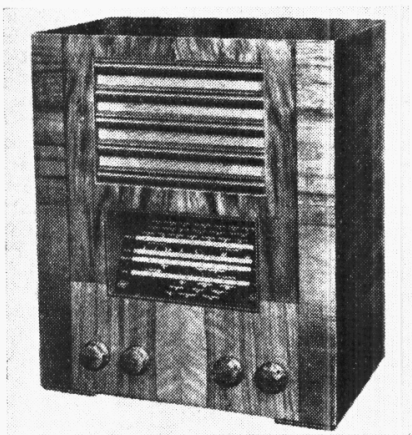
Supplement to The Wireless & Electrical Trader, November 16, 1940

"TRADER" SERVICE SHEET 493

INVICTA B40 BATTERY SUPERHET



The Invicta B40 receiver.

FOUR wavebands are provided in the Invicta B40 4-valve battery superhet, other features of which are transformer AF coupling and flywheel tuning.

The two SW bands are 13-51 m (referred to in this Service Sheet as SW1 band) and 50-200 m (referred to as SW2 band), so that complete coverage is provided from 13-550 m, with the normal LW band in addition.

Altogether, there are five positions on the waveband control, including one for gramophone pick-up operation. Provision is made for connection of an external speaker by means of socketed plugs.

Release date : *June*, 1940.

CIRCUIT DESCRIPTION

Aerial input via alternative aerial sockets **A1, A2** and coupling coils **L1** (SW1), **L2** (SW2) and **L3** (MW and LW) to single tuned circuits **L4, C26** (SW1), **L5, C26** (SW2), **L6, C26** (MW) and **L7, C26** (LW).

Input from socket **A1** feeds signal directly to coupling circuits, while that from **A2** feeds the same circuit via a small series condenser **C1,** for reception of strong local transmissions.

First valve **(V1, Mullard metallised FC2A)** is an octode operating as frequency changer with electronic coupling. Oscillator grid coils **L8** (SW1), **L9** (SW2), **L10** (MW) and **L11** (LW) are tuned by **C27.** Parallel trimming by **C10, C28** (MW) and **C11, C29** (LW); series tracking by **C7** (SW1), **C8** (SW2) and **C9** (MW and LW). There are no trimmers on the SW bands in the oscillator circuit, and the trackers are all fixed.

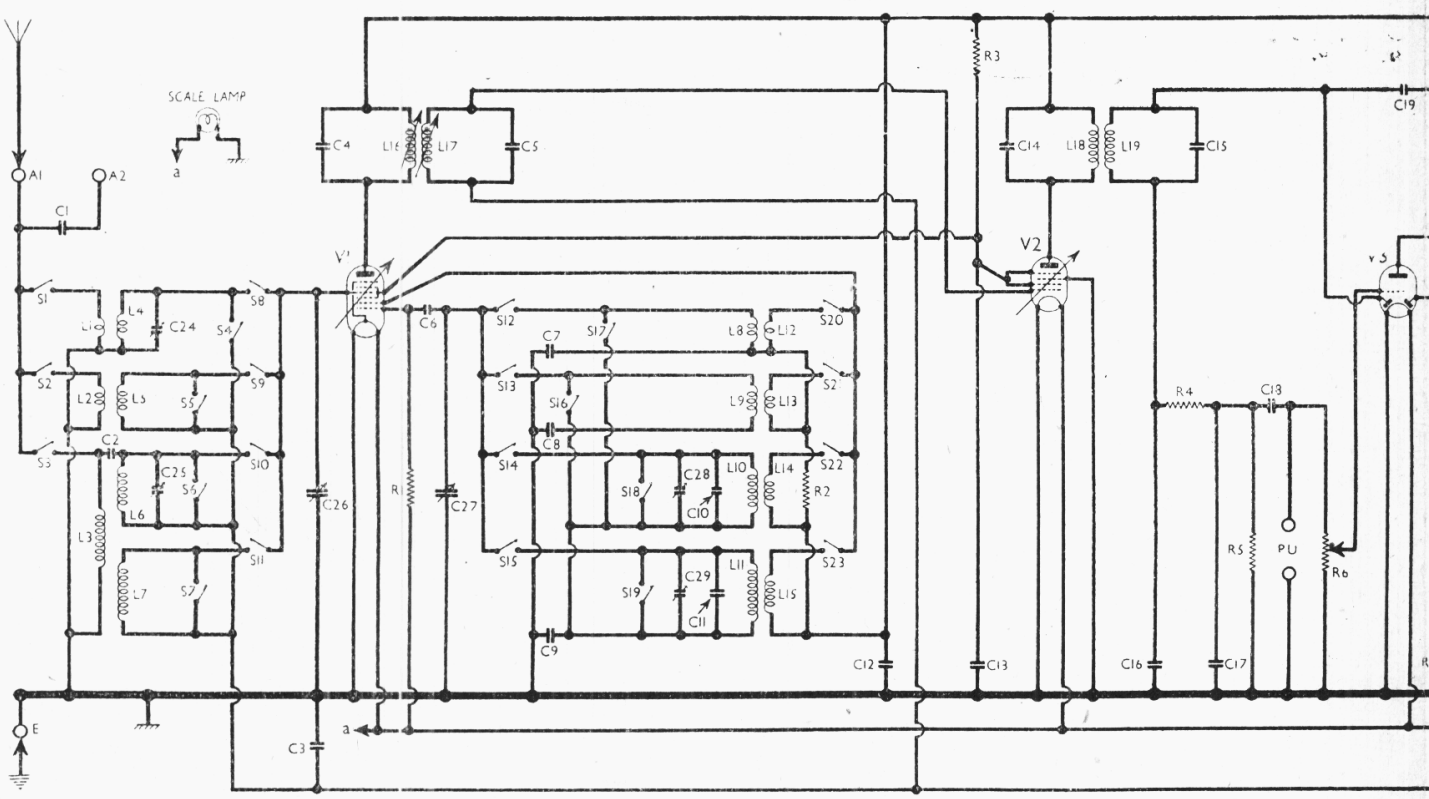
Reaction from anode by coils **L12** (SW1), **L13** (SW2), **L14** (MW) and **L15** (LW). In the case of the SW1 band, reaction coupling by the coil is augmented by that across the tracking condenser, whose impedance (in parallel with **R2, C12**) is common to grid and anode circuits.

Second valve **(V2, Mullard metallised VP2B)** is a variable-mu RF hexode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C4, L16, L17, C5** and **C14, L18, L19, C15.**

The first transformer coils have adjustable iron-dust cores for alignment purposes, while the second transformer coils have air cores. The tuning condensers are fixed in each case. The tuning adjustment, in the case of the second transformer, is carried out at the works and should not require subsequent readjustment.

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve **(V3, Mullard metallised TDD2A).** Audio frequency component in rectified output is developed across load resistance **R5** and passed via AF coupling condenser **C18** and manual volume control **R6** to control grid of triode section, which operates as audio frequency amplifier.



IF filtering by **C16, R4** and **C17** in diode circuit. Provision for connection of gramophone pick-up directly across **R6**.

No switching is included in the pick-up circuit, although a gramophone position is provided on the waveband control. In this position, however, switches **S1-S3, S8-S11, S12-S15** and **S20-S23** are all open, so that radio is muted.

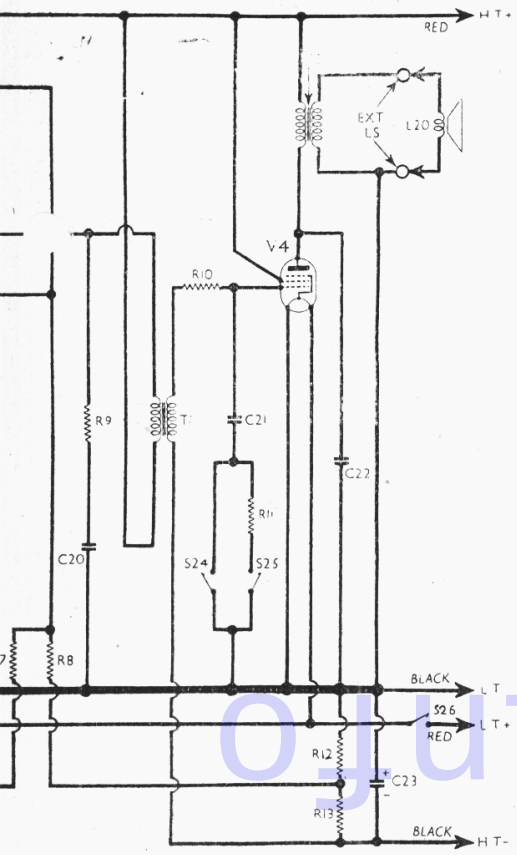
Fixed tone correction by **R9** and **C20** in **V3** triode anode circuit.

Second diode of **V3,** fed from **L19** via the small coupling condenser **C19,** provides DC potential which is developed across load resistance **R8** and fed back through the decoupling circuit **R7, C3** as grid bias to the control grid circuits of **V1** hexode (except on the SW1 band) and IF valves, giving automatic volume control.

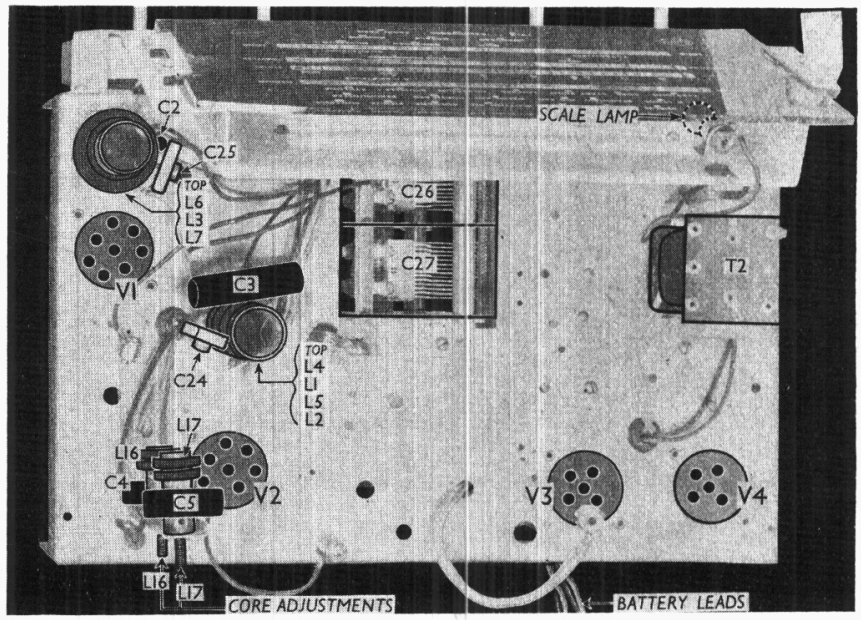
Directly-connected AF transformer coupling by **T1,** via grid stopper **R10,** between **V3** triode and pentode output valve **(V4, Mullard PM22A).** Three-position tone control by **C21, R11** and switches **S24, S25** in control grid circuit. In one position **S24** is closed, connecting **C21** right across the circuit; in the second position **S25** closes, so that **C21** and **R11** are in series; or in the third position both switches are open. Fixed tone correction by **C22** in anode circuit.

The speech coil of the internal speaker is connected by means of plugs and sockets across the output transformer **T2.** The plugs are equipped with further sockets at their outer ends, and a low impedance external speaker may be plugged into them, so that both speakers operate together; or the internal speaker plugs can be withdrawn and replaced by the external speaker plugs, so that the internal speaker is muted.

Grid bias potential for **V4** is obtained automatically from drop across the resistances **R12** and **R13,** which form a potential divider in the negative HT lead to chassis. From the junction of these two resistances is taken a tapping to provide AVC and, via the AVC circuit **R8, R7,** fixed GB voltage for **V1** and **V2.** The electrolytic condenser **C23** by-passes the GB circuit.



Circuit diagram of the Invicta B40 four-band battery superhet receiver. Provision is made for connection of gramophone pick-up and external speaker, and a 'gram' position is provided on the waveband control, although no switches are included in the pick-up circuit. Tone control is effected by a three-position switch.



Plan view of the chassis. **C2** is a wire-wound condenser.

DISMANTLING THE SET

Removing Chassis.—Remove the four control knobs (recessed grub screws) from the front of the cabinet;

withdraw the speaker connecting plugs from the sockets at the rear of the chassis;

remove the four set-screws (with metal and rubber washers) holding the chassis to the bottom of the cabinet.

When replacing, a shaped rubber washer should be fitted to each chassis fixing screw, between the chassis and the bottom of the cabinet;

a flat rubber washer and a metal washer should be fitted under the head of each fixing screw.

Removing Speaker. — Withdraw the speaker connecting plugs from the sockets at the rear of the chassis;

loosen the dust-bag covering the speaker;

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

When replacing, the speech coil tags should be at the bottom.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating with a new HT battery reading 120V on load.

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.

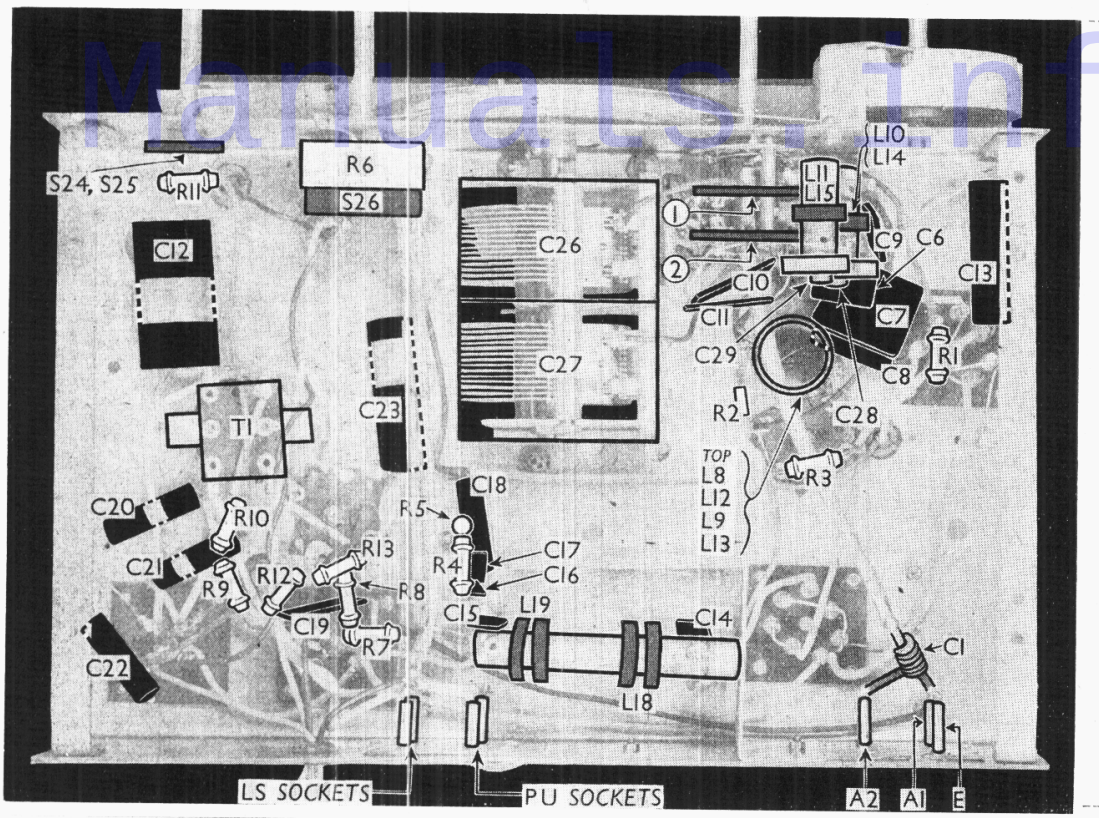
Voltages were measured on the 400V scale of a model 7 Universal Avometer, chassis being negative.

While the screen currents of **V1** and **V2** are being measured, a 0.1 μF non-inductive condenser should be connected directly to the screen (pins 6 and 7) of **V2** holder and chassis, and the present decoupling condenser **C13** should be left directly connected to pin 3 of **V1.**

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 FC2A	115 (Oscillator) 115	0·5 2·5	45	0·75
V2 VP2B	115	1·5	45	0·5
V3 TDD2A	110	2·5	—	—
V4 PM22A	110	3·0	115	0·5

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	V1 osc. CG resistance ...	47,000
R2	SW1 and SW2 reaction damping	1,000
R3	V1, V2 SG's HT feed ...	47,000
R4	IF stopper	47,000
R5	V3 signal diode load ...	470,000
R6	Manual volume control ...	1,000,000
R7	AVC line decoupling ...	1,000,000
R8	V3 AVC diode load ...	1,000,000
R9	Part of fixed tone corrector	47,000
R10	V4 grid stopper	100,000
R11	Part of tone control ...	220,000
R12	V1, V2 fixed GB; V4 GB; and AVC delay pot. divider.	100
R13		330



Under-chassis view. The oscillator circuit trimmers are mounted on the ends of their respective coil units, which are in turn mounted on the two waveband switch units. Diagrams of the switch units are shown in col. 4. C1 is a wire-wound condenser.

	CONDENSERS	Values (μF)
C1	A2 series condenser ...	—
C2	Aerial MW "top" coupling	0·000003
C3	AVC line decoupling ...	0·1
C4, C5	1st IF transformer tuning condensers	0·0001
C6	V1 osc. CG condenser ...	0·0001
C7	Osc. circuit SW1 tracker	0·00007
C8	Osc. circuit SW2 tracker	0·005
C9	Osc. circuit MW and LW tracker	0·0013
C10	Osc. circ. MW fixed trimmer...	0·000657
C11	Osc. circ. LW fixed trimmer	0·00002
C12	HT circuit reservoir ...	0·00026
C13	V1, V2 SG's decoupling...	1·0
C14, C15	2nd IF transformer tuning condensers	0·1
C16, C17	IF by-pass condensers ...	0·0001
C18	AF coupling to V3 triode	0·00015
C19	Coupling to V3 AVC diode	0·005
C20	Part of fixed tone corrector	0·00002
C21	Part of tone control ...	0·01
C22	Fixed tone corrector ...	0·001
C23*	Auto GB circuit by-pass...	0·001
C24‡	Aerial circuit SW1 trimmer	20·0
C25‡	Aerial circuit MW trimmer	0·00003
C26†	Aerial circuit tuning ...	0·00003
C27†	Oscillator circuit tuning...	0·000452
C28‡	Osc. circuit MW trimmer	0·00003
C29‡	Osc. circuit LW trimmer	0·00003

* Electrolytic. † Variable. ‡ Pre-set.

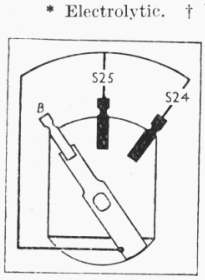


Diagram of the tone control switch unit. Its position is indicated in the under-chassis view above.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial SW1 coupling coil	0·4
L2	Aerial SW2 coupling coil	0·7
L3	Aerial MW and LW coupling coil	60·0
L4	Aerial SW1 tuning coil...	Very low
L5	Aerial SW2 tuning coil...	0·4
L6	Aerial MW tuning coil...	3·5
L7	Aerial LW tuning coil...	13·0
L8	Osc. circ. SW1 tuning coil	Very low
L9	Osc. circ. SW2 tuning coil	0·4
L10	Osc. circ. MW tuning coil	1·8
L11	Osc. circ. LW tuning coil	2·6
L12	Osc. SW1 reaction coil...	0·5
L13	Osc. SW2 reaction coil...	135·0
L14	Osc. MW reaction coil...	11·0
L15	Osc. LW reaction coil...	14·0
L16, L17	1st IF trans. Pri. ...	6·5
	1st IF trans. Sec. ...	6·5
L18, L19	2nd IF trans. Pri. ...	9·0
	2nd IF trans. Sec. ...	9·0
L20	Speaker speech coil ...	2·0
T1	Intervalve trans. Pri. ...	1,000·0
	Intervalve trans. Sec. ...	2,500·0
T2	Output trans. Pri. ...	600·0
	Output trans. Sec. ...	0·2
S1-S23	Waveband switches ...	—
S24, S25	Tone control switches ...	—
S26	LT circuit switch, ganged R6	—

GENERAL NOTES

Switches.—S1-S23 are the waveband switches, in two ganged rotary units beneath the chassis. They are indicated by arrows and numbered circles in our under-chassis view, and shown in detail in the diagrams in col. 4, where they are seen as viewed from the underside of the chassis, as indicated by the arrows.

The table (col. 3) gives the switch positions for the five control settings, starting from fully anti-clockwise. A dash indicates open, and **C**, closed.

It will be seen from the diagram that there are no switches in the gramophone pick-up circuit, although there is a gram. position on the switch control. In the gram. position, however, all the aerial coupling switches, the two sets of CG switches and the oscillator anode circuit switches are open, so that radio is muted, and only **S4** and **S17** are closed.

S24, S25.—These are the tone control switches, in a three-position switch unit, located on the front member of the chassis, and shown in detail in the diagram in col. 1, where it is seen as when viewed from the rear of the underside of the chassis. Its position is indicated in our under-chassis view.

When the control is turned fully anti-clockwise, **S24** closes; in the centre position, **S25** closes; in the fully clockwise

Switch Table

Switch	Gram	SW 1	SW 2	MW	LW
S1	—	C	—	—	—
S2	—	—	C	—	—
S3	—	—	—	C	C
S4	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	—	—	—
S17	C	—	—	—	—
S18	—	—	C	—	—
S19	—	—	—	C	—
S20	—	C	—	—	—
S21	—	—	C	—	—
S22	—	—	—	C	—
S23	—	—	—	—	C

position, both switches are open, giving the maximum high-note response.

S26.—This is the QMB LT circuit switch, ganged with the volume control **R6.**

Coils.—**L1, L2, L4, L5** and **L3, L6, L7** are the aerial coils, in two unscreened tubular units on the chassis deck.

The first IF transformer coils **L16, L17** are also mounted unscreened on the chassis deck with their associated condensers. They are shown in our plan view, where the positions of the core adjusting screws are indicated.

The oscillator circuit coils **L8, L9, L12, L13; L10, L14;** and **L11, L15** are in three unscreened tubular units, mounted in a group round the waveband switch units beneath the chassis. Two of the units, **L10, L14** and **L11, L15** are actually mounted by their connecting tags on the switch units.

The second IF transformer coils **L18, L19** are mounted horizontally beneath the chassis with their associated condensers, and screened by a metal shield. These are fixed tuned at the works and should not require adjustment.

Pre-set Condensers.—The aerial circuit trimmer condensers **C24** and **C25** are mounted directly upon their appropriate coil units on the chassis deck. The oscillator circuit trimmers **C28** and **C29** are similarly mounted beneath the chassis.

Scale Lamp.—This is an Osram low consumption MES type, with a round bulb. It is rated at 3.5V, 0.15A, and is connected by an insulated lead to LT positive. Its other connection is via its mounting clip to chassis; therefore the point at which it is mounted on the scale backing should be scraped free of paint.

Gramophone Pick-up.—Two sockets are provided on a panel at the rear of the chassis for a gramophone pick-up. No switches are directly associated with the pick-up circuit, but on the waveband control a gramophone position is provided, at which radio is muted.

External Speaker.—The output transformer is mounted on the chassis deck, and the outlets from its secondary winding are taken to a pair of speaker sockets marked LS at the rear of the chassis. Normally a pair of plugs from the internal speaker are inserted in these sockets, but they can be withdrawn and replaced by those from low impedance (about 2 O) external speaker, so that the internal speaker is disconnected. Alternatively, the internal speaker plugs, which have sockets in the tops of them, may be left in position, and the plugs of the external speaker can then be inserted into them, so that both speakers operate together.

Condensers C1, C2.—These are both made of insulated wire, one piece being used as a core, with another wound over it. **C1** is formed by winding a braid insulated wire connected to the **A2** socket over a similar wire leaving the **A1** socket, and is indicated in our under-chassis view. **C2** is made of enamelled wire, and is mounted directly on the **L3, L6, L7** coil unit on the chassis deck. It is indicated in our plan view.

A third wire-wound condenser may be found in some chassis, connected between the two sections of the gang condenser. See note under "Chassis Divergencies."

Condenser C23.—This is a 20 μF dry electrolytic, in a tubular cardboard container; it is rated at 30V peak.

Battery Leads and Voltages.—Black lead, spade tag, LT negative; red lead, spade tag, LT positive 2V. Black lead and plug, HT negative; red lead and plug, HT positive 120V. Grid bias is automatic.

Batteries.—No batteries are supplied with the receiver, but the makers suggest that a 2V, 30-50 ampere hour actual accumulator is required. They recommend as suitable types: Invicta LT60, Ever-Ready GS60, or Exide DXG. The space available is approximately 7¼in. x 4 x 8 inches high.

Where first cost is a consideration, standard types of HT battery such as Invicta INV9, Pye K103A, G.E.C. BB720, or Ever-Ready 120V Winner are suggested, but it is recommended that large capacity types, such as Ever-Ready 120L super, are used where economy of upkeep is required. The space available is about 10½ x 4¾ x 8 inches high.

Chassis Divergencies.—**C10,** connected in parallel with **C28** in our chassis, is not shown in the maker's diagram, but a small wire-wound condenser of 1.8 $\mu\mu$F (0.0000018 μF) is shown connected between the high potential ends of the two sections of the tuning condenser gang; this is not in our chassis.

The maker's diagram also shows a 25 O damping resistance connected in the oscillator grid circuit between **C6** and the top of **C27**; and the volume control is shown as having a fixed tapping on its element, with a tone compensating circuit consisting of a resistance and condenser between the tapping and chassis. These were not present in our chassis.

The low potential end of the pick-up sockets, the volume control **R6** and the AVC load resistance **R8,** are all shown as being joined together and taken to the junction of **R12, R13,** whereas in our case only **R8** goes there; the pick-up and **R6** go directly to chassis.

Similarly, **R5** is shown as being returned to LT positive, whereas in our chassis it went to chassis.

R9, which in our chassis was 47,000 O, may be 22,000 O; and **C12,** which was 1.0 μF, is given as 0.1 μF.

Technical Queries

Technical enquiries by telephone cannot be answered by the laboratory, but dealers are invited to address their queries there by letter.

When making such enquiries, dealers are requested to describe all the details of the fault as clearly as possible, and to explain the results of attempts to locate it.

It must be emphasised, however, that all applications for assistance must be accompanied by stamps to the value of 2½d., or an envelope bearing a stamp, otherwise the matter cannot be dealt with.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator, via a 0.1 μF condenser, to control grid (top cap) of **V1** and chassis. Connect a 100,000 O resistance between the control grid and chassis. Switch set to LW, and turn gang and volume control to maximum. Feed in a 465 KC/S signal, and adjust the cores of **L17** and **L16** for maximum output. Remove the condenser and resistance.

The second IF transformer **L18, L19** is permanently adjusted at the works, and should not be interfered with.

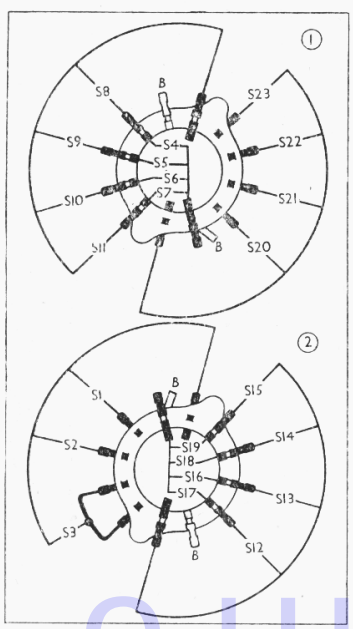
RF and Oscillator Stages.—See that the scale is properly fitted, and that the bottom edge of the glass is horizontal. With the gang at maximum the pointer should coincide with the right-hand ends of the clear sections of the scales. Connect signal generator, via a suitable dummy aerial, to **A** and **E** sockets.

MW.—Switch set to MW, tune to 200 m on scale, feed in a 200 m (1,500 KC/S) signal, and adjust **C28,** then **C25,** for maximum output. There are no variable tracking condensers, but the settings should be checked at 550 m (546 KC/S).

LW.—Switch set to LW, tune to 1,200 m on scale, feed in a 1,200 (250 KC/S) signal, and adjust **C29** for maximum output. Check at 2,000 m (150 KC/S).

SW2.—There are no adjustments on this band, the circuits being fixed-tuned at the works.

SW1.—Switch set to band 1 (second position, the first being fully anti-clockwise), feed in a 14 m (21.4 MC/S) signal, and tune it in accurately. Adjust **C24** for maximum output, while rocking the gang for optimum results. Check at 50 m (6 MC/S).



Diagrams of the waveband switch units, drawn as seen when looking in the direction of the arrows in the under-chassis view.