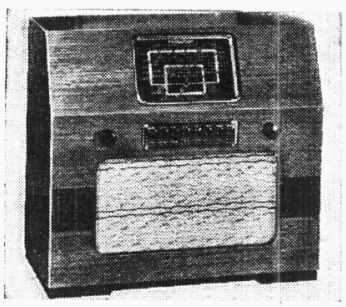
Supplement to The Wireless & Electrical Trader, March 2, 1940.

"TRADER" SERVICE SHEET

454

FERGUSON 902, 902U

TABLE AND RADIOGRAM MODELS



The Ferguson 902 and 902U table model

THE Ferguson 902 series of models includes table and radiogram versions, all using the same 3-band 4-valve (plus valve rectifier) AC superhet chassis. The 902U series is similar, but for AC/DC mains.

The models have provision for automatic tuning of four stations, together with press-button wavechange and gram switching.

The main chassis in each case is almost identical, except for the heater and scale lamp wiring. A separate power and output chassis is used, and this differs in the two series.

The speaker in the AC models is an energised type, while in the AC/DC models it is a permanent magnet type.

In this *Service Sheet* both series are included, with separate diagrams and chassis illustrations for the AC/DC versions. Four models are therefore covered, and their divergencies fully explained.

Release date: All models, Aug., 1939.

CIRCUIT DESCRIPTION

All the switches in this receiver, excepting the mains switch, are press-button operated, and each press-button, excepting the "gram" button, operates two groups of switches: one in the aerial circuit and one in the oscillator circuit.

All the switches in a given group bear the same number, but each switch of the group has a different suffix. Groups **1** and **8** are controlled by the SW button; **2** and **9** by the LW (manual) button; **3** and **10** by the MW (manual) button; **4** and **11**, **5** and **12** by the two MW (auto) buttons; **6** and **13**, **7** and **14** by the two LW (auto) buttons; and **15** by the gram button.

The suffix letters indicate the action of the switches. Normally, when the button is in the "out" position, the **a**, **b**, and **c** switches of both groups are open, while the **w**, **x**, **y** and **z** switches are closed. When the button is pressed the positions are reversed, so that the **a**, **b** and **c** switches close, and the **w**, **x**, **y** and **z** switches open.

Except for the series heater wiring and the addition of **R19** and **C45**, the 902U receiver chassis is similar to that of the AC model, and the circuit description covers both types. The descriptions of the power and output units, which differ considerably, follow that of the receiver chassis.

Receiver Chassis.—Aerial input on SW is via **C1**, **S1a** and **C4** direct to single tuned circuit **L3**, **C27**; on MW it is via **C1**, **S1x**, **S2x**, **S3a** and **L5** (which operates then as coupling coil) to single tuned circuit **L4**, **C27**. **S3y** is now open, and **S2y**, **S6y** and **S7y** are closed, connecting the "top" of **L5** to AVC line; on LW, input is via **C2**, **L1**, **L2**, **C3** to single tuned circuit **L5**, **C27**. **S2x** is now open.

The process is the same for manual or automatic tuning, except that for automatic operation **C27** is left out of circuit and is replaced by one of the pre-set tuning condensers **C28—C31**.

First valve **(V1, Mullard ECH3)** is a triode heptode operating as frequency changer with internal coupling. Triode oscillator anode coils **L7** (SW), **L8** (MW) and **L9** (LW) are tuned by **C38** for manual operation; parallel trimming by **C35** (SW), **C36** (MW) and **C37** (LW); series tracking by **C9**, **C32** (SW), **C33** (MW) and **C34** (LW). Reaction by common impedance of trackers on all bands, plus reaction coil **L6** (SW).

Independent tuning circuits are used for automatic operation in the oscillator circuit. A separate variable iron-cored coil **(L16—L19)** is used for each automatic press-button, and a fixed condenser **C23** provides the tuning capacity. Reaction coupling is effected across the common impedance of **C22**, **R18** in both anode and grid circuits.

Second valve **(V2, Mullard EF9)** is a variable-mu RF pentode operating as intermediate frequency amplifier with

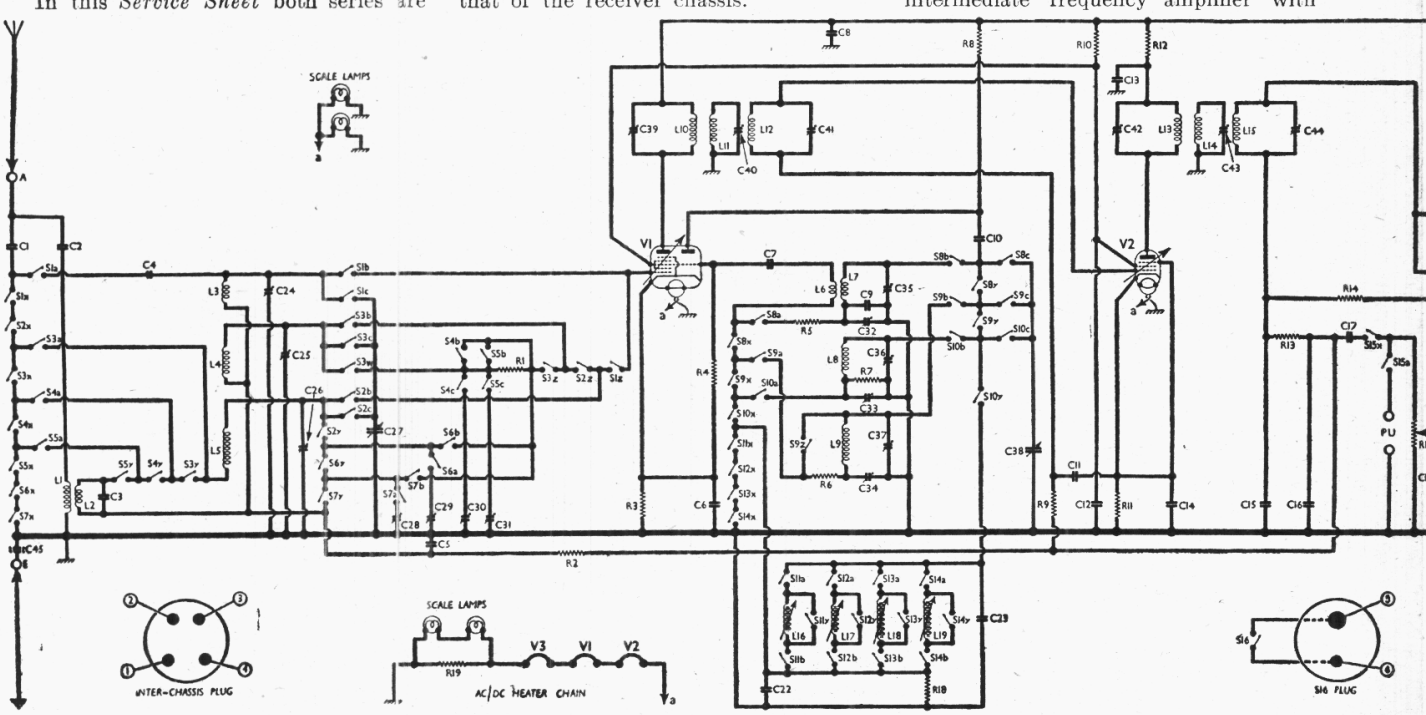


Diagram of the main chassis of all models The AC/DC heater chain is inset beneath the circuit **C45** and **R19** are in the 902U mo

triple-tuned transformer couplings **C39, L10, L11, C40, L12, C41,** and **C42, L13, L14, C43, L15, C44.**

Intermediate frequency 470 KC/S.

Diode second detector is part of double diode triode valve **(V3, Mullard EBC3)** in which the two diode anodes are strapped together to act as a single diode. Audio frequency component in rectified output is developed across load resistance **R14** and passed via **R13,** AF coupling condenser **C17, S15x** and manual volume control **R15** to CG of triode section, which operates as AF amplifier.

IF filtering by **C15, R13** and **C16** in diode circuit, **C18** in CG circuit, and **C20** in triode anode circuit. Provision for connection of gramophone pick-up via **S15a** across **R15.** Variable tone control by **C21, R17** in triode anode circuit.

DC potential developed across **R14** is fed back via **R13** as GB to FC and IF valves, giving automatic volume control.

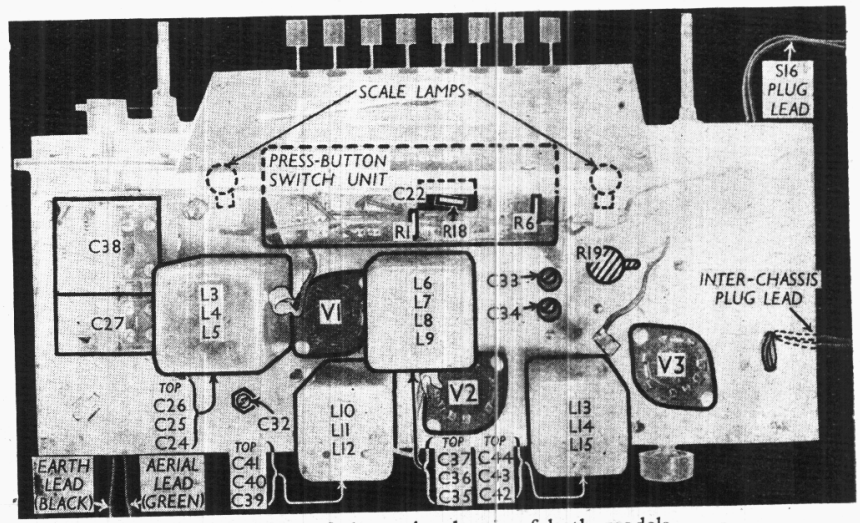
Power and Output Unit (AC).—Resistance-capacity coupling by **R101, C101** and **R102** between **V3** triode and beam tetrode output valve **(V101, Mullard 6V6G).** Fixed tone correction by **C102** in anode circuit. Provision for high impedance external speaker.

HT current is supplied by full-wave rectifying valve **(V102, Mullard 5Y3G).** Smoothing by speaker field **L103** and electrolytic condensers **C104** and **C105.**

Power and Output Unit (AC/DC.).—Resistance-capacity coupling by **R201, C201** and potential divider **R202, R203** between **V3** triode and pentode output valve **(V201, Mullard CL4).** Fixed tone correction by **C202** in anode circuit. Provision for connection of high impedance external speaker.

When the receiver is used with AC mains, HT current is supplied by IHC half-wave rectifying valve **(V202, Mullard CY1),** which with DC mains behaves as a low resistance. Smoothing is effected by iron-cored choke **L202** and dry electrolytic condensers **C204** and **C205.**

Valve heaters of both the power and output unit and the receiver chassis, together with the scale lamps and ballast resistance **R206,** are connected in series across mains input. Filter circuit comprising air-cored chokes **L203** and **L204** and condenser **C206** suppresses mains borne interference, while fuse **F** affords protection against accidental short-circuit.



Plan view of the main chassis of both models

DISMANTLING THE SET

The receiver consists of two units: the receiver chassis, and the power and output unit. The two units and the speaker are interconnected by plugs and sockets which are not interchangeable.

Removing Receiver Chassis.—Remove the two control knobs (pull-off);
withdraw from the power and output unit the two plugs connecting it to the receiver chassis;
remove the four screws (with lock-washers and claw washers) holding the chassis to the shelf in the cabinet. (If a long screwdriver is used, the screws can be reached through holes in the bottom of the cabinet).
When replacing, do not forget to slip the connecting plugs through the apertures in the shelf before fixing the chassis.
Fit a felt washer on each of the two control spindles, between the knob and the front of the cabinet.

Removing Power and Output Unit.—Withdraw the two plugs referred to above, and a third connecting the speaker to the unit;
remove the two screws (with washers and lock-washers) holding the unit to the bottom of the cabinet.
When replacing, note that the square claw washer goes on to the front fixing screw, and the round one on the rear screw, where a recess is made in the cabinet to accommodate it.

Removing Speaker.—Withdraw the speaker plug from the power and output unit;
remove the four nuts holding the speaker to the sub-baffle.
When replacing, see that the transformer is at the bottom.

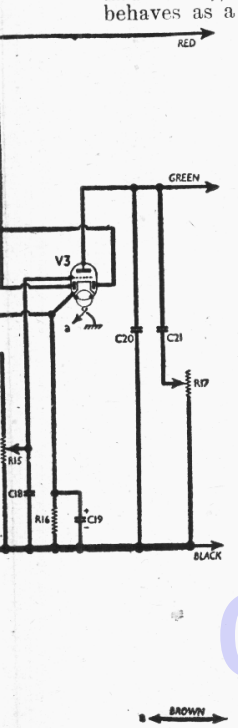
VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on AC mains of 233 V, using the 220-230 V tapping on the mains transformer in the case of the AC model and the 230 V tapping on the mains resistance in the case of the AC/DC model. The receiver was tuned to the lowest wavelength on the MW band, and the volume control was at maximum, but there was no signal input.

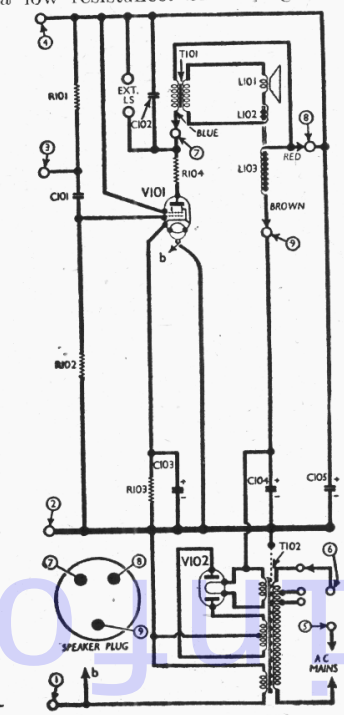
Voltages were measured on the 400 V scale of a model 7 Universal Avometer, chassis being negative.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
	AC MODEL			
V1 ECH3	258 Oscillator 130	2·2 4·8	95	1·0
V2 EF9	252	5·7	95	1·8
V3 EBC3	53	1·0	—	—
V101 6V6G	226	41·0	258	3·3
V102 5Y3G	335*	—	—	—
	AC/DC MODEL			
V1 ECH3	202 Oscillator 109	2·0 3·0	77	0·8
V2 EF9	198	4·3	77	1·3
V3 EBC3	45	0·6	—	—
V201 CL4	186	26·0	202	4·5
V202 CY1†	—	—	—	—

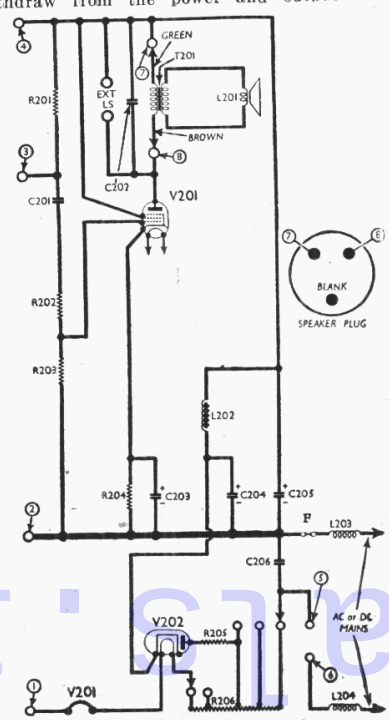
* Each anode, AC.
† Cathode to chassis 215 V, DC.



models only

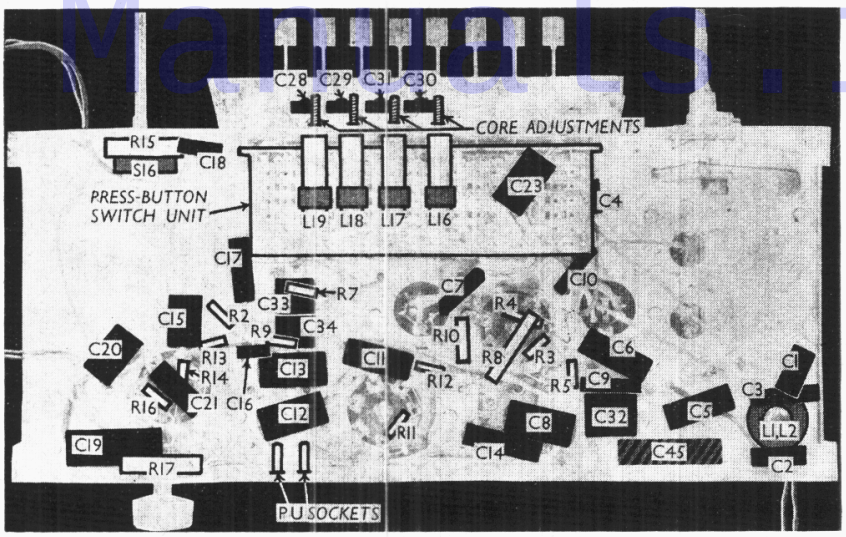


The AC output unit



The AC/DC output unit

Supplement to The Wireless & Electrical Trader, March 2, 1940.



Underneath view of the main chassis of both models

COMPONENTS AND VALVES

	CONDENSERS	Values (μF)
C1	Aerial series condensers	0·00025
C2	Aerial series condensers	0·00025
C3	Part LW aerial coupling	0·002
C4	Aerial SW coupling	0·00001
C5	V1 heptode CG decoupling	0·1
C6	V1 cathode by-pass	0·1
C7	V1 osc. CG condenser	0·0001
C8	HT circuit RF by-pass	0·1
C9	Osc. circ. SW fixed tracker	0·001
C10	V1 osc. anode coupling	0·0001
C11	V2 CG decoupling	0·1
C12	V1, V2 SG's decoupling	0·1
C13	V2 anode decoupling	0·1
C14	V2 cathode by-pass	0·1
C15	IF by-pass condensers	0·00025
C16	IF by-pass condensers	0·00025
C17	AF coupling to V3 triode	0·01
C18	IF by-pass	0·0001
C19*	V3 cathode by-pass	25·0
C20	IF by-pass	0·00025
C21	Part of variable tone control	0·01
C22	Osc. auto reaction coupling	0·00025
C23	Osc. auto tuning condenser	0·0002
C24‡	Aerial circuit SW trimmer	—
C25‡	Aerial circuit MW trimmer	—
C26‡	Aerial circuit LW trimmer	—
C27†	Aerial circuit manual tuning	—
C28‡	Aerial circuit auto tuning trimmers	—
C29‡		—
C30‡		—
C31‡		—
C32‡	Osc. circuit SW tracker	—
C33‡	Osc. circuit MW tracker	—
C34‡	Osc. circuit LW tracker	—
C35‡	Osc. circuit SW trimmer	—
C36‡	Osc. circuit MW trimmer	—
C37‡	Osc. circuit LW trimmer	—
C38†	Osc. circuit manual tuning	—
C39‡	1st IF trans. pri. tuning	—
C40‡	1st IF trans. sec. tuning	—
C41‡	1st IF trans. tert. tuning	—
C42‡	2nd IF trans. pri. tuning	—
C43‡	2nd IF trans. sec. tuning	—
C44‡	2nd IF trans. tert. tuning	—
C45	Earth isolating condenser (AC/DC model only)	0·1
	AC MODEL	
C101	V3 triode to V101 A F coupling	0·01
C102	Fixed tone corrector	0·001
C103*	V101 cathode by-pass	25·0
C104*	HT smoothing condensers	16·0
C105*	HT smoothing condensers	8·0
	AC/DC MODEL	
C201	V3 triode to V201 A F coupling	0·01
C202	Fixed tone corrector	0·001
C203*	V201 cathode by-pass	25·0
C204*	HT smoothing condensers	16·0
C205*	HT smoothing condensers	16·0
C206	Mains RF by-pass	0·1

* Electrolytic. † Variable. ‡ Pre-set.

	RESISTANCES	Values (ohms)
R1	V1 heptode CG resistance	3,000,000
R2	V1 heptode CG decoupling	500,000
R3	V1 fixed GB resistance	500
R4	V1 osc. CG resistance	50,000
R5	Osc. SW reaction damping	20
R6	Osc. LW reaction damping	5,000
R7	Osc. circuit MW damping	5,000
R8	V1 osc. anode HT feed	25,000
R9	V2 CG decoupling	500,000
R10	V1, V2 SG's HT feed	50,000
R11	V2 fixed GB resistance	500
R12	V2 anode HT feed	1,000
R13	IF stopper	25,000
R14	V3 diodes load resistance	500,000
R15	Manual volume control	500,000
R16	V3 triode GB resistance	2,500
R17	Variable tone control	100,000
R18	Osc. auto circuit damping	5,000
R19	Scale lamps shunt (AC/DC model only)	200
	AC MODEL	
R101	V3 triode anode load	250,000
R102	V101 CG resistance	500,000
R103	V101 GB resistance	300
R104	V101 anode stabiliser	100
	AC/DC MODEL	
R201	V3 triode anode load	250,000
R202	V201 CG input potential divider	100,000
R203		250,000
R204	V201 GB resistance	300
R205	V202 anode surge limiter	100
R206	Heater circuit ballast, total	830*

* Tapped at 30 O, 630 O, 730 O and 830 O from V202 heater end.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial circuit choke	224·0
L2	Aerial LW coupling coil	13·0
L3	Aerial SW tuning coil	Very low
L4	Aerial MW tuning coil	4·2
L5	Aerial LW tuning coil	26·5
L6	Oscillator SW reaction	0·5
L7	Osc. circuit SW tuning coil	Very low
L8	Osc. circuit MW tuning coil	4·7
L9	Osc. circuit LW tuning coil	19·3
L10	1st IF trans. Pri.	16·5
L11	1st IF trans. Sec.	16·5
L12	1st IF trans. Tert.	16·5
L13	2nd IF trans. Pri.	16·5
L14	2nd IF trans. Sec.	16·5
L15	2nd IF trans. Tert	16·5
L16	Oscillator circuit auto tuning coils	4·0
L17		4·5
L18		9·5
L19		9·5

	OTHER COMPONENTS (Continued)	Approx. Values (ohms)
S1 a, b, c, x, z to S3 a, b, c, w, x, y, z	Aerial circuit manual waveband switches	—
S4 a, b, c x, y to S7 a, b x, y	Aerial circuit auto tuning selector switches	—
S8a, b, c, x, y to S10a, b, c, x, y	Oscillator circuit manual waveband switches	—
S11a, b, x, y to S14a, b, x, y	Oscillator circuit auto tuning selector switches	—
S15a, x	Radio/gram change switches	—
S16	Mains switch, ganged R15	—
	AC MODEL	
L101	Speaker speech coil	2·2
L102	Hum neutralising coil	0-15
L013	Speaker field coil	1,500·0
T101	Speaker input trans. Pri	620·0
	Speaker input trans. Sec.	0·3
T102	Mains trans. Pri., total	38·0
	Mains trans. Heater sec.	0·2
	Mains trans. Rect. heat sec.	0·2
	Mains trans. H.T. sec., total	410·0
	AC/DC MODEL	
L201	Speaker speech coil	2·2
L202	HT smoothing choke	300·0
L203	Mains filter chokes	3·5
L204	Mains filter chokes	3·5
T201	Speaker input trans. Pri.	620·0
	Speaker input trans. Sec.	0·3
F	Mains circuit fuse, 5A	—

GENERAL NOTES

In the preparation of this *Service Sheet* the main chassis, which is almost identical in both AC and AC/DC models, has been dealt with separately, while the AC and AC/DC power and output units are also separately treated.

Note that components in the main chassis are numbered normally; those in the AC unit are numbered from 101 upwards; and those in the AC/DC unit are numbered from 201 upwards.

Switches.—S1a, b, c, x, z to **S14a, b, x, y** are the wavechange and station selection switches, and **S15a, x** the radio/gram change switches, all contained in the press-button unit, two views of which are given in a detailed diagram. The action of the switches is fully explained at the beginning of the Circuit Description.

S16 is the QMB mains switch, ganged with the volume control **R15.**

Coils.—L1, L2 are in an unscreened unit beneath the chassis. **L3-L5, L6-L9; L10-L12** and **L13-L15** are in four screened units on the chassis deck. **L16-L19** are the four pre-set station oscillator coils, mounted beneath the chassis, with their core adjusting screws projecting through the front chassis member.

Scale Lamps.—These are two National Union type N51 bulbs, with miniature bayonet cap bases. They are in parallel in the AC model, and in series, shunted by **R19,** in the AC/DC model.

External Speaker.—Two sockets are provided on the deck of the power and output unit for a high impedance (5,000) external speaker.

Smoothing Condensers.—In the case of the AC models, **C104** and **C105** are two dry electrolytics in a single metal can mounted on the deck of the power and output unit. The can is the common negative; the red spotted tag is

the positive of **C104** (16μF) and the plain tag is the positive of **C105** (8μF).

In the AC/DC model, the condensers **C204** and **C205** are in a single unit mounted horizontally beneath the deck of the power and output unit. Both condensers are rated at 16μF in this case. The can is negative; the red tag is the positive of **C204** and the plain tag the positive of **C205.**

Chassis and Speaker Connections.—The main chassis is connected to the power and output unit by a 4-pin plug and socket. A diagram of the plug, viewed from the free ends of the pins, is beneath the circuit diagram. The pins are numbered 1 to 4, and the connection points indicated in the circuit.

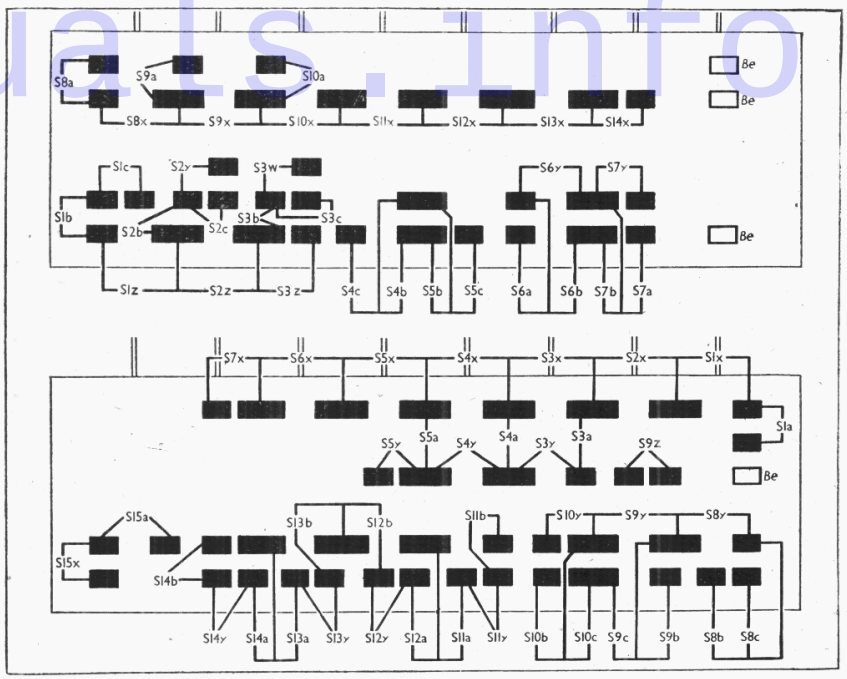
The mains switch **S16** is in the main chassis, but is connected to the other chassis by a 2-pin plug and socket. This plug is also shown beneath the main circuit diagram; the pins being numbered 5 and 6.

The speaker is connected to the power and output unit by a 3-pin plug and socket. This is shown associated with the separate circuit diagrams of the power and output units. In the AC model, all three pins are used (7-9), while in the AC/DC model only two pins are used (7 and 8), the third being blank.

Heater Wiring.—This differs in the two models. The main circuit diagram indicates the AC (parallel) wiring. Inset beneath it is a diagram of the series heater chain for the first three valves of the AC/DC model (the remaining two heaters being shown in the separate diagram of the AC/DC power and output unit).

Resistance R206.—This ballast resistance is in the AC/DC power and output unit only. It is of the vitreous enamelled wire-wound type. At the upper end it has three mains voltage tappings; at the lower end there are two tappings, of which the bottom one is used in the 902 (5-valve) models.

Chassis Divergencies.—**R1** is given by the makers as 4MO; **R16** is given as 250O; **C8** is given as 0·01μF; **C2** is shown in the makers' diagram connected to the bottom of **C1**, not the top; further, **C2** is given as 0·0005μF by the makers. In our chassis, both **C1** and **C2** are 0·00025μF. In the makers' diagram there is a 50,000O resistance connected across the pick-up sockets.



Diagrams of the press-button switch unit. Top, as seen from above the chassis; bottom, as seen from beneath the chassis

PRESS-BUTTON ADJUSTMENT

The press-buttons, from left to right, looking at the front of the set are: 1, Gram; 2, LW station, 1,300-2,000m; 3, LW station, 1,200-1,870m; 4, MW station, 320-560m; 5, MW station, 200-400m; 6, MW manual; 7, LW manual; 8, SW manual.

Stations within the tuning range of the buttons 2-5 are selected by pressing the appropriate button, tuning the oscillator circuit by the core adjustment beneath the button shaft, then tuning the aerial circuit by the trimmer above and to the left of the button shaft.

CIRCUIT ALIGNMENT

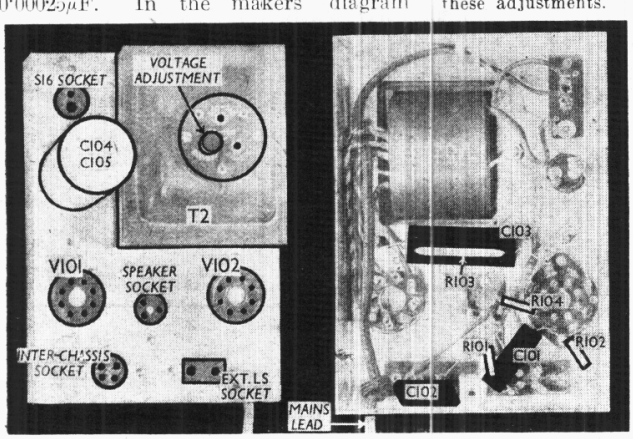
IF Stages.—Press MW manual button and turn gang to maximum. Remove top cap connector of **V1** and connect a 500,000O resistance between the connector and the top cap of the valve. Connect signal generator, via a 0.00025μF condenser, between top cap of **V1** and earth lead. Feed in a 470 KC/S signal, and adjust **C44, C43, C42, C41, C40** and **C39** in turn for maximum output. Repeat these adjustments.

RF and Oscillator Stages.—With gang at maximum, pointer should be horizontal. Connect signal generator, via a dummy aerial, to **A** and **E** leads.

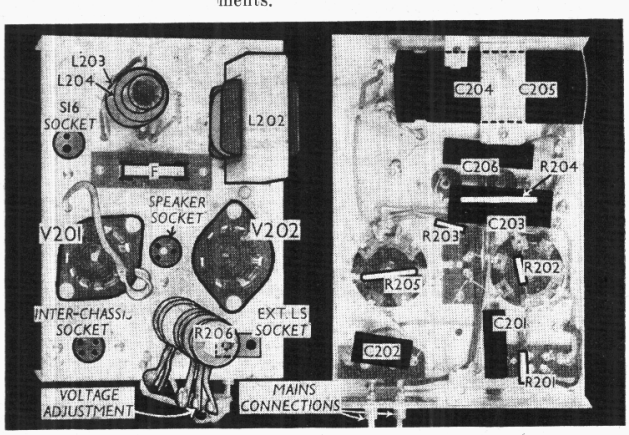
SW.—Press SW manual button, tune to 16 MC/S on scale, feed in a 16 MC/S (18.75 m) signal, and adjust **C35** for maximum output, using the peak involving the lesser trimmer capacity. Then adjust **C24** for maximum output. Feed in a 6 MC/S (50 m) signal, tune it in, and adjust **C32** for maximum output, while rocking the gang for optimum results. Repeat the 16 MC/S adjustments.

MW.—Press MW manual button, tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C36**, then **C25,** for maximum output. Feed in a 500 m (600 KC/S) signal, tune it in, and adjust **C33** for maximum output, while rocking the gang for optimum results. Repeat the 214 m adjustments.

LW.—Press LW manual button, tune to 1,250 m on scale, feed in a 1,250 m (240 KC/S) signal, and adjust **C37,** then **C26,** for maximum output. Feed in a 2,000 m (150 KC/S) signal, tune it in, and adjust **C34** for maximum output, while rocking the gang for optimum results. Repeat the 1,250 m adjustments.



Plan and underneath views of the AC unit



Plan and underneath views of the AC/DC unit

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