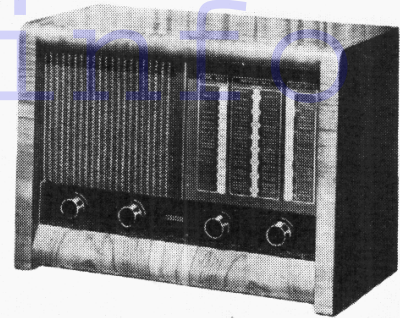## "TRADER" SERVICE SHEET 1028

FERGUSON
321A and 322RG

COMPONENTS AND VALUES

The Ferguson 321A table model.

FOUR receiving valves and a rectifier are used in the Ferguson 321A, a 3-band superhet designed to operate from A.C. mains of 200-250 V, 40-100 c/s. The waveband ranges are 16-55 m, 190-560 m and 750-2,000 m. The A.C./D.C. version 321U is covered separately in *Service Sheet* 1029.

The 322RG is a console autoradiogram employing a chassis that with the exception of the scale assembly is identical with that in the 321A.

Release date, both models, October 1951. Original prices: 321A, £19 16s 6d; 322RG, £45 10s 6d.

CIRCUIT DESCRIPTION

Aerial input and R.F. tuning circuits, frequency changer (**V1**, Mullard ECH42), oscillator and I.F. amplifier (**V2**, Mullard EBF80) are quite straightforward.

Intermediate frequency 470 kc/s.

Diode signal detector is part of **V2**, audio frequency component in rectified output being developed across volume control **R13**, which acts as diode load, and passed via **C21** to control grid of pentode valve (**V3**, Mullard EF41).

Second diode of **V2** is fed via **C16** from anode of pentode section and the voltage developed across its load resistor **R11** is fed back, giving automatic volume control.

Resistance-capacitance coupling by **R16**, **C24** and **R21** between **V3** and pentode output valve (**V4**, Mullard EL41). Speech coil voltages appearing across secondary winding of output transformer **T1** are fed back, via **R20**, **C25**, **R18** and **R19** to **V3** cathode, giving variable tone control.

The value of **C24** and position of **C26** are selected to produce rapid attenuation at very low frequencies, in order to offset the feed-back, which becomes positive. Provision is made for the connection of a low impedance external speaker across **T1** secondary winding, rotation of the speaker plug opening **S18** and muting the internal speaker.

H.T. current is supplied by I.H.C. full-wave rectifying valve (**V5**, Mullard EZ40).

CAPACITORS		Values	Locations
C1	Aerial coupling	0·001µF	F3
C2		500pF	F3
C3	V1 C.G. ...	200pF	G3
C4	V1 S.G. decoupl.	0·1µF	G3
C5	1st I.F. trans. tun-	100pF	A2
C6	ing ...	100pF	A2
C7	V1 osc. C.G.	50pF	G3
C8	A.G.C. decoupling	0·1µF	G4
C9	S.W. osc. trimmer	20pF	G3
C10	L.W. osc. trimmer	30pF	F3
C11		3,550pF	G3
C12	Oscillator trackers	560pF	G3
C13		500pF	G4
C14	Osc. anode coup.	200pF	G3
C15	V2 S.G. decoup.	0·1µF	G4
C16	A.G.C. coupling	50pF	F4
C17	2nd I.F. trans. tun-	100pF	B2
C18	ing ...	180pF	B2
C19	I.F. bypasses	100pF	B2
C20		100pF	B2
C21	A.F. coupling	0·005µF	F4
C22	H.T. by-pass	0·1µF	E3
C23	I.F. by-pass	500pF	F4
C24	A.F. coupling	0·001µF	E4
C25	Part tone control	0·02µF	E4
C26	Tone corrector	0·05µF	E4
C27*	V4 cath. by-pass	50µF	E3
C28	G.B. decoup.	0·1µF	E4
C29*		32µF	C2
C30*	H.T. smoothing	24µF	D4
C31*		24µF	D4
C32	Mains R.F. filter...	0·01µF	E3
C33‡	S.W. aerial trim.	40pF	F3
C34‡	M.W. aerial trim.	40pF	F3
C35‡	L.W. aerial trim.	40pF	F3
C36†	Aerial tuning ...	§528pF	B1
C37†	Oscillator tuning...	§528pF	B2
C38‡	S.W. osc. trim.	40pF	F4
C39‡	M.W. osc. trim.	40pF	F4
C40‡	L.W. osc. trim.	40pF	F4
C41‡	L.W. osc. tracker...	350pF	G4

*Electrolytic. †Variable. ‡Pre-set. §Swing.

RESISTORS		Values	Locations
R1	M.W. aerial shunt	2·3kΩ	F3
R2	Scale lamp ballast	1·5Ω	G4
R3	V1 C.G. ...	1MΩ	G3
R4	V1 S.G. H.T. pot.	22kΩ	G4
R5	divider	33kΩ	G3
R6	V1 osc. C.G.	47kΩ	G3
R7	Tracker shunt	3·3kΩ	G3
R8	Osc. anode feed	27kΩ	G4
R9	Osc. stabilizer	250Ω	F3
R10	V2 S.G. feed	100kΩ	G4
R11	A.G.C. diode load	470kΩ	F4
R12	I.F. stopper	100kΩ	B2
R13	Volume control	500kΩ	E3
R14	V3 C.G.	3·3MΩ	F4
R15	H.T. decoupling	100kΩ	E4
R16	V3 anode load	220kΩ	E4
R17	V3 S.G. feed	1MΩ	E4
R18	Tone control	2·5kΩ	D3
R19	Part tone control...	27kΩ	E4
R20		3·3kΩ	E4
R21	V4 C.G. ...	1MΩ	E4
R22	V1, V2 G.B.	470kΩ	E4
R23		470kΩ	E4
R24		47Ω	E3
R25*	V4 G.B. ...	165Ω	E4
R26	H.T. smoothing	680Ω	D4
R27		820Ω	D4

*Two 330Ω resistors in parallel. §Swing.
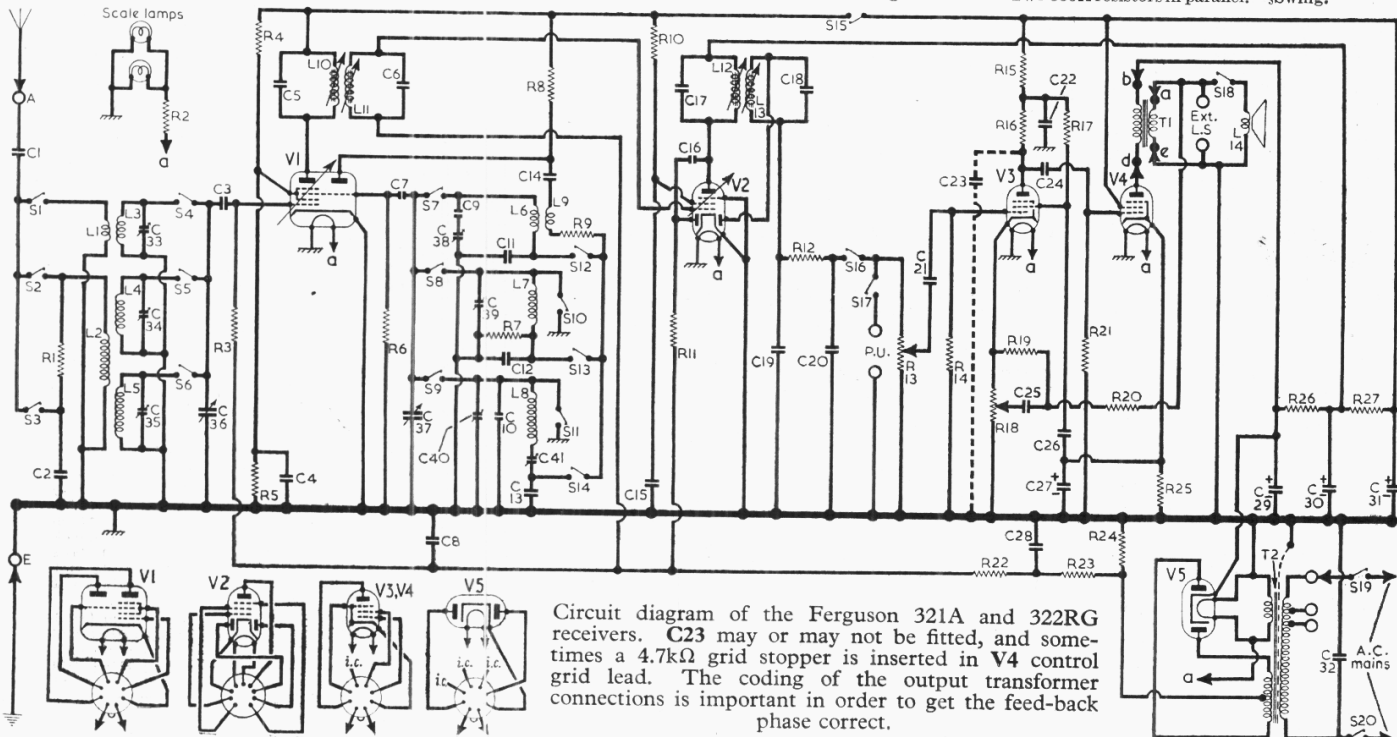
Circuit diagram of the Ferguson 321A and 322RG receivers. **C23** may or may not be fitted, and sometimes a 4.7kΩ grid stopper is inserted in **V4** control grid lead. The coding of the output transformer connections is important in order to get the feed-back phase correct.

OTHER COMPONENTS		Approx. Values (ohms)	Locations
L1	Aerial coupling coils	2·3	A1
L2		28·0	B2
L3		—	A1
L4	Aerial tuning coils	2·6	B2
L5		30·0	B2
L6	Oscillator tuning coils	—	G3
L7		2·5	G3
L8		15·0	G3
L9	Osc. reaction coil	1·0	G3
L10	1st I.F. trans. Pri.	8·0	A2
L11	Sec.	8·0	A2
L12	2nd I.F. trans. Pri.	8·0	B2
L13	Sec.	8·0	B2
L14	Speech coil	2·5	—
T1	O.P. trans. b—d	460·0	B2
	a—e	—	
T2	Pri., total	44·0	
	H.T. sec., total	760·0	C2
	Heater sec.	—	
S1–S17	Waveband switches	—	F3
S18	Int. L.S. switch	—	E4
S19, S20	Mains sw., g'd R18	—	D3
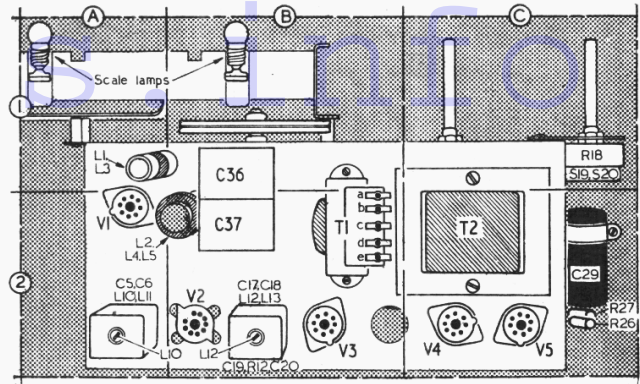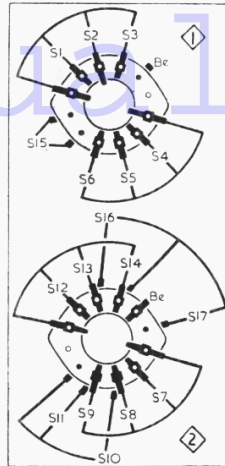
Above.—Plan view of the chassis. The tags of **T1** are coded to agree with the diagram overleaf.
Left.—Waveband switch units as seen from rear of inverted chassis.

VALVE ANALYSIS

Valve voltages and currents given in the table below are derived from the manufacturer's information and were measured on a receiver which was operating from 230 V A.C. mains.

Voltage readings were taken on the 10 V and 400 V ranges of a Model 7 Avometer, chassis being the negative connection. The voltage drop across **R24** was 2.6 V.

Valves	Anode		Screen		Cath.
	V	mA	V	mA	V
V1 ECH42	250 Oscillator	2·7	100	3·7	—
	115	4·7			
V2 EBF80	268	4·3	80	1·7	—
V3 EF41	35	0·5	20	0·1	1·0
V4 EL41	265	35·0	250	5·0	6·8
V5 EZ40	285†	—	—	—	285·0

†A.C. voltage.

GENERAL NOTES

Switches.—S1–S14 are the waveband switches, and S15–S17 are the radio/gram change-over switches, ganged in two rotary units. These are indicated in our underside view of the chassis, and shown in detail in the diagrams inset beside our plan view of the chassis, where they are drawn as seen from the rear of an inverted chassis. The table below them gives the switch positions for the four control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and C, closed.

Scale Lamps.—These are two M.E.S. types, with small clear spherical bulbs, rated at 6.5 V, 0.3 A.

Switches	Gram.	L.W.	M.W.	S.W.
S1	—	—	—	C
S2	C	C	C	C
S3	—	C	—	—
S4	—	—	—	C
S5	—	—	C	—
S6	—	C	—	—
S7	—	—	—	C
S8	—	—	—	C
S9	—	C	—	—
S10	—	—	—	C
S11	—	—	C	C
S12	—	—	C	—
S13	—	—	—	C
S14	—	C	—	—
S15	—	C	C	C
S16	—	C	C	C
S17	C	—	—	—

External Speaker.—A special plug is provided at the rear of the chassis for connecting a low impedance (about 2-3 Ω) external speaker. When the plug is turned a few degrees anti-clockwise in its sockets, **S18** opens and mutes the internal speaker.

Feed-back Modification.—Originally **C26** was returned to **V3** cathode instead of **V4**, and **C24** was 0.05 μF. A grid stopper of 4.7 kΩ was fitted in **V4** C.G. circuit, and **C23** in **V3** anode circuit. The change was made during production because it was found that at frequencies below 80 c/s the sense of the feed-back tended to become positive, resulting in instability.

Drive Cord Replacement.—There are two separate cords for tuning drive and cursor drive. The former requires about two feet of fine gauge nylon braided glass yarn, and the latter about five feet of normal gauge plaited flax fishing line. The method of running these two cords is shown in the sketch below, where they are viewed from the front with the gang at minimum.

CIRCUIT ALIGNMENT

The following adjustments may be made without removing the chassis from its cabinet, access to the under-chassis trimmers and core adjust-
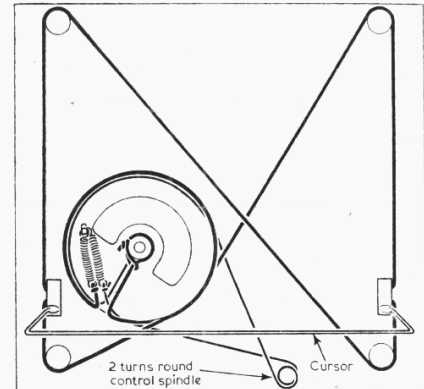
‡Front view of tuning drive system.

ments being gained by removing the cabinet base cover (six wood screws).

I.F. Stages.—Connect output of signal generator to junction of **C36** and **C3**, and turn volume control and gang to maximum. Switch set to M.W., feed in a 470 kc/s (638.3 m) signal and adjust the cores of **L13** (location reference F4), **L12** (B2), **L11** (G4) and **L10** (A2) for maximum output.

R.F. and Oscillator Stages.—Check that with the gang at maximum capacitance, the cursor coincides with the tops of the tuning scales and is horizontal. Transfer signal generator leads to **A** and **E** sockets via a suitable dummy aerial.

L.W.—Switch set to L.W., tune to 857 m (spot on scale), feed in an 857 m (350 kc/s) signal and adjust **C40** (F4) and **C35** (F3) for maximum output. Tune to 1,875 m, feed in a 1,875 m (160 kc/s) signal and adjust **C41** (G4) for maximum output. Repeat these adjustments until no further improvement results.

M.W.—Switch set to M.W., tune to 200 m (spot on scale), feed in a 200 m (1,500 kc/s) signal and adjust **C39** (F4) and **C34** (F3) for maximum output. Check calibration at 517 m (580 kc/s) and if there is a large error check the capacitance of **C12**, replacing it if it falls outside the stated tolerance. If **C12** is not faulty it may be found necessary to replace the coil unit **L6**, **L7**, **L8**, **L9**.

S.W.—Switch set to S.W., tune to 17.7 m (spot on scale), feed in a 17.7 m (17 Mc/s) signal and adjust **C38** (F4) and **C33** (F3) for maximum output, "rocking" the gang when adjusting **C33** to obtain optimum results. Check calibration at 50 m (6 Mc/s) and if there is a large error replace **C11**, if faulty, or the coil unit.

Underside view of the chassis. Some components are mounted outside at one end.