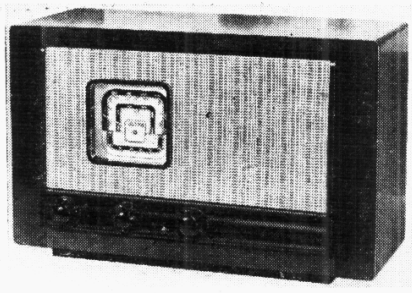
Supplement to The Wireless & Electrical Trader, February 9, 1946

"TRADER" SERVICE SHEET 758

ULTRA T402

AC SUPERHET



The appearance of the Ultra T402.

ONE of the first post war range of Ultra receivers, the T402 is a 3-valve (plus rectifier) 3-band superhet designed for AC mains of 200-260V, 40-100 c/s.

Notable features are the compact tuning unit assemblies, which can be removed for attention, and the provision of a special LT winding for the scale lamps. There is provision for the use of a gramophone pick-up and an external speaker.

Full instruction for the removal of the tuning units are given under "Dismantling the Set."

Release date and original price: November, 1945; £17 17*s.*, *plus* £3 16*s.* 9*d. purchase tax.*

CIRCUIT DESCRIPTION

Aerial input from socket **A1** is via series capacitor **C2** and coupling coils **L2** (SW), **L3** (MW) and **L4** (LW) to single tuned circuits **L5, C34** (SW), **L6, C34** (MW) and **L7, C34** (LW). Tuned acceptor circuit **L1, C3, C30** across aerial circuit filters out interference at intermediate frequency. From **A2,** input is via **C1** to **A1.**

First valve **(V1, Mazda metallised TH41)** is a triode-heptode operating as frequency changer with internal coupling. Triode oscillator anode coils **L11** (SW), **L12** (MW) and **L13** (LW) are tuned by **C40.** Parallel trimming by **C37** (SW), **C38** (MW) and **C14, C39** (LW); series tracking by **C11** (SW), **C12, C35** (MW) and **C13, C36** (LW).

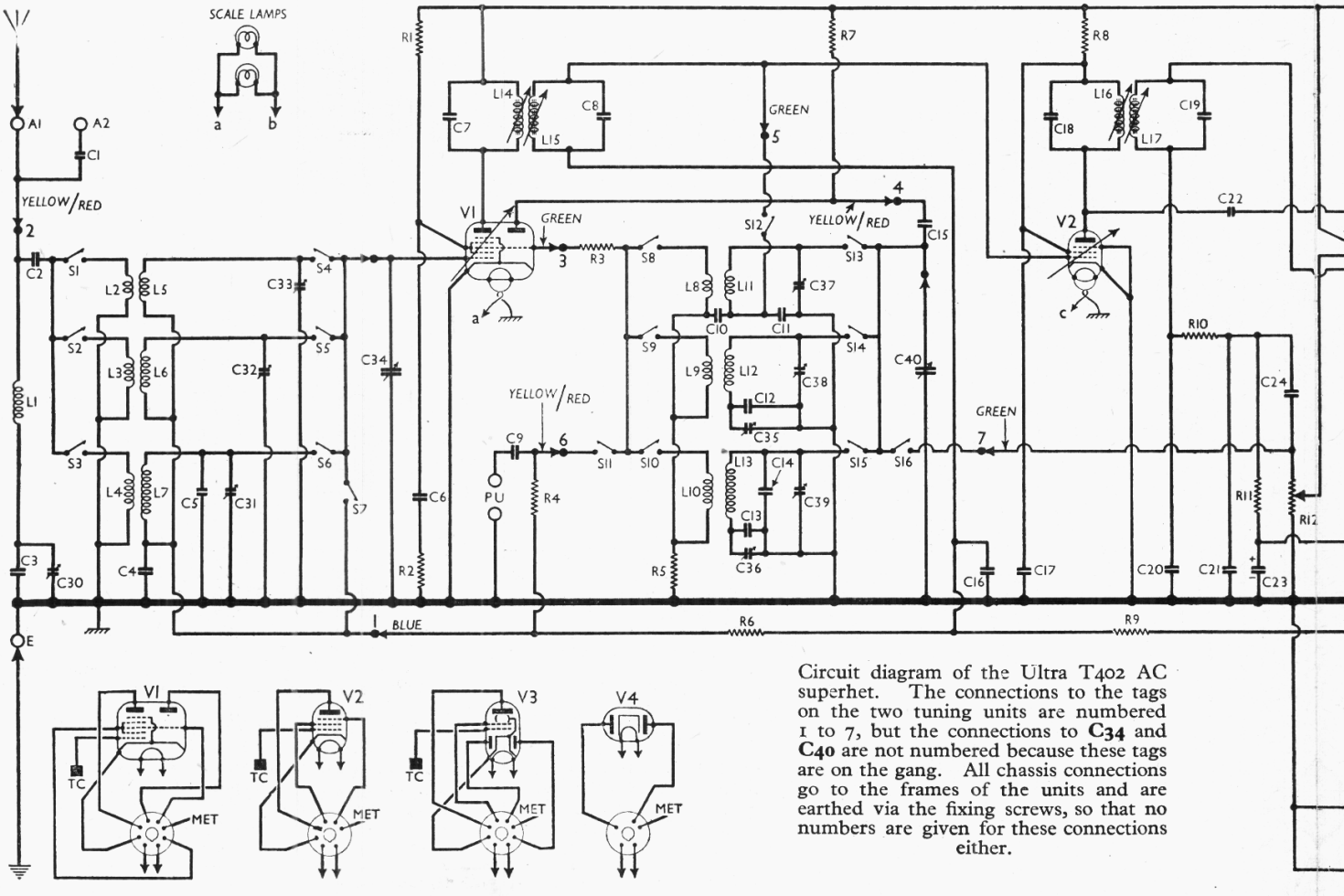
Reaction coupling from grid by coils **L8** (SW), **L9** (MW) and **L10** (LW), with additional coupling across the common impedance of **C11** in grid and anode circuits, via **C10,** on SW. This is made possible by the inclusion of the CG resistor **R5** in the low-potential end of the circuit.

Second valve **(V2, Mazda metallised VP41)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary iron-dust cored transformer couplings **C7, L14, L15, C8** and **C18, L16, L17, C19.**

Intermediate frequency 470 kc/s.

The tuning capacitors are fixed, and trimming adjustments are effected by positioning the cores.

Diode second detector is part of double diode output pentode valve **(V3, Mazda**



Circuit diagram of the Ultra T402 AC superhet. The connections to the tags on the two tuning units are numbered 1 to 7, but the connections to **C34** and **C40** are not numbered because these tags are on the gang. All chassis connections go to the frames of the units and are earthed via the fixing screws, so that no numbers are given for these connections either.

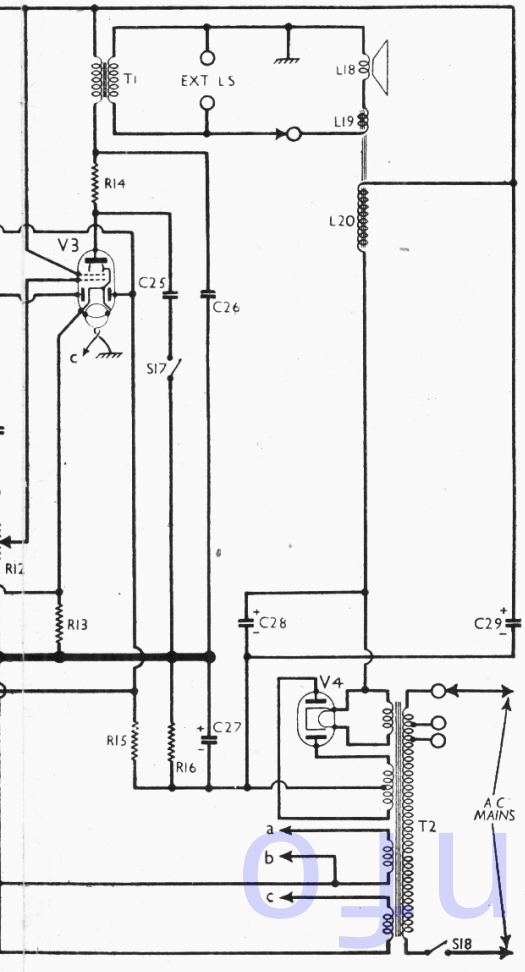
Pen 45DD). Audio frequency component in rectified output is developed across load resistor **R11** and passed via AF coupling capacitor **C24** and manual volume control **R12** to control grid of pentode section.

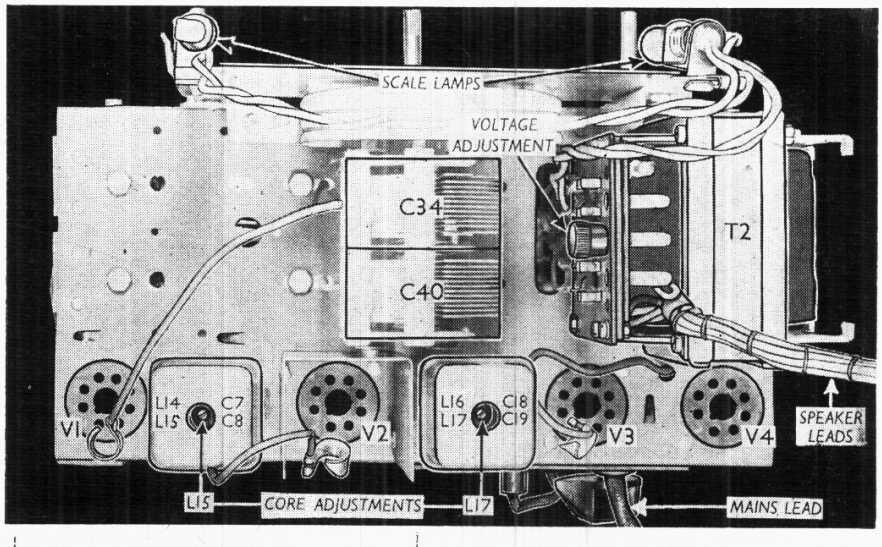
IF filtering by **C20, R10** and **C21.** Two-position tone control by **C25** and **S17.** Fixed tone correction by **C26.** Provision for connection of low impedance external speaker across secondary winding of the internal speaker input transformer **T1,** with a plug and socket device to permit the internal speaker to be muted.

Second diode of **V3,** fed from **V2** anode via **C22,** provides DC potential which is developed across load resistor **R15** and fed back through decoupling circuits to FC and IF valves, giving automatic volume control.

HT current is supplied by IHC full-wave rectifying valve **(V4, Mazda metallised UU6).** Smoothing by speaker field **L20** and dry electrolytic capacitors **C28, C29.**

Fixed GB potential for **V1** and **V2** is obtained from the drop along **R16** in the negative HT lead to chassis. This potential, together with the drop along **R13,** which provides GB potential for the pentode section of **V3,** forms the delay voltage for the AVC system. The scale lamps are energised from an independent LT secondary winding on the mains transformer **T2,** separate from the LT supply for the valve heaters.





Plan view of the chassis. The vertical panel on the left face of the mains transformer **T2** carries the connections between transformer and chassis, and speaker and chassis, besides the voltage adjustment tappings.

When the receiver is used with a gramophone pick-up, the triode section of **V1** is used as an AF amplifier, with **R7** as the anode load resistor and **C15** as AF coupling capacitor.

On turning the switch control to the gram position, the pick-up sockets are connected via **C9** and **S11** to the control grid of **V1** triode and chassis, and the output is coupled via **R7, C15** and **S16** to **R12** and thus to **V3** pentode. GB for **V1** triode is applied via **R4** from the AVC line, which stands at negative HT potential.

When **S11** and **S16** close for pick-up operation, **S7** closes to short-circuit the control grid circuit of the pentode section of **V1,** and **S12** acts similarly in the control grid circuit of **V2,** thus effectively muting radio.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 230 V, using the 220-240 V tapping on the mains transformer.

The receiver was tuned to the lowest wavelength on the MW 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 Avometer, chassis being the negative connection.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 TH41	254	2·2		
	Oscillator		95	5·8
	75	3·7		
V2 VP41	219	11·5	219	2·5
V3 Pen 45DD	240	41·0	254	8·3
V4 UU6	315†	—	—	—

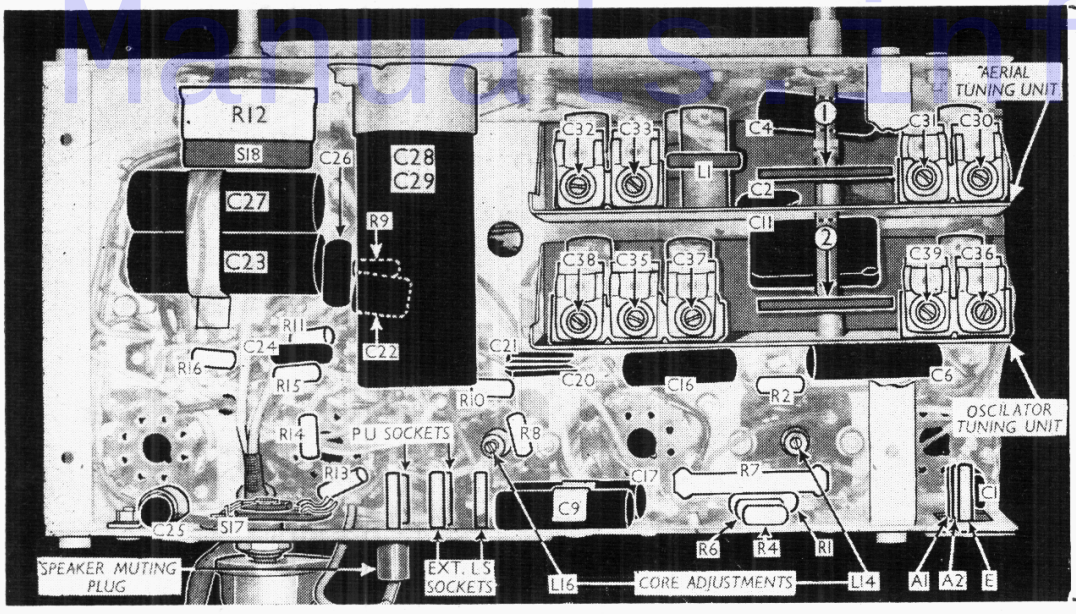
† Each anode, AC.

COMPONENTS AND VALUES

	RESISTORS	Values (ohms)
R1	V1 SG HT feed	27,000
R2	V1 SG stabiliser	68
R3	V1 osc. grid stopper ...	100
R4	V1 triode CG resistors ...	330,000
R5	V1 triode CG resistors ...	47,000
R6	AVC line decoupling ...	100,000
R7	V1 osc. anode HT feed ...	39,000
R8	V2 HT feed resistor ...	2,200
R9	AVC line decoupling ...	1,000,000
R10	IF stopper	100,000
R11	V3 signal diode load ...	470,000
R12	Manual volume control ...	1,000,000
R13	V3 pent. GB and AVC delay	180
R14	V3 pent. anode stopper...	68
R15	V3 AVC diode load ...	470,000
R16	V1, V2 GB and AVC delay	47

	CAPACITORS	Values (μF)
C1	A2 series coupling ...	0·000022
C2	Aerial series coupling ...	0·00047
C3	IF filter fixed tuning ...	0·00018
C4	V1 hept. CG decoupling...	0·05
C5	Aerial LW fixed trimmer	0·000047
C6	V1 SG decoupling ...	0·1
C7	1st IF transformer tuning capacitors	0·00012
C8	1st IF transformer tuning capacitors	0·00012
C9	PU coupling capacitor ...	0·1
C10	Osc. SW reaction coupling	0·00018
C11	Osc. SW tracker	0·005
C12	Osc. MW fixed tracker ...	0·0005
C13	Osc. LW fixed tracker ...	0·00018
C14	Osc. LW fixed trimmer ...	0·0001
C15	V1 osc. anode coupling ...	0·005
C16	V2 CG decoupling ...	0·05
C17	V2 SG decoupling ...	0·1
C18	2nd IF transformer tuning capacitors	0·00012
C19	2nd IF transformer tuning capacitors	0·00012
C20	IF by-pass capacitors ...	0·0001
C21	IF by-pass capacitors ...	0·0001
C22	AVC diode coupling ...	0·00001
C23*	V3 cathode by-pass ...	50·0
C24	AF coupling to V3 pent....	0·005
C25	Tone control capacitor ...	0·02
C26	Fixed tone corrector ...	0·01
C27*	GB circuit by-pass ...	100·0
C28*	HT smoothing capacitors	16·0
C29*	HT smoothing capacitors	24·0
C30‡	IF filter tuning capacitor	0·00007
C31‡	Aerial circ. LW trimmer...	0·00007
C32‡	Aerial circ. MW trimmer...	0·00007
C33‡	Aerial circ. SW trimmer...	0·00007
C34†	Aerial circuit tuning ...	—
C35‡	Osc. circ. MW tracker ...	0·00007
C36‡	Osc. circ. LW tracker ...	0·00007
C37‡	Osc. circ. SW trimmer ...	0·00007
C38‡	Osc. circ. MW trimmer ...	0·00007
C39‡	Osc. circ. LW trimmer ...	0·00007
C40†	Oscillator circuit tuning...	—

* Electrolytic. † Variable. ‡ Pre-set.



Under-chassis view. The two tuning units in the top right quarter are removable for serving as described below, and they are then seen as shown in cols. 5 and 6. The waveband switch units (numbered 1 and 2 in circles) are mounted in them.

OTHER COMPONENTS		Approx. Values (ohms)
L1	IF filter coil	7·6
L2	Aerial SW coupling coil...	0·25
L3	Aerial MW coupling coil...	1·8
L4	Aerial LW coupling coil...	10·3
L5	Aerial SW tuning coil ...	Very low
L6	Aerial MW tuning coil ...	2·3
L7	Aerial LW tuning coil ...	13·0
L8	Osc. SW reaction coil ...	0·2
L9	Osc. MW reaction coil ...	0·8
L10	Osc. LW reaction coil ...	3·0
L11	Osc. SW tuning coil ...	Very low
L12	Osc. MW tuning coil ...	3·0
L13	Osc. LW tuning coil ...	7·4
L14, L15	1st IF trans. Pri. ...	7·5
	1st IF trans. Sec. ...	7·5
L16, L17	2nd IF trans. Pri. ...	7·5
	2nd IF trans. Sec. ...	7·5
L18	Speaker speech coil ...	1·5
L19	Hum neutralising coil ...	0·25
L20	Speaker field coil ...	1000·0
T1	Speaker input trans. Pri. ...	280·0
	Speaker input trans. Sec. ...	0·2
T2	Mains trans. Pri., total ...	34·0
	Mains trans. Heater sec. ...	0·05
	Mains trans. Lamp sec. ...	0·6
	Mains trans. Rect. heat. sec.	0·2
	Mains trans. HT sec., total	750·0
S1-S10, S12-S15	Waveband switches ...	—
S11, S16	Gram PU switches	—
S17	Tone control switch ...	—
S18	Mains switch, ganged R12	—

DISMANTLING THE SET

The cabinet is fitted with a detachable bottom, giving access to the under-chassis compartment.

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

remove the four bolts (with metal washers and rubber washers) holding the chassis to the bottom of the cabinet.

The chassis may now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free chassis entirely, unsolder from the speaker input transformer the five leads connecting it to chassis, and the earthing lead.

When replacing, a metal washer, then a thin rubber washer, should be slipped on to each chassis fixing bolt before it is inserted, and a thick rubber should be fitted on each bolt between the chassis and the bottom of the cabinet.

The longer bolts go at the front.

The speaker leads are connected as follows, numbering the tags on the speaker transformer from top to bottom:

1, red; 2, blue; 3, green; 4, red/yellow; 5, yellow.

The black (earthing) lead goes to the upper speech coil tag.

Removing Tuning Units.—To remove either of these, remove the cross-brace (one 2 BA cheese-head set screw at each end, through front and rear chassis members) which covers them;

switch set to SW and remove the waveband switch control spindle, after removing two 4 BA screws (with nuts and lock washers) holding fixing plate to front chassis member, when the spindle, complete with fixing plate and locating disc, can be withdrawn;

unsolder from tag on fixed vanes of tuning gang the lead emerging through the chassis deck (front section for aerial unit, or rear section for oscillator unit);

remove the two 2 BA hexagon screws (with lock-washers) holding the appropriate unit to the chassis deck.

The unit in question may now be lifted away and tilted for inspection to the extent permitted by its remaining connecting leads; or it may be freed entirely if these are unsoldered (two at one end only on the aerial unit, or three at one end and two at the other on the oscillator unit).

When replacing, see that the rotor of the waveband switch unit has not been disturbed: its position should be as shown in our sketches of the units, with the flats horizontal and the saw-cut uppermost (see cols. 5 and 6 opposite).

Do not tighten up the fixing screws on the chassis deck until the switch spindle is in position, as a small adjustment in the positions of the units may be necessary for correct alignment.

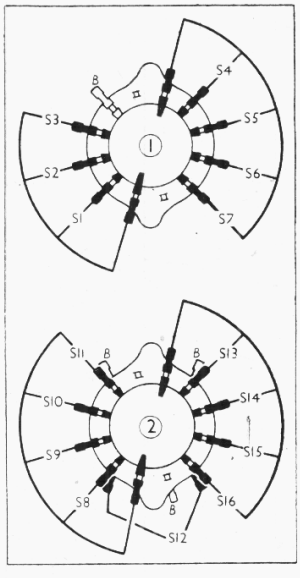
Before inserting control spindle, see that it is turned fully anti-clockwise in its locating disc.

The chassis cross-brace has one leg longer than the other, with a locating stub in it to engage in a hole in the rear chassis member.

The connecting leads are coloured but are not all dissimilar. The tags are numbered in our sketches and in our circuit diagram, but to ensure correct identification we state to what point in the chassis each lead concerned is connected at its further end.

The connections are as follows, but although they are given here in numerical order, it is simpler to perform the operations in the opposite order, starting from tag 7 and working backwards.

Aerial Unit.—Tag 1, blue lead the junction of **R4** and **R6**;



Diagrams of the waveband switch units as seen when viewed from the front of an inverted chassis.

tag 2, yellow/red lead from aerial socket **A1.**

Oscillator Unit.—On the outer end of the unit : tag 3, green lead from pin 5 on **V1** holder (oscillator CG);

tag 4, yellow/red lead from pin 4 on **V1** holder (oscillator anode);

tag 5, green lead from base of 1st IF transformer.

On the inner end of the unit (pick-up connections) : tag 6, yellow/red lead from **R4** and **C9;**

tag 7, green lead from the tag at the junction of **R12** and **C24.**

Removing Speaker.—Remove the vertical wooden batten (four countersunk-head wood screws) clamping the speaker from the rear of the cabinet;

slacken the nuts (with lock washers) on the three clamps holding the speaker to the sub-baffle, and remove one clamp completely, when the speaker may be lifted out.

When replacing, the transformer should point to the top right-hand corner of the cabinet, viewed from the rear.

GENERAL NOTES

Chassis Construction. — The chassis proper breaks down conveniently for the purpose of description into three parts : the chassis pressing, with all the components mounted directly onto it; and two tuning units, which contain all the components associated with the two variable tuning circuits, aerial and oscillator respectively, with the exception of the ganged tuning capacitors.

Throughout this *Service Sheet* these will be referred to as chassis, aerial tuning unit and oscillator tuning unit.

Switches.—S1-S16 are the waveband, gramophone pick-up and radio muting switches, ganged in two rotary units beneath the chassis inside the tuning units.

These switch units are indicated in our under-chassis view, and in the separate sketches of the tuning units, but they are seen in detail only in the diagrams in col. 2, where they are drawn as seen when viewed from the front of an inverted chassis.

The table (below) gives the switch positions for the four control settings, starting from the fully anti-clockwise (SW) position of the control spindle. A dash indicates open, and **C,** closed.

S17 is the two-position tone control switch, mounted on the rear chassis member. The switch closes (for deep tone) when the control is turned anti-clockwise.

S18 is the QMB mains switch, ganged with the manual volume control **R12.**

Switch	SW	MW	LW	Gram
S1	C	—	—	—
S2	—	C	—	—
S3	—	—	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

Coils.—All the aerial circuit and oscillator circuit coils are mounted in their respective tuning units, together with their trimmers, trackers and other associated components. These coils are not shown, nor their positions indicated, in our chassis illustrations, the whole assemblies being embraced in the titles "Aerial Tuning Unit" and "Oscillator Tuning Unit."

All components in these two units are shown clearly in the two sketches seen below, where it should be borne in mind that they are viewed from the front. Instructions for the removal and replacement of these units follow instructions for removing the chassis from the cabinet, under "Dismantling the Set."

The remaining tuning coil units are those of the two IF transformers **L14, L15** and **L16, L17.** These are mounted in screened containers on the chassis deck, their core adjustments projecting above and below the units as indicated in our chassis illustrations.

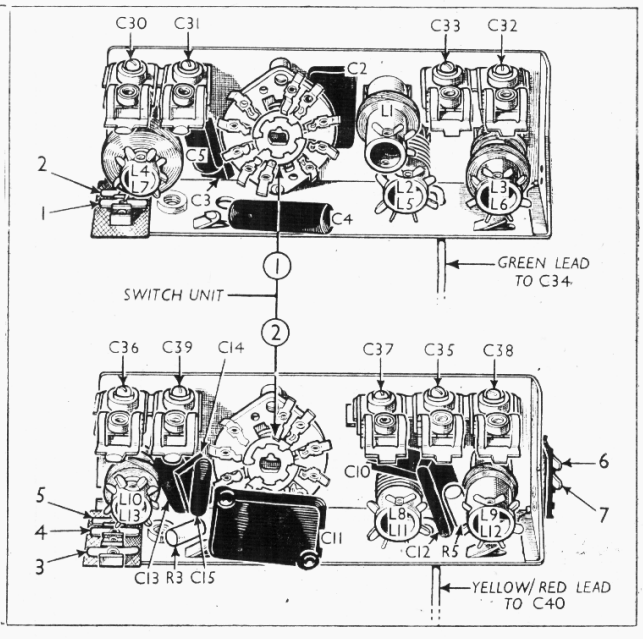
Scale Lamps.—These are two Osram MES type lamps, with spherical bulbs, rated at 6.5 V, 0.3 A. They are energised from their own LT secondary winding on the mains transformer **T2.**

External Speaker.—Two sockets are provided at the rear of the chassis for a low-impedance (about 2.5 Ω) external speaker. A third socket accommodates a plug which may be withdrawn to mute the internal speaker.

Capacitors C28, C29.—These are two dry electrolytics in a waxed cardboard tubular container mounted in a clip beneath the chassis. It is rated at 460 V DC working. The red spotted tag is the positive of **C28** (16 μF) and the plain tag that of **C29** (24 μF); the black spotted tag is the common negative connection.

Chassis Divergencies.—In our chassis, the scale lamp secondary was connected at one end to chassis, but it was not shown so in the makers' diagram. Their diagram did show an earth connection to the speaker frame, but in our chassis the earthing lead was connected to one side of the speech coil, which was isolated from the frame, and there was no DC continuity between the speaker frame and the chassis pressing.

Sketches of the two tuning units, drawn as seen from the front after removal as described under "Dismantling the Set." The upper sketch is of the aerial unit, and the lower one is of the oscillator unit. The connecting tag numbers are repeated in the circuit diagram overleaf.



CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator leads to control grid (top cap) of **V1** and chassis, leaving the existing top cap connector in place. Switch set to MW, turn the gang to maximum capacitance, feed in a 470 kc/s (638.3 m) signal, and adjust the cores of **L17, L16, L15** and **L14** in that order for maximum output.

RF and Oscillator Stages.—Transfer signal generator leads to **A1** and **E** sockets via a suitable dummy aerial (a 0.0002 μF non-inductive capacitor will do for MW and LW, and a 400 Ω resistor for SW).

IF Filter.—Feed in a strong 470 kc/s signal and adjust **C30** for minimum output.

MW.—Tune to 200 m on scale, feed in a 200 m (1,500 kc/s) signal and adjust **C38,** then **C32,** for maximum output. Feed in a 500 m (600 kc/s) signal, tune to 500 m on scale, and adjust **C35** for maximum output, rocking the gang gently if required for optimum results.

SW.—Switch set to SW, tune to 20 m on scale, feed in a 20 m (15 Mc/s) signal, screw up **C37** to maximum capacitance, then slowly unscrew it until two peaks are detected. Adjust **C37** accurately to the second peak (which involves the lesser trimmer capacitance), then adjust **C33** for maximum output. Check calibration at 50 m (6 Mc/s).

LW.—Switch set to LW, tune to 1,000 m on scale, feed in a 1,000 m (300 kc/s) signal, and adjust **C39,** then **C31,** for maximum output. Feed in a 2,000 m (150 kc/s) signal, tune to 2,000 m on scale, and adjust **C36** for maximum output while gently rocking the gang.

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