"TRADER" SERVICE SHEET

1238

FERC

4-b

THE Ferguson 329A is a 5-valve (plus rectifier and tuning indicator) 4-band A.M./F.M. table receiver designed to operate from A.C. mains of 200-250 V, 40-60 c/s.

Model 401RG is a 3-speed auto-radiogram version of the 329A and employs a push-pull output stage with twin speakers. Details of this model are given under "General Notes."

Release date, both models, January 1955. *Original prices: 329A, £27 0s 7d; 401RG, £75 10s 5d. Purchase tax extra.*

CIRCUIT DESCRIPTION

A.M. aerial input via coupling coils **L9** (S.W.) and **L10** (M.W. and L.W.) to single-tuned circuits **L11, C22** (S.W.), **L12, C22** (M.W.) and **L13, C22** (L.W.).

Section **b** of **V2 (Mullard ECH81)** operates as A.M. mixer, and section **a** as oscillator. Oscillator grid coils **L14** (S.W.), **L15** (M.W.) and **L16** (L.W.) are tuned by **C26.** Parallel trimming by **C27** (S.W.), **C28** (M.W.) and **C29** (L.W.); series tracking by **C30** (S.W.), **C31** (M.W.) and **C32, C33, C34** (L.W.). Reaction coupling from oscillator anode by **L17** (S.W.) and via the common impedance of tracker **C31** (M.W.) and **C32** (L.W.). Addition reaction coupling on S.W. across tracker **C30.**

V3 (Mullard EF85) is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned transformer couplings **L18, L19, C38** and **L22, L23, C46.**

A.M. intermediate frequency 470 kc/s.

Diode section **c** of **V4 (Mullard EABC80)** operates as A.M. signal detector. The A.F. signal in its rectified output is developed across **R22** and passed via I.F. filter **C55, R31, C56** and volume control **R34** to triode section **d** of **V4** which operates as A.F. amplifier.

D.C. potential developed across **R22** is fed back as bias to **V2b** and **V3** giving automatic gain control on the A.M. bands. This A.G.C. bias is also fed via **R27** to tuning indicator **T.I. (Mullard EM34).**

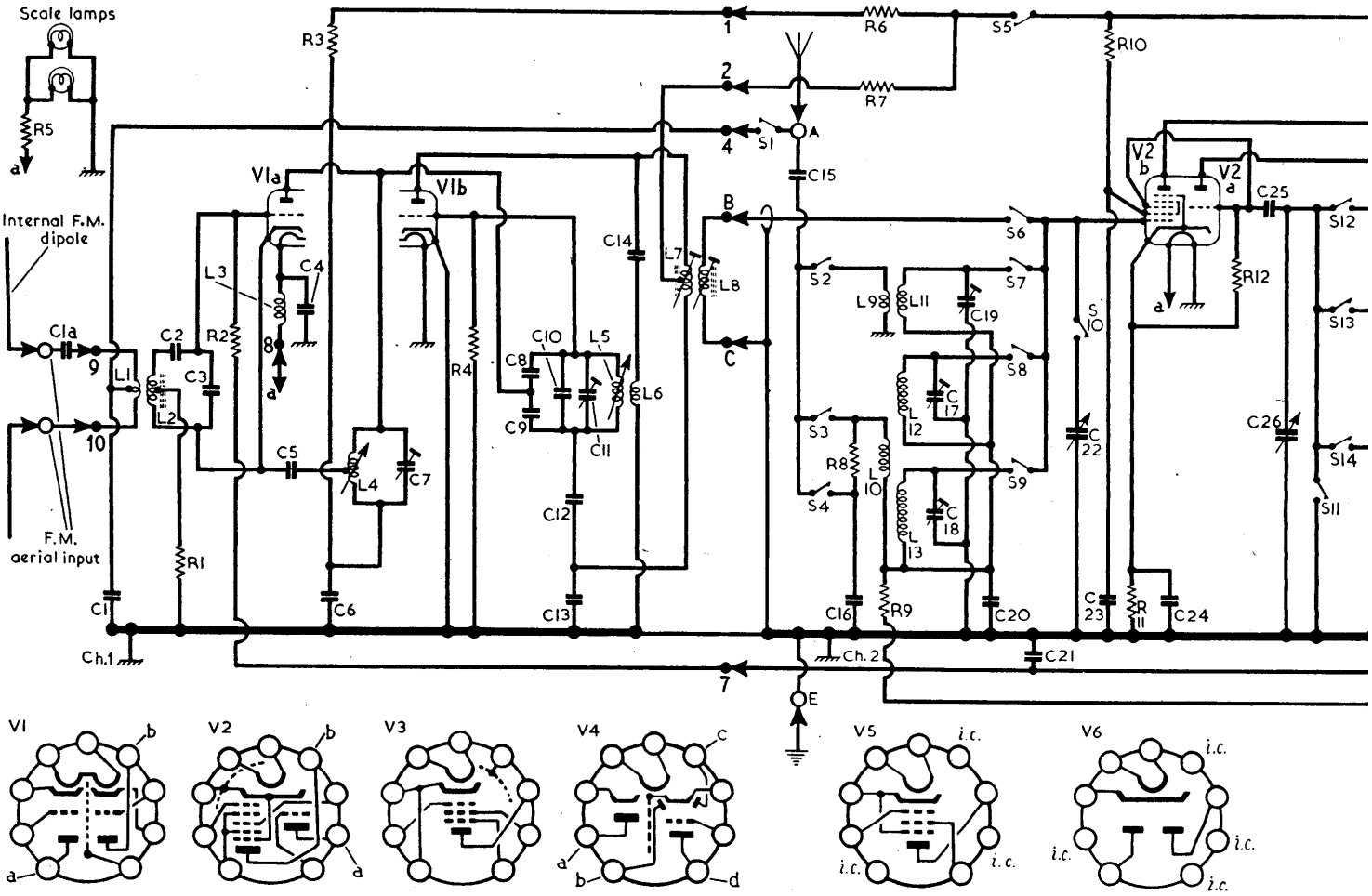
Provision is made for the connection of a pick-up across the volume control circuit via **S28,** which closes in the gram position of the band control. **S11, S21** close and **S24, S26, S27** open in this position to mute the radio section.

Resistance-capacitance coupling by **R38, C61** and **R39** between **V4d** and pentode output valve **V5 (Mullard EL84).** Tone correction in **V5** anode circuit by **R38, C61,** and by negative feed-back via **R44, R45** between winding **b** of the output transformer **T1** and **V4d** grid circuit. Variable-tone control by **R39** which forms part of a negative feed-back circuit with **C65, R43** and **C63** between the anode and control grid circuits of **V5.**

Operation on F.M.

Balanced 75Ω F.M. aerial input via coupling coil **L1** to fixed-tuned aerial circuit **L2, C2, C3.** Section **a** of **V1 (Mullard ECC85)** operates as an earthed-cathode R.F. amplifier. **V1a** anode/grid capacitance is neutralized by **C5.** The amplified output from **V1a** is coupled via single-tuned circuit **L4, C7** to **V1b,** which operates as an oscillator/mixer valve with tuned oscillator grid circuit **L5, C8, C9, C10, C11.** F.M. tuning is by means of the variable cores of **L4, L5** which are ganged to the common A.M./F.M. tuning control.

Oscillator radiation is kept to a minimum by means of **C8, C9, C12, C13** which form



GUSON 329A & 401RG

and Table and Auto-radiogram A.M./F.M. Receivers for A.C. Mains Operation

part of a balanced bridge circuit to prevent oscillator voltages from passing back into the R.F. amplifier.

V2b and **V3** form the two-valve F.M. intermediate frequency amplifier, which is coupled by tuned transformers **L7, L8; C40, L20, L21, C41;** and discriminator transformer **C48, L24, L25, L26, C49** to diode sections **a** and **b** of **V4,** which are connected in a ratio detector circuit.

F.M. intermediate frequency 10.7 Mc/s.

Inter-electrode capacitances of **V3** are neutralized by **C43, C44.** The A.F. output of the ratio detector is developed across **C51,** and is passed via de-emphasis circuit **R25, C52, R26** and **C53** to the volume control circuit. Limiting is performed in **V3** control grid circuit by **R17** and **R18,** and in the ratio detector circuit by the fly-wheel effect of D.C. reservoir **C54.**

A proportion of the limiting voltage in **V3** control grid circuit, that developed across **R18,** is fed back as an F.M. A.G.C. bias to **V1a.** The D.C. potential developed across **C54** is fed to the tuning indicator via **R29, R23** and **R27.**

VALVE ANALYSIS

Valve voltages and currents given in the tables below are those derived from the manufacturers' information. Voltages were measured on the 10 V and 400 V ranges of a Model 7 Avometer, chassis being the negative connection in every case. The receivers were switched to M.W. and the gangs turned to minimum capacitance. There was no signal input, and the receivers were operated from 230 V mains. The voltage measured across **R35** was 2.2 V, positive to chassis.

Table Model

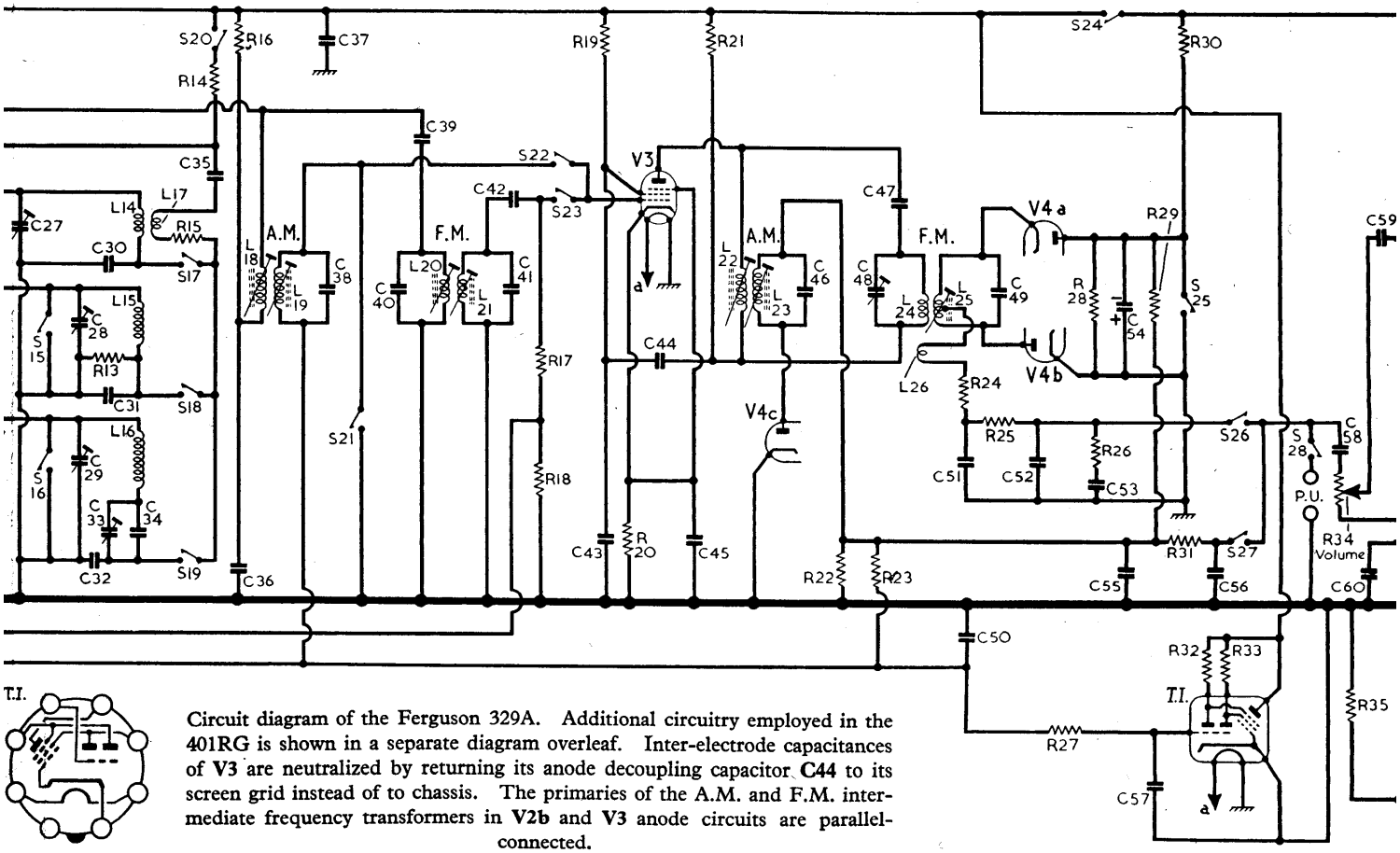
Valve	Anode		Screen		Cath.
	V	mA	V	mA	V
V1 ECC85					
a	—	—	—	—	—
b	—	—	—	—	—
V2 ECH81					
a	110	5·4	—	—	3·0
b	267	3·4	130	6·3	3·0
V3 EF85	259	10·0	129	1·9	2·8
V4 EABC80					
a-c	—	—	—	—	—
d	120	0·4	—	—	—
V5 EL84	305	29·0	270	3·0	10·0
V6 EZ80	263*	—	—	—	318·0†
T.I. EM34	270	—	—	—	—

* A.C. reading, each anode. † Cathode current 62 mA.

Gram Model

Valve	Anode		Screen		Cath.
	V	mA	V	mA	V
V1 ECC85					
a	—	—	—	—	—
b	—	—	—	—	—
V2 ECH81					
a	91	6.3	—	—	1.5
b	244	4·4	112	6·8	1·5
V3 EF85	258	8·1	101	2·3	2·1
V4 EABC80	—	—	—	—	—
V7 EF80	*	*	*	*	*
V8, V9 EL84	359	68·9†	321	7·3†	78·0
V10 GZ30	300‡	—	—	—	362·0§
T.I. EM34	268	—	—	—	—

* No reading taken owing to high circuit resistances. † Total reading, both valves. ‡ A.C. reading, each anode. § Cathode current 105 mA.



T.I.

Circuit diagram of the Ferguson 329A. Additional circuitry employed in the 401RG is shown in a separate diagram overleaf. Inter-electrode capacitances of **V3** are neutralized by returning its anode decoupling capacitor **C44** to its screen grid instead of to chassis. The primaries of the A.M. and F.M. intermediate frequency transformers in **V2b** and **V3** anode circuits are parallel-connected.

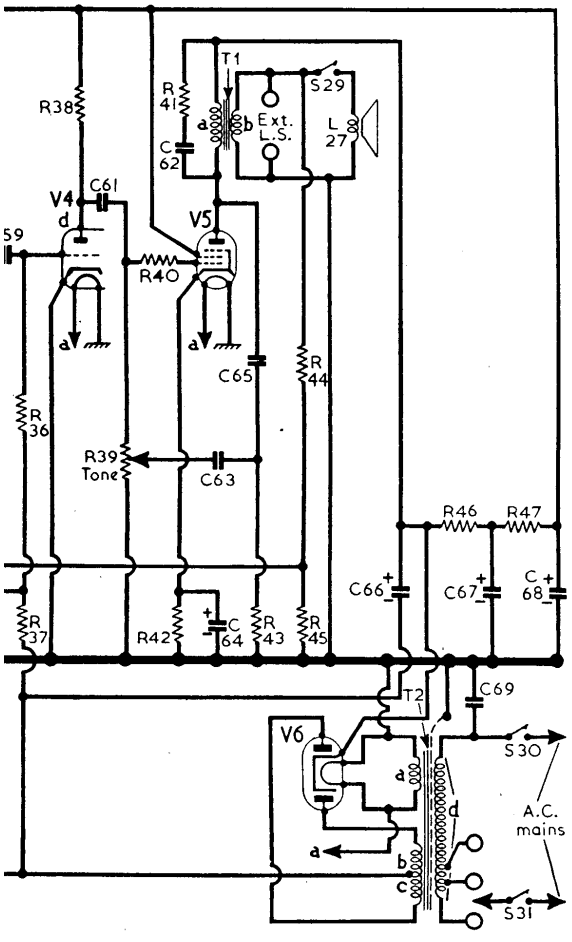
GENERAL NOTES

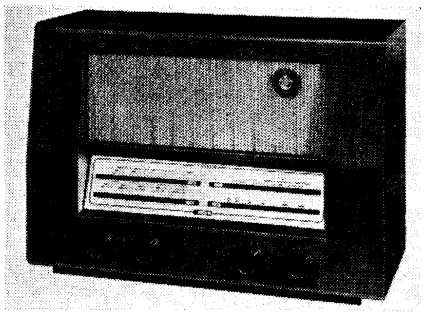
Switches.—S1 is the aerial selector switch and is operated by rotation of the A.M. **A** and **E** plug. When using separate A.M. and F.M. aerials the switch is opened, and when using the F.M. aerial for both A.M. and F.M. reception, the switch is closed.

S2-S28 are the band switches ganged in three rotary units beneath the chassis. These units are indicated in the under-chassis illustration, where the numbered arrows indicate the direction in which the units are viewed in the diagrams in col. 9 overleaf. The switch table (col. 6) indicates the switch operations in the five control settings, starting with the band switch in its fully anti-clockwise position. A dash indicates open, and **C,** closed.

Tuning Drive Cord Replacement.—About 6ft of nylon-braided glass yarn is required for a new drive cord. Turn gang to maximum capacitance and tie one end of the cord to the gang drum boss. Feed the cord out through the gap in the drum rim at 10 o'clock and take it clockwise round the drum for a three-quarters turn. Run the cord on as indicated in the sketch of the tuning drive cord system at the foot of columns 8 and 9 overleaf.

Band Indicator Drive Cord Replacement.—About 21 inches of nylon-braided glass yarn is required for a new drive cord. It should be run as indicated in the sketch of the indicator drive in col. 7 overleaf.





Appearance of the Ferguson 329A.

Scale Lamps.—These are 6.5 V, 0.3A lamps with small bulbs and M.E.S. bases.

Model 401RG.—This is a 3-speed auto-radiogram version of the 329A. It

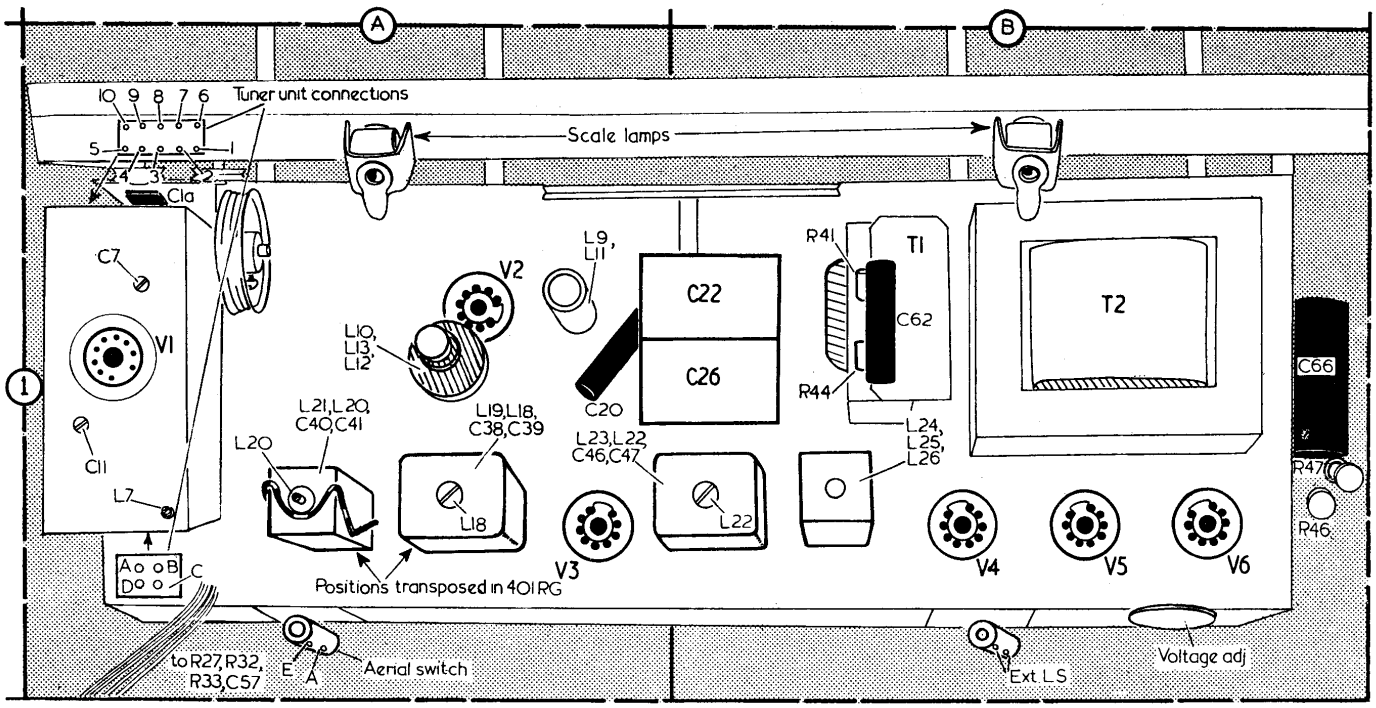
(*Continued col. 1 overleaf*)

CAPACITORS		Values	Locations
C1	Aerial shunt ...	10pF	F4
C1a	Aerial series ...	6pF	A1
C2	V1a C.G.	250pF	F4
C3	F.M. aerial tuning	10pF	F4
C4	Heater by-pass ...	2,500pF	F4
C5	Neut. coupling ...	3.8pF	F4
C6	H.T. decoupling ...	2,500pF	F4
C7	F.M. R.F. trim. ...	10pF	F4
C8		7·5pF	F4
C9	F.M. tuning ...	7·5pF	F4
C10		3·8pF	F4
C11		8pF	F4
C12		8pF	F4
C13		100pF	F4
C14	F.M. osc. reaction	30pF	F4
C15	A.M. aerial coup. ...	0·001μF	D2
C16	L.W. aerial shunt...	500pF	D2
C17	M.W. aerial trim....	40pF	D2
C18	L.W. aerial trim. ...	65pF	D3
C19	S.W. aerial trim. ...	15pF	D2
C20	A.M. A.G.C. decoup.	0·05μF	A1
C21	F.M. A.G.C. decoup.	0·01μF	E3
C22	A.M. aerial tuning	528pF	B1
C23	V2b S.G. decoup.	0·01μF	D2
C24	V2 cath. by-pass ...	0·01μF	D2
C25	V2a C.G.	50pF	D2
C26	A.M. osc. tuning ...	528pF	B1
C27	S.W. osc. trim. ...	15pF	D3
C28	M.W. osc. trim. ...	40pF	D3
C29	L.W. osc. trim. ...	65pF	D3
C30		3,550pF	D2
C31		560pF	E2
C32	A.M. osc. trackers	500pF	D3
C33		80pF	E3
C34		200pF	E3
C35	A.M. osc. coupling	200pF	E2
C36	H.T. by-passes ...	0·01μF	E3
C37		0·01μF	D3
C38	1st A.M. I.F.T. tun.	100pF	A1
C39	F.M. I.F.T. coup....	100pF	A1
C40	2nd F.M. I.F.T.	15pF	A1
C41	tuning	15pF	A1
C42	V3 C.G.	20pF	D3
C43	V3 S.G. decoupling	0·001μF	D3
C44	H.T. by-pass ...	0·001μF	D3
C45	V3 G.B. by-pass ...	0·1μF	D3
C46	2nd A.M. I.F.T. tun.	180pF	B1
C47	F.M. I.F.T. coup....	100pF	B1
C48	3rd F.M. I.F.T.	30pF	D3
C49	tuning	27pF	D3
C50	A.G.C. decoupling	0·1μF	E3
C51	A.F. load ...	300pF	D3
C52	Part F.M. de-em-	500pF	D3
C53	phasis	0·005μF	D3
C54	F.M. D.C. reservoir	4μF	D3
C55	A.M. I.F. by-passes	100pF	D3
C56		100pF	D3
C57	T.I. decoupling ...	0·01μF	A1
C58	A.F. couplings ...	0·005μF	D3
C59		0·1μF	C3
C60	V4d C.G. by-pass...	0·5μF	D3
C61	A.F. coupling ...	0·05μF	C3
C62	Tone corrector ...	0·005μF	B1
C63	Neg. feed-back ...	330pF	C3
C64	V5 cath. by-pass ...	100μF	C2
C65	Neg. feed-back ...	330pF	C3
C66	H.T. smoothing	32μF	B1
C67		24μF	C2
C68		24μF	C2
C69	Mains R.F. by-pass	0·01μF	C2

RESISTORS		Values	Locations
R1	V1a G.B.	20Ω	F4
R2	V1a C.G.	200kΩ	F4
R3	H.T. feed	1kΩ	F4
R4	V1b C.G.	300kΩ	F4
R5	Scale lamp ballast	1·5Ω	C3
R6	H.T. feeds ...	15kΩ	E3
R7		22kΩ	E3
R8	M.W. aerial shunt	3·3kΩ	D2
R9	A.G.C. decoupling	1MΩ	D2
R10	V2b S.G. feed ...	22kΩ	D2
R11	V2b G.B. ...	120Ω	E2
R12	V2a C.G.	47kΩ	E2
R13	M.W. osc. shunt	3·3kΩ	E2
R14	H.T. feed	27kΩ	D2
R15	A.M. osc. stabilizer	330Ω	D3
R16	H.T. feed	4·7kΩ	E3
R17	F.M. A.G.C.	470kΩ	D3
R18	potential divider	470kΩ	D3
R19	V3 S.G. feed ...	68kΩ	D3
R20	V3 G.B.	220Ω	D3
R21	H.T. feed	1kΩ	D3
R22	A.M. diode load ..	1MΩ	D3
R23	A.G.C. decoupling	470kΩ	D3
R24	F.M. balancing ...	150Ω	D3
R25	Parts de-emphasis	100kΩ	D3
R26		100kΩ	D3
R27	T.I. A.G.C. feed ...	2·2MΩ	A1
R28	F.M D.C. load ...	47kΩ	D3
R29	F.M. A.G.C. feed	1MΩ	D3
R30*	F.M. bias ...	3·3MΩ	C3
R31	A..M I.F. stopper	100kΩ	D3
R32	T.I. anode loads	1MΩ	A1
R33		1MΩ	A1
R34	Volume control ...	500kΩ	D2
R35	V4d G.B. ...	33Ω	C2
R36	V4d C.G.	1MΩ	C3
R37		1MΩ	C3
R38	V4d anode load ...	220kΩ	C3
R39	Tone control ...	500kΩ	C2
R40	V5 C.G. stopper ...	47kΩ	C3
R41	Tone correction ...	3kΩ	B1
R42	V5 G.B.	330Ω	D3
R43	Neg. feed-back ...	250kΩ	C3
R44		820Ω	B1
R45		100Ω	D2
R46	H.T. smoothing ...	680Ω	B1
R47		820Ω	B1

* Omitted in later models.

OTHER COMPONENTS		Approx. Values (ohms)	Locations
L1	F.M. aerial ...	—	F4
L2	coup. coils ...	—	F4
L3	Heater choke ...	—	F4
L4	F.M. R.F. coil ...	—	F4
L5	F.M. oscillator	—	F4
L6	coils	—	F4
L7	1st F.M. Pri. ...	—	F4
L8	I.F.T. Sec. ...	—	F4
L9	A.M. aerial coup-	2·3	A1
L10	ling coils	28·0	A1
L11	A.M. aerial tuning	—	A1
L12	coils	2·6	A1
L13		30·0	A1
L14	A.M. oscillator tun-	—	D3
L15	coils	2·5	D3
L16		15·0	D3
L17	S.W. osc. reaction	1·0	D3
L18	1st A.M. I.F.T.		
L19	Pri.	8·0	A1
	Sec.	8·0	A1
L20	2nd F.M. I.F.T.		
L21	Pri.	—	A1
	Sec.	—	A1
L22	2nd A.M. I.F.T.		
L23	Pri.	8·0	B1
	Sec.	6·0	B1
L24	3rd F.M. I.F.T.		
L25	Pri.	—	B1
L26	Sec.	—	B1
	Tert. ...	—	B1
L27	Speech coil ...	2·5	—
T1	O.P. trans. a	440·0	B1
	b	—	
T2	Mains trans. a	—	
	b	155·0	B1
	c	155·0	
	d, total	27·0	
S1	Aerial switch ...	—	E3
S2-S28	Band switches ...	—	D2
S29	Int. L.S. switch ...	—	C3
S30, S31	Mains sw., g'd R39	—	C2



Plan illustration of the chassis showing the F.M. tuner unit and its connections in location reference A1.

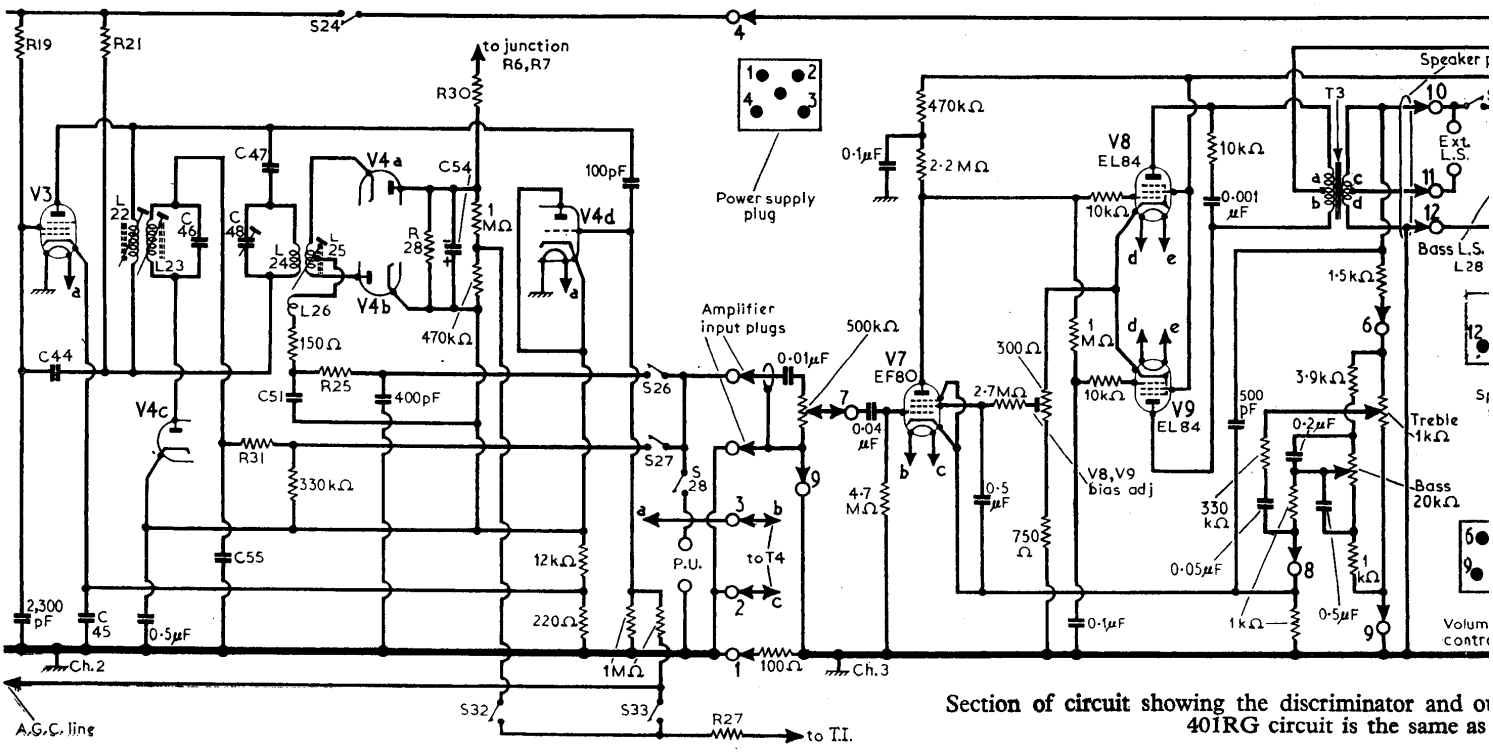
General Notes—*continued*

employs a basic 329A chassis in conjunction with a separate output and power supply chassis employing a push-pull output stage. A separate section of circuit showing this additional unit together with several changes in the detector circuits, appears at the foot of this page.

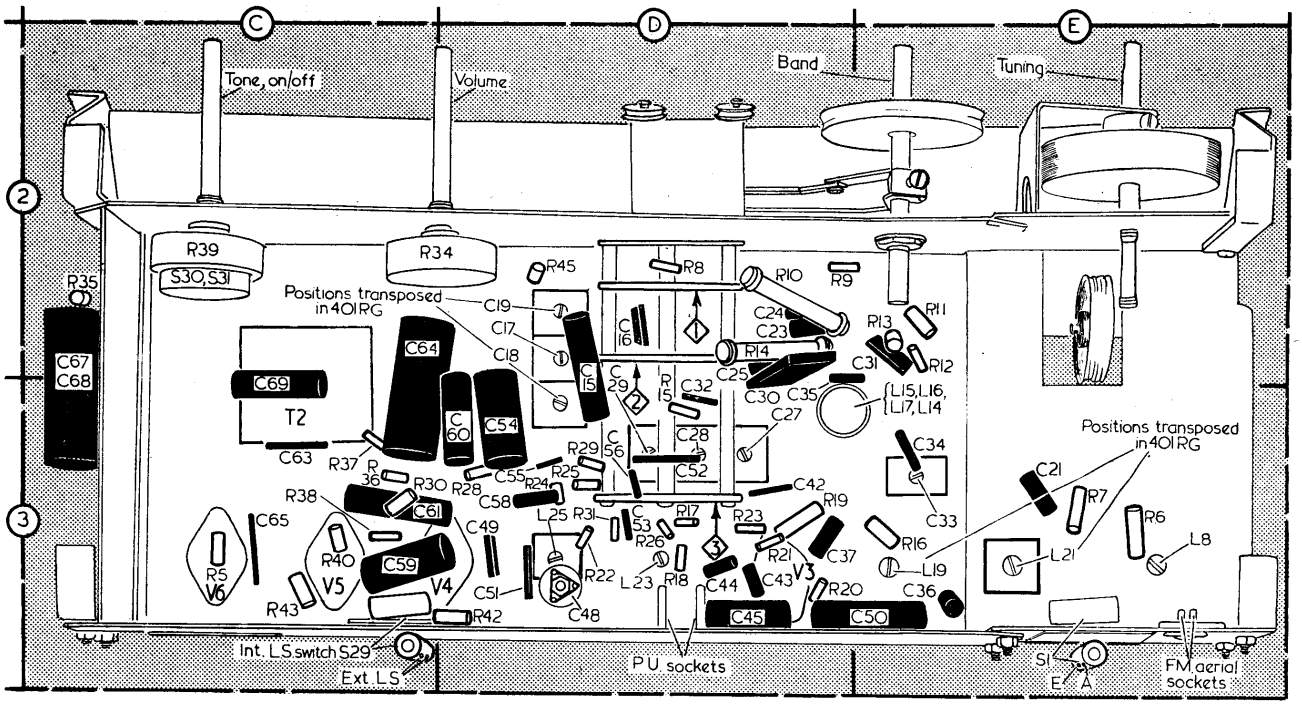
The bias adjustment in the cathode circuit of **V8, V9** is adjusted as follows. Switch receiver to M.W. and disconnect A.M. aerial. Connect milliammeter in series with the 750Ω cathode resistor (on top of power chassis). A link is provided for this purpose on the associated tag strip. Adjust the bias potentiometer for a meter reading of 76 mA. It is important to note that neither of the output valves should be withdrawn while the receiver is operating.

In later versions of the 401RG the 500pF capacitor coupling **V7** cathode to **T3** secondary becomes 30pF, and is connected between **V7** cathode and **V8** anode. This is to prevent local station breakthrough which was caused by signals picked up on the leads to the external speaker sockets and injected into **V7** cathode circuit by the 500pF capacitor. **R30** was omitted in these later models.

The record changer employed in the 401RG is a Garrard RC80M. A 12-inch speaker is used for middle and low-note reproduction, and a 6½-inch unit for high-note reproduction.



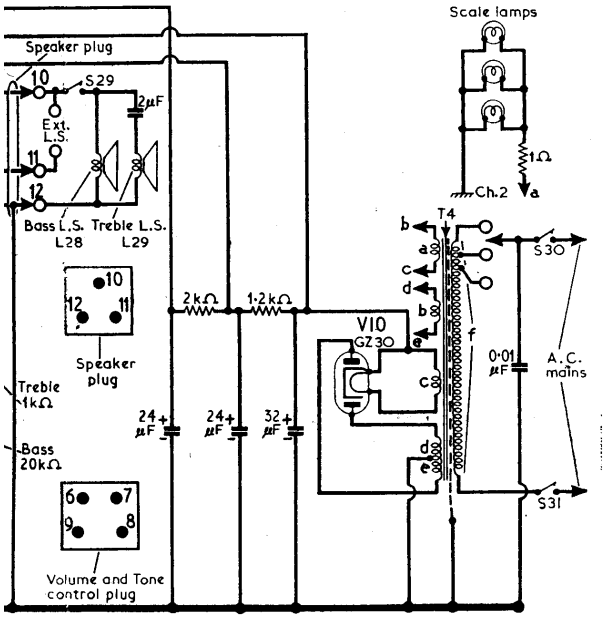
Section of circuit showing the discriminator and o
401RG circuit is the same as



Underside illustration of chassis. In model 401RG, the position of core adjustments **L19** and **L21** in E3 are transposed.

CIRCUIT ALIGNMENT

Equipment Required.—An A.M. signal generator covering the A.M. frequency range of 160 kc/s-17 Mc/s and the F.M. tuning frequency of 94 Mc/s; an F.M. signal generator covering the intermediate frequency of 10.7 Mc/s and the tuning frequency of 94 Mc/s, and capable of being deviated by at least ±75 kc/s (if an F.M. signal generator is not available, an A.M. generator covering the required frequencies, together with a 0-20 V, 20,000 ohms-per-volt output meter, can be employed as indicated under "F.M. Alignment with A.M. Generator"); a 100 pF capacitor; an output meter for F.M. alignment.



or and output stages of the 401RG. The remainder of the same as in the 329A circuit overleaf.

A.M. I.F. Stages

1.—Switch receiver to M.W. and turn gang to maximum capacitance. Connect output of A.M. signal generator between chassis and the live side of **C22** (location reference B1).

2.—Feed in a modulated 470 kc/s signal and adjust the cores of **L23** (D3), **L22** (B1), **L19** (E3) and **L18** (A1) for maximum output.

A.M. R.F. and Oscillator Stages

3.—Check that with gang at maximum, the cursors coincide with the high wavelength ends of tuning scales. The F.M. tuner drive drum should now be anti-clockwise. Transfer A.M. signal generator leads to **A** and **E** sockets. Switch receiver to L.W. and tune to 857m. Feed in a 350 kc/s signal and adjust **C29** (D3) and **C18** (D3) for maximum output. Marks on the tuning scales indicate the positions of all alignment points.

4.—Tune receiver to 1,875m, feed in a 160 kc/s signal and adjust **C33** (E3) for maximum output. Repeat this adjustment and operation 3 until no further improvement results.

5.—Switch receiver to M.W. and tune to 200m. Feed in a 1,500 kc/s signal and adjust **C28** (D3) and **C17** (D2) for maximum output.

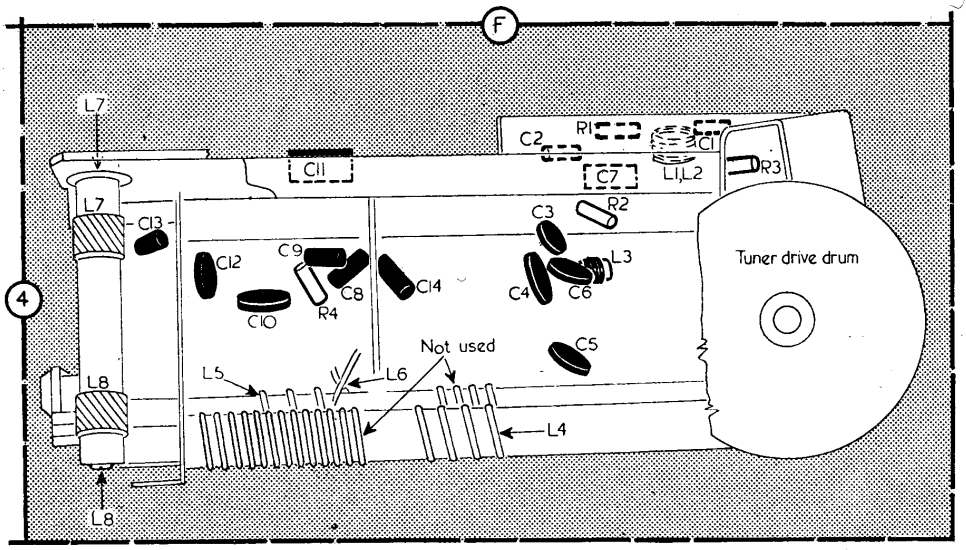
6.—Feed in a 580 kc/s signal and check receiver calibration at 517m. If the calibration is outside the limits of ± 1/8 inch, the tracker **C31,** or the oscillator coil **L15** may need replacement.

7.—Switch receiver to S.W. and tune it to 17.7m. Feed in a 17 Mc/s signal and adjust **C27** (D3) and **C19** (D2) for maximum output, rocking the gang while adjusting **C19** for optimum results.

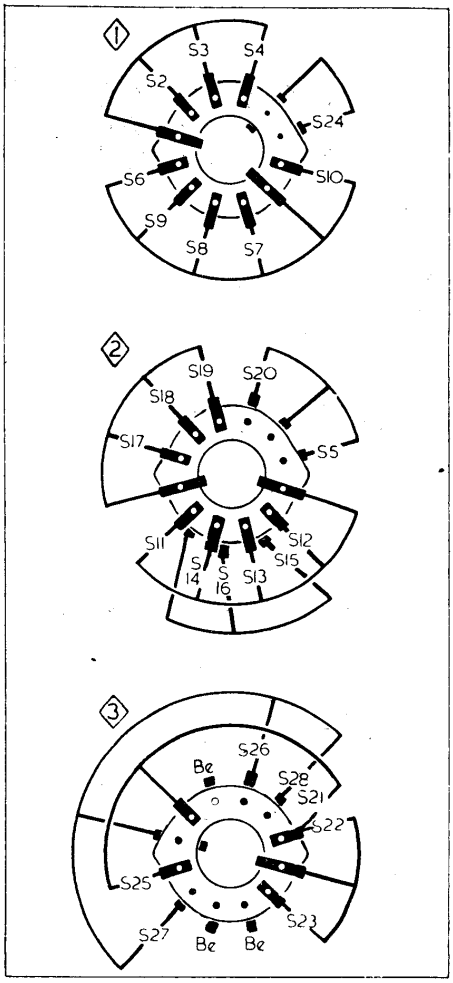
8.—Feed in a 6 Mc/s signal and check receiver calibration at 50m. If the calibration is outside the limits of ± 1/16 inch, the tracker **C30,** or the oscillator coils **L14, L17** may need replacement.

Switch Table

Switches	Gram	F.M.	L.W.	M.W.	S.W.
S2	—	—	—	—	C
S3	—	—	C	C	—
S4	—	—	C	—	—
S5	—	C	—	—	—
S6	—	C	—	—	—
S7	—	—	—	—	C
S8	—	—	—	C	—
S9	—	—	C	—	—
S10	—	—	C	C	C
S11	C	—	—	—	—
S12	—	—	—	—	C
S13	—	—	—	C	—
S14	—	—	C	—	—
S15	—	—	—	—	C
S16	—	—	—	C	—
S17	—	—	—	—	C
S18	—	—	—	C	—
S19	—	—	C	—	—
S20	—	—	C	C	C
S21	C	—	—	—	—
S22	—	—	C	C	C
S23	—	C	—	—	—
S24	—	C	C	C	C
S25	—	—	C	C	C
S26	—	C	—	—	—
S27	—	—	C	C	C
S28	C	—	—	—	—



Side view of the F.M. tuner unit with its screening case withdrawn.



Diagrams of the band switch units as seen from the rear of an inverted chassis.

F.M. Alignment with F.M. Generator

9.—Switch receiver to F.M. and tune it to 94 Mc/s. Connect output of signal generator, via 100pF capacitor in live lead, to tap on **L7** (tuner unit connection 2 in A1) and to chassis. Connect output meter across external speaker sockets. In model 401RG place an earthed screening can over **V4.**

10.—Feed in a 10.7 Mc/s signal deviated by ±25 kc/s and adjust **C48** (D3) and the core of **L25** (D3) for maximum output.

11.—Adjust **C48** and the core of **L21** (E3) for maximum ouput, repeating these adjustments until no further improvement results.

12.—Adjust the cores of **L20** (A1) and **L8** (E3) for maximum output, repeating these adjustments until no further improvement results.

13.—Adjust the core of **L7** (A1) for maximum output.

14.—Transfer signal generator leads to F.M. aerial sockets. Feeding in a 94 Mc/s signal, deviated by ±25 kc/s, adjust **C11** (A1) and **C7** (A1) and the cores of **L7** (A1) and **L8** (E3) for maximum output.

15.—Connect output of A.M. signal generator in place of F.M. generator to F.M. aerial sockets. Feed in a 15μV 30% modulated 94 Mc/s signal and carefully adjust the core of **L25** for minimum output.

16.—Note output meter reading obtained at the end of operation 15. Replace A.M. generator with F.M. generator. Feed in a 15μV 94 Mc/s signal, deviated by ±25 kc/s, and check that the output meter reading is at least thirty-two times (30db) that obtained with the A.M. input.

17.—Increase output of F.M. generator to 60μV and tune it around 94 Mc/s. Check that maximum output coincides with maximum deflection on tuning indicator.

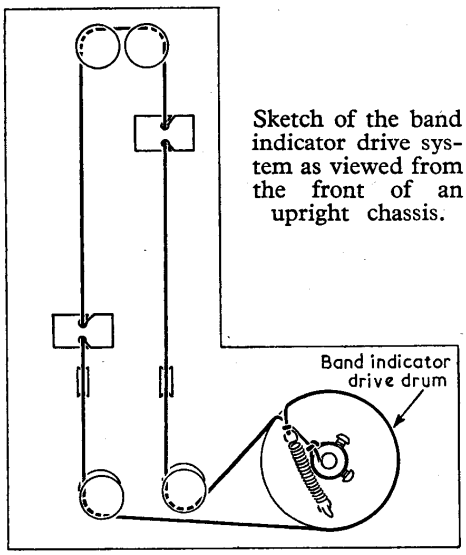
18.—Tune F.M. generator to 94 Mc/s and increase deviation to ±75 kc/s. Check that receiver output is free from distortion.

F.M. Alignment with A.M. Generator

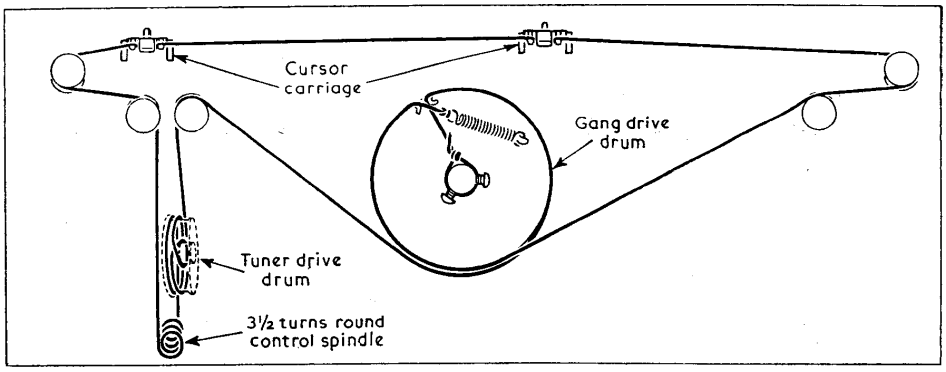
19.—Connect high-resistance voltmeter across **C54.** Carry out operations 9—13, employing A.M. signal generator with an unmodulated 10.7 Mc/s output. Make the adjustments for maximum output on voltmeter.

20.—Make the adjustments described in operation 14, employing an AM. signal generator with an unmodulated 94 Mc/s signal. Adjust for maximum reading on the output meter.

21.—Feed in a 30% modulated 94 Mc/s signal and adjust the core of **L25** (D3) for minimum output from speaker, or for minimum reading on output meter connected across external speaker sockets.



Sketch of the band indicator drive system as viewed from the front of an upright chassis.



Sketch of the tuning drive system as viewed from the rear of an upright chassis.

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