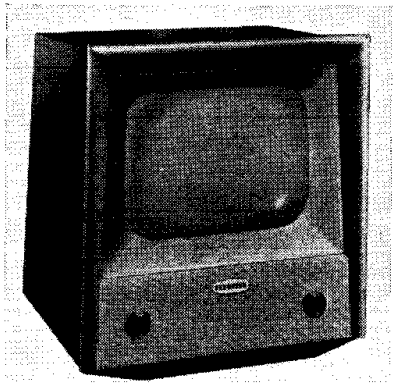
FERGUSON 992T, 994T, 996T



Current prices and release dates: 992T, 62gns. (£48 13s. 11d. *plus* £16 8s. 1d. *tax*), *January*, 1953; 994T, 76gns. (£59 13s. 10d. *plus* £20 2s. 2d. *tax*), *March*, 1953; 996T, 76gns. (£56 11s. 0d. *plus* £19 1s. 0d. *tax*), *February*, 1953.

Fifteen-valve five-channel television receivers with single-control channel selection. Models 992T 994T *have* 14*in. screens; model* 996T, 17*in. Housed in walnut cabinets, and suitable for* 200-250*V DC or AC* 50*c/s. Consumption,* 125*W approximately. Manufactured by Ferguson Radio Corporation Limited, Great Cambridge Road, Enfield, Middlesex.*

THESE receivers differ only in CRT size and type of cabinet. Both the 992T and 994T employ a Mullard CRT, type MW36-24 (14in. rectangular) and are table and console models respectively. Table model 996T incorporates a Mullard MW43-64 tube (17in. rectangular), which requires a slightly weaker focusing magnet and has an additional electrode externally connected to cathode. Both types of tube have dark glass screens. All models employ a tinted filter.

Elliptical speakers are fitted in the table models, while an 8in. circular is used in console 994T.

The superheterodyne circuit operates on lower sideband of vision carrier. Aerial input panel incorporates an attenuator. Aerial, RF and oscillator circuits have single-control five-channel tuning. Vision interference and picture width adjustments are achieved by two sets of three-position plugs at rear of chassis.

Aerial input is designed for 80ohm coaxial. Aerial signal can be fed direct or via an attenuator R1 R2 R3 to primary L2 of aerial input transformer RFT1. Second channel rejector circuit L1 C2 is tunable from 75-100mc/s and forms a trap to interference signals. Outer screen of coaxial and the earthy side of input circuit are DC isolated from receiver chassis by C1.

RF amplifier. Aerial signal is coupled by L2 L3 to grid of RF amplifier V1, the gain of which, together with that of first vision IF amplifier V3, is controlled by R4, the **Contrast** control connected in the common cathode return to chassis. Amplified signal is developed across L4 in the anode circuit, and HT is fed to anode and screen through R5, decoupled by C3. Negative feedback is provided by R6, while R7 is the cathode resistor, with C4 as bypass.

Oscillator is triode V2B connected in an earthed-anode Hartley circuit in which oscillatory tuned coil L5, shunted by C10 (pre-set) and C11 is connected between grid and chassis, with C8 as grid coupling capacitor. Automatic grid bias is developed on C8, R11 being the leak. R10 provides decoupling. Output is taken from cathode and fed by C6 to grid of mixer V2A.

Mixer triode V2A has RF signals from V1 anode fed to its grid via C5. The internal mixing of these two inputs produces a vision IF of 16mc/s and a sound IF of 19.5mc/s across IFT1 primary L6 L8 in the anode circuit. L6 L8 are damped by R13, and bias is derived from R9 in the cathode, with C7 as bypass.

Common IF amplifier. Vision and sound IF signals at mixer V2A anode are coupled by IFT1 to control grid of common IF amplifier V3. The gain of this valve and that of V1 are determined by R4, the contrast control. L9 C13 form an adjacent-channel rejector circuit, tuned to 14.5mc/s. Negative feedback comes from R15, and R16 is the bias resistor, bypassed by C15. Amplified vision and sound IF's appear across IFT2 primary.

Vision channel. Vision IF is coupled to the vision amplifier V4 by bandpass transformer IFT2. A sound-on-vision rejector circuit, tuned to 19.5mc/s and made up of L13 C18, is employed in this stage. R18 acts as leak, R19 is the cathode resistor. R21 feeds HT to V4 anode and screen, with C19 as decoupling.

IFT3 bandpass transformer—with its primary L14 in anode circuit of V4—has the vision signal rectified in its secondary circuit by W1. C21 C22 afford IF bypass to chassis, and L17 L18 constitute a filter choke to ensure that no IF component reaches the control grid of the video amplifier V5.

Metal rectifier W2 in the cathode of V5 prevents current negative feedback at video frequencies. The anode circuit incorporates correction chokes L19 L20, which operate at the higher frequencies and peak at 3 mc/s. R24 R25 are anode load resistors. Output from V5 anode is DC connected to cathode of CRT.

Interference limiter diode V6A has anode connected direct to grid of video valve. Positive cathode bias is derived from a resistor network R27 R28 R29. The amount of bias developed is determined by adjustment of the 2-pin plug (at rear of chassis) which puts R28 R29 in or out of circuit to meet requirements. The requirements are that the cathode should have sufficient positive bias just to cut off diode V6A on a peak-white signal, so that when an interference pulse greater than peak-white occurs at its anode the diode conducts and limits the effect.

Sound channel. The 19.5mc/s sound IF at anode of V3 is fed via C14 to L23 in the grid circuit of double diode pentode V10, which operates as a sound IF amplifier and demodulator. IF signal appearing at anode across L24 is fed to secondary L25, which is connected between one of the valve's diodes and the cathode, with R40 as diode load and C33 as IF bypass. The other diode, together with the suppressor grid, is strapped to cathode, cathode bias being built up across R39 shunted by C32.

Noise suppressor diode V6B has anode positively biased from HT line through R46 R42. When the diode conducts, a potential is set up across R41 C37, the time constant being such that the potential follows that of the audio signal fed via IF choke L26 and capacitor C35 to its anode. When a high-frequency interference pulse appears, however, anode of diode is driven negative with respect to its cathode (the potential of which is maintained by the comparatively long time constant) and the diode is cut off for the duration of the interference pulse.

Audio frequency signals are fed, via C36 and **Volume** control R43, from cathode of V6B to grid of triode amplifier V11A, for which R46 provides HT decoupling and R47 the anode load. Amplified output across R47 goes to control grid of pentode V11B via C41, with R50 as leak and R49 as grid stopper. Negative feedback from anode to grid is achieved by C40. Tone correction is afforded by C38 R48 in circuit across primary of output transformer OP1, the secondary of which feeds a PM speaker of 3ohms impedance.

Sync separator. Signal at junction of L19 L20 in anode circuit of video amplifier V5 is fed via R23 C23 to grid of sync separator V12A. Positive sync pulses cause grid current, and the bias set up across R53 is sufficient to place video part of waveform below cut-off, therefore only sync pulses appear at the anode.

Line sync pulses are developed across R55 and go to grid of line oscillator and amplifier V7 via R33 C27. Screen voltage is reduced to a low value to obtain a short grid base and ensure sync-video separation on weak signals.

Frame sync pulses are integrated by C43 R54 and fed by C44 to grid of V13A.

Frame scan oscillator. Triodes V12B and V13A are cross coupled by C46 C47 to operate in a multi-vibrator circuit, with scan voltage developed on C45. Variation of R60 in grid circuit of V12B provides **Vertical Lock** and the adjustment of HT voltage to V12B anode by R57 affords control of **Picture Height.**

Frame amplifier. Sawtooth waveform generated on C45 is fed via C49 and grid stopper R65 to grid of pentode frame amplifier V13B. Amplified waveform at anode of V13B is transformer coupled by FT1 to frame deflector coils L39 L40 on neck of CRT.

R70 R71 damp out line oscillations due to mutual inductance of line and frame deflector coils. Negative feedback to improve frame output waveform is fed from anode to grid via a network made up of C50 R61 R66 C51 R68 and **Frame Linearity** control R69.

Line scan waveform is derived from a self-oscillating output valve V7 used in conjuntion with booster diode V8. V7 oscillates by virtue of anode to grid feedback through inductive coupling between L31 L29 of line output transformer LT1, the oscillator frequency being determined by R31, the **Horizontal Lock** control. R30 is the grid leak.

Output from V7 is transformer coupled by LT1 to line deflector coils L32 L33 on neck of CRT.

Line amplitude is controlled by a tapped inductance C-D on secondary L31. The tappings are brought out to a panel marked **Width** at rear of chassis, and adjustment is by a 2-pin plug.

Line linearity control consists of inductance L22 shunted by C29 and damped by R35, with a position-adjustable permanent magnet in close proximity (on focus magnet gantry) by which linearity adjustment is made.

Booster diode is V8. High peak voltage which occurs during fly-back is applied, scaled down in proportion to the diode, and the boosted HT voltage is fed via the smoothing circuit R36 C30 to the first anode of CRT, with C28 as decoupling. V8 also supplies extra HT to anode of the line oscillator V7.

EHT of approximately 14.5kV for final anode of CRT is obtained by rectification by V9 of the surge voltage set up across F-G winding on L31 of LT1 during line flyback. Capacity between inner and outer coatings of CRT forms the EHT reservoir capacitor.

HT is provided by two parallel-connected indirectly-heated half-wave rectifiers V14 V15, with anode voltage obtained from the mains through tapped dropper resistor made up of R76 R77 R78 R79. Surge limiters R74 R75 are in series with the cathodes. Choke-capacity smoothing is provided by C53 L27 C52. Reservoir capacitor C53 should have a ripple current rating of 550mA. C42 affords HT decoupling of sound channel. When operating from DC supplies rectifiers V14 V15 can be shorted out by fuse F1 to reduce voltage drop.

Heaters, including CRT but excepting V9, are connected in series and obtain their current from the mains through section of dropper R76 R79, ballast resistor R80, and surge limiter R83 (CZ1A Brimistor) shunted by R81.

C55 C56 are heater bypass capacitors. Heater of EHT rectifier V9 is supplied from an auxiliary winding L28 on line output transformer LT1.

Mains on/off switch S4 S5 is ganged to volume control spindle. Live mains lead is fitted with 1.5A fuse, and input is shunted by filter capacitor C54.

CRT has grey glass screen, ion-trap, and permanent magnet focusing. **Brilliance** is controlled by R73, which varies the grid voltage.

MAINTENANCE

The information given below regarding removal of chassis from cabinet relates only to model 992T.

Removing window. The window may be removed from cabinet without disturbing the chassis.

Turn cabinet on its side and draw off front control knobs. Release footrail by withdrawing the three securing screws on underside of cabinet front. Slide out fabric-covered speaker panel. Window may then be removed by sliding it out of cabinet.

Removing baseplate. The baseplate is secured by two wood screws and when these have been withdrawn the two side lugs on the baseplate should be eased free of cabinet base.

Removing chassis. Draw off two front control knobs, remove baseplate and undo the four bolts securing chassis to cabinet. Chassis, together with CRT assembly and speaker, can then be withdrawn from cabinet as a complete unit.

Removing CRT. Remove chassis from cabinet. Unsolder earth lead and slide off ion-trap magnet. Detach lead from final anode of CRT. Slacken off and then remove the two screws at sides of CRT clamping band. CRT may then be withdrawn without disturbing the deflector coil-focus magnet assembly.

When replacing the CRT it is important that the tube neck be mounted concentrically in deflector coil-focus magnet

unit, since non-concentricity will result in severe astigmatism. Repositioning of magnet in the vertical plane can be achieved by slackening off the hexagonal screws providing a rotational adjustment of deflector coils. Similarly, if the screws permitting deflector coils to be moved along tube neck are released, the magnet position can be altered horizontally.

Removing deflector coil and focus magnet assembly. Remove CRT. Withdraw the two hexagonal screws providing horizontal adjustment of deflector coils. Lift up the assembly and unsolder leads from tag panel below, after which the complete unit may be removed from the gantry.

Important: when removing the deflector coils, note which way round they are assembled, since an error when reassembling will result in a reversed picture.

Removing line output transformer and EY51. There is no need to remove chassis from cabinet. Detach lead from final anode of CRT. Remove screen enclosing PL81 PY81 (V7 V8)—secured to chassis by two screws—and detach leads from top caps. Remove baseplate on underside of cabinet. Unsolder leads from transformer tag panels. Undo the four screws securing transformer to lugs on screening panels. The transformer may then be removed.

The EY51 (V9) is enclosed in a moulded plastic compartment, with removable lid, on top of the line output transformer. After unsoldering its three connection leads it may be removed.

MODIFICATIONS

C26 has been omitted from receivers with serial numbers above 2400 to overcome parasitic oscillation, which may occur at high brightness levels in certain circumstances. The effect is apparent as "line tearing" as the brightness control is advanced.

In some receivers R83 (Brimistor CZ1A or Varite VA1005) is replaced by an alternative component which does not require a parallel resistor. Before replacement check whether a parallel resistor, either as part of the mains dropper or as a separate component is fitted. As an aid to identification, the CZ1A and Varite VA1005 are 1⅛ ins. long, while the alternative component is a little under 1 $\frac{1}{16}$ ins.

On early models R32 was 100K ohms; this has now been replaced by 220K ohms, Erie, type 8.

ALIGNMENT INSTRUCTIONS

Apparatus required. Signal-generator covering 10-20mc/s and 40-70mc/s, and capable of being modulated at audio frequency; AC output meter for sound output; Avometer model 7 for indicating vision output; non-metallic trimming tool.

Preliminary adjustments. Connect output meter across or in place of LS speech coil. Connect Avometer (100V DC range) across anode load R24 R25 of V5, with negative lead to anode. Connected thus, an increase in meter reading will correspond to an increase in output.

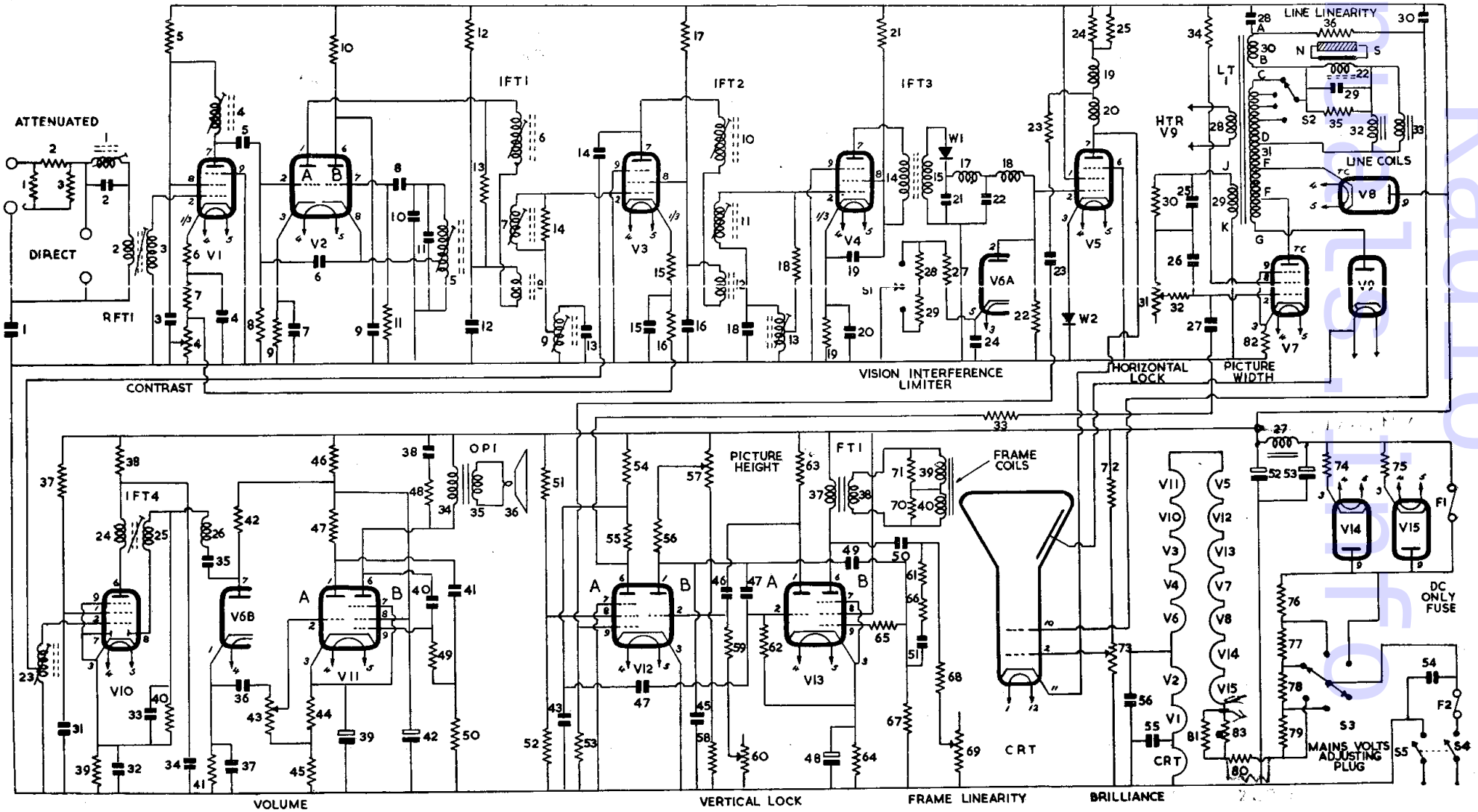
In the alignment of IF and RF inductances given below,

Continued on page 6

INDUCTORS

L		Ohms
1–5	...	Very low
6	}	.5
8		
7	...	.3
9	...	Very low
10	}	.5
12		
11	...	.3
13–15	...	Very low
16	...	No component
17	...	1
18	...	2.5
19	...	7.5
20	...	7.5
21	...	No component

L		Ohms
22	...	1.25
23	...	.25
24	...	.4
25	...	.4
26	...	2.5
27	...	40
28	...	Very low
29	...	JK 90
30	...	AB 7.5
31	{	CD 5.25 DE 8.5 EF 12.5 FG 15K
32	}	2
33		
34	...	600
35	...	Very low



L		Ohms
36	...	2.5
37	...	1150
38	...	.5
39	}	10
40	}	
W1	...	Crystal Diode Type OA60
W2	...	Metal Rectifier

RESISTORS

R	Ohms		Watts
1	82	...	⅛
2	1K	...	⅛
3	82	...	¼
4	5K	Preset WW Potr.	
5	1K	...	⅛
6	47	...	⅛
7	150	...	⅛
8	220K	...	⅛
9	2.2K	...	⅛
10	1K	...	⅛
11	33K	...	⅛
12	1K	...	⅛
13	12K	...	⅛
14	12K	...	⅛
15	47	...	¼
16	150	...	⅛
17	1K	...	⅛
18	2.2K	...	⅛
19	180	...	⅛
20	No Component		
21	1K	...	¼
22	3.9K	...	⅛
23	12K	...	¼
24	6K	...	2
25	6K	...	2
26	No Component		
27	100K	...	¼
28	220K	...	¼
29	470K	...	¼
30	1.5M		
31	250K	Preset Potr.	
32	220K	¼ (Erie types)	
33	470K	...	⅛
34	4.7K	...	2
35	910	...	¼
36	220K	...	⅛
37	33K	...	⅛
38	1K	...	¼
39	470	...	⅛
40	150K	...	⅛
41	1M	...	⅛
42	3.3M	...	⅛
43	500K	Potr. with DP Switch	
44	180	...	⅛
45	180	...	⅛
46	2.2K	...	⅛
47	220K	...	⅛
48	15K	...	⅛
49	12K	...	⅛
50	470K	...	⅛
51	150K	...	⅛
52	15K	...	⅛
53	680K	...	⅛
54	2.2K	...	⅛
55	100K	...	⅛
56	220K	...	⅛
57	1M Preset	Potr.	
58	470K	...	⅛
59	220K	...	¼
60	500K	Pre set Potr.	
61	27K	...	⅛

Continued next col.

VOLTAGE READINGS

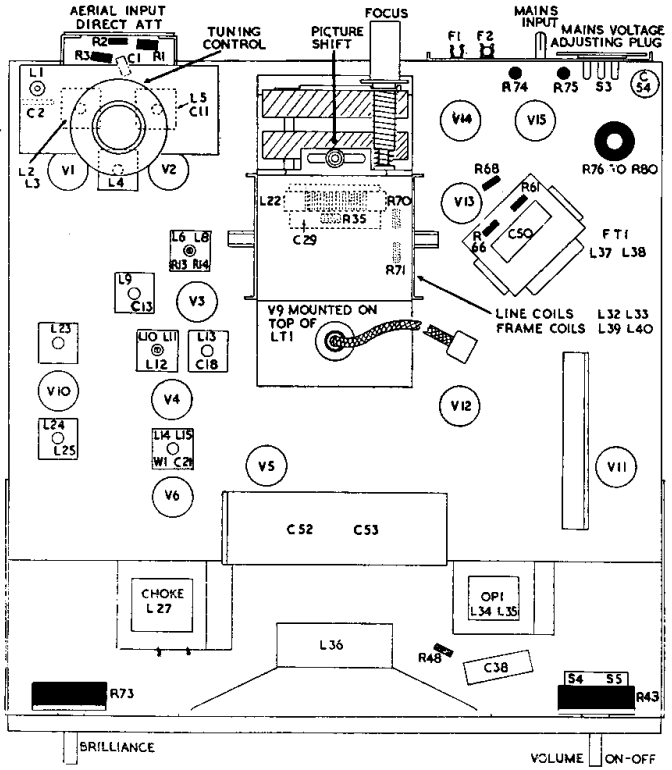
V	Type	A	S	K
1	EF80	192–206*	192–206	2.4–5.5
2A	ECC81	198	—	5.2
2B	ECC81	196	—	—
3	EF80	192–206*	192–206	2.4–5.5
4	EF80	190	190	2.3
5	PL83	155	204	5.1
6A	EB91	—	—	—
6B	EB91	—	—	—
7	PL81	No reading	124	—
8	PY81	204	—	503
9	EY51	—	—	14.5kV
10	EBF80	197	75	1.8
11A	ECL80	50	—	6.9
11B	ECL80	196	195	6.9
12A	ECL80	115	15	0
12B	ECL80	25	—	0
13A	ECL80	85	—	10.5
13B	ECL80	190	204	10.5
14	PY82	215 RMS	—	225
15	PY82	215 RMS	—	225
CRT	MW36–24	14.5kV	503	155†

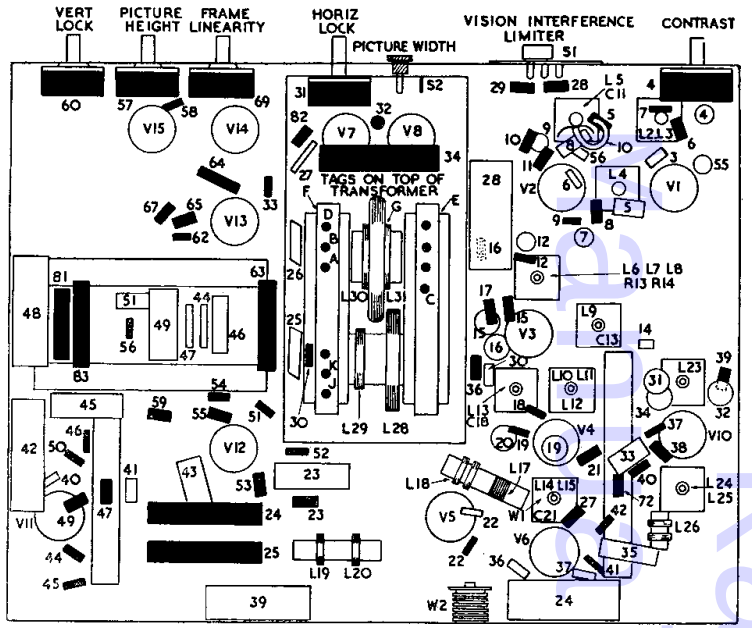
* R4 max.-min.

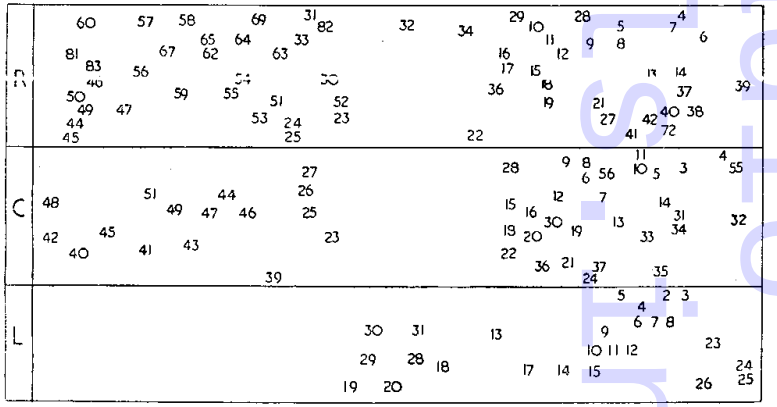
† Grid 0-100, R73 min.-max.

Total HT current = 230mA approx.

Mains current = .7A approx





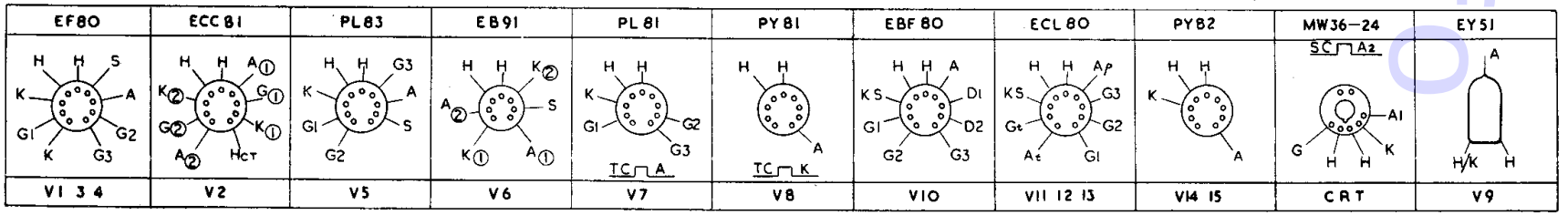


R	Ohms		Watts
62	470K	...	¼
63	22K	...	1
64	620	...	⅛
65	12K	...	⅛
66	150K	...	⅛
67	2.2M	...	⅛
68	100K	...	⅛
69	250K	Pre-set Potr.	
70	1K	...	¼
71	1K	...	⅛
72	100K	...	¼
73	500K	... Potr.	
74	40	WW 3	
75	40	WW 3	
76	20	Tapped Mains Dropper	
77	20		
78	60		
79	60		
80	125		
81	350	WW 5	
82	27	... ¼	
83	CZ1A	Brimistor	

CAPACITORS

C	Capacity	Type
1	.001	Tubular 300V AC
2	20pF	Silver Mica
3	.002	Tubular 350V
4	.001	Ceramic Disc
5	150pF	Silver Mica
6	2pF	Tubular Ceramic
7	.001	Ceramic Disc
8	30pF	Silver Mica
9	.001	Ceramic Disc
10	Formed with Insulated Thin Feeder —Factory adjusted	
11	10pF	Silver Mica
12	.001	Ceramic Disc
13	100pF	Silver Mica
14	5pF	Ceramic
15	.003	Ceramic Disc
16	.003	Ceramic Disc
17	No Component	
18	120pF	Silver Mica
19	.003	Ceramic Disc
20	.003	Ceramic Disc
21	5pF	Tubular Ceramic
22	5pF	Tubular Ceramic
23	.1	Tubular 350V
24	.5	Tubular 350V
25	200pF	Silver Mica
26	4pF	Slvr. Mica 1000V
27	4pF	Slvr. Mica 1000V
28	.25	Tubular 500V
29	1000pF	Silver Mica
30	.01	Tubular 350V
31	.003	Ceramic Disc
32	.003	Ceramic Disc
33	20pF	Silver Mica
34	.003	Ceramic Disc
35	.02	Tubular 350V
36	.003	Moulded Tubular
37	.002	Moulded Tubular
38	.005	Tubular 1000V
39	50	Electrolytic 25V
40	5pF	Tubular Ceramic
41	.003	Moulded Tubular
42	8	Electrolytic 275V
43	.1	Tubular 350V
44	150pF	Silver Mica
45	.1	Tubular 350V
46	.02	Tubular 350V
47	500pF	Silver Mica
48	50	Electrolytic 25V
49	.1	Tubular 350V
50	.05	Tubular 350V
51	.01	Tubular 350V
52	200	Electrolytic 275V
53	100	Electrolytic 275V
54	.1	Tubular 300V CA
55	.001	Ceramic Disc
56	.001	Moulded Tubular

C26 not fitted to chassis above approximately S/N 2400.



FERGUSON—*Continued*

A means that the core is adjusted from above the chassis and **B** indicates that adjustment is made on the underside.

IF alignment. Set R4 (Contrast) and R43 (Volume) at maximum. Insert signal-generator between V1 anode and chassis via .01mF capacitors. A short length of coaxial cable should be employed, the bared ends being as short as possible. Care should be taken not to disturb channel tuner unit wiring during this operation. Disconnect R10 at valveholder end of V2B without disturbing C10, which consists of a short length of twin feeder adjusted for optimum tracking over the frequency range covered by tuner.

When adjusting inductance cores two maximum output peaks may be found. In each case the correct peak will be that where core is in the outer position. Proceed as follows:

Inject 19.5mc/s, adjust L13 (B) for minimum vision.

19.5mc/s, adjust L23 L24-L25 (B) for maximum sound.

14.5mc/s, adjust L9 (B) for minimum vision.

17.6mc/s, adjust L14-L15 (B) L11 (A) L10 (B) L7 (A) L6 (B) for maximum vision.

The tuned circuits to which L11 L10 L7 L6 are coupled should be shunted with a 1K ohm resistor, e.g. when trimming L11, shunt L10. Conversely when adjusting L10 shunt L11.

Retrim L13 L23 L24 L25.

Channel tuner alignment. Disconnect signal-generator from V1 anode and reconnect oscillator anode feed. Connect signal-generator to Direct aerial sockets. It should be noted that the aerial and RF circuits are aligned not to the vision carrier frequency, but to a frequency 1.5mc/s lower. C10, the oscillator trimmer, should not be disturbed.

Set cursor on tuner unit to required channel and inject sound carrier frequency. Adjust oscillator coil L5 for maximum audio output before accurately realigning it. After which L1, image rejector, should be adjusted.

The signal generator should be accurately set before oscillator is tuned. This can be achieved by beating the output with BBC signal. Sound carrier rejection relative to vision carrier should be at least 35dB. The rejection filter is very sharp and care should be exercised when making this measurement. Proceed as follows:

Inject sound carrier frequency and adjust L5 (A) for minimum vision.

L1(A) inject 95mc/s adjust for minimum vision.

Inject a frequency 1.5mc/s below vision frequency and adjust L3 (A) L4 (A) for maximum vision.

Hawkins Hostess—*Contd. from p. 1*

DISMANTLING

Heater unit assembly panel is situated underneath the warming compartment. First take out food containers and remove the two red-headed screws positioned on baseplate between the perforations, one in one corner, the other diagonally opposite to it. Remove lower tray and corner support brackets; stand trolley upside down and undo the 10 screws on periphery of heater unit panel. The panel can then be removed.

Heater elements are mounted on porcelain distance pieces, two for each element, through the centres of which pass 2BA bolts, secured by nuts and spring washers. Before these bolts are withdrawn, however, the wires connected to the element terminals should be removed, noting that on the element from which the indicator lamp takes its current, three terminals are provided, instead of the usual two.

Switchplug is mounted on bracket under heater unit panel and can be removed by undoing the two 4BA screws at back.

Indicator glass is held by spring clip which, when released, allows glass to slide out of its metal frame.

Trolley wheel mountings fit into open ends of tubular frame. By removing two screws in the side of tube, wheel assembly can be withdrawn.

Causes of Interference

THESE two tables show the most frequent causes of interference with sound broadcasting and with television reception, expressed as a percentage of cases reported to the GPO Radio Branch, in the year to January 16, 1953, and considered as closed.

Engineers asked to deal with complaints of interference will find the tables of interest as they can perhaps be regarded as giving the probability factor of the various types of fault. The complete list of all sources of interferences is very much longer.

BROADCASTING		TELEVISION	
Unknown	22.4	Unknown	26.5
Inefficient Ae systems	17.3	Sewing machine motors	18.9
Radiation from T/V timebase	12.1	Faulty receivers	8.1
Faulty receivers	11.2	Hairdryers	7.9
Faulty wiring of buildings	5.1	Inefficient Ae systems	3.5
Sewing machine motors	3.5	Motor car ignition	3.4
Fluorescent tubes	3.4	Motors, miscellaneous	3.1
Refrigerators	2.4	Drills	2.9
Drills	2.1	Vacuum cleaners	2.7
Motors, miscellaneous	2.0	Lamps (filament)	2.3
Bedwarmers	1.7	Fan motors	2.0
Vacuum cleaners	1.4	Overhead power lines	2.0
Overhead power lines	1.2	Refrigerators	1.8
Radio transmitters	1.2	Bedwarmers	1.5
Hairdryers	1.0	Thermostats, miscellaneous	1.4
Smoothing irons	.9	Radio transmitters	1.3
Neon sign tubes	.8	Radiation from superhet oscillator	1.2
External cross modulation	.6	Neon sign tubes	1.2
Sodium lamps	.6	Medical apparatus (valve)	.8
Fan motors	.5	Mis-operation of receivers	.8
Calculating machines	.5	Hairclippers	.7
Generators	.4	Faulty wiring of buildings	.6
Dental motors	.3	Electric toys	.5
Lamp flashers	.3	Dental motors	.
Washing machines	.3	Bells	.5
		Fluorescent tubes	.3
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BUSH AC71

THIS set was brought in with the complaint that Post-Office engineers had located it as a source of interference to neighbouring TV sets.

Shortly after switching on the radio, I observed that the TV set I had placed about three or four feet away had completely blanked out. A few minutes later the picture re-appeared, but fantastically distorted with interference patterns.

By shorting out the various stages in the radio, and observing the effect on the screen, I arrived at an earthing tag, to which were connected earthy end of output valve grid resistor and other earthy leads. Suspecting a poor connection, I removed the nut and bolt and star washer, and replaced same tightening up well.

Still the trouble persisted and the only cure was to run a separate lead from the grid resistor to chassis. —K.U.

MURPHY U144

INTERMITTENT working can often be traced to poor contact between valve pins and valveholder. A little careful "staggering" of the pins proves to be a lasting cure.—E. C.

BSR CHANGER

—Continued from page 2

Once on the turntable a record can be rejected at any stage by use of the REJECT control. Pickup arm is raised and returned to the rest pillar, the next record descends and the cycle of operations begins again. If the record loading spindle is empty, however, pickup is returned to rest and the motor switched off.

ADJUSTMENTS

Needle set down. The set down position of the needle on the records is controlled by the needle-adjusting screw, or bending of the needle-adjusting tongue on certain models (Fig. 5). Adjust the screw or tongue until the correct set down of the needle on a 10in. record is obtained. The correct position is $\frac{1}{8}$in. from the edge of the record. It is advisable to make this adjustment with a number of 10in. records on the turntable. When correctly positioned for 10in., the 12 and 7in. needle set down will also be correct.

Pickup arm height is adjusted by the pickup height adjusting screw (Fig. 5). To raise the pickup arm, turn screw anti-clockwise; to lower, turn clockwise. Pickup height should be adjusted so that with a 1in. stack of records on the turntable, the point of the needle clears the top record by $\frac{1}{16}$in. Check that the pickup arm clears the underside of records loaded on the spindle.

Needle pressure should be between 12 and 15 grams. Adjustments may be made by bending the weight adjusting link (Fig. 5) until the correct pressure is obtained.

DISMANTLING

Removing turntable. Remove circlip and lift turntable vertically upwards over centre spindle. Take care not to lose the thin thrust washer, that sticks to underside of turntable boss, ballrace or second thrust washer. Note: Before replacing assembly, set speed control knob to 45rpm. This allows easy manoeuvrability of drive wheel when replacing turntable, without possible danger of bending the arm.

Removing control arm assembly. Hold the sleeve that protrudes from base of control column moulding firmly in a vice, and with a hammer and punch drive the control spindle through the sleeve. On re-assembly, re-riveting can be accomplished by a number of dot punch indentations on the end of spindle around the circumference. This operation should only be undertaken when adequate mechanical facilities are available.

Removing pickup arm assembly. This must be done after the changer has switched itself off. Remove pickup overload spring, unsolder pickup leads from connecting tagstrip. Unscrew pickup top bearing and lift the pickup arm clear. Replace the pickup top bearing to avoid losing the spacer washer.

Removing main sub-assembly. Remove turntable and pickup arm. Uncouple the connecting link from stop pawl spring. Unscrew 2BA bolt at rear of selector cover and also remove bolts on bracket. Main sub-assembly can then be gently removed from unit-plate.

Removing main gear assembly. Remove circlip and actuating lever. Remove circlip from gear bearing. Slacken off 4BA bolt in support bracket and release pawl reset spring from between spring clamp plate and support bracket. Should pawl reset spring be secured by rivet, and not, therefore, easily removable, it should be flexed out of the way of gear, care being taken not to bend it. Main gear assembly can then be lifted off bearing.

Removing main slide. Remove main gear assembly. Remove circlip and washer, slip record-feed link up and over end of guide pin. Remove washer, circlip and washer. Remove circlip and washer and unhook end of toggle slide return spring from toe of main slide.

Removing pickup cartridge. Turn cartridge round so that 10BA bolt can be unscrewed. Slide out knob. Cartridge should then gently be eased out of its cradle by pressing down against spring. Both spring and pivot are then loose. Slide back the short length of 4mm. PVC sleeving and pull out the two socket tags.

MAINTENANCE

Motor bearings are of the oil retaining type and under normal operating conditions should require little attention.

Occasionally lubricate mechanism as follows: Remove turntable and apply two drops of medium grade oil to bearing; one or two drops to record feed lever; one drop to pickup raising and lowering spindle; two drops to cam under main gear; one drop to stop pin; one drop to control spindle.

Needle replacement. To replace needle hold worn one with a strong pair of tweezers and pull out at an angle of 25 degrees. The new needle should be eased into the needle housing until positioned identically to the needle on the reverse side of the cartridge. Great care should be taken when replacing the needle, as undue pressure might easily damage the crystal.

Note: The changer will not operate correctly unless it is standing level.

POSSIBLE FAULTS AND REMEDIES

If turntable revolves when switch is turned to ON, but pickup remains stationary on rest, the knob is not being turned to its fullest extremity in the ON direction. If the knob is jammed and cannot be turned, rotate the turntable by hand clockwise until the fault is cleared.

Turntable will run slow if mains voltage is low, or the frequency is below 50c/s. It may also run slow if the changer has been standing in a cold place. Also check for binding of motor and turntable bearings.

If the last record has been played but the changer does not switch off, check that the control arm has dropped below offset shoulder of loading spindle. Oil if necessary.

Pickup arm striking record on spindle as it rises, or needle catching on record as it moves out, indicates that pickup arm height is incorrectly adjusted.

Changer continuing to cycle with pickup dropping on to record at each cycle indicates that the pawl reset spring is out of position. Adjust reset spring so that it engages with friction link shoulder as main gear is rotated. The spring should not be set too low or it will foul other components. Ensure that the spring fixing bolt is tightened after adjustment.

If pickup merely rises and falls on rest pillar, actuating lever is either jamming on top or slips to wrong side of reset pin.

When changer returns pickup to rest before the last record on loading spindle has dropped, turntable continues to revolve or mechanism is switched off, the stop bracket assembly is wrongly positioned.

Records failing to drop indicates either broken feed spindle in loading spindle, or broken feed lever.