SERVICE CASEBOOK

At least three types of fault make "Casebook" items—the sheer oddity, the one that is likely to show up in similar models, and the kind that is located by particularly adroit reasoning and testing. Which sort can you report?

PYE 38H

A PYE 38H was brought in with the complaint that the volume would change suddenly from normal to very faint after playing for about half-an-hour. All valves and components were checked and found to be in good condition.

The HT current to various valve electrodes was then observed, one after the other, while the set was tuned to a powerful receiver. The current of the first AF amplifier (EBC33) rose from 2 to 14mA on the instant of silencing at the speaker.

Careful investigation of the stage showed that the positive lug of the 2mF HT decoupling capacitor was almost touching a tag connecting to the centre tap of the mains transformer HT secondary and a 50mF bias decoupling condenser. As the two points made contact, due to expansion of the 2mF unit on warming up, the decoupling resistor was shorted to the common bias point.—SEIN HLAING, Rangoon.

INVICTA T102

ONE of these receivers was recently under investigation for interference on sound occurring at widely separated intervals. The trouble only manifested itself after a long soak test but just prior to this it appeared very "touchy" around the two EF50 RF sound stages. Lightly touching the metal casing of either valve produced an AF rumble from the speaker.

The valves were tested by substitution, voltages checked and decoupling capacitors examined, all being found to be in order. Between these various checks were considerable periods when the receiver functioned perfectly, and it was optimistically hoped that the cure had been effected.

The trouble, unfortunately, recurred after a time, and was finally eliminated by the insertion of two 33 ohm stopper resistors directly connected to the grid sockets of the EF50 valveholders (in series, naturally with the tuning inductors). The set has now been returned to the customer for some weeks without recurrence of the trouble.—E.H.W., Enfield.

EKCO U29X

THE owner of an Ekco U29X AC-DC superhet complained that it was intermittent on all wavebands but added that it would sometimes work for an hour or more before going "off."

Our first move was to give each valve a firm tap to see if any had loose internal connections. Then we removed the chassis and inspected the wiring and soldering for any short circuiting leads or dry joints.

Everything appeared normal so we left the set running while we attended to other work. Throughout the day the receiver failed to go "off" and whenever it was tested during the following four days it worked normally.

We began to think that possibly our circuit probing had dislodged a speck of solder somewhere or that we had properly seated a loose valve in its holder, so after checking that all valves were making good connection in their holders we replaced the chassis.

After about 40 minutes the receiver went off and by what tests we could make with the chassis in the cabinet, it was definitely an AF fault. We quickly removed the chassis and found that the cause of intermittent operation was a faulty resistor supplying the anode and screen of the second EF39.

This valve, a HF pentode, has its anode and screen strapped to function as an AF amplifier, and the half-watt resistor feeding it is stretched from the appropriate pins on the EF39 valveholder to a positive tag on an adjacent electrolytic.

During assembly the resistor had been stretched and when the chassis was tightly screwed into the cabinet the resultant strain had loosened the resistor's leading-out wires.—G.R.W.

ULTRA V600

A FEW receivers of this type have caused us a little trouble due to frame slip, the setting of the control being very critical. A slight modification to the circuit has in all cases cleared the trouble.

It can be seen from the manufacturer's service card that an integrating circuit, connected to the anode of the sync. separator valve, conveys attenuated line sync. pulses, and frame sync. pulses of much greater amplitude to a "chopping" diode, from the anode of which frame pulses (now free from the line pulses) are fed to the suppressor grid of the frame generator.

It has been found that a .01mF capacitor connected from that diode anode down to chassis sharpens the frame pulses considerably and make the frame locking very much easier.—E. H. W., Enfield.

ULTRA T401

A prevalent fault in Ultra T401 receivers dealt with is that the push back wiring through the chassis from the mains transformer is cut into by the brass grommet.

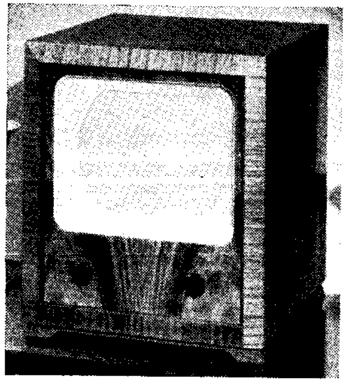
The cure, in fact I do it automatically now with every model that comes in for any service, is to rewire and pass some of the wiring (protected by additional sleeving) through the several other holes available on the chassis, thereby relieving the congestion where the trouble normally arises.

When this fault develops, it usually means just an arcing followed by an open circuit thereby rendering the set inoperative, but if the customer uses a good earth connection, then it's usually a case of a transformer replacement. That is why I always rewire for safety first!—H. L. MITCHELL, Portsmouth.

PRACTICAL WORKSHOP HINT

AT a loss to find suitable fine rubber for gripping the iron cores of coils as used by the manufacturers (it is practically impossible to split an average rubber band down fine enough), I discovered the most suitable rubber available is an old circular replaceable rubber strap used on most pairs of men's braces. In these there are dozens of pieces of rubber just right for the job, yet seemingly unobtainable through normal radio channels!—H. L. MITCHELL, Portsmouth.

PILOT TM54 CM54



Fourteen-valve five-channel television receiver fitted with a 12in. CRT giving a 10½ by 8in. picture. Model TM54 is housed in a walnut finished table cabinet and CM54 is a similarly finished console. Suitable for 195-255V 50c/s. Made by Pilot Radio, Ltd., Park Royal Road, NW10.

THE receiver employs a superheterodyne circuit designed to operate on lower sideband of vision carrier. The RF input and frequency-changer stages are fitted with plug-link selected permeability-tuned inductances to cover all five television channels to be used by the BBC. The RF, frequency-changer and first IF stage are common to sound and vision channels. Vision interference and sound noise suppression circuits are incorporated and EHT is obtained from line flyback pulses. Mains consumption is approximately 200W.

Aerial input circuit is designed for an 80 ohm coaxial feeder. Outer screen of coaxial is DC isolated from chassis by C2 whilst inner conductor is coupled through C3 to tap on aerial coil L2. L1, C1 connected across aerial input form an IF rejector.

RF Amplifier.—Aerial signal, which is developed across L2 on channel 1 and on L2 shunted by either L3, L4, L5 or L6 (selected by S1) on channels 2 to 5, is fed to grid of RF amplifier V1. Gain of V1 is controlled by adjustment of its cathode bias by means of plug-link S4, the **Sensitivity** control.

Amplified signal is developed across anode tuned coil L7 on channel 1 and across L7 shunted by L8, L9, L10, or L11 (selected by S2) on channels 2 to 5 and then fed by C10 to grid of frequency-changer V2. Anode coils are damped by R1 to maintain bandwidth to cover both vision and sound frequencies.

Frequency-changer is V2 operated as a combined oscillator and mixer. The screen (g2) and control grid (g1) are used as triode oscillator, the tuned coil of which is connected in the screen or oscillator anode circuit. On channel 1 the oscillatory tuned circuit is formed by L12, C11, C13, and on channels 2 to 5 shunt coils L13, L14, L15, L16 are switched across L12 by S3.

Automatic bias for oscillator grid is developed on C10 with R10 as leak. The RF signals applied through C10 to g1 are mixed with oscillator signal to produce across primary L17 of IFT1 in the anode circuit resultant IFs of 12mc/s (mean vision) and 10mc/s (sound). Primary L17 is damped by R17 to maintain bandwidth.

Vision and Sound IF.—Signals at anode of V2 are bandpass transformer coupled by IFT1 to common vision and sound IF amplifier V3 in the cathode circuit of which is **Contrast** control R23. Bottom end of secondary L18 of IFT1 is returned to junction of R18, R20, whilst suppressor grid (g3) is connected down to chassis. This in effect gives negative suppressor grid control and maintains reasonably constant the input capacity and resistance of the valve irrespective of setting of R23. Bandwidth is maintained by damping resistor R19 across L18 in grid and by R21 across primary L19 of IFT2 in the anode.

Vision Channel.—Signal at anode of V3 is bandpass transformer coupled by IFT2 to grid of V4 where separation of vision and sound signals takes place. Vision signal is amplified by V4 and single-peak transformer coupled by IFT3 to vision signal rectifier V5A. L21 in cathode of V4 is a sound rejector. Rectified signal across R47 is DC coupled to grid of video amplifier V8 the output of which is fed through interference limiter diode V5B to cathode of CRT.

Interference limiter is diode V5B connected between anode of video amplifier V8 and cathode of CRT. Diode anode is biased positively from HT through V8 anode load R49 and conducts, setting up a voltage across its cathode load R42, R44, R45. The voltage across R45 and part R44, decoupled by C40, is applied to grid of CRT as bias, variation of R44 giving control of **Brightness.**

When a large amplitude high-frequency interference pulse appears with signal then diode anode is driven negative, but due to time constant of R44, R45, C40 the cathode voltage remains unaltered and the diode therefore cuts-off thus removing interference pulse from video signal.

Sound channel signal is taken from grid of V4 by C22 and fed to bandpass coupling transformer IFT4 in grid of V6A a triode leaky-grid detector amplifier. Positive feedback from anode to grid is given by coupling between L46, a reaction winding, and secondary L27 of IFT4. Amount of feedback is controlled by T1 the **Sound Sensitivity** control.

Amplified audio signal at anode V6A is fed through diode noise suppressor V6B to volume control R8 in grid of beam-tetrode sound amplifier V7, the output of which is transformer coupled by OP1 to an 8in. television type speaker L30.

Noise suppression is given by strapped double-diode V6B which is connected with its cathode to bottom of triode section anode load R9 and its anode up to HT through R14. The time constant of R14, C12 is such that voltage on C12 follows that of audio signal passed on to it through diode V6B. When a large amplitude high frequency interference pulse appears with signal then cathode V6B is driven heavily positive but due to time constant of R14, C12 its anode potential remains unchanged and the valve cuts-off thus removing interference pulse from audio signal.

Sync separator.—Video signal fed to cathode of

CRT is also fed through C50 to grid of V9A. Positive sync pulses of video signal drive V9A into grid current and the resultant bias across R58 is sufficient to place video signal below cut-off, thus only the sync pulses appear at anode. Line sync pulses are fed by C48 to anode of V10B which forms one half of a multi-vibrator type oscillator.

Sync pulses at anode V9A are also applied to grid V9B. Due to comparatively long time constant of R53, C44 in the cathode circuit the valve cuts off during the short line sync pulse. The longer frame pulses, however, allow charge on C44 to leak away through R53—the valve conducts and frame sync pulses are developed across R52 in the anode and fed through C43 to anode of frame oscillator V10A.

Frame scan oscillator is triode V10A operated as a grid-blocking oscillator. Scan voltage is developed in grid circuit on C29 and is applied through **Height** control R28, C28 to grid of frame amplifier V11. R30 varies rate of charge of C29 and gives **Frame Hold.** **Linearity** of frame scan voltage is adjusted by variation of V11 grid bias by R27.

Amplified scanning voltage at anode V11 is transformer coupled by FT1 to frame deflector coils L34, L35 on neck of CRT. R61, R63 damp out line oscillations which appear on frame coils due to mutual inductance.

Line Scan waveform is generated by a multi-vibrator type oscillator formed by triode V10B and a second triode formed by screen (g2) and grid (g1) of line output amplifier V12 which are anode to grid cross coupled by T2 and C37. Scan voltage is developed on C36. Adjustment of T2 the coupling capacitor between screen V12 and grid V10B gives **Line Hold.**

Amplified output waveform at anode of V12 is transformer coupled by LT1 through variable **Width** control inductance L39 and DC isolating capacitor C47 to line deflector coils L40, L41 on neck of CRT. **Line linearity** is controlled by adjustment of R54 which varies damping across deflector coils and secondary L37 of output transformer.

Efficiency Diode.—Diode V14 between one side of line output transformer secondary and chassis conducts during line flyback period damping out the flyback oscillation and at the same time charging C39 negatively to the extent of approximately 35V thus providing additional HT to line output valve V12.

EHT of approximately 7.25kV is obtained by V13 rectifying the surge voltage set up across overwound primary L36 of line output transformer LT1 when V12 is cut-off. EHT is smoothed by C41 and fed through R60 to anode of CRT.

HT is provided by halfwave metal rectifier MR1, choke-capacity smoothing being given by L42, C45, C49. Vision channel HT line is RF decoupled by C23. Reservoir smoothing capacitor C49 is rated to handle 500mA ripple current.

Heaters of VI to V8, V10 to V12 are parallel connected and obtain their current from secondary L44 of mains input transformer MT1. Heater V9 is supplied from a separate secondary L43 which also provides CRT heater. Heater V14, the efficiency diode, obtains its current through dropper resistor R56 from 210V tapping on lower end of primary L45 of MT1.

CRT is a 12 in. triode with permanent magnet focusing. Brightness is controlled by variation of bias by R44. R59 prevents high potential developing between heater and cathode.

Primary L45 of MT1 is tapped for inputs of 195-220, 221-235, 236-255V 50c/s AC. S5, ganged to sound volume control, is the ON/OFF switch. Mains input is fitted with 2A fuse and filter capacitor C51.

RESISTORS

R	Ohms	Watts
1	10K	¼
2	150	¼
3	2.7K	¼
4	2.7K	¼
5	180	½
6	1.5K	¼
7	220K	¼
8	500K Potentiometer with DPST switch	
9	220K	¼
10	47K	¼
11	6.8K	¼
12	47K	¼
13	10K	¼
14	3.3M	¼
15	270K	¼
16	2.7K	¼
17	5.6K	¼
18	47K	¼
19	5.6K	¼
20	10K	¼
21	5.6K	¼
22	150	¼
23	10K WW Potr.	
24	2.7K	¼
25	68K	1W
26	100K	¼
27	500K Potentiometer	
28	500K Potentiometer	
29	1M	¼
30	1M Potentiometer	
31	5.6K	¼
32	150	¼
33	68K	¼
34	22K	¼
35	47K	¼
36	470	¼
37	2.7K	¼
38	470K	¼
39	2.7K	½
40	220K	¼
41	100	½
42	22K	¼
43	No Component	
44	100K Lin. Potr.	
45	10K	¼
46	47K	¼
47	4.7K	¼
48	470	¼
49	10K	1W
50	220K	¼
51	100K	¼
52	330K	¼
53	220K	¼
54	6K WW Potr.	
55	4.7K	1W
56	33	½
57	22K	¼
58	270K	¼
59	100K	¼
60	330K	¼
61	470	¼
62	2.7K	¼
63	33K	¼

CAPACITORS

C	Capacity	Type
1	260pF	Silver Mica
2	.001	Tubular 1000V
3	47pF	Silver Mica
4	.001	Tubular 350V
5	.001	Tubular 350V
6	50	Electrolytic 12V
7	.001	Tubular 1000V
8	.1	Tubular 350V
9	.001	Tubular 350V
10	47pF	Silver Mica
11	50pF	Silver Mica
12	.001	Tubular 350V
13	20pF	Tubular Ceramic
14	.005	Tubular 500V
15	.001	Tubular 350V
16	8	Electrolytic 500V
17	47pF	Silver Mica
18	.005	Tubular 500V
19	33pF	Silver Mica
20	6.8pF	Silver Mica
21	No Component	
22	3.3pF	Tubular Ceramic
23	.005	Tubular 500V
24	.005	Tubular 500V
25	.01	Tubular 150V
26	33pF	Silver Mica
27	.01	Tubular 150V
28	.25	Tubular 350V
29	.1	Tubular 500V
30	.1	Tubular 500V
31	.01	Tubular 150V
32	.005	Tubular 500V
33	500pF	Silver Mica
34	.005	Tubular 500V
35	No Component	
36	1000pF	Silver Mica
37	.01	Tubular 500V
38	10pF	Silver Mica

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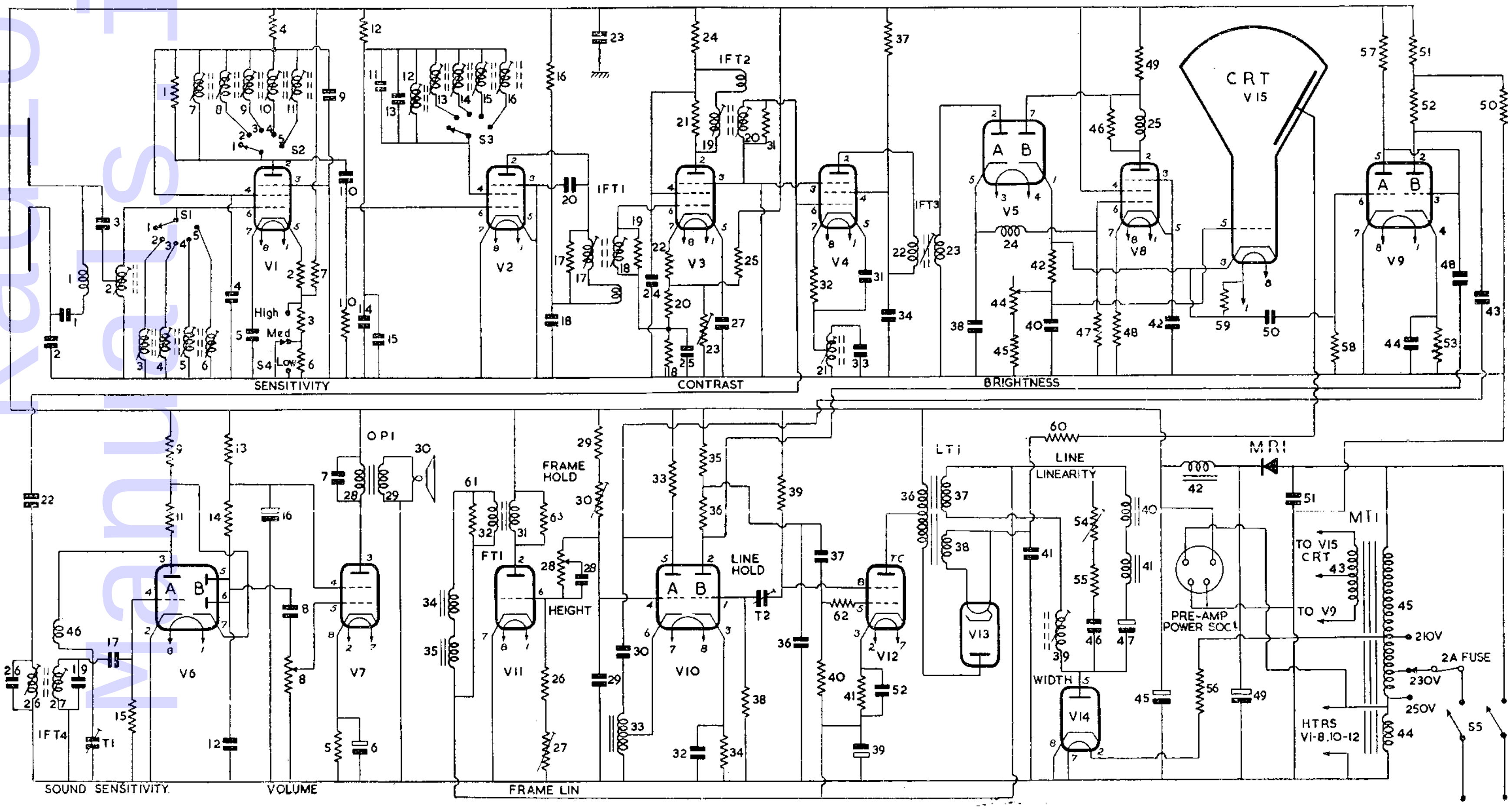
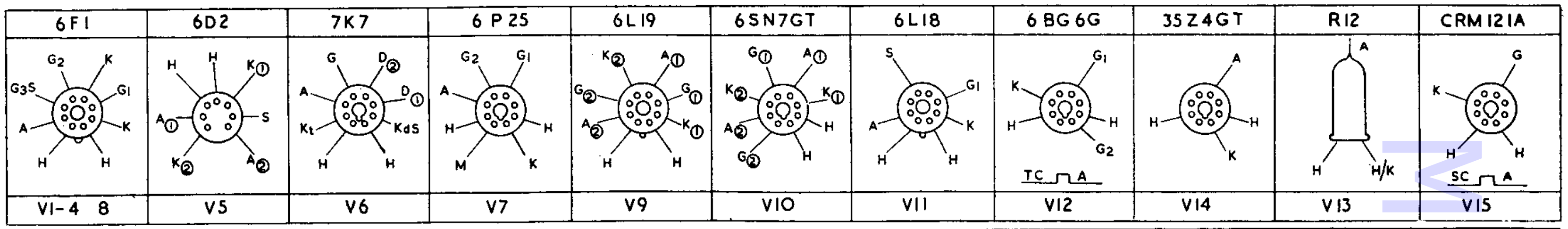




VALVE BASES AND VOLTAGES

V	Type	A	G_2	K	Remarks
1	6F1	220	220	1.9	S4 at High
2	6F1	230	145	—	—
3	6F1	220	220	1.9	R23 at Max.
4	6F1	220	220	1.9	
5 A	6D2	—	—	—	
5 B		170	—	170	
6A	7K7	80	—	—	
7	6P25	250	200	6.8	
8	6F1	190	260	3.5	

Total HT Current = 210*m*A

V	Type	A	G_2	K	Remarks
9 A	6L19	130	—	—	
9 B		100	—	13.5	
10 A	6SN7	200			
10 B		200	—	13	
11	6L18	240	—	—	
12	6BG6G	—	220	—*ve*27	
13	R12	—	—	7KV	
14	35Z4	—	—	—	
15	CRT	7KV	—	170V	Grid 160—190V R44 Min. to Max.

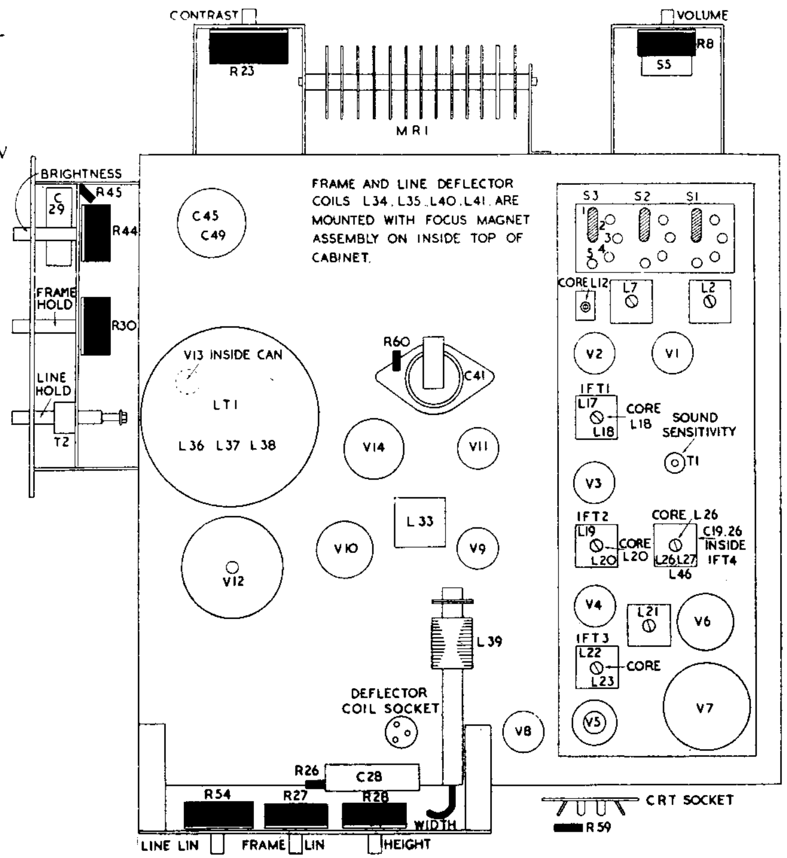
Mains Consumption = .52A

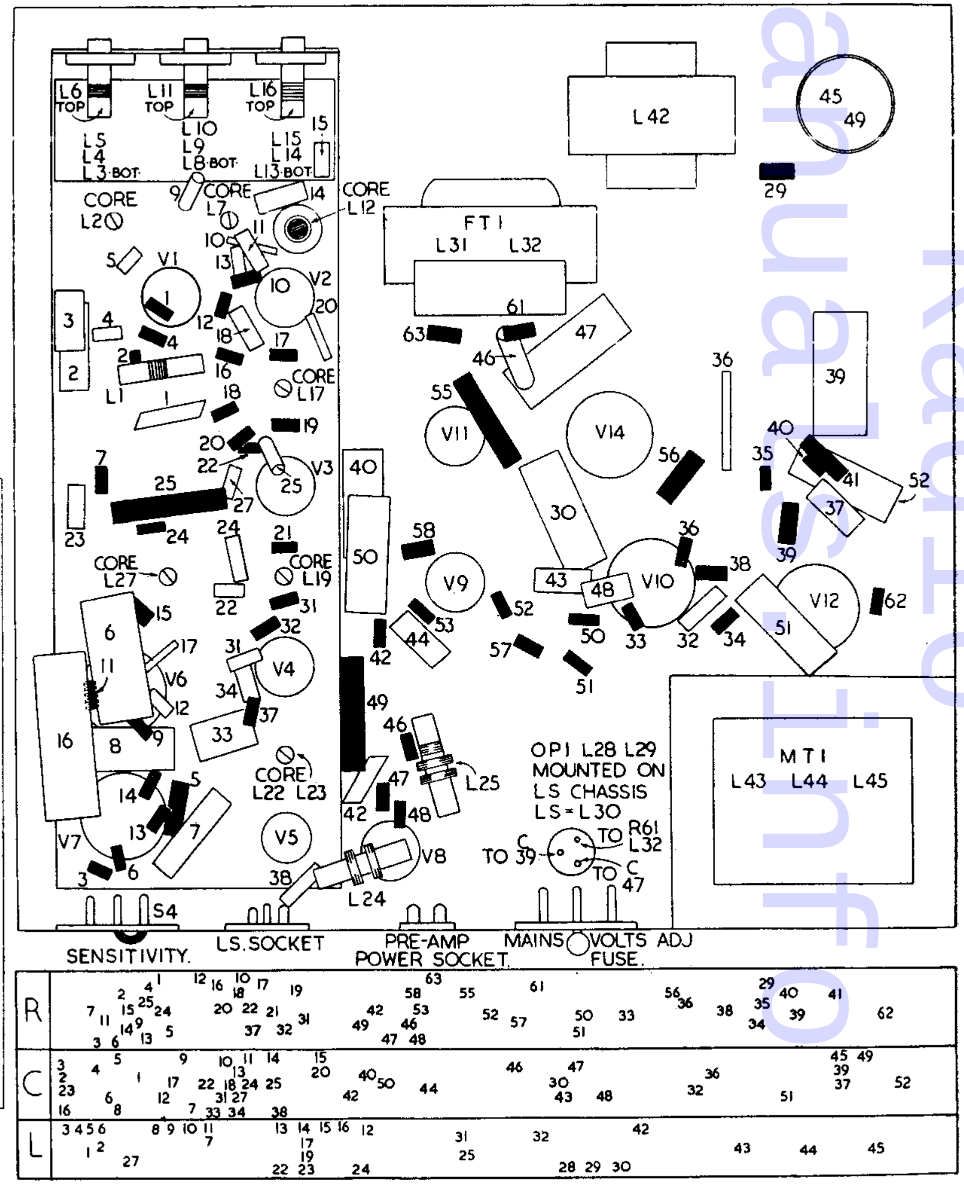
Continued overleaf

C	*Capacity*	*Type*
39	8	Electrolytic 200V
40	.1	Tubular 500V
41	.001	Taper 12KV
42	300pF	Silver Mica
43	.01	Tubular 500V
44	200pF	Silver Mica
45	100	Electrolytic 350V
46	.005	Tubular 500V
47	50	Electrolytic 12V
48	47pF	Silver Mica
49	60	Electrolytic 350V
50	.1	Tubular 500V
51	.05	Tubular 500V
52	.1	Tubular 500V

INDUCTORS

L	*Ohms*
1–16	Very low
17	1
18	.8
19	1
20	.9
21	Very low
22	.8
23	.8
24	3
25	21
26	.5
27	.5
28	700
29	.5
30	2.5
31	1150
32	6
33	64
34, 35	27
36	100 + 325
37	15
38	Very low
39	1.5
40, 41	12
42	85
43	Very low
44	Very low
45	33 total
46	.25





PILOT TM54—*Continued*

ALIGNMENT INSTRUCTIONS

Apparatus required. Accurately calibrated signal generator covering 10-15, 40-70mc/s with up to 60 per cent. modulation and calibrated low-impedance output attenuator; an oscilloscope or valve voltmeter; and an AC voltmeter for sound output indication.

IF stages. Connect signal generator output through a 1K resistor and .1mF isolating capacitor to g1 of frequency-changer V2. Connect the oscilloscope or valve-voltmeter to cathode of CRT through an HF filter consisting of a 2K resistor shunted by .001mF capacitor. Set sig-gen modulation at 60 per cent.

Adjust coil slugs in the order shown below. As alignment proceeds reduce input signal to give a maximum of 15V RMS on oscilloscope or valve voltmeter.

VISION

Inject 12.5mc/s, adjust L22/23

Inject 11.5mc/s, damp L19 with 2.7K resistor, adjust L20 (top).

Inject 12mc/s, damp L20 with 2.7K resistor, adjust L19 (bot).

Inject 12mc/s, damp L17 with 2.7K resistor adjust L18 (top).

Inject 13mc/s, damp L18 with 2.7K resistor, adjust L17 bot).

SOUND

Inject 10mc/s, adjust L21, L26 for *minimum* indication on oscilloscope.

Inject 10mc/s, adjust L27 for maximum deflection on sound output meter connected across primary of OP1.

RF and oscillator stages. The aerial and oscillator tuned circuits consist of tuneable master coils together with factory preset shunt coils which are brought into circuit across the master coils on channels 2 to 5 by means of links. Final channel alignment is carried out by adjustment of master coil cores as below:—

Select appropriate channel coils by means of S1, S2, S3.

Inject appropriate channel sound frequency through 80 ohm resistor to aerial socket and adjust core of L12 for maximum sound output. Inject appropriate vision frequency and adjust core L2 for maximum on oscilloscope.

Inject sound frequency again and adjust L7 for maximum sound output on output meter.

OSRAM FLAT FACE ALUMINISED TV TUBE ON TEST

OSRAM recently introduced two new 12in. TV tubes, the 6705A for parallel operation at 6.3V 0.5A and the 6706A for series working at 0.3A 10.5V. They have a moulded, practically flat screen, and a maximum anode rating of 10kV.

Fitted with international octal bases, they are replacing the types 6703A and 6704A and, like those, have aluminised screens and an external conductive coating that can be used for EHT smoothing.

We recently received a 6705A and were immediately impressed by the generous quantity of high-quality glass employed and the high standard of finish. For testing, the tube was fitted to a View-master receiver which had previously used another type of triode tube.

A special rubber mask to fit the nearly flat face of the tube, supplied by Long and Hambly, Ltd., has a wide rubber collar that pulls the window firmly and accurately against the screen.

EHT was increased to approximately 9kV by fitting a boost circuit using a metal rectifier which was recently described elsewhere by Westinghouse (details obtainable on request from Advice Bureau).

An excellent picture was obtained, the tube giving a very small spot and remaining in focus over the entire picture area. Brilliance is more than adequate for viewing in room daylight or in normal artificial lighting. The colour is just on the warm, sepia, side of black-and-white. Room reflections at the corners of the screen are notably less than with blown tubes and the viewing angle is increased.

The tube requires slightly more scanning power than those working at about 6kV, but the View-master was able to scan the whole picture area; it would seem that with any receiver designed for a 12in. tube, no difficulty should arise providing the scan circuits are up to standard performance.

These tubes made by the General Electric Co., Ltd., Magnet House, Kingsway, London, WC2, are undoubtedly able to present pictures of the highest standards when supplied in commercial receivers, fitted as service replacements or used in constructed receivers. The retail price of both types is £12 15s., plus £6 12s. 8d.

PHILIPS MONO-KNOB GRAM

A PHILIPS Mono-knob radiogram was brought in for a complete overhaul. After servicing the chassis we attended to the gram motor. Owing to its being unused for a long time the motor was almost completely "gummed-up"; so we dismantled it and cleaned off the hardened grease.

After reassembly we connected the motor to the mains before fitting it back into the gram and, although it operated smoothly and quietly, it functioned at almost twice normal speed.

Despite our efforts with the speed regulating mechanism we found it impossible to obtain the correct rpm so we switched off and checked the motor coils for partial short circuits.

The windings, however, were perfect. After no little investigation we found that although the gram was a regular 230V AC job, the motor was designed for 110V supply, and in the receiver was fed from a tapping on the primary of the mains transformer.

Whether many prewar Philips grams were fitted with 110V motors, we haven't discovered, but we will certainly bear the possibility in mind.

—G. R. W.

AMBASSADOR 551—
from opposite page.

AERIAL. The receiver is fitted with an internal loop for the reception of the more powerful MW and LW stations. Sockets for an external aerial and earth are provided for SW reception and for weaker MW and LW transmissions.

External aerial signal is fed through isolating capacitor C1 to SW aerial coupling coil L1 and thence to frame aerial L23 which is connected to bottom end of MW and LW grid coils L3, L4 respectively. R5, C3 are associated with bottom end aerial feed circuit.

Grid coils L2 (SW), L3 (MW), L4 (LW), which are trimmed by T1, T2, T3-C11 respectively, are switched by S1 to aerial tuning capacitor VC1 and coupled through C6 and grid stopper R3 to g1 of triode-heptode frequency-changer V1.

AVC voltages and a small standing bias, decoupled by R10, C4 are applied through R4, R3 to V1. R8 provides a small degree of negative feed-back to cathode. Screen (g2, g4) voltage is obtained from R1 decoupled by C5. Suppressor is internally strapped to one side of cathode. Primary L9, C7 of IFT1 is in the heptode anode circuit.

Oscillator is connected in a tuned-grid shunt-fed circuit. Grid coils L6 (SW), L7 (MW), L8 (LW) trimmed by T4, T5, T6 and padded by C12 (SW) and C12, C13 (MW, LW), are switched by S2 to oscillator tuning capacitor VC2 and coupled by C10 through stopper R6 to oscillator grid.

The gram. switch is utilised to prevent absorption by the LW oscillator circuit on MW, S3 switching out T6, C14. This means that the PU, when left connected and R24 are across these trimmers but effect on LW operation is negligible.

Automatic bias is developed on C10 with R7 as leak. Anode reaction voltages are developed inductively on L5 (SW) and capacitively across padders C12, C13 on MW, LW bands, and are applied through C9 to oscillator anode of which R2 is load.

IF amplifier operates at 420kc/s. Secondary L10, C8 of IFT1 feeds signal together with AVC and standing bias voltages decoupled by R10, C4, to g1 of IF amplifier V2.

Cathode and suppressor are connected down to chassis and screen voltage is obtained from R1 decoupled by C5. Primary L11, C15 of IFT2 is in the anode circuit.

Signal rectifier. Secondary L12, C16 of IFT2 feeds signal to one diode of V3. R11, the volume control, is the diode load and R9, C18 an IF filter.

AVC signal at anode V2 is fed by C17 to second diode of V3. Load resistor R14 is returned to chassis through R20 in negative HT circuit to provide a delay voltage. Delay bias, plus AVC voltage, is fed through decoupling network R10, C4 to grids of V1, V2.

Pickup. Sockets are provided for connection of any high resistance magnetic or crystal pickup. Pickup signal is applied through R24 to S3 which in its gram. position switches signal to volume control R11. Earthy socket is connected to junction of bottom of R11 and cathode feedback resistor R13. When pickup is in use aerial and oscillator coils are switched out and their tuning capacitors VC1, VC2 are shorted down to chassis by S1, S2 respectively.

AF amplifier. Rectified signal on volume control R11 is fed by C19 to grid of triode section of V3. Bias for grid is developed on C19 with R12 as leak resistor.

Negative feedback from secondary L14 of output matching transformer OP1 is applied to R13 in cathode of V3. R15 is anode load and R16, C20 provide HT decoupling.

Output Stage. C21 feeds signal at anode V3 through stoppers R17, R23 to beam-tetrode output amplifier V4. Grid resistor is potentiometer R18 which in conjunction with R17, C22, C23 provides variable top cut tone control. Cathode is at chassis potential, hence grid is provided with negative bias by connecting bottom end of grid load R18 to chassis through R20, R21 (decoupled by C25) which are in negative HT return lead.

V4 is transformer coupled by OP1 to a 6½in. PM speaker L22. Fixed degree of tone correction is given by C24. Sockets are provided on secondary L14 of OP1 for connection of a low-impedance (3 ohm) extension speaker.

HT is provided by an indirectly-heated fullwave rectifier V5 the anode voltages of which are obtained from HT secondary L16 of mains input transformer OP1. Heater current is obtained from L17. Choke-capacity smoothing is given by L15, C26, C27 whilst mains filtering is provided by C29, C30. Reservoir smoothing capacitor C27 is rated to handle 150mA ripple current. Negative side of HT is fed to chassis through R20, R21 decoupled by C25 in order to provide grid bias for V4, delay voltage for AVC diode and standing bias for grids of V1, V2.

Heaters V1 to V4 and dial lights are parallel connected and obtain their current from secondary L21, one side of which is connected to chassis. Primary L18 of MT1 is tapped for input voltages of 200-210, 220-230, 240-250V, 40-100c/s.

Universal model of this receiver differs from the above circuit as follows: Valves used are V1 10C1, V2 10F9, V3 10LD11, V4 10P14, V5 U404.

Heaters are series connected and obtain their current from the mains through a 970 ohm tapped dropper resistor. Rectifier anode is fitted with surge limiter R22.

Output transformer has a separate tertiary winding L19 for connection of extension speaker.

A mains interference filter L20 is also incorporated together with filter capacitor C28. Dial lamps are coupled in series and wired in mains lead to chassis through R21, R20.

Earth socket is isolated from chassis by C2. Reservoir capacitor C27 increased to 32mF.

Mains input is fitted with 1A fuse in each lead and a double-pole ON/OFF switch.

TRIMMING INSTRUCTIONS

Apply signal as stated below	Tune receiver to	Trim in order stated for maximum output
(1) 420kc/s to g1 of V1 via resistive termination	S/C VC2	Cores, L9, 10, 11, 12.
(2) Adjust dial pointers so that they lie vertically down edges of apertures with gang fully meshed.		
(3) 250kc/s to ae socket via dummy aerial	1200 metres	T6, T3
(4) 1.333mc/s as above	225 metres	T5, T2
(5) 15mc/s as above	20 metres	T4, T1