'TRADER' SERVICE SHEET

202

G.E.C. "ALL-WAVE 6"

4-BAND A.C. RECEIVER

A SIGNAL frequency amplifier is included in the G.E.C. "All-Wave 6" 5-valve (plus rectifier) A.C. superhet. Among the refinements provided are a neon tuning indicator, variable selectivity, and a 3-position muting control.

Two models of the receiver are made. The BC3760 has a tuning range of 13·6-30 (referred to below as S.W.1), 29·4-81·2 (S.W.2), 200-550 and 900-2,200 metres, while the BC3762 is very similar but has a range of 75-200 metres instead of the long wave range. Our *Service Sheet* was prepared on one of the former models.

CIRCUIT DESCRIPTION

Aerial input via fixed condenser **C1** to coupling coils **L1** (S.W.1) and **L2** (S.W.2), and to lower ends of single tuned aerial coils **L5** (M.W.) and **L6** (L.W.). On S.W.1 and S.W.2 **L1** and **L2** are coupled to single tuned coils **L3, L4.** Aerial to earth shunt, **R1**, is fitted. Aerial tuning by **C37.**

First valve (**V1, Osram carbonised W42**) is a variable-mu R.F. pentode signal frequency amplifier. Tuned secondary R.F. transformer couplings **L7, L10** (S.W.1), **L8, L11** (S.W.2) and **L9, L12, L13** (M.W. and L.W.), tuned by **C42,** between **V1** and triode-hexode frequency changer valve (**V2, Osram carbonised X41**) which operates with internal coupling.

Oscillator anode coils **L18** (S.W.1), **L19** (S.W.2), **L20** (M.W.) and **L21** (L.W.), tuned by **C49**; parallel trimming by **C43, C44, C45** and **C47**; series tracking by fixed condensers **C13** and **C14** (S.W.1 and S.W.2), **C15** fixed and **C46** variable (M.W.) and **C48** variable (L.W.). Oscillator grid coils **L14** (S.W.1), **L15** (S.W.2), **L16** (M.W.) and **L17** (L.W.).

Single variable-mu pentode I.F. amplifier (**V3, Osram carbonised W42**) operates with tuned-primary tuned-secondary couplings **C50, L22, L23, C51** and **C52, L24, L25, C53.** Coupling between primaries and secondaries is mechanically adjustable, providing variable selectivity.

Intermediate frequency, 445 KC/S.

Diode second detector is part of double diode triode valve (**V4, Osram carbonised DH42**). Audio-frequency component in rectified output developed across **R30** is passed via switch **S38** (closed on radio), coupling condenser **C21** and manual volume control **R32** to C.G. of triode section, which operates as A.F. amplifier. Provision for gramophone pick-up across **C21** and **R32**, switched into circuit by **S39.**

Second diode of **V4,** fed by **C23,** provides D.C. potential which is developed across **R25** and fed back through decoupling circuits as G.B. to R.F., F.C. and I.F. valves, giving automatic volume control. Delay voltage obtained by drop along **V4** cathode resistances **R33** and **R34.**

3-position muting by **R15, R16, R17, R31** and associated switches.

Resistance-capacity coupling by **R36, C26** and **R37** between **V4** triode and pentode output valve (**V5, Osram carbonised N42**). Fixed tone correction in anode circuit by **C27**; variable tone control by R.C. filter **R39, C29.** Provision for connection of low resistance external speaker across secondary of **T1. S40** is a jack for disconnecting the internal speaker speech coil, **L26.**

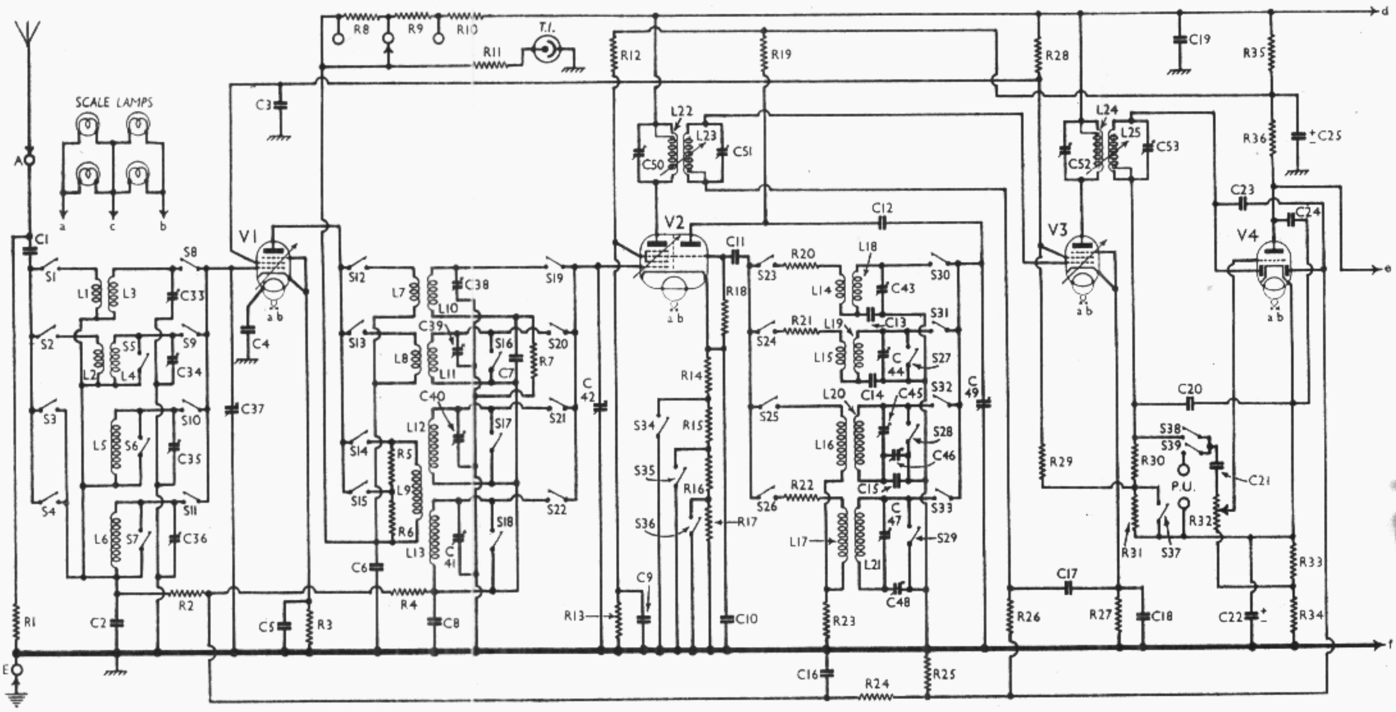
H.T. current is provided by full wave rectifying valve (**V6, Osram U12**). Smoothing by iron-cored chokes **L27, L28** and dry electrolytic condensers **C30, C31** and **C32.**

"Button" type neon tuning indicator fed from anode circuit of **V1,** and adjustable by resistances **R8, R9** and **R10.** Four scale lamps connected in two parallel pairs across each half of **T2** heater secondary winding.

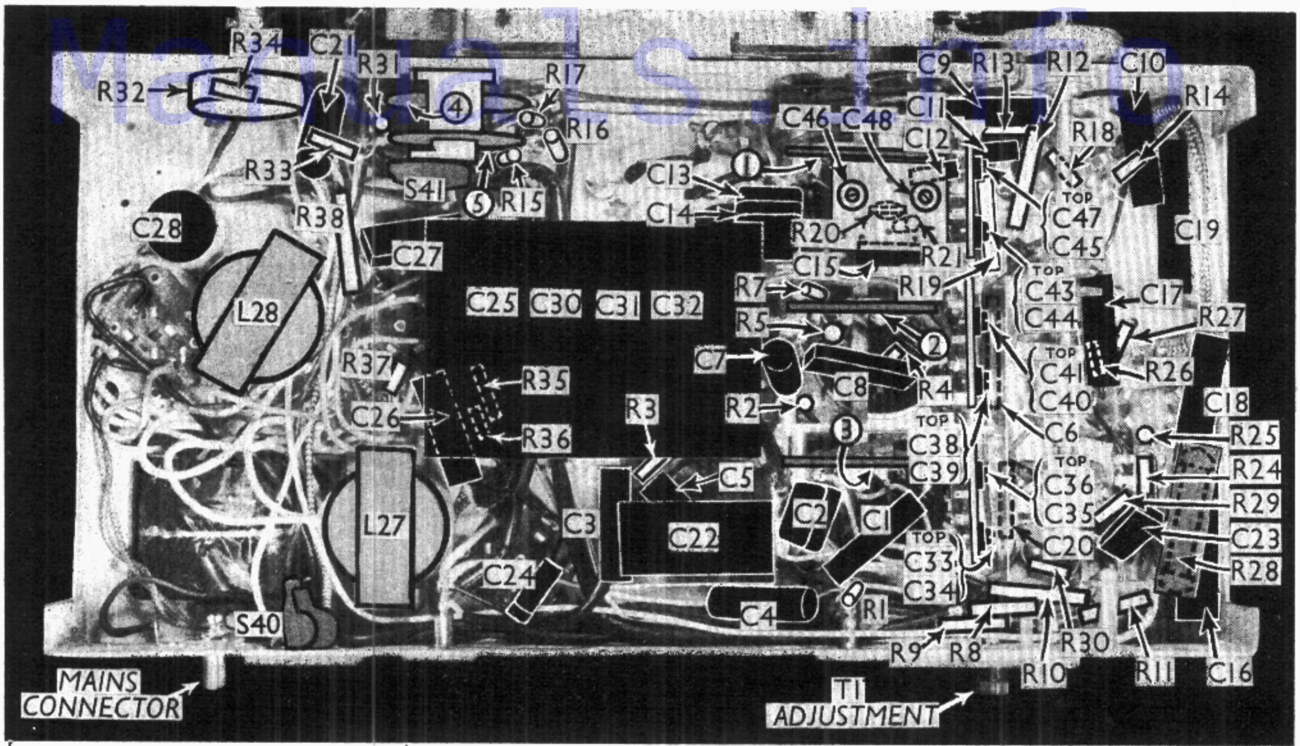
COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	Aerial-earth shunt	9,900
R2	V1 C.G. decoupling	220,000
R3	V1 fixed G.B. resistance	300
R4	V2 C.G. decoupling	220,000
R5	R.F. trans. pri. shunt potr. (M.W. and L.W.)	99
R6		99
R7	R.F. trans. S.W.1 sec. series resistance	220,000

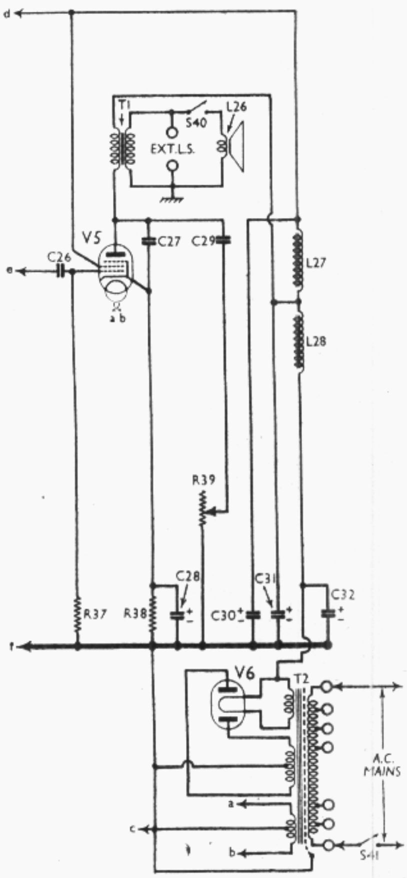
	RESISTANCES (*Continued*)	Values (ohms)
R8	T.I. adjustment resistances	2,200
R9		2,200
R10		7,700
R11	T.I. anode feed	9,900
R12	V2 hex. S.G. H.T. pot. divider	33,000
R13		55,000
R14	V2 G.B. fixed min. resistance	200
R15	V2 muting resistances	500
R16		990
R17		220,000
R18	V2 osc. C.G. resistance	55,000
R19	V2 osc. anode H.T. feed	33,000
R20	Osc. grid circ. resistance (S.W.1)	29
R21	Osc. grid circ. resistance (S.W.2)	150
R22	Osc. grid circ. resistance (L.W.)	3,300
R23	Osc. grid return series res. (M.W. and L.W.)	500
R24	V1, V2 A.V.C. line decoupling	330,000
R25	V4 A.V.C. diode load	330,000
R26	V3 C.G. decoupling	1,000,000
R27	V3 G.B. resistance	300
R28	Parts V3 S.G. H.T. pot. divider	22,000
R29		33,000
R30	V4 signal diode load	220,000
R31	Part muting circuit	2,200
R32	Manual volume control	400,000
R33	V4 G.B. and A.V.C. delay voltage resistances	500
R34		1,500
R35	V4 triode anode decoupling	15,000
R36	V4 triode anode load	220,000
R37	V5 C.G. resistance	444,000
R38	V5 G.B. resistance	400
R39	Part of variable T.C. circuit	50,000



Circuit diagram of the G.E.C. "All-Wave 6" A.C. superhet. The arrows lettered d, e and f denote the junctions between the two portions of the diagram on this and the opposite page. The tuning indicator is a button-type Tuneon. The dust cores of the I.F. transformers are connected to one side of the primary or secondary in each case.



Under-chassis view. The switch units are indicated by numbers in circles and arrows (see page VIII for complete diagrams).



	CONDENSERS	Values (μF)
C1	Aerial series condenser	0·005
C2	V1 C.G. decoupling	0·0026
C3	V1 and V3 S.G. decoupling ..	0·05
C4	V1 heater by-pass	0·05
C5	V1 cathode by-pass	0·05
C6	V1 anode R.F. by-pass ..	0·05
C7	R.F. trans. S.W.1 sec. by-pass	0·05
C8	V2 C.G. decoupling	0·0028
C9	V2 S.G. by-pass	0·05
C10	V2 cathode by-pass	0·05
C11	V2 osc. C.G. condenser ..	0·0001
C12	V2 osc. anode coupling ..	0·0005
C13	Osc. circ. S.W.1 fixed tracker	0·0016
C14	Osc. circ. S.W.2 fixed tracker	0·00147
C15	Osc. circ. M.W. fixed tracker	0·0001
C16	V1, V2 A.V.C. line decoupling	0·25
C17	V3 C.G. decoupling	0·05
C18	V3 cathode by-pass	0·05
C19	H.T. line R.F. by-pass ..	0·05
C20	I.F. by-pass	0·0003
C21	A.F. coupling to V4 triode ..	0·05
C22*	V4 cathode by-pass	35·0
C23	Coupling to V4 A.V.C. diode ..	0·0001
C24	V4 triode anode R.F. by-pass	0·0003
C25*	V4 triode anode decoupling ..	7·0
C26	V4 to V5 A.F. coupling ..	0·02
C27	Fixed tone corrector	0·002
C28*	V5 cathode by-pass	35·0
C29	Part of variable T.C. circuit ..	0·02
C30*	H.T. smoothing ..	7·0
C31*	H.T. smoothing ..	7·0
C32*	H.T. smoothing ..	7·0
C33‡	Aerial circuit S.W.1 trimmer	—
C34‡	Aerial circuit S.W.2 trimmer ..	—
C35‡	Aerial circuit M.W. trimmer	—
C36‡	Aerial circuit L.W. trimmer ..	—
C37†	Aerial circuit tuning	—
C38‡	R.F. trans. sec. S.W.1 trimmer	—
C39‡	R.F. trans. sec. S.W.2 trimmer	—
C40‡	R.F. trans. sec. M.W. trimmer	—
C41‡	R.F. trans. sec. L.W. trimmer	—
C42†	R.F. trans. sec. tuning ..	—
C43‡	Osc. circuit S.W.1 trimmer ..	—
C44‡	Osc. circuit S.W.2 trimmer ..	—
C45‡	Osc. circuit M.W. trimmer ..	—
C46‡	Osc. circuit M.W. tracker ..	—
C47‡	Osc. circuit L.W. trimmer ..	—
C48‡	Osc. circuit L.W. tracker ..	—
C49†	Osc. circuit tuning	—
C50‡	1st I.F. trans. pri. tuning ..	—
C51‡	1st I.F. trans. sec. tuning ..	—
C52‡	2nd I.F. trans. pri. tuning ..	—
C53‡	2nd I.F. trans. sec. tuning ..	—

* Electrolytic. † Variable. ‡ Pre-set.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial S.W. 1 coupling coil ..	1·75
L2	Aerial S.W.2 coupling coil ..	0·4
L3	Aerial S.W.1 tuning coil ..	Very low
L4	Aerial S.W.2 tuning coil ..	0·13
L5	Aerial M.W. tuning coil ..	3·55
L6	Aerial L.W tuning coil ..	29·5
L7	R.F. trans. S W.1 pri ..	0·75
L8	R.F. trans. S.W.2 pri. ..	1·25
L9	R.F. trans. M.W. and L.W. pri.	4·7
L10	R.F. trans. S.W.1 sec. ..	Very low
L11	R.F. trans. S.W.2 sec. ..	0·13
L12	R.F. trans. M.W. sec. ..	3·55
L13	R.F. trans. L.W. sec. ..	29·5
L14	Osc. S.W.1 grid coil	0·53
L15	Osc. S.W.2 grid coil	1·0
L16	Osc. M.W. grid coil	1·6
L17	Osc. L.W. grid coil	3·4
L18	Osc. S.W.1 anode tuning coil	Very low
L19	Osc. S.W.2 anode tuning coil	0·13
L20	Osc. M.W. anode tuning coil	2·4
L21	Osc. L.W. anode tuning coil	14·3
L22	1st I.F. trans. Pri. ..	5·0
L23	1st I.F. trans. Sec. ..	5·0
L24	2nd I.F. trans. Pri. ..	5·0
L25	2nd I.F. trans. Sec. ..	5·0
L26	Speaker speech coil	1·9
L27	H.T smoothing chokes	380·0
L28	H.T smoothing chokes	380·0
T1	Speaker input trans. Pri. ..	330·0
	Speaker input trans. Sec. ..	0·42
T2	Mains trans. Pri. (total) ..	17·0
	Mains trans. Heater sec. (total)	0·05
	Mains trans. Rect. heat. sec.	0·13
	Mains trans. H.T. sec. (total)	340·0
S1-33	Wavechange switches ..	—
S34-37	Muting switches	—
S38-39	Gram. pick-up switches ..	—
S40	Internal speaker switch ..	—
S41	Mains switch	—

DISMANTLING THE SET

Removing Chassis.—To remove the chassis from the cabinet, first remove the knobs from the volume and tone controls, the thumb controls for the switches (pull off) and the tuning knob (recessed grub screw). Now remove the four bolts (with washers, rubber washers and distance pieces) holding the chassis to the bottom of the cabinet.

The chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes. *When replacing*, do not forget the rubber washers and wooden strips between the chassis and the cabinet bottom.

To free the chassis entirely unsolder the speaker

Continued overleaf

G.E.C. "ALL-WAVE 6"—*Continued*

leads from the output transformer on the chassis and *when replacing*, connect them as follows, numbering the tags from right to left: white, 5 on back row (looking from the back of the chassis); black, 2 on front row.

Removing Speaker.—If it is desired to remove the speaker from the cabinet, it will be found best to remove the speaker, sub-baffle and cradle together by removing the four bolts (with washers and spring washers) holding the sub-baffle to the cabinet front. *When replacing*, see that the terminal panel is on the right.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 230 V, with the mains transformer adjusted to that voltage. The receiver was tuned to the lowest wavelength on the medium band and both the volume and sensitivity controls were at maximum (the latter in position 1). The Tuneon adjustment was in the centre socket.

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

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 W42*	170	7·9	110	2·0‡
V2 X41	275	1·6	60	2·7
V3 W42	275	9·0	110	2·2
V4 DH42	85	0·3	—	—
V5 N42	280	32·0	275	5·2
V6 U12	310†	—	—	—

* Oscillator anode 90 V, 2·5 mA.
† Each anode, A.C.
‡ Measured in the "earthy" side of the circuit, as otherwise instability arose.

GENERAL NOTES

Switches.—**S1-S33** are the wavechange switches, in three ganged rotary units beneath the chassis. These units are indicated in our under-chassis view by numbers in circles and arrows, and are shown in detail in the diagram on this page.

S34-S37 are the muting switches, and **S38, S39** the radio to gramophone switches, in two further ganged rotary units, also beneath the chassis, and shown in detail in the switch diagrams.

The tables (col. 2) give the switch positions for the various control settings, O indicating open, and C closed.

S40 is the internal speaker jack switch, at the rear of the chassis, which opens when the external speaker plug is fully inserted.

S41 is the Q.M.B. mains switch, ganged with the muting and pick-up switch units.

Switch	S.W.1	S.W.2	M.W.	L.W.
S1	C	O	O	O
S2	O	C	O	O
S3	O	O	C	O
S4	O	O	O	C
S5	C	O	O	O
S6	C	C	O	O
S7	O	C	C	O
S8	C	O	O	O
S9	O	C	O	O
S10	O	O	C	O
S11	O	O	O	C
S12	C	O	O	O
S13	O	C	O	O
S14	O	O	C	O
S15	O	O	O	C
S16	C	O	O	O
S17	C	C	O	O
S18	O	C	C	O
S19	C	O	O	O
S20	O	C	O	O
S21	O	O	C	O
S22	O	O	O	C
S23	C	O	O	O
S24	O	C	O	O
S25	O	O	C	O
S26	O	O	O	C
S27	C	O	O	O
S28	C	C	O	O
S29	O	C	C	O
S30	C	O	O	O
S31	O	C	O	O
S32	O	O	C	O
S33	O	O	O	C

Switch	Muting 1	Muting 2	Muting 3	Gram.
S34	C	O	O	O
S35	C	C	O	O
S36	O	O	C	O
S37	C	O	O	O
S38	C	C	C	O
S39	O	O	O	C

Coils.—**L1-L6, L7-L13** and **L14-L21** are in three screened units on the chassis deck, the last two containing also the resistances indicated in our plan chassis view. The I.F transformers, **L22, L23** and **L24, L25** are in two further screened units on the chassis deck, containing also the associated trimmers. In each unit the coupling between primary and secondary is mechanically variable by cams, operated by the fidelity control knob, concentric with the wave-change lever. The "normal" position of this knob is located by a "click." Rotating clockwise from this, the I.F. coupling is increased for high fidelity. Rotating anti-clockwise, the coupling is reduced for high selectivity, and at the same time the ganged tone control, **R39**, comes into operation.

L27 and **L28**, beneath the chassis, are the two iron-cored smoothing chokes.

External Speaker.—Two sockets are provided at the rear of the chassis for a low impedance (2-4Ω) external speaker. By pushing the special plug fully home, **S40** opens and disconnects the internal speaker.

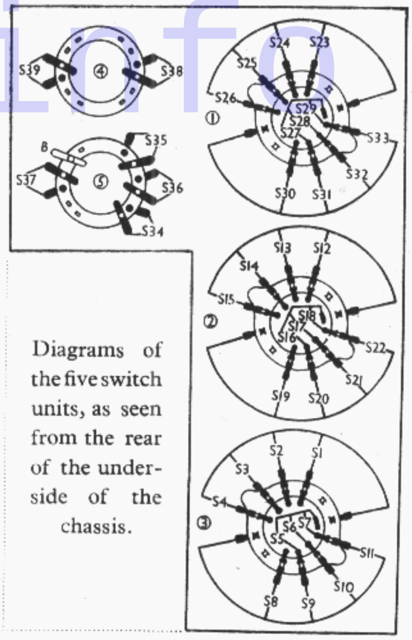
Scale Lamps.—These are four Osram M.E.S. types, rated at 3·5 V, 0·3 A.

Tuning Indicator.—This is an Osram button-type Tuneon bulb, and is provided with a screw plug adjuster at the rear of the chassis. The correct socket for this is that which just makes the lamp glow when no station is in tune.

Condensers C25, C30, C31, C32.—These are four 7 μF dry electrolytics in a single metal case beneath the chassis, and there is a common negative (black) lead. The red leads, starting from that next to the black, are the positives of **C30, C31, C32** and **C25** respectively.

Trimmers.—The twelve trimmers are in three units of four, mounted vertically to the right of the tuning units, beneath the chassis. They are indicated in pairs in our under-chassis view, the top number referring to the upper trimmer in each case.

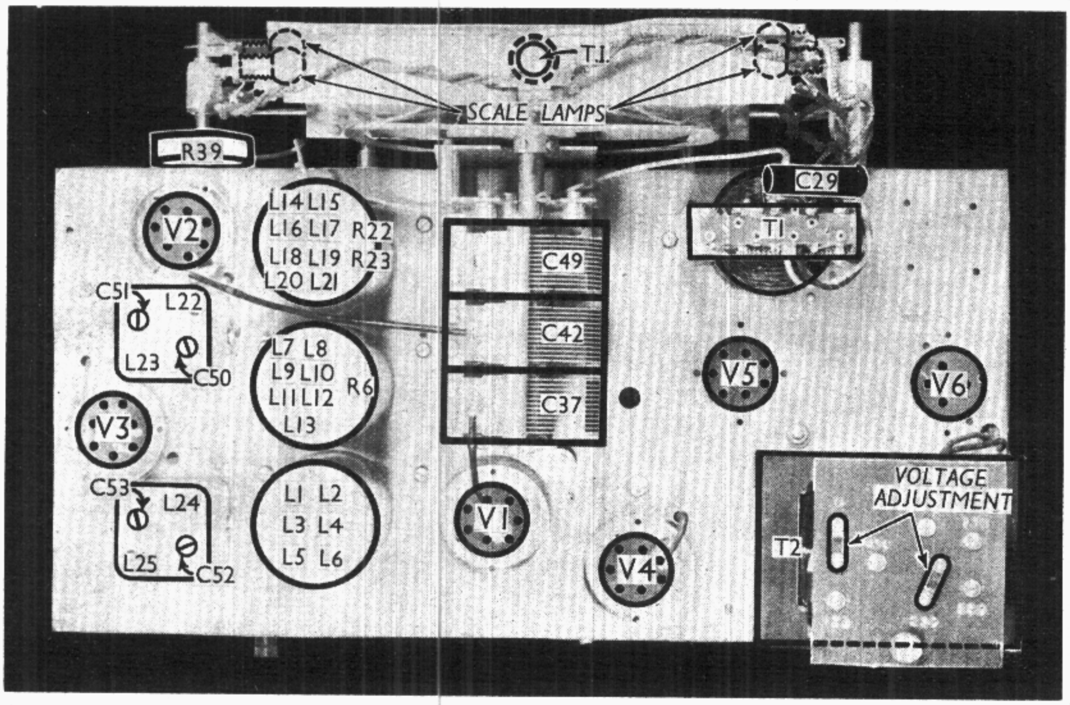
Trackers.—The two variable trackers, **C46, C48,** are on a panel above the oscillator unit beneath the chassis.



Diagrams of the five switch units, as seen from the rear of the underside of the chassis.

CIRCUIT ALIGNMENT

See page V



Plan view of the chassis. Note that resistances are included in two of the coil units. The mains transformer primary has tappings at each end for voltage adjustment.

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CAR RADIO SUPPRESSION

Interesting Lecture and Discussion at first N.R.E.A.—R.M.S. Rally

LAST Monday nearly two hundred service engineers attended a rally and lecture, organised by the N.R.E.A., Ltd., in conjunction with R.M.S., at which F. R. Hornby, of the Philco Engineering Department, spoke on the suppression of car radio interference.

Before dealing with the question of actual suppression, the lecturer pointed out a fact which is not always realised—that unless the receiver and aerial is suitably installed in the best possible position, no amount of subsequent suppression will clear up interference.

Correct installation was therefore dealt with in some detail, and the merits of various types of aerial were discussed.

It appears that a new type of aerial, consisting of a fixed or extensible rod mounted somewhere outside the car, has many points in its favour. It has a pick-up superior to that of most under-car and some roof-type aerials, and, being mounted well away from sources of direct and re-radiated interference, it makes the suppression problem a good deal simpler.

In installing aerials, it is important to keep the screened lead-in as short as possible. Some of the leads to roof aerials, for instance, are often far too long. The lead from the aerial should remain unscreened until it reaches a point where the field of interference begins to be noticeable—usually where the lead leaves the windscreen corner post.

The importance of really substantial earthing braid (about an inch wide) for all earthing points was emphasised. Narrow braid, or ordinary wire, is practically useless.

The lecturer dealt with all the usual methods of suppression of interference from the electrical equipment of a car, most of which will be already known to the majority of service engineers. A big point was made of the necessity or keeping the leads of condenser and choke suppressors as short as possible in all cases. In the same way, the distributor head resistance should be inserted in the H.T. lead right up against the actual head.

In connection with distributor heads, a hint was given which we have not heard before. The interference from this component is caused by the sparks produced when the rotor passes the fixed contacts connected to the plugs. After some use the end of the rotor gets eaten away, increasing the gap and producing more interference. It was suggested that by hammering out the end of the rotor so that it only just cleared the fixed contacts, a considerable reduction in interference could be secured.

The old question of the effect of plug suppressors on engine performance was raised, and the lecturer was supported in his contention that, at any rate on ordinary engines, no noticeable effect was caused, by a letter from Lucas, giving the results of some of their tests and experiences.

Some of the other parts of a car which might need suppression were the L.T. supply (not usual with modern sets), the exhaust pipe (re-radiation from the engine), control wires from the engine, windscreen wiper, trafficators, stop-lamp switch, control unit on C.V.C. type dynamos, and petrol gauge (of the type having a variable resistance in the tank).

The effect of circulating currents in the receiver casing and standing waves in the engine block could be minimised by earthing at the correct points.

The discussion raised a number of interesting queries, which were suitably dealt with by the lecturer, and the N.R.E.A., Ltd., and R.M.S. are to be congratulated on the large attendance secured. It seemed that for future meetings it would be advisable to start at 8 p.m., as many working engineers cannot get away in time for a 7.30 p.m. meeting.

CIRCUIT ALIGNMENT FOR G.E.C. "ALL-WAVE 6"

(*See also pages VI to VIII*)

The receiver must be switched on for at least five minutes before adjustments are attempted.

I.F. Stages.—Switch set to M.W., with gang at maximum, volume control at maximum and selectivity control fully anti-clockwise. Feed a 445 KC/S signal into the control grid (top cap) of **V2**, and adjust **C50, C51, C52** and **C53** for maximum output.

R.F. and Osc. Stages.—Check straightness of pointer, and also that it is vertical when the tuning condenser is set to minimum capacity. Make use of horizontal and vertical marks on the register to line up the pointer.

L.W.—Use a dummy aerial of 25 Ω, 20 μH and 0·0002 μF in series.

Set tuning condenser so that the pointer indicates 1,000 m., and with the receiver switched to L.W., inject a 300 KC/S signal into aerial socket of the receiver via the dummy aerial specified above. Adjust **C47, C41** and **C36** for maximum response.

Disconnect oscillator tuning condenser, **C49,** from its lead, connect an external variable condenser between the disconnected lead and chassis. Inject a 165 KC/S signal, and adjust the receiver tuning control and the external variable condenser simultaneously to give a maximum reading.

Disconnect the external variable condenser and reconnect the oscillator tuning condenser, and then, *without altering the tuning control setting*, adjust the long-wave oscillator tracker, **C48,** for maximum response.

Return to 300 KC/S and re-check the settings of all long-wave trimmers.

M.W.—Use a dummy aerial as above. Set tuning condenser so that the pointer indicates 214 m., and with the receiver switched to M.W., inject a 1,400 KC/S signal. Adjust **C45, C40, C35** for maximum response.

Connect an external variable condenser as before, and inject a 600 KC/S signal. Adjust the receiver tuning control and external variable condenser simultaneously to give a maximum reading.

Disconnect the external variable condenser as before, and re-connect the oscillator tuning condenser, and then, *without altering the tuning control setting*, adjust **C46** for maximum response.

Return to 1,400 KC/S, and re-check the settings of all medium-wave trimmers.

S.W.2.—Use a 400 Ω dummy aerial. Set tuning condenser so that the pointer indicates 9·5 MC/S, and with the receiver switched to S.W.2, inject a 9/5 MC/S (31·2 m.) signal. Adjust **C44, C39** and **C34** for maximum response, and if two settings are obtained on the oscillator trimmer, *use the lower capacity setting*.

S.W.1.—Use a 400 Ω dummy aerial. Set tuning condenser so that the pointer indicates 20 MC/S, and with the receiver switched to S.W.1, inject a 20 MC/S (15 m.) signal. Adjust the oscillator trimmer, **C43,** to the lower of the two settings obtainable. Then adjust **C38** and **C33** for maximum response, *at the same time rocking the gang condenser* over a few degrees in order to obtain the optimum settings.

Carefully seal trimmers with a suitable cellulose adhesive, and re-solder lead to the oscillator section of the gang condenser.

DIARY OF A SERVICE ENGINEER

(*Continued from page I*)

voice was reduced to a whisper that could only be faintly heard. This ensured that the old gentleman would not miss the musical programme, as he could switch on immediately it started. Charged 17s. 6d. for the job, which included rheostat, 4 yards of heavy flex, and a pear-type switch. Customer very satisfied.

Back to shop, and spent rest of day servicing two sets. One, a D.C. Ekco had an open-circuited choke in heater lead. Opened up choke and found break at outside join between winding and lead. Was able to repair, and set was O.K. on test. Rather a problem here. This set had been looked at at customer's house, and the fault found. The client had been quoted for a replacement or rewind, whichever were the cheaper, with a maximum price given. Am I justified in charging for this? In this case, I think yes, because customer had insisted, against my advice, on an estimate.

When the shop was first taken, we had difficulty with D.C. sets as the supply was 250 V 50 C/S A.C. Having two D.C. districts near, we get a proportion of D.C. sets in. Decided that an A.C. to D.C. convertor was too dear, so made up a rectifier that gives about 120 watts at 220 volts.

Used two American 5Z3 rectifiers, and an old transformer I had about, which was rewound. Two 16 μF 450 V electrolytics and an old filament choke completed the job, which cost under 30s. Shows no sign of deterioration after 15 months' use.

Thursday.—Half-day to-day, so got in good morning by shop work. First job a Marconi straight three, from another dealer. Found that dealer's "engineer" had replaced detector anode decoupling condenser with a 25 μF 25 V electrolytic! Replaced with a 400 volt working condenser, and gave instructions to charge dealer plenty.

Second job, a Lotus Universal two-valve. Fault, noisy at all times. Had some trouble locating this trouble, which turned out to be a faulty Microfuse at back of set.

Two other jobs, both valve replacements, finished my half-day's work.

Tried to make up my mind whether to go to local movies or have a complete change and make up some test gear! While sitting down in armchair after lunch, solved problem very satisfactorily by going to sleep for about 3 hours, and only dreaming about test gear!—C.J.G.