Supplement to The Wireless & Electrical Trader, May 18, 1940

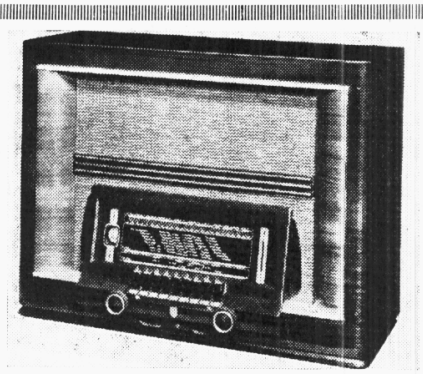
MULLARD MAS 103

"TRADER" SERVICE SHEET

465

PHILIPS 855x

3-BAND AC SUPERHET



The Philips 855x is a table 3-band AC superhet, with the Philips mechanical automatic tuning unit, having six keys for station selection (three of which are for MW and three for MW or LW stations), together with three keys for manual waveband switching.

The set employs five valves, plus valve rectifier, one of the valves being a combined AF amplifier and tuning indicator. The SW range is 13.8-51m, and the set is suitable for 100-260V, 50-100 C/S AC mains.

Release date: September, 1939.

Note.—When ordering spares for this model, dealers quoting our component numbers should mention that they are *Trader* Service Sheet numbers, to avoid confusion.

CIRCUIT DESCRIPTION

Aerial input on MW and LW via coupling coils **L2, L3** to mixed coupled band-pass filter. Primary coils **L5, L6** are tuned by **C49**; secondary coils **L9, L10** are tuned by **C51**. Coupling by **L7, L8** and **C4, C5**. Aerial circuit is permanently shunted by **C1**.

On SW, input is via coupling coil **L1** to single-tuned circuit **L4, C49**.

First valve **(V1, Mullard EF8)** is a variable-mu hexode operating as RF amplifier, with tuned-secondary transformer anode coupling by **L11, L12** on SW, or aperiodic anode coupling by **R3, C12** and **R5** on MW and LW. On MW, **C10** is interposed between **V1** anode and **C12**.

To effect these alternative couplings, **S12** closes for MW and LW, while **S13** opens; **S14** closes for MW, **S15** closes for LW; and **S13** and **S16** close for SW, when **S12** opens. **C51** now becomes the SW RF tuning condenser and is connected across **L12** via switches **S17, S18.**

Second valve **(V2, Mullard ECH3)** is a triode heptode operating as frequency changer with internal coupling. Triode oscillator anode coils **L16** (SW), **L17** (MW) and **L18** (LW) are tuned by **C57**; parallel trimming by **C54** (SW) **C55** (MW) and **C21, C56** (LW); series tracking by **C19** and adjustable wire loop **Lx** (SW), **C20, C52** (MW) and **C53** (LW). Reaction by grid coils **L13** (SW), **L14** (MW) and **L15** (LW).

Third valve **(V3, Mullard EF9)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary iron-cored transformer couplings **C14, L19, L20, L21, C15,** and **C26, L22, L23, C27.**

In each case the tuning condensers are fixed, and alignment is carried out by varying the positions of the iron coil cores. Variable selectivity is provided by the introduction of the coil **L21**; normally (narrow band-width) **S33** is closed, and **L21** is out of circuit; but when **S32** is closed **S33** opens, and the band-width is increased.

Intermediate frequency 470 KC/S.

Diode second detector is part of double diode output pentode valve **(V5, Mullard EBL1).** Audio frequency component in rectified output is developed across load resistances **R17, R18** and the manual volume control **R24** and limiting resistance **R23,** which are in parallel with them, and passed via AF coupling condenser **C33** to CG of pentode section of combined AF amplifier and cathode ray tuning indicator **(V4, Mullard EFM1).**

Provision for connection of gramophone pick-up via **S36** and **R21** across **R24.** When the radiogram change switch lever is raised **S36** closes, while **S34** and **S35** open to mute radio. Tone compensation by **R22, C32** in association with the position of **R24** slider.

DC potential at junction of **R17** and **R18** is communicated via resistances **R19** and **R20** to CG of **V4** pentode, whose GB is thus varied in sympathy with the strength of the incoming carrier. Since this causes a change in the screen current, and the screen is internally connected to the control grid of the tuning indicator section of the valve, visual indication of signal strength is obtained. **C30** prevents AF and IF signals from reaching the control grid via **R19, R20.**

Resistance-capacity coupling by **R29, C39** and **R32,** via grid stopper **R34,** between **V4** pentode and pentode section of **V5.** Provision for connection of low impedance external speaker across part of speaker secondary of output transformer **T1.**

Second secondary of **T1** provides negative feed-back voltages. The output from one section is developed across **R40, R41** and **R42** (SW) or **R40, C45** and **R43** (MW and LW) and fed back to the low potential end of **R24.**

From the other section the output is developed across **R31** and **C35, L24, R27** in **V4** pentode GB circuit, where **R31** operates as variable tone control, and **C35, L24** as a whistle filter.

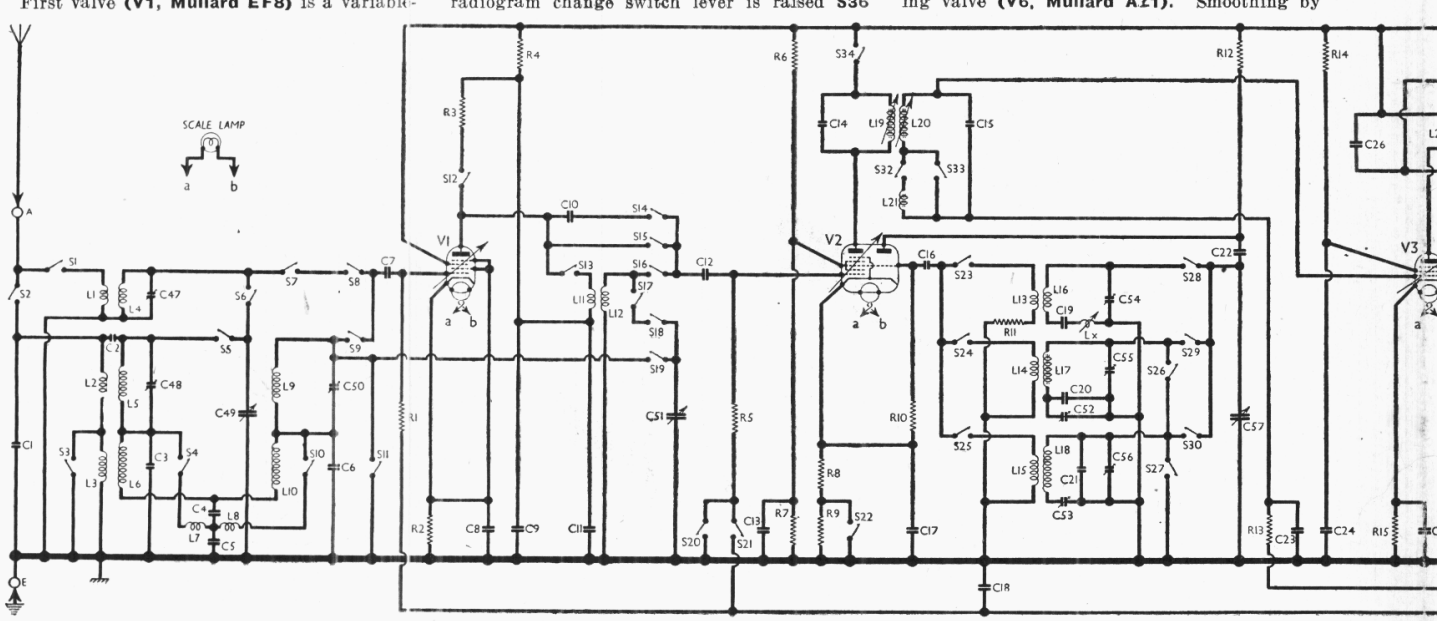
Fixed tone correction by **C43** in **V5** pentode anode circuit.

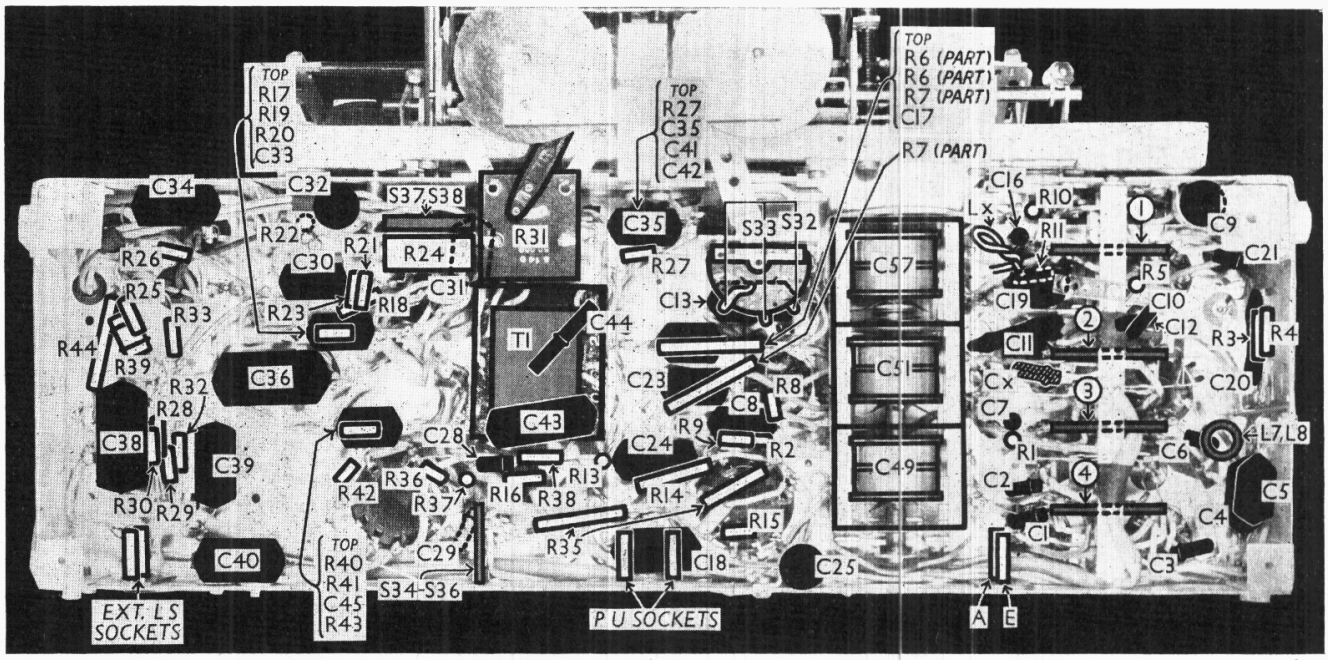
Second diode of **V5,** fed from 'live' end of **L22** via **C29,** provides DC potentials which are developed across resistances **R37, R38** and fed back through decoupling circuits as GB to RF, FC (except on SW, when **S20** closes and **S21** opens) and IF valves, giving automatic volume control.

Delay voltage is obtained from potential divider comprising resistances **R35, R36, R37, R38** which is connected across the HT supply. This biases the diode anode positively, and the diode is thus prevented from rectifying the applied signal until the signal voltage exceeds the delay.

The positive voltages thus applied to the grids of the controlled valves is offset by correspondingly high fixed negative GB voltages.

HT current is supplied by full-wave rectifying valve **(V6, Mullard AZ1).** Smoothing by





Under-chassis view. Diagrams of the wavechange and radio/gram switch units are overleaf. The selectivity switches are indicated. **Lx** is a wire loop for SW tracking; **Cx** is a small condenser not actually used in the circuit. Components in the four vertical assemblies are numbered from top to bottom.

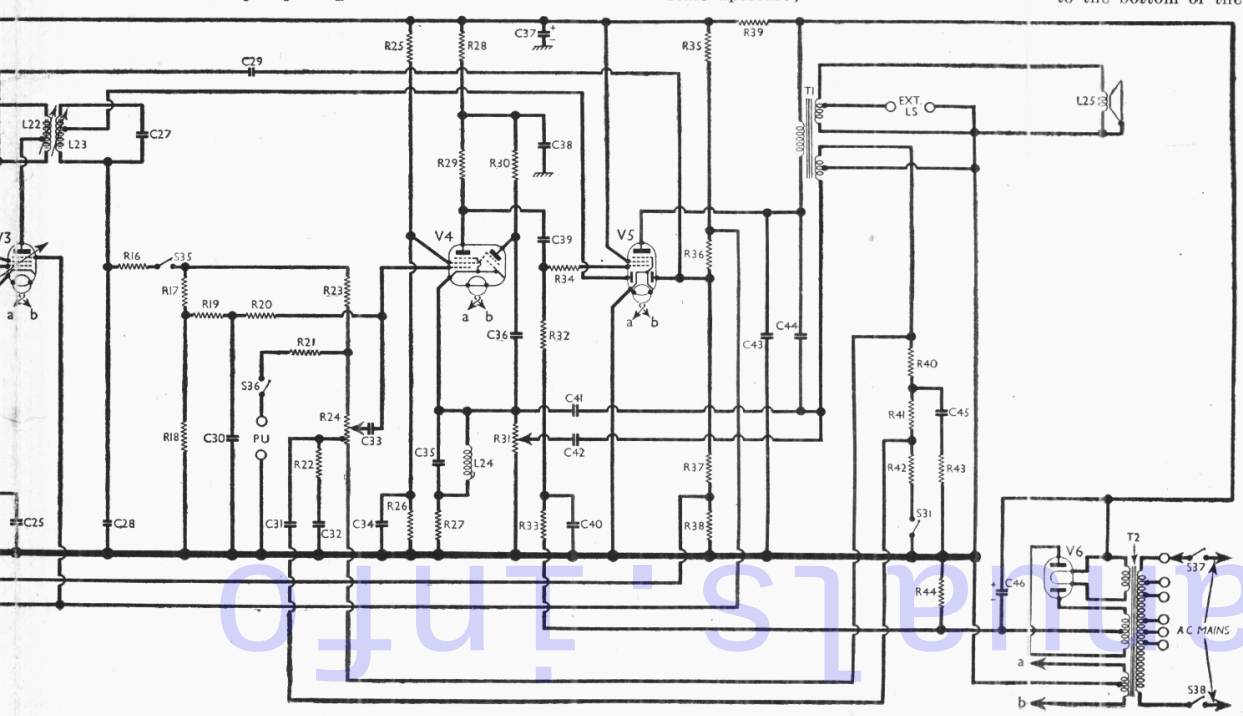
electrolytic condensers **C37, C46** and resistance **R39.**

GB potential for **V5** pentode is obtained automatically from drop along resistance **R44** in negative HT lead to chassis.

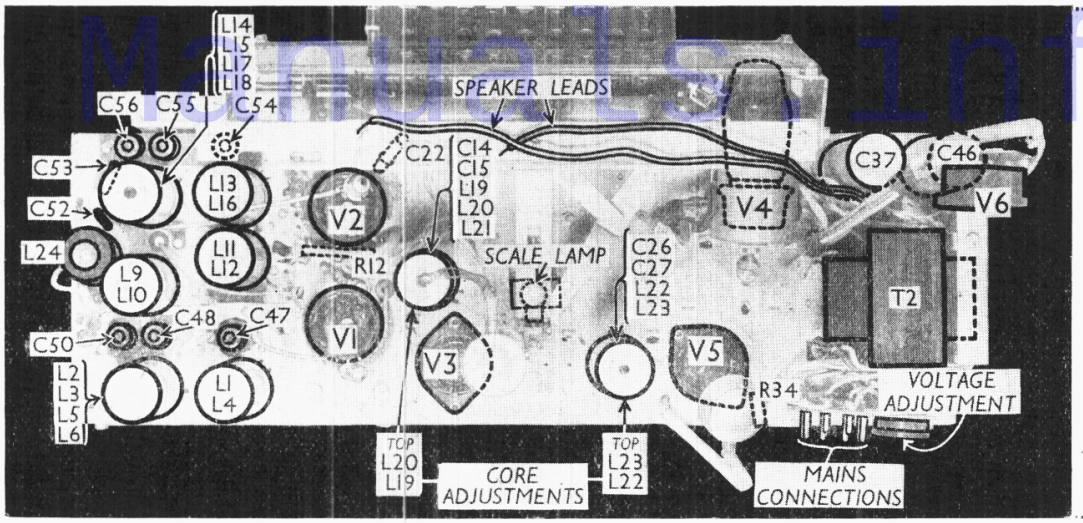
DISMANTLING THE SET

The cabinet is fitted with a detachable bottom, upon removal of which access may be gained to most of the components beneath the chassis.

Removing Chassis.—Remove the two control knobs (recessed grub screws);
release all tuning keys by slightly depressing one of them;
insert the key adjusting tool or a small screwdriver into the key adjustment apertures beneath the 1st, 2nd, 3rd (if LW) and 7th keys in turn, and turn the screw-head thus engaged anti-clockwise until it is possible to depress together the associated key and a MW key in each case.
Now, with the aid of an assistant or a wooden bar, depress all keys together;
remove the ornamental-headed screw (with washer) between the tone and selectivity control discs, and turn to the rear of the receiver.
Remove the four round-head wood screws holding the two diagonally disposed flat brackets to the sub-baffle at the two upper corners of the scale aperture;
remove the milled-head tension screws (with coil springs, washers and flat brackets attached) taking care that the parts do not become separated.
The moulded escutcheon can now be lifted away from the front of the cabinet.
Unsolder the two speaker leads from the three tags on the speaker;
unsolder earthing lead connecting the chassis to a bracket on the floor of the cabinet;
remove the two screws (with rubber washers in cup washers) holding the rear of the chassis to the bottom of the cabinet;
remove the two screws (with flat metal washers) holding the front of the chassis to the bottom of the cabinet.



Circuit diagram of the Philips 855x 3-band AC superhet. The receiver has several unconventional features, notably the use of an RF amplifier circuit which is tuned on SW, but aperiodic on MW and LW; the use of a combined tuning indicator and AF pentode valve **(V4)**; and rather elaborate feedback arrangements.



Plan view of the chassis. Note the trimmers mounted on the chassis deck. The IF core adjustments are indicated. **C52** and **C53** are small wire-wound condensers.

When replacing, fit a thick rubber washer on each of the rear chassis fixing bolts, between the chassis and the cabinet;
connect the black speaker lead to the bottom tag on the speaker, and the remaining (white) lead to the two upper tags;
fit the control knob with the long bush to the tuning control spindle (on the right when facing front of cabinet).

Removing Speaker.—From the tags on the speaker unsolder the two connecting leads; slacken the four clamp nuts (with washers and lock-nuts) holding the speaker to the sub-baffle, and swivel the clamps.

When replacing, the connecting strip should be on the right, and the leads should be connected as indicated above.

Before tightening up the clamp nuts, see that the outer ends of the clamps lie on their metal backing plates, and not on the wooden sub-baffle.

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	V1 CG resistance	820,000
R2	V1 fixed GB resistance	680
R3	V1 MW and LW anode load	6,800
R4	V1 anode HT feed	6,800
R5	V2 heptode CG resistance	820,000
R6	V2 SG HT feed potential divider resistances	21,300*
R7		34,000†
R8	V2 fixed GB resistances	220
R9		470
R10	V2 osc. CG resistance	47,000
R11	Osc. SW reaction damping	47
R12	V2 osc. anode HT feed	‡ 27,000
R13	V3 CG decoupling	1,800,000
R14	V3 SG HT feed resistance	82,000
R15	V3 fixed GB resistance	330
R16	IF stopper	270,000
R17	V5 signal diode load resistances	330,000
R18		330,000
R19	T.I. control feed resistances	820,000
R20		1,000,000
R21	Pick-up feed resistance	82,000
R22	Part of tone compensator	22,000
R23	Volume control limiter	270,000
R24	Manual volume control	850,000‡
R25	V4 SG HT feed potential divider resistances	330,000
R26		470,000
R27	V4 GB resistance	1,000
R28	V4 pentode anode and target HT feed resistance	39,000
R29	V4 pentode anode load	120,000
R30	V4 T.I. target HT feed	47,000
R31	Variable tone control	50,000
R32	V5 CG resistance	470,000
R33	V5 CG decoupling	180,000
R34	V5 grid stopper	1,000
R35	Parts of AVC delay potential divider	9,400,000§
R36		1,200,000
R37	V5 AVC diode load resistances	820,000
R38		220,000
R39	HT feed resistance	1,200
R40	Negative feed-back feed resistances	1,500
R41		4,700
R42		1,500
R43		680
R44	V5 auto GB resistance	100

* Approx. value: 39,000 Ω and 470,000 Ω in parallel
† Two 68,000 Ω resistances in parallel.
‡ Tapped at 200,000 Ω from low potential end.
§ Two 4,700,000 Ω resistances in series.

	CONDENSERS	Values (μF)
C1	MW and LW aerial shunt	0·000039
C2	Aerial "top" coupling	0·00001
C3	Band-pass pri. LW trimmer	0·000015
C4	Band-pass coupling condensers	0·012
C5		0·039
C6	Band-pass sec. LW trimmer	0·0000039
C7	V1 CG condenser	0·0001
C8	V1 cathode by-pass	0·047
C9	V1 anode decoupling	0·033
C10	V1 to V2 MW RF coupling	0·00018
C11	V1 anode SW RF by-pass	0·0016
C12	V2 heptode CG condenser	0·00018
C13	V2 SG decoupling	0·047
C14	1st IF transformer tuning condensers	0·000094
C15		0·000097
C16	V2 osc. CG condenser	0·000047
C17	V2 cathode by-pass	0·047
C18	AVC line decoupling	0·15
C19	Osc. circuit SW tracker	0·0042
C20	Osc. circ. MW fixed tracker	0·00033
C21	Osc. circ. LW fixed trimmer	0·000033
C22	V2 osc. anode coupling	0·00047
C23	V3 CG decoupling	0·068
C24	V3 SG decoupling	0·047
C25	V3 cathode by-pass	0·047
C26	2nd IF transformer tuning condensers	0·000103
C27		0·000113
C28	IF by-pass	0·000039
C29	Coupling to V5 AVC diode	0·000018
C30	T.I. control feed decoupling	0·068
C31	Feed-back feed condenser	0·056
C32	Part of tone compensator	0·18
C33	AF coupling to V4 pent.	0·033
C34	V4 SG decoupling	0·056
C35	Whistle filter tuning	0·027
C36	V4 T.I. target decoupling	0·18
C37*	HT smoothing condenser	50·0
C38	V4 pent. anode decoupling	0·18
C39	V4 pent. to V5 AF coupling	0·047
C40	V5 CG decoupling	0·22
C41	Parts of variable tone control	0·00039
C42		0·0022
C43	Fixed tone corrector	0·0022
C44	Part of variable tone control	0·00015
C45	Part of feed-back feed	0·068
C46*	HT smoothing condenser	50·0
C47‡	Aerial circuit SW trimmer	0·00002
C48‡	Band-pass pri. MW trimmer	0·00002
C49†	SW aerial and band-pass pri. tuning	0·00049
C50‡	Band-pass sec. MW trimmer	0·00002
C51†	SW RF trans. sec. and band-pass sec. tuning	0·00049
C52‡	Osc. circuit MW tracker	0·0002
C53‡	Osc. circuit LW tracker	0·0002
C54‡	Osc. circuit SW trimmer	0·00002
C55‡	Osc. circuit MW trimmer	0·00002
C56‡	Osc. circuit LW trimmer	0·00002
C57†	Oscillator circuit tuning	0·00049

*Electrolytic. †Variable. ‡Pre-set.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial SW coupling coil	2·25
L2	Aerial MW coupling coil	25·0
L3	Aerial LW coupling coil	95·0
L4	Aerial SW tuning coil	Very low
L5	Band-pass primary coils	4·0
L6		45·0
L7	Band-pass coupling coils	0·7
L8		0·7
L9	Band-pass secondary coils	4·0
L10		41·0
L11	SW RF trans. Pri.	1·0
L12	SW RF trans. Sec.	Very low
L13	Osc. SW reaction coil	1·2
L14	Osc. MW reaction coil	6·0
L15	Osc. LW reaction coil	0·05
L16	Osc. circuit SW tuning coil	0·05
L17	Osc. circuit MW tuning coil	6·0
L18	Osc. circuit LW tuning coil	17·0
L19	1st IF trans. Pri.	9·0
L20	1st IF trans. Sec.	8·25
L21	1st IF trans. Coupling	0·6
L22	2nd IF trans. Pri., total	7·25
L23	2nd IF trans. Sec., total	7·25
L24	Whistle filter coil	42·0
L25	Speaker speech coil	3·5
Lx	Osc. SW tracking loop	Very low
T1	Output trans. Pri.	740·0
	Output trans. Spkr. sec. total	0·8
	Output trans. Feed-back sec., total	740·0
T2	Mains trans. Pri., total	31·0
	Mains trans. Heater sec.	0·1
	Mains trans. Rect. heat. sec.	0·15
	Mains trans. HT sec., total	270·0
S1-S31	Waveband switches	—
S32, S33	Variable selectivity switches	—
S34-S36	Radio/gram change switches	—
S37, S38	Mains switches, ganged R24	—

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 236V, using the 220V tapping on the mains trans-

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen urren
V1 EF8	145	7·3	245	0·3
V2 ECH3	245	2·5	112	2·9
	Oscillator			
	131	3·5		
V3 EF9	245	5·5	90	1·7
V4 EFM1	86	0·7	32	0·6
	Target			
	146	0·3		
V5 EBL1	258	32·0	245	3·4
V6 AZ1	284†	—	—	—

† Each anode, AC.

former. 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 400V scale of a model 7 Universal Avometer, chassis being negative.

GENERAL NOTES

Switches. — **S1-S31** are the waveband switches, ganged in four rotary units beneath the chassis. They are indicated in our under-chassis view and shown in detail in the diagrams below, where they are drawn as seen looking from the front of the underside of the chassis. The table (next col.) gives the switch positions for the three waveband settings, starting from the fully anti-clockwise position of the switch spindle.

S32, S33 are the variable selectivity switches, in a small rotary unit mounted horizontally beneath the chassis. It is shown in our under-chassis view, the individual switch tags being indicated. In the "broad" position of the control **S32** is closed, while in the "narrow" position **S33** is closed.

S34-S36 are the radio to gram change switches, in a lever-operated unit at the rear of the chassis. The unit is indicated in our under-chassis view, and shown in detail in the lowest of the switch diagrams below. In the radio position (lever down) **S34** and **S35** are closed, and **S36** open; in the gram position (lever up) **S36** is closed and **S34, S35** open.

S37, S38 are the QMB mains switches, ganged with the volume control **R24.**

Coils.—L7, L8 are in a small unscreened tubular unit beneath the chassis. The remaining tuning coils are in eight screened units on the chassis deck, and are indicated in our plan chassis view. The IF transformers also contain two fixed trimmers each; their core adjustments are reached through holes in the rear of their screens.

L24 is in an unscreened unit on the chassis deck.

The small coil marked **Lx** in the circuit and in the under-chassis view is a loop of insulated wire connected in series with the oscillator SW fixed tracker **C19.** It is used for tracking adjustment on this band.

Scale Lamp.—This is a Philips M.E.S. type, Part No. 8091 D, mounted in a black moulded holder fitting into a moulded bracket on the chassis deck. The lamp can be removed by rotating the holder anti-clockwise and withdrawing it towards the back of the chassis.

External Speaker. Two sockets are provided at the rear of the chassis for a low impedance (5—7 O) external speaker.

Tone Control R31.—This is operated through a link system by a horizontal milled disc beneath the keyboard. It is a carbon-type potentiometer.

Valve V4.—Note that the EFM1 is a combined pentode AF amplifier and tuning indicator. It is fitted with the usual "E" type base, and the contact connections, looking at the underside of the base, and numbering as usual are **1,** Metallising; **2,** heater; **3,** heater; **4,** cathode; **5,** target; **6,** control grid; **7,** screen grid; **8,** anode. Note that, although contact 1 is stated by the makers to be the metallising contact, the EFM1 fitted is not metallised.

Condensers C52, C53.—These are two wire-wound pre-set condensers mounted on the chassis deck.

Resistances R6, R7, R24, R35.—R6 consists of a 39,000 O and a 47,000 O resistor in parallel (21,300 O approx.); **R7** consists of two 68,000 O resistors in parallel; the volume control **R24** is tapped at 200,000 O from the low potential end; **R35** consists of two 4·7 MO resistances in series.

AUTO-TUNING ADJUSTMENT

The first six keys, from left to right, are for station selection. The remaining three keys are for manual waveband switching. Of the six station keys, the first three can be adjusted for MW or LW stations; the remaining three are for MW stations only.

To adjust a station key (without altering the waveband to which it is set, if it is one of the first three), use the tool which is kept in a hole in the back of the receiver at the top left-hand corner. Press down the key concerned, and insert the adjusting tool into the aperture underneath the keyboard, immediately below the key concerned.

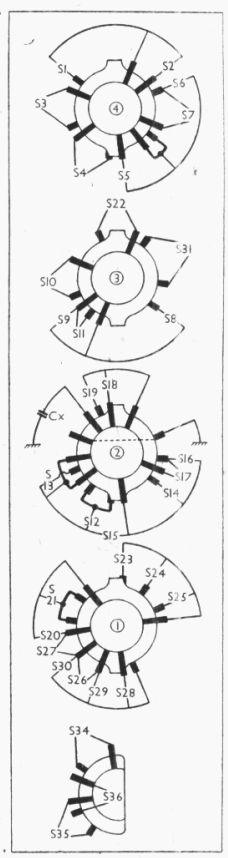
Rotate the tool until it engages with the head of the adjusting screw (this can be felt), then turn it one way or the other until the required station is tuned in. The pointer and tuning indicator will show when the desired station is tuned accurately. Do not press on the tool more than is necessary to keep it engaged with the adjusting screw. When the station is tuned, withdraw the tool.

The head of the tool is recessed to fit the ornamental-headed screws holding the station name escutcheon in place, and can be used to remove these screws when it is desired to change a name.

To change the waveband covered by any one of the three left-hand keys, the same tool is used, but this time the key must not be depressed. If it is, first release it by pressing any other key. Then insert the tool through the aperture as before. To change the key from LW to MW operation, turn the tool anti-clockwise (unscrew) about five complete turns. To change from MW to LW, insert the tool, press it forward, and rotate it clockwise until it is tight.

SWITCH TABLE

Switch	SW	MW	LW
S1	C	—	—
S2	—	C	C
S3	—	C	—
S4	—	C	—
S5	—	C	C
S6	C	—	—
S7	C	—	—
S8	C	—	—
S9	—	C	C
S10	—	C	—
S11	C	—	—
S12	—	C	C
S13	C	—	—
S14	—	C	—
S15	—	—	C
S16	C	—	—
S17	C	—	—
S18	C	—	—
S19	—	C	C
S20	C	—	—
S21	—	C	C
S22	C	—	—
S23	C	—	—
S24	—	C	—
S25	—	—	C
S26	C	—	—
S27	—	C	—
S28	C	—	—
S29	—	C	—
S30	—	—	C
S31	C	—	—



Diagrams of the four wavechange switch units, seen from the front of the underside of the chassis, and (bottom) the **S34-S36** unit, seen from the output end of the chassis. Note, in unit 2, the earthed screen, and also the connection of condenser **Cx** to one tag. This condenser, though fitted in the chassis, does not form part of the circuit, and therefore does not appear in our circuit diagram.

CIRCUIT ALIGNMENT

IF Stages.—Press MW key, tune to 180m on scale, turn volume control to maximum, and switch set to minimum band-width (maximum selectivity).

Connect signal generator to control grid (top cap) of **V2,** and chassis. Connect an 80$\mu\mu$F condenser across **L22,** feed in a 470 KC/S signal, and adjust core of **L23** for maximum output. Remove 80$\mu\mu$F condenser, and connect it across tap on **L23** and junction of **R16, C28.** Adjust cores of **L22, L20** and **L19** in turn for maximum output. Seal all cores after re-checking.

RF and Oscillator Stages.—Connect signal generator to **A** and **E** sockets, via a suitable dummy aerial. Turn volume control to maximum. For setting the gang accurately at the lower wavelength end of each band a special trimming jig will be necessary (Part No. 2V.351.063). For certain adjustments an aperiodic amplifier (GM 2404) or an auxiliary receiver will be required.

SW.—Press SW key and tune to bottom of scale. Fit trimming jig to the rear of the gang spindle, so that it acts as a distance piece between the large washer secured to the end of the spindle and the rear-end plate of the gang assembly. Turn back the gang until it rests on the jig. Feed in a 20.3 MC/S (14.75m) signal, and adjust **C54** for maximum output, on the peak involving the least trimmer capacity. Then adjust **C47** for maximum output.

Remove trimming jig and connect aperiodic amplifier to anode of **V2.** Short-circuit oscillator section of **V2** by connecting oscillator grid to chassis. Feed in a 6 MC/S (50m) signal, tune receiver for maximum output from aperiodic amplifier, and, without disturbing the tuning, remove amplifier, and also remove the short circuit from **V2** oscillator section. Now carefully open or close the loop **Lx** (beneath chassis) for maximum output. Repeat the adjustments of **C54** and **C47,** then seal the trimmers.

MW.—Press MW key and tune to bottom of scale. Fit trimming jig as before, feed in a 1,590 KC/S (188.5m) signal, and adjust **C55, C50** and **C48** for maximum output. Short-circuit oscillator section of **V2** and connect aperiodic amplifier as before. Feed in a 546 KC/S (550m) signal, and tune the receiver by its manual control. This produces two peaks; turn condenser to maximum, turn back until the output meter indicates about one-fifth of the maximum output, and note exact scale reading. Rotate condenser through both peaks until meter again reads one-fifth of the maximum, and note scale-reading. Then set the condenser to the mean of the two readings. Remove short from oscillator circuit, disconnect aperiodic amplifier and adjust **C52** (by removing or adding turns to the winding) for maximum output. Repeat the adjustments of **C55, C50** and **C48,** then seal all trimmers.

LW.—Press LW key, tune to bottom of scale, and fit trimming jig as before. Feed in a 400 KC/S (750m) signal, and adjust **C56** for maximum output. Short circuit oscillator section of **V2** and connect aperiodic amplifier as before. Feed in a 160 KC/S (1,875m) signal, tune receiver for maximum output. Remove oscillator short circuit and disconnect aperiodic amplifier, then adjust **C53** for maximum output. Repeat the **C56** adjustment, then seal it.

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