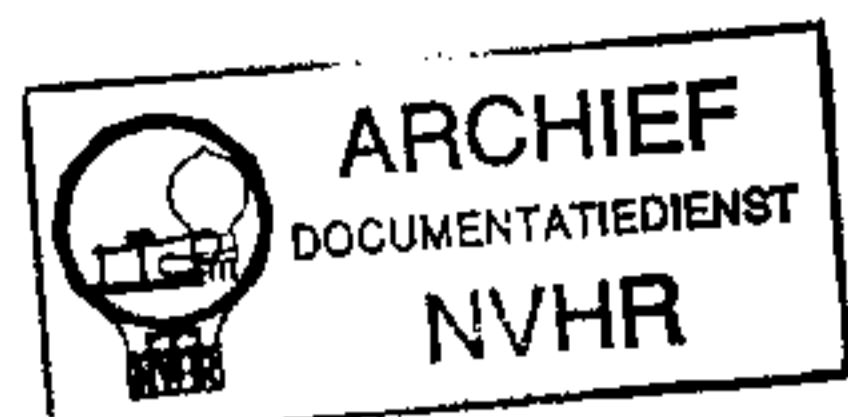
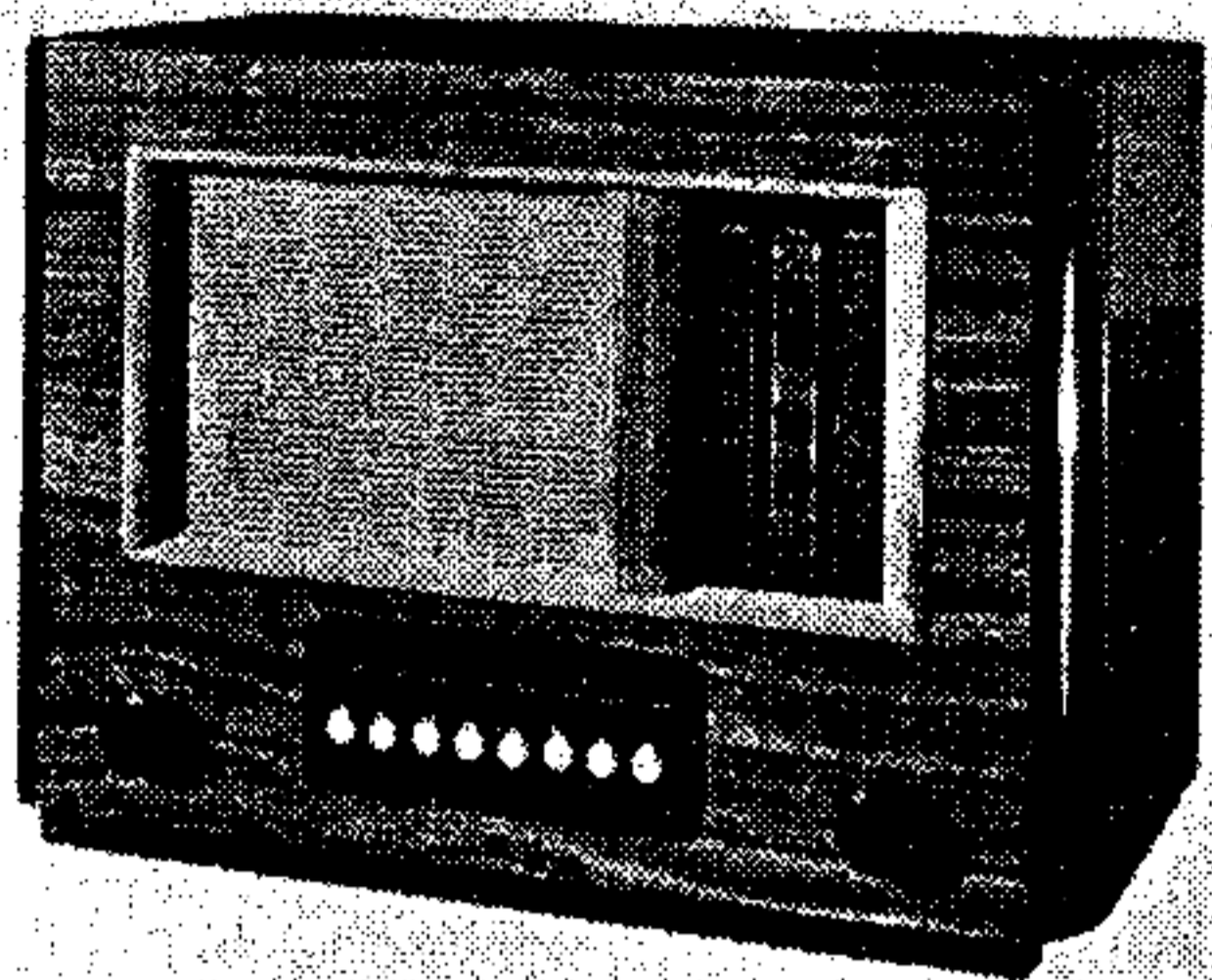


Ned. Ver. v. Historie v/d Radio



# BUSH PB51

## 3-BAND AC SUPERHET



**P**RESS-BUTTONS for four medium-wave and one long-wave stations and also for manual wave-changing are included in the Bush PB51 4-valve (plus rectifier) AC 3-band superhet.

The standard model is for mains of 200-250 V, 40-100 C/S, and a special model is made for 100-110 V, but this *Service Sheet* was prepared on a standard model.

### CIRCUIT DESCRIPTION

The aerial circuit coupling coils are permanently connected as shown in the diagram, no switches being used for wave-band changing. On SW, input is via condenser **C1** and coupling coil **L1** to single-tuned circuit **L4**, **C39**, manual tuning only being employed on this band.

MW coupling coil **L2**, and LW coupling coil **L3** with its shunt **C2**, are connected in

series tracking by **C13** (MW) and **C12** (LW). Reaction by coils **L10** via coupling condenser **C17** (SW), **L11** and **L12** (MW and LW).

The LW oscillator circuit, slightly modified by switching, operates also as master oscillator for automatic tuning, the tuning trimmers in this case being inductances with variable iron cores, connected in turn across the master oscillator tuning coil **L9** according to which but is depressed. The modification referred is that as the button controlling **S11** switches is now in the "Out" position **S11a** and **S11b** are open while **S11c** is closed, so that the LW manual tracker **C12** becomes connected in series with **C11** across the master oscillator circuit, the two together forming an additional trimmer.

This method of numbering makes the action of the switches quite clear from a study of the diagram; if a button is depressed the "a's" and "b's" associated with that button close, while the "c's" open, and when the button is released the converse is the case. It will be seen, therefore, that if the SW button is depressed, **S1a** and **S1b** close, connecting **L4**, **C39** and **V1** hexode CG together, while **S1c** is open; if the MW button is then depressed, the SW button is released, so that **S1c** closes together with **S2a** and **S2b**, connecting **L5** to **V1** hexode CG and **C39**.

When an automatic tuning button is depressed, **S1c**, **S2c** and **S3c** are closed, connecting **V1** CG, **L5** and **L6** to the automatic selector switches. At the same time the appropriate trimmer is connected to **L5** or **L6**, according to which button is depressed.

First valve (**V1**, Mullard metallised **TH4A**) is a triode hexode operating as frequency changer with internal coupling. Triode oscillator grid coils (manual tuning only) **L7** (SW), **L8** (MW) and **L9** (LW) are tuned by **C40**; parallel trimming by **C14**, **C41** (SW), **C15**, **C42** (MW) and **C16**, **C43** (LW);

series tracking by **C13** (MW) and **C12** (LW). Reaction by coils **L10** via coupling condenser **C17** (SW), **L11** and **L12** (MW and LW).

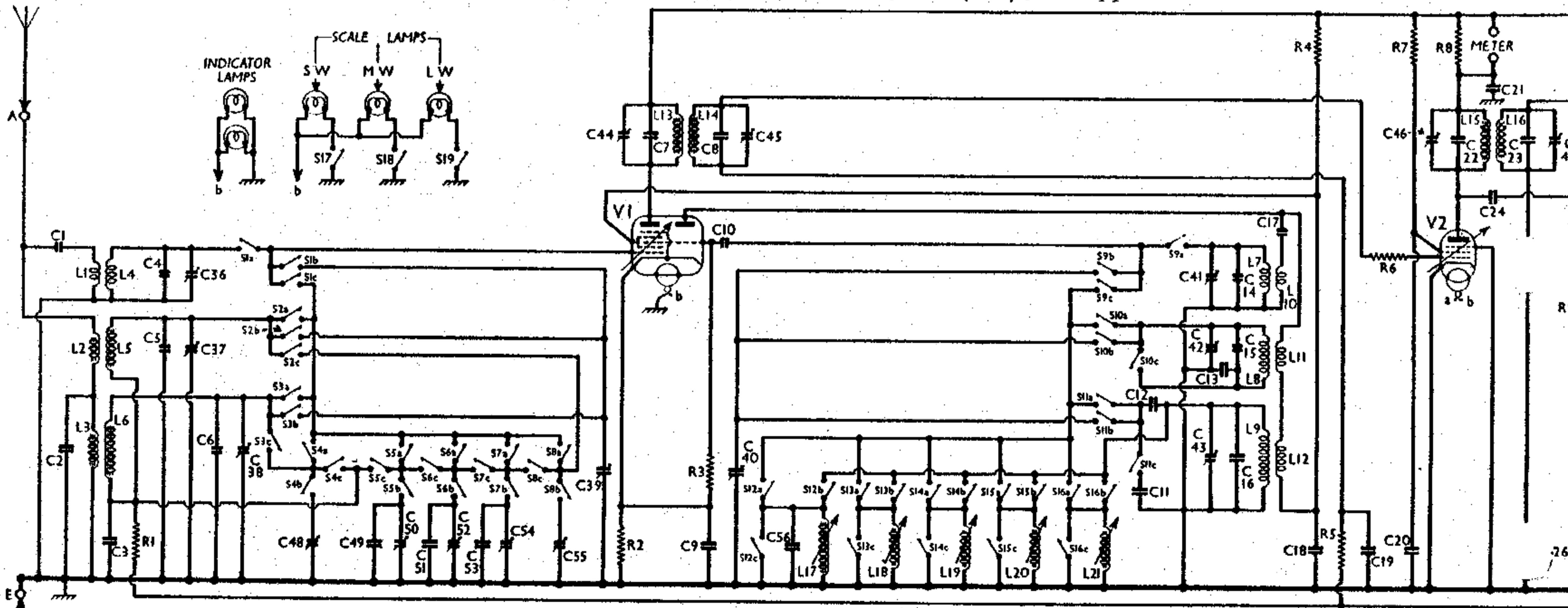
The LW oscillator circuit, slightly modified by switching, operates also as master oscillator for automatic tuning, the tuning trimmers in this case being inductances with variable iron cores, connected in turn across the master oscillator tuning coil **L9** according to which but is depressed. The modification referred is that as the button controlling **S11** switches is now in the "Out" position **S11a** and **S11b** are open while **S11c** is closed, so that the LW manual tracker **C12** becomes connected in series with **C11** across the master oscillator circuit, the two together forming an additional trimmer.

Second valve (**V2**, Mullard metallised **VP4B**) is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary iron-cored transformers **C44**, **C7**, **L13**, **L14**, **C8**, **C45** and **C46**, **C22**, **L15**, **L16**, **C23**, **C47**.

Provision is made for connection of a voltmeter across anode feed resistance **R8** for automatic circuit station setting as explained under "General Notes."

### Intermediate frequency 465KC/S.

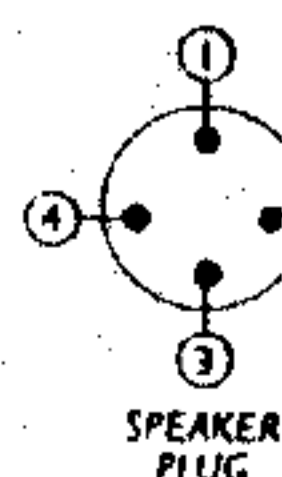
Diode second detector is part of double diode triode valve (**V3**, Mullard metallised **TDD4**), being parallel-fed via **C25** from **L16**. Audio frequency component in rectified output is developed across load resistance **R12** and passed via AF coupling condenser **C27**, manual volume control **R10** and grid stopper **R11** to CG of triode section which



series with each other across the aerial circuit in parallel with **C1**, **L1** and couple the aerial to single-tuned circuits **L5**, **C39** (MW manual) and **L6**, **C39** (LW manual).

Waveband switching for manual tuning in this receiver is effected by press-button

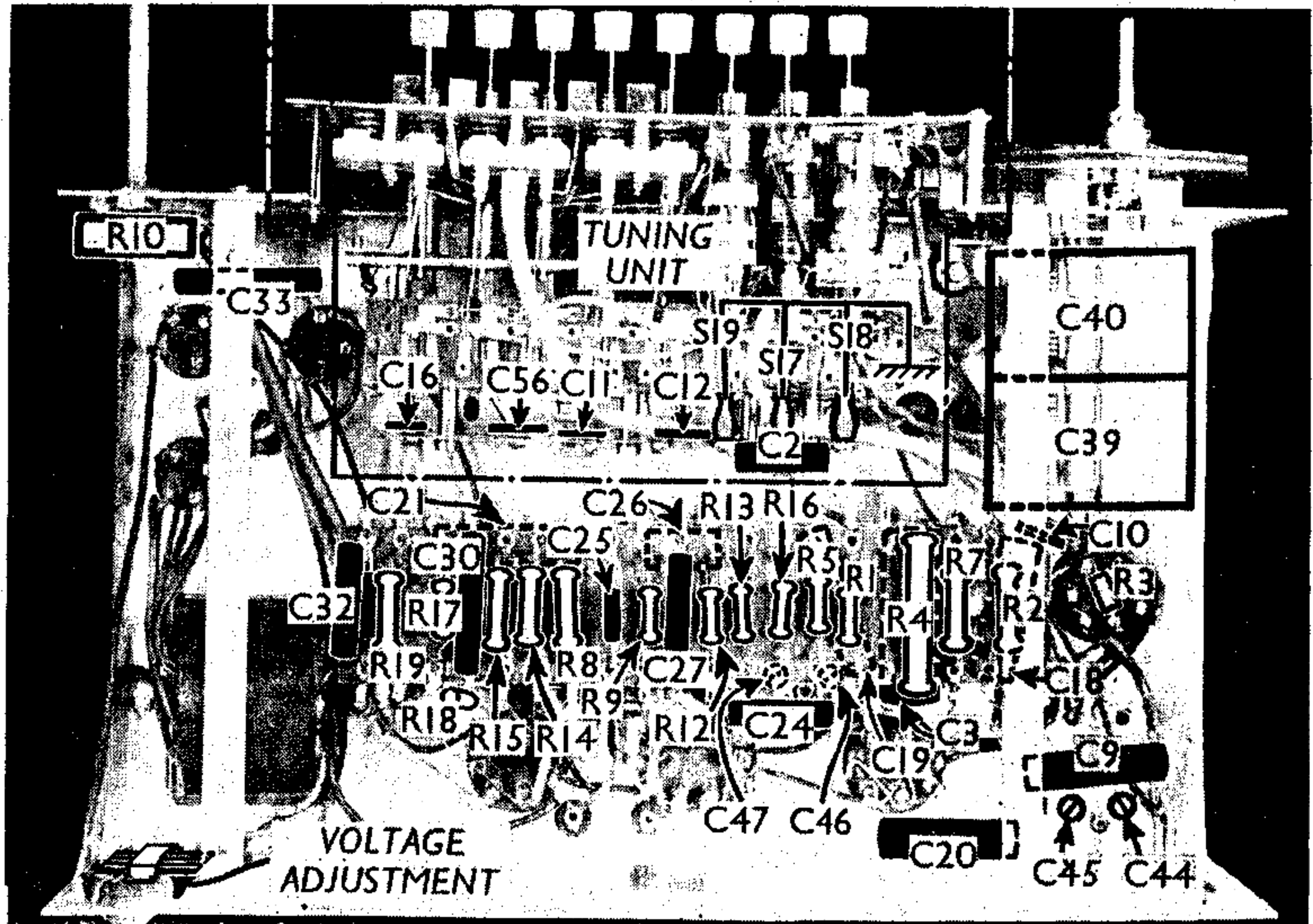
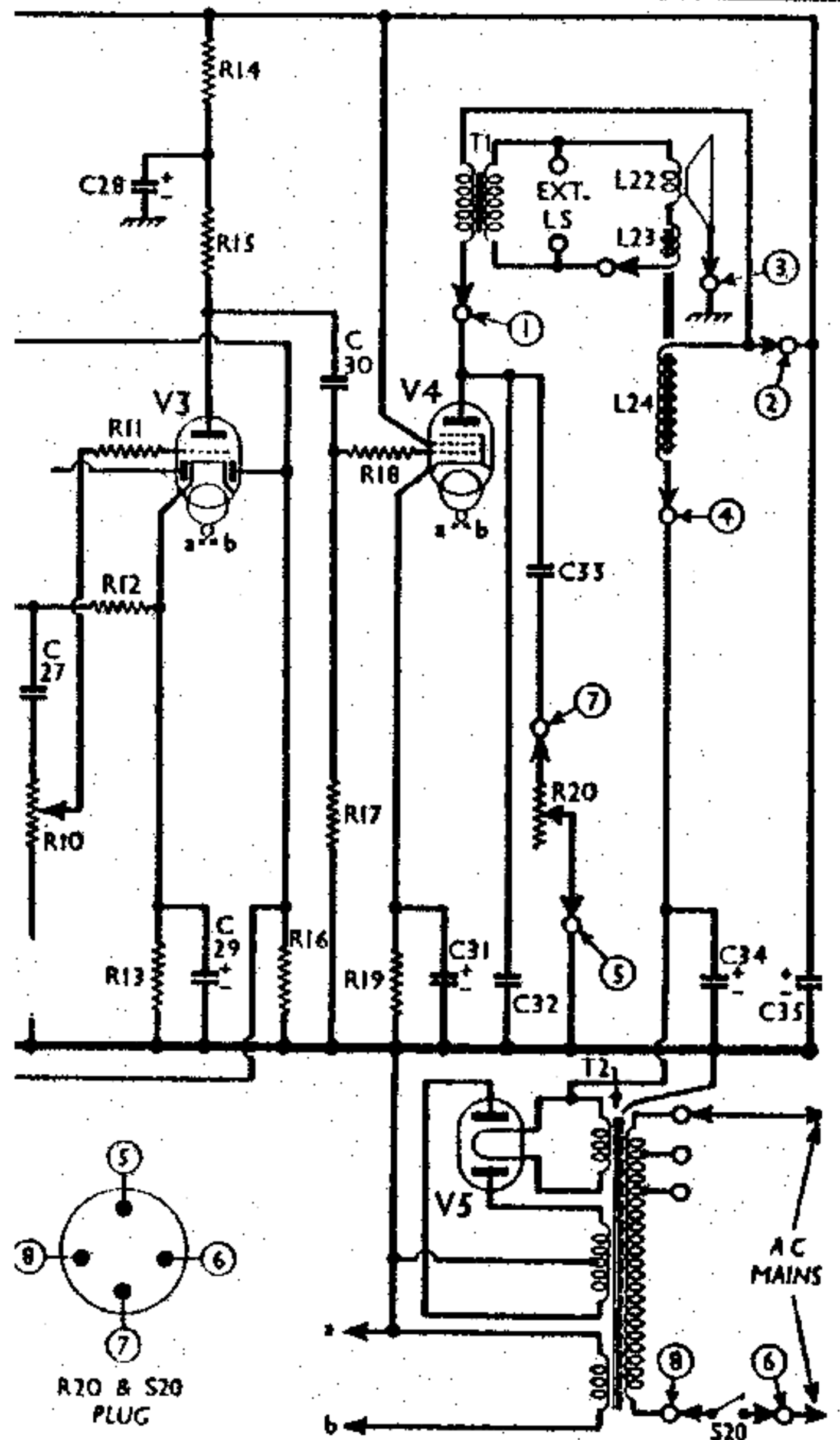
The connections for the speaker and tone control and switch plugs are indicated in this circuit diagram of the Bush PB51 by numbers in circles and arrows. Inset are diagrams of the plugs themselves, with the pins numbered when looking at the free ends of the pins.



operates as AF amplifier. IF filtering by **C26**. Provision for connection of gramophone pick-up across **R10**. Second diode of **V3**, fed from **V2** anode a **C24**, provide DC potential which is developed across load resistance **R16** and back through decoupling circuits as to FC (except on SW) and IF valves, giving automatic volume control. Delay stage is obtained from drop along **R13** cathode lead to chassis. Resistance-capacity coupling by **R15**, **C30**, **R17**, via stopper resistance **R18**, between **V3** triode and pentode output valve **V4**, Mullard PenA4). Fixed tone correction **C32** and variable tone control by **C33**, **C30**, both in anode circuit. Provision for connection of low impedance external speaker across secondary of internal speaker input transformer **T1**, while internal speaker may be muted by removing plug from socket in each coil circuit. HT current is supplied by full-wave rectifying valve (**V5**, Mullard DW4/350). Rectification by speaker field **L24** and dry electrolytic condensers **C34**, **C35**.

**COMPONENTS AND VALUES**

RESISTANCES		Values (ohms)
R1	V1 hexode CG decoupling	1,000,000
R2	V1 fixed GB resistance	100
R3	V1 osc. CG resistance	30,000
R4	V1 SG and osc. anode HT feed	20,000
R5	V2 CG decoupling	2,000,000
R6	V2 grid stabiliser	50
R7	V2 SG HT feed	50,000
R8	V2 anode HT feed	10,000
R9	IF stopper	250,000
R10	Manual volume control	500,000
R11	V3 triode grid stopper	100,000
R12	V3 signal diode load	500,000
R13	V3 GB and AVC delay	1,000
R14	V3 triode anode decoupling	10,000
R15	V3 triode anode load	50,000
R16	V3 AVC diode load	1,000,000
R17	V4 CG resistance	500,000
R18	V4 grid stopper	100,000
R19	V4 GB resistance	200
R20	Variable tone control	50,000



An enlarged illustration of the tuning unit as seen in this under-chassis view (except for the components indicated here) is given on the back of this sheet.

CONDENSERS		Values (μF)
C1	Aerial SW series condenser	0.00005
C2	Aerial LW circuit shunt	0.0008
C3	V1 hexode CG decoupling	0.5
C4	Aerial SW fixed trimmer	0.000005
C5	Aerial MW fixed trimmer	0.000005
C6	Aerial LW fixed trimmer	0.00003
C7	1st IF trans. pri. trimmer	0.00018
C8	1st IF trans. sec. trimmer	0.00018
C9	V1 cathode by-pass	0.05
C10	V1 osc. CG condenser	0.00003
C11	Auto osc. part trimmer (with C12)	0.00034
C12	Osc. circuit LW tracker (manual); part osc. circuit trimmer (auto)	0.000316
C13	Osc. circuit MW tracker	0.000556
C14	Osc. circ. SW fixed trimmer	0.000015
C15	Osc. circ. MW fixed trimmer	0.00001
C16	Osc. circ. LW fixed trimmer	0.000135
C17	V1 osc. anode SW coupling	0.00005
C18	V1 SG and osc. anode decoupling	0.05
C19	V2 CG decoupling	0.05
C20	V2 SG decoupling	0.05
C21	V2 anode decoupling	0.05
C22	2nd IF trans. pri. trimmer	0.00018
C23	2nd IF trans. sec. trimmer	0.00018
C24	Coupling to V3 AVC diode	0.0001
C25	Coupling to V3 signal diode	0.0001
C26	IF by-pass	0.0001
C27	AF coupling to V3 triode	0.005
C28*	V3 triode anode decoupling	2.0
C29*	V3 cathode by-pass	50.0
C30	V3 triode to V4 AF coupling	0.03
C31*	V4 cathode by-pass	50.0
C32	Fixed tone corrector	0.003
C33	Part of variable tone control	0.03
C34*	HT smoothing	8.0
C35*	HT smoothing	16.0
C36†	Aerial circuit SW trimmer	0.00001
C37†	Aerial circuit MW trimmer	0.00001
C38†	Aerial circuit LW trimmer	0.00001
C39†	Aerial circuit tuning	—
C40†	Oscillator circuit tuning	—
C41†	Osc. circuit SW trimmer	0.00001
C42†	Osc. circuit MW trimmer	0.00001
C43†	Osc. circuit LW trimmer	0.00001
C44†	1st IF trans. pri. tuning	0.00006
C45†	1st IF trans. sec. tuning	0.00006
C46†	2nd IF trans. pri. tuning	0.00006
C47†	2nd IF trans. sec. tuning	0.00006
C48†	Aerial LW auto tuning	0.00045
C49†		0.00025
C50†		0.00015
C51†		0.00016
C52†		0.00015
C53†		0.00006
C54†		0.00015
C55†		0.00015
C56†	Auto osc. circuit LW trimmer	0.000316

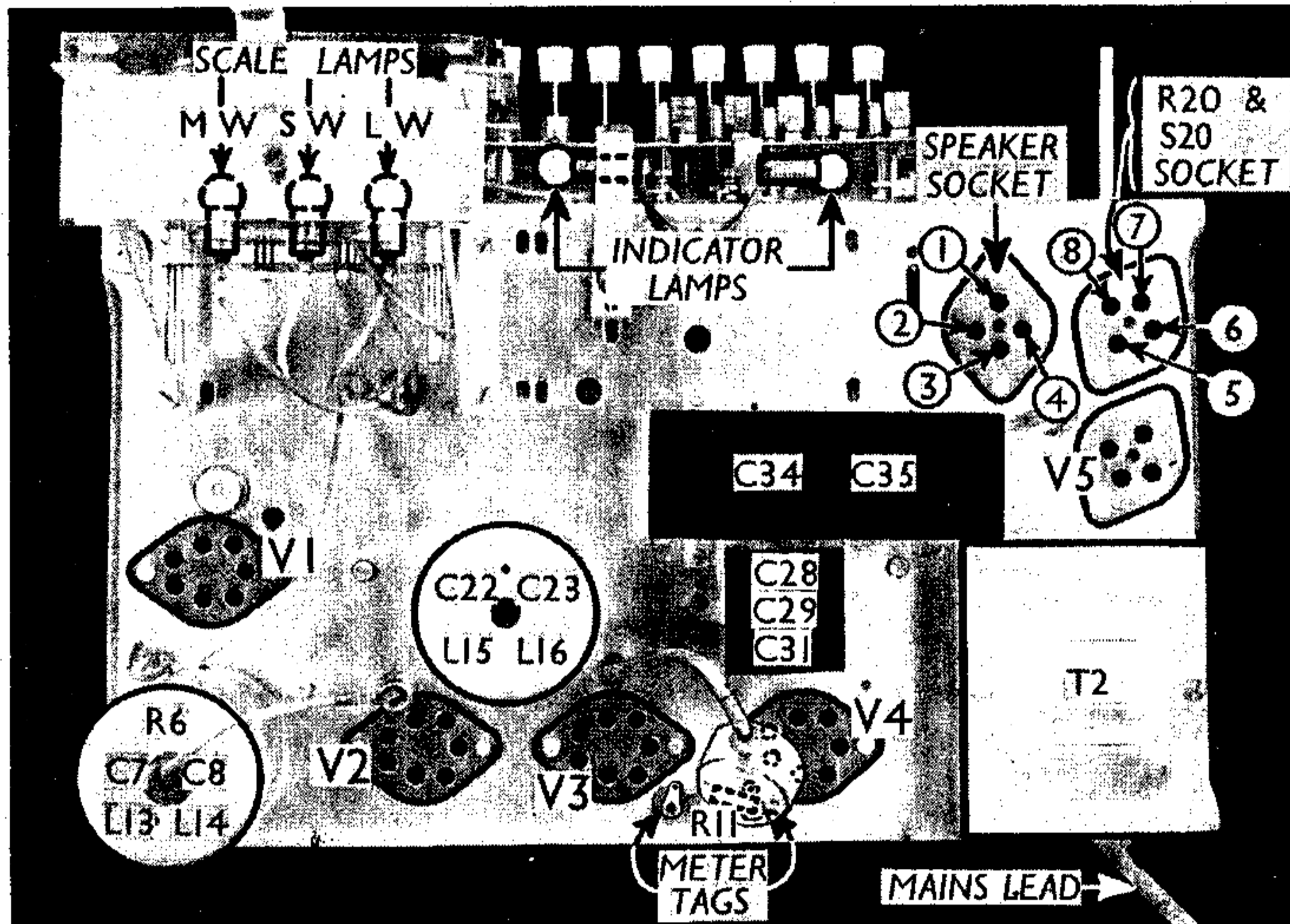
OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial SW coupling coil	0.1
L2	Aerial MW coupling coil	0.6
L3	Aerial LW coupling coil	30.0
L4	Aerial SW tuning coil	0.05
L5	Aerial MW tuning coil	1.3
L6	Aerial LW tuning coil	14.0
L7	Osc. circuit SW tuning coil	0.1
L8	Osc. circuit MW tuning coil	1.6
L9	Osc. circuit LW tuning coil	3.0
L10	Oscillator SW reaction	0.2
L11	Oscillator MW reaction	1.1
L12	Oscillator LW reaction	2.2
L13	1st IF trans. Pri.	4.0
L14	1st IF trans. Sec.	4.0
L15	2nd IF trans. Pri.	4.0
L16	2nd IF trans. Sec.	4.0
L17	Osc. circuit LW auto tuning coil	2.0
L18		1.4
L19	Oscillator circuit automatic tuning coils	1.2
L20		1.0
L21		0.7
L22	Speaker speech coil	2.0
L23	Hum neutralising coil	0.15
L24	Speaker field coil	2,000.0
T1	Speaker input trans.	650.0
	Sec.	0.3
	Pri., total	38.0
T2	Mains trans. Heater sec.	0.1
	Rect. heat. sec.	0.15
	HT sec., total	500.0
S1a-S3c	Waveband and manual auto switches	—
S4a-S8c	Aerial circuit auto tuning trimmer selector switches	—
S12a-S16c	Oscillator circuit auto tuning coil selector switches	—
S17-19	Scale lamp switches	—
S20	Mains switch, ganged R20	—

**DISMANTLING THE SET**

**Removing Chassis.**—To remove the chassis from the cabinet, remove the two control knobs at the front of the cabinet (recessed screws), unplug the speaker and tone control leads from the sockets on the chassis, and remove the four bolts (with washers) holding the chassis to the bottom of the cabinet. By lifting the back upwards, the chassis can now be withdrawn.

When replacing, take care that the speaker

\* Electrolytic. † Variable. ‡ Pre-set.



Plan view of the chassis. The individual contacts of the speaker and tone control and switch sockets are numbered in accordance with the figures in circles in the circuit diagram.

and tone control plugs are inserted in the correct sockets, noting that the sockets are marked, and do not forget to replace the felt washers on the control spindles.

If it is desired to gain access to the underside of the press-button unit, unsolder the lead from **R1** to **L5**, free the brackets holding the unit to the chassis (two round-head self-tapping screws) and remove the four round-head screws (with distance pieces) holding the unit to the front member of the chassis. The unit can now be turned up, exposing the components underneath it.

**Removing Speaker.**—The speaker can be removed from the cabinet by freeing the leads to the extension speaker panel from the cleat holding them to the top of the cabinet and the speaker leads themselves from the cleat holding them to the sub-baffle, removing the extension speaker panel from the cabinet (four round-head wood screws), unplugging the speaker leads from the socket on the chassis and removing the nuts and washers from the four screws holding the speaker to the sub-baffle. When replacing, see that the transformer is at the top.

**VALVE ANALYSIS**

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 6X4A	256 Oscillator	1.9	75	5.0
V2 6V6B	75	4.5	—	—
V3 6DD4	177	6.8	127	2.4
V4 6AN4	96	2.5	—	—
V5 6DW4/350	240 337†	27.0	256	4.1

† Each anode, AC.

Valve voltages and currents given in the table above are those measured in our receiver when it was operating on mains of

230 V, using the 230 V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the medium band and the volume control was at maximum, but there was no signal input.

Voltages were measured on the 400 V scale of a model 7 Universal Avometer, chassis being negative.

**GENERAL NOTES**

**Switches.**—There are eight press-buttons, and each one controls six 2-pole shorting switches, three on each side of the unit. In our circuit diagram and other illustrations the switches are grouped in threes, so that in this way each button controls two numbered groups of three, the individual switches in each group being indicated by suffix letters **a**, **b** and **c** following the group number. There are thus sixteen group numbers, and forty-eight individual switches in the press-button unit.

The arrangement and operation of the switches is fully explained near the beginning of the Circuit Description, and it should be noted that when a button is "out," the associated **a** and **b** switches are open, and the **c** switches closed. When a button is "in," its **a** and **b** switches are closed and its **c** switches are open.

This holds for all buttons, and there is therefore no point in giving a switch table.

Numbering the buttons from left to right looking at the front of the receiver, the first five buttons control pre-set stations, the sixth is the LW button, the seventh the SW and the eighth, on the right, the MW.

The switch groups controlled by the various buttons are: Button 1, **S4** and **S12**; 2, **S5** and **S13**; 3, **S6** and **S14**; 4, **S7** and **S15**; 5, **S8** and **S16**; 6, **S3** and **S11**; 7, **S1** and **S9**; 8, **S2** and **S10**.

In addition to the actual press-button switches, there are three scale lamp switches, **S17-S19**, controlled by the three right-hand

(wavechange) buttons. These switches are formed by the metal plungers of the three press-buttons (which are earthed) and three spring contacts into which the plungers slide when the buttons are depressed.

**S19** is associated with the sixth button, **S17** with the seventh, and **S18** with the eighth.

**S20** is the QMB mains switch, ganged with the tone control **R20**, which is fitted at the left-hand side of the cabinet, and is connected to the chassis by a 4-pin plug and socket.

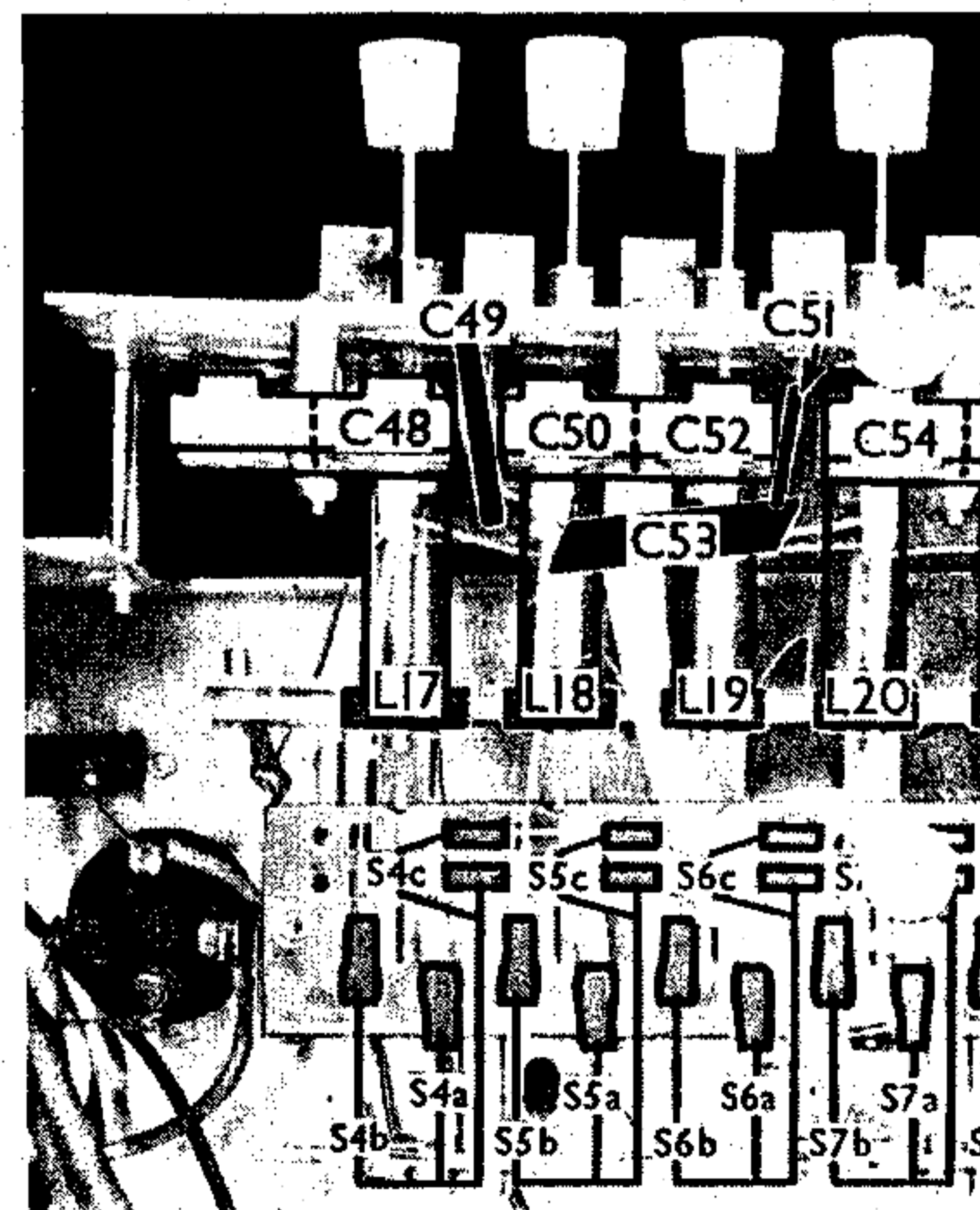
**Coils.**—All the coils, with the exception of the IF transformers, are on unscreened tubular formers, built into a unit, together with the press-button switches and the various trimmers. **L1, L4; L7, L10; L8, L11** and **L9, L12** are air-cored. **L2, L5** and **L3, L6** have fixed iron-dust cores, while **L17** have adjustable iron-dust cores for per ability trimming of the oscillator circuits of the five pre-set station buttons.

The IF transformers **L13, L14** and **L15, L16** are in two screened units on the chassis deck with their associated trimmers. In each case these trimmers comprise both a fixed and a variable condenser across each coil, the variable trimmers being adjusted from beneath the chassis. The first IF transformer **L13, L14** also contains **R6**.

**Scale and Indicator Lamps.**—In all five lamps are used in this receiver, and they are all Ever Ready MES types, rated at 6.2 V, 0.3 A. Three of them are for illuminating the manual tuning scale, and fit into a holder at the back of the scale. If one of these lamps has to be replaced, see that the holder is replaced the correct way round, otherwise the LW scale will be illuminated on MW, and vice versa. The lamps are switched by **S17-S19**, ganged with the waveband press-buttons.

The other two lamps are mounted in holders at the front of the chassis, and serve to illuminate the press-button indicators.

**External Speaker.**—Two sockets are provided on a strip at the rear of the cabinet for a low impedance (2 Ω) external speaker.



The tuning unit as seen from the underside of the button tuning are all cl

plug and socket device permits the internal speaker to be muted when desired.

**Speaker Plug.**—A 4-pin plug and socket device connects the speaker to the receiver chassis. An underneath view of the plug, with the pins numbered 1 to 4, is shown with the circuit diagram, and the connections are indicated by circles and arrows in the diagram itself. The colour coding of the leads to the pins is: 1, yellow; 2, red; 3, black; 4, blue.

**R20 and S20 Plug.**—A similar 4-pin plug and socket device connects the tone control resistor R20 and mains switch S20 to the receiver chassis. This is indicated in the same way, the pins being numbered 5 to 8. The colour coding of the leads to the pins is: 5, black; 6, red; 7, yellow; 8, blue.

**Meter Tags.**—Two tags are fitted on an adjusting strip at the rear of the chassis. They are provided to permit a voltmeter to be connected across R8, which serves as an indicator when setting the tuning selector buttons. The use of the tags is fully explained under "Pre-set Station Selection" below.

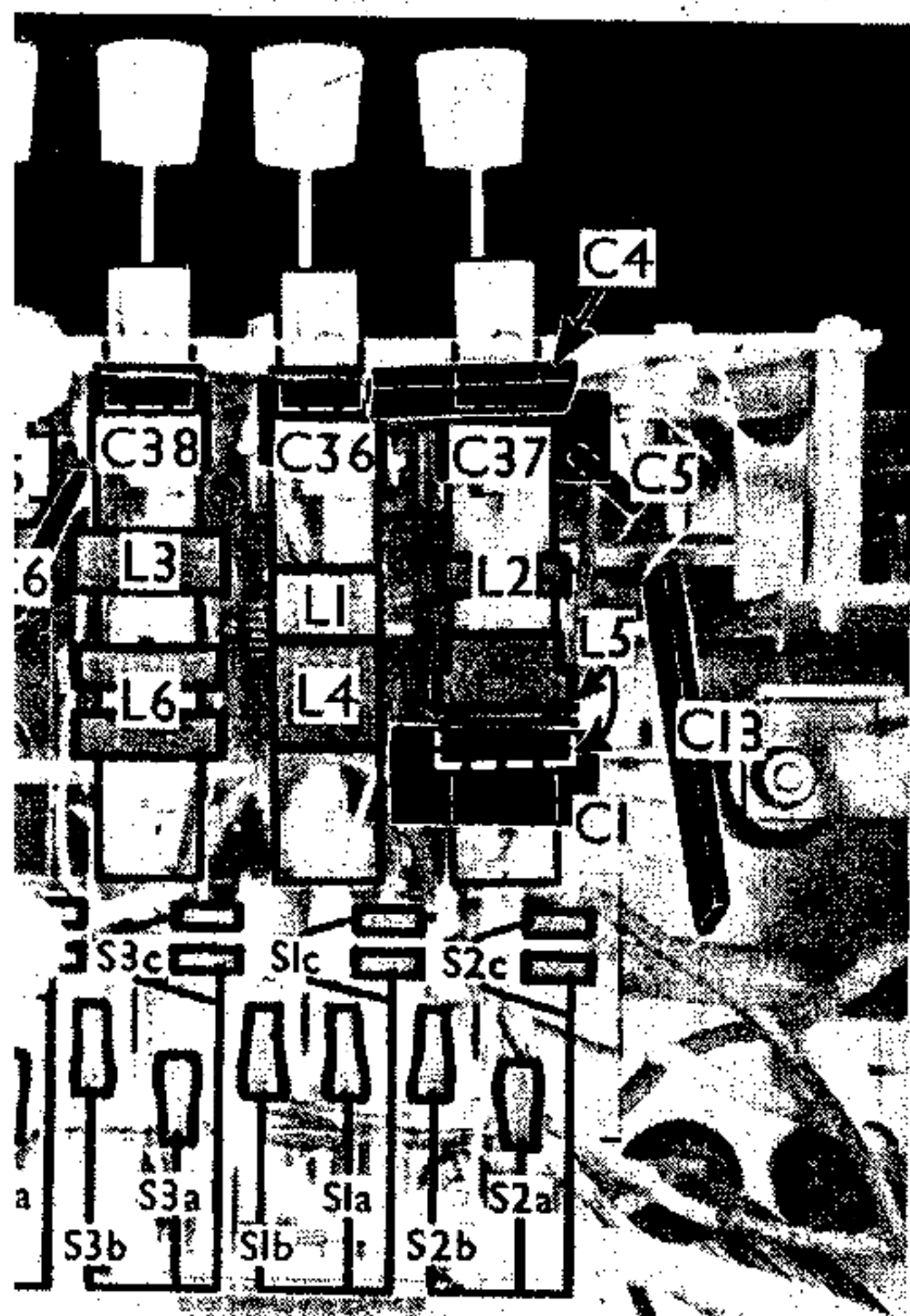
**Condensers C34, C35.**—These are two dry electrolytics in a single carton on the chassis deck, having a common negative (black) lead. The yellow lead is the positive of C34 (8 $\mu$ F) and the red lead is the positive of C35 (10 $\mu$ F). The peak voltage is 550V in each case.

**Condensers C28, C29, C31.**—These are three electrolytics in a single carton on the chassis deck, having a common negative (black) lead. The red lead is the positive of C28 (2 $\mu$ F, 550 PV). The yellow lead to C29 beneath the chassis is the positive of C29 (50 $\mu$ F, 15 PV) and the yellow lead to C31 at the V4 valveholder is the positive of C31 (10 $\mu$ F, 15 PV).

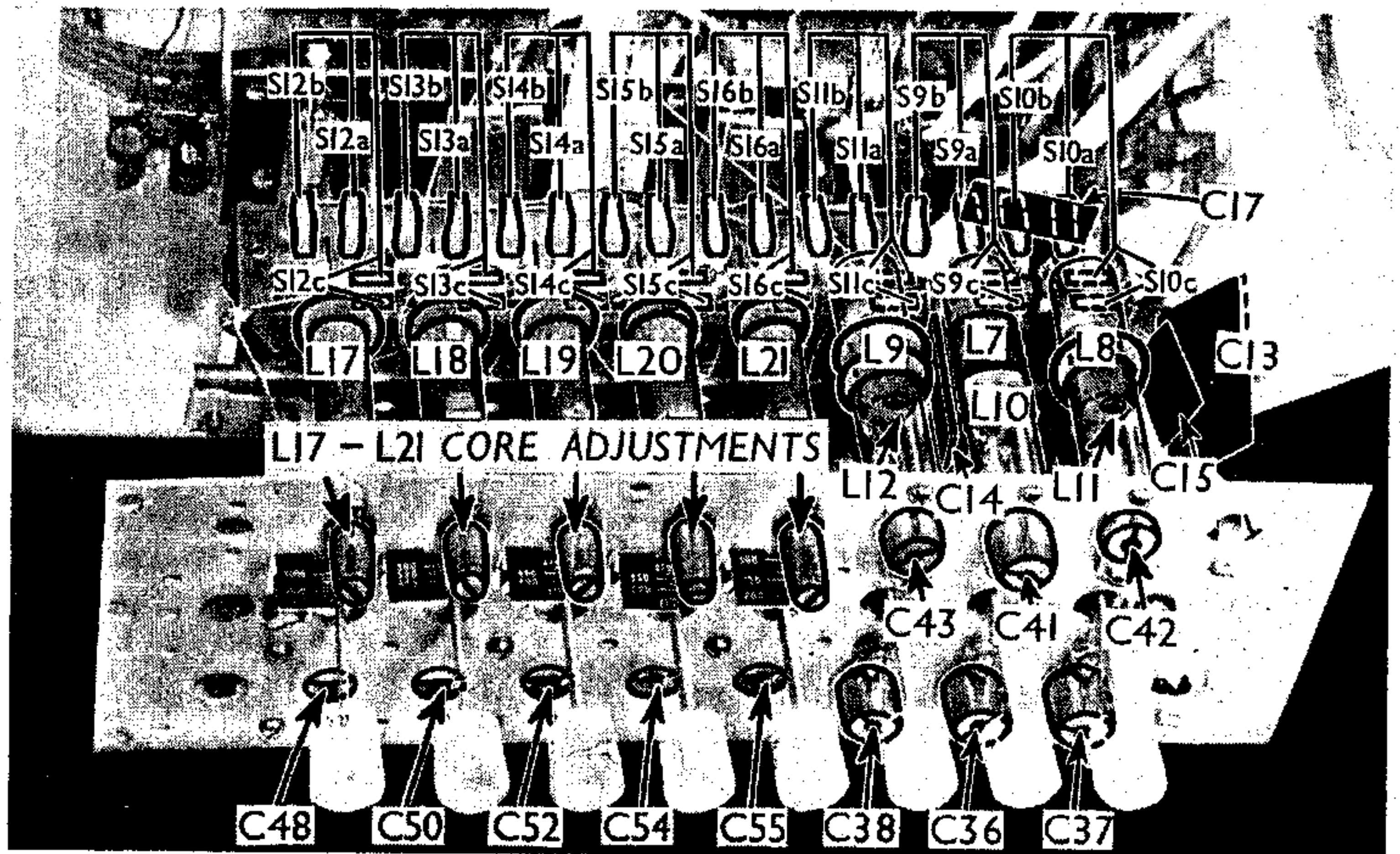
**Resistance R11.**—This is inside the top cover connector to V3.

### ALIGNMENT OF MANUAL CIRCUITS

**RF Stages.**—Press MW manual tuning button, tune to 300 m on the scale, turn



The aerial circuit switches for press-button tuning are all clearly indicated, as are the coil core and trimmer adjustments (with the exception of the IF transformer trimmers).



The tuning unit as seen from the top, when partially withdrawn from the chassis. The oscillator circuit switches for press-button tuning are all clearly indicated, as are the coil core and trimmer adjustments (with the exception of the IF transformer trimmers).

volume control to maximum, and tone control to "low." A damping circuit consisting of a 30,000 O resistor in series with a 0.05  $\mu$ F condenser in series must be used where indicated below.

Connect signal generator between control grid (top cap) of V2 and chassis, and feed in a 465 KC/S signal. Connect damping circuit between anode of V2 and chassis, and adjust C47 for maximum output. Connect damping between V3 signal diode (pin 1) and chassis, and adjust C46 for maximum output.

Connect signal generator between control grid (top cap) of V1 and chassis, connect damping between anode of V1 and chassis, and adjust C45 for maximum output. Connect damping circuit between control grid (top cap) of V2 and chassis, and adjust C44 for maximum output.

**RF and Oscillator Circuits.**—With gang at maximum, indicator should coincide with the tops of the wavelength scales. Remove the escutcheon plate from front of cabinet if chassis has not been removed. Turn volume control to maximum, and tone control to "low." Connect signal generator to A and E sockets.

**SW.**—Press SW button, and tune to 18 m on scale. Feed in an 18 m (16.67 MC/S) signal, and adjust C41 (above SW button) and C36 (below SW button) for maximum output. Check calibration at 50 m.

**MW.**—Press MW button, and tune to 300 m on scale. Feed in a 300 m (1,000 KC/S) signal, and adjust C42 (above MW button) and C37 (below MW button) for maximum output. Check calibration at 500 m.

**LW.**—Press LW button, and tune to 1,500 m on scale. Feed in a 1,500 m (200 KC/S) signal, and adjust C43 (above LW button) and C38 (below LW button) for maximum output. Check calibration at 1,900 m.

### PRE-SET STATION SELECTION

Stations can be selected by buttons 1 to 5, numbering from the left. The wavelength ranges covered by each button are: 1,

1,200-2,000 m; 2, 450-550 m; 3, 375-475 m; 4, 275-375 m; 5, 200-300 m.

To select a station accurately, it is advisable to use a DC voltmeter (0-60 V), connected across the two tags on the chassis deck, as an indicator. Adjustments should always be made for *minimum* reading on the meter.

If the chassis is still in the cabinet, remove the escutcheon of the press-button unit (two instrument-head screws).

Connect the aerial and earth to the receiver and press the button to be used for the desired station. Turn the core adjustment for the associated oscillator coil (above the button) until the index mark is at the approximate wavelength on the small calibrated scale. Then carefully turn the adjustment until the loudest output from the desired station (*minimum* voltmeter reading) is obtained.

Adjust the associated aerial circuit trimmer (below the button) for maximum output (*minimum* voltmeter reading).

Re-adjust both trimmers carefully as a final check.

**NOTE.**—Any adjustment of the manual tuning trimmer C43 will affect the tuning of the pre-selected stations. After manual circuit alignment, therefore, the cores of L17-L21 must be re-adjusted.

Any adjustment of the MW manual tuning aerial trimmer C37 will necessitate re-adjustment of the MW pre-set station trimmers C50, C52, C54, C55. Similarly any adjustment of the LW manual tuning aerial trimmer C38 will affect the setting of C48.

If a new TH4A valve has to be fitted, it may be found necessary to re-adjust the pre-set oscillator circuits. The best way to do this is to use the LW manual trimmer C43 for correction purposes. Press the fifth button, which controls a station near the bottom of the MW band, and adjust C43 until this station is at its maximum volume. When this is so, all the other pre-selected stations will be correct. The slight adjustment of C43 which is necessary will not affect the LW manual alignment appreciably.