

"TRADER" SERVICE SHEET
734

PHILCO 290

TABLE, CONSOLE AND RADIOGRAMS

REVISED ISSUE OF
SERVICE SHEET No. 112



The Philco 290 table model.

NAMED the "Empire Six," the Philco 290 is a 5-valve (plus rectifier) 3-band superhet designed to operate from AC or DC mains of 190-260 V without adjustment. The SW range is 16.6-52.6 m.

An identical chassis is employed in the 290 console, while the small differences in the radiogram and autoradiogram versions are described under "Radiogram Modifications" overleaf. This *Service Sheet* was prepared from a table model.

Release date, all models, 1936. Original prices: Table model, £17 17s.; Console, £22 1s.; Radiogram, £39 18s.; Autoradiogram ARC, £46 4s.

CIRCUIT DESCRIPTION

Input from a normal aerial connected to A socket is via C1 and coupling coils L2 (SW), L3 (MW) and L4 (LW) to single-tuned circuits L5, C45 (SW), L6, C45 (MW) and L7, C45 (LW).

IF filtering in aerial circuit by L1, C40. Provision is made also for the connection of the transmission line from a Philco anti-static aerial at the sockets marked Black and Red.

First valve (V1, Philco 78E) is a variable-mu RF pentode operating as signal frequency amplifier, with tuned-secondary transformer coupling to a heptode valve (V2, Philco 6A7) which operates as fre-

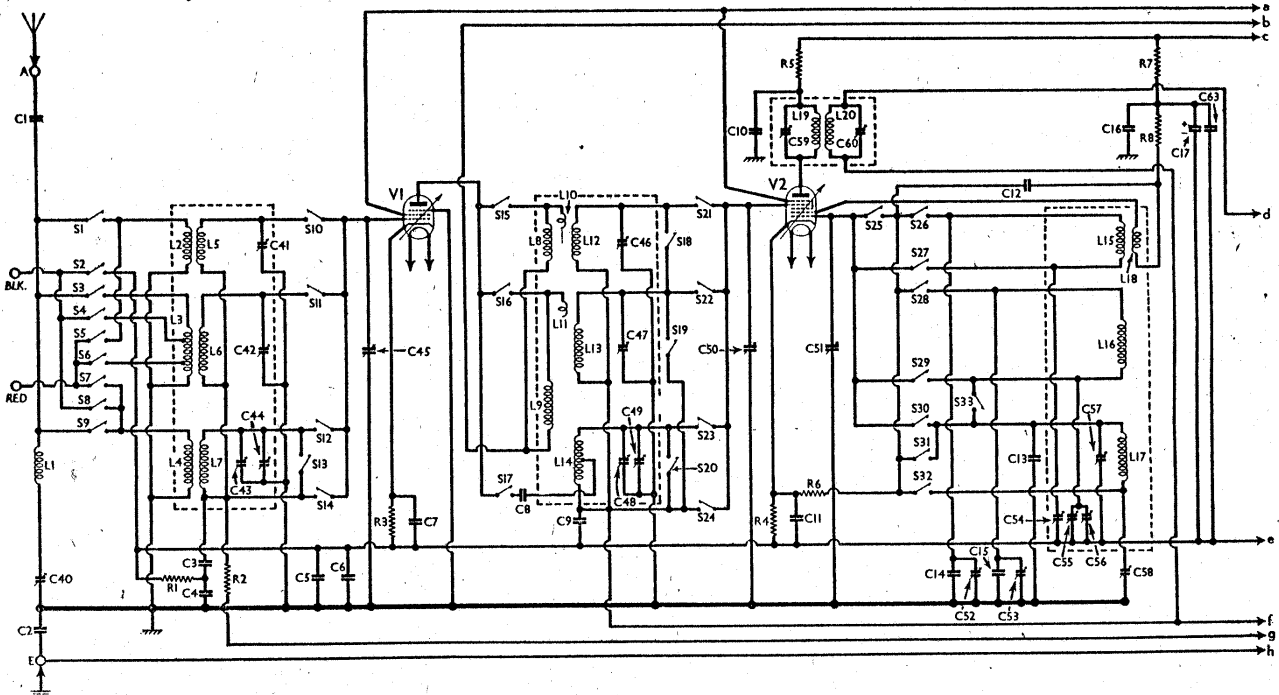
quency changer with electron coupling. RF transformer primary coils L8 (SW) and L9 (MW and LW) provide coupling to the tuned secondary circuits L12, C50 (SW), L13, C50 (MW) and L14, C50 (LW), with balancing couplings by L10 (SW), L11 (MW) and C8 to a tapping on L14 (LW). L10 and L11 consist of a few turns each.

V2 oscillator grid coils L15 (SW), L16 (MW) and L17 (LW) are tuned by C51. Parallel trimming by C54 (SW), C55, C56 (MW) and C13, C57 (LW); series tracking by C14, C52 (SW), C15, C53 (MW) and C58 (LW). Reaction coupling from anode is derived on all bands from the common impedance of the trackers in grid and anode circuits, with additional coupling on SW by L18. The DC return path to cathode for the grid is via the tuning coils and grid resistor R6.

Third valve (V3, Philco 78E) is a second variable-mu RF pentode, which operates as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings C59, L19, L20, C60 and C61, L21, L22, C62.

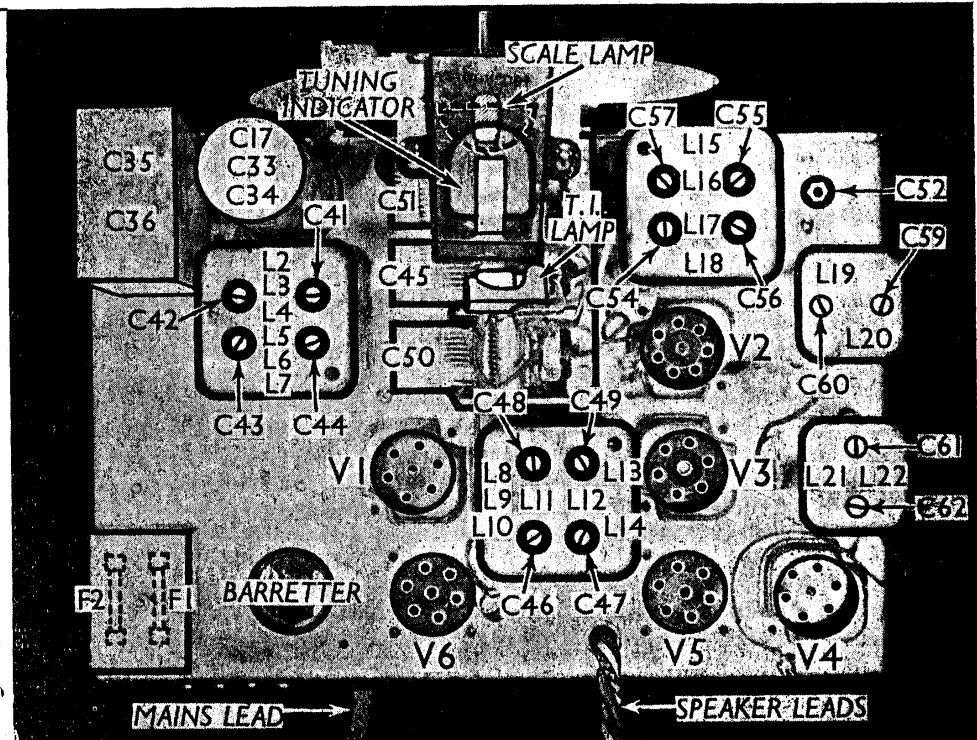
Intermediate frequency 451 kc/s.

Diode second detector is part of double diode triode valve (V4, Philco 75) in which the two diode anodes are strapped together. Audio frequency component in



Circuit diagram of the Philco 290 AC/DC superhet. The diagram is printed in two sections, and the eight points at which the two sections join for the anti-static aerial transmission line. The speaker field is connected in series with R23 across the smoothed HT circuit, a separate circuit here is replaced by a different one in the radiogram

Plan view of the chassis. All the trimmers are indicated here, with the exception of the IF trimmer C40, in the tops of the coil units. C52, in the top right-hand corner, is the SW tracker. The remaining three trackers and C40 are seen in the under-chassis view overleaf. F1, F2 are the mains fuses in a metal case.



rectified output is developed across load resistor R13 and passed via AF coupling capacitor C23, manual volume control R14 and a second AF coupling capacitor C22 to control grid of triode section, which operates as AF amplifier.

IF filtering by C20, R12 and C21 in diode circuit, and C27 in triode anode circuit. Four-position tone control by resistance-capacitance network R15, C24, C25, C26 connected across the lower section of the volume control and operated

by switch unit S35, S36, S37. Provision for connection of gramophone pick-up input across R14 via S34.

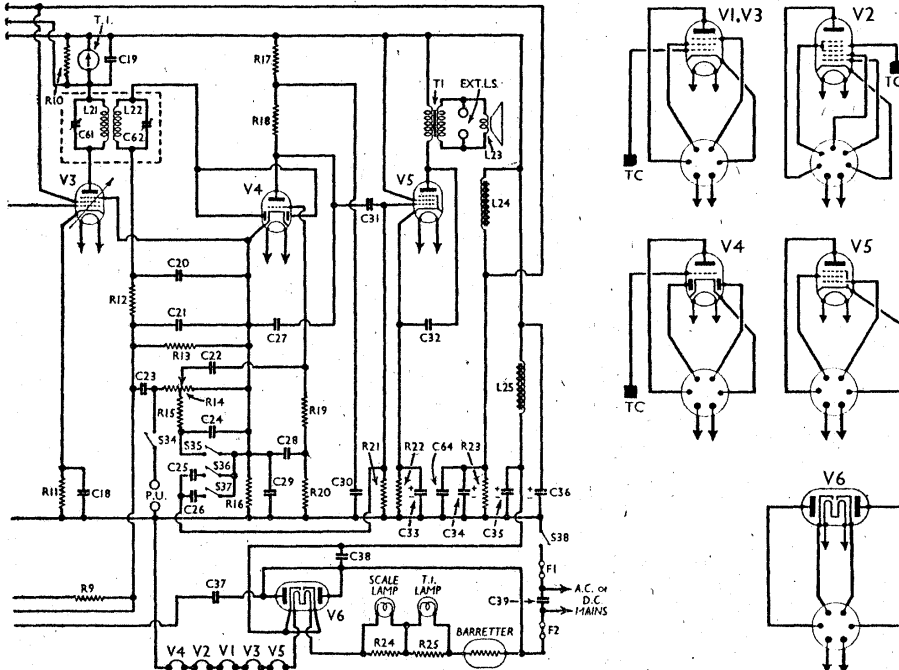
DC potential developed across R13 is tapped off and fed back through decoupling circuits as GB to RF, FC and IF valves on all bands, giving automatic volume control, and the resulting variation of anode current in V1 and V3 is used to operate the moving-iron tuning indicator T.1.

Resistance-capacitance coupling by R18, C31 and R21 between V4 triode and pentode output valve (V5, Philco 18E). Fixed tone correction by C32 in anode circuit. Provision for connection of low-impedance external speaker across secondary of internal speaker input transformer T1.

When the receiver is operated from AC mains, HT current is supplied by half-wave rectifying valve (V6, Philco 25RE), its two sections being connected in parallel. On DC mains it behaves as a low resistance. Smoothing is effected by iron-cored choke L25 and electrolytic capacitors C35, C36. Speaker field L24 is connected in series with its ballast resistor R23 across the HT circuit, from which it obtains its energising current. It thus forms a potential divider from which is taken the screen current for V1, V2 and V3.

Valve heaters, together with scale lamps and current regulating resistance lamp (Barretter, Osram 301), are connected in series across mains input circuit.

The chassis pressing is isolated from the HT circuit and mains. Mains circuit RF filtering is effected by C39 across mains input, C38 across the rectifier, and C37 between the rectifier anode and the earth socket.



are lettered a to h. The two sockets in the aerial circuit marked Red and Black are provided to be used for HT smoothing. As explained overleaf, the tone control circuit

COMPONENTS AND VALUES

CAPACITORS		Values (μF)
C1	Aerial isolator ...	0-001
C2	Earth isolator ...	0-25
C3	V1 CG decoupling ...	0-05
C4		0-05
C5	HT negative line by-pass capacitors ...	0-05
C6		1-0
C7	V1 cathode by-pass ...	0-1
C8	LW RF coupling ...	0-00041
C9	V2 tet. CG decoupling ...	0-05
C10	V2 tet. anode decoupling ...	0-05
C11	V2 cathode by-pass ...	0-0008
C12	V2 osc. anode coupling ...	0-00005
C13	Osc. LW fixed trimmer ...	0-0025
C14	Osc. SW fixed tracker ...	0-00025
C15	Osc. MW fixed tracker ...	0-00025
C16	V2 osc. anode decoupling ...	8-0
C17*		0-1
C18	V3 cathode by-pass ...	0-05
C19	T.I. by-pass ...	0-00011
C20	IF by-pass capacitors ...	0-00025
C21		0-01
C22	AF coupling capacitors ...	0-03
C23		0-01
C24	Parts of TC circuit ...	0-0003
C25		0-0003
C26	IF by-pass ...	0-00011
C27	V4 CG decoupling ...	0-05
C28	V4 cathode by-pass ...	0-05
C29	V4 anode decoupling ...	0-5
C30	V4 to V5 AF coupling ...	0-01
C31	Tone corrector ...	0-0003
C32	V5 cathode by-pass ...	25-0
C33*	SG feed decoupling ...	4-0
C34*	HT smoothing capacitors ...	16-0
C35*		16-0
C36*	Mains RF filter capacitors ...	0-25
C37		0-01
C38	Aerial IF filter tuning ...	0-000035
C39		0-01
C40†	Aerial SW trimmer ...	—
C41†	Aerial MW trimmer ...	—
C42†	Aerial LW trimmers ...	—
C43†		—
C44†	Aerial circuit tuning ...	—
C45†	RF trans. SW trimmer ...	—
C46†	RF trans. MW trimmer ...	—
C47†	RF trans. LW trimmers ...	—
C48†	RF trans. sec. tuning ...	—
C49†	Oscillator tuning ...	—
C50†	Osc. SW tracker ...	0-0015
C51†	Osc. MW tracker ...	0-0002
C52†	Osc. SW trimmer ...	—
C53†	Osc. MW trimmers ...	—
C54†	Osc. LW trimmer ...	—
C55†	Osc. LW tracker ...	0-0004
C56†	1st IF trans. pri. tuning ...	—
C57†	1st IF trans. sec. tuning ...	—
C58†	2nd IF trans. pri. tuning ...	—
C59†	2nd IF trans. sec. tuning ...	—
C60†	V2 osc. anode decoupling ...	0-05
C61†	SG's RF by-pass ...	0-25
C62		
C63		
C64		

* Electrolytic. † Variable. ‡ Pre-set.

DISMANTLING THE SET

Removing Chassis.—Remove the five control knobs (pull off), and the four bolts holding the chassis to the bottom of the cabinet. Chassis may now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes. To free chassis entirely, unsolder the speaker leads. When replacing, note that a rubber washer goes on each fixing bolt between the chassis and the bottom of the cabinet. Connect the speaker leads as follows, numbering the tags from top to bottom: 1, green; 2, white; 3, white/green; 4, black; 5, red.

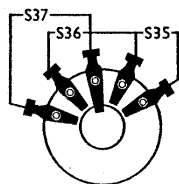


Diagram of the tone control switch unit, as seen from the rear. It is not used in the radiograms.

RESISTORS		Values (ohms)
R1	V1 CG decoupling ...	200
R2		490,000
R3	V1 fixed GB resistor ...	800
R4	V2 fixed GB resistor ...	500
R5	V2 tet. anode decoupling ...	10,000
R6	V2 osc. CG resistor ...	51,000
R7	V2 osc. anode decoupling ...	10,000
R8	V2 osc. anode resistor ...	10,000
R9	V2, V3 AVC line decoupling ...	490,000
R10	T.I. shunt ...	20,000
R11	V3 fixed GB resistor ...	800
R12	IF stopper ...	51,000
R13	V3 signal diode load ...	330,000
R14	Manual volume control ...	1,000,000
R15	Part of TC circuit ...	0-01
R16	V4 GB resistor ...	4,900
R17	V4 anode decoupling ...	70,000
R18	V4 anode load ...	240,000
R19	V4 CG resistor ...	490,000
R20	V4 CG decoupling ...	490,000
R21	V5 CG resistor ...	490,000
R22	V5 GB resistor ...	380
R23	Speaker field coil ballast ...	1,900
R24	Scale lamp shunt ...	25
R25	T.I. lamp shunt ...	25

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

Removing Speaker.—Remove the nuts from the four ornamental headed screws holding the speaker to the front of the cabinet. When replacing, the transformer should be on the right, and the leads should be connected as described previously.

VALVE ANALYSIS

Valve voltages and currents given in the table below were taken with the receiver operating on AC mains of 230 V and with the volume control at maximum. The receiver was tuned

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 78E	190	3-3	68	0-8
	180	1-8		
V2 6A7	{ Oscillator	{ 2-3	68	1-8
	{ 145	{ 2-3		
V3 78E	190	3-3	68	0-8
V4 75	85	0-4	—	—
V5 18E	198	27-0	205	5-9
V6 25RE†	—	—	—	—

† Cathode to HT negative, 245v DC.

to the highest 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.

GENERAL NOTES

Switches.—S1-S34 are the waveband and gramophone pick-up switches, ganged together in four rotary units beneath the chassis. These are indicated in our under-chassis view as "Switch Unit," and shown in detail in the diagrams below.

The table in col. 5 gives the switch positions for the four control settings, starting from the fully anti-clockwise position of the control. A dash indicates open, and C, closed.

S35-S37 are the tone control switches, in a four-position unit beneath the chassis. This is not indicated in our under-chassis view, as it is completely obscured by C24. In the fully anti-clockwise position of the control, S35 is closed; in the next position all switches open; in the third position S36 closes; and in the fourth position S36 and S37 are closed. A diagram of the unit appears at the foot of col. 1.

S38 is the QMB mains switch, ganged with the volume control R14.

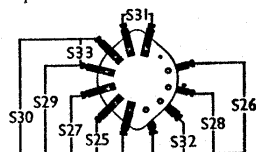
Coils.—All the coils except L1 are in five screened units on the chassis deck. L1 is beneath the chassis, at the rear.

Scale and T.I. Lamps.—These are Philco 6.3 V types, with special small bayonet caps.

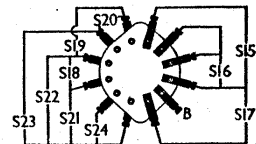
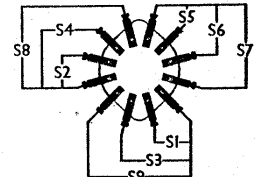
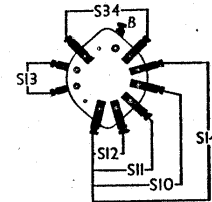
Fuses.—These are 1.5 A 1 1/4 in. glass tubular types enclosed in a container at the left rear corner of the chassis deck.

External Speaker.—Sockets at the rear of the chassis are provided for a low resistance (2.3 Ω) external speaker.

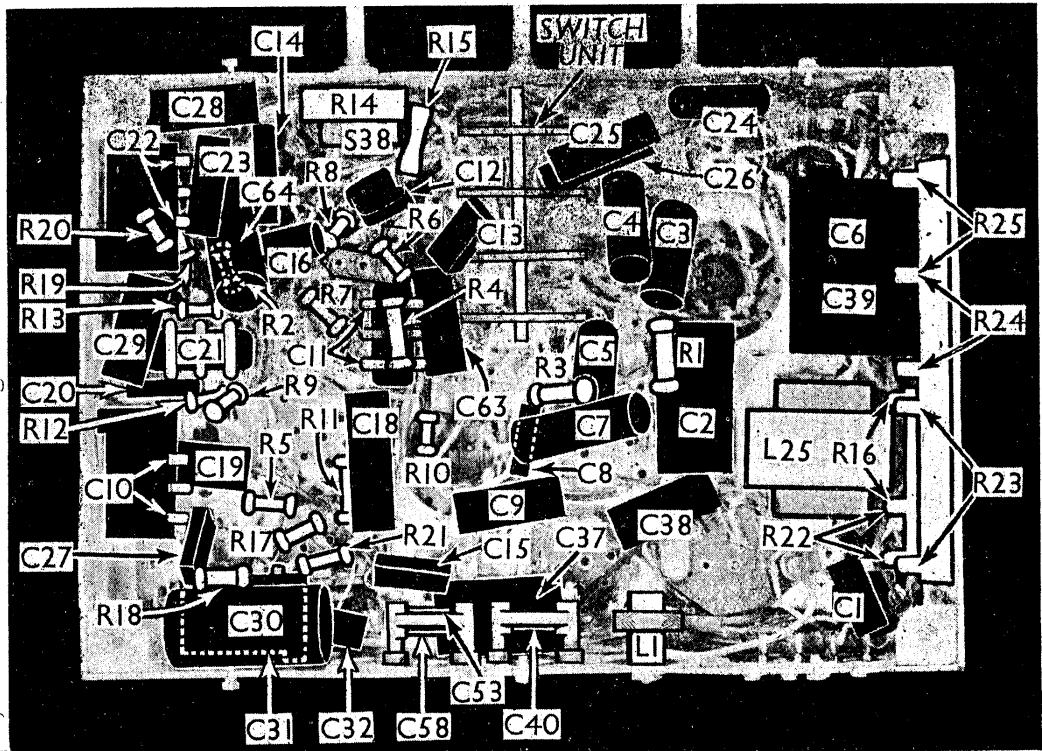
Capacitors C17, C33, C34.—These are in a tubular unit on the chassis deck, but insulated from it. The case is negative. The plain tag is the positive of C33, the



Diagrams of the four waveband switch units, drawn in the same order and from the same sides as seen from the rear of the underside of the chassis, the top unit being that nearest to the control knob.



Under - chassis view. The "Switch Unit" indicated here is the waveband switch assembly, shown in detail in the four diagrams in Col. 3. The tone control switch unit is entirely obscured here by C24, but it is shown in detail in the diagram in Col. 1. R16, R22 and R23-R25 are in two Candohm units.



red the positive of C17, and the blue the positive of C34.

Capacitors C35, C36.—These are two 16 μ F 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.

Capacitors 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 Capacitors.—There are several of these with three connecting tags each. In every case the capacitor elements are connected to the two outer tags, and where the centre tag is used it acts only as a bearer for external connections.

Radiogram Modifications.—In the radiograms the tone control circuit comprising R15, C24, C25, C26 and the S35-S37 switch unit is omitted. Instead, a 0.006 μ F capacitor and 350,000 Ω variable resistor are connected in series between V5 anode and HT negative. A "tweeter" speaker is added, connected across L23 via a 0.5 μ F capacitor, and a 10 μ F capacitor is added across C33.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator leads via a 0.1 μ F capacitor to control grid (top cap) of V2 and chassis, first removing the normal cap connector. Connect a 100,000 Ω resistor between the top cap and the connector.

Switch the set to MW, turn the tone control fully anti-clockwise, the volume control to maximum, tune to 200 m (1,500 kc/s on scale), feed in a 451 kc/s (665.1 m) signal and adjust C62, C61, C60 and C59 in that order for maximum out-

put, keeping the input low. Remove resistor and replace top cap connector.

IF Filter.—Transfer signal generator leads to A and E sockets via a MW dummy aerial, feed in a 451 kc/s signal, and adjust C40 for minimum output.

LW.—Switch set to LW, tune to 290 kc/s on scale, turn C58 (nut) to maximum, then back three-quarters of a turn. Feed in a 290 kc/s (1,035 m) signal, and adjust C57, C48, C49, C43 and C44 for

maximum output. Oscillation may occur if C58 is screwed up too far.

Tune to 160 kc/s on scale, feed in a 160 kc/s (1,875 m) signal, and adjust C58 for maximum output while rocking the gang for optimum results. Repeat 290 kc/s adjustments.

MW.—Switch set to MW, tune to 1,400 kc/s on scale, feed in a 1,400 kc/s (214 m) signal, and adjust C55 and C56 for maximum output. Both should be fairly close to maximum capacitance. Then adjust C47 and C42 for maximum output.

Tune to 600 kc/s on scale, feed in a 600 kc/s (500 m) signal, and adjust C53 (screw) for maximum output while rocking the gang for optimum results. Repeat the 1,400 kc/s adjustments.

SW.—Switch set to SW, and replace dummy aerial with a 400 Ω resistor. Tune to 18 Mc/s on scale, feed in an 18 Mc/s (16.67 m) signal, screw up C54 to maximum, then unscrew it slowly until the second peak is reached. The image signal will be found at about 17.1 Mc/s on scale.

Connect a 21-plate variable capacitor (about 0.0003 μ F) across C51, and adjust C46 and C41 for maximum output, then disconnect the external shunt capacitor and readjust C54.

Tune to 6 Mc/s on scale, feed in a 6 Mc/s (50 m) signal, and adjust C52 for maximum output while rocking the gang for optimum results. Tune to 18 Mc/s on scale, feed in an 18 Mc/s (16.67 m) signal, and readjust C54 for maximum output. Reconnect external shunt capacitor across C51, and check settings of C46 and C41. Disconnect shunt, and finally check C54. Then check calibration at several points on the scale.

Switch Table

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