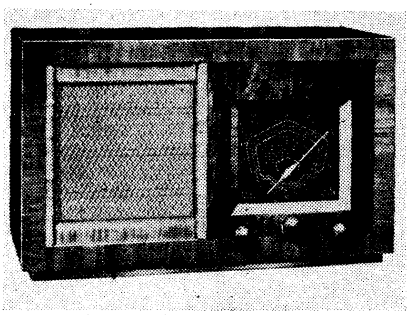
*Supplement to The Wireless & Electrical Trader, January 3, 1942*

"TRADER" SERVICE SHEET

# 550

# FERGUSON 101

## AC SUPERHET



THE Ferguson 101 is a 4-valve (plus rectifier) 3-band superhet, designed to operate from AC mains of 200-250 V, 40-100 C/S. The short-wave range is 13.5-50 m.

Provision is made for the connection of a gramophone pick-up and a high impedance external speaker, and the pick-up may be left connected permanently.

*Release date: January*, 1941.

### CIRCUIT DESCRIPTION

The aerial coupling arrangements in the Ferguson 101 do not follow normal practice. The primary of a transformer **L1, L2, C2** is permanently connected across the aerial circuit, and on LW, low impedance secondary winding **L2** is connected via switch **S1** in the low potential end of the LW aerial tuning circuit **L5, C27,** and thus injects the signal into the circuit.

On MW, **S1** opens, while **S2** and **S4** close, so that the "top" of **L5** is connected to chassis, and the "bottom" of it is connected via **S2, C1** to the aerial, and the coil becomes "inverted." Since it is wound on the same former as **L4,** it is magnetically coupled to it, and thus transfers the signal to the MW tuning circuit **L4, C27.**

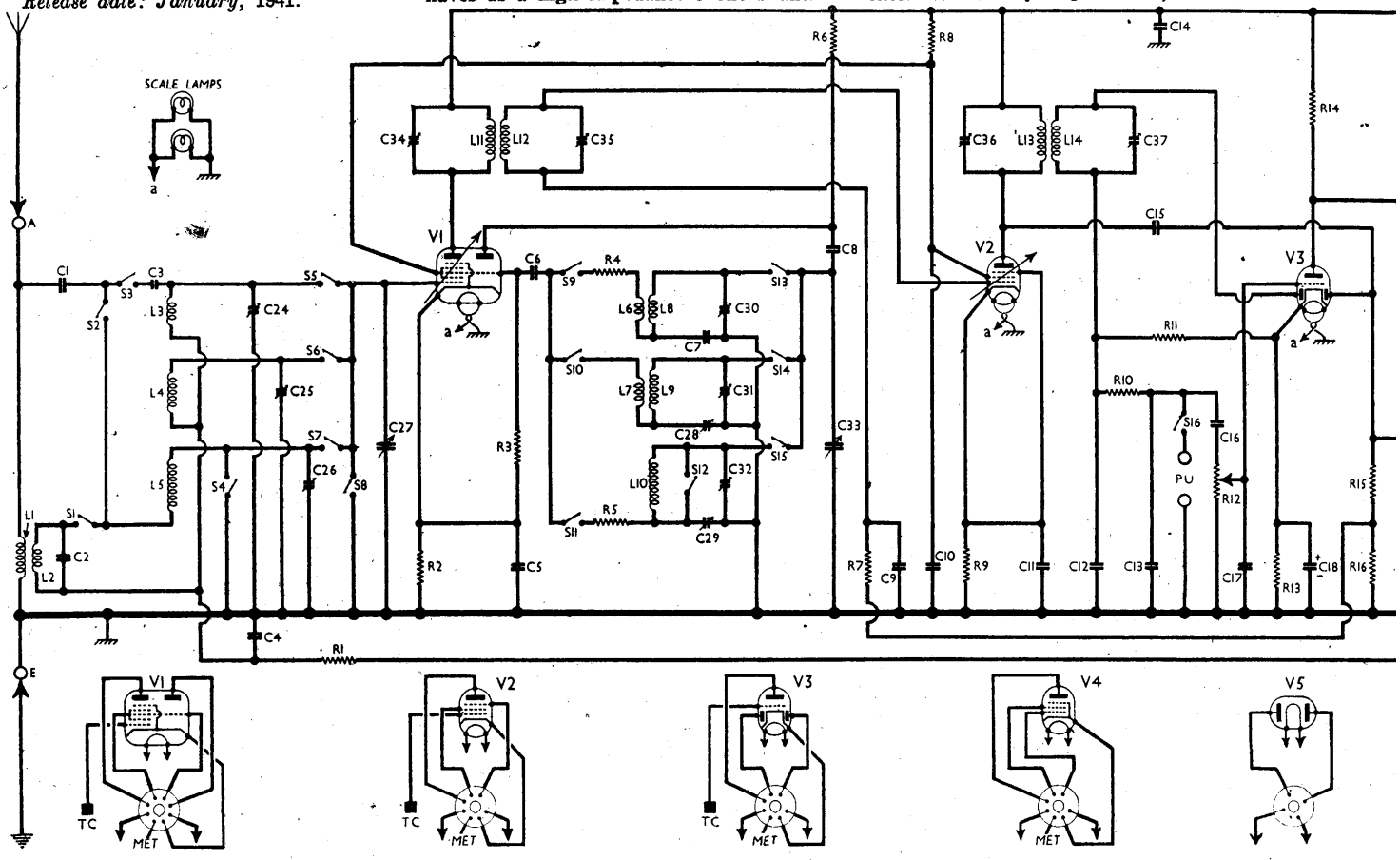
On SW, **S1** and **S2** are open, and **S3** is closed, providing a normal coupling via the series condenser **C3** to the SW tuning circuit **L3, C27.** On the MW and SW bands, **L1** remains in circuit, but it behaves as a high impedance choke shunt.

First valve **(V1, Mullard metallised E6H35)** is a triode-heptode operating as frequency changer with internal coupling. Triode oscillator anode tuning coils **L8** (SW), **L9** (MW) and **L10** (LW) are tuned by **C33.** Parallel trimming by **C30** (SW), **C31** (MW) and **C32** (LW); series tracking by **C7** (SW), **C28** (MW) and **C29** (LW).

Reaction coupling is established by including the trackers in the grid and anode return paths to chassis on all bands, so that they form a common coupling impedance. This coupling is augmented on the SW band by the reaction coil **L6,** and similarly on the MW band by the coil **L7,** and series resistances **R4** (SW) and **R5** (LW) are included in the reaction circuits to prevent parasitic oscillations.

Second valve **(V2, Mullard metallised EF39)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C34, L11, L12, C35** and **C36, L13, L14, C37.**

**Intermediate frequency 470 KC/S.**




Circuit diagram of the Ferguson 101 3-band AC superhet. The aerial coupling circuits are rather unusual, but they are fully described in t oscillator circuits, the trackers **C7, C28** and **C29** also provide reaction coupling. Beneath the circuit are diagrams showing the inte

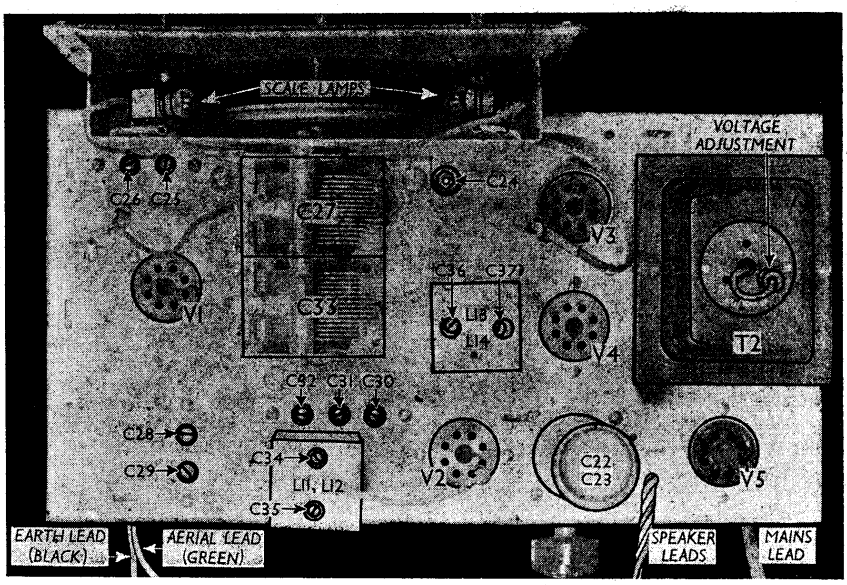
Diode second detector is part of double diode triode valve **(V3, Mullard metallised EBC33).** Audio frequency component in rectified output is developed across load resistance **R11** and passed via IF filter circuit comprising condensers **C12, C13** and resistance **R10,** AF coupling condenser **C16,** manual volume control **R12** and further IF by-pass condenser **C17** to CG of triode section, which operates as AF amplifier.

Provision for connection of gramophone pick-up by sockets across **C16, R12,** via switch **S16.** In the gram position of the waveband control, **S4** and **S8** close to mute radio, while **S16** closes to connect the pick-up, which may consequently be left permanently connected.

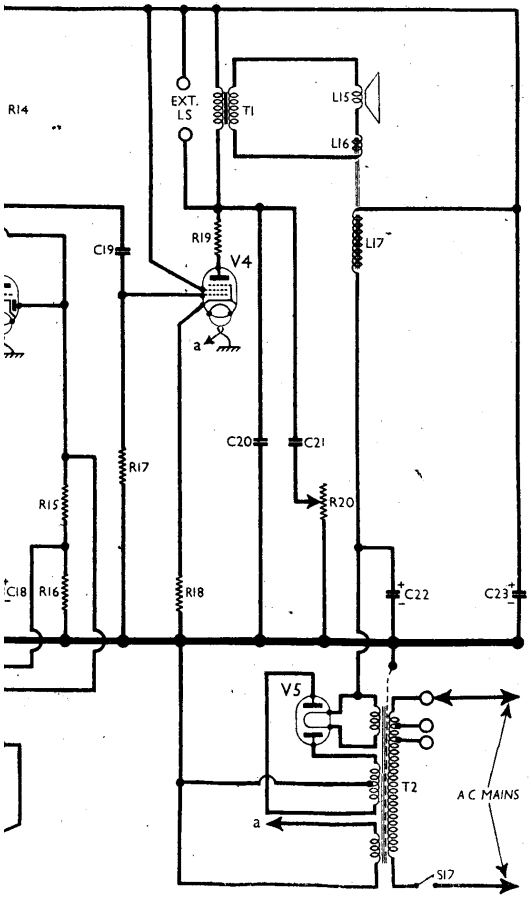
Second diode of **V3,** fed from **V2** anode via **C15,** provides DC potentials which are developed across load resistances **R15, R16** and fed back through decoupling circuits as GB to FC and IF valves, giving automatic volume control. Delay voltage, together with GB for triode section, is obtained automatically from drop along resistance **R13** in cathode lead to chassis.

Resistance-capacity coupling by **R14, C19** and **R17** between **V3** triode and pentode output valve **(V4, Mullard EL33).** Provision for connection of high impedance external speaker in anode circuit. Fixed tone correction by **C20** in anode circuit, and variable tone control by **C21** and **R20,** also in anode circuit. All these devices are connected at the remote end of the anode stopper resistance **R19.** A measure of negative feed-back is achieved by the omission of the usual cathode by-pass condenser.

HT current is supplied by full-wave rectifying valve **(V5, Mullard "Amerty" 5Y3G).** Smoothing by speaker field **L17** in conjunction with dry electrolytic condensers **C22** and **C23.** HT circuit RF filtering by **C14.**




Plan view of the chassis. All the trimmer and tracker adjustments are indicated here. Those of the aerial and oscillator circuits are reached through holes in the chassis deck, and those of the IF transformers through holes in the tops of the cans.




bed in the "Circuit Description" above. In the the internal connections to the valve bases.

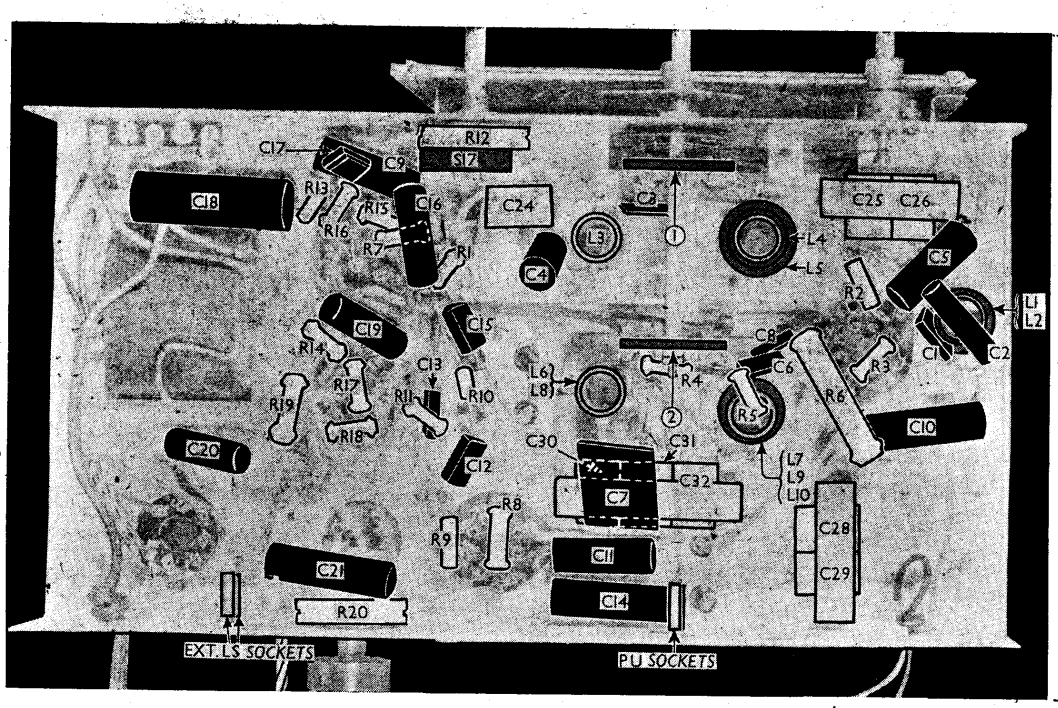
## COMPONENTS AND VALUES

| | CONDENSERS | Values (μF) |
|---|---|---|
| C1 | Aerial MW coupling ... | 0·0005 |
| C2 | Part LW coupling ... | 0·002 |
| C3 | Aerial SW coupling ... | 0·00001 |
| C4 | V1 heptode CG decoupling | 0·1 |
| C5 | V1 cathode by-pass ... | 0·1 |
| C6 | V1 osc. CG condenser ... | 0·0001 |
| C7 | Osc. circuit SW tracker ... | 0·005 |
| C8 | V1 osc. anode coupling ... | 0·0001 |
| C9 | V2 CG decoupling ... | 0·1 |
| C10 | V1, V2 SG's decoupling ... | 0·1 |
| C11 | V2 cathode by-pass ... | 0·1 |
| C12 | IF by-pass condensers ... | 0·00025 |
| C13 | | 0·00025 |
| C14 | HT circuit RF by-pass ... | 0·1 |
| C15 | Coupling to V3 AVC diode | 0·0001 |
| C16 | AF coupling to V3 triode | 0·02 |
| C17 | IF by-pass condenser ... | 0·0001 |
| C18* | V3 cathode by-pass ... | 25·0 |
| C19 | V3 triode to V4 coupling | 0·02 |
| C20 | Fixed tone corrector ... | 0·005 |
| C21 | Part variable tone control | 0·05 |
| C22* | HT smoothing condensers | 16·0 |
| C23* | | 16·0 |
| C24‡ | Aerial circ. SW trimmer... | 0·00003 |
| C25‡ | Aerial circ. MW trimmer | 0·00003 |
| C26‡ | Aerial circ. LW trimmer | 0·00011 |
| C27† | Aerial circuit tuning ... | — |
| C28‡ | Osc. circuit MW tracker... | 0·0006 |
| C29‡ | Osc. circuit LW tracker... | 0·00025 |
| C30‡ | Osc. circuit SW trimmer... | 0·00003 |
| C31‡ | Osc. circuit MW trimmer | 0·00003 |
| C32‡ | Osc. circuit LW trimmer | 0·0002 |
| C33† | Oscillator circuit tuning... | — |
| C34‡ | 1st IF trans. pri. tuning... | — |
| C35‡ | 1st IF trans. sec. tuning... | — |
| C36‡ | 2nd IF trans. pri. tuning... | — |
| C37‡ | 2nd IF trans. sec. tuning | — |

* Electrolytic. † Variable. ‡ Pre-set.

| | RESISTANCES | Values (ohms) |
|---|---|---|
| R1 | V1 heptode CG decoupling | 550,000 |
| R2 | V1 fixed GB resistance ... | 330 |
| R3 | V1 osc. CG resistance ... | 50,000 |
| R4 | Osc. SW reaction damping | 50 |
| R5 | Osc. LW reaction damping | 10,000 |
| R6 | V1 osc. anode HT feed ... | 27,000 |
| R7 | V2 CG decoupling ... | 560,000 |
| R8 | V1, V2, SG's HT feed ... | 50,000 |
| R9 | V2 fixed GB resistance ... | 330 |
| R10 | IF stopper ... ... | 82,000 |
| R11 | V3 signal diode load ... | 500,000 |
| R12 | Manual volume control ... | 2,000,000 |
| R13 | V3 fixed GB ; AVC delay | 2,600 |
| R14 | V3 triode anode load ... | 250,000 |
| R15 | V3 AVC diode load resis- | 560,000 |
| R16 | tances | 560,000 |
| R17 | V4 CG resistance... ... | 560,000 |
| R18 | V4 GB resistance ... | 150 |
| R19 | V4 anode stopper ... | 100 |
| R20 | Variable tone control ... | 100,000 |

| | OTHER COMPONENTS | Approx. Values (ohms) |
|---|---|---|
| L1 | Aerial circuit choke ... | 330·0 |
| L2 | Aerial LW coupling ... | 20·0 |
| L3 | Aerial SW tuning coil... | Very low |
| L4 | Aerial MW tuning coil | 3·0 |
| L5 | Aerial LW tuning coil | 26·0 |
| L6 | Oscillator SW reaction | 0·1 |
| L7 | Oscillator MW reaction | 1·0 |
| L8 | Osc. circ. SW tuning coil | Very low |
| L9 | Osc. circ. MW tuning coil | 2·0 |
| L10 | Osc. circ. LW tuning coil | 5·25 |
| L11 | 1st IF trans. Pri. ... | 8·5 |
| L12 | 1st IF trans. Sec. ... | 8·5 |
| L13 | 2nd IF trans. Pri. ... | 8·5 |
| L14 | 2nd IF trans. Sec. ... | 8·5 |
| L15 | Speaker speech coil ... | 2·0 |
| L16 | Hum neutralising coil... | 0·1 |
| L17 | Speaker field coil ... | 1,500·0 |
| T1 | Speaker input trans. Pri. ... | 550·0 |
| | Sec. ... | 0·3 |
| T2 | Mains trans. Pri., total ... | 29·0 |
| | Heater sec ... | 0·1 |
| | Rect. heat sec. | 0·15 |
| | HT sec., total | 330.0 |
| S1-S15 | Waveband switches ... | — |
| S16 | Gram PU switch ... | — |
| S17 | Mains switch, ganged R12 | — |




Under - chassis view. The two switch units are indicated here by arrows and numbers in circles, and are seen in detail in the diagrams in col. 3 below. The aerial coils **L3, L4, L5** are separated by a metal screen from the oscillator coils **L6-L10.**

## VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 235 V, using the 240-250 V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the medium waveband, 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) |
|---|---|---|---|---|
| V1 ECH35 | 254 | 1·5 | 95 | 1·7 |
| | Oscillator | | | |
| | 126 | 4·3 | | |
| V2 EF39 | 254 | 6·1 | 95 | 1·8 |
| V3 EBC33 | 43 | 0.6 | — | — |
| V4 EL33 | 229 | 34·0 | 254 | 5·0 |
| V5 5Y3G | 340† | — | — | — |

† Each anode, AC.

## DISMANTLING THE SET

**Removing Chassis.**—Remove the three control knobs (pull-off) from the front of the cabinet;

remove the four round-head screws (with square claw washers) holding the chassis to the bottom of the cabinet.

The chassis may now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free chassis entirely, unsolder from the connecting panel on the speaker transformer the three leads connecting it to chassis.

*When replacing,* connect the speaker leads as follows, numbering the tags on the transformer from top to bottom :

1 and 2 (joined together) orange;

3, blue;

4, white.

**Removing Speaker.**—Unsolder the three leads as described above;

remove the four brass hexagon nuts holding the speaker to the sub-baffle.

*When replacing,* the transformer should be at the top left-hand corner of the assembly, when viewed from the rear.

## GENERAL NOTES

**Switches.—S1-S15** are the waveband switches, and **S16** the pick-up switch, ganged in two rotary units beneath the chassis. They are indicated in our under-chassis view, and shown in detail in the diagrams (col. 3) where they are viewed in the direction of the arrows in the under-chassis view.

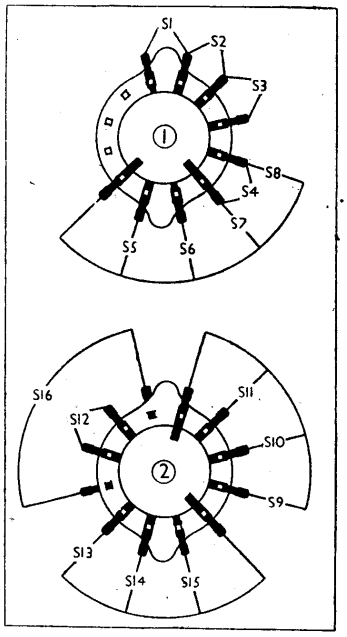
The table below gives the switch positions for the four control settings, starting from the fully anti-clockwise position of the control. A dash indicates open, and **C,** closed.

**S17** is the QMB mains switch, ganged with the volume control **R12.**

### Switch Table

| Switch | SW | MW | LW | Gram. |
|---|---|---|---|---|
| S1 | — | — | C | — |
| S2 | — | C | — | — |
| S3 | C | — | — | — |
| S4 | — | C | — | 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 |

**Coils.**—The aerial coils **L1, L2; L3;** and **L4, L5;** are in three unscreened units beneath the chassis. The oscillator coils **L6, L8** and **L7, L9, L10** are in two unscreened units, also beneath the chassis. **L3-L5** are situated in front of the screening partition, and **L6-L10** are behind it. In the case of the **L6, L8** unit, **L8** is the thick wire winding.




Diagrams of the two switch units, drawn as seen from the rear of the underside of the chassis.

**Gramophone Pick-up.**—Two sockets on the rear of the chassis are provided for connection of a gramophone pick-up, which should have an impedance of about 2,000 Ω. Since a gramophone position

is provided on the waveband control, the leads from the pick-up may be left connected permanently.

**External Speaker.**—Two further sockets are provided at the rear of the chassis for a high impedance (about 5,000 O) external speaker. It should be noted that the sockets are in the HT positive circuit, and are "live."

**Scale Lamps.**—These are two Ever Ready MES types, rated at 6.2 V, 0.3 A, and are connected directly across the heater circuit.

**Condenser C18.**—This is a Plessey dry electrolytic in a tubular cardboard container. It is rated at 25 μF, 25 V working, 35 V surge.

**Condensers C22, C23.**—These are two dry electrolytics in a single tubular cardboard container, mounted vertically in a clip on the chassis deck. They are each rated at 16 μF, 450 V working. The three connecting tags, which are reached from beneath the chassis, are colour coded. The red spotted tag and the plain tag are the positive connections of the two condensers, and the black spotted tag is the common negative connection.

**Pre-set Condensers.**—The aerial and oscillator trimmers and trackers are made up in single, double and triple units. They are mounted on the underside of the chassis deck, and their adjusting screws are accessible from above the deck, through holes punched in the chassis pressing. The units are indicated in our under-chassis view, therefore, and their adjustments in the plan view.

The IF transformer trimmers are in dual units, mounted inside the transformer assemblies. Their adjustments are reached through holes in the tops of the cans.

**Valves.**—All the valves in this receiver are fitted with octal bases. **V1-V4** are Mullard "Red E" types, but with octal bases, and this is indicated by the insertion of a figure 3 in the type number. Thus, EF39 is equivalent to EF9, the figure 3 indicating the octal base. **V5** is a normal Mullard "Amerty" type, from their American series.

## CIRCUIT ALIGNMENT

**IF Stages.**—Switch set to SW, and turn gang and volume control to maximum. Remove the top cap connector of **V1** and connect a 500,000 O resistance between the connector and the top cap of the valve. Connect the signal generator, via a 0.0002 μF condenser, between the grid (top cap) of **V1** and the earth lead.

Feed in a 470 KC/S signal, and adjust **C37, C36, C35** and **C34** in turn for maximum output. Repeat these adjustments.

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

**SW.**—Switch set to SW, tune to 15 m on scale, feed in a 15 m (20 MC/S) signal, and adjust **C30,** using the peak involving the lesser capacity, and then **C24,** in that order, for maximum output. There is no adjustable tracking on this band, but performance should be checked at 50 m (6 MC/S).

**MW.**—Switch set to MW, tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C31,** then **C25,** for maximum output. Feed in a 500 m (600 KC/S) signal, tune it in, and adjust **C28** 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 **C32,** then **C26,** for maximum output. Feed in a 2,000 m (150 KC/S) signal, tune it in, and adjust **C29** for maximum output while rocking the gang for optimum results. Repeat the 1,250 m adjustments.

# THE NEW SERVICE SHEET INDEX

WITH this issue of *The Trader* is included a complete up-to-date index of all the Service Sheets published, from No. 1 to No. 551—well past the half-way mark for the first thousand.

It may appear optimistically long-sighted to talk in terms of thousands. Perhaps it is, in time of war, but we have managed fairly well up to the present. In any case, those issued so far cover well over a thousand receivers.

Much information is to be gleaned from a study of the index, and the one rather disturbing fact that emerges is that the number of "out of print" sheets is growing. Large stocks of reprints have been kept at Dorset House, and, up to the beginning of the war, reprints were available of every sheet published.

Undoubtedly, the war itself has contributed largely to the demand for reprints. Newcomers to radio servicing, increased servicing business to some of the old hands who had not been engaged previously on full-time servicing, and files lost in the blitz have all helped to increase the need for service information, with the result that we receive large orders daily—and here we can speak confidently in terms of thousands—for reprints, and our index becomes sprinkled with asterisks.

It is held proverbially, however, that as one door shuts, another opens. Two doors are closing to us: the one, new sets to provide material for *Service Sheets;* the other, the diminishing stocks of reprints; but a combination of the two provides us with the new opening, of which we have already taken some advantage: the opportunity to revise and republish in our modern style those old sheets whose stocks have become exhausted; and we hope eventually to reissue them all, selecting first those for which the demand is greatest.

Where a revised edition appears in the index, it is annotated with a dagger (†) to indicate that it is a revised issue, and the old *Service Sheet* number that it replaces, in italics, bracketed, precedes the new number.

An example of this can be seen in the case of the Bush model SB1, which was originally *Service Sheet* 11, and is now 526. The Burgoyne AWT, AWTG, on the other hand, is marked with an asterisk to indicate that it is out of print and has not yet been reissued.

### Service Sheet Binders

Owing to paper difficulties and the increased size of the index, it has been necessary to delete from the index the panel, which formerly occupied a centre position on the reverse side of the index, to make room for new entries. The information contained in the panel is, however, important to users of the index, and is, therefore, repeated in a revised form in the next column on this page. It gives the prices of the *Service Sheets* as reprints, and includes a list of those which are at present out of print.

Another item which it includes is the cost of binders. We in the laboratory are not salesmen, and if a dealer already has in use a method by which he can find the sheet he wants immediately, we should advise him to retain it; but from conversations we have held with many dealers, it is very evident that they cannot always find the sheet they want.

Service Sheets, and time, become more valuable every day, and the protection and convenience afforded by these sturdy binders easily justifies their cost. We usually employ one binder for about 60 *Service Sheets,* but a hundred can be accommodated quite comfortably, so that half a dozen of them would suffice to hold the entire set so far issued.

If they are used as suggested, with an index as, say, the first page in each binder, and a number is painted on the spine to indicate which hundred it contains, any sheet can be found immediately. Owing to the nature of the binder, any sheet can be extracted if required in a couple of seconds, and replaced as quickly when it is finished with. If, when a sheet is temporarily removed, it is replaced by an odd scrap of paper on which is written the date and the name of the borrower, track can be kept of missing sheets. Spare copies of the index will be forwarded willingly to any dealer wishing to adopt our suggestion, upon request.

## Service Sheet Reprints

**Nos. 1-52 (single sets) - - Each 4d.**
**Any twelve 3s. 9d.**

**Nos. 53/54-357/358 (in pairs)**
**Each pair 6d.**
**Any twelve 5s.**

**Nos. 359 onwards (single sets)**
**Each 4d.**
**Any twelve 3s. 9d.**

**Clip-back loose-leaf binder - 4s.**

*(Postage extra outside Great Britain.)*

**The following Service Sheets are at present right out of print, and cannot be supplied: 4, 5, 9, 12, 14, 16, 28, 31, 34, 35, 38, 40, 47, 48, 72, 166, 171/2, 175/6, 187/8, 217/8, 239/40, 261/2.**

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