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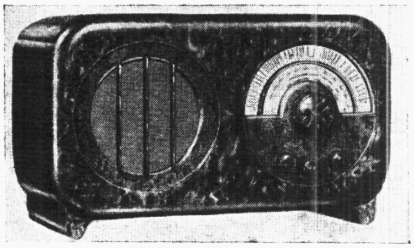
654

EKCO AC85

AC SUPERHET



The appearance of the Ekco AC85 in the walnut finish cabinet.

AMPLIFIED delayed automatic volume control, incorporated with a noise suppressor circuit, with a third IF transformer coupling to the AVC diode, form a novel feature in circuit design in the Ekco AC85. The operation is very 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 high impedance external speaker.

The set is housed in a plastic cabinet, made in walnut or black and chromium finish. A special model is made for 25 c/s mains.

Release date: 1935.

Original prices: walnut, £13 2s. 6d.; black and chromium, £13 13s. 25 c/s mains models 10s. 6d. extra.

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.**

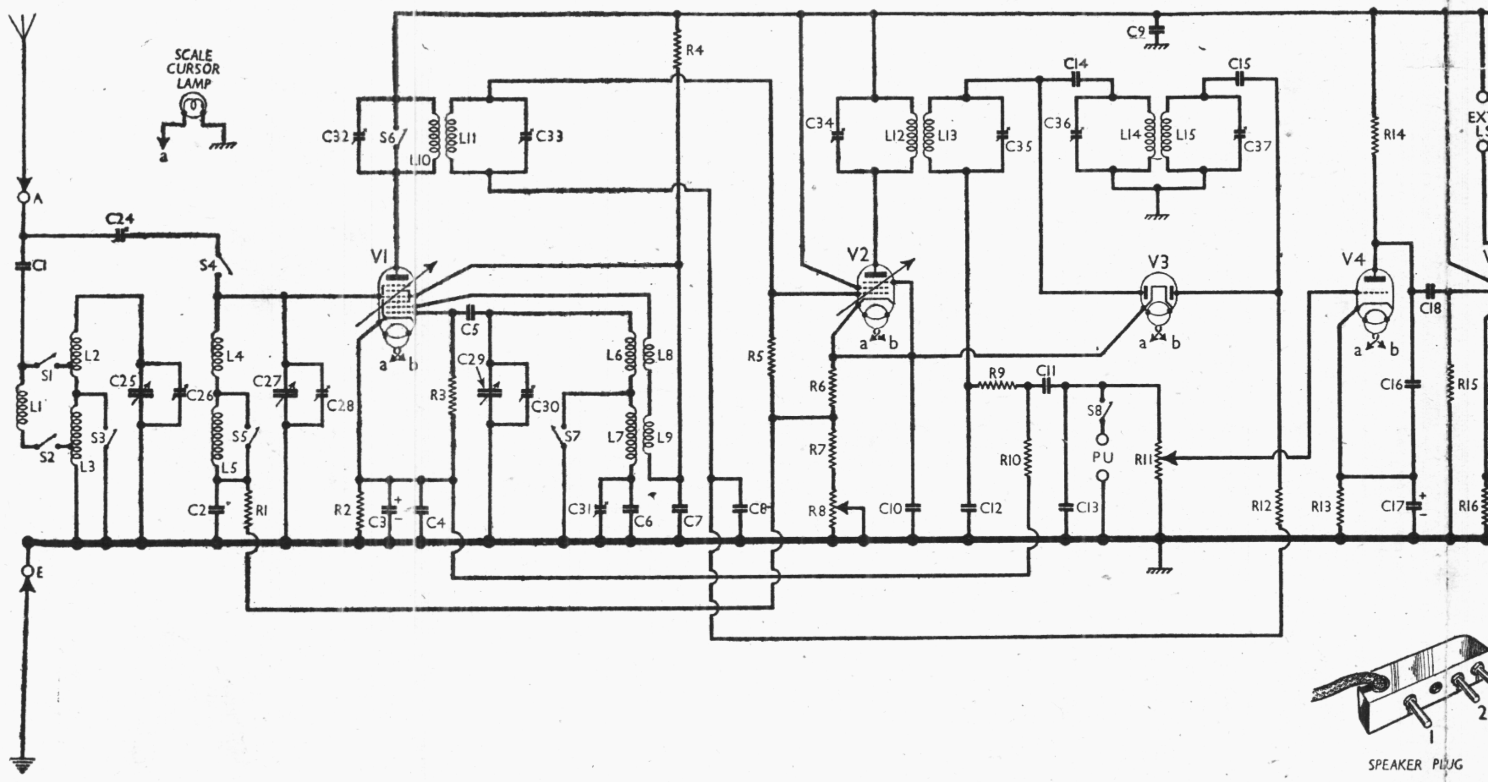
First valve **(V1, Mullard metallised FC4** or **Cossor 41MPG)** is an octode operating as frequency changer with electron coupling. Oscillator grid coils **L6** (MW) and **L7** (LW) are tuned by **C29.** Parallel trimming by **C30** (MW); tracking by specially shaped stator vanes of **C29** (MW), with the addition of series capacity of condensers **C6, 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.** The significance of the resistors **R6, R7, R8** in the cathode lead is explained later.

Intermediate frequency 110 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 **C11** and manual volume control **R11** to control grid of triode valve **(V4, Mullard metallised 354V),** which operates as AF amplifier.

R9 and **R10** together form the total diode load, but only 50 per cent. of the total rectified signal, that across **R11,** is passed on to the AF amplifier. In addition to providing a step-down coupling, **R9** also operates in conjunction with **C12, C13** to form an IF filter. Further IF filtering is performed by **C16,** 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

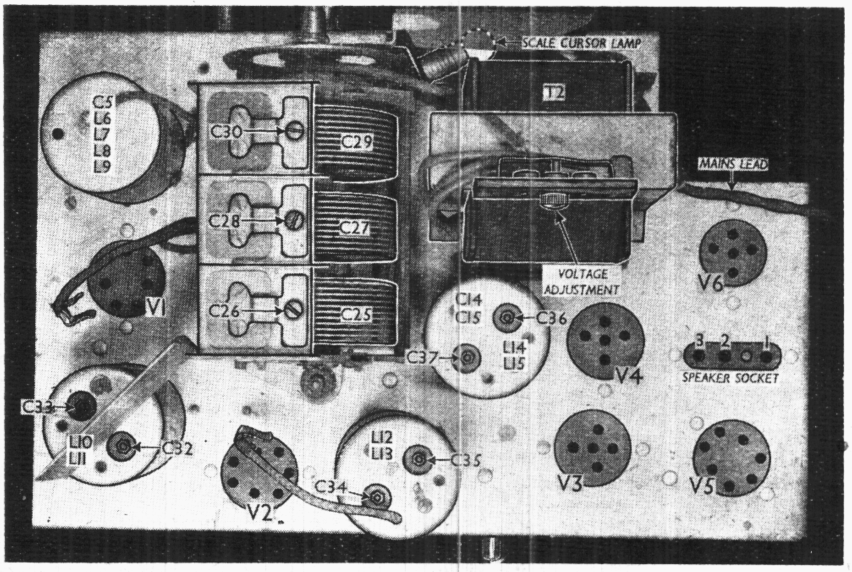


switch control. When **S8** closes, **S6** also closes to short-circuit the output from **V1** and thus mute radio.

Resistance-capacity coupling by **R14, C18, R15** between **V4** and pentode output valve **(V5, Mazda AC/Pen).** Fixed tone correction by **C20** in anode circuit. Three-position tone control adjustment by plug and socket device in association with resistance-capacity filter **C21, R17.** The tone control sockets are marked **L, M, H,** for low, medium and high tone response, as shown in the circuit diagram. There is no connection to the "H" socket.

Provision is made for the connection of a high impedance external speaker in **V1** anode circuit, while **S9** permits the internal speaker to be muted by disconnecting the primary of the output transformer **T1** from the valve anode. The external speaker leads are thus at HT positive potential, and the external speaker must be continuous as the anode current flows via that speaker when the internal speaker is muted.

HT current is supplied by IHC full-wave rectifying valve **(V6, Mullard IW3** or **Mazda UU3).** Smoothing by speaker field **L18** and dry electrolytic condensers **C22, C23.** HT circuit RF filtering by **C9.**



Plan view of the chassis. The link coil coupling condensers, **C14, C15** are contained in the **L14, L15** assembly. The speaker socket is indicated on the right.

The AVC System

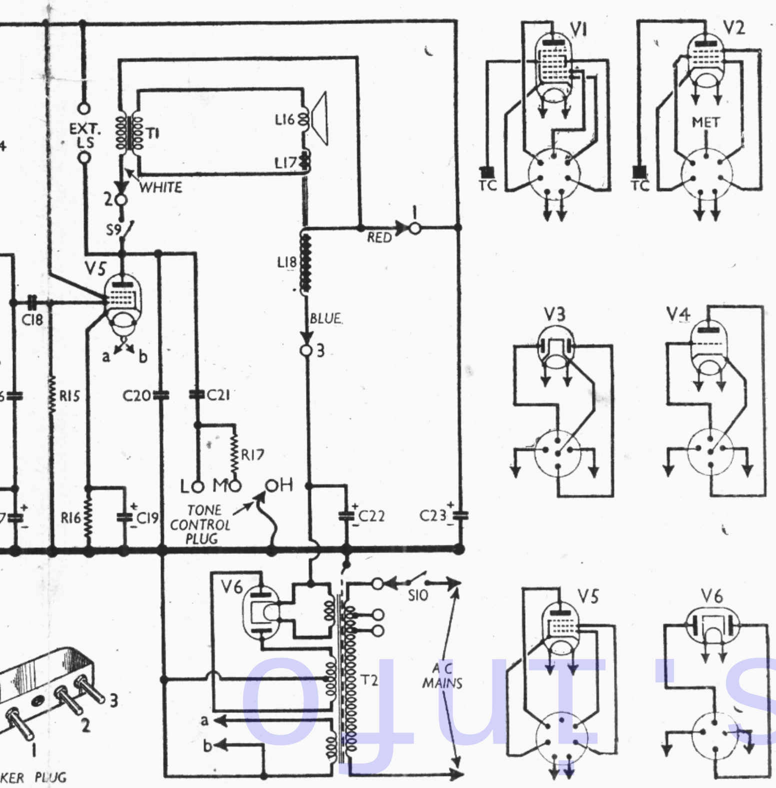
It will be observed from the circuit diagram that the second diode of **V3,** fed from the link coil transformer **C36, L14, L15, C37,** is returned via **R12, L11** and **R5** to a point in the potential divider **R6, R7, R8** in **V2** cathode circuit, and that **V3** cathode is connected directly 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 short-circuited), **V1** cathode is slightly positive with respect to its control grid, the respective voltages being approximately 60 V and 55 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 AC85 superhet. **R12** and **R5** form the AVC diode load, and are connected in series in the normal manner, but via **L11**. **R6** provides AVC delay and **V2** fixed GB. IF coupling to the AVC diode is via the "Link Coil," **L14, L15,** which is a normal IF transformer. The action of the amplified delayed AVC circuit is explained in the "Circuit Description." A sketch of the speaker plug is shown beneath the circuit, and its connecting points 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 95 V positive, while **V1** cathode will be 65 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.

COMPONENTS AND VALUES

CONDENSERS		Values (μF)
C1	Aerial series condenser ...	0·001
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	Osc. circuit LW fixed tracker	0·0008
C7	V1 osc. and SG decoupling	0·1
C8	V2 CG decoupling ...	0·01
C9	HT circuit RF by-pass ...	0·1
C10	V2, V3 cathodes by-pass	0·1
C11	AF coupling to V4 ...	0·01
C12	} IF by-pass condensers ... {	0·0003
C13		0·0005
C14	Link coil input coupling	0·0001
C15	Coupling to V3 AVC diode	0·0001
C16	IF by-pass	0·002
C17*	V4 cathode by-pass ...	25·0
C18	V4 to V5 AF coupling ...	0·1
C19*	V5 cathode by-pass ...	25·0
C20	Fixed tone corrector ...	0·0025
C21	Part of tone control ...	0·01
C22*	} HT smoothing condensers {	8·0
C23*		12·0
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 pri. tuning ...	—
C37‡	Link coil sec. tuning ...	—

* Electrolytic. † Variable. ‡ Pre-set.

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	V4 GB resistor	1,000
R14	V4 anode load	50,000
R15	V5 CG resistor	250,000
R16	V5 GB resistor	375
R17	Part variable tone control	9,000

* Tolerance limits ± 5%.

OTHER COMPONENTS			Approx. Values (ohms)
L1	Aerial LW choke	...	18·0
L2	} Band-pass primary coils ... {		2·7
L3			27·7
L4	} Band-pass secondary coils {		2·7
L5			27·7
L6	Osc. MW tuning coil	...	4·7
L7	Osc. LW tuning coil	...	13·7
L8, L9	} Oscillator reaction coils ...		4·5
L10	1st IF trans.	Pri. ...	110·0
L11		Sec. ...	110·0
L12	2nd IF trans.	Pri. ...	110·0
L13		Sec. ...	110·0
L14	Link coil	Pri. ...	110·0
L15		Sec. ...	110·0
L16	Speaker speech coil	...	1·5
L17	Hum neutralising coil	...	0·2
L18	Speaker field coil ...	...	2,200·0
T1	Speaker input trans.	Pri.	630·0
		Sec.	0·4
T2	Mains trans.	Pri., total ...	36·5
		Heater sec. ...	0·1
		Rect. heat. sec.	0·2
		HT sec., total	609·0
S1-S5, S7	} Waveband siwtches	...	—
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.

Value	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 FC4	260	3·4	90*	4·0
	Oscillator 154	2·8		
V2 AC/VP1	260	2·2	260	9·0
V3 V914	—	—	—	—
V4 354V	133	1·2	—	—
V5 AC/Pen	238	28·0	260	5·4
V6 IW3	360†	—	—	—

†Cathode to chassis, DC.
*Screen to cathode, not chassis.
V1 cathode, 60v approx.
V2 cathode (all stations), 55V approx.
V2 cathode (strong), 95V approx.

DISMANTLING THE SET

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

withdraw the speaker plug from its socket on 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" in the uppermost position.

Removing Speaker.—Withdraw the connecting plug and remove the four nuts holding the speaker to the sub-baffle.

When replacing, the transformer should be on the right.

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

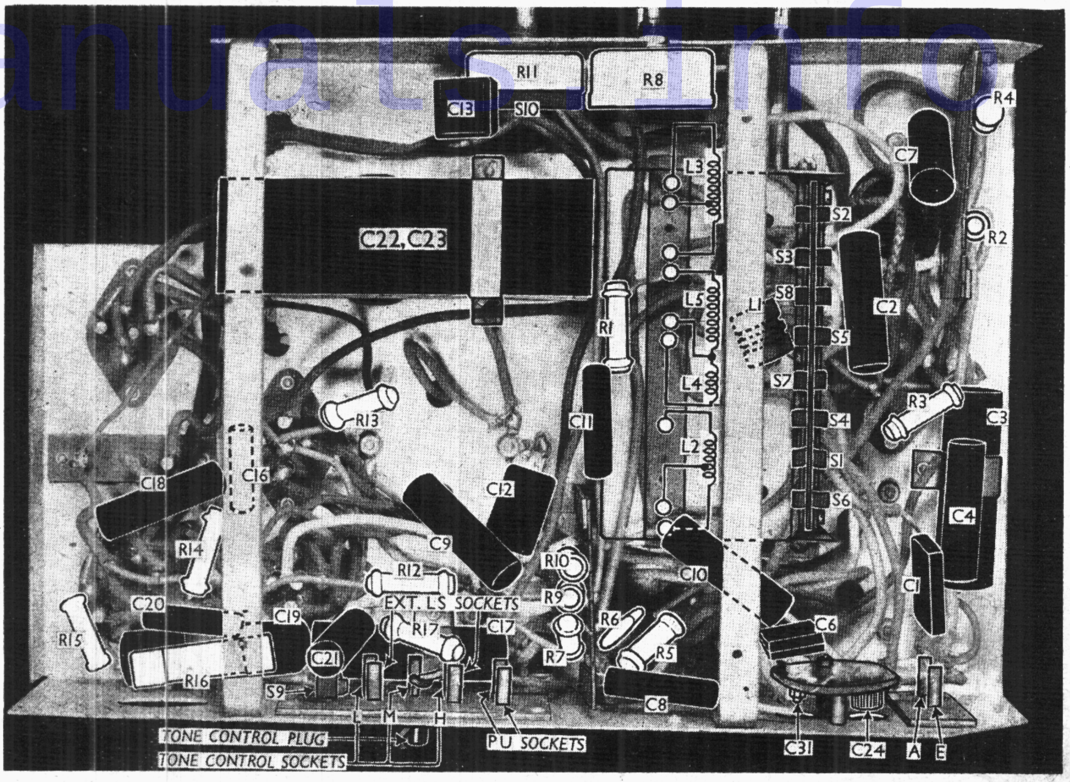
Switch	MW (black)	LW (red)	Gram (white)
S1	C	—	—
S2	—	C	—
S3	C	—	—
S4	C	—	—
S5	C	—	—
S6	—	—	C
S7	C	—	—
S8	—	—	C

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 **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 pin at the top end of **L2** is connected from inside.

The oscillator coils **L6-L9** are in a screened unit on the chassis deck, as are



Under-chassis view. The RF coils and waveband switches are in a combined assembly on the right, and their terminal contacts are indicated, the coils being shown diagrammatically. An external wire connects the two extreme end tags of the coil contacts, joining the bottom of **L2** to the top of **L3**. The values of **R2** and **R4**, on a panel at the top right-hand corner, have close tolerance limits.

also the IF transformers **L10, L11** and **L12, L13,** and the "link" coupling transformer **L14, L15,** the link unit being a replica of the IF transformers. All three transformers contain their respective trimmers, but the link coil also contains its input and output coupling condensers **C14**, **C15.**

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 high impedance (about 8,000 Ω) external speaker. Switch **S9,** described under "Switches," permits the internal speaker to be muted, but when this is done it is necessary that the external speaker circuit should be continuous to DC, as the anode current to **V5** must then flow via the external speaker circuit.

Scale Cursor Lamp.—The scale lamp is enclosed in a metal shield, the light showing through a rectangular 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, 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.

Condensers C17, C19.—These are two tubular electrolytics, each rated at 25 μF, 15 V peak working.

Condensers C22, C23.—These are two electrolytics in a single rectangular cardboard container beneath the chassis. **C22** is 8μF, and **C23** is 12 μF; both are rated at 500 V DC peak. The yellow lead is the positive of **C23,** the red lead the positive of **C22,** and the black lead is the common negative.

CIRCUIT ALIGNMENT

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

Feed in a 110 kc/s (2,728 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. Screw in **C35** a little, then adjust **C36** for maximum output. Now adjust **C37,** selecting the centre of the dip between two peaks that will be found. Finally, adjust **C35** for maximum 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 the cursor bracket should rest, at each end of the sweep, against a stop projecting from the condenser drive assembly.

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 479 m, 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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