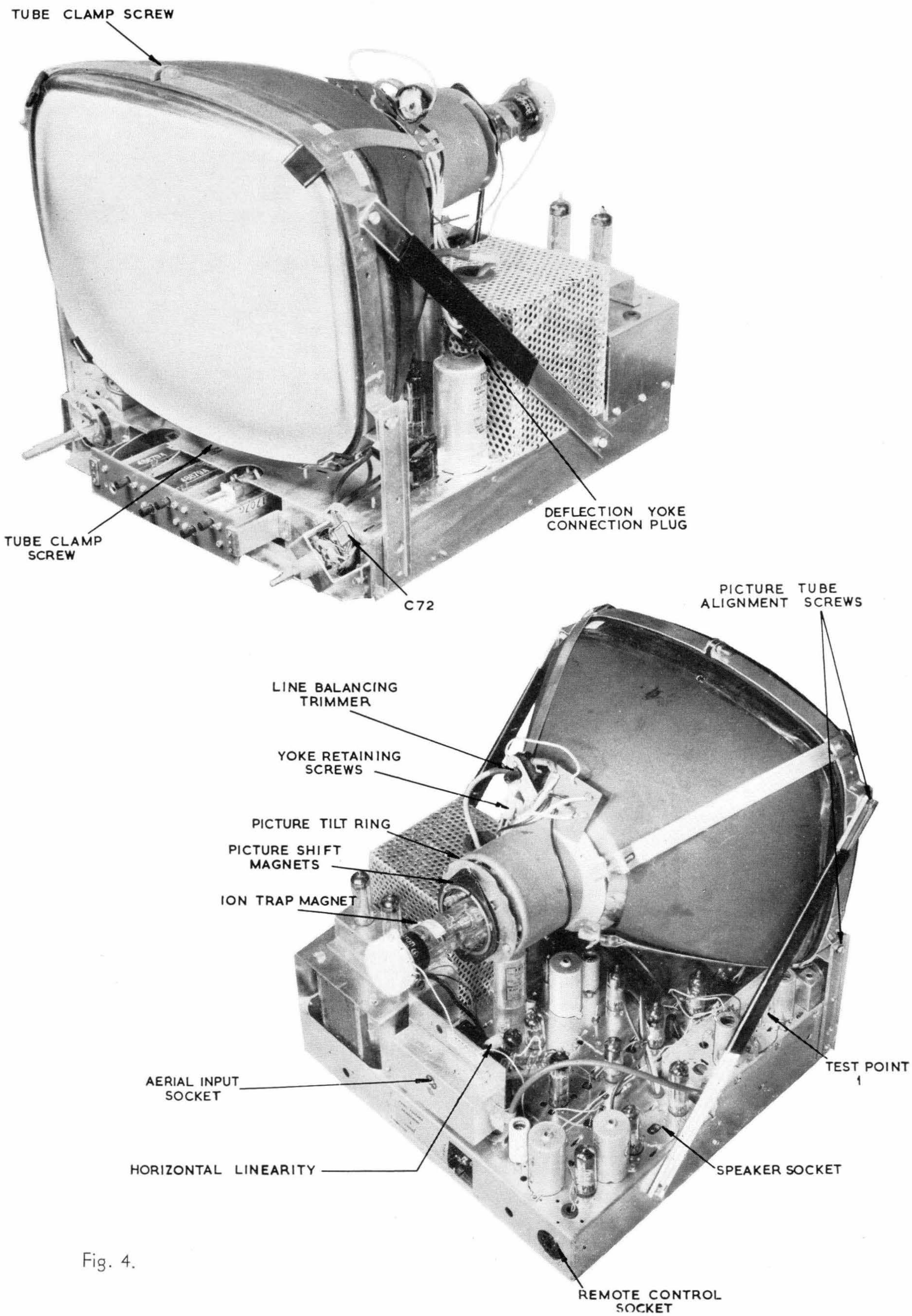

TUBE CLAMP SCREW
TUBE CLAMP SCREW
DEFLECTION YOKE CONNECTION PLUG
C72
PICTURE TUBE ALIGNMENT SCREWS
LINE BALANCING TRIMMER
YOKE RETAINING SCREWS
PICTURE TILT RING
PICTURE SHIFT MAGNETS
ION TRAP MAGNET
AERIAL INPUT SOCKET
HORIZONTAL LINEARITY
TEST POINT 1
SPEAKER SOCKET
REMOTE CONTROL SOCKET

Fig. 4.

DISMANTLING

REMOVAL OF CHASSIS

Disconnect the receiver from the mains supply and remove aerial plug.

Remove the back panel and pull off knobs from the main controls on the front of the receiver. It is not necessary to touch the pre-set control panel.

In table models, remove the loudspeaker from the side of the cabinet.

Remove the four screws underneath the cabinet which secure the chassis.

The chassis may then be withdrawn from the cabinet.

REMOVAL OF PICTURE TUBE

Having removed chassis from cabinet, disconnect the picture tube socket, E.H.T. connector, and slide off the ion trap.

Undo the four knurled screws holding the deflection yoke assembly to support straps and slide these out of the slots in the brackets.

Disconnect the yoke assembly from the chassis and remove from picture tube.

Remove the two screws holding the top of the tube clamping ring to the sloping side supports and allow the tube to pivot about the two bottom screws on the ring until the tube is lowered forward on to its face on some soft support, such as a thick book or block of wood covered with felt.

Slacken the two screws in the tube clamping ring and lift tube out.

N.B.: The picture tube should be carefully handled and should never be placed face down on a bench. Always ensure that it is placed on a soft, clean surface such as felt, so that the tube face does not become scratched. Whenever possible, keep tubes in their original manufacturer's carton.

REPLACEMENT OF PICTURE TUBE

With clamping ring laid forward as above, place the picture tube in position on its face. Ensure that the conductive rubber band is in position, and then tighten clamping screws.

Pivot clamp ring into its vertical position, and insert the two top support screws.

Replace yoke assembly on neck of tube with its tag panel and trimmer on the top.

Replace support straps and tighten knurled screws.

Replace deflection yoke connector, ion trap, picture tube socket, and E.H.T. connector.

N.B.: The rubber band around the picture tube is made from conductive rubber and should never be replaced by a similar, but non-conductive, rubber band.

REPLACEMENT OF CHASSIS IN CABINET

Before returning the chassis to the cabinet, clean the face of the tube and the inside surface of the protective glass screen in the cabinet. Also stretch the rubber dust-sealing ring around the tube clamping ring by hooking it top and bottom behind the clamping screws so that it will remain in this position until the chassis has been replaced in the cabinet.

Place chassis in cabinet and replace screws holding chassis to cabinet base, ensuring that the picture tube is central and hard up against the mask so that there is no gap between mask and tube face.

From back of cabinet prise dust-sealing ring up over the top clamp screw so that it flicks into position around the mask.

Replace loudspeaker in table models.

Replace cabinet back and knobs.

Replace aerial and mains connections.

REMOVAL OF TUNER

With chassis removed from cabinet the tuner may be disconnected by unplugging the coaxial I.F. lead and the power supply leads joining the tuner to the main chassis. Undo the two screws securing the aerial coupling unit to the rear of the receiver chassis and this unit will then come away with the tuner when the four screws securing the tuner to the side of the chassis are removed.

REPLACEMENT OF LINE OUTPUT TRANSFORMER AND E.H.T. RECTIFIER

These two components are contained within petroleum jelly in a moulded plastic container to minimise the effects of corona. If faulty, the unit should be replaced as a whole. When fitting a replacement item ensure that the leads are trimmed to the exact length required and that leads carrying high voltage are not touching the perforated cover. The suppressor choke on the cap of the damper valve should be well away from the side of the cover also.

HORIZONTAL A.P.C. ADJUSTMENT

If either the reactance valve, V16, or the horizontal oscillator valve, V18, are changed, it may be necessary to readjust the pre-set control labelled "Reactance Bias" (VR7). Also, it may be found that as the receiver will not pull-in to lock, in which case it may be possible to correct the trouble by adjustment of "Reactance Bias" without changing the valve.

The procedure for adjustment is as follows:

Render the A.P.C. action ineffective by shorting pin 2 of V10 to earth.

Rotate the "Reactance Bias" control located beneath the centre of the chassis slowly until the line frequency is approximately correct as will be evidenced by a complete picture appearing on the tube (even thought it is not solidly "locked").

The reactance bias should then be checked and should be within the range —3.2 to —3.6V. If the voltage is outside this range, it should be

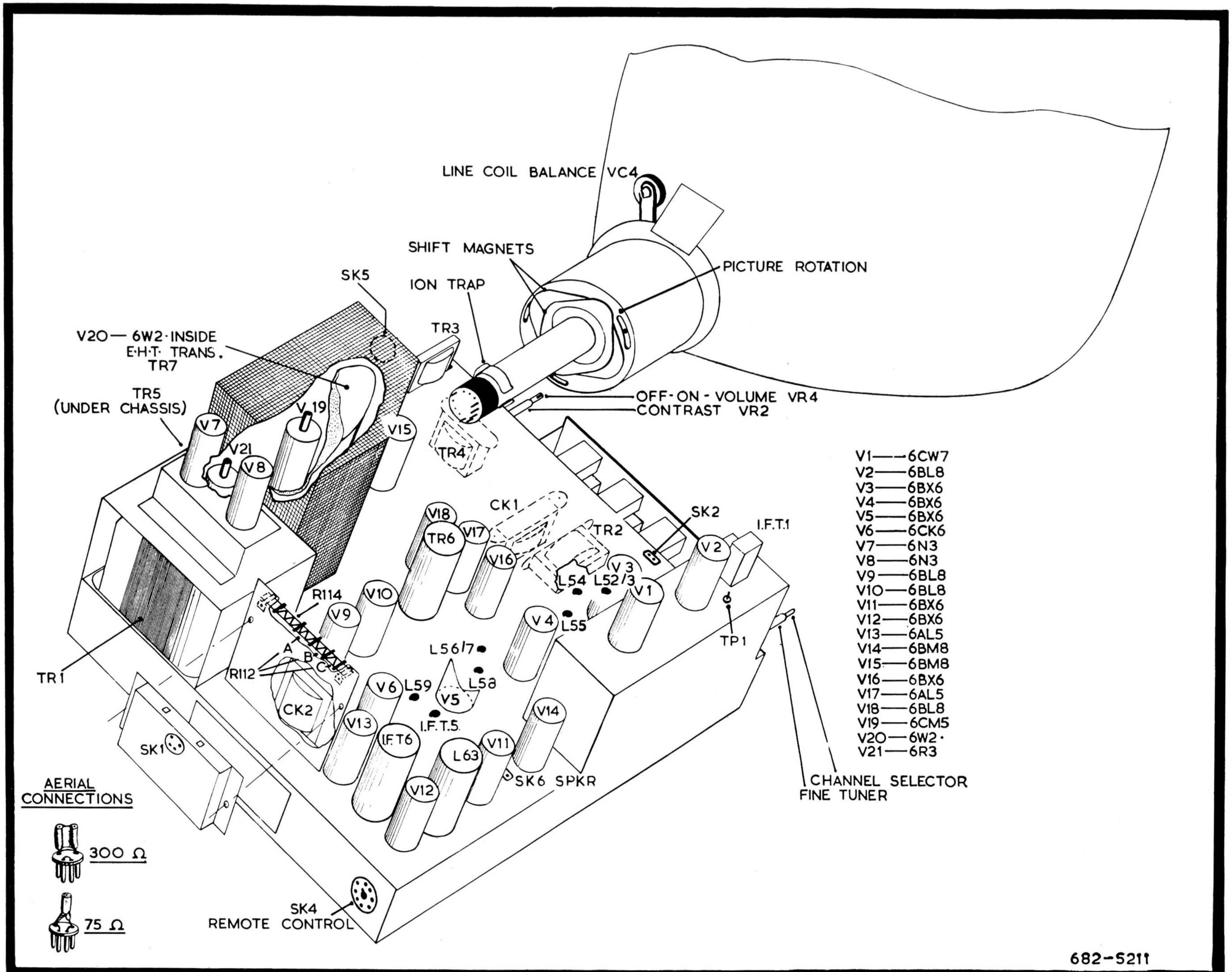

LINE COIL BALANCE VC4
SHIFT MAGNETS
PICTURE ROTATION
SK5
ION TRAP
TR3
V20— 6W2·INSIDE
E·H·T· TRANS.
TR7
TR5
(UNDER CHASSIS)
V7
V21
V8
V19
V15
OFF-ON-VOLUME VR4
CONTRAST VR2
TR4
CK1
V18
TR6
V17
V16
TR2
SK2
I.F.T.1
V2
V3
L54
L52/3
V1
R114
V10
V9
V4
L55
TP1
L56/7
A
B
C
R112
L58
TR1
V6
L59
V5
CK2
I.F.T.5.
V13
I.F.T6
V11
L63
V14
SK1
V12
SK6 SPKR
AERIAL
CONNECTIONS
300 Ω
75 Ω
SK4
REMOTE CONTROL
V1—6CW7
V2—6BL8
V3—6BX6
V4—6BX6
V5—6BX6
V6—6CK6
V7—6N3
V8—6N3
V9—6BL8
V10—6BL8
V11—6BX6
V12—6BX6
V13—6AL5
V14—6BM8
V15—6BM8
V16—6BX6
V17—6AL5
V18—6BL8
V19—6CM5
V20—6W2·
V21—6R3
CHANNEL SELECTOR
FINE TUNER
682-5211

Fig. 5.

set at —3.4V. and the core of TR6 adjusted to bring the picture into a "floating lock."

When the best setting has been found, remove the short circuit. The A.P.C. action is now effective again and the picture will "lock."

A.G.C. ADJUSTMENT

Should the picture be marred by excessive valve noise in a weak signal or overloading on a strong signal, it may be due to variations in the A.G.C. circuit components. If this occurs, the position of the flying load on the resistors, R53 to R55, may require adjustment. Valve noise in weak signal aeras may be improved by reducing the total resistance in this chain. Overloading can probably be overcome by increasing the resistance in the chain.

The correct setting will be one which neither introduces noise on weak signals, nor causes overload on strong signals.

ALIGNMENT OF SOUND I.F.

The following equipment is necessary to carry out this procedure:

(i) A C.W. oscillator accurately tuned to 5.5 Mc/s by a crystal controlled reference.
(ii) A 20,000 ohm/volt meter (Model 8 AVO or similar type).
(iii) A D.C. VTVM.
(iv) A peak-to-peak detector as shown.

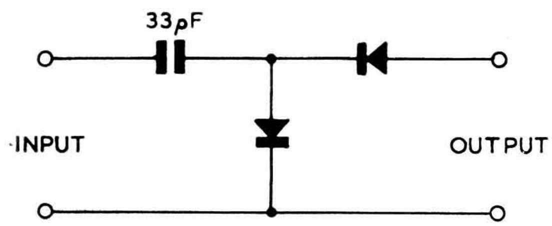


Fig. 6.

(1) Connect the output of the C.W. oscillator between grid (pin 2) of V11 and earth and tune core of L63, amplifier anode coil, to obtain maximum negative reading across the 10K metering resistor, R81, measured with a D.C. VTVM.
(2) Using same input, connect VTVM between junction of R86 and R87, and earth. Set cores of IFT6, ratio transformer, until they are $\frac{3}{8}''$ from ends of former. Rotate top (primary) core of IFT6 one turn in either direction. Continue turning core in the direction that increases the positive reading until a maximum is obtained. Screw in bottom (secondary) core of IFT6 so that meter reading continues to become more positive and then falls, rapidly, to zero volts and would continue negative. Carefully adjust core so that meter reads exactly zero volts.

THE 5.5 MC/S. NULL TRAP (IFT3)

IFT3 is a combined null trap and transformer, working at 5.5 Mc/s. When tuned in the factory, both primary and secondary cores are tuned together, to give a zero output at 5.5 Mc/s. at the video grid and a maximum transfer to the intercarrier amplifier. This can only be accurately done with a swept oscillator and a suitable display having large gain at 5.5 Mc/s. Once set, however, it should not need retuning unless quite large circuits alterations are made. Only the primary core should be returned as the secondary core (nearest chassis) is sealed in the factory.

Should it be necessary to retune IFT3, the following procedure may be adopted:

(1) Inject 5.5 Mc/s. C.W. at approximately 100 mV between L60 and earth. (Disconnecting L60 from C41 and MR1).
(2) Connect the input of the peak-to-peak detector, illustrated, to the junction of L62 and CRT pin 11. Connect output to 20,000 Ohms/Volt meter on 50 micro amps. range.
(3) Adjust primary core of IFT3 to give ZERO reading in meter. *Note*: Do not move secondary core.

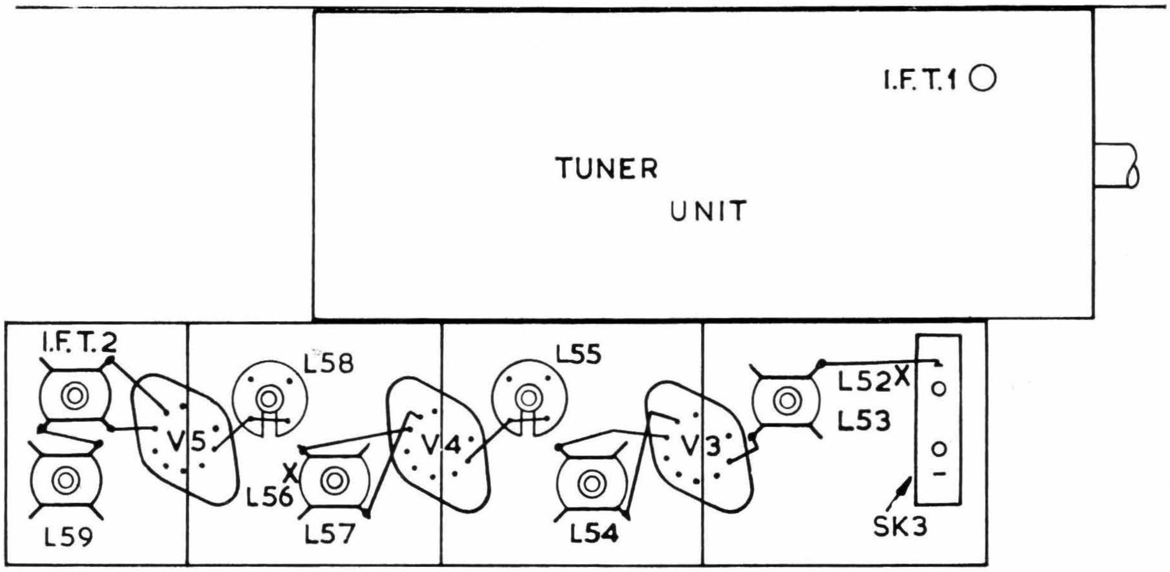
Should it be necessary to replace IFT3, it may be tuned in the same way, except that both cores will require adjustment, and having set up the equipment as in (1) and (2) above, proceed as follows:

(3) Withdraw both cores to end of former and then screw in primary core until a minimum reading is obtained on meter.
(4) Screw in secondary core until meter rises slightly.
(5) Screw out primary core until meter reaches new minimum.
(6) Repeat (4) and (5) until a ZERO reading is obtained.
(7) Seal secondary core.

VISION I.F. ALIGNMENT

GENERAL NOTES

To align the vision I.F., a sweep generator and a marker generator, both covering the range 28.5 to 38.5 mc/s are required, together with a display unit. The marker generator may be a signal generator and the display unit a C.R.O. These instruments should be inter-connected as described in the instructions supplied with the sweep generator. The sweep generator should be terminated with a resistor equal to its output impedance, and connected to the receiver through



LOCATION OF COILS FROM UNDERSIDE OF CHASSIS.
X INDICATES COIL NEAREST CHASSIS

Fig. 7.

a capacitor, say, .01 mfd. The display unit should be adjusted to present a reasonable amplitude display from a signal of 2.0V. peak-to-peak. During alignment this amplitude of display should be kept constant by adjusting the sweep output level.

Before commencing alignment, remove the cores from L53 and L57, and adjust the core in L52 to the maximum inductance position (centre of winding). Move the rest of the cores until they are visible above the top of the chassis. Apply —3 volts bias to junction R55 and R56, and connect the input terminals of the display unit between grid (pin 2) of V6 and chassis. Remove the plug from the tuner unit connecting to the socket in the I.F. strip (SK2), then allow the test equipment and the receiver to warm up for 20 minutes before proceeding.

ALIGNMENT. *Note*: The correct tuning position for all cores except L53 and L57 is the one nearest the chassis.

(1) Connect the sweep generator to the grid (pin 2) of V5 and adjust the core of IFT2 for maximum response at about 33.5 mc/s. Using the core of L59, obtain a symmetrical overcoupled response. Vary these two cores to centre the response on 34.65 mc/s (Fig. 8A).

(2) Move the sweep generator output from V5 to grid (pin 2) of V4 and adjust the core of L56 for maximum response at about 33.5 mc/s. Using the core of L58, obtain a symmetrical overcoupled response. Vary L56 and L58 to centre the response on 34.65 mc/s (Fig. 8B).

(3) Move the sweep generator output from V4 to the grid (pin 2) of V3 and adjust the core of L54 for maximum response at about 34 mc/s. Using the core of L55, obtain a symmetrical response. Vary L54 and L55 to centre the response on 34.65 mc/s (Fig. 8C).

(4) Insert the plug from the tuner to SK3. Remove the sweep generator from the grid of V3 and connect it to the test point TP1 on the tuner. Switch the tuner to the I.F. position, i.e., the position one back from Channel 1. Adjust the core of IFT1 for maximum response at 34.65 mc/s and adjust the core of L52, together with that of IFT1, to obtain the correct symmetrical response centred on 34.65 mc/s (Fig. 8D).

(5) Readjust IFT2 to move the peak response to about 34.2 mc/s so that the response at 36 mc/s is 65% of the peak. Then readjust L56 so that the peak moves to about 33.2 mc/s, and the response at 36 mc/s is 50% of the peak (Fig. 8E).

(6) Insert the core in L57 and take it in until the response at 37.5 mc/s reaches its first minimum.

Insert the core in L53 and take it in until the response at 30.6 mc/s reaches its first minimum.

Adjustment of these traps (L53 and L57) may have altered the final response and some minor adjustments of one of more of the cores may be necessary to achieve the final shape Fig. 8F).

I.F. RESPONSES

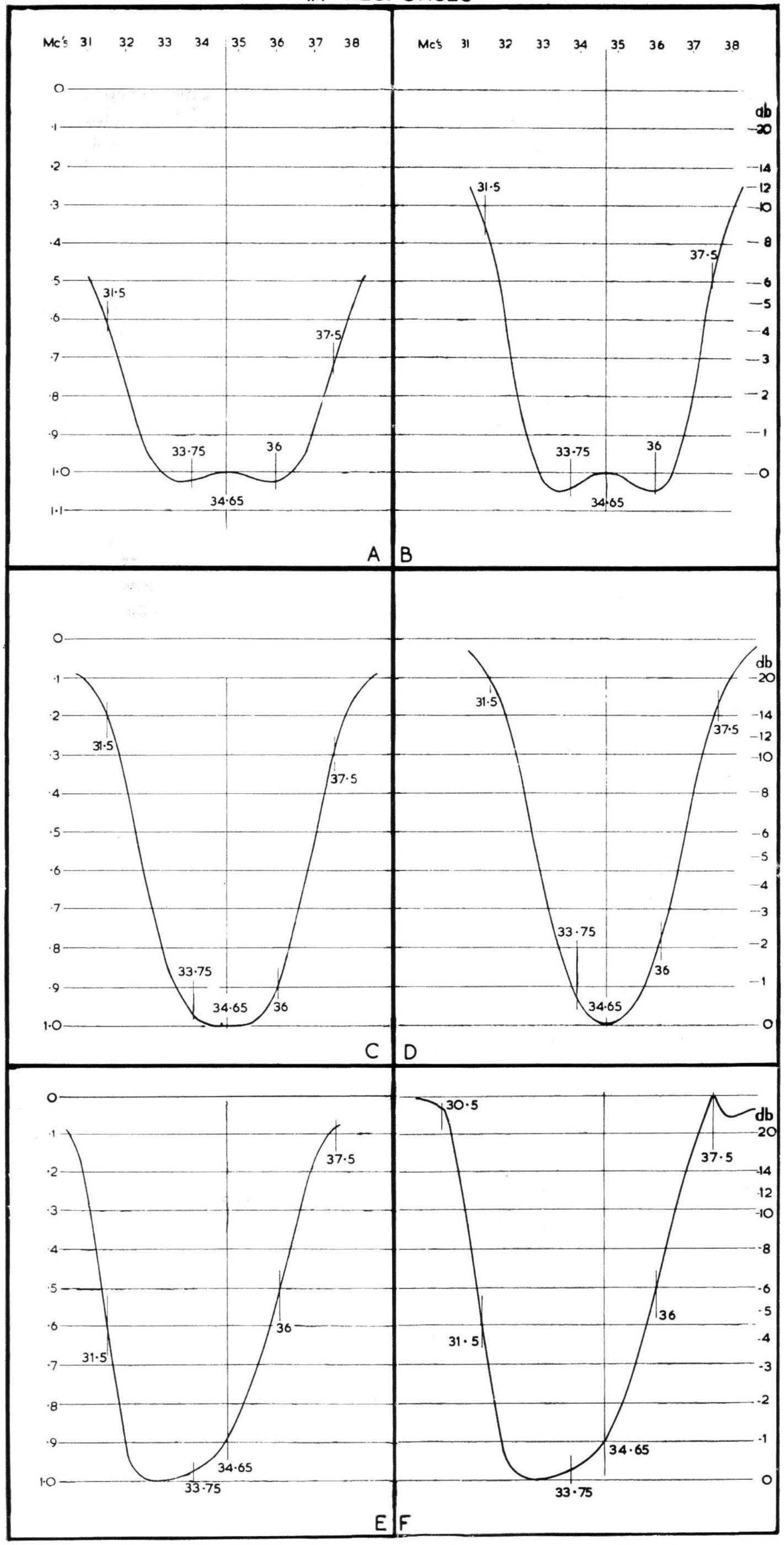


Fig. 8 — Oscilloscope Patterns Obtained with Sweep Oscillator Input.

SWITCHED TUNER ALIGNMENT

INTRODUCTION

The following notes outline the procedure to be adopted when realignment of the tuner unit is contemplated. It is emphasised that the tuner is aligned very accurately in the factory and under normal conditions no further adjustments will be necessary. However, if the converter valve or other component of the tuner is replaced, then realignment is necessary, and the operations should be carried out in the order given.

A marker generator and a sweep generator covering Television Channels 1 - 10 and the I.F. channel (28.5 to 38.5 mc/s) and a display unit are required. A signal generator covering the same range may be used instead of the marker generator, and a C.R.O. substituted for the display unit. The sweep generator output impedance should be 75 ohms, and it should be plugged into the 75 ohm input of the tuner (aerial connection). The 300 ohm input is not suitable.

The tuner must be removed from the receiver chassis for alignment. Filament and H.T. supplies (190V.) can be obtained from the main chassis by extending the leads which normally plug into the sockets on the tuner's power supply strip (See Fig. 9). The A.G.C. terminal on the strip should be shorted to earth.

Wherever reference is made to the television channels by number, e.g., channel 6, the mid-band frequencies are the ones to which the test equipment should be set. A list is given below.

MID-BAND FREQUENCIES

Ch. 1	52.75 mc/s	Ch. 6	177.75 mc/s
Ch. 2	66.75 mc/s	Ch. 7	184.75 mc/s
Ch. 3	88.75 mc/s	Ch. 8	191.75 mc/s
Ch. 4	135.75 mc/s	Ch. 9	198.75 mc/s
Ch. 5	142.75 mc/s	Ch. 10	212.75 mc/s

OSCILLATOR ALIGNMENT

The oscillator section must be aligned first. Attach a germanium diode (0A79 or similar) to the I.F. output plug in the manner shown in Fig. 9

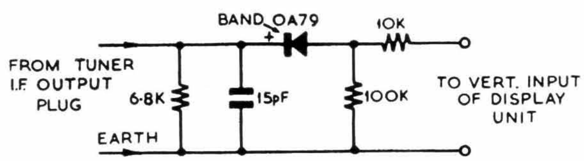


Fig. 9.

Set the fine tuning control at the centre of its travel. It should be left in this position throughout the whole alignment procedure. The tuner cover must be in position for all tests.

Switch the tuner unit and the sweep generator to Channel 10 and adjust L42 brass screw until the display unit shows a trace similar to that in Fig. 10. Switch the tuner unit and sweep generator to Channel 3, and adjust L49 brass screw for the same results as on Channel 10. Return to Channel 10 and step down the sweep generator and tuner unit in unison through all channels, noting the position of the peak on each channel with regard to the tolerance given in Fig. 10.

In an extreme case, such as when the oscillator coils have been damaged or pushed out of shape, it will be necessary to adjust certain of the coils. These are L47 (Ch. 5), L48 (Ch. 4), L50 (Ch. 2), L51 (Ch. 1). The procedure, then, is as follows: Carry out the alignment steps as outlined in the preceding paragraph, then switch to Channel 5. Examine the C.R.O. trace for any variation from the limits of the tolerance. Movement of the peak towards the low frequency (vision) end of the channel may be obtained by squeezing the turns of L47 together. Similarly, the insertion of a knife blade between the turns and a slight opening movement will move the peak towards the high frequency (sound) end of the channel.

Now switch to Channel 4, and after examining the trace, make any adjustment necessary on L48.

The next adjustment is made on Channel 3 by the brass screw in L49.

The remaining two steps are similar to the others in that the peaks are examined and any adjustments necessary are made on L50 (Channel 2) and L51 (Channel 1).

Finally, return to Channel 10 and step down through all channels, checking the position of the peak with regard to the tolerance.

Remove the germanium diode and its circuit from the I.F. output plug.

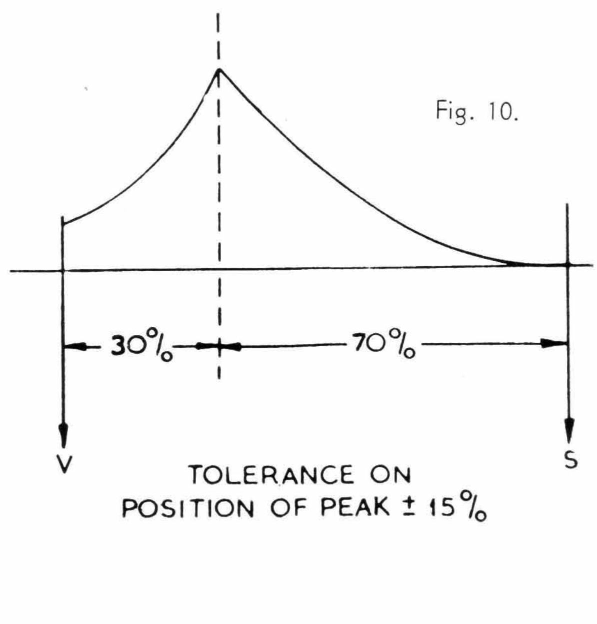


Fig. 10.

PASSBAND SHAPES

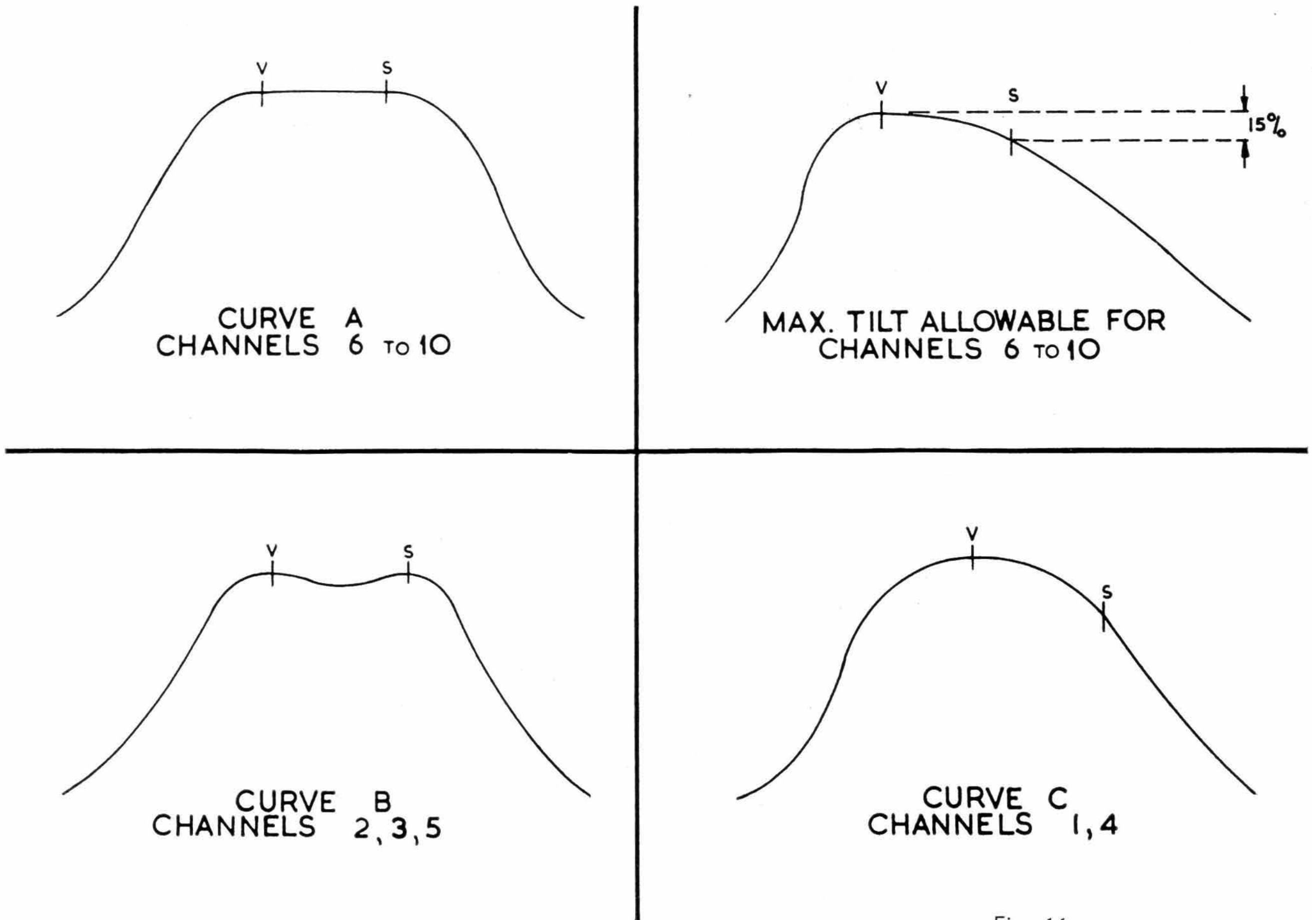


Fig. 11.

This completes the oscillator alignment.

Note: As this is a switched incremental tuner, i.e., inductances are added as the frequency is decreased, any adjustment on the high frequency channels will effect those of a lower frequency. Consequently, any change of inductance such as knifing, must commence at the highest channel requiring it, and carried through the other channels in descending order of frequency. For instance, knifing of Channel 5 (L47) oscillator coil will result in a change on Channel 4 (L48), which, in turn, must be adjusted. Similarly, a readjustment of the brass screw in Channel 3 oscillator coil will effect the range of the fine tuning control on Channels 3, 2 and 1. An adjustment of Channel 2 oscillator coil will also be reflected on Channel 1. Reference to the circuit diagram will make this clear.

SIGNAL CIRCUIT ALIGNMENT

Attach the vertical amplifier input lead of the display unit or C.R.O. to Test Point 1 (see Fig. 10), connecting the earth lead to the tuner chassis.

Switch the tuner unit and the sweep generator to Channel 10 and step down through all channels in unison, examining the passband curves on the display unit, and comparing them with the "ideal" curves for the same group of channels as shown in Fig. 12.

If realignment is decided upon, then it should be carried out in steps in the order given in Table 1.

A useful tool for this purpose is a length of PVC tubing with a small diameter iron-dust core extending from one end, and a small piece of brass rod similarly placed in the other. One end is inserted inside a coil under test, and the movement or tilt of the trace in either the high or low frequency direction will indicate the change which has to be made in the inductance (knifing or squeezing) for a symmetrical passband shape.

Signal circuit alignment is carried out with the A.G.C. terminal on the tuner strip earthed. No bias is required.

The trimmers (VC1 and VC2), located on top of the tuner chassis, and the iron-dust cores (L13, L25 and L36), located underneath through holes in the shield can, will provide sufficient adjustment for realignment as part of normal service procedure.

The tuner cover must always be replaced after any adjustment to coils.

Table I: SIGNAL CIRCUIT ALIGNMENT CHART

Step	Tuner and Sweep	Adjust	Remarks
1	Ch. 6	Trimmers VC1, VC2 for maximum gain, symmetry and bandwith, as shown at "A". Compromise tilt for Channels 7-10, if necessary	Keep vision marker on "flat top" of trace, before "roll off" on low frequency end.
2	Ch. 10	Peaking coil L17 on 6CW7 socket—knife for maximum gain.	Required only when coil has been damaged.
3	Ch. 5	Anode coil L23, grid coil L34 for symmetry as at "B".	Set at factory — no adjustment required in normal service alignment.
4	Ch. 4	Anode coil L24, grid coil L35 for symmetry as at "C".	
5	Ch. 3	Iron-dust cores in L25, L36 for symmetry. L13 for maximum gain as at "B".	Keep vision marker on "flat top" of trace.
6	Ch. 2	Anode coil L26, grid coil L37 for symmetry as at "B".	Set at factory — not adjusted in normal service.
7	Ch. 1	Anode coil L27, grid coil L38 for symmetry as at "C".	Same as above.
8	Ch. 10 to Ch. 1	Step tuner and sweep generator down through all channels for a final check and comparison.	

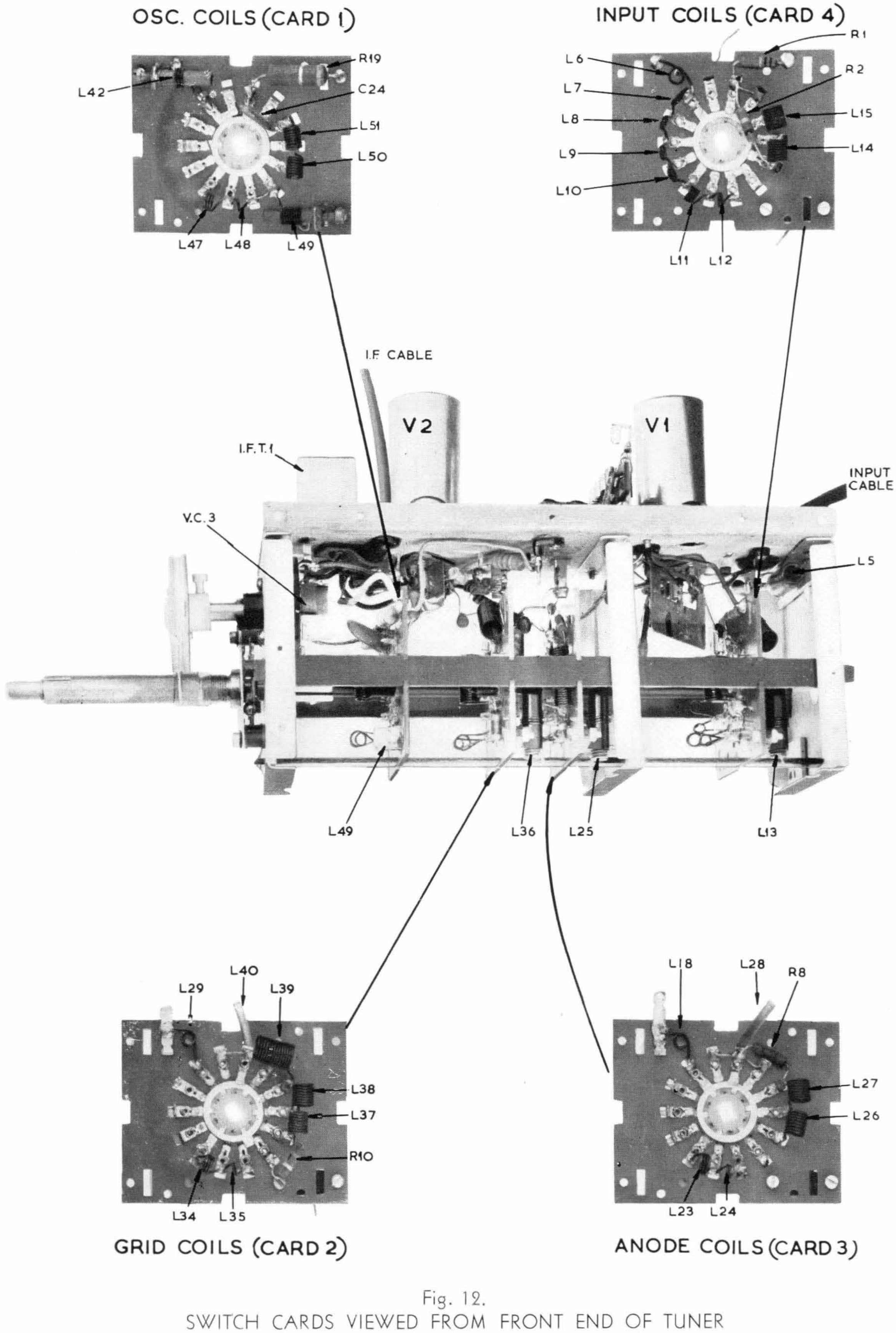


Fig. 12.
SWITCH CARDS VIEWED FROM FRONT END OF TUNER

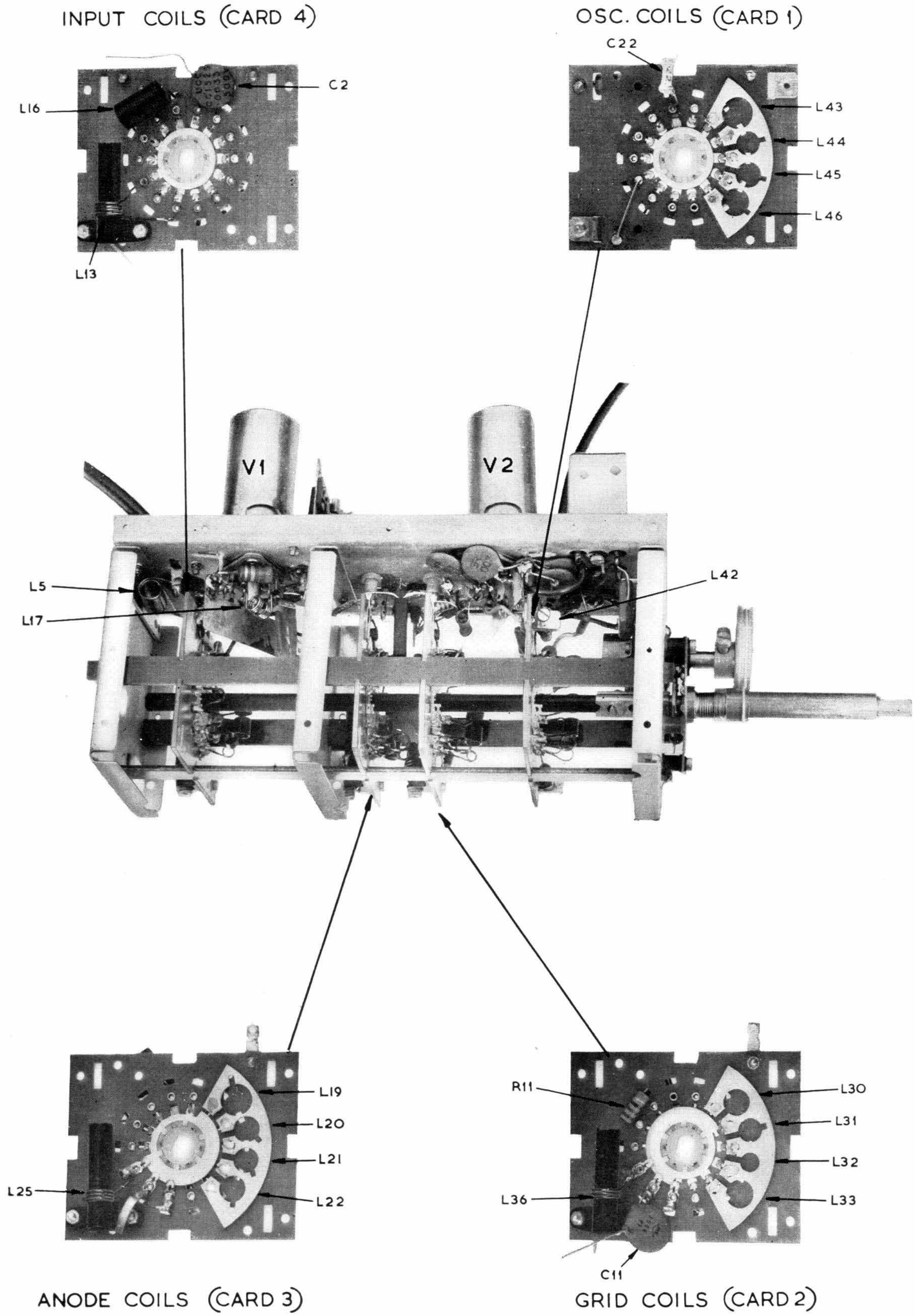


Fig. 13.
SWITCH CARDS VIEWED FROM REAR END OF TUNER

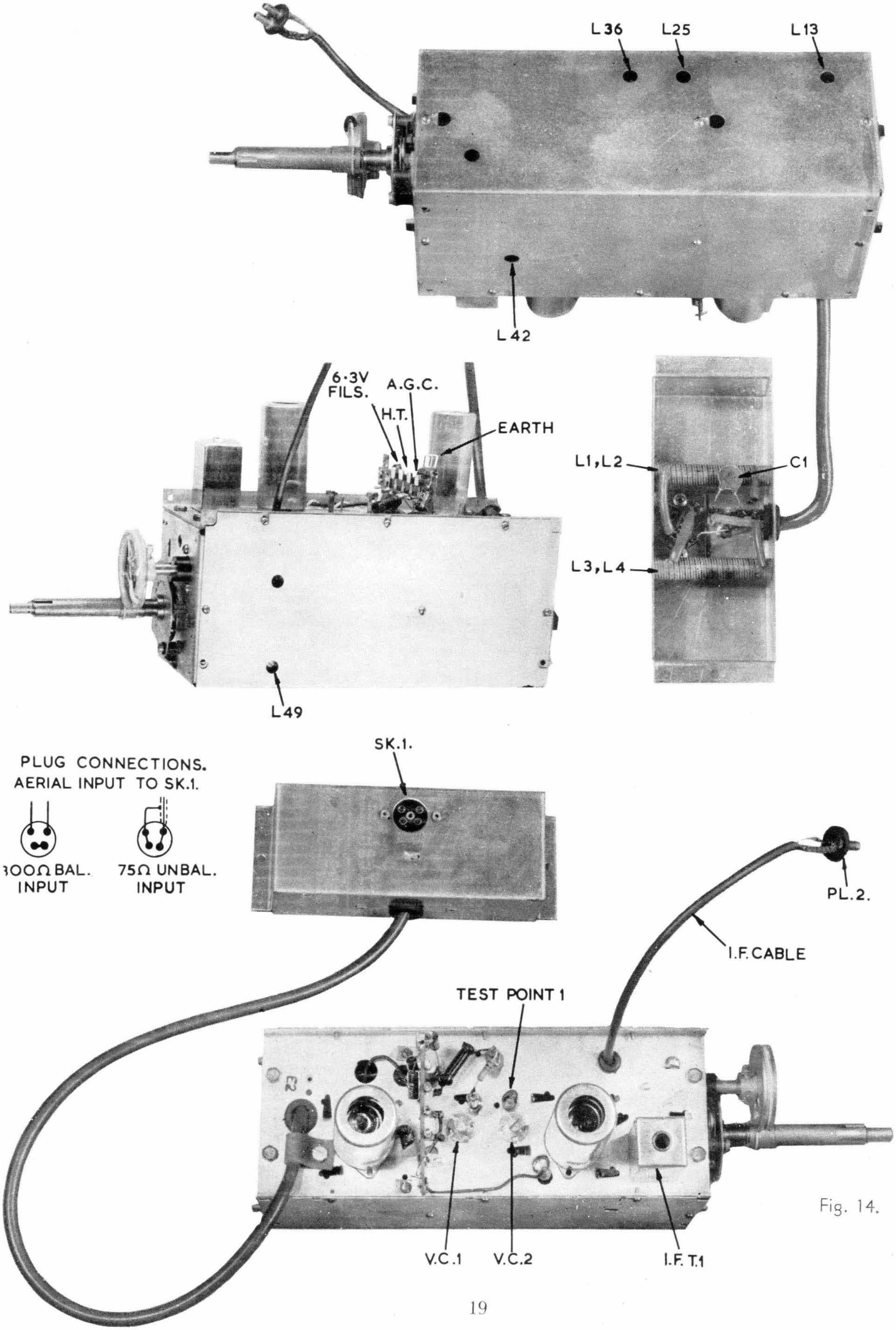

L36
L25
L13
L42
6·3V FILS.
A.G.C.
H.T.
EARTH
L1,L2
C1
L3,L4
L49
SK.1.
PLUG CONNECTIONS.
AERIAL INPUT TO SK.1.
300Ω BAL. INPUT
75Ω UNBAL. INPUT
PL.2.
I.F. CABLE
TEST POINT 1
V.C.1
V.C.2
I.F.T.1

Fig. 14.

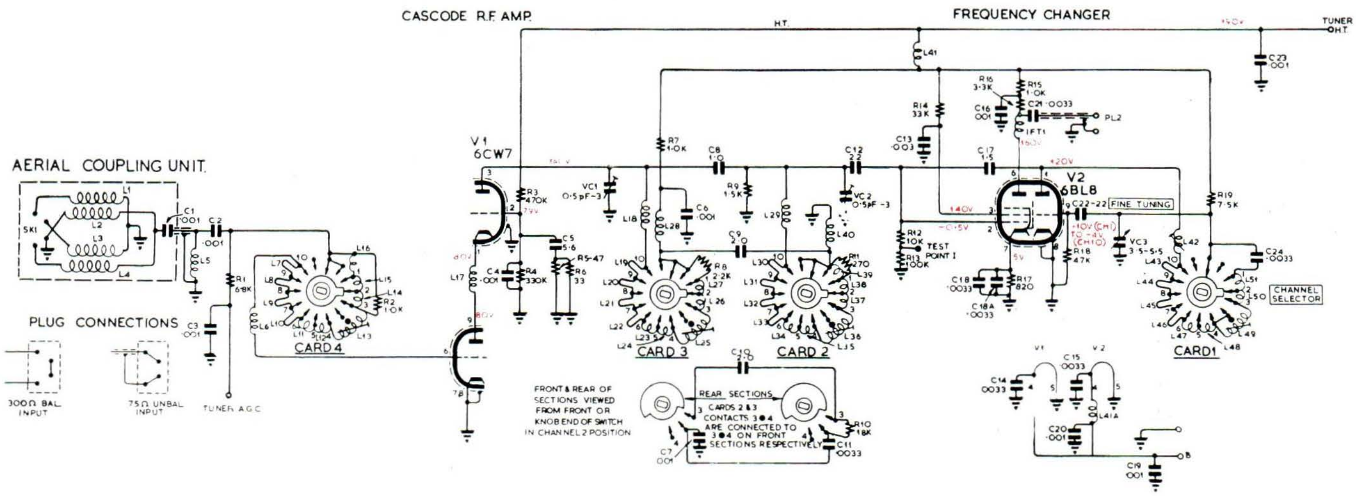
VOLTAGE TABLE

All measurements are taken with a vacuum-tube voltmeter and with nominal mains voltage.

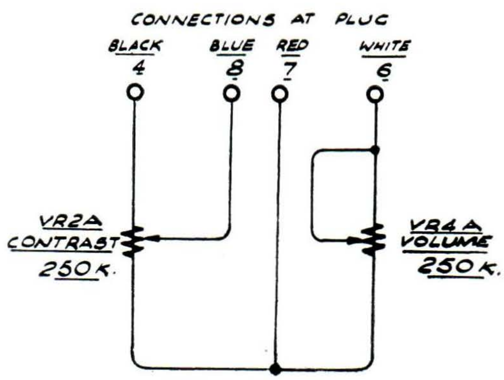
VALVE No.	FUNCTION	TYPE	PENTODE SECTION ANODE	PENTODE SECTION G2	PENTODE SECTION K	PENTODE SECTION G1	TRIODE SECTION ANODE	TRIODE SECTION K	TRIODE SECTION G1	COMMENTS
1	R.F. Amplifier	6CW7	160	—	80	79	80	0	−0.8	Both sections are Triodes
2	Frequency Changer	6BL8	160	140	5.0	−0.5	120	0	−10 to −4	−10 (Chan. 1) to −4 (Chan. 10)
3	1st I.F. Amplifier	6BX6	180	180	1.9	0	—	—	—	
4	2nd I.F. Amplifier	6BX6	180	180	1.9	0	—	—	—	
5	3rd I.F. Amplifier	6BX6	130	180	1.9	0	—	—	—	
6	Video Amplifier	6CK6	85	210	2.2	−0.2	—	—	—	
7	Power Rectifier	6N3	245V.AC	—	238	—	—	—	—	Diode
8	Power Rectifier	6N3	245V.AC	—	238	—	—	—	—	Diode
9	A.G.C. and Noise Inverter	6BL8	0	115	50	38	70	50	35	Pentode fed with Line Pulse
10	Vertical and Horizontal Sync. Separator	6BL8	170	50	0	−3.5	32	0	−3.5	
11	Intercarrier Amp.	6BX6	195	195	2.2	0	—	—	—	
12	Limiter	6BX6	60	58	0	−0.6	—	—	—	
13	Ratio Detector	6AL5	−3.0 (Pin 7)	—	0 (Pin 1)	—	0 (Pin 2)	+3.0 (Pin 5)	—	Both sections are Diodes. Voltages subject to considerable variation with no signal input.
14	Sound Output and Amp.	6BM8	190	202	13	0	94	1.4	0	
15	Vert. Output and Osc.	6BM8	195	200	14	0	110	14	−18	
16	Reactance Valve	6BX6	210 (Pin 7)	185	0	−3.1	—	—	—	
17	Phase Discriminator	6AL5	−3.4	—	—	−3.3 (Pin 2)	—	—	—	Both sections are Diodes. Voltages subject to considerable variation with no signal input.
18	Horizontal Osc.	6BL8	100	114	0	−20	140	0	−20	
19	Horizontal Output	6CM5	*	130	.09	−50	—	—	—	*High Voltage. Do not Measure.
20	E.H.T. Rectifier	6W2	*	—	16KV	—	—	—	—	*High Voltage. Do not Measure.
21	Damper Diode	6R3	225	—	*	—	—	—	—	*High Voltage. Do not Measure.
CRT	Picture Tube	TYPE	ANODE	G2	K	G1	G4			G4 Voltage adjusted on Test at Factory.
		17HP4B	16KV	350	85	0-70V.	0, 225, 350 or 550 V.			

HT1: 225V.
HT2: 210V.
HT3: 185V.
Boost HT: 550V.
Tuner HT: 180V.
Reactance Bias: 3.4 on Wiper of Control.
Filaments: 6.3V. A.C.
Current Fuse 1: (2 amp.) 780 mA.
Current Fuse 2 (500 mA.) 170 mA.
Current Fuse 3: (250 mA) 180 mA.

Conditions of Measurement:
- Brightness — Low.
- Width and Height — Normal.
- Contrast — Normal.
- Vertical Hold — Normal.
- Tuner — No Signal, Aerial Short-Circuited.
- No Remote Control Unit.



CIRCUIT DIAGRAM — TUNER



CIRCUIT DIAGRAM.

REMOTE CONTROL

PARTS LIST

RESISTORS

Ref.	Part No.	Description
R1	740-0762	6,800 ohms ± 20% BTS
R2	738-0021	1,000 ohms ± 20% BTS
R3	738-0071	470,000 ohms ± 10% BTA
R4	738-0061	330,000 ± 10% BTS
R5	738-0001	47 ohms ± 20% Morganite ½ W.
R6	739-0001	33 ohms ± 20% Morganite ½ W.
R7	738-0021	1,000 ohms ± 20% BTS
R8	740-0032	2,200 ohms ± 10% BTS
R9	740-0253	1,500 ohms ± 10% Morganite
		½ Watt
R10	740-0303	18,000 ohms ± 20% Morganite
		½ Watt
R11	740-0292	270 ohms ± 10% BTS
R12	738-0031	10,000 ohms ± 220% BTS
R13	738-0051	100,000 ohms ± 20% BTS
R14	738-0041	33,000 ohms ± 10% BTS
R15	740-0022	1,000 ohms ± 10% BTS
R16	740-0052	3,300 ohms ± 10% BTS
R17	738-0011	820 ohms ± 10% BTS
R18	740-0582	47,000 ohms ± 20% BTS
R19	739-0011	7,500 ohms ± 10% BTA
R20	740-0412	820 ohms ± 10% BTS
R21	740-0812	3,300 ohms ± 20% BTS
R22	740-0463	33 ohms ± 10% Morganite ½ W.
R23	740-0653	100 ohms ± 10% Morganite ½ W.
R24	742-0712	2,200 ohms ± 20% BTA
R25	740-0782	120,000 ohms ± 110% BTS
R26	740-0042	2,700 ohms ± 10% BTS
R27	740-0112	27,000 ohms ± 10% BTS
R28	740-0603	68 ohms ± 10% Morganite ½ W.
R29	740-0603	68 ohms ± 10% Morganite ½ W.
R30	742-0712	2,200 ohms ± 20% BTA
R31	740-0302	1,800 ohms ± 10% BTS
R32	740-0273	150 ohms ± 10% Morganite ½ W.
R33	742-0712	2,200 ohms ± 20% BTA
R34	740-0252	1,500 ohms ± 10% BTS
R35	740-0042	2,700 ohms ± 10% BTS
R37	750-0121	2,700 ohms ± 5% Reco Wire
		Wound 10W.
R39	740-0713	47 ohms ± 10% Morganite 10 W.
R40	742-0082	39,000 ohms ± 10% BTA
R41	740-0622	470,000 ohms ± 20% BTS
R42	740-0622	470,000 ohms ± 20% BTS
R43	740-0532	1.0 Megohm ± 20% BTS
R44	740-0612	10,000 ohms ± 20% BTS
R45	742-0483	220 ohms ± 20% Morganite 1 W.
R46	750-0141	1 Watt
		22 ohms ± 5% Reco Wire
R47	742-0802	Wound 10 Watt
		4,700 ohms ± 20% BTA
R48	742-0522	680 ohms ± 10% BTA
R49	742-0522	680 ohms ± 10% BTA
R50	742-0772	3.9 Megohms ± 10% BTA
R51	742-0222	4.7 Mogohms ± 10% BTA
R52	740-0202	2.2 Megohms ± 10% BTS
R53	740-0842	820,000 ohms ± 10% BTS
R54	740-0852	560,000 ohms ± 10% BTS
R55	740-0172	270,000 ohms ± 10% BTS
R56	740-0833	68 ohms ± 20% Morganite ½ W.
R57	742-0431	18,000 ohms ± 10% BTA
R58	742-0762	12,000 ohms ± 10% BTA
R60	740-0102	22,000 ohms ± 10% BTS
R61	740-0862	18,000 ohms ± 10% BTS
R63	742-0132	220,000 ohms ± 10% BTA
R63A	742-0412	100,000 ohms ± 20% BTA
R64	742-0522	820,000 ohms ± 10% BTA
R64A	742-0492	68,000 ohms ± 10% BTA
R65	742-0152	330,000 ohms ± 10% BTA
R66	740-0782	120,000 ohms ± 10% BTS
R67	740-0082	10,000 ohms ± 10% BTS
R68	740-0232	39,000 ohms ± 10% BTS
R69	740-0822	33,000 ohms ± 20% BTS
R70	740-0202	2.2 Megohms ± 10% BTS
R71	740-0732	12,000 ohms ± 10% BTS
R72	740-0202	2.2 Megohms ± 10% BTS
R73	740-0822	33,000 ohms ± 20% BTS
R74	742-0162	390,000 ohms ± 10% BTA
R75	742-0092	47,000 ohms ± 10% BTA
R76	740-0092	15,000 ohms ± 10% BTS
R76A	740-0073	39 ohms ± 10% Morganite ½ W.
R77	740-0273	150 ohms ± 10% Morganite ½ W.
R77A	740-0512	100,000 ohms ± 20% BTS
R78	742-0322	1,000 ohms ± 20% BTA
R79	740-0142	100,000 ohms ± 20% BTS
R80	740-0122	47,000 ohms ± 10% BTS
R81	740-0612	10,000 ohms ± 20% BTS
R82	740-0612	10,000 ohms ± 20% BTS
R83	742-0792	68,000 ohms ± 20% BTA
R84	740-0742	2,200 ohms ± 20% BTS
R85	740-0102	22,000 ohms ± 10% BTS
R86	740-0092	15,000 ohms ± 10% BTS
R87	740-0092	15,000 ohms ± 10% BTS
R88	740-0122	47,000 ohms ± 10% BTS
R89	740-0102	22,000 ohms ± 10% BTS
R90	740-0122	47,000 ohms ± 10% BTS
R91	740-0702	56,000 ohms ± 10% BTS
R92	742-0452	220,000 ohms ± 20% BTA
R93	740-0052	3,300 ohms ± 10% BTS
R94	740-0622	470,000 ohms ± 20% BTS
R95	740-0622	470,000 ohms ± 20% BTS
R96	742-0322	1,000 ohms ± 20% BTA
R97	742-0322	1,000 ohms ± 20% BTA
R98	742-0823	270 ohms ± 10% Morganite 1 W.
R99	740-0762	6,800 ohms ± 20% BTS
R100	742-0382	33,000 ohms ± 220% BTA
R101	740-0082	10,000 ohms ± 10% BTS
R102	740-0082	10,000 ohms ± 10% BTS
R103	740-0082	10,000 ohms ± 10% BTS
R104	740-0182	470,000 ohms ± 10% BTS
R105	740-0512	100,000 ohms ± 20% BTS
R106	740-0072	4,700 ohms ± 10% BTS
R107	740-0582	47,000 ohms ± 20% BTS
R108	740-0552	2.2 Megohms ± 20% BTS
R109	740-0522	220,000 ohms ± 20% BTS
R110	740-0503	390 ohms ± 10% Morganite 1 W
R111	742-0423	470 ohms ± 20% Morganite 1 W.
R112A	750-0151	1.2 ohms)
R112B	750-0151	2.4 ohms) Tag Resistor
R112C	750-0151	4.8 ohms)
R114	750-0151	4.0 ohms)
R115	740-0732	12,000 ohms ± 10% BTS
R115A	742-0712	2,200 ohms ± 20% BTA
R116	740-0532	1.0 Megohm ± 20% BTS
R117	742-0852	120,000 ohms ± 5% BTA
R119	742-0852	120,000 ohms ± 5% BTA
R120	740-0612	10,000 ohms ± 20% BTS
R121	749-0081	22,000 ohms ± 20% BTB
R122	740-0182	470,000 ohms ± 10% BTS
R123	740-0162	220,000 ohms ± 10% BTS
R124	742-0492	68,000 ohms ± 10% BTA
R125	740-0222	180,000 ohms ± 10% BTS
R126	740-0512	100,000 ohms ± 20% BTS
R127	740-0162	220,000 ohms ± 10% BTS
R128	740-0102	22,000 ohms ± 10% BTS
R129	742-0092	47,000 ohms ± 10% BTA
R130	742-0562	470,000 ohms ± 20% BTA
R130A	740-0862	18,000 ohms ± 10% BTS
R131	740-0572	1,000 ohms ± 20% BTS
R132	750-0171	4,700 ohms ± 5% 5W. Reco
R133	746-0182	1.0 ohm ± 5% BW½
R135	742-0342	330,000 ohms ± 20% BTA
R137	742-0792	68,000 ohms ± 20% BTA

CONDENSERS

Ref.	Part No.	Description
C1	271-0111	.001 mfd. D.S. H1-K Ceramic
C2	271-0111	.001 mfd. D.S. H1-K Ceramic
C3	271-0261	.001 mfd. +80% —20% 400V. wkg.
C4	271-0261	.001 mfd. +80% —20% 400V. wkg.
C5	275-0071	5.6 pF. ± 20% L.E.M.
C6	271-0081	.001 mfd. Lead Through
C7	271-0081	.001 mfd. Lead Through
C8	526-1821	1.0 pF Capacitor Lead
C9	271-0221	2.0 pF M30 NPO Bead
C10	271-0221	2.0 pF M30 NPO Bead
C11	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C12	271-0061	22 pF ± 5% Ceramic Tube
C13	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C14	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C15	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C16	271-0261	.001 mfd. +80% —20% 400V. wkg.

PARTS LIST

CONDENSERS — *continued*

Ref.	Part No.	Description
C17	271-0001	1.5 pF ± 33% 750V. wkg.
C18	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C18A	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C19	271-0261	.001 mfd. +80% —20% 400V. wkg.
C20	271-0081	.001 mfd. Lead Through
C21	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C22	271-0071	22 pF ± 5% Tubular Ceramic
C23	271-0261	.001 mfd. +80% —20% 400V. wkg.
C24	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C25	273-0591	68 pF ± 5% Silver Mica M.S.
C26	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C27	271-0181	15 pF ± ½ pF Tubular Ceramic NPO
C28	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C29	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C30	526-1831	1.45 pF Capacitor Lead
C31	271-0111	.001 mfd. D.S. H-1K Ceramic
C32	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C33	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C34	526-1961	1.85 pF Capacitor Lead
C35	273-0061	150 pF ± 10% P.T.
C36	273-0061	150 pF ± 10% P.T.
C37	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C38	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C39	271-0121	5:6 pF ± ½ pF Tubular Ceramic NPO
C40	526-1971	1.0 pF Capacitor Lead
C40A	271-0131	8.2 pF ± ¼ pF Tubular Ceramic NPO
C41	271-0131	8.2 pF ± ¼ pF Tubular Ceramic NPO
C42	279-1541	.0022 mfd. ± 20% Paper Tube 400V. wkg.
C43	279-4581	.0047 mfd. ± 10% Paper Tube 400V. wkg.
C44	271-0051	100 pF ± 20% Ceramic Tube 2KV
C45	269-0391	40 mfd. Electrolytic 250V. wkg.
C46	269-0381	200 mfd. Electrolytic 250V. wkg.
C47	269-0391	80 mfd. Electrolytic 250V. wkg.
C48	269-0381	100 mfd. Electroyltic 250V. wkg.
C49	279-1161	.22 mfd. ± 20% Paper Tube 200V. wkg.
C50	279-1161	.22 mfd. ± 20% Paper Tube 200V. wkg.
C51	279-1161	.22 mfd. ± 20% Paper Tube 200V. wkg.
C52	271-0231	68 pF ± 10% Ceramic Disc 3KV wkg.
C52A	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C53	271-0221	2.2 pF Ceramic Bead NPO
C53A	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C54	279-4661	.022 mfd. ± 10% 400V. wkg.
C55	271-0221	2.2 pF Ceramic Bead NPO
C56	273-0691	220 pF ± 10% Silver Mica M.S.
C57	279-1121	0.1 mfd. ± 20% Paper Tube 200V. wkg.
C57A	526-2611	0.8 pF Lead Capacitor
C58	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C58A	273-0171	.002 mfd. ± 10% S.M.
C59	279-1621	.01 mfd. ± 20% Paper Tube 400V. wkg.
C60	273-0561	10 pF ± 110% I.F. Type
C61	271-0151	6.8 pF ± ¼ pF Ceramic Type NPO
C62	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C63	273-0561	10 pF ± 10% I.F. Type
C64	273-0981	330 pF ± 20% Mica M.S.
C65	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C66	273-0331	100 pF ± 5% I.F. Type
C67	273-0351	100 pF ± 5% Silver Mica M.S.
C68	273-0351	100 pF ± 5% Silver Mica M.S.
C69	269-0371	10 mfd. Electrolytic 25V. wkg.
C70	279-4021	.015 mfd. ± 10% Paper Tube 200V. wkg.
C71	273-0951	.0033 mfd. ± 10% Mica S.M.
C72	273-0971	680 pF ± 10% Mica P.T.
C73	279-4001	.01 mfd. ± 20% Paper Tube 200V. wkg.
C74	269-0371	10 mfd. Electrolytic 25V. wkg.
C75	279-1621	.01 mfd. ± 20% Paper Tube 400V. wkg.
C76	269-0401	40 mfd. Electrolytic 250V. wkg.
C77	269-0221	25 mfd. Electrolytic 40V. P.K.
C78	279-1541	.0022 mfd. ± 20% Paper Tube 400V. wkg.
C79	269-0211	8 mfd. Electrolytic 250V. wkg.
C80	279-1541	.0022 mfd. ± 20% Paper Tube 400V. wkg.
C81	279-1541	.0022 mfd. ± 20% Paper Tube 400V. wkg.
C82	279-0281	1 mfd. Metalised Uaper 200V. wkg.
C83	279-4721	.068 mfd. ± 110% Paper Tube 400V. wkg.
C84	279-1121	0.1 mfd. ± 20% Paper Tube 200V. wkg.
C85	279-1741	0.1 mfd. ± 20% Paper Tube 400V. wkg.
C86	269-0401	80 mfd. Electrolytic 250V. wkg.
C86A	269-0061	16 mfd. Electrolytic 350V. Peak
C87	269-0361	1100 mfd. Electrolytic 40V. P.K.
C88	273-0991	220 pF ± 20% Mica M.S.
C89	279-0281	1 mfd. Metalised 200V. wkg.
C90	273-0821	33 pF ± 5% Silver Mica M.S.
C91	279-4581	.0047 mfd ± 10% Paper Tube 400V. wkg.
C92	279-4581	.0047 mfd ± 10% Paper Tube 400V. wkg.
C93	273-1001	.0039 mfd. ± 5% Silver Mica S.M.
C94	279-1121	0.1 mfd. ± 20% Paper Tube 200V. wkg.
C95	273-0351	100 pF ± 5% Silver Mica M.S.
C96	279-1121	0.1 mfd. ± 20% Paper Tube 200V. wkg.
C97	273-0541	47 pF ± 10% Mica M.S.
C98	279-1661	.022 mfd. ± 20% Paper Tube 400V. wkg
C99	279-1581	.0047 mfd ± 10% Paper Tube 400V. wkg.
C99A	279-1121	0.1 mfd. ± 20% Paper Tube 200V. wkg.
C100	279-1661	.022 mfd. ± 20% Paper Tube 400V. wkg.
C101	271-0031	.0033 mfd. + 100% — 0% 500V. Ceramic Disc
C102	279-1741	0.1 mfd. ± 20% Paper Tube 400V. wkg.
C103	279-0451	.047 mfd. ± 10% 400V. wkg.

COILS

Ref.	Part No.	Description
L1, L2	908-0061	Transformer Aerial Input
L3, L4	908-0061	Transformer Aerial Input
L5	259-0061	H.F. Choke
L6	259-0471	Incremental Inductance
L7	259-0451	Incremental Inductance
L8	259-0461	Incremental Inductance
L9	259-0471	Incremental Inductance
L10	259-0481	Incremental Inductance
L11	259-0111	Incremental Inductance
L12	259-0121	Incremental Inductance
L13	259-0131	Incremental Inductance
L14	259-0141	Incremental Inductance
L15	259-0151	Incremental Inductance
L16	259-0161	Incremental Inductance
L17	259-0051	Coupling Coil
L18	259-0211	Incremental Inductance

PARTS LIST

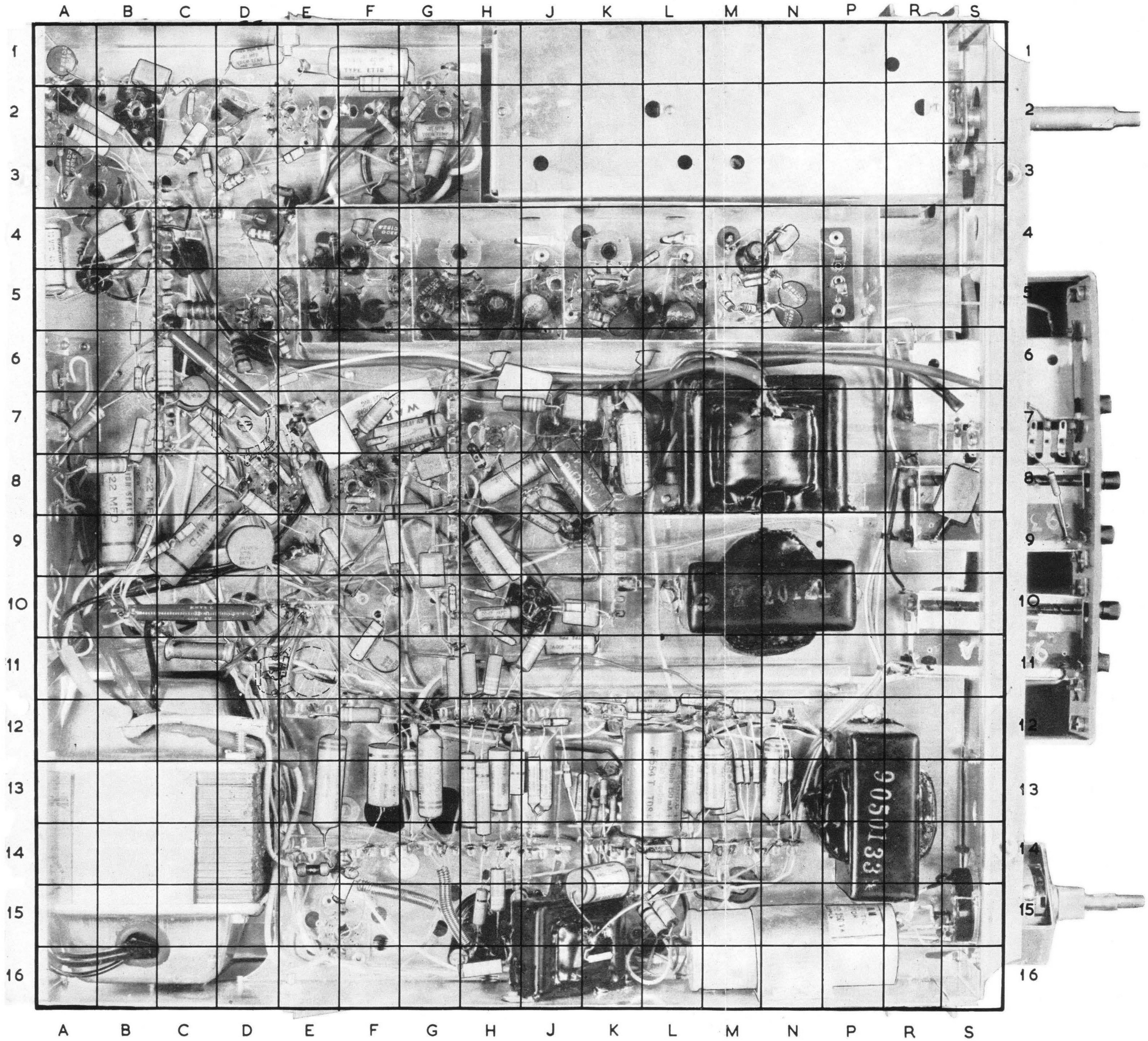
COILS — *continued*

Ref.	Part No	Description
L19, L20, L21, L22	259-0551	Incremental Inductance
L23	259-0531	Incremental Inductance
L24	259-0501	Incremental Inductance
L25	259-0231	Incremental Inductance
L26	259-0521	Incremental Inductance
L27	569-2161	Incremental Inductance
L28	569-2161	Incremental Inductance
L29	259-0271	Incremental Inductance
L30, L31, L32, L33	259-0561	Incremental Inductance
L34	259-0221	Incremental Inductance
L35	259-0541	Incremental Inductance
L36	259-0231	Incremental Inductance
L37	259-0191	Incremental Inductance
L38	259-0201	Incremental Inductance
L39	259-0261	Incremental Inductance
L40	569-2161	Incremental Inductance
L41	232-0131	H.T. Choke
L41A	259-0581	R.F. Choke
L42, L43, L44, L45, L46	259-0571	Incremental Inductance
L47	259-0171	Incremental Inductance
L48	259-0181	Incremental Inductance
L49	259-0281	Incremental Inductance
L50	259-0291	Incremental Inductance
L51	259-0511	Incremental Inductance
L52, L53	259-0361	1st I.F. Grid and Trap
L54	259-0371	1st I.F. Anode
L55	259-0381	2nd I.F. Grid
L56, L57	259-0391	2nd I.F. Anode and Trap
L58	259-0411	3rd I.F. Grid
L60	259-0741	Vision Detector
L61	259-0781	I.F. Filter
L62	259-0771	Shunt Video Peaking
L63	259-0031	Series Video Peaking
L64	259-0031	I.F. Sound Coupling
L64	232-0151	Filament Choke
L65	232-0151	Filament Choke
L66	259-0431	Width Control
L67	259-0042	Anti-Parasitic
L68	259-0042	Anti-Parasitic
L69	259-0321	Horizontal Linearity

MISCELLANEOUS

Ref.	Part No.	Description
VR1	677-0231	25,000 ohms
VR2	677-0262	500,000 ohms
VR2A	677-0381	250,000 ohms
VR2B	677-0171	25,000 ohms
VR3	677-0241	500,000 ohms
VR4	677-0262	1 Megohm tapped at 500,000 ohms
VR5	677-0231	25,000 ohms
VR6	677-0241	500,000 ohms
VR7	677-0171	25,000 ohms
VC1	281-0131	0.5—3 pF. Capacitor Trimmer
VC2	281-0131	0.5—3 pF. Capacitor Trimmer
VC2	281-0121	3.5—5.5 pF. Rotor Assy. Capacitor
VC4	281-0151	150 pF Max. 3KV Capaacitor Trimmer
IFT1	906-0112	Transformer I.F.
IFT2	906-0132	Transformer I.F.
IFT3	906-0181	Transformer I.F.
IFT4	906-0101	Transformer Ratio Detector
CK1	232-0122	Choke 1.5H 300 mA.
CK2	232-0112	Choke 2.9H 150 mA.
TR1	904-0151	Transformer—Power
TR2	905-0143	Transformer—Audio Output
TR3	908-0052	Transformer—Blocking Oscillator
TR4	905-0133	Transformer—Frame Output
TR5	908-0181	Transformer—Vertical Feedback
TR6	908-0191	Transformer—Horizontal Osc.
TR7	908-0071	Transformer—Line Output
TR8	908-0111	Transformer—Synch. Coupling
MR1	032-0591	0A70 Diode
MR2	932-0791	0A81 Diode
MR3	932-0611	39K2 Diode
V1	932-0541	6CW7 Valve
V2	932-0501	6BL8 Valve
V3	932-0521	6BX6 Valve
V4	932-0521	6BX6 Valve
V5	932-0521	6BX6 Valve
V6	932-0661	6CK6 Valve
V7	932-0551	6N3 Valve
V8	932-0551	6N3 Valve
V9	932-0501	6BL8 Valve
V10	932-0501	6BL8 Valve
V11	932-0521	6BX6 Valve
V12	932-0521	6BX6 Valve
V13	932-0491	6AL5 Valve
V14	932-0511	6BM8 Valve
V15	932-0511	6BM8 Valve
V16	932-0521	6BX6 Valve
V17	932-0491	6AL5 Valve
V18	932-0501	6BL8 Valve
V19	932-0531	6CM5 Valve
V20	932-0631	6W2 Valve
V21	932-0561	683 Valve
	259-0761	Deflection Yoke Assembly

H. CLARK PTY. LTD.
Printers
CAMPERDOWN, N.S.W.



COMPONENTS LOCATION

RESISTORS

R20	M-5	R63A	D-7	R101	J-12
R21	N-4	R64	D-7	R102	J-13
R22	M-5	R64A	D-7	R103	K-13
R23	M-5	R65	D-7	R104	N-13
R24	L-6	R66	E-7	R105	L-15
R25	L-4	R67	E-8	R106	N-13
R26	K-5	R68	D-8	R107	K-16
R27	K-4	R69	E-7	R108	K-13
R28	K-5	R70	E-8	R109	K-13
R29	K-5	R71	F-8	R110	H-13
R30	H-6	R72	E-7	R111	G-13
R31	H-5	R73	E-6	R112A	
R32	G-5	R74	F-9	R112B	Above
R33	F-3	R75	F-7	R112C	Chassis
R35	D-4	R76	F-7	R114	
R37	D-6	R77	C-3	R115	K-8
R39	E-6	R78	C-2	R115A	L-14
R40	J-7	R79	In Can	R116	K-8
R41	M-13	R80	C-2	R117	J-8
R42	M-13	R81	C-1	R119	J-8
R43	M-13	R82	B-1	R120	In Can
R44	K-12	R83	B-2	R121	H-9
R45	Yoke	R84	A-2	R122	G-10
R46	C-10	R85	A-4	R123	H-10
R47	L-14	R86	B-4	R124	J-11
R48	H-11	R87	B-4	R125	J-10
R49	H-11	R88	S-8	R126	G-8
R50	D-8	R89	S-8	R127	H-10
R51	B-7	R90	S-8	R128	G-7
R52	B-8	R91	S-15	R129	H-11
R53	C-9	R92	G-3	R130	H-15
R54	C-9	R93	K-7	R130A	H-16
R55	B-9	R94	F-2	R131	H-14
R56	C-7	R95	G-2	R132	H-13
R57	E-9	R96	L-15	R133	H-15
R58	D-8	R97	L-15	R135	F-12
R60	D-11	R98	F-1	R137	A-2
R61	E-11	R99	L-14	RT1	C-11
R63	D-7	R100	M-12		

VARIABLE RESISTORS

VR1	S-9	VR2B	E-11	VR5	S-6
VR2	S-15	VR3	S-8	VR6	S-11
VR2A	D-7	VR4	S-16	VR7	F-7

CAPACITORS

C25	N-4	C52A	C-6	C77	F-1
C26	N-5	C53	E-7	C78	J-13
C27	N-4	C53A	C-6	C79	L-13
C28	N-5	C54	E-8	C80	J-13
C29	L-5	C55	E-6	C81	J-13
C30	K-5	C56	F-7	C82	M-13
C31	K-5	C57	G-7	C83	M-13
C32	K-5	C57A	D-2	C84	N-13
C33	J-5	C58	D-3	C85	K-14
C34	H-5	C58A	D-2	C86	M-16
C35	H-5	C59	D-1	C87	J-13
C36	H-5	C60	In Can	C88	G-8
C37	G-5	C61	In Can	C89	K-8
C38	F-4	C62	A-1	C90	J-7
C39	E-4	C63	In Can	C91	J-8
C40	E-4	C64	C-1	C92	J-8
C40A	E-3	C65	A-3	C93	J-6
C41	E-5	C66	In Can	C94	H-9
C42	M-13	C67	B-4	C95	G-9
C44	L-13	C68	B-4	C96	H-8
C45	F-10	C69	A-4	C97	K-10
C46	L-15	C70	B-4	C98	J-11
C47	F-10	C71	S-8	C99	H-10
C48	L-15	C72	S-15	C99A	E-13
C49	B-8	C73	S-15	C100	H-13
C50	B-8	C74	K-8	C101	F-11
C51	C-9	C75	G-2	C102	F-13
C52	D-9	C76	N-16	C103	G-13

COILS

L52	M-4	L58	H-4	L64	F-15
L53	L-4	L59	F-4	L65	G-15
L54	L-5	L60	E-5	L66	S-11
L55	K-4	L61	D-6	L67	F-14
L56	H-4	L62	C-5	L68	Above
L57	H-5	L63	D-2	L69	Chassis

TRANSFORMERS

IFT2	F-4	TR3	Above Ch.	TR7	Above Ch.
IFT3	D-4	TR4	R-13	TR8	H-7
IFT4	A-2	TR5	K-15	CK1	N-10
IFT6	B-3	TR6	H-9 (Above Chassis)	CK2	Above Ch.
TR1	B-14				
TR2	N-7				

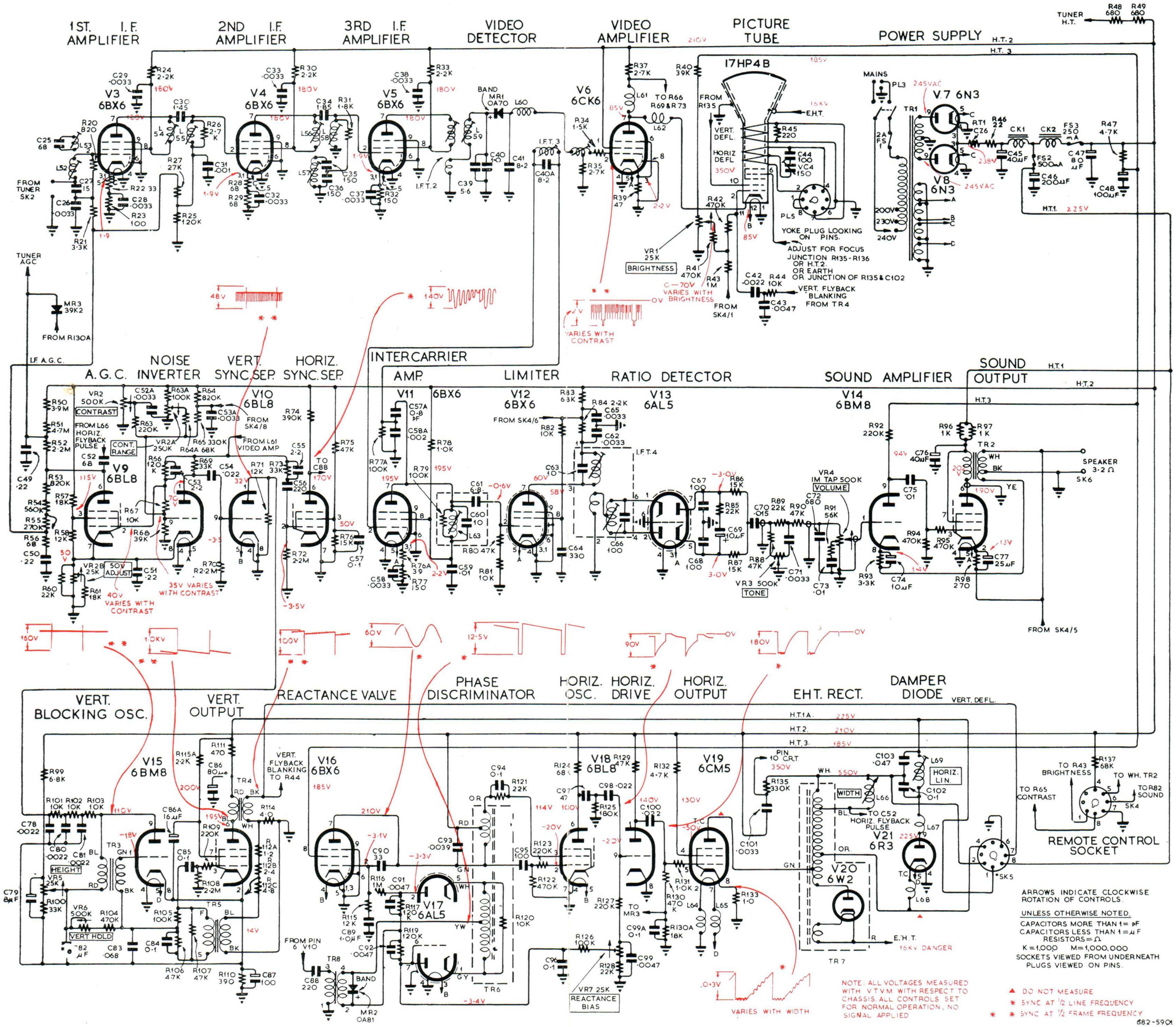
DIODES

MR1	E-5	MR2	H-7	MR3	E-14

VALVES

V3	M-5	V10	F-8	V17	J-9
V4	J-5	V11	E-2	V18	J-10
V5	G-5	V12	B-2	V19	H-15
V6	D-5	V13	B-5	V20	Above Ch.
V7	Above	V14	G-2	V21	F-15
V8	Chassis	V15	K-13		
V9	E-8	V16	K-7		

"H·M·V" CHASSIS TYPE E2



CIRCUIT DIAGRAM — MAIN CHASSIS