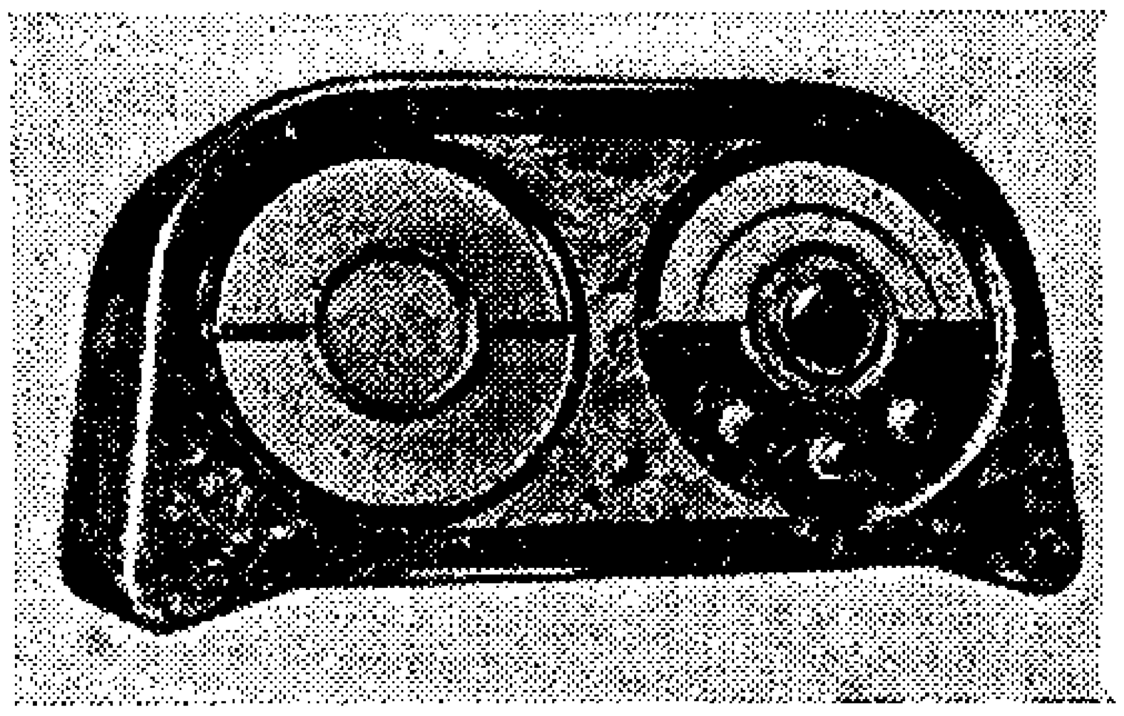
EKCO AC86 AND RG86 AC SUPERHETS



The Ekco AC86 in the walnut finish cabinet.

AMPLIFIED delayed automatic volume control, incorporated with a noise suppressor circuit, with a third IF transformer winding for coupling to the AVC diode, form a novel feature in circuit design in the Ekco AC86. The operation is somewhat complex, but it is fully explained in the circuit description that follows.

The receiver is a 5-valve (plus rectifier) 2-band superhet, designed to operate from AC mains of 200-250 V, 40-80 c/s. Provision is made for the connection of a gramophone pick-up and a low impedance external speaker.

The set is housed in a plastic cabinet, made in walnut or black and chromium finish.

The RG86 is a radiogram version of the AC86, employing a chassis basically the same as that in the table model. Some small modifications occur in the pick-up circuit, but there are no considerable differences between the two chassis.

Release date, all models : 1936.

Original prices : *AC*86, *walnut*, £13 2s. 6d.; *black and chromium*, £13 13s. *RG*86, £23 2s.

CIRCUIT DESCRIPTION

Aerial input via series condenser **C1** and **S1** (MW), or **C1**, **L1** and **S2** (LW), to tappings on primary coils of inductively coupled band-pass filter. Primary coils **L2** (MW) and **L3** (LW) are tuned by **C25**; secondary coils **L4** (MW) and **L5** (LW) are tuned by **C27**. Coupling by mutual inductance of primary and secondary windings, which are wound on a common former. **L1** is included in the aerial lead on LW to prevent MW break-through on that band. Image suppression by **C24**.

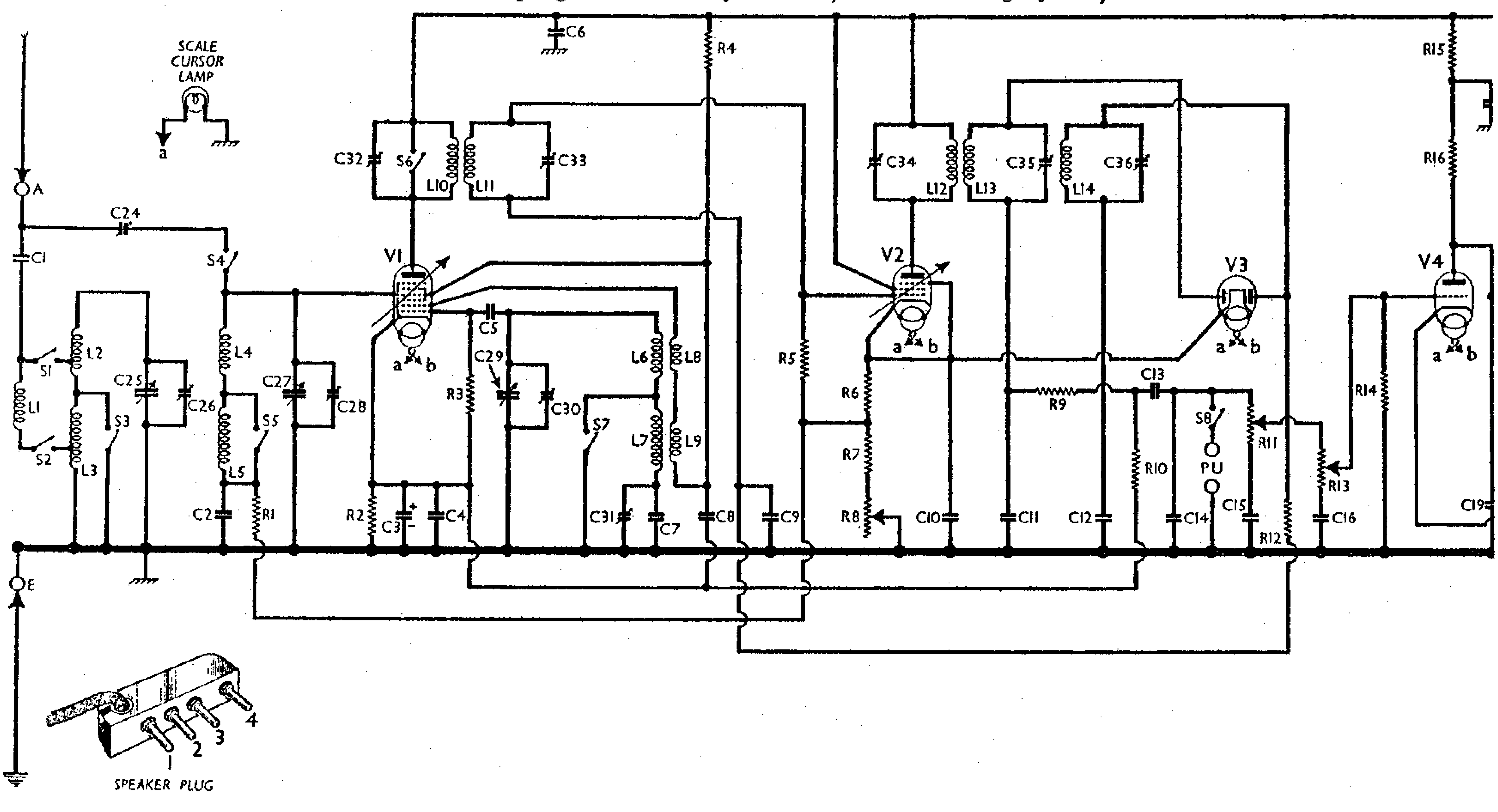
First valve **(V1, Mullard metallised FC4** or **Cossor 41MPG)** is an octode operating as frequency changer with electron coupling. Oscillator grid coils **L6** (MW) and **L7** (LW) are tuned by **C29**. Parallel trimming by **C30** (MW); tracking by specially shaped stator vanes of **C29** (MW), with the addition of series capacity of condensers **C7**, **C31** (LW). Reaction coupling from anode by coils **L8**, **L9**.

Second valve **(V2, Mazda metallised AC/VP1)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C32**, **L10**, **L11**, **C33** and **C34**, **L12**, **L13**, **C35**, **L14**, **C36**. The significance of the resistors **R6**, **R7**, **R8** in the cathode lead, and the third circuit **L14**, **C36** of the second IF transformer, is explained later under "The AVC System."

Intermediate frequency 130 kc/s.

Diode second detector is part of separate double diode valve **(V3, Mazda metallised V914** or **Mullard 2D4A)** Audio frequency component in rectified output developed across load resistor **R10** which, it should be noted, is returned to **V1** cathode, is passed via AF coupling condenser **C13**, manual volume control **R11**, **C15** and variable tone control circuit **R13**, **C16** to control grid of triode valve **(V4, Mullard metallised 354V)**, which operates as AF amplifier. **C15** compensates for the normal loss of bass as the volume control is turned down.

R9 and **R10** together form the total diode load, but only 50 per cent. of the total rectified signal, that across **R10**, is passed on to the AF amplifier. In addition to providing a step-down coupling, **R9** also operates in conjunction with **C11**, **C14** to form an IF filter. Further IF filtering by **C19**, in **V4** anode circuit.

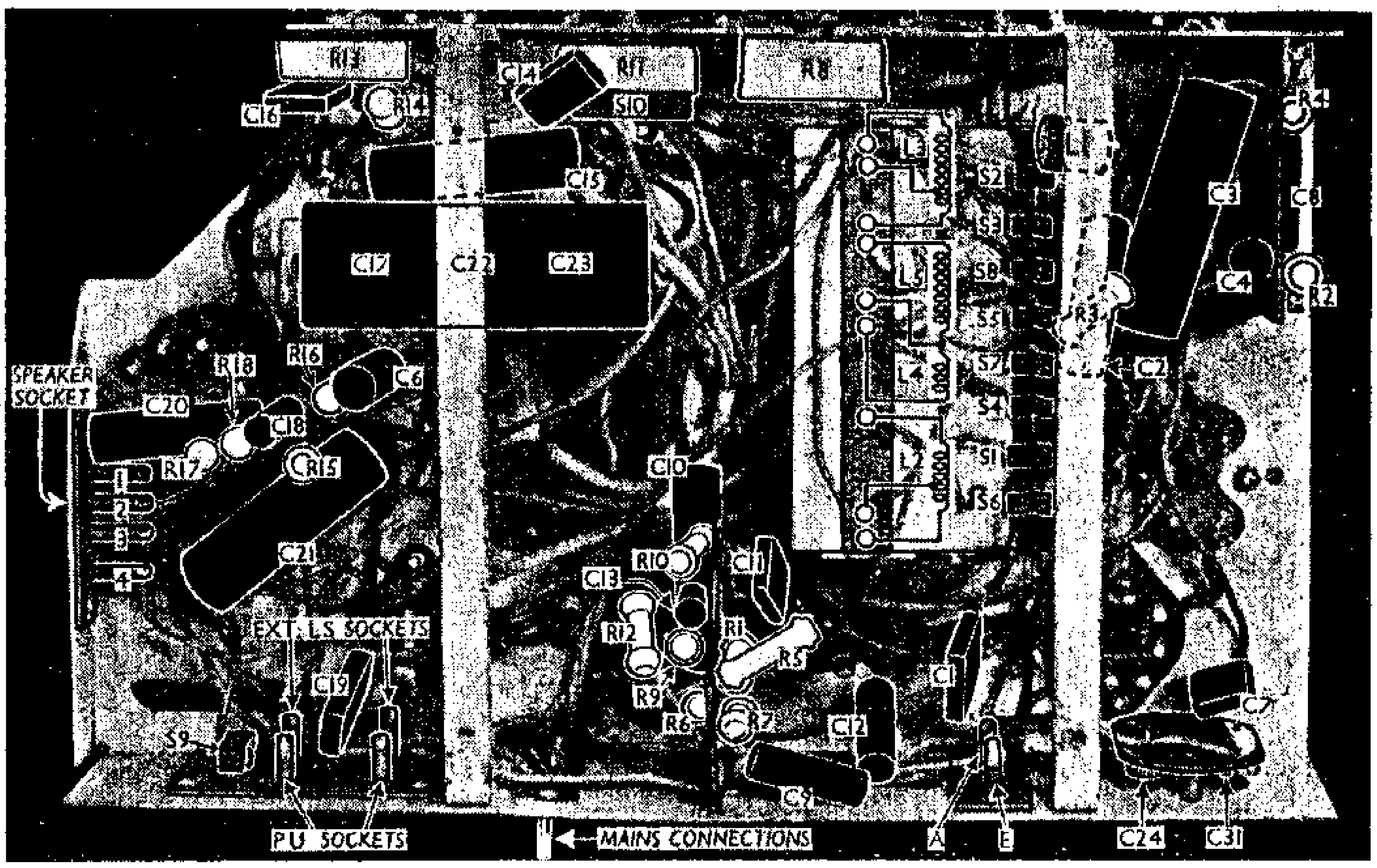


Provision is made for the connection of a gramophone pick-up, which may be left permanently connected since it is connected across **R11** via **S8** which, in turn, is operated by the main waveband switch control. When **S8** closes, **S6** also closes to short-circuit the output from **V1** and thus mute radio.

Resistance-capacity coupling by **R16, C18, R17** between **V4** and pentode output valve **(V5, Mazda AC/Pen).** Fixed tone correction by **C20** in anode circuit.

Provision is made for the connection of a low impedance external speaker by sockets across the secondary winding of the output transformer **T1,** while **S9** permits the internal speaker to be muted if desired.

HT current is supplied by IHC full-wave rectifying valve **(V6, Mullard IW3** or **Mazda UU3).** Smoothing by speaker field **L17** and dry electrolytic condensers **C22, C23.** HT circuit RF filtering by **C6.**



Under-chassis view. The RF coils, shown diagrammatically, are in a screened container. The waveband switches, in a unit attached to the coil unit, are identified here by numbers at the side of the row of connecting tags.

The AVC System

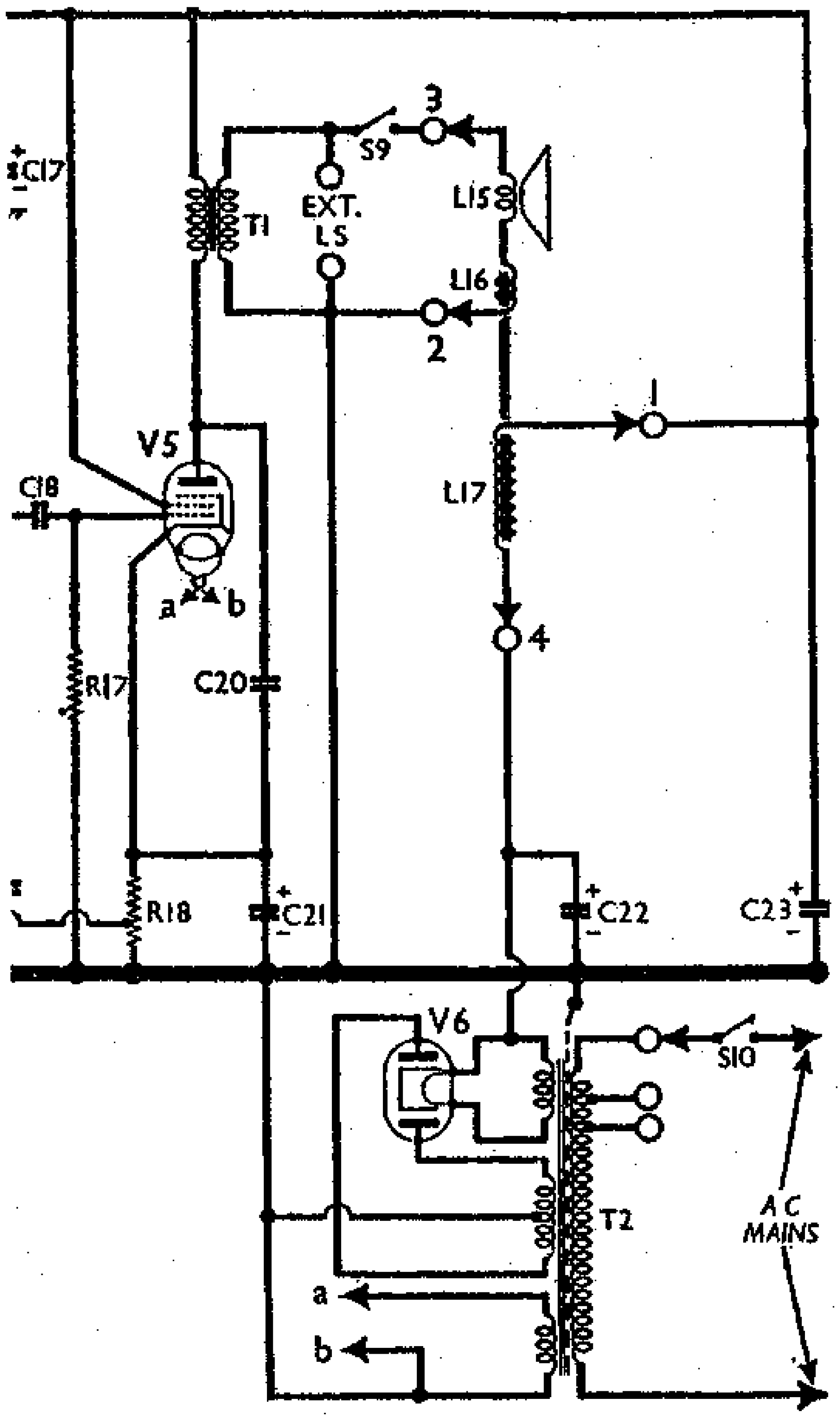
It will be observed from the circuit diagram that the second diode of **V3,** fed from the link coil (the third winding, **L14,** on the second IF transformer) is returned via **R12, L11** and **R5** to a point in the potential divider **R6, R7, R8** in **V2** cathode circuit, and that **V3** cathode is connected directly to **V2** cathode. Thus the second, or AVC diode of **V3** is biased negatively with respect to its cathode; the nominal potential difference is 2-3 V.

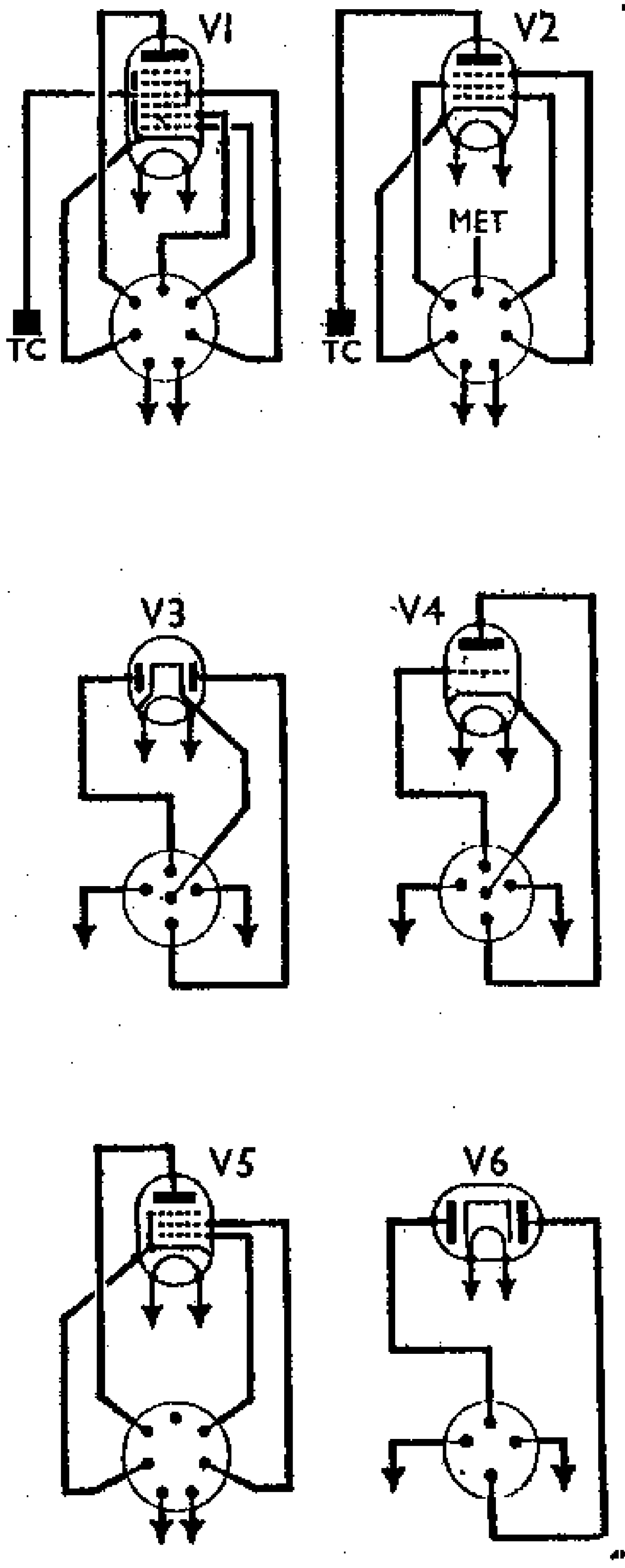
R12 and **R5** are the AVC diode load resistors, and are actually connected in series in the normal manner. The potential across **R6** provides a semi-fixed GB for **V2** at the same time as it provides AVC delay, and when a signal strong enough to overcome the delay voltage reaches the AVC diode, the diode current flowing through **R5** increases the bias potential applied to **V2** control grid, causing the anode current to fall in the usual manner, applying simple direct AVC to **V2.**

V1 pentode control grid is returned via a decoupling circuit to the same point in **V2** cathode circuit as **R5,** and with the noise suppression control **R8** at the "All Stations" position, or maximum sensitivity (when **R8** is virtually short-circuited), **V1** cathode is slightly positive with respect to its control grid, the respective voltages being approximately 44 V and 42 V above chassis before AVC action commences.

As **V2** HT current falls, however, with AVC action, the positive potential at the top of **R7** falls also, so that **V1** control grid becomes more negative with respect to its cathode. The stronger the signal at **V3** diodes, the more negative does **V2** control grid become; and consequently the more negative does **V1** control grid become also, but at a greater rate according to the amplification of **V2,** resulting in delayed amplified AVC action.

The signal diode anode load **R9, R10** is returned to **V1** cathode, which has been slightly positive with respect to **V2, V3** cathodes throughout the process, so that the diode handles any signal which reaches it.





Circuit diagram of the Ekco AC86. The signal diode load is returned to V1 cathode. V1 control grid is returned to V2 cathode, as is also the AVC diode load circuit R12, R5. L14 is the "Link coil" coupling to the AVC diode. A sketch of the speaker plug appears beneath the circuit, and the points of connection are numbered in the diagram.

Noise Suppression

The noise suppressor control is marked in three grades: "All Stations", "Medium" and "Strong", although actually this means for our purposes minimum, medium and maximum noise suppression respectively. The markings refer to the strength of signal required to overcome the delay.

The AVC action with minimum suppression has just been described. When the suppressor control is turned to "Strong", all except very strong transmissions are suppressed, and as the control is continuously variable, it is intended to be adjusted to a position in which all stations too weak to be heard satisfactorily above local interference are suppressed, with the interference. The following describes the action when the suppressor is turned to "Strong", or maximum suppression.

The slider of **R8** is now at the bottom of its element, and the total resistance of **R7** and **R8** is 15,000 Ω. **R6** may be neglected, except to remember that it delays AVC action. In the absence of a signal, **V2** cathode will be about 90 V positive, while **V1** cathode will be 60 V positive, with respect to chassis, so that

V1 control grid is biased to about 30 V positive, and **V3** signal diode about 30 V negative, with respect to their own cathodes.

Under these conditions, **V1** will operate very inefficiently, while no signal will be rectified by the heavily biased signal diode. A very strong signal, however, will force its way through to the IF stages, and if it reaches the AVC diode in sufficient strength to overcome the AVC delay, AVC action will commence, reducing the HT current through **V2**, causing the potential difference across **R7, R8** to fall, and thus reducing the positive voltage applied to **V1** control grid and the negative delay voltage to the signal diode, until at some point the signal diode delay will be exceeded by the signal voltage, and a rectified signal will be handed on to the AF stages. **V1** control grid will continue to become increasingly negative as the signal strength increases, resulting in normal AVC action once the suppression voltage has been overcome.

At intermediate positions of the suppressor control, the same thing happens with a smaller initial delay voltage, and only in very bad conditions of interference is it necessary to use maximum suppression.

DISMANTLING THE SET

Removing Chassis.—Remove the five control knobs (recessed grub screws) from the front of the cabinet;

withdraw the speaker plug from its socket at the side of the chassis deck;

remove the four screws from beneath the cabinet, when the chassis, with its two mounting rails, may be withdrawn. The rails may be detached from the chassis if the fixing screws are removed.

When replacing, the control spindle of the noise suppressor should be turned to its fully clockwise position. The knob should then be fitted, with the sector marked "Strong" uppermost.

Removing Speaker.—Withdraw the connecting plug, remove the screw from the speaker magnet support (threaded into the magnet) and remove the four nuts holding the speaker to the sub-baffle.

When replacing, the magnet support screw hole should be at the top.

COMPONENTS AND VALUES

	RESISTORS	Values (ohms)
R1	V1 pent. CG decoupling...	500,000
R2	V1 fixed GB resistor ...	6,000*
R3	V1 osc. CG resistor ...	50,000
R4	V1 osc. and SG HT feed...	15,000*
R5	Part AVC diode load ...	250,000
R6	V2 fixed GB resistor and AVC delay	300
R7	Noise suppressor limiter...	5,000
R8	Noise suppressor control	10,000
R9	IF stopper	100,000
R10	V3 signal diode load ...	100,000
R11	Manual volume control	250,000
R12	Part AVC diode load ...	250,000
R13	Variable tone control ...	500,000
R14	V4 CG resistor	1,000,000
R15	V4 anode decoupling ...	9,000
R16	V4 anode load	25,000
R17	V5 CG resistor	250,000
R18	V4, V5 GB resistor ...	400†

* Tolerance limits ± 5%.
† Tapped at 75 Ω from chassis.

	CONDENSERS	Values (μF)
C1	Aerial series condenser...	0·0008
C2	V1 pent. CG decoupling	0·1
C3*	V1 cathode AF by-pass...	10·0
C4	V1 cathode RF by-pass...	0·1
C5	V1 osc. CG condenser ...	0·001
C6	HT circuit RF by-pass...	0·1
C7	Osc. LW fixed tracker ...	0·0007
C8	V1 HT decoupling ...	0·1
C9	V2 CG decoupling ...	0·01
C10	V2 cathode by-pass ...	0·1
C11	IF by-pass	0·0002
C12	Link coil DC isolator ...	0·01
C13	AF coupling to V4 ...	0·01
C14	IF by-pass	0·0003
C15	Base compensator ...	0·25
C16	Part variable tone control	0·0005
C17*	V4 anode decoupling ...	2·0
C18	V4 to V5 AF coupling ...	0·01
C19	IF by-pass	0·001
C20	Fixed tone corrector ...	0·0025
C21*	V5 cathode by-pass ...	25·0
C22*	HT smoothing condensers	8·0
C23*	HT smoothing condensers	8·0
C24‡	Image suppressor ...	—
C25†	Band-pass pri. tuning ...	—
C26‡	B-P pri. MW trimmer ...	—
C27†	Band-pass sec. tuning ...	—
C28‡	B-P sec. MW trimmer ...	—
C29†	Oscillator circuit tuning	—
C30‡	Osc. circ. MW trimmer...	—
C31‡	Osc. circ. LW tracker ...	—
C32‡	1st IF trans. pri. tuning	—
C33‡	1st IF trans. sec. tuning	—
C34‡	2nd IF trans. pri. tuning	—
C35‡	2nd IF trans. sec. tuning	—
C36‡	Link coil tuning ...	—

* Electrolytic. † Variable. ‡ Pre-set.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial LW choke ...	50·0
L2	Band-pass primary coils...	3·0
L3	Band-pass primary coils...	30·0
L4	Band-pass secondary coils	3·0
L5	Band-pass secondary coils	30·0
L6	Osc. MW tuning coil ...	5·0
L7	Osc. LW tuning coil ...	10·0
L8, L9	Oscillator reaction coils, total	5·0
L10	1st IF trans. Pri. ...	80·0
L11	1st IF trans. Sec. ...	80·0
L12	2nd IF trans. and link coil	80·0
L13	2nd IF trans. and link coil	80·0
L14	2nd IF trans. and link coil	120·0
L15	Speaker speech coil ...	2·2
L16	Hum neutralising coil ...	0·2
L17	Speaker field coil ...	2,200·0
T1	Speaker input trans. Pri.	800·0
	Speaker input trans. Sec.	0·4
T2	Mains trans. Pri. total ...	36·5
	Heater sec. ...	0·1
	Rect. heat. sec.	0·2
	H.T. sec., total	600·0
S1-S5, S7	Waveband switches ...	—
S6	Radio muting switch ...	—
S8	Gram PU switch ...	—
S9	Internal speaker switch...	—
S10	Mains switch, ganged R11	—

VALVE ANALYSIS

Valve voltages and currents given in the table below are those quoted in the makers' manual. When taking readings the volume control should be at maximum, and the noise suppressor should be at "All Stations." There should be no signal input.

Except in the case of **V1** screen, all voltages are measured with the negative meter lead connected to chassis, and as **V1** and **V2** cathode voltages are not normal, their approximate values are quoted beneath the table.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 FC4	250	3.4	90*	4.0
	Oscillator 125	Oscillator 2.8		
V2 AC/VP1	250	7.1	250	0.9
V3 2D4A	—	—	—	—
V4 354V	150	2.5	—	—
V5 AC/Pen	225	28.0	250	5.4
V6 IW3	300†	—	—	—

†Cathode to chassis, D.C.
*Screen to cathode, not chassis.
V1 cathode (all stations), 44V approx.
V1 cathode (strong), 60 V approx.
V2 cathode (all stations), 42V approx.
V2 cathode (strong), 90V approx.

GENERAL NOTES

Switches.—S1-S5 and **S7** are the waveband switches, and **S6, S8** are the radio muting and gramophone pick-up switches, in a three-position ganged assembly beneath the chassis. The assembly is indicated in our under-chassis view, where the pairs of tags associated with each switch are individually identified.

The control is continuously rotatable in either direction, but the knob, which is located by its fixing screw in a slot in the control spindle, is marked with three coloured spots to indicate the position to which it is turned: black (MW); red (LW); white (gram). The table below gives the switch positions for the three control settings, starting with the black spot uppermost (MW) and turning in a clockwise direction.

Switch Table

Switch	MW (black)	LW (red)	Gram (white)
S1	C	—	—
S2	—	C	—
S3	C	—	—
S4	C	—	—
S5	C	—	—
S6	—	—	C
S7	C	—	—
S8	—	—	C

S9 is a screw-type switch, mounted on a panel at the rear of the chassis, for muting the internal speaker. It is closed when screwed up.

S10 is the QMB mains switch, ganged with the volume control **R11.**

Coils.—L2-L5 are the band-pass tuning coils, wound on a wooden former and enclosed in metal screen which completely surrounds them. The screen is then bolted to the case of the waveband switch assembly, the whole forming a complete unit. **L1** is an RF choke, mounted outside the unit. Its purpose is to prevent MW break-through on the LW band. The assembly is shown in our under-chassis view, where the connections from the coils, brought out to pins protruding through an insulating panel, are indicated diagrammatically. An external wire connects together the two pins at the extreme ends.

The oscillator coils **L6-L9** are in a screened unit on the chassis deck, as are also the IF transformers **L10, L11** and **L12, L13, L14.** Both IF units contain their respective trimmers.

Gramophone Pick-up.—Two sockets are provided on the panel at the rear of the chassis for the connection of a gramophone pick-up, and as they are switched in and out of circuit by the main switch control, the pick-up may be left permanently connected. The socket nearer the chassis deck is connected directly to chassis.

External Speaker.—Two further sockets are provided on the same panel for connecting a low-impedance (about 4-6 Ω) external speaker. Switch **S9**, described under "Switches," permits the internal speaker to be muted if desired.

Scale Cursor Lamp.—The scale lamp is enclosed in a metal shield, the light showing through a double "V" aperture at the front of the shield to illuminate part of the scale. A cursor line between the ends of the aperture throws a shadow on the scale, and the whole assembly then travels over the scale as a cursor, illuminating the scale from the rear.

The lamp is rated at 6.3 V, 0.3 A; it is fitted with an MES base and a large clear spherical bulb. Its flexible connecting lead is taken in one or two large loops round the tuning spindle to one side of the holder; the return connection runs to chassis via the mounting bracket.

R2, R4, C3.—Special conditions are required in the case of these three components. The resistors **R2, R4** have critical tolerance limits, and replacements should be within ± 5% of the rated values. **R2** is rated at 6,000 Ω, and **R4** at 15,000 Ω.

The condenser **C3** is not critical as regards its rated capacity, but it performs an unusual function, and if it deteriorates to any considerable extent, AVC "flutter," which gives the impression of AF instability, occurs, and is extremely difficult to trace. It is electrolytic, but it requires an RF by-pass, which is provided by **C4**. Further, as **V1** cathode operates at unusually high positive potentials, **C3** is rated at 100 V working. The sample in our chassis was a TCC type AW, rated at 10 μF, 100 V.

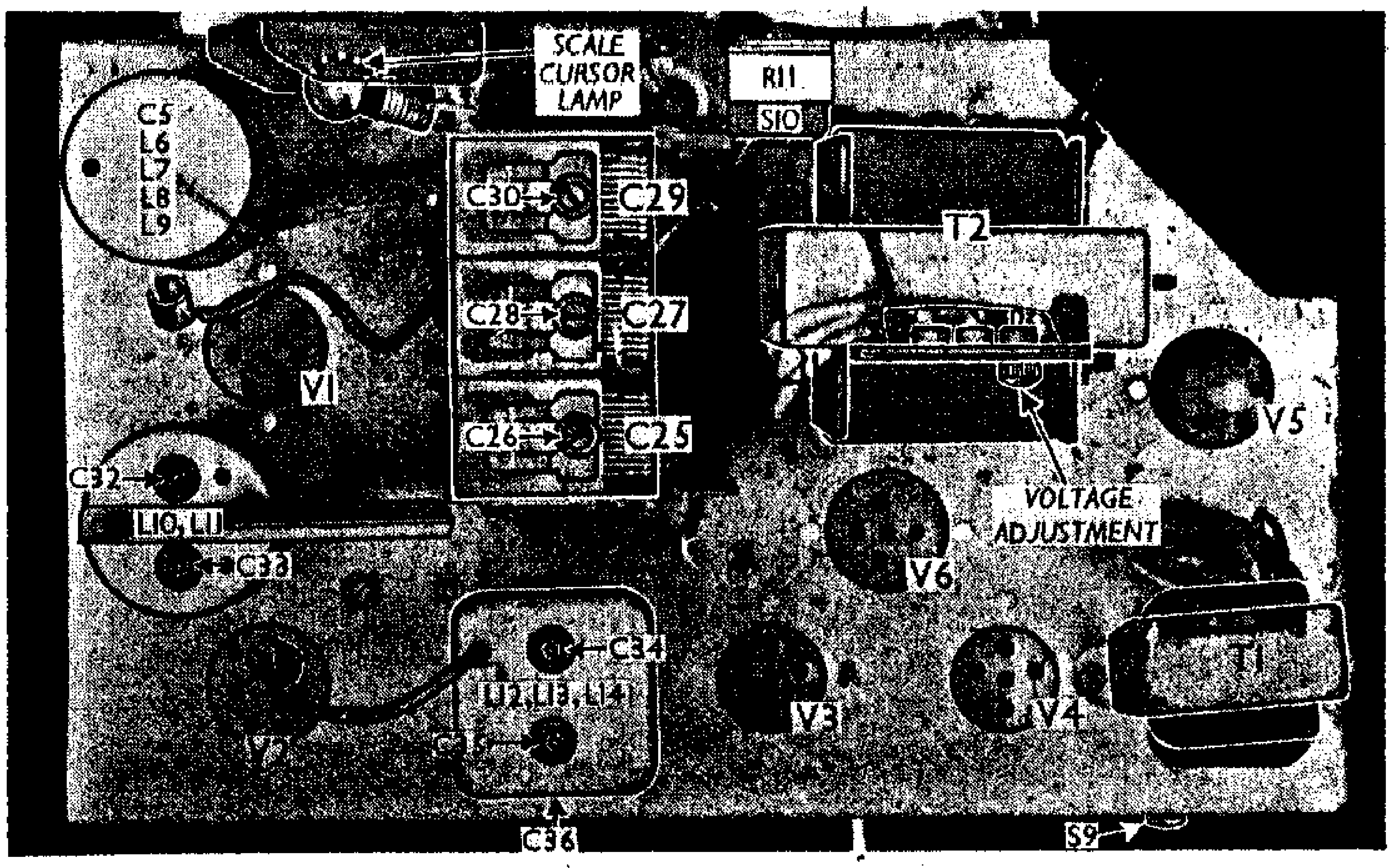
Condenser C21.—This is a tubular electrolytic, rated at 25 μF, 15 V peak working.

Condensers C17, C22, C23.—These are three electrolytics in a single cardboard rectangular container fitted beneath the chassis. All three condensers are rated at 500 V peak. The red and blue outlet leads are the positive connections for **C22** and **C23** (8 μF each), and the yellow lead is the positive of **C17** (2 μF). The black lead is the common negative connection.

Resistor R18.—This is the combined GB resistor for **V4** and **V5**. It is wire-wound, with a tapping point 75 Ω from the chassis end. The whole resistor is included in **V5** cathode lead, and **V4** cathode is connected to the tapping. A safe power rating for a replacement would be 1 watt.

Common Faults.—The most common faults, and some which can be baffling, are an untraceable AF motor-boating, insensitivity, unresponsive volume control action, and instability, with bad quality, in the output stage.

The apparent AF motor-boating can be caused by deterioration of **C3**, as previously explained, and is actually AVC "flutter." Sometimes it produces untraceable trouble with the volume control. Another fault that affects the volume control directly, and renders it inoperative, is the base compensator **C15** if it becomes open-circuited. The remedy here is to replace the condenser or, alternatively, to dispense with the compensator and connect the bottom of **R11** directly to chassis.



Plan view of the chassis. The speaker socket is on the right-hand end of the chassis, but can only be seen in the under-chassis view overleaf.

Insensitivity can be produced by unequal ageing of **V1** and **V2**, the effect being out of all proportion to the loss that would be expected from the same degree of ageing in a normal circuit. The result is an enhanced suppression effect, amplifying the normal action of the suppressor circuit. If **V1** and **V2** age together, the trouble should not occur. It would, however, be advisable always to replace the two valves together when one fails.

Bad quality, sometimes having the appearance of instability, will result from a small deterioration in the quality of **C21**. A quick test can be made by connecting a good 25 μF electrolytic condenser temporarily in parallel with **C21**, and if a change is observed, the old condenser should be removed and the replacement fitted.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator to **A** and **E** sockets, turn the noise suppressor control to the "All Stations" position, the volume control to maximum, switch set to LW, and turn the gang to maximum capacity.

Feed in a 130 kc/s (2,307.7 m) signal. If it cannot be detected, transfer aerial clip to control grid (top cap) of **V1**. Adjust **C32, C34, C33** and **C35** in that order, for maximum output, reducing signal input as the circuits come into line. Now adjust **C36** for *minimum* output.

RF and Oscillator Stages.—Connect signal generator leads via a suitable dummy aerial to **A** and **E** sockets. At minimum and maximum positions of the gang the cursor should be horizontal. In this position, stops on the cursor arm should rest, at each end of the sweep, against the condenser drive spindle support bracket.

MW.—Switch set to MW, tune to 200 m on scale, feed in a 200 m (1,500 kc/s) signal; and adjust **C30** for maximum output. Tune to 250 m on scale, feed in a 250 m (1,200 kc/s) signal, and adjust **C26** and **C28** for maximum output. Check calibration at 500 m (600 kc/s) and other convenient points on the scale.

LW.—Switch set to LW, tune to 1,600 m on scale, feed in a 1,600 m (187.5 kc/s) signal and adjust **C31** for maximum output while rocking the gang slightly for optimum results.

Image Suppressor.—This was originally intended to operate at various wavelengths according to the location of the receiver, but the relative powers and frequencies of transmitters have since been modified considerably, and their sites may have been changed, so that the original adjustment may not be effective.

If image interference is experienced, therefore, it may be minimised by tuning the receiver to the frequency at which it is found and adjusting **C24** for minimum interference, using the speaker as an indicator.

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