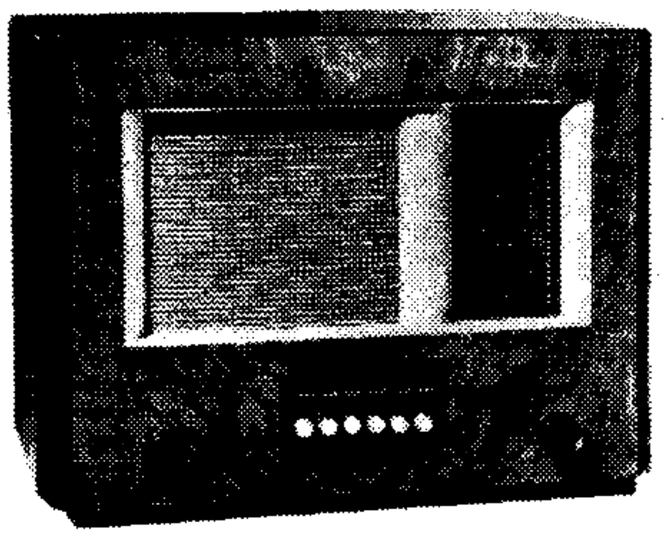
BUSH BA61

BATTERY PRESS-BUTTON SUPERHET



THE Bush BA61 is a 4-valve battery superhet table receiver, including press-button tuning for three stations (two MW, one LW), and press-buttons for manual wavechanging. A SW range of 16·5 to 51 m is included. The circuit uses trimmer condensers for the aerial circuit auto-tuning, and variable iron-cored coils for the oscillator circuit.

Release date : January, 1939.

CIRCUIT DESCRIPTION

The aerial circuit coupling coils are permanently connected as shown in the diagram, no switches being used for waveband changing. On SW, input is via condensers **C1, C2** and coupling coil **L1** to single-tuned circuit **L4, C36,** manual tuning only being employed on this band.

MW coupling coil **L2,** and LW coupling coil **L3** with its shunt **C3,** are connected in series with each other across the aerial circuit in parallel with **C2, L1,** and couple the aerial to single-tuned circuits **L5, C36** (MW manual) and **L6, C36** (LW manual).

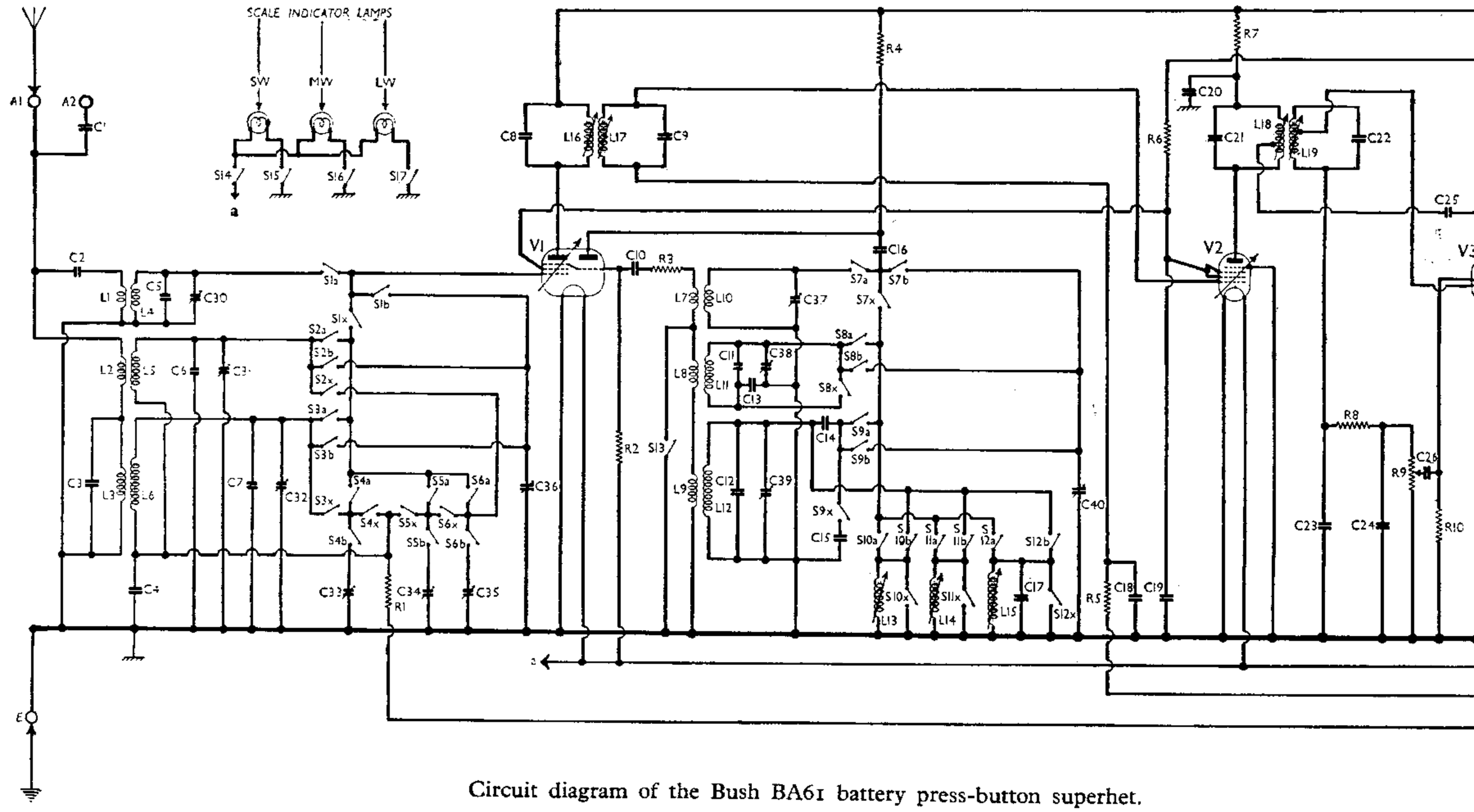
Waveband switching for manual tuning in this receiver is effected by press-button switches similar to those used for the automatic tuning. These switches are arranged in groups of three and in the diagram each group has been given a number, while each arm of each group has a letter **a, b** or **x** added as a suffix to its number, so that the SW group is numbered **S1a, S1b** and **S1x,** the MW group **S2a, S2b** and **S2x** and so on throughout the waveband and automatic switching.

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 " **x's** " open, and when the button is released (by pressing another button) the converse is the case. It will be seen, therefore, that if the SW button is depressed, **S1a** and **S1b** close, connecting **L4, C36** and **V1** pentode CG together, while **S1x** is open ; if the MW button is then depressed, the SW button is released, so that **S1x** closes together with **S2a** and **S2b,** connecting **L5** to **V1** pentode CG and **C36.**

When an automatic tuning button is depressed, **S1x, S2x** and **S3x** 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, Mazda metallised TP23**) is a triode pentode operating as frequency changer with internal coupling. Triode oscillator anode coils (manual tuning only) **L10** (SW), **L11** (MW) and **L12** (LW) are tuned by **C40 ;** parallel trimming by **C37** (SW), **C11, C38** (MW) and **C12, C39** (LW) ; series tracking by **C13** (MW) and **C14** (LW). Reaction by grid coils **L7** (SW), **L8** and **L9** (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 **L12** according to which button is depressed. The modification referred



Circuit diagram of the Bush BA61 battery press-button superhet.

to is that, as the LW manual button controlling **S9** group is now in the "Out" position, **S9a** and **S9b** are open while **S9x** is closed, so that the LW manual tracker **C14** becomes connected in series with **C15** across the master oscillator circuit, the two together forming an additional trimmer.

Second valve (**V2, Mullard metallised VP2B**) is a variable-mu RF hexode operating as intermediate frequency amplifier with tuned-primary tuned-secondary variable iron-cored transformer couplings **C8, L16, L17, C9** and **C21, L18, L19, C22.**

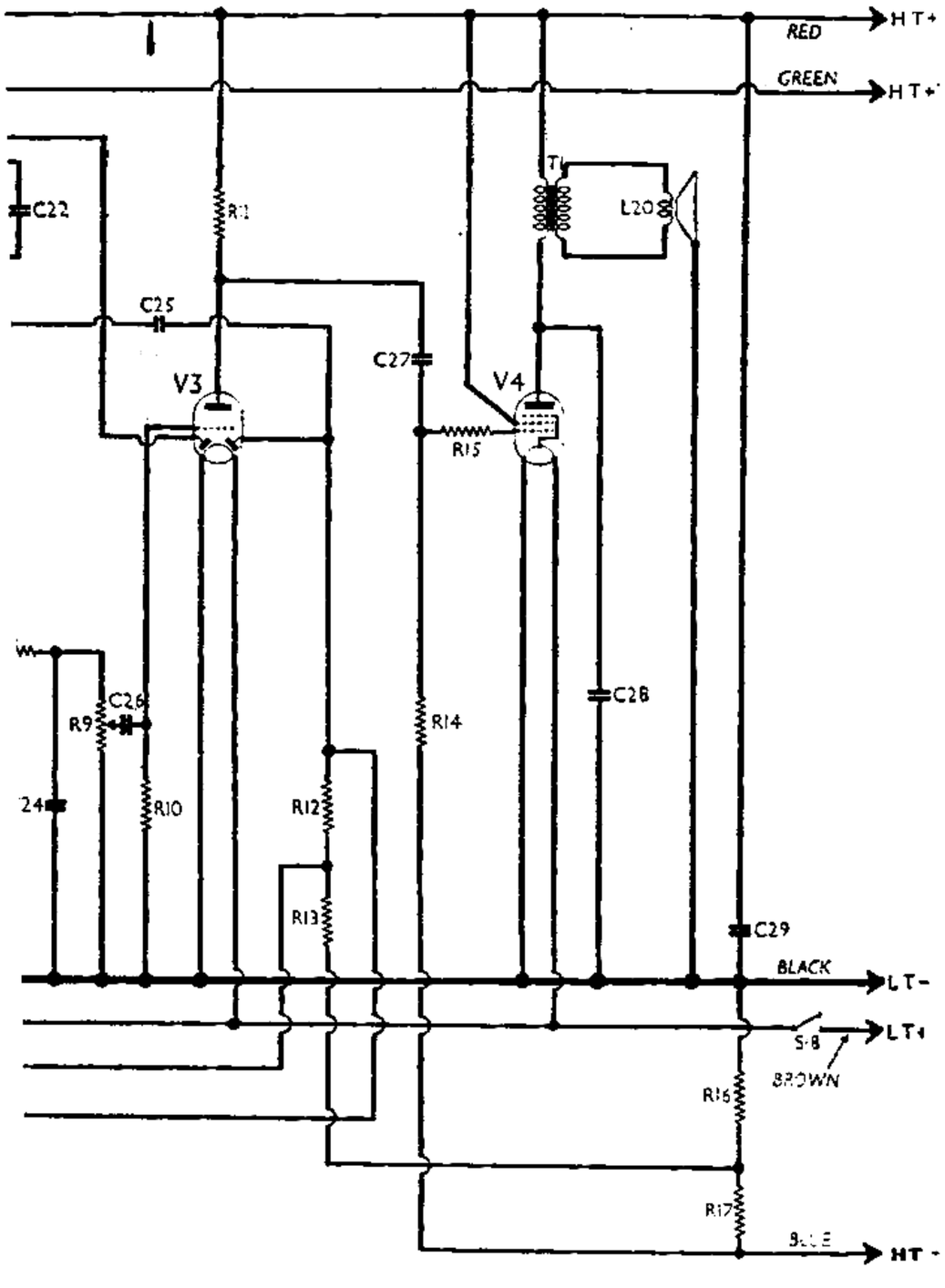
Intermediate frequency 465 KC/S.

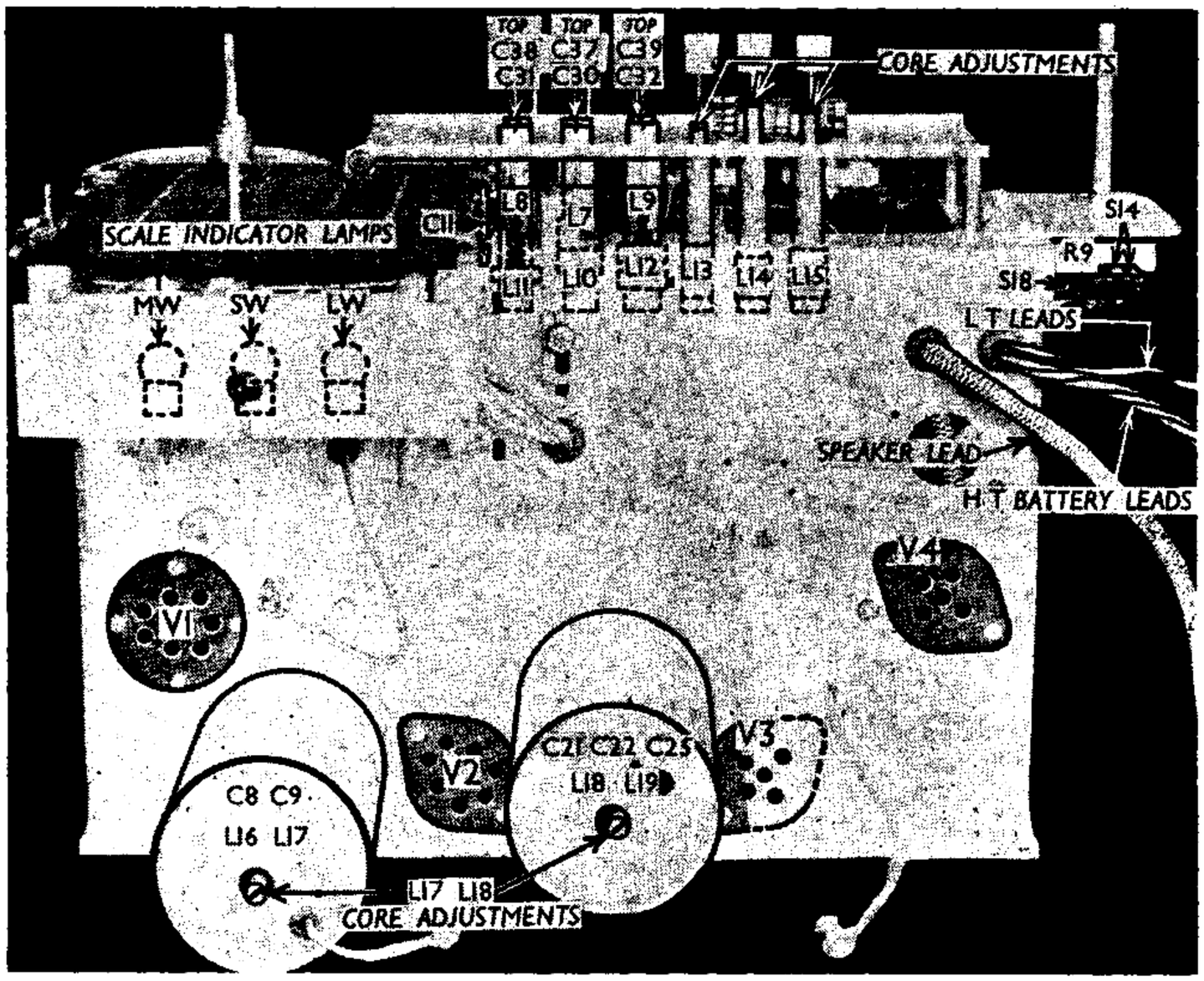
Diode second detector is part of double diode triode valve (**V3, Mullard metallised TDD2A**). Audio frequency component in rectified output is developed across manual volume **R9,** which also operates as load resistance, and passed via AF coupling condenser **C26** and CG resistance **R10** to CG of triode section, which operates as AF amplifier. IF filtering by **C23, R8** and **C24.**

Second diode of **V3,** fed from tapping on **L18** via **C25,** provides DC potentials which are developed across load resistances **R12** and **R13** and fed back through decoupling circuits as GB to FC (except on SW) and IF valves, giving AVC.

Resistance-capacity coupling by **R11, C27** and **R14,** via grid stopper **R15,** between **V3** triode and pentode output valve (**V4, Mullard PM22A**). Fixed tone correction by **C28** in anode circuit.

GB potential for **V4,** fixed minimum GB potential for **V1** and **V2** and AVC delay potential, are automatically obtained from drop along resistances **R16** and **R17** which are connected in series with the HT negative lead to chassis.





Plan view of the chassis, showing the positions of the various oscillator coils and certain of the trimmers. **S14** is closed by pressing the spindle of **R9.**

DISMANTLING THE SET

Removing Chassis.—Remove the two control knobs (grub screws) and the four bolts (with washers) holding the chassis to the bottom of the cabinet. After removing the clip (one wood screw) which holds the speaker and battery leads to the bottom right-hand corner of the speaker sub-baffle, the chassis can be removed to the extent of the speaker leads, which is sufficient for normal purposes.

To free the chassis entirely, unsolder the speaker leads, and, *when replacing*, connect them as follows, numbering from bottom to top: 1, brown, 2, red. The black lead goes to the tag on the speaker frame. In some models a yellow, green or white lead may take the place of the brown one.

Removing Speaker.—The speaker may be removed by unsoldering the three leads to it and removing the four hexagon nuts (with washers) holding it to the sub-baffle. *When replacing*, see that the transformer is on the left and connect the leads as indicated above.

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	V1 pentode CG decoupling ..	1,000,000
R2	V1 osc. CG resistance ..	40,000
R3	V1 osc. grid circuit stabiliser	25
R4	V1 osc. anode HT feed ..	40,000
R5	V2 CG decoupling	1,000,000
R6	V1, V2 SG's HT feed resistance	15,000
R7	V2 anode HT feed	5,000
R8	IF stopper	50,000
R9	V3 signal diode load; manual volume control ..	500,000
R10	V3 triode CG resistance ..	5,000,000
R11	V3 triode anode load ..	100,000
R12, R13	V3 AVC diode load resistances	1,000,000 each
R14	V4 CG resistance	500,000
R15	V4 grid stopper	100,000
R16, R17	V1, V2 fixed GB, V4 GB and AVC delay potential divider	100, 400

	CONDENSERS	Values (μF)
C1	A2 aerial series condenser ..	0·0001
C2	Aerial SW series condenser ..	0·00005
C3	LW aerial circuit shunt ..	0·0008
C4	V1 pentode CG decoupling ..	0·5
C5	Aerial circuit SW fixed trimmer	0·000005
C6	Aerial circuit MW fixed trimmer	0·000005
C7	Aerial circuit LW fixed trimmer	0·00003
C8, C9	1st IF transformer fixed tuning condensers	0·00015 each
C10	V1 osc. CG condenser ..	0·0005
C11	Osc. circuit MW fixed trimmer	0·000005
C12	Osc. circuit LW fixed trimmer	0·000125
C13	Osc. circuit MW tracker ..	0·000556
C14	Osc. circuit LW tracker (manual); part osc. circuit trimmer (auto.)	0·000316
C15	Auto osc. circuit part trimmer (with C14)	0·00034
C16	V1 osc. anode coupling ..	0·0001
C17	LW auto circuit trimmer ..	0·000316
C18	V2 CG decoupling	0·1
C19	V1, V2 SG's decoupling ..	0·5
C20	V2 anode decoupling ..	0·1
C21, C22	2nd IF transformer fixed tuning condensers	0·00015, 0·00016
C23, C24	IF by-pass condensers ..	0·0001 each
C25	Coupling to V3 AVC diode ..	0·00005
C26	AF coupling to V3 triode ..	0·001
C27	V3 triode to V4 AF coupling	0·03
C28	Fixed tone corrector.. ..	0·003
C29	HT reservoir condenser ..	2·0
C30‡	Aerial circuit SW trimmer ..	0·00001
C31‡	Aerial circuit MW trimmer ..	0·00001
C32‡	Aerial circuit LW trimmer ..	0·00001
C33‡	Aerial LW auto tuning trimmer	0·00045
C34‡, C35‡	Aerial circuit MW automatic tuning trimmers	0·00045, 0·00015
C36†	Aerial circuit manual tuning condenser	—
C37‡	Osc. circuit SW trimmer ..	0·00001
C38‡	Osc. circuit MW trimmer ..	0·00001
C39‡	Osc. circuit LW trimmer ..	0·00001
C40†	Oscillator circuit manual tuning condenser	—

† Variable. ‡ Pre-set.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial SW coupling coil ..	0·05
L2	Aerial MW coupling coil ..	0·5
L3	Aerial LW coupling coil ..	30·0
L4	Aerial SW tuning coil ..	0·05
L5	Aerial MW tuning coil ..	1·0
L6	Aerial LW tuning coil ..	5·0
L7	Oscillator SW reaction coil ..	0·1
L8	Oscillator MW reaction coil ..	1·0
L9	LW and master oscillator reaction coil	5·0
L10	Osc. circuit SW tuning coil ..	0·05
L11	Osc. circuit MW tuning coil ..	1·5
L12	LW manual and master automatic oscillator circuit tuning coil	3·0
L13	Oscillator circuit MW automatic tuning coils	0·04
L14		0·05
L15	Osc. circuit LW auto coil ..	0·05
L16	1st IF trans. Pri	4·0
L17	1st IF trans. Sec.	4·0
L18	2nd IF trans. Pri., total ..	4·0
L19	2nd IF trans. Sec., total ..	4·0
L20	Speaker speech coil	2·5
T1	Speaker input trans. Pri. ..	800·0
	Speaker input trans. Sec. ..	0·2
S1a, b, x to S3a, b, x	Aerial circuit waveband and manual auto switches ..	—
S4a, b, x to S6a, b, x	Aerial circuit automatic selector switches	—
S7a, b, x to S9a, b, x	Oscillator circuit waveband and manual/auto switches	—
S10a, b, x to S12a, b, x	Oscillator circuit automatic selector switches	—
S13	Part of waveband switching	—
S14	Scale lamps master switch, ganged R9	—
S15-S17	Scale lamps selector switches	—
S18	LT circuit switch, ganged R9	—

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating with a new 144 V HT battery, reading 148 V on load, and a fully charged 2 V LT accumulator. 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.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 TP23 ..	140	0·3	48	0·7
	Oscillator			
	48	2·0		
V2 VP2B ..	130	1·3	48	0·2
V3 TDD2A	54	0·7	—	—
V4 PM22A	138	4·2	140	0·6

GENERAL NOTES

Switches.—There are six 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 numberd groups of three, the individual switches in each group being indicated by suffix letters **a, b** and **x,** following the group number.

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 **x** switches *closed*. When a button is "in," its **a** and **b** switches are *closed* and its **x** switches are *open*.

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

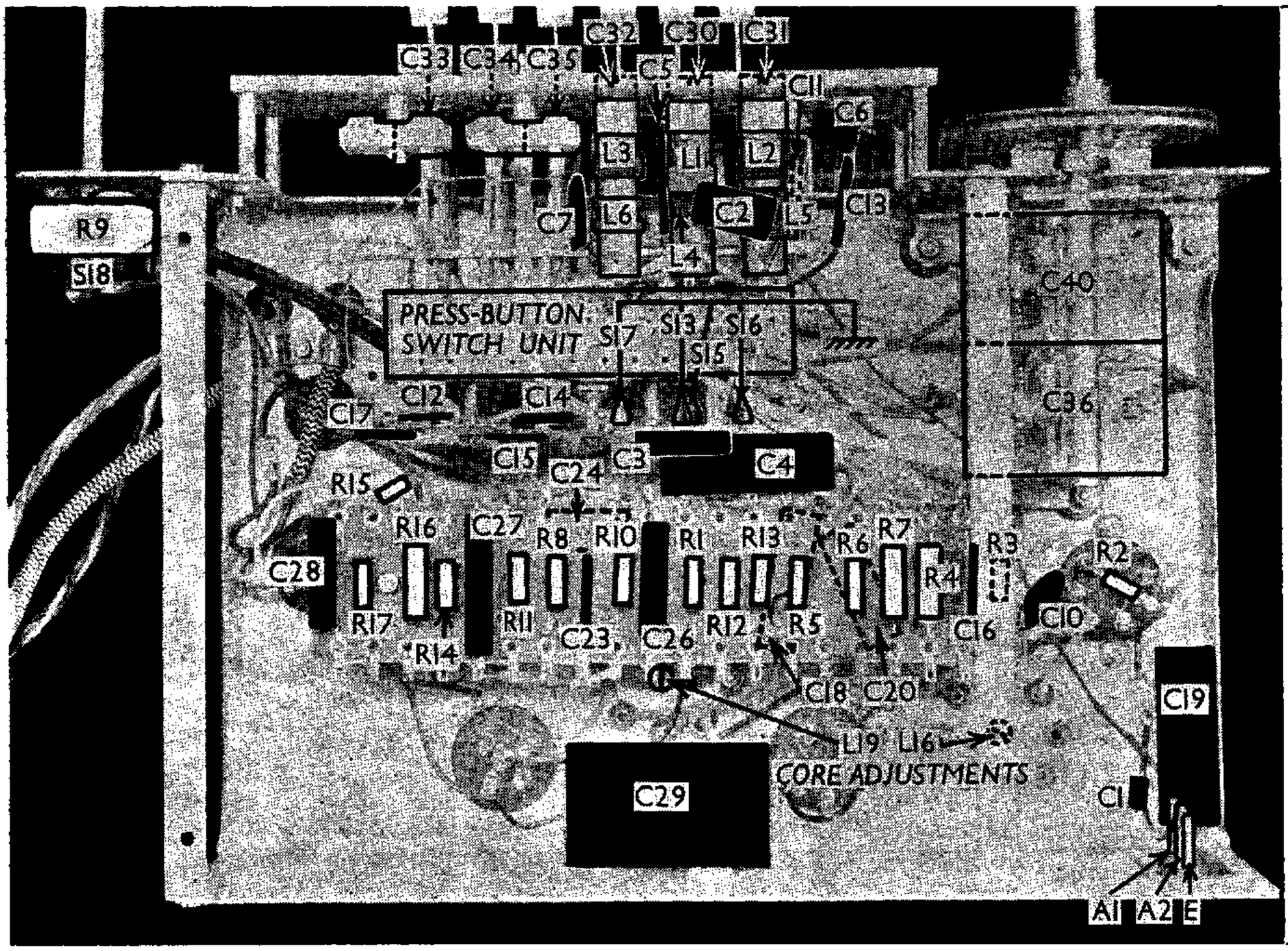
In addition to the actual press-button switches, there is a group of four switches, **S13,** and **S15-S17,** controlled by the three right-hand (wavechange) buttons. These switches are formed by the metal plungers of the three press-buttons (which are earthed) and a number of spring contacts into which the plungers slide when the buttons are depressed. **S13** and **S15** are both controlled by the SW button, **S15** being a scale lamp switch. The other two scale lamp switches, **S16** and **S17,** are controlled by the MW and LW buttons respectively.

S18 is the LT circuit switch, ganged with the volume control **R9.**

S14, the scale lamp master switch, is also associated with **R9,** and closes when the volume control knob is pushed in. This switch is provided for LT battery economy.

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 aircored. **L2, L5** and **L3, L6** have fixed iron-dust cores, while **L13-L15** have adjustable iron-dust cores for permeability trimming of the oscillator circuits of the three pre-set station buttons.

The IF transformers **L16, L17** and **L18, L19** are in two screened units on the chassis deck. The windings have adjustable iron cores, each can having one adjustment at its top, and one at its base, reached from beneath the chassis.



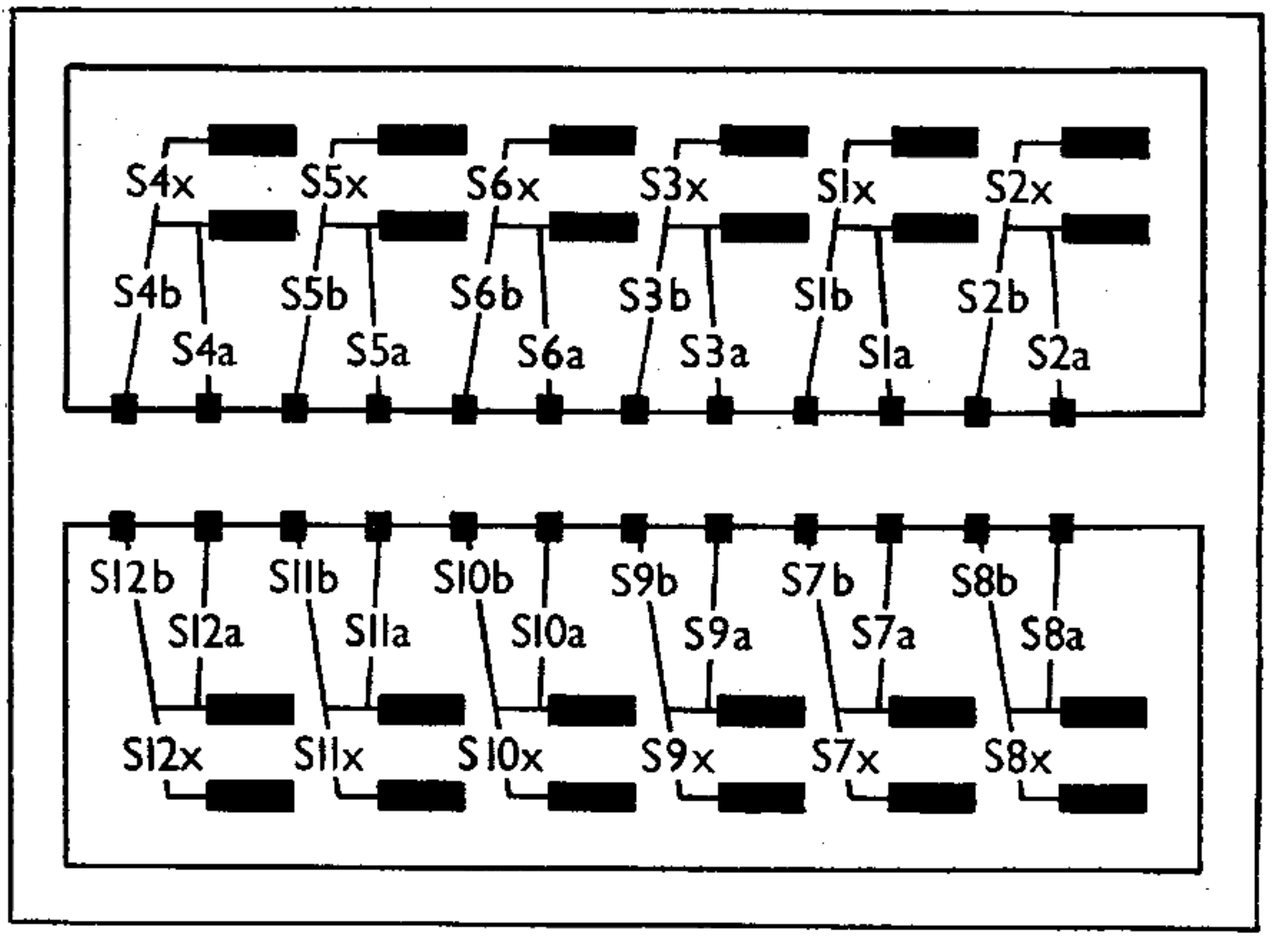
Under-chassis view. The aerial coils and certain of the trimmers can be seen. The press - button switch unit is shown in detail in cols. 5 and 6. Note the extra switches **S13** and **S15-S17** behind the press-button unit. The core adjustments for **L16** and **L19** are indicated.

Scale Lamps.—These are three Osram MES types, rated at 2·5 V, 0·3 A. They 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. The lamps are switched by **S15-S17,** ganged with the waveband press-buttons, **S14** being a master control switch, operated by pressing in the volume control knob.

Loudspeaker.—In our receiver a Rola 8Z/9·5 PM was used, but in others a Celestion PM8LA may be found. In this case **T1** primary will be 850 O, and **T1** secondary, 0·3 O; **L20** will be 2·4 O.

Batteries.—LT, Exide 2 V 20 AH celluloid-cased cell, type CZH2B. HT, 144 V dry battery with 72 V tapping, Drydex H1151. GB is automatic.

Battery Leads and Voltages.—Black lead, spade tag, LT negative; brown lead, spade tag, LT positive 2 V; blue lead, black plug, HT negative; green lead and plug, HT positive 72 V; red lead and plug, HT positive 144 V.



Two views of the press-button switch unit. The upper one is the side seen looking from the rear of the underside of the chassis, and the lower one, the reverse side as seen from the front of the chassis.

ALIGNMENT OF MANUAL CIRCUITS

IF Stages.—Press MW manual tuning button, tune to 300 m on the scale, and turn volume control to maximum. A damping circuit consisting of a 30,000 O resistor in series with a 0·05 μF condenser 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 core of **L19** for maximum output. Connect damping between **V3** signal diode (centre pin) and chassis, and adjust core of **L18** for maximum output.

Connect signal generator between control grid (top cap) of **V1** and chassis, feed in a 465 KC/S signal, and adjust cores of **L16** and **L17** 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. Connect signal generator to **A1** 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 **C37** (above SW button) and **C30** (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 **C38** (above MW button) and **C31** (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 **C39** (above LW button) and **C32** (below LW button) for maximum output. Check calibration at 1,900 m.

PRE-SET STATION SELECTION

Stations can be selected by buttons 1 to 3, numbering from the left. The wavelength ranges covered by each button are: 1, 1,200-2,000 m; 2, 340-550 m; 3, 200-350 m.

If the chassis is still in the cabinet, remove the escutcheon of the press-button unit (two countersunk-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 is obtained.

Adjust the associated aerial circuit trimmer (below the button) for maximum output.

Re-adjust both trimmers carefully as a final check.

NOTE.—Any adjustment of the LW oscillator manual trimmer **C39** will affect the tuning of the pre-selected stations. After manual circuit alignment, therefore, the cores of **L13** to **L15** must be re-adjusted.

Any adjustment of the MW manual tuning aerial trimmer **C31** will necessitate readjustment of the MW pre-set station trimmers **C34, C35.** Similarly any adjustment of the LW manual tuning aerial trimmer **C32** will affect the setting of **C33.**

If a new TP23 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 **C39** for correction purposes. Press the third button, which controls a station near the bottom of the MW band, and adjust **C39** 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 **C39** which is necessary will not affect the LW manual alignment appreciably.