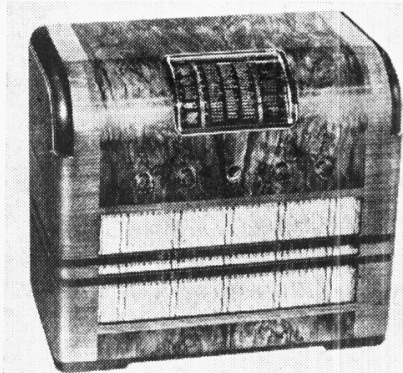


"TRADER" SERVICE SHEET

486

FERGUSON 904, 904U



THE Ferguson 904 is an AC 3-band 5-valve (plus rectifier and tuning indicator) table superhet, while the 904U is the corresponding AC/DC model.

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. Both models are therefore covered,

and their divergencies fully explained. Release date: Both models, Aug., 1939.

CIRCUIT DESCRIPTION

Except for the series heater wiring and the addition of R25 and C52, the 904U (AC/DC) receiver chassis is similar to 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, C2 and C4 to single tuned circuit L3, C34. On LW, the signal is picked up from L1, which is permanently shunted across the aerial circuit by the coupling L2, C3, and is thus fed into the low potential end of the single tuned circuit L5, C34. On MW, when S1 and S3 close, the coupling is mixed; the signal is fed via C1, C2 and S3 to one end of L5, which now operates as a coupling coil, while L2, C3 are connected via S1 to the other end, and the signal is thus passed on to the MW circuit L4, C34.

First valve (V1, Mullard EF8) is a variable-mu hexode operating as signal frequency amplifier, with a choke-transformer coupling unit L6, L7, C9 in its anode circuit.

Coupling is then via C8, C10 (SW) and L7, C9 and S11 (LW) to the RF tuning circuits L8, C38 (SW) and L10, C38 (LW), while on MW S12 closes and connects C8 across L6. On MW, S10 and S13 close and the signal is passed via L10 to the MW RF circuit L9, C38.

Second valve (V2, Mullard ECH3) is a triode heptode operating as frequency

changer with internal coupling. Triode oscillator anode coils L12 (SW), L13 (MW) and L14 (LW) are tuned by C45. Parallel trimming by C42 (SW), C43 (MW) and C44 (LW); series tracking by C18, C39 (SW), C40 (MW) and C41 (LW). Reaction coupling is effected on all bands by the common impedance of the trackers in grid and anode circuits, augmented on SW by the addition of the reaction coil L11.

Third valve (V3, Mullard EF9) is a variable-mu RF pentode operating as intermediate frequency amplifier with triple-tuned transformer couplings C46, L15, L16, C47, L17, C48 and C49, L18, L19, C50, L20, C51.

Intermediate frequency 470 KC/S.

Diode second detector is part of double diode triode valve (V4, Mullard EBC3) in which the two diode anodes are strapped together to operate as a single diode. Audio frequency component in rectified output is developed across load resistance R18 and passed via R17, AF coupling condenser C26, S33 and manual volume control R19 to CG of triode section, which operates as AF amplifier. Tone compensation by C25. IF filtering in diode circuit by C24 and R17; in triode CG circuit by C27; and in triode anode circuit by C29.

Provision for connection of gramophone pick-up across R19 via switch S34, which closes when the control is turned to the "gram" position while S33 opens to mute radio. Variable tone control by R21, C30 in triode anode circuit.

DC potential developed across R18 is

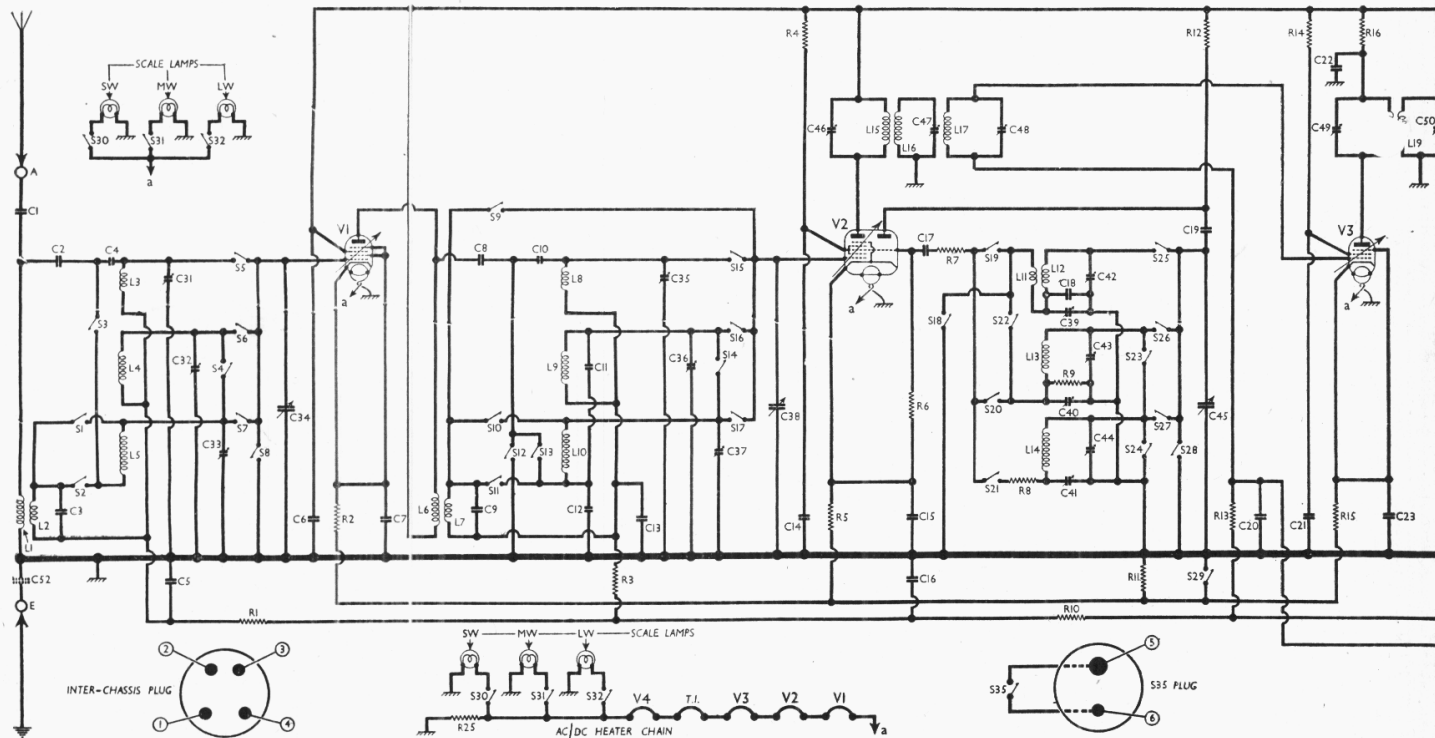
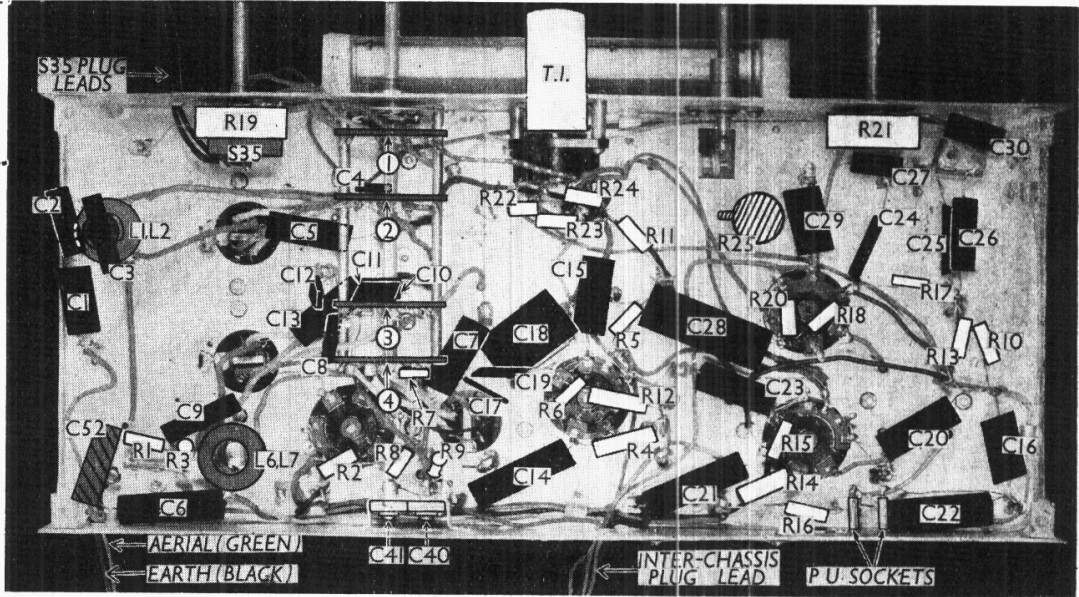


Diagram of the main chassis of both models. The AC/DC heater chain is inset beneath the circuit. C52 and R25 are in

Underneath view of the main chassis of both models.



fed back via **R17** and decoupling circuits as GB to RF, FC and IF valves, giving automatic volume control. Fixed GB voltages for these valves is obtained automatically in the usual manner by passing their cathode currents to chassis via the resistances **R2**, **R5** and **R15** respectively, but on MW and LW the voltages are increased by returning the resistances to chassis via a further resistance **R11**. On SW **R11** is short-circuited by **S29**.

AVC potential as applied to **V3** is tapped off and used as control voltage for the cathode ray tuning indicator (**T.I.**, Mullard **EM4**), which is of the double-action type.

Power and Output Unit (AC).— Resistance-capacity coupling by **R101**, **C101** and **R102** between **V4** triode and tetrode output valve (**V101**, Mullard **EL3**). Fixed tone correction by **C102**, **R105** in anode circuit. Provision for connection of high impedance external speaker across primary of internal speaker

input transformer **T101**.

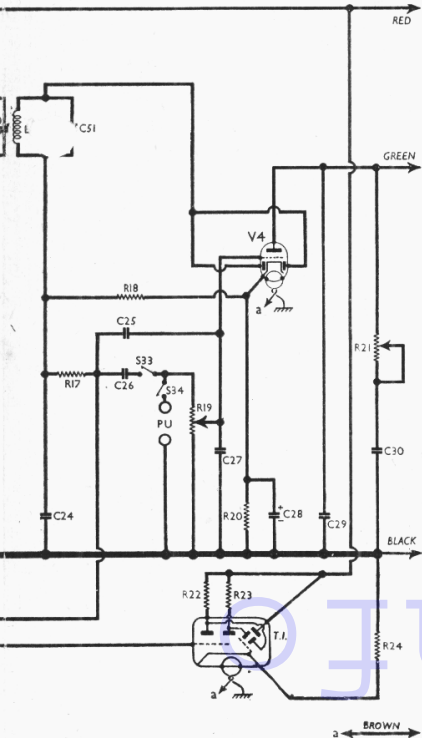
HT current is supplied by full-wave rectifying valve (**V102**, Mullard **5Y3G**). Smoothing by speaker field **L103** and electrolytic condensers **C104** and **C105**.

Power and Output Unit (AC/DC).— Resistance-capacity coupling by **R201**, **C201** and potential divider **R202**, **R203** between **V4** triode and pentode output valve (**V201**, Mullard **CL4**). Fixed tone correction by **C202**, **R206** in anode circuit. Provision for connection of high impedance external speaker across primary of internal speaker input transformer **T201**.

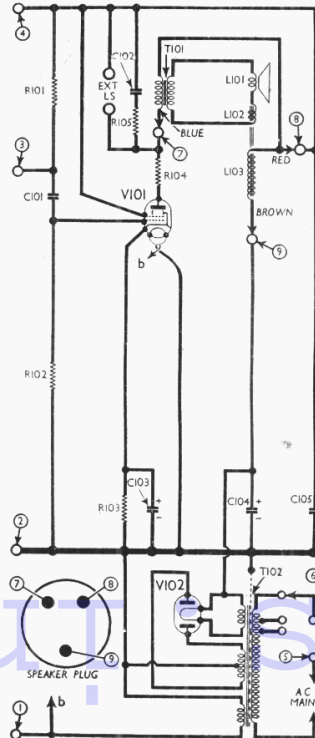
When the receiver is used with AC

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 special barretter lamp, 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.



The AC output unit.



The AC/DC output unit.

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 four control knobs (pull-off).

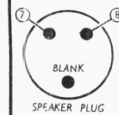
Withdraw from the power and output unit the two plugs connecting it to the receiver chassis.

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.)

Loosen the four nuts on the bolts holding the shelf to the fillets on the side of the cabinet.

Remove the two slotted wooden packing pieces from beneath the shelf, lowering the shelf on to the fillets. The chassis can now be withdrawn.

When replacing, fit a felt washer to each control spindle, between the knob and 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

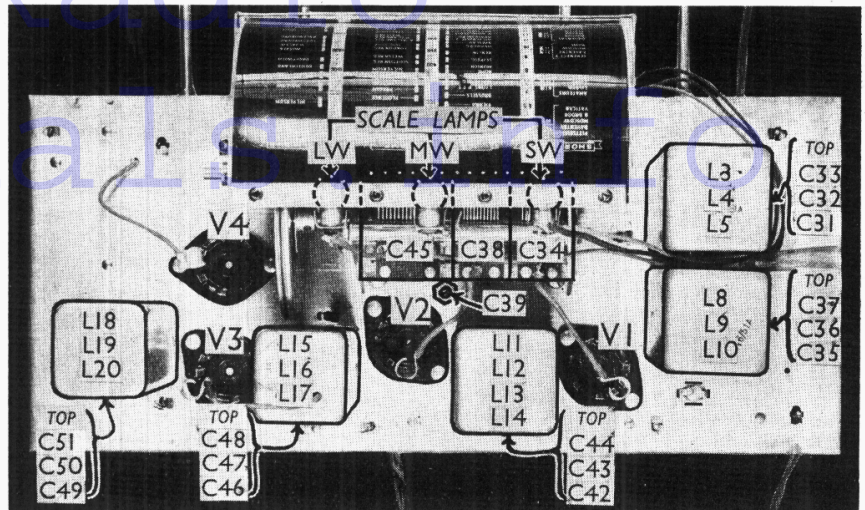
Valve voltages and currents given in the table below are those measured in our receivers when they were operating on AC mains of 235V, using the 220-230V tapping on the mains transformer in the case of the AC model. The receivers were tuned to the lowest wavelength on the MW band.

| Valve | Anode Voltage (V) | Anode Current (mA) | Screen Voltage (V) | Screen Current (mA) |
|-----------|-------------------|--------------------|--------------------|---------------------|
| V1 EF8 | AC MODEL 265 | 4.7 | 265 | 0.2 |
| V2 ECH3 | 265 | 4.0 | 160 | 0.6 |
| | Oscillator 135 | 4.3 | | |
| V3 EF9 | 258 | 3.8 | 133 | 1.3 |
| V4 EBC3 | 60 | 0.8 | — | — |
| V101 EL3 | 230 | 29.8 | 265 | 5.3 |
| V102 5Y3G | 293† | — | — | — |
| T.I. EM4 | 35* Target | 0.2* | — | — |
| | 265 | 0.8 | | |
| V1 EF8 | AC/DC MODEL 250 | 4.7 | 250 | 0.2 |
| V2 ECH3 | 250 | 3.5 | 165 | 0.5 |
| | Oscillator 130 | 3.8 | | |
| V3 EF9 | 245 | 3.3 | 128 | 1.2 |
| V4 EBC3 | 60 | 0.8 | — | — |
| V201 CL4 | 220 | 32.5 | 250 | 5.7 |
| V202 CY1 | 270‡ | — | — | — |
| T.I. EM4 | 35* Target | 0.2* | — | — |
| | 250 | 0.7 | | |

† Each anode, AC. * Approx. each anode, DC. ‡ Cathode to chassis, DC.

COMPONENTS AND VALUES

| RESISTANCES | | Values (ohms) |
|-------------|---------------------------------------|---------------|
| R1 | V1 CG decoupling | 250,000 |
| R2 | V1 fixed GB resistance | 400 |
| R3 | V2 heptode CG decoupling | 250,000 |
| R4 | V2 SG HT feed | 100,000 |
| R5 | V2 fixed GB resistance | 500 |
| R6 | V2 osc. CG resistance | 50,000 |
| R7 | Osc. reaction stabiliser | 20 |
| R8 | Osc. LW reaction damping | 25,000 |
| R9 | Osc. circuit MW damping | 5,000 |
| R10 | AVC line decoupling | 100,000 |
| R11 | V1, V2, V3 MW and LW GB | 200 |
| R12 | V2 osc. anode HT feed | 25,000 |
| R13 | V3 CG decoupling | 500,000 |
| R14 | V3 SG HT feed | 100,000 |
| R15 | V3 fixed GB resistance | 500 |
| R16 | V3 anode HT feed | 1,000 |
| R17 | IF stopper | 25,000 |
| R18 | V4 diode load resistance | 500,000 |
| R19 | Manual volume control | 500,000 |
| R20 | V4 triode GB resistance | 25,000 |
| R21 | Variable tone control | 100,000 |
| R22 | T.I. anodes HT feed | 1,000,000 |
| R23 | | 1,000,000 |
| R24 | T.I. GB resistance | 1,000 |
| R25 | Scale lamps shunt (AC/DC model only.) | 100 |
| AC MODEL | | |
| R101 | V4 triode anode load | 240,000 |
| R102 | V101 CG resistance | 500,000 |
| R103 | V101 GB resistance | 150 |
| R104 | V101 anode stabiliser | 100 |
| R105 | Part fixed tone corrector | 10,000 |
| AC/DC MODEL | | |
| R201 | V4 triode anode load | 240,000 |
| R202 | V201 CG input potential divider | 100,000 |
| R203 | V201 divider | 250,000 |
| R204 | | 300 |
| R205 | V201 GB resistance | 300 |
| R206 | V202 anode surge limiter | 100 |
| | Part fixed tone corrector | 10,000 |



Plan view of the main chassis of both models.

| CONDENSERS | | Values (μF) |
|-------------|--|-------------|
| C1 | Aerial series condenser... | 0.00025 |
| C2 | Aerial MW coupling ... | 0.00025 |
| C3 | Part LW aerial coupling | 0.002 |
| C4 | Aerial SW coupling ... | 0.00002 |
| C5 | V1 CG decoupling ... | 0.1 |
| C6 | V1 SG decoupling ... | 0.1 |
| C7 | V1 cathode by-pass ... | 0.1 |
| C8 | Part RF coupling ... | 0.0001 |
| C9 | Part LW RF coupling ... | 0.002 |
| C10 | V1 to V2 hept. SW coupling ... | 0.00002 |
| C11 | RF MW fixed trimmer... | 0.000005 |
| C12 | Part RF coupling ... | 0.00001 |
| C13 | V2 heptode CG decoupling ... | 0.1 |
| C14 | V2 SG decoupling ... | 0.1 |
| C15 | V2 cathode by-pass ... | 0.1 |
| C16 | AVC line IF by-pass ... | 0.00025 |
| C17 | V2 osc. CG condenser ... | 0.0001 |
| C18 | Osc. circ. SW fixed tracker ... | 0.002 |
| C19 | V2 osc. anode coupling... | 0.0001 |
| C20 | V3 and T.I. CG's decoupling ... | 0.1 |
| C21 | V3 SG decoupling ... | 0.1 |
| C22 | V3 anode decoupling ... | 0.1 |
| C23 | V3 cathode by-pass ... | 0.1 |
| C24 | IF by-pass condenser ... | 0.00025 |
| C25 | Tone compensator ... | 0.00025 |
| C26 | AF coupling to V4 triode | 0.01 |
| C27 | IF by-pass ... | 0.0001 |
| C28* | V4 cathode by-pass ... | 25.0 |
| C29 | IF by-pass ... | 0.00025 |
| C30 | Part of variable tone control... | 0.01 |
| C31† | Aerial circuit SW trimmer | — |
| C32† | Aerial circuit MW trimmer | — |
| C33† | Aerial circuit LW trimmer | — |
| C34† | Aerial circuit tuning ... | — |
| C35† | RF coupling SW trimmer | — |
| C36† | RF coupling MW trimmer | — |
| C37† | RF coupling LW trimmer | — |
| C38† | RF coupling tuning ... | — |
| C39† | Osc. circuit SW tracker | — |
| C40† | Osc. circuit MW tracker | — |
| C41† | Osc. circuit LW tracker | — |
| C42† | Osc. circuit SW trimmer | — |
| C43† | Osc. circuit MW trimmer | — |
| C44† | Osc. circuit LW trimmer | — |
| C45† | Oscillator circuit tuning | — |
| C46† | 1st IF transformer tuning condensers | — |
| C47† | | — |
| C48† | 2nd IF transformer tuning condensers | — |
| C49† | | — |
| C50† | Earth isolating condenser (AC/DC model only) | — |
| C51† | | — |
| C52 | — | 0.1 |
| AC MODEL | | |
| C101 | V4 triode to V101 AF coupling ... | 0.01 |
| C102* | Part fixed tone corrector | 0.01 |
| C103* | V101 cathode by-pass ... | 25.0 |
| C104* | HT smoothing condensers | 8.0 |
| C105* | | 16.0 |
| AC/DC MODEL | | |
| C201 | V4 triode to V201 AF coupling ... | 0.01 |
| C202* | Part fixed tone corrector | 0.01 |
| C203* | V201 cathode by-pass ... | 25.0 |
| C204* | HT smoothing condensers | 16.0 |
| C205* | | 16.0 |
| C206 | Mains RF by-pass ... | 0.1 |

* Electrolytic. † Variable. ‡ Pre-set.

| OTHER COMPONENTS | | Approx. Values (ohms) | |
|------------------|--------------------------------|------------------------------------|------|
| L1 | Aerial circuit choke ... | 200.0 | |
| L2 | Aerial LW coupling ... | 15.0 | |
| L3 | Aerial SW tuning coil ... | Very low | |
| L4 | Aerial MW tuning coil... | 4.0 | |
| L5 | Aerial LW tuning coil ... | 25.0 | |
| L6 | V1 anode circuit choke... | 200.0 | |
| L7 | LW RF coupling coil ... | 13.0 | |
| L8 | RF SW tuning coil ... | Very low | |
| L9 | RF MW tuning coil ... | 4.0 | |
| L10 | RF LW tuning coil ... | 25.0 | |
| L11 | Osc. SW reaction coil ... | 0.5 | |
| L12 | Osc. circuit SW tuning... | Very low | |
| L13 | Osc. circuit MW tuning... | 4.5 | |
| L14 | Osc. circuit LW tuning... | 19.0 | |
| L15 | 1st IF trans. { Pri. ... | 17.0 | |
| L16 | | Sec. ... | 17.0 |
| L17 | | Tert. ... | 17.0 |
| L18 | 2nd IF trans. { Pri. ... | 17.0 | |
| L19 | | Sec. ... | 17.0 |
| L20 | | Tert. ... | 17.0 |
| S1-S32 | Waveband switches | — | |
| S33, S34 | Radio/gram change switches | — | |
| S35 | Mains switch, ganged R19 ... | — | |
| AC MODEL | | | |
| L101 | Speaker speech coil ... | 2.2 | |
| L102 | Hum neutralising coil ... | 0.15 | |
| L103 | Speaker field coil ... | 1,500.0 | |
| T101 | Speaker input { Pri. ... | 650.0 | |
| | trans. { Sec. ... | 0.3 | |
| T102 | Mains trans. { Pri., total ... | 32.0 | |
| | | Heater sec. ... | 0.15 |
| | | Rect. heat. sec. HT sec., total... | 0.1 |
| | | 410.0 | |
| AC/DC MODEL | | | |
| L201 | Speaker speech coil ... | 2.2 | |
| L202 | HT smoothing choke ... | 300.0 | |
| L203 | Mains filter chokes ... | 3.5 | |
| L204 | | 3.5 | |
| T201 | Speaker input { Pri. ... | 650.0 | |
| | trans. { Sec. ... | 0.3 | |
| F | Mains circuit fuse (1A)... | — | |

GENERAL NOTES

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.—S1—S32 are the waveband switches, and S33, S34 the radio/gram change switches, in four rotary units beneath the chassis. They are shown in detail in the diagrams in col. 5, where they are drawn as seen looking from the rear of the underside of the chassis. The table (col. 4) gives the switch positions for the four control settings, starting from fully anti-clockwise. A dash indicates open, and C, closed.

S35 is the QMB mains switch, ganged

with the volume control **R19**. Its leads terminate in a 2-pin plug, fitting into a socket in the power and output chassis.

Coils.—**L1, L2** and **L6, L7** are in two unscreened units beneath the chassis. **L3-L5, L8-L10, L11-L14** and the IF transformers **L15-L17** and **L18-L20** are in five screened units on the chassis deck. Each unit contains three trimmers, the positions of which are indicated in the plan chassis view.

Scale Lamps.—These are three National Union type N51 bulbs, with miniature bayonet cap bases. They are shunted by **S30-S32**, and the one in use is switched by **R25** 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 Ω) external speaker.

Smoothing Condensers.—In the case of the AC model, **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 **C105** (16 μ F) and the plain tag is the positive of **C104** (8 μ F).

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 16 μ F 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 inter-connections between the two chassis, and the speaker, are carried out by various plugs and sockets.

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 **S35** 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 four valves and the T.I. of the AC/DC model (the remaining two heaters being shown in the separate diagram of the AC/DC power and output unit).

Barretter.—This is used in the 904U model only. It fits into a 4-pin holder on the AC/DC power and output unit. The type fitted is numbered 150A, and is rated for a current of 0.2A. The make is not specified. In early models, in place of the barretter, a tapped ballast resistance may be fitted. At the upper end of this will be three mains voltage tapings. At the lower end will be two tapings, of which the upper one is used in the 904U.

Resistance R25.—This is the scale lamp shunt, which is only used in the AC/DC model. It is shown dotted in the underneath view of the main chassis.

Condenser C52.—The earth isolating condenser is only used in the AC/DC model. It is shown dotted in the circuit.

Chassis Divergencies.—**R105** (AC) and **R206** (AC/DC) are not in the makers' diagram, neither are **C11** and a number of shorting switches. The makers show the control grid of the T.I. fed from the AVC line, and **C25** returned to chassis, instead of being connected to V4 CG, as in our models. **C103** (AC) was missing in our chassis. Several of the components have values somewhat different from those in our models.

CIRCUIT ALIGNMENT

IF Stages.—Switch set to MW and turn gang to maximum. Remove top cap connector of **V2** and connect a 500,000 Ω resistance between the connector and the top cap of the valve. Connect signal generator, via a 0.00025 μ F condenser, between top cap of **V2** and earth lead. Feed in a 470 KC/S signal, and adjust **C51, C50, C49, C48, C47** and **C46** in turn for maximum output. Repeat these adjustments.

RF and Oscillator Stages.—With gang at maximum, pointer should be over the two short horizontal lines at the top left-hand edge of the scale. Connect signal generator, via a dummy aerial, to **A** and **E** leads.

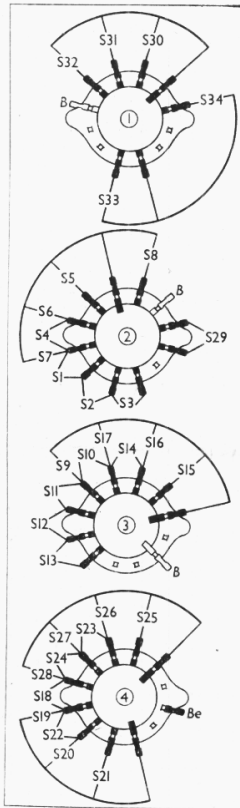
SW.—Switch set to SW, tune to 16 MC/S on scale, feed in a 16 MC/S (18.75 m) signal, and adjust **C42** for maximum output, using the peak involving the lesser trimmer capacity. Then adjust **C35** and **C31** for maximum output. Feed in a 6 MC/S (50 m) signal, tune it in, and adjust **C39** for maximum output, while rocking the gang for optimum results. Repeat the 16 MC/S adjustments.

MW.—Switch set to MW, tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C43**, then **C36** and **C32**, for maximum output. Feed in a 500 m (600 KC/S) signal, tune it in, and adjust **C40** for maximum output, while rocking the gang for optimum results. Repeat the 214 m adjustments.

LW.—Switch set to LW, tune to 1,250 m on scale, feed in a 1,250 m (240 KC/S) signal, and adjust **C44**, then **C37** and **C33**, for maximum output. Feed in a 2,000 m (150 KC/S) signal, tune it in, and adjust **C41** for maximum output, while rocking the gang for optimum results. Repeat the 1,250 m adjustments.

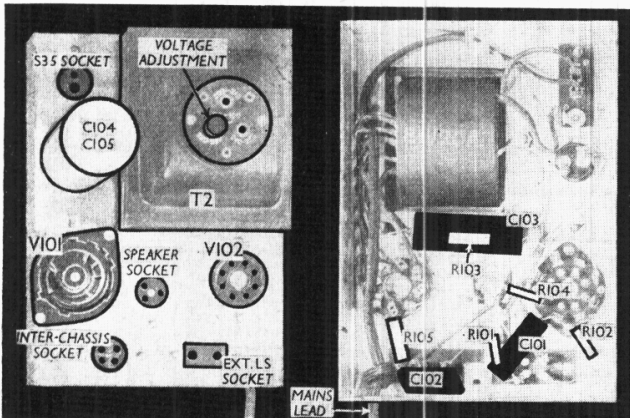
Switch Table

| Switch | SW | MW | LW | Gram |
|--------|----|----|----|------|
| S1 | — | — | — | — |
| S2 | — | — | — | — |
| S3 | — | — | — | — |
| S4 | — | — | — | — |
| S5 | — | — | — | — |
| S6 | — | — | — | — |
| S7 | — | — | — | — |
| S8 | — | — | — | — |
| S9 | — | — | — | — |
| S10 | — | — | — | — |
| S11 | — | — | — | — |
| S12 | — | — | — | — |
| S13 | — | — | — | — |
| S14 | — | — | — | — |
| S15 | — | — | — | — |
| S16 | — | — | — | — |
| S17 | — | — | — | — |
| S18 | — | — | — | — |
| S19 | — | — | — | — |
| S20 | — | — | — | — |
| S21 | — | — | — | — |
| S22 | — | — | — | — |
| S23 | — | — | — | — |
| S24 | — | — | — | — |
| S25 | — | — | — | — |
| S26 | — | — | — | — |
| S27 | — | — | — | — |
| S28 | — | — | — | — |
| S29 | — | — | — | — |
| S30 | — | — | — | — |
| S31 | — | — | — | — |
| S32 | — | — | — | — |
| S33 | — | — | — | — |
| S34 | — | — | — | — |
| S35 | — | — | — | — |



The four switch units, seen from the rear of the underside of the chassis.

Plan and underneath views of the AC unit.



Plan and underneath views of AC/DC unit.

