WHY A DIPOLE?

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WHY is it necessary for a TV set to have an aerial system comprising a special antenna connected to the receiver via a length of feeder, instead of a piece of wire round the room as used with a broadcast receiver? In the answer to this question lies the fundamental difference between broadcast and television receiver aerials.

A broadcast receiver when tuned to a local station is receiving a strong signal that is fairly efficiently picked up by a length of wire only a fraction of a wavelength long. Such a length of wire can be connected directly to the set aerial terminal without any matching arrangement because the input circuit of all modern sets is designed to work with such an aerial which is short compared with the wavelength.

Varying the length of such an aerial from say 10 to 50 feet or changing the waveband from MW to LW does not affect the performance other than to give increased signal pickup with the longer lengths. Summarising, the broadcast receiver aerial is a high-impedance aerial whose resonant frequency is sufficiently higher than its working frequency for it not to exhibit resonance effects in the MW and LW bands.

If such an aerial were connected to the set via a length of screened coaxial feeder considerable losses would occur unless step-down and step-up transformers were connected at the aerial and set ends of the feeder respectively. This is done in interference-reducing broadcast aerial systems where the aerial is a vertical rod mounted on the chimney stack, and connected to the set via a screened cable.

MATCHING CABLE IMPEDANCE

A television aerial system is very similar to such broadcast aerial systems except that the matching transformers are eliminated. This is accomplished by designing the input circuit of the television receiver to match the screened (usually coaxial) cable and connecting the other end of the cable to the aerial in such a manner that the aerial impedance matches (i.e. equals) the cable impedance.

By impedance we mean the ratio of RF voltage to RF current existing at the terminals of the device in question. An aerial has the same impedance (i.e. matches) a cable if, when either the aerial or the cable is connected to a RF signal generator, the same current flows in each.

However, it is important to realise that in the case of an RF cable the impedance at one end pair of terminals is only equal to the characteristic impedance when the other end pair of terminals are connected to a resistor of value equal the cable characteristic impedance. In that case the length has no effect on the value of current flowing into the terminals of the cable connected to the signal generator (i.e. the impedance at the cable terminal is constant).

If the cable is open or short circuited at one end, the impedance measured at the other end varies between zero ohms and practically infinite ohms depending on the length.

Thus we see that in a television aerial system the TV set terminates one end of the cable and, provided that the set input circuit is designed to match the particular type of cable used, the impedance at the other end of the cable is equal to the set input impedance and, of course, equal at the same time to the characteristic impedance of the cable.

We thus now have to consider how we can connect some form of aerial to the end of the cable so that at the point of connection the aerial impedance equals the cable impedance.

The simplest form of aerial is a vertical straight rod. If it is not vertical the voltage induced in it will be reduced when receiving the vertically-polarised TV transmissions.

Since the cable has two terminals at the end (inner conductor and outer braiding with coaxial) the simplest form of aerial must be broken at some intermediate point along its length to provide a suitable connection. If a simple vertical rod aerial is made approximately one half of a wave-length long, and if it is broken at the centre, it is found that the impedance at the break, i.e. the aerial terminal, is approximately equal to 73 ohms.

Since the usual RF cable when designed for a characteristic impedance of 73 ohms comes out to very convenient dimensions facilitating easy production, it is obvious that our half-wave centre-fed aerial, or single dipole as it is called, does exactly what is required of it, for it directly matches standard RF cable without any transformer.

Consequently we see that the half-wave single centre-fed dipole has been evolved as the simplest form of television aerial which can be conveniently erected remote from the TV set and connected to it via a RF cable without any complicated matching arrangement.

Going back to our broadcast aerial round the room, we see that such an aerial would be unsatisfactory for TV reception because its length would be comparable to the very short TV wavelengths. Consequently its impedance where it was connected to the set would be critically dependent on the length, making it impossible to design the input circuit of the set to meet the diversity of room aerial lengths that would be met in practice.

At the same time TV signals cover a band of wavelengths over which the impedance of such a wire aerial would vary considerably, causing distortion of the picture.

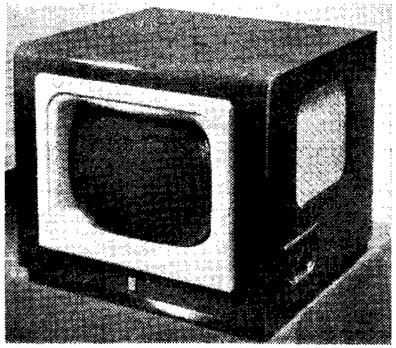
REDUCING IMPEDANCE VARIATION

Provided the single dipole previously mentioned is made of rod at least $\frac{1}{4}$in. in diameter impedance variation over the TV band is not present. Obviously a single wire picture rail aerial $\frac{1}{4}$in. in diameter would be impracticable.

If a room TV aerial were reduced to a small fraction of a wavelength long, as in broadcast reception room aerials, then it would exhibit a high impedance which would be reasonably constant over the required band, as it would be far from resonance. Such an aerial would be completely useless however because, owing to its short length (say one foot) the voltage induced in it would be far too small.

Consequently indoor TV aerials usually consist of a single dipole, with the lower element horizontal to reduce the height needed for installation, connected to the set with a short length of cable, Making the lower half horizontal reduces the signal pickup but this defect is not too serious in practice as indoor aerials for TV reception are not used unless the field strength is high.

FERGUSON 968T, 978T



Fourteen-valve "black screen" table model television receiver fitted with a 12in. tube giving a 10$\frac{1}{8}$ by 7$\frac{3}{4}$ins. picture. Model 968T is for London frequencies and 978T for Birmingham frequencies. Suitable for 200-250V AC 50c/s or DC. Made by Ferguson Radio Corporation Ltd., Great Cambridge Road, Enfield, Middlesex.

THE receiver employs permeability tuned TRF circuits, the first RF amplifier being common to both sound and vision channels. Vision interference and sound noise suppression circuits are incorporated. EHT is obtained from line flyback pulses.

Model 968T is for operating within 30 miles of Alexandra Palace. Model 968TS is modified to give greater vision sensitivity for use in fringe areas. Mains consumption is approximately 140 Watts.

Aerial input is designed for a 75 ohm co-axial feeder. A two-position aerial socket enables aerial to be connected direct or through an attenuator R1, R2, R66 to coupling coil L1 of aerial input transformer. Outer screen of co-axial feeder and earthy side of L1 are DC isolated from receiver chassis by C1.

Vision channel consists of three RF amplifiers V1, V2, V3, signal rectifier and interference suppressor V4 and video output amplifier V5. Bandpass transformer coupling is used between V1, V2, V3 and signal rectifier V4A.

Tuned circuit L3, L4 in anode V1 is damped by R6 to provide wide bandwidth to cover both sound and vision frequencies. V2 anode tuned circuit L10, L11 is damped by R11 to maintain vision channel bandwidth.

Gain of V1, V2 is controlled by R7 the **Contrast** control in the common cathode circuit.

Overall bandwidth of RF stages is 4.25mc/s at 6dB down.

L6, L7 in anode V1 and L8, L9 in anode V2, which are tuned to 41.5mc/s, are sound frequency rejector circuits.

Rectified signal is developed across R14 and DC coupled to video amplifier V5, the output of which is in turn DC coupled through L33 to cathode of CRT. R19 is CRT cathode voltage limiter resistor.

Interference suppressor is diode V4B, the cathode of which is coupled through C13 to anode of video amplifier V5. The charge developed on C13 is equal to "peak white" and is just sufficient to hold V4B cut-off. When a high frequency negative going interference pulse appears at anode V5, due to long time constant of R15, C13, the cathode of V4B is driven negative and the diode conducts to short circuit the interference pulse.

Sound channel. The sound signal of 41.5mc/s is amplified with the vision by V1 and is developed across sound rejector coupling coil L6 in the anode circuit and thence fed by C18 to L17 tuned to 41.5mc/s in grid of first sound RF amplifier V6.

Single peak transformer coupling is used between V6 and second sound RF amplifier V7, and between anode V7 and its signal rectifier diode. Rectified signal developed on R27, C26 is fed through RF choke L22 and noise suppressor rectifier and coupled by C30 to volume control R30 in grid circuit of triode AF amplifier section of V8 for amplification before being passed to pentode output section.

Audio output is fed into a 6$\frac{1}{2}$in. PM speaker. Fixed tone control is given by R36, C35 across primary L23 of output matching transformer OP1.

AVC. The DC component of the rectified signal, decoupled by R23, C22, R20, C19, is fed through L17 to first sound RF amplifier V6.

Noise suppression. Metal rectifier WX1 is biased positively from HT through R28 and therefore conducts, setting up a voltage across R29, C29. At the same time the rectified audio signal is fed by C28 through the rectifier to R29. The time constant of R29, C29 is such that the voltage across the network follow that of the audio signal.

When a high-frequency interference pulse appears with the audio signal, rectifier anode is driven negative whilst its cathode voltage remains unaltered because of comparatively long time constant of R29, C29. Rectifier is cut-off and the pulse is removed from the signal.

Sync separator. Video signal at anode of video output amplifier V5 is fed through R37, C36 to pentode section of V12. Positive sync pulses cause grid current flow and a steady negative bias is developed across R38 sufficient to place video signal beyond cut-off, thus only the positive sync pulses are amplified by V12.

Screen voltage is reduced to a low value to obtain a short grid base to ensure sync-video separation on weak signals. HT for pentode anode V12 is obtained from screen dropper R39 of line oscillator and amplifier V10, thus the negative line sync pulses, developed across R39 by conduction of sync separator V12 are automatically applied to screen of line oscillator V10.

Frame sync pulses are developed across R43, C42 in the screen circuit of V12 and are fed by C41 to anode of triode section of V13.

Frame scan oscillator. Triode sections of V12, V13 are cross-coupled by C43, C44 to operate in a multi-vibrator circuit, the oscillation frequency of which is determined by time constants of R45, C44 and R46, C43. Scan voltage is developed on C45.

Adjustment of HT voltage to V13 triode anode by R52 gives frame **Height** control and adjustment of its grid bias by R54 gives **Vertical Hold** control.

Frame amplifier. Sawtooth waveform generated across C45 is fed by C46 to pentode section of V13. Amplified waveform in anode circuit is transformer coupled by FT1 to frame deflector coils L36, L37 on neck of CRT.

R51 damps out line oscillations due to mutual inductance of line and frame deflector coils. Negative feedback to improve frame output waveform is fed by C48, R49, R50, C47 from anode to grid. Cathode voltage of V13 is stabilised by connecting its cathode resistor R55 in series with R52, R53, R54 across the HT supply. C49 is cathode bias decoupling.

Line scan waveform is obtained from a self-oscillating output valve V10 used in conjunction with a booster diode V9. V10 is caused to oscillate by anode to grid feedback through inductive coupling between L26 and L28 of line output transformer. Frequency is controlled by R40 the **Horizontal Hold** control which varies series grid resistance.

HT to anode of line oscillator V10 and to screen of CRT is boosted by approximately 125V by rectification by V9 of high voltage surge set up in LT1 during flyback. C37 is booster diode reservoir capacitor.

Output waveform across anode section of primary L26 of LT1 is fed by secondary L27 through L30 to line deflector coils L31, L32 on neck of CRT.

Line Amplitude is adjusted by variation of series inductance L30 and **Line Linearity** by adjustment of shunt damping across L30 by R41. C40 isolates DC from deflector coils.

EHT of approximately 8kV for final anode of CRT is obtained by rectifying by V11 the surge voltage set up across overwound primary L27 of LT1 during line flyback. Capacity between inner and outer coatings of CRT forms the EHT reservoir capacitor.

HT is provided by an indirectly-heated twin rectifier V14 strapped for operating in a half-wave circuit. Its anode voltage is obtained from the mains through tapped dropper resistor formed by R58 to R61. Choke-capacity smoothing is provided by L38, C50, C51. Reservoir capacitor C51 is fitted with current limiter R57 and should be rated to handle at least 250mA ripple current. Vision channel HT line is RF decoupled by C15.

Heaters of V1 to V10, V12 to V14 and CRT are connected in series and obtain their current of 300 mA from the mains through section of tapped dropper R58-R61, ballast resistor R62 and surge limiter R63A.

C53, C54, C55, C56 are heater bypass capacitors. Heater of EHT rectifier V11 is supplied from an auxiliary secondary winding L29 on line output transformer LT1

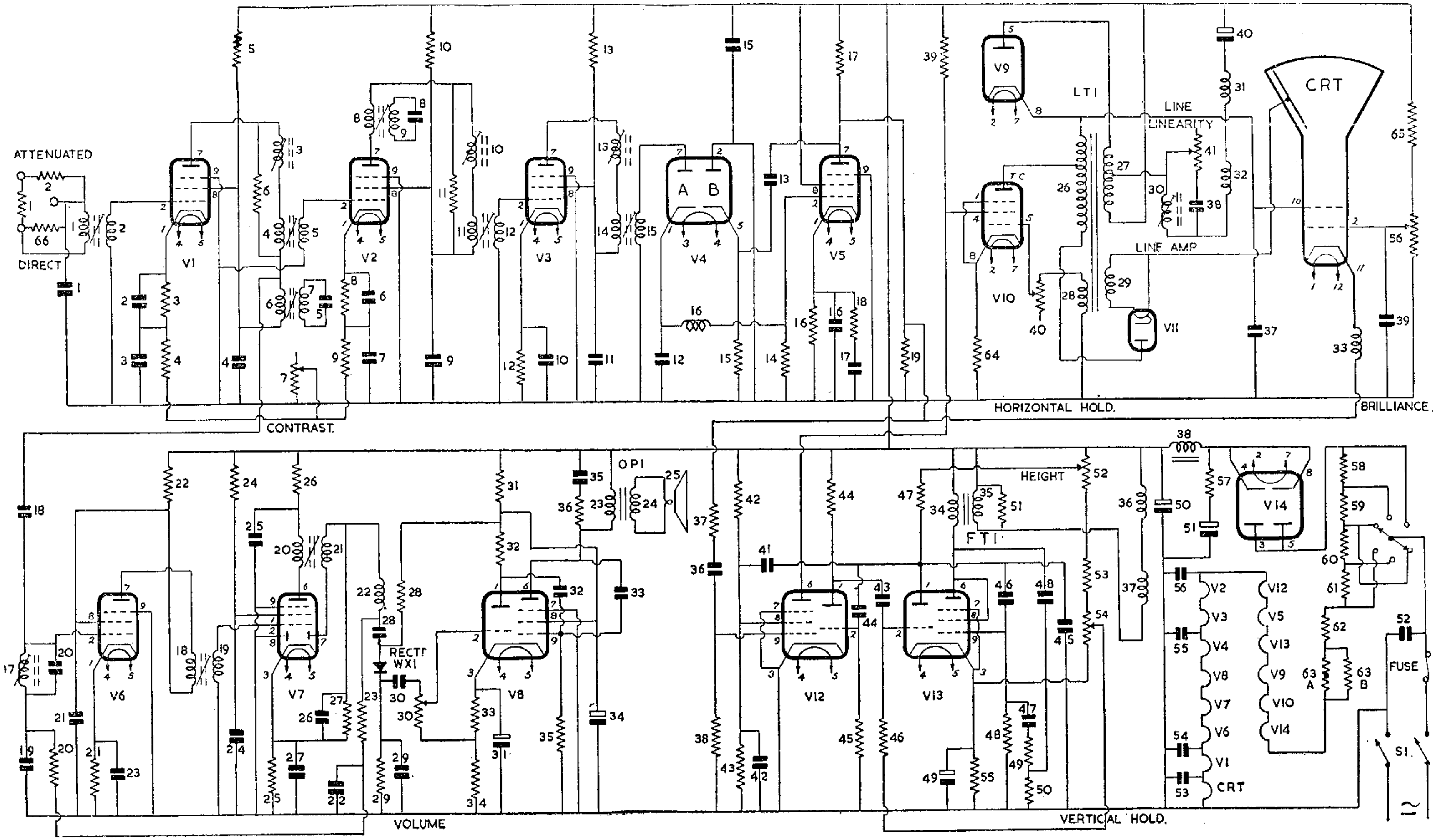
S1 which is ganged to the volume control spindle is the ON/OFF switch. Live mains lead is fitted with a 1A fuse and input is shunted by filter capacitor C52.

CRT is a 12in. tetrode with permanent magnet focusing. **Brilliance** is controlled by variation of grid voltage by R56. Black screen effect is obtained by the use of neutral density filter implosion screen.

BIRMINGHAM MODEL

The circuit of Model 978T, which covers the Birmingham frequencies, differs from the above circuit as follows :—

R6, R11 deleted and L8, L9, C8 transferred to anode circuit of V3. Earthy end of V3 grid coil L12 returned to chassis through centre tap on additional sound trap coil L39 tuned by C57. RF choke L16 inserted between R14, decoupled by C12, and gl of video output amplifier V5 instead



CAPACITORS

C	Capacity	Type
1	1000pF	Tubular
2	15pF	Silver Mica
3	1000pF	Tubular
4	1000pF	Tubular
5	30pF	Silver Mica
6	15pF	Silver Mica
7	1000pF	Tubular
8	30pF	Silver Mica
9	1000pF	Tubular
10	1000pF	Tubular
11	1000pF	Tubular
12	4pF	Silver Mica
13	.1	Tubular 500V
14	Not Fitted	
15	1000pF	Tubular
16	300pF	Silver Mica
17	1000pF	Silver Mica
18	4pF	Silver Mica
19	1000pF	Tubular
20	15pF	Silver Mica
21	1000pF	Tubular
22	.1	Tubular 350V
23	1000pF	Tubular
24	1000pF	Tubular
25	1000pF	Tubular
26	50pF	Silver Mica
27	1000pF	Tubular
28	.1	Tubular 350V
29	.005	Tubular 500V
30	.002	Tubular 500V
31	50	Electrolytic 12V
32	.002	Tubular 500V
33	2pF	Silver Mica
34	8	Electrolytic 350V
35	.005	Tubular 1000V
36	.1	Tubular 350V
37	.5	Tubular 350V
38	.02	Tubular 1000V
39	1000pF	Tubular
40	50	Electrolytic 12V
41	.02	Tubular 500V
42	.01	Tubular 500V
43	.02	Tubular 1000V
44	500pF	Silver Mica
45	.1	Tubular 350V
46	.1	Tubular 350V
47	.01	Tubular 500V
48	.05	Tubular 500V
49	50	Electrolytic 12V
50	200	Electrolytic 275V
51	100	Electrolytic 275V
52	.1	Tubular 300V AC
53	1000pF	Tubular
54	1000pF	Tubular
55	1000pF	Tubular
56	1000pF	Tubular

(C1, 3, 4, 7, 9-11, 15, 19, 21, 23-25,27, 39, 53-56 minimum value permissable is 800pF.)

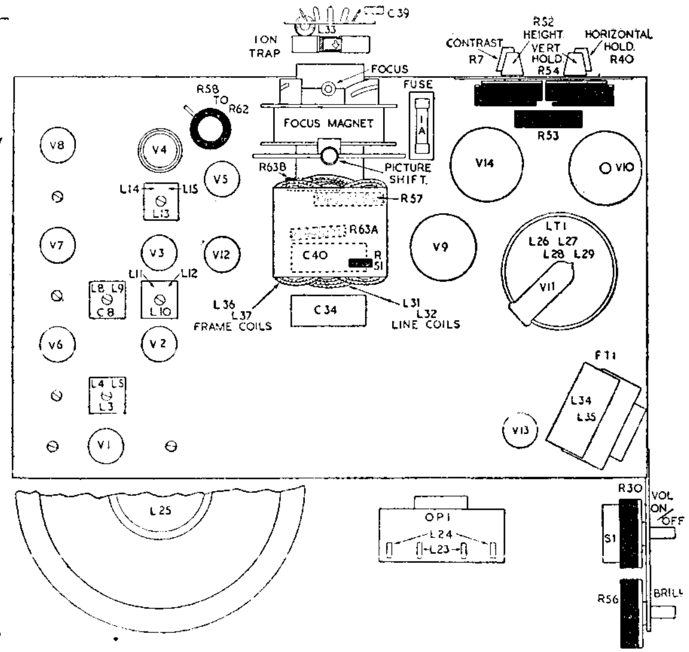
RESISTORS

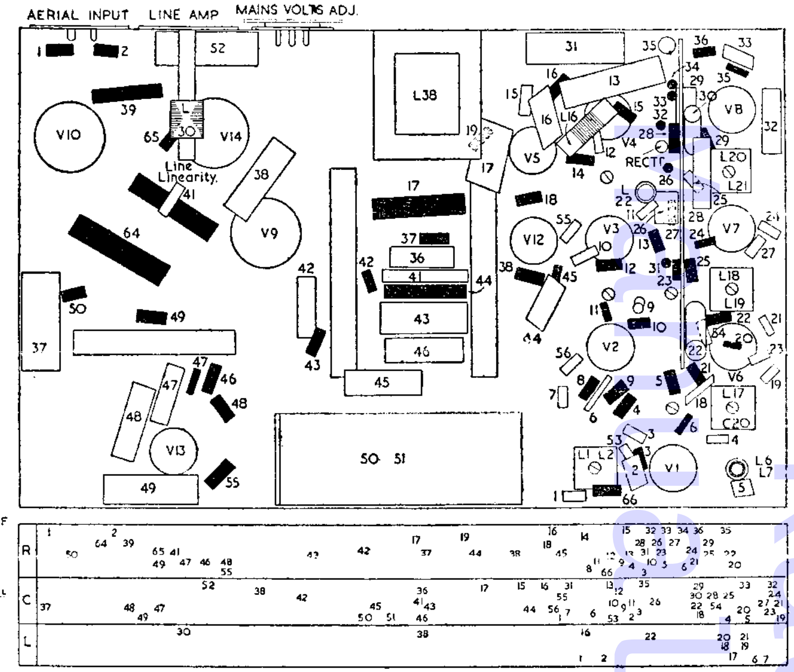
R	Ohms	Watts
1	1K	¼
2	82	¼
3	47	¼
4	150	¼
5	1K	¼
6	33K	¼
7	5K	WW Potr.
8	47	¼
9	150	¼
10	1K	¼
11	33K	¼
12	180	¼
13	1K	¼
14	5.6K	¼
15	3.3M	¼
16	390	¼
17	12K	2W
18	390	¼
19	68K	¼
20	1M	¼
21	390	¼
22	1K	¼
23	1M	¼
24	68K	¼
25	330	¼
26	1K	¼
27	22K	¼
28	3.3M	¼
29	1M	¼
30	500K with Dpst Switch	Potr.
31	2.2K	½
32	220K	¼
33	180	¼
34	180	¼
35	680K	¼
36	15K	¼
37	12K	¼
38	2.2M	¼
39	2K	5W
40	5K	WW3W
41	1K	Preset
42	150K	¼
43	47K	¼
44	22K	1W
45	470K	¼
46	680K	¼
47	470K	¼
48	2.2M	¼
49	51K	¼
50	150K	¼
51	150	¼
52	5K WW Potr.	
53	5K	1W
54	5K WW Potr.	
55	390	¼
56	500K Potr.	
57	40	10W
58	10	500MA Tapped Dropper
59	20	500MA Tapped Dropper
60	60	500MA Tapped Dropper
61	60	500MA Tapped Dropper
62	60	500MA Tapped Dropper
63a	CZ1 Brimistor	
63b	350 WW 10W	
64	47	2W
65	470K	¼
66	150	¼

INDUCTORS

L	Ohms
1—21	very low
22	1.5
23	700
24	.5
25	2.5
26	60 x 14000*
27	7.5
28	18
29	very low
30	7.5
31, 32	7.5
33	3
34	750
35	2.5
36, 37	7.5
38	75

*Resistance wire used on overwind.





of between C12 and R14.

An additional cathode resistor R67 decoupled by C58 is inserted between R12, C10 and cathode V3. A further choke or peaking coil L40 is connected in lead between anode V5 and R19.

C18, L17, C20 deleted and L7, C5 used as grid input circuit to first sound RF amplifier V6.

Additional cathode resistor R68 decoupled by C59 is inserted between R21, C23 and cathode V6.

Earthy end of C26 connected down to chassis instead of to cathode V7. C55 removed from junction of V3, V4 heaters and reconnected to junction of V2, V3 heaters.

ALIGNMENT

Modulation of 1000c/s at 30 per cent. should be available for sound alignment. A sound power output meter is required.

For vision output indicator, a model 7 Avometer may be used if connected up as follows :—Switch meter to 400V DC range, connect positive lead to CRT cathode and take negative lead to a convenient chassis point. Meter will read approximately 100V and all vision sensitivity measurements are taken for a drop of 10V from the static no-signal reading.

Other types of meter may be used but they should have a series resistance of not less than 200K ohms.

When adjusting the primary of a band-pass transformer a resistor of 150 to 470 ohms should be connected across the secondary and conversely, when adjusting the secondary, the resistor must be connected across the entire primary.

PROCEDURE

968T and 968TS. With the signal generator co-axial lead connected to the Direct aerial socket, turn the Contrast control to maximum and trim the two rejector circuits (L7 and L8) for minimum vision output. Next align all 45mc/s coils for maximum vision output and finally align the three sound receiver coils L17, L18 and L20 with the Volume control at maximum.

978T. With the signal generator co-axial lead connected to the Direct aerial socket, turn the Contrast control to maximum and feed in 63mc/s signal. Adjust L8 for minimum vision output. Follow by trimming the rejector coils L7 and L39 for minimum vision output, and then trim all the 60.25mc/s coils. Finally, trim the sound receiver circuits L18 and L20 with the Volume control at maximum.

Tune signal generator to peak reading in the vision sideband and note the reading on the vision output meter. Tune to the carrier frequency 61.75mc/s and adjust L8 until the carrier frequency output voltage is 6dB (2: 1) lower than the peak sideband output voltage. Repeat this last adjustment until two sets of identical readings are obtained.

Sensitivity. Upon feeding in an unmodulated signal at 45mc/s, the vision output meter reading should fall 10V

Continued page 13

ALIGNMENT INSTRUCTIONS

Adjust-ment	Frequency in Mc/s 968 T	978 T	Indication
L 2	45.0	60.25	Max. Vision
L 3	45.0	60.25	Max. Vision
L 5	45.0	60.25	Max. Vision
L 7	41.5	58.25	Min. Vision
L 8	41.5	*	Min. Vision
L10	45.0	60.25	Max. Vision
L12	45.0	60.25	Max. Vision
L13	45.0	60.25	Max. Vision
L15	45.0	60.25	Max. Vision
L17	41.5	—	Max. Sound
L18	41.5	58.25	Max. Sound
L20	41.5	58.25	Max. Sound
L23	—	58.25	Min. Vision

* Reference should be made to 978T alignment procedure for the alignment of this coil.

MODEL 978T

Components in addition to or differing from 968T version.

RESISTORS

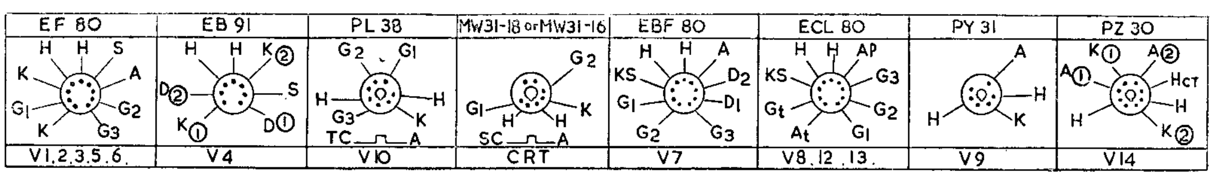
R	Ohms	Watts
12	150	¼
18	1K	¼
20	100K	¼
21	470	¼
67	47	¼
68	47	¼

CAPACITORS

C	Capacity	Type
1	500pF	Tubular
3	500 pF	Tubular
4	500pF	Tubular
5	40pF	Silver Mica
7	500pF	Tubular
8	22pF	Silver Mica
9	500pF	Tubular
10	500pF	Tubular
11	500pF	Tubular
16	500pF	Tubular
19	500pF	Tubular
21	500pF	Tubular
23	500pF	Tubular
24	500pF	Tubular
25	500pF	Tubular
27	500pF	Tubular
29	.02	Tubular
33	20pF	Silver Mica
57	22pF	Silver Mica
58	15pF	Silver Mica
59	15pF	Silver Mica
53, 54, 55, 56	500pF	Tubular

INDUCTORS

L	Ohms
39	very low
40	3



VALVE VOLTAGE READINGS

V	Type	A	G_2	K	Remarks.
1	EF80	205	205	2–6	R7 Max.–Min.
2	EF80	205	205	2–6	R7 Max.–Min.
3	EF80	195	195	2.3	
4	EB91	—	—	K_2 2.5	
5	EF80	115	210	5.2	No Signal
6	EF80	200	205	2	
7	EBF80	197	80	2.1	
8	ECL80	Ap 195 At 60	197	7.5	
9	PY31	—	—	330	
10	PL38	—	135	8	
11	EY51		—	7.5to 8kV	measured with electrostatic voltmeter.
12	ECL80	Ap 135 At 80	35	0	
13	ECL80	200 35	200	9.4	
14	PZ30	225rms	—	220	Ik = 105mA.
CRT	MW31–18 MW31–16	7.5 to 8kV	330	115	G1.0 to 22V. R56 Min-Max.

Mains consumption at 230V AC = 600mA

EKCO A110—*Continued*

and L1, L2 are tuned by T4, C3 which are switched in circuit by S2A.

On the three MW programmes S2 short circuits LW frame L1 and either T1, T2 or T3 is switched in across L2 by S2A.

External aerial signal is switched by S1 to tap on L2 for MW ranges and to bottom of L1 on LW.

AVC decoupled by C5 is fed through R1 to V1. Cathode bias is provided by R4 decoupled by C6. Screen voltage is obtained from potential divider R2, R3, decoupled by C4. Primary L9, C10 of IFT1 is in the hexode-anode circuit.

Oscillator is fundamentally a tuned-anode shunt-fed circuit in which a permeability-tuned master oscillator coil L8, trimmed by C8, is shunted by preset permeability tuned coils L4 to L7 to produce the required frequency.

Upper section of L8, tuned by C8, and forming the tuned-anode coil, is coupled by C9 to oscillator anode of V1, R6 being the load resistor. Reaction voltages are developed across lower section of L8 and coupled by C7 to oscillator grid of V1.

Automatic bias for oscillator grid is developed on C7 with R5 as leak.

The preset tuned coils L4, L5, L6 (MW) and L7, C12 (LW) are switched by S3 across upper (anode) section of L8.

IF amplifier operates at either 455 or 460kc/s according to the area for which the set is intended. The former frequency is for southern and the latter for northern areas. Receiver chassis are stamped on the rear with N or S to indicate the appropriate frequency.

Secondary L10, C11 of IFT1 feeds signal and AVC voltages, decoupled by C5, to IF amplifier V2. Cathode bias is by R8 decoupled by C20. Screen voltage is obtained from potential divider R2, R3 decoupled by C4. Suppressor is internally strapped to cathode.

Primary L11, C14 of IFT2 is in the anode circuit, the HT for which is decoupled by R7, C13.

Signal rectifier. Secondary L12, C15 of IFT2 feeds signal to one diode of V3. R10 is the load and R9, C17, C18 an IF filter.

AVC. IF signal is coupled by C16 to second diode of V3 of which R14, R15 form a tapped diode load. Approximately two-thirds of the rectified control voltage is applied to V2 and through R1 to V1. AVC line decoupling is given by C5 and delay bias by cathode voltage across R12, C21.

AF amplifier. Rectified audio signal is fed by C19 to volume control R11 and thence to grid of triode section of V3. Cathode bias is by R12 decoupled by C21. R13 is anode load—the HT for anode being obtained from R7 decoupled by C13 which also decouples the HT to V2.

Pickup. Sockets are fitted at rear of chassis for connection of a high-impedance magnetic or crystal pickup. In Gram position of S4 the pickup signal is switched to volume control R11 and at the same time external aerial is disconnected from input circuit by S1 and of V1 is earthed to chassis through C2 by S2A.

Output stage. C23 feeds signal at anode V3 to pentode output valve V4. R17 is its grid resistor and C22, R16 form a variable top-cut tone control. Cathode bias is by R19 decoupled by C26.

Primary L13 of output matching transformer OP1 is in the anode circuit. Secondary L14 feeds signal to an 8 in. PM speaker L15. Sockets are fitted on L14 for connection of a low-impedance extension speaker. S6 enables internal LS to be disconnected.

Negative feedback from anode to g1 of V4 is given by R18, C24.

HT is provided by an indirectly-heated full-wave rectifier V5. Its anode voltages are obtained from HT secondary L17 of mains input transformer MT1.

Choke-capacity smoothing is given by L16, C27, C28. Reservoir smoothing capacitor C28 should be rated to handle 100mA ripple current.

Heaters are connected in parallel and obtain their current from secondary L18 of MT1.

Station indicator lamps, D1 to D4, are switched by S5—which is ganged to selector switches S1 to S4—to a tapping on secondary L18. In Gram position of selector switch both D1 and D4 are illuminated. Primary L19 of MT1 is tapped for inputs of 200-210, 220-230, 240-250 V, 50-100c/s, S7 ganged to volume control spindle, is ON/OFF switch.

Chassis removal. Remove rear panel of cabinet and from inside cabinet undo the two grub screws in each control knob and remove knobs. Remove the four chassis fixing bolts on underside of cabinet. Loosen the nuts on LS clamps—rotate clamps sideways to allow LS to be removed from baffle. Chassis and LS can be withdrawn.

Alignment. To adjust IF circuits inject 455kc/s to Southern area models with S on chassis, or 460kc/s to Northern area models with N on chassis, to g1 of V1 via 0.1mF capacitor and trim cores of L12, 11, 10 and 9 for maximum output.

The master oscillator coil should not need adjustment but if it does switch to gram, inject 135kc/s to V1 and adjust L8.

Range of adjustment for each preset tuning position is indicated on rear panel of cabinet. Select appropriate oscillator coil core for required station, tune in station, then adjust aerial trimmer for maximum.

SERVICE CASEBOOK

ULTRA V116

THE frame generator could be stopped or started by subjecting the chassis to a sharp knock. Since so many new receivers seem to be blessed with similar symptoms, due to dry joints, intermittent valves, etc., it first appeared as though this fault was one of the many. Thus, the valves were tapped and the time base circuit examined for dry joints and some joints re-soldered.

The fault persisted but eventually it was noticed that a resistor connected to the height control pot. was overheating; a more detailed analysis revealed a short circuit from the height control pot. to earth.

Removing the metal cover from the control exposed the cause; a small piece of metal swarf. —G. J. KING, Oxford.

GEC BT2147

FAULTS were: (a) Insufficient adjustment available on " horizontal hold," causing picture to tear during bursts of interference, and (b) intermittent frame scan.

Components associated with the line oscillator were first checked and after these were proved to be normal, the line oscillator valve V8B, a B36, was substituted. This effected a cure for fault (a): the emission of the original valve appeared to be normal, but its characteristics had somehow varied. Although a slight modification of the circuit constants might have rendered the circuit normal, it was decided to change the valve.

Since the frame oscillator uses the other triode section of the B36, it was thought that perhaps replacing the valve would also clear up fault (b). This was not the case. Due to the extremely intermittent nature of this fault, diagnosis was very difficult. Finally an intermittent 0.1 mF capacitor (C53 in the service sheet), connected from the cold end of the primary of the frame blocking feedback transformer to chassis, was found to be the culprit. —G. J. KING, Oxford.

MULLARD MTS684

A MULLARD MTS 684 T/V receiver had been giving intermittent trouble for several nights, working OK for probably an hour or more, then the line hold suddenly failing; this could be re-synchronised on adjusting the line-hold control, but then the oscillator would suddenly fail completely and the raster disappear.

The set uses a single valve power oscillator for line scanning. This valve and the UY41 " damping " diode were substituted without a cure. The chassis was removed to the workshop, and by now the line oscillator would only function for a minute or so on switching on.

A systematic check was then carried out, using an R/C bridge, of all capacitors and resistors in the line oscillator circuit, including C54, a 15pF condenser coupling the line sync pulses into the oscillator grid. Still the fault persisted, appearing to leave only the line O/P transformer or scan coils faulty.

A new O/P transformer was fitted, the oscillator started up OK and continued for about three minutes (I was just shaking hands with myself) and the oscillator failed again.

I decided to check each component by *substitution.*

On coming to C54 again (line sync input) a new 15 pF condenser was fitted; oscillations commenced and continued. A check on picture proved OK now.

The faulty condenser was checked on the bridge again, and read exactly 15 pF but on fitting it in the set again the fault came on. A new condenser was permanently fitted and the set is now OK.

Another identical set also caused me a bit of head scratching. The picture would slip rapidly in and out of line sync, at the same time the brilliance would vary, and the line osc. whistle could be heard varying in pitch.

This at first led me to suspect the line osc. stage faulty, but on checking the voltage between tube grid and cathode, this was found very low. The cathode connects directly back to the video amplifier anode, and it was now found that no voltage existed between here and chassis.

The 3,300 ohm ½th watt load resistor had gone O/C; this was replaced with a similar resistor of more tolerant wattage rating, and the set has been OK ever since.

This fault was misleading in that one would have expected no picture modulation on the tube with the VF anode load O/C.—C. G. HINE, MORETON-IN-MARSH.

PHILIPS 209U

A PHILIPS 209U receiver reported to be producing a lot of noise, had the symptoms of a dry joint. The source proved to be the dial lamp which is of the 25V type.

The filament was intact but slight movement at the centre suspension caused the noise.—A.C.T.

ULTRA U626

AN Ultra U626 was stated by the customer to work satisfactory and then to suddenly " burst forth " at terrific volume, but only when the volume control was turned low. The most obvious thing faulty was the volume control but this proved OK.

Eventually it was found that on tapping the paxolin tube protruding from the top of the first IF can, the signal increased suddenly.

The IF was removed from the chassis and inspection showed that pF condensers are stamped into the paxolin base of the IF. By carefully dissecting, it was possible to trace a crack in the sprayed mica. As the wire ends of the IF actually solder on to the eyelets of the condensers between the paxolin, it was necessary to cut away part of the paxolin to remove all traces of the condenser.

A new 120pF condenser was fitted inside of the can and the set returned to normal working.— H. L. MITCHELL, Portsmouth.

SIMPLE TOOLS

ASK your wife for some old knitting needles; select the " odd " bone or plastic ones.

File a nick near the point of one pin and you have a useful tool for testing suspicious joints in those difficult-to-reach places by hooking and pulling the wires. It can also be used for " fishing " tuning cords past difficult points.

Fit a rubber washer to the end of another pin and you have a neat hammer for tapping valves.

Other needles can be shaped to form trimming tools.—A.C.T.

FERGUSON 968T, 978T

Continued from page 11.

for an input of not more than 130 microvolts (40 microvolts for 968TS) to the Direct aerial socket.

968T only. On either side of this frequency (45mc/s) peaks will be found in the response curve. The lower of these should occur at a frequency not higher than 43mc/s and the higher at a frequency not lower than 47.25mc/s. These peaks should be approximately 6dB (i.e. 2: 1) up on the response at 45mc/s.

968TS only. The peak response will occur at approximately 45mc/s and the frequencies at which the response is 6dB (i.e. 2: 1) down on that at 45mc/s must not be less than 1.5mc/s either side of 45mc/s.

Sound channel rejection should be at least 32dB relative to vision carrier (i.e. 40: 1) on both models.

Sound sensitivity (taken with a 30 per cent. 1000c/s modulated signal at 41.5mc/s) should be better than 70 microvolts (40 microvolts on 968TS) for a 50mW output into a 3 ohm load across OP1 secondary.

MODEL 978T

Upon feeding in an unmodulated signal at 61.75mc/s (vision carrier frequency) the vision output meter reading should fall 10V for an input of not more than 300 microvolts to the Direct aerial socket.

If the input frequency is gradually reduced, the response should increase to approximately 6dB (i.e. 2: 1) up on that at 61.75mc/s and then fall again as the frequency is reduced further. The frequency at which the response is level with that at 61.75mc/s should be not greater than 59.75mc/s.

Sound channel rejection should be at least 27dB relative to vision carrier (23: 1).

Sound sensitivity (taken with a 30 per cent. 1000c/s modulated signal at 58.25mc/s) should be better than 100 microvolts for a 50mW output in to a 3 ohm load across OP1 secondary.