NUMBER 112 **'TRADER' SERVICE SHEETS**

PHILCO 290

ALL-WAVE UNIVERSAL MODELS

THE Philco 290 is a 5-valve (plus rectifier) A.C./D.C. all-wave superhet receiver covering ranges of 16.6-52.6, 174-547 and 857-2,068 metres. A similar chassis is fitted in the 290 console, radio-gramophone and automatic radio-gramophone.

CIRCUIT DESCRIPTION

Aerial input via **C1** and coupling coils **L2** (S.W.), **L3** (M.W.) and **L4** (L.W.) to tuned circuit comprising **C45** and coils **L5** (S.W.), **L6** (M.W.) and **L7** (L.W.) which are switched separately. Filter circuit **L1, C40** by-passes interference at the I.F. Provision for connection of special transmission line to terminals marked "Black" and "Red."

First valve (**V1, Philco 78E**) is a variable-mu pentode operating as signal frequency amplifier with tuned-secondary transformer coupling to heptode frequency changer (**V2, Philco 6A7**). Primaries **L8** (S.W.) and **L9** (M.W. and L.W.); secondaries **L12** (S.W.), **L13** (M.W.) and **L14** (L.W.) are tuned by **C50** and are independently switched. Oscillator grid coils **L15** (S.W.), **L16** (M.W.) and **L17** (L.W.) are tuned by **C51**; tracking by **C14, C52** (S.W.), **C15, C53** (M.W.) and **C58** (L.W.); reaction is applied by **C12** and small coil **L18.**

Third valve (**V3, Philco 78E**) is a variable-mu H.F. pentode operating as I.F. amplifier with transformer couplings **L19, L20** and **L21, L22.**

Intermediate frequency 451 KC/S.

Moving iron meter visual tuning indicator **T.I.** in common H.T. line to **V1** and **V3** anodes.

Diode second detector forms part of double diode triode (**V4, Philco 75**) which has diode anodes strapped. Audio frequency component in rectified output is developed across **R13** and passed via **C23** to manual volume control **R14,** thence via **C22** to triode grid. Four-point tone control is effected by means of tapping on volume control, and **R15, C24, C25** and **C26,** which work in conjunction with switches **S35-S37.**

D.C. potential developed across **R13** is fed back as G.B. to H.F., F.C. and I.F. valves, giving A.V.C.

R.C. coupling by **R18, C31** and **R21** to output pentode (**V5, Philco 18E**). Fixed tone correction by **C32.**

When the receiver is used with A.C. mains H.T current is supplied by a half-wave rectifier (**V6, Philco 25RE**), which, with D.C. supplies, behaves as a low resistance. Smoothing by choke **L25** and electrolytic condensers **C35, C36.**

Speaker field coil **L24** is connected in series with ballast resistance **R23** and forms part of **V1, V2, V3** S.G.'s H.T. potential divider.

Heaters of valves are connected in series together with scale lamps and barretter lamp (**Osram 301**) across mains input circuit.

DISMANTLING THE SET

Removing Chassis.—Remove the five control knobs (pull off) and the four bolts (with washers) holding chassis to bottom of cabinet. These bolts may have been removed already. Chassis can now be withdrawn to the extent of speaker leads, which is sufficient for normal purposes. *When replacing chassis,* do not forget to replace the four rubber washers between chassis and cabinet bottom.

To free the chassis entirely, unsolder the speaker leads and *when replacing* connect as follow, numbering tags from bottom to top:—1, red; 2, black; 3, white/green; 4, white; 5, green.

Removing Speaker.—Remove nuts from the four bolts with ornamental heads, which hold speaker to front of cabinet. *When replacing,* see that transformer is on the right and connect as above.

VALVE ANALYSIS

Readings of valve voltages and currents given in the table (Col. 3) were taken with the receiver operating on A.C. mains of 230 V and with the volume control at maximum. The receiver was tuned to the maximum wavelength on the medium band but there was no signal input.

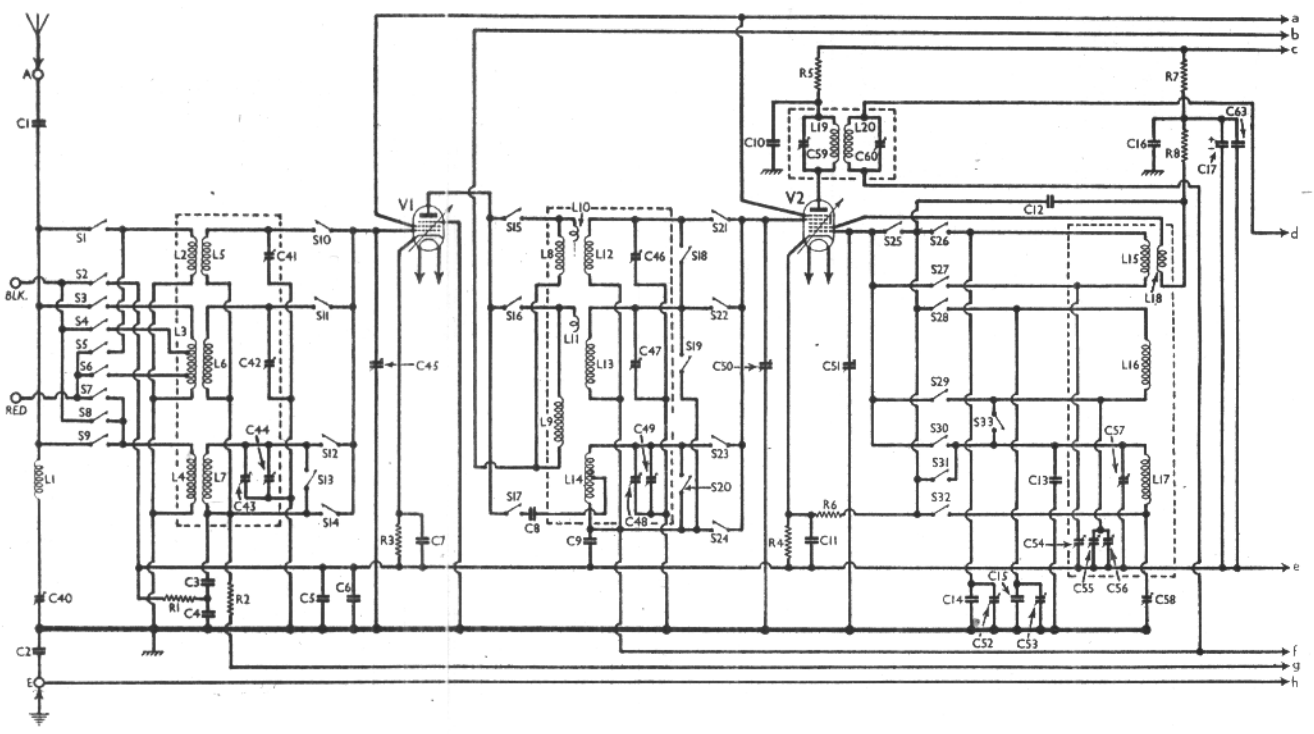
Voltages were measured on the 1,200 V scale of an Avometer, negative being the cathode of the valve concerned.

Valve	Anode Volts	Anode Current (mA)	Screen Volts	Screen Current (mA)
V1 78E	190	3·3	68	0·8
V2 6A7*	180	1·8	68	1·8
V3 78E	190	3·3	68	0·8
V4 75	85	0·4	—	—
V5 18E	198	27·0	205	5·9
V6 25RE†	—	—	—	—

* Osc. anode (G2) 145 V, 2·3 mA.
† Cathode to anode, 245 V D.C.

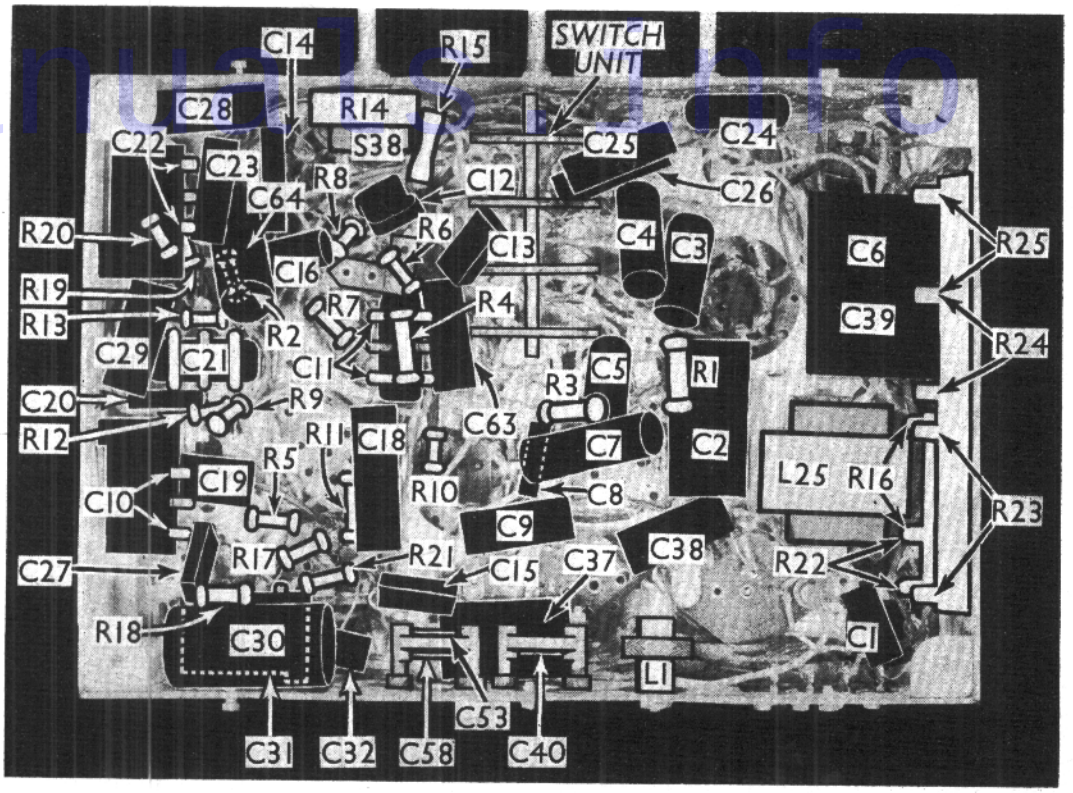
COMPONENTS AND VALUES

	Resistances	Values (ohms)
R1	V1 C.G. decoupling ..	200
R2	V1 C.G. decoupling ..	490,000
R3	V1 fixed G.B. resistance ..	800
R4	V2 fixed G.B. resistance ..	500
R5	V2 tet. anode decoupling ..	10,000
R6	V2 osc. C.G. resistance ..	51,000
R7	V2 osc. anode decoupling ..	10,000
R8	V2 osc. anode resistance ..	10,000
R9	V2, V3 A.V.C. line decoupling	490,000
R10	T.I. shunt	20,000
R11	V3 fixed G.B. resistance ..	800
R12	I.F. stopper	51,000
R13	V3 signal diode load	330,000
R14	Manual volume control ..	1,000,000
R15	Part of T.C. circuit	25,000
R16	V4 G.B. resistance	4,900
R17	V4 anode decoupling ..	70,000
R18	V4 anode load	240,000
R19	V4 C.G. resistance	490,000
R20	V4 C.G. decoupling	490,000
R21	V5 C.G. resistance	490,000
R22	V5 G.B. resistance	380
R23	Speaker field coil ballast ..	1,900
R24	Scale lamp shunt	25
R25	T.I. lamp shunt	25



C 6

Under-chassis view. Separate diagrams of the main switch unit, and the tone control switch unit (beneath C24) are given overleaf. The resistances R16, R22 and R23 to R25 are in two Candohm units at the right of the chassis. The tags of each resistance are indicated. C31 is beneath C30. R2 is beneath C64. The condenser in each moulded unit is between the two outer tags in each case.



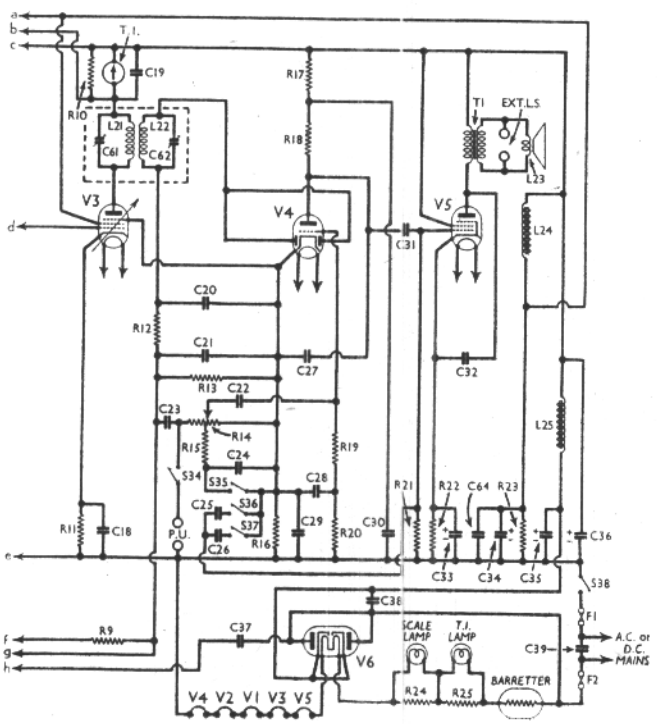
Condensers		Values (μF)
C1	Aerial series condenser	0·001
C2	Earth blocking condenser	0·25
C3, C4	V1 C.G. decoupling	0·05
C5, C6	H.T. negative line by-passes	0·05
C7	V1 cathode by-pass	1·0
		0·1

Condensers (contd.)		Values (μF)
C8	V1 to V2 capacitative coupling (L.W.)	0·00041
C9	V2 tet. C.G. decoupling	0·05
C10	V2 tet. anode decoupling	0·05
C11	V2 cathode by-pass	0·05
C12	V2 osc. anode condenser	0·0008
C13	Osc. L.W. trimmer	0·00005

Condensers (contd.)		Values (μF)
C14	Osc. S.W. tracker	0·0025
C15	Osc. M.W. tracker	0·00025
C16	V2 osc. anode decoupling	0·01
C17*		8·0
C18	V3 cathode by-pass	0·1
C19	T.I. by-pass	0·05
C20, C21	I.F. by-passes	0·00011
C22, C23	L.F. coupling condensers	0·00025
C24		0·01
C25, C26	Parts of T.C. circuit	0·03
C27	V4 anode I.F. by-pass	0·01
C28	V4 grid decoupling	0·0003
C29	V4 cathode by-pass	0·0003
C30	V4 anode decoupling	0·00011
C31	V4 to V5 L.F. coupling	0·05
C32	Tone corrector	0·05
C33*	V5 cathode by-pass	0·5
C34*	V1, V2, V3 S.G.'s by-pass	0·01
C35*, C36*	H.T. smoothing	0·0003
C37	V6 anode by-pass	25·0
C38	V6 anode-cathode by-pass	4·0
C39	Mains by-pass	16·0
C40‡	Aerial I.F. filter tuning	16·0
C41‡	Aerial S.W. trimmer	0·25
C42‡	Aerial M.W. trimmer	0·01
C43‡, C44‡	Aerial L.W. trimmers	0·25
C45†	Aerial circuit tuning	0·000035
C46‡	H.F. trans. S.W. sec. trimmer	—
C47‡	H.F. trans. M.W. sec. trimmer	—
C48‡, C49‡	H.F. trans. L.W. sec. trimmers	—
C50†	H.F. trans. sec. tuning	—
C51†	Oscillator tuning	—
C52‡	Osc. S.W. tracker	—
C53‡	Osc. M.W. tracker	0·0015
C54‡	Osc. S.W. trimmer	0·0002
C55‡, C56‡	Osc. M.W. trimmers	—
C57‡	Osc. L.W. trimmer	—
C58‡	Osc. L.W. tracker	—
C59‡	1st I.F. trans. pri. tuning	0·0004
C60‡	1st I.F. trans. sec. tuning	—
C61‡	2nd I.F. trans. pri. tuning	—
C62‡	2nd I.F. trans. sec. tuning	—
C63	V2 osc. anode decoupling	0·05
C64	V1, V2, V3 S.G.'s by-pass	0·25

* Electrolytic. † Variable. ‡ Pre-set.

(Continued overleaf)



On the left, and continued across the previous page, is the circuit diagram of the Philco 290 receiver. The small letters a-h merely indicate the joins in the two sections of the diagram. All the switches are shown as single-pole types (See General Notes).

PHILCO 290 (Continued)

GENERAL NOTES

Switches.—All the switches in our circuit are shown as single-pole types, and there are 34 for wavechange and gramophone switching, mounted in four ganged rotary units, of which separate diagrams are given. The table below gives the switch positions for the various control settings, O indicating open and C, closed.

Other Components		Approx. Values (ohms)
L1	Aerial I.F. filter coil	17·0
L2	Aerial S.W. coupling coil	0·5
L3	Aerial M.W. coupling coil	36·0
L4	Aerial L.W. coupling coil	120·0
L5	Aerial S.W. tuning coil	0·05
L6	Aerial M.W. tuning coil	2·5
L7	Aerial L.W. tuning coil	15·0
L8	H.F. trans. S.W. primary	5·0
L9	H.F. trans. M.W. and L.W. pri.	120·0
L10	Small couplings	Very low
L11	Small couplings	Very low
L12	H.F. trans. S.W. sec.	0·05
L13	H.F. trans. M.W. sec.	2·5
L14	H.F. trans. L.W. sec.	15·0
L15	Osc. S.W. tuning coil	0·05
L16	Osc. M.W. tuning coil	2·2
L17	Osc. L.W. tuning coil	5·6
L18	Osc. anode reaction coil	0·4
L19	1st I.F. trans. Pri.	7·5
L20	1st I.F. trans. Sec.	12·0
L21	2nd I.F. trans. Pri.	12·0
L22	2nd I.F. trans. Sec.	7·5
L23	Speaker speech coil	2·2
L24	Speaker field coil	3,300·0
L25	H.T. smoothing choke	300·0
T1	Speaker input trans. Pri.	215·0
	Speaker input trans. Sec.	0·25
T.I.	Tuning indicator meter	3,300·0
S1-S33	Waveband switches	—
S34	Gram. pick-up switch	—
S35-S37	Tone control switches	—
S38	Mains switch, ganged R14	—
F1, F2	Mains circuit fuses, 1·5 A	—

Switch	L.W.	M.W.	S.W.	Gram.
S1	O	O	C	O
S2	O	O	C	O
S3	O	C	O	O
S4	O	C	O	O
S5	O	O	C	O
S6	O	C	O	O
S7	C	O	O	O
S8	C	O	O	O
S9	C	O	O	O
S10	O	O	C	O
S11	O	C	O	O
S12	C	O	O	O
S13	O	C	O	O
S14	O	O	O	C
S15	O	O	C	O
S16	C	O	O	C
S17	C	O	O	C
S18	O	O	O	C
S19	O	O	C	O
S20	O	C	C	O
S21	O	O	C	O
S22	O	C	O	O
S23	C	O	O	O
S24	O	O	O	C
S25	O	O	O	C
S26	O	O	C	O
S27	O	O	C	O
S28	O	C	O	O
S29	O	C	O	O
S30	C	O	O	O
S31	O	C	O	O
S32	C	O	O	O
S33	O	O	O	C
S34	O	O	O	C

S35-S37 are in another rotary unit, also shown separately. In the fully anti-clockwise position of the tone control, **S35** is *closed*. In the next position all are *open*, in the third position **S36** is *closed*, and in the fully clockwise position **S36** and **S37** are both *closed*.

S38 is the Q.M.B. mains switch, ganged with **R14.**

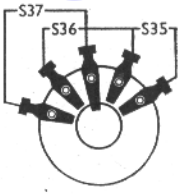


Diagram of the tone control switch unit, seen from the rear of the chassis. The centre tag and the next on the right are common to all three switches.

Coils.—All the coils except **L1** are in five screened units on the chassis deck. **L1** is beneath the chassis, at the rear.

Scale and T.I. Lamps.—These are Philco 6·3 V types, with special small bayonet caps.

Fuses.—These are 1·5 A 1¼ in. glass tubular types.

External Speaker.—Sockets at the rear of the chassis are provided for a low resistance (2·3 O) external speaker.

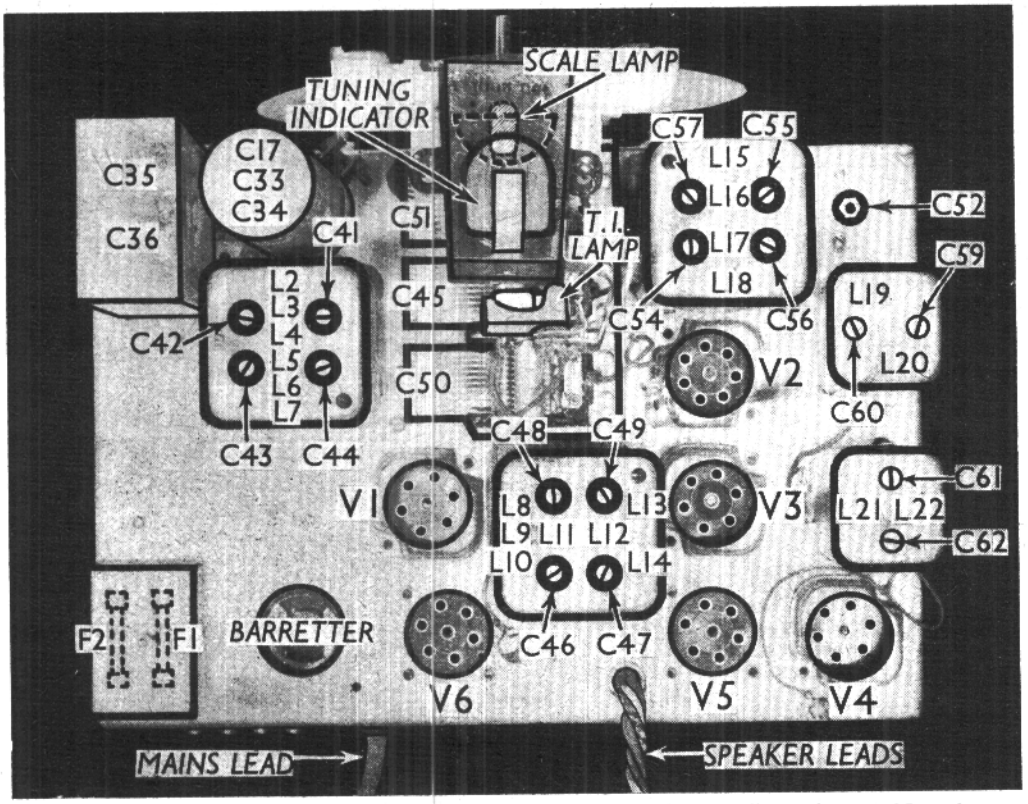
Condensers C17, C33, C34.—These are in a tubular unit on the chassis deck, but insulated from it. The case is negative. The plain tag is the positive of **C33,** the red the positive of **C17,** and the blue the positive of **C34.**

Condensers C35, C36.—These are two 16 μF types in a metal case on the chassis deck. There are three tags, one being the common negative, and connected to the negative of the tubular unit. The other two are the positives.

Condensers C6, C39.—These are two paper types in a metal case. **C6** is connected between brown lead and the case, and **C39** between the two red leads.

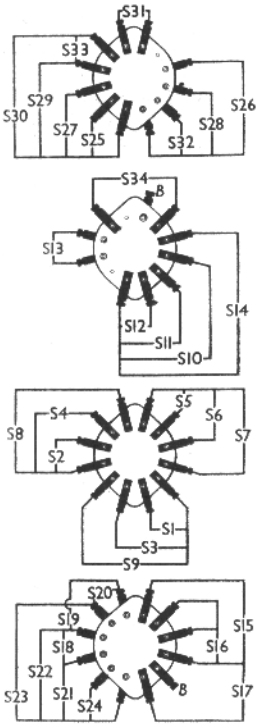
Black Moulded Condensers.—In every case the condenser is across the two outer tags, the central tag being a bearer only.

Receiver Alignment.—See page IV this week.



Above is a plan view of the chassis. The fuses F1 and F2 are inside a small metal case. Note the two electrolytic condenser units, C35, C36, and C17, C33, C34.

Below: The four switch units, looking at the underside of the chassis, from the rear. The top unit is that nearest to the knob. B indicates blank tags.



MAINTENANCE HINTS & PROBLEMS

Routine Tests : Helpful Gadgets : Unusual Faults

Shorting Tuning Condenser

Recently an Ultra Lynx A.C. receiver was brought in for service. The fault was that over certain sections of the tuning dial reception was very weak and sometimes ceased entirely.

Owing to the absence of crackle, the tuning condensers were not suspected. Only after testing every other component, and very nearly pulling the set to pieces, did suspicion fall on them. When tested, the aerial tuning condenser showed a resistance varying between a few ohms and infinity.

It appears that the set had recently been moved, and in the course of moving had been turned upside down. The electrolytic condensers in this set are of the wet type and are mounted next to the tuning condensers, so that when the set was moved some of the electrolyte had leaked out of the smoothing condensers and had dripped down between the vanes of the aerial tuning condenser.

Owing to the semi-transparent nature of the liquid it could not be seen by the eye. When, however, the electrolyte was cleaned off the vanes of the tuning condenser the set functioned perfectly.—K. G. P.

Dirt in Tuning Condenser

The complaint with a Pye A.C. transportable receiver was that after a few minutes' operation the N. Regional programme would fade out, the N. National programme not being affected.

Upon test, it was found that the N. Regional station would disappear with a small "click" in the speaker after approximately 3-4 minutes' operation. The other Regional programmes were still receivable all right, as was the N. National programme.

Using an Avominor and an Avodapter, it was noticed that as the programme disappeared the anode current of the MHD4 valve rose, pointing to the fact that the A.V.C. was working and that the fault lay in the preceding circuits, or the MHD4 valve.

Disconnecting the Avodapter and replacing the MHD4 valve the set was again switched on before any further tests were carried out. On this occasion it was noticed that as the programme disappeared a small spark came apparently from the rear section of the 3-gang tuning condenser. By switching off and on again, this fact was confirmed.

Upon close examination it was found that the vanes were very dusty, and with all the vanes nearly in mesh, the dust, which must have been of a metallic character, proved to be a faulty dielectric, and broke down, causing the H.T. voltage applied to the VMS4B valve to be partially shorted and, of course, upsetting the tuned circuit. A good clean with a stiff brush and a feather cured the trouble.

It should be explained that the two valves referred to above had been inserted by some other person to replace the Mazda types normally fitted.—C. J. P.

Crackling and Distortion

A modern superhet was brought in for service because it crackled, and on occasions distorted very badly.

The crackle was at once traced to faulty contacts on the wave-change switch, but there was no noticeable distortion. However, the components likely to cause distortion were checked and found O.K., so the set was allowed to run for several hours. As everything appeared in order it was returned to the customer.

A fortnight later it was returned by the customer, who stated that the distortion was still present. He also mentioned that the switching on and off of the set usually put the matter right for a short time.

The fault was found to be a dry joint (underneath the terminal panel of the mains transformer) on the separate 4 V 2 A winding used for the super-power output triode. The variation in resistance of this joint caused the heater voltage to vary, and hence introduced the distortion.—M. J. S.

Partial Short in H.F. Choke

Several years ago I made up a simple oscillator, making use of the Hartley circuit and plug-in coils. Whilst it was not as accurate as a proper signal generator it was extremely useful. Recently, however, there was a decided falling off in the output on the longer wavelength ranges, although the M.W. ranges remained satisfactory. Other coils were tried but brought about no improvement.

It was eventually found that the H.F. choke, in the H.T. lead to the oscillator valve, was partially shorted inside.

Thus, whilst its inductance was still sufficient on the shorter wave-ranges, it was insufficient on the longer ranges. This explained the lack of output on these ranges.—M. J. S.

Useful Wire Brush

I have found that the little wire brushes selling at 2d. and made by the Dunlop Rubber Co. for inner tube cleaning are excellent for removing the deposit from the bottom of electrolytics, also for cleaning earthing points, etc.—M. J. S.

PHILCO 290 ALIGNMENT NOTES

See pages VI to VIII for circuit diagram and chassis illustrations.

FOR the alignment of this set, a signal generator capable of giving signals of 6 and 18 MC/S is required (e.g., Philco Model 099). Connect a suitable output meter to the receiver, set waveband switch to M.W. (2nd position), turn tone control anti-clockwise, and volume control to maximum. Turn the gang condenser to indicate 1,500 KC/S.

Align the I.F. stages by feeding a 451 KC/S signal to the grid (top cap) of **V2,** with the existing lead disconnected. Adjust signal generator to give a low reading on the output meter, and adjust **C62, C61, C60** and **C59** (in this order) for maximum output.

Now connect the signal generator output to the aerial socket *via* a dummy aerial, and feed in the 451 KC/S signal. Adjust **C40** for *minimum* output.

Switch receiver to L.W. band (first position of switch) and set gang condenser to read 290 KC/S. Adjust **C58** (nut) to three-quarters of a turn from maximum. Feed in a 290 KC/S signal, and adjust trimmers **C57, C48, C49, C43** and **C44** for maximum output. If **C58** is previously adjusted too tight, oscillation may occur. Now tune set to 160 KC/S, feed in a 160 KC/S signal, and adjust **C58** for maximum output, rocking the gang condenser meanwhile to improve results. Re-adjust **C57, C48, C49, C43** and **C44** at 290 KC/S.

Switch set to M.W. (2nd position of switch), and tune to 1,400 KC/S on scale. Feed in a 1,400 KC/S signal, and adjust **C55** and **C56** for maximum output. Both should be reasonably tight. Now adjust **C47** and **C42.** Feed in a 600 KC/S signal, and adjust **C53** (screw) while rocking the gang condenser. Re-adjust **C55, C56, C47** and **C42** at 1,400 KC/S.

Switch set to S.W. (3rd position of switch). Substitute a 400 Ω resistor for the dummy aerial. Tune set to 18 MC/S on scale, and feed in an 18 MC/S signal. Adjust **C54.** To avoid adjusting to the image frequency, screw up **C54** fully, and then unscrew until the *second* tuning point is reached. The image signal will be at about 17.1 MC/S on the scale.

Now connect a 21 plate variable condenser (about .0003 μF) across the oscillator tuning condenser **C51,** and adjust **C46** and **C41.** Disconnect the shunt condenser, and re-trim **C54.**

Feed in a 6 MC/S signal, tune to 6 MC/S on scale, and adjust **C52** for maximum output, rocking gang condenser to improve results. Set scale to 18 MC/S, and feed in 18 MC/S signal. Re-adjust **C54** for maximum. Re-connect shunt condenser across **C51,** and check **C46** and **C41.** Disconnect shunt, and finally check **C54.** Check calibration of the set.