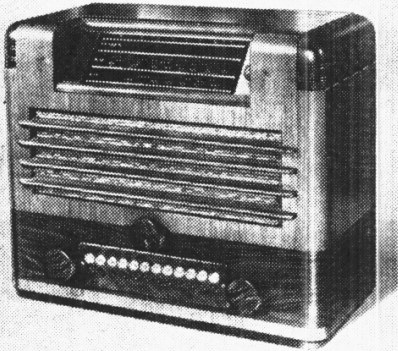


"TRADER" SERVICE SHEET

514

INVICTA A46PB

PRESS-BUTTON SUPERHET



TWELVE press-buttons provide for manual waveband switching and eight pre-set stations on the Invicta A46PB receiver, a 4-valve (plus rectifier) 4-band superhet. The receiver is designed for use with AC mains of 200-250 V, 40-100 C/S.

There are four manually tuned wavebands, and in this Service Sheet they are indicated as follows: SW1 (13-52 m), SW2 (50-200 m), MW and LW.

There is provision for a gramophone pick-up and an external speaker, and the pick-up is switched into circuit when all the buttons are in the "out" (released) position.

Release date: August, 1939.

CIRCUIT DESCRIPTION

The waveband switches, all of which, together with the scale lamp switches **S1-S12**, are associated with the press-button unit, have been numbered and lettered so that their action is obvious from a study of the circuit diagram.

All the switches bearing the number 1, 2, 3 or 4 are controlled by the SW1, SW2, MW and LW manual buttons respectively; those with the number 5 or 6 by one of the LW auto tuning buttons; and those numbered 7 to 9 by one of the MW auto tuning buttons.

The lettered suffix indicates in the case of an **a, b, c, d, e** or **f** that the switch closes when its button is pressed, while a **p, v, w, x, y** or **z** indicates that the switch opens at that time. When the button is released by pressing another button, the action is reversed, **a, b, c, d, e** and **f** switches opening, and **p, v, w, x, y** and **z** switches closing.

Aerial input is via coupling coils **L1** (SW1), **L2** (SW2) and **L3** (MW and LW) to single tuned circuits **L4, C34** (SW1), **L5, C34** (SW2), **L6, C34** (MW manual) and **L7, C34** (LW manual); or for automatic tuning, **L6** tuned by one of the pre-set condensers **C37 to C42** (MW; buttons 7-12) or **L7** tuned by **C35** or **C36** (LW; buttons 5 and 6), according to which button is pressed.

First valve (**V1, Mullard ECH3**) is a triode-hexode operating as frequency changer with internal coupling. For manual tuning, oscillator anode coils **L12** (SW1), **L13** (SW2), **L14** (MW) and **L15** (LW) are tuned by **C46**. Parallel trimming by **C43** (SW1), **C44** (MW) and **C7**, **C45** (LW); series tracking by **C8** (SW1), **C9** (SW2) and **C10** (MW and LW). Reaction by grid coils **L8** (SW1), **L9** (SW2), **L10** (MW) and **L11** (LW), via stabilising resistance **R3**.

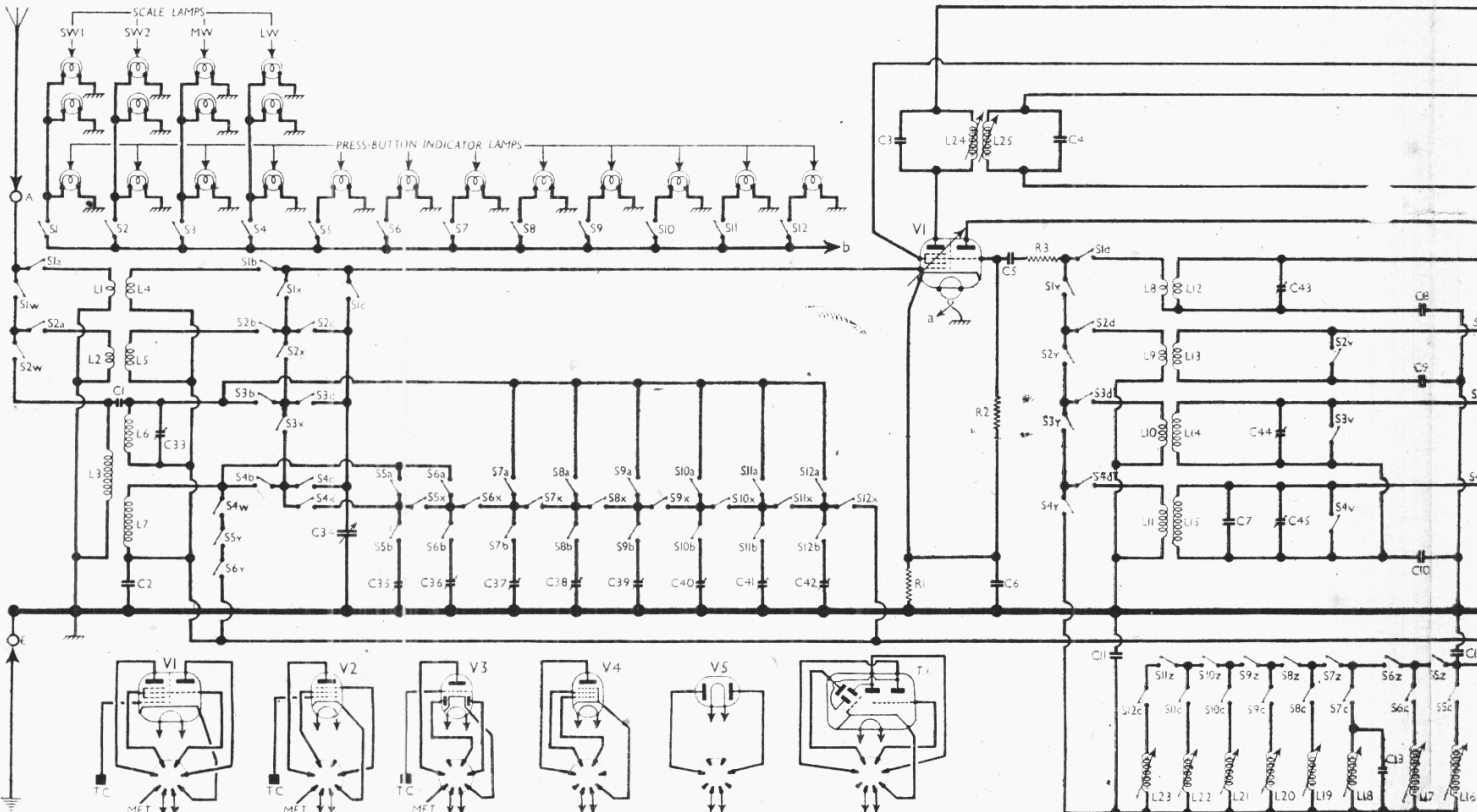
For automatic tuning, a colpitts circuit is employed, one of the coils **L16-L23** is connected between the oscillator grid and anode, and tuned by **C11** and **C12**.

Second valve (**V2, Mullard EF9**) is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-secondary, tuned-secondary transformer couplings **C3, L24, L25, C4** and **C16, L26, L27, C17**.

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve (**V3, Mullard EBC3**). Audio frequency component in rectified output is developed across load resistances **R11, R12** and passed via AF coupling condenser **C22** and manual volume control **R14** to CG of triode section, which operates as AF amplifier.

IF filtering by **C19, R7** and **C20**. Tone compensation by **C24, R13** across the



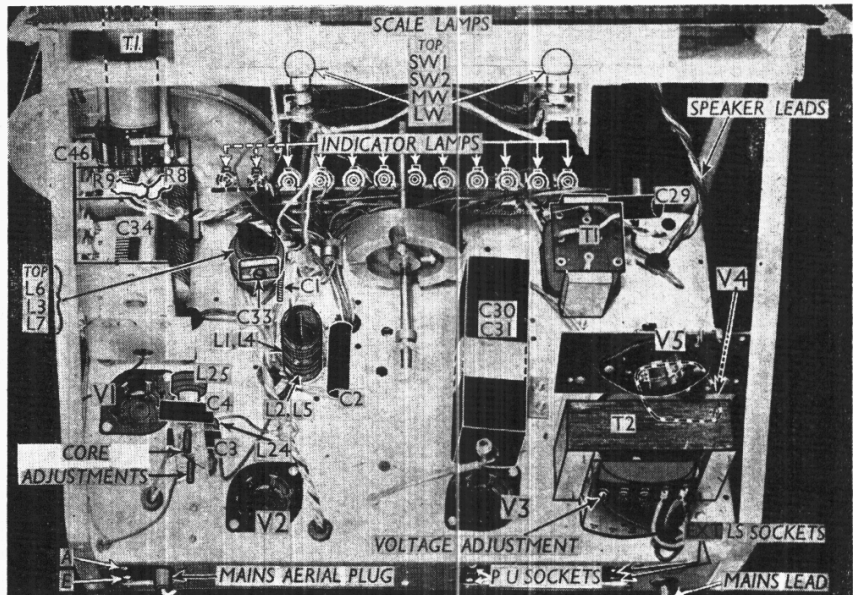
lower half of **R14**, which is centre-tapped. Provision for connection of gramophone pick-up across **R14**, via switches **S1p** to **S12p**. The method of switching the pick-up into circuit is to half-depress one of the press-buttons to release the depressed button, so that all buttons are out; then, since **p** switches and **x** switches close when their buttons are released, the pick-up sockets will be in circuit, and **V1** hexode control grid will be short-circuited to the AVC line, thus muting radio.

DC potential developed across **R11** and **R12** is tapped off at their junction and fed via decoupling circuit **R10**, **C21** as control voltage to CG of tuning indicator (**T1**, Mullard EM4).

Second diode of **V3**, fed from **L27** via **C26**, provides DC potential which is developed across load resistance **R19** and fed back through decoupling circuit as GB to FC and IF valves, giving automatic volume control. Delay voltage, together with GB for triode section, is obtained from drop along resistance **R15** in cathode lead to chassis.

Resistance-capacity coupling by **R17**, **C27** and **R20**, via grid stopper **R21**, between **V3** triode and pentode output valve (**V4**, Mullard EL3). Three-position tone control by **C29**, **R23** and switches **S13**, **S14** in anode circuit. Provision for connection of low impedance external speaker across secondary of output transformer **T1**, by means of jack-type sockets incorporating switch **S15**, which permits internal speaker to be muted by opening its speech coil circuit.

HT current is supplied by full-wave rectifying valve (**V5**, Mullard AZ1). Smoothing by speaker field **L30** and dry electrolytic condensers **C30**, **C31**.



Plan view of the chassis. **V4** is hidden by **T2** and **V5**.

VALVE ANALYSIS

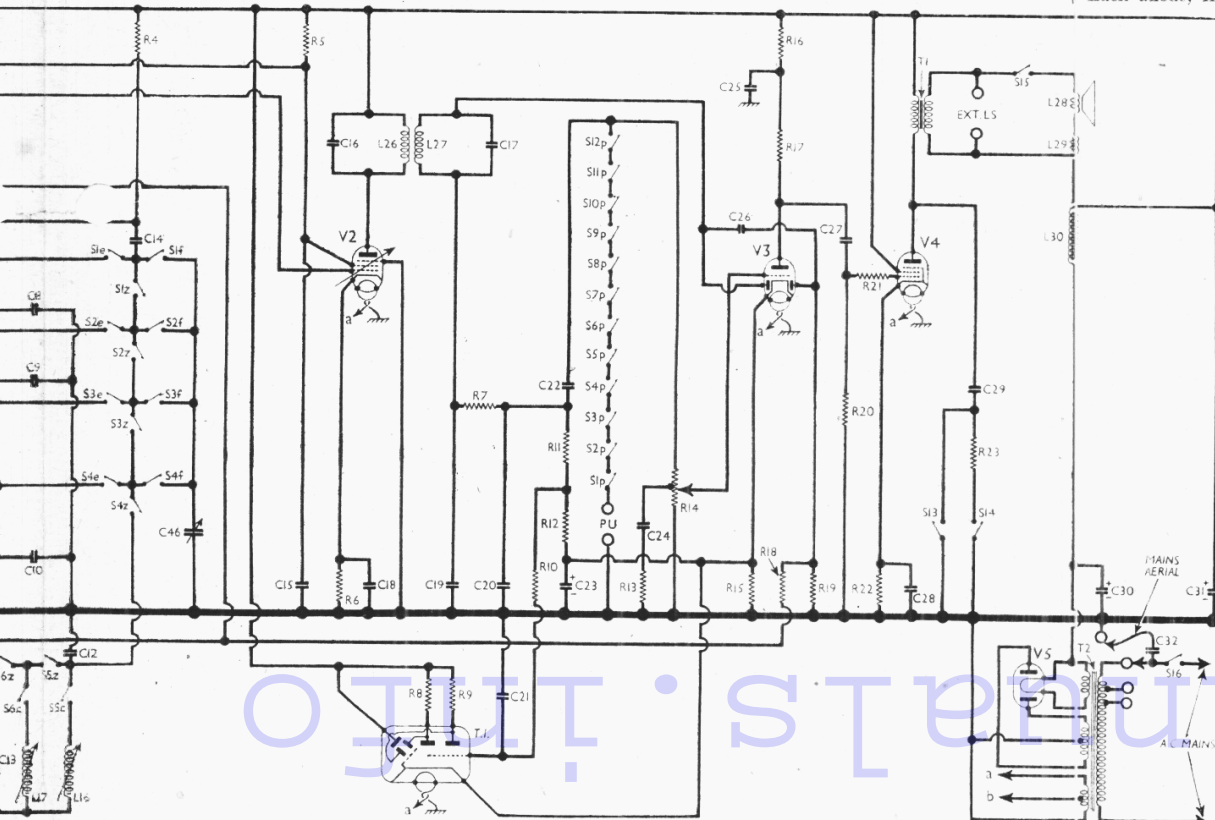
Valve voltages and currents given in the table (col. 6) are those measured in our receiver when it was operating on mains of 238V, using the 236-250V tapping. The receiver was tuned to the lowest wavelength on the medium band and the volume control was at maximum, but there was no signal input.

Voltages were measured on the 400 V scale of the model 7 Universal Avometer.

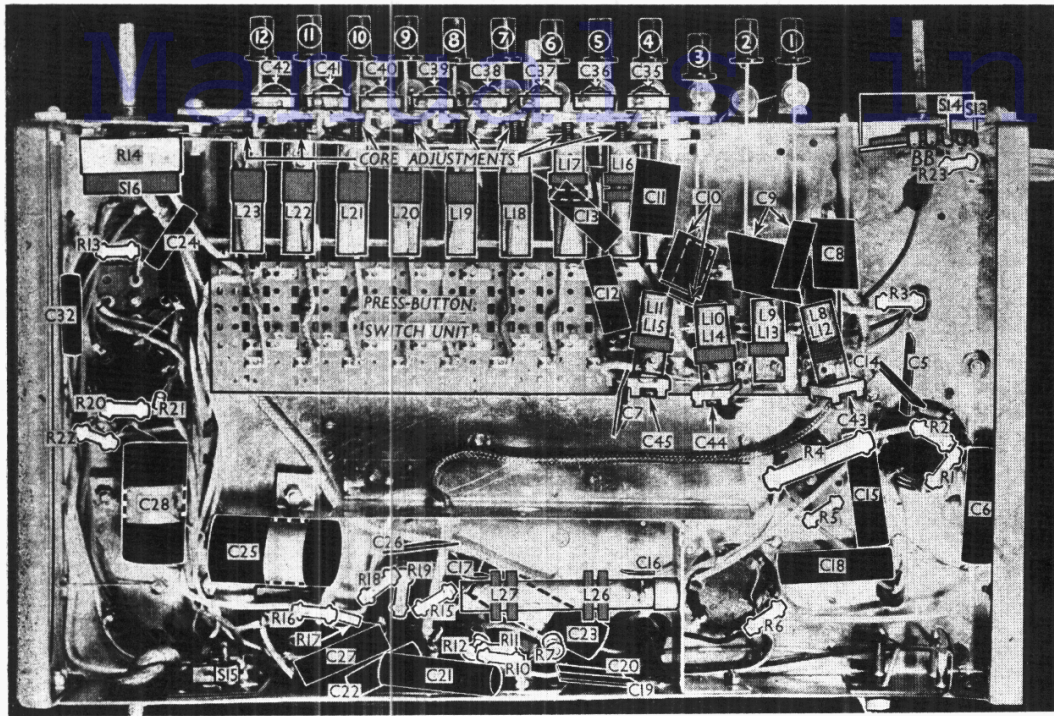
Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 ECH3	240	1.2	70	2.6
	Oscillator			
V2 EF9	240	4.0	80	1.8
	4.5			
V3 EBC3	102	0.6	—	—
V4 EL3	235	35.0	240	4.7
V5 AZ1	355†	—	—	—
	17*	0.1*	—	—
	Target			
T.1. EM4	240	0.6	—	—

† Each anode, AC.

* Each anode, DC.



Circuit diagram of the Invicta A46PB press-button AC superhet. The action of the switches is described under "Circuit Description." The pick-up is connected in circuit via switches **S1p-S12p**, all of which close when all the press-buttons are in the "out" position. Condensers **C35-C42** and coils **L16-L23** are the adjustable auto-tuning elements.



Under-chassis view. The press-buttons are numbered to agree with the switch numbers in the circuit diagram. The press-button unit is indicated here, and shown in detail in the diagrams in cols. 5 and 6 opposite. The oscillator coils are mounted by their tags on the unit.

COMPONENTS AND VALUES

CONDENSERS		Values (μF)
C1	Aerial MW "top" coupling	Very low
C2	AVC line decoupling	0.1
C3	1st IF transformer tuning	0.0001
C4	condensers	0.0001
C5	V1 osc. CG condenser	0.00015
C6	V1 cathode by-pass	0.1
C7	Osc. LW fixed trimmer	0.00026
C8	Osc. circ. SW1 tracker	0.00515
C9	Osc. circ. SW2 tracker	0.00132
C10	Osc. MW and LW tracker	0.000357
C11	Osc. auto circuit tuning	0.0003
C12	condensers	0.00015
C13	No. 7 button fixed trimmer	0.0002
C14	V1 osc. anode coupling	0.00015
C15	V1, V2 SG's decoupling	0.1
C16	2nd IF transformer tuning	0.0001
C17	condensers	0.0001
C18	V2 cathode by-pass	0.1
C19	V2 osc. anode coupling	0.00015
C20	IF by-pass condensers	0.00015
C21	T.I. CG decoupling	0.1
C22	AF coupling to V3 triode	0.005
C23*	V3 cathode by-pass	20.0
C24	Part tone compensator	0.005
C25	V3 triode anode decoupling	1.0
C26	Coupling to V3 AVC diode	0.0002
C27	V3 triode to V4 coupling	0.01
C28	V4 cathode by-pass	1.0
C29	Part of tone control	0.05
C30*	HT smoothing condensers	8.0
C31*		8.0
C32	Mains RF by-pass	0.001
C33†	Aerial circuit MW trimmer	0.00003
C34†	Aerial circuit manual tuning	0.000542
C35†	Aerial auto circuit LW	0.000525
C36†	tuning condensers	0.000525
C37†		0.000525
C38†		0.000525
C39†	Aerial auto circuit MW	0.000525
C40†	tuning condensers	0.00025
C41†		0.00025
C42†		0.00025
C43†	Osc. circuit SW1 trimmer	0.0003
C44†	Osc. circuit MW trimmer	0.0003
C45†	Osc. circuit LW trimmer	0.0003
C46†	Oscillator circuit manual tuning	0.000542

* Electrolytic. † Variable. ‡ Pre-set.
§ 0.005 μF and 0.00015 μF in parallel.
¶ 0.0013 μF and 0.00002 μF in parallel.

RESISTANCES

	Values (ohms)	
R1	V1 fixed GB resistance ... 150	
R2	V1 osc. CG resistance ... 22,000	
R3	Oscillator reaction stabiliser ... 47	
R4	V1 osc. anode HT feed ... 22,000	
R5	V1, V2 SG's HT feed ... 47,000	
R6	V2 fixed GB resistance ... 330	
R7	IF stopper ... 47,000	
R8	T.I. anodes HT feed resistances ... 2,200,000	
R9	T.I. CG decoupling ... 220,000	
R10	V3 signal diode load resistances ... 220,000	
R11		220,000
R12		220,000
R13	Part tone compensator ... 47,000	
R14	Manual volume control ... 1,000,000*	
R15	V3 triode GB; AVC delay ... 3,300	
R16	V3 triode anode decoupling ... 47,000	
R17	V3 triode anode load ... 100,000	
R18	AVC line decoupling ... 1,000,000	
R19	V3 AVC diode load ... 1,000,000	
R20	V4 CG resistance ... 470,000	
R21	V4 grid stopper ... 100,000	
R22	V4 GB resistance ... 150	
R23	Part of tone control ... 3,300	

* Centre-tapped.

OTHER COMPONENTS

	Approx. Values (ohms)	
L1	Aerial SW1 coupling ... 0.3	
L2	Aerial SW2 coupling ... 0.8	
L3	Aerial MW and LW coupling ... 65.0	
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 ... 13.5	
L8	Osc. SW1 reaction coil ... 35.0	
L9	Osc. SW2 reaction coil ... 6.75	
L10	Osc. MW reaction coil ... 10.0	
L11	Osc. LW reaction coil ... 11.5	
L12	Osc. SW1 tuning coil ... Very low	
L13	Osc. SW2 tuning coil ... 0.9	
L14	Osc. MW tuning coil ... 2.0	
L15	Osc. LW tuning coil ... 2.0	
L16	Oscillator auto circuit	
L17	LW tuning coils ... 4.0	
L18		4.0
L19		5.0
L20	Oscillator auto circuit	
L21	MW tuning coils ... 4.0	
L22		4.0
L23		4.0

(Continued next col.)

OTHER COMPONENTS (continued)

	Approx. Values (ohms)	
L24	1st IF trans. { Pri. ... 6.5 Sec. ... 6.5	
L25		Pri. ... 9.0
L26		Sec. ... 9.0
L27	2nd IF trans. { Pri. ... 2.0 Sec. ... 2.0	
L28		Hum neutralising coil ... 0.1
L29	Speaker field coil ... 2,000.0	
L30	Speaker speech coil ... 300.0	
T1	Output trans. { Pri. ... 0.2 Sec. ... 23.0	
T2	Mains trans. { total ... 0.2 Heater sec. ... 0.1 Rect., heat sec. ... 700.0 HT sec., total ...	
S1a, to S4z	Waveband switches ...	
S5a, to S12z	Auto tuning switches ...	
S1-S12	Scale and indicator lamp switches ...	
S13, S14	Tone control switches ...	
S15	Internal speaker switch ...	
S16	Mains switch, ganged R14 ...	

DISMANTLING THE SET

Removing Chassis.—Remove the tuning control knob (recessed grub screw) and the remaining two knobs (pull-off) from the front of the cabinet; remove the two wood screws (with a large and small washer and a spacing collar each) if fitted, holding the scale support to the sub-baffle; remove the four set screws (with metal and rubber 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 chassis entirely, unsolder from connecting panel on the speaker the four leads connecting it to chassis. When replacing, connect the speaker leads as follows, numbering the speaker tags from top to bottom: 1, red; 2, yellow; 3, no external connection; 4, green; 5, black. Two rubber washers should be fitted to each chassis fixing screw, one going either side of the bottom of the cabinet; the shaped one

should go inside, between the chassis and the bottom of the cabinet. The brass spacing collars should be fitted between the scale support and the sub-baffle, if the transit screws are replaced.

Removing Speaker.—Unsolder from the speaker panel the four connecting leads; remove the four nuts holding the speaker to the sub-baffle.

When replacing, the connecting panel should be on the right, and the leads should be connected as previously indicated.

GENERAL NOTES

Switches.—All the waveband, gramophone pick-up and scale lamp switches are comprised in a press-button unit. They are coded to indicate their action, which is fully described at the beginning of the "Circuit Description."

The unit is double-sided, and each press-button plunger controls two groups of switches, all of which bear the same number as control button (as seen in our under-chassis view), one group (aerial circuit) being on the upper side of the unit and the other (oscillator circuit) on the underside, seen in our under-chassis view. The diagrams in cols. 5 and 6 show the two sides of the unit in detail.

S13, S14 are the tone-control switches, in a three-position unit mounted on the front member of the chassis and seen in our under-chassis view. In the fully anti-clockwise position of the control spindle (deep tone) **S13** is closed; in the central position **S14** is closed; in the fully clockwise position both switches are open (maximum treble response).

S15 is the internal speaker muting switch, associated with the external speaker sockets.

S16 is the QMB mains switch, ganged with the volume control **R14**.

Coils.—The aerial coils **L1-L7** are in two unscreened tubular units on the chassis deck. The oscillator coils **L8-L15** are in four unscreened tubular units, one for each waveband, beneath the chassis. They are mounted directly by their connecting tags on the press-button unit with their associated trimmers and trackers.

The oscillator pre-tuned automatic tuning coils **L16-L23** are mounted in a row beneath the chassis, in front of the press-button unit. They have adjustable iron-dust cores, the adjusting screws of which project towards the front of the chassis, in a line with the aerial pre-set condensers.

The first IF transformer **L24, L25** is mounted unscreened on the chassis deck. Its coils have adjustable iron-dust cores, the screws of which face the rear of the chassis. The second IF transformer **L26, L27** is air-cored and has no tuning adjustments. It is fitted beneath the chassis.

External Speaker.—Two sockets are provided at the rear of the chassis for a low impedance (about 2.4 O) external speaker. **S15** is associated with them.

Gramophone Pick-up.—Two further sockets are provided at the rear of the chassis for a pick-up. They are connected via switches **S1p-S12p**, which run the whole length of the press-button unit, across the manual volume control **R14**. When all the buttons are in the "out" position the sockets are in circuit.

Scale Lamps.—There are eight of these, two to each waveband scale. They are

Ever Ready MES types, rated at 6.2 V, 0.3 A, with spherical bulbs.

Indicator Lamps.—These are twelve further Ever Ready MES types, rated at 6.2 V, 0.3 A. The bulbs should be 6.2 mm. spherical or flat. All the scale and indicator lamps are fed from a special tapping (marked **b** in the diagram) on the heater secondary of the mains transformer **T2**.

Condenser C1.—This is a small coupling condenser in the aerial circuit, made by winding several turns of fine enamelled wire round a core of thicker wire.

Condensers C30, C31.—These are two dry electrolytics in a rectangular cardboard former held by a metal clamp to the chassis deck. The red leads are the positives of the two condensers, and the black lead the common negative. They are rated at 8 μF, 550 V peak each.

Chassis Divergencies.—Some of the components in our chassis had values different from those given in the makers' information. **R1** was 150 O, as against 220 O in the makers' information; **R2** was 22,000 O, as against 47,000 O; **R5** was 47,000 O, as against 22,000 O, and was a single feed resistance, whereas at one time a potential divider was used, the lower section of which was 47,000 O.

C8 was given in the makers' information as 0.005 μF; in our chassis this condenser was present, but it was shunted by an additional 0.00015 μF condenser. Similarly, **C9** was there as listed, at 0.0013 μF, but was shunted by an additional 0.00002 μF condenser. **C7** was not shown in the makers' diagram, but was present in our chassis, as was the case also with **C13**. The **SW1** trimmer **C43** was shown in the aerial circuit, whereas in our chassis it was in the oscillator circuit.

CIRCUIT ALIGNMENT

IF Stages.—Only the first IF transformer should be adjusted; the second is permanently tuned before leaving the works, and should not be altered.

Connect signal-generator via a 0.1 μF condenser to control grid (top cap) of **V1** and chassis, and a 100,000 O resistance between the grid and chassis. Feed in a 465 KC/S (645.16 m) signal, and adjust the cores of **L24** and **L25** for maximum.

RF and Oscillator Stages.—See that the glass scale is properly in position: the bottom edge should be horizontal. With the gang at maximum, the pointer should coincide with the vertical lines at the high-wavelength ends of the scales. The pointer can be adjusted by loosening the screws holding the drive disc to the gang spindle. Turn volume control to maximum, and transfer signal generator leads to **A** and **E** via a dummy aerial.

MW.—Press the MW button (No. 3) tune to 250 m on scale, feed in a 250 m (1,200 KC/S) signal, and adjust **C44**, then **C33**, for maximum output. Check calibration at 550 m (546 KC/S).

LW.—Press No. 4 button, tune to 1,200 m on scale, feed in a 1,200 m (250 KC/S) signal, and adjust **C45** for maximum output. Check at 2,000m (150 KC/S).

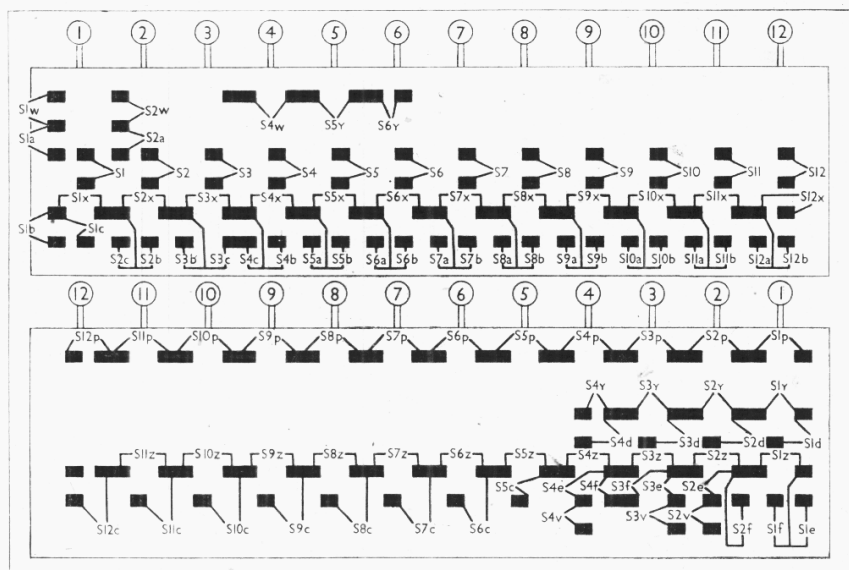
SW1.—Press No. 1 button, tune to 14 m on scale, feed in a 14m (21.4 MC/S) signal, and adjust **C43** for maximum output (or the aerial circuit trimmer, if fitted). Check at 50m (6 MC/S).

SW2.—This is the Trawler band, and it is not provided with any adjustments, being permanently tuned at works.

It may be necessary to readjust the pre-set condensers after any alteration to the MW alignment of the receiver, but the oscillator coils will not be affected.

PRESS-BUTTON RANGES

Button No.	Wavelength Coverage
5	900—2,000
6	900—2,000
7	300—540
8	300—540
9	300—540
10	200—420
11	200—420
12	200—420



Diagrams of both sides of the press-button unit. Above: side facing chassis deck; below: underside, seen in our under chassis view.

