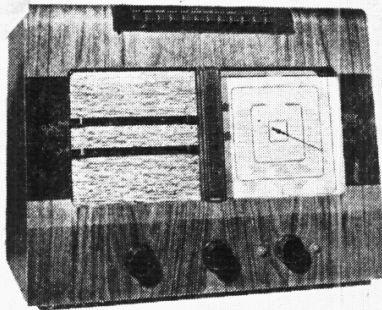


TRADER SERVICE SHEET  
**684**

# EKCO PB510 & C511

## MOTOR TUNED PRESS-BUTTON SUPERHETS



The Ekco PB510.

**M**OTOR-DRIVEN "Radio Brain" automatic tuning for eight stations, with motor-driven automatic waveband selection, are the outstanding features of the Ekco PB510, a 4-valve (plus rectifier) 3-band super-

het designed for use on AC mains of 200-250 V, 50-60 c/s. The SW range is 13-50 m.

The C511 is a console employing a chassis identical with that in the PB510. This Service Sheet covers both models, but it was prepared from a PB510.

Release date, both models: July, 1939. Original prices: PB510, £14 14s.; C511, £17 17s.

### CIRCUIT DESCRIPTION

Except that the receiver is muted during automatic tuning operations, there is no difference in the circuit between automatic and manual tuning. In the following description, therefore, no reference is made to the automatic circuits until the end of the receiver circuit description, where it is fully described.

Aerial input on MW and LW is via **C1** (MW), or **L1** (LW), to tapings on the primary coils of a band-pass filter circuit. Primary coils **L2**, **L3** are tuned by **C39**; secondaries **L6**, **L7** by **C43**. Coupling by mutual inductance of primary and secondary windings. Image suppression by **C36** on MW.

On SW, input is via coupling coil **L4** to single-tuned circuit **L5**, **C45**.

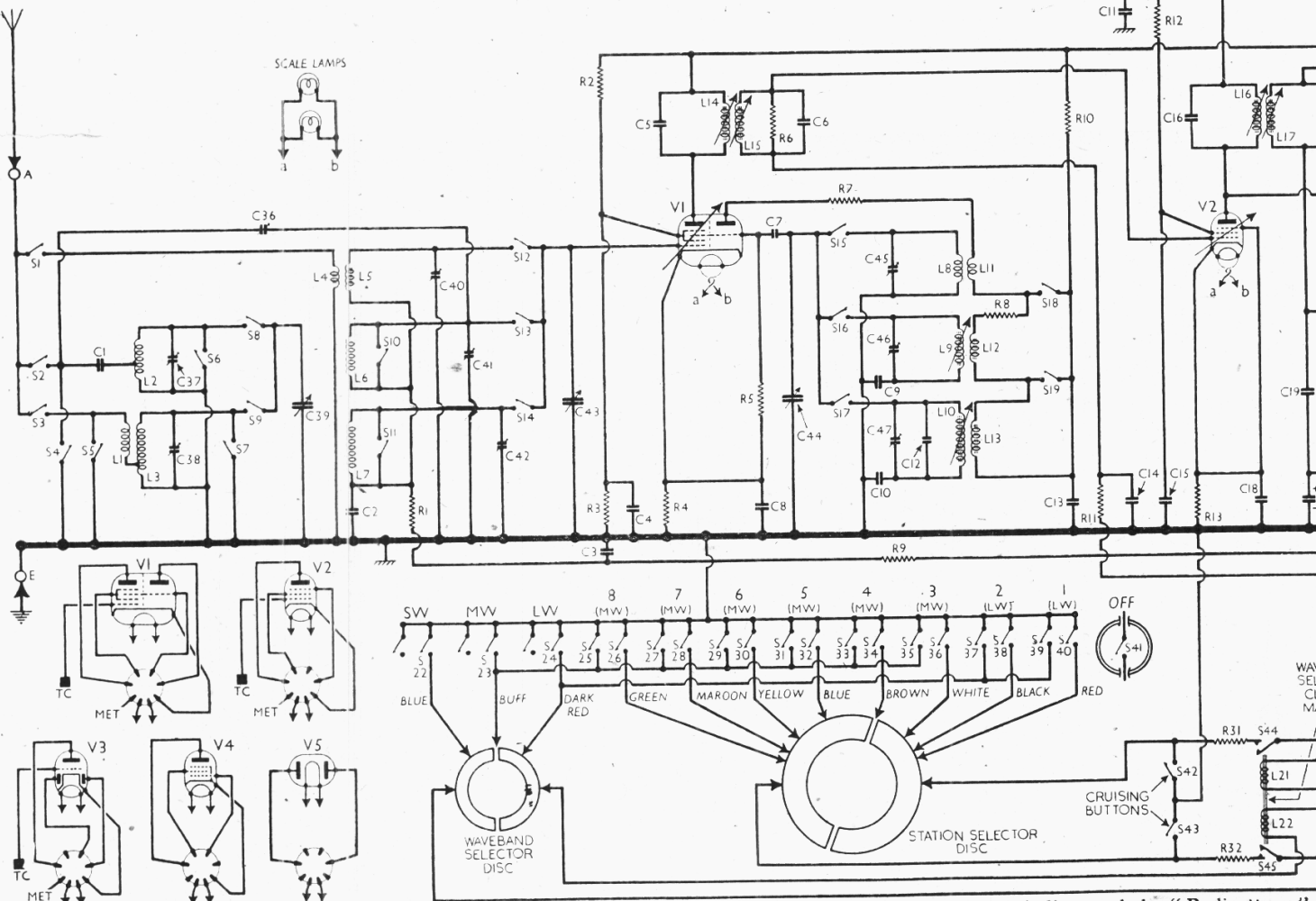
First valve (**V1**, Mullard metallised ECH3) is a triode-hexode operating as frequency changer with internal coupling. Triode oscillator grid coils **L8** (SW), **L9** (MW) and **L10** (LW) are

tuned by **C44**. Parallel trimming by **C45** (SW), **C46** (MW) and **C12**, **C47** (LW); fixed series tracking by **C9** (MW) and **C10** (LW). No tracking adjustment is provided for the SW band, but on MW and LW the coils have adjustable dust-iron cores. Reaction coupling by coils **L11** (SW), **L12** (MW) and **L13** (LW) which are connected in series, MW and LW coils being short-circuited by **S18**, **S19** when not required.

Second valve (**V2**, Mullard metallised EF9) is a variable- $\mu$  RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary dust-iron cored transformer couplings **C5**, **L14**, **L15**, **C6** and **C16**, **L16**, **L17**, **C17**. Intermediate frequency 126.5 kc/s.

Diode second detector is part of double diode triode valve (**V3**, Mullard metallised EBC3). Audio frequency component in rectified output is developed across load resistor **R15** and passed via **R16**, **C23**, **C24** and the manual volume control **R20**, **R21** to CG of triode section, which operates as AF amplifier. IF filtering by **C19**, **R14**, **C20**. Provision for connection of gramophone pick-up across **R20**, **R21** via **C24**, **R18**.

Second diode of **V3**, fed from **V2** anode via **C22**, provides DC potentials which are developed across load resistors **R25**, **R26** and fed back through decoupling circuits as GB to FC and IF valves, giving automatic volume control. Delay voltage, together with GB for triode



Circuit diagram of the Ekco PB510 and C511 superhets. The normal radio circuit is shown above the chassis line, and the "Radio Brain" automatic tuning circuit is shown below.

section, is derived from the drop along R22 in cathode lead to chassis.

Resistance-capacity coupling by R24, C18 and the potential divider R27, R28, between V3 triode and pentode output valve (V4, Mullard EL3). Whistle suppression by low-pass filter L18, C29 in anode circuit. Fixed tone correction by C30. Provision for connection of low impedance external speaker across speech coil secondary of output transformer T1, while the speech coil L19 may be muted by opening S21.

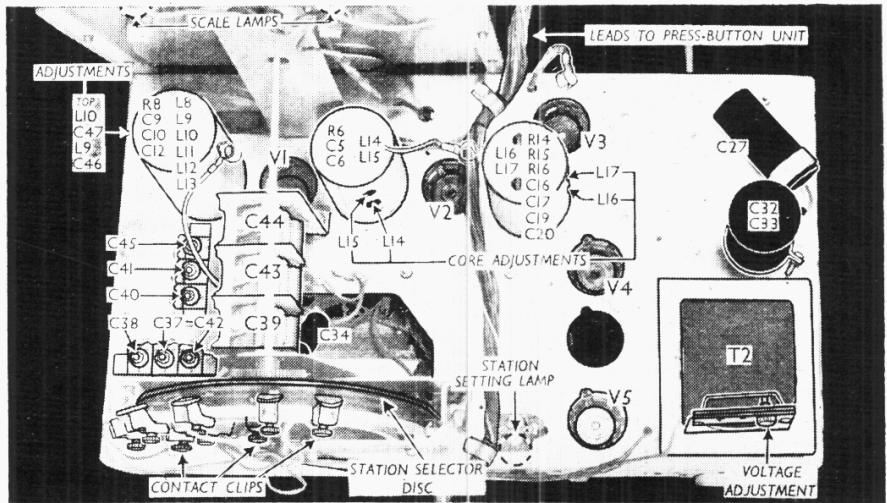
A second secondary winding on T1 provides voltages which are fed back through filter circuits R19, C26, R17, C25 and R18, C24 to V3 triode CG circuit in inverse, or negative, sense, and R17, which is the variable tone control, can be adjusted to obtain the desired tonal balance. S20, which closes on SW, short-circuits the feedback output, but R30 prevents the switch from short-circuiting the secondary winding.

HT current is supplied by full-wave rectifying valve (V5, Mullard AZ1). Smoothing by iron-core choke L20 and electrolytic condensers C32, C33.

### Automatic Tuning Control.

The mains transformer T2 has a fourth secondary winding to energise the tuning motor, and one end of it is normally connected via the station setting plug and socket N to chassis. The tuning motor windings are connected via tag Z to the free end of this secondary, so that the motor will run if either of the terminals X, Y at the opposite end is connected to chassis, clockwise or anti-clockwise according to which of the two alternative connections is used. It is in these leads to chassis that the press-button station and waveband selection mechanism are inserted.

**Station Selection.**—Considering first the station selection alone, it will be seen from the circuit diagram that the common bus-bar of



Plan view of the chassis. C46 and C47 are in the L8-L13 unit.

the press-button switch unit is connected to chassis. When any of the buttons, which are numbered 1 to 8, is pressed, connection is thus made between one of the station selector disc plates and chassis. If No. 5 button is pressed, for instance, S31 and S32 close, and all the other switches on the bank remain open, and the blue lead contacts a disc plate via its clip,

which also is numbered 5, like its button. An unnumbered clip contacts the same plate (the left-hand one in our diagram) and thus permits current to flow from that plate via R32 and S45 (which is closed) to the Y connection of the motor winding, so that the motor will run, in a given direction.

The selector disc is mechanically coupled to the tuning motor through a chain of gears, and the condenser gang is directly coupled to the disc. When the motor runs, the direction of disc rotation is such that the insulated gap (the upper one in our diagram) travels towards the contact clip. In our case, the disc would now travel anti-clockwise.

When the gap reaches clip No. 5, therefore, in our example, the current is cut off. In practice, the gap over-runs the clip, owing to momentum, and the clip contacts the opposite plate. Current then flows via the second unnumbered clip, R31 and S44 to motor contact X; the motor reverses, and the gap comes back again to clip No. 5.

Owing to the "slow-motion" action of the condenser drive, however, reversal of direction of travel introduces a 5 to 1 reduction ratio in speed, so that the gap returns at one-fifth of its original speed, and the disc stops without over-running, and the station is tuned.

The motor bearings are permitted a certain amount of intentional end-play, and when at rest, a spring pushes the armature spindle towards one end bearing. When the motor runs, the armature is pulled magnetically against the spring, towards the opposite end-bearing, so that one end of the armature spindle projects further out of the motor casing and the other end recedes. The projecting end presses the blades of switch S46, so that it closes and short-circuits the pick-up sockets, muting the receiver as long as the motor is running; the receding end draws in the lugs of a dog-clutch attached to it, engaging the condenser drive mechanism. This clutch is introduced to permit the motor to expend its momentum freely after the current has been cut off, disengaging it from the drive.

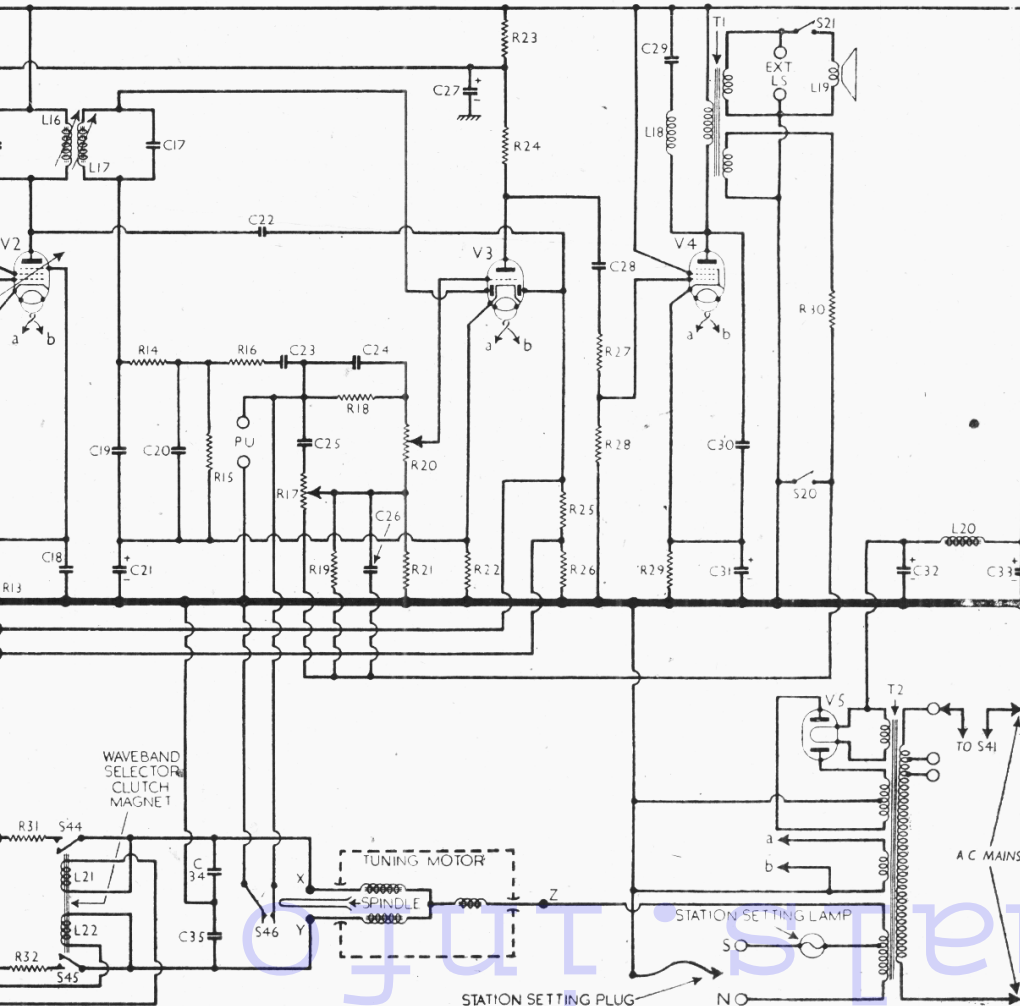
The two "cruising" buttons are provided to permit manual control of the electrical drive system when tuning manually.

**Station Setting.**—For setting up the system to receive the desired stations, a station setting lamp replaces the motor drive and acts as an indicator. The station setting plug is transferred from its normal socket N to the setting socket S, so that only a small portion of the motor secondary winding on T2 is in circuit between the motor connection Z and chassis, and the lamp is in series with it.

If a press-button that would normally cause the motor to run were now pressed, the lamp would light; the motor, although still in circuit, would not run at the low voltage now available.

When the appropriate clip has been moved along its carrier rail to a position where its contact lies on the insulated gap between the two plates, the light will go out and the gang will in future return to the same position when that button is pressed and the setting plug is at N. Prior to this operation the operator, of course, has tuned the set manually to the desired station.

**Waveband Selection.**—No purely manual or mechanical control is provided for wave-



Radio Brain "automatic station and waveband selector circuits beneath it. S46 is the muting switch.

band switching. Instead, three press-buttons are used, one for each band, and they are associated with switches S22, S23 and S24 on the press-button unit.

The principle of waveband selection is the same as that just described for station selection, but it involves the use of another selector disc and a relay. If, for instance, matters were arranged as shown in our diagram, with the set switched to MW, and the LW button were pressed, connection would be made between chassis and the Y motor contact, but now the current would flow via the LW clip (dark red lead), the right-hand plate on the waveband selector disc and the magnet winding L22.

The magnet forms part of a relay, and has two windings L21, L22. When either winding energises the magnet, the armature, or latch-bar, is attracted; but the latch-bar engages with a geared dog-clutch, and when the relay is energised the clutch closes and engages with the tuning drive to the condenser gang, so that it becomes motor-driven with the gang, and as its gear teeth are engaged with those of the waveband selector disc, this rotates until the gap between the plates reaches the LW contact clip, when the motor current is cut off. The set is then switched to the LW band.

The latch-bar, however, also performs a second function. When the relay closes, two insulated prods on the latch-bar press against the blades of switches S44 and S45, so that they open and disconnect the station selector disc and its associated circuit from the motor altogether until the wave-changing operation is completed, when the relay relaxes, disengaging the dog-clutch and permitting S44, S45 to close again.

Owing to the presence of L21, L22, the voltage of the motor secondary on T2 is higher than is required by the motor in order to compensate for the drop along these windings when they are in use. For station selection only, the voltage would consequently be too high, so R31 and R32 are inserted in the station selector leads to drop the same voltage.

**Combined Action.**—If the receiver is switched to one band, say MW, and a button of the other band (say No. 2 button, LW) is pressed, the "Radio Brain" system automatically selects first the correct waveband and then the desired wavelength.

All the MW buttons control a duplicate of switch S23 for waveband control, and the two LW buttons control a duplicate of S24, in addition to their station selector switches. When No. 2 button is pressed, therefore, S37 and S38 close, bringing in circuit station selector clip No. 2 (black lead) and the LW clip on the waveband selector. Obviously, both systems will try to work, but the waveband selector magnet will open S44, S45 and the station selector will be cut out of circuit until the waveband has been selected as described under "Waveband Selection."

Immediately this is completed S44, S45 close, and the procedure described under "Station Selection" is performed.

**COMPONENTS AND VALUES**

RESISTORS		Values (ohms)
R1	V1 hex. CG decoupling...	1,000,000
R2	V1 SG HT feed potential divider	47,000
R3	V1 fixed GB resistor	68,000
R4	V1 osc. CG resistor	200
R5	1st IF trans. sec. shunt...	100,000
R6	Oscillator reaction circuit damping resistors	470,000
R7	V1 osc. CG resistor	220
R8	V1 osc. anode HT feed...	1,000
R9	V2 CG decoupling	150,000
R10	V2 SG HT feed	47,000
R11	V2 fixed GB resistor	680,000
R12	IF stopper	91,000
R13	V3 signal diode load	510
R14	V3 AVC diode load	270,000
R15	AF feed resistor	100,000
R16	Variable tone corrector	56,000
R17	Parts of tone corrector circuit	500,000
R18	Manual volume control	220,000
R19	Part feed-back coupling	47,000
R20	V3 GB resistor	1,000
R21	V3 triode anode decoupling	820
R22	V3 triode anode load	1,000
R23	V3 AVC diode load	3,300
R24	V3 AVC diode load resistors	56,000
R25	V3 AVC diode load resistors	470,000
R26	V4 CG potential divider	470,000
R27	V4 GB resistor	100,000
R28	V4 GB resistor	270,000
R29	Feed-back coupling	150
R30	Tuning motor ballast resistors	15,000
R31	Tuning motor ballast resistors	5
R32	Tuning motor ballast resistors	5

CONDENSERS		Values (μF)
C1	Aerial MW coupling	0-001
C2	V1 hex. CG decoupling	0-1
C3	AVC line decoupling	0-02
C4	V1 SG decoupling	0-1
C5	1st IF transformer tuning condensers	0-00014
C6	V1 osc. CG condenser	0-00014
C7	V1 osc. CG condenser	0-000025
C8	V1 cathode by-pass	0-1
C9	Osc. circ. MW tracker	0-001505
C10	Osc. circ. LW tracker	0-000425
C11	HT circuit RF by-pass	0-1
C12	Osc. LW fixed trimmer	0-00002
C13	V1 osc. anode decoupling	0-1
C14	V2 CG decoupling	0-01
C15	V2 SG decoupling	0-1
C16	2nd IF transformer tuning condensers	0-00014
C17	V2 cathode by-pass	0-00014
C18	IF by-pass condensers	0-1
C19	V3 cathode by-pass	0-0002
C20	AVC diode coupling	0-0002
C21*	Coupling to V3 triode	25-0
C22	Parts of tone corrector circuit	0-000015
C23	V3 cathode by-pass	0-01
C24	Parts of tone corrector circuit	0-0003
C25	V3 cathode by-pass	0-0025
C26	V3 cathode by-pass	0-08
C27*	V1 and V3 triode anode decoupling	4-0
C28	AF coupling to V4	0-1
C29	Whistle filter tuning	0-005
C30	Fixed tone corrector	0-0025
C31*	V4 cathode by-pass	50-0
C32	HT smoothing condensers	8-0
C33	Tuning motor shunt condensers	14-0
C34	Image suppressor	0-02
C35	Image suppressor	0-02
C36†	B-P pri. MW trimmer	—
C37†	B-P pri. LW trimmer	—
C38†	Band-pass pri. tuning	—
C39†	Aerial circ. SW trimmer	—
C40†	B-P sec. MW trimmer	—
C41†	B-P sec. LW trimmer	—
C42†	B-P sec. and SW tuning	—
C43†	Oscillator circuit tuning	—
C44†	Osc. circ. SW trimmer	—
C45†	Osc. circ. MW trimmer	—
C46†	Osc. circ. LW trimmer	—
C47†	Osc. circ. LW trimmer	—

\* Electrolytic. † Variable. ‡ Pre-set

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial LW coupling coil	28-0†
L2	Band-pass primary coils	3-0
L3	Aerial SW coupling coil	28-0
L4	Aerial SW tuning coil	0-2
L5	Band-pass secondary coils	Very low
L6	Osc. SW tuning coil	3-0
L7	Osc. MW tuning coil	29-0
L8	Osc. LW tuning coil	Very low
L9	Osc. SW reaction coil	3-0
L10	Osc. MW reaction coil	10-0
L11	Osc. LW reaction coil	0-5
L12	Osc. MW reaction coil	0-5
L13	Osc. LW reaction coil	0-7
L14	1st IF trans. { Pri. ...	43-0
L15	1st IF trans. { Sec. ...	46-0
L16	2nd IF trans. { Pri. ...	43-0
L17	2nd IF trans. { Sec. ...	46-0
L18	Whistle filter coil	85-0
L19	Speaker speech coil	2-4
L20	HT smoothing choke	650-0
L21	Clutch magnet windings	5-5
L22	Clutch magnet windings	5-5
T1	Output trans. { Pri. ...	360-0
	Output trans. { Speech Sec. ...	0-4
	Output trans. { FB sec. ...	45-0
	Output trans. { Pri. total ...	33-0
	Output trans. { Heater sec. ...	0-2
	Output trans. { Rect. heat sec. ...	0-2
	Output trans. { Motor sec. total ...	2-0
	Output trans. { HT sec. total ...	540-0
TM	Tuning motor windings	5-0*
S1-S20	Waveband switches	—
S21	Int. speaker switch	—
S22-S40	Press-button switches	—
S41	Mains switch	—
S42	Mains switch	—
S43	PB cruising switches	—
S44	Wavechange clutch switches	—
S45	Wavechange clutch switches	—

† Including the lower end of L3. \* Either winding. Measured between X and Z or Y and Z.

**DISMANTLING THE SET**

The base of the cabinet is fitted with a detachable cover, upon removal of which (eight countersunk head wood screws) access can be gained to most of the components beneath the chassis.

**Removing Chassis.**—Remove the three rotary control knobs (recessed grub screws); remove the four bolts (with washers) holding the chassis to the bottom of the cabinet; free the press-button leads from the cleat holding them to the top of the cabinet, when the chassis may be withdrawn.

Chassis may be freed entirely if the two cheese-head screws (with lock-washers) holding the press-button unit to the front of the cabinet (one at each end) are removed, freeing the unit; and the two speaker leads are unsoldered.

When replacing, the press-button unit should be fitted with the mains switch on the right, when viewed from the rear.

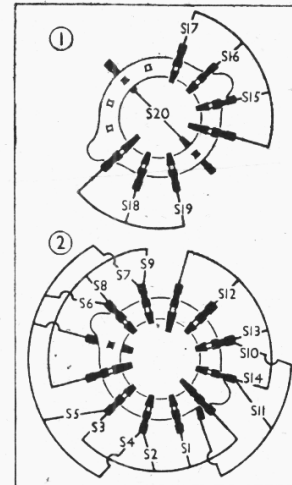
Before inserting chassis replace cruising buttons. **Removing Speaker.**—Slacken the nuts holding the four clamps to the rim of the speaker, and swivel the clamps.

When replacing, the connecting panel should be on the right.

**GENERAL NOTES**

**Switches—S1-S20** are the waveband and feed-back muting switches, in two ganged rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the diagrams below, where they are drawn, as seen when viewed in the directions of the arrows in the under-chassis view.

The usual waveband control knob for manual operation is omitted in this receiver, and waveband changing is performed electrically. It is controlled automatically by the press-buttons, which are associated with switches S22-S40. The action of these switches is fully explained under "Circuit Description," and the unit is shown

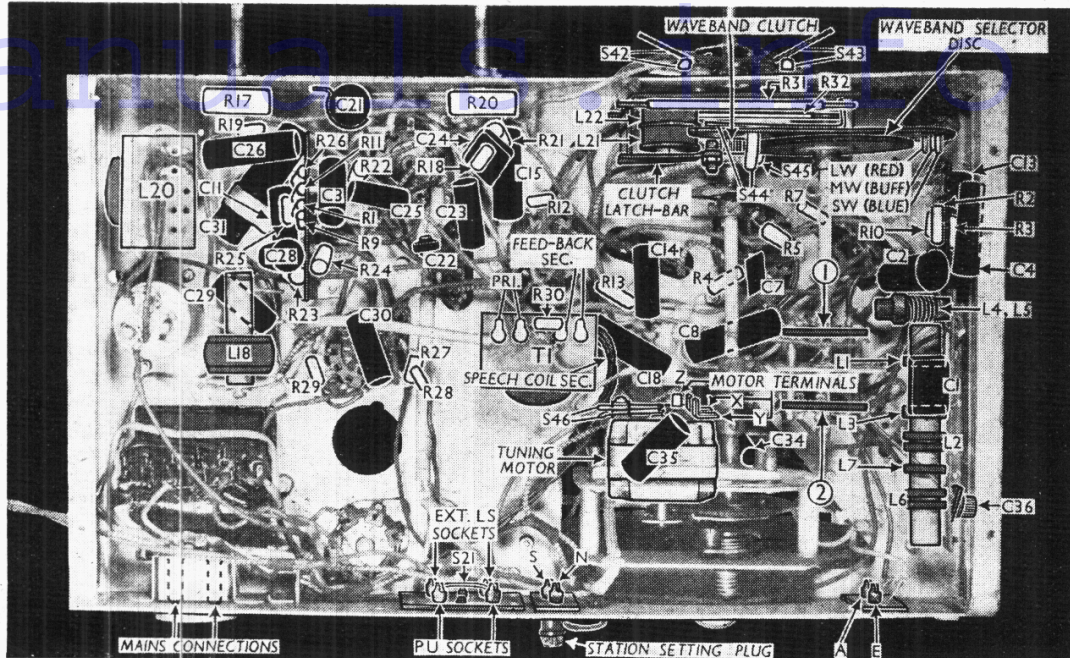


Above: Diagrams of the waveband switch units.

Below: The associated switch table.

Switch	SW	MW	LW
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	C	—
S14	C	—	C
S15	C	—	—
S16	—	C	—
S17	—	—	C
S18	C	—	—
S19	—	C	—
S20	C	—	—

Under-chassis view. The tuning motor is seen near bottom centre. The mechanism associated with waveband-switching is mounted in an assembly at the top right corner.



in detail in the drawing in cols. 5 and 6, where the unit is viewed from above and to the rear of the chassis deck. The action of the waveband switches S1-S20 is shown for the three waveband positions in the table in col. 3.

S21 is the screw type internal speaker muting switch.

S41 is the mains circuit switch. It is mounted on the press-button unit and controlled by any button, although it has a button of its own marked "OFF."

S42, S43 are the cruising button switches, controlled by two separate press-buttons mounted on the front of the cabinet, one being either side of the manual tuning control knob. Their purpose is to permit rapid traversal of the scale when tuning manually.

S44, S45 are included to isolate the automatic tuning circuits while waveband changing is being performed. Their function is fully explained under "Circuit Description."

S46 is an automatic muting switch, which silences the receiver during automatic waveband and station selection. It is operated by the tuning motor armature spindle, and is entirely automatic.

S42-S46 are all indicated in our under-chassis illustration.

**Scale and Setting Lamps.**—These are all MES types, rated at 6.5 V, 0.35 A. The makers' number for them is A5767. Replacements should not be of a lower voltage, as the heater circuit voltage is 6.3 V.

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

**Condensers C27, C32, C33.**—In our chassis these consist of two units: C27 in a cardboard tubular container mounted at a corner on the chassis deck, and rated at 4 μF, 500 V DC working, 600 V surge; and C32, C33 in a wet electrolytic unit of three sections mounted partly above and partly below the chassis deck.

In the makers' manual, C27, C32 and C33 are all contained in the wet unit, but they explain that sometimes the arrangement found in our chassis may be used. The three sections of the wet unit are rated at 10 μF, 350 V working (brought out to the red terminal), 8 μF, 440 V working (yellow terminal) and 4 μF, 440 V working (green terminal). The terminals are all positive, and the case forms the common negative connection.

In the original arrangement C27 was the 4 μF section, C33 was 10 μF, and C32 was 8 μF. In our chassis, where C27 was a separate unit, the spare 4 μF section was connected in parallel with the 10 μF section (red and green terminals joined together), making C33 14 μF, although the makers say that the 4 μF will then be connected in parallel with the 8 μF section.

**Automatic Tuning Mechanism.**—The tuning motor is indicated in our under-chassis view, beneath the tuning condenser gang. On it are shown the connections of S46, and its own connecting tags are marked X, Y and Z to agree with the circuit diagram. It drives, through reduction gears, the manual tuning spindle which runs from front to rear across the chassis via two flexible couplings.

The press-button unit fits over the scale assembly, but it is actually fitted to the cabinet.

**Chassis Divergencies.**—Apart from the different electrolytic condenser arrangements, explained under "Condensers C27, C32, C33," there are also several other differences in early models.

V1 hexode anode, its screen feed R2 and oscillator anode feed R10 were all taken to the HT positive line at the same point as R12 and V4 screen. R10 was then 56,000 Ω instead of 47,000 Ω, R13 was 1,000 Ω instead of 510 Ω, and R23 was 10,000 Ω instead of 3,300 Ω. R25 was omitted, and the bottom of R11 went to the junction of R26 and V3 AVC diode anode, in common with V1 AVC line. R26 was then 1,000,000 Ω.

### VALVE ANALYSIS

In the table below are the valve voltages and currents as quoted in the makers' manual.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 ECH3	218	1.65	65	2.2
	Oscillator			
V2 EF9	82	2.7	110	1.4
V3 EBC3	250	4.8		
V4 EL3	100	2.2		
V5 AZ1	235	43.0		
	275†	—	250	4.8

† Each anode, AC.

### CIRCUIT ALIGNMENT

**IF Stages.**—Switch set to LW, and turn the gang to maximum. Connect signal generator via a 0.01 μF condenser to CG (top cap) of V1 and chassis, turn the gain control to maximum, feed in a 126.5 kc/s (2,372 m) signal and, using a fully insulated tool with a flat blade, adjust the cores of L17 (upper coil), L16 (lower coil) and L15 (upper coil), L14 (lower coil) for maximum output, keeping input low. These adjustments will not peak sharply.

**RF 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 50 m calibration mark on the scale.

**SW.**—Press the SW button, and tune to 14 m on scale. Feed in a 14 m (21.4 Mc/s) signal, and adjust C45 for maximum output, using the peak involving the lesser trimmer capacity if two are found. Tune to 15 m on scale, feed in a 15 m (20 Mc/s) signal, and adjust C40 for maximum output. The calibration should now be correct at both ends of the scale. If it is not, check that the C45 has been set to the correct peak.

**MW.**—Press the MW button, tune to 500 m on scale, feed in a 500 m (600 kc/s) signal, and adjust the core of L9 for maximum output. Tune to 190 m on scale, feed in a 190 m (1,579 kc/s) signal, and adjust C46 for maximum output, using the peak involving the lesser trimmer capacity. Tune to 250 m on scale, feed in a 250 m (1,200 kc/s) signal, and adjust C37 and C41 for maximum output. Readjust L9 at 500 m, and if any adjustment is necessary to secure correct calibration, return afterwards to the 190 m and 250 m adjustments and repeat the MW procedure.

**LW.**—Press the LW button, tune to 1,700 m on scale, feed in a 1,700 m (176.6 kc/s) signal, and adjust L10 for maximum output. Tune to 1,000 m on scale, feed in a 1,000 m (300 kc/s) signal, and adjust C47 for maximum output, using the peak involving the lesser trimmer capacity if two are found.

Tune to 1,300 m on scale, feed in a 1,300 m (231 kc/s) signal, and adjust C38 and C42 for maximum output. Readjust L10 at 1,700 m, and if any adjustment is required to secure correct calibration, return to 1,000 m and 1,300 m and repeat the LW procedure.

**Image Suppressor.**—Press the MW button, feed in a strong 300 m (1,000 kc/s) signal, and locate the image signal at about 406.5 m on scale. Then adjust C36 for minimum output.

**Station Setting.**—This is explained under "Circuit Description" overleaf.

Diagram of the press-button switch unit, as seen from above and the rear.

