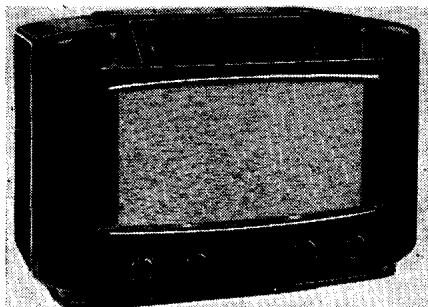


"TRADER" SERVICE SHEET

770

# PHILIPS 170A

## AND MULLARD MAS281



The Philips 170A A.C. superhet.

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**,

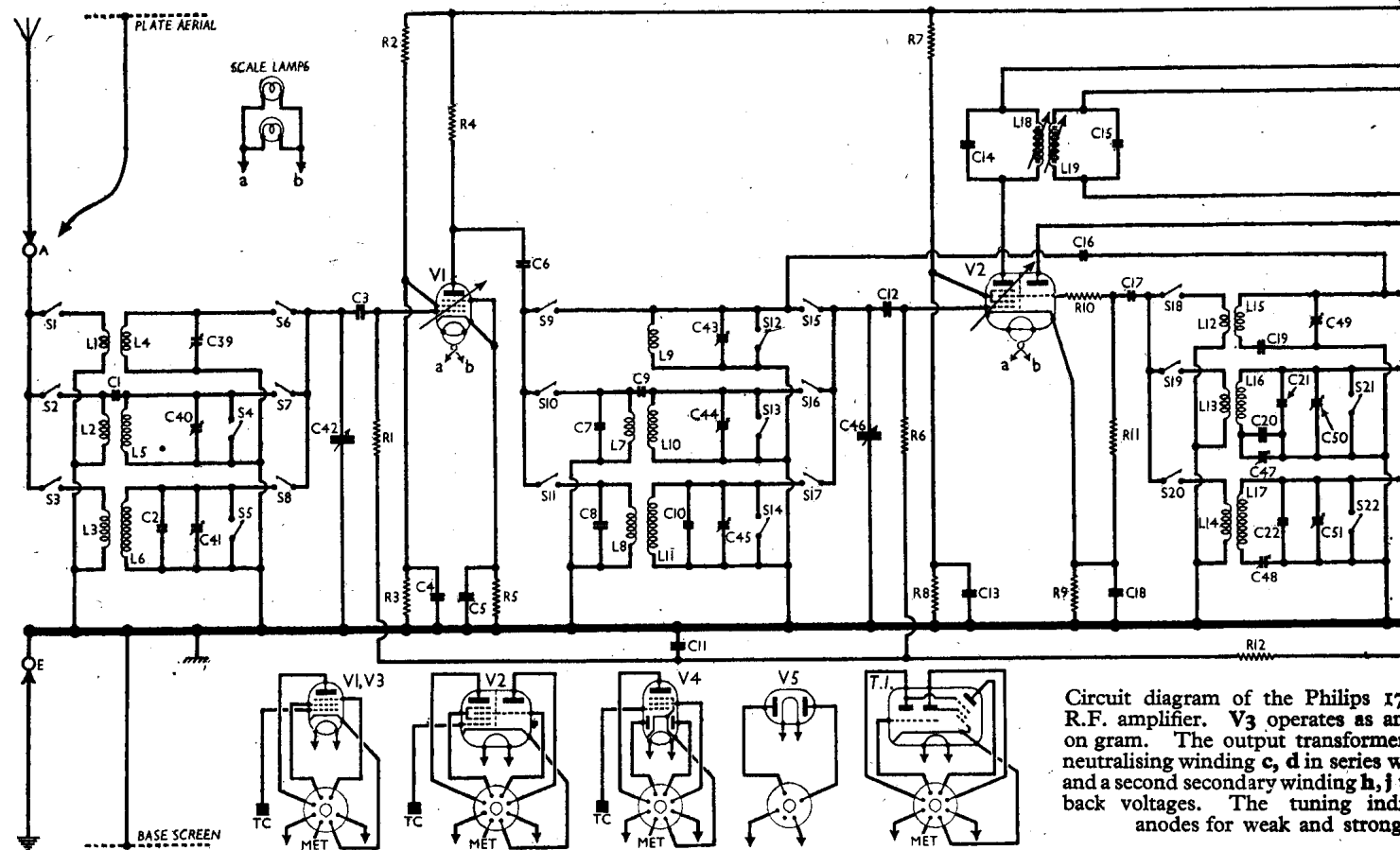
**C50** (M.W.) and **C22, C51** (L.W.); series tracking by **C19** (S.W.), **C20, C47** (M.W.) and **C48** (L.W.). Reaction coupling from control grid circuit by coils **L12** (S.W.), **L13** (M.W.) and **L14** (L.W.).

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**.

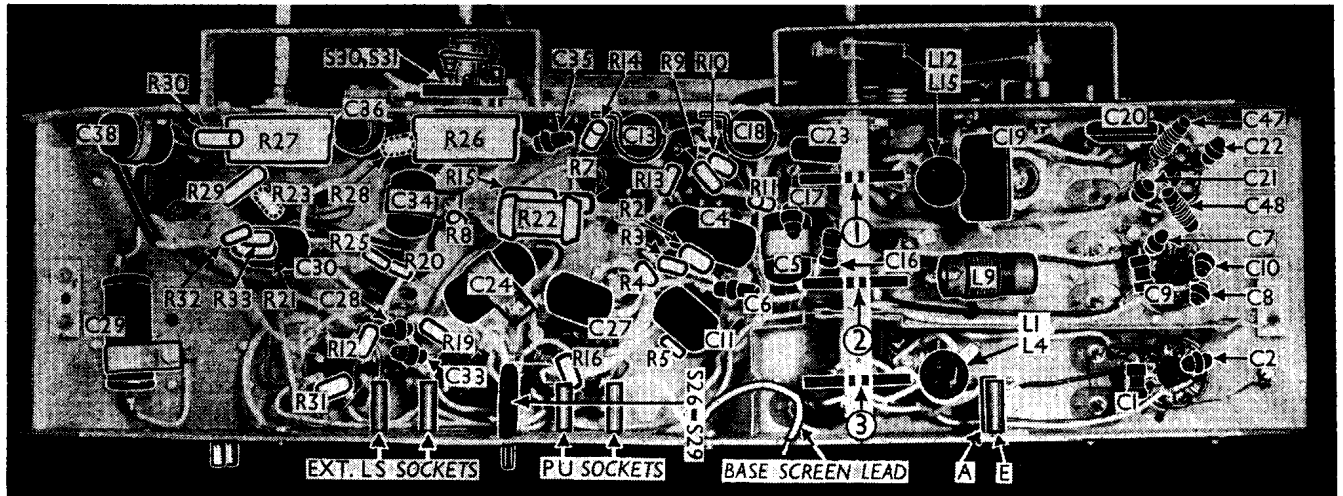
Intermediate frequency 470 kc/s.

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 170 R.F. amplifier. **V3** operates as an on gram. The output transformer neutralising winding **c, d** in series with a second secondary winding **h, j** back voltages. The tuning inductors 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.

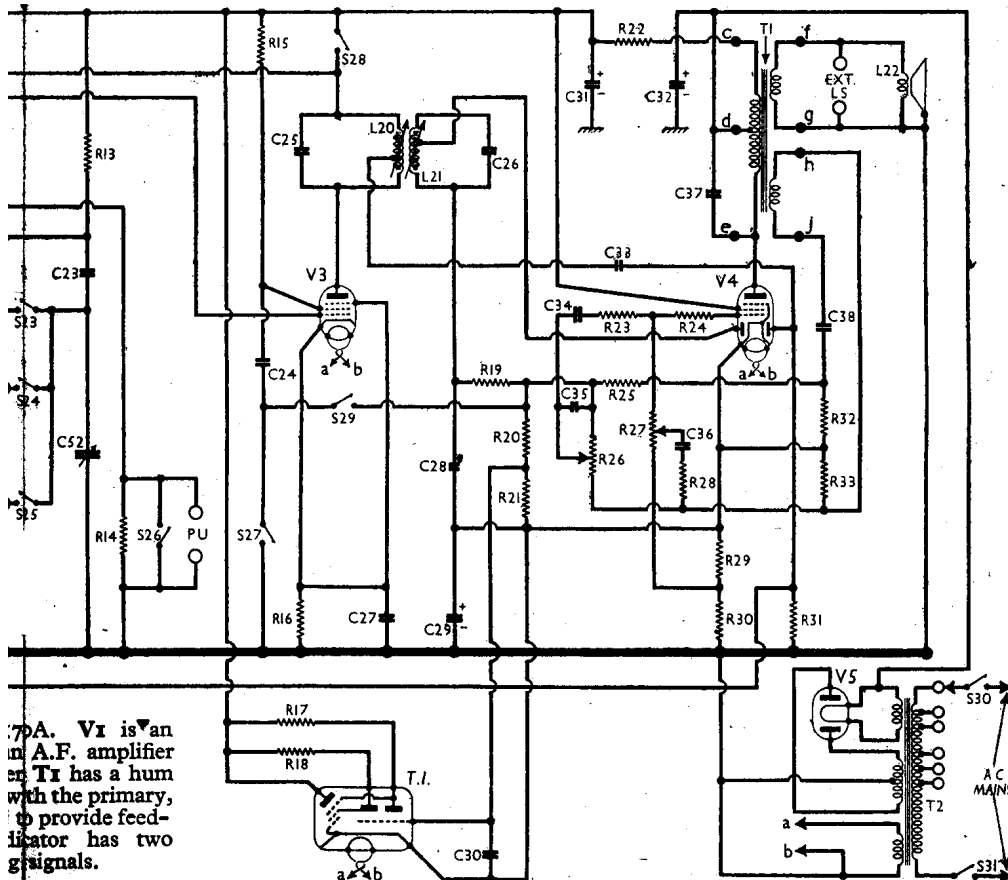
Variable tone control operates in conjunction with the feed-back circuit, varying the amount of negative feed-back applied. When the tone control R27 slider is at the upper (control grid) end of the track, negative feed-back at treble frequencies is at a maximum, falling as the slider is lowered. In 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. 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 e, 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 and T1 has a hum with the primary, to provide feed-back has two signals.

COMPONENTS AND VALUES

RESISTORS		Values (ohms)
R1	V1 C.G. resistor ...	1,000,000
R2	V1 S.G. H.T. potential divider ...	47,000
R3	V1 anode load ...	56,000
R4	V1 fixed G.B. resistor ...	18,000
R5	V2 hex. C.G. resistor ...	390
R6	V2 S.G. H.T. potential divider ...	1,000,000
R7	V2 osc. C.G. resistor ...	39,000
R8	V2 fixed G.B. resistor ...	100,000
R9	V2 osc. C.G. stabiliser ...	150
R10	V2 osc. C.G. resistor ...	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. anodes ...	820,000
R18	H.T. feed resistors to T.I. anodes ...	820,000
R19	Diode isolator ...	27,000
R20	T.I. C.G. potential divider ...	3,300,000
R21	H.T. smoothing resistor ...	1,000,000
R22	H.T. smoothing resistor ...	1,500
R23	V4 pentode C.G. stoppers ...	100,000
R24	V4 pentode C.G. stoppers ...	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	Variable tone control ...	8,200
R29	V4 pent. G.B. and A.V.C. delay resistors ...	120
R30	V4 pent. G.B. and A.V.C. delay resistors ...	180
R31	V4 A.V.C. diode load ...	820,000
R32	Feed-back phase dividing resistors ...	8,200
R33	Feed-back phase dividing 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 shunt capacitors ...	0.00082
C8	R.F. transformer primary shunt capacitors ...	0.00033
C9	R.F. top coupling ...	0.000015
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 capacitors ...	0.000103
C15	1st I.F. transformer tuning 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 trimmer ...	0.00033
C21	Osc. M.W. fixed trimmer ...	0.000056
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 tuning capacitors ...	0.000103
C26	2nd I.F. transformer tuning 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*	H.T. smoothing capacitors ...	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†	Aerial circuit tuning ...	0.00002
C44†	R.F. transformer secondary trimmers ...	0.00002
C45†	R.F. transformer secondary trimmers ...	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

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial S.W. coupling coil	2.9
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 coils ...	290.0
L8	R.F. transformer primary 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	1st I.F. trans. { Sec. ...	6.9
L20	2nd I.F. trans. { Pri. total ...	6.5
L21	2nd I.F. trans. { Sec. total ...	7.0
L22	Speaker speech coil ...	3.5
T1	Output trans. { Pri., c-d ...	16.0
	Output trans. { Pri., d-e ...	540.0
	Output trans. { Sec., f-g ...	1.8
	Output trans. { Sec., h-i ...	205.0
	Output trans. { Pri., total ...	32.0
T2	Mains Heater sec. ...	Very low
	Mains trans. Rect. heat. sec. ...	Very low
	Mains trans. H.T. sec., total ...	205.0
S1-S25	Waveband switches ...	—
S26-S29	Radio/gram switches ...	—
S30-S31	Mains switches ...	—

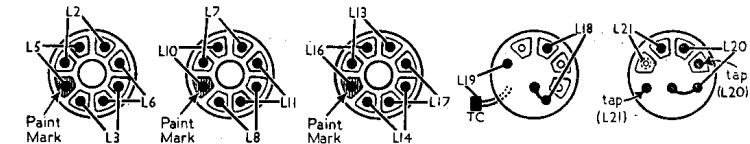
average chassis when it is operating with the mains voltage adjustment correctly set, tuned to 2,000m, but with no signal input.

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.

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
	132	3.6		
V3 EF39	215	5.6	92	1.6
V4 EBL31	243	36.0	215	3.5
V5 AZ31	225†	—	—	—
	50*	0.3	—	—
	72§	0.25	—	—
T.I. EM34	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 compressed 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 un-screened and further inwards beneath 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.

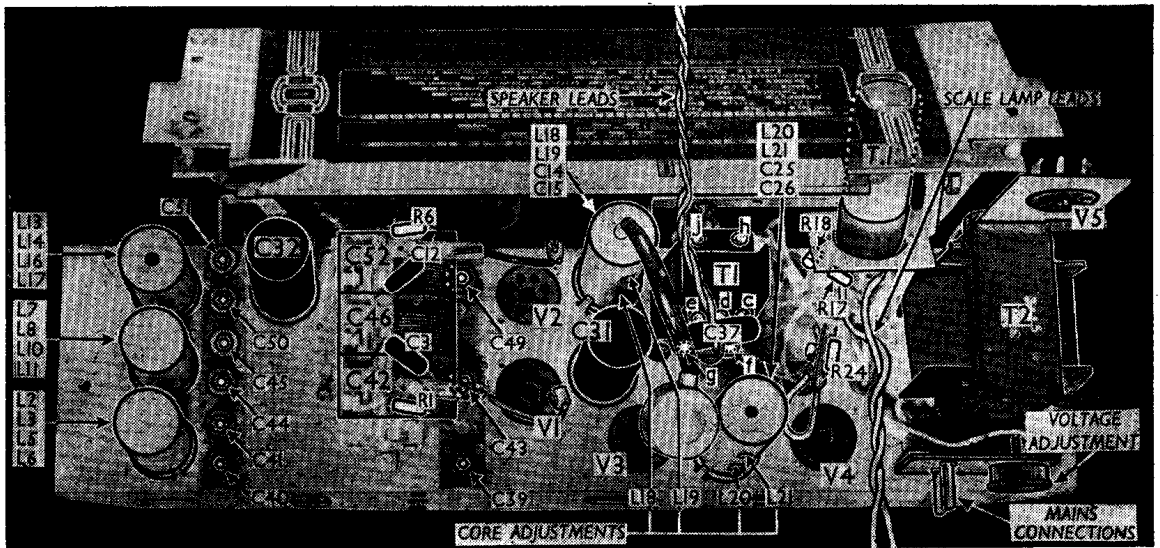
**Output Transformer T1.**—This has virtually four windings, including the normal primary

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.**—The e arc 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 for attention 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  $\mu$ F, 25 V D.C. working.

**Capacitors C31, C32.**—These are two wet electrolytics rated at 82  $\mu$ F, 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, L16 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  $\mu$ F, becomes 0.004  $\mu$ F 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  $\mu$ F 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  $\mu$ F (0.00008  $\mu$ F) 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

**SWITCH TABLE AND DIAGRAMS**

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

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.

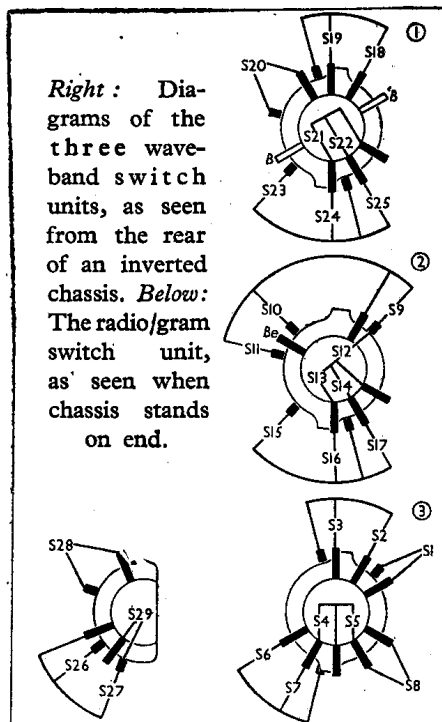
Finally adjust the pointer so that calibration is maintained over the scale, and seal off all trimmers with wax.

**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 ½ 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.



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.