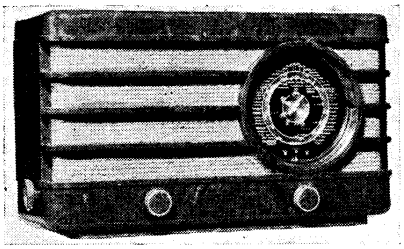
Supplement to The Wireless & Electrical Trader, May 22, 1943

"TRADER" SERVICE SHEET

621

PHILIPS 470U

AC/DC SUPERHET



THREE wavebands are provided in the Philips 470U, the SW range being 16.7-51 m. The receiver is a 3-valve (plus rectifier) superhet, designed to operate from AC or DC mains of 200-260 V, 50-100 C/S in the case of AC. No voltage adjustment is provided, a barretter lamp regulating the heater circuit current within the mains voltage range quoted.

No provision is made for the connection of a gramophone pick-up or an external speaker, but an indicator is fitted to show the waveband to which the receiver is switched.

Release date and original price: August, 1938; £8 18s. 6d.

CIRCUIT DESCRIPTION

Aerial input on MW and LW via **C1** and coupling coils **L2, L3** to capacity coupled band pass filter. Primary coils **L4** (MW) and **L5** (LW) are tuned by **C29;** secondary coils **L10** (MW) and **L11** (LW) by **C31.** Coupling by **C5, C6,** with the additional inductive coupling by **L6, L7** on MW only.

On SW, input is via **C1** and coupling coil **L8** to single tuned circuit **L9, C31.**

Image suppression by **C3.** MW "top" coupling by **C4.** Aerial circuit IF filtering by **L1, C27.** The aerial and earth sockets are isolated from the chassis (and mains) by condensers **C1, C2,** and in order to prevent these condensers from developing a charge, **R1** is connected between them to maintain DC continuity.

First valve **(V1, Mullard metallised EK2)** is an octode operating as frequency changer with electron coupling. Oscillator grid coils **L12** (SW), **L13** (MW) and **L14** (LW) are tuned by **C32.** Parallel trimming by **C33** (MW) and **C34** (LW); series tracking by **C11** (MW) and **C10** (LW). Control grid condenser **C9** prevents **L12** from short-circuiting the CG resistance **R6** on SW, but on MW and LW **C9** is short-circuited by **S8,** the tracking condensers **C10, C11** providing DC isolation.

Reaction coupling from anode by coils **L15** (SW), **L16** (MW) and **L17** (LW), and damping is provided by resistances **R7** (SW) and **R8** (MW and LW).

Second valve **(V2, Mullard metallised EF9)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C35, L18, L19, C36** and **C37, L20, L21, C38.**

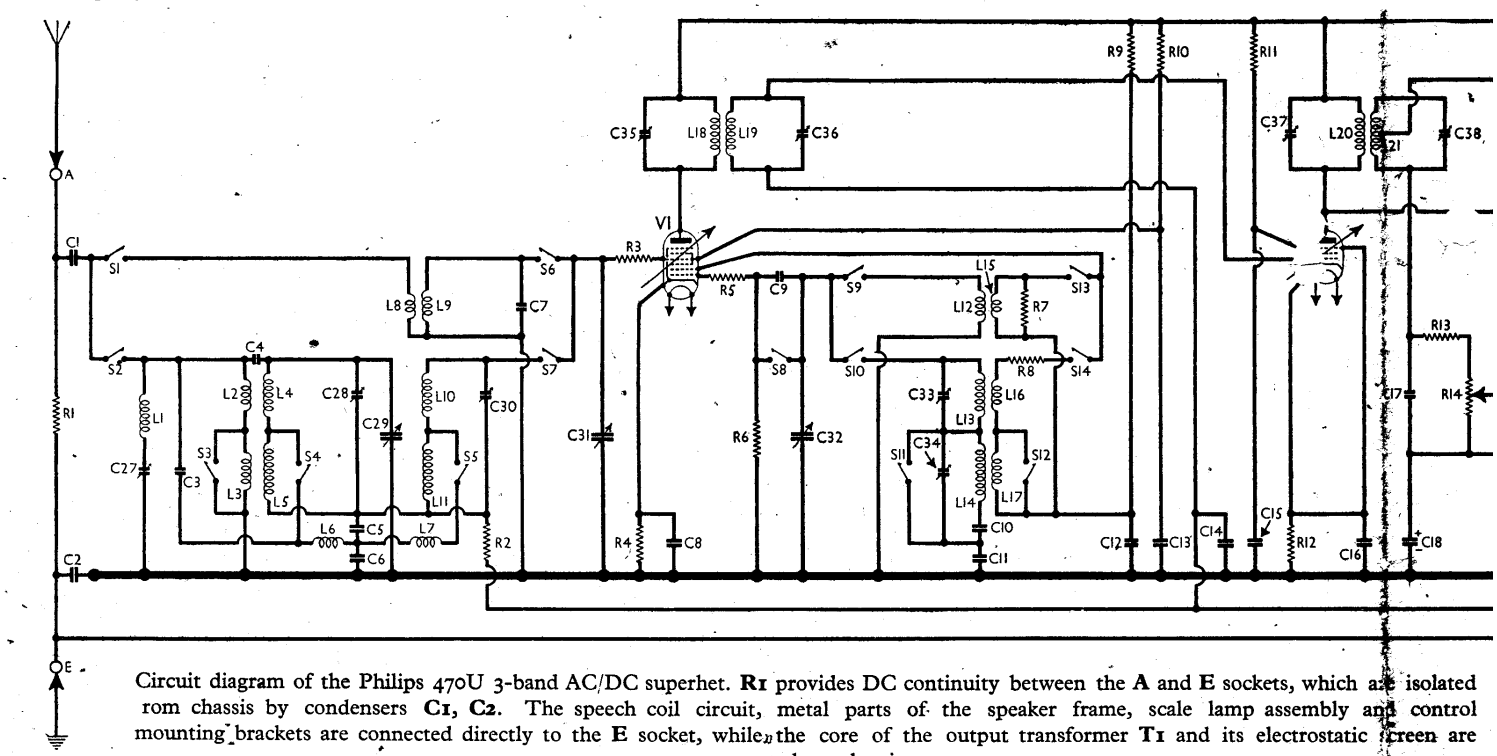
Intermediate frequency 128 KC/S.

Diode second detector is part of double diode output pentode valve **(V3, Mullard CBL1).** Audio frequency component in rectified output is developed across manual volume **R14,** which also operates as load resistance, and passed via AF coupling condenser **C20** and grid stopper **R16** to CG of pentode section. IF filtering by **C17, R13** and the screening of the leads to **R14** in diode circuit, and **C21, R16** and the grid/cathode capacity in control grid circuit. No provision is made for the connection of a gramophone pick-up.

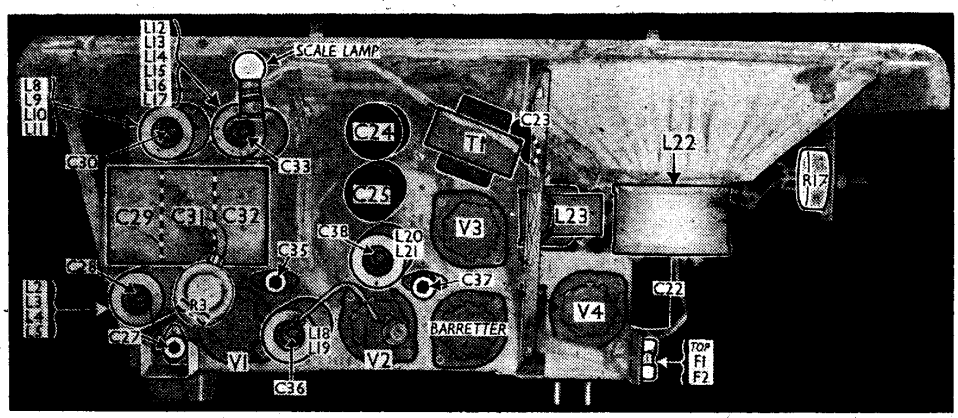
Second diode of **V3,** fed from **V2** anode via **C19,** provides DC potential which is developed across load resistance **R22** and fed back through decoupling circuits as GB to FC (except on SW band) and IF valves, giving automatic volume control.

Delay voltage, together with GB for pentode section, is obtained from the drop along resistances **R19, R20,** which form a potential divider in the cathode lead to chassis.

Fixed tone correction by **C23** in anode circuit. Variable tone control by variable resistance **R17** and **C22, R18,** also in anode circuit. No provision is made for the connection of an external speaker.



Circuit diagram of the Philips 470U 3-band AC/DC superhet. **R1** provides DC continuity between the **A** and **E** sockets, which are isolated from chassis by condensers **C1, C2.** The speech coil circuit, metal parts of the speaker frame, scale lamp assembly and control mounting brackets are connected directly to the **E** socket, while the core of the output transformer **T1** and its electrostatic screen are connected to chassis.



Plan view of the chassis. The chassis and speaker complete are mounted on the baffle in a single unit. The trimmers, all of which with the exception of **C34** are indicated here, should be sealed with a touch of hot wax after adjustment. **R3** is located in **V1** top cap.

The core of the output transformer **T1** is connected directly to chassis, but the metal speaker frame, **T1** secondary and speech coil **L22**, together with the scale assembly and casings and brackets of the volume and tone controls, are connected directly to the earth socket, so that they are isolated from the chassis by **C2**.

When the receiver is operating from AC mains, HT current is supplied by IHC half-wave rectifying valve **(V4, Mullard CY1)**, which, with DC mains, behaves as a low resistance. Smoothing is effected by iron-cored choke **L23** and large capacity electrolytic condensers **C24, C25**.

Valve heaters, together with scale lamp and current regulating ballast resistance **(Barretter, Philips C1)**, are connected in series across mains input. Filter circuit comprising air-cored chokes **L24, L25** and by-pass condenser **C26** suppresses mains-borne interference. Current limiting resistance **R23** protects **V4** from damage due to initial current surges, while fuses **F1, F2** protect the mains input circuit from accidental short-circuits.

VALVE ANALYSIS

Valve voltages and currents given in the table below are taken from those quoted in the makers' manual. They represent conditions to be expected in an average chassis when it is operating with no signal input, and were obtained by taking the average readings of measurements made on a large number of receivers. Differences up to, say, 20 per cent. should not necessarily be taken as indicating a fault.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 EK2	190 / Oscillator / 170	2·2 / — / 2·6	70	1·2
V2 EF9	190	7·5	105	2·0
V3 CBL1	165	38·0	180	7·0
V4 CY1	215†	—	—	—

† Cathode to chassis, DC.

Voltages were measured on Philips test boards type 4256 and type 7629, whose meters have a resistance of 2,000 O per volt, the negative lead being connected in each case to the cathode of the valve concerned, not to chassis. This does not, of course, apply to **V4**. The total consumption of the receiver on 225 V mains is 66 watts.

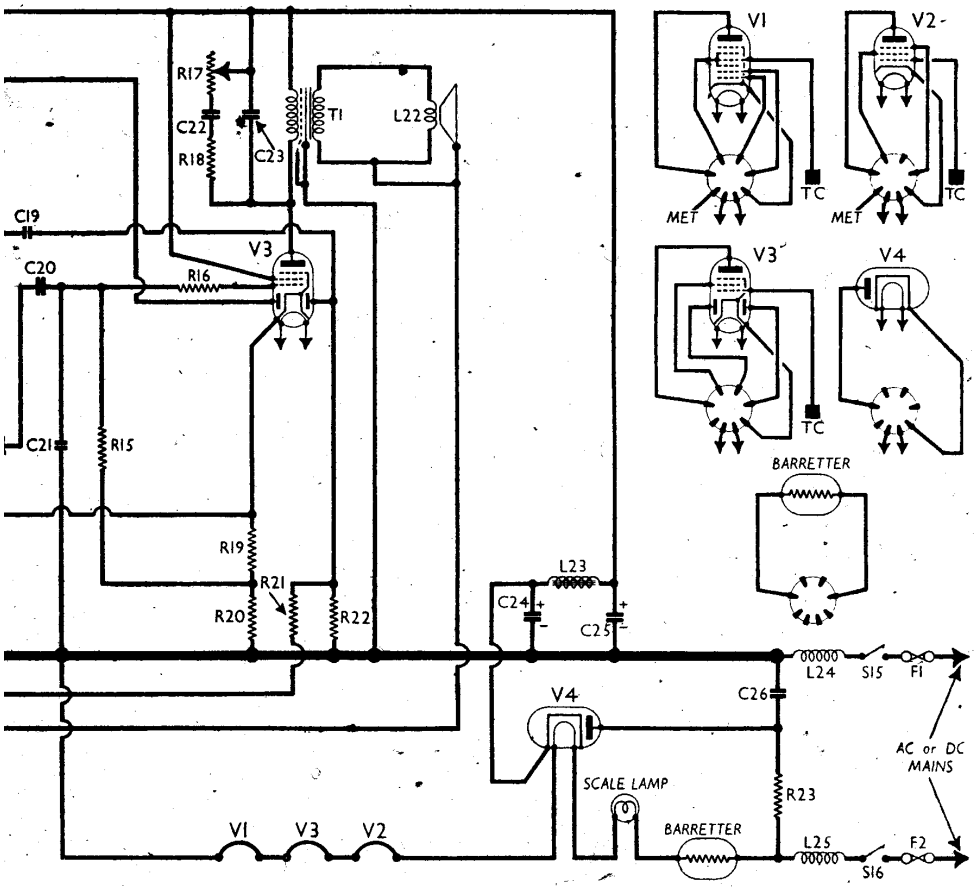
COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	Aerial circuit shunt ...	100,000
R2	V1 hex. CG decoupling ...	100,000
R3	V1 hex. grid stopper ...	50
R4	V1 fixed GB resistance ...	400
R5	V1 osc. grid stopper ...	40
R6	V1 osc. CG resistance ...	50,000
R7	SW reaction damping ...	20,000
R8	MW and LW reaction damping	4,000
R9	V1 osc. anode HT feed ...	10,000
R10	V1 SG HT feed	125,000
R11	V2 SG HT feed	50,000
R12	V2 fixed GB resistance ...	320
R13	IF stopper	50,000
R14	Manual volume control; V3 signal diode load ...	500,000
R15	V3 pent. CG resistance ...	1,000,000
R16	V3 pent. grid stopper ...	10,000
R17	Variable tone control ...	50,000
R18	Part variable tone control	100
R19, R20	V3 pentode GB and AVC delay resistances ...	200, 400*
R21	AVC line decoupling ...	2,000,000
R22	V3 AVC diode load ...	500,000
R23	V4 surge limiter ...	125

* Made up of two 800 O resistances connected in parallel.

	CONDENSERS	Values (μF)
C1, C2	Aerial and earth isolating condensers	0·001, 0·05
C3	Image suppressor ...	0·00004
C4	"Top" aerial coupling	0·000016
C5, C6	Band-pass coupling condensers	0·0125, 0·04
C7	Aerial circ. SW trimmer	0·0000125
C8	V1 cathode by-pass ...	0·05
C9	V1 osc. CG (SW) condenser	0·00005
C10	Osc. circ. LW tracker ...	0·00068
C11	Osc. circ. MW tracker	0·001575
C12	V1 osc. anode decoupling	0·05
C13	V1 SG decoupling ...	0·05
C14	V2 CG decoupling ...	0·05
C15	V2 SG decoupling ...	0·05
C16	V2 cathode by-pass ...	0·05
C17	IF by-pass	0·00008
C18*	V3 cathode by-pass ...	25·0
C19	Coupling to V3 AVC diode	0·000004
C20	AF coupling to V3 pentode	0·0025
C21	IF by-pass	0·00008
C22	Part variable tone control	0·1
C23	Fixed tone corrector ...	0·002
C24*, C25*	HT smoothing condensers	32·0, 32·0
C26	Mains RF by-pass ...	0·02
C27‡	Aerial IF filter tuning ...	0·0001
C28‡	B-P pri. MW trimmer ...	0·00003
C29†	Band-pass pri. tuning ...	0·00049
C30‡	B-P sec. MW trimmer	0·00003
C31†	Band-pass sec. and aerial SW tuning	0·00049
C32†	Oscillator circuit tuning	0·00049
C33‡	Osc. circ. MW trimmer...	0·0001
C34‡	Osc. circ. LW trimmer	0·00003
C35‡	Ist IF trans. pri. tuning	0·0001
C36‡	Ist IF trans. sec. tuning	0·0001
C37‡	2nd IF trans. pri. tuning	0·0001
C38‡	2nd IF trans. sec. tuning	0·0001

* Electrolytic. † Variable. ‡ Pre-set.



	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial IF filter coil ...	125·0
L2	Aerial MW and LW coupling coils	30·0
L3		100·0
L4	Band-pass primary coils	4·8
L5		42·0
L6	Band-pass MW coupling coils	0·6
L7		0·6
L8	Aerial SW coupling coil	2·4
L9	Aerial SW tuning coil ...	very low
L10	Band-pass secondary coils	4·8
L11		42·0
L12	Osc. circ. SW tuning coil	very low
L13	Osc. circ. MW tuning coil	11·0
L14	Osc. circ. LW tuning coil	32·0
L15	Osc. SW reaction coil ...	1·4
L16	Osc. MW reaction coil ...	4·0
L17	Osc. LW reaction coil ...	8·0
L18	1st IF trans. Pri. ...	130·0
L19	1st IF trans. Sec. ...	130·0
L20	2nd IF trans. Pri. ...	130·0
L21	2nd IF trans. Sec., total	130·0
L22	Speaker speech coil ...	4·0
L23	HT smoothing choke ...	400·0
L24	Mains RF filter chokes ...	4·5
L25		4·5
T1	Output trans. Pri. ...	330·0
	Output trans. Sec. ...	0·6
S1-S14	Waveband switches ...	—
S15,S16	Mains switches, ganged R14	—
F1, F2	Mains fuses, 600 mA ...	—

DISMANTLING THE SET

Removing Chassis.—Remove the two control knobs (recessed grub screws) from the front of the cabinet, and the two knobs at the sides (grub screws accessible from inside the cabinet);

remove the six set-screws from the six clamps holding the sub-baffle to the front of the cabinet.

The entire assembly, chassis, scale, speaker and sub-baffle may now be withdrawn as a single unit.

When replacing, it is necessary to replace the top, middle and bottom right-hand clamping plates before fitting the fixing screws; the remaining four are fixed in position by wood screws.

Do not omit to re-wax the grub-screw heads

Removing Speaker.—Unsolder from the connecting panel on the speaker the leads connecting it to chassis and sub-baffle;

slacken the nuts (with lock nuts and washers) holding the three clamps to the rim of the speaker, and swivel the clamps out of the way, when the speaker may be lifted out.

When replacing, the connecting panel should be on the left, and the leads should be connected as follows:

middle and bottom tags (joined together), lead from rear lower right-hand tag on output transformer and the earthing lead from the volume and tone control brackets;

top tag, lead from rear upper right-hand tag on output transformer.

The foregoing assumes that the output transformer is mounted vertically, as in our chassis, but it may be mounted horizontally, in which case it would be like ours turned through 90 degrees in an anti-clockwise direction, so that the two secondary connecting tags are at the top instead of being on the right-hand side, as in our case.

GENERAL NOTES

Switches.—S1-S14 are the waveband switches, in two ganged rotary units beneath the chassis. These are indicated in our under-chassis view, where they are identified by arrows and numbers in circles. The arrows indicate the direction in which the units are viewed in the diagrams in col. 3, where they are shown in detail and the numbers in circles are repeated.

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

S15, S16 are the QMB mains switches, ganged with the volume control **R14.** As will be seen from our under-chassis view, the switches are fitted in front of the volume control, not behind it as is usual with such ganged units.

The IF filter coil **L1** is on an unscreened former mounted beneath the chassis near the aerial socket. **L2-L5; L8-L11; L12-L17** and the IF transformers **L18, L19** and **L20, L21** are in five screened units on the chassis deck. Each unit contains a pre-set trimmer condenser, and in the case of the IF transformers a second trimmer of the same type is mounted on the chassis deck. These are the primary tuning condensers, the secondaries being those enclosed in the units.

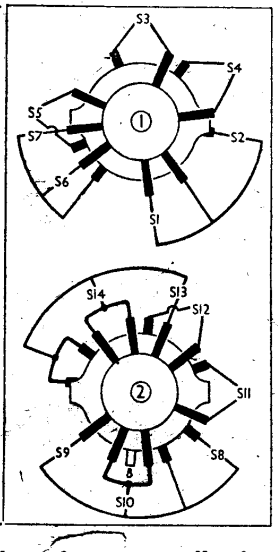
The connections of these coil units are brought to soldering tags on the bases of the units, and are accessible from beneath the chassis. These bases are all of a uniform pattern, and have eight tag positions each, although they may not all be used.

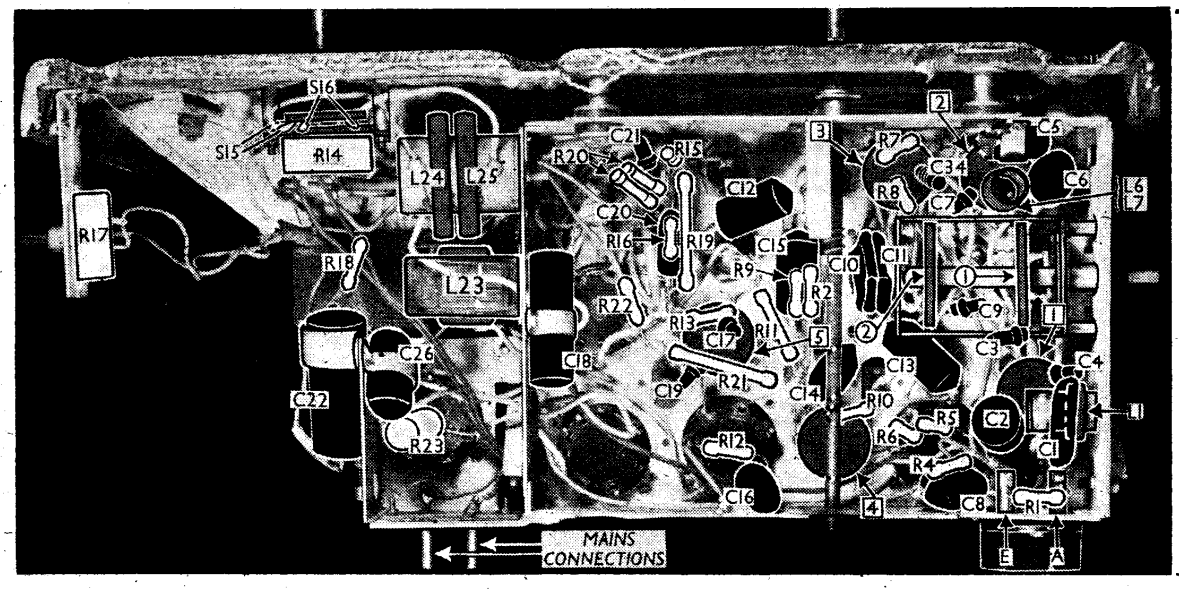
Diagrams of the five bases, showing the internal connections, appear in cols. 5 and 6, where they are drawn as seen when viewed from the rear of the underside of the chassis, their angular positions being the same as those in our chassis. In other chassis, these may differ slightly by a few degrees in either direction, but this can be checked by the components attached to the tags externally, while in all but one case there were in our chassis coloured paint marks in one position on each base; these, of course, permit the

Switch Table and Diagrams

Switch	SW	MW	LW
S1	C	—	—
S2	—	C	C
S3	—	C	—
S4	—	C	—
S5	C	C	—
S6	C	—	—
S7	—	C	C
S8	—	C	C
S9	C	—	—
S10	—	C	C
S11	—	C	—
S12	—	C	—
S13	C	—	—
S14	—	C	C

Diagrams of the two waveband switch units, drawn as seen when viewed in the direction indicated by the arrows from circles in the under-chassis view below.





Under-chassis view. The two switch units are indicated by arrows and numbers in circles, and are shown in detail in the diagrams above. The arrows and numbers in squares show the positions of the five coil units, the internal connections of which are shown in detail in the diagrams at the top of cols. 5 and 6. Resistance **R23** on the left of the illustration is wire wound.

angular position to be determined at once, and they are, therefore, indicated in our diagrams.

The locations of the bases of the five units are indicated in our under-chassis view, where they are identified by numbers in square surrounds which are repeated in the diagrams in cols. 5 and 6. It will be seen that in the case of the oscillator coil unit there are nine connections, the extra one being a lead which emerges from the top of the can and is taken through a hole in the chassis deck to the switch unit.

L23 is the HT smoothing choke, and **L24, L25** are the mains RF filter coils. These are mounted close together beneath the speaker and in front of **V4,** as seen in our under-chassis view.

Scale Lamp.—This is a special Philips lamp with a large spherical bulb and an MES cap. It is rated at 6.2 V, 0.3 A, and its makers' part number is 8092D-07.

External Speaker.—There is no provision on this model for either an external speaker or a gramophone pick-up. The makers indicate in their manual that these have been omitted deliberately, no doubt owing to the fact that the receiver is of the AC/DC type. An external speaker could, of course, be used if it were connected to the speech coil connections of the internal speaker. The impedance should be low, about 6-10 O.

Condensers C24, C25.—These are two electrolytics in separate tubular metal containers mounted on the chassis deck. They are both rated at 32 μF, 320 V working.

Pre-set Trimmers.—These are all special Philips type condensers, and with the exception of **C34** they have screw cap adjustments which are indicated in our plan view of the chassis. **C28** and **C30** are rated at 0.0003 μF each, but **C27, C33** and the IF trimmers **C35-C38** are given in the makers' manual as 70 + 30 μμF each (0.00007 + 0.00003 μF). Presumably the first part represents the fixed minimum capacity and the second the additional variable capacity. In our tables they are given as 0.0001 μF.

C34 is of the wire-wound type, in which a fixed wire electrode is contained in a hollow glass tube, and the variable electrode consists of wire wound round the tube. Adjustment is effected by increasing or reducing the number of turns of wire, the free end of the wire being near chassis potential. After adjustment the free end should be fixed by sealing wax or shellac.

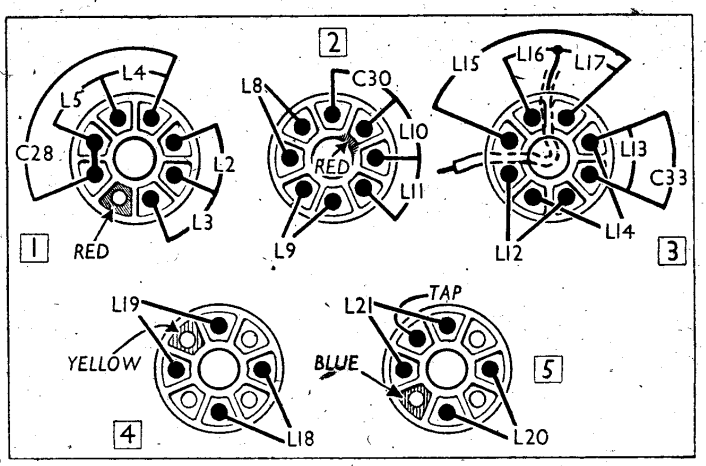
Fuses.—F1 and **F2** are the mains input circuit fuses, fitted on a bakelised panel at one end of the chassis, behind the speaker. They are both rated at 600 mA, and their length is ¾ inch.

Earthing Arrangements.—As this receiver is designed for AC or DC mains operation, the aerial and earth sockets are isolated from chassis by condensers **C1** and **C2** respectively, while DC continuity is maintained between them by **R1** to prevent a difference of DC potential from developing. If socket **E** is connected to a good earth, therefore, both sockets will be at earth DC potential.

The secondary winding of the output transformer **T1,** the speech coil **L22,** the metal frame of the speaker, the scale assembly and the spindles and brackets of the volume and tone controls are all connected directly to the earth socket, not to chassis; while the core of **T1,** and a screen shown in the makers' diagram between the primary winding and the core of **T1,** go directly to chassis.

Chassis Divergencies. — The makers state that the value of **R12** may, in some chassis, be 250 O instead of 320 O. The output transformer may be mounted a different way up from ours (see "Dismantling the Set").

Diagrams showing the internal connections of the five coil units. They bear numbers corresponding with those in square surrounds in the under chassis view opposite. Their angular positions are the same as those in our chassis when viewed from the rear underside.



CIRCUIT ALIGNMENT

The makers recommend that, where AC is available, all operations involving contact with the chassis should be carried out with the mains connected via a double wound transformer which has a high insulation resistance between primary and secondary windings. The chassis end of the secondary should be earthed.

IF Stages.—Switch set to LW, turn the gang to minimum and the volume control to maximum. Connect signal generator leads via a 0.032 μF condenser to control grid (top cap) of **V1** and chassis. Connect a 50,000 O resistance across **C36,** and an 80,000 O resistance across **C37.**

Feed in a 128 KC/S (2,340 m) signal, and adjust **C38,** then **C35,** for maximum output. Transfer the 50,000 O resistance across **C35,** and the 80,000 O resistance across **C38,** and adjust **C37,** then **C36,** for maximum output. Remove the damping resistances.

IF Filter.—Transfer signal generator leads to **A** and **E** sockets, and feed in a 128 KC/S signal. With the set still switched to LW, turn the gang to maximum (2,000 m) and adjust **C27** for *minimum* output.

RF and Oscillator Stages.—Signal generator leads should be connected to **A** and **E,** and the volume control should remain at maximum.

MW.—Switch set to MW, and fit the special Philips 15 degree jig to the condenser, turning the gang until the plates bear on the jig. Feed in a 1,442 KC/S (208 m) signal, and adjust **C33, C30** and **C28,** in that order, for maximum output. Readjust **C33** and **C30** if necessary. Remove 15 degree jig.

LW.—Switch set to LW, and turn volume control to minimum. Connect an aperiodic amplifier (Philips GM 2404) to anode of **V1.** Connect an output meter to the output terminals of the aperiodic amplifier, and connect a 0.1 μF condenser between the oscillator grid (pin 6) of **V1** and chassis.

Feed in a 400 KC/S (750 m) signal to **A** and **E** sockets, and tune it in on the receiver to give maximum output on the amplifier. Disconnect the amplifier and 0.1 μF condenser. Connect output meter to output of receiver. Turn volume control to maximum and adjust **C34** for maximum output without altering the position of the gang. The method of adjusting **C34,** which is a wire-wound type of condenser, is explained under "Pre-set Trimmers."

TECHNICAL INFORMATION

Although announcements have been made frequently to the effect that enquiries for information, whether technical or otherwise, must be accompanied by a stamp for our reply, dealers continue to send in queries unaccompanied by a stamp.

Other conditions, including those relating to orders for *Service Sheets,* applications for the loan of technical information (either because the *Service Sheet* is out of print or for sets that have not been covered) and purely technical enquiries, are also not observed.

We ask dealers, therefore, to make a careful note of the following conditions:

When applying for **factual information** (trade addresses, component values, etc.) **always enclose a stamp for our reply;** otherwise, no reply will be forthcoming.

When applying for the **loan of technical data** (out of print *Service Sheets* or makers' manuals), either **send a shilling and a promise to return the material within three working days** (no stamp is necessary) in case we have the data; or **enclose a stamp and enquire whether we have data.**

When making a **technical enquiry, enclose 2s. 6d.** (no stamp is necessary). The scope of this service is limited to queries arising from normal service work.

When **ordering** *Service Sheets,* **do not order sheets marked "OP"** on our Index: this means that the sheet is out of print, as clearly explained on the Index. Enclose 8d. for each sheet ordered (no stamp is required). Orders such as "No. 20 OP" have actually been received.

If these conditions are observed, unnecessary correspondence will be avoided; the work of our depleted staffs will be eased; and a source of mystery to writers of unanswered letters will be removed.

Printed in Great Britain by The Cornwall Press Ltd., Paris Garden, London, S.E.1