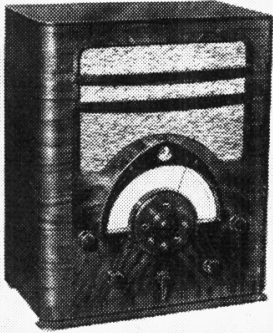


"TRADER" SERVICE SHEET

388

ULTRA 400

PRESS-BUTTON DIAL TUNING



The Ultra 400 AC superhet, which has a dial-operated mechanical automatic tuning system.

IN addition to ordinary manual tuning the Ultra 400 includes a mechanical auto-tuning system using a finger-hole type of dial catering for eight stations. The receiver is a 4-valve (plus rectifier) AC 3-band superhet with two IF stages, and a short-wave range of 16.8-50 m.

Release date : April, 1938.

CIRCUIT DESCRIPTION

Although the manual tuning circuits are used for automatic tuning in this receiver, the band-pass primary circuit and the first IF transformer coupling are modified for automatic tuning. This modification is effected by turning the "Manual-Auto" control knob, which controls the S27 to S29 switch unit, to "Auto," which action also relieves the

tension on the manual drive cord by the withdrawal of a jockey wheel.

Aerial input on MW and LW is via coupling coils and condensers L1, C1 (MW) and L2, C2 (LW) to capacity coupled band-pass filter. Primary coils L3, L4 are tuned by C39; secondaries L7, L8 by C43; bottom coupling by C3, and top coupling by C4. On auto, S27 closes to connect R1 across the primary tuning circuit. On SW, input is via coupling coil L5 to single tuned circuit L6, C43.

First valve (V1, Mazda metallised AC/TH1) is a triode pentode operating as frequency changer with internal coupling. Triode oscillator anode coils L12 (SW), L13 (MW) and L14 (LW) are tuned by C49; parallel trimming by C44 (SW), C45 (MW) and C15, C46 (LW); series tracking by C16 (SW), C47 (MW) and C48 (LW). Reaction by grid coils L9 (SW), L10 (MW) and L11 (LW) via coupling condensers C12 (SW) and C13 (MW and LW).

The intermediate frequency appearing at the anode of V1 pentode is fed into an IF amplifier which consists of two variable-mu RF pentodes (V2, V3, Mazda metallised AC/VP2's). Input coupling to V2 is a tuned-primary tuned-secondary iron-cored transformer C7, L15, L16, L17, C8 with which are associated switches S28, S29; for manual tuning S28 is closed and normal coupling exists between L15, L17; for auto tuning S28 opens and S29 closes so that the coupling is modified by the introduction of L16. Aperiodic coupling by R16, L18, C20 and R18 is employed between V2 and V3, while the

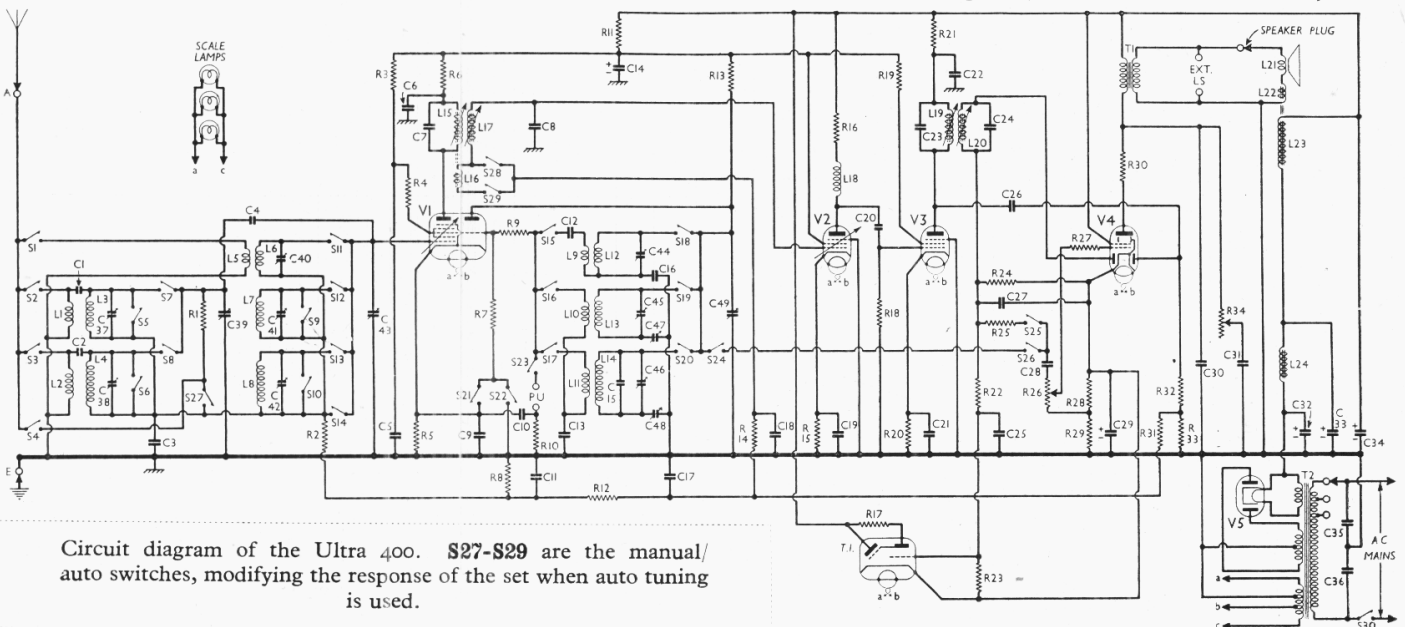
output coupling in V3 anode circuit is a second tuned-primary tuned-secondary iron-cored transformer C23, L19, L20, C24. In each transformer the tuning condensers are fixed, and tuning adjustments are effected by adjustment of the iron cores.

Intermediate frequency 456 KC/S.

Diode second detector is part of double diode beam tetrode output valve (V4, Mazda AC5/PenDD). Audio frequency component in rectified output is developed across the load resistance R24 and passed via IF stopper R25, switch S25, AF coupling condenser C28, manual volume control R26 and grid stopper R27 to control grid of tetrode section, which provides the total AF amplification on radio. Provision for low impedance external speaker across secondary of T1. Fixed tone correction by C30, and variable tone control by R34, C31, both in anode circuit. DC potential developed across R24 is fed via decoupling circuit R22, C25, R23 to control grid of tuning indicator (T.I., Mazda ME41).

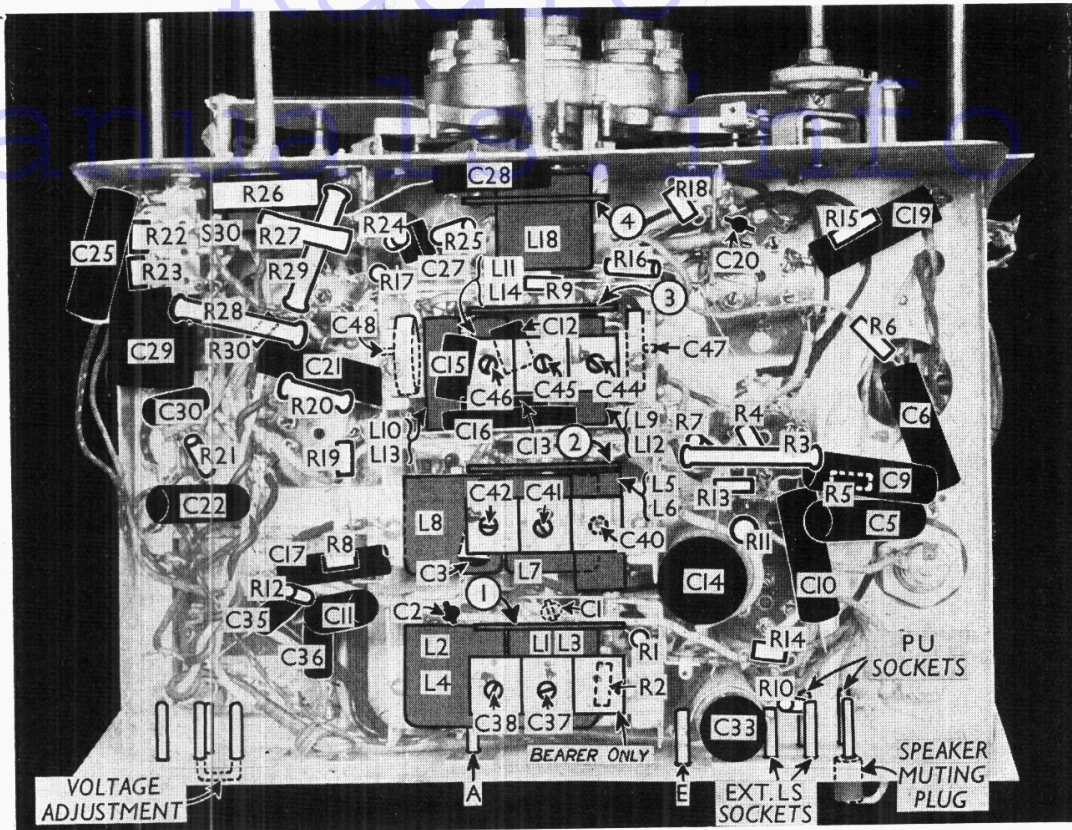
For use with a gramophone pick-up, arrangements are made to use the triode section of V1 as an AF amplifier. Sockets are provided between its control grid via S23, and cathode via C10, R10, and the GB is adjusted by closing S22 and opening S21. Resistance-capacity coupling by R13, via S24, S26 and C28, R26, is employed between the anode circuit and V4 tetrode. S25 opens on gram to mute radio.

Second diode of V4, fed from V3 anode via C26, provides DC potentials which are developed across load resistances R32,



Circuit diagram of the Ultra 400. S27-S29 are the manual/auto switches, modifying the response of the set when auto tuning is used.

Under-chassis view. The switch, coil and trimmer assembly in the centre is rather difficult to show clearly, but the approximate positions of all the components have been indicated. The four wave change switch units are shown in detail in the diagrams in col. 6 over-leaf. Note that the first three are viewed from the front of the chassis, and the fourth from the rear. The trimmer next to C38, C37 is used as a bearer only.



R33 ; that across R33 is fed back through filter circuit as GB to FC and both IF valves as GB, giving automatic volume control. Delay voltage is obtained from drop along R28, R29.

HT current is supplied by IHC full-wave rectifying valve (V5, Mazda UU4). Smoothing by speaker field L23, iron-cored choke L24 and electrolytic condensers C32, C33 and C34.

COMPONENTS AND VALUES

RESISTANCES		Values (ohms)
R1	Band-pass pri. damping ..	100,000
R2	V1 pentode CG decoupling ..	25,000
R3	V1 SG HT feed ..	20,000
R4	V1 SG RF stopper ..	60
R5	V1 fixed GB resistance ..	165
R6	V1 pent. anode HT feed ..	4,000
R7	V1 osc. CG resistance ..	25,000
R8	Part of AVC line filter ..	1,500,000
R9	V1 osc. CG stabiliser ..	60
R10	V1 osc. CG PU decoupling ..	1,000,000
R11	V1 HT and V2, V3 SG's HT feed ..	7,000
R12	Part of AVC line filter ..	1,000,000
R13	V1 osc. anode HT feed ..	40,000
R14	V2 CG decoupling ..	1,000,000
R15	V2 fixed GB resistance ..	700
R16	V2 anode load corrector ..	3,000
R17	T.I. anode HT feed ..	1,000,000
R18	V3 CG resistance ..	1,000,000
R19	V3 SG RF stopper ..	60
R20	V3 fixed GB resistance ..	4,000
R21	V3 anode HT feed ..	4,000
R22	T.I. CG feed resistances ..	750,000
R23	V4 signal diode load ..	500,000
R24	IF stopper ..	50,000
R25	Manual volume control ..	1,000,000
R26	V4 tetrode CG stopper ..	1,000
R27	V4 tetrode GB and AVC delay ..	160
R28	resistance ..	480
R29	resistance ..	60
R30	V4 tetrode anode stabiliser ..	1,000,000
R31	Part of AVC line filter ..	1,000,000
R32	V4 AVC diode load resistances ..	250,000
R33	Variable tone control ..	2,000,000
R34	Variable tone control ..	2,000,000

CONDENSERS		Values (μF)
C1	Aerial MW top coupling ..	0.000005
C2	Aerial LW top coupling ..	0.00001
C3	Band-pass bottom coupling ..	0.025
C4	Small coupling ..	Very low
C5	V1 SG decoupling ..	0.1
C6	V1 pent. anode decoupling ..	0.1
C7	1st IF transformer fixed ..	0.00015
C8	tuning condensers ..	0.00015
C9	V1 cathode by-pass ..	0.1
C10	V1 triode CG PU decoupling ..	0.1
C11	Part of AVC line filter ..	0.05
C12	V1 osc. SW CG condenser ..	0.0001
C13	V1 osc. MW and LW CG cond. ..	0.001
C14*	V1, V2 and V3 SG's decoupling ..	8.0
C15	Osc. circuit LW fixed trimmer ..	0.00006
C16	Osc. circuit SW tracker ..	0.004
C17	Part of AVC line decoupling ..	0.05
C18	V2 CG decoupling ..	0.05
C19	V2 cathode by-pass ..	0.1
C20	V2 to V3 IF coupling ..	0.00005
C21	V3 cathode by-pass ..	0.1
C22	V3 anode decoupling ..	0.1
C23	2nd IF transformer fixed ..	0.00015
C24	tuning condensers ..	0.00015
C25	T.I. CG decoupling ..	0.1
C26	Coupling to V4 AVC diode ..	0.0002
C27	IF by-pass ..	0.0002
C28	AF coupling to V4 tetrode ..	0.01
C29*	V4 cathode by-pass ..	50.0
C30	Fixed tone corrector ..	0.004
C31	Part of variable tone control ..	0.025
C32*	HT smoothing condensers ..	8.0
C33*	HT smoothing condensers ..	4.0
C34*	HT smoothing condensers ..	16.0
C35	Mains RF by-pass condensers ..	0.0002
C36	Mains RF by-pass condensers ..	0.0002
C37	Band-pass pri. MW trimmer ..	—
C38†	Band-pass pri. LW trimmer ..	—
C39†	Band-pass primary tuning ..	—
C40†	Aerial circuit SW trimmer ..	—
C41†	Band-pass sec. MW trimmer ..	—
C42†	Band-pass sec. LW trimmer ..	—
C43†	Band-pass secondary and SW aerial tuning ..	—
C44†	Osc. circuit SW trimmer ..	—
C45†	Osc. circuit MW trimmer ..	—
C46†	Osc. circuit LW trimmer ..	—
C47†	Osc. circuit MW tracker ..	—
C48†	Osc. circuit LW tracker ..	—
C49†	Oscillator circuit tuning ..	—

* Electrolytic. † Variable. ‡ Pre-set.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial MW coupling coil ..	11.0
L2	Aerial LW coupling coil ..	70.0
L3	Band-pass primary coils ..	1.5
L4		20.0
L5	Aerial SW coupling coil ..	0.2
L6	Aerial SW tuning coil ..	0.05
L7	Band-pass secondary coils ..	1.5
L8		20.0
L9	Osc. circuit SW reaction ..	7.5
L10	Osc. circuit MW reaction ..	1.0
L11	Osc. circuit LW reaction ..	1.2
L12	Osc. circuit SW tuning coil ..	0.05
L13	Osc. circuit MW tuning coil ..	5.5
L14	Osc. circuit LW tuning coil ..	9.6
L15	1st IF trans. pri. coil ..	4.25
L16	Part IF coupling (auto) ..	0.25
L17	1st IF trans. sec. coil ..	4.25
L18	V2 anode RF choke ..	42.0
L19	2nd IF trans. { Pri. ..	4.25
L20		{ Sec. ..
L21	Speaker speech coil ..	2.0
L22	Hum neutralising coil ..	0.1
L23	Speaker field coil ..	1,000.0
L24	HT smoothing choke ..	315.0
T1	Output trans. { Pri. ..	295.0
		{ Sec. ..
	{ Pri., total ..	16.5
T2	Mains Heater sec., total ..	0.1
	trans. Rect. heat. sec. ..	0.1
	HT sec., total ..	340.0
S1-S20	Waveband switches ..	—
S21-26	Radio/gram. change switches ..	—
S27-29	Manual/auto change switches ..	—
S30	Mains switch, ganged R26 ..	—

DISMANTLING THE SET

A detachable bottom is fitted to the cabinet and upon removal (six round-head wood screws) gives access to the trimmers and some of the components beneath the chassis.

Removing Chassis.—If it is necessary to remove the chassis from the cabinet, remove the five control knobs (pull off), taking care not to lose the springs, unscrew the knurled boss in the centre

TABLE AND DIAGRAMS OF THE SWITCH UNITS

Bearer Trimmer.—It will be noticed in the under-chassis view that the trimmer on the right of **C37** is marked "Bearer only." It serves as a convenient fixing for **R2**, which is wired across it, but it is not indicated in the circuit or list of condensers, since its capacity serves no useful purpose.

Condenser C4.—This is a very small coupling, formed of insulated wires from **C39** to **C43** twisted together. It is shown in the plan chassis view.

Trackers C47, C48.—Note that these are adjustable at opposite ends of the oscillator coil assembly unit beneath the chassis.

Chassis Divergencies.—**C4, S4, S5, S6, S9** and **S10** were not shown on the makers' diagram. **S4** is an "incidental" switch. **C17** was 0.05 μ F in our chassis, not 0.00015 μ F as in the makers' diagram.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator to control grid (top cap) of **V1**, and chassis, switch set to "Manual," feed in a 456 KC/S signal, and adjust the iron cores of **L20, L19, L17** and **L15**, in that order, for maximum output.

RF and Oscillator Stages.—With gang at maximum, pointer should cover horizontal line at the high wavelength end of the scale. Connect signal generator to **A** and **E** sockets.

MW.—Switch set to MW (manual), tune to 200 m on scale, feed in a 200 m (1,500 KC/S) signal, and adjust **C45**, then **C41** and **C37**, for maximum output. Feed in a 500 m (600 KC/S) signal, tune it in, and adjust **C47** for maximum output, while rocking the gang for optimum results. Repeat these adjustments.

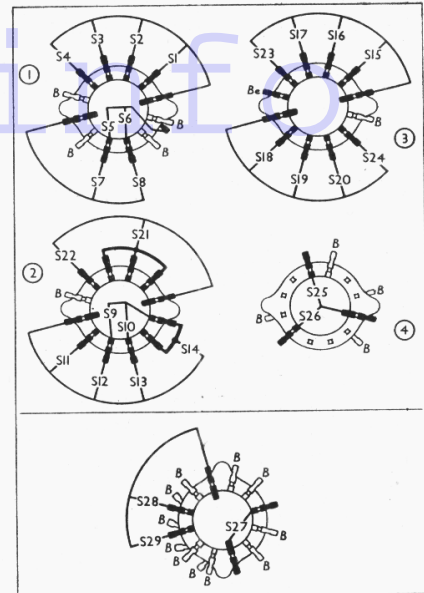
LW.—Switch set to LW (manual), tune to 1,300 m on scale, feed in a 1,300 m (230 KC/S) signal, and adjust **C46**, then **C42** and **C38**, for maximum output. Feed in a 1,700 m (176 KC/S) signal, tune it in, and adjust **C48** for maximum output, while rocking the gang for optimum results. Repeat these adjustments.

SW.—Switch set to SW (manual), tune to 19 m on scale, feed in a 19 m (15.8 MC/S) signal, and adjust **C44**, then **C40**, for maximum output. If **C40** is found to be fully opened, it should not be altered.

AUTOMATIC STATION SELECTION

A full description of the press-button dial assembly was given in *Radio*

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



Maintenance for May 21, 1938, and it is also included in pages 8 and 11 of the *ABC of Automatic Tuning*.

The following adjustment instructions are issued by the manufacturers:

With the spanner provided, unscrew the centre boss holding the bakelite press-button cover and take the cover off. There is a small raised number on the press-button plate against each press button, and each button covers a section of the wavelength scale, as in the table below.

Buttons	MW (metres)	LW (metres)
1 and 5	450-550	1,700-2,000
2 and 6	330-490	1,300-1,800
3 and 7	230-390	950-1,400
4 and 8	200-260	850-1,050

Each button overlaps the range of the button above and below it, but when setting press-buttons remember that the actuating rods on them are like the spokes of a wheel and cannot cross one another. For example, button 1 covers 450-550 m, and button 2 covers 330-490 m. If button 1 is set to 460 m, it will not be possible to set button 2 to 470 m, but only to a station between 330 and 460 m. As there is practically no broadcasting between 850 and 1,050 m, button 5 can be used on the 200-260 m section, in addition to button 4.

The first four switch units are those situated beneath the chassis. The first three are as viewed from the front of the underside of the chassis, and the fourth as viewed from the rear. The fifth unit, at the bottom, is for manual/auto switching, and is drawn as seen from the rear of the top deck of the chassis.

Switch the set on, and turn the manual-automatic switch to "Auto." Next find the wavelength of the desired station and the correct button to use for it. Pull off the station name cover, and place the spanner jaws in the slots of the collar nut of the press-button you are re-setting.

Push the button down with the spanner and with the other hand turn the press-button plate round till the button latches. The button must be held pushed in with the spanner until the following operations are completed. Hold the press-button plate firmly with the left hand, and slacken the collar nut with the spanner. Do not remove the collar nut. Now turn the press-button plate round and tune the station in accurately, as shown by the tuning indicator. Finally, holding the press-button plate firmly, tighten the collar nut.

S A T O R

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of the dial and remove the dial, and remove the tuning indicator by slackening the thumb screw holding the clamp. Next remove the chassis holding bolts. The chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes. *When replacing*, see that there is a felt washer between each knob and the cabinet.

To free the chassis entirely, unsolder the speaker leads and *when replacing*, connect them as follows, numbering the tags from bottom to top:—Right-hand, 1, red; 2, no external connection; 3, yellow; 4, green/black. Left-hand, 1, black; 2, blue; 3, green, 4, black/white.

Removing Speaker.—The speaker can be removed from the cabinet by unsoldering the leads and removing the two round-head wood screws and the four clamps (nuts and spring washers) holding it to the sub-baffle. *When replacing*, see that the smoothing choke is at the bottom and connect the leads as follows, numbering the tags from bottom to top:—Left-hand, 1, black to chassis and black to speaker input transformer; 2, blue to chassis and green to choke; 3, green to chassis and green to choke; 4, black/white to chassis and black to choke. Right-hand, 1, red; 2, no external connection; 3, yellow; 4, green/black.

VALVE ANALYSIS

Valve voltages and currents given in the table (col. 2) are those measured in our receiver when it was operating on mains of 226 V, using the 220-240 V tapping on the mains transformer. The

receiver was tuned to the lowest wavelength on the medium 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 AC/TH1	166	2.2	72	5.1
	Oscil	lator		
V2 AC/VP2	55	2.5	180	1.1
	255	4.1	180	1.1
V3 AC/VP2	248	4.4		
V4 AC/5Pen/DD	255	44.0	272	8.0
	336†	—		
V5 UU4	42	0.2	—	—
	Tar	get		
T.I. ME4t	272	0.8	—	—

† Each anode, AC.

GENERAL NOTES

Switches.—S1-S26 are the waveband and radio-gram switches, in four rotary units beneath the chassis, indicated in our under-chassis view, and shown in detail in the diagrams in col. 6 where units 1, 2 and 3 are as viewed from the front of the chassis, and unit 4 from the rear. The table (col. 5) gives the switch positions for the four control settings, starting from fully anti-clockwise. A dash indicates open, and C, closed.

S27-S29 are the manual-auto switches, in a separate rotary unit above the chassis, indicated in our plan chassis view. A diagram of this unit, seen from the rear

of the chassis, is in col. 6. In the manual (anti-clockwise) position, S28 is closed, and S27 and S29 open. In the auto (clockwise) position, S27 and S29 are closed, and S28 open.

S30 is the QMB mains switch, ganged with the volume control R26.

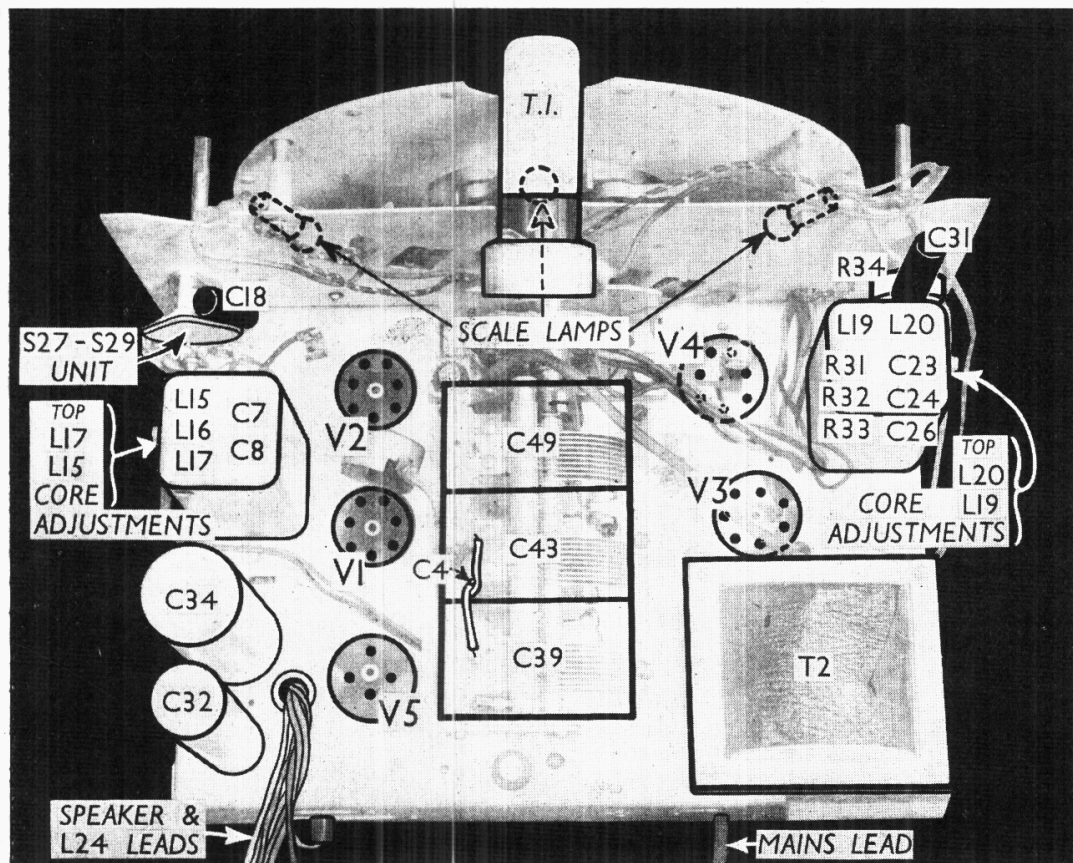
Coils.—All the coils, with the exception of the IF transformers, are beneath the chassis in small screened and unscreened units inside three box-like assemblies, which carry the trimmers and the switch units, and also contain many of the other components. Some of these are difficult to indicate in a two-dimensional view, but their positions are shown in all cases.

The IF transformers L15, L16, L17 and L19, L20 are in two screened units on the chassis deck, and their inductance trimmers can be reached through holes in the sides of their cans. The IF choke L18 is in a screened unit beneath the chassis, behind the centre of the front member.

The smoothing choke L24 is mounted beneath the speaker, while the transformer T1 is on the cabinet, to the left of the speaker.

Scale Lamps.—These are three Osram MES types, rated at 6.5 V, 0.3 A. Note that they are connected across the points a and c on the heater secondary of T2, and so get a higher voltage than the valve heaters.

External Speaker.—Two sockets are provided at the rear of the chassis for a low impedance (2-4Ω) external speaker. A plug and socket device permits the internal speaker to be muted if desired.



Plan view of the chassis. A diagram of the S27-S29 unit is in col. 6. Note that the IF transformer cores are adjustable through holes in the sides of the cans, their positions being indicated by arrows. The units also contain certain additional components. C4 is a small coupling formed of twisted insulated wires.