NUMBER SEVENTY **'TRADER' SERVICE SHEETS**

BUSH SAC21

SUPERHET FOR A.C. MAINS

FOUR receiving valves and a valve rectifier are employed in the Bush SAC21 superhet, which is constructed to operate on A.C. mains of 200-260 V. It incorporates a 3-position switch which operates as a combined tone and inter-station noise suppressor control.

The circuit consists of an octode frequency changer, a variable-mu pentode I.F. amplifier, a separate double diode, and a pentode output valve. Sockets are fitted for a gramophone pick-up and an extension speaker, and there is a plug and socket device for cutting out the internal speaker.

CIRCUIT DESCRIPTION

Aerial input via coupling coils **L1, L2** to inductively-coupled band-pass filter. Primary **L3, L4** tuned by **C21**; secondary **L7, L8** tuned by **C23**; coupling coils **L5, L6.** Image suppression by coil **L9** and condenser **C1.**

First valve (**V1, Mullard metallised FC4**) is an octode operating as frequency changer with electron coupling. Oscillator grid coils **L10, L11** tuned by **C25**; anode reaction coils **L12, L13**; tracking by specially shaped condenser vanes and condensers **C6, C28** (L.W.).

Second valve, a variable-mu H.F. pentode (**V2, Mullard metallised VP4**), operates as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **L14, L15** and **L16, L17.**

Intermediate frequency 123 KC/S.

Diode second detector forms part of double diode valve (**V3, Mullard metallised 2D4A**). Second diode provides D.C. potential which is developed across load resistance **R14** and fed back through decoupling circuits as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage is obtained from potential divider **R15, R16, R17** across H.T. supply. The voltage developed across **R16** when switch **S6** is open is applied as negative bias to the rectifier diode, and thus gives a degree of inter-station noise suppression.

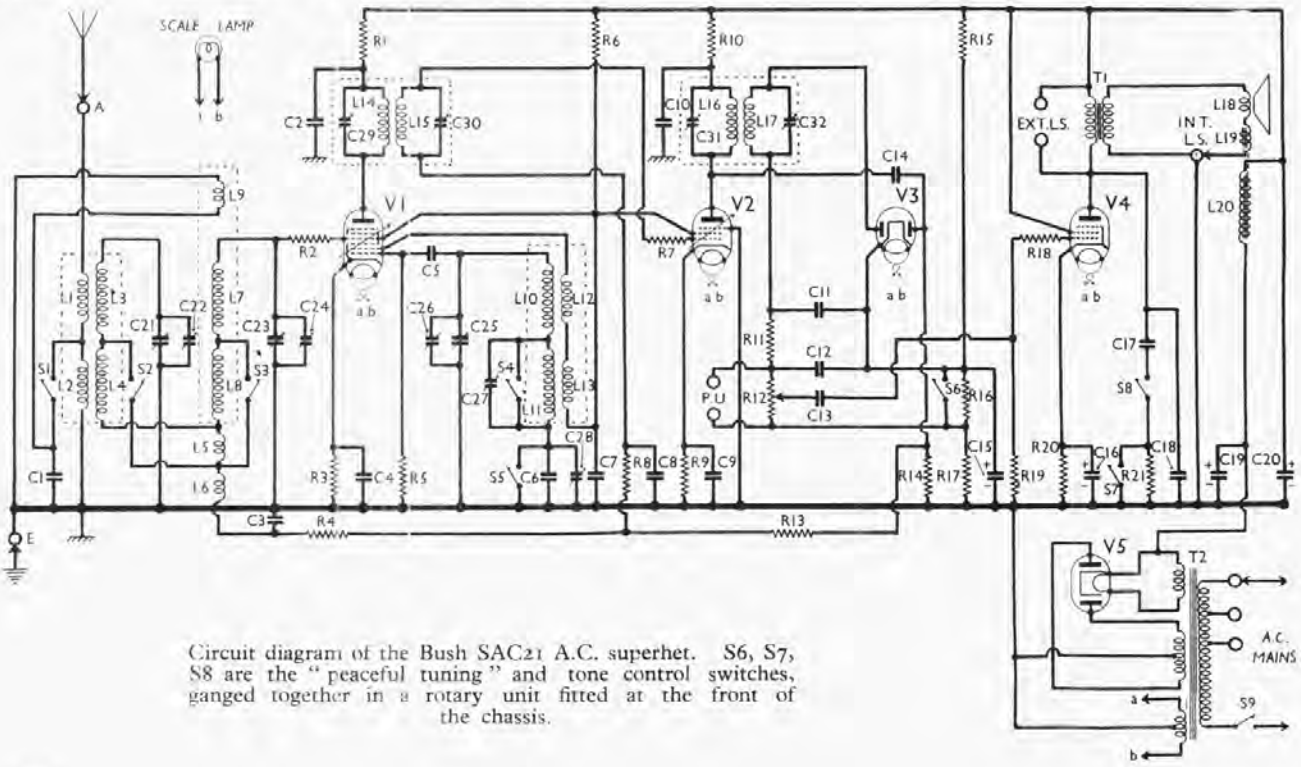
Audio-frequency output from rectifier is developed across manual volume control **R12** and passed via coupling condenser **C13** and I.F. stopper **R18** to control grid of output pentode (**V4, Mullard Pen 4VB**). Provision for connection of gramophone pick-up across volume control. Tone compensation in anode circuit by **R21, C17, C18,** which work in conjunction with switches **S7, S8.** Provision for connection of external high resistance speaker across primary of transformer **T1.** Plug and socket device enables speech coil circuit of internal speaker to be broken.

H.T. current is supplied by full-wave rectifying valve (**V5, Mullard IW3**). Smoothing by speaker field winding **L20** and electrolytic condensers **C19, C20.**

COMPONENTS AND VALUES

	Condensers	Values (μF)
C1	Part of image suppression circuit	0·01
C2	V1 anode decoupling	0·1
C3	V1 cont. grid decoupling	0·1
C4	V1 cathode by-pass	0·1
C5	V1 osc. grid condenser	0·0005
C6	Oscillator L.W. tracker	0·001
C7	V1, V2 S.G.'s by-pass; osc. anode decoupling	0·1
C8	V2 cont. grid decoupling	0·1
C9	V2 cathode by-pass	0·1
C10	V2 anode decoupling	0·1
C11, C12	I.F. by-passes	0·0001, 0·0002
C13	L.F. coupling to V4	0·005
C14	Coupling to V3 A.V.C. diode	0·0001
C15*	V3 cathode by-pass	25·0
C16*	V4 cathode by-pass	25·0
C17, C18	Parts of tone control filter	0·03, 0·001
C19*, C20*	H.T. smoothing	8·0, 8·0
C21	Band-pass primary tuning	—
C22‡	Band-pass primary trimmer	0·00005
C23	Band-pass secondary tuning	—
C24‡	Band-pass secondary trimmer	0·00005
C25	Oscillator tuning	—
C26‡	Oscillator main trimmer	0·00005
C27‡	Oscillator L.W. trimmer	0·000075
C28‡	Oscillator L.W. tracker	0·0003
C29‡	1st I.F. trans. pri. tuning	0·00015
C30‡	1st I.F. trans. sec. tuning	0·00015
C31‡	2nd I.F. trans. pri. tuning	0·0003
C32‡	2nd I.F. trans. sec. tuning	0·0003

* Electrolytic. ‡ Pre-set.

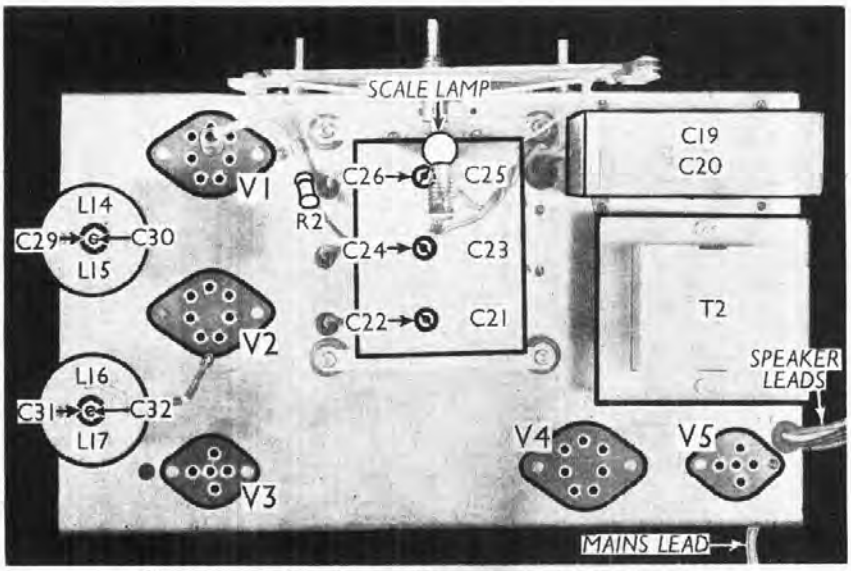


Circuit diagram of the Bush SAC21 A.C. superhet. S6, S7, S8 are the "peaceful tuning" and tone control switches, ganged together in a rotary unit fitted at the front of the chassis.

Resistances		Values (ohms)
R1	V1 anode decoupling	10,000
R2	V1 cont. grid series resistance	250
R3	V1 fixed G.B. resistance	250
R4	V1 cont. grid decoupling	1,000,000
R5	V1 osc. grid resistance	30,000
R6	V1 and V2 S.G.'s and osc. anode H.T. feed	20,000
R7	V2 cont. grid series resistance	250
R8	V2 cont. grid decoupling	1,000,000
R9	V2 fixed G.B. resistance	250
R10	V2 anode decoupling	10,000
R11	I.F. stopper	50,000
R12	Manual volume control	500,000
R13	A.V.C. circuit decoupling	1,000,000
R14	A.V.C. diode load	1,000,000
R15	A.V.C. delay voltage potential divider	100,000
R16		1,500
R17		10,000
R18	V4 grid I.F. stopper	100,000
R19	V4 grid resistance	500,000
R20	V4 auto. G.B. resistance	150
R21	Part of tone control filter	10,000*

* 20,000 Ω in some early chassis.

Other Components		Values (ohms)
L1	Aerial coupling coils	1·5
L2		7·0
L3	Band-pass primary coils	3·0
L4		12·0
L5	Band-pass coupling coils	3·5
L6		0·5
L7	Band-pass secondary coils	3·0
L8		12·0
L9	Image suppression coil	Very low
L10	Oscillator tuning coils	3·5
L11		8·5
L12	Oscillator anode coils	3·5
L13		
L14	1st I.F. trans. Pri.	110·0
L15	1st I.F. trans. Sec.	110·0
L16	2nd I.F. trans. Pri.	60·0
L17	2nd I.F. trans. Sec.	60·0
L18	Speaker speech coil	1·75



Plan view of the chassis. Note the dual I.F. trimmers.

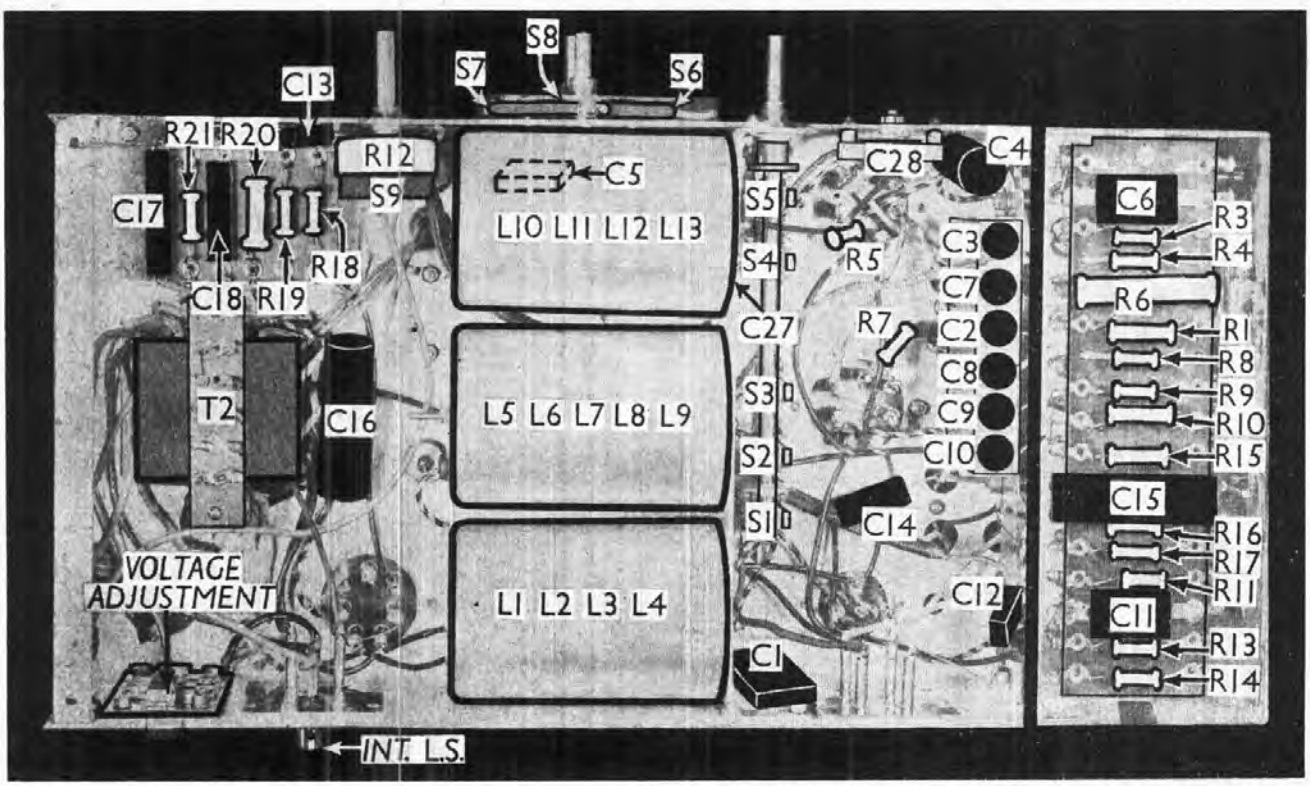
Other Components (Contd.)		Values (ohms)
L19	Hum neutralising coil	0·2
L20	Speaker field winding	2000·0
T1	Speaker input trans. Pri.	600·0
	Speaker input trans. Sec.	0·35
T2	Mains trans. Pri. total	25·0
	Mains trans. Heater sec.	0·05
	Mains trans. Rect. heat. sec.	0·1
	Mains trans. H.T. sec.	600·0
S1-S5	Waveband switches	—
S6	Interstation noise suppressor switch	—
S7, S8	Tone control switches	—
S9	Mains switch (ganged R12)	—

DISMANTLING THE SET

A detachable bottom is fitted to the cabinet, and by removing it (eight round-head wood screws) access can be gained to most of the components under the chassis.

Removing Chassis.—Should it be necessary to remove the chassis from the cabinet, remove the back and the four control knobs (recessed grub screws). Free the speaker leads from the two clips on the side of the cabinet and remove the four chassis fixing bolts (with

(*Continued overleaf*)



Under-chassis view. The strip at the right shows the components on the right-hand side of the paxolin panel. C5 is inside the top screening can. The positions of S6, S7 and S8 are roughly indicated.

BUSH SAC21 (continued)

large metal washers), the heads of which are underneath the cabinet. The chassis can now be withdrawn to the extent of the speaker leads, which is adequate for normal purposes.

To remove the chassis entirely, unsolder the leads from the speaker terminal panel, when the chassis can be withdrawn. *When replacing* the following is the code to follow, numbering the tags from top to bottom:—1 and 2 joined together, red; 3, black; 4, brown; 5, yellow; 6, blue.

Removing Speaker.—To remove the speaker, remove the nuts and washers from the four bolts holding the speaker to the sub-baffle. By tilting it so that the bottom comes out first, it can then be freed.

VALVE ANALYSIS

Valve voltages and currents given in the table below were measured with the receiver operating on A.C. mains of 225 V, with no aerial connected, the volume control at maximum and the tuning condenser at maximum, the wavechange switch being in the L.W. position. The "Peaceful Tuning" switch was in position 1.

Voltages were read on the 1,200 V scale of an Avometer, using the chassis as negative.

Valve	Anode Volts	Anode Current (mA)	Screen Volts	Screen Current (mA)
V1 PC1*	180	2·4	70	0·2
V2 VP1	195	4·0	70	1·0
V3 2D1A				
V4 Pen4VB	210	36·0	240	4·0
V5 1W	305†			

* Osc. anode (G2) 80 V, 2·2 mA.
† Each anode, A.C.

GENERAL NOTES

Switches.—The wavechange switches, **S1-S5,** are in a single unit, seen in the under-chassis view, where they are clearly indicated. They are all *closed* on the M.W. band, and *open* on the L.W. band.

S6, S7 and **S8** are the "peaceful tuning" and tone control switches, ganged in a unit fitted to the front of the chassis. Their positions are indicated roughly in the under-chassis view. In each position of the control knob only one of the switches opens. In position 1 **S8** opens; position 2 **S7** opens; position 3, **S6** opens.

In case of trouble with these switches, make sure that the paxolin panel carrying them has not warped, causing one or other of the switches to be shorted to chassis.

S9 is the Q.M.B. mains switch, ganged with the volume control **R12.**

Coils.—These are in five screened units. The signal frequency and oscillator units are beneath the chassis. The central one, containing the band-pass coils **L5-L8,** also includes **L9,** the image suppression coil, the coupling of which is adjustable by means of the nut on the screwed rod projecting through the top of the screen. The oscillator unit also contains the fixed condenser **C5** and the L.W. trimmer **C27.** The latter is adjustable through a hole in the metal partition carrying the coils.

The screens of these units are held by bayonet catches, which are punched at the works to prevent unauthorised removal of the screens. The insertion of a thin screwdriver as a lever will be sufficient to permit the screens to be rotated and pulled off. The oscillator coil screen can only be taken off after the volume control and switch have been temporarily removed from the front of the chassis to provide clearance.

The I.F. coils are on top of the chassis and the screens are easily removable by undoing the nuts (with washers) on the screws projecting through the tops of the screens. The trimmers are of the dual type, with hexagonal nuts operating the primary trimmers, and central grub screws operating the secondary trimmers.

Scale Lamp.—This is an Osram M.E.S. type, rated at 6.2 V, 0.3 A.

External Speaker.—This should be of the high resistance type (6,000-8,000 Ω), and should be plugged into the sockets provided at the rear of the chassis. The internal speaker can be silenced by unplugging the plug from the "Int. L.S." socket at the rear of the chassis. This should not be done until the external speaker has been connected up.

Condensers C19, C20. These are two 8 μF dry electrolytics in a single unit mounted on top of the chassis. They have a common negative (black) lead, and separate positives (red).

Condenser C28.—This trimmer, at the front of the chassis, is a single unit, though it is fitted with the dual type of adjustment. Actually, it is the hexagonal nut alone which adjusts the condenser.

HINTS AND PROBLEMS

Unusual Source of Hum

In modernising a rather out-of-date "quality" receiver, which had an exceptionally efficient smoothing system, an annoying background of hum became evident after completion, which could not be traced directly to any of the alterations, but which was finally traced to the fact that the air gap in one of the constant-inductance smoothing chokes had become closed up.

The slightly higher current consumption of the altered receiver, and consequent reduction of inductance of the choke due to the air gap being closed, was sufficient to reduce the efficiency of the smoothing system.—W. E. M.C.

Replacement Scale Lamps

Many modern receivers are fitted with M.E.S. (miniature Edison screw) type bulbs rated at 6.3 V, 0.3 A, fed from one of the 4 V heater windings of the mains transformer. The reason for the use of bulbs of this voltage is that their life, when operated from a 4 V A.C. supply, will be considerably longer than that of 4 V or 4.5 V bulbs.

Some receivers are still fitted with lower voltage bulbs, and old sets are often found with 3.5 V bulbs, which have quite a short life under these conditions.

It is a good plan to replace them with standard 6.3 V types, thus ensuring a much longer life.

Battery receivers fitted with scale lamps generally employ 2.5 V bulbs, of fairly low consumption.

It is advisable to fit bulbs of a well-known make, cheap unnamed types generally being unreliable and of short life. The extra cost is small, and is soon repaid.

Earth Faults

Although most modern receivers, particularly mains-operated types, will work quite well without an earth connection, there is no doubt that a good earth connection is still desirable, particularly where electrical interference is troublesome.

This is a point which should be explained to new set owners when installing a receiver. A good connection to a *main* water pipe, or to an earth tube or plate in moist soil, is still the best form of earth, and earths made to gas pipes, subsidiary water pipes, radiators, electrical conduit, etc., should be viewed with suspicion.

We recently heard of a case where a powerful set (not incorporating A.V.C.) was subject to fluctuations in volume which could not be traced to any fault in the set itself, or in the aerial. The earth also seemed satisfactory, and the wire was properly bonded to a galvanised pipe.

Further inspection revealed the fact that the pipe was part of the gas system. The receiver was working correctly when the service engineer called, but it was noticed that when a heavy person walked about the room the fluctuations in volume occurred. The service engineer at once suspected the earth, and being an enthusiast, secured permission to pull up a few floor-boards. He then found that at one point the gas pipe crossed over a water pipe. Normally the two were touching, but when a weight was placed on one of the floor joists, to which the water pipe was secured, the two pipes separated.

Obviously, the gas pipe was not a satisfactory earth, but was improved when it touched the water pipe.

The engineer transferred the earth connection to the water pipe, and the trouble was cured. Before replacing the floor-boards, however, he separated the two pipes so that they could not touch, thus avoiding any possibility of scratching noises in the set.

It is not suggested that in similar cases floor-boards should be removed to reach the source of the trouble, but it is a good plan to try a new earth, if only of a temporary nature, to see whether the fault can be cured.