"TRADER" SERVICE SHEET
1293

BUSH VHF90 & VI

2-band A.M./F.M. Table Receivers for operation from A.C.

FITTED with internal aerials, and housed in a plastics cabinet, the Bush VHF90 is a 2-band A.M./F.M. table receiver designed to operate from A.C. or D.C. mains of 200-250V, 40/100 c/s in the case of A.C. Total mains consumption is 45W. Seven Mullard valves are employed. The band ranges are 187.5-572.5m and 87.5-100 Mc/s. F.M., but no A.M., aerial sockets are provided.

Model VHF90C is the same as the VHF90 except that it is fitted with aerial and earth sockets for M.W. operation.

Release date, both models, July 1956. *Original prices: VHF*90, £16 12*s* 8*d; VHF*90C, £17 7*s* 9*d. Purchase tax extra.*

CIRCUIT DESCRIPTION

Tuned M.W. internal aerial circuit **L8, C15** precedes triode pentode frequency changer **V2** which operates as A.M. frequency changer with external coupling.

M.W. oscillator grid coil **L9** is tuned by **C19.** Parallel trimming by **C20**; series tracking by **C21.** Reaction coupling from oscillator anode via **L10.**

V3 and **V4** are variable-mu R.F. pentodes operating as A.M. I.F. amplifiers with tuned transformer couplings **L13, L14; L17, L18** and **L22, L23.**

A.M. Intermediate frequency 470 kc/s

Diode section **c** of triple diode triode valve **V5** operates as A.M. signal detector. Audio frequency component in its rectified output is developed across **R23** and is passed via volume control **R24** and **C52** to triode section **d** of **V5** which operates as A.F. amplifier. I.F. filtering by **C46, R20, C47.**

Resistance-capacitance coupling via **R27, C57** and **R29** between **V5d** and pentode output valve **V6.** Negative feed-back tone correction between **V6** cathode circuit and **V5d** grid circuit via **C53, R28** and **R24, R25.** Tone correction in **V6** anode circuit by **R34, C58, C59.**

H.T. current is supplied by half-wave I.H.C. rectifying valve **V7.** Smoothing by **R31, R33** and electrolytic capacitors **C55, C56** and **C60.** Residual hum is neutralized by passing H.T. current through section **a** of **T1** primary winding.

R35 protects **V7** from current surges. **R38** protects the scale lamps from current surges and maintains the heater circuit in the event of scale lamp failure. **C66** prevents modulation hum by by-passing mains-borne R.F. signals.

Operation on F.M.

80Ω balanced F.M. aerial input is coupled via **L1** and fixed-tuned aerial circuit **L2, C4** to earthed-grid R.F. amplifier **V1a.** Section **b** of **V1** operates as oscillator/mixer valve with tuned oscillator grid circuit **L4, C6, C7, C8, C9.**

Reaction coupling from oscillator anode via **L5.** Output of **V1a** is developed across R.F. tuning coil **L3** and is coupled via **C6, C7** to **V1b.**

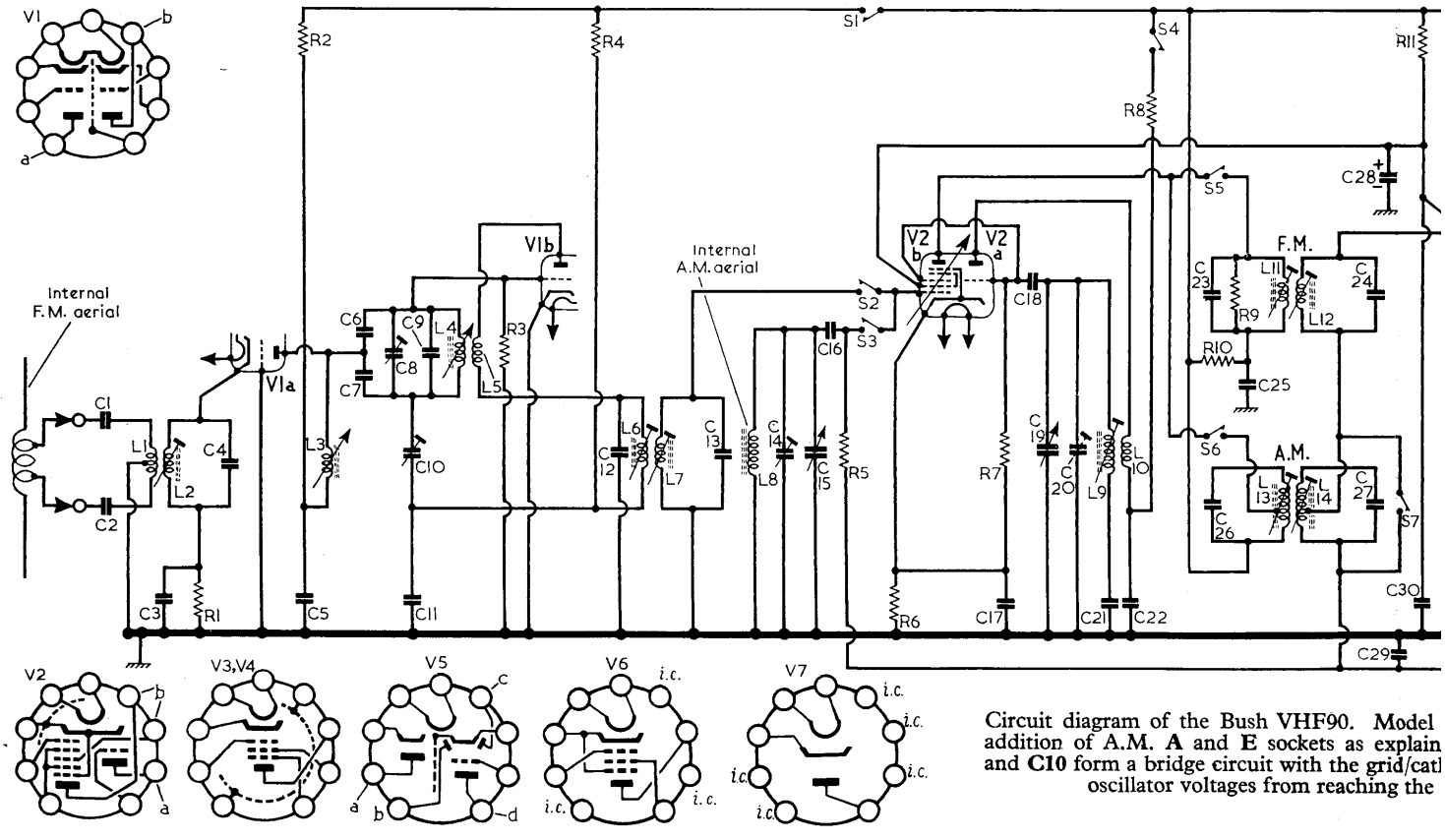
Oscillator radiation is kept to a minimum by means of **C6, C7** and **C10** which, together with the grid/cathode inter-electrode capacitance of **V1b,** form a bridge neutralizing circuit to prevent oscillator voltages from passing back into the R.F. and aerial circuits. Tuning is by means of the variable cores of **L3** and **L4** which are ganged to the main drive drum.

V2b, V3 and **V4** form the 3-valve F.M. I.F. amplifier with I.F. transformers **L6, L7; L11, L12; L15, L16** and discriminator transformer **L19, L20, L21.**

F.M. Intermediate frequency 10.7 Mc/s

Diode sections **a** and **b** of **V5** operate in a ratio detector circuit whose A.F. output is developed across **C49** and passed via **C51** to the volume control circuit. **R19** and **C48** improve the balancing of the detector circuit.

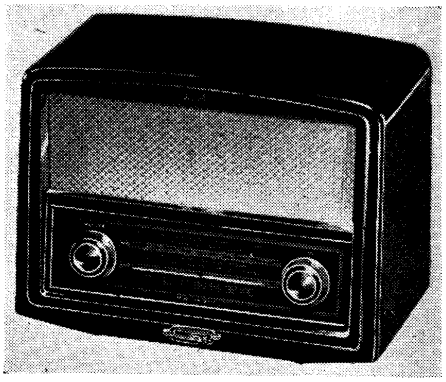
Limiting is performed by the flywheel action of D.C. reservoir circuit **C50, R22. S10** closes on F.M. operation; muting the A.M. signal, and introducing limiting into **V4** control grid circuit via **R21, C39.**



Circuit diagram of the Bush VHF90. Model addition of A.M. **A** and **E** sockets as explain and **C10** form a bridge circuit with the grid/cat oscillator voltages from reaching the

HF90C

. or D.C. Mains.



GENERAL NOTES

Switches.—S1-S12 are the A.M./F.M. switches ganged in a single slide-type unit beneath the chassis. This unit is shown in the under chassis illustration (location references G4, H4) where the individual switch contacts are identified. Switches **S3, S4, S6, S9** and **S12** close for M.W. operation, and switches **S1, S2, S5, S7, S8, S10** and **S11** close for F.M. operation.

Model VHF90C.—This is the same as the VHF90 except that it is fitted with

(*Continued col.* 1 *overleaf*)

COMPONENT VALUES AND LOCATIONS

Capacitors

C1	470pF	A2
C2	470pF	A2
C3	560pF	J5
C4	10pF	A2
C5	560pF	J5
C6	22pF	J5
C7	22pF	J5
C8	15pF	J5
C9	5·6pF	J5
C10	15pF	J5
C11	47pF	J5
C12	10pF	J5
C13	47pF	A2
C14	50pF	A1
C15	—	B2
C16	100pF	H3
C17	0·02μF	H4
C18	47pF	H4
C19	—	B2
C20	30pF	H3
C21	556pF	H3
C22	0·01μF	H4
C23	47pF	B2
C24	47pF	B2
C25	0·002μF	H4
C26	110pF	B2
C27	110pF	B2
C28	1μF	H4
C29	0·04μF	G4
C30	0·01μF	G4
C31	0·02μF	G4
C32	47pF	C2
C33	47pF	C2
C34	0·002μF	G4
C35	110pF	C2
C36	110pF	C2
C37	0·002μF	E3
C38	0·01μF	F4
C39	0·04μF	F4
C40	0·02μF	F4
C41	0·01μF	F4
C42	10pF	C2
C43	47pF	C2
C44	110pF	C2
C45	110pF	C2
C46	100pF	E4
C47	100pF	E3
C48	470pF	F3
C49	470pF	F4
C50	5μF	F3
C51	0·04μF	F3
C52	0·01μF	E4
C53	0·1μF	E3
C54	2,200pF	E4
C55	50μF	C1
C56	2μF	E4
C57	0·01μF	E4
C58	0·01μF	D1
C59	0·01μF	D1
C60	50μF	C1
C61	0·01μF	E4
C62	560pF	J5
C63	560pF	J5
C64	560pF	J5
C65	0·002μF	G4
C66	0·05μF	D2

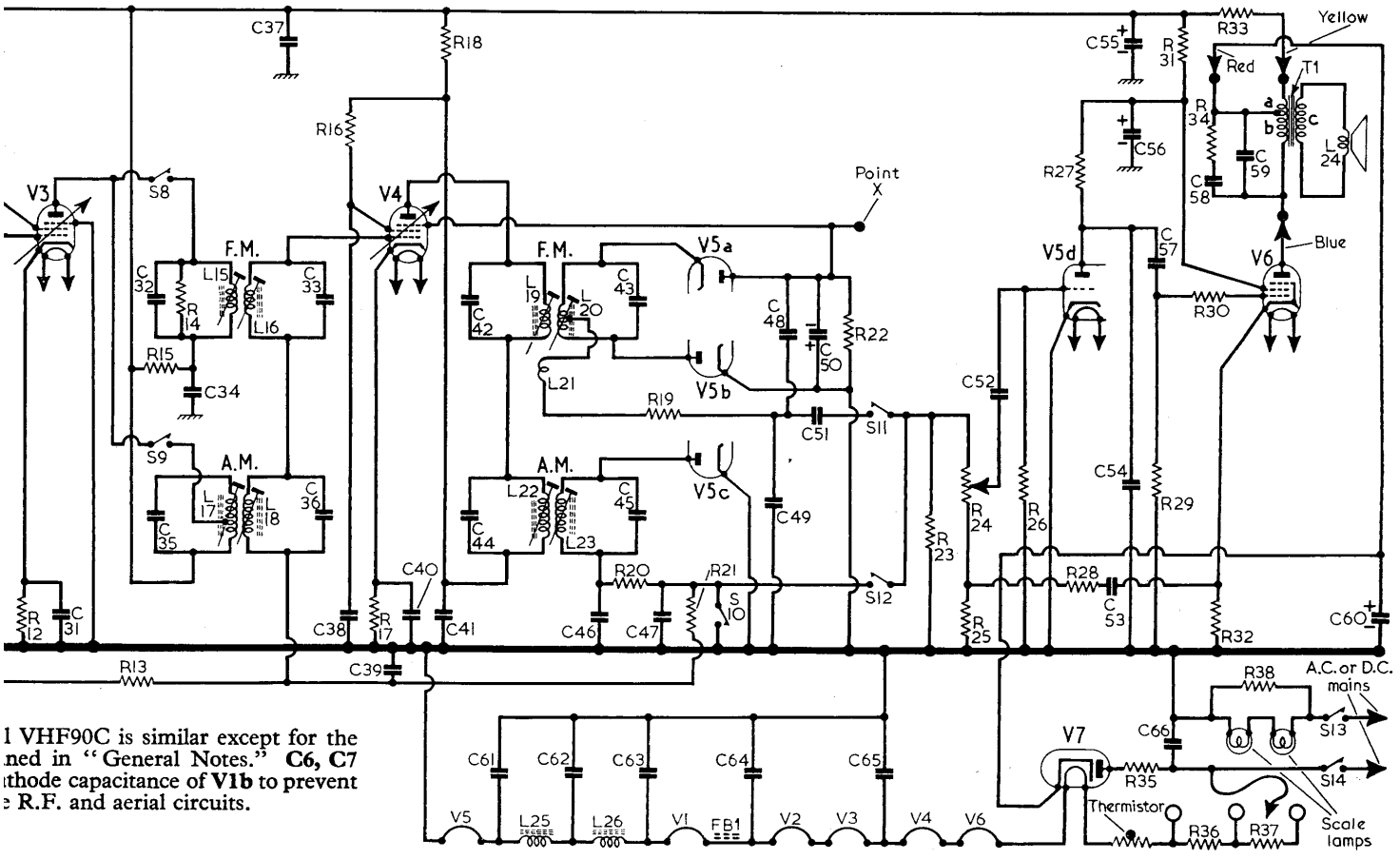
Resistors

R1	150Ω	J5
R2	2·2kΩ	J5
R3	100kΩ	J5
R4	6·8kΩ	J5
R5	680kΩ	H3
R6	150Ω	H4
R7	47kΩ	H4
R8	27kΩ	H4
R9	22kΩ	B2
R10	1kΩ	G4
R11	18kΩ	H4
R12	150Ω	G4
R13	2·2MΩ	G3
R14	22kΩ	C2
R15	1kΩ	G4
R16	39kΩ	F4
R17	150Ω	F4
R18	1kΩ	F4
R19	100Ω	F4
R20	47kΩ	E4
R21	2·2MΩ	G3
R22	22kΩ	F3
R23	180kΩ	G3
R24	500kΩ	D1
R25	1kΩ	F3
R26	15MΩ	E4
R27	220kΩ	E4
R28	4·7kΩ	F3
R29	1MΩ	E4
R30	4·7kΩ	E4
R31	15kΩ	E3
R32	220Ω	E4
R33	1kΩ	D2
R34	10kΩ	D1
R35	160Ω	E3
R36	200Ω	D1
R37	200Ω	D1
R38	30Ω	F3

Other Components†

L1	—	A2
L2	—	A2
L3	—	J5
L4	—	J5
L5	—	J5
L6	—	A2
L7	—	A2
L8	—	A1
L9	4·0	A1
L10	1·0	A1
L11	—	B2
L12	—	B2
L13	14·0	B2
L14	14·0	B2
L15	—	C2
L16	—	C2
L17	14·0	C2
L18	14·0	C2
L19	—	D2
L20	—	D2
L21	—	D2
L22	14·0	C2
L23	14·0	C2
L24	2·8	D1
L25	—	G3
L26	—	J5
T1 a	5·0	D1
T1 b	600·0	
T1 c	—	
Thermistor	CZ1	D2
FB1	*	J5
S1-S12	—	G4
S13, S14	—	D1

†Approximate D.C. resistance in ohms. *Ferrite bead.



l VHF90C is similar except for the
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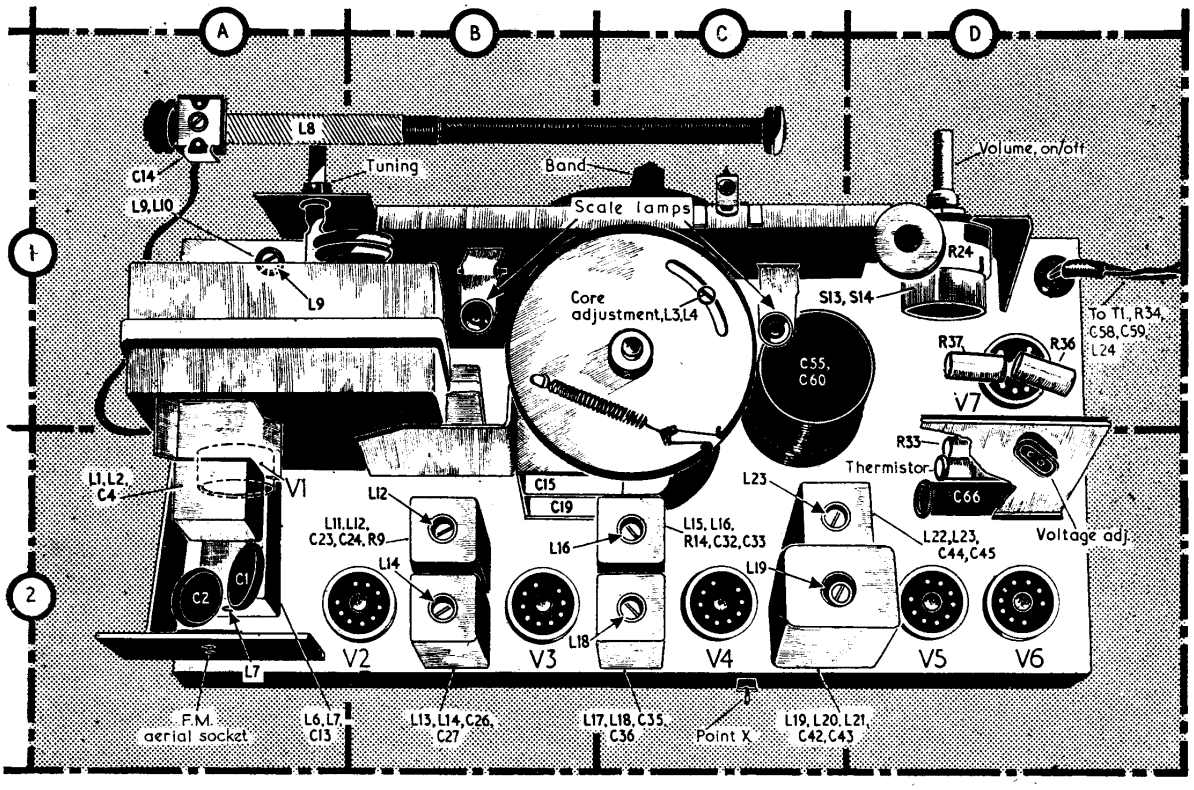


Plan illustration of the chassis. The internal M.W. aerial coil **L8** and trimmer **C14** are mounted on the speaker baffle in the cabinet.

General Notes—*continued*

M.W. aerial and earth sockets. The aerial socket is connected via a 5.6 pF capacitor to a tapping on **L8,** and the earth socket is connected to chassis via an 0.01 μF capacitor.

Gang Drive Cord.—About 34in of nylon-braided glass yarn is required for a new drive cord. One end of the cord should be tied to its anchoring clip, and the clip attached to the spring in the drive drum.

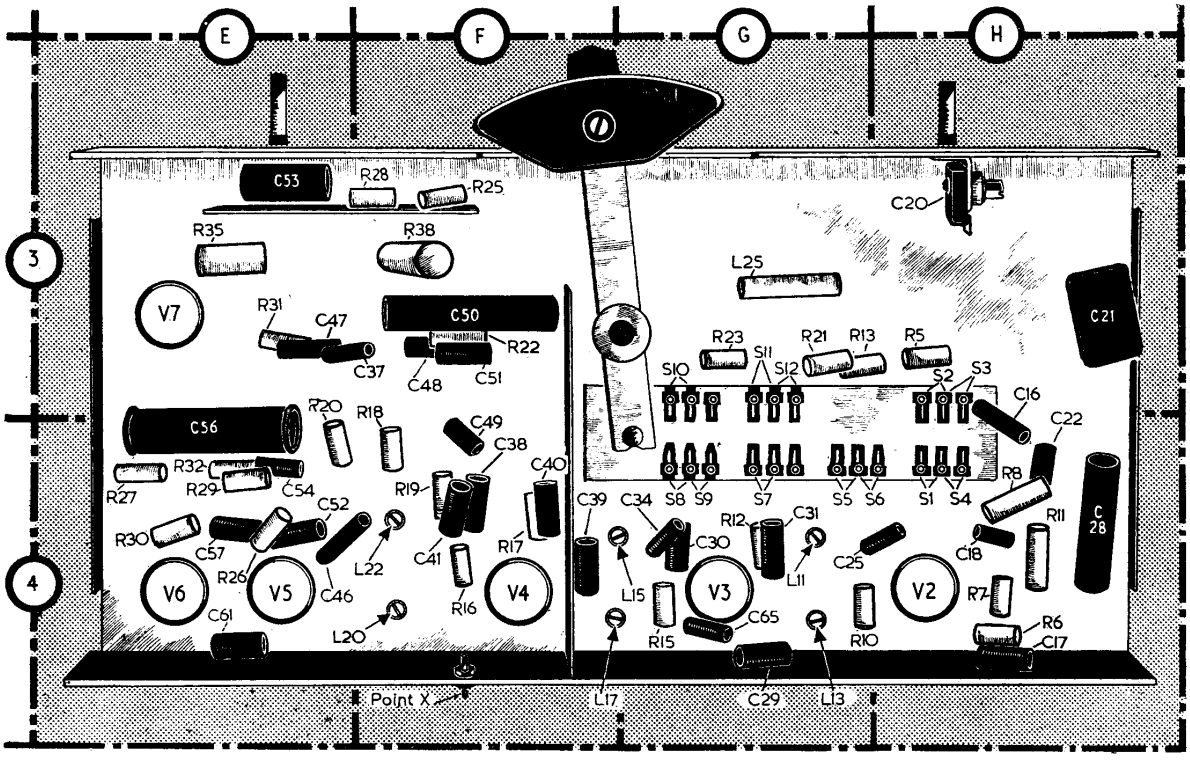
Then, with the gang turned to maximum capacitance, the cord should be passed out through the opening in the drive drum, run clockwise round the drive drum, and carried on as indicated in the sketch of the tuning drive system at the head of columns 5 and 6.

F.M. Drive Cord.—Should a breakage occur in any section of the F.M. drive cord, or should one of the tuning cores break, the manufacturers recommend that the complete drive cord and core assembly (Part Number AP24888) be replaced. Access to the drive and tuning cores is obtained by removing the front cover of the F.M. tuner unit. (Seven 6BA 1$\frac{1}{8}$in nuts and bolts.)

The screw on the drive drum which adjusts the position of the cores of **L3** and **L4** (location reference C1) should be removed. Then the gang drive cord and the drive drum should be removed.

The new drive cord and core assembly should then be threaded through the formers of **L3** and **L4,** and with the gang turned to minimum capacitance the cord should be run as indicated in the front illustration of the tuner unit.

Scale Lamps.—These are two lamps, with small clear spherical bulbs and M.E.S. bases, rated at 3.5V, 0.15A. They are shunted by a 30Ω cement-coated resistor R38, and they only glow dimly in operation.



Underside illustration of the chassis. The band switch contacts are identified in location references G4, H4. Point X in F4 is used for the connection of an output meter during alignment.

CIRCUIT ALIGNMENT

Equipment Required.—An accurately calibrated signal generator covering the A.M. alignment frequencies of 470-1,500 kc/s and the F.M. alignment frequencies of 10.7 Mc/s and 87.5-100 Mc/s (unmodulated); a Model 8 Avometer, or alternatively a D.C.. valve voltmeter and a D.C. 0.50 μA microammeter; two matched 47 kΩ resistors; a 1 kΩ damping resistor.

A.M. I.F. Stages

1.—Remove chassis from cabinet. As the tuning scale remains in the cabinet, a substitute scale is provided on the top of the scale backing plate. The calibration marks on this scale are identified with their frequencies in the sketch at the top of column 6. Check that with the gang at maximum capacitance, the cursor coincides with the datum point on the scale.

2.—Switch receiver to M.W. and tune it to 1 Mc/s. Connect output of signal generator, via an 0.01 μF capacitor in each lead, to control grid (pin 2) of **V4** and chassis

3.—Feed in a 470 kc/s modulated signal and adjust the cores of **L23** (location reference C2) and **L22** (F4) for maximum audio output.

4.—Transfer live signal generator lead to control grid (pin 2) of **V3.** Feeding in a 470 kc/s signal, adjust the cores of **L18** (C2) and **L17** (G4) for maximum audio output.

5.—Transfer live signal generator lead to control grid (pin 2) of **V2b.** Feeding in a 470 kc/s signal, adjust the cores of **L14** (B2) and **L13** (C4) for maximum.

A.M. R.F. Stages

6.—With signal generator output connected to **V2b** control grid, tune receiver to 600 kc/s, feed in a 600 kc/s modulated signal and adjust the core of **L9** (A1) for maximum audio output.

7.—Tune receiver to 1.5 Mc/s, feed in a 1.5 Mc/s modulated signal and adjust **C20** (H3) for maximum audio output.

8.—Repeat operations 6 and 7. Loosely couple output to **L8,** and adjust **C14** (A1) for maximum output.

9.—No adjustment of the internal aerial **L8** should be necessary unless it has been replaced. If a new internal aerial has been fitted it should be adjusted by loosely coupling the output of the signal generator to it, and then sliding the coil up and down on its ferrite rod for maximum audio output at 600 kc/s.

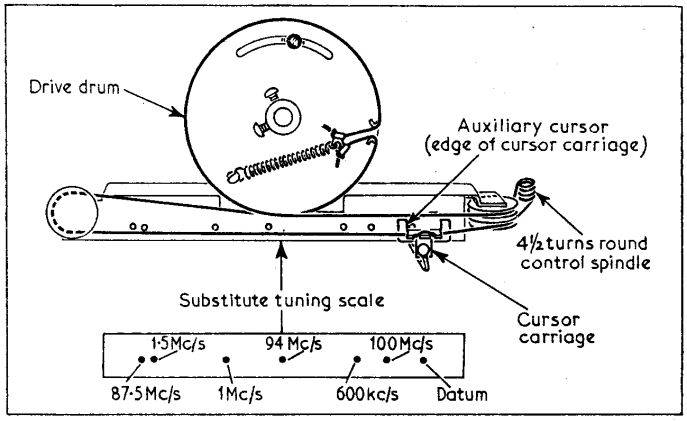
F.M. I.F. Stages

10.—Switch receiver to F.M. Connect the 47 kΩ resistors in series between chassis and point X (location reference F4). Connect Model 8 Avometer (switched to 10V D.C. range), or D.C. valve voltmeter, between chassis and point X.

11.—Connect output of signal generator between control grid (pin 2) of **V2b** and chassis.

12.—Feed in a 10.7 Mc/s unmodulated signal. During the following operations, adjust the output of the signal generator to maintain a 4V reading on the output meter, and when adjusting the cores choose the peak nearer the adjusting end of the coil former, excepting **L19** which is set to the second peak in.

Sketch of the gang tuning drive system as seen looking down from the front of an upright chassis with the gang at maximum capacitance. The calibration points on the substitute tuning scale are identified on a separate sketch beneath the drive cord system.



13.—Adjust the core of **L19** (C2) for maximum reading on meter.

14.—Connect the 1 kΩ resistor across **L16** and adjust the core of **L15** (G4) for maximum reading on meter.

15.—Connect the 1 kΩ resistor across **L15** and adjust the core of **L16** (C2) for maximum reading on meter.

16.—Connect the 1 kΩ resistor across **L12** and adjust the core of **L11** (G4) for maximum reading on meter.

17.—Connect the 1 kΩ resistor across **L11** and adjust the core of **L12** (B2) for maximum reading on meter.

18.—Disconnect meter from point X. Connect Avometer (switched to 50 μA D.C. range), or D.C. microammeter, between junction of the 47 kΩ resistors and the junction of **R19, C51.**

19.—Adjust the core of **L20** (F4) for a zero reading on the microammeter. This will occur midway between a positive-going and a negative-going peak.

20.—Disconnect meter and 47 kΩ resistors. Connect Avometer (switched to 10 V D.C. range), or D.C. valve voltmeter, between chassis and point X.

21.—Transfer signal generator leads to F.M. aerial sockets. Adjust the cores of **L6** (J5) and **L7** (A2) for maximum output on meter.

F.M. R.F. Stages

22.—Tune receiver to 87.5 on substitute scale, feed in an 87.5 Mc/s signal and adjust the cores of **L3, L4** by means of a screw in the gang drum (C1) which should be slackened off and moved along its radial slot until a position giving a maximum meter reading is found. Tighten up screw.

23.—Tune receiver to 94, feed in a 94 Mc/s signal and adjust the core of **L2** (J5) for maximum reading on meter. **C8** and **C10** are accurately aligned at the factory with special equipment, and should not need re-adjustment. No instructions are therefore given for adjusting these trimmers.

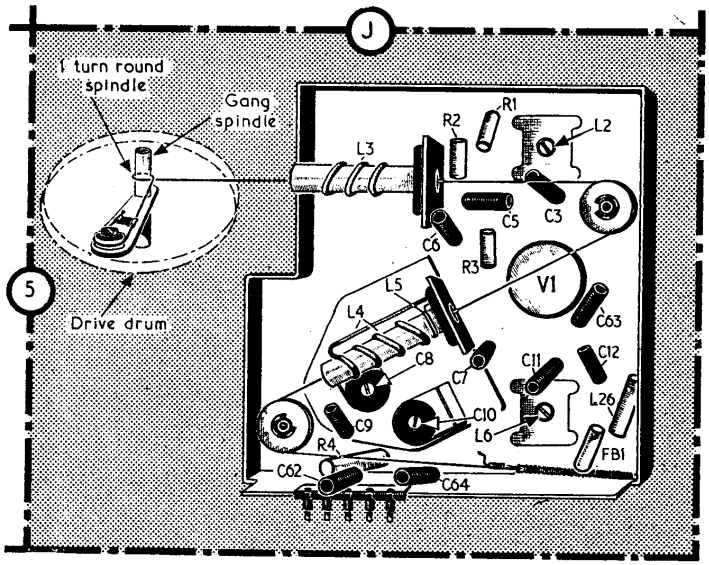
VALVE ANALYSIS

Valve voltages and currents given in the table below are those derived from the manufacturers' information. They were measured on the 10V and 1,000V ranges of a Model 7 Avometer, chassis being the negative connection in every case. Except where otherwise indicated, the receiver was switched to F.M.

Valve		Anode (V)	Screen (V)	Cathode V	Cathode mA
V1 UCC85	a	155	—	1·3	8·6
	b	140	—	—	5·0
V2 UCH81	a	82[1]	—	1·3	8·6
	b	165	70		
V3 UF89		165	70	1·3	8·6
V4 UF89		165	75	1·4	9·3
V5 UABC80	a-c	—	—	—	—
	d	60	—	—	0·3
V6 UL84		185	135	10·5	50·0
V7 UY85 ...		*	—	220·0	*

**No reading given.*
[1]Receiver switched to M.W.

Front view of the F.M. tuner with its screening cover removed. **C8, C10** and the cores of **L2** and **L6** are accessible through holes in the screening cover, but the capacitors should not be disturbed. The F.M. drive cord system is also shown in this illustration.



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