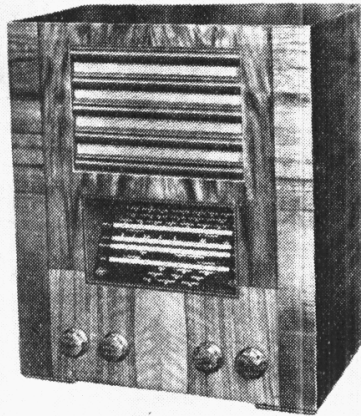


"TRADER" SERVICE SHEET

497

INVICTA U40

AC/DC SUPERHET



The Invicta U40 receiver.

FOUR wavebands and a gramophone position are provided on the waveband control of the Invicta U40 table receiver, a 3-valve (plus rectifier) AC/DC superhet, designed to operate from 200-250 V mains (25-100 C/S in the case of AC).

The triode section of the frequency changer is employed as an AF amplifier for gramophone operation, while the pick-up sockets are safely isolated from the mains. An external speaker may be connected, with or without the internal speaker. Tone control is provided by means of a three-position switch.

The SW ranges are: 13.5-51 m (referred to in this *Service Sheet* as SW1) and 50 to 200 m (referred to as Trawler Band on the scale, and as SW2 in this *Service Sheet*).

Release date: May, 1940.

CIRCUIT DESCRIPTION

Aerial input via mains isolating condensers **C1** (in the aerial lead), **C2** (in the earth lead) and coupling coils **L1** (SW1), **L2** (SW2) and **L3** (MW and LW) to single tuned circuits **L4**, **C34** (SW1), **L5**, **C34** (SW2), **L6**, **C34** (MW) and **L7**, **C34** (LW). On MW, coupling is assisted by small condenser **C3** connected between **L3** and **L6**.

First valve (**V1**, Mullard ECH3) is a triode-heptode operating as frequency changer with internal coupling. Triode oscillator anode coils **L12** (SW1), **L13**

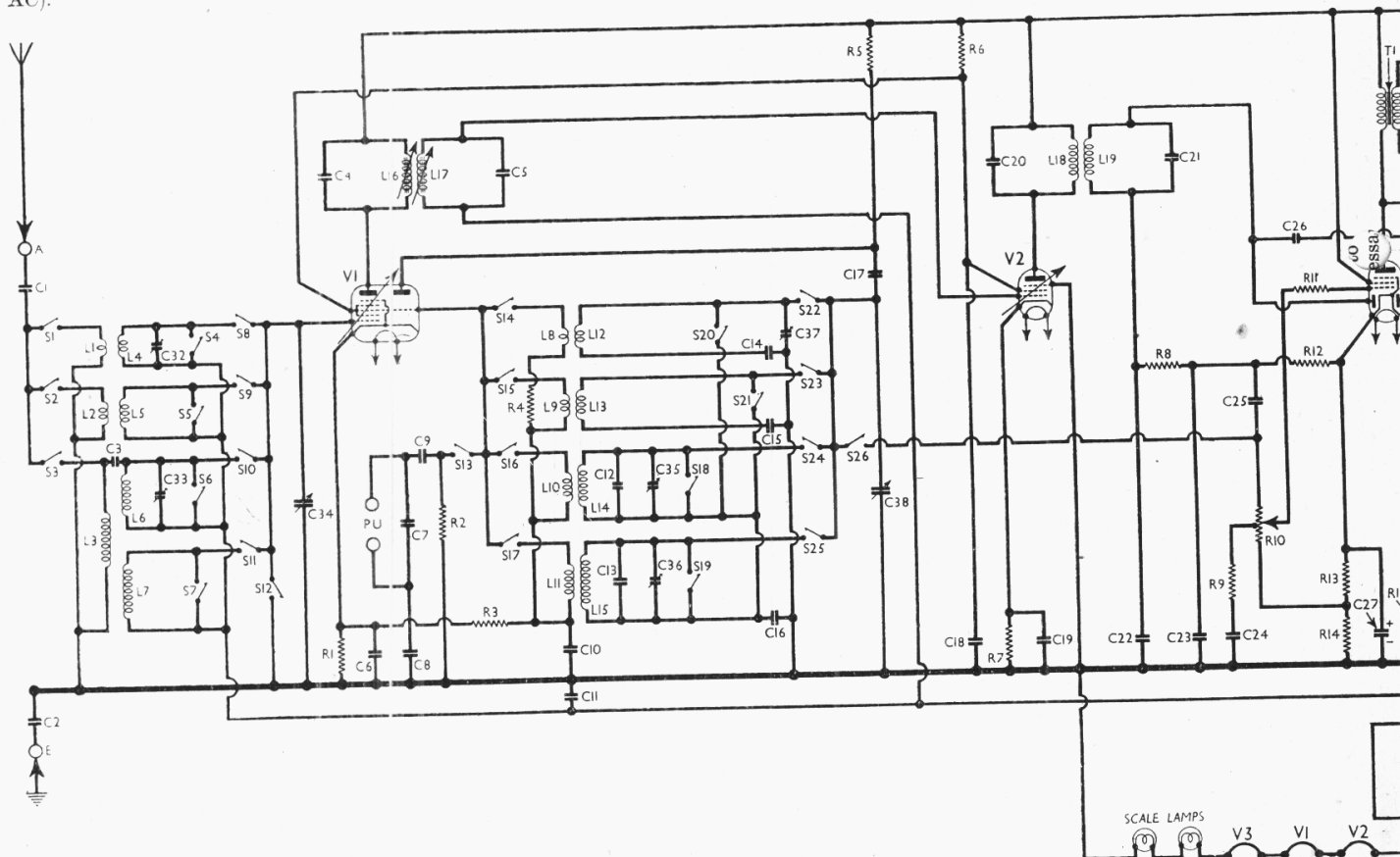
(SW2), **L14** (MW) and **L15** (LW) are tuned by **C38**; parallel trimming by **C37** (SW1), **C12**, **C35** (MW) and **C13**, **C36** (LW); series tracking by **C14** (SW1), **C15** (SW2) and **C16** (MW and LW). Reaction by grid coils **L8** (SW1), **L9** (SW2), **L10** (MW) and **L11** (LW). The CG resistance **R3** and condenser **C10** are in the low-potential end of the reaction circuit. **R4** is fitted to stabilise the reaction circuit on the SW1 band.

Second valve (**V2**, Mullard EF9) is a variable-mu RF pentode operating as IF amplifier with tuned-primary, tuned-secondary transformer couplings, **C4**, **L16**, **L17**, **C5** and **C20**, **L18**, **L19**, **C21**.

Both of the IF transformers have fixed tuning condensers. The first transformer has threaded iron-dust cores for alignment adjustment, but the second is fixed tuned at the works, and should not require subsequent readjustment.

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode pentode output valve (**V3**, Mullard CBL1). Audio frequency component in rectified output is developed across load resistance **R12** and passed via AF coupling condenser **C25**, manual volume con-



SCALE LAMPS

V3 V1 V2

trol **R10** and grid stopper **R11** to CG of pentode section, which provides the only AF amplification on radio.

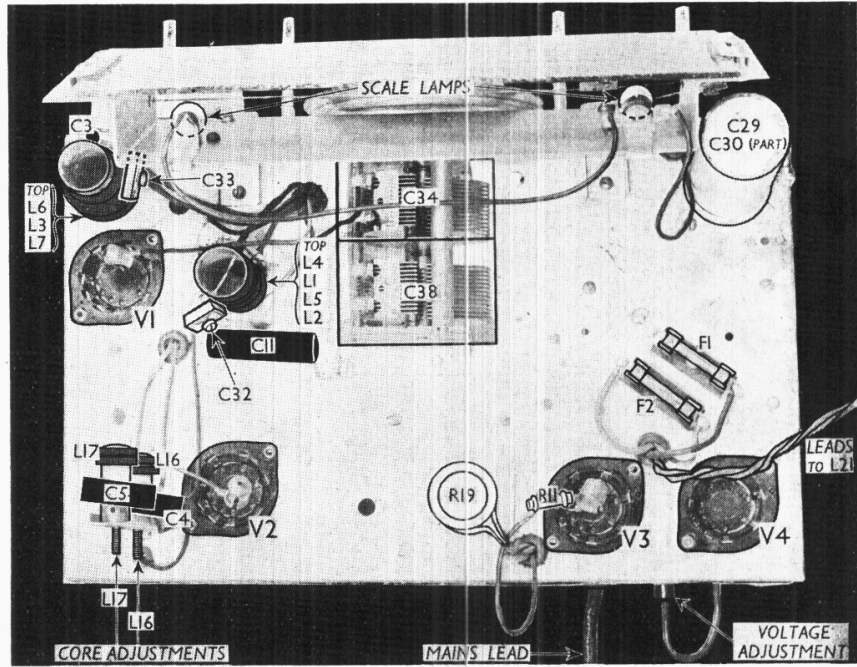
IF filtering by **C22**, **R8** and **C23** in diode circuit. Tone compensation for changes in the setting of the volume control by RC filter **R9**, **C24**.

For operation with a gramophone pick-up a pair of sockets is provided in the grid circuit of the triode section of **V1** via **S13**. When the switch control is turned to the "Gram" position, **S13** and **S26** close, and **V1** triode section becomes an AF amplifier, with **R5** as its anode load resistance and **C17** as its output coupling condenser. Thus the pick-up output is handed on via **C17** and **S26** to the volume control, across which it is developed in amplified form.

The pick-up sockets are isolated from chassis by the condensers **C9**, **C8**, and the pick-up input is shunted by **C7**. The CG resistance **R2** returns the triode control grid circuit to chassis for gramophone operation, so that **R1** then becomes the triode section GB resistance.

Three-position tone control in pentode anode circuit by **C28**, **R17**, **R18** and switches **S27**, **S28**. Either or both of the switches may be opened. Provision for connection of low impedance external speaker by sockets across secondary of the output transformer **T1**. As these sockets are used also to connect the internal speaker, the plugs of the latter are provided with a further socket each, so that both speakers may be operated together if desired.

Second diode of **V3**, fed from **L19** via



Plan view of the chassis. The aerial circuit trimmers **C32**, **C33** are seen mounted on their coil units. The core adjustments of **L16**, **L17** are indicated.

the small coupling condenser **C26**, provides DC potential which is developed across load resistance **R16** and fed back through a decoupling circuit to FC and IF valves, giving automatic volume control. Delay voltage, together with GB for pentode section, is obtained from drop along resistances **R13** and **R14** in cathode lead to chassis.

When the receiver is used with AC mains, HT current is supplied by IHC half-wave rectifying valve (**V4**, Mullard **CY1**), which, with DC mains, behaves as a low resistance. Smoothing is effected by iron-cored choke **L21** in conjunction with dry electrolytic condensers **C29**, **C30**.

Valve heaters, together with ballast resistance **R19** and the scale lamps, are connected across the mains input circuit. Condenser **C31** by-passes RF from the mains, and fuses **F1**, **F2** afford protection against accidental short-circuit.

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 233 V, using the 216-235 V tapping on the mains resistance. The receiver was tuned to the lowest wavelength on the medium wave 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 ECH3	230	0.6	60	1.3
	Oscil lator			
	110	4.2		
V2 EF9	230	2.7	60	0.8
V3 CBL1	219	42.0	230	7.1
V4 CY1	262†	—	—	—

† Cathode to chassis, DC.

DISMANTLING THE SET

Removing Chassis.—Remove the four control knobs (recessed grub screws) from the front of the cabinet; withdraw the speech coil plugs from the LS sockets at the rear of the chassis; unsolder from the smoothing choke on the sub-baffle the two leads connecting it to chassis;

remove the staples holding the protective insulating strips to the bottom of the cabinet, and lift the strips, to expose the heads of the chassis fixing screws (four round-head set-screws, with metal and rubber washers) which remove.

When replacing, fit a shaped rubber washer to each chassis fixing screw, between the chassis and the bottom of the cabinet;

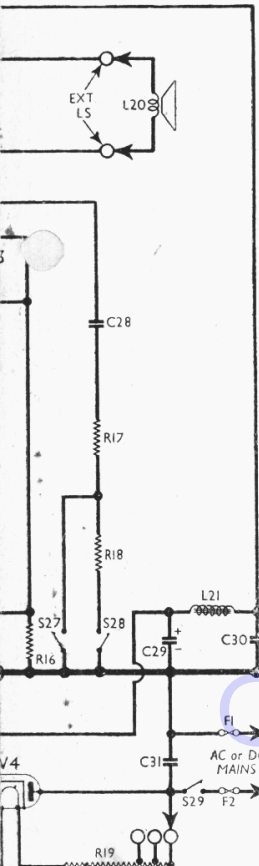
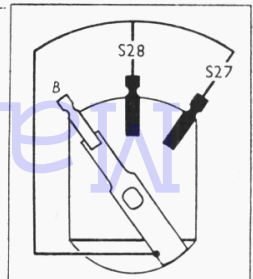
fit a flat metal washer, then a flat rubber washer to each fixing screw before inserting it into its hole in the bottom of the cabinet.

Do not forget to refix the card strips over the heads of the fixing screws.

Removing Speaker.—Withdraw the speech coil plugs from the LS sockets at the rear of the chassis; remove the four nuts holding the speaker to the sub-baffle.

When replacing, the speech coil tags should be at the bottom.

Diagram of the tone control switch unit, viewed in the direction of the arrow in the under-chassis view.

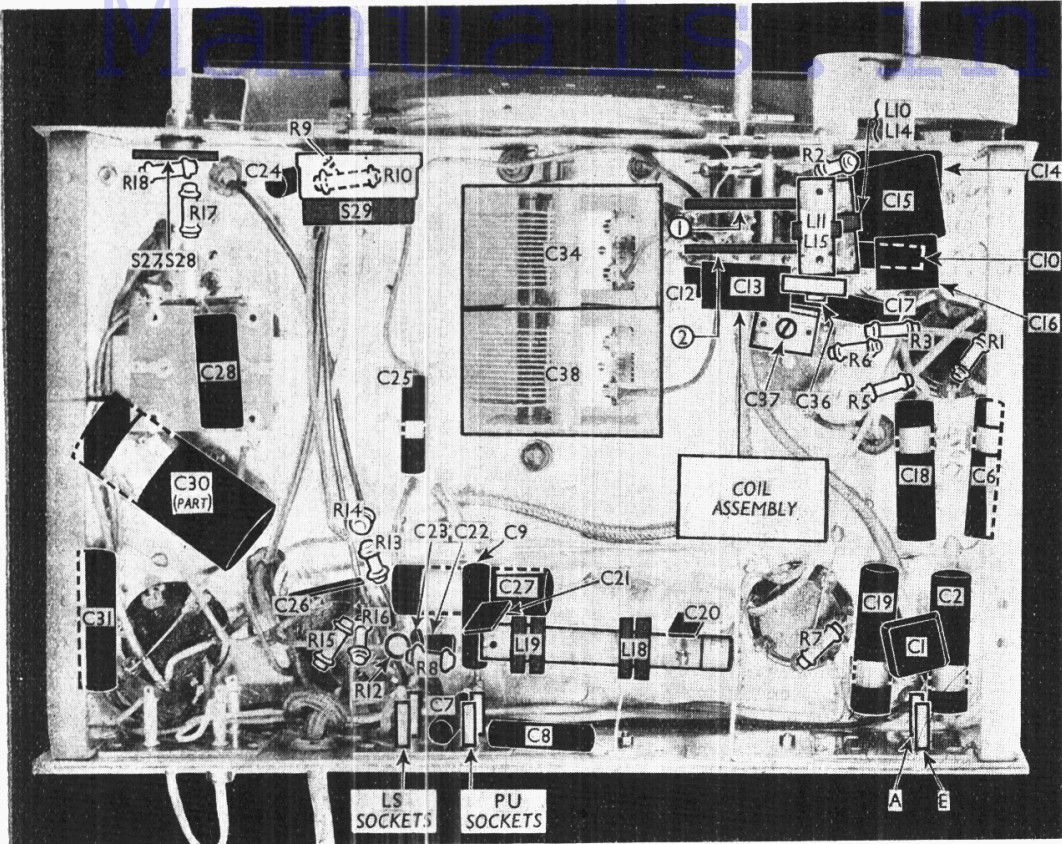


Circuit diagram of the Invicta model U40 AC/DC superhet receiver. Provision is made for connection of a gramophone pick-up and an external speaker. When operating on gramophone, the triode section of **V1** is used as a pick-up amplifier, its output being passed via **C17** and **S26** to the volume control **R10**. The first IF transformer has adjustable iron-dust cores, but the second IF transformer is fixed tuned.

receivers known to order useful

Radio

Manuals Info



Under-chassis view. The oscillator coil assembly is mounted on the tags of the waveband switch units, and cannot be indicated clearly here. It is, therefore, shown in detail in the sketch in column 5 opposite. Diagrams of the waveband switch units are given in column 6 opposite, where they are viewed in the direction of the arrows numbered 1 and 2. A diagram of the tone control switch unit S27, S28 is given at the foot of column 6 overleaf.

COMPONENTS AND VALUES

CONDENSERS		Values (μF)
C1	Aerial isolating condenser	0-0003
C2	Earth isolating condenser	0-05
C3	Aerial MW "top" coupling	0-000006
C4	1st IF transformer tuning	0-0001
C5	condensers	0-0001
C6	V1 cathode by-pass	0-1
C7	Gram pick-up shunt	0-005
C8	Gram pick-up isolating	0-01
C9	condensers	0-01
C10	V1 osc. CG condenser	0-00015
C11	AVC line decoupling	0-1
C12	Osc. circ. MW fixed trimmer	0-00002
C13	Osc. circ. LW fixed trimmer	0-00026
C14	Osc. circ. SW1 tracker	0-005
C15	Osc. circ. SW2 tracker	0-0013
C16	Osc. circ. MW and LW tracker	0-000657
C17	V1 osc. anode coupling	0-005
C18	V1, V2 SG's decoupling	0-1
C19	V2 cathode by-pass	0-1
C20	2nd IF transformer tuning	0-0001
C21	condensers	0-0001
C22	IF by-pass condensers	0-00015
C23	IF by-pass condensers	0-00015
C24	Part of tone compensator	0-005
C25	AF coupling to V3 pentode	0-005
C26	Coupling to V3 AVC diode	0-00002
C27	V3 cathode by-pass	20-0
C28	Part of tone control	0-05
C29	HT smoothing condensers	24,08
C30	Mains RF by-pass	0-1
C31	Aerial circuit SW1 trimmer	0-00003
C32	Aerial circuit MW trimmer	0-00003
C33	Aerial circuit LW trimmer	0-00054
C34	Osc. circuit MW trimmer	0-00003
C35	Osc. circuit LW trimmer	0-00003
C36	Osc. circ. SW1 trimmer	0-00003
C37	Osc. circ. SW2 trimmer	0-00003
C38	Oscillator circuit tuning	0-00054

RESISTANCES

	Values (ohms)
R1	V1 fixed GB resistance ... 150
R2	V1 osc. gram CG resistance 22,000
R3	V1 osc. radio CG resistance 22,000
R4	Osc. SW1 reaction damping ... 47
R5	V1 osc. anode HT feed ... 22,000
R6	V1, V2 SG's HT feed ... 100,000
R7	V2 fixed GB resistance ... 330
R8	IF stopper ... 47,000
R9	Part of tone compensator 47,000
R10	Manual volume control ... 1,000,000*
R11	V3 pentode grid stopper ... 100,000
R12	V3 signal diode load ... 470,000
R13	V3 pentode GB and AVC delay resistances ... 150
R14	AVC line decoupling ... 330
R15	V3 AVC diode load ... 1,000,000
R16	V3 AVC diode load ... 1,000,000
R17	Parts of tone control ... 3,300
R18	Parts of tone control ... 10,000
R19	Heater circuit ballast ... 815†

* Centre-tapped.
† Tapped at 615 0 + 100 0 + 100 0 from V+ heater end.

OTHER COMPONENTS

Continued		Approx. Values (ohms)
L14	Osc. circ. MW tuning coil ...	2-0
L15	Osc. circ. LW tuning coil ...	3-0
L16	1st IF trans. { Pri. ...	7-0
L17	{ Sec. ...	7-0
L18	2nd IF trans. { Pri. ...	9-0
L19	{ Sec. ...	9-0
L20	Speaker speech coil ...	2-0
L21	HT smoothing choke ...	500-0
T1	Output trans. { Pri. ...	240-0
{ Sec. ...		9-2
S1-S12	Waveband switches ...	—
S13, S26	Gram pick-up switches ...	—
S27, S28	Tone control switches ...	—
S29	Mains switch, ganged	—
R10	Mains circuit fuses ...	—
F1, F2	Mains circuit fuses ...	—

GENERAL NOTES

Switches.—S1-S26 are the waveband and gramophone pick-up switches, in two ganged rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the diagrams in col. 6, where they are drawn as seen looking from the rear of the underside of the chassis.

The table (col. 4) gives the switch positions for the five control settings, starting from fully anti-clockwise. A dash indicates open, and C, closed.

Several components are mounted directly to the tags of the switch units, as shown in the sketch in col. 5.

S27, S28 are the tone control switches, in a three-position rotary unit beneath the chassis. It is shown in our under-chassis

OTHER COMPONENTS

	Approx. Values (ohms)
L1	Aerial SW1 coupling coil ... 0-3
L2	Aerial SW2 coupling coil ... 0-8
L3	Aerial MW and LW coupling coil ... 65-0
L4	Aerial SW1 tuning coil ... Very low
L5	Aerial SW2 tuning coil ... 0-3
L6	Aerial MW tuning coil ... 3-6
L7	Aerial LW tuning coil ... 13-3
L8	Oscillator SW1 reaction ... 43-0
L9	Oscillator SW2 reaction ... 6-6
L10	Oscillator MW reaction ... 10-0
L11	Oscillator LW reaction ... 12-0
L12	Osc. circ. SW1 tuning coil ... Very low
L13	Osc. circ. SW2 tuning coil ... 1-0

Continued in next column

* Electrolytic. † Variable. ‡ Pre-set. § 8μF and 16μF in parallel.

view, where the arrow indicates the direction in which it is viewed in the diagram in col. 6 overleaf. The resistances **R17** and **R18** are mounted directly on the tags of the unit.

In the fully anti-clockwise position of the control, **S27** closes, giving maximum treble attenuation; in the middle position, **S28** closes, giving reduced treble attenuation; in the fully clockwise position, both switches are open, giving maximum treble response.

S29 is the QMB mains switch, ganged with the volume control **R10**.

Switch Table

Switch	Gram	SW1	SW2	MW	LW
S1	—	C	—	—	—
S2	—	—	C	—	—
S3	—	—	—	C	C
S4	C	—	—	—	—
S5	—	C	—	—	—
S6	—	—	C	—	—
S7	—	—	—	C	—
S8	—	C	—	—	—
S9	—	—	C	—	—
S10	—	—	—	C	—
S11	—	—	—	—	C
S12	C	—	—	—	—
S13	C	—	—	—	—
S14	—	C	—	—	—
S15	—	—	C	—	—
S16	—	—	—	C	—
S17	—	—	—	—	C
S18	—	—	C	—	—
S19	—	—	—	C	—
S20	C	—	—	—	—
S21	—	C	—	—	—
S22	—	—	C	—	—
S23	—	—	C	—	—
S24	—	—	—	C	—
S25	—	C	—	—	C
S26	C	—	—	—	—

Coils.—**L1, L2, L4, L5; L3, L6, L7** and the first IF transformer **L16, L17** are in four unscreened tubular units on the chassis deck. They are shown in our plan view, where the **L16, L17** core adjustments are indicated. **L8, L12; L9, L13; L10, L14** and **L11, L15** are in four unscreened tubular units beneath the chassis, mounted around the switch units. The positions of these cannot be clearly seen in the under-chassis view, so a separate diagram is given in col. 5, as seen from the rear of the underside of the chassis. The last two of these units have trimmers mounted on them.

The second IF transformer is fitted beneath the chassis, mounted horizontally on its screening shield. It is fixed-tuned at works, and should not require further adjustment, for which no provision is made.

The HT smoothing choke **L21** is mounted on the sub-baffle beside the speaker, and is not shown in our chassis illustrations, although the connecting leads to it are indicated in our plan view.

Scale Lamps.—These are two MES types with 15 mm. round bulbs. They are quoted by the makers as being rated at 6.2 V, 0.3 A. Our chassis was equipped with 5.5 V lamps, but voltage variations within small limits are immaterial.

Gramophone Pick-up.—Two sockets are provided at the rear of the chassis for a gramophone pick-up. They are isolated from the chassis by condensers **C8** and **C9**, and are fed into the grid circuit of the triode section of **V1** when the waveband control is turned to the gramophone

(white spot) position, so that **V1** triode operates as an AF amplifier.

External Speaker.—Another pair of sockets is provided at the rear of the chassis for the speech coil of the internal speaker, whose leads are terminated with socketed plugs. If the internal speaker is not required, the plugs can be withdrawn and replaced by those of a low impedance (about 2 O) external speaker; or, if both speakers are required, the external speaker plugs can be inserted into the sockets in the internal speaker plugs.

Condenser C3.—This is a $6 \mu\mu\text{F}$ ($0.000006 \mu\text{F}$) condenser made by winding one piece of enamelled wire over another. Its position is indicated on the **L3, L6, L7** unit in the plan view.

Condenser C27.—This is a 20 μF electrolytic in a tubular cardboard container. It is rated at 30 V peak.

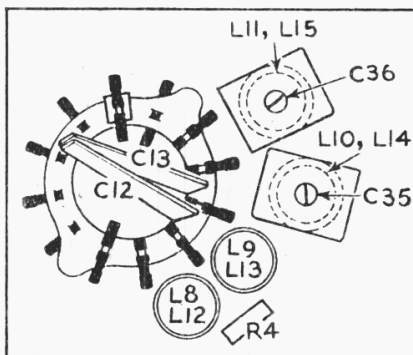
Condensers C29, C30.—These are, altogether, three electrolytics; two of them are in a single tubular cardboard container mounted vertically on the chassis deck, while a third is in a tubular cardboard container mounted horizontally under a clip beneath the chassis.

C29 is 8 μF , and is part of the dual unit; **C30** consists of two condensers, one (8 μF) forming part of the dual unit, while the other (16 μF) is the separate unit. The two sections of the dual unit are both rated at 550 V peak, while the single 16 μF unit is rated at 350 V peak.

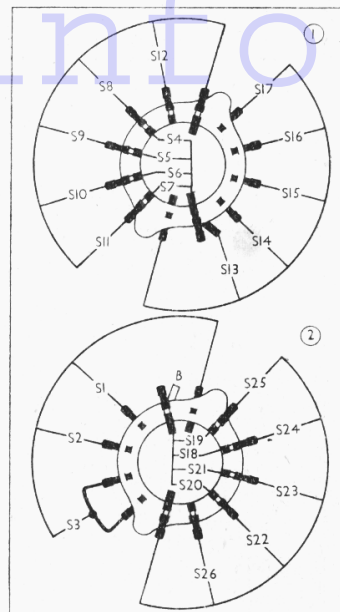
Pre-set condensers.—The two aerial trimmers **C32, C33** are mounted on their associated coil units on the chassis deck. The oscillator circuit trimmers are beneath the chassis. **C35** and **C36** are mounted at the ends of their respective coil units, and are indicated in the sketch below. The remaining trimmer **C37** is fitted beneath the chassis deck, near its coil unit.

Chassis Divergencies.—**C12** is not shown in the makers' diagram, where **C24** and **R9** are shown transposed as compared with our diagram. **C37** is shown as connected directly across **L12**, whereas in our chassis one side of it goes to chassis.

Resistance **R1** is given in the makers' manual as 220 O, whereas in our chassis it was 150 O; **R7** as 150, against 330 O; and **R14** as 300 O, against our 330 O.



Sketch showing the details of the oscillator coil assembly, which is grouped round the waveband switch units beneath the chassis. Its position is indicated in the under-chassis view, where an arrow indicates the direction in which it is seen in the sketch.



Diagrams of the two waveband switch units as seen when viewed in the direction of the numbered arrows in the under-chassis view. A table giving the switch positions appears in col. 4.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator via a 0.1 μF non-inductive condenser to control grid (top cap) of **V1** and chassis. Connect a 100,000 O resistance between the control grid and chassis. Switch set to LW, turn gang and volume control to maximum. Feed in a 465 KC/S signal, and adjust the cores of **L17** and **L16** for maximum output. Remove condenser and resistance.

The second IF transformer **L18, L19** is permanently adjusted at the works, and should not be interfered with.

RF and Oscillator Stages.—See that the scale is properly fitted, and that the bottom edge is horizontal. With the gang at maximum, the pointer should cover the right-hand ends of the clear sections of the scales. Connect signal generator, via a suitable dummy aerial, to **A** and **E** sockets.

MW.—Switch set to MW, tune to 200 m on scale, feed in a 200 m (1,500 KC/S) signal, and adjust **C35**, then **C33**, for maximum output. There are no variable tracking condensers, but the calibration should be checked at 550 m (546 KC/S).

LW.—Switch set to LW, tune to 1,200 m on scale, feed in a 1,200 m (250 KC/S) signal, and adjust **C36** for maximum output. Check at 2,000 m (150 KC/S).

SW2.—There are no adjustments on this band, the circuits being aligned permanently at the works.

SW1.—Switch set to SW1, feed in a 14 m (21.4 MC/S) signal, and tune it in accurately. Adjust **C37**, then **C32**, for maximum output, while rocking the gang very slightly for optimum results. Check calibration at 50 m (6 MC/S).