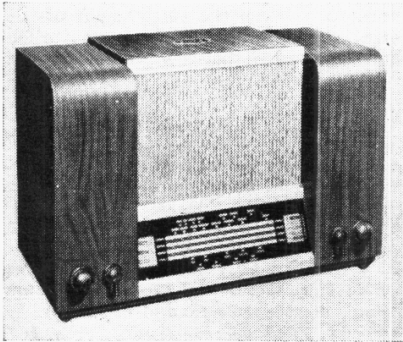


"TRADER" SERVICE SHEET  
783

# INVICTA 30

## 4-BAND A.C. SUPERHET



The Invicta model 30 A.C. superhet. If the wooden beading beneath the scale is removed, the glass scale can be withdrawn.

**F**OUR wavebands are covered in the Invicta model 30, comprising a S.W. band of 13-50 m, which is referred to throughout this *Service Sheet* as S.W.1, a "Trawler" band of 50-200 m, referred to as S.W.2, and the usual M.W. and L.W. bands.

The receiver is a 3-valve (plus rectifier) superhet designed to operate from A.C. mains of 200-250 V, 40-100 c/s. There is provision for the connection of a gramophone pick-up and an external speaker.

For gramophone operation, the triode section of the frequency changer is used as a pre-amplifier, and a screw-type switch is fitted to mute the internal speaker. A plug on a flexible lead acts as a mains aerial connector. The scale lamps are energized from a tapping on the L.T. transformer winding. A 3-position tone

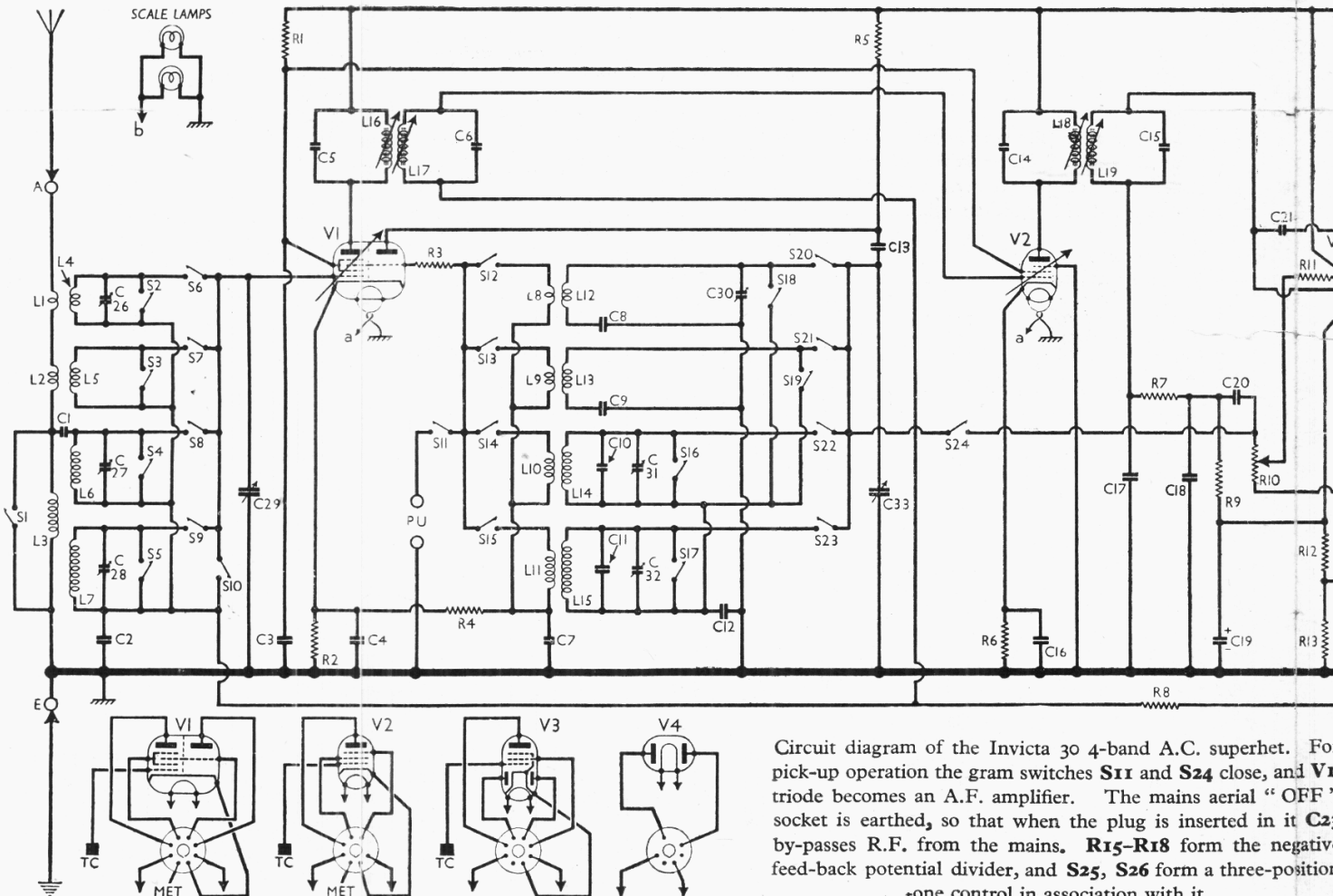
control is associated with a negative feedback circuit.

*Release date and original price: January, 1946; £17 0s, plus purchase tax, £3 13s 2d.*

### CIRCUIT DESCRIPTION

Aerial input is via coupling coils **L1** (S.W.1), **L2** (S.W.2) and **L3** (M.W. and L.W.) to single-tuned circuits **L4, C29** (S.W.1), **L5, C29** (S.W.2), **L6, C29** (M.W.) and **L7, C29** (L.W.) which precede triode hexode valve (**V1, Mullard metallised ECH35**) operating as frequency changer with internal coupling.

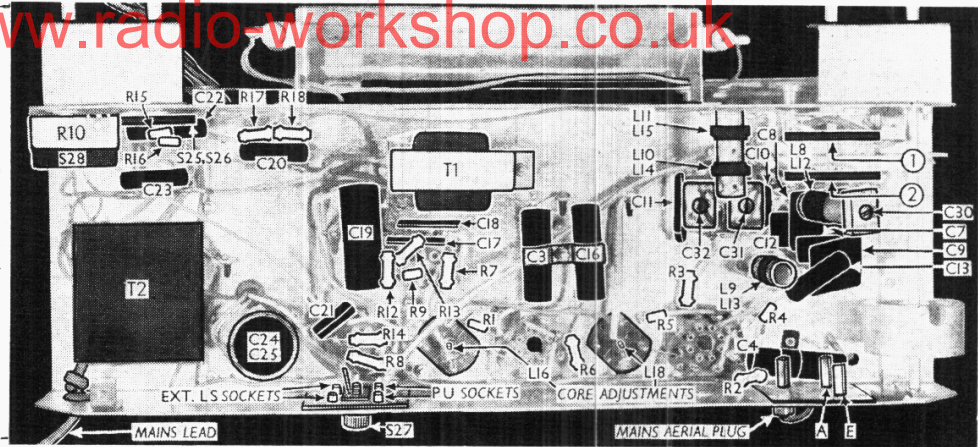
Triode oscillator anode coils **L12** (S.W.1), **L13** (S.W.2), **L14** (M.W.) and **L15** (L.W.) are tuned by **C33**. Parallel trimming by **C30** (S.W.1), **C10, C31** (M.W.) and **C11, C32** (L.W.); series tracking by **C8** (S.W.1), **C9** (S.W.2) and **C12** (M.W. and L.W.). Reaction coupling by



Circuit diagram of the Invicta 30 4-band A.C. superhet. For pick-up operation the gram switches **S11** and **S24** close, and **V1** triode becomes an A.F. amplifier. The mains aerial "OFF" socket is earthed, so that when the plug is inserted in it **C2** by-passes R.F. from the mains. **R15-R18** form the negative feedback potential divider, and **S25, S26** form a three-position tone control in association with it.

www.radio-workshop.co.uk

Under-chassis view. The waveband switch units (marked 1 and 2 in circles) are indicated here and shown in detail in the diagrams in col. 4 overleaf. The tone control switch unit S25, S26 indicated on the left, is shown in detail in a diagram in col. 2 overleaf.



grid coils L8 (S.W.1), L9 (S.W.2), L10 (M.W.) and L11 (L.W.).

Second valve (V2, Mullard metallised EF39) is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings C5, L16, L17, C6 and C14, L18, L19, C15. All the tuning

capacitors are fixed, and trimming is effected by adjusting the iron-dust cores.

**Intermediate frequency 465 kc/s.**

Diode second detector is part of double diode pentode output valve (V3, Mullard metallised EBL31). Audio frequency component in rectified output is developed across load resistor R9, and passed via A.F. coupling capacitor C20, manual volume control R10 and grid stopper R11 to C.G. of pentode section. I.F. filtering by C17, R7 and C18 in diode circuit, and R11 in pentode C.G. circuit. Provision is made for the connection of a low impedance external speaker, and a screw type switch S27 permits the internal speaker to be muted.

For pick-up operation, the triode section of the frequency changer V1 is used as an A.F. amplifier. The pick-up output is fed in via S11 to the control grid circuit, and the output from the anode is developed across R5 and passed via C13 and S24 to the manual volume control R10, and so on to the control grid of V3 pentode. S11 and S24 close when the waveband control is turned to the gram position together with a muting switch S10, and two incidental switches S2, S18.

Second diode of V3, fed from L19 via C21, provides D.C. potential which is developed across load resistor R14 and fed back through decoupling circuit as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage, together with G.B. for pentode section, is obtained from the drop along resistors R12, R13 in V3 cathode lead to chassis.

The output from V3 pentode anode is developed across a potential divider comprising R15, R16, C22, R17, R18 and switches S25, S26, and the fraction of the output appearing across R18 is fed back via R10 to the control grid circuit of the pentode section. Bias for the control grid is obtained by returning R18 to the junction of R12, R13.

For tone control purposes the frequency characteristic of the feed-back circuit is modified, from the "Brilliance" condition (both switches open) to "Normal" (S25 closed) and "Mellow" (S26 closed).

H.T. current is supplied by a full-wave rectifying valve (V4, Mullard AZ31). Smoothing by speaker lead L22 and electrolytic capacitors C24, C25. Mains aerial connection is provided by a plug

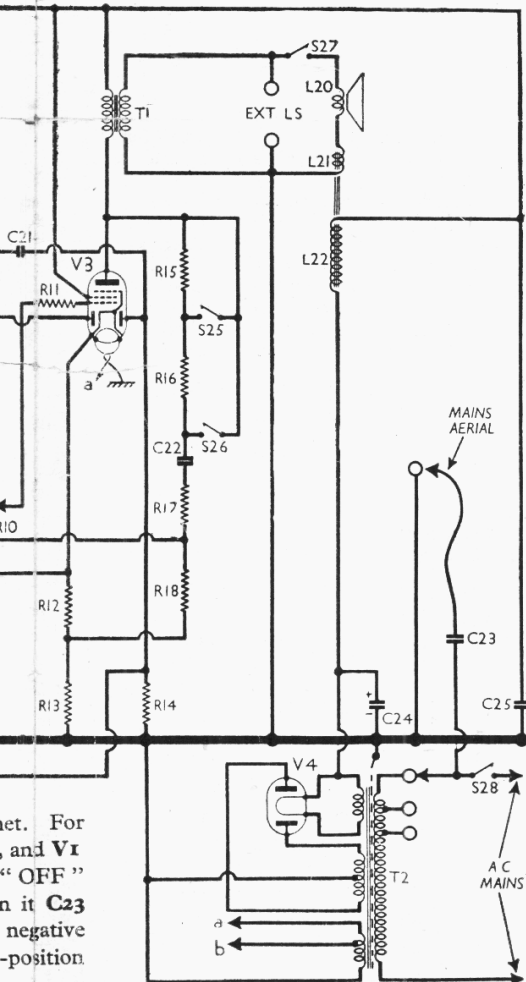
and flexible lead, via coupling capacitor C23. When not required, the plug is inserted in a specially provided earthed socket and C23 then functions as a mains R.F. by-pass capacitor.

**COMPONENTS AND VALUES**

| CAPACITORS |  | Values (μF) |
|------------|--|-------------|
| C1         | Aerial "top" coupling ...                  | 0-00006     |
| C2         | A.V.C. line decoupling ...                 | 0-1         |
| C3         | V1, V2 S.G.'s decoupling ...               | 0-1         |
| C4         | V1 cathode by-pass ...                     | 0-1         |
| C5         | 1st I.F. transformer tuning ...            | 0-00007     |
| C6         | capacitors ...                             | 0-00007     |
| C7         | V1 osc. C.G. capacitor ...                 | 0-000047    |
| C8         | Osc. circuit S.W.1 tracker ...             | 0-005       |
| C9         | Osc. circuit S.W.2 tracker ...             | 0-0013      |
| C10        | Osc. M.W. fixed trimmer ...                | 0-000022    |
| C11        | Osc. L.W. fixed trimmer ...                | 0-00034     |
| C12        | Osc. M.W. and L.W. tracker ...             | 0-00065     |
| C13        | V1 osc. anode coupling ...                 | 0-001       |
| C14        | 2nd I.F. transformer tuning capacitors ... | 0-00014     |
| C15        | V2 cathode by-pass ...                     | 0-1         |
| C16        | V2 cathode by-pass ...                     | 0-00015     |
| C17        | I.F. by-pass capacitors ...                | 0-00015     |
| C18        | V3 cathode by-pass ...                     | 25-0        |
| C19*       | A.F. coupling to V3 pent. ...              | 0-005       |
| C20        | V3 A.V.C. diode coupling ...               | 0-000022    |
| C21        | Neg. feedback coupling ...                 | 0-01        |
| C22        | Mains aerial coupling ...                  | 8-0         |
| C23*       | H.T. smoothing capacitors ...              | 16-0        |
| C24†       | Aerial circ. S.W.1 trimmer ...             | 0-00003     |
| C25†       | Aerial circ. M.W. trimmer ...              | 0-00003     |
| C26†       | Aerial circ. L.W. trimmer ...              | 0-00003     |
| C27†       | Aerial circuit tuning ...                  | 0-000532    |
| C28†       | Osc. circ. S.W.1 trimmer ...               | 0-00003     |
| C29†       | Osc. circ. M.W. trimmer ...                | 0-00003     |
| C30†       | Osc. circ. L.W. trimmer ...                | 0-00003     |
| C31†       | Oscillator circuit tuning ...              | 0-000532    |

\* Electrolytic. † Variable. ‡ Pre-set.

| RESISTORS |  | Values (ohms) |
|-----------|--|---------------|
| R1        | V1, V2 S.G.'s H.T. feed ...                  | 47,000        |
| R2        | V1 fixed G.B. resistor ...                   | 150           |
| R3        | V1 osc. grid stopper ...                     | 47            |
| R4        | V1 osc. C.G. resistor ...                    | 47,000        |
| R5        | V1 osc. anode H.T. feed ...                  | 47,000        |
| R6        | V2 fixed G.B. resistor ...                   | 220           |
| R7        | I.F. stopper ...                             | 47,000        |
| R8        | A.V.C. line decoupling ...                   | 1,000,000     |
| R9        | V3 signal diode load ...                     | 470,000       |
| R10       | Manual volume control ...                    | 1,000,000     |
| R11       | V3 pent. grid stopper ...                    | 100,000       |
| R12       | V3 pent. G.B. and A.V.C. delay resistors ... | 150           |
| R13       | A.V.C. diode load ...                        | 330           |
| R14       | Tone control resistors ...                   | 1,000,000     |
| R15       | Feedback potential divider ...               | 100,000       |
| R16       | ...  | 47,000        |
| R17       | ...  | 15,000        |
| R18       | ...  | 4,700         |



net. For and V1 "OFF" in it C23 negative position

| OTHER COMPONENTS |                                   | Approx. Values (ohms)   |          |
|------------------|-----------------------------------|-------------------------|----------|
| L1               | Aerial S.W.1 coupling ...         | 0.45                    |          |
| L2               | Aerial S.W.2 coupling ...         | 0.6                     |          |
| L3               | Aerial M.W. and L.W. coupling ... | 65.0                    |          |
| L4               | Aerial S.W.1 tuning ...           | 0.1                     |          |
| L5               | Aerial S.W.2 tuning ...           | 0.5                     |          |
| L6               | Aerial M.W. tuning ...            | 3.7                     |          |
| L7               | Aerial L.W. tuning ...            | 12.8                    |          |
| L8               | Osc. S.W.1 reaction coil ...      | 55.0                    |          |
| L9               | Osc. S.W.2 reaction coil ...      | 0.65                    |          |
| L10              | Osc. M.W. reaction coil ...       | 1.2                     |          |
| L11              | Osc. L.W. reaction coil ...       | 1.6                     |          |
| L12              | Osc. circ. S.W.1 tuning ...       | Very low                |          |
| L13              | Osc. circ. S.W.2 tuning ...       | 1.0                     |          |
| L14              | Osc. circ. M.W. tuning ...        | 1.7                     |          |
| L15              | Osc. circ. L.W. tuning ...        | 2.3                     |          |
| L16              | 1st I.F. trans. { Pri. ...        | 8.5                     |          |
| L17              |                                   | { Sec. ...              | 8.5      |
| L18              | 2nd I.F. trans. { Pri. ...        | 6.0                     |          |
| L19              |                                   | { Sec. ...              | 6.0      |
| L20              | Speaker speech coil ...           | 2.0                     |          |
| L21              | Hum neutralising coil ...         | Very low                |          |
| L22              | Speaker field coil ...            | 1,000.0                 |          |
| T1               | Output trans. { Pri. ...          | 255.0                   |          |
|                  |                                   | { Sec. ...              | Very low |
| T2               | Mains trans. { Pri., total ...    | 17.5                    |          |
|                  |                                   | { Heater sec. ...       | Very low |
|                  |                                   | { Rect. heat. sec., ... | Very low |
|                  |                                   | { H.T. sec., total ...  | 350.0    |
| S1-S24           | Waveband switches ...             | —                       |          |
| S25, S26         | Tone control switches ...         | —                       |          |
| S27              | Int. speaker switch ...           | —                       |          |
| S28              | Mains switch, ganged R10          | —                       |          |

**VALVE ANALYSIS**

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 230 V, using the 220-230 V tapping on the mains transformer.

The receiver was tuned to the lowest wavelength on the M.W. band, the volume control was at maximum and the tone control was at the "Brilliance" setting, but there was no signal input. Voltages were measured on the 400 V scale of a model 7 Universal Avometer, chassis being the negative connection.

| Valve    | Anode Voltage (V) | Anode Current (mA) | Screen Voltage (V) | Screen Current (mA) |
|----------|-------------------|--------------------|--------------------|---------------------|
| V1 ECH35 | 290               | 2.7                | 82                 | 2.9                 |
|          | Oscillator        | —                  |                    |                     |
| V2 EF39  | 92                | 3.0                | 82                 | 1.75                |
|          | 290               | 6.3                |                    |                     |
| V3 EBL31 | 275               | 37.5               | 290                | 4.2                 |
| V4 AZ31  | 333†              | —                  | —                  | —                   |

† Each anode, A.C.

**DISMANTLING THE SET**

The cabinet is fitted with a detachable bottom cover, upon removal of which (four round-head wood screws) access may be gained to the oscillator and I.F. trimmer adjustments and most of the under-chassis components.

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

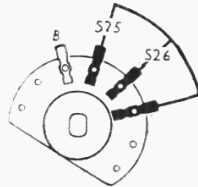


Diagram of the tone control switch unit, drawn as seen when viewed from the rear of an inverted chassis.

remove the four bolts (with steel washers, rubber grommets, and brass sleeves) holding the chassis to the base of the cabinet, when the chassis may be withdrawn to the extent of the speaker leads.

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

When replacing, connect the speaker leads as follows, numbering the tags on the connecting panel from top to bottom: 1, red; 2, yellow; 3, green; 4, no external connection; 5, black.

Two of the specially shaped rubber washers should be fitted to each chassis bolt, one going each side of the base of the cabinet, with a brass distance piece between them; a flat steel washer fits beneath the head of each bolt. This operation is simplified if the two front rubber washers are placed in position inside the cabinet before inserting the chassis.

**Removing Speaker.**—Remove the nuts from the four bolts holding the speaker to the sub-baffle.

When replacing, the connecting panel should be on the right, and if the leads

have been unsoldered they should be reconnected as previously described.

**GENERAL NOTES**

**Switches.**—S1-S24 are the waveband, pick-up and muting switches, ganged in two rotary units beneath the chassis. These are shown in our under-chassis view, where they are indicated by numbers (1 and 2) in circles, and arrows. The arrows show the direction in which they are viewed in the diagrams in col. 4, where the units are shown in detail.

The table below gives the switch positions for the five control settings, starting

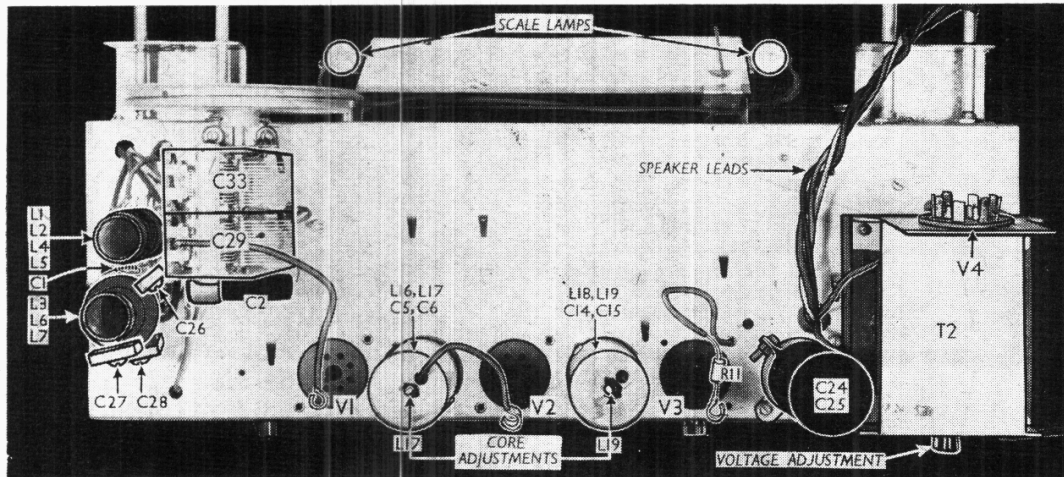
**Waveband Switch Table**

| Switch | Gram. | S.W.1 | S.W.2 | M.W. | L.W. |
|--------|-------|-------|-------|------|------|
| S1     | —     | C     | C     | —    | —    |
| S2     | C     | —     | —     | —    | —    |
| S3     | —     | C     | —     | —    | —    |
| S4     | —     | —     | C     | —    | —    |
| S5     | —     | —     | —     | C    | —    |
| S6     | —     | C     | —     | —    | —    |
| S7     | —     | —     | C     | —    | —    |
| S8     | —     | —     | —     | C    | —    |
| S9     | —     | —     | —     | —    | C    |
| S10    | C     | —     | —     | —    | —    |
| S11    | —     | —     | —     | —    | —    |
| S12    | —     | C     | —     | —    | —    |
| S13    | —     | —     | C     | —    | —    |
| S14    | —     | —     | —     | C    | —    |
| S15    | —     | —     | —     | —    | C    |
| S16    | —     | —     | C     | —    | —    |
| S17    | —     | —     | —     | C    | —    |
| S18    | C     | —     | —     | —    | —    |
| S19    | —     | C     | —     | —    | —    |
| S20    | —     | —     | —     | —    | —    |
| S21    | —     | —     | C     | —    | —    |
| S22    | —     | —     | —     | C    | —    |
| S23    | —     | —     | —     | —    | C    |
| S24    | C     | —     | —     | —    | —    |

from the fully anti-clockwise position of the control. A dash indicates open, and C, closed.

S25, S26 are the tone control switches, which modify the characteristics of the negative feed-back circuit. In the normal (fully clockwise) position of the control, both switches are open for "Brilliance"; in the next position, S25 closes for "Normal"; and in the fully anti-clockwise position, S25 opens and S26 closes for "Mellow."

S27 is the internal speaker switch, mounted on the rear member of the chassis in a panel with the pick-up and external speaker sockets. It is operated

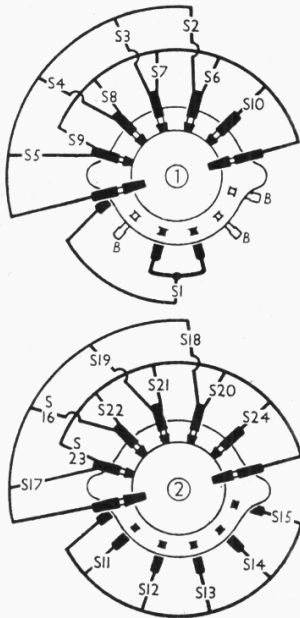


Plan view of the chassis. The small capacitor C1 is seen on the side of the L3, L6, L7 coil unit beside the gang. The I.F. transformer secondary adjustments are indicated here; the primary adjustments are shown in our under-chassis view overleaf.

by a thumb-screw which connects together a threaded tag and a contact plate, which are interleaved in the panel, when screwed fully home.

S28 is the Q.M.B. mains switch, ganged with the manual volume control R10.

### Waveband Switch Diagrams



Diagrams of the waveband switch units, drawn as seen when viewed from the rear of the underside of the chassis. "B" indicates a blank tag.

**Coils.**—The S.W.1 and S.W.2 aerial circuit coils L1, L2, L4, L5 are in a tubular unit on the chassis deck, with the S.W.1 trimmer C26 mounted on the side of it, facing the rear of the chassis. L4 is the thick wire winding, and L1 is interwound with it.

The M.W. and L.W. aerial coils L3, L6, L7 are in a second tubular unit on the chassis deck, beside the first unit, with their pre-set trimmers C27 (top) and C28 (bottom) mounted on its side, facing rearwards. The small "top" coupling capacitor C1 is also mounted on the side of the unit.

The oscillator circuit coils L8, L12; L9, L13; and L10, L11, L14, L15 are in three unshielded tubular units beneath the chassis deck. The S.W.1 unit is mounted on the rear unit of the waveband switch unit, the S.W.2 unit is mounted on the underside of the chassis deck, and the M.W. and L.W. unit is mounted on the front chassis member.

The I.F. transformers L16, L17 and L18, L19 are in two screened units on the chassis deck, their core adjustments projecting from the tops and bottoms of the units.

**Scale Lamps.**—Those recommended by the makers are rated at 6.2 V, 0.3 A, with 15 mm clear spherical bulbs and M.E.S. bases. As the valve heater

secondary on the mains transformer from which they are energized is designed for 6.3 V valves, a tapping (marked "b" in our circuit diagram) is provided specially for the lamps.

**External Speaker.**—Two sockets are provided at the rear of the chassis for the connection of a low impedance (about 2 Ω) external speaker. A screw-type switch beside them permits the external speaker to be muted.

**Capacitor C1.**—This is a small "top" aerial coupling, made by winding a thin enamelled copper wire over a thicker one. It is mounted directly on the L3, L6, L7 coil unit.

### Drive Cord and Scale Replacements

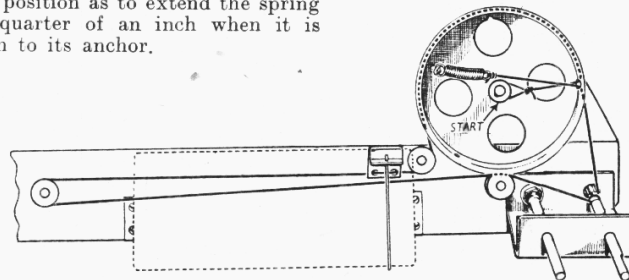
**Replacing Scale.**—The glass scale plate may be replaced, if it becomes obsolete or broken, without removing the chassis. It is only necessary to invert the cabinet, protecting its top with a soft cloth, and remove the two wood screws holding the lower white ornamental rail to the bottom of the cabinet, and withdraw the rail, when the glass scale can be removed by drawing it towards the bottom edge of the cabinet.

When replacing, it is advisable to tuck in some cotton wool along the ends of the glass to prevent it from rattling.

**Replacing Drive Cord.**—The length of the drive cord is 48 in, and a suitable material is Cutty Hunk twine, which is available from dealers in fishing tackle.

Tie a loop in one end of the cord, slip it over the grooved boss marked "Start" in the sketch below, and turn the gang to maximum capacitance. Thread the cord through the hole in the groove in the periphery of the drum, then through the two holes in the pointer carrier (starting and finishing at the back of the carrier).

The cord should now be fed round the three pulleys as shown in the sketch below, then under the control spindle, round it one complete turn, passing behind the first line, up to the drum and through the hole in the groove. Now tie off the cord on one end of the extension spring, in such a position as to extend the spring about a quarter of an inch when it is hooked on to its anchor.



Sketch showing the course taken by the drive cord. Particular care must be taken to turn it round the control spindle in the right direction, as described in the text.

The pointer can be slid along the cord if the spring is unhooked to slacken the cord, and with the gang at maximum, the carrier should be in about the position shown in our sketch. Final adjustment can be made with the chassis in the cabinet by adjusting the position of the

drum on the gang spindle, after slackening the fixing screw.

**Chassis Divergencies.**—The oscillator circuit M.W. and L.W. fixed trimming capacitors C10, C11 may have values in some cases which are different from those quoted in our tables. The A.V.C. line decoupling resistor R8 is shown in our diagram as it was found in our chassis. In the makers' diagram it was shown connected between the earthy ends of the control grid circuits of the controlled valves, instead of between these and the A.V.C. diode anode.

### CIRCUIT ALIGNMENT

**I.F. Stages.**—Connect signal generator leads to control grid (top cap) of V1 and chassis via a 0.1 μF capacitor, and connect a 100,000 Ω shunt resistor between the same two points. Feed in a 465 kc/s (645.16 m) signal, and adjust the cores of L16, L17, L18 and L19 for maximum output. Remove shunt and capacitor.

**R.F. and Oscillator Stages.**—Transfer signal generator leads to A and E sockets, via a suitable dummy aerial. The pointer should register with the ends of the four scales at minimum and maximum positions of the gang. It may be adjusted while in the cabinet at the low wavelength end of the scales if the fixing screw on the drive drum is slackened.

**M.W.**—Switch set to M.W., tune to 200 m on scale, feed in a 200 m (1,500 kc/s) signal, and adjust C31, then C27, for maximum output. Check calibration at 500 m (600 kc/s).

**L.W.**—Switch set to L.W., tune to 1,200 m on scale, feed in a 1,200 m (250 kc/s) signal, and adjust C32, then C28, for maximum output. Check calibration at 2000 m (150 kc/s).

**S.W.1.**—Switch set to S.W.1 (Short), tune to 14 m on scale, feed in a 14 m (21.43 Mc/s) signal, and adjust C30, then C26, for maximum output, while rocking the gang for optimum results. Check calibration at 50 m (60 Mc/s).

**S.W.2.**—No adjustments are provided for this (Trawler) band, the only likely variation being in the position of the wiring. The calibration should be checked at 60 m (50 Mc/s) and 200 m (150 kc/s). Any adjustment attempted should be made at 60 m.