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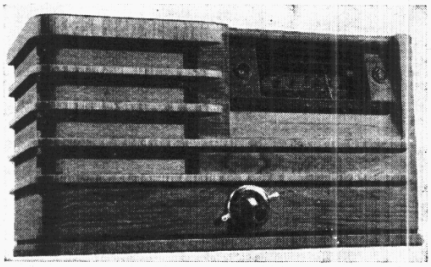
Supplement to The Wireless & Electrical Trader, September 25, 1943

"TRADER" SERVICE SHEET 639

MULLARD MUS5 (AC & DC); AND MAS5 (AC ONLY)



A TRIPLE-ACTION knob for volume (vertical movement), band-width (horizontal movement) and tuning (axial rotation) control is a novel feature in the Mullard MUS5, a rotary action chromium ring, mounted concentrically with the knob, controlling waveband, gramophone and mains switching.

The receiver is a 4-valve (plus rectifier) 3-band superhet, designed to operate from AC or DC mains of 100-250 V. The SW range is 16.7-51 m.

A special mains input circuit permits the receiver to operate directly from AC mains or, via a self-contained "Square Type" vibratory converter, from DC mains when the converter plug is inserted in its socket. A full description of the converter is contained in *Service Sheet* 594.

The MAS5 is another version of the same receiver, but is suitable only for operation from AC mains. Both models are covered by this *Service Sheet*, but it was prepared from an MUS5.

Release date and original prices: *August*, 1936 (*both models*); *MUS5*, £18 18s.; *MAS5*, £17 17s.

CIRCUIT DESCRIPTION

Aerial input on MW and LW via **S1, S4** and coupling coils **L2, L3** to capacity coupled band-pass filter. Primary coils **L4, L5** are tuned by **C37**; secondary coils **L7, L8** by **C39.** Coupling by **C5** (MW) and **C4, C5** (LW). IF filtering by **L1, C34.** Image suppression by **C1, C35.** Provision by switches **S1, S2** for change-over to mains aerial coupling via **C33.**

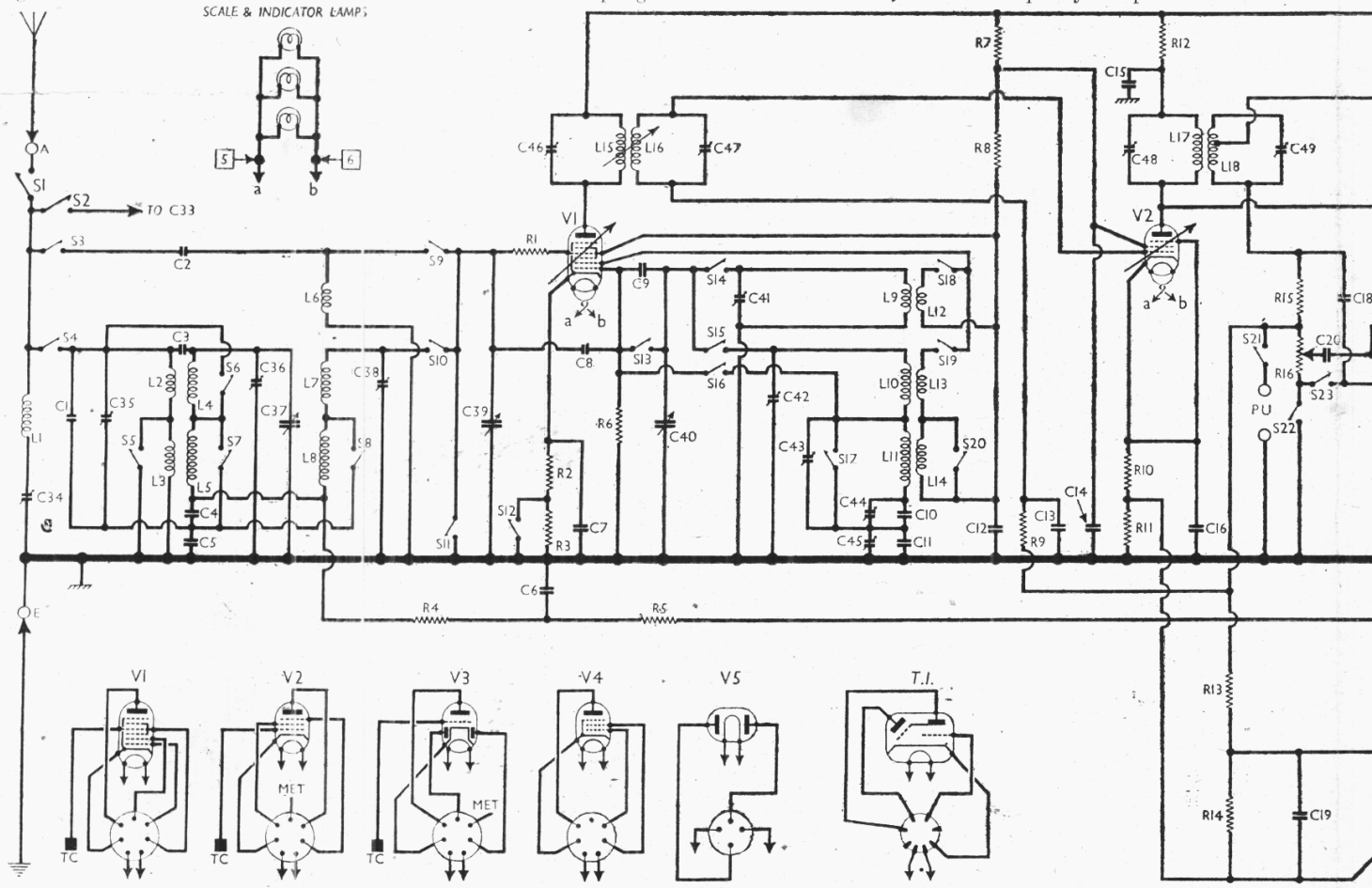
On SW, input is via **S1, S3** and **C2** to single tuned circuit **L6, C39.**

First valve **(V1, Mullard metallised FC4)** is an octode operating as frequency changer with eletron coupling. Oscillator grid coils **L9** (SW), **L10** (MW) and **L11** (LW) are tuned by **C40.** Parallel trimming by **C41** (SW), **C42** (MW) and **C43** (LW); series tracking by **C11, C45** (MW), plus **C10, C44** (LW). Reaction coupling from anode via coils **L12** (SW), **L13** (MW) and **L14** (LW). **C9** is the CG condenser on SW only; on MW and LW it is short-circuited by **S13.**

Second valve **(V2, Mullard metallised VP4B)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C46, L15, L16, C47** and **C48, L17, L18, C49.** Variable band-width is achieved by mechanically varying the coupling between **L15** and **L16.**

Intermediate frequency 128 kc/s.

Diode second detector is part of double diode triode valve **(V3, Mullard metallised TDD4).** Audio frequency component in



Circuit diagram of the Mullard MUS5. The converter itself is omitted, but the numbers in circles associated with **T2** primary are the sa in square enclosures refer to the tags on the connecting strip between chassis and speaker. **S1, S2; S28, S29;** and **S30** are printed in a large

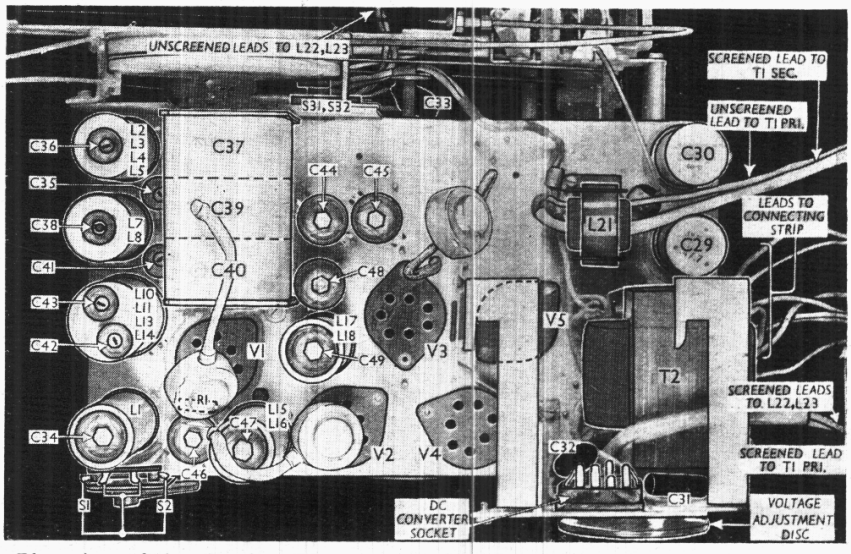
rectified output is developed **R15** and manual volume control **R16,** which operate as the load resistance, and passed via AF coupling condenser **C20,** bass attenuator **C21** and grid stopper **R17** to CG of triode section, which operates as AF amplifier. **R15** limits the maximum diode output voltage and, in conjunction with its lead capacity and **C18,** forms an IF filter.

Control voltage for cathode ray tuning indicator **(T.I., Mullard TV4)** is obtained from potential appearing across **R16** and fed via decoupling circuit **R13, R14, C19. S23** is closed on radio, and the initial bias imposed by **R20, R21** and off-set by **R10, R11** is suitably divided by **R13, R14.** The potential at the top of **R16** is also applied as AVC voltage to **V2.**

Second diode of **V3,** fed from **V2** anode via **C17,** provides DC potential which is developed across load resistor **R27** and fed back via decoupling circuit as GB to **V1,** giving automatic volume control to that stage. Delay voltage, together with GB voltage for triode section, is obtained from drop along resistors **R20, R21.**

Resistance-capacity coupling by **R24, C24** and **R28,** via grid stopper **R30,** between **V3** triode and pentode output valve **(V4, Mullard PenA4). R29, C25** and **R31,** in **V4** CG circuit, form a continuously variable tone control. Fixed tone correction by **C26** in anode circuit. Provision for connection of high impedance external speaker in anode circuit, while **S30** in **T1** secondary circuit permits the internal speaker to be muted.

Signal voltages at **T1** secondary are developed also across **R34, L20, R19,** which form a frequency discriminating potential divider across the winding to provide negative feed-back voltages. **R19, L20** are included in **V3** cathode circuit, into which feed-back signals are injected.



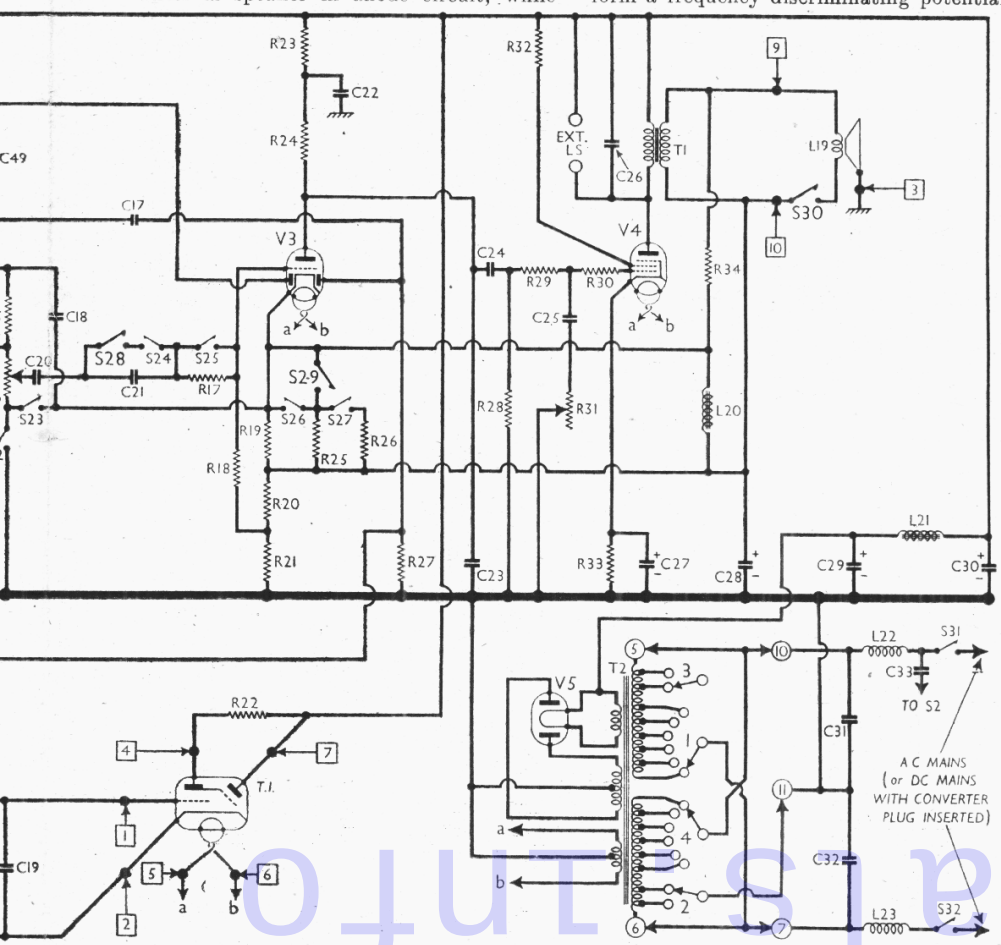
Plan view of the chassis. The converter unit, which normally stands on the two hook-shaped pieces above **T2,** has been removed. The connecting leads are not coded, but they are numbered in the circuit below.

The coupling can be modified for tone control purposes by closing **S29,** a lever-operated switch, connecting **R25** in parallel with **R19.** At the same time **S28,** which is ganged with **S29** to form the bass control, opens, and in this position bass response is attenuated.

Other switches associated with bass control, **S24, S26, S27,** are operated by the waveband switch control, so that on SW **S24** and **S27** are open, and **S26** is closed, and the optional bass control has no effect. On MW, LW and gram, however, the position is reversed, except that **S26** closes on gram, with the addition of **R26** in parallel with **R25** via **S27.** In order to distinguish the lever-operated switches from those in the ganged assembly, they are printed throughout the circuit diagram in a larger size, with larger figures.

Pick-up input is fed via **S21** across **R16,** and when the control switch is turned to gram, **S23** opens and **S22** closes. At the same time all the tuning coil connections, such as **S3, S4; S9, S10;** etc., open, while **S6, S16** and **S11** close; **S12** also opens, applying a high bias to **V1** hexode, and as **S18, S19** are open, **V1** oscillator anode is deprived of HT supply, muting radio.

HT current is supplied by full-wave rectifying valve **(V5, Mullard DW2).** Smoothing by iron-cored choke **L21** and electrolytic condensers **C29, C30,** and when the receiver is operating from AC mains, the mains input circuit is as depicted in our circuit diagram. For operation from DC mains (possible only with the MUS5) the converter plug is inserted at the points numbered **10, 11, 7,** across the mains RF filter condensers **C31, C32,** and an AC output from the converter is handed on to the mains transformer **T2** primary, from which point onwards the operation is the same as for AC mains. A full explanation of the converter action is contained in "*Trader*" *Service Sheet* 594



re the same as those on *Service Sheet* 594 where the converter is fully described. The numbers in a large size in order to distinguish them from those ganged and operated by the waveband control.

COMPONENTS AND VALUES

	RESISTORS	Values (ohms)
R1	V1 hex. grid stopper ...	50
R2	V1 fixed GB resistors ...	250
R3	V1 fixed GB resistors ...	2,500
R4	V1 CG decoupling resistors	100,000
R5	V1 CG decoupling resistors	100,000
R6	V1 osc. CG resistor ...	50,000
R7	V1 osc. and V1, V2 SG's HT feed resistors ...	16,000†
R8	V1 osc. and V1, V2 SG's HT feed resistors ...	20,000
R9	V2 CG decoupling ...	1,600,000
R10	V2 fixed GB resistors ...	320
R11	V2 fixed GB resistors ...	800
R12	V2 anode decoupling ...	1,600
R13	T.I. CG feed resistors ...	5,000,000
R14	T.I. CG feed resistors ...	1,600,000
R15	Part signal diode load ...	100,000
R16	Manual volume control ...	500,000
R17	V3 triode grid stopper ...	1,600,000
R18	V3 triode CG resistor ...	1,600,000
R19	Feed-back coupling ...	32
R20	V3 triode GB and AVC delay resistors	3,200
R21	V3 triode GB and AVC delay resistors	4,000
R22	T.I. anode HT feed ...	2,000,000
R23	V3 triode anode decoupling	50,000
R24	V3 triode anode load ...	100,000
R25	Bass control resistors ...	32
R26	Bass control resistors ...	10
R27	V3 AVC diode load ...	500,000
R28	V4 CG resistor	800,000
R29	Part variable tone control	100,000
R30	V4 grid stopper	1,000
R31	Variable tone control ...	5,000,000
R32	V4 SG stopper	32
R33	V4 GB resistor	160
R34	Feed-back coupling ...	200

† Made up of two 32,000 Ω resistors in parallel.

	CONDENSERS	Values (μF)
C1	Image suppressor ...	0·00002
C2	Aerial SW coupling ...	0·000016
C3	"Top" coupling ...	0·00001
C4	Band-pass coupling condensers ...	0·016
C5	Band-pass coupling condensers ...	0·025
C6	AVC line decoupling ...	0·1
C7	V1 cathode by-pass ...	0·05
C8	Neutralising coupling ...	0·000002
C9	V1 osc. CG condenser ...	0·0001
C10	Osc. fixed LW tracker ...	0·00065
C11	Osc. fixed MW tracker	0·001375
C12	V1 osc. and SG decoupling	0·1
C13	V2 CG decoupling ...	0·1
C14	V2 SG decoupling ...	0·1
C15	V2 anode decoupling ...	0·1
C16	V2 cathode by-pass ...	0·1
C17	Coupling to V3 AVC diode	0·00001
C18	IF by-pass	0·0001
C19	T.I. CG decoupling ...	0·05
C20	AF coupling to V3 triode	0·002
C21	Bass control condenser...	0·00025
C22	V3 triode anode decoupling	0·5
C23	IF by-pass	0·0004
C24	AF coupling to V4 ...	0·02
C25	Part variable tone control	0·008
C26	Fixed tone corrector ...	0·004
C27*	V4 cathode by-pass ...	25·0
C28*	V3 cathode by-pass ...	25·0
C29*	HT smoothing condensers ...	32·0
C30*	HT smoothing condensers ...	32·0
C31	Mains RF by-pass condensers ...	0·002
C32	Mains RF by-pass condensers ...	0·002
C33	Mains aerial coupling ...	0·0005
C34‡	Aerial IF filter tuning ...	0·00017
C35‡	Image suppressor trimmer	0·00003
C36‡	B-P pri. MW trimmer ...	0·0003
C37†	Band-pass pri. tuning ...	0·00047
C38‡	B-P sec. MW trimmer ...	0·00003
C39†	B-P sec. and SW aerial tuning	0·00047
C40†	Oscillator circuit tuning	0·00047
C41‡	Osc. circuit SW trimmer	0·00003
C42‡	Osc. circuit MW trimmer	0·00003
C43‡	Osc. circuit LW trimmer	0·00003
C44‡	Osc. circuit LW tracker...	0·00017
C45‡	Osc. circuit MW tracker	0·00017
C46‡	1st IF trans. pri. tuning...	0·00017
C47‡	1st IF trans. sec. tuning	0·00017
C48‡	2nd IF trans. pri. tuning	0·00017
C49‡	2nd IF trans. sec. tuning	0·00017

* Electrolytic. † Variable. ‡ Pre-set.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial IF filter coil ...	140·0
L2	Aerial coupling coils ...	25·0
L3	Aerial coupling coils ...	95·0
L4	Band-pass primary coils ...	4·0
L5	Band-pass primary coils ...	40·0
L6	Aerial SW tuning coil ...	0·05
L7	Band-pass secondary coils ...	4·0
L8	Band-pass secondary coils ...	37·0
L9	Osc. SW tuning coil ...	0·05
L10	Osc. MW tuning coil ...	10·0
L11	Osc. LW tuning coil ...	25·0
L12	Osc. SW reaction coil ...	30·0
L13	Osc. MW reaction coil ...	4·0
L14	Osc. LW reaction coil ...	8·0
L15	1st IF trans. Pri. ...	140·0
L16	1st IF trans. Sec. ...	140·0
L17	2nd IF trans. Pri.	140·0
L18	2nd IF trans. Sec., total	135·0
L19	Speaker speech coil ...	5·0
L20	Feed-back coupling choke	7·0
L21	HT smoothing choke ...	385·0
L22	Mains RF filter chokes ...	2·0
L23	Mains RF filter chokes ...	2·0
T1	Output trans. Pri.	310·0
T1	Output trans. Sec.	0·4
T2	Mains trans. Pri., total ...	72·0
T2	Mains trans. Heater sec. ...	0·04
T2	Mains trans. Rect. heat. sec.	0·17
T2	Mains trans. HT sec., total	500·0
S1, S2	Mains aerial switches ...	—
S3-S27	Waveband and PU switches	—
S28,S29	Bass control switches ...	—
S30	Speaker muting switch ...	—
S31,S32	Mains circuit switches ...	—

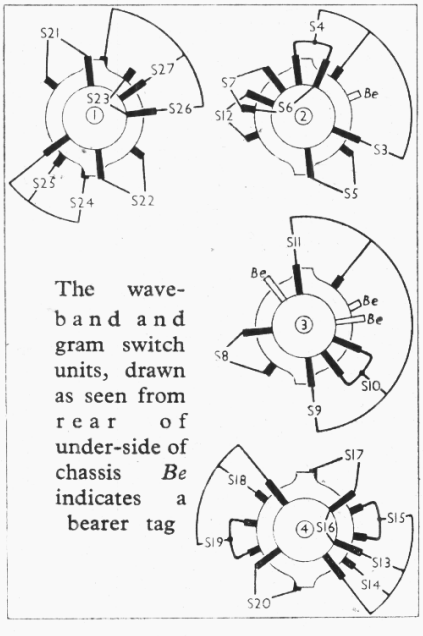
VALVE ANALYSIS

Valve voltages and currents given in the table below are those quoted in the makers' manual. The conditions under which they were computed are not stated, but it is explained that they are approximate only to what may be found in individual chassis.

Voltages quoted are actual, not measured, so that allowances must be made for meter current unless a very high resistance instrument is employed for making measurements. The negative meter lead should be connected to chassis.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 FC4	260	1·5	90	4·7
	Oscillator			
	90	2·0		
V2 VP4B	230	5·7	155	1·9
V3 TDD4	105	1·1	—	—
V4 PenA4	245	37·0	260	4·5
V5 DW2	250†	—	—	—
	*	0·3		
T.I. TV4	Target		—	—
	260	*		

† Each anode, AC. * Not quoted.



The wave-band and gram switch units, drawn as seen from rear of under-side of chassis *Be* indicates a bearer tag

DISMANTLING THE SET

The instructions immediately following refer in particular to the MUS5. They apply also to the MAS5 except for the differences explained at the end of this section.

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

Removing Chassis.—Remove the converter unit (two set-screws at base of rear) after withdrawing its plug;

remove the valves and the four bolts (with washers), holding the chassis to the base of the cabinet;

push the chassis forward, and remove the moulded ring and chromium wavechange switch control ring behind it from the monoknob control at the front of the cabinet.

The moulded ring is held by two phosphor-bronze claws which lock into slots cut in the side of the ring, just beneath two small semi-circular notches or channels visible on the outer edge of the ring at positions ninety degrees clockwise from a vertical centre-line.

To release one of the claws, insert in one of the channels a fine crochet needle, or a pin with a very small hook at its pointed end, turn the hook inwards towards the cabinet and lift it, at the same time pulling gently at the edge of the ring to draw it away. The hook should engage in the sprung claw and lift it out of its slot in the ring.

Slip the Bowden control wire nipples from their slots in the waveband and band-width controls, and unscrew their adjusting ferrules;

slacken the screw at the rear of the scale cursor carriage, freeing the drive wire;

remove the two nuts at the ends of the drive wire carrier at the top of the scale assembly, and remove the carrier complete with control wires. It is advisable to attach this carrier firmly to some part of the chassis before commencing repairs, to avoid damaging the wire.

Remove the large RF choke unit **L22, L23,** from the right-hand side of the cabinet (four round-head wood screws) and unsolder from it the two unscreened leads;

number with paper tags the six leads from chassis to the 10-way connecting strip mounted on the speaker, and unsolder them;

code in the same fashion the leads from chassis to the output transformer (primary left, secondary right) mounted on the speaker support and unsolder them.

The chassis may now be withdrawn, leaving the speaker, connecting strip, output transformer, speaker switch, scale lamps and tuning indicator in the cabinet, all connected to the strip.

When replacing, pass the unscreened lead to **L22, L23** directly beneath the speaker magnet, and solder it to its tags before fixing the coil.

See that a wooden spacer is in position between the coil bracket and the side of the cabinet before fixing the coil.

Connect the leads to the output transformer in exactly their original positions, as otherwise the feed-back phasing may be reversed.

When fitting the chassis bolts, see that the monoknob switch ring does not foul the cabinet.

Removing Speaker.—With the chassis already disconnected as previously described, but not necessarily removed, slacken the knurled screw on the tuning indicator bracket, swivel the bracket and withdraw the valve and holder;

withdraw the three scale and indicator lamps from their clips around the scale assembly;

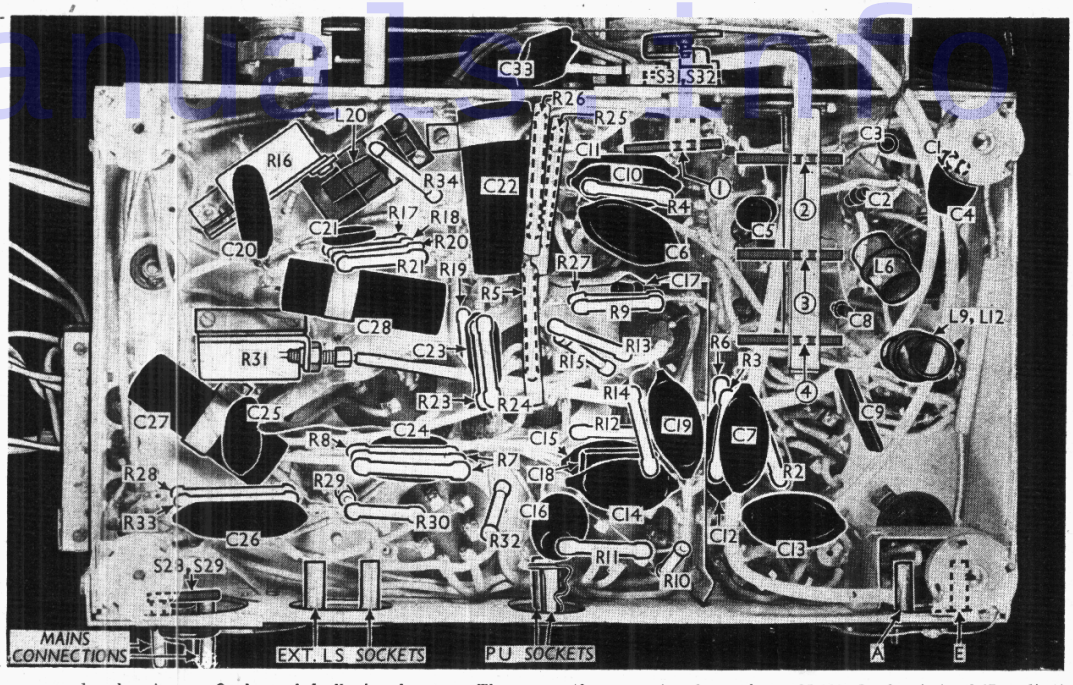
remove the speaker switch (two round-head wood screws with washers) from the wood block on the base of the cabinet;

remove four bolts (with washers) holding the speaker support to the base of the cabinet.

MAS5.—In the AC model the converter and **L22, L23** are omitted and the 10-way strip is mounted on the chassis in front of the mains transformer. To remove the chassis, therefore, the leads to the speaker, etc., should be coded and unsoldered, but the scale lamps and tuning indicator will come away with the chassis.

GENERAL NOTES

Switches.—S3-S27 are the waveband and gramophone switches, in four ganged rotary units beneath the chassis. Three of these units are operated from a common spindle, while a fourth (unit No. 1 in our illustrations) is link-operated from them.



Under-chassis view. The four ganged switch units (1–4 in circles) are indicated, No. 1 being offset to the left. They are shown in detail in the diagrams at the foot of col. 2. **R22** is mounted on the 10-way connecting strip, and **S30** and **L22, L23** on the cabinet, so they do not appear in the illustrations. **R16** and **R31** are operated by Bowden controls

These units are indicated in our under-chassis view, and shown in detail in the diagrams in col. 2, where they are drawn as seen from the rear of the underside of the chassis, while the table (below) gives the switch positions for the four active control settings, starting from the inactive (off) position (fully anti-clockwise) of the control. A dash indicates open, and **C**, closed.

S1, S2; S28, S29; and **S30**, which are all lever-operated, are shown in our circuit diagram in a larger size than the remaining switches so as to distinguish them from those which are controlled by the waveband switch control.

S31, S32 are the QMB mains switches, ganged with the waveband switches.

Coils.—All the coils associated with the RF, oscillator and IF circuits, with the exception of the SW coils **L6** and **L9, L12,** are contained in six screened units on the chassis deck. Each unit contains also at least one pre-set trimmer, and with each unit is associated at least one external pre-set condenser. The SW coils are in two unscreened units beneath the chassis.

L20 is the feed-back coupling choke, mounted near **R16** beneath the chassis, while the HT smoothing choke **L21** is mounted just above it on the chassis deck.

The mains RF filter chokes **L22, L23** are wound together on a single former and mounted on the side of the cabinet. They do not, therefore, appear in our chassis illustrations, although the leads to them are indicated.

Switch	SW	MW	LW	Gram.
S3	C	—	—	—
S4	—	C	C	—
S5	—	C	—	—
S6	—	—	—	C
S7	C	C	—	C
S8	—	C	—	C
S9	C	—	—	—
S10	—	C	C	—
S11	—	—	—	C
S12	C	C	C	—
S13	—	C	C	—
S14	C	—	—	—
S15	—	C	C	—
S16	—	—	—	C
S17	—	C	—	—
S18	C	—	—	—
S19	—	C	C	—
S20	—	C	—	—
S21	—	—	—	C
S22	—	C	—	C
S23	C	C	C	—
S24	—	C	C	C
S25	—	—	—	C
S26	C	—	—	C
S27	—	C	C	C

Scale and Indicator Lamps.—These are three MES type lamps, with frosted tubular bulbs. They are special Philips types 8041 and 8042.

External Speaker.—Two sockets are provded at the rear of the chassis for a high impedance (8,000 Ω) external speaker. Switch **S30** permits the internal speaker to be muted if desired.

External Chassis Connections.—In addition to the speaker and output transformer **T1,** the scale and indicator lamps, tuning indicator, speaker switch **S30** and mains RF filter chokes **L22, L23** are all mounted on the cabinet, and the connections between most of these and the chassis are effected by means of a ten-way connecting strip mounted on the speaker support.

The points at which the connections occur are indicated in the circuit diagram by large black dots and numbers in square enclosures. The tags on the connecting strip are numbered 1-10, reading from left to right when viewed from the rear, and the corresponding numbers are given in the square enclosures in the circuit diagram. Tag 8 is blank.

DC/AC Converter Unit.—Space does not permit a full description of the converter unit here, but a full description appears in *Service Sheet* 594.

MAS5 Modifications.—With the exception of the mains input circuit, the circuit diagram overleaf applies equally to the MAS5 and MUS5. In the MAS5, which is suitable only for AC mains operation, the primary winding is like that in *Service Sheet* 540, and the filter circuit **L22, L23, C31, C32** is omitted. HT sec. is 360Ω.

CIRCUIT ALIGNMENT

NOTE.—Apart from the usual equipment, a special 15 degree jig (Code No. M.09991741) will be required to adjust the gang to the standard setting point, and an auxiliary radio receiver or aperiodic amplifier will be needed to determine when the signal on **V1** hexode control grid reaches a maximum.

IF Stages.—When adjusting one winding of an IF transformer, a damping resistor must be connected across the other; or, if the ends of the winding are not easily accessible, the shunt may be connected between the appropriate anode (or grid) and chassis, via a 0.1μF condenser. When applying the signal generator to the control grid of a valve, the top cap connector must remain in position. The monoknob control should be set to its top right-hand position: maximum gain and maximum band-width. Access to trimmers can be facilitated by standing the receiver on its side.

Switch set to LW, short-circuit **R6,** and connect signal generator to control grid (top cap) of **V1** and chassis. Feed in a 128 kc/s (2,340 m) signal, apply a 25,000 Ω shunt to **L17,** adjust **C49** for maximum output, and remove shunt; apply a 10,000 Ω shunt to **L16,** adjust **C46** for maximum output, and remove shunt; apply the 25,000 Ω shunt to **L18,** adjust **C48,** and remove shunt; apply 10,000 Ω shunt to **L15,** adjust **C47,** and remove shunt and the short-circuit from **R6.**

RF and Oscillator Stages.—Stand receiver on its base again and connect a good earth lead. Adjust **C34** nearly to its maximum position, and set the monoknob control to its top left-hand position: maximum gain and minimum band-width. Fit the 15 degree jig by slipping the boss over the locating pin just above the condenser spindle on the gang, and turn the gang towards its minimum position until the cross-bar bears on the boss of the jig. The vanes are now advanced 15 degrees, which is the standard trimming position. Transfer signal generator leads, via a suitable dummy aerial, to **A** and **E** sockets. It should be noted that the oscillator frequency is 128 kc/s *higher* than the signal frequency on MW and LW, but 128 kc/s *lower* on SW.

MW.—Switch set to MW, feed in a 1,442 kc/s (208 m) signal, and adjust **C42,** then **C36** and **C38,** for maximum output. Short-circuit **R6,** couple **V1** hexode anode via a 0.000025μF condenser to the aerial socket of the auxiliary receiver, and transfer output meter to this receiver.

Feed in a 550 kc/s (545 m) signal, and adjust the gang of MUS5 receiver for maximum output on the auxiliary receiver. Disconnect auxiliary receiver and reconnect output meter to MUS5, removing short-circuit from **R6.** Now adjust **C45** for maximum output, and then repeat the 208 m adjustments.

LW.—Switch set to LW, feed in a 395 kc/s (760 m) signal. Short-circuit **R6,** and reconnect auxiliary receiver as described for MW, tuning MUS5 for maximum output. Disconnect auxiliary receiver and remove short-circuit from **R6,** and adjust **C43** for maximum output.

Feed in a 160 kc/s (1,875 m) signal, short-circuit **R6** again, and connect up auxiliary receiver as before, tuning MUS5 for maximum output on the meter. Disconnect auxiliary receiver, remove short-circuit, and adjust **C44** for maximum reading on the output meter.

SW.—Switch set to SW, and turn the gang to bear on the jig. Feed in a 17 Mc/s (17.6 m) signal, and adjust **C41** for maximum output. If two positions are found, select that employing the *greater* trimmer capacity.

IF Filter.—Switch set to LW, and turn the gang to maximum capacity. Feed in a strong 128 kc/s signal, and adjust **C34** for minimum output.

Image Suppressor.—Switch set to MW, feed in a 744 kc/s (403 m) signal, and tune it in. Without altering the position of the gang, feed in a strong 1,000 kc/s (300 m) signal, and adjust **C35** for minimum output.

Printed in Great Britain by The Cornwall Press Ltd., Paris Garden, London, S.E.1

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