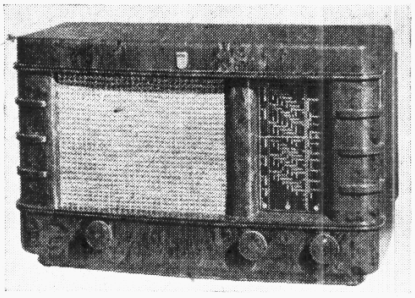
Supplement to The Wireless & Electrical Trader, January 16, 1943

"TRADER" SERVICE SHEET

603

PHILIPS 206H

AC/DC SUPERHET



SEVERAL unusual features are found in the output valve circuit of the Philips 206H, a 3-valve (plus rectifier) 3 band AC/DC superhet operating from mains of 200-250 V, 40-100 C/S in the case of AC. The SW range is 16.7-50 m.

Negative feed-back, hum neutralisation, mains voltage adjustment and a magnetic relay, in addition to the usual biasing resistance, are all introduced in the cathode circuit of the output valve. A switch associated with the relay short-circuits the scale lamp until the valves have warmed up.

Release date : *May*, 1940.

CIRCUIT DESCRIPTION

Aerial input via mains isolating condensers **C1, C2** and coupling coils **L1** (SW), **L2** (MW) and **L3** (LW) to single-tuned circuits **L4, C36** (SW), **L5, C36** (MW), **L6, C36** (LW), which precede a triode-hexode valve **(V1, Mullard metallised ECH3)** operating as frequency changer with internal coupling.

The **A** and **E** sockets are shunted by resistance **R1** to maintain DC continuity between them. An IF rejector **L7, C8** in **V1** hexode control grid lead is tuned by a variable iron-dust core. Condensers **C3** and **C4** across the aerial coupling coils tune them to resonate somewhere outside their respective operating bands.

The roof and base of the cabinet are lined with metallic screening foil; that in the roof is connected directly to **A** socket, via a solder-tag connection **ae,** and may be used as an emergency aerial; that on the base acts as a normal screen, and is returned to chassis directly via a separate mains isolating condenser **C5.** A second solder-tag connection **ea** is connected directly to the earth socket.

V1 oscillator anode coils **L11** (SW), **L12** (MW) and **L13** (LW) are tuned by **C40.** Parallel trimming by **C16** (SW), **C38** (MW) and **C39** (via **S10**) (LW); series tracking by **C15** (MW) and **C37** (LW). Reaction coupling by grid coils **L8** (SW), **L9** (MW) and **L10** (LW).

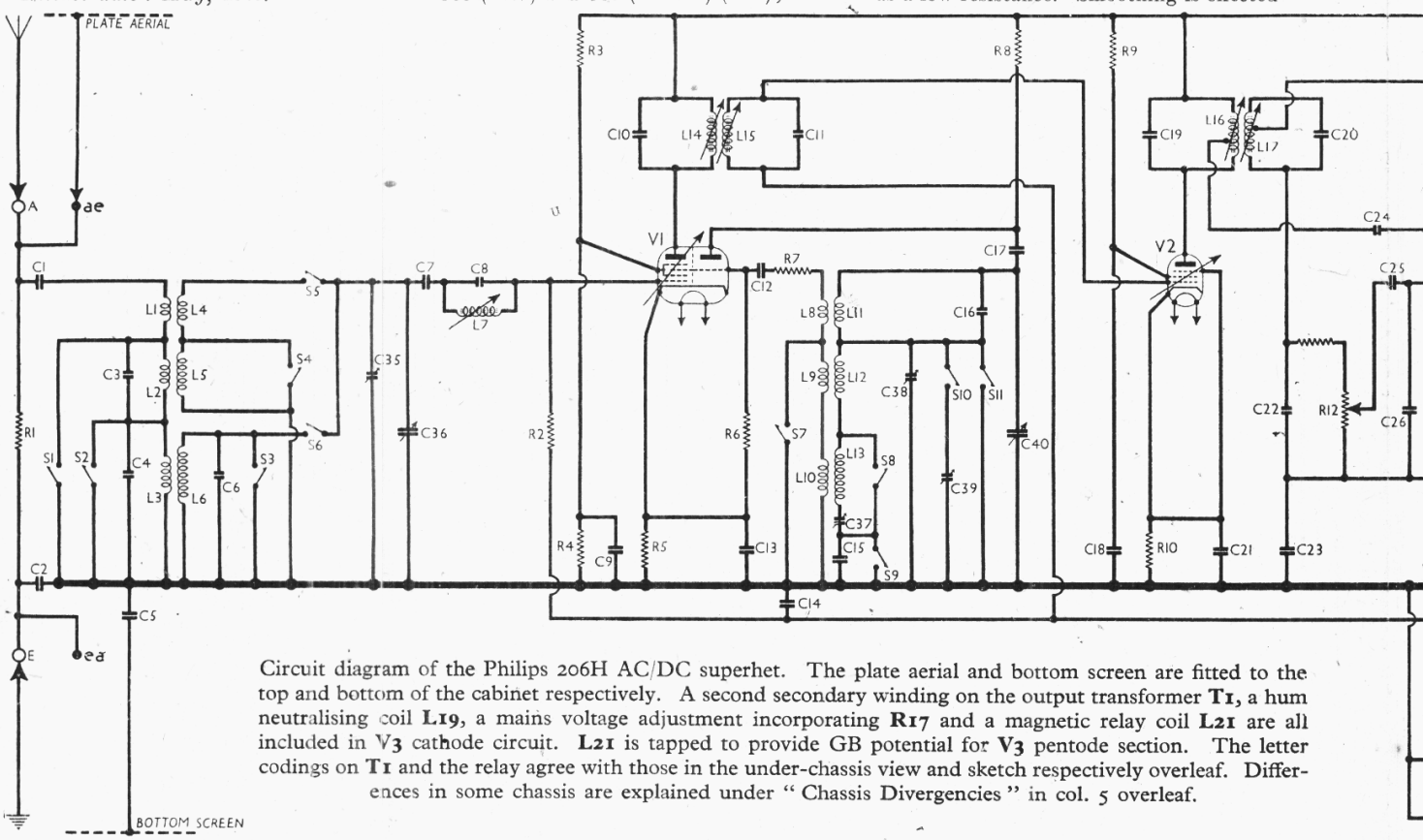
Second valve **(V2, Mullard metallised EF9)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned secondary iron-dust cored transformer couplings **C10, L14, L15, C11** and **C19, L16, L17, C20.**

Intermediate frequency 470 KC/S.

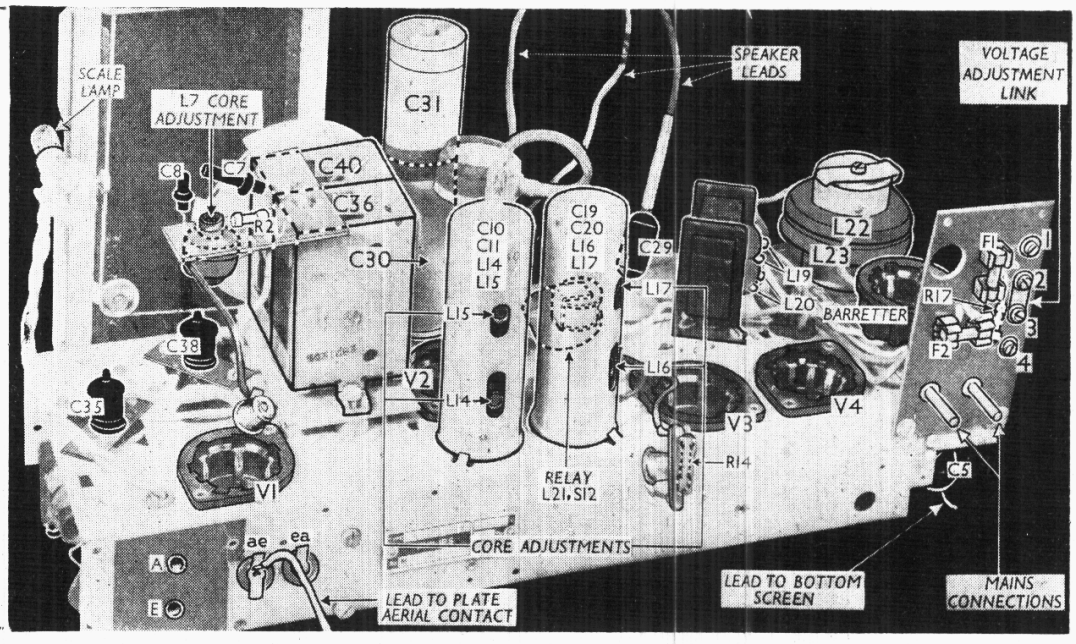
Diode second detector, fed from tapping on **L17,** is part of double diode pentode output valve **(V3, Mullard CBL1).** Audio frequency component in rectified output is developed across the manual volume control **R12,** which also operates as load resistance, and passed via AF coupling condenser **C25** and grid stopper **R14** to CG of pentode section, which provides the total AF amplification. IF filtering by **C22, R11** and **C26.**

Second diode of **V3,** fed from tapping on **L16** via **C24,** provides DC potential which is developed across load resistance **R16** and fed back through decoupling circuit as GB to FC and IF valves, giving automatic volume control.

When the receiver is operating from AC mains, HT current is supplied by IHC half-wave rectifying valve **(V4, Philips CY1),** which, with DC mains, behaves as a low resistance. Smoothing is effected



Circuit diagram of the Philips 206H AC/DC superhet. The plate aerial and bottom screen are fitted to the top and bottom of the cabinet respectively. A second secondary winding on the output transformer **T1,** a hum neutralising coil **L19,** a mains voltage adjustment incorporating **R17** and a magnetic relay coil **L21** are all included in V3 cathode circuit. **L21** is tapped to provide GB potential for **V3** pentode section. The letter codings on **T1** and the relay agree with those in the under-chassis view and sketch respectively overleaf. Differences in some chassis are explained under " Chassis Divergencies " in col. 5 overleaf.



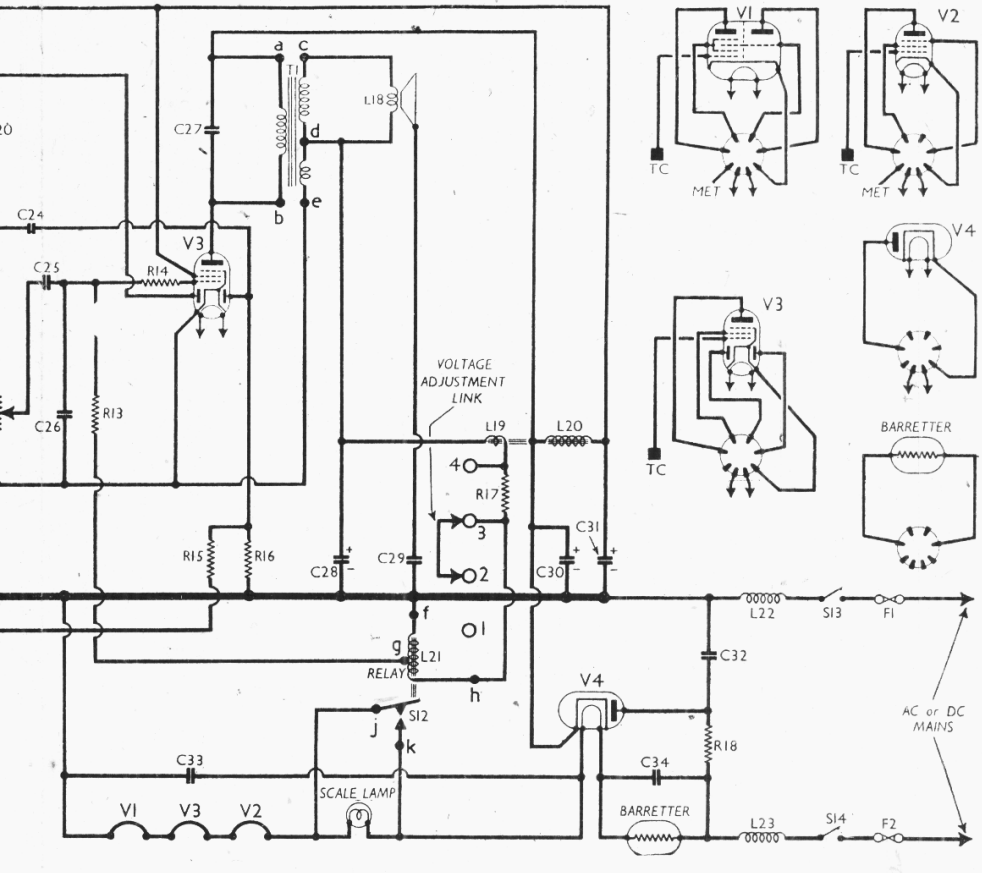
Plan view of the chassis. **C30** is indicated beneath **C31**; it is partly obscured by the gang unit. **V2** holder and the magnetic relay are almost completely hidden by the IF transformers, but the relay is shown in a sketch in col. 6 overleaf. Resistance **R14** is mounted on the top cap of **V3**. The respective connections of **L19** and **L20** are indicated. **R17** is attached to voltage adjustment terminals **3** and **4**, and is shown here dotted through the panel.

by iron-cored choke **L20** and electrolytic condensers **C30, C31.**

Valve heaters, together with current regulating barretter **(Philips C1)** and scale lamp, are connected in series across mains input circuit. Filter comprising air-cored chokes **L22, L23** and condenser **C32** suppresses mains-borne interference, while the heater and barretter circuits are by-passed by **C33** and **C34.** **S12** is part of a magnetically operated relay, and is described later. A third isolating condenser **C29** returns the metal speaker frame to chassis.

OUTPUT VALVE CIRCUIT

The cathode circuit of **V3** is complicated by the inclusion in it of arrangements for negative feed-back, hum neutralisation, bias adjustment (according to mains voltage) and scale lamp protection, as explained below.



The output transformer **T1** has two secondary windings : one, for speech output, between the tags identified in our diagram by the letters **c** and **d**; and the other, to provide the negative feed-back voltage, between tags **d** and **e.** The latter is included in the cathode circuit, where the feed-back voltage is thus injected.

The HT smoothing choke **L20** also has on its core a second winding, **L19.** Hum voltages developed across **L20** in the process of smoothing result in image voltages of smaller amplitude appearing across **L19.** These are fed in anti-phase into cathode circuit to neutralise hum.

As there is no voltage adjustment of the normal type in the mains input circuit, the HT line voltage will be determined by the voltage of the mains, and in order to compensate for this, a two-position grid bias adjustment is provided for **V3** in the form of a mains voltage adjustment panel, comprising resistance **R17,** which is included in **V3** cathode circuit, a short-circuiting link, and four terminals arranged in a vertical column. For mains of 200-225 V, the link is between terminals **3** and **4,** where it short-circuits **R17**; for mains of 225-250 V, it is between terminals **2** and **3,** so the **R17** is left in circuit, and increases the GB voltage for **V3** pentode.

The fourth device in the cathode circuit is the winding **L21** of the magnetic scale lamp protecting relay. This provides the resistance across which the grid bias voltage is developed, and takes the place of the normal self-biasing cathode resistance; it is tapped to provide the correct potential. In the relaxed position, when the set is switched off, the relay switch **S12** is closed and the scale lamp short-circuited. When **V3** has had time to warm up, however, after switching on, cathode current flowing through **L21** energises the magnet and opens the switch, so that the scale lamp lights up.

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	Aerial circuit shunt ...	100,000
R2	V1 hex. CG resistance ...	470,000
R3	V1 SG HT feed potential divider	27,000
R4		22,000
R5	V1 fixed GB resistance ...	330
R6	V1 osc. CG resistance ...	47,000
R7	Oscillator reaction stabiliser	150
R8	V1 osc. anode HT feed ...	22,000
R9	V2 SG HT feed	68,000
R10	V2 fixed GB resistance ...	270
R11	IF stopper	47,000
R12	Manual volume control; V3 signal diode load	500,000
R13	V3 pent. CG resistance ...	1,000,000
R14	V3 pent. grid stopper ...	1,000
R15	AVC line decoupling ...	1,500,000
R16	V3 AVC diode load ...	1,000,000
R17	V3 GB voltage adjustment	39
R18	V4 surge limiter	180

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial coupling coils	2·0
L2		23·0
L3		170·0
L4	Aerial SW tuning coil ...	0·1
L5	Aerial MW tuning coil	4·0
L6	Aerial LW tuning coil	45·0
L7	IF rejector coil ...	10·0
L8	Oscillator reaction coils	1·0
L9		2·0
L10		250·0
L11	Osc. circ. SW tuning coil	0·1
L12	Osc. circ. MW tuning coil	7·0
L13	Osc. circ. LW tuning coil	16·0
L14	1st IF trans. Pri. ...	7·0
L15	1st IF trans. Sec. ...	7·0
L16	2nd IF trans. Pri., total	7·0
L17	2nd IF trans. Sec., total	7·0
L18	Speaker speech coil ...	2·0
L19	Hum neutralising coil ...	4·0
L20	HT smoothing choke ...	700·0
L21	Relay magnetising coil, total	330·0
L22	Mains RF filter chokes	5·0
L23		5·0
T1	Output trans. Pri. ...	330·0
	Output trans. Sec., total*	3·5
F1, F2	Mains circuit fuses, 600 mA	—
S1-S11	Waveband switches ...	—
S12	Scale lamp shunt ...	—
S13,S14	Mains circuit switches	—

* Measured between tag c on T1 and V3 cathode.

	CONDENSERS	Values (μF)
C1	Mains isolating condensers	0·001
C2		0·0047
C3	Aerial circuit coil shunts	0·000039
C4		0·000039
C5	Screen isolating condenser	0·0047
C6	Aerial LW trimmer ...	0·0000039
C7	V1 hex. CG condenser ...	0·00033
C8	IF rejector tuning ...	0·000047
C9	V1 SG decoupling ...	0·047
C10	1st IF transformer tuning condensers	0·000103
C11		0·000097
C12	V1 osc. CG condenser ...	0·0001
C13	V1 cathode by-pass ...	0·047
C14	AVC line decoupling ...	0·047
C15	Osc. circ. MW tracker ...	0·0004355
C16	Osc. circ. SW trimmer	0·000022
C17	V1 osc. anode coupling ...	0·00047
C18	V2 SG decoupling ...	0·047
C19	2nd IF transformer tuning condensers	0·000103
C20		0·000103
C21	V2 cathode by-pass ...	0·047
C22	IF by-pass	0·000056
C23	Part of feed-back coupling	0·047
C24	Coupling to V3 AVC diode	0·0000039
C25	AF coupling to V3 pentode	0·022
C26	IF by-pass	0·0001
C27	Fixed tone corrector ...	0·0047
C28*	V3 cathode by-pass ...	25·0
C29	Speaker isolating condenser	0·0047
C30*	HT smoothing condensers	50·0
C31*		15·0
C32	Mains RF by-pass ...	0·022
C33	Heater circuit RF by-pass condensers	0·047
C34		0·047
C35‡	Aerial circ. MW trimmer	0·00003
C36†	Aerial circuit tuning ...	0·00049
C37‡	Osc. circ. LW tracker ...	0·0002
C38‡	Osc. circ. MW trimmer ...	0·00003
C39‡	Osc. circ. LW trimmer ...	0·000032
C40†	Oscillator circuit tuning	0·00049

* Electrolytic. † Variable. ‡ Pre-set.

Voltages should be measured with a high resistance meter, chassis being the negative connection.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 ECH3	180	1·3	68	1·3
	Oscillator			
	105	3·3		
V2 EF9	181	4·2	91	1·3
V3 CBLI	170	37·8	169	6·2
V4 CYI	199†	—	—	—

† Cathode to chassis, DC.

VALVE ANALYSIS

Valve voltages and currents given in the table (col. 2) are those given in the maker's manual. They represent conditions to be expected in an average receiver, but will vary slightly according to the mains voltage. They will be correct when the voltage across **C31** is 180 V.

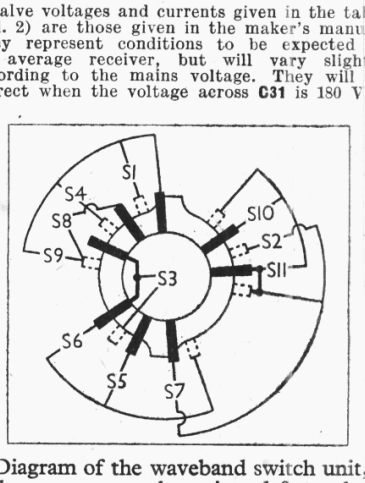


Diagram of the waveband switch unit, drawn as seen when viewed from the front of the underside of the chassis. The tags at the rear are indicated by dotted outlines.

DISMANTLING THE SET

Removing Chassis.—Remove the three control knobs (two recessed grub screws each) from the front of the cabinet;
remove the screw holding the plate aerial lead, with its spring contact strip and small baffle clamping lug, to the moulded projection at the top of the front inside the cabinet;
remove the two set screws (with washers) holding the scale assembly to the front of the cabinet;
unsolder the three leads from the connecting panel on the speaker;
unsolder from the tag screwed to right-hand end of baseboard the wire end of **C5**;
remove the four bolts (with washers) holding the chassis and baseboard to the bottom of the cabinet.
When replacing, the baseboard should be so placed that the totally screened side faces downwards; the end at which the screen overlaps on the upper side should be on the right, when viewed from the rear.
It should be carefully noted when inserting the chassis that the fixing screws engage with threaded insulating bushes fitted to the cross-brace members of the chassis, and are not in metallic contact with the chassis itself. If the bushes are loose, they should be cemented in position before replacing the chassis. Each bush consists of two parts: a small threaded collar with a hexagon shoulder which fits the hole stamped in the cross-member; and a larger, flat spacing washer with three pointed claws on one side.
The small collar should go above (inside) the cross-member, and the spacing washer below it with its claws pointing downwards to grip the wooden baseboard.
Connect the plain yellow speaker lead to the left-hand tag on the connecting panel, and the second yellow lead (with a green splash near the end) to the middle tag. The black (earthing) lead from **C29** goes to the right-hand tag, which is clamped under the fixing nut.
Removing Speaker.—First remove the chassis, as already described;
slacken the screws holding the remaining four baffle clamping lugs to the front of the cabinet, and swivel the lugs, when baffle and speaker can be withdrawn together.
When replacing, the connecting panel should be at the top.
Finally, when replacing the valves, it should be noted that a metal heat deflector should be fitted by means of its spring clips to the envelope of the barretter tube. The deflector should be turned so as to deflect the heat towards the rear of the cabinet.

GENERAL NOTES

Switches.—S1-11 are the waveband switches, in a single rotary unit built on to a large paxolin plate beneath the chassis, which also carries five coil units. The unit is indicated in our under-chassis view, and shown in detail in the diagram (col. 1), where it is drawn as seen looking from the front of the underside of the chassis. The table below gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control. A dash indicates open, and **C**, closed.

S12 is the scale lamp protecting switch, associated with a magnetic relay. The switch is closed while the receiver is switched off, and opens a short time after the receiver is switched on, so preventing the surge current in the heater circuit from damaging the scale lamp. The relay is described below.

S13, S14 are the QMB mains switches, in a unit in front of the chassis, ganged with the volume control **R12.**

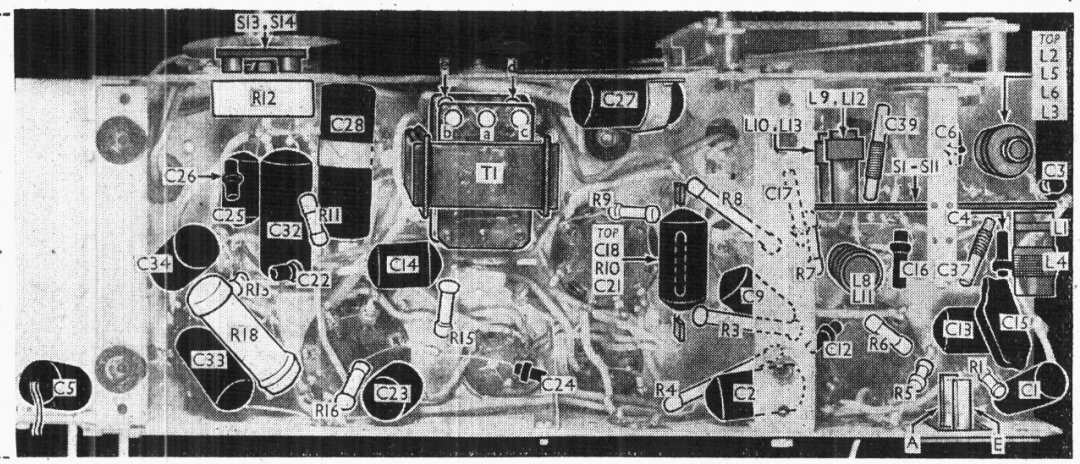
Coils.—L1, L4; L2, L3, L5, L6; L8, L11; L9, L12 and **L10, L13** are in five unscreened tubular units mounted on the paxolin plate carrying the wavechange switch. **L7** is an adjustable iron-cored unit on a panel attached to the gang condenser above the chassis. The IF transformers **L14, L15** and **L16, L17** are in two screened units on the chassis deck. Each unit contains its two associated fixed trimmers, while the core adjustments are reached through holes at the rear of the cans, indicated in our plan chassis view.

L19, L20 are the hum neutralising coil and HT smoothing choke respectively, wound in a single unit mounted on the chassis deck. The unit is seen in our three-quarter plan view, where the four connecting tags are identified. **L22, L23** are two air-cored mains filter chokes, in a single unit also mounted on the chassis deck.

Relay.—L21 is the energising winding of the magnetic relay which protects the scale lamp by short-circuiting it until the receiver has been working long enough for the heaters to warm up. The relay is mounted on the chassis deck, but it is

Switch Table

Switch	SW	MW	LW
S1	C	—	—
S2	C	C	—
S3	C	C	—
S4	C	—	C
S5	C	C	—
S6	—	—	C
S7	C	—	—
S8	—	C	—
S9	—	—	C
S10	—	—	C
S11	C	—	—



Under - chassis view. The output transformer **T1** is indicated near the front of the chassis, and the connections to it are identified by letters to correspond with those in the circuit diagram overleaf. The position of the **S1-S11** switch unit is indicated here. It is shown in detail in the diagram at the foot of col. 1.

hidden from view in our three-quarter plan illustration by the IF transformers. Its position is indicated by a dotted outline, but the unit is shown in detail in the sketch in col. 6, where its connections are identified by the letters **f, g, h, j, k** to correspond with those in the circuit diagram.

L21 also operates as **V3** GB resistance, and is tapped at **g** to provide the correct potential. The resistance from **f** to **g** is 180 O, and from **g** to **h,** 150 O. In some models, a thermal delay switch may be used in place of **S12,** and in such cases **L21** will be replaced by two 3-watt resistances of the same ohmic values as those described for the two sections of **L21** respectively. The heating element is connected in series with the heater circuit, between **V4** heater and the junction of the scale lamp, **S12** and **C33.** Its resistance is 37 O.

Output Transformer T1.—This is a normal transformer with an additional secondary winding for negative feed-back purposes. Its five connections are coded with the letters **a, b, c, d, e** in the circuit diagram, and these are identified in our under-chassis view, where the transformer is indicated.

In the makers' diagram, **T1** secondary is shown as a single winding, the section between **d** and **e** being omitted. **V3** cathode lead then goes directly to tag **c,** tag **d** going to the junction of **C28** and **L19.** In an alternative arrangement in the makers' manual, the section between **d** and **e** is present, but the connections are slightly different from those in our chassis, the speech coil **L18** being connected to tags **c** and **e** instead of **c** and **d.** The other connections to **d** remain as shown in our diagram.

It should be noted that there are three possible DC resistance values for **L18.** The makers give alternative values: 2.5 O for the first arrangement described above; 5 O for the second. As will be seen from our tables, the value in our case was 2 O.

Mains Voltage Adjustment.—Normally, in receivers equipped with a barretter, no voltage adjustment is provided, heater circuit current being automatically regulated by the barretter, and HT line voltage being determined by the mains voltage. In this receiver, however, an additional bias resistance **R17** is inserted in **V3** cathode lead on high voltage mains to compensate for the increased HT voltage.

The resistance is mounted behind the mains input panel, seen on the right of our three-quarter plan view of the chassis, carrying the four voltage adjustment terminals and the shorting link. The terminals are numbered **1** to **4,** but only numbers **2** to **4** are actually used. **R17** is connected between terminals **3** and **4;** the link is connected between **3** and **4,** short-circuiting **R17,** for 200-220 V mains, or between **2** and **3** for 225-250 V mains. There are no internal connections to terminals **1** and **2.**

Scale Lamp.—This is a Philips lamp, type 8034D-OO. It has an MES cap and a clear tubular bulb.

Condensers C30, C31.—These are two dry electrolytics in a single tubular metal container mounted vertically on the chassis deck. The can is the common negative connection; the tag emerging from the top of the can is the positive of **C31** (15 μF), while the tag emerging beneath the chassis is the positive of **C30** (50 μF).

Chassis Divergencies. — A thermal delay switch may in some chassis take the place of **S12,** when **L21** will be replaced by resistances. This is explained under "Relay."

There are three possible arrangements for **T1** and **L18,** and the differences are described under "Output Transformer T1."

In addition, the gang condenser may use brass vanes, as in our sample, but where brass vanes are not used, **C6** and **C16** will be omitted from the chassis. **C16** may be 0.000018 μF.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator via a 0.032 μF condenser, to control grid (top cap) of **V1** and earth socket. Switch set to MW, turn gang to minimum and volume control to maximum. Feed in a 470 KC/S (638.3 m) signal, connect an 80 $\mu\mu$F condenser across **L16** for detuning, then adjust core of **L17** for maximum output. Transfer 80 $\mu\mu$F condenser to **L17,** and adjust core of **L16** for maximum output. Connect 80 $\mu\mu$F condenser across **L14,** and adjust core of **L15** for maximum output. Transfer 80 $\mu\mu$F condenser to **L15,** and adjust core of **L14** for maximum output. Finally, remove the detuning condenser.

RF and Oscillator Stages.—Connect signal generator via a suitable dummy aerial to **A** and **E** sockets. A Philips 15 deg. jig will be required for setting the gang at the lower wavelength ends of the scales. (Code No. 09.992.440.) No SW adjustments are provided.

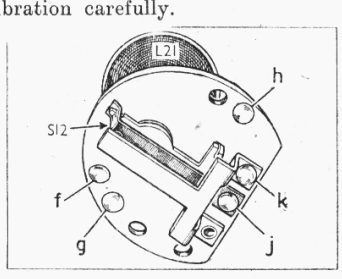
MW.—Switch set to MW, fit the 15 deg. jig, and set the gang to it. Feed in a 1,550 KC/S (193.5 m) signal and adjust **C38,** then **C35,** for maximum output. Recheck **C38,** then seal the trimmers.

LW.—Switch set to LW, set the gang to the 15 deg. jig, feed in a 408 KC/S (734 m) signal and adjust **C39** (by varying the turns of wire) for maximum output. Connect an aperiodic amplifier (type GM2404) to hexode anode of **V1,** and short circuit the **C40** section of the gang. Feed in a 160 KC/S (1,875 m) signal, tune it in on the set for maximum output from the aperiodic amplifier. Without altering the tuning of the set, remove the amplifier, and the short circuit from **C40,** and adjust **C37** (by adding or removing turns) for maximum output. Finally, repeat the 408 KC/S adjustment.

If a new tracker is fitted, unwind one-quarter of the wire winding before commencing alignment.

Where no aperiodic amplifier is available, **C37** must be adjusted while rocking the gang for optimum output.

IF Rejector.—Switch set to MW, turn gang to maximum, feed in a strong 470 KC/S signal, and adjust core of **L7** for *minimum* output. Finally, check calibration carefully.



Sketch showing the underside of the magnetic relay. The connections are all indicated and coded.

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