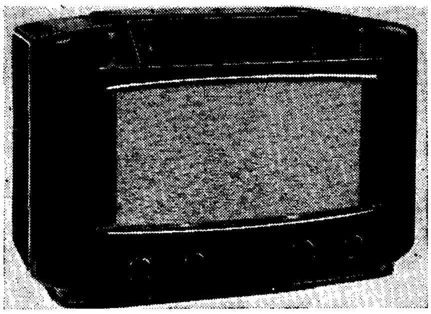
Supplement to The Wireless & Electrical Trader, May 18, 1946

"TRADER" SERVICE SHEET

770

PHILIPS 170A

AND MULLARD MAS281



The Philips 170A A.C. superhet.

A NEW type of chassis, styled on special lines to facilitate quick removal and easy access, with legs to permit it to stand firmly on end, is employed in the Philips 170A, the first model in the post-war range. The set is a 4-valve (plus rectifier) 3-band superhet with an R.F. amplifying stage, designed to operate from A.C. mains of 100-260V, 50-100 c/s. The S.W. range is 16.7-51 m.

The Mullard MAS281 employs an identical chassis, but it is housed in a wooden cabinet, whereas the Philips model has a plastic cabinet.

Release dates and original prices: Philips 170A, February, 1946, £18, plus £3 17s 5d purchase tax. Mullard MAS281, April, 1946, £18 18s, plus purchase tax £4 1s 3d.

CIRCUIT DESCRIPTION

Aerial input via coupling coils **L1** (S.W.), **L2** (M.W.), and **L3** (L.W.) to single-tuned circuits **L4, C42** (S.W.), **L5, C42** (M.W.) and **L6, C42** (L.W.), which precede first valve **(V1, Mullard metallised EF39)**, a variable-mu R.F. pentode operating as signal frequency amplifier. A plug connected to the plate aerial permits temporary operation without an external aerial.

Mixed resistance-capacitance and tuned-secondary R.F. transformer coupling by **R4, C6** and **L9, C46** (S.W.), **L7, L10, C46** (M.W.); **L8, L11, C46** (L.W.) between **V1** and triode-hexode valve **(V2, Mullard metallised ECH35)** which operates as frequency changer with internal coupling.

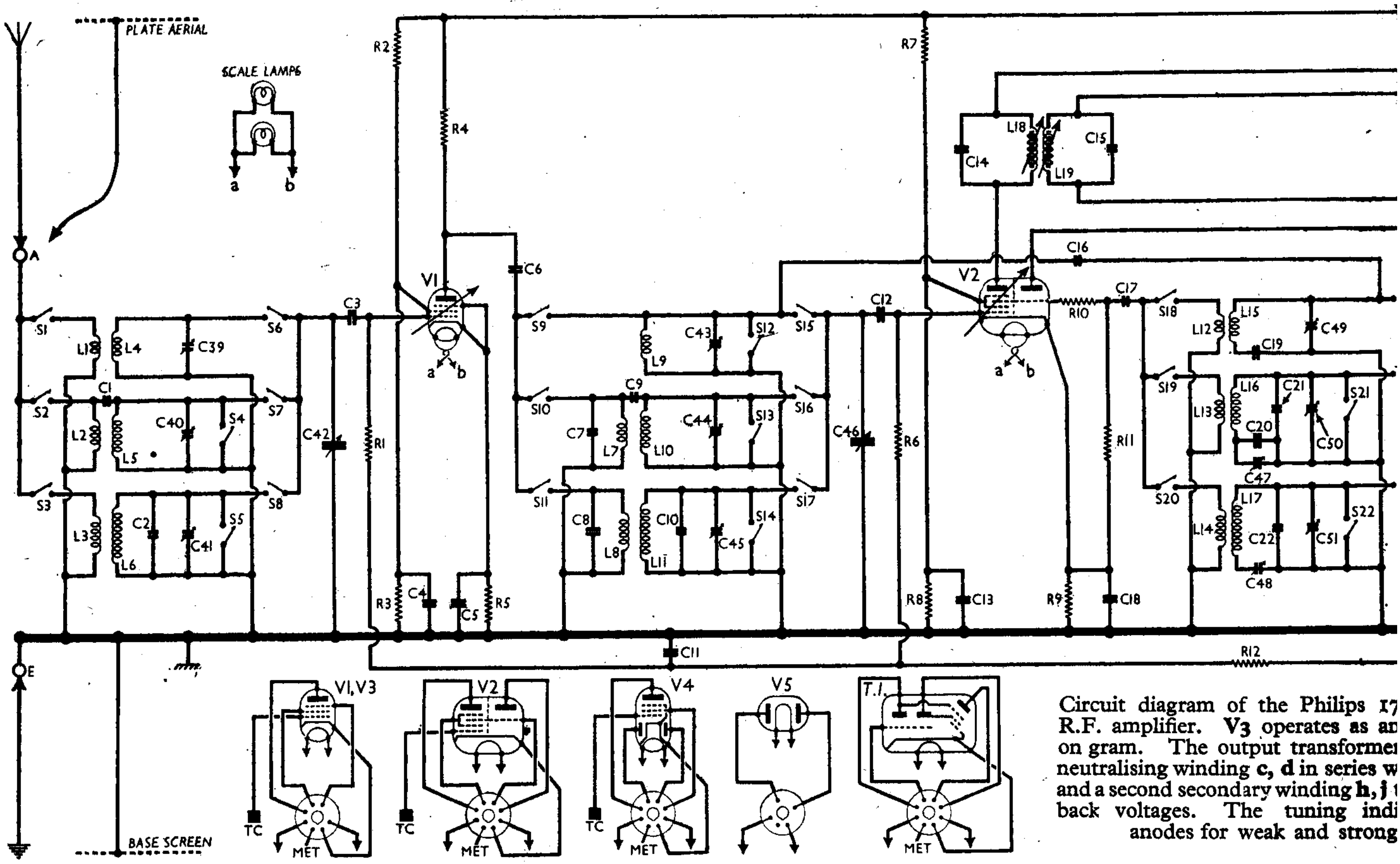
Oscillator anode coils **L15** (S.W.), **L16** (M.W.) and **L17** (L.W.) are tuned by **C52.** Parallel trimming by **C49** (S.W.), **C21, C50** (M.W.) and **C22, C51** (L.W.); series tracking by **C19** (S.W.), **C20, C47** (M.W.) and **C48** (L.W.). Reaction coupling from control grid circuit by coils **L12** (S.W.), **L13** (M.W.) and **L14** (L.W.).

Third valve **(V3, Mullard metallised EF39)** is a second R.F. pentode, operating this time as intermediate frequency amplifier, at fixed grid bias, with tuned-primary, tuned-secondary iron-cored transformer couplings **C14, L18, L19, C15** and **C25, L20, L21, C26.**

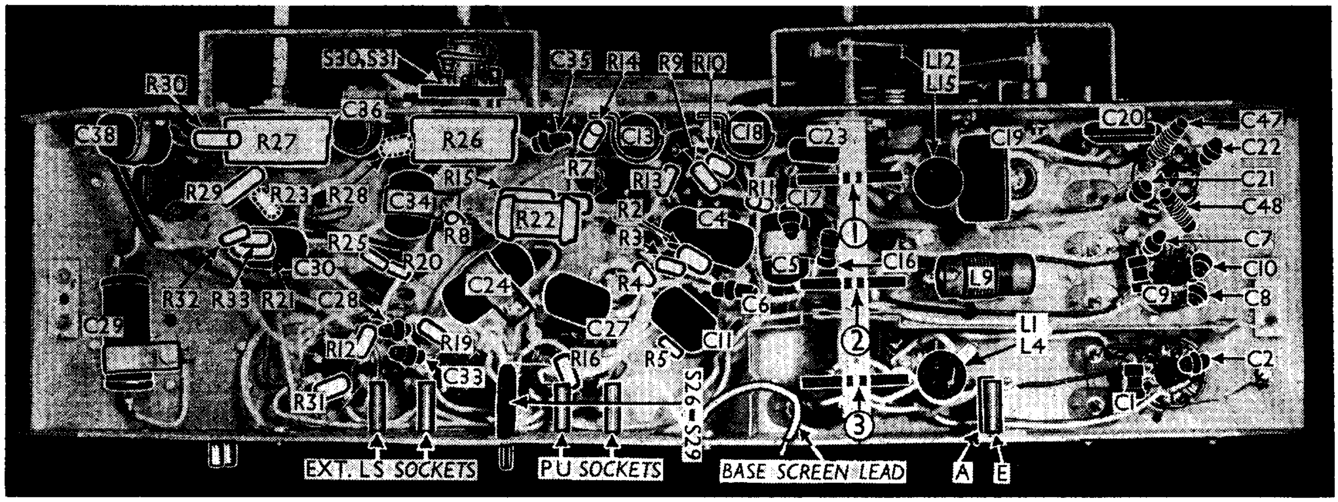
Intermediate frequency 470 kc/s.

Diode second detector is part of double diode pentode output valve **(V4, Mullard EBL31).** Audio frequency component in rectified output is developed across the manual volume control **R26,** which also operates as load resistor, and passed via A.F. coupling capacitor **C34** and resistors **R23, R24** to control grid of pentode section. I.F. filtering by **C28** in diode circuit and **R23, R24** and the valve capacitance in **V4** control grid circuit. High-note compensation by **C35,** and fixed tone correction by **C37** across the output transformer **T1** primary winding.

D.C. potential developed in the diode circuit appears also across resistors **R20, R21,** which form a potential divider across it. The potential developed across **R21**



Circuit diagram of the Philips 17
R.F. amplifier. V3 operates as an
on gram. The output transforme
neutralising winding c, d in series w
and a second secondary winding h, j
back voltages. The tuning indi
anodes for weak and strong



Under-chassis view. The waveband switch units, 1, 2, 3 are shown in detail in the diagrams in col. 5 overleaf. With them is a diagram of the **S26-S29** unit also, viewed as shown by the arrow in this view, with the chassis stood on end.

is tapped off and applied as control voltage to the two-speed cathode ray tuning indicator **(T.I., Mullard metallised EM34).**

The output transformer has a double primary winding, identified in our circuit diagram by **c, d, e,** and two secondary windings **f, g** and **h, j.** Secondary **f, g** feeds the speech coil of the speaker, and sockets connected across it are provided for a low impedance external speaker.

Secondary **h, j** provides signal voltages which are used to apply feed-back to the control grid circuit of **V4** pentode. The output from **h, j** appears across **C38, R32** and **R33**, and that across **R32, R33** is applied to **R25, R26** which are mutually in series and form a potential divider across **R32, R33**, so that only a fraction of the feed-back voltage appears across **R26.** The junction of **R32** and **R33** is connected to **V4** cathode.

Relative to the cathode, voltages at the junction **R32, C38** are in phase with signals at the control grid, while voltages at **R33, h** are out of phase with them. Component values are so adjusted that with the volume control turned close to maximum, the in-phase feed-back voltage is just equal to, and therefore neutralises, the out-of-phase voltage.

Thus there is no negative feed-back when the volume control is advanced for maximum sensitivity, but as it is retarded from that position, the out-of-phase voltages exceed the in-phase voltages, and the feed-back becomes increasingly more negative as the volume control is turned further back for stronger signals.

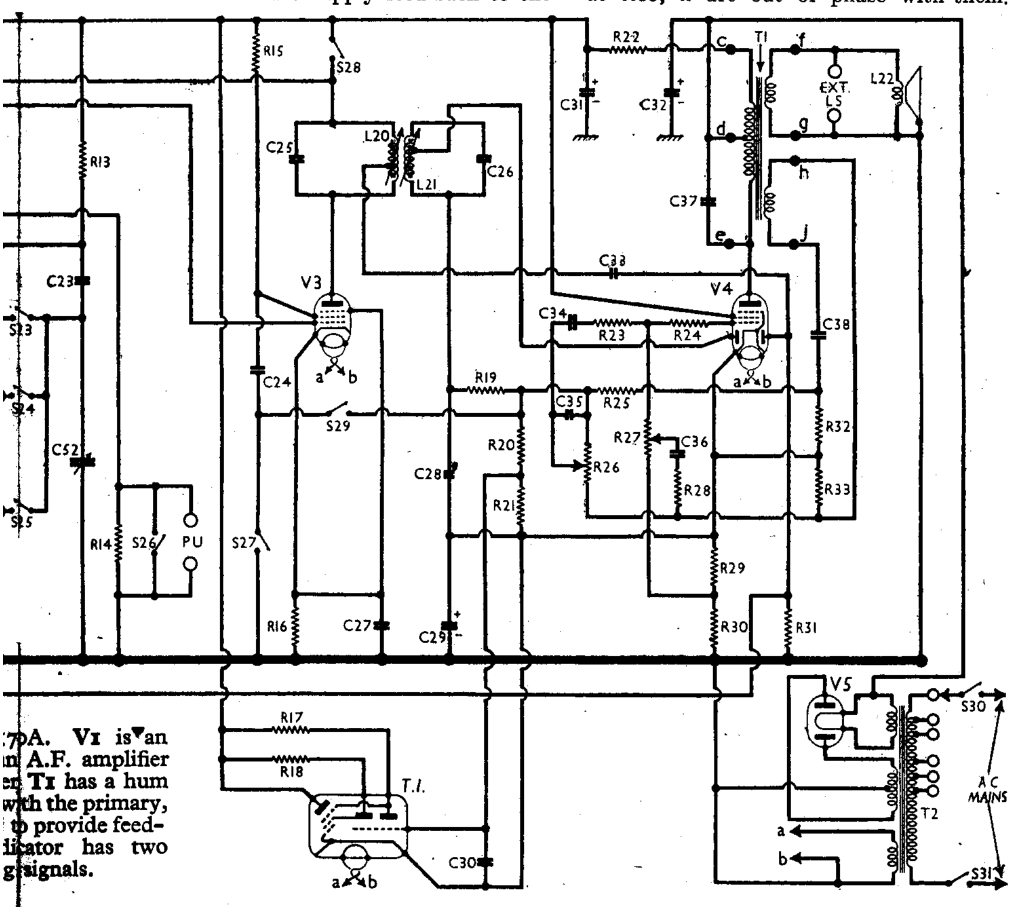
Variable tone control operates in conjunction with the feed-back circuit, varying the amount of negative feed-back applied. When the tone control **R27** slider is at the upper (control grid) end of the track, negative feed-back at treble frequencies is at a maximum, falling as the slider is lowered. In the upper position, **R23** serves to prevent **C36, R28** imposing a heavy load across **R26.**

Second diode of **V4,** fed via **C33** from a tapping on **L20,** provides D.C. potential which is developed across load resistor **R31** and fed back through decoupling circuits as G.B. to R.F. and F.C. valves, giving automatic volume control. This is not applied to **V3.**

For gramophone pick-up operation, **V3** is used as a triode A.F. amplifier. The pick-up sockets, which are in **V3** control grid circuit, are normally short-circuited by **S26,** which opens for pick-up work. **S28** also opens, cutting off the H.T. feed to **V2** and **V3** anodes to mute radio. **S27,** which connects the screen decoupling capacitor **C24** to chassis for radio operation, also opens, while **S29** closes.

Pick-up signals are then amplified by **V3,** the screen acting as the anode, and are passed via **C24** to **R26,** and so on to **V4** pentode control grid.

H.T. current is supplied by full-wave rectifying valve **(V5, Mullard AZ31).** Smoothing is effected by resistor **R22** and large capacitance electrolytics **C31, C32,** residual hum being cancelled out by passing the H.T. current through a special hum neutralizing winding **c, d** in series with the primary winding **d, e** on **T1,** the hum currents in the two windings being in phase opposition.



70A. V1 is an ... A.F. amplifier ... T1 has a hum ... with the primary, ... to provide feed- ... dicator has two ... signals.

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COMPONENTS AND VALUES

	RESISTORS	Values (ohms)
R1	V1 C.G. resistor	1,000,000
R2	V1 S.G. H.T. potential	47,000
R3	divider	56,000
R4	V1 anode load	18,000
R5	V1 fixed G.B. resistor ...	390
R6	V2 hex. C.G. resistor ...	1,000,000
R7	V2 S.G. H.T. potential	39,000
R8	divider	100,000
R9	V2 fixed G.B. resistor ...	150
R10	V2 osc. C.G. stabiliser ...	220
R11	V2 osc. C.G. resistor ...	39,000
R12	A.V.C. line decoupling ...	1,000,000
R13	V2 osc. anode H.T. feed	22,000
R14	V3 C.G. resistor ...	1,500,000
R15	V3 S.G. H.T. feed	82,000
R16	V3 G.B. resistor	330
R17	H.T. feed resistors to T.I.	820,000
R18	anodes	820,000
R19	Diode isolator	27,000
R20	T.I. C.G. potential divider	3,300,000
R21		1,000,000
R22	H.T. smoothing resistor...	1,500
R23	V4 pentode C.G. stoppers	100,000
R24		1,000
R25	Feed-back coupling ...	2,200,000
R26	Manual volume control; V4 signal diode load ...	600,000
R27	Variable tone control ...	1,000,000
R28		8,200
R29	V4 pent. G.B. and A.V.C.	120
R30	delay resistors	180
R31	V4 A.V.C. diode load ...	820,000
R32	Feed-back phase dividing	8,200
R33	resistors	1,800

	CAPACITORS	Values (μF)
C1	Aerial "top" coupling ...	0·0000015
C2	Aerial L.W. fixed trimmer	0·000012
C3	V1 C.G. capacitor... ...	0·0001
C4	V1 S.G. decoupling ...	0·047
C5	V1 cathode by-pass ...	0·047
C6	R.F. coupling	0·00022
C7	R.F. transformer primary	0·000082
C8	shunt capacitors ...	0·00033
C9	R.F. top coupling ...	0·0000015
C10	R.F. L.W. fixed trimmer...	0·000015
C11	A.V.C. line decoupling ...	0·047
C12	V2 hex. C.G. capacitor ...	0·0001
C13	V2 S.G. decoupling ...	0·047
C14	1st I.F. transformer tuning	0·000103
C15	capacitors	0·000097
C16	Small coupling ...	0·0000004
C17	V2 osc. C. G. capacitor ...	0·000056
C18	V2 cathode by-pass ...	0·047
C19	Osc. circ. S.W. tracker ...	0·00455
C20	Osc. M.W. fixed tracker ...	0·00033
C21	Osc. M.W. fixed trimmer...	0·0000056
C22	Osc. L.W. fixed trimmer	0·000033
C23	V2 osc. anode coupling ...	0·0001
C24	V3 S.G. decoupling ...	0·047
C25	2nd I.F. transformer tun-	0·000103
C26	ing capacitors	0·000103
C27	V3 cathode by-pass ...	0·047
C28	I.F. by-pass	0·000082
C29*	V4 cathode by-pass ...	25·0
C30	T.I. C.G. decoupling ...	0·047
C31*	H.T. smoothing capacitors	32·0
C32*		32·0
C33	Coupling to A.V.C. diode	0·0000068
C34	A.F. coupling to V4 pent.	0·047
C35	High-note compensator	0·000033
C36	Part of tone control ...	0·001
C37	Fixed tone corrector ...	0·001
C38	Feed-back coupling ...	0·1
C39‡	Aerial circ. S.W. trimmer	0·00002
C40‡	Aerial circ. M.W. trimmer	0·00002
C41‡	Aerial circ. L.W. trimmer	0·00002
C42†	Aerial circuit tuning	0·00049
C43‡	R.F. transformer second-	0·00002
C44‡	ary trimmers	0·00002
C45‡		0·00002
C46†	R.F. trans. sec. tuning ...	0·00049
C47‡	Osc. circ. M.W. tracker ...	0·000155
C48‡	Osc. circ. L.W. tracker ...	0·000155
C49‡	Osc. circ. S.W. trimmer ...	0·00002
C50‡	Osc. circ. M.W. trimmer...	0·00002
C51‡	Osc. circ. L.W. trimmer ...	0·00002
C52†	Oscillator circuit tuning ...	0·00049

* Electrolytic. † Variable. ‡ Pre-set.

VALVE ANALYSIS

Valve voltages and currents in the table (next col.) are those quoted in the makers' manual. They represent conditions to be expected in an average chassis when it is operating with the mains voltage adjustment correctly set, tuned to 2,000m, but with no signal input.

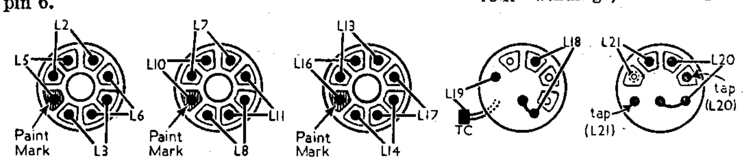
Voltages were measured with a meter whose resistance was 20,000 ohms per volt, chassis being the negative connection. If a meter of lower resistance is used, some of the readings will be considerably lower, particularly those of the anodes of the tuning indicator.

The oscillator anode voltage quoted for **V2** is its value when oscillating. If the application of the meter stops oscillation, the reading will be much lower.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial S.W. coupling coil	2·3
L2	Aerial M.W. coupling coil	25·0
L3	Aerial L.W. coupling coil	100·0
L4	Aerial S.W. tuning coil...	Very low
L5	Aerial M.W. tuning coil	4·0
L6	Aerial L.W. tuning coil...	48·0
L7	R.F. transformer primary	290·0
L8	coils	500·0
L9	R.F. S.W. tuning coil ...	Very low
L10	R.F. trans. M.W. sec. ...	4·3
L11	R.F. trans. L.W. sec. ...	45·0
L12	Osc. S.W. reaction coil ...	0·75
L13	Osc. M.W. reaction coil...	2·6
L14	Osc. L.W. reaction coil ...	5·5
L15	Osc. S.W. tuning coil ...	Very low
L16	Osc. M.W. tuning coil ...	7·0
L17	Osc. L.W. tuning coil ...	20·0
L18	1st I.F. trans. Pri.	6·9
L19	Sec. ...	6·9
L20	2nd I.F. Pri., total	6·5
L21	trans. ... Sec., total	7·0
L22	Speaker speech coil ...	3·5
T1	Output trans. Pri., c–d ...	16·0
	Pri., d–e ...	540·0
	Sec., f–g ...	1·8
	Sec., h–j ...	205·0
T2	Mains trans. Pri., total ...	32·0
	Heater sec.	Very low
	Rect. heat. sec.	Very low
	H.T. sec., total	205·0
S1-S25	Waveband switches ...	—
S26-S29	Radio/gram switches ...	—
S30-S31	Mains switches	—

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 EF39	140	4.5	87	1·3
V2 ECH35	215	1·6	74	3·0
	Oscillator			
	132	3·6		
V3 EF39	215	5·6	92	1·6
V4 EBL31	243	36·0	215	3·5
V5 AZ31	225†	—	—	—
T.I. EM34	50*	0·3	—	—
	72§	0·25		
	Target			
	215	0·15		

† Each anode, A.C. * Anode 1, pin 3. § Anode 2, pin 6.



Diagrams of the five coil bases, as seen from below.

DISMANTLING THE SET

Removing Chassis.—Remove the four control knobs (recessed grub screws);

from a tag screwed to the foil on the base of the cabinet, beneath the rear member of the chassis, unsolder base screen lead;

lay the receiver face down on the bench, and from the ends of the scale assembly remove two short set screws at each end which hold the scale to the top of the cabinet. These screws are in the *upper* end plates, flush with the cabinet; recesses being cut in the lower end-plates to permit access to them;

from each end of the chassis remove one fixing screw (with steel washer) holding the chassis deck to the base of the bracket fixed to the front of the cabinet. The rubber grommets may be left in position in the brackets.

The chassis may now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes. If the pegs holding the front chassis member to the bottoms of the brackets tend to stick, the chassis can be eased away from them.

To free chassis entirely, unsolder the speaker leads from their tags on the speaker.

When replacing, see that the grommets at the ends of the front member are properly in position, and that they engage the pegs properly as chassis is lowered into the cabinet again.

When connecting the speaker leads, the beige earth lead from chassis goes to the two tags close together on the speaker connecting strip. The yellow lead goes to the remaining tag.

Removing Speaker.—Remove the nuts (with washers and lock-nuts) from the two lower clamps, and slacken those of the upper clamps, which hold speaker to sub-baffle, when speaker may be withdrawn.

When replacing, slip the upper edge of the speaker rim under the compresed fibre strap on the sub-baffle, the connecting strip being at the top.

The clamps may then be positioned, and care should be taken that their outer ends bear squarely on the back-plates provided for them. If the connecting leads have been unsoldered they should be connected as explained previously.

GENERAL NOTES

Switches.—S1-S25 are the waveband switches ganged in three rotary units beneath the chassis. These are indicated in our under-chassis view, where the units are numbered **1, 2** and **3** with arrows showing the direction in which they are viewed in the diagrams, showing the units in detail, in col. 5.

The table (col. 5) gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and **C**, closed.

S26-S29 are the radio/gram changeover switches, in a semi-circular, lever-operated, rotary type unit mounted on the rear member of the chassis. When the lever is lowered for radio operation, **S26, S27** and **S28** close, and **S29** opens. When it is raised (for gram) these positions are reversed.

The unit is indicated in our under-chassis view, where the numbers and the arrow indicate the direction in which it is viewed in the detailed diagram included with the wave-band units in col. **5**. It is seen conveniently in this position when the chassis is stood on the "legs" at its mains transformer end.

S30, S31 are the Q.M.B. mains switches, mounted over and operated by the volume control spindle.

Coils.—The M.W. and L.W. R.F. and oscillator coils are in three screened units at one end of the chassis deck, their respective trimmers being mounted beside them. The S.W. units are unscreened and further inwards beside the deck, their trimmers again being close to them.

The I.F. transformers **L18, L19** and **L20, L21** are in two screened units on the chassis deck with their fixed tuning capacitors.

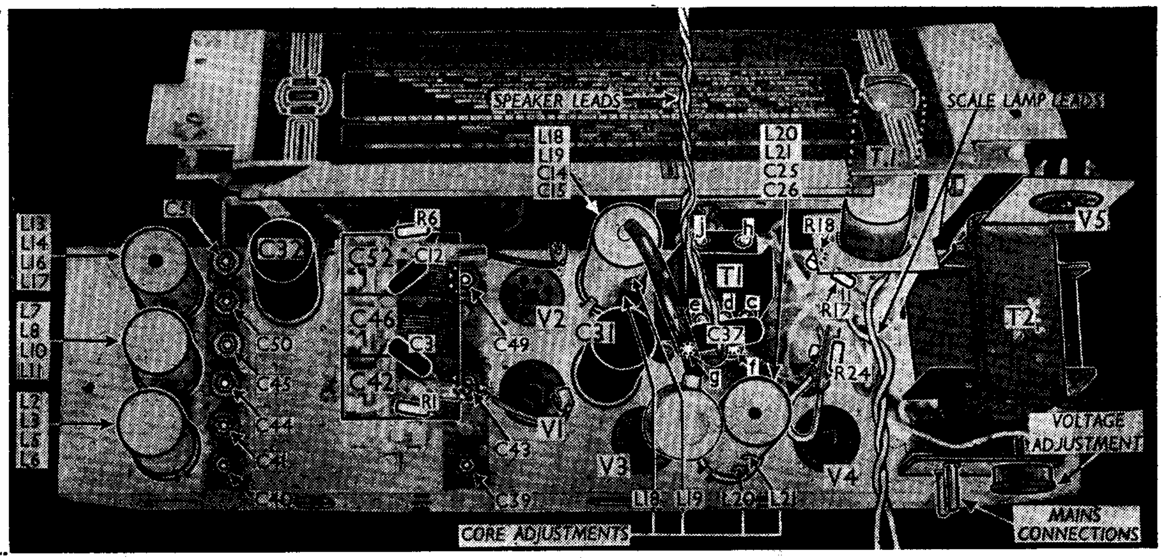
Diagrams showing the base connections of all the enclosed coil units are given in drawings below. The bases are all of similar type, although in some there are fewer tags than in others. The tags are identified by reference to one tag sector which is dabbed with paint.

Output Transformer T1.—This has virtually four windings, including the normal primary and an additional winding in series with it for hum cancellation, through which the whole of the H.T. current for the receiver flows. All the outlet connections are lettered in our plan view to agree with those in the circuit diagram. It is important that the feed-back secondary winding connections **h, j** are the correct way round relative to primary **d, e.**

Scale Lamps.—There are two Philips lamps with large, clear spherical bulbs and M.E.S. bases. They are type 8045D-00, rated at 6.3v, 0.32A, and are mounted in a reflector between the scale assembly and the chassis deck. Both the reflector and lamps were removed before our photograph of the plan view was taken as they obscured most of the chassis deck, but the flexible connecting leads for them are indicated in our illustration. The lamps may be easily extracted from the rear of the set by turning their holders, which are bayonet-fitted, though about 90 deg, and drawing them downwards.

External Speaker.—Two sockets are provided at the rear of the chassis for the connection of a low impedance (about 7Ω) external speaker.

Plan view of the chassis. The scale lamp reflector has been removed to permit a clear view. Legs projecting from the mains transformer provide a convenient and safe support when the chassis is stood on end. The tags on the output transformer are lettered to agree with the circuit diagram overleaf.



Capacitor C29.—This is a T.C.C. "Micropack" dry electrolytic, mounted beneath the chassis deck. It is rated 25 μF, 25 V D.C. working.

Capacitors C31, C32.—These are two wet electrolytics rated at 32 μF, 320 V.

Chassis Divergencies.—Two alternative types of tuning gang are used on this model, one with aluminium vanes and the other with brass vanes. Our sample chassis was fitted with one of the aluminium type.

Although both types take the same maximum capacitance value, they each follow a slightly different "Law," and modifications to compensate for this occur in associated components.

All the S.W. coil units **L1, L4; L9; L12, L15** have different part numbers in the makers' manual according to whether they are for use with the brass or aluminium vane gang, so that when ordering these parts it is necessary to specify the type of gang. Also, the tracker **C19**, which in our sample was 0.00455 μF, becomes 0.004 μF in the brass-vaned chassis. Alignment is also affected.

CIRCUIT ALIGNMENT

The oscillator frequency is higher than the signal frequency on all three bands. An output meter can be connected to the external speaker sockets, and the input should be kept low to avoid A.V.C. action, while the volume control should be at maximum.

The yellow wax on the pre-set trimmers can be broken off with tweezers. Before adjusting the cores of the I.F. transformers, a warm screwdriver should be inserted in the slots and rotated backwards and forwards to free the wax.

Adjustment of the wire-wound trackers **C47** and **C48** is effected by unwinding some of the wire from the "free" end to reduce the capacitance. Turns cannot be added, as they will loosen, changing the value. In making adjustments, first replace both capacitors with new ones, whose capacitance will be larger than is required; then unwind each as required when adjusting it until the meter reading just passes maximum. A turn or two replaced will then restore it to maximum, when the surplus wire should be cut off and the end secured with wax.

I.F. Stages.—Connect signal generator leads via a 0.032 μF capacitor to control grid (top cap) of **V2** and chassis, tune the receiver to approximately 192 m, and turn the volume control to maximum. When adjusting one core of the I.F. transformers, the winding of one of the others should be damped by shunting across it an 80 μμF (0.00008 μF) capacitor as instructed.

Feed in a 470 kc/s (638.3 m) signal, connect the shunt across **L20**, and adjust the core of **L21** for maximum output. Transfer shunt to **L19**, and adjust the cores of **L20**, then **L18**, for maximum output. Transfer the shunt to **L18**, and adjust the core of **L19** for maximum output. Remove shunt.

R.F. and Oscillator Circuits.—With the gang at maximum, the pointer should be in line with one of the outer limbs of the "m" at the end of each scale line. The left-hand limb for brass-vaned gangs, and the right-hand limb of aluminium gangs. The pointer carriage can be slid along the driver wire upon slackening the clamp nut. Transfer signal generator leads, via a suitable dummy aerial, to **A** and **E** sockets.

S.W.—Switch set to S.W., tune to 17.65 m on scale, feed in a 17.65 m (17 Mc/s) signal, and adjust **C49** for maximum output, selecting the peak involving the lesser trimmer capacitance Then adjust **C43** and **C39** for maximum output. Repeat these adjustments.

M.W.—Switch set to M.W. and if the gang vanes are aluminium, tune to 207 m on scale, feed in a 207 m (1,449 kc/s) signal, and adjust **C50**, then **C44** and **C40** for maximum output. (If the gang vanes are brass, the wavelength should be 200 m (1,500 kc/s.) Tune to 461.5 m on scale, feed in a 461.5 m (650 kc/s) signal, and adjust **C47** as explained earlier. Repeat the whole of the M.W. procedure to check its accuracy.

L.W.—Switch set to L.W., and if the gang vanes are aluminium, tune to 833 m on scale, feed in a 833 m (360 kc/s) signal, and adjust **C51**, then **C45** and **C41** for maximum output. If the gang vanes are brass, the wavelength should be 789.4 m (380 kc/s). Tune to 1,875 m on scale, feed in a 1,875 m (160 kc/s) signal, and adjust **C48** as explained earlier. Repeat the whole of the L.W. procedure to check its accuracy.

Finally adjust the pointer so that calibration is maintained over the scale, and seal off all trimmers with wax.

Tuning Drives.—The tuning drive from the control spindle to the gang is a special cord which goes 2½ times round the control spindle and about half-way round the smaller-diameter groove on the drive wheel. Its overall length is 400 mm, or 15.75 ins. (when the control spindle vernier drum is 25/64 in diameter); or 450 mm, or 17.72 ins. (when drum is ⅜ in diameter), with its loops already tied. From the anchor spring on the drive wheel it comes down over the control spindle drum, and round it in a clockwise direction, winding from the chassis outwards two and a half times, then under it and back to the drive wheel.

The cursor drive is a Bowden wire 1,005 mm (39½ ins.) overall, with loops, which runs roughly half-way round the larger-diameter groove, on the edge of the drive wheel, and up over the two brass pulleys mounted on the scale assembly over the wheel, its remote end going round a third brass pulley at the far end of the scale.

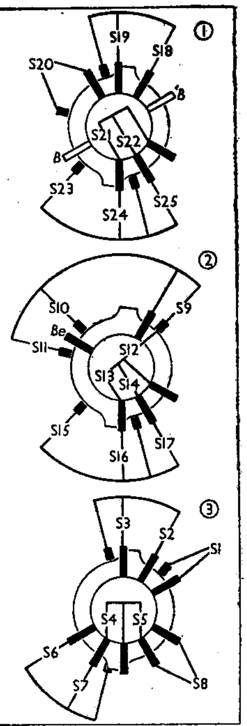
In both cases the manner of winding is very simple and requires no special explanation or diagrams beyond what is given in the foregoing. The waveband indicator wire is also very straightforward, merely linking two studs, but it should be noted that the upper end stud is adjustable. The length of the wire is 165 mm (6½ ins.) overall, including loops.

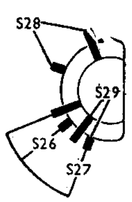
When adjusting the indicator, which may be done without removing the chassis from the cabinet, face the front of the set, switch to S.W. band, tilt set forward and insert the left hand into the cabinet. Place the thumb against the top edge of the indicator plate, and the fingers under the lower edge of the adjuster plate, slacken the screw, adjust indicator and tighten up screw.

SWITCH TABLE AND DIAGRAMS

Switch	S.W.	M.W.	L.W.
S1 ...	C	—	—
S2 ...	—	C	—
S3 ...	—	—	C
S4 ...	C	—	—
S5 ...	—	C	—
S6 ...	C	—	—
S7 ...	—	C	—
S8 ...	—	—	C
S9 ...	C	—	—
S10 ...	—	C	—
S11 ...	—	—	C
S12 ...	—	C	—
S13 ...	C	—	—
S14 ...	C	C	—
S15 ...	C	—	—
S16 ...	—	C	—
S17 ...	—	—	C
S18 ...	C	—	—
S19 ...	—	C	—
S20 ...	—	—	C
S21 ...	C	—	—
S22 ...	C	C	—
S23 ...	C	—	—
S24 ...	—	C	—
S25 ...	—	—	C

Right: Diagrams of the three waveband switch units, as seen from the rear of an inverted chassis. *Below:* The radio/gram switch unit, as seen when chassis stands on end.





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