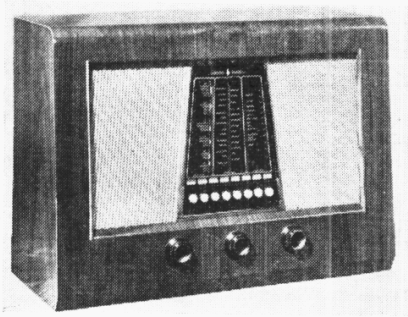
"TRADER" SERVICE SHEET
1022

BUSH 22 Series

Covering Models PB22 (A.C.) and DAC22 (A.C./D.C.)



PRESS-BUTTON tuning for four stations, with press-button waveband and gramophone pick-up switching, is provided in the Bush PB22, a 4-valve (plus rectifier) 3-band superhet designed to operate from A.C. mains of 100-120 V and 200-250 V, 40-100 c/s. Waveband ranges are 16-50 m, 187-578 m and 882-2,000 m.

Although a double-wound mains transformer is used, and the chassis is thus isolated from the mains, the receiver is so designed that it can easily be converted to A.C./D.C. operation, when, of course, the chassis becomes "live" to the mains. The model No. is then DAC22, and the small differences between the two models are explained under "General Notes" overleaf.

Release date and original price, both models: August 1950, £23 8s 9d, plus purchase tax.

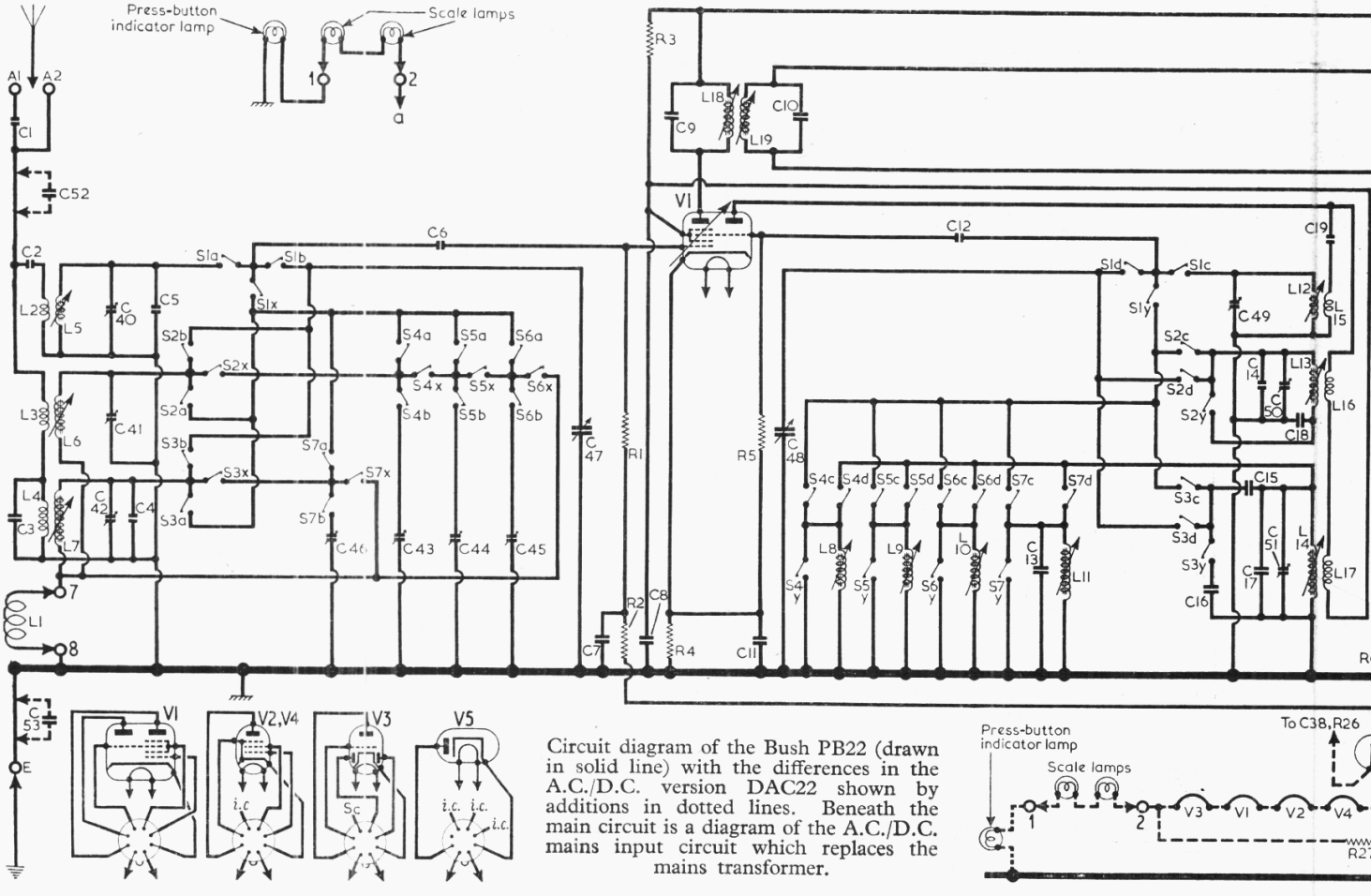
CIRCUIT DESCRIPTION

All the switches associated with the press-button unit have been coded to indicate their action when a button is pressed. Thus a switch bearing the suffix **a, b, c** or **d** closes when its button is pressed, while one bearing **x** or **y** opens. When the button is released these actions are reversed. Each button, with the exception of Gram., operates two sets of switches, one in the aerial circuit and one in the oscillator circuit. All the switches in both groups operated by a given button bear the same number, the individual switches being identified by their suffixes.

The aerial is coupled inductively on all ranges by **L2, L3, L4** to single tuned circuits comprising **L5** (S.W.), **L6** (M.W.) and **L7** (L.W.) tuned manually by **C47** or automatically by pre-set capacitors **C43, C44, C45** (M.W.) or **C46** (L.W.). Image suppression on L.W. by **C3** connected across **L4.** In areas of good signal strength, frame aerial input from **L1** may be used.

First valve **(V1, Mullard UCH42)** is a triode hexode operating as frequency changer with internal coupling. For manual tuning, triode oscillator grid coils **L12** (S.W.), **L13** (M.W.) and **L14** (L.W.) are tuned by **C48.** Parallel trimming by **C49** (S.W.), **C14, C50** (M.W.) and **C17, C51** (L.W.); series tracking by **C18** (M.W.) and **C15** (L.W.). Reaction coupling from anode by **L15** (S.W.); **L16** (M.W.) and **L17** (L.W.).

For automatic tuning, coils **L8, L9, L10** (M.W.) or **L11** (L.W.) are shunted across



Circuit diagram of the Bush PB22 (drawn in solid line) with the differences in the A.C./D.C. version DAC22 shown by additions in dotted lines. Beneath the main circuit is a diagram of the A.C./D.C. mains input circuit which replaces the mains transformer.

L14, tuning adjustments being made by means of the pre-set coil cores. **L14, L17** form a master oscillator circuit whose natural frequency is shifted below the broadcast range by the capacitor **C16.**

Second valve **(V2, Mullard UF41)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned transformer couplings **C9, L18, L19. C10** and **C24, L20, L21, C25.**

Intermediate frequency 465 kc/s.

Diode signal detector is part of double diode triode valve **(V3, Mullard UBC41).** Audio frequency component in rectified output is developed across diode load resistor **R11** and passed via **C28,** volume control **R12** and grid stopper **R15** to control grid of triode section, which operates as A.F. amplifier.

Second diode of **V3** is fed from **V2** anode via **C29,** and the resulting D.C. potential built up across load resistor **R18** is fed back as bias to F.C. and I.F. stages, giving automatic gain control. I.F. filtering by **C26** and **C31.**

Provision is made for the connection of a gramophone pick-up across **R12** via **S8d** which closes on Gram. **S8y** opens in this position to mute the radio.

Resistance-capacitance coupling by **R16, C32** and **R20** between **V3** and control grid of pentode output valve **(V4, Mullard UL41).** Variable tone control by **R24** and **C35** in anode circuit. Fixed tone correc-

(Continued col. 1 overleaf)

COMPONENTS AND VALUES

	RESISTORS	Values	Locations
R1	V1 C.G.	470kΩ	D4
R2	A.G.C. decoupling	1MΩ	E4
R3	V1 S.G. feed ...	15kΩ	E4
R4	V1 G.B.	220Ω	D4
R5	V1 osc. C.G. ...	47kΩ	D4
R6	A.G.C. decoupling	2·2MΩ	E4
R7	V2 C.G. stopper ...	220Ω	E5
R8	V2 screen feed ...	47kΩ	E4
R9	V2 anode decoup....	10kΩ	E4
R10	V2 G.B.	330Ω	E4
R11	Diode load ...	330kΩ	F4
R12	Volume control ...	2MΩ	F3
R13	Neg. feedback ...	1kΩ	F3
R14		3·3kΩ	F4
R15	V3 C.G. stopper ...	100kΩ	F3
R16	V3 anode load ...	150kΩ	F4
R17	V3 G.B.	5·6kΩ	E4
R18	A.G.C. diode load...	1MΩ	E4
R19	H.T. smoothing ...	4·7kΩ	F4
R20	V4 C.G.	330kΩ	F4
R21	V4 C.G. stopper ...	10kΩ	F5
R22	Neg. feed-back ...	330Ω	F4
R23	V4 G.B.	220Ω	F4
R24	Tone control ...	50kΩ	E3
R25	Part tone correction	10kΩ	F4
R26	H.T. smoothing ...	3·3kΩ	G4
R27	Lamp ballast ...	10kΩ	—
R28	Surge limiter ...	150Ω	—
R29	Heater ballast ...	*1·25kΩ	—

*Tapped at 950Ω + 150Ω + 150Ω from V5 heater.

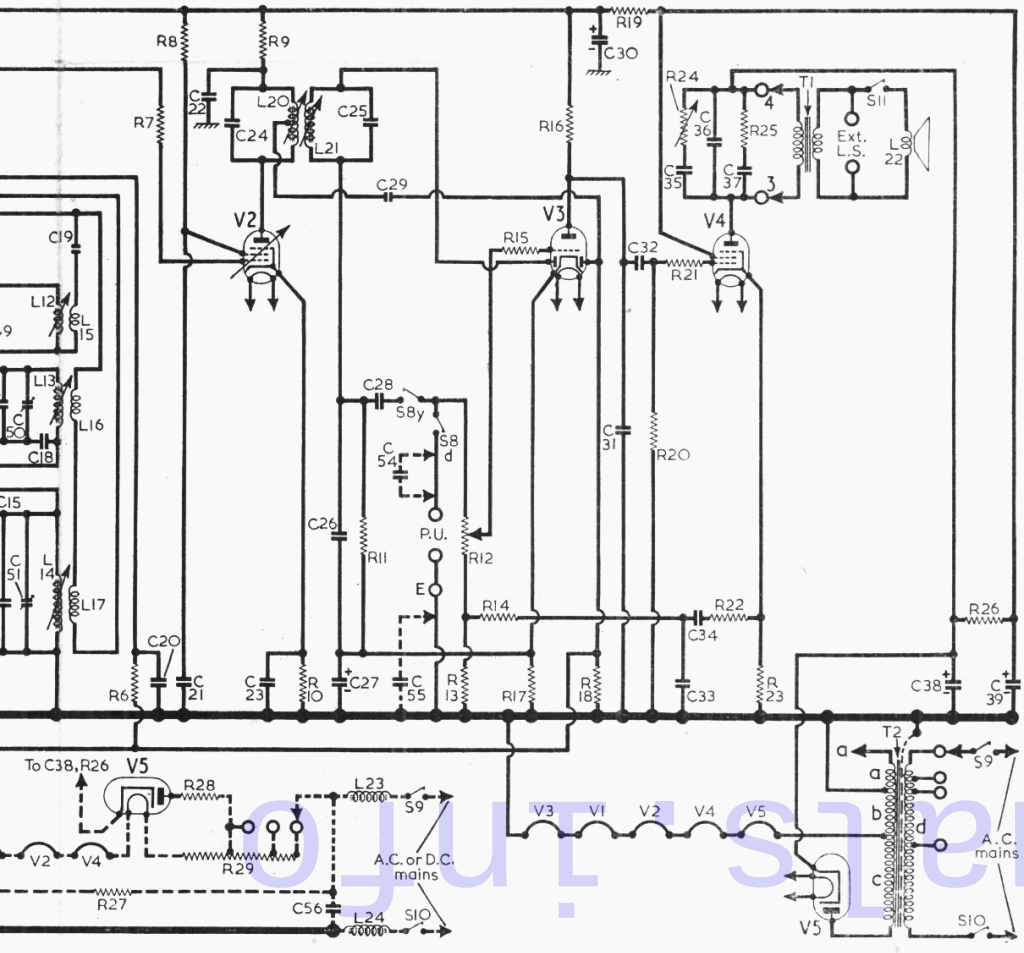
If the component numbers given in the accompanying tables are used when ordering replacement parts, dealers are advised to mention the fact on the order, as these numbers may differ from those used in the manufacturers' diagram.

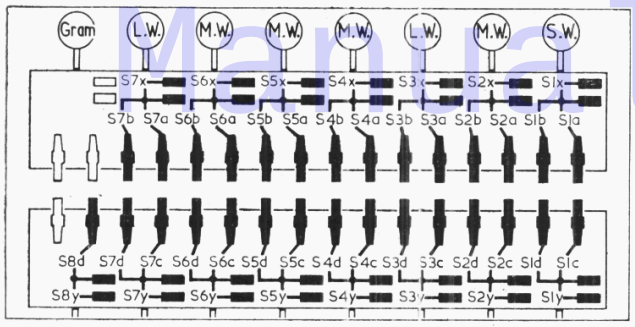
	CAPACITORS	Values	Locations
C1	Aerial series ...	50pF	D5
C2	S.W. aerial coup. ...	50pF	C1
C3	Image rejector ...	800pF	B1
C4	L.W. fixed trim. ...	27pF	B1
C5	S.W. fixed trim. ...	10pF	C2
C6	V1 C.G.	50pF	D4
C7	A.G.C. decoupling	0·05μF	D4
C8	V1 S.G. decoup. ...	0·05μF	D5
C9	1st I.F. trans. tuning ...	110pF	C2
C10		110pF	C2
C11	V1 cath. by-pass ...	0·05μF	D4
C12	V1 osc. C.G. ...	50pF	D4
C13	L.W. pre-set trim.	316pF	B1
C14§	M.W. fixed trim. ...	10pF	B1
C15	L.W. osc. tracker	316pF	B1
C16	Pre-set swamp ...	340pF	B1
C17	L.W. fixed trim ...	125pF	B1
C18	M.W. osc. tracker...	556pF	C1
C19	S.W. reaction coup.	50pF	C1
C20	A.G.C. decoupling	0·05μF	E4
C21	V2 S.G. decoup. ...	0·05μF	E4
C22	V2 anode decoup.	0·05μF	E4
C23	V2 cath. by-pass...	0·05μF	E4
C24	2nd I.F. trans. tuning ...	110pF	B2
C25		110pF	B2
C26	I.F. by-pass ...	100pF	F4
C27*	V3 cath. by-pass ...	50μF	E3
C28	A.F. coupling ...	0·01μF	F4
C29	A.G.C. feed ...	50pF	E5
C30*	H.T. smoothing ...	2μF	G3
C31	I.F. by-pass ...	0·001μF	F4
C32	A.F. coupling ...	0·01μF	F5
C33	Neg. feed-back ...	0·1μF	F4
C34		0·05μF	F4
C35	Part tone control...	0·05μF	F4
C36	Tone correctors ...	0·001μF	F4
C37		0·01μF	F4
C38*	H.T. smoothing ...	50μF	C2
C39*		50μF	C2
C40‡	S.W. aerial trim. ...	—	C1
C41‡	M.W. aerial trim....	—	B1
C42‡	L.W. aerial trim. ...	—	B1
C43‡	M.W. aerial pre-set tuning capacitors ...	150pF	B1
C44‡		300pF	B1
C45‡		450pF	B1
C46‡	L.W. pre-set tune...	450pF	B1
C47†	Manual tuning ...	528pF	C1
C48†		528pF	C1
C49‡	S.W. osc. trimmer	—	C1
C50‡	M.W. osc. trimmer	—	B1
C51‡	L.W. osc. trimmer	—	B1
C52	A.C./D.C. chassis isolators	0·005μF	—
C53		0·01μF	—
C54		0·005μF	—
C55		0·1μF	—
C56	R.F. filter ...	0·01μF	—

* Electrolytic. † Variable. ‡ Pre-set
§ Two 5pF capacitors in parallel.

	OTHER COMPONENTS	Approx. Values (ohms)	Locations
L1	Frame aerial ...	—	—
L2	Aerial coupling coils	—	C1
L3		0·5	B1
L4		33·0	B1
L5	Aerial tuning coils	—	C1
L6		4·5	B1
L7		17·0	B1
L8	M.W. pre-set tuning coils	1·0	B1
L9		1·5	B1
L10		2·0	B1
L11	L.W. pre-set coil ...	3·0	B1
L12	Oscillator tuning coils	—	C1
L13		3·5	B1
L14		9·6	B1
L15	Oscillator reaction coils	—	C1
L16		0·5	B1
L17		2·0	B1
L18	1st I.F. trans. Pri. ...	12·5	C2
L19	Sec. ...	12·5	C2
L20	2nd I.F. trans. Pri. ...	*12·5	B2
L21	Sec. ...	12·5	B2
L22	Speech coil ...	2·5	—
L23	R.F. chokes (A.C./D.C. model only)	3·0	—
L24		3·0	—
T1	O.P. trans. Pri. ...	700·0	—
	Sec. ...	0·41	—
T2	Mains trans. a ...	3·4	
	b ...	32·0	
	c ...	76·0	A2
	d, total	43·0	
S1-S8	P.b. switch unit ...	—	B1
S9, S10	Mains sw., g'd R12	—	F3

* Tapped at 6.25Ω.





Diagrams showing the two sides of the press-button switch unit, that above being the upper side, carrying the aerial circuit switches. The button designations are indicated in the upper diagram.

Circuit Description—*continued*

tion by **C36** and **R25, C37** and by negative feed-back between **V4** cathode and **V3** grid circuit via **R13, R14, C33, C34, R22, R23.**

H.T. current supplied by I.H.C. half-wave rectifying valve **(V5, Mullard UY41).** Smoothing by **R19, R26** and electrolytic capacitors **C30, C38** and **C39.**

In the power circuit of the A.C. model, mains transformer **T2** is double-wound, so that the chassis is isolated from the mains, but there is only a single secondary winding. This is tapped at 14.5 V to feed the scale lamps, and at 118 V to feed the valve heaters, which are series connected.

In the power circuit of the A.C./D.C. model the valve heaters, together with the scale lamps, ballast resistor **R29** and R.F. chokes **L23, L24,** are connected in series across the mains input. R.F. filtering by **C56** in conjunction with **L23** and **L24.**

The rest of the diagram and circuit description, with a few minor exceptions, apply equally to the A.C. or A.C./D.C. model, as the chassis is designed to be convertible from one to the other. The exceptions are indicated by dotted lines, which show positions in the circuit of the isolating capacitors **C52-C55** which are found only in the A.C./D.C. version.

DISMANTLING THE SET

Removing Chassis.—Remove three control knobs (pull-off) from front of cabinet;
withdraw frame aerial plug from right-hand side of chassis and scale lamp and output plug from left-hand side;
lift cursor driver off cursor carriage;
remove two screws securing rear edges of chassis to cabinet and withdraw chassis.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those derived from the manufacturer's information. They were measured on a set operating from 230 V A.C. mains and switched to M.W., but with no signal input.

Voltage readings were measured on the 1,00 V and 10 V ranges of a Model 7 Avometer. Chassis was the negative connection.

Voltages and currents on the A.C./D.C. model will be approximately 20% less than the quoted figures, assuming that they are obtained on similar mains.

Valve	Anode		Screen		Cath.
	V	mA	V	mA	V
V1 UCH42	120	3·0	60	1·5	1·4
	Oscillator				
	60	1·5			
V2 UF41	78	3·0	66	1·0	1·6
V3 UBC41	68	0·16	—	—	0·9
V4 UL41	203	40·0	175	5·0	10·0
V5 UY41	224†	—	—	—	230·0

† A.C. voltage.

GENERAL NOTES

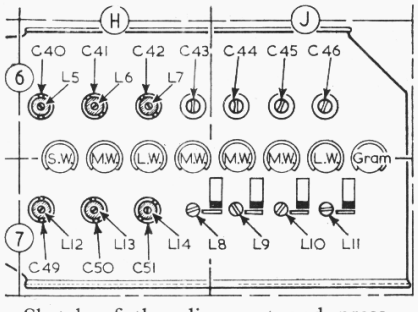
Switches.—**S1a, b, c, d** and **x, y** to **S7a, b, c, d** and **x, y** are the waveband switches, and **S8d** and **y** are the radio/gram. change-over switches. They are contained in an eight-button press-button unit, and they perform the functions of waveband changing (three buttons), preset station selection (four buttons) and radio/gram. change-over (eighth button).

The action of the switches is explained at the beginning of "Circuit Description" overleaf, and a diagram of the switch unit, showing both sides, appears in cols. 1 and 2. Limited access to the underside of the unit can be obtained by removing the fixing screws, although some leads would have to be unsoldered to permit it to be turned over to give free access.

S9, S10 are the Q.M.B. mains switches, ganged with the volume control **R12.**

Scale and Indicator Lamps.—These are three M.E.S.-type lamps, with large clear spherical bulbs, rated at 6.2 V, 0.3 A (A.C. model). In the A.C./D.C. model they are rated at 3.5 V, 0.15 A.

The press-button indicator lamp is on the chassis, but the two scale lamps are mounted in the cabinet and connection to them is effected via two of the four pins of the output socket, pins **1** and **2.**

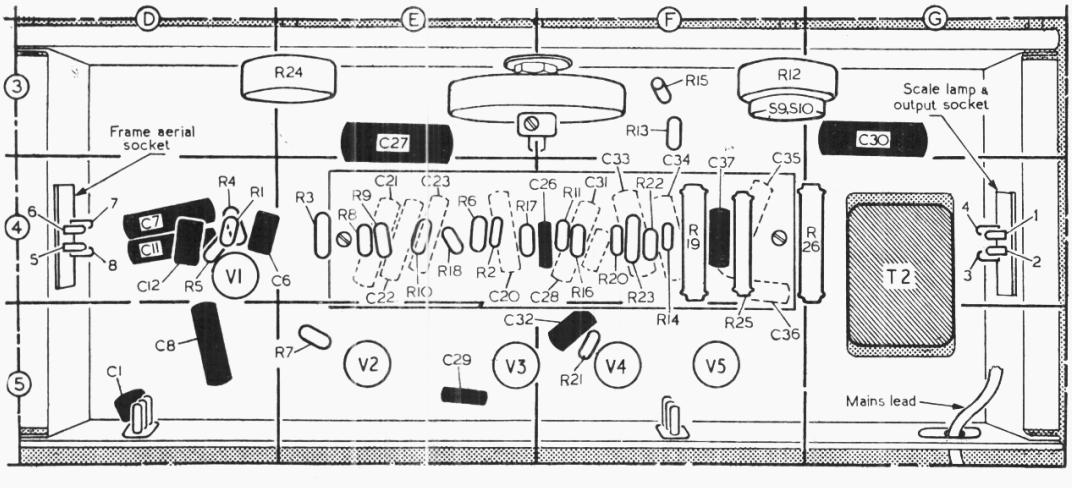


Sketch of the alignment and press-button trimmer panel, drawn as seen from the front of the receiver after removing the press-button escutcheon. The centre row of circles represents the actual buttons.

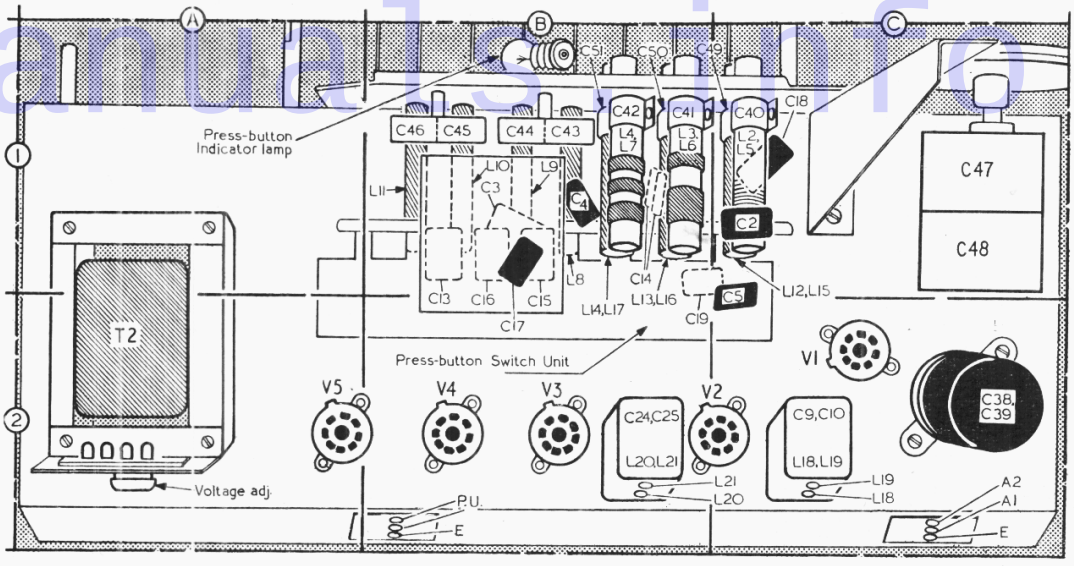
External Speaker.—Two sockets are provided on a panel at the rear of the cabinet for the connection of a low impedance (about 2.5 Ω) external speaker, a screw-type switch **S11** being provided to mute the internal speaker if desired.

Output Transformer T1. — This is mounted on the speaker and connected to the receiver chassis via pins **3** and **4** of the output plug and socket.

A.C. to A.C./D.C. Conversion. — The chassis of PB22 is so designed that conversion to A.C./D.C. operation is simple,



Underside drawing of the chassis, in which most of the small components are mounted on the central tag board. Input connections from the frame aerial, and output connections to the speaker, are made by 4-pin plugs at either end of the chassis.



Plan view of the chassis. A diagram at the head of cols. 1 and 2 shows the two sides of the press-button switch unit.

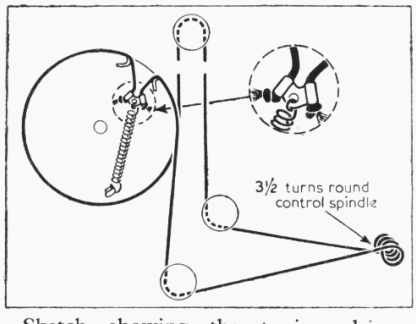
involving only the substitution of an A.C./D.C. mains input unit for the mains transformer and the insertion of four isolating capacitors. The receiver is then known as a DAC22.

The circuit changes are indicated in our circuit diagram, by connections in dotted line. The main diagram in solid line is that of our sample, which was an A.C. version, and the dotted lines show the differences involved in the conversion to A.C./D.C.

The complete mains input circuit for the latter is shown beneath the complete diagram, from which it will be seen that the scale lamp and heater circuits are not disturbed in the conversion. The ballast resistor **R27** which shunts the valve heaters provides an additional path for current for the scale lamps.

DRIVE CORD REPLACEMENT

Above 50 inches of nylon braided glass yarn is required for a new drive cord, and it is advisable to make it up before fitting it. To do this, tie a non-slip knot at one end and thread the cord through one side of the anchor-plate, then thread the other end through the other side of the plate, and tie a second knot so that the overall length of cord from knot to knot is 48 inches.



Sketch showing the tuning drive system, drawn as seen from the front of the chassis when the gang is at maximum. Inset is shown the method of tying cord to the anchor plate.

The cord should then be run on as shown in the sketch in col. 4, where the drive system is drawn as seen when viewed from the front of the chassis with the gang at maximum capacitance. Inset in the sketch is a drawing of the anchor-plate, enlarged to show the direction and method of fixing the knots.

CIRCUIT ALIGNMENT

All the following adjustments can be carried out with the chassis in its cabinet.

I.F. Stages.—Switch set to M.W. and tune to approximately 300 m. Connect output of signal generator, via a 0.1 μF capacitor in the "live" lead, to control grid (pin 6) of **V2** and the earth socket. Screw the cores of **L18** (location reference C2), **L19** (C2), **L20** (B2) and **L21** (B2) fully out. Feed in a 465 kc/s signal and adjust the cores of **L21** and **L20** for maximum output. Transfer "live" signal generator lead to control grid (pin 6) of **V1** and adjust the cores of **L19** and **L18** for maximum output.

R.F. and Oscillator Stages.—Although the following adjustments may be made with the chassis in the cabinet, it is convenient to refer to the substitute tuning scale printed on the back of the tuning drum. Readings on this scale are made against the top edge of the metal cursor. Transfer signal generator leads, via a dummy aerial, to **A2** and **E** sockets. Check that with the gang at maximum capacitance the top edge of the substitute cursor coincides with the line marked "Datum" on the substitute tuning scale, and that the tuning scale cursor coincides with the line along the top of the L.W. and S.W. tuning scales. The following adjustments are made accessible by removing the press-button escutcheon.

L.W.—Switch set to L.W., tune to 2,000 m on substitute scale, feed in a 2,000 m (150 kc/s) signal and adjust the cores of **L14** (H7) and **L7** (H6) for maximum output. Tune set to 1,000 m, feed in a 1,000 m (300 kc/s) signal and adjust **C51** (H7) and **C42** (H6) for maximum output. Check calibration and repeat these adjustments if necessary.

M.W.—Switch set to M.W., tune to 500 m, fed in a 500 m (600 kc/s) signal and adjust the cores of **L13** (H7) and **L6** (H6) for maximum output. Tune set to 200 m, feed in a 200 m (1,500 kc/s) signal and adjust **C50** (H7) and **C41** (H6) for maximum output. Check calibration and repeat these adjustments if necessary.

S.W.—Switch set to S.W., tune to 50 m, feed in a 50 m (6.0 Mc/s) signal and adjust the cores of **L12** (H7) and **L5** (H6) for maximum output. Tune set to 16.6 m, feed in a 16.6 m (18 Mc/s) signal and adjust **C49** (H7) and **C40** (H6) for maximum output. Check calibration and repeat these adjustments if necessary.

Pre-set stations.—A signal generator output may be used to set those adjustments roughly, but they should be subsequently adjusted on the stations they are intended to receive.

Numbering from left to right, when viewed from the front, the manually tuned press-buttons are: 1, S.W.; 2, M.W.; 3, L.W. Then follow the pre-set press-buttons: 4, 200-350 m; 5, 250-400 m; 6, 325-550 m; 7, 1,100 1,875 m. Button 8 is Gram.

When setting up a station, the pre-set button covering the appropriate range is pressed, the press-button escutcheon is removed, and the core adjustment below the button is set so that the groove round the end of the adjustment coincides approximately with the wavelength of the desired station on the small metal tuning scale. The core adjustment is rotated carefully in both directions until the signal is heard, and is then set for maximum output. The pre-set capacitor above the press-button is then adjusted for maximum output.

Adjustment to **L6** or **C41** will alter the tuning of the M.W. pre-set station trimmers, and after alignment of the M.W. manual circuits **C43, C44** and **C45** should be checked. Adjustment of **L7** or **C42** will alter the tuning of the L.W. pre-set trimmer, and adjustment of **C51** or **L14** will alter the tuning of all the pre-set coils, so that it is necessary after alignment of the L.W. manual circuits to check **C46, L8, L9, L10** and **L11.**

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