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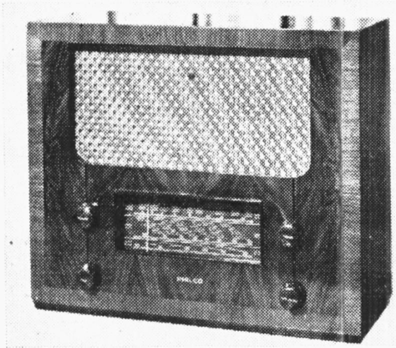
"TRADER" SERVICE SHEET

483

PHILCO A9BG
A9CG, A9RG, A9ARG



The Philco A9BG table receiver.

THE Philco A9 is 4-valve (plus valve rectifier) 3-band AC superhet. A fourth position on the wavechange switch is provided for gram switching. The circuit includes tone compensation and variable tone control both on radio and gram. The SW range is 16.5 to 55m, the scale being marked in megacycles/sec. from 5.5 to 18. The receiver is suitable for use on 200-250V, 50-100 C/S AC mains.

In addition console (Concert Grand), radiogram and auto-radiogram models are available. The differences in the radiograms as far as the chassis is concerned are explained under "Radiogram Modifications."

Release dates: A9BG, Feb., 1940; A9CG, A9ARG, March, 1940; A9RG, May, 1940.

CIRCUIT DESCRIPTION

Aerial input on SW is via coupling coil **L2** to single tuned circuit **L3, C30.** On MW and LW the signal is developed across the aerial choke **L1** and coupling condensers **C1, C2,** whence part of it, that across **C2,** is coupled to the tuned circuits **L4, C30** (MW) and **L5, C30** (LW) by virtue of the fact that **C2** is included in the tuning circuit.

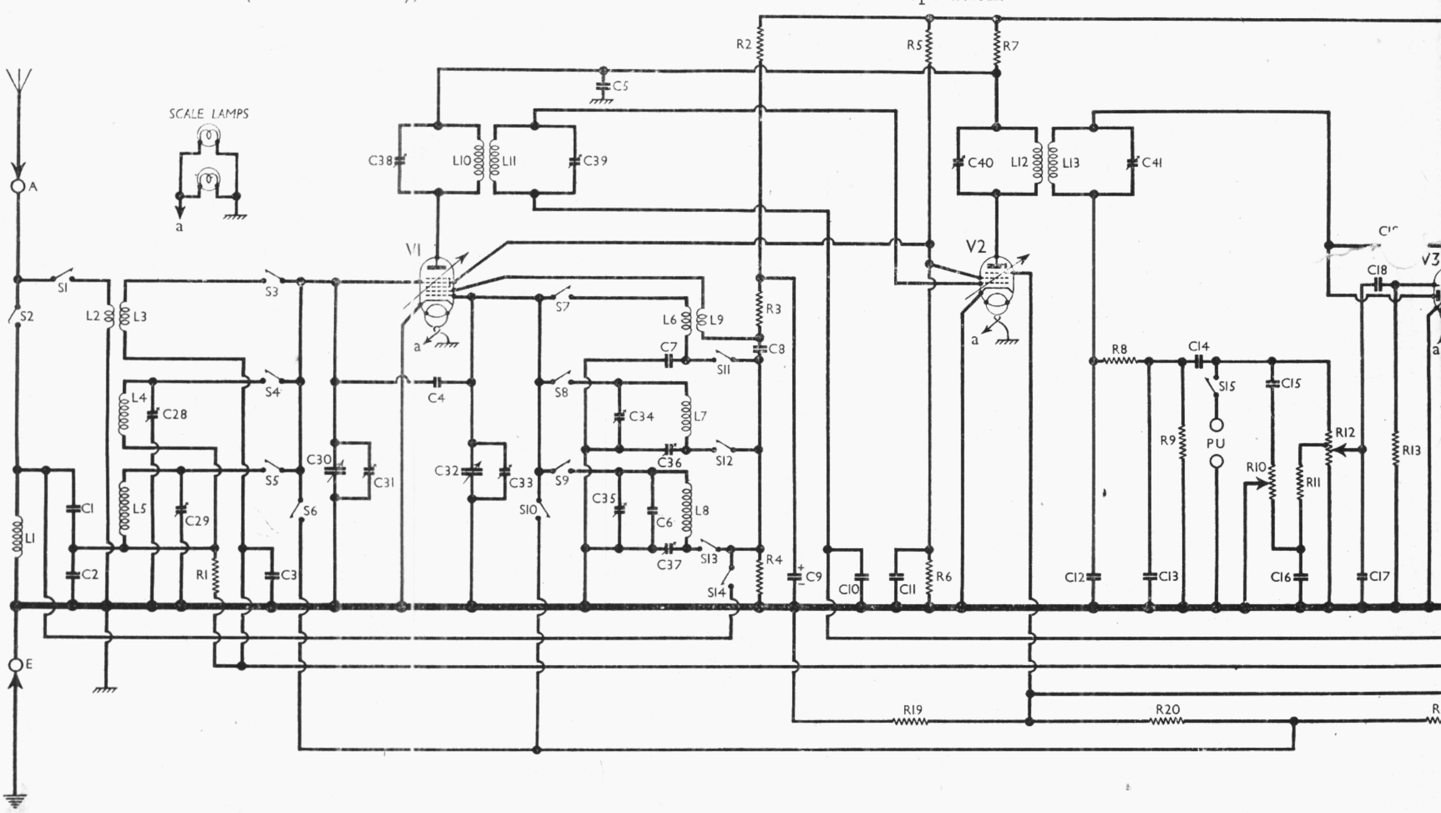
First valve **(V1, Brimar 6A7)** is a heptode operating as frequency changer with electron coupling. Oscillator grid coils **L6** (SW), **L7** (MW) and **L8** (LW) are tuned by **C32.** Parallel trimming by **C33** (SW), **C34** (MW) and **C6, C35** (LW); series tracking by **C7** (SW), **C36** (MW) and **C37** (LW). Reaction coupling is accomplished by including the trackers in grid and anode circuits, via **C8,** on all bands, with additional coupling by coil **L9** on the SW band.

Second valve **(V2, Brimar 78)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C38, L10, L11, C39** and **C40, L12, L13, C41.**

Intermediate frequency 451 KC/S.

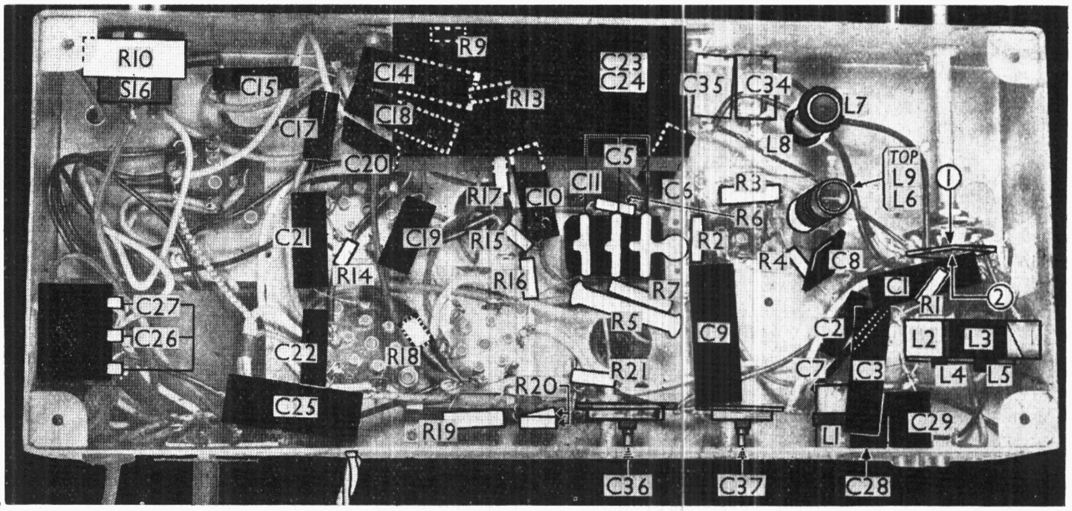
Diode second detector is part of double diode triode valve **(V3, Brimar 75).** Audio frequency component in rectified output is developed across load resistance **R9** and passed via AF coupling condenser **C14,** manual volume control **R12,** second AF coupling condenser **C18** and CG resistance **R13** to CG of triode section, which operates as AF amplifier. IF filtering by **C12, R8** and **C13** in diode circuit, **C17** in triode CG circuit, and **C20** in triode anode circuit.

Provision for connection of gramophone pick-up via **S15,** which closes when the waveband control is turned to the gramophone position, across **R12.** Tone compensation for changes in the position of **R12** slider is provided by **R11, C16,** while in conjunction with it **C15** and **R10** provide variable tone control. Both the tone compensation and tone control circuits are effective on radio and gramophone operation.



Circuit diagram of the Philco A9 series of models. The radiograms have only very slight modifications. Early chassis of all mode
(See "Chassis Divergencies"). Note the suppressor connection of **V2.**

Under-chassis view. Note the double condensers **C5, C11** and **C26, C27. C36** and **C37** may also be in a dual unit, close to the switch unit on the right. Two views of the switch unit are given in diagrams overleaf. Resistances **R19** and **R21** should be transposed in this illustration.

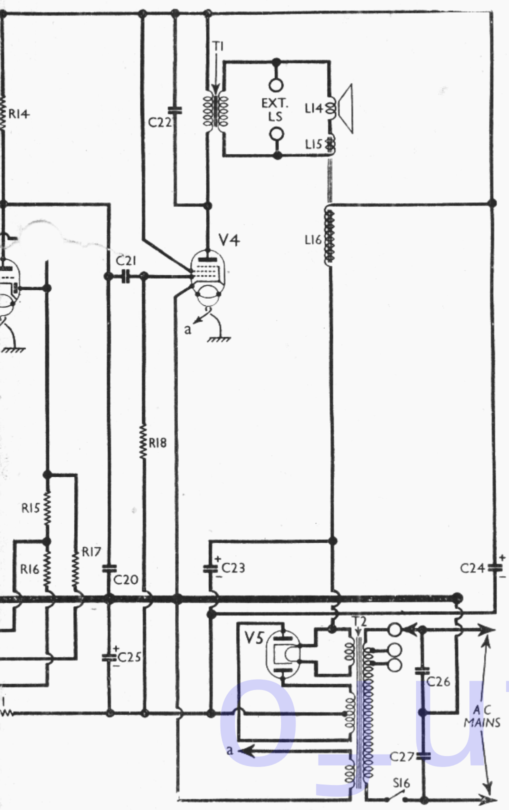


Second diode of **V3**, fed from **L13** via **C19**, provides DC potentials which are developed across load resistances **R15** and **R16** and fed back through decoupling circuits as GB to FC and IF valves, giving automatic volume control.

Resistance-capacity coupling by **R14, C21** and **R18** between **V3** triode and pentode output valve **(V4, Brimar 42).** Fixed tone correction by **C22** in anode circuit. Provision for connection of low impedance external speaker across secondary of internal speaker input transformer **T1.**

HT current is supplied by IHC full-wave rectifying valve **(V5, Brimar 80S** or directly heated **80).** Smoothing by speaker field **L16** and electrolytic condensers **C23, C24.** Mains RF filtering by **C26** and **C27.**

Fixed GB voltage for **V1** and **V2,** AVC delay voltage, and **V4** GB, are obtained automatically from potential divider comprising resistances **R19, R20** and **R21** in negative HT lead to chassis. A third point on the potential divider, at the junction of **R20** and **R21,** is connected via switches **S6** and **S10,** which close when the waveband control is turned to the gramophone position, to the pentode and oscillator control grids to mute the receiver and reduce the HT consumption.



ls may have modified AVC arrangements

COMPONENTS AND VALUES

	CONDENSERS	Values (μF)
C1	Aerial MW and LW coupling potential divider ...	0·01
C2		0·0046
C3	V1 pentode SW CG decoupling	0·04
C4	Small coupling	Very low
C5	V1, V2 anodes decoupling	0·09
C6	Osc. circ. LW fixed trimmer	0·00004
C7	Osc. circuit SW tracker ...	0·004
C8	V1 osc. anode coupling ...	0·00025
C9*	V1 osc. anode decoupling ...	8·0
C10	V2 CG decoupling ...	0·065
C11	V1, V2 SG's decoupling ...	0·09
C12	IF by-pass condensers ...	0·0001
C13		0·0001
C14	AF coupling to R12 ...	0·01
C15	Part of variable tone control	0·004
C16	Part of tone compensator ...	0·01
C17	IF by-pass	0·00004
C18	R12 to V3 triode AF coupling	0·01
C19	Coupling to V3 AVC diode	0·00015
C20	IF by-pass	0·00015
C21	V3 triode to V4 AF coupling	0·065
C22	Fixed tone corrector ...	0·0065
C23*	HT smoothing condensers .	8·0
C24*		16.0
C25*	Auto GB circuit by-pass ...	50·0
C26	Mains RF by-pass condensers	0·015
C27		0·015
C28‡	Aerial circuit MW trimmer	§
C29‡	Aerial circuit LW trimmer	§
C30†	Aerial circuit tuning ...	—
C31‡	Aerial circuit SW trimmer	—
C32†	Oscillator circuit tuning ...	—
C33‡	Osc. circuit SW trimmer ...	—
C34‡	Osc. circuit MW trimmer ...	§
C35‡	Osc. circuit LW trimmer ...	§
C36‡	Osc. circuit MW tracker ...	§
C37‡	Osc. circuit LW tracker ...	§
C38‡	1st IF trans. pri. tuning ...	—
C39‡	1st IF trans. sec. tuning ...	—
C40‡	2nd IF trans. pri. tuning ...	—
C41‡	2nd IF trans. sec. tuning ...	—

* Electrolytic. † Variable. ‡ Pre-set.
§ See " Chassis Divergencies."

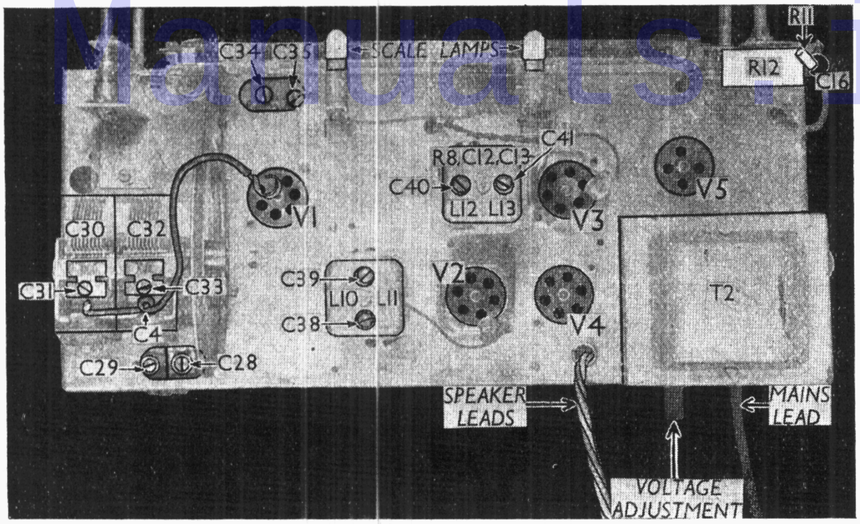
	RESISTANCES	Values (ohms)
R1	V1 pentode CG decoupling	51,000
R2	V1 oscillator anode HT feed resistances	11,000
R3		6,500
R4	V1 osc. CG resistance ...	40,000
R5	V1, V2 SG's HT feed potential divider resistances	32,000
R6		25,000
R7	V1, V2 anodes HT feed resistance	3,000
R8	IF stopper	51,000
R9	V3 signal diode load ...	330,000
R10	Variable tone control ...	500,000
R11	Part of tone compensator ...	40,000
R12	Manual volume control ...	2,000,000*
R13	V3 triode CG resistance ...	9,000,000
R14	V3 triode anode load ...	250,000
R15	V3 AVC diode load resistances	650,000
R16		330,000
R17	AVC line decoupling ...	1,000,000
R18	V4 CG resistance	330,000
R19	V1, V2 fixed GB ; V4 GB ; and AVC delay resistances	63
R20		35†
R21		200

* Centre tapped
† Two 70 O resistances in parallel.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial circuit choke ...	20·0
L2	Aerial SW coupling coil ...	0·2
L3	Aerial SW tuning coil ...	Very low
L4	Aerial MW tuning coil ...	3·0
L5	Aerial LW tuning coil ...	25·0
L6	Osc. circuit SW tuning coil	Very low
L7	Osc. circuit MW tuning coil	2·5
L8	Osc. circuit LW tuning coil	16·5
L9	Oscillator SW reaction coil	0·5
L10	1st IF trans. Pri. ...	8·0
L11	1st IF trans. Sec. ...	12·0
L12	2nd IF trans. Pri. ...	12·0
L13	2nd IF trans. Sec. ...	8·0
L14	Speaker speech coil ...	2·0
L15	Hum neutralising coil ...	0·1
L16	Speaker field coil	1,500·0
T1	Speaker input trans. Pri. ...	500·0
	Speaker input trans. Sec. ...	0·2
T2	Mains trans. Pri., total ...	30·0
	Mains trans. Heater sec. ...	0·1
	Mains trans. Rect. heat. sec.	0·1
	Mains trans. HT sec., total ...	400·0
S1-S14	Waveband switches ...	—
S15	Gram pick-up switch ...	—
S16	Mains switch, ganged R10	—

DISMANTLING THE SET

Removing Chassis.—Remove the four control knobs (recessed grub screws); remove the four self-tapping bolts (with metal washers) holding the chassis to the bottom of the cabinet.



Plan view of the chassis. Many of the trimmer adjusting screws are indicated. Note the small coupling C4.

The chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free the chassis entirely, unsolder from the connecting strip on the speaker transformer the three leads connecting it to chassis.

When replacing, connect the speaker leads as follows, numbering the tags from top to bottom:

1, green/white lead (together with red lead from speaker field);

2, white lead (together with black lead from speaker field);

3, green lead.

Note that a thick shock absorbing rubber washer is fitted to each chassis fixing bolt, between the chassis and the floor of the cabinet.

Removing Speaker.—Unsolder the three connecting leads;

remove the four nuts (with spring washers) holding the speaker to the sub-baffle.

When replacing, the transformer should be on the right and the leads should be connected as indicated above.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 236V, using the 230-250V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the medium band and the volume control was at maximum, but there was no signal input.

Voltages were measured on the 400V scale of a model 7 Universal Avometer, chassis being negative.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 6A7	248	2·1	73	2·7
	Oscillator			
	163	5·8		
V2 78	248	3·0	73	0·7
V3 75	85	0·6	—	—
V4 42	250	37·0	266	6·1
V5 80S	340†	—	—	—

† Each anode, AC.

GENERAL NOTES

Switches.—**S1-S14** are the wavechange switches and **S15** the gram pick-up switch ganged in a double-sided rotary unit beneath the chassis. This is indicated in our under-chassis view, and shown in detail in the diagrams of each side in col. 3. Side 1 is that viewed from the front of the underside of the chassis, side 2 being that seen from the rear of the underside of the chassis. The table below gives the switch positions for the four control settings, starting from fully anti-clockwise. A dash indicates open, and **C** closed.

S16 is the QMB mains switch, ganged with the tone control **R10.**

Coils.—**L1; L2, L3; L4, L5; L6, L9** and **L7, L8** are in five unscreened tubular units beneath the chassis. The IF transformers **L10, L11** and **L12, L13** are in two screened units on the chassis deck, with their associated trimmers. In addition, the second also contains **R8, C12** and **C13.** The two condensers form part of the dual trimmer assembly in this unit.

Scale Lamps.—These are two Tung-Sol types, rated at 6.3V, 0.35A, and fitted with miniature bayonet cap bases.

External Speaker.—Two sockets are provided on the internal speaker connecting panel for a low impedance (2-30) external speaker.

Condensers C23, C24.—These are two dry electrolytics in a single carton beneath the chassis, having a common negative (black) lead. The yellow lead is the positive of **C23** (8μF) and the red lead the positive of **C24** (16μF).

Switch Table

Switch	LW	MW	SW	Gram
S1	—	—	C	—
S2	C	C	—	—
S3	—	—	C	—
S4	—	C	—	—
S5	C	—	—	—
S6	—	—	—	C
S7	—	—	C	—
S8	—	C	—	—
S9	C	—	—	—
S10	—	—	—	C
S11	—	—	C	—
S12	—	C	—	—
S13	C	—	—	—
S14	—	—	—	C
S15	—	—	—	C

Condensers C5, C11; C26, C27.—These are in two dual black moulded units of the usual Philco type. In each case one of the end tags is common to the pair of condensers, and is connected to chassis by the fixing screw. The tags of the individual condensers are indicated in our under-chassis view.

Resistance R20.—This consists of two 700 resistors in parallel in our chassis.

Condenser C4.—This is a small coupling capacity formed by the wire to the top cap of **V1** twisted once round a stator tag of **C32** in the gang.

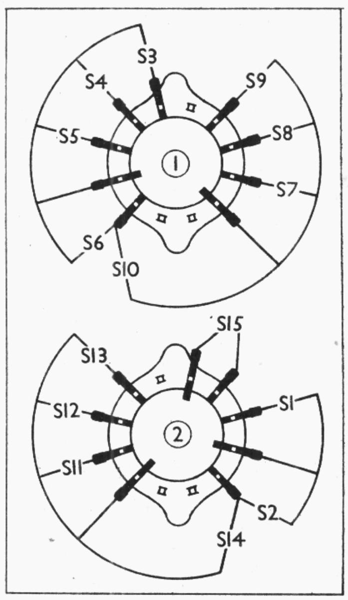
Trimmers.—Apart from the four IF trimmers, two in each unit, there are two trimmers on the gang condenser (in the case of **C33,** the adjusting screw was removed in our chassis, the condenser being at its minimum value). Two more are reached through a slot in the chassis deck close to the gang, a further two are reached through a similar slot near the front of the chassis deck, and two trackers are reached through two holes in the rear chassis member.

Chassis Divergencies.—In some chassis the AVC feed arrangements may differ from those shown in our diagram. **R15** may be 1,000,000O, and **R16** and **C10** may be missing. The lead from the bottom of **L11** then goes to the bottom of **R17,** so that **V1** and **V2** receive the same AVC voltage.

Resistances **R19, R20, R21** may be formed of a tapped Candohm resistor of 190+35+1900. Across the **R19** 1900 section a 100 O resistor is connected in parallel.

Many of the other components may have values slightly different from those given in our tables.

C28, C29 may be in a dual unit; **C34, C35** may also be in a dual unit; **C36, C37** may be beneath the chassis deck close to



Diagrams of the switch unit. Above, as seen from the front of the underside of the chassis; below, as seen from the rear of the underside of the chassis.

the switch unit, in which case they are also in a dual unit. This will have a screw and nut adjustment for its two elements. The screw adjusts **C36** and the nut **C37.**

In some cases a different speaker and transformer may be used, in which case the resistance of **L16** will be 1,140 O, not 1,500 O.

RADIOGRAM MODIFICATIONS

The radiogram models are suitable for use on 50-60C/S mains only. The pick-ups have a resistance of 2,000 O. Shunted across them is a potentiometer formed of a 20,000 O and a 45,000 O resistor in series, the second being at the chassis end. The junction of the two goes to the bottom of **S15.**

A larger loudspeaker unit is fitted in these models.

CIRCUIT ALIGNMENT

IF Stages.—Switch set to MW and turn volume control to maximum. Connect signal generator, via a 0.1μF condenser, to control grid (top cap) of **V1** and chassis. Feed in a 451 KC/S signal, and adjust **C41, C40, C39** and **C38** in turn for maximum output. Repeat these adjustments.

RF and Oscillator Stages.—To check pointer position, open the gang to its fullest extent, insert a 0.006in. feeler gauge under the heel of the moving vanes and close the gang on the gauge. In this position the pointer should cover the lower wavelength ends of the scales. Connect signal generator, via a suitable dummy aerial, to **A** and **E** sockets.

SW.—Switch set to SW, tune to 18 MC/S on scale, feed in an 18 MC/S (16.67 m) signal, and adjust **C33** for maximum output. The correct peak is that involving the least trimmer capacity, and the trimmer may have to be fully open. Next adjust **C31** for maximum output. Check that with the input of 18 MC/S, an image signal is obtained at about 17.1 MC/S on the scale. Repeat the **C33** adjustment. Check the alignment with a 6 MC/S (50m) signal.

MW.—Switch set to MW, tune to 214m (dot on scale), feed in a 214m (1,400 KC/S) signal and adjust **C34,** then **C28,** for maximum output. Feed in a 500m (600 KC/S) signal, tune it in, and adjust **C36** (the screw if a double unit is fitted) for maximum output, while rocking the gang for optimum results. Readjust **C34** at 214m.

LW.—Switch set to LW, tune to 1,034.5m (dot on scale under "T" in "Tiflis"), feed in a 1,034.5m (290 KC/S) signal and adjust **C35** for maximum output. Feed in a 1,304m (230 KC/S) signal, tune it in, and adjust **C29** for maximum output. Feed in an 1,875m (160 KC/S) signal, tune it in, and adjust **C37** (the nut if a double unit is fitted) for maximum output, while rocking the gang for optimum results. Re-adjust **C35** at 1,034.5m.

MODERN VARIABLE RESISTORS

Notes on Wirewound and Composition Types

FOLLOWING the description of the types of fixed resistors used in modern radio receivers, one turns naturally to a consideration of resistors of the variable type, by which is meant those which are continuously variable, and not merely tapped, for the latter were considered among the fixed types.

Included among variable resistors are all types of potentiometers, which are, of course, merely variable resistors with an extra terminal. In fact, most variable resistors used in radio sets are in the form of potentiometers, the third terminal in some cases being unused.

In all variable resistances and potentiometers there is a resistance element with some kind of movable contact whereby the element can be tapped at various points to provide the variable feature of the component. In the majority of cases the movable contact is a slider, operated by a knob and spindle, but occasionally the resistance element has a number of tappings brought out to contact studs over which the slider moves.

This type of resistor is not used to any appreciable extent in modern radio receivers, although it is often employed in specialised equipment, such as charging boards and laboratory instruments.

As in the case of fixed resistors, the variable types have either wirewound or composition elements. Wirewound types are not used to-day to such a large extent as they were in the past. Most early types of sets used filament resistors of the variable type, and these were always wirewound, while wirewound potentiometers were often employed for biasing purposes.

In nearly all cases the wirewound element was formed of a single layer winding of resistance wire on a flat insulating former, which was subsequently bent round into circular form and mounted on the body of the component. The slider then operated directly on the wire winding and was connected to one terminal of the component, the two ends of the winding being connected to two more terminals.

This type of construction served admirably for components such as filament resistors or potentiometers, where the total resistance value required was low (of the order of 5 to 30 O) and a fairly heavy gauge of resistance wire could therefore be used. Such an element was robust, and gave practically no trouble in use.

The trend of receiver design soon began to demand potentiometers and variable resistors of much higher resistance value, and the difficulties of dealing with the extremely fine gauges of resistance wire necessary to produce such elements were considerable. Apart from the problem of manufacture, such elements were not sufficiently robust for general use in radio receivers. For instance, the former on which the element was wound often tended to shrink in use, with the result that the turns of wire in the winding became loose, and got damaged when the slider passed over them.

The result is that, although wirewound elements are still common in values up to about 5,000 O total, anything above this usually has a composition element.

Much research work has gone into the production of reliable composition elements which will not vary in value or disintegrate in use, and nearly as much attention has been paid to the form of slider used. If half a dozen potentiometer volume controls of different makes are opened up, nearly as many different forms of variable contact will usually be found. One variety which may be a little confusing to the novice is that known as the "swash-plate" (or in some quarters the "squash-plate") type. In this the slider does not make direct contact with the element, but a springy metal plate, normally sprung away from the element, is interposed between slider and element. As the slider is rotated, it presses the portion of the metal plate beneath it on to the element, and thus makes a variable contact. As the plate does not slide over the element, however, no wear on the element takes place.

Whatever form the contact takes, the element is always of some hard graphitic material deposited on an insulating base. A component with a good element and a well-designed slider will have a long, trouble-free life, but occasionally the element partially breaks up or wears, with the result that intermittent or noisy effects are produced. Many service engineers maintain that they can cure this type of fault by rubbing the track of the element with a soft lead pencil, but at the best this can only be a temporary repair, and in any case it is likely to affect the value of the resistance seriously.

So far it has been assumed that the resistance element gives an even progression of resistance from one end of the element to the other. Such elements are designated as "straight line" types, but in many circuits some form of grading of the resistance is desirable, where equal angular rotation of the spindle does not produce equal increments in resistance.

A common type is the logarithmic grading, where the change in resistance value is slow at first, becoming progressively faster as the spindle is rotated. When replacing a volume control, or similar potentiometer, it is therefore necessary to ascertain whether the original type fitted followed a straight-line, logarithmic or other law.

The most commonly used values for volume control purposes in a superhet receiver are 250,000, 500,000, or 1,000,000 O. In certain of the older "straight" receivers, the volume control took the form of a bias control for the RF valve, in which case values of 2,000 to 5,000 O were common, and wirewound types were employed. Variable tone controls usually have values of from 10,000 O to 50,000 O.

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