"TRADER" SERVICE SHEET

FERGUSON-771

The Ferguson 771 table model.

HE Ferguson 771 "Pressabutton" receiver is a 4-valve (plus rectifier) AC 3-band superhet with pressbutton trimmer tuning for seven stations and press-button switches for gramophone and wave-change purposes. It is suitable for mains of 200-250 V, 50-100 c/s, and has a short-wave range of 16-50 m, while provision is made for the connection of an external speaker.

An identical chassis is fitted in the 774 Console, but this Service Sheet was prepared on a 771.

Release date for both models: August,

Original prices: 771, £12 1s. 6d.; 774, £15 15s.

CIRCUIT DESCRIPTION

Throughout the circuit diagram the switches associated with the press-buttons have been numbered according to a code which indicates their functions, and once the code has been grasped the action of the switches can be read off from the circuit diagram.

As the switches that are controlled by a single press-button fall naturally into groups, each switch in the group bears the group number. For instance, in the aerial circuit, the SW button controls all the switches in group one, which includes S1a, S1b, S1c and S1x; in the oscillator circuit, this button controls group eighteen: S18a, S18b and S18x.
For group two (MW manual button)

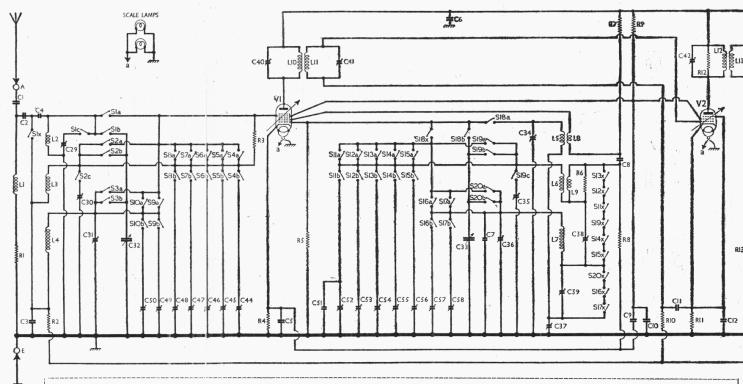
we have in the aerial circuit S2a, S2b and

S2c; and in the oscillator circuit group nineteen: \$19a, \$19b, \$19c and \$19x.

The LW manual button controls groups three (aerial circuit) and twenty (oscillator circuit). The remaining seven pressbuttons control the automatic tuning switch groups, five of which are MW, and two LW.

The number, therefore, indicates to which group the switch is attached. The suffix letters a, b, c and x indicate the action of each switch when the button is pressed. Switches bearing the suffix a, b or c close when the button is pressed, while those bearing the suffix x open. When the button is released by pressing another button, the position is reversed, so that it must be borne in mind that an "x" switch is always closed except when its button is depressed. S1x, for instance, which is operated by the SW button, is closed when any MW or LW button is depressed.

Aerial input is fed on MW and LW via series condenser C1 to coupling condensers C2, C3, which form a potential divider via \$1x, that portion of the signal which appears across C3 being coupled to the tuning coils L3 (MW) and L4 (LW). On SW, input is via C1 and coupling condensers C2, C4 to tuning coil L2, S1x then



Circuit diagram of the Ferguson 771 table and 774 console "Pressabutton" superhets. All the switches with the exception of S22 are press-button operated, and they are code-numbered in the diagram to show their action. The coding is fully explained at the beginning of "Circuit Description." Differences in early models are described under "Chassis Divergencies" overleaf.

FERGUSON 771

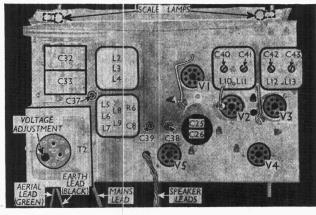
being open. Manual tuning is effected in the conventional manner by the variable condenser G32 connected to the appropriate coil via switches S1b (SW), S2b (MW) and S3b (LW), V1 tetrode control grid being connected similarly via switches S1a (SW), S2a (MW) and S3a (LW).

Automatic tuning is effected by pressing one of the automatic press-buttons which, in the aerial circuit, are associated with switches numbered 4 to 10, numbers 4 to 8 being connected to the MW coil and 9 and 10 to the LW coil, thus applying one of the automatic tuning trimmers across the appropriate tuning coil according to which button is depressed.

Resistor R3 is connected between V1 tetrode CG and L3 to prevent the grid becoming free when all switches are open.

First valve (V1, 6A8G) is a heptode operating as frequency changer with electron coupling. Oscillator grid coils L5 (SW), L6 (MW) and L7 (LW) are tuned by C33 via switches S18a, b (SW), S19b (MW) and S20b (LW) for manual tuning, or by one of the trimmers C52 to C58 for automatic tuning via switches numbered 11 to 15 (MW) and 16, 17 (LW). Normal parallel trimming by C34 (SW), C35 (MW—manual only) and C7, C36 (LW); series tracking by C37 (SW), C38 (MW) and C39 (LW). Reaction coupling by coils L8 (SW), L9 (MW) and by the common impedance of trackers C37, C38 in grid and anode circuits via C8 (LW). When a MW station is being received, auto or manual, one of the switches S11x to S15x and S19x, whichever is associated with the depressed button, is open, while if a SW or LW

Plan view of the chassis. The tracker adjustments are indicated. R6 and C8 are inside the L5-L9 coil unit screen.



station is being received they are all closed, their buttons being out; when a LW station is being received S16x, S17x or S20x will be open, all three being closed when operating on SW or MW.

Second valve (V2, 6U7G) is a variable-

Second valve (V2, 6U7G) is a variablemu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings C40, L10, L11, C41 and C42, R12, L12, L13, C43.

Intermediate frequency 465 kc/s.

Diode second detector is part of double diode triode valve (V3, 6Q76), both diode anodes being strapped together. Audio frequency component in rectified output is developed across load resistor R13 and passed via IF stopper R14, AF coupling

condenser C16, manual volume control R16 and further AF coupling condenser C17, to CG of triode section, which operates as AF amplifier. IF filtering by C13, R14, C14 in diode circuit, C18 in grid circuit and C19 in the triode anode circuit. Variable tone control by C20, R19 in anode circuit. Provision for connection of gramophone pick-up across C16, R16 via switch S21a, the a indicating of course that the switch closes when the "GR" button is depressed.

DC potential developed across R13 is fed back through decoupling circuits as GB to FC (except on SW) and IF valves, giving automatic volume control.

Resistance-capacity coupling by R18, C21 and R20 between V3 triode and beam tetrode output valve (V4, 6V6G). Fixed tone correction in anode circuit by RC network C23, R22 and C22, R21. Provision for the connection of a nigh impedance external speaker in anode circuit.

HT current is supplied by full-wave rectifying valve (V5, 5Y3G). Smoothing by speaker field L16 and electrolytic condensers C25, C26. Mains RF filtering by C28.

GB potential for V3 is obtained from the drop along resistor R26 in the negative HT lead to chassis. On gram, this potential is also applied as a muting bias to the signal diode anode by the closing of \$212.

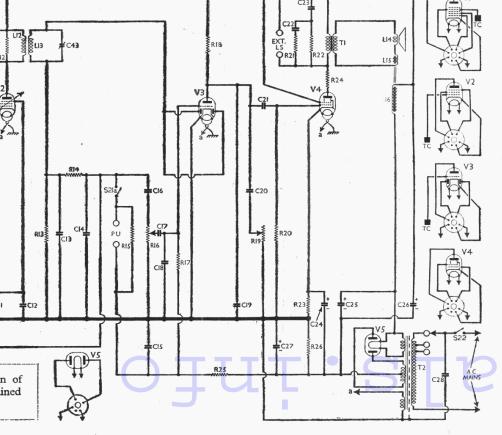
VALVE ANALYSIS

Valve voltages and currents given in the table below are those quoted in the makers' manual. Readings were taken on a receiver working from 240 V AC mains, the voltage adjustment being appropriately set. The receiver was tuned to the longest wavelength on the MW band, while the A and E leads were joined together and the volume control was at minimum.

Voltages were measured on a meter having a resistance of 1,000 ohms per

Valve	Anode	Anode	Screen	Screen
	Voltage	Current	Voltage	Current
	(V)	(mA)	(V)	(mA)
V1 6A8G V2 6U7G V3 6Q7G V4 6V6G V5 5Y3G	$\begin{cases} 240 \\ \text{Oscil} \\ 138 \\ 240 \\ 115 \\ 220 \\ 315 \\ \dagger \end{cases}$	$\left. egin{array}{c} 5 \cdot 2 \\ 1 ext{ator} \\ 7 \cdot 2 \\ 0 \cdot 4 \\ 35 \cdot 0 \\ - \end{array} \right\}$	90 90 240	3·4 2·1 — 3·2 —

† Each anode, AC.



Radio

Supplement to The Wireless & Electrical Trader, July 1, 1944

volt, and its negative lead was connected to chassis in each case.

If **V2** should become unstable when its screen current or anode is being measured, it can be stabilised by connecting a noninductive condenser of about 0.1 4F from grid (top cap) to chassis.

DISMANTLING THE SET

Removing Chassis.—Remove the two control knobs (pull-off) and the eleven press-buttons (pull-off);

remove the four bolts (with washers and lock-washers) holding the chassis to the bottom of the cabinet.

The chassis may now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free the chassis entirely, unsolder from the connecting panel on the speaker transformer the leads connecting it to chassis.

When replacing, take care that the pressbutton plungers do not foul the front of the cabinet, and fit the buttons in the following order, reading from left to right: National, Midland, London, Gram, SW, MW, North, Athlone, LW, Luxembourg, Droitwich (noting the differences in early chassis described under "Chassis Divergencies" in col. 4.

A felt washer should be fitted between each of the two control knobs and the cabinet

The speaker leads should be connected as follows, reading from top to bottom, but using the numbers marked beside the tags on the connecting panel: F and 1 (joined together), red; 2, no tag fitted; 3, blue; F, red/white.

Removing Speaker.—The speaker can be

removed from the cabinet by removing the nuts from the four screws holding it to the sub-baffle.

When replacing, see that the transformer is on the left. If the leads have been unsoldered, they should be connected as previously described.

Switches .- All the exception of \$22, the m the press-button type, in a single double-side side the front of the ch controlled by each assigned a number, fo letter a, b, c or x. The close when their butto the x switches open w pressed.

The action of the sw in detail under "Circui

The switch unit is under-chassis view, bu of the individual swit on this side of this s sulted. These diagram sides of the switch unit. The lower one shows the switches as seen when looking at the underside of the chassis, while the upper one shows the switches on the unit which are normally hidden from view by the chassis deck.

To examine the upper side, the whole switch unit must be removed. First unsolder the fourteen leads from the pre-set station trimmers tags and remove the trimmer assembly (two screws). Now code in a rough sketch the remaining external connecting wires to the switch unit and unsolder them. Then remove the screws holding the two banks of three trimmers (above and below the switch unit) and the two screws holding the unit to the chassis. When replacing, note that each wire from the switch unit to the preset station trimmers goes straight across

to the nearest tag.

\$22 is the QMB mains switch, ganged with the volume control R16.

Scale Lamps .- These are two National Union miniature bayonet cap types, marked N51. The rating is 6-8 V, 0.2 A.

External Speaker.—Two sockets are

provided at the rear of the chassis for a (Continued in col. 4)

GENERAL NOTES

NOTES	СО	MPONENTS AND VA	LUES
switches, with the nains switch, are of and are contained		RESISTORS	Values (ohms)
d unit mounted in- leassis. The switches press-button are bellowed by a suffix a, b and c switches in is pressed, while then their button is	R1 R2 R3 R4 R5 R6 R7 R8 R9	Anti-modulation damping V1 tetrode CG decoupling V1 tetrode CG resistor V1 fixed GB resistor V1 osc. CG resistor Osc. MW reaction damping V1 osc. anode HT feed V1 osc. CG resistor V1, V2 SG's HT feed	10,00 $500,00$ $3,000,00$ 15 $500,00$ $2,50$ $25,00$ $50,00$ $25,00$
witches is explained it Description." is indicated in our at for identification teches the diagrams sheet must be con- ms are of the two	R10 R11 R12 R13 R14 R15 R16 R17 R18	V2 CG decoupling V2 fixed GB resistor 2nd IF trans. pri. damping V3 diodes load resistor IF stopper Gramophone PU shunt Manual volume control. V3 triode CG resistor V3 triode anode load Variable tone control	500, 00 600,00 500,00 25,00 25,00 500,00 500,00 100,00

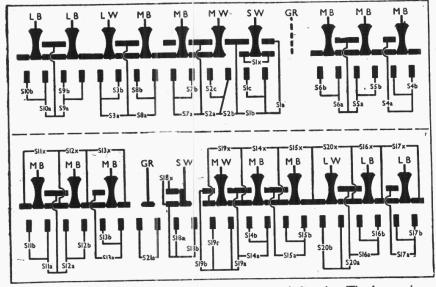
R7	V1 osc, anode HT feed	25,000
R8	V1 osc. CG resistor	50,000
R9	V1, V2 SG's HT feed	25,000
R10	V2 CG decoupling	500,000
R11	V2 fixed GB resistor	300
R12	2nd IF trans. pri. damp-	
11.12		600,000
D 10	V3 diodes load resistor	500,000
R13		25,000
R14	IF stopper	25,000
R15	Gramophone PU shunt	500,000
R16	Manual volume control	
R17	V3 triode CG resistor	500,000
R18	V3 triode anode load	250,000
R19	Variable tone control	100,000
R20	V4 CG resistor	500,000
R21) Parts of fixed tone cor- \(\)	10,000
R22	rector	10,000
R23	V4 GB resistor	300
R24	V4 anode stopper	100
R25	V3 CG decoupling	250,000
R26	V3 GB resistor	35
1020	V5 GB Tesistor	
	,	
	CONDENSERS	Values
		(μF)
C11	A	0.0005
C1	Aerial series condenser	0.0000

10,000 500,000 3,000,000 150 500,000

2,500

	CONDENSERS	Values (µF)
C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C21 C21 C21 C22 C23 C24* C25*	Aerial series condenser Aerial circuit LW coup- ling potential divider Aerial SW coupling V1 cathode by-pass HT circuit RF by-pass Osc. LW fixed trimmer V1 osc. anode coupling V1 SG RF by-pass V1, V2 SG's decoupling V2 cathode by-pass IF by-pass condensers V3 triode CG decoupling AF coupling condensers to V3 triode IF by-pass condensers Part tone control V3 triode to V4 coupling Parts of fixed tone cor- rector V4 cathode by-pass HT smoothing condensers {	$\begin{array}{c} 0.0005 \\ 0.0001 \\ 0.0004 \\ 0.00002 \\ 0.1 \\ 0.00006 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00025 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.00015 \\ 0.0001$
C27* C28 C29‡	V3 GB circuit by-pass Mains RF by-pass Aerial SW (manual) trim-	25·0 0·01
C30‡	Mer Aerial MW (manual) trimmer	
C31‡ C32† C33† C34‡ C35‡	Aerial LW trimmer Aerial manual tuning Oscillator manual tuning Osc. circ. SW trimmer Osc. MW (manual) trimmer	
C36‡ C37‡ C38‡ C39‡	Osc. circ. LW trimmer Osc. circ. SW tracker	=
C40‡ C41‡ C42‡ C43‡ C44‡	Osc. circ. LW tracker 1st IF trans. pri. tuning 1st IF trans. sec. tuning 2nd IF trans. pri. tuning 2nd IF trans. sec. tuning	=
C45‡ C46‡ C47‡ C48‡	Aerial circuit MW auto- matic tuning trimmers	_
C481 C491 C501 C51 C521	Aerial circuit LW auto- matic tuning trimmers	0.00005
C531 C541 C551 C561	Oscillator circuit MW automatic tuning trimmers	-
C57‡ C58‡	Scillator circuit LW auto tuning trimmers	-,

* Electrolytic. † Variable. ‡ Pre-set.



Diagrams showing both sides of the press-button switch unit. The lower view is that seen from beneath the chassis, and the upper one is that facing the underside of the chassis deck.

0	THER COMPONENTS	Approx. Values (ohms)
L1	Anti-modulation choke	20.0
L2		3.0
L_3	Aerial MW tuning coil Aerial LW tuning coil	17.0
L4	Osc. SW tuning coil	0.1
$^{ m L5}_{ m L6}$	Osc. MW tuning coil	3.0
L7	Osc. LW tuning coil	5.0
L8	Osc. SW reaction	0.5
L9	Osc. MW reaction	1.0
L10) (Pri	9.0
Lii	1st IF trans. Sec	11.0
$\tilde{L}12$	(Dri	12.0
Lii	2nd IF trans. Sec.	9.0
L14	Speaker speech coil	2.0
$\tilde{L}15$	Hum neutralising coil	0.15
L16	Speaker field coil	1,800.0
T1	Speaker input & Pri	500.0
	trans. \ \ Sec	0.5
	(Pri., total	30.0
T2	Mains Heater sec	0.05
	trans. Rect. heat. sec.	0.1
	(HT sec., total	360.0
S1a,)	
b,c,x	SW manual button groups	
S18a,		
b, x	(
S2a, b, c		-
S19a,	MW manual button groups	
b, c, x)	
S3a, b	1	
S20a,	LW manual button groups	-
b, x) I ii III II	
S4a, b)	
to		
S8a, b		
S11a,	MW automatic button	
b, x to	groups	
S15a,		
b, x	,	
S9a, b		1,00
S10a,		
b:	THE automotic button	
0110-	LW automatic button groups	_
S16a,		
b, x	groups	1
b, x S17a,	groups	
b, x	Gram PU switch	

General Notes (continued)

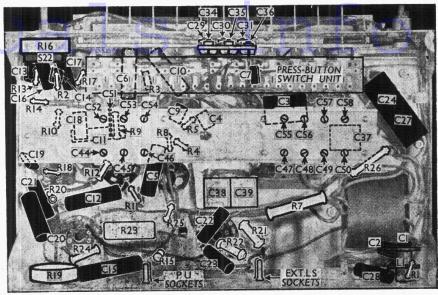
high impedance (about 5,000 Ω) external speaker.

Condensers C25, C26.—These are two dry electrolytics in a single tubular metal case on the chassis deck. Beneath the chassis there are three tags. That spotted black is the common negative; that spotted red is the positive of C25 (16 μ F); while the plain tag is the positive of C26 $(8 \ \mu F)$.

Condensers C24, C27.—These are two dry electrolytics (35 V working) in a single carton beneath the chassis, having a common negative (black) lead. The red lead is the positive of C24 (5 μ F), while the yellow lead is the positive of C27 $(25 \mu F)$.

CHASSIS DIVERGENCIES

A few chassis went out at the beginning of the run with a rather different circuit. Our sheet has been prepared from one of the later chassis, which can be identified by the fact that the screw holding the L1 unit at the back of the chassis has a black washer underneath its head, while the early models have no such washer. The arrangement of the press-buttons is also different. Reading from left to right, looking at the front of the set, our chassis has buttons as follows: Three MW preset; gram; SW; MW; two MW pre-set; LW; two LW pre-set. The arrangement in the early chassis was: Three MW preset; Gram; SW; MW; LW; two MW pre-set; two LW pre-set.



Under-chassis view. The press-button switch unit is shown in detail in the diagrams at the foot of columns 1 and 2 opposite. The pre-set station trimmers are in two rows just behind the switch unit.

In early chassis also, the aerial coupling on SW was different, the bottom end of L2 being returned to the junction of R2, C3 and S1x. The oscillator circuit switching and coil arrangements were also slightly different, and trackers C37 and C38 were interchanged in position.

In some chassis, too, the fixed tone corrector may be modified, R21, C22 being omitted, and C51, in the oscillator auto-tuning bank, may not be present.

CIRCUIT ALIGNMENT

IF Stages.—Remove the grid (top cap) connection of V1, and connect a 500,000 Ω resistor between the connection and the cap. Connect signal generator between the cap (via a 0.00025 µF condenser) and Switch set to MW, and turn chassis. gang and volume control to maximum.

Feed in a 465 kc/s (645.16 m) signal, and adjust C43, C42, C41 and C40 for maximum output. Re-check these settings, then remove the resistor and replace top cap.

RF and Oscillator Stages .- With the gang at maximum, pointer should be at the right hand terminations of the horizontal scales. Connect signal generator to A and E leads, via a suitable dummy aerial. Turn volume control to maximum.

sw.—Since the SW tracker is in series with the MW and LW trackers it is essen-

tial to align the SW band first. Switch set to SW, tune to 15 Mc/s on scale, and feed in a 15 Mc/s (20 m) signal. Adjust C34 for maximum output, using the peak involving the lesser trimmer capacity. Now adjust C29 for maximum output.

Feed in a 6 Mc/s (50 m) signal, tune it in, and adjust C37 for maximum output, while rocking the gang for optimum results. Return to 15 Mc/s and re-check C29 and C34. Repeat until no further improvement results

MW.—Switch set to MW and tune to 250 m on scale. Feed in a 250 m (1,200

kc/s) signal, and adjust **C35**, the **C30** for maximum output. Feed in a 520 m (580 kc/s) signal, tune it in, and adjust C38 for maximum output, while rocking the gang for optimam results. Return to 250 m and re-check C35 and C30. Repeat until no further improvement results.

LW.—Switch set to LW, and tune to 1,250 m on scale. Feed in a 1,250 m (240 kc/s) signal, and adjust C36, then C31, for maximum output. Feed in a 2,000 m (150 kc/s) signal, tune it in and adjust C39 for maximum output, while rocking the gang for optimum results. Return to 1,250 m and re-check C36 and C31. Repeat until no further improvement results.

STATION SETTING

In the model 771 the station trimmers may be adjusted through holes in the bottom of the cabinet. In Console 774 it is necessary to withdraw the chassis to re-set the trimmers.

Looking at the front of the set, the first three buttons counting from the left cover wavebands of 200-300 m, 250-350 m, and 300-400 m respectively. The seventh and eighth buttons cover 350-500 m and 400-550 m. The tenth and eleventh buttons (LW) cover 1,000-1,600 m and 1,400-

tons (LW) cover 1,000-1,000 m and 1,400-2,000 m respectively.

The trimmer screws are indicated in our underchassis view. Thus C44 and 652 belong to the first button (200-300 m), while C50 and C58 belong to the eleventh button (1,400-2,000 m). Select the button covering the wavelength of the required station, and adjust the corresponding oscillator trimmer until the station is heard. Then adjust the corresponding aerial trimmer for maximum output. Finally readjust both trimmers.

for maximum output. Finally readjust both trimmers.

If the station to which the button is being adjusted is not very strong, it may be difficult to hear it on the oscillator trimmer while its aerial trimmer is far off tune. It may then he necessary to tune both trimmers to the nearest strong known station, and then to take the aerial trimmer up or down in small steps, searching on the oscillator trimmer for the required station at each step.

Alternatively, a signal generator may be used for rough adjustment, and then final check can be made on the station itself.

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