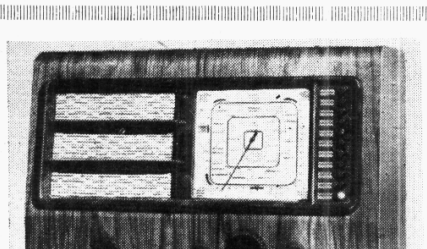
Supplement to The Wireless & Electrical Trader, April 6, 1946

"TRADER" SERVICE SHEET 765

EKCO PB189

Covering C389 CONSOLE and PB189U



The Ekco PB189 and PB189U.

AUTOMATIC frequency correction is used in the Ekco PB189 to ensure accurate tuning with the press-button motor drive. The receiver is a 6-valve (plus rectifier) 3-band superhet with press-button automatic tuning for ten M.W. and L.W. stations. The S.W. range is 15-50 m.

The console version C389 employs an identical chassis except that the tone control is in a different position and eleven station press-buttons are provided. The PB189U is the PB189 with a Philips vibratory converter for D.C. operation. Details are given overleaf.

Release date, all models, 1938. *Original prices: PB189,* £13 2s. 6d.; *C389,* £16 5s. 6d.; *PB189U,* £15 4s. 6d.

CIRCUIT DESCRIPTION

Aerial input on M.W. and L.W. is via **C1** (M.W.), or **L1** (L.W.), to tappings on the primary coils of a band-pass filter circuit. Primary coils **L2, L3** are tuned by **C42;** secondaries **L6, L7** by **C46.** Coupling by mutual inductance of primary and secondary windings. Image suppression by **C40** on M.W.

On S.W. input is via coupling coil **L4** to single-tuned circuit **L5, C46.**

First valve **(V1, Mullard metallised TH4A)** is a triode-heptode operating as frequency changer with internal coupling. Triode oscillator grid coils **L10** (S.W.), **L11** (M.W.), and **L12** (L.W.), are tuned by **C48.** Parallel trimming by **C49** (S.W.), **C50** (M.W.), and **C51** (L.W.); series tracking by **C10** (M.W.) and **C11** (L.W.). These trackers are fixed, but the coils have adjustable iron-dust cores.

Reaction coupling from anode by coils **L13** (S.W.), **L14** (M.W.) and **L15** (L.W.), the longer-waveband coils being short-circuited by switches **S20, S21** when not in use.

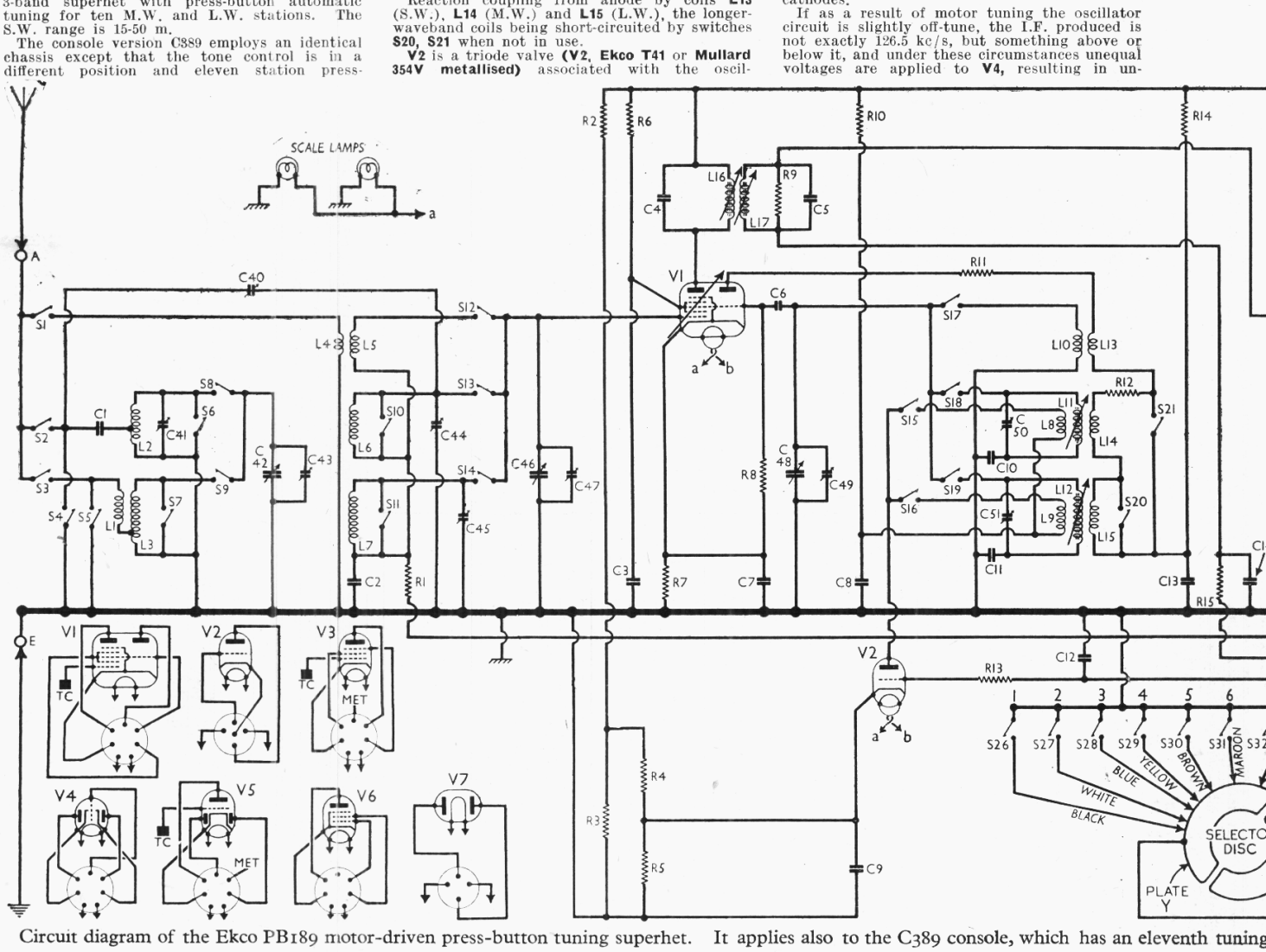
V2 is a triode valve **(V2, Ekco T41** or **Mullard 354V metallised)** associated with the oscillator circuit only in connection with the A.F.C. circuit, and will be dealt with shortly. Third valve **(V3, Ekco VP41** or **Mullard VP4B metallised)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary iron-cored transformer couplings **C4, L16, L17, C5** and **C17, L18, L19, C18.** A further tuned secondary circuit **L21, C22,** remote from its primary but coupled to it by the link coil **L20,** is the radio signal channel to the diode signal detector.

Intermediate frequency 126.5 kc/s.

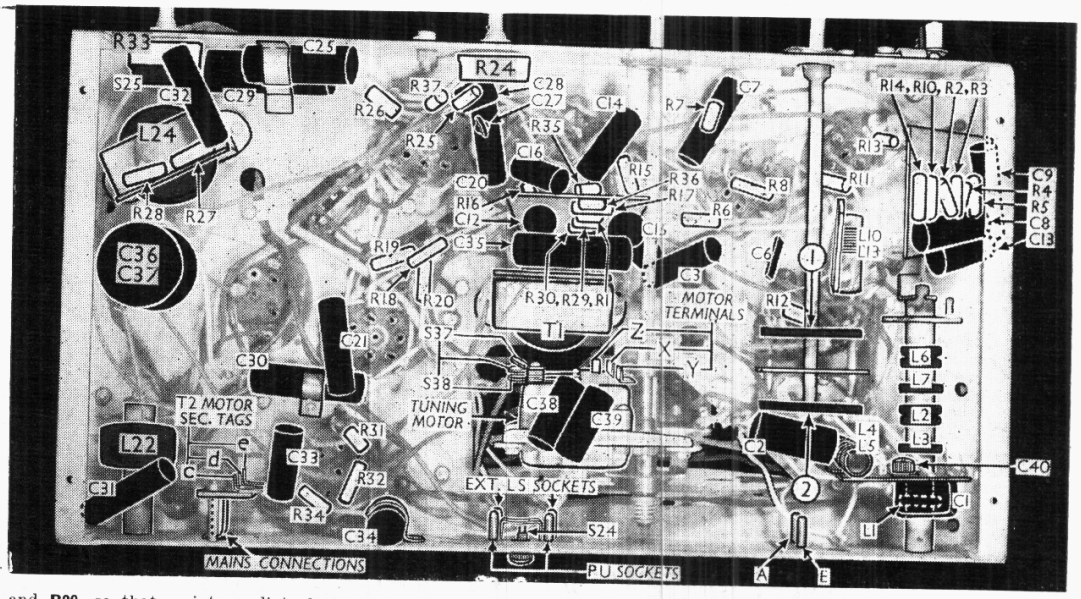
The output from secondary winding **L19,** which is centre-tapped, is divided virtually into two halves, and the two outputs are applied to the two diodes of the double diode valve **(V4, Ekco 2D41** or **Mullard 2D4B metallised)** which has separate cathodes and acts as the discriminator for automatic frequency correction.

When the intermediate frequency signal is exactly 126.5 kc/s, the voltages applied to the anodes of **V4** from **L19, C19** are equal and of opposite phase, and they produce equal voltage drops along the diode load resistors **R19, R20** in the cathode circuits, but as these are connected in opposition they cancel out, and there is no potential difference between the two cathodes.

If as a result of motor tuning the oscillator circuit is slightly off-tune, the I.F. produced is not exactly 126.5 kc/s, but something above or below it, and under these circumstances unequal voltages are applied to **V4,** resulting in un-



Circuit diagram of the Ekco PB189 motor-driven press-button tuning superhet. It applies also to the C389 console, which has an eleventh tuning



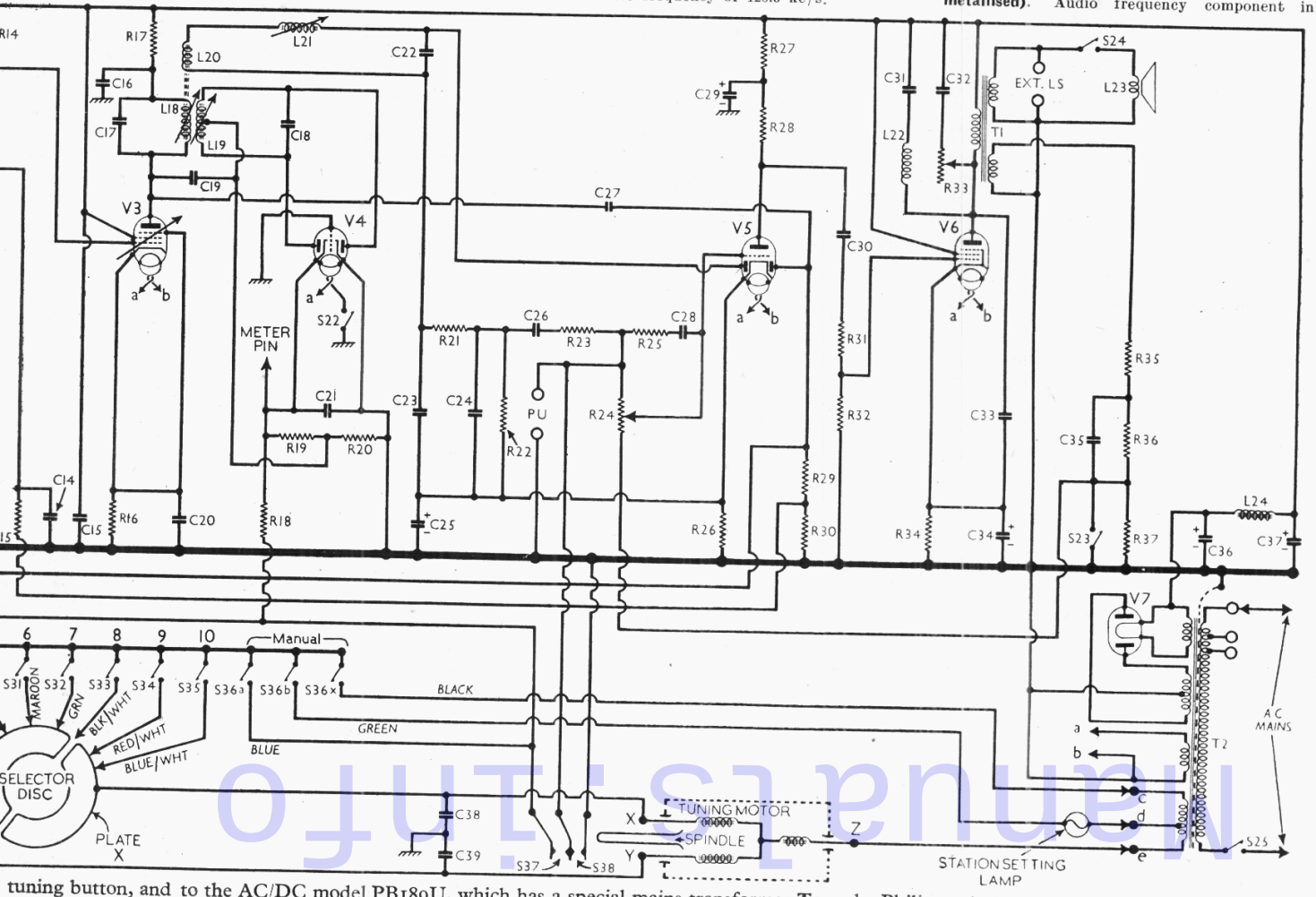
balanced voltages across **R19** and **R20**, so that there is a potential difference between them.

One end **(R20)** is connected to chassis, so the other end (connected to the meter pin) becomes positive or negative with respect to chassis. From it a control line is taken via decoupling circuit **R18, C12, R13** to the control grid of **V2**, whose anode current consequently varies if the intermediate frequency is high or low. Since **V2** anode current flows through **L8** on M.W., or **L9** on L.W., and these coils are coupled to the oscillator circuit tuning coils, the change of current will cause a change in the inductance of the tuning coils in such a direction as to correct the frequency error and produce an intermediate frequency of 126.5 kc/s.

On S.W., **S22** opens and breaks the heater circuit of **V4**, and renders the valve inoperative. On manual operation **S36a** short-circuits the A.F.C. control line, so that A.F.C. operates only with motor tuning.

Diode second detector is part of double diode triode valve **(V5, Ekco DT41** or **Mullard TDD4 metallised)**. Audio frequency component in

Under - chassis view. The waveband switch numbers are indicated by arrows and numbers **1** and **2** in circles. The two small assemblies have been tilted artificially to show their contents.



tuning button, and to the AC/DC model PB189U, which has a special mains transformer **T2** and a Philips tubular converter for D.C. operation.

Supplement to The Wireless & Electrical Trader, April 6, 1946

rectified output is developed across load resistors **R21, R22,** and that across **R22** is passed via A.F. coupling capacitor **C26** and manual volume control **R24** to C.G. of triode section, which operates as A.F. amplifier.

Tone compensation for changes in setting of volume control by **R25, C28.** I.F. filtering by **C23, R21** and **C24.** Provision for the connection of a gramophone pick-up across **R24.**

Second diode of **V5,** fed from **V3** anode via **C27,** provides D.C. potentials which are developed across load resistors **R29, R30** and fed back through decoupling circuits as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage, together with G.B. for triode section, is derived from the drop along **R26** in cathode lead to chassis.

Resistance-capacitance coupling by **R28, C30** and **R31, R32,** the two resistors giving a step-down coupling, between **V5** triode and pentode output valve (**V6, Ekco OP42** or **Mullard PenA4**). Whistle suppression by low-pass filter **L22, C31** in anode circuit. Fixed tone correction by **C33,** and variable tone control by **R33, C32,** in anode circuit. Provision for the connection of a low-impedance external speaker across speech coil secondary winding of output transformer **T1,** switch **S24** permitting the internal speaker to be muted if desired.

A second secondary winding on **T1** provides voltages which are fed back through a filter circuit **R35, R36, C35, R37** and applied in negative sense via **R24** to **V5** triode control grid circuit on M.W. and L.W. On S.W. **S23** closes, short-circuiting the coupling resistor **R37** and deleting the feed-back signal, but **R35** prevents the switch from short-circuiting the secondary winding. On gram. negative feed-back is optional, the user being advised that he will obtain greater output upon switching to S.W.

H.T. current is supplied by full-wave rectifying valve (**V7, Ekco R41** or **Mullard DW4/350**). Smoothing by iron-cored choke **L24** and electrolytic capacitors **C36, C37.**

Automatic Tuning

The mains transformer **T2** is equipped with a special secondary winding to drive the tuning motor, and one end of the winding **e** is connected directly to one of the motor terminals **Z.** The other end of the winding **c** goes via switch **S36X** (which is closed when the manual (white) button is out) to the frame of the press-button unit and chassis.

The outer ends of the motor windings, **X** and **Y,** are connected each to one of the semi-circular commutator plates on the selector disc, which is mounted on the spindle of the tuning gang. The motor runs if one of these plates is connected to chassis, the direction of rotation depending upon whether **X** or **Y** is involved.

If button **3** in our circuit diagram is pressed, switch **S28** closes, connecting contact clip **3,** and thus the commutator plate **Y,** to chassis, the motor runs, and as it is geared to the selector disc, this also turns, the direction being such that the upper gap between the two plates travels towards clip **3** until it reaches it, when the motor circuit is broken by the gap and the motor stops. In turning the disc, the motor turns the gang and tunes in the required station, any inaccuracy being corrected by the A.F.C. circuit described earlier.

If the white manual or "Knob Tuning" button is pressed, **S36a** and **S36b** close, and **S36X** opens, disconnecting the chassis end **C** of the motor secondary, so that the motor cannot run. Tuning is then performed in the normal manner by hand.

In order to suppress various noises which may occur in the process of tuning, **S38** closes and short-circuits **R24.** At the same time **S37** closes and suppresses the A.F.C. circuit. Both of these switches are operated by the thrust of the motor spindle, which closes them only while the motor is running.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those quoted in the maker's manual.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 TH4A	250	2·2	90	5·2
	Oscillator			
	130	5·0		
V2 T41	220	2·0	—	—
V3 VP41	240	10	250	4·0
V4 2D41	—	—	—	—
V5 DT41	110	2·4	—	—
V6 OP42	240	32·5	250	5·0
V7 R41	300†	—	—	—

† Each anode, A.C.

COMPONENTS AND VALUES

	RESISTORS	Values (ohms)
R1	V1 hept. C. G. decoupling	1,000,000
R2	V2 G.B. potential divider resistors	25,000
R3		25,000
R4		15,000
R5		1,200
R6	V1 S.G. H.T. feed	30,000
R7	V1 fixed G.B. resistor	200
R8	V1 osc. C. G. resistor	100,000
R9	I.F. trans. sec. shunt	500,000
R10	V2 anode H.T. feed	15,000
R11	Oscillator reaction stabilisers	200
R12		3,000
R13	V2 C.G. decoupling	250,000
R14	V1 osc. anode H.T. feed	20,000
R15	V3 C.G. decoupling	1,000,000
R16	V3 fixed G.B. resistor	300
R17	V3 anode H.T. feed	1,000
R18	Discriminator load decoupling	100,000
R19	V4 discriminator load resistors	500,000
R20		500,000
R21	I.F. stopper	100,000
R22	V5 signal diode load	100,000
R23	A.F. feed resistor	50,000
R24	Manual volume control	1,000,000
R25	Part of tone compensator	500,000
R26	V5 triode G.B.; A.V.C. delay.	1,000
R27	V5 triode anode decoupling	10,000
R28	V5 triode anode load	50,000
R29	V5 A.V.C. diode load resistor	500,000
R30		750,000
R31	V6 C.G. potential divider	100,000
R32		250,000
R33	Variable tone control	60,000
R34	V6 G.B. resistor	120
R35	Negative feed-back potential divider	15,000
R36		15,000
R37		500

	CAPACITORS	Values (μF)
C1	Aerial M.W. coupling	0·001
C2	V1 hept. C.G. decoupling	0·1
C3	V1 S.G. decoupling	0·1
C4	1st I.F. transformer tuning capacitors	0·00014
C5		0·00014
C6	V1 osc. C.G. capacitor	0·000025
C7	V1 cathode by-pass	0·1
C8	V2 anode decoupling	0·1
C9	V2 cathode by-pass	0·1
C10	Osc. circ. M.W. tracker	0·00168
C11	Osc. circ. L.W. tracker	0·0008
C12	V2 C.G. decoupling	0·04
C13	V1 osc. anode decoupling	0·1
C14	V3 C.G. decoupling	0·04
C15	H.T. circuit R.F. by-pass	0·1
C16	V3 anode decoupling	0·02
C17	2nd I.F. transformer tuning capacitors	0·00014
C18		0·00014
C19	Phasing capacitor	0·0001
C20	V3 cathode by-pass	0·1
C21	V4 output reservoir	0·1
C22	2nd I.F. trans. signal sec. tuning	0·00014
C23	I.F. by pass capacitors	0·0002
C24		0·0002
C25*	V5 cathode by-pass	25·0
C26	A.F. coupling to V5 triode	0·01
C27	A.V.C. diode coupling	0·000015
C28	Part of tone compensator	0·0001
C29*	V3 triode anode decoupling	2·0
C30	A.F. coupling to V6	0·1
C31	Whistle filter tuning	0·005
C32	Part variable tone control	0·1
C33	Fixed tone corrector	0·0025
C34*	V6 cathode by-pass	50·0
C35	Part of feed-back circuit	0·2
C36	H.T. smoothing capacitors	8·0
C37		16·0
C38	Tuning motor shunt capacitors	0·02
C39		0·02
C40‡	Image suppressor	—
C41‡	B.-P. pri. M.W. trimmer	—
C42‡	Band-pass pri. tuning	—
C43‡	B.-P. pri. L.W. trimmer	—
C44‡	B.-P. sec. M.W. trimmer	—
C45‡	B.-P. sec. L.W. trimmer	—
C46‡	B.-P. sec. and S.W. tuning	—
C47‡	Aerial circ. S.W. trimmer	—
C48‡	Oscillator circuit tuning	—
C49‡	Ocs. circ. S.W. trimmer	—
C50‡	Osc. circ. M.W. trimmer	—
C51‡	Osc. circ. L.W. trimmer	—

* Electrolytic. † Variable. ‡ Pre-set.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial L.W. coupling coil	50·0†
L2	Band-pass primary coils	2·5
L3		25·0
L4	Aerial S.W. coupling coil	0·2
L5	Aerial S.W. tuning coil	Very low
L6	Band-pass secondary coils	2·5
L7		25·0
L8	Osc. M.W. A.F.C. coil	19·0
L9	Osc. L.W. A.F.C. coil	90·0
L10	Osc. S.W. tuning coil	Very low
L11	Osc. M.W. tuning coil	2·0
L12	Osc. L.W. tuning coil	9·0
L13	Osc. S.W. reaction coil	Very low
L14	Osc. M.W. reaction coil	1·0
L15	Osc. L.W. reaction coil	2·3
L16	1st I.F. trans. Pri.	45·0
L17	Sec.	45·0
L18	2nd I.F. trans. Pri.	45·0
L19	Disc. sec., total	45·0
L20	Coupling coil	2·0
L21	Signal sec.	45·0
L22	Whistle filter coil	80·0
L23	Speaker speech coil	2·3
L24	H.T. smoothing choke	650·0
T1	Output trans. Pri.	350·0
	Speech sec.	0·5
	F.-B. sec.	38·0
T2	Mains trans. Pri., total	33·0
	Heater, sec.	Very low
	Rect. heat. sec.	Very low
	Motor sec., total	2·5
	H.T. sec., total	460·0
Motor	Tuning motor windings	6·3*
S1-S23	Waveband switches	—
S24	Int. speaker switch	—
S25	Mains switch, ganged R33	—
S26-S36	Press-button switches	—
S37	Tuning motor muting switches	—
S38		—

† Including the lower end of L3.
* Either winding. Measured between X and Z or Y and Z with press-buttons out.

GENERAL NOTES

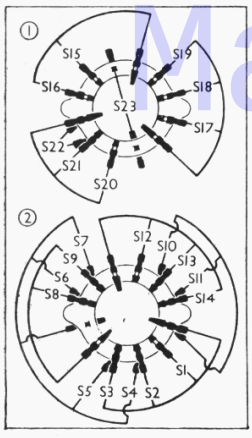
Switches.—**S1-S23** are the waveband switches ganged in two rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the diagram in col. 4, where they are drawn as seen in the directions of the arrows in the chassis illustration. The table below gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and **C,** closed.

S24 is the screw-type internal speaker switch. It mutes the speaker when unscrewed a few turns. **S25** is the Q.M.B. mains switch, ganged with the tone control **R33.**

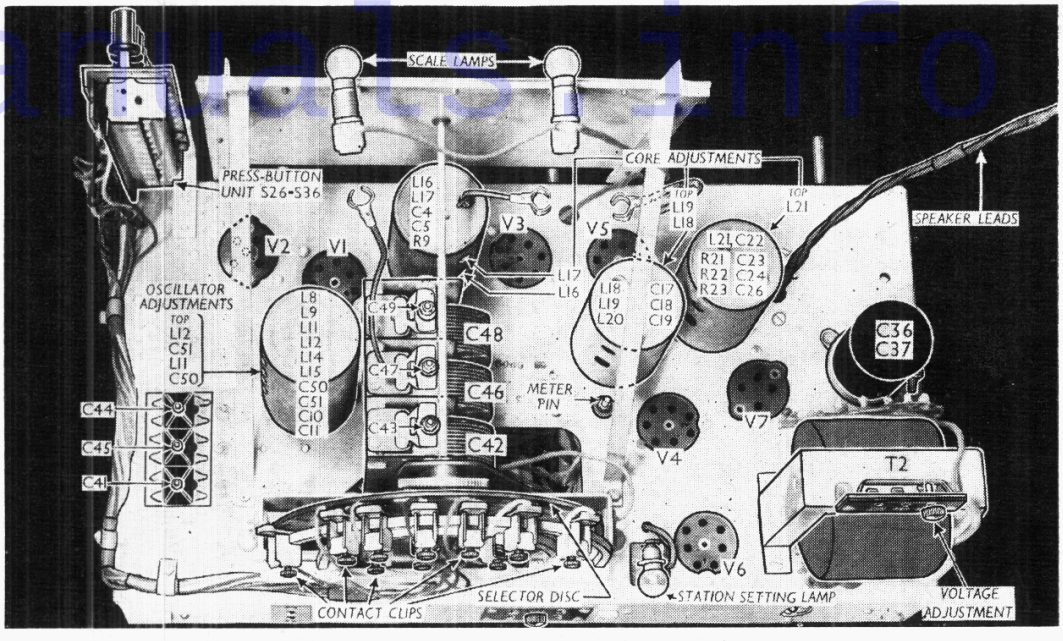
S26-S35 are the ten station buttons, and **S36a, b** and **x** are the three switches associated with the manual ("Knob Tuning") button, on the press-button unit which is mounted vertically on the chassis deck beside the tuning scale. **S26** belongs to button No. 1, and the rest of the ten station buttons have one switch each up to No. 10, which controls **S35.**

The eleventh button, which is coloured white and is at the bottom of the assembly, is really a manual-auto change-over button switching to manual when pressed. When another button is pressed it is automatically released, and switches over to auto. It controls three switches **S36a S36b** and **S36x. S36a** and **b** close

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



Above : Diagrams of the waveband switch units.



Right : Plan view of the chassis. All four screened coil units have core adjustments as indicated.

when the button is pressed; when it is released, these open, and **S36x** closes.

No diagram is given of the press-button unit switches, as the first ten consist merely of a single fixed contact which "makes" to the frame of the unit, and thus to chassis, via the moving contact when the button is pressed. The three switches numbered **S36** controlled by the manual button are very simple to identify and need no diagram either.

S37, S38 are two muting switches, operated by the tuning motor spindle, which is permitted a certain amount of end-play. When running, the forward thrust of the armature pushes the spindle against the blades of these switches, causing them to close, muting the radio sound channel and also muting the A.F.C. circuit.

Coils.—All the band-pass and aerial circuit coils **L1-L7** are mounted in a single assembly near the aerial socket beneath the chassis. The oscillator circuit coils **L8, L9; L11, L12; L14, L15** are in a screened unit on the chassis deck, the four adjustments being indicated in the order in which they occur in our chassis illustration. The SW coils **L10, L13** are in an unscreened unit beneath the chassis deck.

The two I.F. transformers **L16, L17; L18, L19, L20;** and **L21** are in three screened units on the chassis deck, **L21** having a separate can which it shares with several other components.

Scale and Setting Lamps.—These are all M.E.S. type lamps, with large spherical bulbs, rated at 6.2 V, 0.3 A.

External Speaker.—Two sockets are provided at the rear of the chassis for the connection of a low impedance (3-4 Ω) external speaker.

Capacitors C36, C37.—These are two T.C.C. wet electrolytics in a single tubular metal container mounted in a clip through a hole in the chassis deck. The positive connections are brought out to tags on the base of the unit, the 16 μF tag being indicated by a red washer, and the 8 μF tag by a yellow washer. The case forms the common negative connection. The unit is rated at 350 V working.

A.C./D.C. Model PB189U

This receiver is identical with the A.C. version on which this *Service Sheet* was prepared except that it is fitted with the Philips tubular converter type 7880C or 7881C for D.C. operation, and thus has a special mains transformer. This cannot be covered here, but it is fully covered in *Service Sheet* 713.

CIRCUIT ALIGNMENT

IF Stages.—Switch set to L.W., press the white button (manual), turn the gang to maximum, the tone control to high and the volume control to maximum. Clip the signal generator leads via a 0.02 μF capacitor to the insulation on the top-cap lead to **V1** and chassis, connect a 0.5 V A.C. voltmeter to the external speaker sockets, a 100,000 Ω resistor across **L16,** and another across **L18.** Feed in a 126.5 kc/s (2,372 m) signal, and adjust the cores of **L16, L17, L18** and **L21** in that order for maximum output. Very little movement should be necessary, and it is advisable to try half a turn each way to see if any improvement occurs, then continue in the direction that shows an increase. Disconnect output meter and resistors.

Discriminator Stage.—The 0-10 V scale of a voltmeter having an internal resistance of not less than 1,000 ohms per volt (10,000 Ω) must be used as an indicator for this adjustment, and its leads are connected (in either direction) to the Meter Pin (indicated in our plan view of the chassis) and chassis. Connect the "live" signal generator lead clip directly to the top-cap connector of **V1,** feed in 126.5 kc/s signal at about 10 mV, and adjust the discriminator secondary coil **L19** core for maximum reading, and note the value; then readjust core so that reading falls to zero, passes it, and backs off the scale.

Reverse the meter leads, getting a positive reading again, and continue the adjustment until maximum is again reached, but in reverse polarity. The two maximum readings should be compared, and they should be equal; the actual value each time with 10 mV input to **V1** should be about 5 V. If a centre-zero meter is available the lead-reversing process can be avoided.

Should the two readings not be similar, something is wrong with the discriminator circuit, possibly unequal emission of the two sections of **V4** or unequal values for **R19** and **R20.** When it has been established that the readings are equal, readjust **L19** core for zero reading precisely. This adjustment is very critical, and it is important that it should be exact.

R.F. and Oscillator Stages.—Transfer signal generator leads to **A** and **E** sockets via a suitable dummy aerial. With the gang at maximum, the pointer should cover the calibration mark on the outside (S.W.) scale line at the long-wave end of the scale.

S.W.—Switch set to S.W., tune to 18 Mc/s or 16.6 m on scale, feed in an 18 Mc/s signal, and adjust **C49.** Tune to 17 Mc/s or 17.6 m on scale, feed in at 17 Mc/s signal, and adjust **C47** for maximum output. Calibrations should now be checked at 6 Mc/s (50 m) where it should be found to be correct if previous adjustments were effected accurately.

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 **C50** for maximum output. Tune to 250 m on scale, feed in a 250 m (1,200 kc/s) signal, and adjust **C44** and **C41** for maximum output. Tune to 500 m on scale, feed in a 500 m (600 kc/s) signal, and adjust the core of **L11** for maximum sensitivity and accurate calibration, keeping the core-piece on the far side of the coil centre when viewed from the trimming end. Repeat the 200 m and 500 m adjustments until no improvement results.

L.W.—Switch set to L.W., tune to 1,300 m on scale, feed in a 1,300 m (230 kc/s) signal, and adjust **C51** for maximum output, then adjust **C43.** Tune to 1,700 m on scale, feed in a 1,700 m (176.5 kc/s) signal, and adjust the core of **L12** for maximum output, keeping the core-piece on the far side of the coil centre when viewed from the trimming end. Repeat the 1,300 m and 1,700 m adjustments until no improvement results.

Image Rejector.—If image trouble is experienced, the image rejector **C40** may be adjusted on the image until it is at a minimum. This adjustment is always mounted on the **L1-L7** coil assembly, where we show it, but in some cases it may be adjusted from the front, and in others from the rear.

Station Setting.—For setting the contact clips correctly on their carrier rails, the station setting lamp is used as an indicator.

First press the white button, and tune in the required station by hand. Then holding down the white button, press the button whose clip it is desired to set, when the setting lamp will light. Now free the appropriate clip (it bears the same number as its button) by slackening its screw and slide it along the rail to a position where its contact point lies on the gap between the commutator plates, when the light will go out. In this position the clip is correctly set.

If two clips are set to adjacent stations, they may be accommodated on opposite carrier rails. When changing a clip over from one rail to another, the clip must be inverted. Finally, check each newly set button by motor tuning, and fit an appropriate station-name card in the adjoining aperture.

DISMANTLING THE SET

The cabinet is fitted with a detachable bottom cover, upon removal of which (eight countersunk-head wood screws) access may be gained to the under-chassis compartment.

Removing Chassis.—Remove the four control knobs (recessed grub screws);
remove the cheese-head set screw (with lock-washer) holding top of press-button switch unit to front of cabinet;
remove the four cheese-head screws (with flat metal washers) holding the chassis to the bottom of the cabinet.

If the speaker leads are now freed from the fibre cleat (wood screw) on the sub-baffle, the chassis may be withdrawn to the extent of the speaker leads, which is sufficient for most purposes.

To free the chassis entirely, these leads must be unsoldered from the tags on the speaker.

Removing Speaker.—Slacken the nuts on the four clamps holding the speaker to the sub-baffle, and swivel clamps, when speaker may be lifted out.

When replacing, the connecting panel should go at the top.

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