

FERGUSON 502, 502C AND 502RG

A SHORT-WAVE range of 16-50 metres is covered by the Ferguson 502 6-valve (plus rectifier) A.C. 3-band superhet, special features being push-pull output and a cathode-ray tuning indicator. The receiver is suitable for mains of 200-250 V, 40-60 C/S, and includes provision for both an extension speaker and a gramophone pick-up.

An identical chassis is fitted in the 502C console and the chassis in the 502RG radiogram is very similar, the difference being explained in "General Notes." This Service Sheet was prepared on a 502.

CIRCUIT DESCRIPTION

Aerial input via series condenser C1, coupling condenser C2, coupling coil L2 (S.W.) and coupling condenser C3 (M.W. and L.W.) to single tuned circuits L3, C32 (S.W.), L4, C32 (M.W.) and L5, C32 (L.W.) which precede heptode valve (V1, National Union 6A7), operating as frequency changer with electron coupling.

The choke L1 across aerial circuit is claimed to prevent mains hum modulating a carrier and resistance R1 damps the retractor circuit to prevent a resonance peak.

Oscillator grid coils L6 (S.W.), L7 (M.W.) and L8 (L.W.) are tuned by C33; parallel trimming by C35 (S.W.), C36 (M.W.) and C7, C37 (L.W.); series tracking by C38 (S.W.), C34 (M.W.) and C39 (L.W.). Reaction by coils L9 (S.W.) and L10 (M.W.); on L.W. anode is coupled back to low potential end of L8.

Second valve (V2, National Union 8D6) is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings C40, L11, L12, C41 and C42, L13, L14, C43.

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve (V3, National Union 75). Audio frequency component in rectified output is developed across load resistance R12 and passed via A.F. coupling condenser C15 and manual volume control R11 to C.G. of triode section, which operates as A.F. amplifier. Fixed tone correction by C16 in grid circuit and variable tone control by R10, C14 across diode load. I.F. filtering by R9, C12 and C13.

Second diode of V3, fed from L14 via C17, provides D.C. potential which is developed across load resistance R16 and fed back through decoupling circuit as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage is obtained from drop along R13 in V3 cathode lead.

Operating potential for cathode ray tuning indicator (T.I. National Union 6G5) is obtained from A.V.C. line.

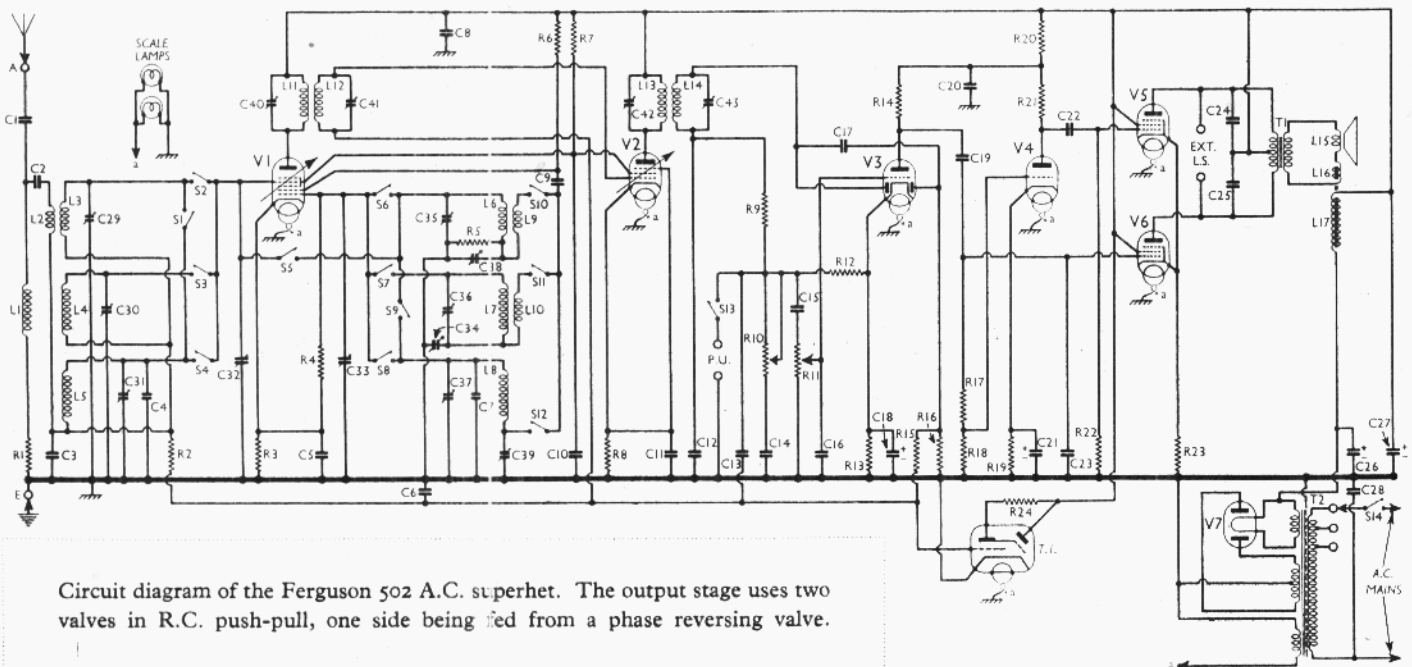
Resistance-capacity coupling by R14, C19 and R17, R18 between V3 triode and one section (V6) of push-pull output stage comprising two pentodes (V5, V6, National Union 42's). Second section (V5) is fed by phase-reversing valve (V4, National Union 76), which obtains its

input voltage from junction of R17, R18. Fixed tone correction in output stage by condensers C24, C25. Provision for connection of high impedance external speaker across primary of T1.

H.T. current is supplied by full-wave rectifying valve (V7, National Union 80). Smoothing by speaker field L17 and dry electrolytic condensers C26, C27. Mains R.F. filtering by C28.

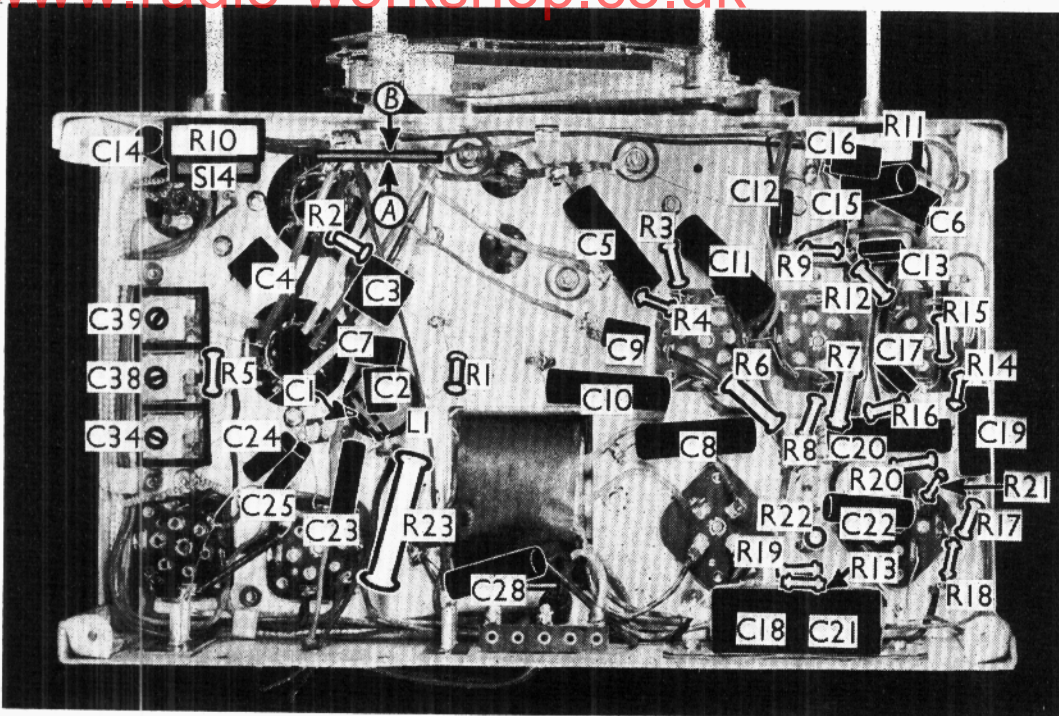
COMPONENTS AND VALUES

| RESISTANCES | | Values (ohms) |
|-------------|-------------------------------------|---------------|
| R1 | A.F. retractor damping | 2,500 |
| R2 | V1 hexode C.G. decoupling | 500,000 |
| R3 | V1 fixed G.B. resistance | 200 |
| R4 | V1 osc. C.G. resistance | 25,000 |
| R5 | Oscillator S.W. circuit stabiliser | 500,000 |
| R6 | V1 osc. anode H.T. feed | 25,000 |
| R7 | V1, V2 S.G. H.T. feed | 50,000 |
| R8 | V2 fixed G.B. resistance | 300 |
| R9 | I.F. stopper | 25,000 |
| R10 | Variable tone control | 500,000 |
| R11 | Manual volume control | 500,000 |
| R12 | V3 signal diode load | 500,000 |
| R13 | V3 G.B. and A.V.C. delay resistance | 10,000 |
| R14 | V3 triode anode load | 250,000 |
| R15 | A.V.C. line decoupling | 500,000 |
| R16 | V3 A.V.C. diode load | 500,000 |
| R17 | V4 C.G. resistances | 50,000 |
| R18 | V4 G.B. resistance | 10,000 |
| R19 | V3 triode, V4 anodes H.T. feed | 100,000 |
| R20 | V4 anode load | 250,000 |
| R21 | V5 C.G. resistance | 500,000 |
| R22 | V5, V6 G.B. resistance | 300 |
| R23 | T.I. anode H.T. feed | 250,000 |
| R24 | | |



Circuit diagram of the Ferguson 502 A.C. superhet. The output stage uses two valves in R.C. push-pull, one side being fed from a phase reversing valve.

Under-chassis view. The two sides of the single switch unit are marked A and B, and diagrams looking in the directions of the arrows are on page VIII. The trackers C34, C38 and C39 are adjusted from the chassis deck.



| CONDENSERS | | Values (μF) |
|------------|--------------------------------------|-------------|
| C1 | Aerial series condenser | 0.00025 |
| C2 | Aerial coupling condenser | 0.00025 |
| C3 | M.W. and L.W. aerial coupling | 0.002 |
| C4 | Aerial L.W. fixed trimmer | 0.00002 |
| C5 | V1 cathode by-pass | 0.1 |
| C6 | A.V.C. line decoupling | 0.1 |
| C7 | Oscillator L.W. fixed trimmer | 0.00002 |
| C8 | H.T. circuit R.F. by-pass | 0.1 |
| C9 | V1 osc. anode coupling | 0.00025 |
| C10 | V1, V2 S.G. decoupling | 0.1 |
| C11 | V2 cathode by-pass | 0.1 |
| C12 | I.F. by-passes | 0.00025 |
| C13 | I.F. by-passes | 0.00025 |
| C14 | Part of variable T.C. circuit | 0.01 |
| C15 | A.F. coupling to V3 triode | 0.01 |
| C16 | Fixed tone corrector | 0.00025 |
| C17 | Coupling to V3 A.V.C. diode | 0.00025 |
| C18* | V3 cathode by-pass | 25.0 |
| C19 | V3 triode to V4 and V6 A.F. coupling | 0.01 |
| C20 | V3, V4 anodes decoupling | 0.1 |
| C21* | V4 cathode by-pass | 5.0 |
| C22 | V4 to V5 A.F. coupling | 0.01 |
| C23 | Fixed tone correctors | 0.001 |
| C24 | Fixed tone correctors | 0.002 |
| C25 | Fixed tone correctors | 0.002 |
| C26* | H.T. smoothing | 8.0 |
| C27* | H.T. smoothing | 8.0 |
| C28 | Mains R.F. by-pass | 0.01 |
| C29† | Aerial circuit S.W. trimmer | — |
| C30† | Aerial circuit M.W. trimmer | — |
| C31† | Aerial circuit L.W. trimmer | — |
| C32† | Aerial circuit tuning | — |
| C33† | Oscillator circuit tuning | — |
| C34† | Osc. circuit M.W. tracker | — |
| C35† | Osc. circuit S.W. trimmer | — |
| C36† | Osc. circuit M.W. tracker | — |
| C37† | Osc. circuit L.W. trimmer | — |
| C38† | Osc. circuit S.W. tracker | — |
| C39† | Osc. circuit L.W. tracker | — |
| C40† | 1st I.F. trans. pri. tuning | — |
| C41† | 1st I.F. trans. sec. tuning | — |
| C42† | 2nd I.F. trans. pri. tuning | — |
| C43† | 2nd I.F. trans. sec. tuning | — |

* Electrolytic. † Variable. ‡ Pre-set.

| OTHER COMPONENTS | | Approx Values (ohms) |
|------------------|---------------------------------|----------------------|
| L1 | Aerial A.F. modulation rejector | 20.0 |
| L2 | Aerial S.W. coupling coil | Very low |
| L3 | Aerial S.W. tuning coil | 0.05 |
| L4 | Aerial M.W. tuning coil | 3.0 |

| OTHER COMPONENTS (Continued) | | Approx. Values (ohms) |
|------------------------------|-------------------------------|-----------------------|
| L5 | Aerial L.W. tuning coil | 15.5 |
| L6 | Oscillator S.W. tuning coil | Very low |
| L7 | Oscillator M.W. tuning coil | 2.0 |
| L8 | Osc. L.W. tuning and reaction | 5.0 |
| L9 | Oscillator S.W. reaction coil | 0.15 |
| L10 | Oscillator M.W. reaction coil | 0.7 |
| L11 | 1st I.F. trans. Pri. | 9.5 |
| L12 | 1st I.F. trans. Sec. | 13.0 |
| L13 | 2nd I.F. trans. Pri. | 13.0 |
| L14 | 2nd I.F. trans. Sec. | 9.5 |
| L15 | Speaker speech coil | 1.5 |
| L16 | Hum neutralising coil | 0.1 |
| L17 | Speaker field coil | 1,000.0 |
| T1 | Speaker input Pri., total | 650.0 |
| | trans. Sec. | 0.15 |
| | Pri., total | 15.0 |
| T2 | Mains trans. Heater sec. | Very low |
| | Rect. heat. sec. | 0.1 |
| | H.T. sec., total | 175.0 |
| St-S12 | Waveband switches | — |
| S13 | Gram. pick-up switch | — |
| S14 | Mains switch, ganged R10 | — |

DISMANTLING THE SET

Removing Chassis.—If it is desired to remove the chassis from the cabinet, remove the four knobs (pull off) and the felt washers from the control spindles, and remove the four bolts (with washers and spring washers) holding the chassis to the bottom of the cabinet. The chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free the chassis entirely, unsolder the speaker leads and when replacing, connect them as follows, numbering the tags on the transformer terminal panel from bottom to top:—1 and 3 joined together, red; 2, blue; 4, blue; 5, red/white.

Removing Speaker.—To remove the speaker from the cabinet, remove the nuts from the four screws holding it to the sub-baffle and when replacing, see that the transformer is on the right and connect the leads as above.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 219 V, using the 220-230 V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the medium band and the volume control was at maximum, but there was no signal input, and the aerial and earth leads were connected together.

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

If V2 should become unstable when its screen current is being measured, as in our case, it can be stabilised by connecting a non-inductive condenser of about 0.1 μF from grid (top cap) to chassis.

| Valve | Anode Voltage (V) | Anode Current (mA) | Screen Voltage (V) | Screen Current (mA) |
|----------|-------------------|--------------------|--------------------|---------------------|
| V1 6A7 | 257 | 1.8 | 62 | 2.3 |
| | 168 | 3.1 | — | — |
| V2 6D6 | 257 | 4.2 | 62 | 1.2 |
| V3 75 | 63 | 0.2 | — | — |
| V4 76 | 45 | 0.4 | — | — |
| V5 42 | 248 | 26.0 | 257 | 5.8 |
| V6 42 | 248 | 26.0 | 257 | 5.1 |
| V7 80 | 325† | — | — | — |
| T.I. 6G5 | 47 | 0.9 | — | — |
| | Target anode | — | — | — |
| | 257 | 0.1 | — | — |

† Each anode, A.C.

GENERAL NOTES

Switches.—S1-S12 are the waveband switches and S13 the pick-up switch, all ganged in a double-sided rotary unit beneath the chassis. The two sides are marked with the letters A and B in circles in our under-chassis view, and are shown in detail in the diagrams on page VIII. Note that in many cases

Continued overleaf

FERGUSON 502—Continued

tags opposite each other on either side of the paxolin support are common.

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

| Switch | S.W. | M.W. | L.W. | Gram. |
|--------|----------|----------|----------|----------|
| S1 | --- | C | --- | --- |
| S2 | C | C | --- | --- |
| S3 | --- | C | --- | --- |
| S4 | --- | --- | C | C |
| S5 | C | --- | --- | --- |
| S6 | C | C | --- | --- |
| S7 | --- | C | C | --- |
| S8 | --- | C | C | --- |
| S9 | --- | C | --- | --- |
| S10 | C | --- | --- | --- |
| S11 | --- | C | --- | --- |
| S12 | --- | --- | C | --- |
| S13 | --- | --- | --- | C |

S14 is the Q.M.B. mains switch, ganged with the tone control, **R10**.

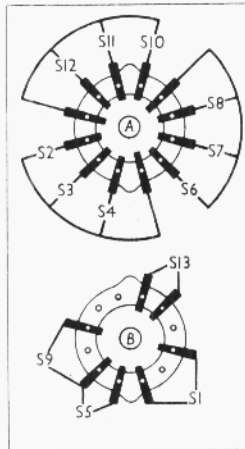
Coils.—**L1** is unscreened, and is mounted beneath the chassis. **L2-L5**; **L6-L10**; **L11, L12** and **L13, L14** are in four screened units on the chassis deck, with their associated trimmers.

Scale Lamps.—These are two miniature bayonet cap types, rated at 4.5 V, 0.3 A.

External Speaker.—Two sockets are provided at the rear of the chassis for a high impedance external speaker.

Condensers C26, C27.—These are two 8 μ F dry electrolytics in a single metal can on the chassis deck. The can is the common negative connection, and the two tags projecting beneath the chassis deck are the two positives. One is coded with a blue dot, and this is the positive of **C26**. The plain tag is the positive of **C27**.

Condensers C18, C21.—These are two dry electrolytics in a single carton beneath the chassis, fixed to the rear member. The tag on the left (looking from the rear of the chassis) is the common negative, and the two on the right are the positives. The upper one is the positive of **C18** (25 μ F) and the lower the positive of **C21** (5 μ F).



Trimmers and Trackers.—All the trimmers are housed inside the cans of the coil units with which they are associated. The three trackers, **C34, C38, C39**, are adjusted by means of

The switch unit seen in the directions of the two arrows in the under-chassis view.

screws above the chassis deck, on the right-hand side as seen in our plan chassis view.

A-E Leads.—These are short lengths of insulated wire, terminating in fahnstock clips. The aerial wire has a green covering, and the earth, black.

Valve Bases.—The American valves fitted have bases of the ordinary pin (not octal) type. Full information as to the connections will be found on page 45 of *The Wireless Trader Year Book* for 1938.

Radiogram Model.—The 502RG has a similar chassis, the only difference being that a 25,000 Ω resistance is connected across the pick-up terminals.

CIRCUIT ALIGNMENT

The scale pointer should be vertical when the gang is fully meshed, marks being provided for accurate setting.

I.F. Stages.—Connect signal generator to grid (top cap) of **V2** and earth lead, feed in a 405 KC/S signal and adjust **C42** and **C43** for maximum output. Transfer signal generator to grid (top cap) of **V1**, switch set to L.W., see that gang is fully meshed, and adjust **C40** and **C41** for maximum output. Keep input low.

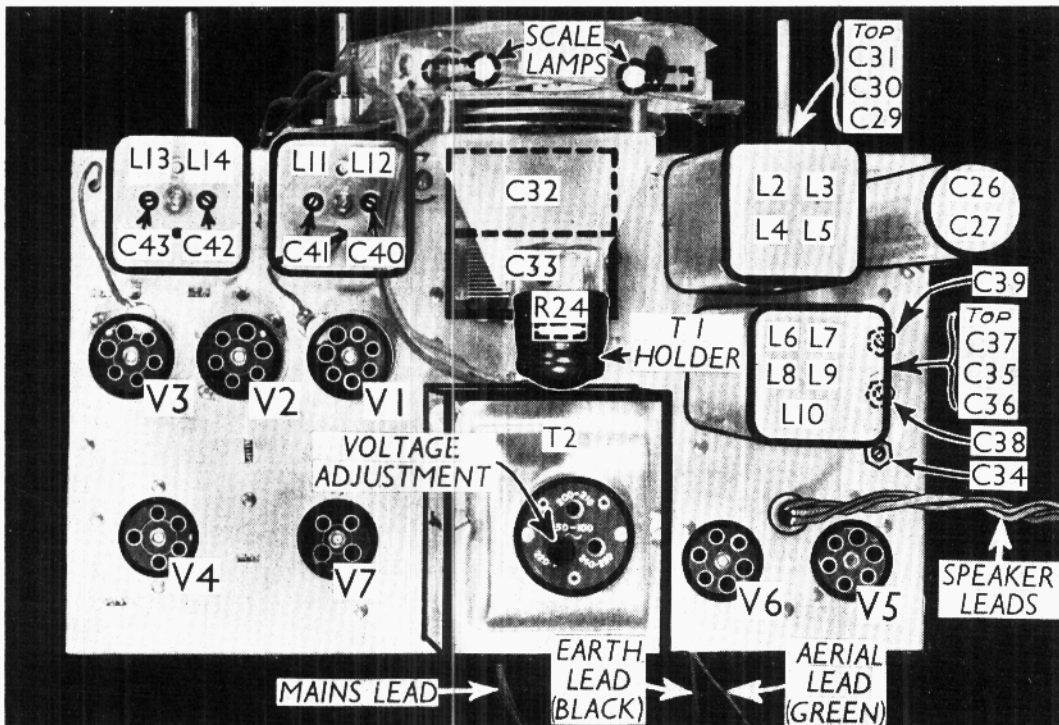
If necessary, re-adjust **C42** and **C43**.
R.F. and Oscillator Stages.—First adjust trackers for maximum output at the top of each band, with the gang fully meshed. To do this, connect a high frequency buzzer via a 50 μ F condenser to the aerial lead of the set, and adjust **C38** on the S.W. band, **C34** on the M.W. band and **C39** on the L.W. band for maximum output.

Switch set to S.W., connect signal generator to **A** and **E** leads and feed in a 21 m. signal. Tune to 21 m. on scale (about 235 m. on M.W. calibrated scale). Adjust **C35** and **C29** for maximum output. Fully mesh the gang again and re-track **C38** as above. Return to 21 m. and re-adjust **C35** and **C29**. Re-track **C38** again.

On the M.W. band, repeat above procedure, trimming **C36** and **C30** at 250 m. and tracking **C34** at the top of the scale.

On L.W., trim **C37** and **C31** at 1,200 m., and track **C39** at top of scale.

On the S.W. band, if **C35** peaks at two places, that with the least trimmer capacity is correct.



Plan view of the chassis. The trimmers of the R.F. and oscillator coil units are reached through holes in the sides of the cans, and are numbered from top to bottom. The trackers are adjusted by the screws on the right of the chassis deck. **R24** is inside the T.I. holder.