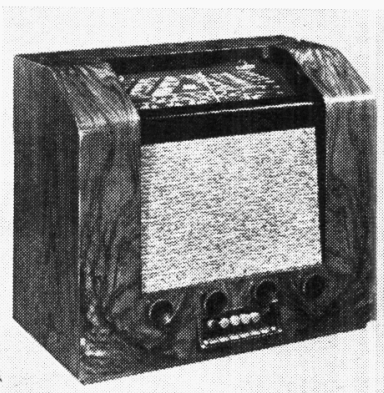


"TRADER" SERVICE SHEET

385

G.E.C. BC3960, BC3964 AND BC3968



The G.E.C. BC3960 AC superhet.

PRESS-BUTTON tuning of the trimmer type for five stations is incorporated in the G.E.C. BC3960, AC Touchtune Five, 4-valve (plus rectifier) AC 3-band superhet. It is suitable for mains of 190-250 V, 40-100 C/S, and has a short-wave range of 16.5-50m and provision for both a gramophone pick-up and an extension speaker.

An identical chassis is fitted in the BC3964 console and the chassis of the BC3960L table model and BC3964L console are very similar but are for mains

of 110-130 and 210-230 V, 40-100 C/S. The chassis of the BC3968 radiogram is also very similar and the differences are explained under "Model 3968 Modifications." This *Service Sheet* was prepared on a BC3960.

Release dates: BC3960 and BC3960L, June, 1938; BC3968, July, 1938; BC3964 and BC3964L, August, 1938.

CIRCUIT DESCRIPTION

Two alternative aerial input sockets, **A1** via small series condenser **C1** on SW and MW only, and **A2** direct, to coupling condenser **C2**, small MW coupling coil **L2**, SW coupling coil **L1** and MW and LW coupling condenser **C3**, and thus to single-tuned circuits comprising coils **L3** (SW), plus **L4** (MW), plus **L5** (LW), which are tuned by **C34** (manual) via switch **S14** or by automatic tuning trimmers **C45** to **C49** via **S13** and selector switches **S8** to **S12** according to which press-button is operated, for automatic tuning.

First valve (**V1**, Osram **X65**) is a triode hexode operating as frequency changer with internal coupling. Triode oscillator grid coils **L6** (SW), plus **L7** (MW), plus **L8** (LW), are tuned by **C35** (manual) via **S15** or by automatic tuning trimmers **C50** to **C54** via **S16** and selector switches **S17** to **S21** for automatic tuning. Reaction by anode coil **L9** (SW) and direct coupling via **C14** (MW and LW).

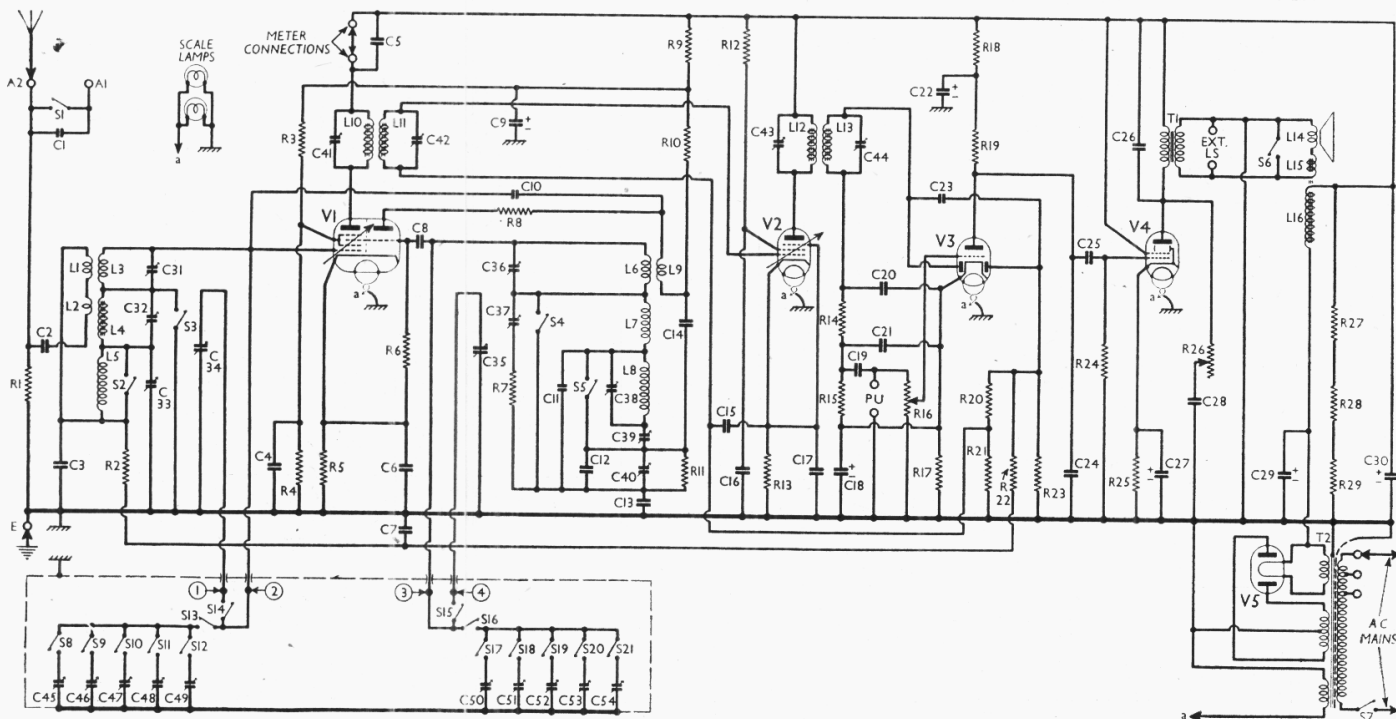
Second valve (**V2**, Osram **W63** or **KTW63**) is a variable-mu RF pentode (or tetrode) operating as intermediate frequency amplifier with tuned-primary tuned-secondary iron-cored transformer couplings **C41**, **L10**, **L11**, **C42** and **C43**, **L12**, **L13**, **C44**.

Intermediate frequency 456 KC/S.

Diode second detector is part of double diode triode valve (**V3**, Osram **DH63**). Audio frequency component in rectified output is developed across load resistance **R15** and passed via AF coupling condenser **C19** and manual volume control **R16** to CG of triode section, which operates as AF amplifier. IF filtering by **C20**, **R14** and **C21** in diode circuit and **C24** in triode anode circuit. Provision for connection of gramophone pick-up across **R16**.

Second diode of **V3**, fed from **L13** via **C23**, provides DC potential which is developed across load resistance **R23** and fed back through decoupling circuit as GB to FC valve (except on SW); potential divider **R20**, **R21** provides a reduced control voltage which is fed back as GB to IF valve; from these two lines is obtained automatic volume control.

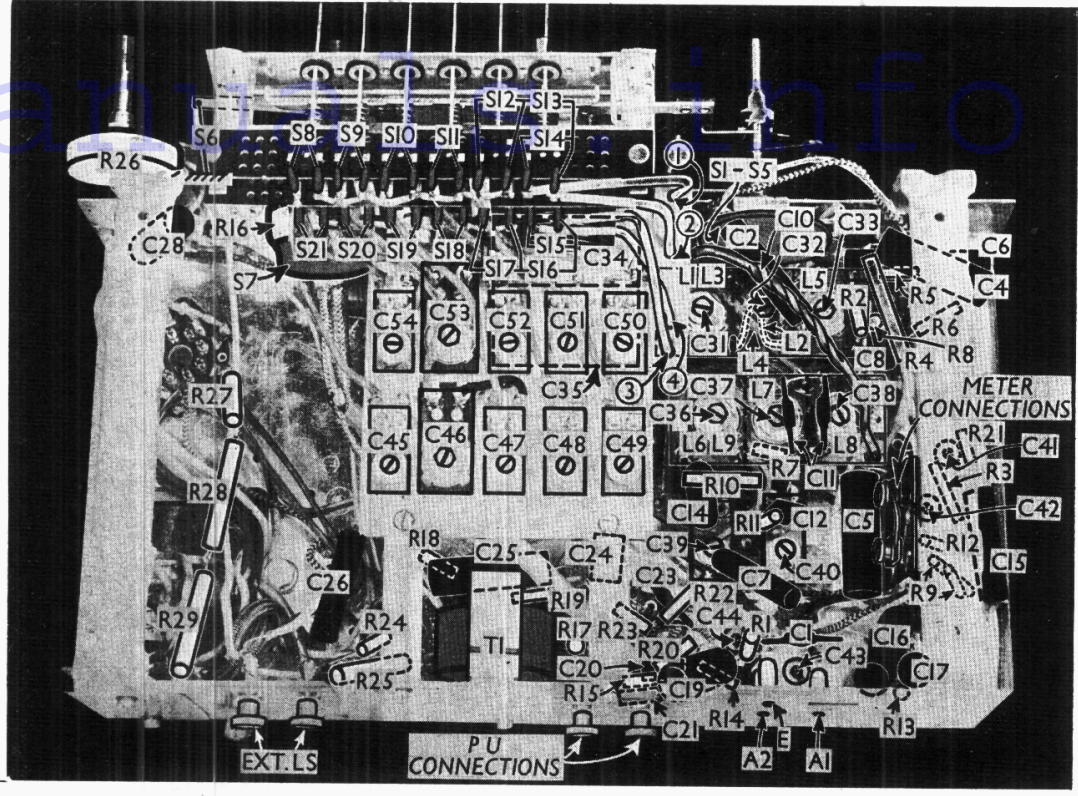
Resistance-capacity coupling by **R19**, **C25** and **R24** between **V3** triode and beam tetrode output valve (**V4**, Osram **KT63**). Fixed tone correction by **C26** in anode circuit. Variable tone control by **R26**, **C28** also in anode circuit. Provision for



Circuit diagram of the G.E.C. BC3960 press-button AC superhet. The modifications in the BC3968 radiogram are in col. 4 overleaf.

Main Info

Under-chassis view. The coils are in units beneath the trimmers at the top right-hand of the chassis, and their positions are roughly indicated. L2 is a single loop of thick wire. The tags of all the press-button switches are shown. S6 is a muting switch, explained in "General Notes." Note the bank of auto-tuning trimmers, and the meter terminals.



connection of low impedance external speaker across secondary of output transformer **T1**. Switch **S6** short-circuits **T1** secondary temporarily during the movement of any of the press-buttons to mute the speaker.
 HT current is supplied by full-wave rectifying valve (**V5**, Osram **U50**). Smoothing by speaker field **L16** and dry electrolytic condensers **C29** and **C30**.

COMPONENTS AND VALUES

RESISTANCES		Values (ohms)
R1	Aerial circuit shunt	9,900
R2	V1 hexode CG decoupling	99,000
R3	V1 SG HT potential divider	4,400
R4		15,000
R5	V1 fixed GB resistance	300
R6	V1 osc. CG resistance	99,000
R7	Oscillator circuit MW and LW damping	75
R8	V1 osc. anode stabiliser	150
R9	V1 osc. and SG HT feed	8,200*
R10	V1 osc. HT feed resistance	8,800
R11	Part V1 osc. anode coupling	5,500
R12	V2 SG HT feed	99,000
R13	V2 fixed GB resistance	400
R14	IF stopper	55,000
R15	V3 signal diode load	440,000
R16	Manual volume control	1,000,000
R17	V3 triode GB; AVC delay	3,300
R18	V3 triode anode decoupling	22,000
R19	V3 triode anode load	220,000
R20	V2 AVC pot. divider	2,000,000
R21		2,000,000
R22	AVC line decoupling	2,000,000
R23	V3 AVC diode load	440,000
R24	V4 GB resistance	440,000
R25	V4 GB resistance	400
R26	Variable tone control	55,000
R27	HT surge limiting resistances	6,600
R28		6,600
R29		6,600
R29		8,800

*Approx. value: One 13,000 Ω + one 22,000 Ω in parallel.

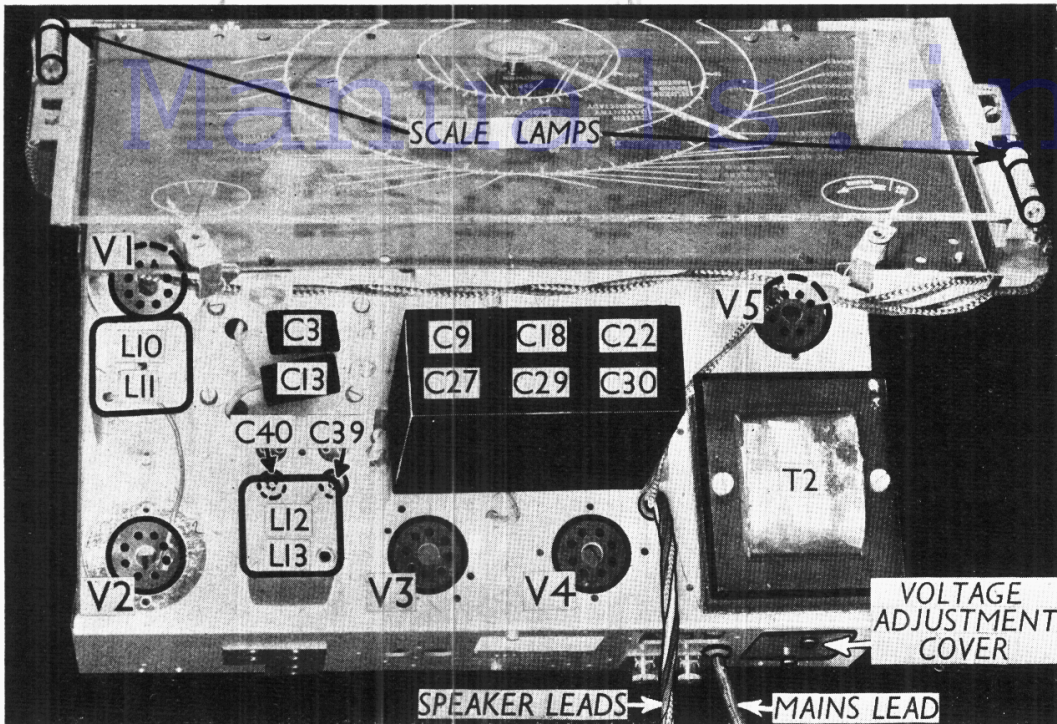
CONDENSERS		Values (μF)
C1	A1 series condenser	0.00002
C2	Aerial coupling condensers	0.005
C3		0.003
C4		0.005
C5	V1 SG decoupling	0.005
C6	Station setting meter shunt	0.05
C7	V1 cathode by-pass	0.1
C8	AVC line decoupling	0.005
C9	V1 osc. CG condenser	0.0001
C9*	V1 osc. anode and SG decoupling	6.0‡
C10	Small coupling	0.000035
C11	Osc. circuit LW fixed trimmer	0.00004†
C12	Osc. circuit MW fixed tracker	0.0001
C13	Osc. circuit SW tracker	0.00425
C14	V1 osc. anode coupling	0.005
C15	V2 CG decoupling	0.05
C16	V2 SG decoupling	0.05
C17	V2 cathode by-pass	0.1
C18*	V3 cathode by-pass	35.0
C19	AF coupling to V3 triode	0.02
C20	IF by-pass condensers	0.0003
C21		0.0001
C22*	V3 triode anode decoupling	3.0
C23	Coupling to V3 AVC diode	0.00002
C24	IF by-pass	0.0005
C25	V3 triode to V4 AF coupling	0.02
C26	Fixed tone corrector	0.005
C27*	V4 cathode by-pass	35.0
C28	Part of variable tone control	0.05
C29*	HT smoothing condensers	14.0
C30*	7.0	
C31‡	Aerial circuit SW trimmer	—
C32‡	Aerial circuit MW trimmer	—
C33‡	Aerial circuit LW trimmer	—
C34‡	Aerial circ. manual tuning	—
C35†	Osc. circ. manual tuning	—
C36‡	Osc. circuit SW trimmer	—
C37‡	Osc. circuit MW trimmer	—
C38‡	Osc. circuit LW trimmer	—
C39‡	Osc. circuit LW tracker	—
C40‡	Osc. circuit MW tracker	—
C41‡	1st IF trans. pri. tuning	—
C42‡	1st IF trans. sec. tuning	—
C43‡	2nd IF trans. pri. tuning	—
C44‡	2nd IF trans. sec. tuning	—
C45‡	Aerial circuit automatic tuning trimmers	—
C46‡		—
C47‡		—
C48‡		—
C49‡		—

Continued in next column

CONDENSERS (Continued)		Values (μF)
C50†	Oscillator circuit automatic tuning trimmers	—
C51†		—
C52†		—
C53†		—
C54†		—

* Electrolytic. † Variable. ‡ Pre-set.
 § Two 3 μF condensers in parallel.
 ¶ Two 0.0002 μF condensers in parallel.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial SW coupling	0.3
L2	Part aerial MW coupling	Very high
L3	Aerial SW tuning coil	0.08
L4	Aerial MW tuning coil	2.0
L5	Aerial LW tuning coil	22.0
L6	Osc. circuit SW tuning coil	0.07
L7	Osc. circuit MW tuning coil	2.7
L8	Osc. circuit LW tuning coil	8.0
L9	Oscillator SW reaction	0.4
L10	1st IF trans.	Pri. 7.0
L11		Sec. 7.0
L12	2nd IF trans.	Pri. 4.0
L13		Sec. 4.0
L14	Speaker speech coil	2.2
L15	Hum neutralising coil	0.1
L16	Speaker field coil	1,200.0
T1	Output trans.	Pri., total 485.0
		Sec. 0.4
T2	Mains trans.	Heater sec. 0.19
		Rect. heat. sec. 0.16
		HT sec., total 580.0
S1-S5	Waveband switches	—
S6	Speaker muting switch	—
S7	Mains switch, ganged R16	—
S8-S12	Aerial auto selector switches	—
S13-S16	Auto/manual change switches	—
S17-S21		Osc. auto selector switches



Plan view of the chassis. C39 and C40 are adjusted through two holes in the chassis deck. The IF trimmers are reached from beneath the chassis. Note the multiple electrolytic condenser unit.

DISMANTLING THE SET

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

Removing Chassis.—If it is necessary to remove the chassis from the cabinet, remove the four control knobs and the six buttons (pull off), and the cross-bar at the back of the cabinet (two counter-sunk-head wood screws). Now remove the two round-head wood screws (with washers) holding the scale assembly to the top of the cabinet and the four bolts (with washers and spring washers) holding the chassis to the bottom of the cabinet.

By pulling the scale assembly downwards the chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes. When replacing, see that the red button is on the left and the brown on the right, and make sure that the cross-bar is so positioned that the screws are below the clips for the cabinet back.

To free the chassis entirely, unsolder the speaker leads, and when replacing, connect them as follows, numbering the tags from left to right:—1, red; 2, black; 3, white; 4, red/white.

Removing Speaker.—To remove the speaker from the cabinet first remove the chassis as described above, then unsolder the leads and remove the four bolts (with washers and spring washers) holding the speaker to the sub-baffle.

When replacing, see that the terminal panel is at the top and connect the leads as follows, numbering the tags from left to right:—1, red; 2, black and black to speaker frame; 3, white; 4, red/white.

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 210-230 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.

If, as in our case, V2 should become unstable when its anode and screen currents are being measured, it can be stabilised by connecting a non-inductive condenser of about 0.1 μF from the electrode concerned to chassis.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 X65	245	1.5	84	4.2
	Oscillator			
V2 W63	94	3.5	86	1.6
	245	6.0		
V3 DH63	70	0.5	—	—
V4 KT63	226	32.0	245	5.6
V5 U50	330†	—	—	—

† Each anode, AC.

GENERAL NOTES

Switches.—S1-S5 are the waveband switches, in a single rotary unit beneath the chassis. It is indicated in our under-chassis view, and shown in detail in the diagram in col. 6. The table (col. 5) gives the switch positions for the three control settings, starting from fully anti-clockwise. A dash indicates open and C closed.

S6 is the speaker muting switch, which closes when any press-button is being depressed. It is open when the button is out, and also when it is dully depressed. The switch is situated on the press-

button switch assembly at the front of the chassis, and is operated by movement of the press-button latch plate.

S7 is the QMB mains switch, ganged with the volume control R16.

S8-S21 are the press-button switches, in a double-sided unit beneath the chassis, the tags of each switch being indicated in the under-chassis view. Each button, except that switching to manual tuning (the right-hand one), controls two switches, and these are open when their button is out, and closed when it is depressed.

The right-hand button controls S13-S16. When the button is out, S13, S16 are closed, and S14, S15 open; when the button is depressed, S13, S16 are open, and S14, S15 are closed.

Coils.—L1-L9 are in unscreened units beneath the chassis, to the right of the gang condenser in our under-chassis view. They are underneath two paxolin panels carrying six trimmers, and their positions are roughly indicated by arrows in our illustration. L2 is a small coupling coil consisting of one turn of thick tinned copper wire.

The IF transformers L10, L11 and L12, L13 are in two screened units on the chassis deck, their trimmers being at their bases, and adjustable from beneath the chassis.

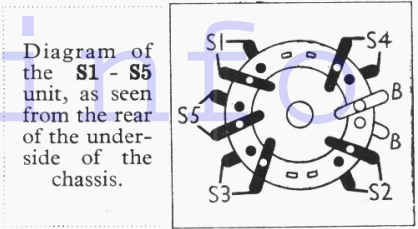
Scale Lamps.—These are two Osram MES types, with 10 mm diameter bulbs, rated at 6.5 V 0.3 A.

External Speaker.—Two terminals are provided at the rear of the chassis for a low impedance (2-4 Ω) external speaker.

Condenser Block.—The condenser block on the chassis deck contains seven dry electrolytic condensers, indicated in our plan chassis view. Two of these are connected in parallel to form C9 in our diagram.

TABLE AND DIAGRAM OF THE SI-S5 SWITCH UNIT

Switch	LW	SW	MW
S1	C	C	—
S2	—	C	—
S3	—	C	—
S4	—	C	—
S5	—	C	C



The black and red leads are the negative and positive respectively of **C29** (14 μ F).

The brown lead is the common negative of **C9**, **C22** and **C30**. The yellow lead is the positive of **C30** (7 μ F); the green lead to the junction of **R18**, **R19** (bearer tag on **V4** valveholder) is the positive of **C22** (3 μ F); and the two green leads to one side of **R10** form the positive of **C9** (6 μ F).

The grey lead is the common negative of **C18** and **C27**. The blue lead to **V3** valveholder is the positive of **C18** (35 μ F) and the blue lead to **V4** valveholder is the positive of **C27** (35 μ F).

Condenser C11.—This fixed trimmer consists of two 0.0002 μ F types parallel.

Condenser C10.—This is a small coupling consisting of two twisted insulated wires.

Resistance R9.—This consists of one 13,000 Ω and one 22,000 Ω resistor in parallel in our chassis.

Meter Terminals.—Two terminal screws, normally shorted by a wire link, are provided on a small panel beneath the chassis for the insertion of a milliammeter for accurate station selection.

Models BC3960L and 3964L.—The only difference in the low voltage models is in the mains transformer primary winding, which has a resistance of 26 Ω total, instead of 41.5 Ω .

MODEL 3968 MODIFICATIONS

The radiogram model is similar to the table and console models, but with the addition of a radio to gram switch at the side of the cabinet. This consists of two single pole shorting switches, which are open on radio, and closed on gram. One is connected across **L10**, and mutes radio on gram. The other is in series with the unearthed pick-up socket and the junction of **R16**, **C19**. In addition, there is a resistance of 44,000 Ω across the pick-up.

CIRCUIT ALIGNMENT

IF Stages.—Switch set to MW and turn gang to maximum. Turn volume control to maximum. Short-circuit **C35** and connect signal generator via a 0.1 μ F condenser to grid (top cap) of **V1** and chassis. Leave existing top cap connection in place.

Feed in a 456 KC/S signal, and adjust **C41**, **C42**, **C43** and **C44** for maximum output. Remove the short from **C35**.

RF and Oscillator Stages.—Check that

the scale is central in its clips, and that the pointer is straight, and coincides with the horizontal mark on the scale when the gang is at maximum. Connect signal generator via a suitable dummy aerial to the **A2** and earth sockets.

MW.—Switch set to MW, tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C37**, then **C32**, for maximum output.

Disconnect **C35** by unsoldering the lead from its fixed plates, and connect an external variable condenser between the disconnected lead and chassis. Feed in a 500 m (600 KC/S) signal, and adjust external condenser and receiver tuning control together for maximum output. Disconnect external condenser and re-connect **C35**. Without altering tuning control setting, adjust **C40** for maximum output. Repeat the 214 m adjustments.

LW.—Switch set to LW, and tune to 1,000 m on scale. Feed in a 1,000 m (300 KC/S) signal, and adjust **C38**, then **C33**, for maximum output.

Disconnect **C35** as before, and connect external condenser. Feed in an 1,818 m (165 KC/S) signal, and adjust external condenser and receiver tuning control together for maximum output. Disconnect external condenser, re-connect **C35**, and without altering tuning control setting, adjust **C39** for maximum output. Repeat the 1,000 m adjustments.

SW.—Switch set to SW, tune to 16.7 m on scale, feed in a 16.7 m (18MC/S) signal (via a SW dummy aerial), and adjust **C36**, then **C31**, for maximum output. **C36** should be adjusted to the higher frequency peak (lower capacity). If "pulling" is experienced when **C31** is adjusted, rock the gang slightly to compensate for this.

AUTO TUNING ADJUSTMENT

To reach the auto tuning trimmers in the table model, remove the card panel underneath the base of the cabinet. In the console and radiogram models there is a detachable speaker baffle which can be released and swung back for the same purpose.

The press-buttons, from left to right, looking at the front of the set, are—1, LW; 2.5, MW; and 6, manual. The actual wavelength ranges for the various buttons are: 1, 1,250-1,625 m; 2, 215-280 m; 3, 260-320 m; 4, 295-390 m; 5, 380-510 m. The range of button 2 may be extended downwards, below 215 m, if desired, by substituting a ceramic washer for the upper brass washer of **C46** and **C53**. Suitable ceramic washers for this purpose will be found fixed to a cross batten in the base of the receiver.

The upper limits of the above ranges are not the absolutely highest wavelengths that can be covered, but it is recommended that the values quoted should not be exceeded, to avoid frequency drift.

If it is desired to set up a station above 510 m on button 5, silvered mica 0.0001 μ F fixed condensers should be connected across **C49** and **C50**.

To set up a station, after access to the trimmers has been gained, remove the link between the meter terminals beneath the chassis and connect a milliammeter (0.3 mA to 0.10 mA) between the terminals. Switch on the receiver and allow it to run for 15 minutes.

Set the wavechange switch to the appropriate waveband, depress the manual tuning button, and tune manually to the desired station. Note the meter reading at the correct tuning point.

Depress the required auto button and adjust the appropriate oscillator trimmer (**C50** to **C54**) until the desired station is heard, turning up the volume control if necessary. If the oscillator trimmer has to be adjusted by a large amount, the corresponding aerial trimmer (**C45-C49**), must first be approximately adjusted before finally adjusting the oscillator trimmer. Then adjust the aerial trimmer accurately. The correct positions of the trimmers are those giving the lowest meter reading.

If more than one station is transmitting the same programme, the station to which the button is actually tuned can be checked by noting that the meter reading is about the same as that obtained when the same station is tuned manually.

After re-setting stations, disconnect meter, re-connect wire link, and replace bottom panel or speaker baffle.

S A T O R

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