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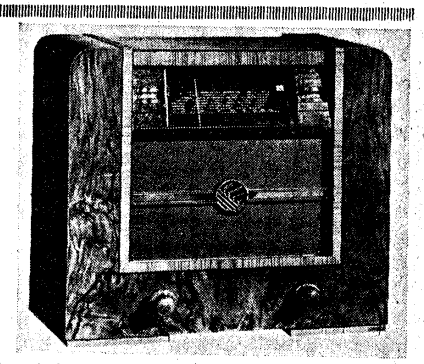
"TRADER" SERVICE SHEET

774

REVISED ISSUE OF SERVICE SHEET No. 192

MULLARD MAS4, MUS4

PHILIPS 797A & U; 790A & U; 791A & U



The Mullard MAS4 and MUS4.

ADJUSTABLE for AC mains of 100-150 and 200-250 V, the Mullard MAS4 receiver is a 4-valve (plus rectifier) 3-band superhet with a short-wave range of 16.7-51 metres. It is provided with variable selectivity, and sockets are provided for a gramophone pick-up and an external speaker. Light pressure on the volume control mutes the receiver for silent tuning.

The Mullard MUS4 is a similar receiver designed to operate from A.C. or D.C. mains, D.C. operation being achieved by the medium of the "Square Type" vibratory converter. This converter, and the differences involved in chassis using it, are fully covered in *Service Sheet* 594.

The Philips 797A is a table model employing a chassis identical with that of the MAS4. The small differences in the console model (790A) and radiogram (791A) are described overleaf. The A.C./D.C. versions which, like the Mullard MUS4, employ the "Square Type" converter, are 797U, 790U and 791U respectively.

Release date, all models, 1936. *Original prices: MAS4, £14 14s; MUS4, £15 15s; 797A, £15 4s 6d; 797U, £16 5s 6d; 790A, £21; 790U, £22 1s; 791A, £30 9s; 791U, £32 11s.*

CIRCUIT DESCRIPTION

Aerial input on M.W. and L.W. via coupling coils **L2, L3** and small capacitor **C3** to capacitance-coupled band-pass filter. Primary coils **L4, L5** are tuned by **C35;** secondaries **L7, L8** are tuned by **C37;** coupling by **C4, C5.** I.F. filter **L1, C32** shunts aerial-earth circuit. Image suppression by **C1** and **C33.** On S.W. band, aerial input is via **C2** to single-tuned circuit comprising **L6** and **C37.**

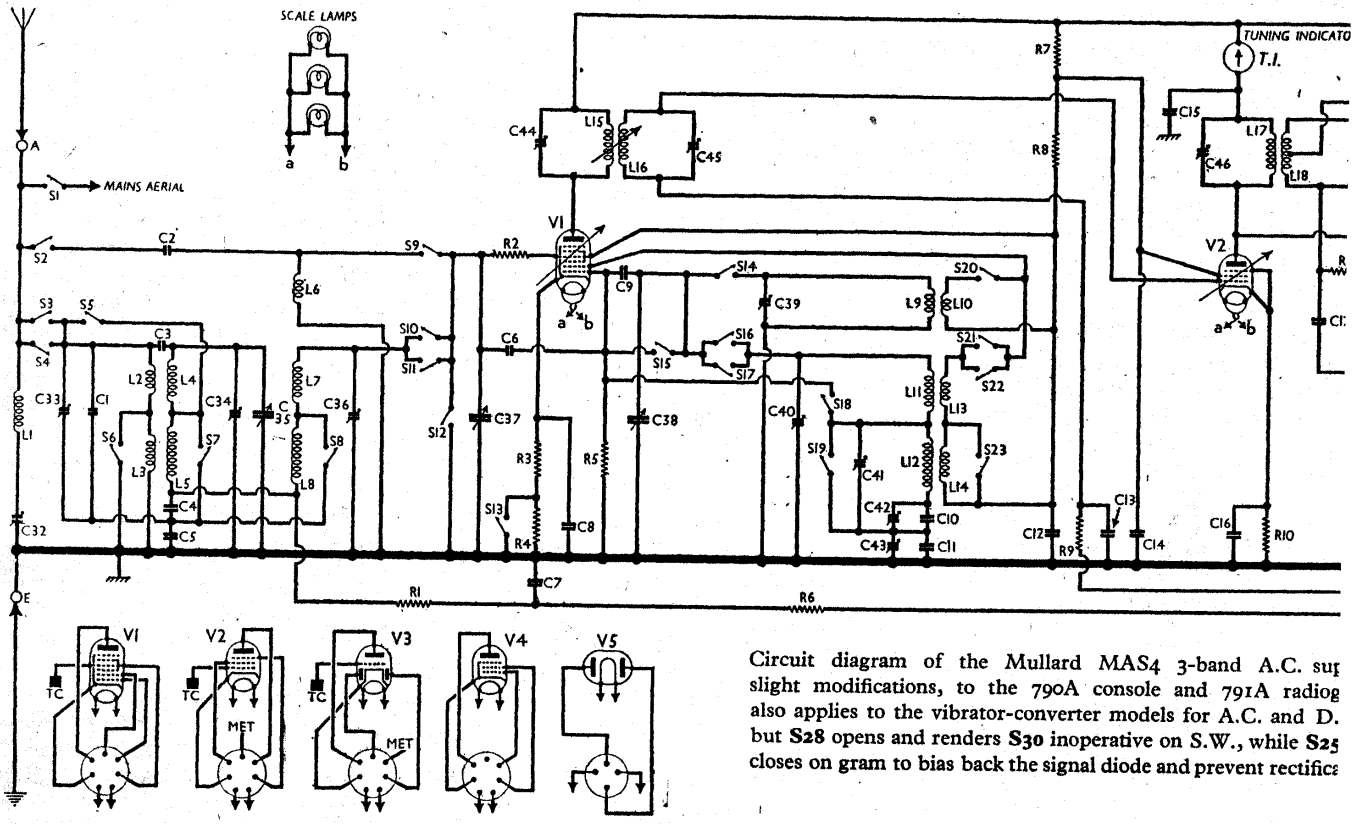
First valve **(V1, Mullard metallised FC4)** is an octode operating as electron-coupled frequency changer. Oscillator grid coils **L9** (S.W.) **L11, L12** (M.W. and L.W.) are tuned by **C38;** parallel trimming by **C39** (S.W.); **C40** (M.W.), **C41** (L.W.); series tracking by **C10, C42** (L.W.), **C11, C43** (M.W.); oscillator anode reaction coils **L10** (S.W.), **L13, L14** (M.W. and L.W.).

Second valve **(V2, Mullard metallised VP4B)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **C44, L15, L16, C45** and **C46, L17, L18, C47.** Provision is made for varying the coupling between primary and secondary windings of the first transformer in order to give variable selectivity.

Intermediate frequency 128 kc/s.

Moving-iron meter tuning indicator **T.I.** in **V2** anode H.T. feed circuit.

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



Circuit diagram of the Mullard MAS4 3-band A.C. sup slight modifications, to the 790A console and 791A radiog also applies to the vibrator-converter models for A.C. and D. but **S28** opens and renders **S30** inoperative on S.W., while **S25** closes on gram to bias back the signal diode and prevent rectifica

across manual volume **R12** and passed via **C18** and **R13** to C.G. of triode amplifier section.

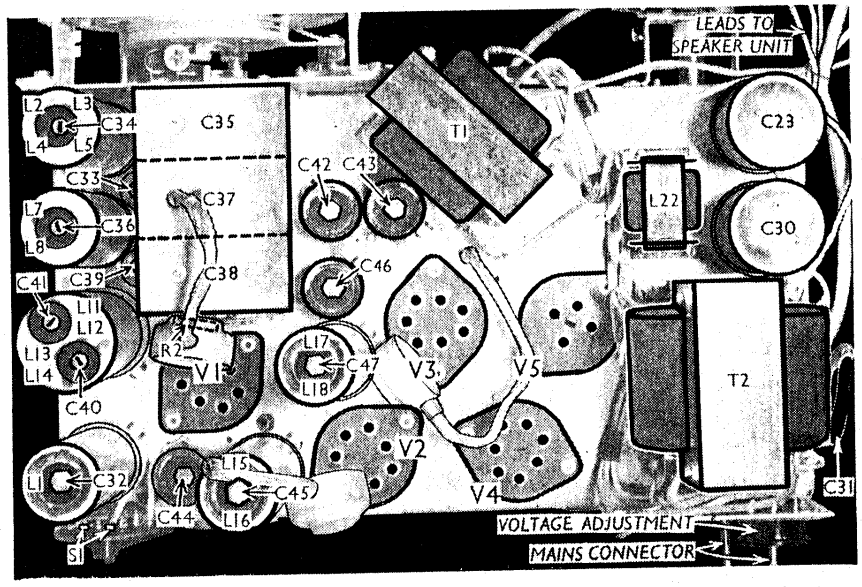
Capacitor **C19** is connected in series with **C18** in order to provide a degree of bass attenuation in conjunction with switches **S28, S30, S31.** Provision for connection of gramophone pick-up across volume control via switches **S26** and **S27. C28** is operated by the waveband switch control, and is closed in every position except S.W.; **S30** and **S31** are operated by a separate bass control at the discretion of the user.

Second diode of **V3,** fed from **V2** anode via **C22,** provides D.C. potential which is developed across load resistor **R21** and fed back through decoupling circuits as G.B. to F.C. valve giving automatic volume control. The I.F. valve is also A.V.C. controlled, but the bias is obtained from the D.C. potential developed across the manual volume control **R12,** which operates as the signal diode load resistor.

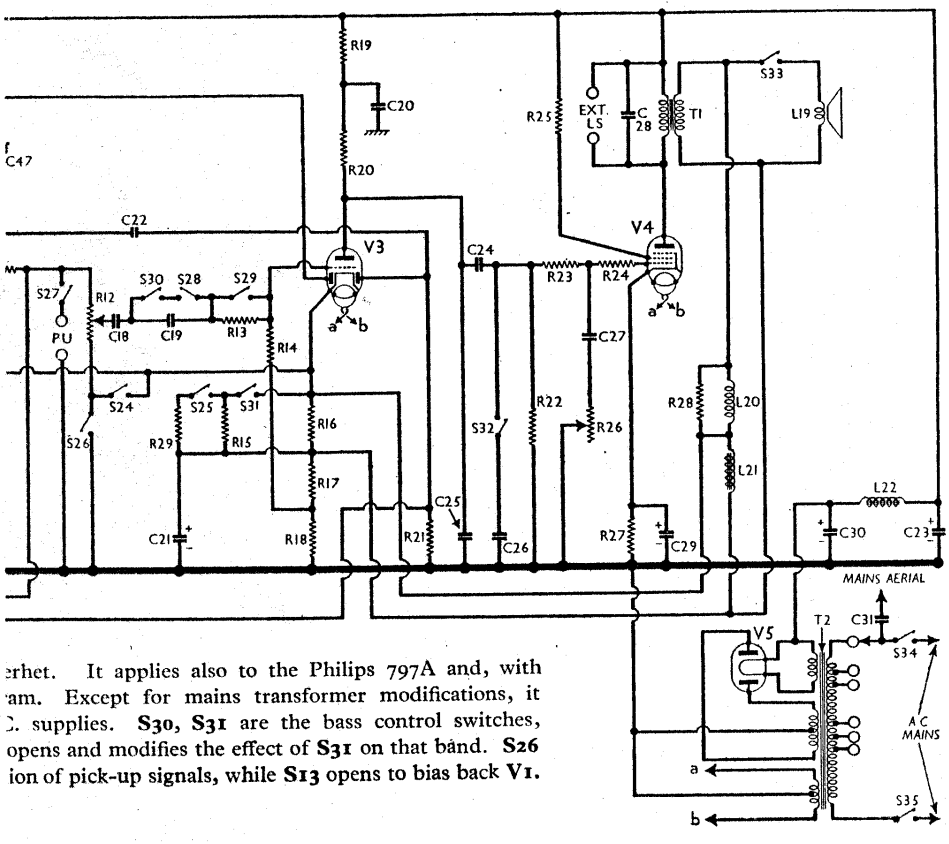
Resistance-capacitance coupling by **R20, C24** and **R22** between **V3** triode and pentode output valve **(V4, Mullard PenA4).** Variable tone control by R.C. filter **R23, C27** and **R26,** in C.G. circuit; fixed tone correction in anode circuit by **C28.** Capacitor **C26** shunts C.G. circuit when switch **S32** is closed, to mute the receiver, **S32** being controlled by the operator when he desires silent tuning.

Provision is made for the connection of a high impedance external speaker across the primary of the output transformer **T1,** while **S33** in the secondary circuit permits the internal speaker to be muted. **T1** secondary voltages are developed across chokes **L20, L21,** those across **L21** being fed back in inverse phase to **R16** in the cathode circuit of **V3,** giving negative feed-back whose characteristic can be modified by operating the bass control switch **S31. S25** opens only on S.W., while **S26** closes only on gram.

H.T. current is supplied by full-wave rectifying valve **(V5, Mullard DW2).** Smoothing by iron-cored choke **L22** and electrolytic capacitors **C23, C30.** Mains aerial coupling by **C31.**



Plan view of the chassis. All the trimmers are indicated here, many of them in the tops of their coil cans. **R2** is carried in the top cap connector of **V1.**



erhet. It applies also to the Philips 797A and, with am. Except for mains transformer modifications, it C. supplies. **S30, S31** are the bass control switches, opens and modifies the effect of **S31** on that band. **S26** ion of pick-up signals, while **S13** opens to bias back **V1.**

COMPONENTS AND VALUES

	CAPACITORS	Values (μF)
C1	Image suppressor ...	0·00002
C2	Aerial S.W. coupling ...	0·000016
C3	Aerial M.W., L.W. coupling	0·00001
C4	Band-pass couplings ...	0·016
C5	Band-pass couplings ...	0·025
C6	Neutralising coupling ...	0·000002
C7	V1 A.V.C. line decoupling	0·1
C8	V1 cathode by-pass ...	0·05
C9	V1 osc. C.G. capacitor ...	0·0001
C10	Osc. fixed L.W. tracker...	0·00065
C11	Osc. fixed M.W. tracker...	0·001375
C12	V1 H.T. decoupling ...	0·1
C13	V2 C.G. decoupling ...	0·1
C14	V2 S.G. decoupling ...	0·1
C15	V2 anode decoupling ...	0·1
C16	V2 cathode by-pass ...	0·1
C17	I.F. by-pass	0·0001
C18	A.F. coupling to V3 triode	0·002
C19	Bass control capacitor ...	0·00025
C20	V3 anode decoupling ...	0·5
C21*	V3 cathode by-pass ...	25·0
C22	V3 A.V.C. diode feed ...	0·00001
C23*	H.T. smoothing	32·0
C24	V3 to V4 A.F. coupling ...	0·02
C25	V3 anode I.F. by-pass ...	0·0004
C26	Muting capacitor ...	0·1
C27	Tone control capacitor ...	0·008
C28	Fixed tone corrector ...	0·004
C29*	V4 cathode by-pass ...	25·0
C30*	H.T. smoothing capacitor	32·0
C31	Mains aerial coupling ...	0·0005
C32‡	Aerial I.F. filter tuning ...	0·00017
C33‡	Image suppressor ...	0·00003
C34‡	Band-pass pri. trimmer ...	0·00003
C35†	Band-pass pri. tuning ...	0·00047
C36‡	Band-pass sec. trimmer ...	0·00003
C37†	B.-P. sec. and S.W. tuning	0·00047
C38†	Osc. circuit tuning ...	0·00047
C39‡	Osc. circ. S.W. trimmer ...	0·00003
C40‡	Osc. circ. M.W. trimmer...	0·00003
C41‡	Osc. circ. L.W. trimmer...	0·00003
C42‡	Osc. circ. L.W. tracker ...	0·00017
C43‡	Osc. circ. M.W. tracker...	0·00017
C44‡	1st I.F. trans. pri. tuning	0·00017
C45‡	1st I.F. trans. sec. tuning	0·00017
C46‡	2nd I.F. trans. pri. tuning	0·00017
C47‡	2nd I.F. trans. sec. tuning	0·00017

* Electrolytic. † Variable. ‡ Pre-set.

	RESISTORS	Values (ohms)
R1	V1 pent. C.G. decoupling	100,000
R2	V1 pent. C.G. stabiliser	50
R3	V1 fixed G.B. resistor	250
R4	V1 G.B. resistor (gram.)	2,500
R5	V1 osc. C.G. resistor	50,000
R6	V1 A.V.C. line decoupling	1,000,000
R7	V1, V2, S.G.'s and osc. anode H.T. feed	16,000*
R8		22,500†
R9	V2 C.G. decoupling	1,600,000
R10	V2 fixed G.B. resistor	1,250
R11	I.F. stopper	100,000
R12	Manual volume control	500,000
R13	I.F. stopper	1,600,000
R14	V3 triode C.G. resistor	1,600,000
R15	Bass control resistor	32
R16	Inverse feed-back coupling	32
R17	V3 G.B. and A.V.C. delay voltage resistors	3,200
R18		4,000
R19	V3 triode anode decoupling	50,000
R20	V3 triode anode load	100,000
R21	V3 A.V.C. diode load	500,000
R22	V4 C.G. resistor	800,000
R23	V4 C.G. I.F. stoppers	100,000
R24		1,000
R25	V4 S.G. stabiliser	32
R26	Variable tone control	2,580,000
R27	V4 G.B. resistor	160
R28	Inverse feed-back resistor	500
R29	Bass control resistor	10

* Two 32,000 Ω in parallel. † 12,500 and 10,000 Ω in series ; or may be 20,000 Ω.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial I.F. filter coil	140·0
L2	Aerial M.W. and L.W. coupling coils	25·0
L3		95·0
L4	Band-pass primary coils	4·0
L5		40·0
L6	Aerial S.W. tuning coil	0·05
L7	Band-pass secondary coils	4·0
L8		37·0
L9	Osc. S.W. tuning coil	0·05
L10	Osc. S.W. reaction coil	30·0
L11	Osc. M.W. and L.W. tuning coils	10·0
L12		25·0
L13	Osc. M.W. and L.W. reaction coils	4·0
L14		8·0
L15	1st I.F. trans. Primary	140·0
L16	Secondary	140·0
L17	2nd I.F. trans. Primary	140·0
L18	Secondary	135·0
L19	Speaker speech coil	5·0
L20	Parts of inverse feed-back circuit	150·0
L21		7·0
L22	H.T. smoothing choke	385·0
T1	Output trans. Pri.	310·0
	Sec.	0·4
T2	Mains trans. Pri. total	35·0
	Heater sec.	0·04
	Rect. fil. sec.	0·17
	H.T. sec. total	360·0
T.I.	Tuning indicator meter	2000·0
S1	Mains aerial switch	—
S2-23	Waveband and muting switches	—
S24-27	Radio-gram. change switches	—
S29		—
S28	Bass control switches	—
S30-31		—
S32	Muting switch	—
S33	Internal speaker switch	—
S34-35	Mains circuit switches	—

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 245 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 1,200 V scale of an Avometer, with chassis as negative.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 FC4	245	1·6	65	2·6
	Oscillator			
	55	1·4		
V2 VP4B	230	4·9	150	1·8
V3 TDD4	80	0·9	—	—
V4 PenA4	230	32·0	245	4·1
V5 DW2	240†	—	—	—

† Each anode A.C.

Voltages were measured on the 1,200 V scale of an Avometer, with chassis as negative.

DISMANTLING THE SET

The cabinet is fitted with a detachable bottom held by four screws (with washers).

Removing Chassis.—It will be found convenient to remove both the chassis and speaker at the same time, and care should be taken to handle the Bowden cables gently, as otherwise kinks may develop in the wire.

Remove the four control knobs (recessed grub screws) from the front of the cabinet;

unclip the four scale lamps;

free the cables from the waveband and variable selectivity controls, loosen the lock-nuts at their far ends, and withdraw the cables;

free the two cleats on the speaker fixing bolts;

release the scale pointer by loosening the small screw holding it to the Bowden wire, and free the pointer drive bridge (two nuts);

unsolder the earthing lead from the screen at the bottom of the cabinet, and remove the tuning indicator (two nuts) and the speaker switch assembly (two round-head wood screws).

Free the speaker from the three clamps holding it to the sub-baffle, when it can be lifted from the cabinet.

Removing Speaker.—To remove the speaker alone, unsolder the leads and slacken the three clamps holding it to the sub-baffle.

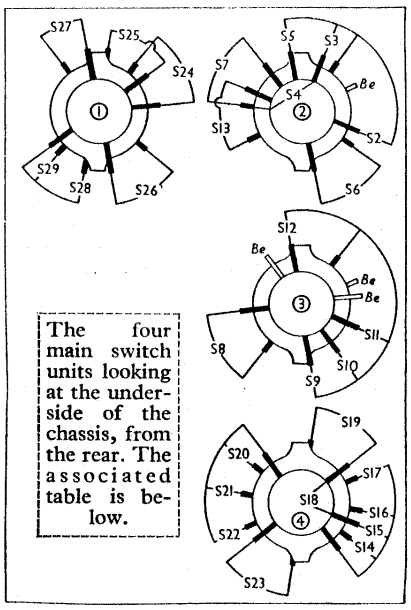
When replacing, see that the terminal strip is pointing to the top right-hand corner of the cabinet, and connect the leads as follows, numbering them from left to right:

Bottom row: 1, screened lead in insulating sleeving; 2, lead to H.T. smoothing choke; 3 and 4, white leads to main transformer; 5 and 6, leads to output transformer; 7, speech coil.

Top row: 1, screened lead to tuning indicator; 2, other lead to T.I.; 3, white lead to screening on two other leads; 4 and 5, scale lamps; 6 and 8, speaker switch; 7, speech coil.

Do not forget to bond together the screening on the two screened leads.

SWITCH DIAGRAMS AND TABLE



The four main switch units looking at the underside of the chassis, from the rear. The associated table is below.

Switch	S.W.	M.W.	L.W.	Gram.
S2	C	—	—	—
S3	—	C	—	—
S4	—	—	—	C
S5	—	—	C	—
S6	—	C	—	—
S7	C	C	—	C
S8	—	C	—	C
S9	C	—	—	—
S10	—	C	—	—
S11	—	—	C	—
S12	—	—	—	C
S13	C	C	C	—
S14	C	—	—	—
S15	—	C	C	—
S16	—	C	—	—
S17	—	—	C	—
S18	—	—	—	C
S19	—	C	—	—
S20	C	—	—	—
S21	—	C	—	—
S22	—	—	C	—
S23	—	C	—	—
S24	C	C	C	—
S25	—	C	C	C
S26	—	—	—	C
S27	—	—	—	C
S28	—	C	C	C
S29	—	—	—	C

GENERAL NOTES

Switches.—**S2-S29** are the waveband and radio/gramophone change switches, in four ganged units beneath the chassis. These are indicated in our under-chassis view by numbers **(1** to **4)** in circles, with arrows showing the direction in which the units are viewed in the diagrams in col. 2 where they are shown in detail. Three of these units **(2, 3** and **4)** are in line on a common spindle, while the fourth unit **(1)** is off-set, and is operated by a link from the main control spindle.

The table (col. 2) gives the switch positions for four of the five control settings, starting from the fully anti-clockwise position. A dash indicates open, and **C,** closed; the remaining position is "off."

S34 and **S35** are the Q.M.B. mains switches, in a rotary unit fitted to the front of the chassis, and ganged with the **S2-S29** units.

S1 is the Q.M.B. mains aerial switch mounted on a bracket at the back of the chassis. The unit contains two switches, but only one is used.

S30 and **S31** are the bass control switches, in a single unit at the rear of the chassis. They are each indicated in the under-chassis view.

S32 is the muting switch, mounted between **R12** and **R26,** and operated by the operator for silent tuning by depressing the volume control knob.

S33 is the internal speaker switch, mounted on a bracket fitted at the back of the cabinet.

Coils.—**L1; L2-L5; L7, L8; L11-L14; L15, L16** and **L17, L18** are in six tubular screened units on the chassis deck, the last two being I.F. transformers. All the units, except **L11-L14,** have single trimmers at the tops of their cans; the **L11-L14** unit has two trimmers.

The first I.F. transformer, **L15, L16,** is of the variable selectivity type, the coupling between primary and secondary being adjustable by the Bowden-type cable fitted.

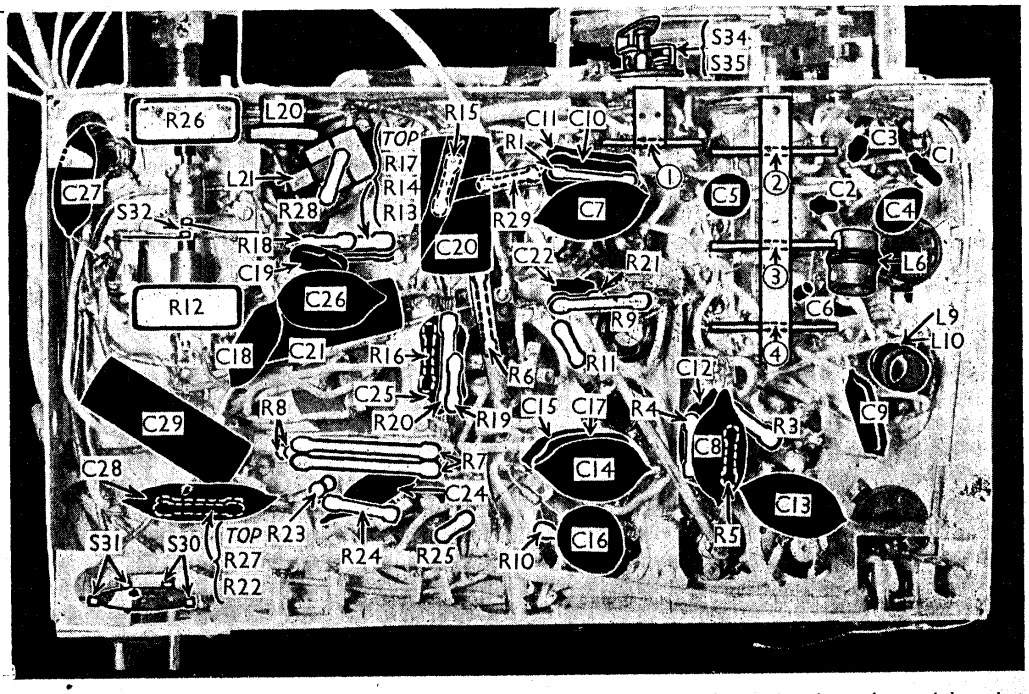
L6 and **L9, L10** are two small unscreened tubular units beneath the chassis.

L19 is the speaker speech coil; **L20, L21** are beneath the chassis, and **L22** is on the chassis deck.

Scale Lamps.—These are Philips 8042 M.E.S., frosted bulb types wired in parallel.

External Speaker.—Two sockets are provided at the rear of the chassis for a high impedance (8,000 Ω) external speaker The internal speaker can be cut out of circuit by means of **S33** if desired.

Resistors R7, R8.—In our chassis, **R7** consists of two 32,000Ω resistors in parallel, and **R8** of a 10,000 Ω and a 12,500 Ω resistor in series. It may, however, be a single 20,000 Ω resistor.



Under - chassis view. The waveband switch units **1**, **2**, **3** and **4** are indicated here and shown in detail in the diagrams in col. 2 opposite. **S32** is operated by the volume control spindle, closing when the knob is pressed for silent tuning. **R6**, **R15** and **R29** are enclosed in sleeving. **R29** may be omitted in some chassis. **L20** is omitted from the Philips console and radiogram versions.

Resistor R29.—This is not in the makers' diagram, but is included in our chassis, with the extra switch **S25.** The tone compensation circuit arrangements may be a little different in early chassis.

MODELS 790 and 791

The principal difference between the table model and the radiogram 791A or U is a small modification in the pick-up input circuit, stepping down the pick-up output.

The pick-up is shunted by a 0.002 μF capacitor, and across it again is a potential divider comprising two resistors, one of 32,000 Ω and the other of 64,000 Ω. One side of this network goes to chassis, connecting one side of the pick-up, one side of the capacitor, and the outer end of the 32,000 Ω resistor go to chassis.

The junction of the two resistors goes to the position shown in our circuit diagram for the "line" pick-up socket, so that actually the ends of 32,000 Ω resistor are connected to the two points to which the pick-up sockets are shown connected in our diagram.

Another small difference is that **L20** is omitted from the radiogram. It is also omitted from the console 790 A or U, which is the only electrical difference in this model from the table version.

CIRCUIT ALIGNMENT

Note.—Apart from the usual equipment, a special 15 deg. jig (Code No. M.0999174) will be necessary for adjusting the gang to the standard checking point, and an auxiliary radio receiver or aperiodic amplifier will be required to determine when a signal on the control grid of **V1** reaches a maximum.

When adjusting one winding of an I.F. transformer, damping must be applied to the other winding by a shunt resistor. If the two ends of the winding to be damped are not accessible, the damping may be connected between the anode or grid side of the winding and chassis, but with a 0.1 μF condenser in series with the resistor and on the chassis side of it.

When applying signals to the control grid of a valve its normal grid circuit must remain connected, that is, the top cap must not be removed.

I.F. Stages.—Connect output meter to external speaker sockets. Turn volume control to maximum, selectivity control to minimum selectivity position (maximum band width), and switch set to L.W., short-circuit **R5,** and apply a 128 kc/s (2,344 m) signal to control grid (top cap) of **V1,** leaving existing connection undisturbed.

Shunt **C46** with a 25,000 Ω resistor, and adjust **C47** for maximum output. Remove shunt. Shunt **C45** with a 10,000 Ω resistor and 0.1 μF capacitor in series. Adjust **C44** for maximum output. Remove shunt. Shunt **C47** with a 25,000 Ω resistor and adjust **C46** for maximum output. Remove shunt. Shunt **C44** with a 10,000 Ω resistor and 0.1 μF capacitor in series. Adjust **C45** for maximum output. Remove shunt, and also the short circuit across **R5.**

R.F. and Oscillator Stages.—Shunt **L15** with a 25,000 Ω resistor. Earth the chassis, and turn **C32** so that it is almost at maximum. Fit the 15 deg. jig by slipping the boss over the locating pin just above the gang spindle. The jig ensures that when the gang is turned so that it bears upon it, the vanes are advanced exactly 15 degrees, which is the standard trimming position.

M.W.—Switch to M.W. and set selectivity control to maximum selectivity position (minimum band width). Turn gang until it bears on jig. Apply a 1,442 kc/s (208 m) signal to the aerial socket via a standard artificial aerial. Adjust **C40, C36** and **C34** for maximum output.

Short circuit **R5.** Connect anode of **V1** via a 25 $\mu\mu$F capacitor to aerial socket of auxiliary receiver, and connect output meter to this receiver.

Feed in a 550 kc/s (545 m) signal to the MAS4, and tune to maximum output on auxiliary receiver. Disconnect auxiliary receiver, remove short from **R5,** and reconnect output meter to MAS4. Keeping input at 550 kc/s, adjust **C43** for maximum output. Retrim at 442 kc/s as above.

L.W.—Switch to L.W., feed in a 395 kc/s (760 m) signal, short **R5,** connect auxiliary receiver and output meter as for M.W., and tune MAS4 for maximum output. Disconnect auxiliary receiver, remove short from **R5,** and reconnect output meter to MAS4. Adjust **C41** for maximum output.

Apply a 160 kc/s (1,875 m) signal, short **R5,** connect auxiliary receiver and output meter as before, and tune MAS4 for maximum output. Disconnect auxiliary receiver, remove short from **R5** and reconnect output meter to MAS4. Adjust **C42** for maximum output.

S.W.—Switch to S.W. Turn gang until it bears on jig. Apply a 17 Mc/s (17.6 m) signal to aerial socket via a S.W. artificial aerial, and adjust **C39** for maximum output. The peak obtained with the greater trimmer capacity is correct.

I.F. Filter.—Switch set to L.W. and set tuning capacitor to maximum (2,000 m). Apply a 128 kc/s signal, and adjust **C32** for minimum output.

Image Frequency Filter.—Switch set to M.W. Apply a 774 kc/s (403 m) signal to the aerial socket and tune it in. Without altering the tuning, apply a strong 1,000 kc/s (300 m) signal, and adjust **C33** for minimum output.

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