

FERGUSON 207

COVERING A.C. and A.C./D.C. VERSIONS

CIRCUIT DESCRIPTION

THREE versions are made of the Ferguson 207: the 207A, for A.C. mains only of 200-250 V; the 207L for A.C. mains only of 100-250 V; and the 207U, for A.C. or D.C. mains of 200-250 V. All versions are suitable for mains frequencies of 50-100 c/s.

The difference between the two A.C. versions is confined to the mains transformer primary, but either A.C. version can be converted to an A.C./D.C. version by replacing the power unit and valves and rewiring the heaters. The two power units are shown separately in our circuit diagram, where seven leads on each show clearly how either may be connected to the main chassis. In either case the chassis is "live" to the mains.

The 207 is a 4-valve (plus rectifier) 3-band superhet. with provision for two pre-set M.W. stations in the fourth and fifth positions (PS2 and PS1) of the waveband switch. The ranges are 16.55 m, 197-577.5 m, and 690-2015 m.

Release date, all models, October, 1947. Original prices: 207A, 207U, £24 plus purchase tax; 207L is available only for export.

Aerial input is via series capacitor C1 and coupling coils L1 (S.W.), L2 (M.W.) and L3 (L.W.) to single-tuned circuits L4, C29 (S.W.), L5, C29 (M.W.) and L6, C29 (L.W.). For pre-set tuning in the aerial circuit on M.W., C34 is replaced by pre-set trimmer type capacitors C32 and C33, selected by switches S9, S10 at the fourth and fifth positions of the waveband switch.

First valve (V1, Mullard metallized ECH 35) is a triode-hexode operating as frequency changer with internal coupling. For manual operation triode oscillator anode coils L9 (S.W.), L10 (M.W.) and L11 (L.W.) are tuned by C39. Parallel trimming by C38 (S.W.), C35 (M.W.) and C36 (L.W.); series tracking by C9 (S.W.), C10 (M.W.) and C11, C37 (L.W.). Reaction coupling to grid circuit is obtained from C11 on L.W., reaction coil L8 on M.W., and from L7 and C9 on S.W.

For pre-set tuning all the foregoing circuits are disconnected and replaced by one of the iron-dust cored pre-set coils L14, L15, which are tuned by C12 and selected by S25, S26. Reaction coupling is then by L12 or L13 via S15, S16.

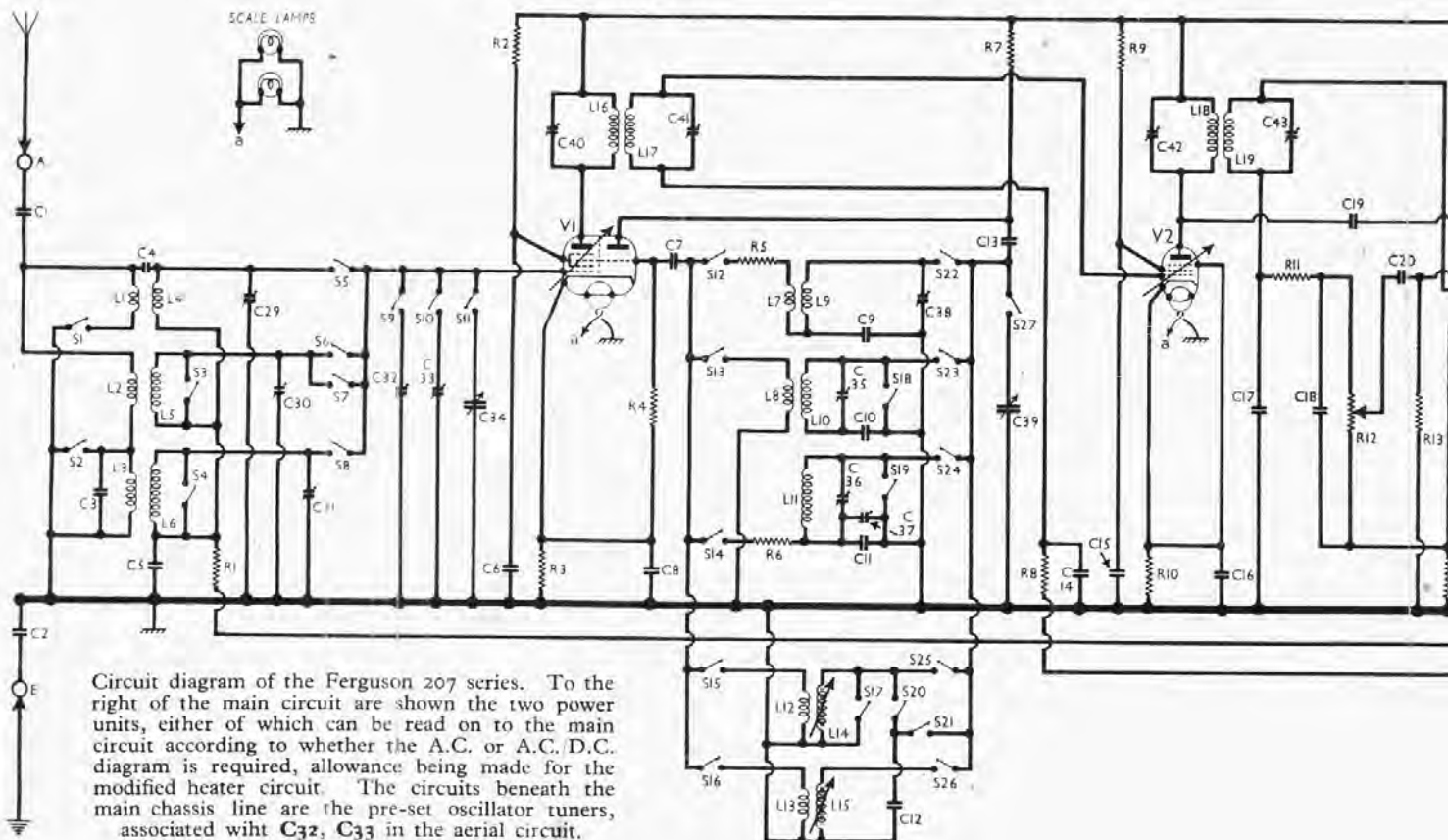
Second valve (V2, Mullard metallized EF39) is a variable-mu R.F. pentode operating as intermediate frequency amplifier with transformer couplings.

Intermediate frequency 470 kc/s.

Diode second detector is part of double diode triode valve (V3, Mullard metallized EBC33). Audio-frequency component in rectified output is developed across manual volume control R12, which is also the diode load resistor, and passed via A.F. coupling capacitor C20 to C.G. of triode section, which operates as A.F. amplifier. I.F. filtering by C17, R11 and C18 in diode circuit, and C21 in triode anode circuit.

Second diode of V3, fed from V2 anode via C19, provides D.C. potentials, which are developed across load resistors R17, R18 and fed back via decoupling circuits as G.B. to F.C. and I.F. valves, giving A.V.C.

Resistance-capacitance coupling by R16, C22 and R19, via grid stopper R21, between triode and pentode output valve (V4, Mullard EL33). Variable tone control in C.G. circuit by C23, R20, and fixed tone correction by C24 in anode circuit.





The appearance of the Ferguson 207 receivers.

Power Supplies

In the A.C. version, H.T. current is supplied by half-wave rectifier (V5, Mullard AZ31) operating with its anodes strapped in parallel, from the extended primary of the heater transformer T2, which forms an auto-transformer. Smoothing by resistor R23 and electrolytic capacitors C27 and C26. The H.T. feed to V3 triode anode via R15 is decoupled by C44. R.F. filtering by C45 in the H.T. circuit and C46 in the mains input circuit. The valve heater chain, scale lamps, V6 heater and the current regulating barretter (Atlas 150/A4) in series are connected across the mains input.

In the A.C./D.C. version, the A.C. power unit, shown in our diagram slightly spaced from the main receiver circuit, is replaced by the A.C./D.C. power unit, shown beyond it. The seven leads terminated in arrow-heads replace those of the A.C. unit, and the valve heaters are rewired to form a series chain as shown beneath the circuit.

H.T. current is supplied by L.H.C. half-

wave rectifying valve (V6, Mullard CY31) which, with D.C. mains, behaves as a low resistance. Smoothing by iron-cored choke L21 and electrolytic capacitors C27 and C26. The H.T. feed to V3 triode anode via R15 is decoupled by C44. R.F. filtering by C45 in the H.T. circuit and C46 in the mains input circuit. The valve heater chain, scale lamps, V6 heater and the current regulating barretter (Atlas 150/A4) in series are connected across the mains input.

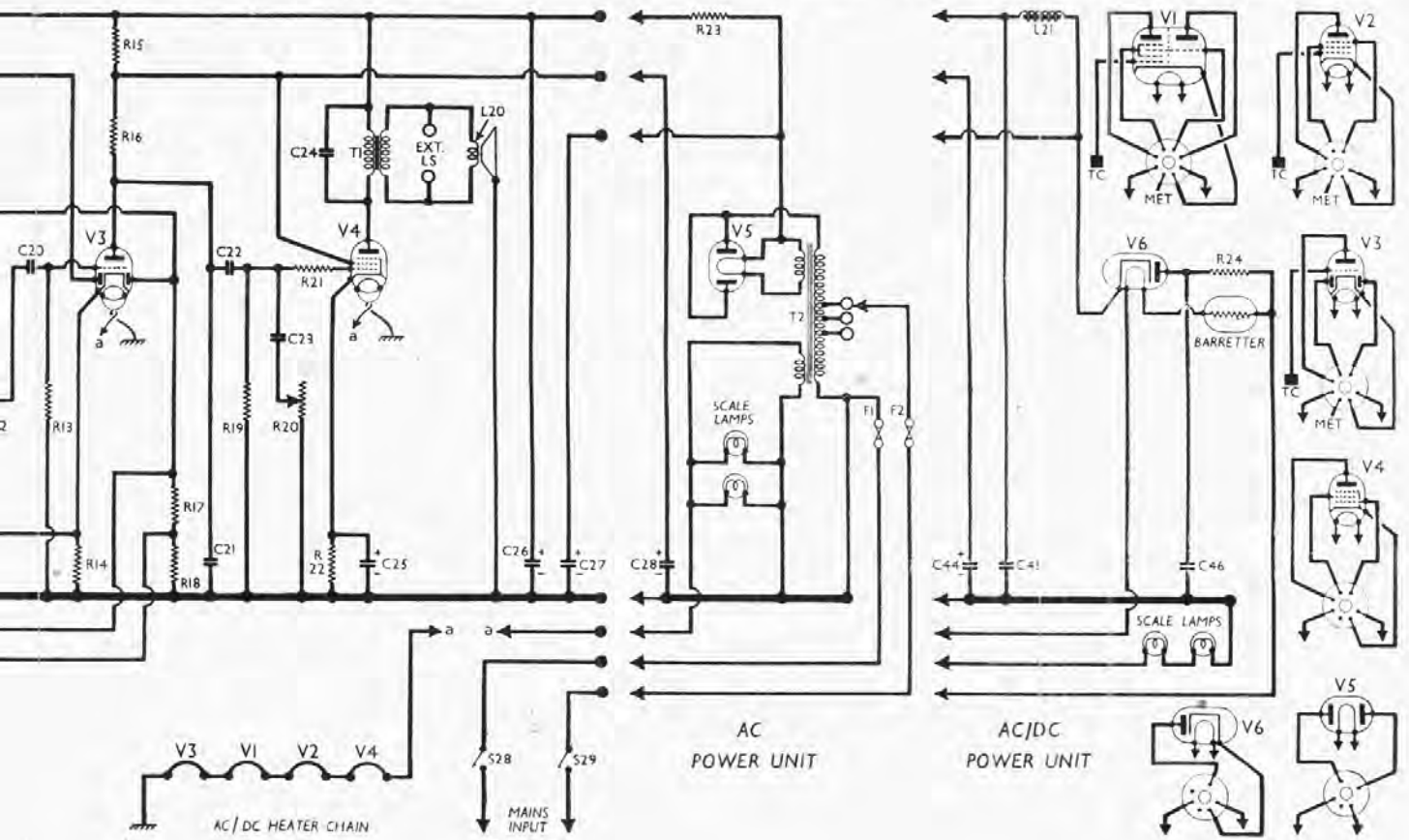
COMPONENTS AND VALUES

RESISTORS		Values (ohms)	Location
R1	V1 hex. C.G. decoup.	1,000,000	H7
R2	V1 S.G. feed	100,000	J8
R3	V1 fixed G.B.	500	K8
R4	V1 osc. C.G.	50,000	K8
R5	Osc. S.W. stab.	30	J7
R6	Osc. L.W. stab.	8,200	I6
R7	Osc. H.T. stab.	25,000	J8
R8	V2 C.G. decoup.	1,000,000	H7
R9	V2 S.G. feed	100,000	H7
R10	V2 fixed G.B.	500	H8
R11	I.F. stopper	100,000	G7
R12	Volume control	500,000	D3
R13	V3 C.G. resistor	2,000,000	G7
R14	V3 G.B., A.V.C. delay	3,000	G7
R15	H.T. feed resistor	10,000	E6
R16	V3 triode load	250,000	F7
R17	A.V.C. diode load	680,000	H7
R18	resistors	680,000	H7
R19	V4 C.G. resistor	680,000	F7
R20	Tone control	100,000	E7
R21	V4 C.G. stopper	5,000	F7
R22	V4 G.B. resistor	150	F7
R23	H.T. smoothing	1,200	C1
R24	V6 surge limiter	100	—

CAPACITORS

	Values (μF)	Location
C1	Aerial series	0.00025 K6
C2	Earth isolator	0.005 L7
C3	Aerial L.W. shunt	0.0001 K6
C4	Aerial S.W. coup.	0.000005 K6
C5	V1 hex. C.G. decoup.	0.05 K9
C6	V1 S.G. decoupling	0.1 J1
C7	V1 osc. C.G.	0.0001 J7
C8	V1 cath. by-pass	0.1 K7
C9	Osc. S.W. tracker	0.005 J6
C10	Osc. M.W. tracker	0.000515 I6
C11	Osc. L.W. tracker	0.0001 L5
C12	Osc. P.S. tuning	0.00025 J7
C13	Osc. anode coup.	0.0001 J7
C14	V2 C.G. decoup.	0.05 H7
C15	V2 S.G. decoup.	0.1 H7
C16	V2 cath. by-pass	0.1 L8
C17	I.F. by-pass cap.	0.0001 G7
C18	capacitors	0.0001 G7
C19	A.V.C. coupling	0.0001 G8
C20	A.F. coupling	0.02 F7
C21	I.F. by-pass	0.0001 F8
C22	A.F. coupling	0.02 F7
C23	Tone control	0.005 F8
C24	Tone corrector	0.002
C25*	V4 cath. by-pass	25.0 F6
C26*	H.T. smoothing	16.0 F5
C27*	capacitors	16.0 F5
C28*	H.T. feed decoup.	4.0 G6
C29†	Aerial S.W. trim	0.00005 K5
C30†	Aerial M.W. trim	0.00005 K5
C31†	Aerial L.W. trim	0.00005 J5
C32†	Aerial P.S.2 tune	0.00015 K8
C33†	Aerial P.S.1 tune	0.0004 K8
C34†	Aerial tuning	0.000483§ A3
C35†	Osc. M.W. trim	0.00005 J5
C36†	Osc. L.W. trim	0.00005 L5
C37†	Osc. L.W. track	0.00003 B2
C38†	Osc. S.W. trim	0.00005 J5
C39†	Oscillator tuning	0.000483§ A3
C40†	1st I.F. transformer f	0.00018 C4
C41†	tuning	0.00018 C4
C42†	2nd I.F. transformer f	0.00018 C4
C43†	tuning	0.00018 D4
C44*	H.T. feed decoup.	4.0
C45	H.T. R.F. by-pass	0.1
C46	Mains R.F. by-pass	0.01

* Electrolytic. † Variable. ‡ Pre-set. § "Swing" value, minimum to maximum.



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Waveband Switch Unit Diagrams and Table

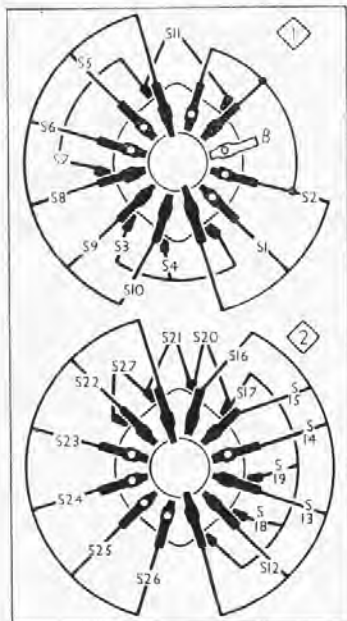
OTHER COMPONENTS		Approx. Values—(ohms)	Designations	
L1	Aerial coupling coils	2.2	K0	
L2		17.5	K0	
L3		20.5	K0	
L4	Aerial tuning coils	Very low	K0	
L5		3.5	K0	
L6		22.0	K0	
L7	Oscillator reaction coils	0.1	J6	
L8		1.5	J6	
L9		Very low	J6	
L10	Oscillator tuning coils	2.0	J6	
L11		6.0	J6	
L12		2.0	J8	
L13	P.S. 1 react. coil	1.4	J7	
L14		1.8	J8	
L15		1.4	J7	
L16	1st I.F. (Pri.) trans. (Sec.)	8.0	C4	
L17		8.0	C4	
L18		8.0	D4	
L19	2nd I.F. (Pri.) trans. (Sec.)	8.0	D4	
L20		8.0	D4	
L21		2.0	—	
L22	H.T. choke	130.0	—	
T1		Speaker (Pri. trans.) (Sec.)	245.0	—
T2			0.3	—
T2	85.0		C2	
T2	Mains (Htr. sec. Rect. heat. soc.)	0.15	C2	
T2		0.1	C2	
T2		—	C2	
S1-S27	W/band switches	—	K7	
S28	Mains switches	—	F7	
S29	ganged R20	—	D2	
F1, F2	Mains fuses, 10 A.	—	—	

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receivers when they were operating from A.C. mains of 232 V. using the 220-230 V tapping on the mains transformer in the case of the A.C. model. The receivers were tuned to the lowest wavelength on the M.W. band, with volume controls at

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
A.C. Model				
V1 ECH35	283	2.6	150	1.4
	82	5.3		
V2 EF39	283	5.9	92	1.0
V3 EHC34	57	0.7	—	—
V4 EL33	268	34.0	230	3.6
V5 AZ31	320*	—	—	—
A.C./D.C. Model				
V1 CCH35	210	1.9	62	1.3
	104	3.9		
V2 EF39	210	4.4	62	1.2
V3 EHC34	56	0.4	—	—
V4 CL33	200	36.0	160	3.5
V6 CV31†	—	—	—	—

* Anode, A.C.
† Cathode to chassis—223 V, D.C.



Diagrams of the two waveband switch units, drawn as seen when viewed from the power unit end of an inverted chassis. B indicates a blank tag. The associated table is on the right of the diagrams.

Switch	S.W.	M.W.	L.W.	P.S.2	P.S.1
S1	C	—	—	C	C
S2	—	—	—	—	—
S3	—	—	—	—	—
S4	—	—	—	—	—
S5	—	—	—	—	—
S6	C	C	—	—	—
S7	—	—	—	—	—
S8	—	—	—	C	C
S9	—	—	—	—	—
S10	—	—	—	C	C
S11	—	—	—	—	—
S12	C	C	C	—	—
S13	—	—	—	—	—
S14	—	—	—	—	—
S15	—	—	—	C	—
S16	—	—	—	—	C
S17	—	—	—	—	—
S18	C	C	C	—	—
S19	—	—	—	—	—
S20	—	C	—	C	—
S21	—	—	—	—	C
S22	C	—	—	—	—
S23	—	C	—	—	—
S24	—	—	C	—	—
S25	—	—	—	C	—
S26	—	—	—	—	C
S27	C	C	C	—	—

To free the chassis entirely, unsolder the black lead from a tag beneath the upper right-hand speaker fixing nut, and the two leads from the connecting panel on the speaker input transformer.

When replacing, reconnect the red lead and black/brown lead to tags on the speaker input transformer, and the black lead to the earthing tag on the speaker chassis. Do not omit the replacement of the insulating covers over the heads of the chassis retaining screws.

Removing Speaker.—Remove chassis as previously described, and extract the two round-head wood screws securing the extension speaker socket panel to the cabinet; loosen the nuts of the four speaker retaining clamps and lift out speaker.

When replacing, the connecting panel on the input transformer should point to the top left-hand corner of the cabinet.

GENERAL NOTES

Switches.—S1-S27 are the waveband and pre-set station switches, ganged in two rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the diagrams in col. 2, where they are drawn as seen when viewed from the mains input end of an inverted chassis.

The table (above) gives the switch positions for the five control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and C, closed.

S28, S29 are the Q.M.B. mains switches, ganged with the tone control R20.

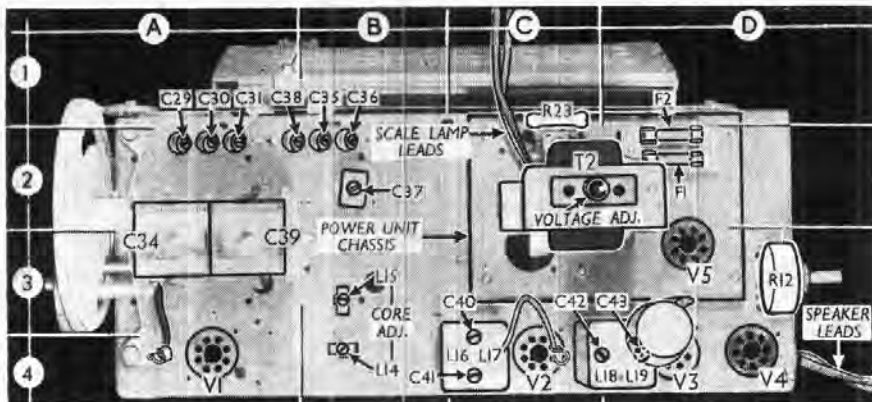
Scale Lamps.—These are two Osram lamps with clear spherical bulbs and M.E.S. bases. They are rated at 6.5 V (or 6.2 V), 0.3 A for any of the three versions of chassis.

External Speaker.—Two sockets are provided on a panel at the rear of the cabinet for the connection of a low impedance (about 2 Ω) external speaker.

Capacitors C26, C27.—These are two dry electrolytics in a tubular cardboard container mounted in a clip beneath the chassis.

Both are rated at 16 μF, 450 V D.C. working, but the red tag is the positive of the reservoir section (C27) and the yellow one that of the other (C26). The black tag is the common negative connection.

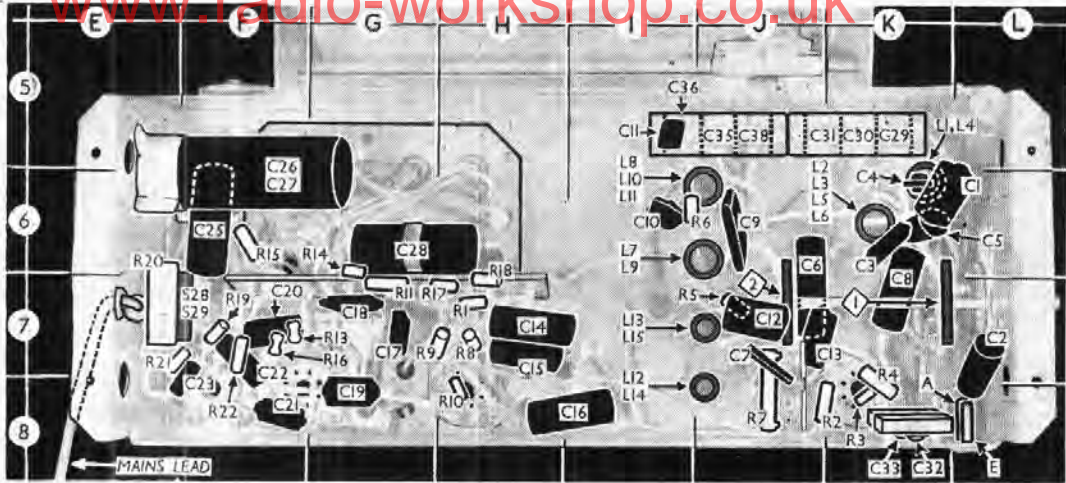
Chassis Divergencies.—R5, which is quoted in our component tables as 30Ω, may be anything between 20 Ω and 40 Ω.



Plan view of the A.C. chassis. If the power unit is replaced, it applies equally to the A.C. D.C. version. The two pre-set station oscillator adjustments L14, L15 are indicated on the chassis deck. The aerial circuit adjustments C32, C33 are shown in the under-chassis view.

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Under-chassis view. C28 is mounted on the power unit chassis, but the C26, C27, unit is mounted on the side of the main chassis. The waveband switch units (marked 1 and 2 in diamonds) are indicated on the right, but they are viewed from the left in the diagrams in col. 2, as indicated by the arrows here.



C17, which was returned to chassis in our sample, may be returned to V3 cathode. If wired as in our diagram, it should be altered to the latter arrangement if signals are distorted when the volume control is near to minimum. A 51,000 Ω resistor may be found in parallel with L6.

In most A.C. versions, a 0.1 μF tubular capacitor is connected between the H.T. positive line (at the output end of R23) and chassis, like C45 in the A.C./D.C. version, and this should be added if not already there. R24 and C46 may be omitted from early A.C./D.C. versions.

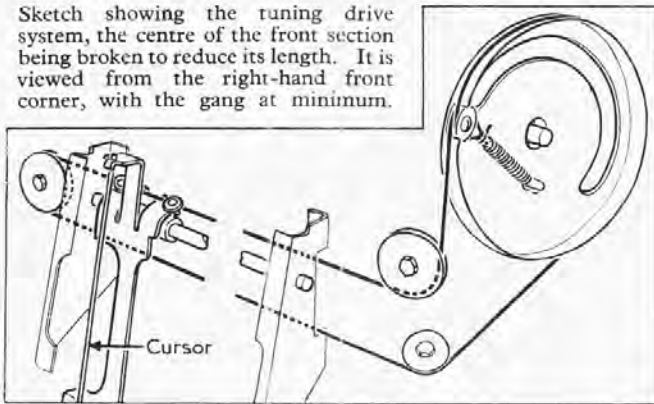
A.C. to A.C./D.C. Conversion.—The

and V3 are the same types in either version. The complete ranges of valves for the two versions are given in the table in "Valve Analysis" in col. 1.

DRIVE CORD REPLACEMENT

Five feet of cord is sufficient to replace the drive cord and leave ample length for tying off. To set drive drum correctly, slacken fixing screws in the boss, turn the gang to minimum, and turn the drum anti-clockwise (viewed from its open side) to its stop, and tighten up fixing screws. It will then be in the position

Sketch showing the tuning drive system, the centre of the front section being broken to reduce its length. It is viewed from the right-hand front corner, with the gang at minimum.



components shown in the two power unit diagrams, separated from the main circuit and to the right of it in our circuit diagram overleaf, can be removed as a complete assembly if the seven leads are unsoldered at the points indicated and the four fixing bolts, holding the power unit to the main chassis deck, are removed.

Thus to convert an A.C. mains version to an A.C./D.C. version, the power units can be exchanged. In addition, however, a different range of valves must be used and their heaters must be wired in series. The scale lamps are wired differently also, but this is automatically corrected in replacing the power unit.

Replacing the valves involves only changing V1, V4 and the rectifier a-V2

shown in our sketch (above), where the scale has been removed.

Tie one end of the cord to the free end of the spring, run it over the small pulley, out through the gap in the drum, round the other three pulleys as shown in the sketch, round the drum, and return through the gap round the other side of the small pulley, tying off finally again on the free end of the spring, whose tension should be sufficient to prevent any slackness in the cord.

The cursor should be adjusted so that it covers the high wavelength ends of the scales when the gang is at maximum. If the two clamping screws on the carrier are slackened, it can be slid along the cord as required.

CIRCUIT ALIGNMENT

I.F. Stages.—Connect signal generator, via an 0.1 μF capacitor in each lead, to control grid (top cap) of V1 and chassis, removing the original top cap connector, but connecting a 500,000 Ω resistor between the top cap of the valve and chassis.

Switch set to M.W., turn the volume control to maximum, and tune to 197 m on scale. Feed in a 470 kc/s (638.3 m) signal, and adjust C40, C41, C42 and C43 (chassis locations C4, D4) for maximum output, keeping the input small to avoid A.V.C. action. Finally, remove the 500,000 Ω resistor and replace top cap.

R.F. and Oscillator Stages.—With the gang at maximum capacitance check that the cursor is vertical and that it coincides with the high wavelength ends of the three scales. If any error exists, slacken the two screws clamping the cursor carriage to the drive cord, adjust the carriage, and tighten the clamping screws.

S.W.—Switch set to S.W., tune to 18 Mc/s on scale, feed in an 18 Mc/s (16.67 m) signal, and adjust C38 (B2) and C29 (A2) for maximum output. If two peaks are found for C38, choose the one involving the lesser capacitance.

M.W.—Switch set to M.W., tune to 200 m on scale, feed in a 200 m (1,500 kc/s) signal, and adjust C35 (B2) and C30 (A2) for maximum output. Check calibration at 500 m.

L.W.—Switch set to L.W., tune to 750 m on scale, feed in a 750 m (450 kc/s) signal, and adjust C36 (B2) and C31 (A2) for maximum output. Tune to 1,875 m on scale, feed in an 1,875 m (160 kc/s) signal, and adjust C37 (B2) for maximum output. Repeat these adjustments until no improvement can be obtained.

PRE-SET STATION SETTING

The average wavelength coverage of each pre-set circuit is: P.S.1, 200-325 m; P.S.2, 325-545 m. To set either circuit, switch to the appropriate position on the waveband switch and adjust the core of L15 (B3) (P.S.1) or L14 (B4) (P.S.2), and C33 (K8) (P.S.1) or C32 (K.8) (P.S.2) for maximum output on the desired transmission. Bear in mind that the chassis may be "live" to earth.