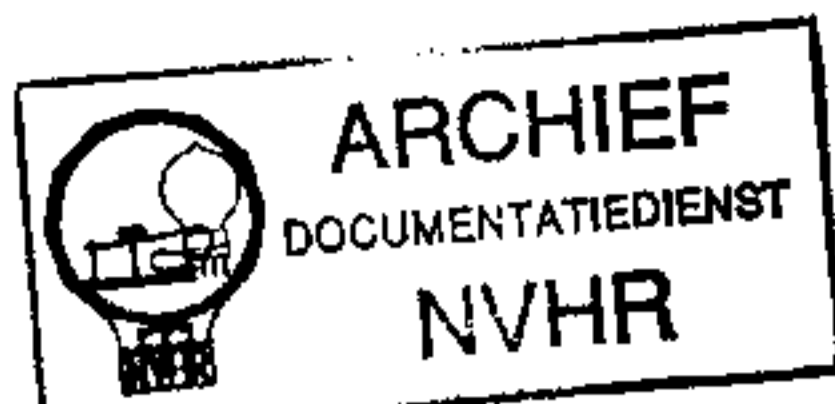
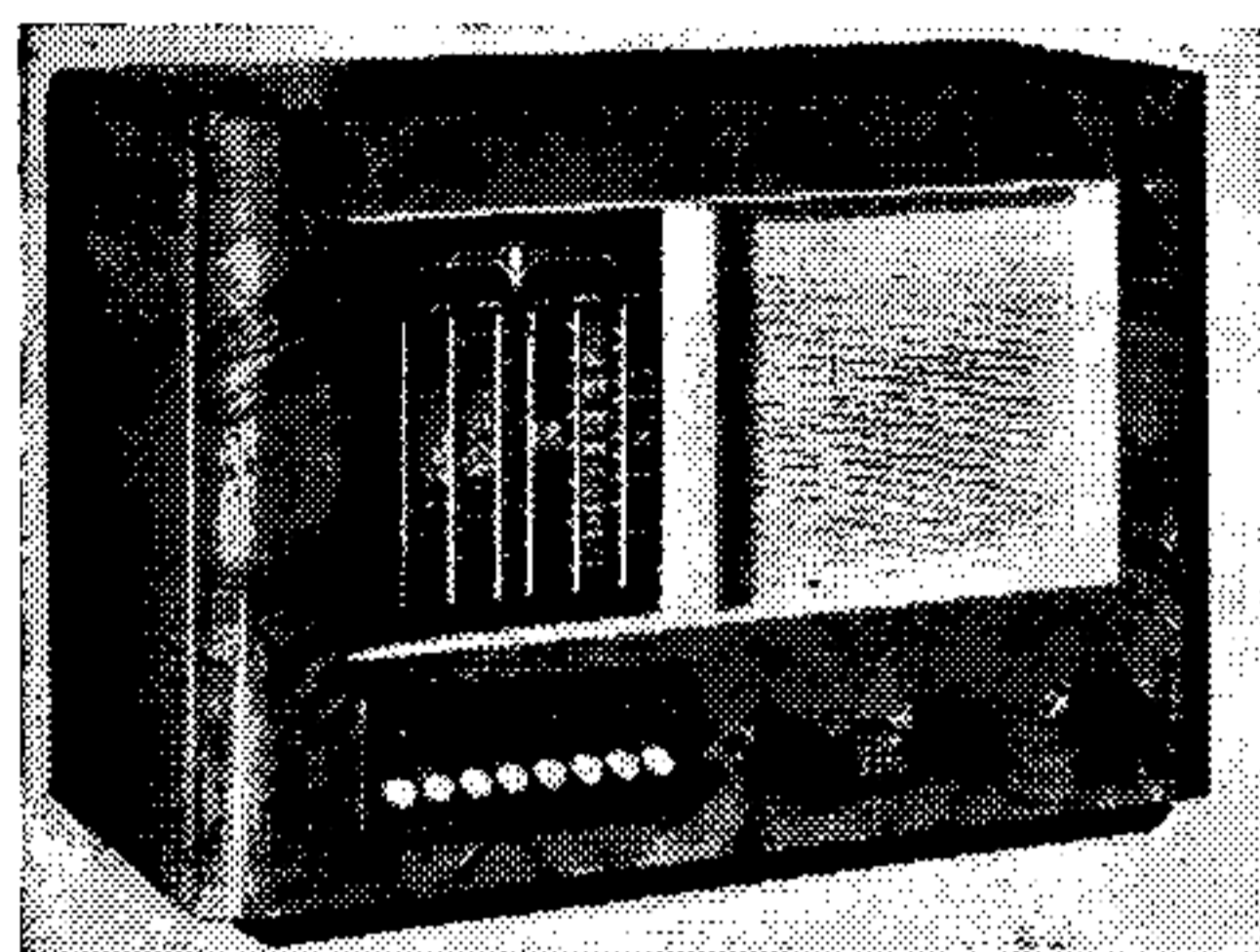


Ned. Ver. v. Historie v/d Radio



BUSH PB73 AND SUG73 CONSOLE



The chassis employed in the SUG73 console is similar in every respect, but this *Service Sheet* was prepared from a model PB73. Release date, both models, June, 1940.

CIRCUIT DESCRIPTION

All the switches associated with the press-button unit have been numbered and coded to indicate their action, so that their functions can be seen from an inspection of the circuit diagram.

The switches are arranged in groups, and two groups, one in the aerial circuit and one in the oscillator circuit, are controlled by each press-button. The press-buttons have been numbered off from 1 to 8, reading from right to left when viewed from the front of the chassis, and each switch bears the same number as the button that controls it.

Each switch also bears a lettered suffix for the dual purpose of distinguishing it from others of the same number and indicating its action, thus: if the suffix letter is a, b, c or d, the switch *closes* when its button is pressed; while those switches of the same number but with suffixes x, y and z *open*. When the button is released, by pressing another button, the a, b, c and d switches open, and the x, y and z switches close.

The scale lamp switches, numbered S1-S6, bear no suffix letter. These switches close when their buttons are pressed, and open when their buttons are released.

Aerial input from socket A1 directly, or from A2 via C1, is via coupling coils L3 (SW), L4

(MW) and L5 (LW) to single tuned circuits. A frame winding L1 and series choke L2 provide a means of operating the receiver without an external aerial if desired.

On SW, of which there are four bands, the aerial tuning coil L6 is pre-tuned to the middle of the appropriate band by C49 (16 m band), C5, C50 (19 m band), C6, C51 (25 m band), or C7, C52 (31 m band), according to which button is depressed.

On MW, L7 is tuned manually by C55, or automatically by C56 or C57; on LW, L8 is tuned, manually only, by C55.

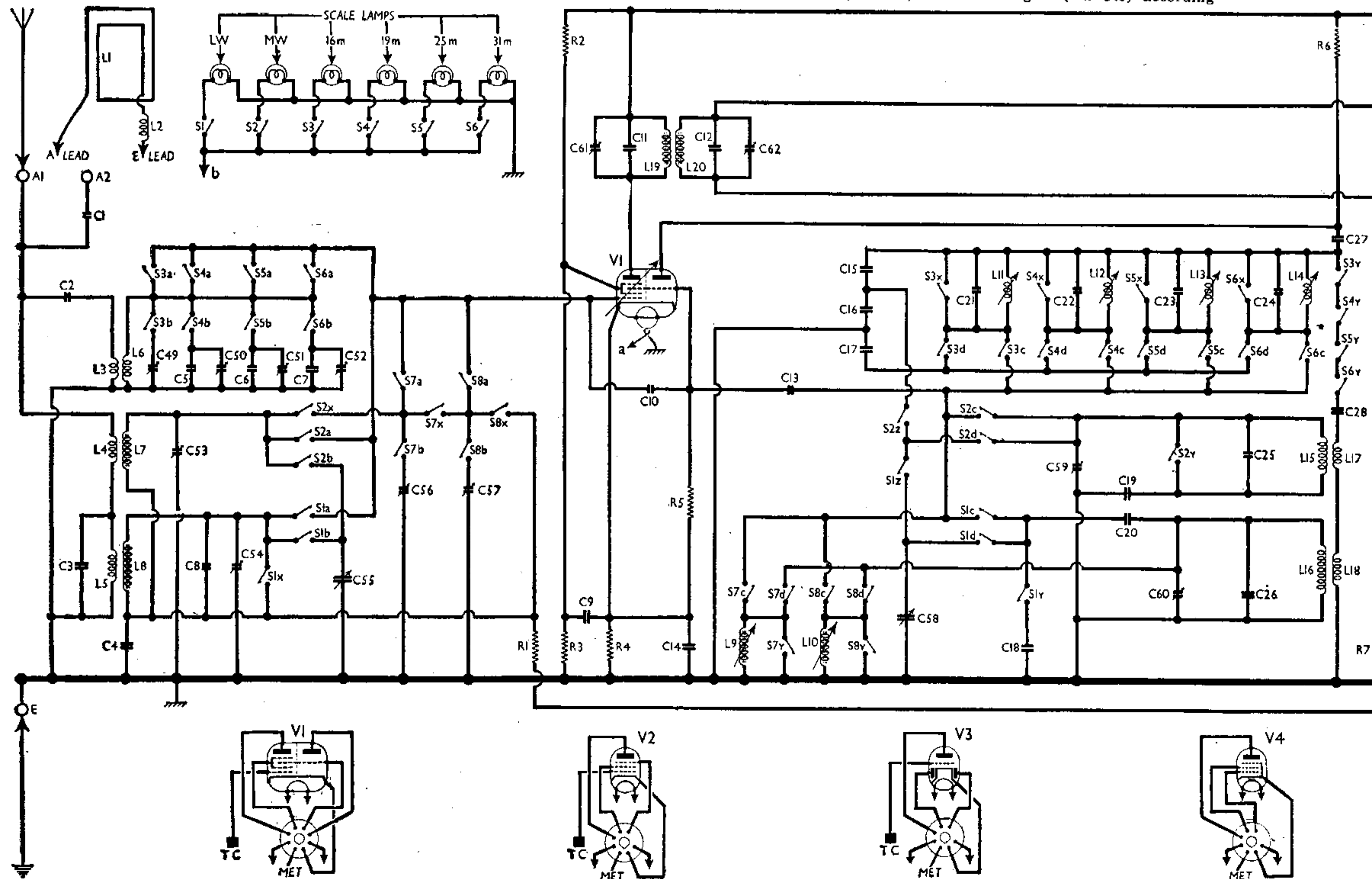
First valve (V1, Mullard ECH35 or ECH33) is a triode-hexode operating as frequency changer with internal coupling. For MW and LW manual tuning, oscillator grid coils L15 (MW) and L16 (LW) are tuned by C58. Parallel trimming by C25, C59 (MW) and C26, C60 (LW); series tracking by C19 (MW) and C20 (LW). Reaction coupling by L17, L18 via C27, S3y-S6y and C28.

For automatic tuning, which is available for two MW stations only, the pre-set coils L9, L10 are alternatively connected directly across the LW circuit, which operates as master oscillator. Since the LW button (No. 1) is not depressed, S1y remains closed, and L16 is, therefore, shunted by C20, C18.

For SW operation, a band-spread system of tuning is employed, using a Colpitts type of circuit. One of the coils L11 (16 m band) L12 (19 m band), L13 (25 m band) or L14 (31 m band) is connected between V1 oscillator anode (via C27) and control grid (via C13) according

FOUR band-spread SW bands and two MW pre-set stations, besides the usual MW and LW manually tuned bands, are provided in the Bush PB73 AC superhet. Waveband switching is controlled by eight press-buttons. The band-spread band ranges are: 16.45-17.2 m, 19.15-20.1 m, 24.85-25.8 m, and 30.25-31.85 m.

The receiver employs four valves (plus rectifier) and is designed to operate from 200-250 V, 40-100 C/S mains. Provision is made for connection of a gramophone pick-up and an external speaker, and switching permits either to be connected permanently and switched in and out of circuit at will.



to which button is pressed; at the same time one of the switches S3y-S6y opens, disconnecting L17 and L18 from the anode circuit, while all the remaining tuning coils are short-circuited.

The tuning capacity consists of C15, C16 and C17 connected in series across the tuning coil, with C58, the oscillator manual tuning condenser, connected across C16 to provide band-spread tuning via switches S22, S12, one of which opens when the MW or LW button is pressed. It will be observed that the point of chassis potential is at the junction of C16, C17. Condenser C16 has a negative temperature characteristic, and compensates for frequency drift.

Second valve (V2, Mullard EF39) is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary iron-cored transformer couplings.

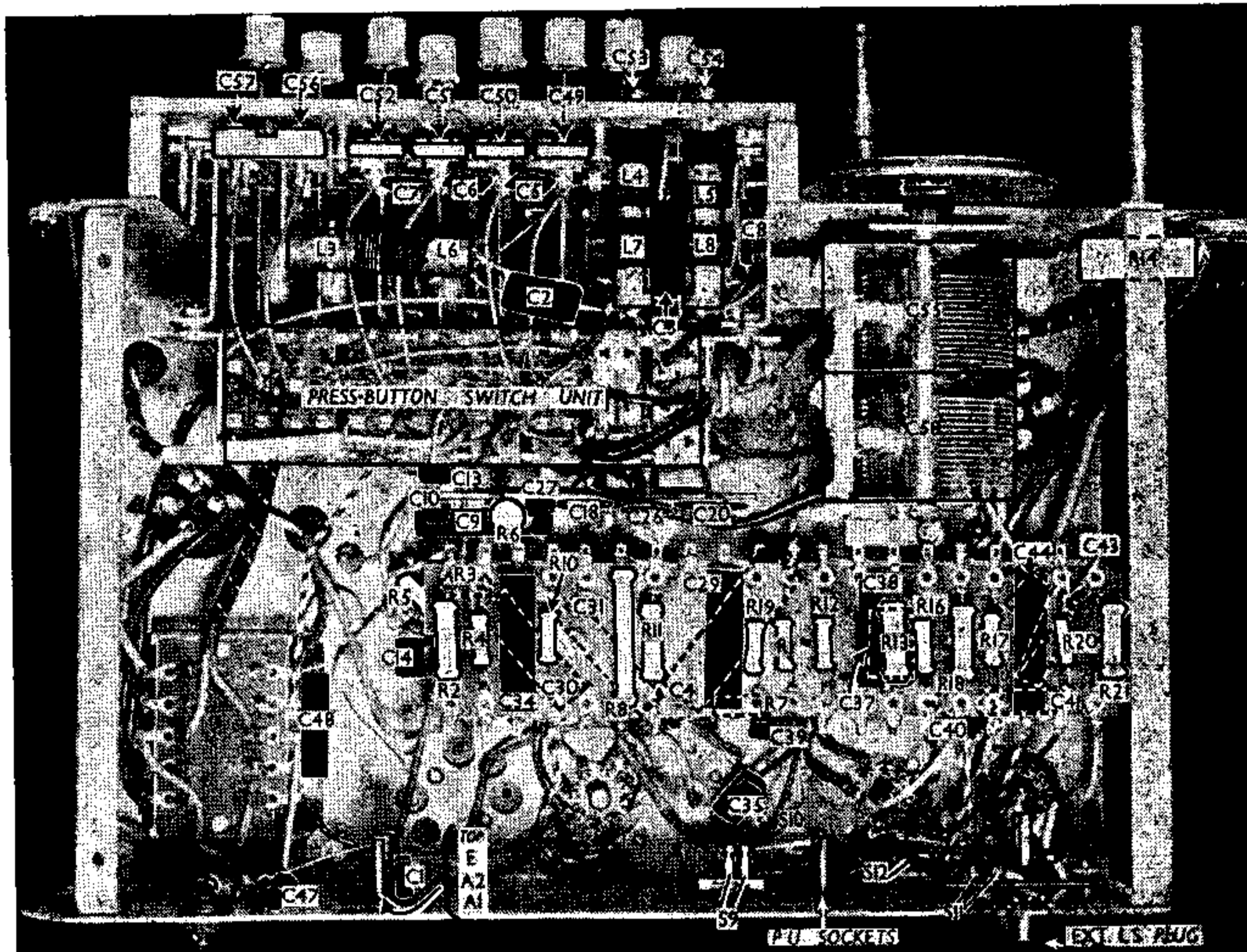
Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve (V3, Mullard EBC33). The signal diode is parallel-fed via C35, and audio frequency component in rectified output is developed across load resistance R13 and passed via C38 and manual volume control R14 to CG of triode section.

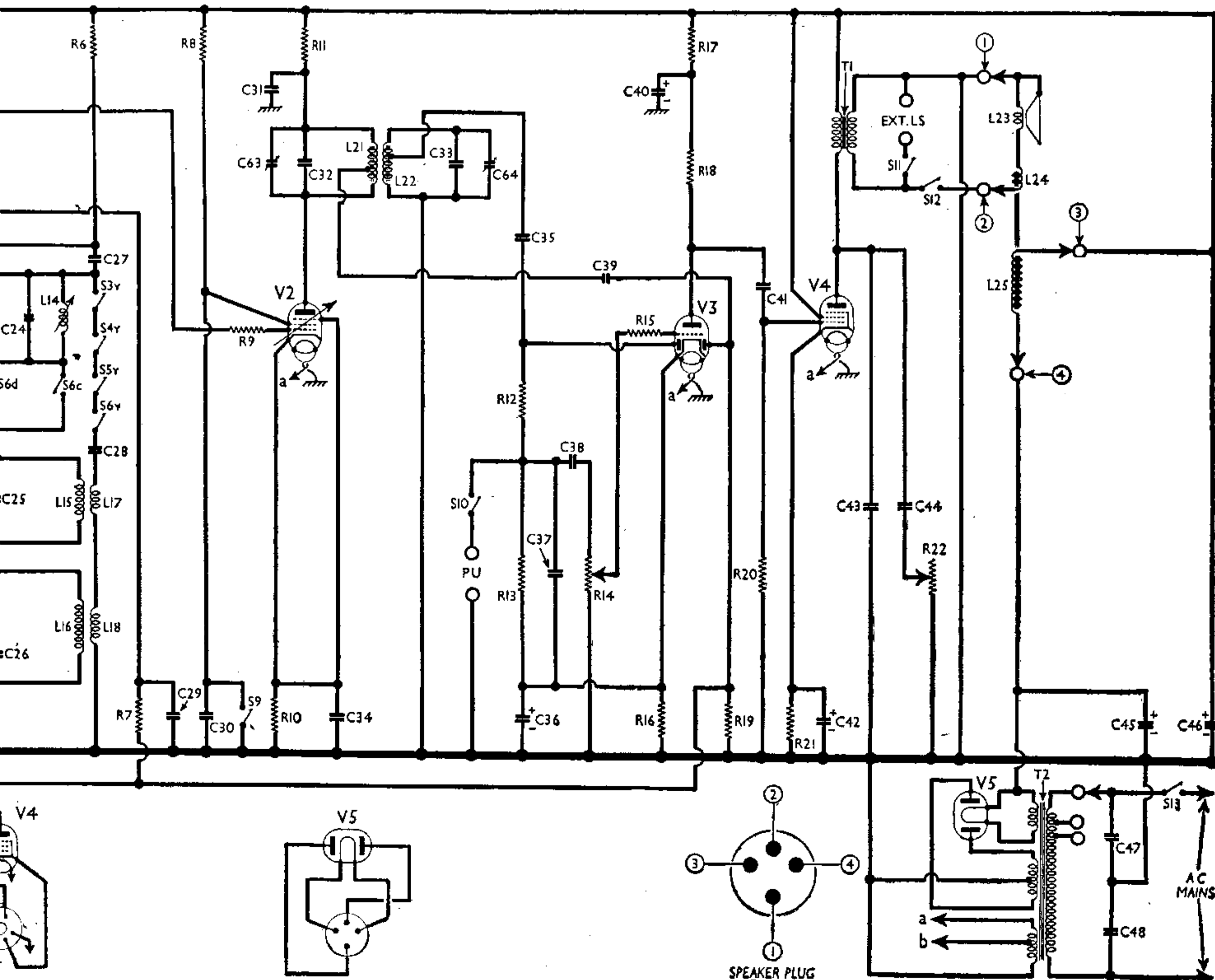
Second diode of V3, fed from tapping on L21 via C39, provides DC potential which is developed across load resistance R19 and fed back through decoupling circuits as GB to FC (except on SW) and IF valves, giving AVC.

Resistance-capacity coupling by R18, C41 and R20 between V3 triode and pentode output valve (V4, Mullard EL33). Fixed tone correction by C43 in anode circuit, variable tone control by C44, R22, also in anode circuit. Provision for connection of low-impedance external speaker across secondary of output transformer T1. Switches S11, S12, permit either or both speakers to be used by turning the external speaker plug.

HT current is supplied by full-wave rectifying valve (V5, Mullard DW4/350). Smoothing by speaker field L25 and condensers C45, C46. Mains circuit RF filtering by C47, C48.



Under-chassis view. Several components are shown dotted through the paxolin panel carrying most of the others. The underside of the tuning unit is seen here, but the upper side is shown in our illustration of the tuning unit in cols. 5 and 6 overleaf.



Circuit diagram of the Bush PB73 press-button superhet. Four band-spread SW bands are employed, and they are controlled by buttons numbered 3, 4, 5 and 6. The aerial circuit is tuned to the middle of each band, and the oscillator coils L11-L14 are tuned by C58 in conjunction with C15, C16, C17. Station names are marked on the scale. Two MW pre-set stations are tuned by L7, C56, C57 and L9, L10 in association with the LW oscillator circuit, which then operates as a master oscillator. The speaker plug diagram, viewed from the free ends of the pins, is inset beneath the circuit diagram.

COMPONENTS AND VALUES

RESISTANCES		Values (ohms)
R1	V1 hexode CG decoupling	1,000,000
R2	V1 SG HT feed potential divider	100,000
R3	V1 fixed GB resistance	100,000
R4	V1 osc. CG resistance	200
R5	V1 osc. anode HT feed	30,000
R6	V2 CG decoupling	40,000
R7	V2 SG HT feed	1,000,000
R8	V2 CG stabiliser	100,000
R9	V2 fixed GB resistance	60
R10	V2 anode HT feed	300
R11	V2 anode HT feed	10,000
R12	IF stopper	220,000
R13	V3 signal diode load	600,000
R14	Manual volume control	500,000
R15	V3 triode grid stopper	100,000
R16	V3 triode GB; AVC delay	1,000
R17	V3 triode anode decoupling	10,000
R18	V3 triode anode load	50,000
R19	V3 AVC diode load	1,000,000
R20	V4 CG resistance	600,000
R21	V4 GB resistance	200
R22	Variable tone control	50,000

CONDENSERS		Values (μF)
C1	Aerial series condenser	0.00005
C2	Aerial SW series condenser	0.00005
C3	Aerial LW shunt	0.0008
C4	V1 hexode CG decoupling	0.5
C5	19 m aerial band-set	0.00002
C6	25 m aerial band-set	0.00008
C7	31 m aerial band-set	0.00015
C8	Aerial LW fixed trimmer	0.000033
C9	V1 SG decoupling	0.05
C10	Small coupling	0.0000015
C11	1st IF transformer fixed tuning condensers	0.0001
C12	V1 osc. CG condenser	0.00005
C13	V1 cathode by-pass	0.05
C14	Oscillator circuit SW band spread fixed tuning condensers	0.00015
C15	Osc. circ. part auto trimmer	0.00034
C16	Osc. circuit MW tracker	0.000556
C17	Osc. circuit LW tracker	0.000316
C18	Osc. circ. 16 m fixed trimmer	0.00005
C19	Osc. circ. 19 m fixed trimmer	0.000033
C20	Osc. circ. 25 m fixed trimmer	0.000047
C21	Osc. circ. 31 m fixed trimmer	0.000011
C22	Osc. circ. MW fixed trimmer	0.000015
C23	Osc. circ. LW fixed trimmer	0.000125
C24	V1 osc. anode coupling condensers	0.0005
C25	V2 CG decoupling	0.0002
C26	V2 CG decoupling	0.05

Continued next col.

CONDENSERS (continued)		Values (μF)
C30	V2 SG decoupling	0.05
C31	V2 anode decoupling	0.05
C32	2nd IF transformer fixed tuning condensers	0.0001
C33	V2 cathode by-pass	0.0001
C34	Coupling to V3 signal diode	0.05
C35	V3 cathode by-pass	0.0001
C36*	IF by-pass	50.0
C37	AF coupling to V3 triode	0.0001
C38	Coupling to V3 AVC diode	0.01
C39	V3 triode anode decoupling	0.00005
C40*	V3 triode anode decoupling	2.0
C41	V3 triode to V4 coupling	0.01
C42*	V4 cathode by-pass	50.0
C43	Fixed tone corrector	0.003
C44	Part variable tone control	0.03
C45*	HT smoothing condensers	8.0
C46*	Mains RF by-pass condensers	16.0
C47	16 m aerial trimmer	0.01
C48	19 m aerial trimmer	0.00004
C49†	25 m aerial trimmer	0.00004
C50†	31 m aerial trimmer	0.00004
C51†	Aerial circuit MW trimmer	0.00004
C52†	Aerial circuit LW trimmer	0.00001
C53†	Aerial manual tuning	0.00001
C54†	Aerial circuit auto tuning trimmers	0.00045
C55†	Osc. circ. manual tuning	0.00045
C56†	Osc. circ. MW trimmer	0.00001
C57†	Osc. circ. LW trimmer	0.00001
C58†	1st IF trans. pri. trimmer	0.00009
C59†	1st IF trans. sec. trimmer	0.00009
C60†	2nd IF trans. pri. trimmer	0.00009
C61†	2nd IF trans. sec. trimmer	0.00009

* Electrolytic. † Variable. ‡ Pre-set.
§ Made up of two 0.00005 in parallel.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Frame aerial winding	2.0
L2	Frame series choke	2.2
L3	Aerial SW coupling coil	0.1
L4	Aerial MW coupling coil	0.5
L5	Aerial LW coupling coil	30.0
L6	Aerial SW tuning coil	Very low
L7	Aerial MW tuning coil	2.0
L8	Aerial LW tuning coil	14.0
L9	Oscillator circuit auto tuning coils	2.0
L10	Osc. circuit 16 m coil	2.0
L11	Osc. circuit 19 m coil	Very low
L12	Osc. circuit 25 m coil	Very low
L13	Osc. circuit 31 m coil	Very low
L14	Osc. circ. MW tuning coil	1.5
L15	Osc. circ. LW and master tuning	2.7
L16	Oscillator MW reaction	1.0
L17	Osc. LW and master reaction	2.3

Continued next col.

OTHER COMPONENTS (continued)		Approx. Values (ohms)
L19	1st IF trans. { Pri. ... Sec. ...	3.8
L20		3.8
L21	2nd IF trans. { Pri., total ... Sec., total ...	3.8
L22		3.8
L23	Speaker speech coil	2.6
L24	Hum neutralising coil	0.2
L25	Speaker field coil	2,000.0
T1	Output trans. { Pri. ... Sec. ...	700.0
T2		0.3
	Mains trans. { Pri., total ... Heat. sec., total ... Rect. heat. sec. ... HT sec., total ...	53.0 0.1 0.1 700.0
S1-S8	Scale lamps switches	—
S1a-S1z	Aerial and osc. LW switches	—
S2a-S2z	Aerial and osc. MW switches	—
S3a-S3y	Aerial and osc. 16 m switches	—
S4a-S4y	Aerial and osc. 19 m switches	—
S5a-S5y	Aerial and osc. 25 m switches	—
S6a-S6y	Aerial and osc. 31 m switches	—
S7a-S7y	Aerial and oscillator-pre-set station switches	—
S8a-S8y		—
S9	Radio muting switch	—
S10	Gram pick-up switch	—
S11, S12	Speaker circuit switches	—
S13	Mains switch, ganged R22 ...	—

DISMANTLING THE SET

Removing Chassis.—Remove the three control knobs (recessed grub screws); withdraw the speaker plug from its socket on the chassis deck; remove the three round-head wood screws holding the top of the scale assembly to the front of the cabinet; remove the four round-head set screws (with claw washers) holding the chassis to the bottom of the cabinet. *When replacing,* fit a felt washer to each control spindle, between the knob and the cabinet. **Removing Speaker.**—Withdraw the connecting plug from its socket; remove the four brass nuts (with washers) holding the speaker to the sub-baffle. *When replacing,* the leads should emerge from the right of the speaker.

VALVE ANALYSIS

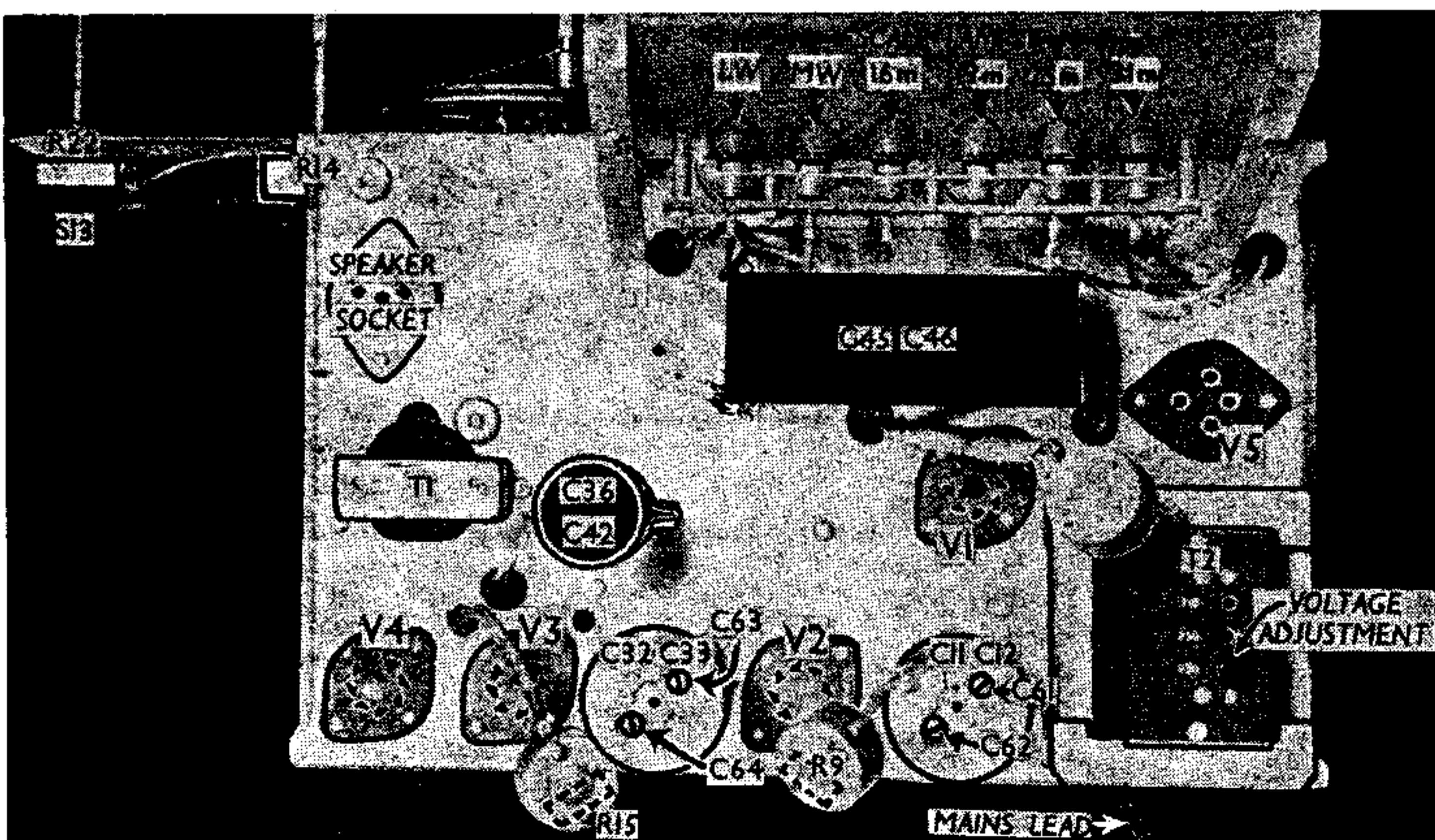
Valve voltages and currents given in the table below are those measured in our receiver when it was operating on AC mains of 235 V, using the 230 V tapping on the mains transformer. The receiver was tuned to the lowest wave length on the medium band and the volume control was at maximum, but there was 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 ECH35	265	1.1	55	1.3
	{ Oscillator 95	{ 4.6		
V2 EF39	200	5.0	90	1.7
V3 EBC33	110	2.2	—	—
V4 EL33	245	30.0	265	4.0
V5 DW4/350	360†	—	—	—

† Each anode, AC.

GENERAL NOTES

Switches.—All the RF and oscillator switches are comprised in a double-sided press-button unit, and are operated by eight press-buttons. Each button controls two groups of switches: one group (on the underside of the unit) in the aerial circuit, and another on the upper side (facing the chassis deck) in the oscillator circuit. The buttons are numbered from 1 to 8, and the switches all bear corresponding numbers, according to which button controls them. The suffix letters a, b, c, d and x, y, z indicate the action of the switches, as fully described in the "Circuit Description." The oscillator side of the unit is normally hidden from view, but it can be exposed by removing the four mounting screws holding the unit to the front of the chassis, when the whole tuning assembly can be dropped down, as shown



Plan view of the chassis. R9 and R15 are in their valve caps.

in our illustrations in cols. 5 and 6. This also is the manner in which the upper diagram in cols. 4 and 5 is viewed; the lower diagram is viewed as seen in the under-chassis view.

S10 is the gram pick-up switch, which, with S9, forms a unit at the rear of the chassis. S9 closes at the same time as S10 and short-circuits V2 screen to chassis, thus muting radio.

S11 and S12 are respectively the external and internal speaker switches, which form a dual unit with the external speaker sockets, which have a rotary movement. The plug may be left permanently inserted, and when it is in a vertical position S11 is open and S12 closed; when turned through 45 degrees clockwise, S11 closes and S12 opens; at 90 degrees both switches close, so that the two speakers operate together.

S13 is the QMB mains switch, ganged with the tone control R22.

Coils.—All the RF and oscillator coils are mounted as a complete tuning assembly with the press-button unit. The unit can be removed as a whole by unsoldering the connecting leads and removing the fixing screws; or, if the leads are left connected, the unit can be dropped as shown in our illustration of the unit, to expose its upper side.

The aerial coils are mounted on the underside of the unit, and the oscillator coils in a row on the upper side.

L1 is a small frame winding of a few turns, mounted inside the top of the cabinet. L2 is a small choke mounted with L1 and connected in series with the earthy end of it.

In the L15, L17 and L16, L18 units the reaction coils L17, L18 are wound on separate formers and fitted inside the L15, L16 formers.

The two pre-set MW coils L9, L10 and the four SW coils L11-L14 have inductance adjustments which project through the front plate of the tuning assembly.

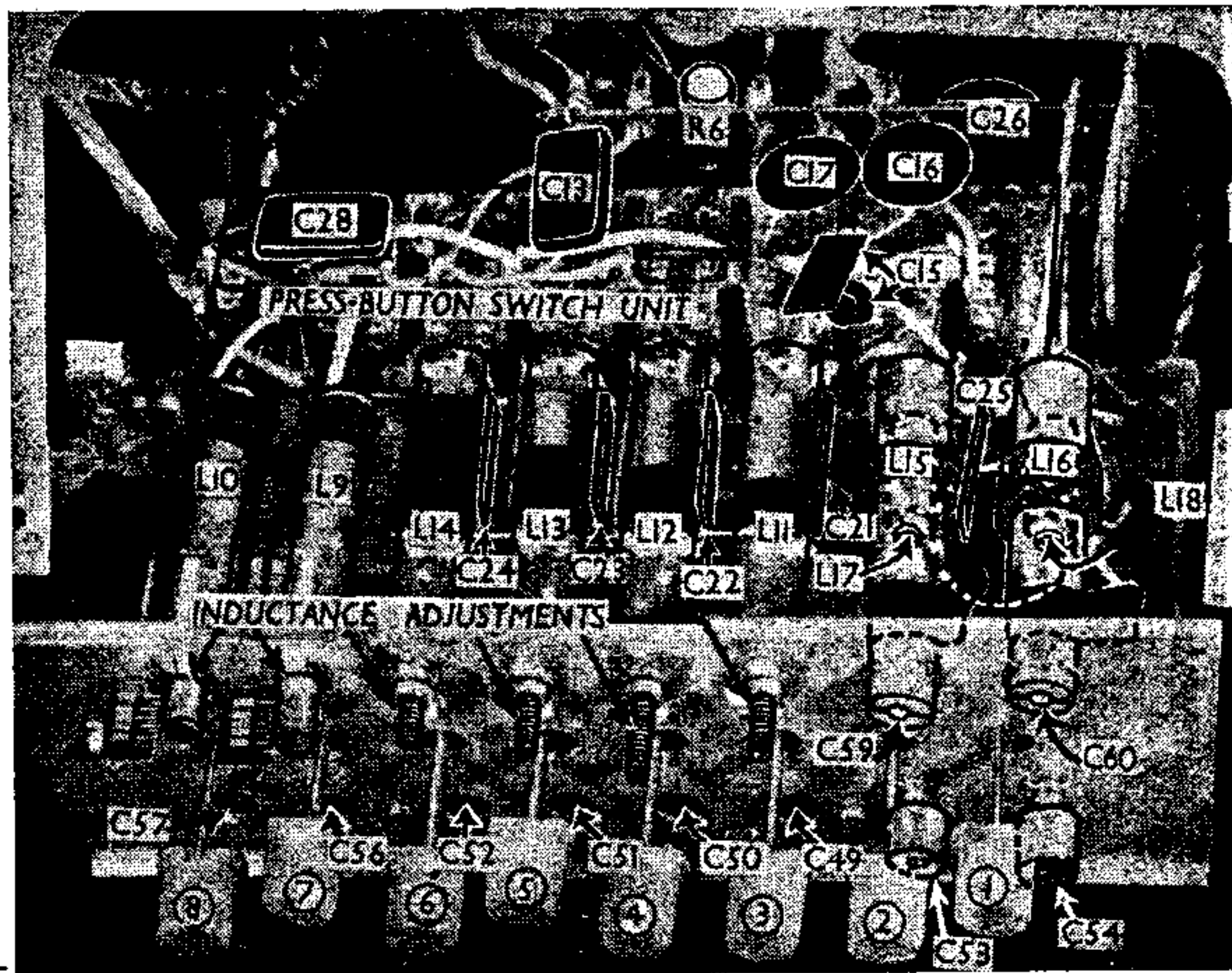
The IF transformers L19, L20 and L21, L22 are in two screened units on the chassis deck with their associated trimmers.

Scale Lamps.—There are six scale lamps, one for each band. Each lights when its corresponding button is pressed and illuminates the appropriate scale. There are no lamps associated with buttons 7 and 8. The lamps are rated at 6.2 V, 0.3 A. They have MES bases and large spherical bulbs. The switches controlling the lamps bear the same numbers as their press-buttons, without suffix letters.

Condensers C36, C42.—These are two electrolytics in a tubular metal container which forms the common negative connection, mounted on the chassis deck. They are rated at 50 μ F, 12 V working, 15 V surge each. In some chassis C40 may be in the same container, but in our sample this was a cardboard tubular type beneath the chassis.

Condensers C45, C46.—These are two electrolytics in a rectangular cardboard container.

View of the upper side of the tuning unit, as seen from front of the chassis when the fixing screws have been removed to allow the unit to drop. All the pre-set adjustments and oscillator coils are shown. The button numbers correspond with those of the switches.



They are rated at 550 V peak. The black lead is the common negative; red is the positive of C46; yellow is the positive of C45.

Condenser C15.—This was made up of two condensers connected in parallel in our chassis. One was a rectangular silver-mica type; the other a domed disc type. Both were 50 μ F (0.00005 μ F). It is important that similar types are used as replacements, because the combination has a negative temperature coefficient to compensate for tuning drift.

Chassis Divergencies.—Several resistances had values different from those quoted in the makers' manual: R9 was 60 Ω instead of 50 Ω ; R12 was 220,000 Ω instead of 250,000 Ω ; R13 and R20 were 600,000 Ω instead of 500,000 Ω . None of these is serious, and no doubt they were used to avoid production delays. The values given in our tables are those found in our chassis.

C40 was in a single unit beneath the chassis, but in some chassis it may be included in the C36, C42 unit on the chassis deck. C59 is shown in the maker's manual connected directly across C25, but in our chassis its earthy side was returned directly to chassis.

CIRCUIT ALIGNMENT

IF Stages.—Press MW button and tune to 300 m on scale. Turn the volume control to maximum, and the tone control fully clock-

wise. A damping shunt consisting of a 30,000 Ω resistance and a 0.05 μ F condenser in series should be made up.

Connect the shunt between V2 anode and chassis, and the signal generator leads to CG (top cap) of V2 and chassis. Feed in a 465 KC/S (645.16 m) signal and adjust C64 for maximum output. Transfer shunt to signal diode of V3 and adjust C63 for maximum output.

Transfer signal generator lead to control grid (top cap) of V1, leaving existing connector in place. Transfer shunt to anode of V1 hexode, and adjust C62 for maximum output. Transfer shunt to V2 control grid, and adjust C61 for maximum output. Disconnect shunt.

RF and Oscillator Stages (Manual).—With the gang at maximum, scale cursor should coincide with the marks near the tops of the scales. Connect signal generator leads to A1 and E sockets, via a suitable dummy aerial. If the escutcheon plate is removed from the front of the cabinet, the chassis need not be removed.

MW.—With the receiver still tuned to 300 m, feed in a 300 m (1,000 KC/S) signal, and adjust C59, then C53, for maximum output. Check calibration at 500 m (600 KC/S).

LW.—Press LW button, tune to 1,500 m on scale, feed in a 1,500 m (200 KC/S) signal, and adjust C60, then C54, for maximum output. Check calibration at 1,900 m (157.8 KC/S).

SW Bands.—The makers recommend that alignment on these bands should be carried out on the signal of a known station, because the ordinary signal generator would not be satisfactory. Alignment should only be necessary after a component has been replaced, or a new frequency changer fitted. The operator is advised first to tune in on another set a known station near the middle of the appropriate band. The wavelengths should be close to the following: 16 m band, 16.8 m; 19 m band, 19.6 m; 25 m band, 25.4 m; 31 m band, 31 m. The second receiver should be used for checking and identifying the transmission.

If the four bands are to be aligned, always commence with the 31 m band. Tune in the required station on the monitor (second) receiver, and identify it carefully. Press the appropriate button on the Bush receiver, tune to the identified station on the scale, and adjust the appropriate oscillator coil (L11-L14), then the aerial trimmer (C49-C52) for maximum output. Repeat the procedure on the 25 m, 19 m, then the 16 m bands. The aerial trimmer tuning will be found to be fairly flat.

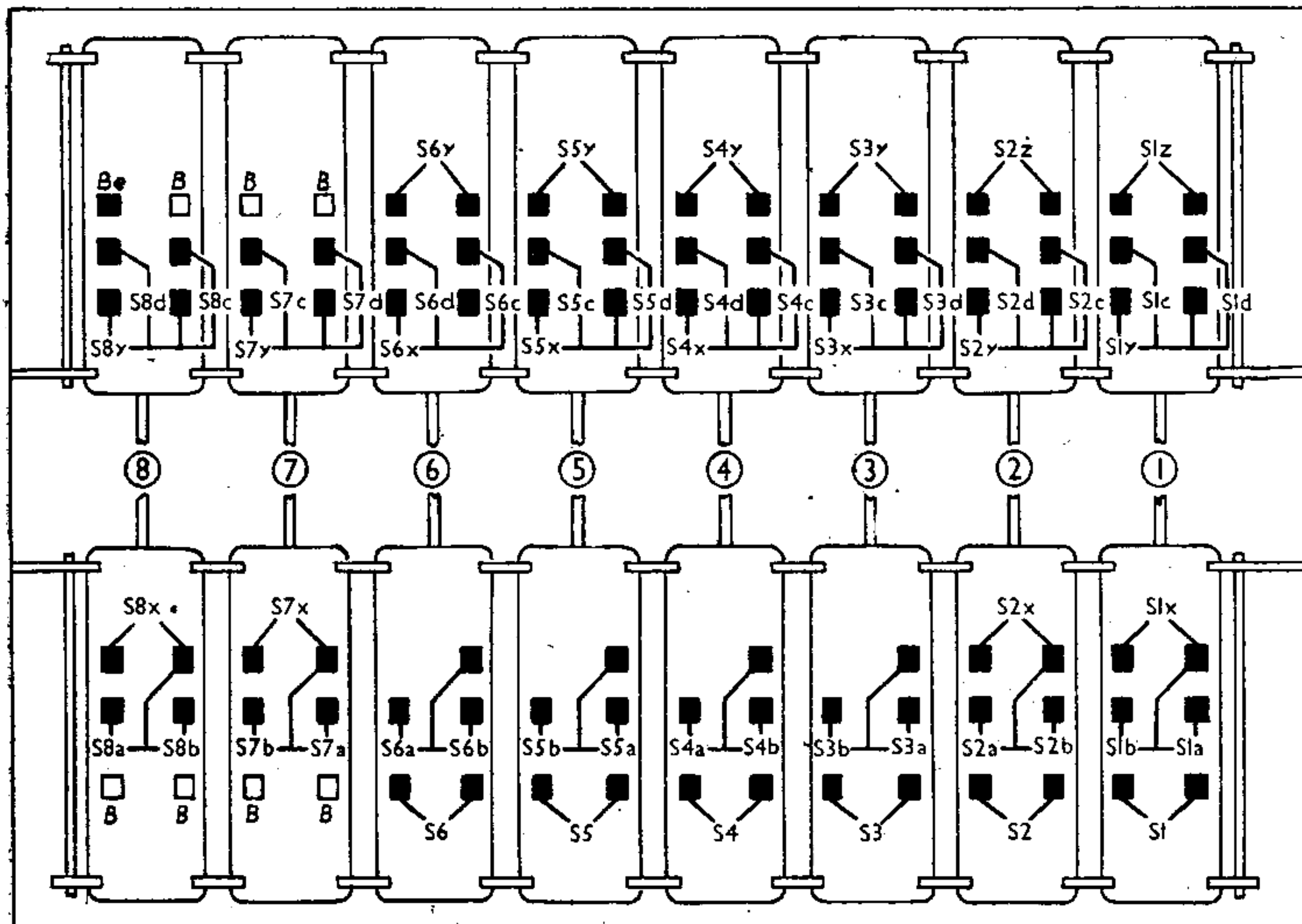
The lock-nut securing the inductance adjusting screw should be slackened before making the adjustment, and the screw should be held securely while the nut is tightened.

PRE-SET STATIONS

The range of each of these is 325-550 m (923-545 KC/S). It is recommended that the adjustment should be made on the actual transmission.

Press the appropriate button, and adjust the oscillator coil core (L9, L10). A clockwise movement increases the wavelength. Then adjust the aerial trimmer (C56, C57) in the same direction. The lock-nut should be treated as described at the end of the SW alignment.

Re-adjustment will be necessary after any alteration to MW and LW manual circuits.



Diagrams showing both sides of the press-button switch unit. Above: side facing chassis deck; below: side seen in under-chassis view. The switches without lettered suffixes are the scale lamp switches.