

"TRADER" SERVICE SHEET

661

FERGUSON 378 (AC)

TABLE, CONSOLE AND RADIOGRAM

REVISED ISSUE OF
SERVICE SHEET No. 154

FOUR wavebands are covered in the Ferguson 378, a 7-valve (plus rectifier) superhet designed to operate from AC mains of 200-250 V, 50-100 c/s.

The circuit includes an R-C coupled push-pull output circuit employing a triode phase inverter. The shortest waveband (12.5-30 m) is referred to throughout this Service Sheet as SW1, and the next (30-60 m) as SW2. There is provision for the connection of a gramophone pick-up and a high impedance external speaker.

An identical chassis is employed in the console and radiogram versions, which bear the same model number, but the radiogram is applicable only to AC mains of 50-60 c/s, and is fitted with an automatic record changer.

Release date, all models: April, 1936.

Original prices: Table model, £17 6s. 6d.; console, £23 2s.; radiogram, £39 18s.

CIRCUIT DESCRIPTION

Aerial input via fixed condenser C1 (SW, MW and LW), coupling condenser C2 (SW and MW), coupling condenser C4 (SW only), coupling Coil L5 (MW) and condenser C3 (LW) to independently switched single tuned circuits L3, C36 (SW1), L4, C36 (SW2), L6, C36 (MW), and L7, C36 (LW), which precede a variable-mu RF pentode valve (V1, National Union 6D6) operating as signal frequency amplifier.

Choke-fed, tuned-grid RF coupling via L8, C9, and L9, C41 (SW1), L10, C41 (SW2), L11, L12, C41 (MW) and L13, C41 (LW), bottom coupling by R6, C10 being employed on LW, between V1 and heptode valve (V2, National Union 6A7), which operates as frequency changer with electron coupling.

Oscillator grid coils L14 (SW1), L16 (SW2), L18 (MW), L20 (LW), are tuned by C42; parallel trimming by C43 (SW1), C44 (SW2), C45 (MW), C46, C55 (LW); series tracking by C47 (SW1), C48 (SW2), C49 (MW), C13, C50 (LW).

Reaction coupling from anode via coupling condenser C12 by L15 (SW1) and L17 (SW2), aided in each case by the

common impedance of their trackers; by L19 (MW); and by common impedance of C13, C50 only (LW).

Third valve, a variable-mu RF pentode (V3, National Union 6D6), operates as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings C51, L21, L22, C52 and C53, L23, L24, C54.

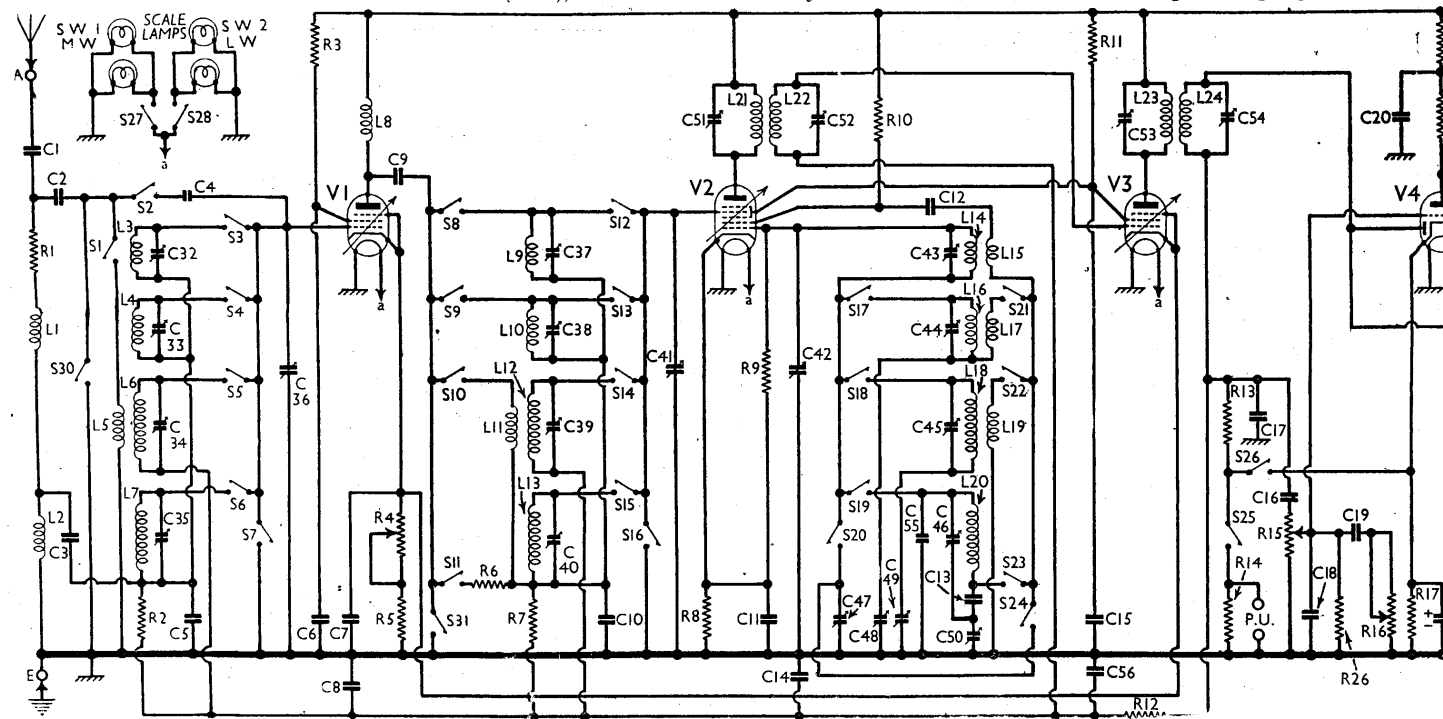
Intermediate frequency 456 kc/s.

Sensitivity control by variable resistor R4 in V1 and V3 common cathodes circuit, which varies fixed GB applied. R5 imposes a fixed minimum GB limit.

Diode second detector is part of double diode triode valve (V4, National Union 75). Audio-frequency component in rectified output is developed across load resistor R13 and passed via AF coupling condenser C16 and manual volume control R15 to CG of triode section.

Variable tone control by RC filter R16, C19. Provision for connection of gramophone pick-up by change-over switches S25, S26. IF filtering by by-pass condensers C17, C18 in diode circuit, and C22 in triode anode circuit.

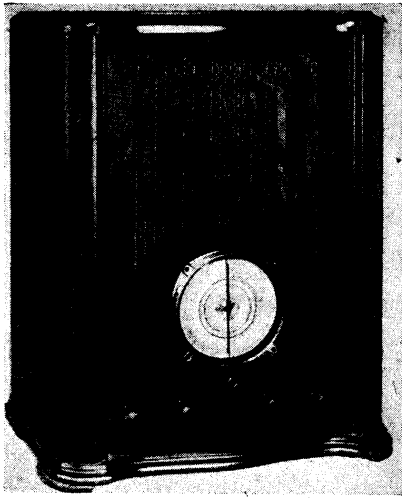
DC potential developed across diode load R13 is fed back through decoupling



Circuit diagram of the Ferguson 378 AC four-band superhet. V6 is fed via a phase-reversing valve V5 from the step-down coupling formed by R22, R23 in V7 control grid circuit. R4 is the sensitivity control, by which the initial GB voltage to V1 and V3 can be adjusted. The speaker unit is connected to the chassis by means of a 4-pin plug, a diagram of which, viewed from the free end of the pins, is inset beneath the circuit. The points of inter-connection are indicated in the circuit by arrows and circles.

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The appearance of the 378 table model.

circuits as GB to RF, FC and IF valves, giving automatic volume control.

Resistance-capacity coupling by R19, C23 and R22, R23 to one section (V7) of push-pull output stage comprising two pentodes (V6, V7, National Union 42's). Second section (V6) is fed by phase reversing triode valve (V5, National Union 76), which obtains its input voltage from a tapping on a potential divider (at the junction of R22 and R23) to obtain a

step-down coupling. Fixed tone correction in output stage by condensers C26, C27. Provision for connection of high-impedance external speaker across primary of internal speaker input transformer T1.

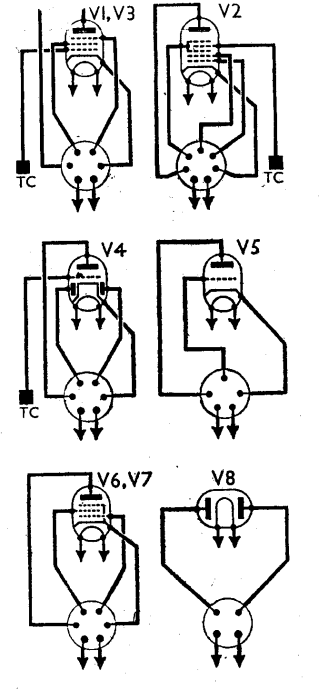
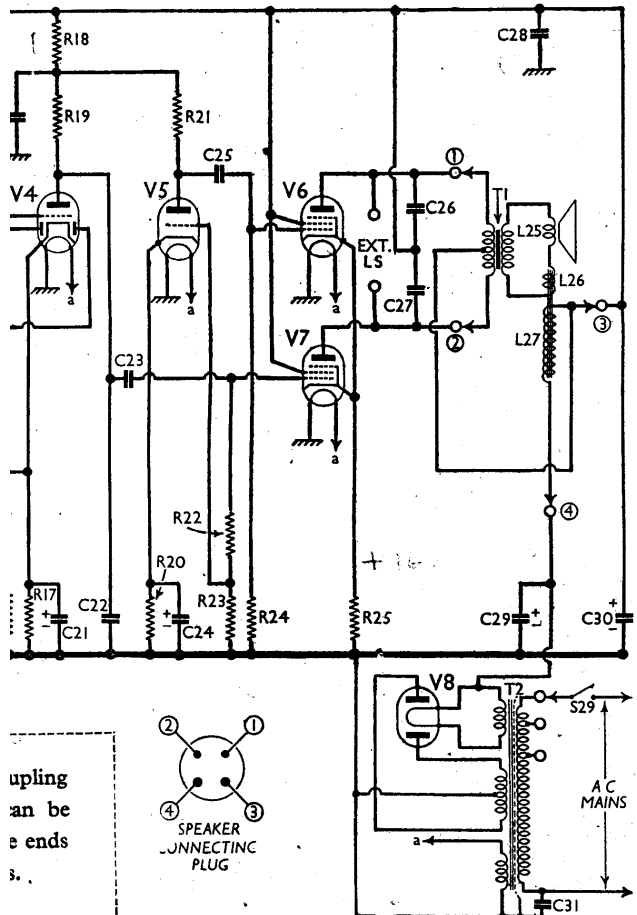
HT current is supplied by full-wave rectifying valve (V8, National Union 80). Smoothing by speaker field coil L27 and dry electrolytic condensers C29, C30. Mains RF filtering by C31.

COMPONENTS AND VALUES

RESISTORS		Values (ohms)
R1	Aerial circuit resistor ...	2,500
R2	V1 CG decoupling ...	500,000
R3	V1 SG HT feed ...	100,000
R4	Sensitivity control	3,000
R5		
R6	V2 pentode GB series resistor (LW) ...	50,000
R7	V2 pent. CG decoupling ...	500,000
R8	V2 fixed GB resistor ...	500
R9	V2 osc. CG resistor ...	50,000
R10	V2 osc. anode HT feed ...	25,000
R11	V2, V3 SG's HT feed ...	50,000
R12	AVC line decoupling ...	250,000
R13	V4 signal diode load ...	250,000
R14	Gram PU shunt ...	25,000
R15	Manual volume control ...	500,000
R16	Variable tone control ...	500,000
R17	V4 GB resistor ...	10,000
R18	V4, V5 anodes decoupling ...	100,000
R19	V4 triode anode load ...	250,000
R20	V5 GB resistor ...	10,000
R21	V5 anode load ...	250,000
R22	V5, V7 CG resistors	500,000
R23		
R24	V6 CG resistor ...	500,000
R25	V6, V7 GB resistor ...	300
R26	Manual vol. control shunt	250,000

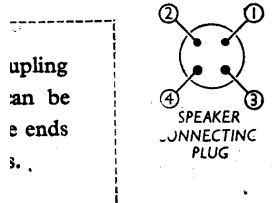
CONDENSERS		Values (μF)
C1	Aerial series condenser ...	0.01
C2	Aerial coupling condensers	0.00025
C3		0.01
C4		0.00005
C5	V1 CG decoupling ...	0.002
C6	V1 SG decoupling ...	0.1
C7	V1, V3 cathodes by-pass ...	0.1
C8	RF AVC line decoupling ...	0.1
C9	V1 to V2 RF coupling ...	0.00025
C10	V2 pent. CG decoupling ...	0.002
C11	V2 cathode by-pass ...	0.1
C12	V2 osc. anode coupling ...	0.00025
C13	Osc. LW fixed tracker ...	0.00025
C14	AVC line decoupling ...	0.1
C15	V2, V3 SG's decoupling ...	0.1
C16	AF coupling to V4 triode ...	0.01
C17	IF by-pass condensers	0.00025
C18		
C19	Tone control condenser ...	0.01
C20	V4, V5 anodes decoupling ...	0.1
C21*	V4 cathode by-pass ...	30.0
C22	V4 anode IF by-pass ...	0.001
C23	V4 to V7 AF coupling ...	0.01
C24*	V5 cathode by-pass ...	5.0
C25	V5 to V6 AF coupling ...	0.01
C26	Fixed tone correctors	0.002
C27		
C28	HT circuit RF by-pass ...	0.1
C29*	HT smoothing condensers	8.0
C30*		
C31	Mains RF by-pass ...	0.01
C32†	Aerial trimmer (SW1) ...	—
C33†	Aerial trimmer (SW2) ...	—
C34†	Aerial trimmer (MW) ...	—
C35†	Aerial trimmer (LW) ...	—
C36†	Aerial circuit tuning ...	—
C37†	V2 CG trimmer (SW1) ...	—
C38†	V2 CG trimmer (SW2) ...	—
C39†	V2 CG trimmer (MW) ...	—
C40†	V2 CG trimmer (LW) ...	—
C41†	V2 CG circuit tuning ...	—
C42†	Oscillator circuit tuning ...	—
C43†	Oscillator trimmer (SW1) ...	—
C44†	Oscillator trimmer (SW2) ...	—
C45†	Oscillator trimmer (MW) ...	—
C46†	Oscillator trimmer (LW) ...	—
C47†	Oscillator tracker (SW1) ...	—
C48†	Oscillator tracker (SW2) ...	—
C49†	Oscillator tracker (MW) ...	—
C50†	Oscillator tracker (LW) ...	—
C51†	1st IF trans. pri. tuning ...	—
C52†	1st IF trans. sec. tuning ...	—
C53†	2nd IF trans. pri. tuning ...	—
C54†	2nd IF trans. sec. tuning ...	—
C55	Osc. circuit trimmer (LW) ...	0.000025
C56	AVC line decoupling ...	0.01

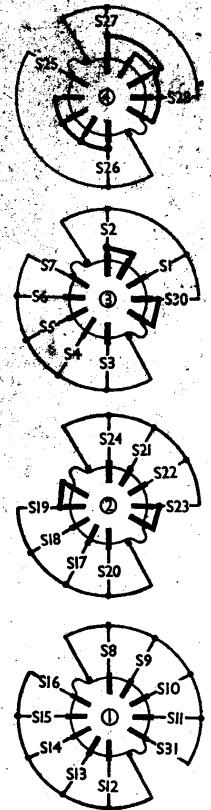
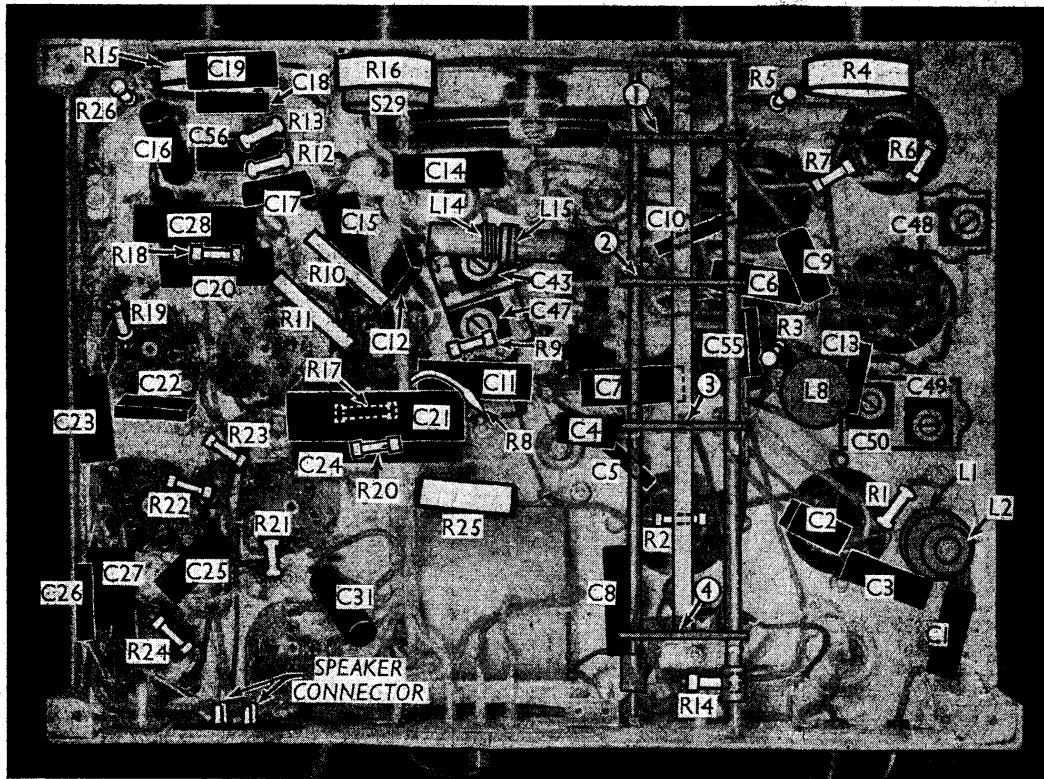
* Electrolytic. † Variable. ‡ Pre-set.



Valve diagrams, showing their base connections as seen from the free ends of the pins. One of them applies to V1 and V3, which are similar types, while another applies to V6 and V7.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial choke coils ...	21.0
L2		17.0
L3	Aerial tuning coil (SW1) ...	Very low
L4	Aerial tuning coil (SW2) ...	0.05
L5	Aerial coupling coil (MW) ...	0.5
L6	Aerial tuning coil (MW) ...	5.5
L7	Aerial tuning coil (LW) ...	25.0
L8	V1 anode RF choke ...	21.0
L9	CG tuning coil (SW1) ...	Very low
L10	CG tuning coil (SW2) ...	0.05
L11	CG coupling coil (MW) ...	0.5
L12	CG tuning coil (MW) ...	5.5
L13	CG tuning coil (LW) ...	25.0
L14	Osc. tuning coil (SW1) ...	Very low
L15	Osc. reaction coil (SW1) ...	0.6
L16	Osc. tuning coil (SW2) ...	0.05
L17	Osc. reaction coil (SW2) ...	0.6
L18	Osc. tuning coil (MW) ...	3.2
L19	Osc. reaction coil (MW) ...	2.5
L20	Osc. tuning coil (LW) ...	6.0
L21	1st IF trans.	Pri. ... 9.5
L22		Sec. ... 13.0
L23	2nd IF trans.	Pri. ... 13.0
L24		Sec. ... 8.5
L25	Speaker speech coil ...	1.6
L26	Hum neutralising coil ...	0.1
L27	Speaker field coil ...	1,000.0
T1	Speaker input trans. { Pri., total ... 750.0	
	{ Sec. ... 0.2	
	{ Pri., total ... 23.0	
	{ Heater sec. ... 0.05	
	{ Rect. fl. sec. ... 0.1	
	{ H.T. sec. total ... 310.0	
S1-24	Waveband and muting switches ...	—
S30, 31	Gram. PU switches ...	—
S25, 26	Scale lamp switches ...	—
S27, 28	Mains switch, ganged R16 ...	—





Under-chassis view. R8 is a flexible resistor. L1, L2 and L8 are indicated here, but the only tuning coils beneath the chassis are L14, L15, near the centre. The four waveband switch units are indicated by numbers in circles and arrows; while on the left of this illustration are detailed diagrams of the units, viewed in the same direction as the arrows.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 215 V, using the 220 V tapping on the mains transformer. Both the volume and sensitivity controls were at maximum (fully clockwise) and the set was tuned to the lowest wavelength on the medium band, but there was no signal input.

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

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 6D6 ...	265	5.6	70	1.6
V2 6A7 ...	265	1.5	75	2.6
	Oscillator			
	150	4.0	75	1.4
V3 6D6 ...	265	5.7	—	—
V4 75 ...	65	0.2	—	—
V5 76 ...	50	0.4	—	—
V6 42 ...	250	27.0	265	5.3
V7 42 ...	250	26.0	265	4.7
V8 80 ...	300†	—	—	—

† Each anode, A.C.

DISMANTLING THE SET

Removing Chassis.—Remove the six control knobs (recessed grub screws), withdraw from its socket at the rear of the chassis the speaker connecting plug;

remove the four bolts (with plain and spring washers) holding the chassis to the bottom of the cabinet.

When replacing, do not forget the felt

washers between the knobs and the cabinet, and note that the knobs are marked, so that they must be placed on the correct spindles. Also note that the wave-change switch knob is marked "G," "LW," "MW," "SW" and "USW"; and as there is no flat on the spindle, care must be taken to see that it is replaced correctly.

Removing Speaker.—Withdraw the speaker plug and remove the nuts from the four bolts holding the speaker to the sub-baffle.

When replacing, see that the transformer is on the right.

Alternatively, the speaker and the sub-baffle may be withdrawn together by removing the four countersunk head wood screws holding the sub-baffle to the cabinet front.

If the leads should be unsoldered from the speaker transformer, reconnect as follows, number the tags from bottom to top: 1 and 3 joined together, yellow; 2, blue; 4, blue; 5 red.

GENERAL NOTES

Switches.—In all there are twenty-eight wavechange, muting and scale lamp switches, and two pick-up switches, arranged in four 5-position rotary units, ganged together beneath the chassis. The numbers in circles in our under-chassis view refer to the units as shown in the separate switch diagrams on its left, the arrows indicating the directions in which they are viewed.

Note that each unit consists of two separate sets of five switches.

The table below gives the switch positions for the various control settings, starting from the fully anti-clockwise position of the control, a dash indicating open, and C, closed.

Switch	SW1 (USW)	SW2 (SW)	MW	LW	Gram
S1	—	—	C	—	—
S2	C	C	—	—	—
S3	C	—	—	—	—
S4	—	C	—	—	—
S5	—	—	C	—	—
S6	—	—	—	C	—
S7	—	—	—	—	C
S8	C	—	—	—	—
S9	—	C	—	—	—
S10	—	—	C	—	—
S11	—	—	—	C	—
S12	C	—	—	—	—
S13	—	C	—	—	—
S14	—	—	C	—	—
S15	—	—	—	C	—
S16	—	—	—	—	C
S17	—	C	—	—	—
S18	—	—	C	—	—
S19	—	—	—	C	—
S20	C	—	—	—	—
S21	—	C	—	—	—
S22	—	—	C	—	—
S23	—	—	—	C	—
S24	C	—	—	—	—
S25	—	—	—	—	C
S26	C	C	C	C	—
S27	C	C	C	C	—
S28	—	C	C	C	—
S30	—	—	—	—	C
S31	—	—	—	—	C

S29 is the QMB mains switch, ganged with control R16.

Coils.—L1 and L2, L8 and L14, L15 are beneath the chassis, the remaining coils being in seven screened units on the

chassis deck. Six of the units incorporate two trimmers each, the seventh containing three. Where they cannot be seen in our plan-view illustration, their positions are approximately indicated.

Scale Lamps.—These are four National Union MES types, marked "6-8 V."

External Speaker.—Provision is made for connecting a high impedance (about 15,000 Ω) external speaker.

Condensers C29, C30.—These are two 8 μ F dry electrolytics in a single metal can on the chassis deck, with a common negative (black) lead. The red lead is the positive of C29 and the yellow the positive of C30.

Condenser C21.—In our chassis this consists of a 25 μ F tubular, with an extra 5 μ F, inside the C24 unit, in parallel.

Speaker Connecting Plug.—This is a four-pin plug which fits into a socket at the rear of the chassis. The points of interconnection are indicated by numbers in the circuit diagram, the numbers agreeing with those in the diagram of the plug, inset beneath the circuit, drawn as seen from the free ends of the pins.

CIRCUIT ALIGNMENT

IF Stages.—First feed in a signal of 456 kc/s (657.9 m) between the control grid (top cap) of V3 and chassis, and adjust C53 and C54 for maximum output. Next, switch the set to MW, and turn the gang condenser to maximum. Feed in the 456 kc/s signal between the grid (top cap) of V2 and chassis, and adjust C51 and C52 for maximum output, keeping the

input as low as possible to avoid AVC action. Readjust C53 and C54 if necessary, then disconnect signal generator leads.

Owing to the high IF sensitivity, instability may occur as the circuits come into line, due to the long leads from the signal generator. This may be counteracted by reducing the IF sensitivity slightly with the aid of the sensitivity control.

RF and Oscillator Stages.—With the gang at maximum capacity, the scale pointer should be vertical, and the drive disc should be on the left of the assembly when viewed from the front. When adjusting, see that the disc is at the end of its travel before bolting the drive collar to the gang spindle.

On completion of the IF alignment, the tracking condensers C47, C48, C49, C50 should be adjusted for maximum output at the top of each band (gang condenser fully meshed). The simplest method of doing this is to connect a high frequency buzzer via a 50 μ F condenser to the aerial lead of the set, and adjust the trackers for maximum sound output. It will be found that the padders peak quite sharply on resonance.

Connect signal generator leads via a suitable dummy aerial to aerial and earth leads of the receiver.

LW.—Switch set to LW, tune to 1,200 m on scale, feed in a 1,200 m (250 kc/s) signal and adjust C46, then C40 and C35, for maximum output. Turn the gang to maximum, and readjust C50,

with buzzer input signal as before, for maximum output. Reconnect signal generator, and readjust C46, C40 and C35 at 1,200 m, then readjust C50 again with buzzer input.

MW.—Switch set to MW, tune to 250 m on scale, feed in a 250 m (1,200 kc/s) signal, and adjust C45, then C39 and C34, for maximum output. Connect up buzzer, turn gang to maximum, and readjust C49 for maximum output. Now repeat the 250 m adjustments with signal generator input, and finally readjust C49 with buzzer input.

SW2.—Switch set to SW2, tune to 34 m on scale, feed in a 34 m (8.82 Mc/s) signal, and adjust C44, then C38 and C33 for maximum output. If two peaks are found for C44, use that involving the lesser trimmer capacity. Now replace signal generator with buzzer, turn the gang to maximum, and readjust C48 for maximum output. Repeat the 34 m adjustments with signal generator input, and finally readjust C48 with buzzer input.

SW1.—Switch set to SW1, tune to 15.5 m on scale, feed in a 15.5 m (19.35 Mc/s) signal, and adjust C43, then C37 and C32, for maximum output. Two peaks should be found for C43, and that involving the lesser trimmer capacity must be selected. Now replace signal generator with buzzer, turn the gang to maximum and readjust C47 for maximum output. Repeat the 15.5 m adjustments with signal generator input, and finally readjust C47 with buzzer input as before.

Plan view of the chassis. Several of the trimmers are reached through holes in the sides of screening cans. They cannot be seen here, but their relative positions are indicated. All the trackers C47-C50 are reached through holes in the chassis deck, as is also C43. The aerial leads are not marked, but they are coloured green and black for aerial and earth respectively.

