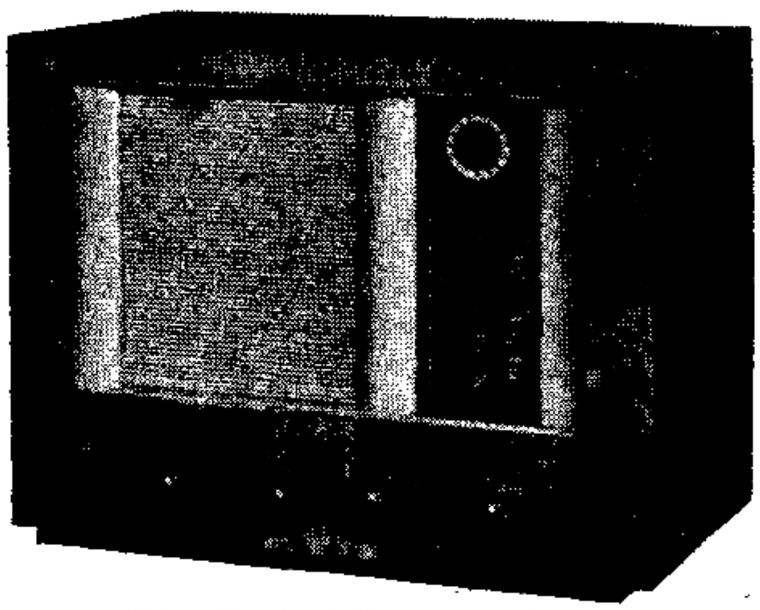
Supplement to The Wireless & Electrical Trader, June 21, 1941

BUSH AC71

AC SUPERHET



The Bush AC71 superhet.

THE Bush AC71 is a 4-valve (plus rectifier) 3-band table superhet, designed to operate from AC mains of 200-250 V, 40-100 C/S. The SW range is 16.5-51 m.

An internal frame aerial is provided for use where an external aerial is not available, and alternative aerial sockets permit two degrees of aerial selectivity to be obtained. Provision is also made for the connection of a gramophone pick-up and an external speaker, and arrangements are made for muting the internal speaker.

Release date: April, 1940.

CIRCUIT DESCRIPTION

Aerial input from socket **A1** via coupling coils **L3** (SW,) **L4** (MW) and **L5** (LW) to single tuned circuits **L6, C40** (SW), **L7, C40** (MW) and **L8, C40** (LW). A second aerial socket **A2** feeds the input circuits via a small series condenser **C1** to increase the selectivity of the aerial circuit. Socket **A1** is marked "Max. sensitivity" and socket **A2** "Max. selectivity."

For use on occasions when no external aerial is available, an internal aerial, comprising coils **L1, L2** is fitted.

First valve **(V1, Mullard ECH33)** is a triode hexode operating as frequency changer with internal coupling. Oscillator grid coils **L9** (SW), **L10** (MW) and **L11** (LW) are tuned by **C41.** Parallel trimming by **C42** (SW), **C12, C43** (MW) and **C13, C44** (LW); series tracking by **C10** (MW) and **C11** (LW). Reaction from anode by coils **L12** (SW) via **C14, L13** (MW) and **L14** (LW).

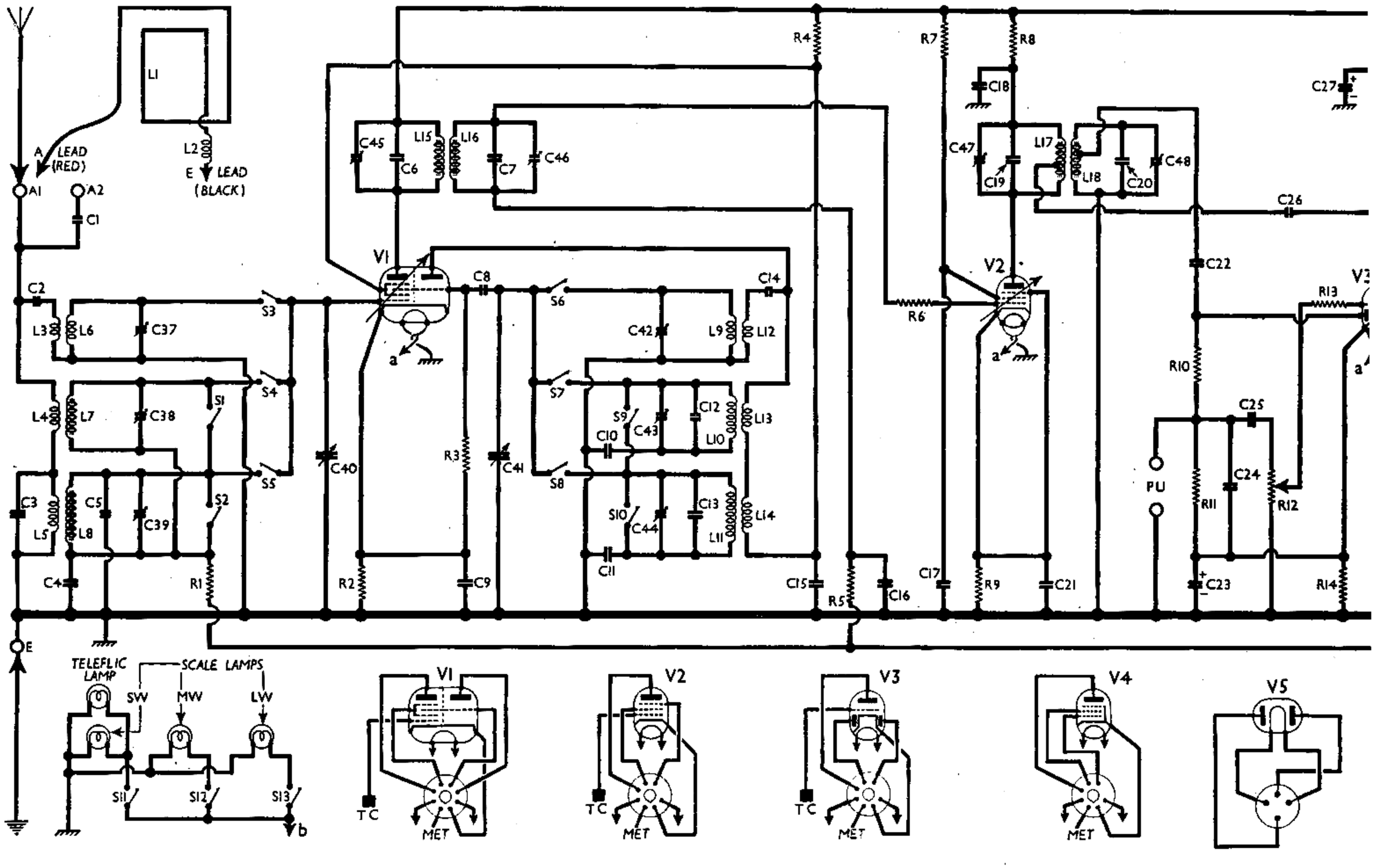
Second valve **(V2, Mullard EF39)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer coupling **C45, C6, L15, L16, C7, C46** and **C47, C19, L17, L18, C20, C48.** The transformers have iron-cored coils, but adjustments are effected by the preset trimming condensers.

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve **(V3, Mullard EBC33).** It is parallel-fed from a tapping on **L18** via the coupling condenser **C22,** and the audio frequency component in the rectified output is developed across load resistances **R10, R11.** The AF signal across **R11** is then passed via AF coupling condenser **C25,** manual volume control **R12** and grid stopper **R13** to CG of triode section, which operates as AF amplifier.

IF filtering by **R10, C24.** Provision for connection of gramophone pick-up by sockets across **C25, R12.** Variable tone control by **R18, C30** in triode anode circuit.

Second diode of **V3,** fed from tapping on **L17** via small coupling condenser **C26,** provides DC potential which is de-



veloped across load resistance **R17** and fed back through decoupling circuits as GB to FC (except on SW) and IF valves, giving automatic volume control.

Delay voltage, together with GB for triode section, is obtained from drop along **R14** in **V3** cathode lead to chassis.

Resistance-capacity coupling by **R16, C29** and **R19** between **V3** triode and pentode output valve **(V4, Mullard EL33).** Fixed tone correction by **C31** in anode circuit. Provision for connection of low impedance external speaker by sockets across the secondary winding of the output transformer **T1,** while a plug and socket device permits the internal speaker to be muted if desired.

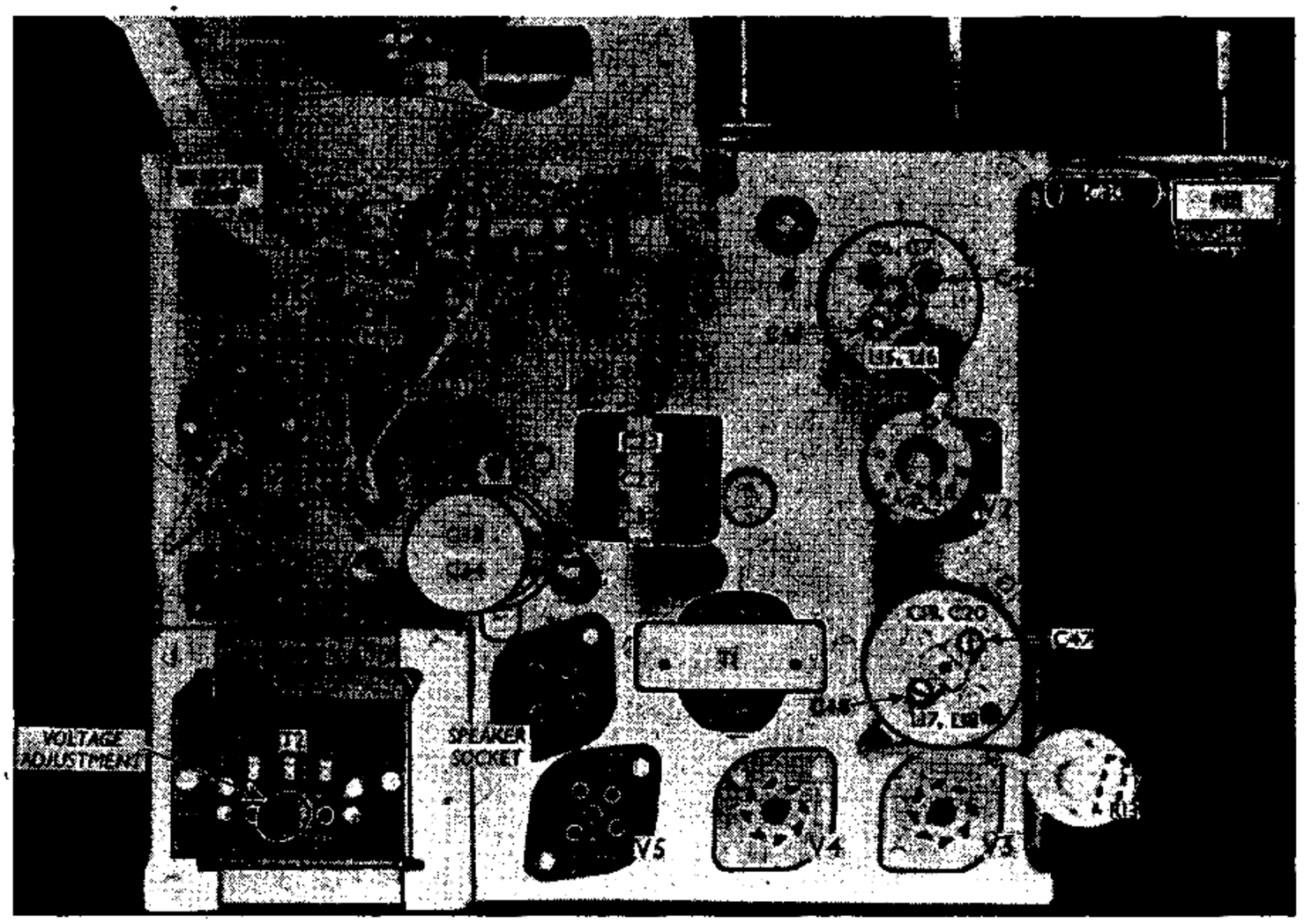
HT current is supplied by full-wave rectifying valve **(V5, Mullard DW4/350).** Smoothing by speaker field **L21** and dry electrolytic condensers **C33, C34.**

VALVE ANALYSIS

Valve voltages and currents given in the table below are those, measured in our receiver when it was operating with mains of 237 V, using the 230 V tapping on the mains transformer.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 ECH33	265	1·6	75	2·6
	Oscillator			
	75	4·0		
V2 EF39	200	5·0	75	1·6
V3 EBC33	110	2·2	—	—
V4 EL33	245	30·0	265	4·0
V5 DW4/350	350†	—	—	—

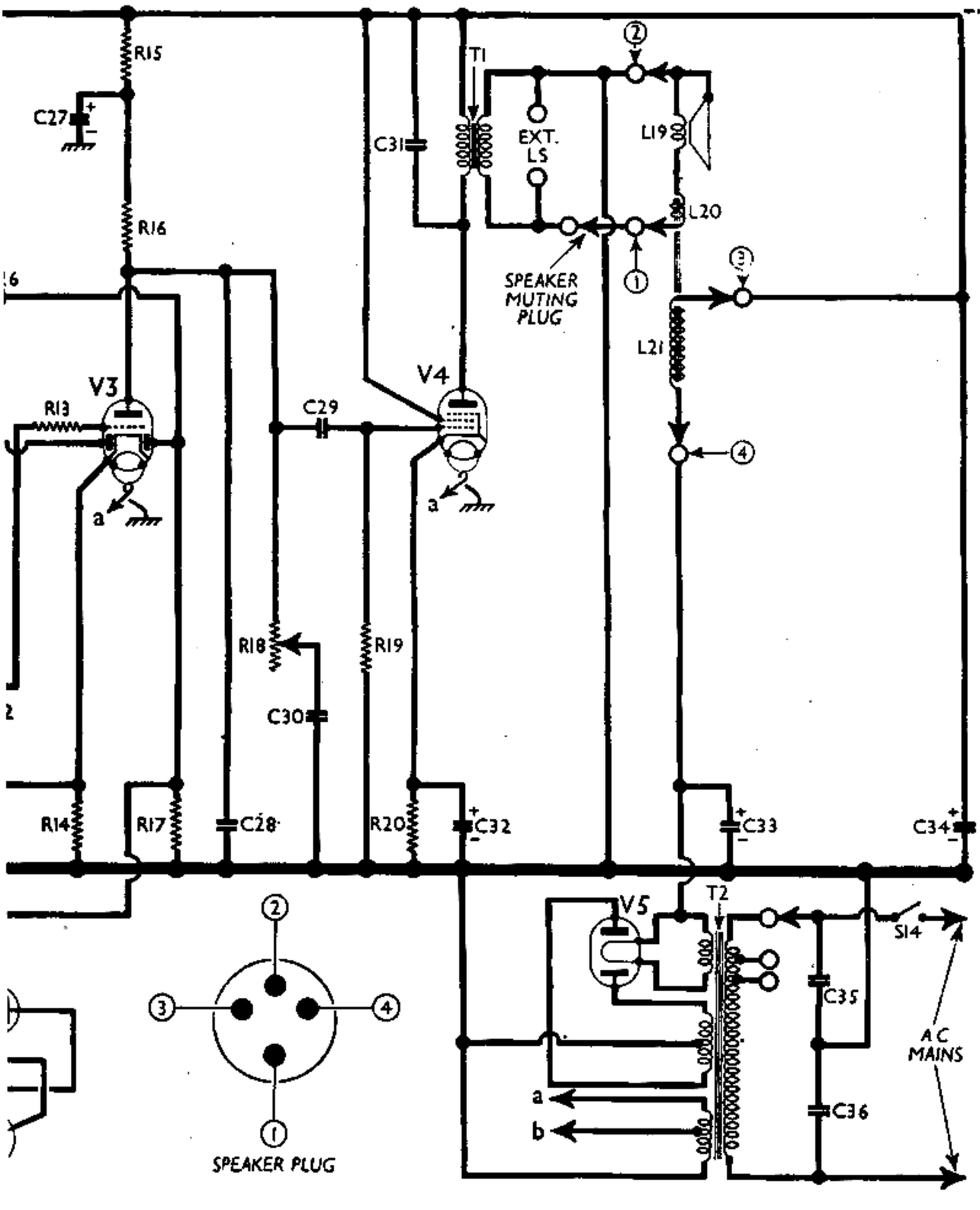
† Each anode, AC.



Plan view of the chassis. **R6** and **R13** are in the top cap screens of **V2** and **V3** respectively. The IF trimmers are indicated.

The receiver was switched to MW and tuned to 300 m, 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.

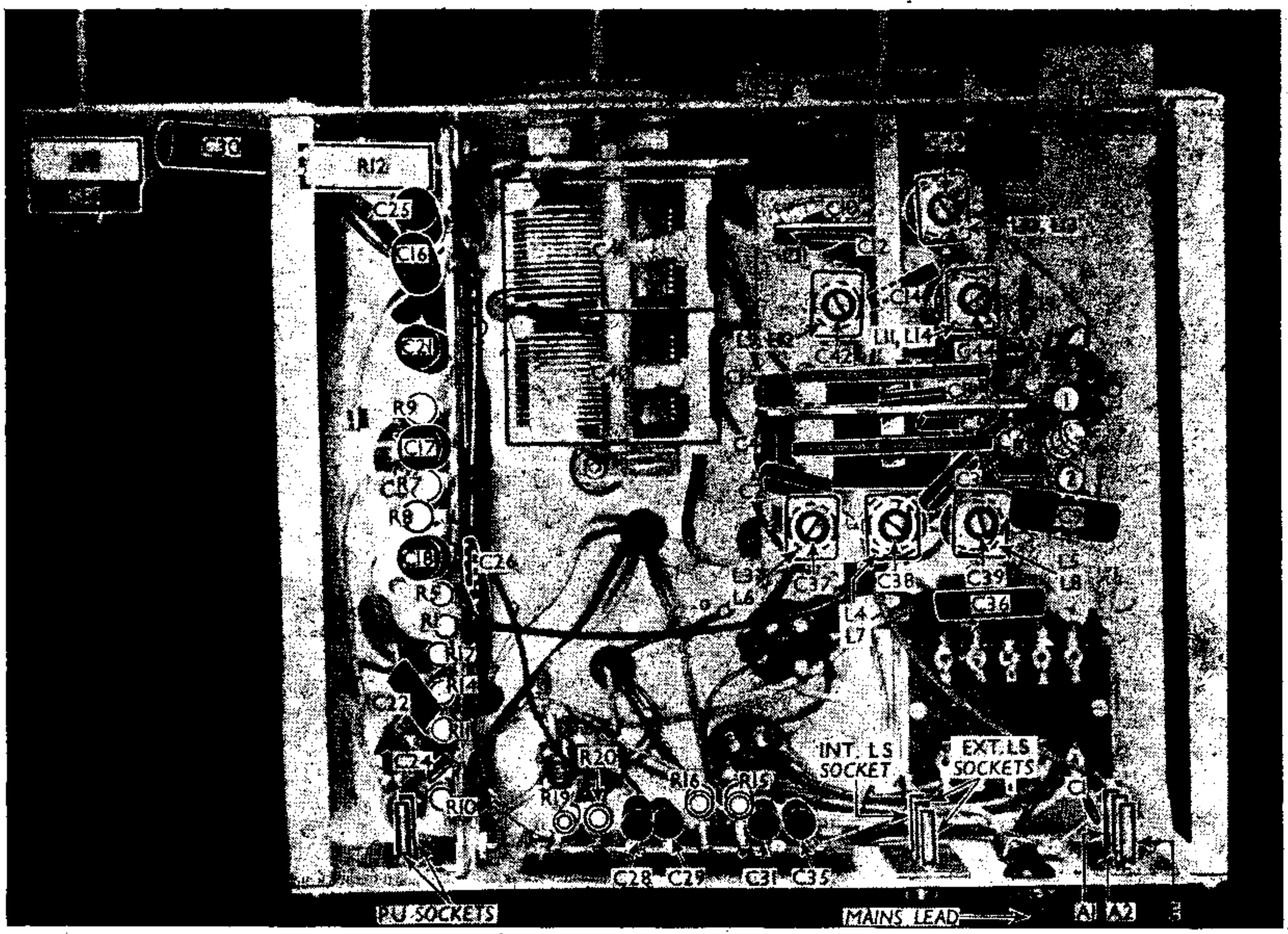


Circuit diagram of the Bush AC71 superhet. **L1, L2** form the internal aerial windings. The 6.3V valve heaters of **V1-V4** are fed from lead *a* on **T2** heater secondary, but the scale lamps are fed from a tapping marked *b*; all return to chassis. The "Teleflic" lamp lights only on the SW band. **V3** signal diode is parallel-fed to load resistances **R10, R11.** Inset below the circuit is a diagram of the speaker plug, drawn as seen when viewed from the free ends of the pins.

COMPONENTS AND VALUES

	CONDENSERS	Values (μF)
C1	A2 series condenser ...	0·00005
C2	Aerial SW coupling ...	0·00005
C3	Aerial LW shunt	0·0008
C4	V1 hexode CG decoupling	0·5
C5	Aerial LW fixed trimmer	0·00003
C6	1st IF transformer fixed tuning condensers ...	0·0001
C7		0·0001
C8	V1 osc. CG condenser ...	0·00003
C9	V1 cathode by-pass ...	0·05
C10	Osc. circuit MW tracker...	0·000556
C11	Osc. circuit LW tracker...	0·000316
C12	Osc. MW fixed trimmer ...	0·00002
C13	Osc. LW fixed trimmer ...	0·00013
C14	V1 osc. anode SW coupling	0·00005
C15	V1 osc. anode and SG decoupling	0·05
C16	V2 CG decoupling ...	0·05
C17	V2 SG decoupling ...	0·05
C18	V2 anode decoupling ...	0·05
C19	2nd IF transformer fixed tuning condensers ...	0·0001
C20		0·0001
C21	V2 cathode by-pass ...	0·05
C22	Coupling to V3 signal diode	0·0001
C23*	V3 cathode by-pass ...	50·0
C24	IF by-pass	0·0001
C25	AF coupling to V3 triode	0·01
C26	Coupling to V3 AVC diode	0·00005
C27*	V3 triode anode decoupling	2·0
C28	Fixed tone corrector ...	0·001
C29	V3 triode to V4 coupling...	0·01
C30	Part variable tone control	0·02
C31	Fixed tone corrector ...	0·003
C32*	V4 cathode by-pass ...	50·0
C33*	HT smoothing condensers	8·0
C34*		16·0
C35	Mains RF by-pass condensers	0·01
C36		0·01
C37‡	Aerial circ. SW trimmer...	0·00004
C38‡	Aerial circ. MW trimmer	0·00004
C39‡	Aerial circ. LW trimmer...	0·00004
C40†	Aerial circuit tuning ...	—
C41†	Oscillator circuit tuning...	—
C42‡	Osc. circ. SW trimmer ...	0·00004
C43‡	Osc. circ. MW trimmer ...	0·00004
C44‡	Osc. circ. LW trimmer ...	0·00004
C45‡	1st IF trans. pri. trimmer	0·00009
C46‡	1st IF trans. sec. trimmer	0·00009
C47‡	2nd IF trans. pri. trimmer	0·00009
C48‡	2nd IF trans. sec. trimmer	0·00009

* Electrolytic.
† Variable.
‡ Pre-set.



Under - chassis view. The two wavechange switch units are indicated by the numbers in circles and arrows, which show the direction in which the units are viewed in the diagrams in col. 5 opposite. All the RF and oscillator trimmers are indicated here. They can be adjusted without dismantling the set if the detachable cover beneath the cabinet is removed.

RESISTANCES		Values (ohms)
R1	V1 hexode CG decoupling	1,000,000
R2	V1 fixed GB resistance ...	200
R3	V1 osc. CG resistance ...	30,000
R4	V1 osc. and SG HT feed ...	30,000
R5	V2 CG decoupling ...	1,000,000
R6	V2 CG stabiliser	50
R7	V2 SG HT feed	100,000
R8	V2 anode HT feed ...	10,000
R9	V2 fixed GB	300
R10	IF stopper	250,000
R11	V3 signal diode load ...	500,000
R12	Manual volume control ...	500,000
R13	V3 triode grid stopper ...	100,000
R14	V3 triode GB ; AVC delay	1,000
R15	V3 triode anode decoupling	10,000
R16	V3 triode anode load ...	50,000
R17	V3 AVC diode load ...	1,000,000
R18	Variable tone control ...	250,000
R19	V4 CG resistance... ...	500,000
R20	V4 GB resistance... ...	200

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	0·6
L5	Aerial LW coupling coil	30·0
L6	Aerial SW tuning coil ...	Very low
L7	Aerial MW tuning coil ...	1·8
L8	Aerial LW tuning coil ...	15·0
L9	Osc. circ. SW tuning coil	Very low
L10	Osc. circ. MW tuning coil	1·7
L11	Osc. circ. LW tuning coil	2·7
L12	Osc. SW reaction coil ...	0·1
L13	Osc. MW reaction coil ...	1·0
L14	Osc. LW reaction coil ...	2·1
L15	1st IF trans. Pri.	3·8
L16	1st IF trans. Sec.	3·8
L17	2nd IF trans. Pri., total ...	3·8
L18	2nd IF trans. Sec., total ...	3·8
L19	Speaker speech coil ...	2·0
L20	Hum neutralising coil ...	0·2
L21	Speaker field coil ...	2,000·0
T1	Output trans. Pri.	700·0
	Output trans. Sec.	0·3
T2	Mains trans. Pri., total ...	53·0
	Mains trans. Heater sec., total	0·1
	Mains trans. Rect. heat. sec....	0·1
	Mains trans. HT sec., total ...	700·0
S1-S10	Waveband switches ...	—
S11-S13	Scale lamp switches ...	—
S14	Mains switch, ganged R18	—

DISMANTLING THE SET

The base of the cabinet is fitted with a detachable cover, upon removal of which (four round-head wood screws) access can be gained to the RF and oscillator trimmers and other components beneath the chassis.

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

withdraw the speaker plug from its socket on the chassis deck;

remove the two round-head wood screws holding the top of the scale assembly to the front of the cabinet;

remove the four screws (with claw washers, embedded in the cabinet) holding the chassis to the bottom of the cabinet.

When replacing, fit a felt washer to each control spindle, between the knob and the front of the cabinet.

Removing Speaker.—Withdraw the connecting plug from its socket on the chassis deck, and free the leads from the cleat;

remove the four nuts (with brass washers) holding the speaker to the sub-baffle.

When replacing, the connecting leads should emerge from the upper side of the speaker assembly.

GENERAL NOTES

Switches.—S1-S10 are the waveband and **S11-S13** the scale lamp switches, in two ganged rotary units beneath the chassis. They are indicated by arrows and numbers in circles in our under-chassis view, and shown in detail in the diagrams in column 5, where they are drawn as seen when viewed from the rear of the underside of the chassis. The table (next col.) gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control.

An additional switch, not shown in the diagrams, is formed by the centre (shorting) plate in the scale lamp section of the switch assembly. It closes on SW, connecting the outer contact of **S12** to that of **S13.** This switch is incidental in the design of the unit, and is of no importance.

S14 is the QMB mains switch, ganged with the tone control **R18.**

Coils.—L1 is a small frame winding for use as an internal aerial when no external aerial is available. A small RF choke **L2** is connected in series with the earthy end of it. A flexible cable from the two ends of the system is terminated in a pair of plugs for insertion in the "**Max.** sensitivity" aerial **(A1)** and earth sockets. The aerial plug is red, and the earth plug black.

All the RF and oscillator tuning and coupling coils **L3-L14** are in six unscreened tubular units, with their pre-set trimmers mounted at the ends of the respective units, beneath the chassis.

The six units, with the waveband switches and other components associated with the tuning circuits, are mounted on a metal platform to form a tuning unit.

Switch Table

Switch	LW	MW	SW
S1	—	C	C
S2	—	C	C
S3	—	—	C
S4	—	C	—
S5	C	—	—
S6	—	—	C
S7	—	C	—
S8	C	—	—
S9	—	—	C
S10	—	C	—
S11	—	—	C
S12	—	C	—
S13	C	—	—

The aerial and oscillator sections are separated by a vertical metal screen.

The IF transformers **L15, L16** and **L17, L18** are in two screened units on the chassis deck with their associated fixed tuning condensers and pre-set trimmers.

Scale and Indicator Lamps.—These are four Ever Ready MES types, with spherical bulbs, rated at 6.2 V, 0.3 A. Three are used to illuminate the tuning scales, each lighting only when its appropriate scale is in use; the fourth illuminates the "Teleflic" scale, and lights only when the SW band is in use. The lamps are energised from a tapping (marked **b** in the circuit diagram) on the heater secondary of **T2.**

The three scale lamps are mounted on an insulated strip, which can be withdrawn upon removal of two square nuts (with lock-washers). The "Teleflic" lamp and reflector is mounted on a bracket, which is fixed by two knurled nuts.

Condensers C23, C27, C32.—These are three dry electrolytics in a cardboard container mounted by a metal strap on the chassis deck. Of the leads, which emerge through a hole in the deck into the underside of the chassis, the red is the positive of **C27,** which is rated at 2 μF, 550 V peak. The two yellow leads are the positive connections of **C23** and **C32,** which are rated at 50 μF, 15 V peak. The black lead is the common negative, and goes directly to chassis.

Condensers C33, C34.—These are two dry electrolytics in a tubular metal container mounted vertically on the chassis deck. The red spotted tag is the positive of **C33** (8 μF) and the other the positive of **C34** (16 μF). Both condensers are of the surge limiting type, and are rated at 450 V working.

Speaker Plug.—The speaker leads are terminated by a four-pin valve base type plug. A diagram of the plug, viewed from the free ends of the pins, is inset beneath the circuit diagram, showing the pin numbers. The connections are indicated in the circuit diagram by circles and arrows, and each point is numbered to correspond with the appropriate plug pin.

Gramophone Pick-up.—Two sockets are provided at the rear of the chassis for a gramophone pick-up. The pick-up plugs must be withdrawn for radio operation.

External Speaker.—Three sockets are provided at the rear of the chassis for a low impedance (about 2.5 O) external speaker and internal speaker muting. The middle and top sockets are strapped together, and the speaker muting plug is normally left in the top socket; the middle and bottom sockets are the external speaker sockets. The plug must be withdrawn from the top socket to mute the internal speaker only when an external speaker is connected.

Valves.—All the valves in this receiver, with the exception of the rectifier, are Mullard E types fitted with standard American octal bases. This is indicated in their type numbers by the addition of a prefix figure 3 in the numbered portion of their type numbers. Thus: **EF39** is the octal equivalent of the side-contact based **EF9**, the **3** indicating that an octal base is fitted. The valves require a **6.3** heater secondary on the mains transformer, and as the scale lamps require only 4 V AC, they are fed from a tapping on the same secondary.

SERVICE HINTS

Low Sensitivity.—The valves should be replaced by a set known to be up to standard.

Voltage readings should be checked on all valves before trying to locate insensitivity in any part of the circuit.

If these are found to be correct, apply an AF signal into the pick-up sockets to check for sensitivity in **V3** and **V4** and their associated circuits; should these prove to be correct, a 465 KC/S signal from the generator should be fed into the control grid (top cap) of the IF stage **V2.** This will enable the components between the anode of **V2** and the control grid of **V3** to be checked.

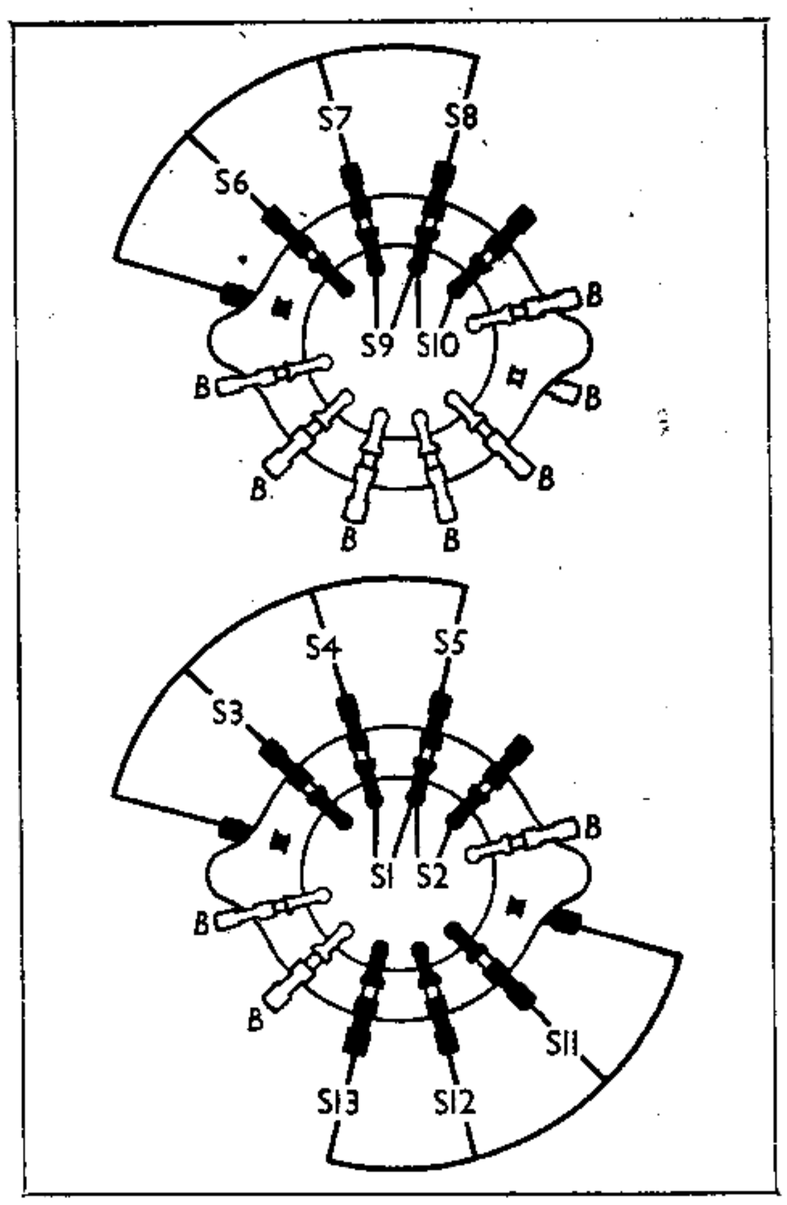
To check the 1st IF transformer, transfer the signal generator to the hexode anode of **V1** (pin 3).

From these tests it should be possible to trace the fault to the aerial or oscillator circuits of **V1.**

The oscillator circuits can then be checked by connecting the generator to the hexode control grid (top cap) and inserting an RF signal within the limits of each band.

If the circuits are oscillating, transfer the generator to the aerial input and check the components by inserting a similar signal to that used for the oscillator circuits on each waveband.

Provided one carefully studies the circuit diagram and checks back from the rectifying to the aerial circuits, there should be no difficulty in locating the most obscure fault should it arise. It is essential that the HT voltages should be checked first, and with the help of the valve table in col. 4 overleaf, abnormal readings can be traced, leading to the actual part of the circuit at fault.



Diagrams of the two switch units as seen when viewed from the rear of the underside of the chassis.

Instability.—Instability is mostly caused by a failure in one of the decoupling condensers; these condensers can be grouped around each valve circuit.

V1—C4, C9, C15;
V2—C16, C17, C18, C21;
V3—C23, C27;
V4—C32;
V5—C33, C34.

Faulty screening of the AF input leads to the control grid of **V3** will cause AF instability.

It should be noted that when a continuity test is made on the output transformer primary, the condenser **C31** is connected directly across the winding; if **C31** is short-circuited this will show as a short on the primary.

CIRCUIT ALIGNMENT

IF Stages.—A damping circuit consisting of a 30,000 O resistance and a 0.05 μF condenser should be made up before alignment is commenced. Switch the receiver to MW and tune to 300 m on scale, connect signal generator leads to the control grid (top cap) of **V2** and chassis, turn volume control to maximum, and tone control to "low" (anti-clockwise). Feed in a 465 KC/S (645.16 m) signal, connect damping circuit between **V2** anode and chassis, and adjust **C48** for maximum output. Transfer "top" end of damping circuit to signal diode (pin 5) of **V3,** and adjust **C47** for maximum output.

Transfer signal generator leads to control grid (top cap) of **V1** and chassis, and the "top" of the damping circuit to **V1** anode. Still feeding in the same signal, adjust **C46** for maximum output. Transfer "top" of damping circuit to control grid (top cap) of **V2,** and adjust **C45** for maximum output. Remove damping circuit.

RF and Oscillator Stages.—With the gang at maximum, the pointer should coincide with the highest calibration mark on the SW scale. Transfer signal generator leads to **A1** and **E** sockets via suitable dummy aerials. These may consist of a 400 O non-inductive resistance for SW, and a 0.0002 μF condenser for MW and LW. Access to the RF and oscillator trimmers may be obtained if the detachable cover is removed from the bottom of the cabinet.

SW.—Switch set to SW, tune to 18 m on scale, feed in an 18 m (16.67 MC/S) signal, and adjust **C42,** then **C37,** for maximum output. Check calibration at 50 m (6.0 MC/S).

MW.—Switch set to MW, tune to 300 m, feed in a 300 m (1,000 KC/S) signal, and adjust **C43,** then **C38,** for maximum output. Check calibration at 500 m (600 KC/S).

LW.—Switch set to LW, tune to 1,500 m on scale, feed in a 1,500 m (200 KC/S) signal, and adjust **C44,** then **C38,** for maximum output. Check calibration at 1,900 m (157.6 KC/S).

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