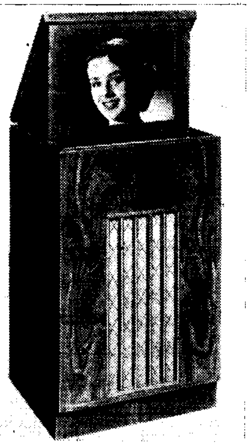


ETRONIC PROJECTION RECEIVER ECS2231

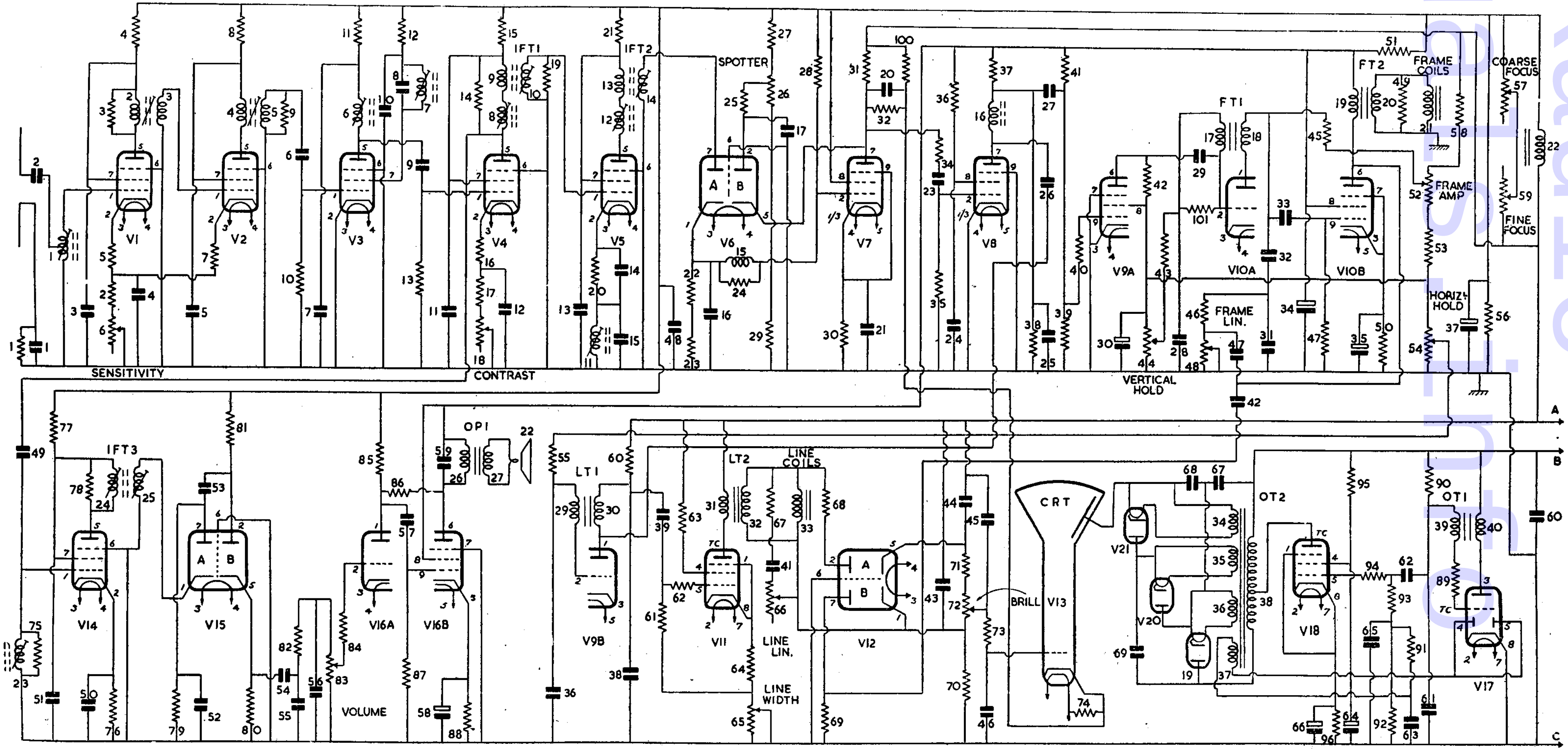
Twenty-one valve superheterodyne television receiver fitted with a 2½in. projection type CRT providing a 16 by 12in. picture. In figured walnut veneered cabinet fitted with hinged close-down screen assembly. Suitable for 200-250V 50c/s AC. Model ECS2231 is for London and 2231/B for Birmingham frequencies. Made by Hale Electric Co., Ltd., Talbot Road, West Ealing, London, W13.

THE receiver employs a superheterodyne circuit designed to operate on lower sideband of vision carrier. The two RF amplifiers V1 V2, frequency changer V3, and first amplifier V4 are common to both sound and vision. Vision interference and sound noise suppression circuits are incorporated. EHT of 25kV for the anode of the 2½in. diameter

Continued on page 12.

RESISTORS

R	Ohms	Watts
1	150K	¼
2	56	¼
3	4.7K	¼
4	1.5K	¼
5	33	¼
6	10K	WWPotr.
7	33	¼
8	1K	¼
9	6.8K	¼
10	33K	¼
11	1.5K	¼
12	47K	¼
13	2.2K	¼
14	5.6K	¼
15	1.5K	¼
16	33	¼
17	120	¼
18	10K	WWPotr.
19	5.6K	¼
20	150	¼
21	1.5K	¼
22	4.7K	¼
23	330	¼
24	47K	¼
25	3M	¼
26	50K	WWPotr.
27	47K	¼
28	2M	¼ or 1W
29	82K	¼
30	820	¼
31	15K (2 x 30K)	2W
32	47K (2 x 82K)	¼
33	No Component	
34	10K	¼
35	680K	¼
36	820K	¼
37	120K or 56K	¼
38	56K	¼
39	56K	¼
39A	24K	¼
40	1.5M	¼
41	1.5M	¼
42	10K	¼
43	1.5M	¼
44	30K	WWPotr.
45	50K or 470K	¼
46	4.7K or 10K	¼
47	2.2M	¼
48	500K	Potr.
49	330	¼
50	1K	½
51	1K	W1
52	10K	WWPotr.
53	27K	½
54	30K	WWPotr.
55	270K	¼
56	15K	WW6W
57	10K	WWPotr.
58	10K	½
59	2K	WWPotr.
60	390K	¼
61	820K	¼
62	1K	¼
63	330	¼
64	120	WW1W
65	200	WW Potr.
66	2K	WW Potr.
67	1K	WW 6W
68	33K	¼
69	390K	¼
70	1M	¼
71	270K	¼
72	500K	Potr. with DPST switch
73	47K	¼
74	1.2M	¼
75	68K	¼
76	150	¼
77	1.5K	¼
78	68K	¼
79	68K	¼
80	1.5M	¼
81	1M	¼
82	47K	¼
83	200K	Potr.
84	47K	¼
85	220K	¼
86	470K	¼
87	470K	¼
88	330	¼
89	39	¼
90	560K	¼
91	1.5M	¼
92	470K	½
93	150K	¼
94	39	¼
95	3.5K	½
96	120	1
97	120	WW 6W
98	120	WW 6W
99	No Component	
100	47 (2 x 82K)	¼
101	56K	½

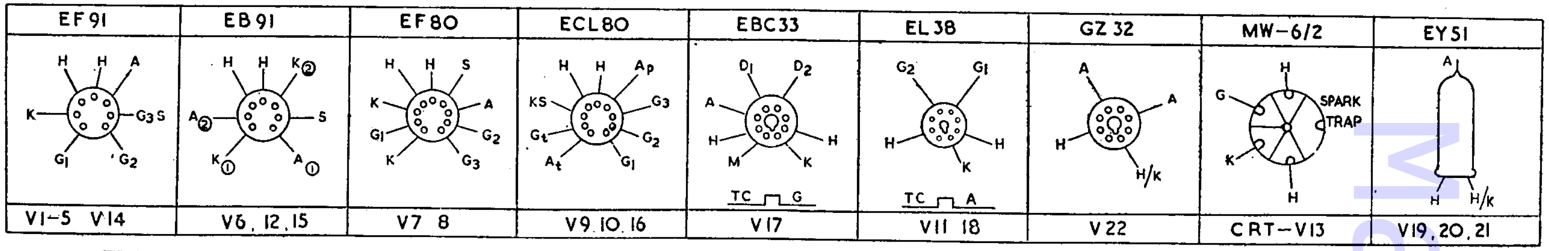


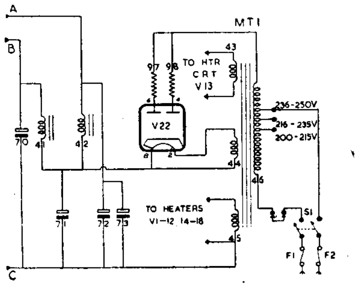
CAPACITORS

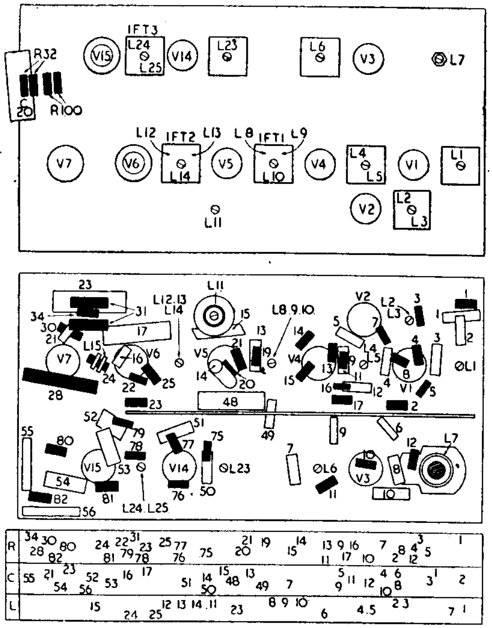
C	Capacity	Type
1	.002	Tubular 500V
2	.002	Tubular 500V
3	.001	Tubular 500V
4	.001	Tubular 500V
5	.001	Tubular 500V
6	100pF	Tub. Ceramic
7	.005	Tubular 500V
8	{ 50pF / 30pF	Silver Mica L / Silver Mica B
9	100pF	Tub. Ceramic
10	.01	Tubular 500V
11	.005	Tubular 500V
12	.005	Tubular 500V
13	.005	Tubular 500V
14	.005	Tubular 500V
15	800pF	Silver Mica
16	5pF	Tub. Ceramic
17	.05	Tubular 500V
18	} No Component	
19	} No Component	
20	.1	Tubular 500V
21	680pF	Tub. Ceramic
22	No Component	
23	.1	Tubular 500V
24	.1	Tubular 500V
25	.001	Tubular 500V
26	30pF	Mica
27	2400pF	Silver Mica
28	.01	Tubular 500V
29	50pF	Silver Mica
30	16	Electrolytic 350V
31	.05	Tubular 500V
32	.02 + .01	Tubular500v
33	.1	Tubular 500V
34	60	Electrolytic 350V
35	500	Electrolytic 12V
36	500pF	Silver Mica
37	16	Electrolytic 350V
38	.001	Tubular 500V
39	.01	Tubular 500V
40	No Component	
41	.005	Tubular 500V
42	.1	Tubular 500V
43	.1	Tubular 500V
44	.01	Tubular 500V
45	.02	Tubular 500V
46	.01	Tubular 500V
47	.05	Tubular 500V
48	.05	Tubular 500V
49	2pF	Tubular Ceramic
50	.005	Tubular 500V
51	.005	Tubular 500V
52	50pF	Silver Mica
53	.01	Tubular 500V
54	.01	Tubular 500V
55	500pF	Silver Mica
56	500pF	Silver Mica
57	.005	Tubular 500V
58	500	Electrolytic 12V
59	.002	Tubular 500V
60	.033	Tubular 500V
61	.0333	Silver Mica
62	.1	Tubular 500V
63	.027	Tubular 500V
64	25	Electrolytic 350V
65	.015	Tubular 500V
66	25	Electrolytic 12V
67	5000pF	Mica
68	2500pF	Mica
69	2500pF	Mica
70	32 (16 + 16)	Electrolytic 350V
71	60	Electrolytic 450V
72	100	Electrolytic 450V
73	100	Electrolytic 450V

INDUCTORS

L	Ohms
1-5	Very low
6	.52
7, 11	Very low
8 } 9 }	1
10	.5
12 } 13 }	.75
14	.75
15	7
16	40
17	500
18	250
19	600
20	1.5
21	12
22	1300
23	1.5
24	1.5
25	2.4
26	380
27	Very low
28	2.5
29	80
30	36
31	100
32	1.6
33	4.5
34, 35, 36	In Sealed Unit
37	4.5
38	300 (Anode Section)
39	120
40	600
41	55
42	70
43-45	Very low
46	10.5

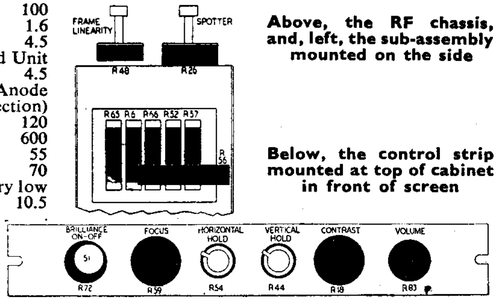


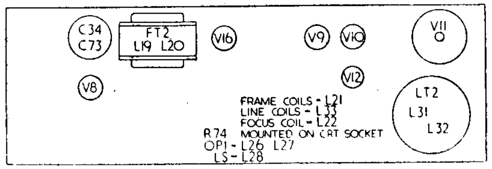




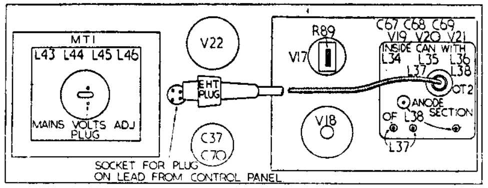
Above, the RF chassis, and, left, the sub-assembly mounted on the side

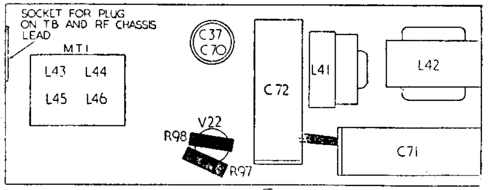
Below, the control strip mounted at top of cabinet in front of screen



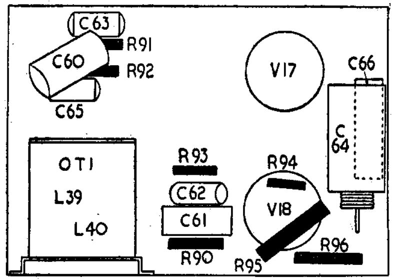


Layouts of the timebase chassis (above and right)





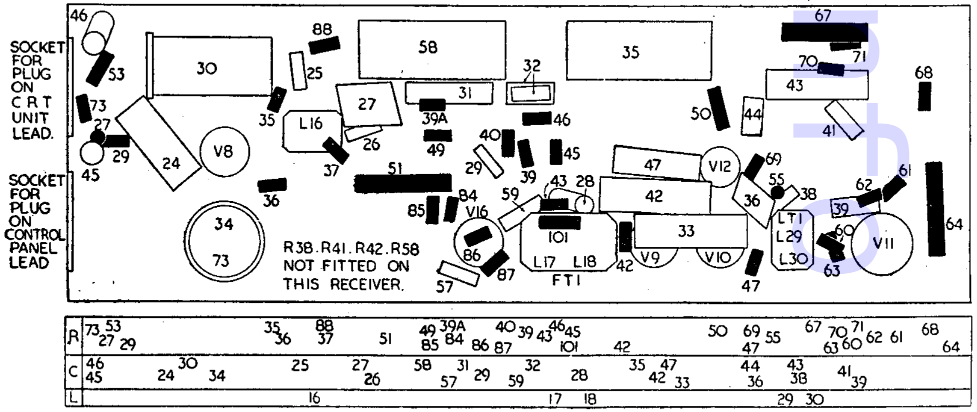
Above, the power pack, including EHT unit, the underside layout of which is below



VALVE VOLTAGE READINGS

V	Type	A	G_2	K	
1	EF91	240	240	1.5–4.5	} R6 Max to Min.
2	EF91	240	240	1.5–4.5	} R6 Max to Min.
3	EF91	230	135	—	
4	EF91	230	230	1.9–5	R18 Max to Min.
5	EF91	230	230	1.5	
6A	EB91	—	—	—	
6B		210–125	—	245	R26 Max. to Min.
7	EF80	245	250	6	
8	EF80	150	35	0	
9A	ECL80	5	35	} 0	Applies when used as clipper
9B		50	—	} 0	Grid volts taken at slider of R54 = 0 to 35V
10A	ECL80	45–65	—	} 12.5	Grid volts taken at slider of R44 = 0 to 35V
10B		210	225	} 12.5	
11	EL38	—	310	8–25	R65 Min. to Max.
12A	EB91	—	—	—	} No readings advisable
12B		—	—	—	} No readings advisable
13	MW6/2	25kV	—	215 to 250	Grid volts 40 to 70V R72 Min. to Max.
14	EF91	230	230	1.5	
15A	EB91	0	—	0	
15B		40	—	40	
16A	ECL80	90	—	} 7	
16B		215	220	} 7	
17	EBC33	320	—	0	
18	EL38	—	.305	3	
22	GZ32	A(1) 315 RMS	A(2) 315 RMS	325	Total Current = 210mA.

EHT at V21k = 25kV.



projection CRT is provided by a special oscillator, ringing-choke stage and voltage tripler unit. The picture is projected by a mirror-lens optical system on to the back of a 16 by 12in. screen which is mounted on a frame assembly attached to underside of the lid of cabinet.

Aerial input circuit is for a 75 to 80 ohm co-axial feeder which is isolated from chassis by C1 C2 with DC continuity provided by R1.

RF amplifiers. Signal is coupled by C2 to tap on L1 in grid of first RF amplifier V1. Signal at anode is single-peak transformer coupled by L2 L3 to second RF amplifier V2, which in turn is single-peak transformer coupled by L4 L5 through C6 to grid of pentode frequency-changer V3. Gain of V1 and V2 is controlled by R6 the **Sensitivity control** in the cathode. Cathode negative feedback across R5 R7 provides compensation for changes in input capacity and resistance of valves. Bandwidth is maintained by damping resistors R3 R9.

Frequency-changer is V3 operated as combined oscillator and mixer. The screen and grid are employed as anode and grid of a tuned-anode triode oscillator. L7 C8 form the tuned anode oscillatory circuit whilst R10 provides bias.

The RF signals applied through C6 are mixed with oscillator signal and resultant intermediate frequencies of 12.25mc/s (vision) and 10.5mc/s (sound) are developed across L6.

Vision and Sound IF. Signals at anode of V3 are coupled by C9 to common vision and sound IF amplifier V4, in the cathode circuit of which is **Contrast control** R18. Cathode negative feedback is developed across R16. Bandwidth is maintained by resistor R14 across primary L8 L9 of IFT1.

Separation of vision and sound signals takes place in this stage. Vision signal is bandpass transformer coupled by IFT1 to further IF amplifier V5. Signal is then bandpass transformer coupled by IFT2 to rectifier V6A. Sound-on-vision rejection is given by L23 in grid of sound IF amplifier V14, and by L11, C15 in cathode of second vision IF amplifier V5.

Rectified vision signal developed across R22, R23 is fed through IF filter L15, R24 to grid of video amplifier V7 the output of which is DC/AC coupled by R32 C20 to cathode of CRT V13.

Interference limiter is diode V6B connected with its cathode to anode of video amplifier V7 and its anode up to HT line through R25 R26 and R27. **Spotter control** R26 is normally adjusted so that V6B just begins to conduct on peak-white of signal. When an interference pulse greater in amplitude than peak-white appears then V6B conducts the pulse down to chassis through C17.

Sound channel. Signal taken from primary L8 L9 of IFT1 is fed by C49 to L23 in grid of sound IF amplifier V14. This is bandpass transformer coupled by IFT3 to signal rectifier V15A. Rectified audio signal is developed across R79 C52 and fed by C53 through noise suppressor V15B and C54 to **Volume control** R83 in grid of triode AF amplifier V16A.

Audio signal at anode V16A is fed by C57 to grid of pentode sound amplifier V16B the output of which is fed by OP1 to an 8in. PM speaker L28.

Noise suppressor. Rectified audio signal across R79 C52 is fed by C53 to anode of noise suppressor diode V15B. Anode of V15B is biased positively through R81 hence it conducts and sets up a voltage across R80 in its cathode. The time constant of R80 C54 C55 is such that the cathode voltage will follow that of the audio signal fed to its anode by C53. Large amplitude high frequency interference pulses however drive anode V15B heavily negative but due to comparatively long time constant of R80 C54 C55 the cathode potential is unable to follow and the valve cuts off thus removing the interference.

Sync separator. Video signal at anode of V7 is fed through R34 C23 to grid of sync separator V8. Positive sync pulses drive the valve into grid current and a negative charge is built up on C23 sufficient to place video signal below cut-off, thus only the sync pulses appear in anode circuit. Line sync pulses are developed across choke L16 and fed by C26 to anode of line scan oscillator V9B.

Frame sync pulses are developed across R37 and fed by C27 R40 to grid of frame pulse clipper V9A. This valve is provided with a small positive grid bias through R41 R39 and is fitted with stopper R40. The bias on the grid is just sufficient to cause the positive portion of sync pulse waveform (AC coupling being used between anode V8 and grid V9A) to drive V9A into grid current—thus the smaller amplitude line sync pulses which are fed together with frame pulses are attenuated due to lowered valve resistance and only the larger frame pulses are passed by V9A through C29 to grid of frame scan oscillator V10A.

On later versions of the receiver the frame clipping circuit is omitted and the frame sync pulses are developed on differentiator network consisting of C27 and R39 connected between junction of R37 L16 and chassis. The pulse appearing across R39 is then fed by C29 to grid of frame scan oscillator V10A as before.

In this later circuit R38, R41, R42 are deleted and R40 is connected from g1 of V9A down to chassis. In addition anode and screen are both connected to top of R44, C30.

Frame scan oscillator is triode V10A operated as a grid-blocking oscillator with anode to grid back-coupling by transformer FT1. Scan waveform is developed across C31 C32. Variation of positive bias fed to grid V10A gives **Vertical Hold** control and variation of oscillator HT by R52 gives **Frame Amplitude** control.

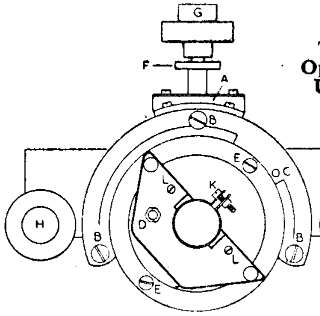
Frame amplifier is pentode V10B. Scan voltage developed across C31, C32 is fed by C33 to its grid. Amplified output waveform at anode is transformer coupled by FT2 to the frame deflector coils L21 mounted in projection unit. **Frame Linearity** is controlled by R48 which varies the amount of negative feedback applied from anode V10B through C47 R46 etc., to its grid. R49 damps deflector coils to prevent ringing.

Line scan oscillator is triode V9B operated as a grid-blocking oscillator with anode to grid back-coupling by transformer LT1. Scan waveform is developed on C38. Variation of positive bias fed to grid V9B gives **Horizontal Hold.**

Line amplifier is pentode V11. Scan voltage developed on C38 is fed through C39 R62 to grid. Output is transformer coupled by LT2 to line deflector coils L33. Adjustment of R65 varies gain of V11 and hence the amplitude of output waveform and gives **Line Width** control. R67 C41 with adjustable R66 which are connected across secondary L32 control of **Line Linearity.**

CRT protection circuit. Voltage across line deflector coils L33 is applied through R68 to anode of diode V12A and frame output voltage at anode V10B is fed by C42 to diode V12B.

The rectified voltage at cathode V12A is developed across R71 R72 R70 and that of V12B across R70 only. The voltage developed across R70 and part R72 is applied through R73 to grid of CRT to give brilliance control. If either of the scan voltages cease then the current flowing through the resistance network will drop and in consequence the bias voltage fed to grid of CRT will drop. The fall in voltage is sufficient to cut-off the CRT and hence prevent destruction of screen surface by the high velocity electron beam.



The Optical Unit

EHT of 25kV for the anode of CRT is provided by a specially designed EHT unit consisting of oscillator and driver valves followed by a cascade voltage tripler rectifier circuit.

The oscillator is triode section of V17 operated as a grid blocking oscillator with anode to grid back-coupling by transformer OT1. The sawtooth waveform developed on C61 at a frequency of approximately 1000c/s is fed through C62, R94 to pentode driver V18. This valve is biased well below cut-off so that it conducts during only a part of the sawtooth input. When it is cut-off sharply at end of each sawtooth the inductance L38 in the anode circuit " rings " at a frequency of the order of 25kc/s and develops a voltage of between 8 and 9kV across the full primary winding.

This voltage is applied to a conventional three stage voltage tripler rectifier circuit V19, V20, V21 to produce an output of approximately 25kV. Regulation of output voltage is controlled by feeding to grid of V18 a voltage which is derived from rectification, by strapped diodes of V17, of a voltage provided from a tertiary winding L37 on OT2. The control voltage is filtered by R91, C63, C65 before being fed through R93, R94 to grid of driver V18. On very recent receivers R95, C64 are deleted and screen V18 is fed direct from HT line.

HT is provided by an indirectly heated twin rectifier V22 coupled in a halfwave circuit. Its anode voltages are obtained through limiters R97, R98 from over-wind or primary L46 of mains input transformer MT1, and its heater current from LT secondary L44. HT feed to video stage V7, line scan oscillator V9B, line amplifier V11 and frame scan oscillator V10A is choke-capacity smoothed by L42, C71, C72, C73 after which it is passed through CRT focus coil L22 and focus controls R57, R59, where it is stabilised and further smoothed by R56, C37 before supplying remainder of vision and all except V16B of sound channels.

Finally the feed to sync separator V8 and frame output valve V10B, and sound output valve V16B is resistance-capacity smoothed by R51, C34.

The HT for EHT unit is separately choke-capacity smoothed by L41, C70.

Reservoir smoothing capacitor C71 should be rated to handle 500mA ripple current.

CRT is a 2½in. projection type Mullard MW6-2. R74 prevents high voltage developing between heater and cathode.

SERVICING AND ADJUSTMENT

Remove the push-in type LS grille on front of cabinet to allow access to the optical unit, etc.

Mechanical centering of picture on CRT screen. Remove focus and deflection coil assembly complete with CRT from optical unit by removing locking plate A held by four screws. Loosen the three screws B and turn coil assembly clockwise until it is checked by stop C and withdraw CRT and coil assembly carefully. When doing this make sure the side cap of CRT is in a position to clear the lower edge of support frame.

Switch on receiver and adjust Brightness Control so that raster can just be seen—low brilliance is important when operating tube outside optical unit to avoid generation of X-rays. Adjust Focus and Linearity controls to give a good picture on CRT.

To centre picture, loosen locking nut on screw D and unscrew D several turns. Adjust screws E until picture is correctly centred on CRT screen, being careful to see that focus coil does not bear against neck of tube. Screw in screw D so that it just bears against endplate of pot and tighten its locknut.

Replace coil assembly in optical unit.

Mechanical adjustment of focus. See that locking plate A is removed. Slacken knurled locknut F below knob G and turn G to one extremity of travel. This results in a narrow slightly diagonal strip of picture being in focus.

Slacken locknuts on knobs H and J and adjust both knobs in same direction until the strip of focus passes through the geometrical centre of picture. Then adjust H and J in opposite directions until focused strip is vertical and central. Finally adjust G to spread focus over picture area, and when optimum results are obtained tighten locknuts on all three knobs and replace locking plate A.

Centering picture on viewing screen. The optical unit is bolted to a wood platform which rests on top of a wood support frame fixed to floor of cabinet. The holes through which the platform securing bolts pass are sufficiently large to allow the platform to be moved sideways and lengthways. To centre the picture on viewing screen it is necessary only to loosen the three fixing bolts and adjust the position of platform. Finally tighten fixing bolts and replace LS grille.

Replacement of CRT. Remove LS grille on front of cabinet. Remove coil assembly complete with CRT as described previously. Remove EHT lead from side-cap on CRT and pull off connecting base socket. Slacken screw K on tube clamp and also screws L securing clamps to bridge—this allows clamp to float. Withdraw CRT.

Insert new CRT through coil assembly and push well home so that flare of tube seats snugly up against end of coil assembly. Make sure earthing strip on inside of coil unit is making good contact with external coating of CRT. Rotate tube so that side anode cap is positioned so that it will be at bottom when coil assembly is placed in optical unit.

Tighten screws L and K on CRT clamp. Apply Silicone Grease Compound DC4 to inside and outside of CRT side-cap shield. Reconnect EHT lead to anode cap and plug connecting socket on end of tube. Finally replace coil assembly in optical unit and set up unit as described previously.

ALIGNMENT INSTRUCTIONS

Connect high-resistance AC voltmeter across secondary L27 of OP1 for measurement of sound output. Connect 0 to 1mA meter shunted by 5000pF between junction R22, R23 and chassis for measurement of vision output.

Place Volume and Contrast controls at maximum—fully clockwise. Place slider of Sensitivity control at top of its travel. Inject 10.5mc/s to g1 of V3 and adjust L23, L24, L25 for maximum on sound output meter.

Then adjust L11 and again L23 for minimum output on vision meter. Inject 13.5mc/s to g1 of V3 and adjust L8, L9 (top) and L12, L13 (top) for maximum on vision meter.

Inject 11mc/s to g1 of V3 and adjust L10 (bot.) and L14 (bot.) for maximum on vision meter.

Inject 12mc/s to V3 and adjust L6 for flat response.

Inject 41.5mc/s (L) or 58.25mc/s (B) into aerial socket and adjust for maximum on sound output meter.

Inject 43mc/s (L) or 60mc/s (B) into aerial socket and adjust L4, L5 for maximum on vision meter.

Inject 44mc/s (L) or 61mc/s (B) into aerial socket and adjust L2, L3 for maximum on vision meter.

Inject 45mc/s (L) or 61.75mc/s (B) into aerial socket and adjust L1 for maximum on vision meter.