"TRADER" SERVICE SHEET
979

FERGUSON 299RG

Covering the Table Model 289A

THE Ferguson 299RG is an automatic radiogram employing a 6-valve (plus rectifier), 3-band superhet chassis and a 3-speed record changer. It is designed to operate from A.C. mains of 200-250 V, 50 c/s, but may also be used on 40 or 60 c/s mains by the addition of adaptor pulleys to the record changer. The waveband ranges are 15.5-55.4 m, 184-576 m and 730-2,050 m.

289A is a table model using a similar chassis, but with a modified feed-back circuit, details of which are given overleaf.

Release dates and original prices: 299RG, October 1950, £58 14s 9d; 289A, September 1950, £23 6s 8d. Purchase tax extra.

CIRCUIT DESCRIPTION

Aerial input via **C1** and coupling coils **L1** (S.W.), **L2** (M.W.) and **L3** (L.W.) to single-tuned circuits **L4, C35** (S.W.), **L5, C35** (M.W.) or **L6, C35** (L.W.). **C2** is connected across **L3** to make it resonate outside the L.W. band.

First valve **(V1, Mullard ECH35)** is a triode-hexode operating as frequency changer with internal coupling. Oscillator anode coils **L9** (S.W.), **L10** (M.W.) and **L11** (L.W.) are tuned by **C43.** Parallel trimming by **C40** (S.W.), **C41** (M.W.) and **C10, C42** (L.W.); series tracking by **C8** (S.W.), **C9, C38** (M.W.) and **C39** (L.W.). Reaction coupling from grid by **L7** (S.W.) and **L8** (M.W. and L.W.), with additional coupling on S.W. across the common impedance of **C8.**

Second valve **(V2, Mullard EF39)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned transformer couplings **C36, L12, L13, C37** and **C44, L14, L15, C45.**

Intermediate frequency 475 kc/s

Diode signal detector is part of double diode valve **(V3, Mullard EB34).** Audio frequency component in rectified output is developed across volume control **R17,** which is also the diode load, and passed via **C18** to the control grid of the A.F. amplifier **(V4, Mullard EF39).** I.F. filtering by **C16, R16** and **C17.**

In the Gram position of the waveband control, the pick-up is connected via **S14** across **R17.** **S6** closes, and **S13** opens on Gram to prevent radio break-through.

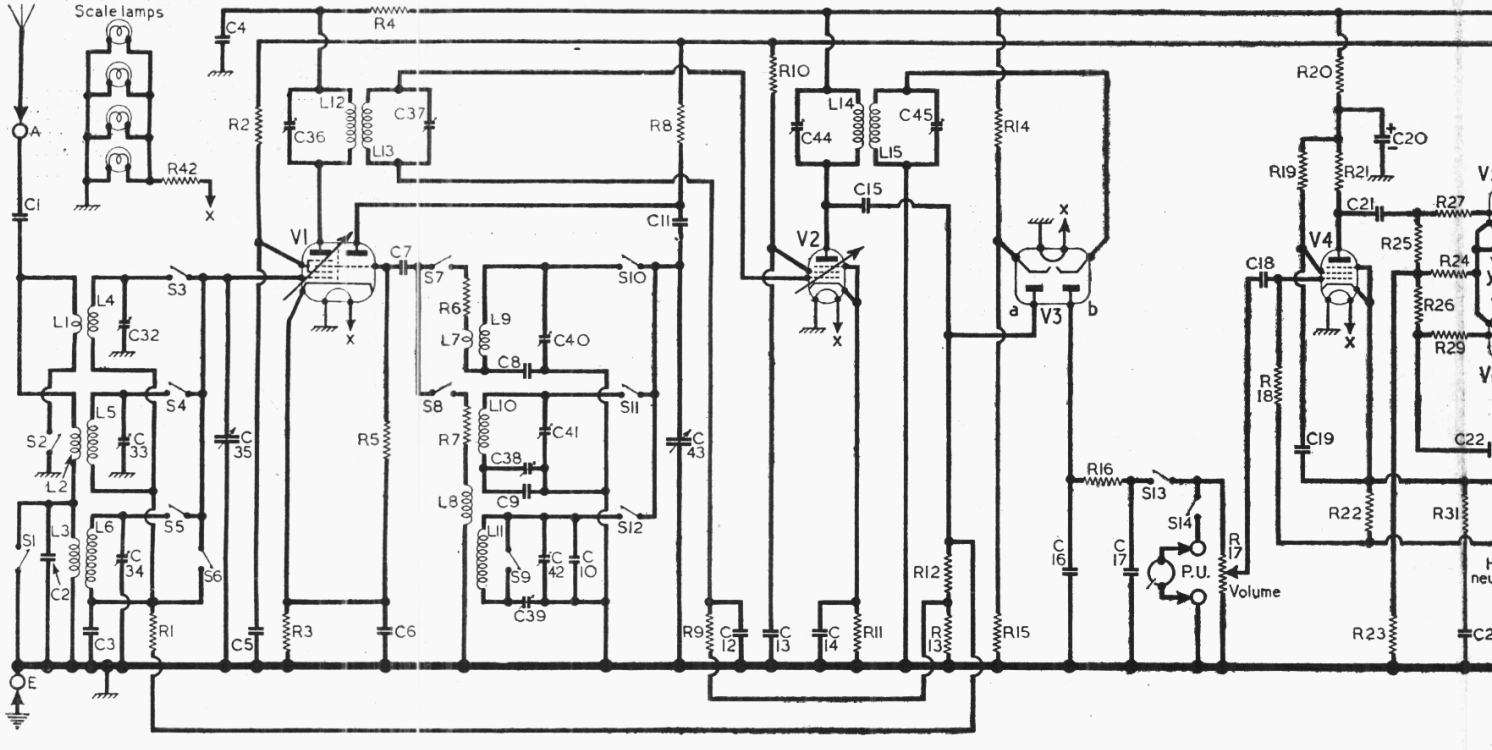
Second diode of **V3,** fed from **V2** anode via **C15,** is biased by potential divider **R14, R15,** and provides D.C. potentials which are developed across **R12, R13.** The total potential is fed back to F.C. valve, and a proportion of it, developed across **R13,** is fed back to I.F. valve giving automatic gain control.

Resistance-capacitance coupling by **R21, C21** and **R25** between **V4** and one side of pentode push-pull output stage **(V5, V6, Mullard EL33's).** Second valve of output stage is coupled in inverse phase to the first by the common impedance of **R23** in their grid and cathode circuits. Grid bias for both valves is obtained from the voltage drop along **R24.** Mains hum appearing in the output stage is neutralised by feeding a proportion of the hum voltage in the H.T. supply, that developed across **R33** in potential divider **R32, R33,** via **C22** to the grid of **V6.** Provision is made for the connection of a low impedance external speaker across the secondary winding of **T1,** and rotation of the speaker plug opens **S15,** muting the internal speaker.

Tone correction by **R34, C25** across **T1** primary winding. A proportion of the speech coil voltage is fed back to the grid of **V4** via control **R38** in potential divider **R37, R38** and **R39,** giving bass control. **C26, C27** and **R36** determine the frequency characteristic of this feed-back. **R35** is the treble control, connected directly across **T1** secondary and feeding back speech coil voltage, suitably corrected by **R21, C23** to grid and cathode circuits of **V4.**

In model 289A the feed-back circuit is modified as shown overleaf, feed-back being applied only to the cathode circuit of **V4** and the bass and treble controls being replaced by a single tone control.

H.T. current is supplied by full wave



rectifying valve **(V7, Mullard AZ31).** Smoothing by **R40, R41** and electrolytic capacitors **C28, C29** and **C30. V5, V6** are fed with unsmoothed H.T. from **C30.**

COMPONENTS AND VALUES

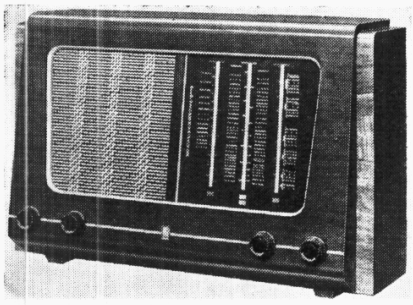
	CAPACITORS	Values	Locations
C1	Aerial coupling ...	100pF	J5
C2	L.W. aerial shunt	150pF	H4
C3	A.G.C. decoupling	0·05μF	G4
C4	V1 anode decoup....	0·1μF	H5
C5	V1 S.G. decoup. ...	0·1μF	H4
C6	V1 cath. by-pass ...	0·1μF	J4
C7	V1 osc. C.G. ...	100pF	H5
C8	S.W. tracker ...	0·004μF	H5
C9	M.W. tracker ...	250pF	G4
C10	L.W. trimmer ...	30pF	H4
C11	Osc. anode coup....	100pF	H4
C12	A.G.C. decoupling	0·05μF	G5
C13	V2 S.G. decoup. ...	0·1μF	G5
C14	V2 Cath. by-pass	0·1μF	G5
C15	A.G.C. coupling ...	100pF	G5
C16	I.F. by-passes ...	100pF	G5
C17		100pF	F5
C18	A.F. coupling ...	0·01μF	G4
C19	V4 S.G. decoup. ...	0·5μF	F3
C20*	H.T. decoupling ...	4·0μF	E3
C21	A.F. coupling ...	0·05μF	F4
C22	Push-pull coup. ...	0·05μF	E5
C23	Neg. feed-back ...	0·05μF	F4
C24		0·02μF	F3
C25	Tone correction ...	0·005μF	E4
C26	Neg. feed-back ...	0·05μF	G3
C27		0·5μF	G3
C28*	H.T. smoothing ...	8μF	K6
C29*		16μF	K6
C30*		24μF	K6
C31	R.F. by-pass ...	0·01μF	K6
C32‡	S.W. aerial trim. ...	40pF	H4
C33‡	M.W. aerial trim....	40pF	H4
C34‡	L.W. aerial trim....	40pF	H4
C35†	Aerial tuning ...	528pF	A1
C36‡	1st I.F. trans. tuning ...	100pF	B2
C37‡		100pF	B2
C38‡	M.W. osc. tracker	300pF	G4
C39‡	L.W. osc. tracker	300pF	G4
C40‡	S.W. osc. trimmer	40pF	H4
C41‡	M.W. osc. trimmer	40pF	H4
C42‡	L.W. osc. trimmer	40pF	H4
C43†	Oscillator tuning...	528pF	B1
C44‡	2nd I.F. trans. tuning ...	100pF	C2
C45‡		180pF	C2

* Electrolytic. † Variable. ‡ Pre-set.

	RESISTORS	Values	Locations
R1	A.G.C. decoupling	1.47MΩ*	G4
R2	V1 S.G. feed ...	100kΩ	H5
R3	V1 G.B.	220Ω	H5
R4	V1 anode decoup.	4.7kΩ	G5
R5	V1 osc. C.G. ...	47kΩ	H5
R6	Osc. stabilisers ...	47Ω	H5
R7		2.2kΩ	H5
R8	Osc. anode feed ...	22kΩ	H5
R9	A.G.C. decoupling	1MΩ	F5
R10	V2 S.G. feed ...	68kΩ	G5
R11	V2 G.B.	330Ω	G5
R12	A.G.C. diode load	470Ω	F5
R13		470Ω	F5
R14	V3a G.B. pot. ...	470kΩ	F4
R15	divider ...	3.3kΩ	F5
R16	I.F. stopper ...	47kΩ	F5
R17	Volume control ...	500kΩ	J3
R18	V4 C.G.	2MΩ	G4
R19	V4 S.G. feed ...	330kΩ	F4
R20	V4 H.T. decoup.	100kΩ	E4
R21	V4 anode load ...	100kΩ	F4
R22	V4 G.B.	1kΩ	F4
R23	V5, V6 cath. coup.	425Ω	D2
R24	V5, V6 G.B. ...	75Ω	E5
R25	V5, V6 C.G. ...	500kΩ	F5
R26		500kΩ	E5
R27	V5 stoppers ...	4·7Ω	F5
R28		100Ω	E5
R29	V6 stoppers ...	4·7Ω	E5
R30		100Ω	E5
R31	Neg. feed-back ...	5Ω	F4
R32	Hum neut. pot.	250kΩ	E4
R33	divider ...	2kΩ	D1
R34	Tone correction ...	10kΩ	E4
R35	Treble control ...	2·5kΩ	F3
R36	Neg. feed-back ...	1·5kΩ	G3
R37		4·7kΩ	G3
R38	Bass control ...	25kΩ	G3
R39	Neg. feed-back ...	1kΩ	G3
R40	H.T. smoothing	4·7kΩ	K6
R41		4.7kΩ	K6
R42	Scale l'mp ballast	0.75Ω†	F4

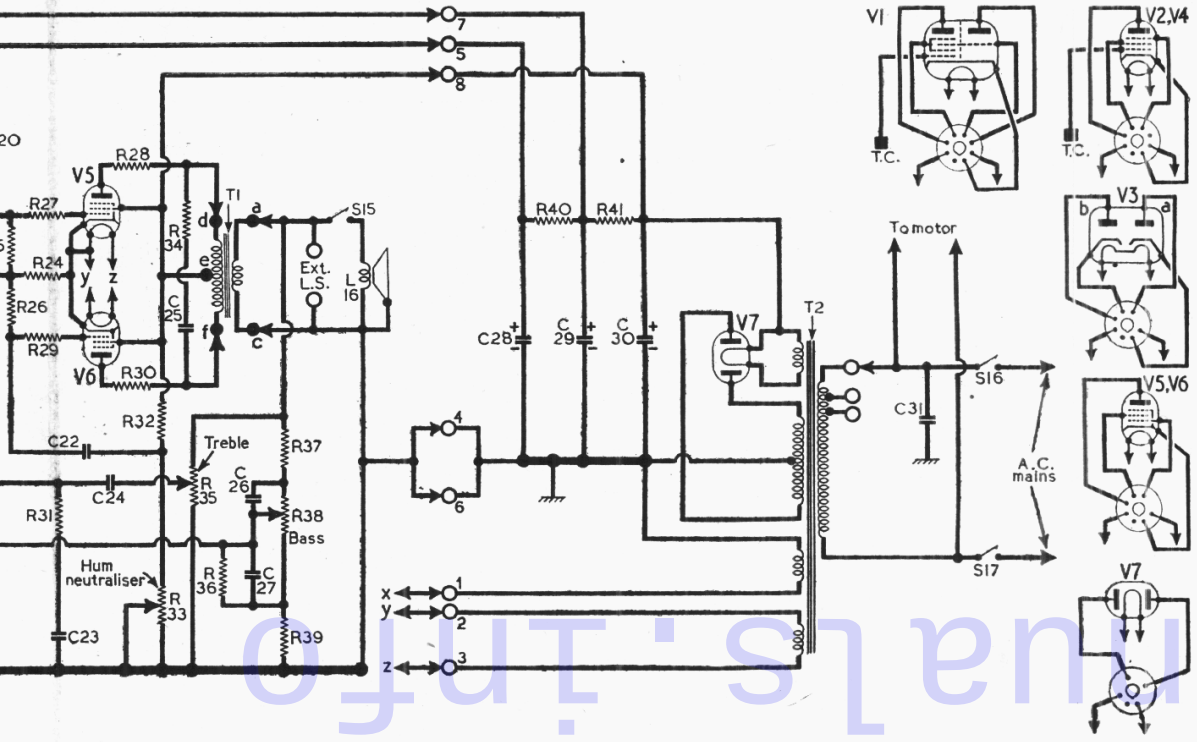
* Made up of a 1 MΩ and a 470kΩ resistor in series.

† Made up of two 1.5Ω resistors in parallel.

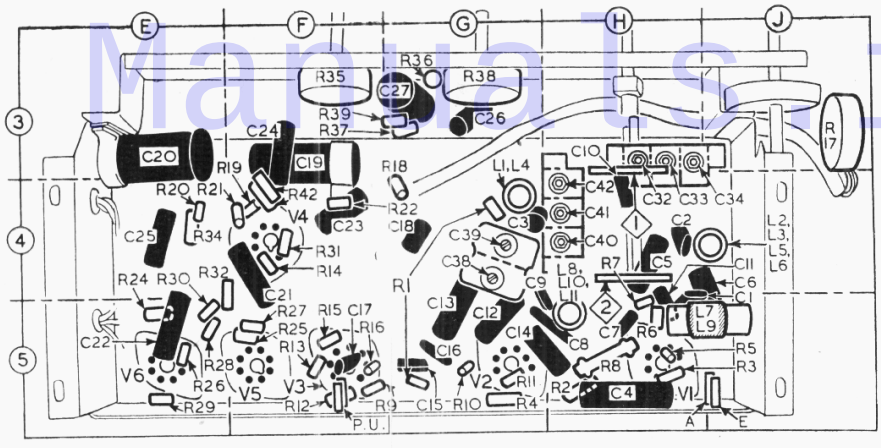


The Ferguson 289A table model. A photograph of the 299 radiogram appears overleaf.

	OTHER COMPONENTS	Approx. Values (ohms)	Locations
L1	Aerial coupling coils	3·6	G4
L2		3·6	J4
L3		54·0	J4
L4	Aerial tuning coils	Very low	G4
L5		2·3	J4
L6		28·0	J4
L7	Osc. reaction coils...	Very low	J5
L8		4·4	H5
L9	Osc. tuning coils ...	Very low	J5
L10		2·4	H5
L11		6·0	H5
L12	1st I.F. trans. Pri.	8·5	B2
L13	1st I.F. trans. Sec.	8·5	B2
L14	2nd I.F. trans. Pri.	8·5	C2
L15	2nd I.F. trans. Sec.	7·5	C2
L16	Speech coil ...	2·3	—
T1	Primary, d–e ...	150·0	
	Primary, e–f ...	140·0	C2
	Secondary ...	Very low	—
T2	Primary, total ...	20·0	
	H.T. sec., total ...	440·0	
	Rect. htr. sec. ...	Very low	K6
	V1–V4 htr. sec. ...	Very low	
	V5, V6 htr. sec. ...	Very low	
S1–S14	Waveband and gram switches ...	—	H4
S15	Speaker switch ...	—	—
S16 S17	Mains switches ...	—	—



Circuit diagram of the Ferguson 299 radiogram. Apart from the reversed detector diode connections, the first three stages are conventional, although the H.T. feed circuits are unusually well decoupled. **V4** is a conventional A.F. amplifier but it is involved in the rather elaborate feed-back tone-control circuit associated with the push-pull output stage. **R32, R33** simply introduce anti-phase hum voltages, making an adjustable hum control. **C22** is part of the push-pull coupling. The power unit associated with **V7** is a separate unit.

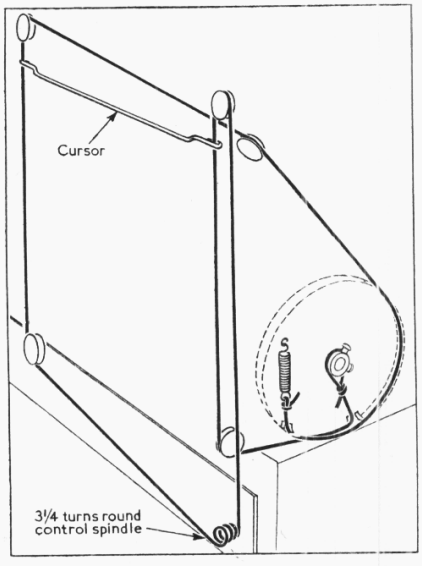


Underside view of the radiogram chassis, with the volume control in approximately the same position as it adopts in the cabinet. In the table model it is mounted on an extension bracket with the single tone control **R35**.

DRIVE CORD REPLACEMENT

About seven feet of high-grade plaited and waxed flax fishing line is required for a new tuning drive cord, which should be run as shown in the sketch below, where the system is drawn as seen from the right-hand front corner of the chassis, when the gang is at maximum capacitance.

It is advisable to start by making a non-slip loop with a diameter of about $\frac{5}{8}$in at one end of the cord, turning the gang to maximum, and slipping the loop over the drive drum fixing boss. Thereafter



Sketch showing the tuning drive system in both models. It is drawn as seen from the front right-hand corner of the chassis.

the cord can be held in position by pulling the drum against the gang stop.

The cursor is fixed by bending its ends round and clamping them to the cord, and for this purpose the glass scale panel must be removed. It is held by three springy clips on the top rail of the scale assembly and three more at the bottom.

The clips can be prised off with a screwdriver blade, but it is advisable to steady them with one finger as they are liable to fly off and get lost.

GENERAL NOTES

Switches.—**S1-S12** are the waveband switches, and **S13, S14** the radio/gram change-over switches, ganged in two rotary units beneath the chassis. These are indicated in our under-chassis drawing, and shown in detail in the diagrams in col. 5, where they are drawn as seen from the rear of an inverted chassis.

The table (col. 5) gives the switch positions for the four control settings, starting from the fully anti-clockwise position of the control spindle. A dash indicates open, and **C** closed.

S15 is the internal speaker muting switch, operated by the external speaker connecting plug. The panel on which it is mounted is fitted to a rear vertical member of the cabinet.

S16, S17 are the Q.M.B. mains switches fitted on a special mounting on one side of the cabinet, beside the volume control.

Scale Lamps. — These are four Osram M.E.S. types, with small clear spherical bulbs, rated at 6.5 V, 0.3 A.

External Speaker.—Two sockets and a special plug are provided for the connection of a low-impedance (about 4Ω) external speaker. If the plug is turned a few degrees anti-clockwise from the vertical, **S15** opens and mutes the internal speaker.

Inter-chassis Connections. — All eight pins of an octal connecting plug are used to connect the power unit to the main chassis. The interconnecting points in the circuit are numbered **1** to **8** in a vertical column. On the plug, the pins are numbered 1 to 8 counting clockwise from the spigot key, as on a valve base. Two of the pins are used to connect chassis to chassis.

Gramophone Unit.—The 299RG is normally fitted with a Garrard RC72 3 speed auto-changer gramophone unit, although other types may be used owing to shortages from time to time.

The RC72 is provided with two interchangeable heads for standard and LP records. Change-over is effected simply by sliding off one and sliding on the other in grooved guides. Connection is automatic. The lighter head is for microgroove records, and is coded with a red spot on top of the needle mount. The heavier head, with a chromium headpiece, is for standard 78 R.P.M. records. This is coded with a green spot.

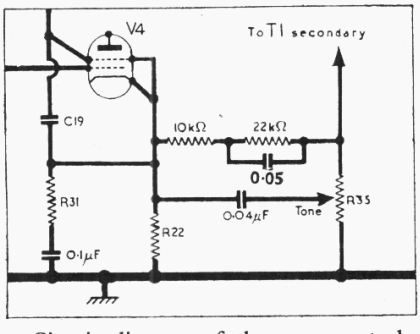
A holder is provided for the spare head, just behind the turntable on the playing deck. The auto-changer unit is mounted on the deck by four sets of bolts, washers and springs on which it floats.

MODIFICATIONS

Approximately the first 650 299RG's and the first 200 289A's were fitted with I.F. transformers like those in our sample, but later versions had adjustable iron-dust cores and fixed capacitors. One of the two resistors forming **R1** was added during production.

Table Model Modifications

Our work was carried out entirely on the radiogram model 299. The 289 table employs a modified 299 chassis in which the electrical differences are concerned only with the feed-back circuit. These differences are shown in the circuit diagram below.



Circuit diagram of the tone control feed-back system, redrawn as it is in the 289A table. Only a single tone control is provided.

DISMANTLING THE SET

Removing Chassis.—Pull off the four control knobs, with felt washers, from the panel inside the lid, and the two control knobs, with their plastic escutcheon, from the right hand side of the cabinet;

pull out the aerial, earth and pick-up plugs from their sockets on the bottom chassis flange, and disconnect the earth lead from the top left hand speaker nut;

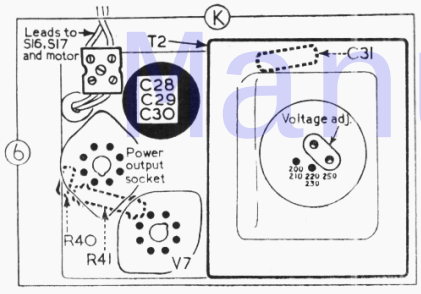
slacken the fixing screws of the two metal brackets which hold the top of the scale lamp assembly to the cabinet, and swivel them aside;

remove nut, with lock washer, securing volume control to bracket in right hand side of cabinet;

slacken the front nut and remove the rear nut holding the bracket to the cabinet, swivelling the bracket downwards and withdrawing the volume control from it;

withdraw the octal plug from the power unit;

unsolder the speaker leads from the tags on the speaker and release the external speaker panel from the rear right hand edge of cabinet by removing two wood screws;



Plan view of the power unit, as seen from the rear. Several components on the underside are indicated in broken line.

slacken four 2BA nuts holding chassis base board to cabinet and allow the chassis to drop to the full extent of the slots in the base board;

holding the chassis forward with one hand, remove the base board fixing nuts with the other, and withdraw chassis complete with base board.

To gain access to under-chassis, remove the base board, held by four 2BA bolts, which pass through the chassis flanges and the base board into two tapped metal strips.

Removing Power Unit.—Release the mains switch leads from the terminal block on top of unit;

tilting the cabinet forward, remove the four self-tapping screws, with washers, from the underside of the cabinet, and withdraw power unit.

Removing Speaker.—Loosen the four speaker clamps, swivel them to one side and lift out the speaker.

When replacing, the speech coil tags should be at the top.

In order to operate the receiver on the bench, the octal power plug should be re-connected and a temporary mains lead inserted into the terminal block on top of the power unit. It should be noted that under these conditions there is no provision for disconnecting the receiver from the mains via a switch.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those quoted by the manufacturers, and were taken while the receiver was operating on A.C. mains of 245 V, the mains adjustment being set to the appropriate tapping. There was no signal input and voltages were measured with a Model 7 Avometer, chassis being the negative connection.

Valve	Anode		Screen		Cath.
	V	mA	V	mA	V
V1 ECH35	211	1·0	52	1·5	1·3
	Oscillator				
	100	3·5			
V2 EF39	220	4·9	74	1·5	2·0
V3 EB34	—	—	—	—	—
V4 EF39	37	0·8	22	0·25	0·9
V5 EL33	280	36·0	290	4·0	39·0
V6 EL33					
V7 AZ31	300†	—	—	—	290·0

† A.C., each anode.

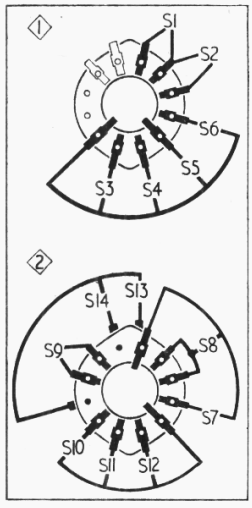
CIRCUIT ALIGNMENT

299RG.—I.F. alignment may be carried out with the chassis in the cabinet, but to gain access to all the R.F. adjustments the chassis should be removed.

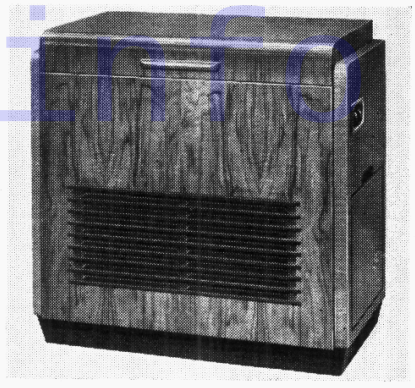
289A.—Access can be gained to all the I.F. and R.F. adjustments by removing the back and base covers.

I.F. Stages.—Remove **V1** top cap lead and connect a 500 kΩ resistor between the top cap (grid) and chassis. Connect the signal generator via a 0.01 μF capacitor in each lead, across the 500 kΩ resistor. Switch set to M.W., turn volume control and gang to maximum, feed in a 475 kc/s (631.6 m) signal and adjust **C45, C44** (location reference C2) and **C37, C36** (B2) for maximum output, reducing the input as the circuits come into line to avoid A.G.C. action. Repeat these adjustments.

Diagrams of the wave-band switch units, drawn as seen from the rear of an inverted chassis. Below the diagrams is the associated switch table.



Switch	S.W.	M.W.	L.W.	Gram.
S1	—	C	—	—
S2	C	—	—	—
S3	C	—	—	—
S4	—	C	—	—
S5	—	—	C	—
S6	—	—	—	C
S7	C	—	—	—
S8	—	C	C	—
S9	—	C	—	—
S10	C	—	—	—
S11	—	C	—	—
S12	—	—	C	—
S13	C	C	C	—
S14	—	—	—	C



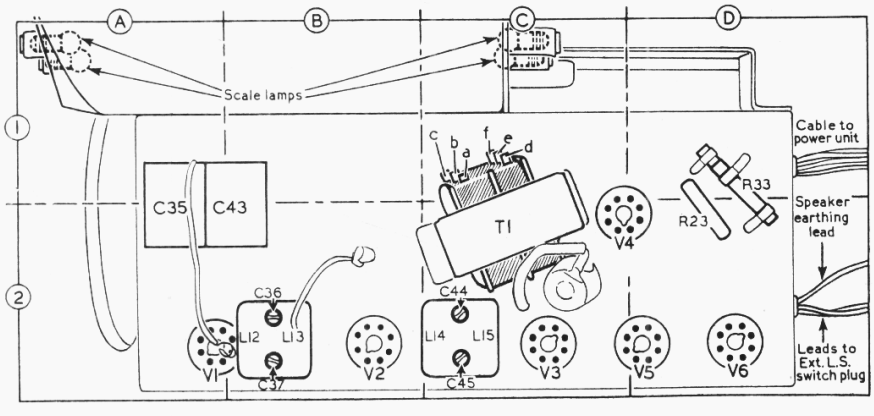
The appearance of the 299 radiogram.

R.F. and Oscillator Stages.—With the gang at maximum capacitance, the cursor should coincide with the high wavelength ends of the tuning scales. Remove the 500 kΩ resistor, re-connect **V1** top cap lead and transfer the signal generator leads, via a suitable dummy aerial, to the **A** and **E** sockets.

S.W.—Switch set to S.W., tune to 20 m on scale, feed in a 20 m (15 Mc/s) signal and adjust **C40** (H4) and **C32** (H3) for maximum output. Tune to 50 m, feed in a 50 m (6 Mc/s) signal and check calibration. If the calibration error is large, as may occur when **L7, L9** have been replaced, the position of the top turn of **L9** (J5) should be adjusted and the alignment repeated until satisfactory calibration results.

M.W.—Switch set to M.W., tune to 200 m, feed in a 200 m (1,500 kc/s) signal and adjust **C41** (H4) and **C33** (H3) for maximum output. Tune to 500 m, feed in a 500 m (600 kc/s) signal and adjust **C38** (G4) for maximum output. Repeat these adjustments.

L.W.—Switch set to L.W., tune to 800 m, feed in a 800 m (375 kc/s) signal and adjust **C42** (H4) and **C34** (H3) for maximum output. Tune to 1,875 m, feed in a 1,875 m (160 kc/s) signal and adjust **C39** (G4) for maximum output. Repeat these adjustments.



Plan view of the chassis, showing the tag coding for the **T1** connecting tags.

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