'TRADER' SERVICE SHEET 187

# FERGUSON 366

## 3-BAND A.C./D.C. SUPERHET

SUITABLE for operation on mains of 200-250 V, the Ferguson 366 is a 4-valve (plus rectifier) A.C./D.C. superhet of the 3-band type, the short-wave range covered being 16-50 metres. Provision is made for using a gramophone pick-up, and a barretter is fitted.

### CIRCUIT DESCRIPTION

Aerial input via series condenser **C1**, coupling condenser **C2** and coil **L2** (S.W. and L.W.), choke **L1** and bottom coupling condenser **C3** to single-tuned input circuits **L3, C24** (S.W.), **L3, L4, C24** (M.W.), **L3, L4, L5, C24** (L.W.).

First valve (**V1, National Union 6A7**) is a heptode operating as electron coupled frequency changer. Oscillator grid coils **L6, L7, L8,** are tuned by **C25**; parallel trimming by **C26** (S.W.), **C27** (M.W.), **C28** (L.W.); series tracking by **C29** (S.W.), **C30** (M.W.), **C31** (**L.W.**); oscillator anode reaction coils **L9, L10.**

Single variable-mu R.F. pentode intermediate frequency amplifier (**V2, National Union 6D6**) operates with tuned transformer couplings **C32, L11, L12, C33,** and **C34, L14, L15.**

**Intermediate frequency 456 KC/S.**

Diode second detector is part of double diode triode valve (**V3, National Union 75**). Audio-frequency component in rectified output developed across load resistance **R7** is passed via coupling condenser **C11** and manual volume control **R8** to C.G. of triode section, which operates as amplifier. Provision for connection of gramophone pick-up in C.G. circuit.

Resistance-capacity coupling by **R10, C15** and **R11** between **V3** triode and pentode output valve (**V4, National Union 43**). Fixed tone correction in anode circuit by **C16.**

When the receiver is used with A.C. mains, H.T. current is supplied by half-wave rectifying valve (**V5, National Union 12Z3**) which, with D.C. mains, behaves as a low resistance. Smoothing by speaker field coil **L18** and electrolytic condensers **C18, C19.**

Valve heaters are connected in series together with barretter (**National Union 185/R8**) and additional ballast resistances **R14, R15** across mains input circuit. Scale lamps are fed from tapping on barretter resistance.

### COMPONENTS AND VALUES

| | RESISTANCES | Values (ohms) |
|---|---|---|
| R1 | Aerial circuit series | 10,000 |
| R2 | V1 tet. C.G. decoupling | 500,000 |
| R3 | V1, V2 fixed G.B. resistance | 200 |
| R4 | V1 osc. C.G. resistance | 25,000 |
| R5 | V1, V2 S.G.'s H.T. feed | 25,000 |
| R6 | A.V.C. line decoupling | 500,000 |
| R7 | V3 diode load | 500,000 |
| R8 | Manual volume control | 500,000 |
| R9 | V3 G.B. resistance | 10,000 |
| R10 | V3 anode load | 500,000 |
| R11 | V4 C.G. resistance | 500,000 |
| R12 | V4 G.B. resistance | 600 |
| R13 | V5 anode resistance | 100 |
| R14 | Part heater circ. ballast | 100 |
| R15 | Main heater circ. ballast | 350* |

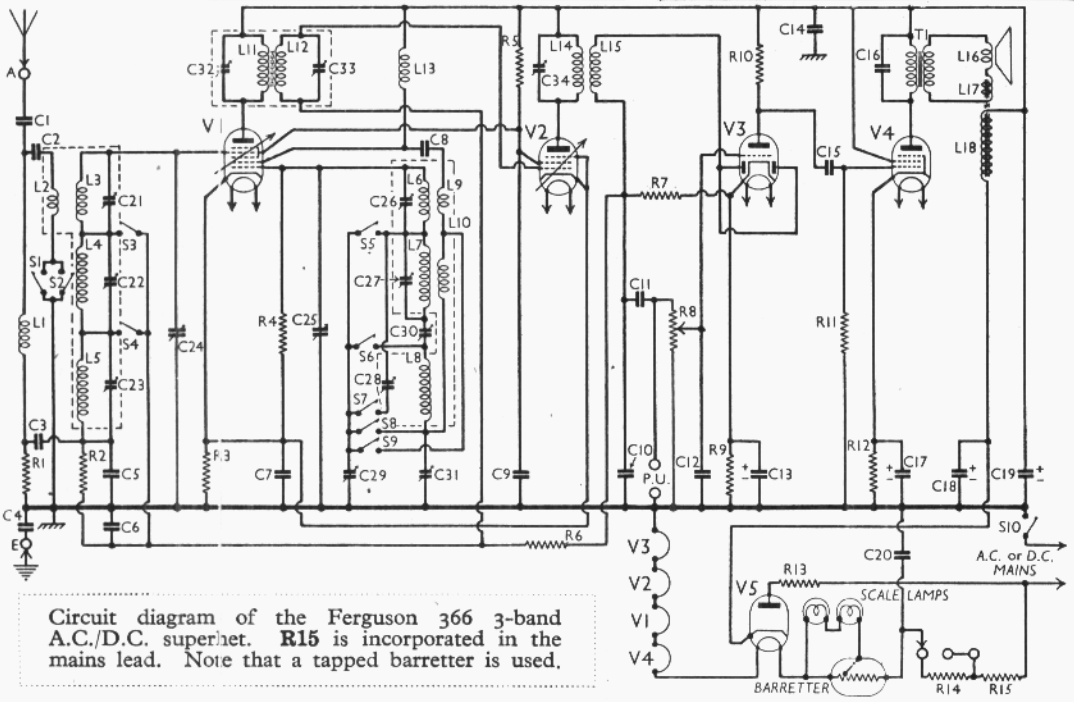
* In mains lead.

| | CONDENSERS | Values (μF) |
|---|---|---|
| C1 | Aerial series condenser | 0·00025 |
| C2 | Aerial coupling condenser (S.W., L.W.) | 0·00005 |
| C3 | Aerial bottom coupling | 0·002 |
| C4 | Earth blocking condenser | 0·1 |
| C5 | V1 tetrode C.G. decoupling | 0·002 |
| C6 | A.V.C. line decoupling | 0·1 |
| C7 | V1, V2 cathode by-pass | 0·1 |
| C8 | V1 osc. anode condenser | 0·00025 |
| C9 | V1, V2 S.G.'s by-pass | 0·1 |
| C10 | I.F. by-pass | 0·00025 |
| C11 | A.F. coupling to V3 triode | 0·01 |
| C12 | V3 C.G. I.F. by-pass | 0·00025 |
| C13* | V3 cathode by-pass | 10·0 |
| C14 | H.T. supply R.F. by-pass | 0·1 |
| C15 | V3 to V4 A.F. coupling | 0·01 |
| C16 | Fixed tone corrector | 0·01 |
| C17* | V4 cathode by-pass | 5·0 |
| C18* | H.T. smoothing | 12·0 |
| C19* | H.T. smoothing | 12·0 |

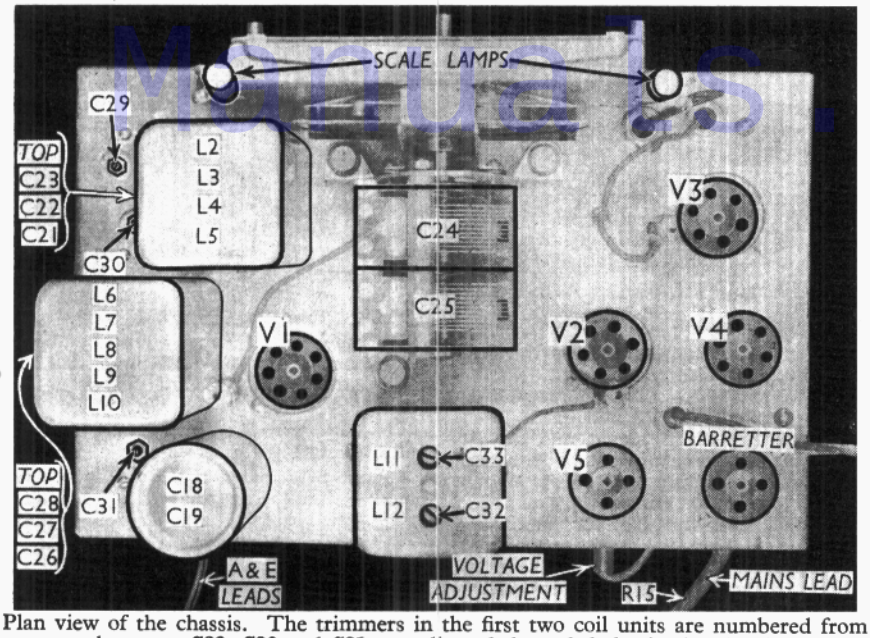
| | CONDENSERS (*Continued*) | Values (μF) |
|---|---|---|
| C20 | Mains circuit R.F. by-pass | 0·05 |
| C21‡ | Aerial circuit S.W. trimmer | — |
| C22‡ | Aerial circuit M.W. trimmer | — |
| C23‡ | Aerial circuit L.W. trimmer | — |
| C24† | Aerial circuit tuning | — |
| C25† | Oscillator circuit tuning | — |
| C26‡ | Osc. circuit S.W. trimmer | — |
| C27‡ | Osc. circuit M.W. trimmer | — |
| C28‡ | Osc. circuit L.W. trimmer | — |
| C29‡ | Osc. circuit S.W. tracker | — |
| C30‡ | Osc. circuit M.W. tracker | — |
| C31‡ | Osc. circuit L.W. tracker | — |
| C32‡ | 1st I.F. trans. pri. tuning | — |
| C33‡ | 1st I.F. trans. sec. tuning | — |
| C34‡ | 2nd I.F. trans. pri. tuning | — |

* Electrolytic. † Variable. ‡ Pre-set.

| | OTHER COMPONENTS | Approx. Values (ohms) |
|---|---|---|
| L1 | Aerial circuit choke | 21·0 |
| L2 | Aerial coupling coil | 0·7 |
| L3 | Aerial circuit tuning coils | Very low |
| L4 | | 4·0 |
| L5 | | 23·0 |
| L6 | Oscillator circuit tuning coils | Very low |
| L7 | | 3·1 |
| L8 | | 4·7 |
| L9 | Oscillator reaction coils | 0·6 |
| L10 | | 3·5 |
| L11 | 1st I.F. trans. Pri. | 5·7 |
| L12 | 1st I.F. trans. Sec. | 5·7 |
| L13 | Osc. anode choke | 21·0 |
| L14 | 2nd I.F. trans. Pri. | 20·0 |
| L15 | 2nd I.F. trans. Sec. | 15·0 |
| L16 | Speaker speech coil | 1·7 |
| L17 | Hum neutralising coil | 0·1 |
| L18 | Speaker field coil | 1,800·0 |
| T1 | Speaker input trans. Pri. | 290·0 |
| | Speaker input trans. Sec. | 0·25 |
| S1-9 | Waveband switches | — |
| S10 | Mains switch, ganged R8 | — |




Circuit diagram of the Ferguson 366 3-band A.C./D.C. superhet. **R15** is incorporated in the mains lead. Note that a tapped barretter is used.




Plan view of the chassis. The trimmers in the first two coil units are numbered from top to bottom. **C29, C30** and **C31** are adjusted through holes in the chassis deck.

## DISMANTLING THE SET

**Removing Chassis.**—If it is desired to remove the chassis from the cabinet, remove the three control knobs (recessed grub screws) and the four bolts (with washers and spring washers) which hold the chassis to the bottom of the cabinet. The chassis can now be withdrawn to the extent of the speaker leads, which should be just sufficient for normal purposes.

*When replacing the chassis*, do not forget the felt washers between the control knobs and the cabinet, and since there is no flat on the spindle of the wave-change switch and the knob is marked, take care that it is positioned correctly.

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

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

## VALVE ANALYSIS

| Valve | Anode Voltage (V) | Anode Current (mA) | Screen Voltage (V) | Screen Current (mA) |
|---|---|---|---|---|
| V1 6A7* .. | 160 | 1·4 | 60 | 2·6 |
| V2 6D6 .. | 160 | 3·5 | 60 | 1·0 |
| V3 75 .. | 40 | 0·2 | — | — |
| V4 43 .. | 150 | 31·0 | 160 | 6·1 |
| V5 12Z3† .. | — | — | — | — |

* Oscillator anode (G2) 160 V, 3·6 mA.
† Cathode to chassis, 245 V D.C.

Valve voltages and currents given in the table above are those measured in our receiver when it was operating on mains of 220 V, using the 220 V tapping on the mains resistance. 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, the aerial and earth leads being connected together.

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

If **V2** should become unstable when its screen current is being measured, as in our case, the valve can be stabilised by connecting a non-inductive condenser of about 0·1 $\mu$F from the control grid (top cap) to chassis.

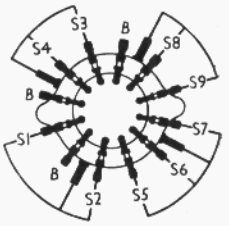
## GENERAL NOTES

**Switches.—S1-S9** are the waveband switches, in a single rotary unit beneath the chassis. A diagram of this, looking at the underside of the chassis from the rear, is given on this page.

The table below gives the switch positions for the three control settings, starting from the fully anti-clockwise position. O indicates open, and C, closed.

| Switch | S.W. | M.W. | L.W. |
|---|---|---|---|
| S1 | C | O | O |
| S2 | O | O | C |
| S3 | C | O | O |
| S4 | O | C | O |
| S5 | C | O | O |
| S6 | O | C | O |
| S7 | O | O | C |
| S8 | O | C | O |
| S9 | C | O | O |

Switch diagram, looking at the underside of the chassis, from the rear.




**S10** is the Q.M.B. mains switch, ganged with the volume control **R8.**

**Coils.**—**L1** is beneath the chassis, while **L2-L5** and **L6-L10** are in two screened units on the chassis deck. Each of these contains three trimmers, which are at the sides of the units, and are numbered from top to bottom in our plan chassis view.

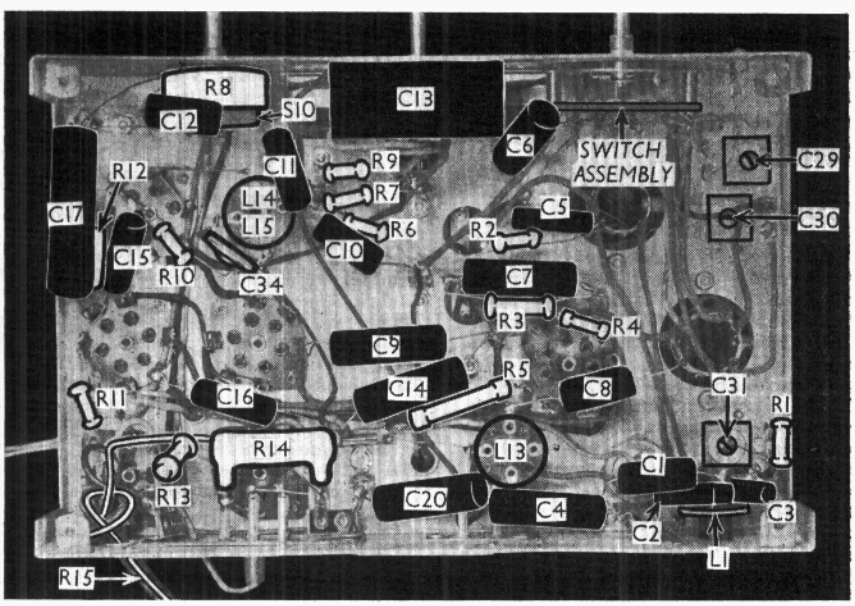
The first I.F. transformer, **L11, L12** is in another screened unit on the chassis deck, with its associated trimmers.

**L13** is an unscreened H.F. choke, beneath the chassis, while also beneath the chassis is the second I.F. transformer, **L14, L15,** which is uncreened, and supports the primary trimmer **C34.** The secondary has no trimmer.

**Scale Lamps.**—These are two National Union M.E.S. types, rated at 6-8 V. They are connected in series, from the low voltage side of the barretter to its tapping.

**Barretter.**—This is a 185/R8 type. The total resistance is connected across the

*Continued overleaf*




Under-chassis view. **R15** is incorporated in the mains lead. A diagram of the switch assembly is in Col. 3.

**FERGUSON 366**—*Continued*

two large pins. Looking at the base with these at the bottom, the top right-hand small pin is the tapping, the fourth pin being blank. The resistance of our barretter, cold, was 145 + 45 O.

**Voltage Adjustment.**—This is carried out by a plug and sockets, putting **R14** in or out of circuit. Although three sockets, marked 200, 220 and 250 V are provided in our chassis, those for 200 and 220 V are joined together.

**Resistance R15.**—This is incorporated in the mains lead. It is additional to the two rubber-covered wires in the lead which go to chassis and anode of **V5** via **R13.** The resistance is thus only included in the barretter, scale lamp and heater circuit.

**External Speaker.**—No provision is made for this, but a low resistance type could be connected across the secondary tags of **T1.** An external speaker should *not* be connected across the primary of this set.

**P.U. Sockets.**—Note that these are not isolated from chassis.

**Condensers C18, C19.**—These are two 12 $\mu$F dry electrolytics in a single tubular metal container on the chassis deck. The case is negative, the yellow lead is the positive of **C18** and the red the positive of **C19.**

**Condenser C13.**—This consists of two 5$\mu$F dry electrolytics in parallel in our chassis. The black lead is negative, and the red and yellow leads joined together form the positive.

## CIRCUIT ALIGNMENT

The scale pointer should be vertical when the gang is fully meshed.

**I.F. Stages.**—Connect signal generator to grid (top cap) of **V2** and earth lead, feed in a 456 KC/S signal and adjust **C34** 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 **C33** and **C32** for maximum output. Re-adjust **C34** if necessary. Keep input low.

**H.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 $\mu\mu$F condenser to the aerial lead of the set, and adjust **C29** on the S.W. band, **C30** on the M.W. band and **C31** on the L.W. band for maximum output.

Switch set to S.W., connect signal generator to **A** and **E** leads and set pointer to 21 m. on scale. Adjust **C26** and **C21** for maximum output. Fully mesh the gang again and re-track **C29** as above. Return to 21 m., and re-adjust **C26** and **C21.** Re-track **C29** again.

On the M.W. band, repeat above procedure, trimming **C27** and **C22** at 250 m. and tracking **C30** at the top of the scale.

On L.W., trim **C28** and **C23** at 1,200 m., and track **C31** at top of scale.

On the S.W. band, if **C26** peaks at two places, that with the least trimmer capacity is correct.

Note that the three bands are interdependent, and any re-alignment of one band will affect the others.

# MAINTENANCE PROBLEMS

## Noisy Condenser Drive

MY experience with a noisy slow-motion drive, and the nature of the cure effected may prove of help to fellow service engineers.

The set was an Ekco AC85, and the condenser drive was found to cause terrific crackling, even if the spindle was lightly touched, let alone rotated.

The drive was mechanically released, by means of the set screw provided, from the gang condenser, and again rotated. The noise was still present. Attention was therefore directed to the ball-bearing friction drive itself.

It was decided to wash this out with petrol, and afterwards to re-pack with grease. This proved to be a complete and lasting cure of the fault, and it has since been tried on several other makes of receivers with perfect results.—G. WITT, READING.

## L.T. Fireworks

I HAVE recently had an unusual experience with an Alba battery model 205. When I supplied the set, it was found that the L.T. accumulator would only last a few days, and the cause finally showed itself in no uncertain way. The customer came one night to say that the set had burst into flames!

On investigation I found the whole speaker cover burnt away, but the set operated as usual. The flames had been put out before the speaker diaphragm was damaged. I found that the detector valve was tight against the speaker chassis. Since its metallising was connected to L.T. positive, I presume that it had shorted the L.T. to the speaker chassis, and ignited the inflammable cover.

A binding of adhesive tape remedied the defect.—E. TIDESWELL, SALTERFORTH.

## O.C. Grid Resistance

RECENTLY a Philips superinductance receiver came in because of very poor performance and intermittent working. This set was tried out and it was soon found that it required a rectifier valve, so a new one was fitted and the set left on soak.

Several times the output from this set dropped off, but soon returned again in full. Eventually it was found that every time the output of the set dropped the anode current of the Pen 4A output valve went very high.

By quickly bridging the resistors in the bias and grid circuits when the fault developed again I traced the trouble to a defective suppressor resistance in the grid circuit of the output valve. Renewing this component cleared the trouble. —J. GIBBONS, WALLASEY.

## More Trimmer Trouble

AN Ultra 22 A.C. radio-gram was recently sent in for service, the complaint being no reception on the L.W. band.

As a preliminary, the AC/TP valve was replaced as, although no stations were received, there was a certain amount of "background noise." The AC/TP having been proved O.K., the chassis was removed for test. The coils were checked by an ohmmeter. This showed both coils and switching to be O.K.

Only one thing was now left, i.e., the padding condenser. When the oscillator coil can was removed the long wave padder was found to be saturated with machine oil which had dipped from the gramophone motor immediately above. On fitting a new condenser and re-ganging, the set was perfect.

What had happened was that the oil had seeped between the condenser plates, changed the dielectric and thrown the capacity completely out. It was for this reason that the "background noise" could be heard and yet no stations received even on adjusting the trimmer.—F. TIDMARSH, HORNCHURCH.

## Faulty Gang Condenser

A BATTERY receiver was returned for service, the fault being that the set could not be made to agree with the wavelength calibration. London National came in at 200 metres and the other stations all below their proper positions.

The coils were pronounced O.K. by the makers and it was also ascertained that the three-gang condenser was suitable for the coils in use. This only left the gang itself. It was removed and each section checked on a capacity bridge. At maximum all sections agreed at 0·0005 $\mu$F, but at minimum the readings varied around 0·0001 $\mu$F. Further, an exceptionally high power factor was noticed.

The trimmers were removed, but made little difference. Next the screws and paxolin strip holding the fixed vanes to the gang chassis were removed. Immediately the power factor improved and the capacity at minimum dropped to 0·00005 $\mu$F.

It was then found that the soldering iron had partly charred the paxolin and that a large amount of flux had formed a film over the strip. On cleaning the strips and replacing them the minimum remained at about ·00005 $\mu$F, and on reassembling the set and reganging, the trouble was removed, the calibration becoming correct. —F. TIDMARSH, HORNCHURCH.