"TRADER" SERVICE SHEET
1549

BUSH VTR103

A.M./F.M. Portable Radio Receiver

MEDIUM, Long and F.M. wavebands are covered by the Bush VTR103 battery operated transistorized portable receiver. The wavechange switches are operated by a three-position press-button unit and a separate tuner unit containing the R.F. amplifier and frequency changer stages is brought into circuit on F.M.

The all-metal chassis is conventionally wired and can be removed from the cabinet complete with ferrite aerial and loudspeaker. The circuit comprises nine transistors (seven on A.M.) and three crystal diodes. Waveband ranges are 187-570m (M.W.), 1,070-1,900m (L.W.) and 87.5-100Mc/s (F.M.). The receiver is powered by a 9V battery and has an audio output of 200mW.

Release date and original price: August, 1961, £22 9s. Purchase tax extra.

TRANSISTOR ANALYSIS

Transistor voltages given in the table in col. 2 were derived from information supplied by the manufacturers. They were measured on the 10V range of an Avometer model 8. The receiver was switched to F.M. and the volume control was set for minimum output. There was no signal input. All voltages are approximate and are *positive* with respect to chassis.

CIRCUIT DESCRIPTION

Operation on F.M.

The first two stages, **VT1** and **VT2,** are in operation on F.M. only and are connected to the battery supply by **S6. VT1,** which operates as an earthed base amplifier, receives the R.F. input to its emitter via wide-band coupling **L1, L2.** The collector load of **VT1** is formed by the tuned circuit **L3, CT1** which with **C5** couples the output to the emitter of the self-oscillating mixer **VT2.**

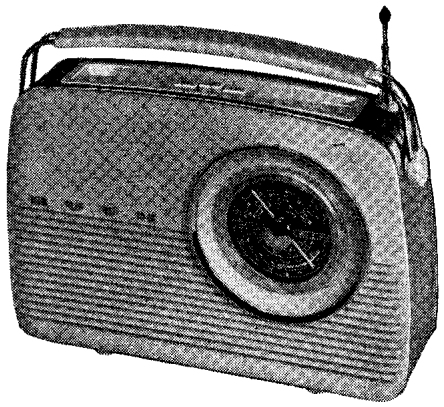
L5 in conjunction with **CT2** and **C10** is tuned at oscillator frequency. The oscillator feedback coupling is effected between **VT2** collector and emitter via **C7.** Base bias for **VT1** and **VT2** is obtained from the normal potential divider arrangement. Intermediate frequency at 10.7Mc/s is developed across the I.F. transformer secondary winding **L7** and fed via **S3** and **C14** to the base of **VT3** which operates on F.M. as an I.F. amplifier.

Two further stages of amplification at I.F. are provided by **VT4** and **VT5** with double tuned interstage transformer couplings **L18, L19** and **L20, L21.** The transformer windings are suitably tapped for correct transistor impedance matching. Amplified output from **VT5** is fed to the discriminator transformer primary **L24** and via the secondary **L26** to the ratio detector diodes **CD2** and **CD3. RV1** is variable to enable optimum balance for A.M. rejection to be established.

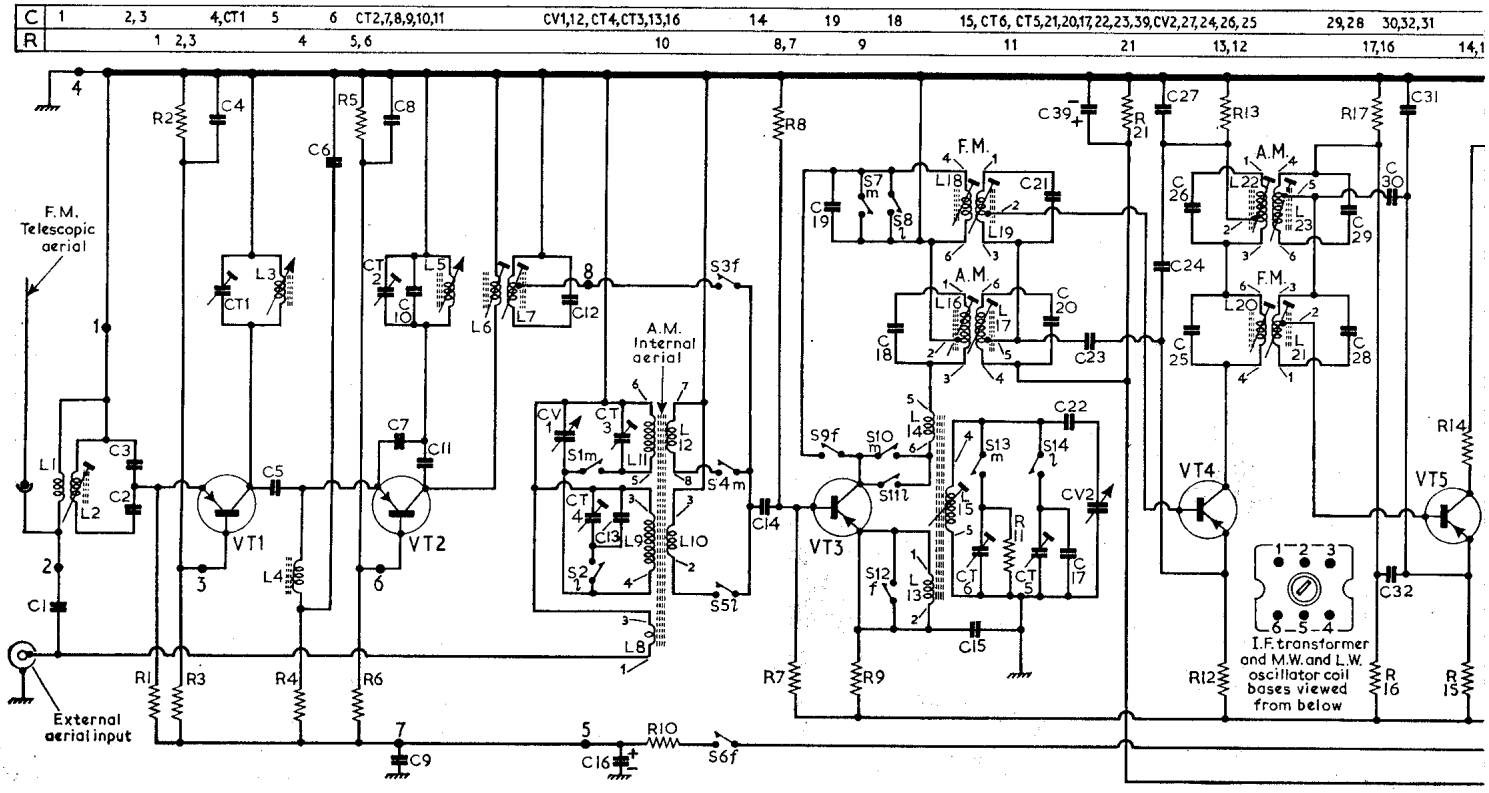
Audio output from the detector receives de-emphasis by the filter **R18, C40** and is then developed across the volume control **RV2** from the slider of which it is taken to the base of audio amplifier **VT6. VT7** is

Transistor Table

Transistor		Emitter (V)	Base (V)	Collector (V)
VT1	AF114 ..	7·3	6·9	—
VT2	AF115 ..	6·9	6·8	—
VT3	AF116 ..	5·6	5·2	—
VT4	AF116 ..	6·1	5·6	2·15
VT5	AF116 ..	5·9	5·5	0·2
VT6	OC71 ..	5·9	5·5	4·1
VT7	OC81D ..	5·95	—	0·35
VT8	OC81 ..	8·9	8·75	—
VT9	OC81 ..	8·9	8·75	—



Appearance of the Bush VTR103



Circuit diagram of Bush VTR103 also showing the transistor and I.F. transformer base connections. **VT1** *and*

a driver stage and has the phase-splitting transformer **T1** connected in its collector circuit. The bases of the push-pull output stage **VT8** and **VT9** receive equal and opposite audio voltages from the centre-tapped secondary, and the output drives the loudspeaker **L29** via the output transformer **T2**. Negative feedback covering the driver and output stages is provided by **R32** and **C53**.

Operation on A.M.

VT1 and **VT2** are switched out of circuit and **VT3** operates as a self-oscillating mixer. The short-circuit is removed from oscillator coupling coil **L13** by the opening of **S12**, and the associated A.M. I.F. transformer **L16, L17** is switched into circuit via **S10** or **S11**.

R.F. input to **VT3** is via the internal ferrite aerial and coupling coils **L11, L12** (M.W.) and **L9, L10** (L.W.) or via **L8** from the external aerial socket. **L15** is tuned at oscillator frequency in conjunction with **C22, CT6, CV2** (M.W.) and **C22, CV2, C17** and **CT5** (L.W.). The intermediate frequency selected by **L16, L17** is at 470kc/s. **VT4** and **VT5** operate as I.F. amplifiers with associated coupling transformer **L22, L23.**

A.M. detector diode **CD1** is connected in the secondary winding circuit of I.F. transformer **L27, L28** and the rectified audio output signal is developed across **RV2,** which also functions as the load resistance. A positive voltage present at the junction of **R19** and **C38** is fed back via **R20** to the base of **VT4** as A.G.C. bias. The audio stages operate as for F.M.

CIRCUIT ALIGNMENT

Equipment Required.—An A.M. signal generator with the necessary frequency coverage modulated 30 per cent at 400c/s; an output wattmeter with a range of 0-200mW to match 3 ohms impedance; a non-metallic bladed type trimming tool; an Avo meter model 8, or both a D.C. valve voltmeter and a 0-50μA meter; a matched pair of 220kΩ resistors for use in connection with the F.M. balance meter and a 10pF capacitor suitably mounted for use as an injector unit for the external aerial socket.

Alignment Notes.—For calibration purposes the receiver should be removed from the cabinet and the pointer replaced. Switch on the signal generator about 15 minutes before alignment. Disconnect the internal loudspeaker and connect the output wattmeter in its place.

Note: If at any time the output meter is connected without the speaker being disconnected, ensure that the power output from the receiver is never greater than 70mW or damage to the output transistors may result. Set the volume control to the maximum output position and the tone control to maximum treble (clockwise).

Adjust the signal generator as the circuits come into line to maintain an output of 50mW (20mW if the internal speaker is left connected).

A.M. I.F. Circuits.—Where two peaks occur, the one with the core nearer the outer of the former is correct.

1.—Switch to M.W. and set the tuning

(*Continued overleaf, col.* 1)

Resistors

R1	560Ω	K7
R2	27kΩ	K7
R3	4·7kΩ	K7
R4	560Ω	K7
R5	6·8kΩ	K7
R6	1·5kΩ	K7
R7	6·8kΩ	B2
R8	27kΩ	B2
R9	1kΩ	F5
R10	120Ω	H6
R11	120kΩ	F4
R12	680Ω	G5
R13	2·2kΩ	B2
R14	220Ω	G6
R15	1kΩ	F6
R16	3·9kΩ	G6
R17	18kΩ	C3
R18	3·8kΩ	F6
R19	330Ω	C3
R20	8·2kΩ	C3
R21	56kΩ	C3
R22	330Ω	†
R23	1·8kΩ	C1
R24	18kΩ	C3
R25	15kΩ	F5
R26	82kΩ	F5
R27	1·2kΩ	F5
R28	5·6kΩ	C3
R29	8·2kΩ	F5
R30	39kΩ	F6
R31	470Ω	C1
R32	330kΩ	F5
R33	1kΩ	F5
R34	5·6kΩ	C3
R35	5·6kΩ	D3
R36	10Ω	D3
R37	10Ω	D3
RV1	1kΩ	C3
RV2	5kΩ	C1
RV3	10kΩ	B1

Capacitors

C1	10pF	H4
C2	47pF	K7
C3	22pF	K7
C4	1,000pF	K7
C5	5·6pF	K7
C6	470pF	K7
C7	1pF	K7
C8	1,000pF	K7
C9	1,000pF	K7
C10	25pF	K7
C11	70pF	K7
C12	70pF	K7
C13	150pF	G4
C14	0·02μF	G4
C15	0·02μF	G5
C16	100μF	B3
C17	490pF	F4
C18	300pF	C2
C19	180pF	B2
C20	300pF	C2
C21	180pF	B2
C22	556pF	G5
C23	3,300pF	G5
C24	0·05μF	G5
C25	180pF	C2
C26	300pF	B2
C27	0·05μF	G5
C28	180pF	C2
C29	300pF	B2
C30	3,300pF	F5
C31	0·05μF	G5
C32	0·05μF	G6
C33	250pF	B3
C34	300pF	C3
C35	1,000pF	G6
C36	330pF	F6
C37	0·01μF	G6
C38	0·01μF	B3
C39	8μF	G5
C40	0·01μF	F6
C41	50pF	C3
C42	0·25μF	F5
C43	0·04μF	C1
C44	350μF	D2
C45	1,000pF	F6
C46	8μF	C3
C47	8μF	C2
C48	100μF	F5
C49	8μF	C2
C50	0·01μF	C3
C51	100μF	F6
C52	0·25μF	B1
C53	0·02μF	D2
C54	0·02μF	C3
C55	0·02μF	C3
C56	0·1μF	D3
C57	350μF	E5
CV1	523pF	B2
CV2	523pF	B2
CT1	25pF	A3
CT2	10pF	A2
CT3	40pF	B1
CT4	40pF	B1

*Coils**

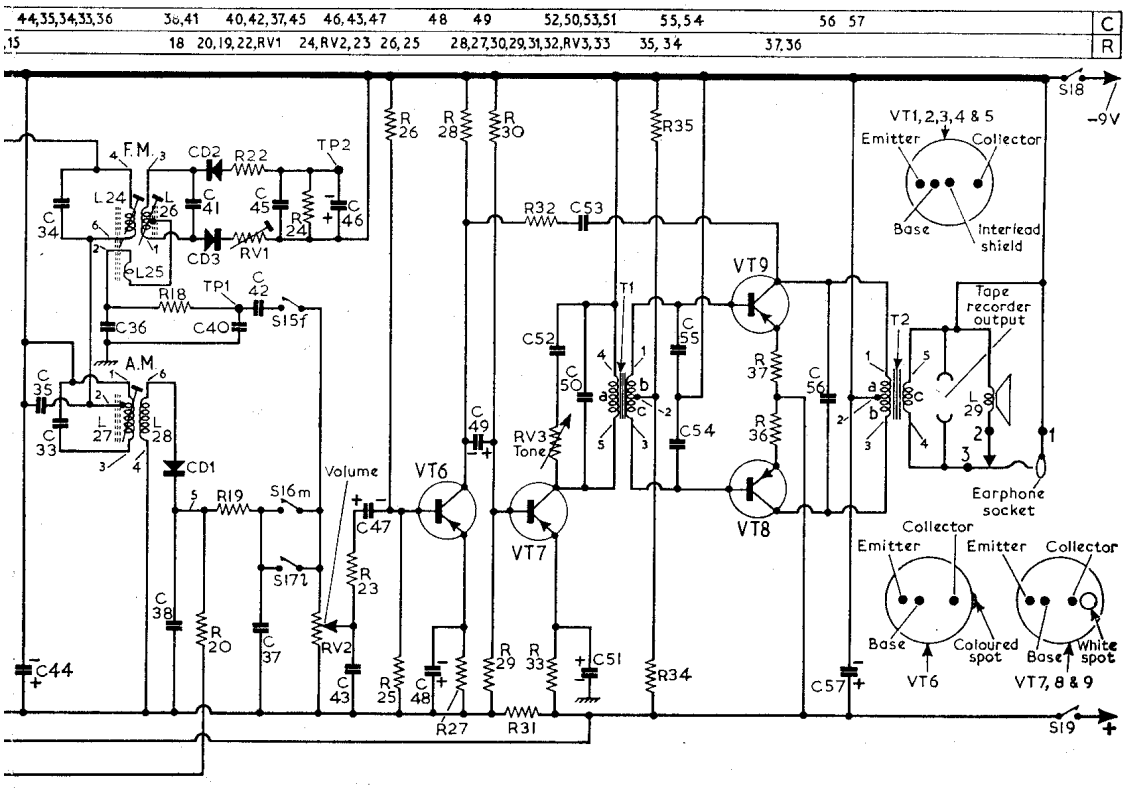
L1	—	A3
L2	—	A3
L3	—	J7
L4	—	K7
L5	—	J7
L6	—	J7
L7	—	K7
L8	1·0	B2
L9	12·5	B2
L10	1·25	B2
L11	0·5	D2
L12	0·5	D2
L13	—	C2
L14	—	C2
L15	2·5	C2
L16	4·0	C2
L17	4·0	C2
L18	—	B2
L19	—	B2
L20	—	C2
L21	—	C2
L22	4·0	B2
L23	4·0	B2
L24	—	C3
L25	—	C3
L26	—	C3
L27	3·5	B3
L28	0·5	B3
L29	2·5	C2

*Transformers**

T1	a	138·0	C3
	b	57·0	
	c	63·0	
T2	a	3·2	D3
	b	3·6	
	c	0.3	

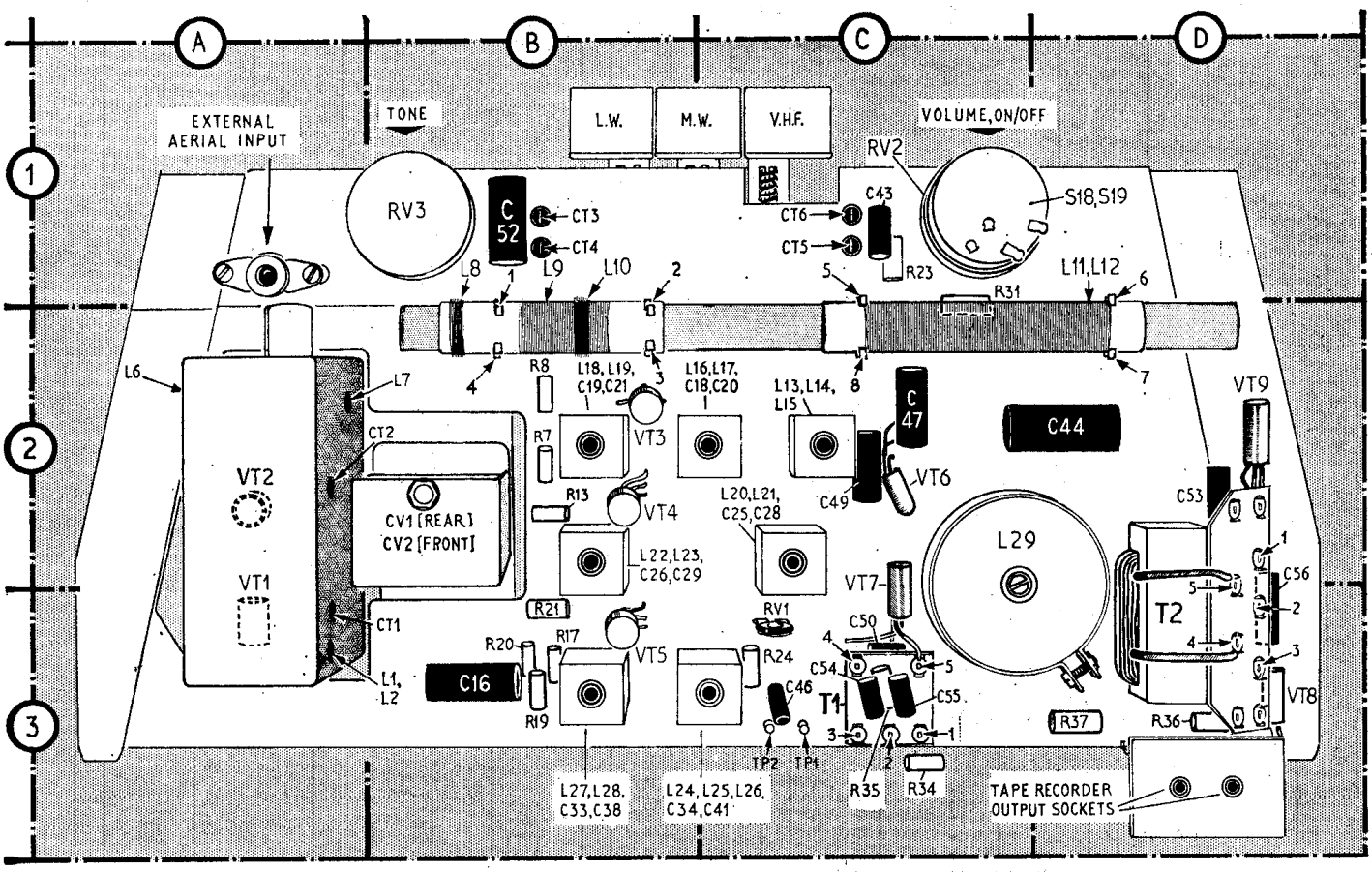
Miscellaneous

CD1	OA90	§
CD2	OA79	F6
CD3	OA79	F6
S1-S17	—	G4
S18, S19	—	H4



VT2 *form an F.M. tuner unit which is switched out of circuit on A.M.*

§*Inside* **L27/L28** *assembly.*
**Approximate D.C. resistance in ohms.*
†*Omitted in our chassis.*



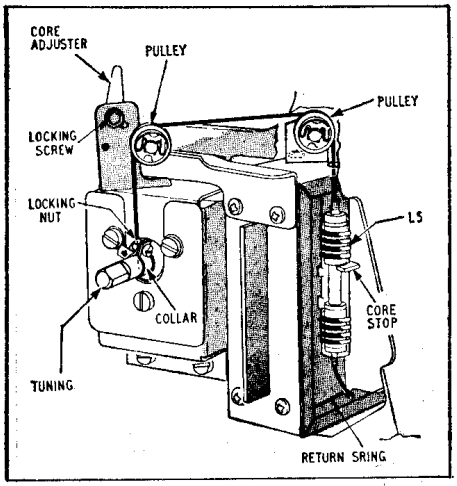
View of the chassis from the rear which illustrates in particular the circuit alignment adjustments

Circuit Alignment—*continued*

pointer to 1,000 kc/s calibration dot.

2.—Feed in a 470kc/s modulated signal via a 0.1μF capacitor to the base of **VT3** and adjust the cores of **L27/L28** (location reference B3), **L22/L23** (B2) and **L16/L17** (C2) in that order for maximum output. Adjust each transformer once only. **L17** and **L23** are "top" adjustments and **L16** and **L22** "bottom" adjustments.

A.M. R.F. Circuits.—Ensure that the tuning pointer is in line with the horizontal datum line on the auxiliary calibration scale when the tuning gang is at maximum capacitance. Connect the signal generator via the series 10pF capacitor to the external aerial socket. Turn the volume control to maximum output.



Three-quarter front view of the F.M. unit tuning drive. The core stop in L3/L5 limits the travel of the core plunger *(see "General Notes")*

1.—Switch to M.W. and set the tuning pointer to the 600kc/s calibration mark. Feed in a 600kc/s signal and adjust **L15** (C2) for maximum output.

2.—Set the tuning pointer to 1,500kc/s, feed in a 1,500kc/s signal and adjust **CT6** (C1) for maximum output.

3.—Repeat operations 1 and 2 for correct calibration.

4.—Switch to L.W. and set the tuning pointer to 214kc/s. Feed in a 214kc/s signal and adjust **CT5** (C1) for maximum output.

5.—Switch to M.W. and set the tuning pointer 1,500kc/s. Feed in a 1,500kc/s signal and adjust **CT3** (B1) for maximum output.

6.—Set the tuning pointer to 600kc/s, feed in a 600kc/s signal and adjust **L11** (D1) for maximum output.

7.—Repeat operations 5 and 6 for optimum gain at both points.

8.—Switch to L.W. and set the tuning pointer to 214kc/s. Feed in a 214kc/s signal and adjust **CT4** (B1) for maximum output.

Note: Although the M.W. aerial coil **L11** may be adjusted where necessary, the L.W. aerial coil **L9** should not be moved.

F.M. I.F. Circuits.—**L6** and **L7** are located inside the F.M. tuner unit. **L19, L21** and **L26** are "top" adjustments; **L18, L20** and **L24** are "bottom" adjustments.

Wire the two 220kΩ resistors in series and connect the outer ends between **TP2** and chassis. Connect the D.C. voltmeter between **TP2** and chassis i.e. in parallel with the resistors, positive terminal to chassis. Connect the 0-50μA meter between the junction of the 220kΩ resistors and **TP1**. Set **RV1** to its approximate mid-position. Adjust the signal generator during alignment to maintain an output of 0.5-1V on the D.C. meter.

1.—Switch the receiver to F.M. and set the tuning pointer to the 94Mc/s calibration mark. Connect the signal generator via a 0.1μF capacitor to the base of **VT3.**

2.—Feed in a 10.7Mc/s modulated signal and adjust **L24** (C3) for maximum deflection on the D.C. output meter. Adjust **L26** (C3) for zero output on the μA balance meter.

3.—Adjust **L20** (C2), **L21** (C2), **L18** (B2) and **L19** (B2) for maximum deflection on the D.C. output meter.

4.—Adjust **RV1** (C3) for minimum audio output with the volume control set to the maximum output position.

5.—Re-adjust **L24** for maximum deflection on the D.C. output meter.

6.—Transfer the signal generator to the external aerial socket. Feed in a 10.7Mc/s C.W. signal and adjust **L6** (A2) and **L7** (A2) for maximum deflection on the D.C. output meter.

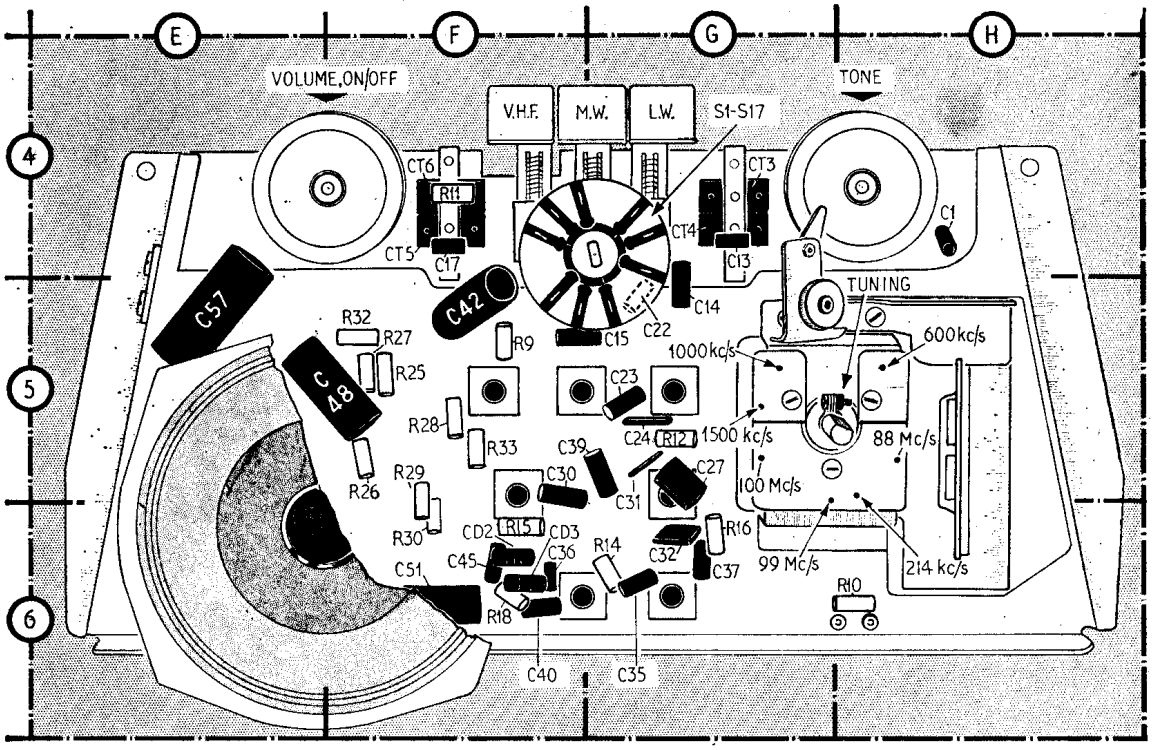
F.M. R.F. Circuits.—Before calibrating the F.M. waveband ensure the tuner unit screening cover is securely in position. Remove the 220kΩ resistors and the 0.50μA balance meter but leave the D.C. output meter connected as for "F.M. I.F. Circuits." Connect the signal generator to the external aerial socket. Calibration is carried out by means of the pivoted lever core adjuster (see illustration of the F.M. tuning drive assembly in col. 1).

1.—Set the tuning pointer to 94Mc/s on the calibration scale and feed in a 94Mc/s C.W. signal. Slacken the hexagon headed locking screw and set the core adjuster for maximum deflection in the D.C. output meter, then re-tighten the locking screw.

2.—With the receiver and signal generator settings left as in operation 1, adjust the core of **L2** (A3) for maximum deflection on the D.C. output meter.

3.—Check the calibration at 87.5 and 100Mc/s.

Note: **CT1** and **CT2** are set at 94Mc/s during



Front view of the complete chassis with the speaker partly cut away to reveal components behind. The switch unit **S1-S17** *comprises two wafers on a single spindle. These are shown in detail in col. 6 where the upper drawing represents the outer wafer and the lower drawing the inner, as observed from the same angle as the unit indicated here*

production and are not likely to require subsequent adjustment during alignment.

DISMANTLING

Removal of Chassis.—Rotate the tuning knob for maximum capacitance. Remove the tuning knob and pointer from the front of the cabinet. The tuning knob is difficult to grip with the hand and a useful tool for this purpose is a rubber suction-pad of the type used domestically for clearing sink drainpipes. The pad is pressed on the knob which may then be removed without straining.

Loosen the large screw in the centre of the cabinet back and remove the back, then disconnect and remove battery.

Extend the telescopic aerial sufficiently to facilitate removal of chassis and disconnect aerial clip.

Loosen and remove the four chassis-retaining screws. Lift the chassis out of the cabinet from the bottom, allowing the control knobs and tuning spindle to clear their respective holes.

GENERAL NOTES

Tape Recorder.—Sockets are provided at the back of the receiver affording a low-impedance signal for feeding a tape recorder. This signal is derived from the output transformer secondary and is suitable for a tape recorder input impedance of not less than 10 ohms.

F.M. Tuning Drive Replacement.—If a breakage occurs in either the cord or the cores, the complete assembly should be replaced. The drive cord may be replaced as illustrated in col. 1 using the procedure outlined below.

Remove the chassis from the cabinet. Loosen and remove the two 6 BA bolts securing the pillars of the external aerial socket to the chassis and lift assembly clear. Loosen and remove the two 6 BA nuts securing the F.M. tuner unit cover and remove the cover.

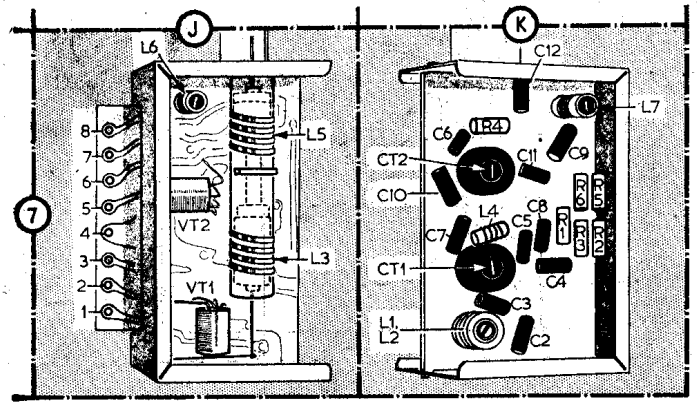
Pull out the core stop from the tuning inductance former. Slacken the P.K. screw securing the tuner unit pulley bracket and move the bracket away from the core aperture. Unhook the drive cord from the return spring and withdraw drive cord cores. The new drive cord should be replaced as shown in col. 1.

When refitting the cord drive, ensure that the core stop is correctly located between the faces of the core plunger.

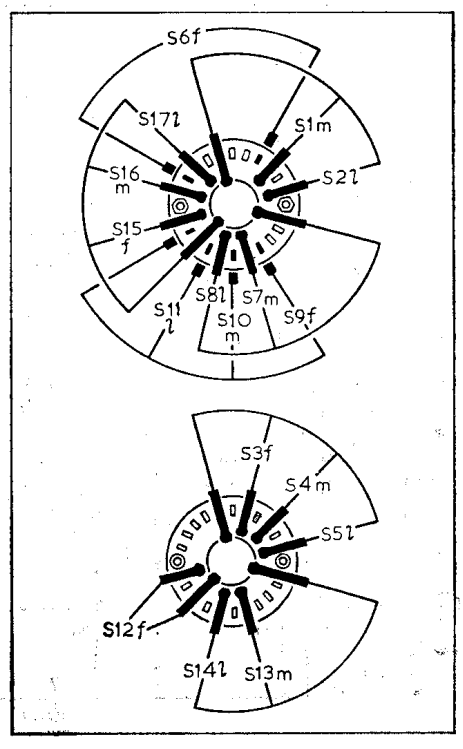
After reassembly set the tuning capacitor for maximum. Ensure that the tuning spindle collar is reset so that the core of **L5** just touches the core stop with no slack in the cord drive and with the pivoted core adjuster set to approximately the midway position. The pivoted lever core adjuster should be finally reset as described in the alignment procedure.

Earphone Socket.—An earphone socket is provided into which an earpiece with an impedance of not greater than 300 ohms may be plugged. Insertion of the plug automatically mutes the internal loudspeaker. Some early production models are not fitted with this facility.

Battery.—9V Ever-Ready PP9 or equivalent.



Left: F.M. tuner unit chassis, side elevation with the screening cover removed



Right: Outer (upper) and inner (lower) waveband switch wafers as they appear when looking from the front of the chassis

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