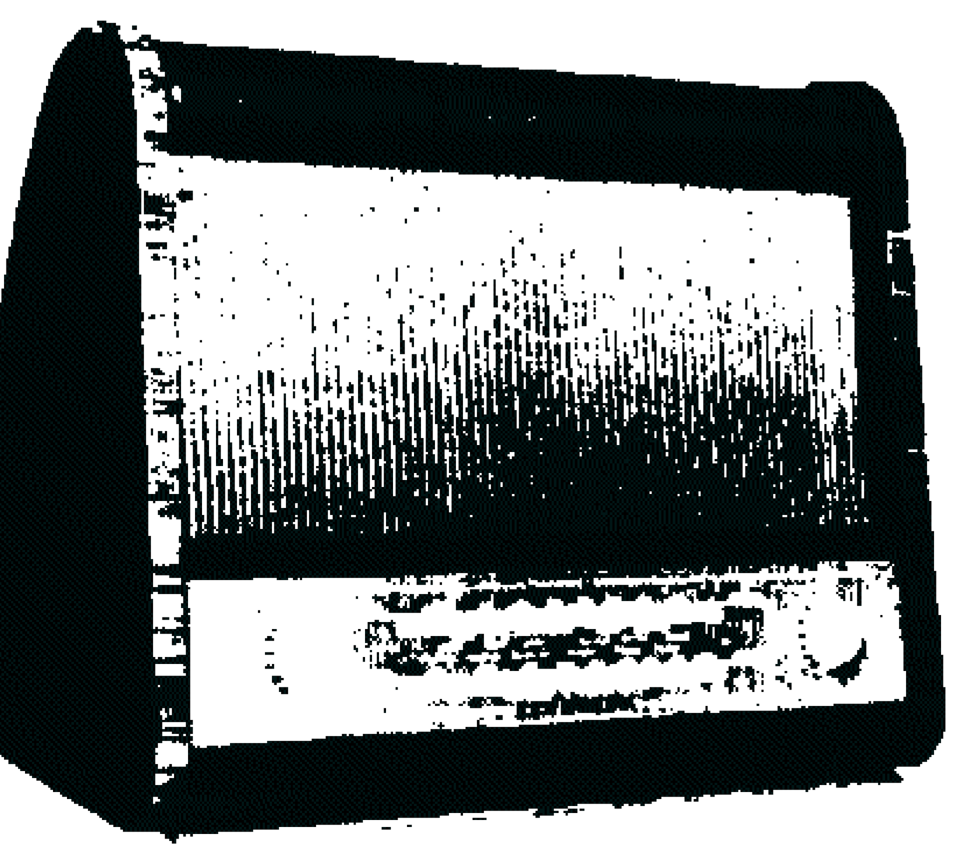
FERGUSON 353 Series

Covering Early and Late Versions of 353A and 353U Receivers



BOTH the A.C. and A.C./D.C. versions of the Ferguson 353 series are covered here, together with a full description of the differences between them and two earlier versions of the same series.

The basic A.C. receiver, model 353A, is a 3-valve (plus rectifier) 3-band superhet table model, with a frame aerial for M.W. and L.W., designed to operate from A.C. mains of 200-250V, 40-60 c/s using a double-wound transformer. The A.C./D.C. version, model 353U, is designed to operate from mains of the same range ratings. Differences between our samples and the early versions are fully explained under "Modifications" overleaf.

Release date and original price, all models: November, 1952, £16 3s 1d.

CIRCUIT DESCRIPTION

Tuned frame aerial input by **L1, C33** (M.W.) and **L1**, loading coil **L3** and **C33** (L.W.). On S.W. the tuned circuit **L4, C33** is coupled via **L2** to the frame aerial, which then acts as an untuned internal aerial, provision also being made for the connection of an external aerial via **C1. R1** is shunted across **L3** to give an increased margin of stability on L.W. In the A.C./D.C. model **C39** isolates the **E** socket from chassis which is "live" to the mains.

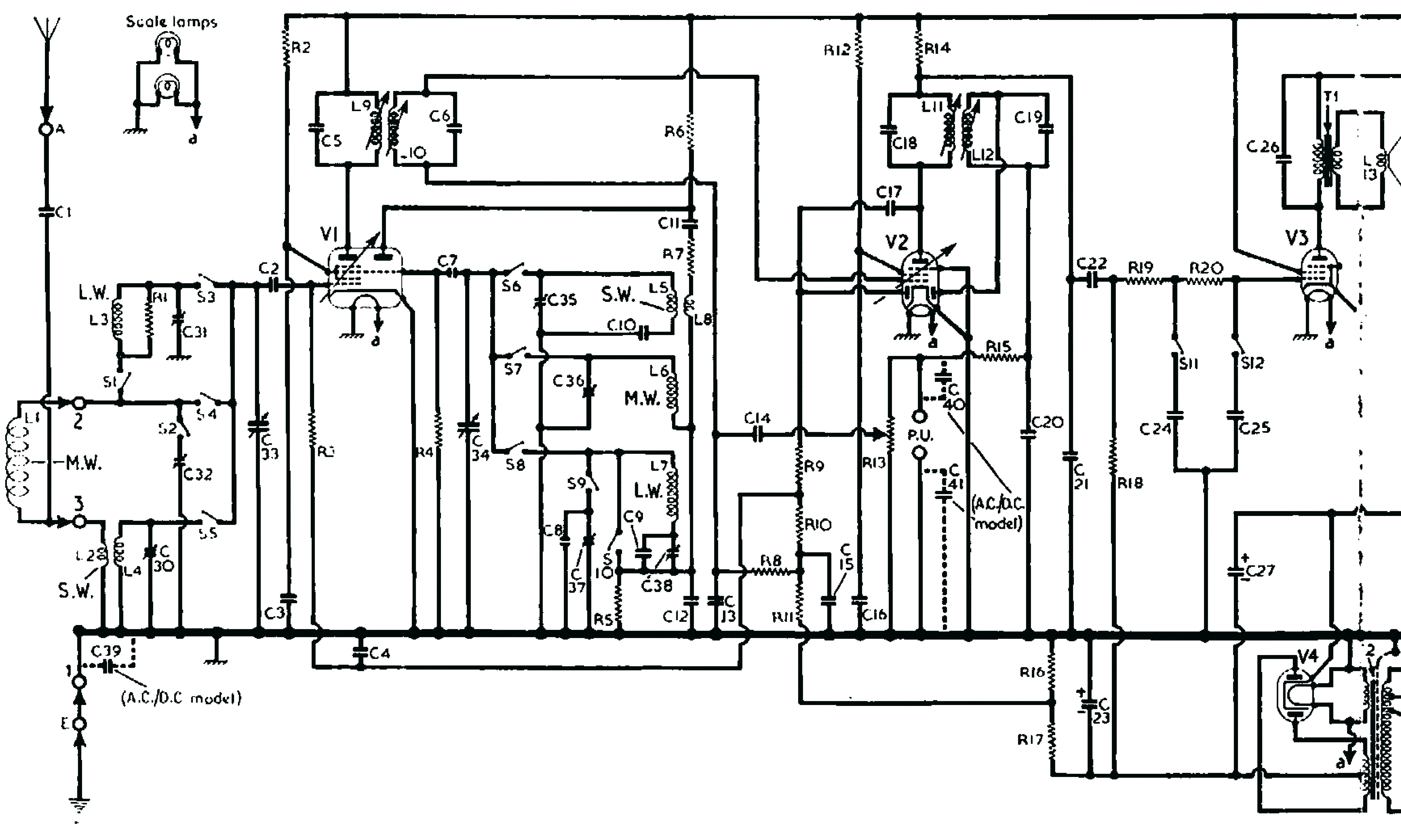
V1 (Mullard ECH42 (A.C. model) or **UCH42** (A.C./D.C. model)) is a triode hexode valve operating as frequency changer with internal coupling. Oscillator grid coils **L5** (S.W.), **L6** (M.W.) and **L7** (L.W.) are tuned by **C34.** Parallel trimming by **C35** (S.W.), **C36** (M.W.) and **C8, C37** (L.W.); series tracking by **C10** (S.W.), **C12** (M.W.) and **C9, C12, C38** (L.W.). Reaction coupling across the common impedance of tracker **C12** (M.W. and L.W.) and via **L8** (S.W.). **R5** limits the reaction coupling on M.W. and L.W. Oscillator stabilization by **R7.**

Second valve **(V2 Mullard EBF80** (A.C. model) or **UBF80** (A.C./D.C. model)) is a double diode pentode valve, its pentode section operating as a reflex I.F./A.F. amplifier with tuned transformer I.F. couplings **C5, L9, L10, C6** and **C18, L11, L12, C19.**

Intermediate frequency 470 kc/s.

First diode section of **V2** operates as signal detector, the A.F. component in its rectified output being developed across volume control **R13,** which acts as diode load, and passed via **C14** and **L10** to control grid of **V2** pentode section, which then operates as A.F. amplifier. I.F. filtering by **C13, R15, C20** and **C21.** Provision is made for the connection of a gramophone pick-up across **R13,** the pick-up sockets in the A.C./D.C. model being isolated from chassis by **C40** and **C41.**

Second diode of **V2** is fed via **C17** from **V2** pentode anode, and the resulting D.C. component is developed across load



resistors **R9, R10, R11,** which act as a potential divider, bias for **V1** and **V2** being tapped off from it to give automatic gain control.

Amplified A.F. output from **V2** is developed across audio load resistor **R14** and passed via **C22, R19** and **R20** to pentode output valve **(V3, Mullard EL41** (A.C. model) or **UL41** (A.C./D.C. model)**).** Tone correction in anode circuit by **C26.** Three-position tone control is provided by **C24, C25** and switches **S11, S12.**

In the A.C. model H.T. current is supplied by full-wave I.H.C. rectifying valve **(V4, Mullard EZ40).** Smoothing by **R21, R22** and electrolytic capacitors **C27, C28** and **C29.** A double-wound mains transformer **T2** feeds the valve heaters from a common secondary winding. Grid bias for **V3** is developed across **R16, R17** in the H.T. negative lead to chassis. A proportion of this voltage, that across **R16,** is used as delay bias for the A.G.C. diode and standing bias for **V1** and **V2** pentode section.

In the A.C./D.C. model H.T. current is supplied by half-wave I.H.C. rectifying valve **(V4, Mullard UY41).** Smoothing by **R21, R25** and electrolytic capacitors **C27, C42** and **C43.** The valve heaters, together with ballast resistor **R27,** scale lamps with shunts **R28** and **R29,** and mains R.F. filter chokes **L14, L15,** are connected in series across the mains input. **R26** protects **V4,** and **R28** the scale lamps, from current surges. Thermistor **R29 (Brimistor, CZ2)** maintains the heater circuit should the scale lamps fail, and prevents **R28** from being overloaded by the heater current.

COMPONENTS AND VALUES

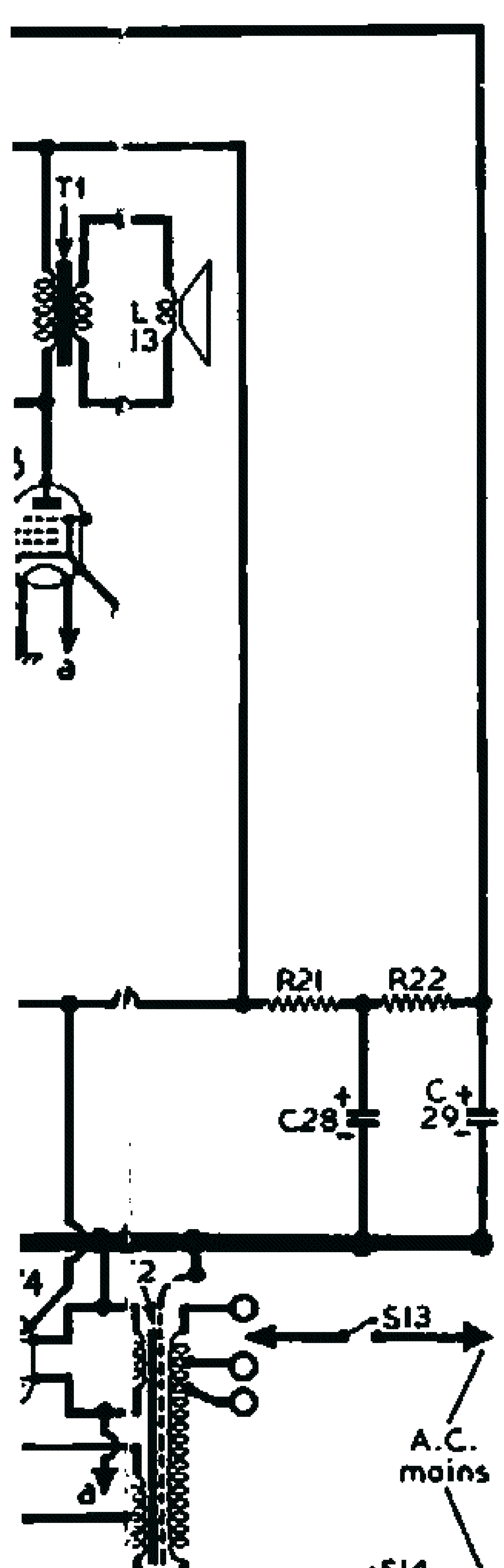
	CAPACITORS	Values	Locations
C1	Aerial coupling ...	0·001μF	—
C2	V1 C.G.	200pF	G3
C3	V1 S.G. decoupling	0·05μF	G3
C4	A.G.C. decoupling	0·02μF	G3
C5	1st I.F. trans. tuning ...	100pF	B1
C6		100pF	B1
C7	V1 osc. C.G. ...	50pF	G3
C8	L.W. osc. trim. ...	50pF	G3
C9	L.W. osc. tracker	250pF	G3
C10	S.W. osc. tracker...	¶4,550pF	F3
C11	Osc. anode coup.	100pF	F3
C12	M.W. osc. tracker	520pF	F3
C13	A.G.C. decoupling	500pF	E3
C14	A.F. coupling ...	0·01μF	D3
C15	A.G.C. decoupling	0·05μF	E4
C16	V2 S.G. decoupling	0·1μF	E4
C17	A.G.C. coupling ...	100pF	E3
C18	2nd I.F. trans. tuning ...	100pF	C1
C19		100pF	C1
C20	I.F. by-passes ...	200pF	D3
C21		0·002μF	D3
C22	A.F. coupling ...	0·01μF	E4
C23*	G.B. by-pass ...	100μF	E4
C24	Parts tone control	0·002μF	D3
C25		0·002μF	D3
C26	Tone corrector ...	‖0·002μF	B2
C27*	H.T. Smoothing ...	32μF	G4
C28*		24μF	G4
C29*		24μF	G4
C30‡	S.W. aerial trim.	70pF	A1
C31‡	L.W. aerial trim.	70pF	A1
C32‡	M.W. aerial trim.	30pF	A2
C33†	Aerial tuning ...	§528pF	A1
C34†	Oscillator tuning	§528pF	A1
C35‡	S.W. osc. trim. ...	70pF	A1
C36‡	M.W. osc. trim. ...	70pF	A1
C37‡	L.W. osc. trim. ...	70pF	A1
C38‡	L.W. osc. tracker	70pF	A2
C39	Earth isolator ...	0·005μF	—
C40	P.U. isolators ...	0·005μF	—
C41		0·05μF	—
C42*	H.T. smoothing ...	32μF	—
C43*		16μF	—
C44	Mains R.F. by-pass	0·01μF	—

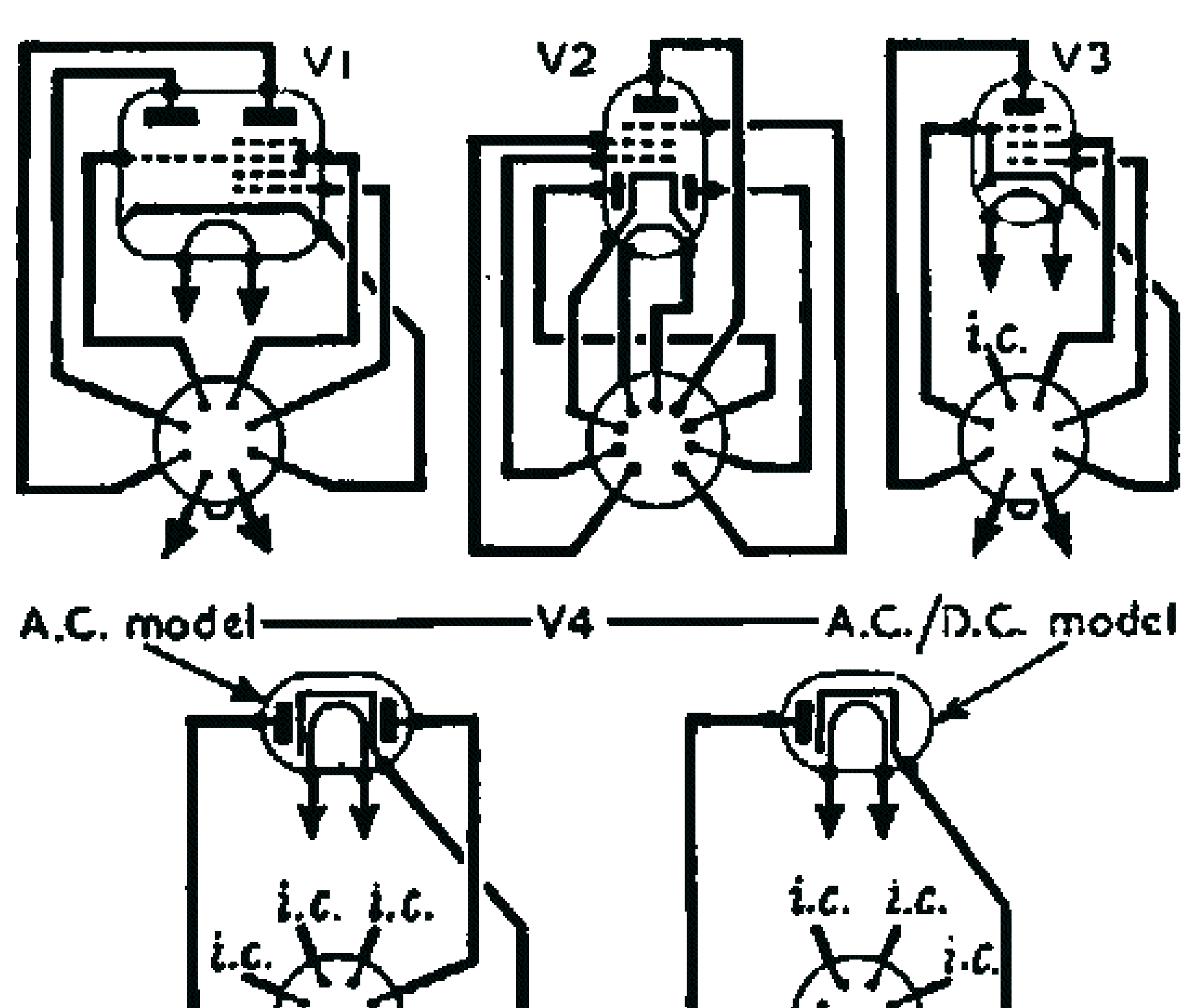
* Electrolytic.
† Variable.
‡ Pre-set.
§ " Swing " value, minimum to maximum.
¶ Two capacitors, 1,000pF and 3,550pF, in parallel.
‖ 0·005μF in A.C./D.C. model.

	RESISTORS	Values	Locations
R1	L.W. stabilizer ...	220kΩ	G3
R2	V1 S.G. feed ...	*47kΩ	E3
R3	V1 C.G.	1MΩ	G3
R4	V1 osc. C.G. ...	47kΩ	F3
R5	Osc. reaction limiter	3·9kΩ	F3
R6	Osc. anode feed ...	†27kΩ	F4
R7	Osc. stabilizer ...	220Ω	F3
R8	V2 C.G.	1MΩ	E3
R9	A.G.C. potential divider	‡270kΩ	E3
R10		§1·2MΩ	E3
R11		**47kΩ	E4
R12	V2 S.G. feed ...	‖100kΩ	E3
R13	Volume control ...	500kΩ	D3
R14	V2 A.F. load ...	10kΩ	E3
R15	I.F. stopper ...	100kΩ	E3
R16	G.B. potential divider ...	30Ω	E4
R17		82Ω	E4
R18	V3 C.G.	470kΩ	E4
R19	Parts tone control	47kΩ	E3
R20		47kΩ	E4
R21	H.T. smoothing ...	470Ω	G4
R22		820Ω	G4
R23	G.B. potential ... divider ...	33Ω	—
R24		150Ω	—
R25	H.T. smoothing ...	820Ω	—
R26	V4 surge limiter	140Ω	—
R27	Heater ballast ...	¶1,220Ω	—
R28	Scale lamp shunt ...	1·2kΩ	—
R29	Brimistor CZ2 ...	—	—

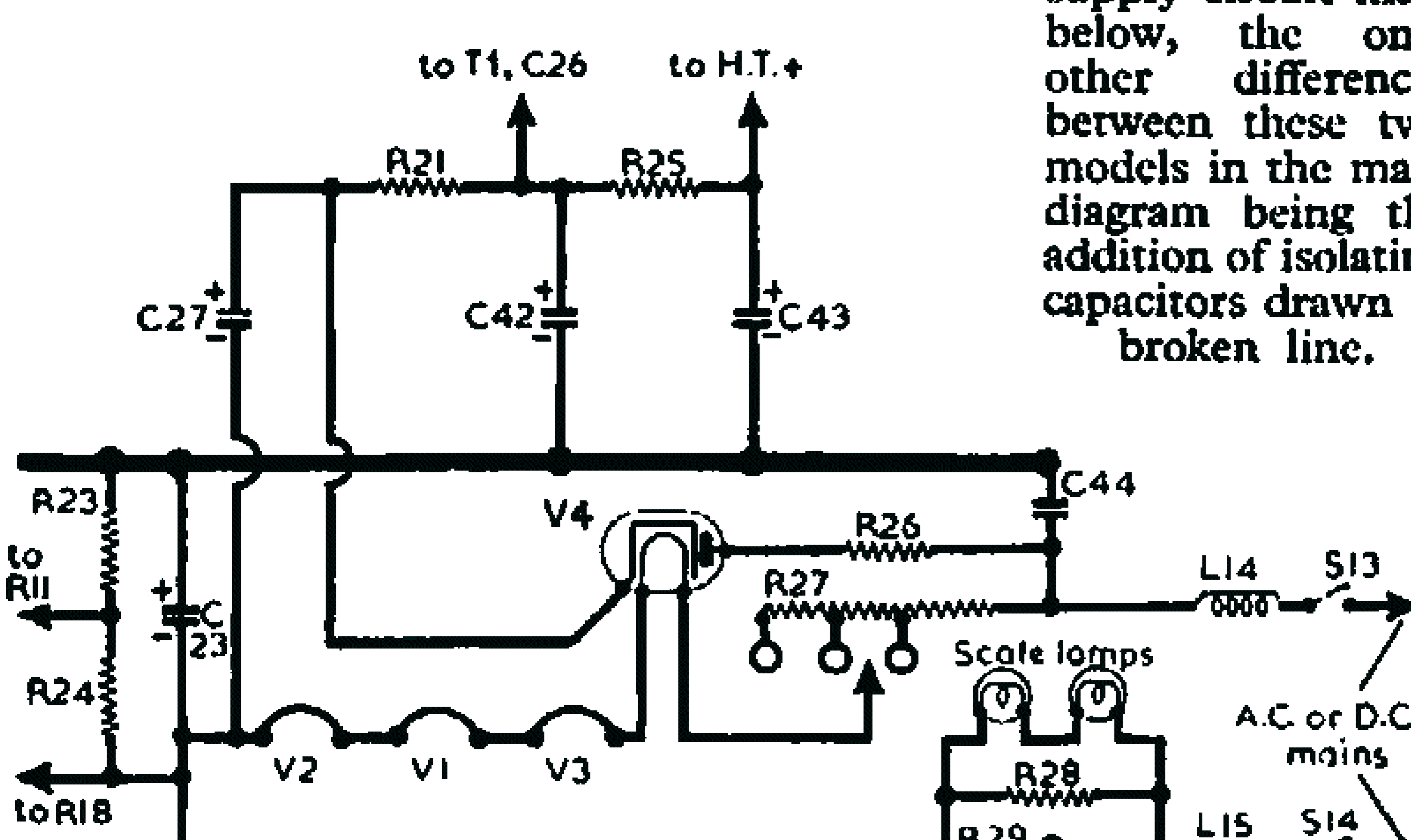
* 33kΩ, ‡ 330kΩ, ** 150kΩ } A.C./D.C. model
¶ Tapped at 820Ω + 200Ω : 200Ω from L14.
† 22kΩ, § 680 kΩ, ‖ 27kΩ } A.C./D.C model

	OTHER COMPONENTS	Approx. Value (ohms)	Locations
L1	Frame aerial ...	1·5	—
L2	S.W. aerial coup. ...	—	G3
L3	L.W. loading coil ...	15·0	G3
L4	S.W. aerial tuning	—	G3
L5	Oscillator tuning coils	—	F3
L6		2·7	G4
L7		12·0	G4
L8	S.W. osc. reaction ...	—	F3
L9	1st I.F. trans. Pri.	8·0	B1
L10	Sec.	8·0	B1
L11	2nd I.F. trans. Pri.	8·0	C1
L12	Sec.	6·0	C1
L13	Speech coil ...	2·5	—
L14	R.F. filter chokes	3·5	—
L15		3·5	—
T1	O.P. trans. Pri. ...	480·0	B1
	Sec. ...	—	
T2	Mains trans. Pri., total	41·0	C2
	H.T. sec., total ...	550·0	
	Htr. sec. ...	—	
S1-S10	Waveband switches		G3
S11, S12	Tone control sw. ...	—	D3
S13, S14	Mains sw., g'd R13	—	D3





Circuit diagram of the Ferguson Model 353A. The A.C./D.C. version, Model 353U, is covered by the additional power supply circuit inset below, the only other differences between these two models in the main diagram being the addition of isolating capacitors drawn in broken line.



GENERAL NOTES

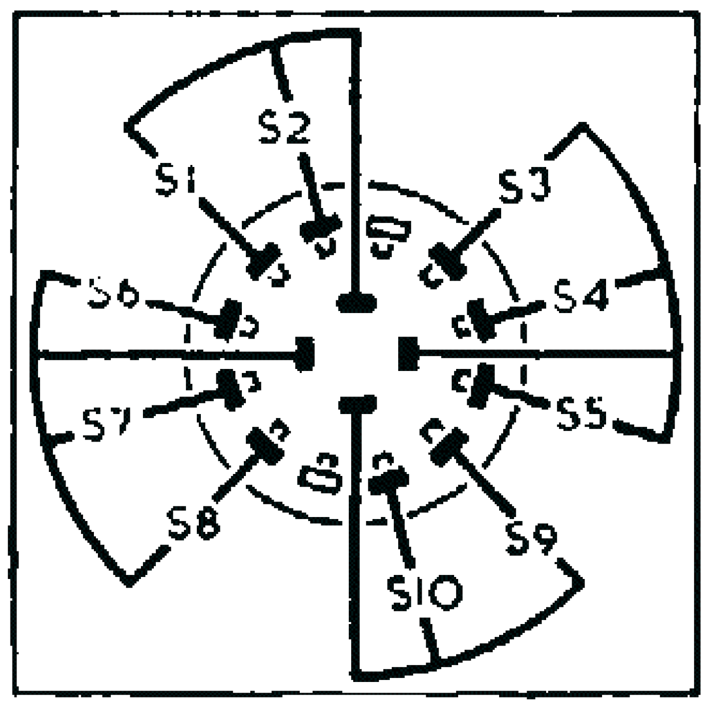
Switches.—S1-S10 are the waveband switches, ganged in a single 3-position rotary unit beneath the chassis. The unit is indicated in our underside view of the chassis, and is shown in detail in the diagram in col. 1 overleaf, where it is drawn as seen when viewed from the rear of an inverted chassis.

The table beside it gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control spindle. A dash indicates open, and **C,** closed.

S11, S12 are the tone control switches, in a 3-position unit beneath the chassis. This is indicated in our underside view of the chassis, and shown again in the diagram in col. 3 overleaf, where it is viewed in the same direction as seen in the chassis drawing.

Scale Lamps.—These are two M.E.S. type lamps, with small clear spherical bulbs. In the A.C. version they are rated at 6.3 V, 0.3 A, and the A.C./D.C. version they are rated at 8 V, 0.15 A. They are in plastic holders which can be withdrawn from their flat mounting lugs without removing the chassis.

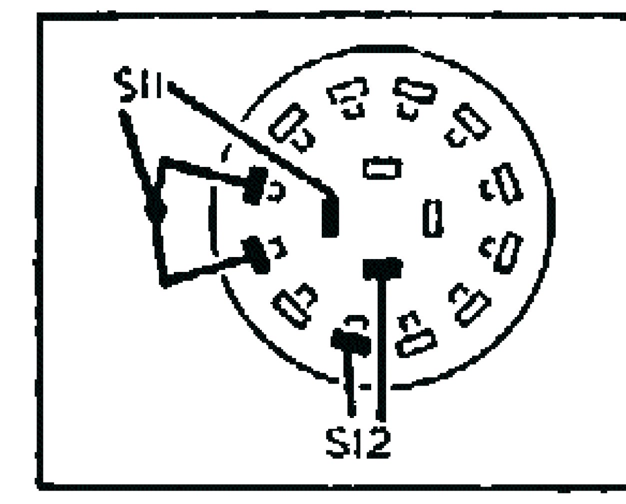
Waveband Switch Diagram and Table



Waveband switches, drawn as seen from the rear of an inverted chassis. On the right is the associated table.

Switches	S.W.	M.W.	L.W.
S1	—	—	C
S2	—	C	C
S3	—	—	C
S4	—	C	—
S5	C	—	—
S6	C	—	—
S7	—	C	—
S8	—	—	C
S9	—	—	C
S10	—	C	—

Tone control switches, drawn as indicated in the under-chassis view.



VALVE ANALYSIS

Valve voltages and currents given in the tables below are those derived from the manufacturers' information and were measured with the receivers operating from 230 V A.C. mains, the voltage adjustments being set to the 220-230 V tappings. The receivers were tuned to a point at the high wavelength end of the M.W. scale where there was no signal pick-up. Measurements made on early production models were slightly higher than those quoted in our tables.

Voltages were measured on the 10 V and 400 V ranges of a Model 7 Avometer, chassis being the negative connection in every case. In the A.C. model, the voltage across **C27** was 243 V, across **C28** it was 234 V and across **R16**, **R17** it was 5.7 V. In the A.C./D.C. model the voltage across **C27** was 190 V, across **C42** was 166 V and across **R23**, **R24** it was 9.5 V.

A.C. Model

Valve	Anode V	Anode mA	Screen V	Screen mA
V1 ECH42	220 Oscillator 72	2·4 5·5	70	2·9
V2 EBF80	175	4·2	60	1·6
V3 EL41	228	26·5	220	3·8
V4 EZ40	240*	—	—	—

* A.C. reading, each anode.

A.C./D.C. Model

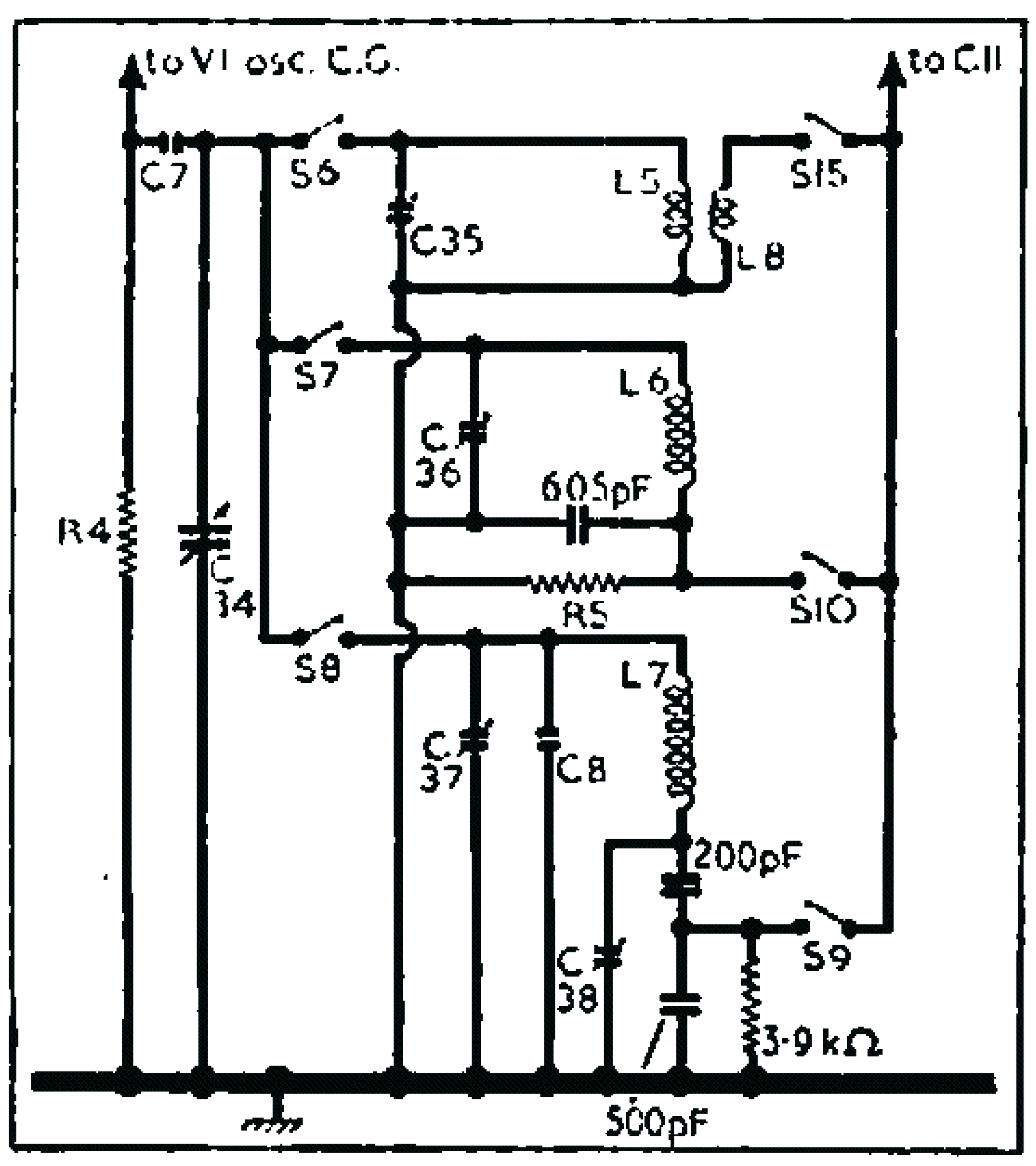
Valve	Anode V	Anode mA	Screen V	Screen mA
V1 UCH42	150 Oscillator 70	2·6 3·1	60	2·8
V2 UBF80	83	6·0	85	2·5
V3 UL41	155	29·0	150	6·0
V4 UY41	222*	—	—	—

* A.C. reading.

MODIFICATIONS

There are two versions of the 353 series, an early production version and a late production version. This *Service Sheet* was prepared from two samples of the late version, and our information is presented as it was in those samples, one A.C., and the other A.C./D.C.

Our circuit diagram is based on the A.C. version, but differences in the A.C./D.C. version are shown in the diagram by additional items connected by broken lines, and outside it by a separate section diagram of the A.C./D.C. power supply circuit. Where component values



Oscillator circuit of the early version receiver, showing the differences between this and the late version described under " Modifications."

differ between the A.C. and A.C./D.C. models, these are indicated in the component tables. One difference that may be found in all versions is the omission of **R1**.

Early Version.—Differences between our sample and the earlier production version are numerous, and the oscillator circuit is quite different. A diagram of the earlier oscillator circuit is shown above, where the component values that are different from ours are shown. **C10** was omitted, and so was **R7**, and **R6** was 22 kΩ. The control grid and anode sections were physically transposed on the waveband switch wafer as compared with our switch diagram.

There were a few differences in the aerial circuit. **C1**, which is now 0.001 μF, was 15 pF, and it went to the top of **L1** instead of the bottom, so that the external aerial could be used on M.W. and L.W. **R1** was omitted, and **C32** was permanently connected to the top of **L1**. **C31** was then a fixed 47 pF capacitor, and its position in our plan view was then occupied by **C32**, which in our sample was a single unit, not part of an assembly. **C32** was 70 pF. **L2**, **L3**, **L4** were mounted on the chassis deck.

In the A.F. circuits, **C40** was included in both A.C. and A.C./D.C. versions, and **C26** was 0.005 μF. The tone control circuit was omitted from **V3** control grid circuit and was connected across **C26**, but the switch then became a single-pole 3-position unit, and it shunted a 0.01 μF or a 0.005 μF, or neither, across **T1** primary. **R19** and **R20** were then a single 100 kΩ grid stopper.

Chassis of the early production can be recognized by the presence of the aerial coils **L2**, **L3**, **L4** in the chassis deck, a 2-pin frame aerial plug and an **E** socket lead soldered to a chassis tag. The late production chassis can be recognized by the absence of tuning coils on the chassis deck, the presence of the lono trimmer **C32** mounted vertically on the deck, and the use of a 3-pin frame aerial plug.

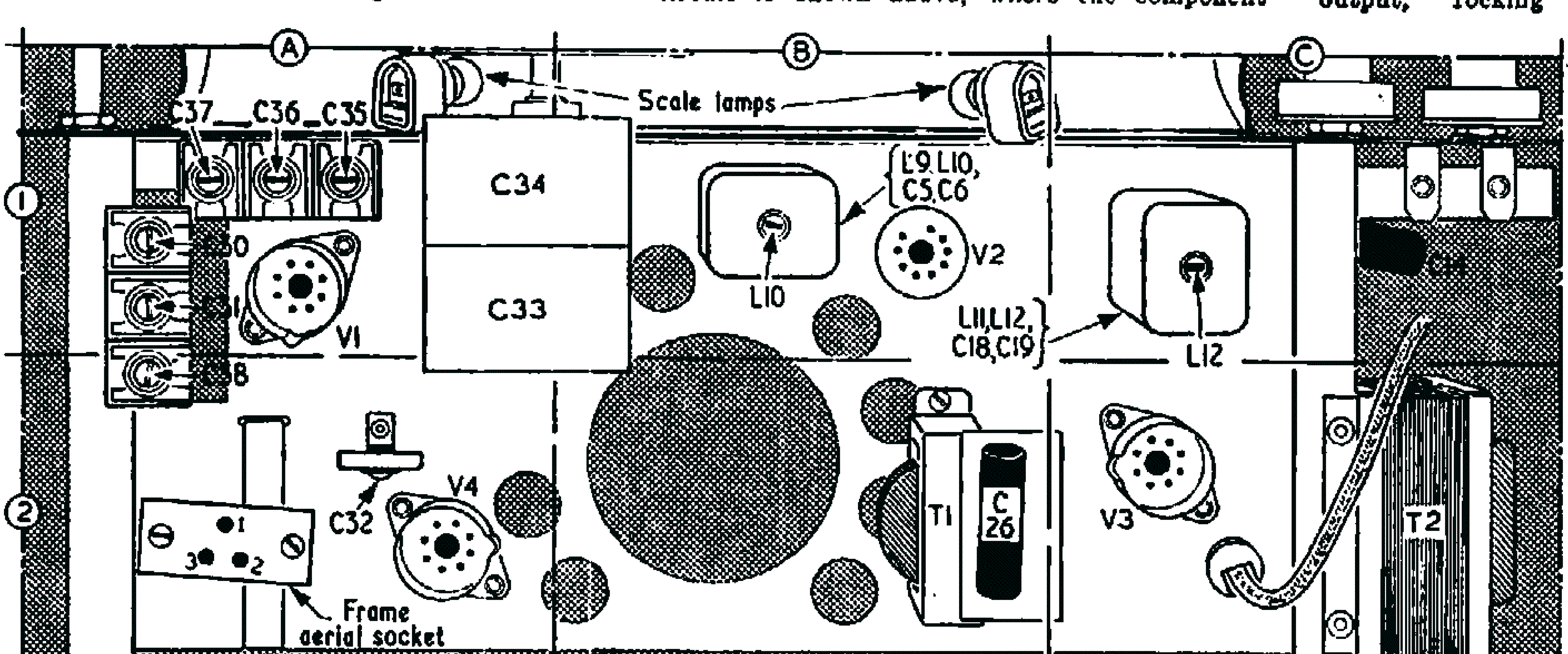
CIRCUIT ALIGNMENT

I.F. Stages.—Remove chassis from cabinet and stand it on the bench with the frame aerial connected. Switch set to M.W. and turn gang and volume control to maximum. Connect output of signal generator, via an 0.1 μF capacitor in each lead, to the junction of **C33** and **C2**, and to chassis. Feed in a 470 kc/s (638.3 m) signal and adjust the cores of **L12** (location reference C1), **L11** (E3), **L10** (B1) and **L9** (F3) for maximum output, reducing the input as the circuits come into line to avoid A.G.C. action. Repeat these adjustments until no further improvement results.

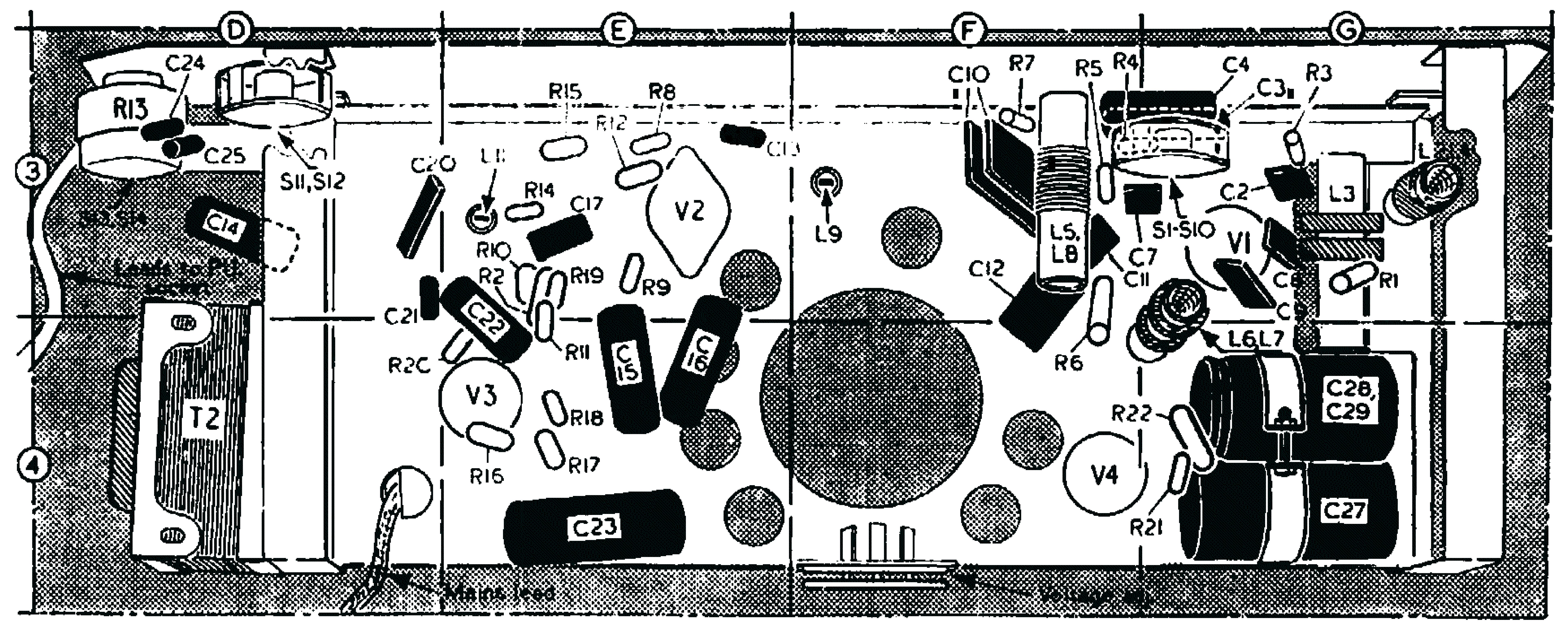
Late Production Models

R.F. and Oscillator Stages.—Replace chassis in cabinet, leaving the back open to give access to the trimmers but keeping the frame aerial connected. Disconnect signal generator leads and lay them near the frame aerial. The alignment points given in the following instructions are indicated by calibration marks above the clear sections of the tuning scale. Check that with the gang at maximum capacitance the cursor coincides with the vertical marks at the high wavelength ends of the tuning scales.

S.W.—Switch receiver to S.W., tune to 17 Mc/s, feed in a 17 Mc/s (17.65 m) signal and adjust **C35** (A1) and **C30** (A1) for maximum output, "rocking" the gang while adjusting



Plan view of chassis, showing the vertically mounted trimmer **C32** which in the early version models takes the place where we show **C31**, this trimmer being replaced by a fixed capacitor. The frame aerial socket is a 2-pin type in the early versions.



Under-chassis view of receiver. The arrows pointing to the tone control and waveband switches indicate the directions in which they are viewed in the diagrams in cols. 1 and 3.

the latter for optimum results. Repeat these adjustments until no further improvement results.

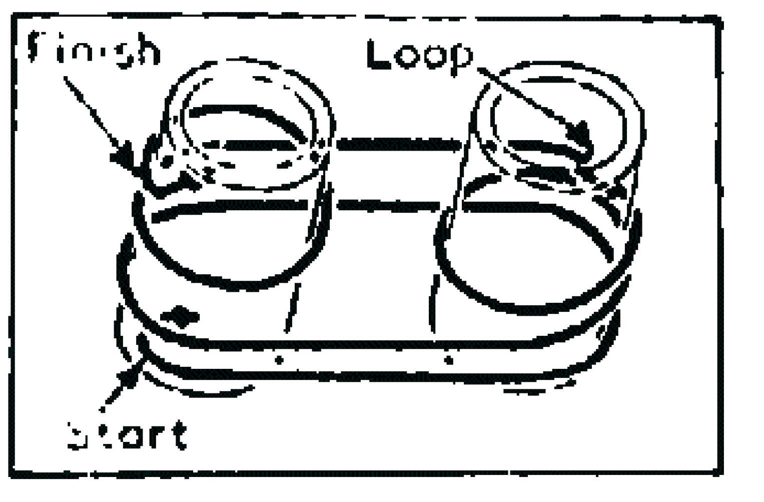
M.W. Oscillator.—Switch receiver to M.W., tune to 200 m, feed in a 200 m (1,500 kc/s) signal and adjust **C36 (A1)** for maximum output.

L.W.—Switch receiver to L.W., tune to 857 m, feed in an 857 m (350 kc/s) signal and adjust **C37 (A1)** and **C31 (A1)** for maximum output. Tune receiver to 1,875 m, feed in a 1,875 m (160 kc/s) signal and adjust **C38 (A2)** for maximum output, while "rocking" the gang for optimum results. Repeat these adjustments until no further improvement results.

M.W. Aerial.—Replace cabinet back cover and lay the signal generator leads near the frame aerial. Switch receiver to M.W., tune to 200 m, feed in a 200 m (1,500 kc/s) signal and adjust **C32 (A2)**, through the hole provided in the back cover, for maximum output.

Early Production Models

R.F. and Oscillator Stages.—As calibration marks are not printed on the tuning scale in these models, it will be found difficult to set the cursor accurately for the L.W. trimming and tracking points (on S.W. and M.W. these points coincide with scale divisions), and to facilitate this operation, a substitute tuning scale should be made up in the following way. Measure off on a strip of paper two calibration marks, the first at 1 5/16in. and the second at 7⅛in from the right-hand edge of the paper. These points represent the cursor settings for L.W. tracking and trimming respectively, and the paper should be held up to the tuning scale with its right-hand edge lined up with the high wavelength ends of the tuning scales.



Sketch of volume control drive cord system, as seen from front of chassis.

After completing the I.F. stage alignment, replace chassis in cabinet. Disconnect signal generator leads and lay them near the frame aerial. Check that with the gang at maximum capacitance the cursor coincides with the high wavelength ends of the tuning scales.

S.W. and M.W.—Alignment on these bands should be carried out as described for the late production models, but when adjusting the aerial circuit on M.W., the cabinet back must be unfastened at the top to give access to trimmer **C32** which is part of the trimmer bank in location A1, and takes the place of **C31**.

L.W.—Switch receiver to L.W., tune to tracking point on substitute scale, feed in a 1,875 m (160 kc/s) signal and adjust **C38 (A2)** for maximum output. Tune receiver to trimming point on substitute scale, feed in an 857 m (350 kc/s) signal and adjust **C37 (A1)** for maximum output, while rocking the gang for optimum results.

DRIVE CORD REPLACEMENT

Tuning Drive.—This is unusual, in that there is a two-to-one step-up drive on the cursor section of the cord, devised by means of an anchored loop to which the cursor is attached. Altogether, about five feet of high-grade flax fishing line, plaited and waxed, is required, and it is divided into three lengths.

First make the cursor loop. This consists of a cord with a small loop at each end, measuring 13¼in overall. The two loops are slipped over the anchor stud and preferably pulled up tight so that they won't slip off. The large loop so formed is identified as the cursor loop in the accompanying sketch, which shows the complete system as seen from the front with the gang at maximum.

Next make up the cord **L**. For this take about 20in of cord and tie the left-hand eyelet **L** to one end of it, but doing so while the anchored loop lies in the eyelet groove, so that not only the eyelet but the loop also is included. At the remote end of cord **L** make a small loop for anchoring, so that the overall length of cord **L** is 18¼in. Then hook the end loop to the tension spring and run the cord as shown in the sketch.

Now take about 26in of cord for cord **R**, and tie one end to eyelet **R**, again including the cursor loop. Make a small loop at the far end big enough to take a 4BA screw, so that the overall length is 23¼in. The cord system is now completely made up, and cord **R** is run as shown in the sketch, pulling against the gang stop all the way, until the end loop is anchored to the boss screw in the gang drum, as shown. The tension can be eased while fixing this end by slipping the spring off its anchor temporarily.

The cursor should be fitted afterwards, and is adjusted as described under "Circuit Alignment."

Volume Control Drive.—The volume control is offset from its control knob by about an inch and a half, and the drive is transferred to it by cord of the same type as is used for the tuning drive. Two feet of cord is ample.

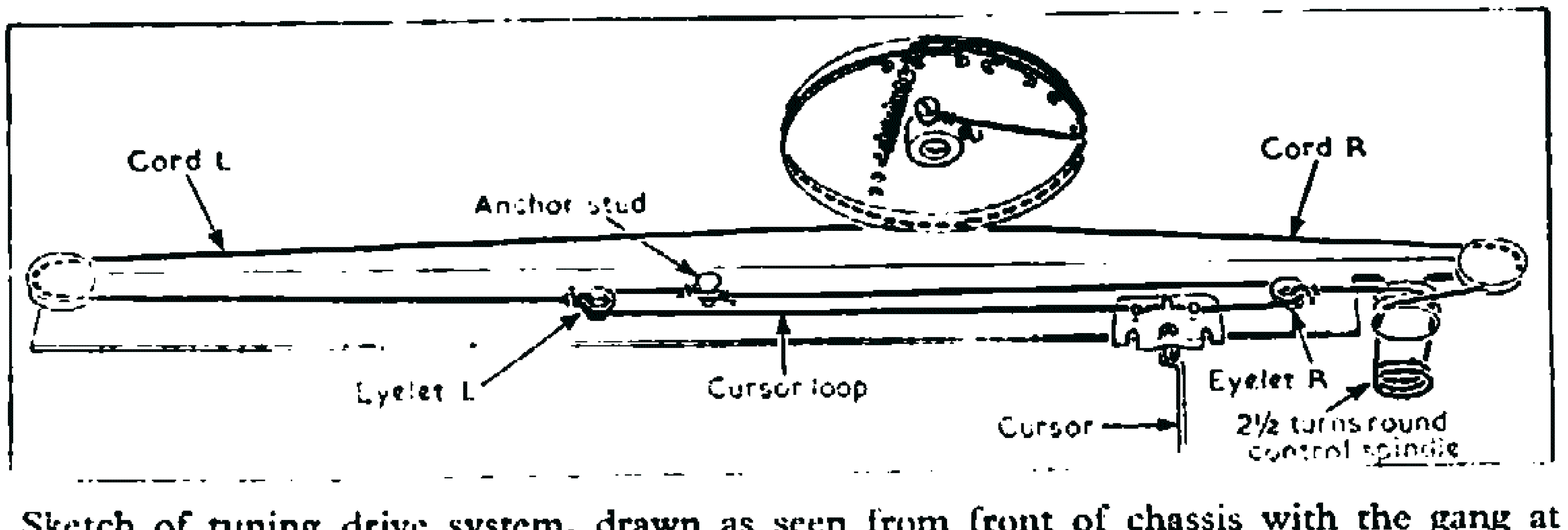
The cord is run as shown in the accompanying sketch (col. 4) where it is drawn as seen from the front with the mains switch in the "off" position, starting and finishing as indicated by tying knots in the cord, but the full procedure is complicated by the necessity of moving the volume control to obtain tension.

First slacken the volume control fixing nut under the left-hand drum, using a thin spanner of 3/16in between flats, and slide the volume control along towards the right-hand drum as far as it will go, and tighten up nut lightly.

Run the cord as shown, anchoring it to the drums by means of the slots, and make it as tight as possible. Then slacken the fixing nut again and pull the volume control as far as possible away from the right-hand drum, working the control backwards and forwards to allow the slack to be taken up, and tighten up the nut again with the cord in firm tension. A touch of Durofix on the knots will prevent them from slipping.

DISMANTLING

Removing Chassis. Remove back cover and unplug frame aerial lead (on Early Versions unsolder chassis lead from **E** socket);
unsolder leads from speech coil tags on speaker;
remove two wood screws securing P.U. socket panel to side of cabinet;
remove four self-tapping screws and large washers securing chassis to cabinet (in the A.C./D.C. model the screw heads are covered by cardboard insulating caps which must first be prised off);
withdraw chassis complete with knobs.



Sketch of tuning drive system, drawn as seen from front of chassis with the gang at maximum capacitance. There are three cords in the system, one of which, the cursor loop, is tied to an anchor stud to effect a two-to-one step-up in cursor movement.

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