Supplement to The Wireless & Electrical Trader, April 5, 1947

"TRADER" SERVICE SHEET

806

PHILIPS 209U

A.C./D.C. SUPERHET

FOUR Continental-type valves are used in the Philips 209U receiver, information on which is not yet available in British valve data tables. Essential data on them is therefore given under "General Notes."

The receiver is a 3-valve (plus rectifier) 3-band superhet designed to operate from A.C. or D.C. mains of 95-115 V and 190-260 V, 40-100 c/s in the case of A.C. No provision is made for a gramophone pick-up or external speaker, which the makers say should not be used with it.

Release date and original price: December, 1946; £12 0s, plus £2 11s 7d purchase tax.

CIRCUIT DESCRIPTION

Aerial input is via coupling coils **L1** (S.W.), **L2** (M.W.) and **L3** (L.W.) to single-tuned circuits **L4, C28** (S.W.), **L5, C28** (M.W.) and **L6, C28** (L.W.).

First valve **(V1, Mullard UCH21)** is a triode heptode operating as frequency changer with injector grid coupling between triode and hexode sections.

Triode oscillator anode coils **L11** (S.W.), **L12** (M.W.) and **L13** (L.W.) are tuned by **C31.** Parallel trimming by **C29** (M.W.) and **C11** (L.W.); series tracking by **C10** (M.W.) and **C30** (L.W.). Reaction coupling by grid coils **L8** (S.W.), **L9** (M.W.) and **L10** (L.W.).

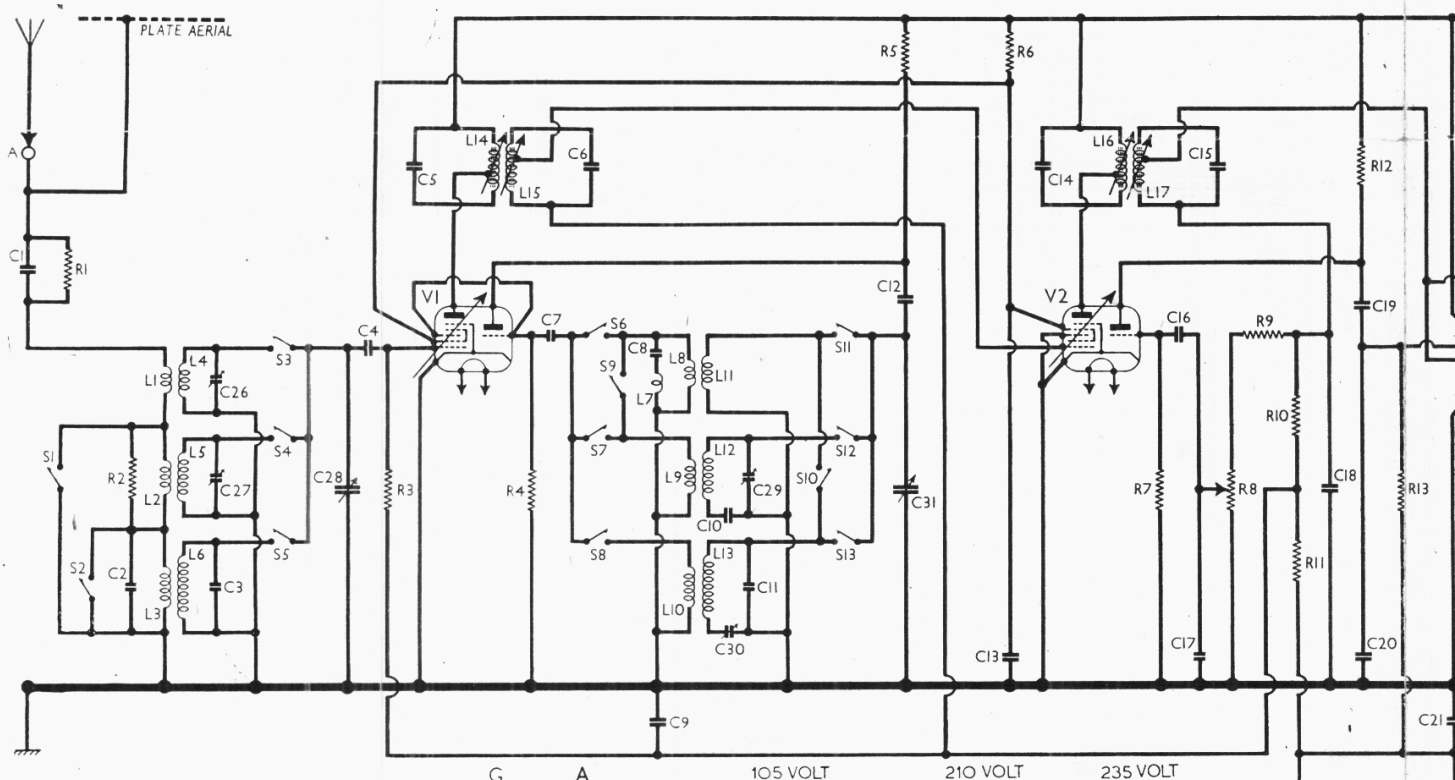
Second valve **(V2, Mullard UCH21)** is another triode heptode, in which the heptode section operates as a variable-mu intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C5, L14, L15, C6** and **C14, L16, L17, C15.**

Intermediate frequency 470 kc/s.

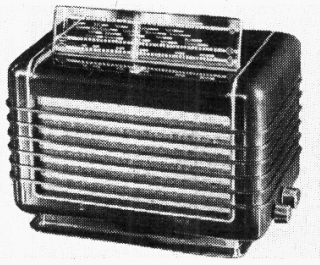
Diode second detector is part of double diode pentode output valve **(V3, Mullard UBL21)** in which the diode sections are strapped in parallel. Audio frequency component in rectified output is developed across manual volume control **R8,** which also acts as diode load resistor, and passed via A.F. coupling capacitor **C16** and C.G. resistor **R7** to C.G. of **V2** triode section, which operates as A.F. amplifier.

D.C. potential developed across **R8** and **R9** in series is applied to the potential divider **R10, R11,** from the tapping on which it is fed back as G.B. to F.C. and I.F. valves, giving automatic volume control. I.F. filtering by **C18, R9** and **C17** in diode circuit.

Resistance-capacitance coupling by **R12, C19** and **R13,** with I.F. filtering by **C20,** between **V2** triode and pentode section of **V3.** Fixed tone correction in anode circuit by **C22.** G.B. potential for **V3,** together with fixed G.B. for F.C. and I.F. valves, is obtained from the drop along **R15** in the H.T. negative lead to chassis.



Circuit diagram of the Philips 209U A.C./D.C. superhet. The valves are of Continental type, **V1** and **V2** being similar, **R8, R9, R10** and **R11** form a potential divider across **R15,** applying a negative bias to the A.V.C. line and the signal diode. In the complete circuit diagram, the voltage adjustment is shown set for high-voltage mains, around 200 V, the dotted lines showing the voltage adjustment for low-voltage mains. Adjustment is affected by the plugs inset beneath the circuit diagram. To the left of the plugs is a diagram o



When the receiver is operated from A.C. mains, H.T. current is supplied by half-wave rectifying valve **(V4, Mullard UY21)** which, with D.C. mains, behaves as a low resistance. Smoothing is effected by resistor **R16** and electrolytic capacitors **C23, C24,** but the H.T. supply for **V3** anode is obtained direct from the rectifier cathode.

When operating on mains of 190-260 V, **V1, V3** and **V2** heaters, together with **R14, V4,** the scale lamp, surge-limiting resistor **R18,** and resistors **R19, R20** are connected in series across the mains input. For the 190-225 V range only, **R20** is short-circuited.

When operating from 95-115 V mains **V4** heater, together with the scale lamp and resistors **R18** and **R19,** are connected in series **(R20** being short-circuited) across the mains input as one chain; while **V1, V3** and **V2** heaters and **R14** form a second chain across the mains input.

These two arrangements are shown separately in the circuit diagram, the low-voltage circuit being inset above the high-voltage one; the necessary interconnections are carried out by means of the voltage adjustment plugs.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those quoted by the manufacturers, who give the unsmoothed H.T. voltage as 180 V. Readings were taken with a 20,000-ohms-per-volt meter, chassis being the negative connection.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 UCH21	148	1·75	78	5·0
	Oscillator			
	102	4·15		
V2 UCH21	148	4·5	78	3·0
	Triode			
	33	1·75		
V3 UBL21	165	43·5	147	7·0
V4 UY21†	—	—	—	—

† Cathode to chassis, 180 V, D.C.

COMPONENTS AND VALUES

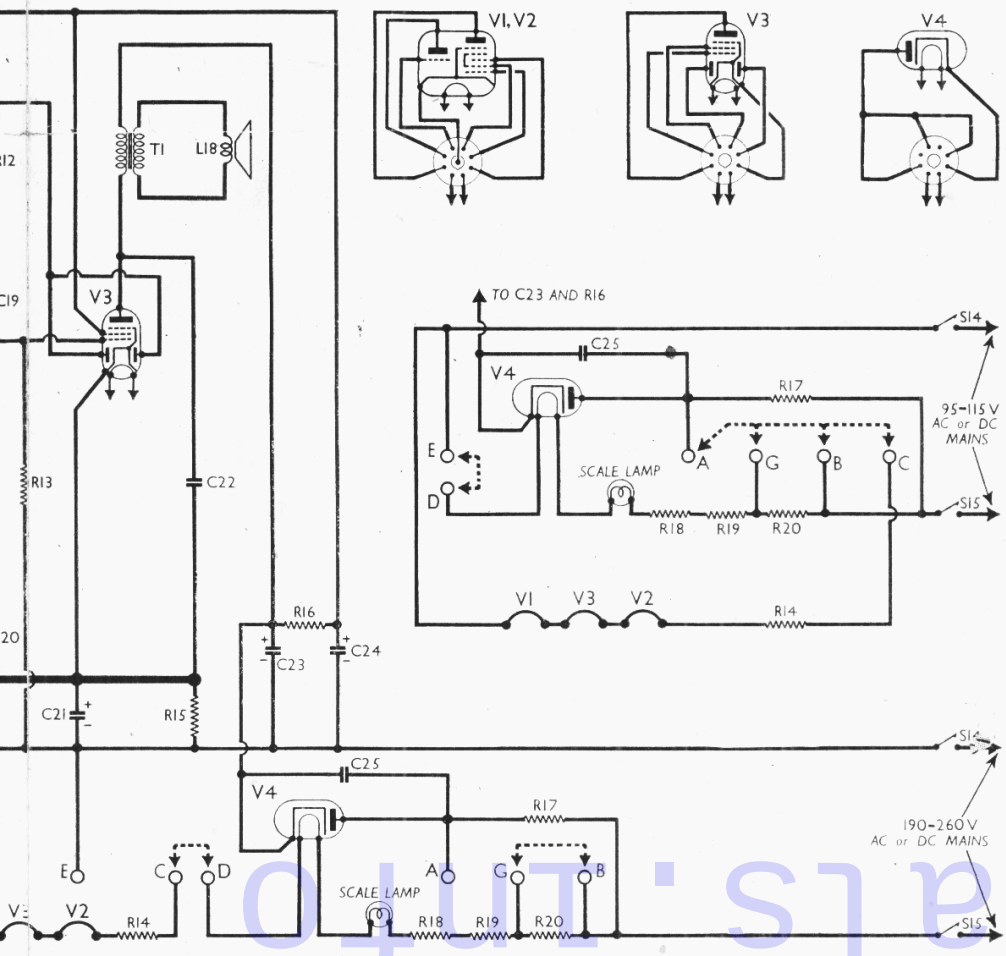
	CAPACITORS.	Values (μF)
C1	Aerial series capacitor ...	0·001
C2	Aerial L.W. shunt	0·000039
C3	Aerial L.W. fixed trimmer	0·000022
C4	V1 hept. C.G. capacitor ...	0·00012
C5	1st I.F. transformer fixed	0·000103
C6	tuning capacitors ...	0·000103
C7	V1 osc. C.G. capacitor ...	0·000082
C8	Part S.W. reaction stabiliser	0·000056
C9	A.V.C. line decoupling ...	0·047
C10	Osc. circ. M.W. tracker ...	0·000432
C11	Osc. L.W. fixed trimmer	0·000047
C12	V1 osc. anode coupling	0·00047
C13	V1, V2 S.G.'s decoupling	0·047
C14	2nd I.F. transformer fixed	0·000103
C15	tuning capacitors ...	0·000103
C16	A.F. coupling to V2 triode C.G.	0·022
C17	I.F. by-pass capacitors ...	0·00068
C18		0·0001
C19	A.F. coupling to V3 pent.	0·0068
C20	V3 pent. C.G. I.F. by-pass	0·00015
C21*	V1, V2, V3 G.B. by-pass...	75·0
C22	Fixed tone corrector ...	0·0047
C23*	H.T. smoothing capacitors	47·0
C24*		32·0
C25	Mains R.F. by-pass ...	0·022
C26‡	Aerial circ. S.W. trimmer	0·000032
C27‡	Aerial circ. M.W. trimmer	0·000032
C28†	Aerial circuit tuning ...	0·000492
C29‡	Osc. circ. M.W. trimmer...	0·000032
C30‡	Osc. circ. L.W. tracker ...	0·0002
C31†	Oscillator circuit tuning ...	0·000492

* Electrolytic. † Variable. ‡ Pre-set.

	RESISTORS.	Values (ohms)
R1	Aerial series resistor ...	1,000,000
R2	Aerial M.W. shunt ...	18,000
R3	V1 hept. C.G. resistor ...	1,000,000
R4	V1 osc. C.G. resistor ...	47,000
R5	V1 osc. anode H.T. feed ...	10,000
R6	V1, V2 S.G.'s H.T. feed ...	10,000
R7	V2 triode C.G. resistor ...	6,800,000
R8	Manual volume control ...	500,000
R9	I.F. stopper	47,000
R10	V1, V2 fixed G.B. and	1,000,000
R11	A.V.C. potential divider	6,800,000
R12	V2 triode anode load ...	68,000
R13	V3 C.G. resistor	680,000
R14	Part heater circuit ballast	100
R15	V1, V2, V3 fixed G.B. resistor	120
R16	H.T. smoothing resistor ...	1,200
R17	V4 anode surge limiter ...	150
R18	Heater circ. surge limiter	*
R19	Heater circuit ballast re-	170
R20	sistors	250

* Special resistor, see "General Notes."

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial S.W. coupling coil...	2·75
L2	Aerial M.W. coupling coil...	40·0
L3	Aerial L.W. coupling coil ...	175·0
L4	Aerial S.W. tuning coil ...	Very low
L5	Aerial M.W. tuning coil ...	6·5
L6	Aerial L.W. tuning coil ...	43·0
L7	Osc. S.W. reaction stabiliser	Very low
L8	Osc. S.W. reaction coil ...	2·5
L9	Osc. M.W. reaction coil ...	6·0
L10	Osc. L.W. reaction coil ...	7·0
L11	Osc. S.W. tuning coil ...	Very low
L12	Osc. M.W. tuning coil ...	5·0
L13	Osc. L.W. tuning coil ...	17·0
L14	1st I.F. trans. Pri., total	11·5
L15	Sec., total	14·0
L16	2nd I.F. trans. Pri., total	11·0
L17	Sec., total	13·7
L18	Speaker speech coil ...	3·0
T1	Output trans. Pri. ...	350·0
	Sec. ...	0·4
S1-S13	Waveband switches ...	—
S14, S15	Mains switches, ganged R8	—



justment links; in the small diagram inset on the right, the voltage adjustment has been set agram of the pin plate to which they are applied, as seen from inside an inverted chassis.

Diagram of the waveband switch unit, as seen from the end of an inverted chassis. Below is the associated switch table.

Switch	S.W.	M.W.	L.W.
S1	C	—	—
S2	—	C	—
S3	C	—	—
S4	—	C	—
S5	—	—	C
S6	C	—	—
S7	—	C	—
S8	—	—	C
S9	—	—	C
S10	—	C	—
S11	C	—	—
S12	—	C	—
S13	—	—	C

GENERAL NOTES

Switches.—**S1-S13** are the waveband switches, ganged in a single rotary unit beneath the chassis. The unit is indicated in our under-chassis view, and shown in detail in the diagram above, where it is drawn as seen when viewed from the end of an inverted chassis, along the control spindle. The table above 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.

S14, S15 are the Q.M.B. mains switches, ganged with the manual volume control **R8.**

Coils.—The aerial M.W. and L.W. and oscillator M.W. and S.W. coils are in two screened units on the chassis deck. The aerial S.W. coils are in a large unscreened unit mounted on top of the **L7, L8, L9, L11, L12** container on the chassis deck, while the oscillator L.W. coils are in a small unscreened unit beneath the chassis.

The I.F. transformers are in two further screened units on the chassis deck.

Diagrams of the coil bases, drawn as seen from the rear of an inverted chassis, are given in cols. 4 and 5.

Scale Lamp.—This is a Philips' lamp, with a tubular bulb and an M.E.S. base, rated at 25 V, 0.1 A. Its type No. is 8095D-99. One half of the bulb is painted black to prevent light from shedding downwards.

Resistor R18.—This is a special "Temco" resistor with a wide-range negative temperature coefficient, inserted in the heater chain to protect the scale lamp from overload by preventing the initial surge when the valve heaters are cold. When it is cold, this resistor has a resistance of about 5,000 Ω, but as it warms up due to the passage of current its value falls rapidly until, at operating temperature, it settles at about 160 Ω. In the circumstances, of course, its resistance cannot be checked while it is cold. Its part No. is MK. 796.11.

Resistors R14, R17, R19, R20.—These together are comprised in a long narrow vitreous enamel unit mounted horizontally on the chassis deck, with bead-insulated flexible leads. **R14** is isolated from the other three sections. **R14, R19** and **R20** form parts of the heater circuit ballast, and are used for mains voltage adjustment. **R17** is the rectifier surge limiter.

Mains Voltage Adjustment.—Voltage adjustment operations are performed by means of the familiar Philips' circular rotary cap, containing linked sockets, and a fixed plate carrying contact pins at the rear of the chassis. If the cap is withdrawn from the pins and turned until the desired voltage range, as marked on the rear face, is uppermost, and is then pushed home, the adjustment is correctly set. In this case, two separate caps are provided; one for the 100 V range, and one for the two high voltage ranges.

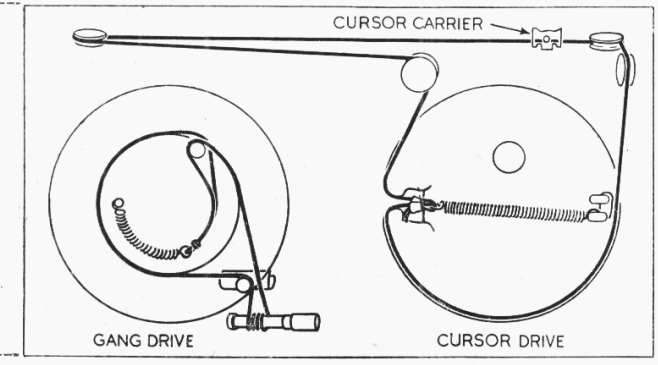
Beneath our circuit diagram is inset a diagram of the pin plate, viewed from the *front* of an *inverted* chassis, with the pins lettered **A** to **G.** Beside it, viewed in the same direction, are three diagrams of the caps: one for each voltage position, with broken lines to show the internal connections. If these cap diagrams are superimposed on the plate diagram, they show which pins on the plate are joined in any given voltage position. Pin **F** is blank. **LP** indicates the position of the locating pip.

In the circuit diagram, these pins are indicated by circles, with their code letters beside them, and broken lines again show the shorting links in the adjustment caps. In the 235 V position, pins **C** and **D** only are joined; in the 210 V position, pins **C, D** are joined, and pins **B, G;** in the 105 V position (separate diagram inset on right of circuit proper) using the low voltage plug, **E, D** are joined, and **A, B, C, G,** are joined, connecting up the heater circuit in two parallel chains.

Chassis Divergencies.—**R16** may be a single 1,200 Ω resistor or two 22,000 Ω resistors connected in parallel. **C3** may be a single 22$\mu\mu$F capacitor, or consist of two 10$\mu\mu$F capacitors in parallel (0.00002μF), or it may be only a single 10$\mu\mu$F (0.00001μF). **C2** may be 220$\mu\mu$F (0.00022μF). **C11** may be 39$\mu\mu$F (practically 0.00004μF).

Valve Series.—The valve types used in this model are "borrowed" from a Continental series, and their technical data do not appear so far in British valve charts. They are all fitted with a base similar to the American "Loctal," and have series-type heaters rated at 0.1A (100mA). The heater voltages are: UCH21, 20 V; UBL21, 55 V; UY21, 50 V. The UCH21 has no British equivalent type, quite apart from the heater current, as it contains separate triode and heptode sections, the latter having an injector grid, brought out to its own pin on the base, for frequency-changer work. Its cathode, it is important to note, goes to the centre spigot.

Diagrams showing the two drive cords in the positions they should adopt when seen from the front with the gang at maximum capacitance. *Left*, the gang drive; *Right*, the cursor drive. The gang drive cord is seen through the drive drum.



DRIVE CORD REPLACEMENT

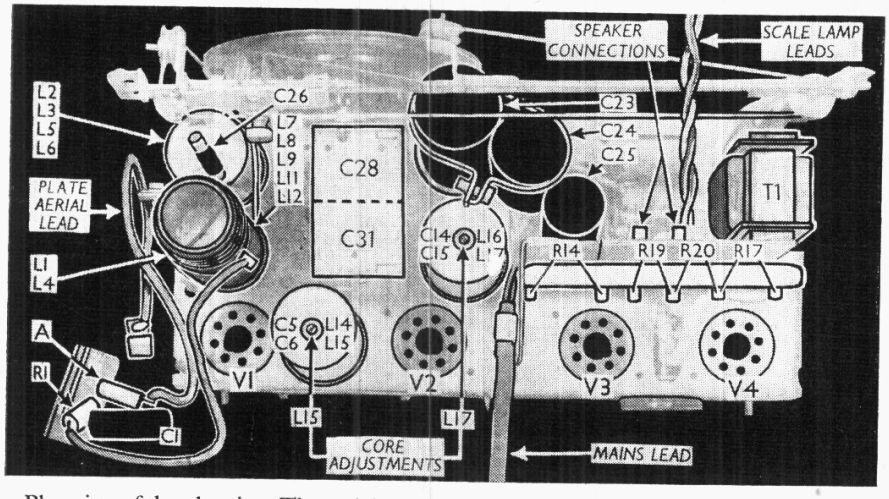
Two separate cords are used in the complete tuning drive: the gang drive, and the pointer drive, and they must be made up to the correct lengths before they are fitted. Their overall lengths, with loops made, are 346 mm (13.6in) and 698 mm (27.5in) respectively. Suitable replacement cords, complete with loop clamps, may be obtained from the manufacturers.

As the plastic drive drum must be removed in order to fit the new gang drive cord, this cord must be fitted first.

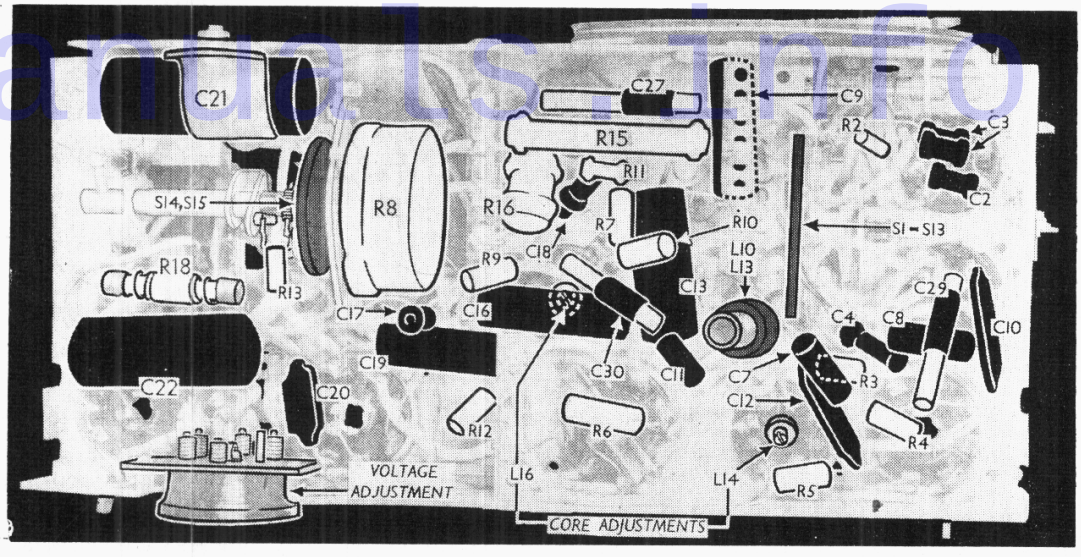
Gang Drive.—Having removed the chassis from the cabinet, remove the drum from the gang spindle (two set screws) and lay it, face down, on the bench. Next, thread one end of the gang drive cord round the tuning control spindle (beneath the chassis) for 3½ turns, as shown in the left-hand diagram in the sketch above, finally taking the ends through the aperture in the chassis deck.

Now, attach the two loops to the free end of the tension spring on the back of the drive drum and lay the cord around the small rim provided for it, in the manner shown in the sketch, bearing in mind that the cord is shown as if viewed through the drum. Then replace the drum on the gang spindle, check that the gang is at maximum capacitance, and tighten the set screws.

Pointer Drive.—Having ascertained that the gang drive is in good order, hook the two ends of the cursor drive cord to the free end of the tension spring, loop the rest of the cord over the two horizontal pulleys at the scale ends, then over the two vertical jockey wheels, and strain it into the drum groove, as shown



Plan view of the chassis. The aerial panel carrying **R1** and **C1** is attached by a flexible lead. The speaker connections are mounted on the ballast resistor heat deflector.



Under - chassis view. The waveband switch unit **S1-S13** is indicated by an arrow which shows the direction in which it is viewed in the diagram in col. 1 opposite. **R18** forms part of the heater chain, but it is actually a special type of resistor inserted to protect the scale lamp.

in the sketch. Finally, slip the cord into the clamp on the cursor carriage, replace the chassis in the cabinet, and adjust the cursor as explained under "Circuit Alignment."

DISMANTLING THE SET

Almost unimpeded access to the top and underside of the chassis may be gained upon removal of the back and bottom covers (four screws with washers, each).

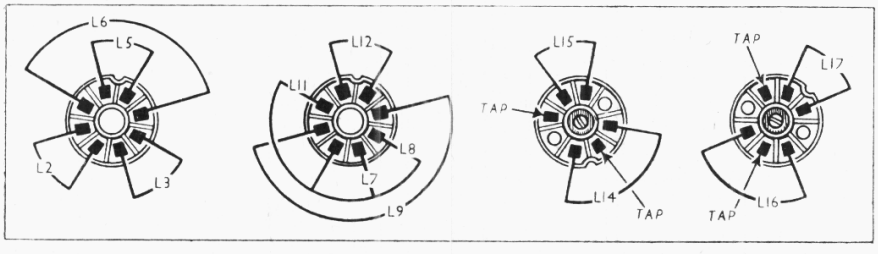
Removing Chassis.—Remove back and bottom covers as previously described.

Remove glass scale (pull out) and turn cursor to the horizontal position, so that it lies in the scale slot.

Remove all valves and unsolder speaker leads from their connecting strip.

Remove the three control knobs by completely withdrawing their retaining screws, which are accessible through holes in the cabinet base.

Remove the screws (with washers) securing the left- and right-hand corners of the cursor carriage assembly to the front of the cabinet.



Base diagrams of the four screened coil units, as seen from the rear of an inverted chassis.

Remove the scale lamp assembly (one captive screw and washer).

Remove the plate aerial connecting lead (green, rubber-covered) secured by one screw (with washer) on the left-hand side of the cabinet.

Remove the two screws (with washers) securing the rear chassis member to the cabinet, and slide out the chassis.

When replacing, the waveband switch knob should be fitted point upwards. The fixing screws may be conveniently inserted by the use of a magnetized screwdriver, or a little plasticine on the blade.

Removing Speaker.—Remove chassis as previously described and remove one nut and two screws (all with washers) securing the speaker to the sub-baffle. *When replacing*, the speaker should be positioned so that its connecting leads are at the top.

CIRCUIT ALIGNMENT

All alignment operations may be carried out with the chassis in its cabinet, as it must be when scale readings are involved. See that scale sits centrally in its slot.

I.F. Stages.—Switch set to M.W., and tune to about 192 m on scale. Connect signal generator leads via a 0.032 μF capacitor and an isolating capacitor to control grid (pin 6) of **V1** and chassis, turn gain control to maximum, feed in a 470 kc/s (638.3 m) signal, and adjust the cores of **L17, L16, L15** and **L14** in that order, damping the primary winding in each case with an 80 $\mu\mu$ F (0.00008 μF) capacitor while adjusting a secondary core, and vice versa.

R.F. and Oscillator Stages.—With the gang at minimum, the pointer should cover the small calibration mark just below 200 m on the scale. A milled screw is provided to release the pointer carrier from the drive cord for adjustment. Transfer signal generator lead to **A** socket, via a suitable dummy aerial.

When adjusting a wire-wound trimmer, wire should be unwound until output, having reached maximum, just begins to fall back. Winding should then be sealed with wax, and surplus cut off. Do not attempt to add wire to increase capacitance, as turns would not remain firm, but replace capacitor. Obviously it is desirable to start with a new one each time. Note that the oscillator frequency is higher than the signal frequency on all bands.

S.W.—Switch set to S.W., tune to 17.5 Mc/s on scale, feed in a 17.5 Mc/s (17.14 m) signal, and adjust **C26** for maximum output.

M.W.—Switch set to M.W., tune as near as possible to 208.3 m on scale, feed in a 208.3 m (1,440 kc/s) signal, and adjust **C29,** then **C27,** for maximum output.

L.W.—Switch set to L.W., tune to 1,875 m on scale, feed in a 1,875 m (160 kc/s) signal, and adjust **C30** for maximum output.

Service Short-Cut

Philips 209U

Hum in these receivers may be rather difficult to trace, owing to the nature of the circuit and to the fact that spare valves may not be available.

In this receiver V1 is frequency changer, V2, I.F. and A.F. amp., V3, det. and output, V4, rectifier, so it will be seen that the signal moves backwards and forwards between V2 and V3 slightly more than somewhat!

By changing round V1 and V2 (both same type) and earthing the I.F. section grid of V2, valves V1 or V2 can be found to be faulty or eliminated.

The diodes in V3 should be separated. By connecting the circuit to each diode in turn the hum can sometimes be traced to this point. It will be found that a leakage (perhaps 1 meg) between diode and *heater* is the cause of the trouble. The remedy is to leave the offending diode disconnected.

The writer presumes that the leakage is taking place inside the base rather than in the electrode assembly.—**R. C. B.,** Ambleside.

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