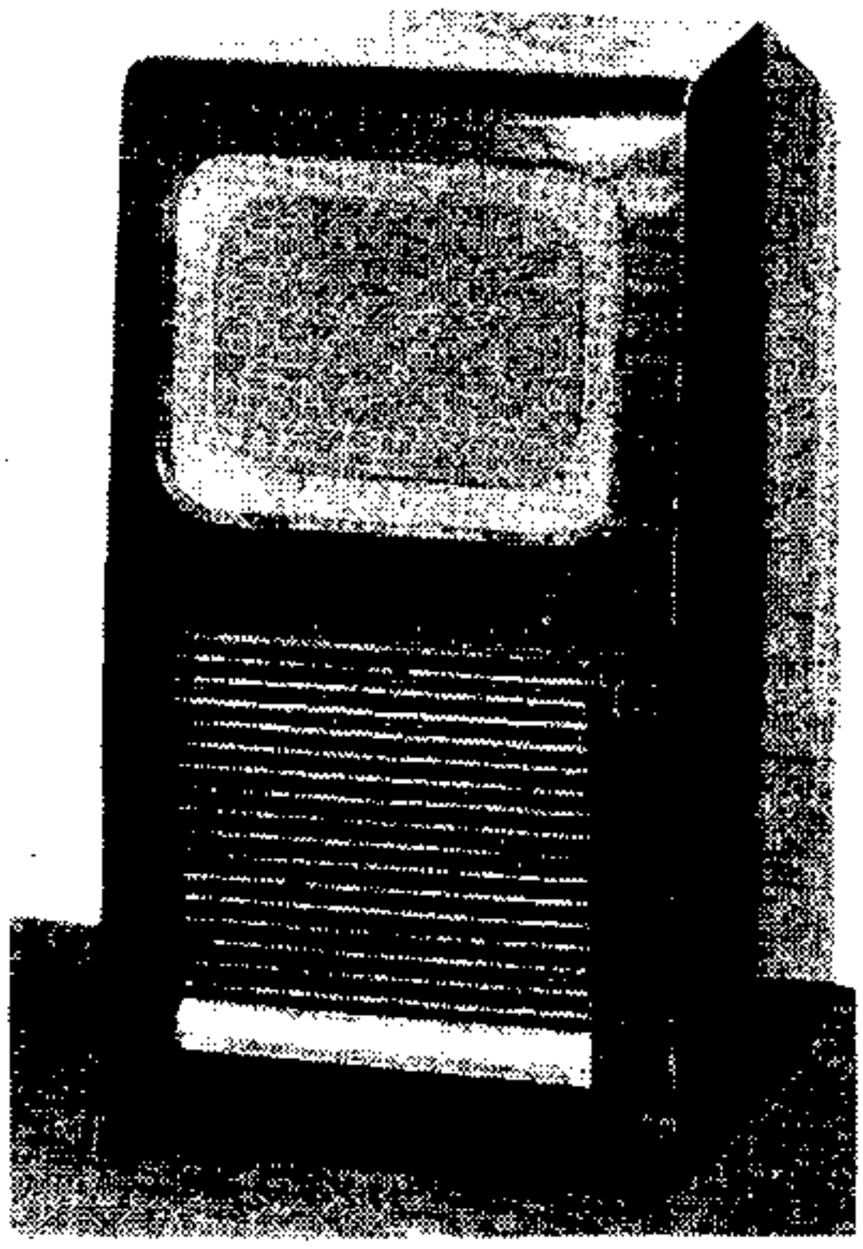
FERGUSON 989T



Nineteen-valve, five-channel television receiver with 16in. flat-screen metal-coned CRT with neutral tinted filter, giving a 13¼in. by 10in. picture and incorporating push-pull sound output. Walnut veneered console or oak period style cabinet with panelled doors. For 200-250V DC or AC 50c/s. Manufactured by Ferguson Radio Corporation Ltd, Great Cambridge Road, Enfield, Middlesex.

THE receiver is a superhet operating on lower sideband of vision carrier. Aerial input panel incorporates an attenuator; aerial, RF and oscillator circuits are tuneable to any of the five BBC channels. Vision interference and sound noise suppression circuits are adjustable by three-position plug at rear of chassis.

Mains consumption is 120-150W.

Aerial input is for use with 80ohm coaxial. Aerial signal can be fed direct or through an attenuator R1 R2 R3 to primary L1 of aerial input transformer RFT1. Filter circuit L19 T2, which is tuneable from approximately 70-100mc/s, is fitted to trap interference signals. Outer screen of coaxial and earthy side of aerial input circuit are DC isolated from receiver chassis by C1.

RF amplifier. Aerial signal is coupled by secondary L2 of RFT1 to grid of RF amplifier V1, the gain of which is controlled, with that of first vision IF amplifier V3, by R8 the **Contrast** control in their common cathode return to chassis. Amplified signal is developed across L3.

Frequency-changer is V2 operated as combined oscillator and mixer. Oscillatory tuned circuit L4 C7 C8 T9 is connected between screen and grid through C10, the screen or oscillator anode voltage being obtained through R7 from anode of RF amplifier V1. Automatic bias for oscillator grid is developed on C10 with R9 as leak. RF signals at anode V1 are fed through R7 C6 and mixed with oscillator signal to produce in V2 anode circuit a sound IF of 19.5mc/s across L7 C12 and a vision IF of 16mc/s across L5 damped by R10.

Vision channel consists of two IF amplifiers V3 V4, signal rectifier W1, video output amplifier V5 and interference suppressor V6A.

Bandpass transformer coupling is employed between anode of V2 and first vision IF amplifier V3, and between V3 V4 and vision signal rectifier W1. Wide bandwidth is maintained by damping resistors R10 R11 R13 R14 and R19.

L8 C13, tuned to 14.5mc/s in grid of V3, is an adjacent-channel rejector circuit, whilst sound-on-vision rejection at 19.5mc/s is given by L7 C12 in anode V2 and by L11 C16 in anode V3.

The video signal is developed across R21 in grid of video amplifier V5, the anode of which is connected through correcting choke L23, damped by R24, to cathode of CRT.

Interference limiter is diode V6A shunted by R25 R26 R27 and connected with its anode direct down to chassis and its cathode, through C22, to junction of video correcting chokes L21 L22 in anode of V5. Potential set up on C22 is equal to peak-white signal and is just sufficient to hold V6A cut-off. When a high frequency negative-going interference pulse is passed by C22, cathode V6A is driven negative to anode and the diode conducts to short the pulse to chassis. Choice of three values of shunt load by S1, which forms one section of **Interference Limiter** control, enables degree of limiting to be adjusted.

Sound channel consists of two IF amplifiers V10 V11, signal rectifier W2, noise suppressor V6B, AF amplifier V12A, phase-reverser V13A and push-pull output amplifiers V12B V13B.

Sound signal of 19.5mc/s, developed across L7 C12 in anode of V2, is fed by C32, together with AVC voltages decoupled by R43 C35, to grid of first sound IF amplifier V10. Single-peak transformer coupling is employed between V10 V11 and signal rectifier W2.

Audio signal is developed across R45 and fed by C39 through noise limiter V6B and thence fed by C42 to **Volume** control R48 in grid of AF amplifier V12A. Amplified signal at anode is fed by C45 to grid of one push-pull amplifier V12B, and in addition an attenuated signal derived from potential divider R50 R51 between anodes V12A V13A is fed by C47 to grid V13A. Opposite-phase signal at anode V13A is thence coupled by C46 to other push-pull amplifier V13B.

Output is transformer fed by OP1 to an 8in. PM speaker L38. Fixed tone correction is provided by R59 C49 and C50.

AVC. The DC component of the rectified signal is decoupled by R43 C35 and applied to grid of first sound IF amplifier V10 as AVC voltage.

Noise suppressor. Anode of diode V6B is positively biased from HT line through R46 and

conducts to set up a potential across R47 C40 C41, the time constant of this network is such that the potential across it follows that of the audio signal fed through C39 to anode V6B. When a high-frequency interference pulse appears, anode V6B is driven negative to its cathode, the potential of which is maintained by the comparatively long time constant. The diode is cut-off for duration of interference pulse.

Time constant of V6B cathode circuit can be adjusted by S4 to give three degrees of limiting. Sound and vision limiter adjusters S4, S1 are ganged to a common **Interference Limiter** control.

Sync separator. Signal at junction of L21 L22 in anode video amplifier V5 is fed through R60 C51 to grid of sync separator V14A. Positive sync pulses cause grid current and bias set up across R61 is sufficient to place video portion of waveform below cut-off; thus only sync pulses appear at anode. Line sync pulses are developed across R64 and fed through C53 and anti-parasitic choke L27 to grid of line oscillator and amplifier V8. Frame sync pulses are differentiated from line sync pulses by action of V14B in conjunction with V15.

Grid V14B is positively biased from HT line through R66 and hence the valve conducts heavily with consequent low anode voltage. Anode V14B is directly connected to grid V15 and as cathode bias of this latter valve, obtained from potential divider R67 R68, is more positive than the voltage applied to its grid, is normally cut-off. Negative sync pulses, fed by C54 to grid V14B, cause its anode voltage to rise positively. Time constant of R65 C55 is such that the potential on C55 becomes more positive than cathode voltage V15, thus allowing V15 to conduct, only when the long-duration frame sync pulses are on grid V14B.

Frame sync pulses are developed across R69 and fed by C59 to pentode screen (g2) of frame scan oscillator V16.

Frame scan oscillator. Triode V16A is cross-coupled by C57 C58 with screen and grid of pentode V16B in a multivibrator circuit, the oscillation frequency being determined by time constants of R72 C58 and R74 R75 C57. Adjustment of the latter network by R75 gives **Vertical Hold.** Frame scan voltage is developed on C61 in anode V16B. Variation of HT to anode V16B by R76 gives **Picture Height** control.

Frame amplifier. Scan voltage on C61 is fed by C62 through stopper R82 to grid of pentode frame amplifier V17. Amplified scanning waveform at anode is transformer coupled by FT1 to frame deflector coils L41 L42. Centre tap of coils is connected through R36 to HT line. Variation of cathode bias voltage by R71 gives control of **Frame Linearity** whilst R81 R80 C63 C64 provides negative feedback waveform correction.

Line scan voltage is generated by a self-oscillating pentode output amplifier V8. Valve is driven into oscillation by positive grid feedback, through C25 R32 R31 from secondary L31 of line output transformer LT1. Adjustment of feedback network by R32 gives **Horizontal Hold.**

Output waveform is coupled by secondary L31 through linearity coil L25, damped by R37 C31, and DC isolating capacitor C30 to line deflector coils L34 L35. **Line Linearity** is controlled by variation of inductance of series coil L25 by means of a position-adjustable permanent magnet placed in close proximity to the coil.

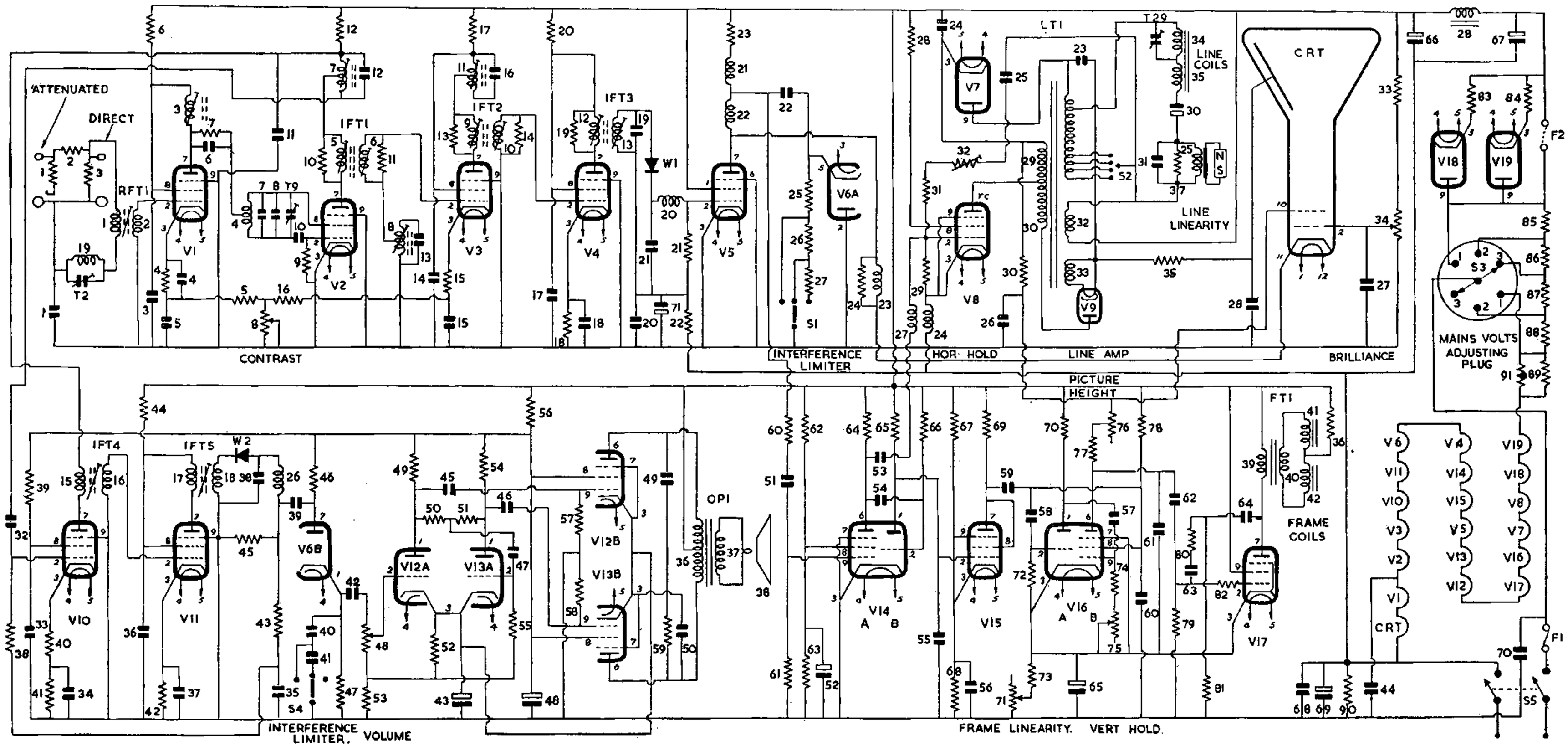
Negative bias for grid of V8 is obtained by returning grid resistor R29 through anti-parasitic choke L24 to bias network R90 C68 C69 in negative HT return lead to chassis. **Line Amplitude** is adjusted by plug S2 which connects deflector coil to tappings on output secondary L31 of LT1.

Efficiency diode. Additional drive for line output valve V8 is provided by diode V7 which rectifies high surge voltage set up on secondary L31 when V8 is cut-off at end of each line.

Voltage stored on C24 is smoothed by R30 C26 and fed to second anode of CRT, and to anode of second frame scan multivibrator valve V16B.

EHT of approximately 13.5kV for final anode of CRT is provided by V9 which rectifies the high surge voltage on primary L29 and overwind L30 of LT1 when V8 is cut-off. Approximately 2kV of the 13.5kV is obtained by connecting earthy side of EHT reservoir smoothing capacitor C23 to end of overwind of secondary L31. EHT is smoothed by R35 C23 C28.

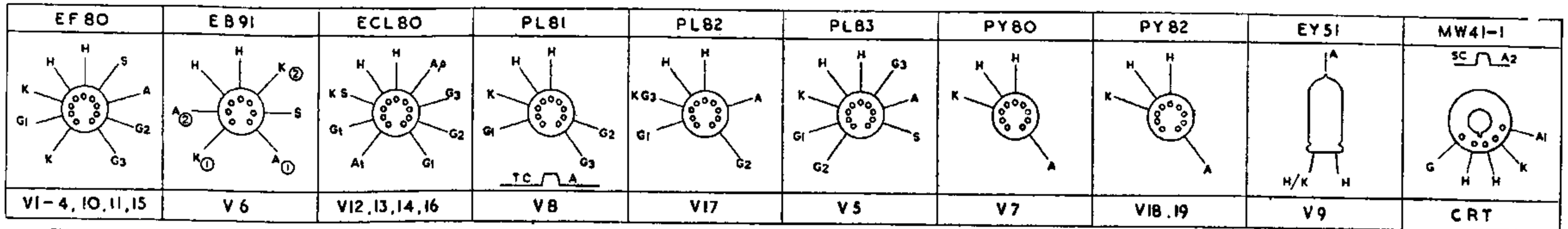
HT is provided by two indirectly-heated halfwave rectifiers V18 V19 connected in parallel and fed from the input mains direct on 200-210V or through droppers R85 and R86 on 220-230V and 240-250V supplies respectively. R83 R84 are cathode surge limiters. Choke-capacity smoothing is provided by L28 C66 C67. Reservoir smoothing capacitor C67 should be rated to handle 600 mA

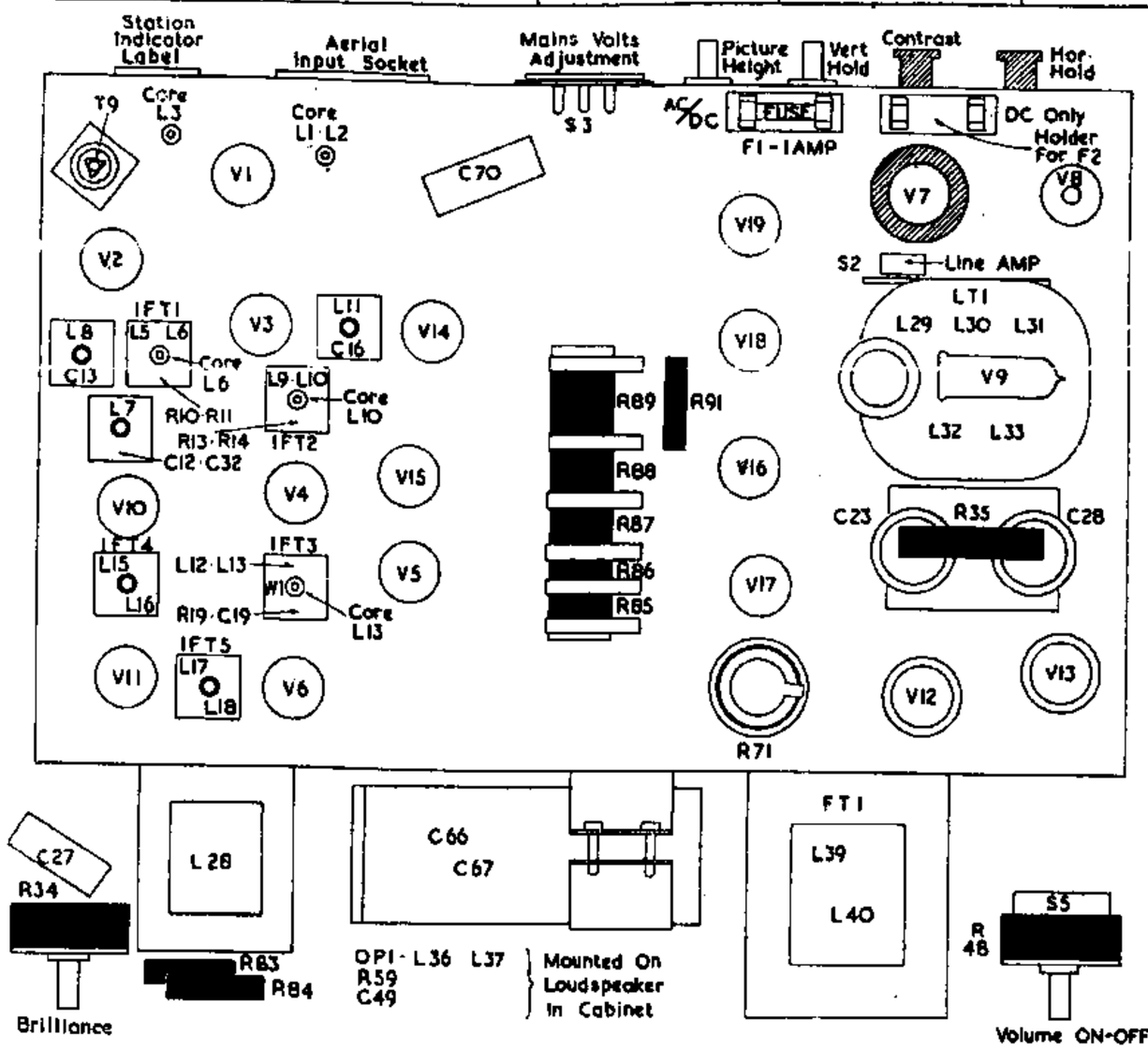


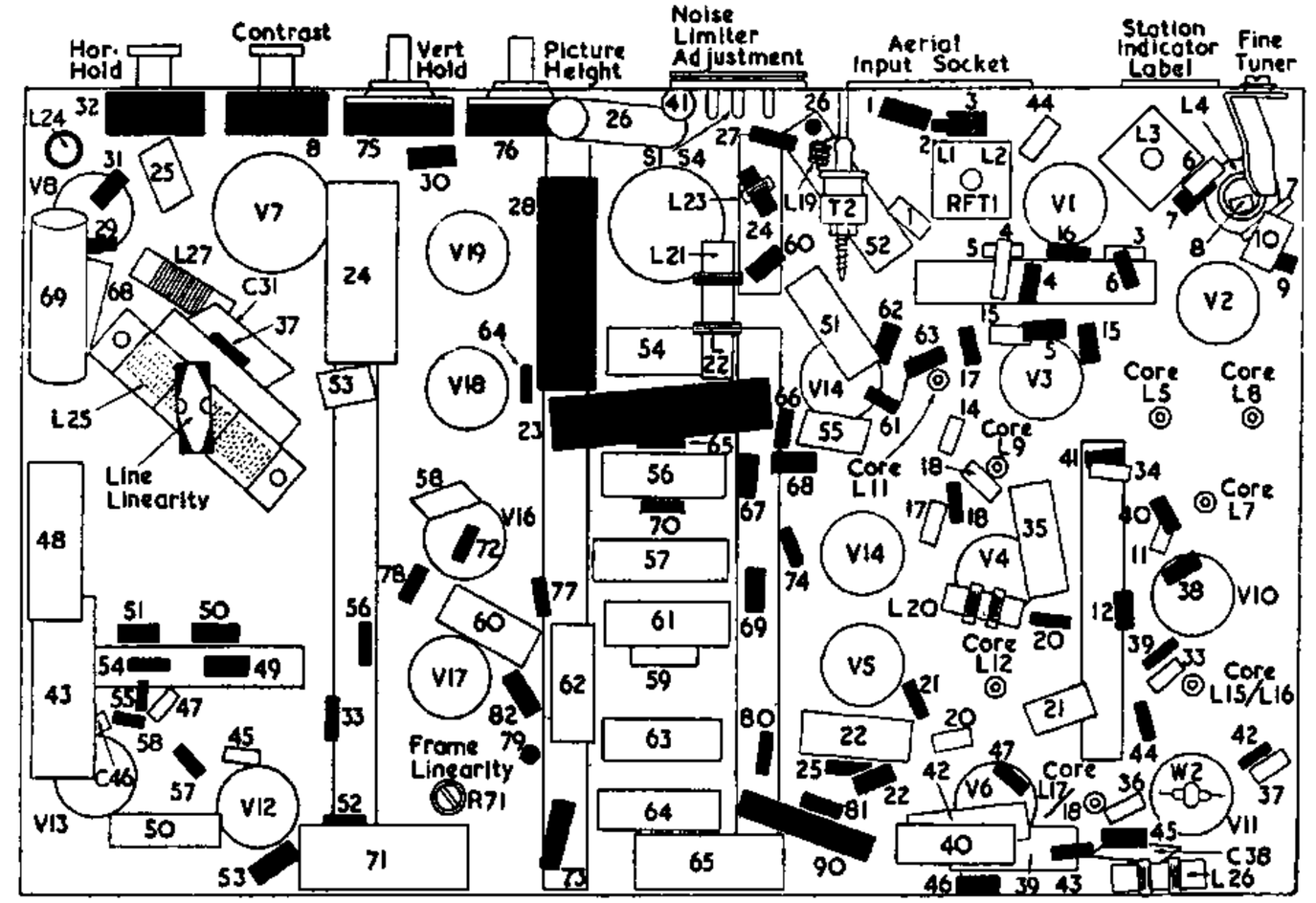
VOLTAGE READINGS

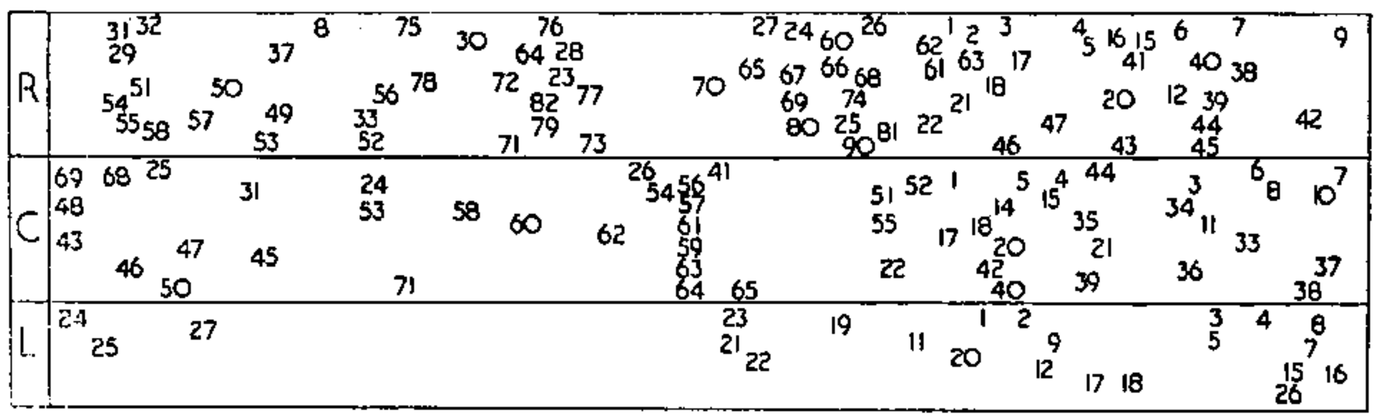
V	Type	A	G_2	K
1	EF80	178–192*	178–192	2.2–4.9
2	EF80	184	113	—
3	EF80	178–192*	178–192	2.2–4.9
4	EF80	178	178	2.2
5	PL83	148	192	—
A		—	—	—
6	EB91			
B		—	—	—
7	PY30	—	—	457
8	PL81	—	111	— 4.2
9	EY51	—	—	14.5kV
10	EF80	182	168	1.9
11	EF80	177	177	2.2
A		54	—	
12	ECL80			6.5
B		185	171	
A		54	—	
13	ECL80			6.5
B		185	171	
A		109	16	
14	ECL80			0
B		2.6	—	
15	EF80	170	170	32.5
A		45**	—	
16	ECL80			11.15
B		33	165	
17	PL82	176	190	13
18	PY82	—	—	
19	PY82	—	—	203
CRT	MW41-1	14.5kV	457	148

*R8 max.–min. **R71 min.–max.
Total HT current = 285mA
Mains current = .84A









RESISTORS

R	Ohms	Watts
1	82	½
2	1K	½
3	82	½
4	47	½
5	150	½
6	1K	½
7	22K	½
8	5K	WW Potr.
9	150K	½
10	12K	½
11	12K	½
12	470	½
13	22K	½
14	22K	½
15	47	½
16	150	½
17	1K	½
18	180	½
19	12K	½
20	1K	½
21	5.6K	½
22	6.8K	½
23	3K	3
24	5.6K	½
25	470K	½
26	11.5M	½
27	1.5M	½
28	3K	3
29	2.2M	½
30	22K	½
31	68K	½
32	250K	Potr.
33	100K	½
34	500K	Potr.
35	1.5M	2
36	2.2K	½
37	910	½
38	68K	½
39	1K	½
40	47	½
41	150	½
42	180	½
43	220K	½
44	1K	½
45	47K	½
46	3.3M	½
47	1M	½
48	500K	Potr. with DP Switch
49	220K	½
50	750K	½
51	1M	½
52	100	½
53	100	½
54	220K	½
55	470K	½
56	2.2K	½
57	680K	½
58	680K	½
59	15K	½
60	12K	½
61	2.2M	½
62	150K	½
63	15K	½
64	100K	½
65	750K	½
66	330K	½
67	68K	½
68	15K	½
69	22K	½
70	100K	½
71	500	Potr.
72	560K	½
73	220	½
74	470K	½
75	1M	Potr.
76	1M	Potr.
77	470K	½
78	22K	½
79	1M	½
80	27K	½
81	180K	½
82	12K	½

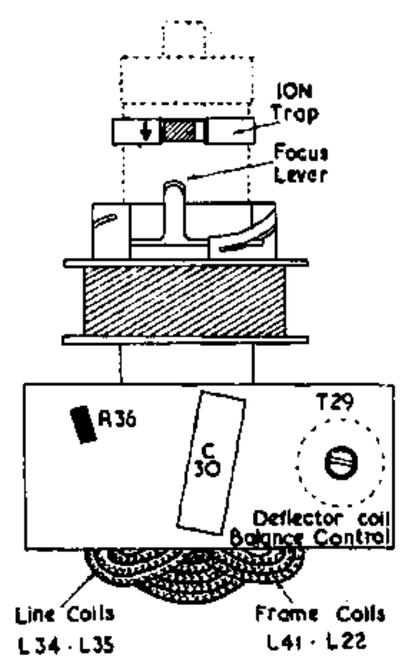
R	Ohms	Watts
83	40	WW3
84	40	WW3
85	20	Tapped Mains Dropper
86	20	
87	60	
88	60	
89	350	
90	35	1
91	CZ1A Brimistor	

CAPACITORS

C	Capacity	Type
1	.001	Tubular 300V-AC
2	No Component	
3	.001	Tubular Ceramic
4	15pF	Silver Mica
5	.001	Tubular Ceramic
6	.001	Tubular 350V
7	10pF	Silver Mica
8	5pF ±0.5pF	Ceramic
9	No Component	
10	30pF	Silver Mica
11	3000pF	Tubular 350V
12	70pF	Silver Mica
13	100pF	Silver Mica
14	3000pF	Tubular 350V
15	3000pF	Tubular 350V
16	70pF	Silver Mica
17	3000pF	Tubular 350V
18	3000pF	Tubular 350V
19	2pF ±0.5pF	Ceramic
20	3000pF	Tubular 350V
21	4pF ±0.5pF	Silver Mica
22	.1	Tubular 350V
23	500pF	—15kV
24	.1	Tubular 300 V-AC
25	200pF	Sil. Mica 500V
26	.1	Tubular 500V
27	.1	Tubular 150V
28	500pF	—15kV
29	No Component	
30	50	Electrolytic 12V
31	1000pF	Silver Mica
32	30pF	Silver Mica
33	3000pF	Tubular 350V
34	3000pF	Tubular 350V
35	.1	Tubular 350V
36	3000pF	Tubular 350V
37	3000pF	Tubular 350V
38	30pF	Silver Mica
39	.1	Tubular 350V
40	.02	Tubular 350V
41	.005	Tubular 600V
42	.1	Tubular 350V
43	50	Electrolytic 25V
44	.001	Tubular 350V
45	.002	Tubular 350V
46	.002	Tubular 350V
47	.002	Tubular 350V
48	8	Electrolytic 275V
49	.005	Tubular 350V
50	.005	Tubular 1000V
51	.1	Tubular 350V
52	4	Electrolytic 150V
53	10pF	Silver Mica
54	.1	Tubular 350V
55	150pF	Silver Mica
56	.1	Tubular 350V
57	.02	Tubular 1000V
58	500pF	Silver Mica
59	100pF	Silver Mica
60	.01	Tubular 350V
61	.1	Tubular 350V
62	.1	Tubular 350V
63	.05	Tubular 350V
64	.05	Tubular 350V
65	50	Electrolytic 25V
66	250	Electrolytic 275 V
67	60	Electrolytic V
68	.01	Tubular 350V
69	100	Electrolytic 25V
70	.1	Tubular 300V-AC
71	100	Electrolytic 25V

INDUCTORS

L	Ohms
1	Very low
2	Very low
3	Very low
4	Very low
5	.5
6	.4
7	Very low
8	Very low
9	.5
10	.4
11	Very low
12	.5
13	.6
14	No component
15	Very low
16	Very low
17	Very low
18	Very low
19	Very low
20	2.5
21	9
22	5
23	6.5
24	4.5
25	1.5
26	2.5
27	10
28	35
29	44
30	250
31	7.5
32	4
33	Very low
34	7.5 together
35	
36	750
37	Very low
38	2.5
39	400
40	1.75
41	7.5 together
42	



ripple current. On DC supplies rectifiers can be shorted out to give increased HT by insertion of a 1A fuse in holder F2.

Heaters V1-8, V10-19 and CRT are series connected with thermal surge limiter R91 shunted by R89 and fed from input mains direct on 200-210V or through droppers R88 and R87 on 220-230 and 240-250V supplies respectively.

Appropriate dropping resistors for HT rectifier anode voltage and valve heater circuit are selected by calibrated adjustable plug at rear of chassis.

Mains input to receiver is fitted with fuse F1 in live lead. On AC supplies fuse should be 1A P 4 type and on DC supplies a 2A P 6 type. C70 is mains RF bypass capacitor. S5, which is ganged to sound volume control, is ON/OFF switch.

CRT is a tetrode Mullard MW41—1 with metal cone and 16in. diameter flat screen. Permanent magnet focusing is employed. Video signal is applied to its cathode and **Brilliance** is controlled by variation of grid voltage by R34.

ALIGNMENT INSTRUCTIONS

Apparatus required : Signal generator covering 10-20mc/s and 40-70mcs/ ; AC output meter ; Avometer model 7 to indicate vision output. Connect AC output meter across or in place of LS speech coil.

Connect positive lead of Avometer through a 50K resistor to cathode of CRT (resistor must be connected as close as possible to cathode pin of CRT holder). Connect negative lead of Avometer to slider of 20K potentiometer connected between HT line and chassis. Switch meter to 2mA DC range and adjust potentiometer to give a reading of 20V with zero signal input (full scale reading of meter connected as above is 100V).

Signal-generator should be connected to injection point by short length of co-axial cable the bared ends of which should also be kept as short as possible. Place Volume and Contrast controls in their maximum positions.

IF stages. Short circuit L4 and feed signal as given below, through a .01 mF capacitor to anode V1.

14.5mc/s adjust L8 for min. vision.
19.5mc/s adjust L11 for min. vision.
19.5mc/s adjust L7 for min. vision.
19.5mc/s adjust L17 for max. sound.
19.5mc/s adjust L15 for max. sound.
17.75mc/s adjust L13 for max. vision.
17.75mc/s adjust L12 for max. vision.
17.75mc/s damp L9 with 1K resistor and adjust L10 for max. vision.
17.75mc/s damp L10 and adjust L9 for max. vision.
17.75mc/s damp L5 and adjust L6 for max. vision.
17.75mc/s damp L6 and adjust L5 for max. vision.
Note on TS (fringe area) receivers the last six operations should be carried out at 17.1mc/s.

RF Stages. It is essential to adjust oscillator trimmer T9 so that sound rejection peak occurs exactly at sound carrier frequency.

Inject appropriate sound carrier frequency into Direct aerial socket and with Fine Tuner at rear of chassis set in approximately mid position, adjust T9 for maximum sound and also maximum vision outputs. Inject appropriate vision carrier frequency and adjust L3 and L2 for maximum vision output.

Finally check to see that sound frequency rejection relative to vision carrier frequency is at least 35 dB—approximately 56 : 1.

Image rejector. This is factory aligned to 95mc/s but can be realigned to any known interference frequency between 70-100mc/s. Adjustment can be made by trimming T2 for minimum interference on CRT or if exact frequency of interference signal is known then this frequency can be injected into aerial socket and T2 adjusted for minimum deflection on vision output meter.