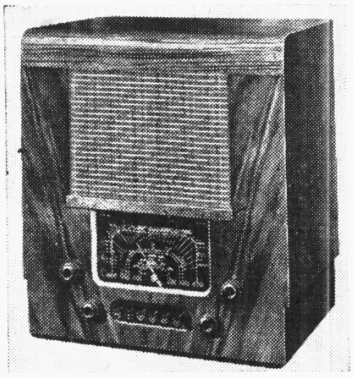
Supplement to The Wireless & Electrical Trader, March 8, 1941

"TRADER" SERVICE SHEET 509

McMICHAEL 393

3-BAND BATTERY SUPERHET



SIX mechanical press-buttons, four-position tone control, including variable selectivity, and QPP output are provided in the McMichael 393 receiver, a 4-valve 3-band battery superhet.

Provision is also made for connection of a gramophone pick-up and an external speaker. An IF filter is connected across the aerial circuit. Grid bias is automatic.

Release date : *August*, 1939.

CIRCUIT DESCRIPTION

Aerial input is via coupling coils **L2** (SW) and **L3** (MW and LW) to single tuned circuits **L4, C34** (SW), **L5, C34** (MW) and **L6, C34** (LW). Coupling is modified by "top" coupling condenser **C2** on MW. On LW, **S4** closes, and coupling occurs across **L3** and **C4** which are then in parallel, via **C3.** On MW, **S5** closes and short-circuits **C4; C3** is then **V1** pentode CG decoupling. An IF filter **C1, L1,** whose coil has an adjustable iron-dust core, is shunted across the aerial circuit together with resistance **R1.**

First valve **(V1, Mazda metallised TP25)** is a triode-pentode operating as frequency changer with internal coupling. Triode oscillator anode coils **L9** (SW), **L10** (MW) and **L11** (LW) are tuned by **C38.** Parallel trimming by **C17, C39** (SW), **C36** (MW) and **C16, C37** (LW); series tracking by **C13** (SW), **C14** (MW) and **C15** (LW). Reaction by grid coils **L7,** augmented by common impedance of **C13** in grid and anode circuits (SW) and **L8,** via stabilising resistances **R6** (MW and LW) and **R5** (all bands).

Second valve **(V2, Mazda metallised VP23)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C40, C9, L12, L13, L14, C10, C41** and **C42, L15, L16, C43.**

Variable selectivity is achieved by reversing the sense in which the small coupling coil **L12** is connected, according to which of the switches **S17** and **S18** is closed.

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve **(V3, Mazda metallised HL23DD).** Audio frequency component in rectified output is developed across load resistance **R12** and passed via AF coupling condenser **C23,** manual volume control **R13** and grid stopper **R14** to CG of triode section, which operates as AF amplifier.

IF filtering by **C21, R11, C22** in diode circuit, and **C24** in triode anode circuit. Provision for connection of gramophone pick-up across **C23, R13.**

Second diode of **V3,** fed from **V2** anode via coupling condenser **C20,** provides DC potentials which are developed across load resistances **R17** and **R18** and fed back through decoupling circuits as GB to FC and IF valves, giving automatic volume control.

Parallel-fed transformer coupling by **R15, C25** and intervalve transformer **T1** between **V3** triode and quiescent push-pull double-pentode output valve **(V4, Mazda QP25).** Four-position tone control by condensers **C26, C27** in conjunction with switches **S19, S20** and the variable selectivity switches **S17, S18.**

Fixed tone correction by **C28, C29** connected between **V4** anodes and chassis. Provision for connection of low impedance external speaker by sockets across the secondary of the internal speaker input transformer **T2.**

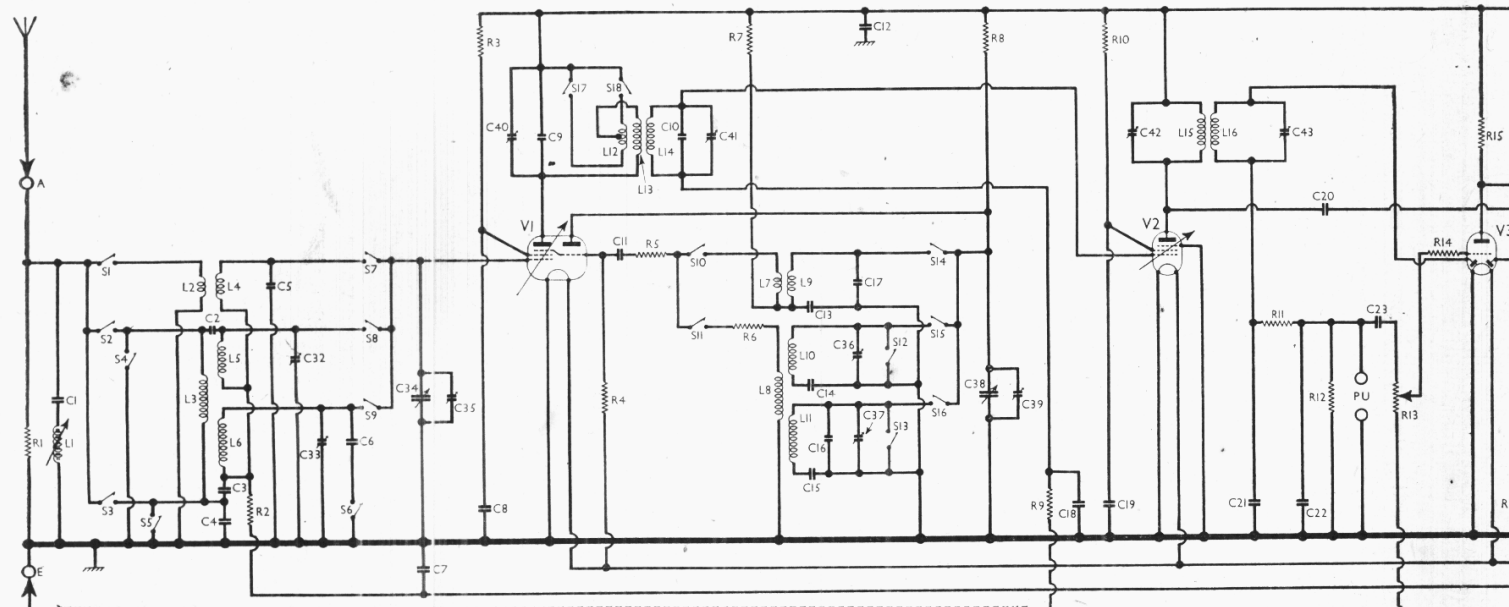
Fixed GB potential for **V1** and **V2,** GB potentials for **V3** triode and **V4,** and AVC delay potential are obtained automatically from drop along resistances **R20** and **R21** which form a potential divider in the negative HT lead to chassis.

DISMANTLING THE SET

Removing the Chassis.—Remove the four control knobs (recessed grub screws) from the front of the cabinet;

remove the three countersunk-head set screws (with large metal washers) holding the chassis to the bottom of the cabinet.

Chassis may now be withdrawn to the



Circuit diagram of the McMichael 393 superhet. Variable selectivity is included, and is associated with the tone control, which has four positions. Grid bias is automatic. Six mechanical press-buttons provide automatic tuning. **S21** closes when any button is pressed.

extent of the speaker leads, which is sufficient for normal purposes.

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

When replacing, connect the speaker leads as follows, numbering the tags on the transformer from top to bottom :

1, yellow ;
2, red ;
3 and 4, no external connection ;
5, yellow.

The black (earthing) lead goes to the tag at the foot of the transformer.

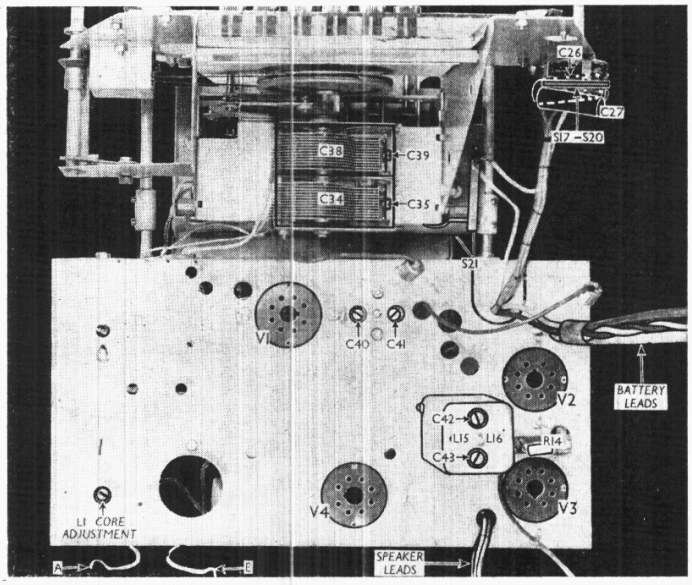
Do not forget to replace the circuit diagram card under the washers on the bottom of the cabinet.

The loose screening cap should be fitted on to **V2** and pressed well home.

Removing Speaker.—Unsolder the four connecting leads ;
remove the four brass nuts holding the speaker to the sub-baffle.

When replacing, the transformer should be on the right, and the leads should be connected as previously indicated.

Plan view of the chassis. **C26** and **C27** are mounted on the tone control switch unit, a diagram of which appears in column 4 overleaf.



COMPONENTS AND VALUES

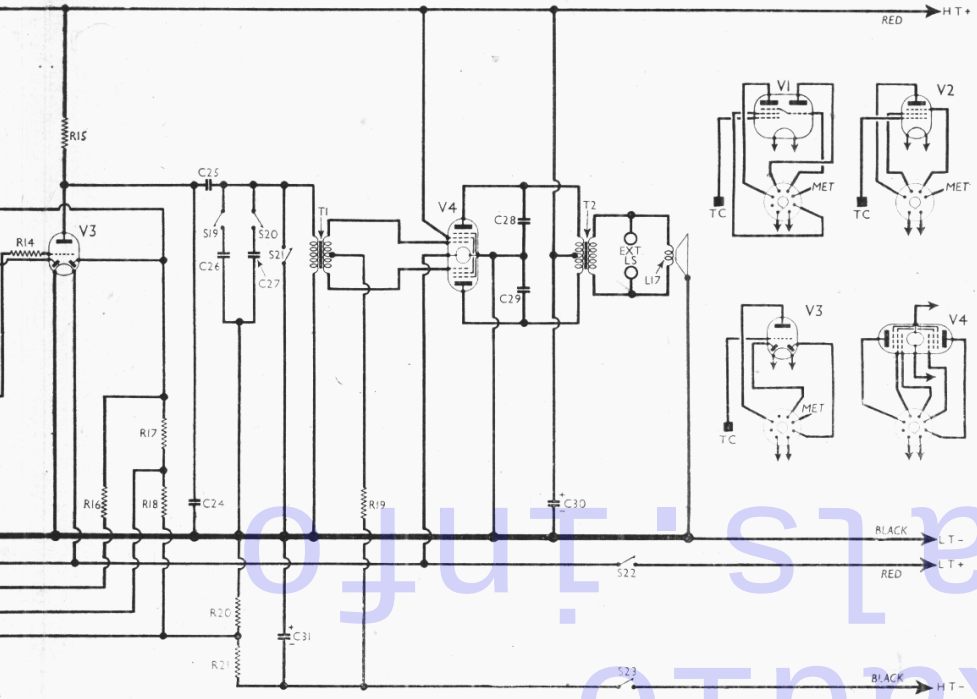
	RESISTANCES	Values (ohms)
R1	Aerial circuit shunt ...	2,000
R2	V1 pentode CG decoupling	500,000
R3	V1 SG HT feed	100,000
R4	V1 osc. CG resistance ...	50,000
R5	Oscillator reaction circuit stabilisers	100
R6		1,500
R7	V1 oscillator anode HT feed resistances ...	20,000
R8		40,000
R9	V2 CG decoupling ...	1,000,000
R10	V2 SG HT feed resistance	200,000
R11	IF stopper	50,000
R12	V3 signal diode load ...	500,000
R13	Manual volume control ...	1,000,000
R14	V3 triode grid stopper ...	100,000
R15	V3 triode anode load ...	50,000
R16	AVC line decoupling ...	500,000
R17	V3 AVC diode load resistances	500,000
R18		500,000
R19	V4 CG's decoupling ...	100,000
R20	V1, V2 fixed GB ; V3 triode and V4 GB ; AVC delay	120
R21		800

	CONDENSERS	Values (μF)
C1	Aerial IF filter condenser	0·0004
C2	Aerial MW top coupling ...	0·000006
C3	Aerial LW coupling condensers	0·1
C4		0·004
C5	Aerial circuit SW trimmer	0·000005
C6	L6 muting on MW ...	0·001
C7	AVC line decoupling ...	0·01
C8	V1 SG decoupling ...	0·1
C9	1st IF transformer fixed trimmers	0·00005
C10		0·00005
C11	V1 osc. CG condenser ...	0·0001
C12	HT circuit RF by-pass ...	0·1
C13	Osc. circuit SW tracker ...	0·0035
C14	Osc. circuit MW tracker ...	0·0005075
C15	Osc. circuit LW tracker ...	0·000168
C16	Osc. circ. LW fixed trimmer	0·00005
C17	Osc. circuit SW trimmer	0·000005
C18	V2 CG decoupling ...	0·1
C19	V2 SG decoupling ...	0·1
C20	Coupling to V3 AVC diode	0·0001

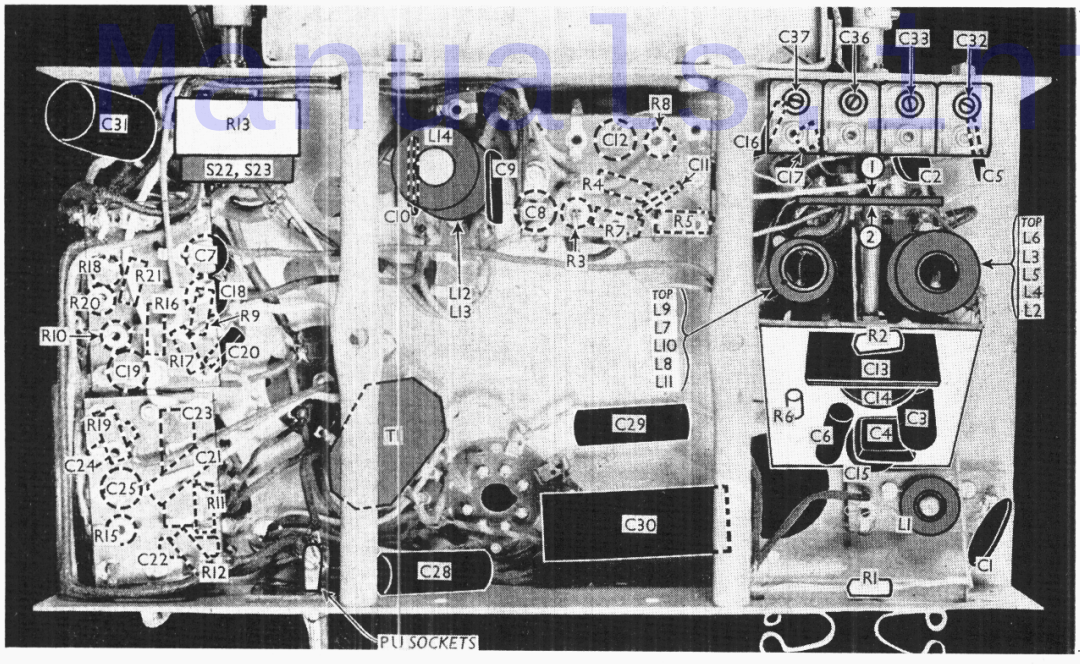
(*Continued next col.*)

	CONDENSERS (*continued*)	Values (μF)
C21	IF by-pass condensers ...	0·0001
C22		0·0001
C23	AF coupling to V3 triode	0·005
C24	IF by-pass	0·0003
C25	AF coupling to T1 ...	0·1
C26	Tone control condensers ...	0·02
C27		0·01
C28	Fixed tone correctors ...	0·001
C29		0·001
C30*	HT reservoir condenser ...	8·0
C31*	Auto GB circuit by-pass ...	50·0
C32‡	Aerial circuit MW trimmer	—
C33‡	Aerial circuit LW trimmer	—
C34†	Aerial circuit tuning ...	—
C35‡	Aerial circuit SW trimmer	—
C36‡	Osc. circuit MW trimmer	—
C37‡	Osc. circuit LW trimmer	—
C38†	Oscillator circuit tuning ...	—
C39‡	Osc. circuit SW trimmer	—
C40‡	1st IF trans. pri. tuning ...	—
C41‡	1st IF trans. sec. tuning ...	—
C42‡	2nd IF trans. pri. tuning	—
C43‡	2nd IF trans. sec. tuning	—

* Electrolytic. † Variable. ‡ Pre-set.



	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial IF filter coil ...	1·7
L2	Aerial SW coupling coil	0·3
L3	Aerial MW and LW coupling coil	18·0
L4	Aerial SW tuning coil ...	Very low
L5	Aerial MW tuning coil ...	2·0
L6	Aerial LW tuning coil ...	21·0
L7	Oscillator SW reaction	0·4
L8	Osc. MW and LW reaction	3·9
L9	Osc. circ. SW tuning coil	Very low
L10	Osc. circ. MW tuning coil	2·2
L11	Osc. circ. LW tuning coil	8·5
L12	Variable selectivity coil, total	1·3
L13	1st IF trans. Pri. ...	12·0
L14		12·0
L15	2nd IF trans. Pri. ...	12·0
L16		12·0
L17	Speaker speech coil ...	2·2
T1	Intervalve trans. Pri. ... Sec., total	500·0 5,000·0
T2	Speaker input trans. Pri., total Sec. ...	600·0 0·15
S1–S16	Waveband switches ...	—
S17, S18	Variable selectivity switches	—
S19, S20	Tone control switches ...	—
S21	Auto muting switch ...	—
S22	LT circ. switch ganged	—
S23	HT circ. switch R13	—



Under-chassis view. Most of the components are grouped about the valves and are hidden by the panels on which they are mounted. They are therefore shown dotted. The assembly just below the two coil units **L2-L6** and **L7-L11** has been artificially tilted to show the components mounted **on it.**

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating with a new HT battery reading 115 V on load. The receiver was tuned to the lowest wavelength on the MW band and the volume control was at maximum, but there was no signal input.

Voltages were measured on the 400 V scale of a model 7 Universal Avometer, chassis being negative.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 TP25	105	0·5	43	0·6
	Oscillator			
	43	1·8		
V2 VP23	105	1·0	41	0·3
V3 HL23DD	70	0·6	—	—
V4 QP25	104†	2·25†	105	1·2

† Each anode.

GENERAL NOTES

Switches.—S1-S16 are the waveband switches, in a single double-sided rotary unit beneath the chassis. The unit is indicated in our under-chassis view, and diagrams showing the two sides of the unit appear in column 3, where side 1 is drawn as seen from the front of the underside of the chassis, and side 2 from the rear. The upper table (column 2) gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and **C** closed.

S17-S20 are the variable selectivity and tone control switches, in a single rotary unit mounted on the scale bracket. It is indicated in our plan view of the chassis, in the top right-hand corner, and shown in detail in the diagram in column 4, where it is drawn as seen from the rear of the chassis. The lower table (col. 2) gives the switch positions for the four settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and **C** closed.

Switch Tables

Switch	SW	MW	LW
S1	C	—	—
S2	—	C	—
S3	—	—	C
S4	C	—	C
S5	—	C	—
S6	—	C	—
S7	C	—	—
S8	—	C	—
S9	—	—	C
S10	C	—	—
S11	—	C	C
S12	C	—	—
S13	—	C	—
S14	C	—	—
S15	—	C	—
S16	—	—	C

Switch	Fld.	Norm.	Bass	Foreign
S17	C	—	—	—
S18	—	C	C	C
S19	—	—	C	—
S20	—	—	—	C

S21 is the press-button muting switch indicated in our plan view beside the tuning gang. It is formed of a flat spring contact and a hinged contact-plate, operated by any of the press-buttons. Its action is to short-circuit **T1** primary, thus muting radio, whenever a press-button is operated.

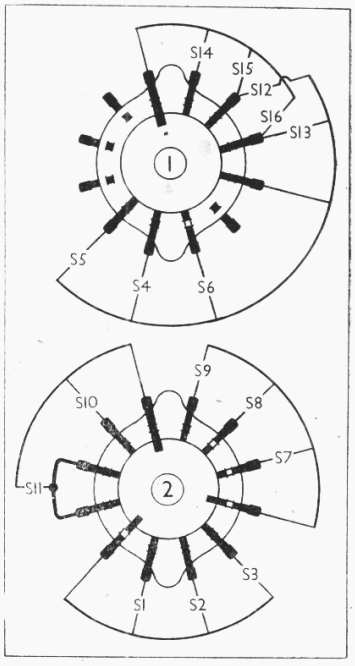
S22, S23 are the QMB LT and HT circuit switches respectively, ganged with the volume control **R13.**

Coils.—The RF and oscillator coils are grouped on two unscreened tubular units and are shown on the right in our under-chassis view. **L2-L6** are the aerial coils, in the right-hand unit; the oscillator coils **L7-L11** are in the left-hand unit.

L1 is the IF filter coil, seen in the lower right-hand corner of our under-chassis view, with its associated condenser **C1.** The core adjustment is reached through a hole in the chassis deck, and is shown in our plan view of the chassis.

The first IF transformer **L12-L14** is an unscreened unit beneath the chassis, while the second IF transformer **L15-L16** is in a screening can on the chassis deck. The trimmers for both transformers are reached from above the chassis and are indicated in our plan view.

External Speaker.—Two sockets are provided on the connecting panel on the speaker transformer for a low impedance (2-4 Ω) external speaker.



Diagrams of the two sides of the wave-change switch unit. *Above :* as seen from front ; *below :* as seen from rear.

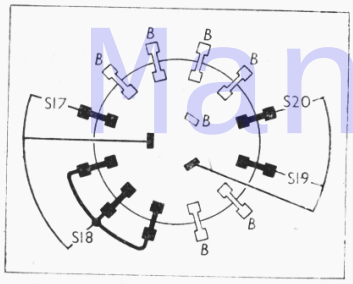


Diagram of the tone control switch unit, as seen when viewed from rear of chassis.

Condenser C30.—This is an 8 μF Dubilier "Drilitic" electrolytic in a tubular cardboard container. It is rated at 120 V DC peak working.

Condenser C31.—This is a 50 μF "Drilitic," also in a tubular cardboard former, rated at 12 V DC peak working.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator between control grid (top cap) of **V1** and chassis, and feed in a 465 KC/S signal. Adjust **C40, C41** and **C42, C43** in turn for maximum output. Re-check these settings.

Transfer signal generator leads to **A** and **E** clips, feed in a strong 465 KC/S signal, and adjust **L1** core for *minimum* output.

RF and Oscillator Stages.—With gang at maximum, pointer should be horizontal. Connect the signal generator to the **A** and **E** clips, via a suitable dummy aerial.

SW.—Switch set to SW, turn gang to minimum, feed in an 18.5 m (16.2 MC/S) signal and adjust **C39** for maximum output. Feed in a 19.6 m (15.3 MC/S) signal, tune to 19.6 m on scale, and adjust **C35** for maximum output.

MW.—Switch set to MW, turn gang to minimum, feed in a 190 m (1,580 KC/S) signal, and adjust **C36** for maximum output. Tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C32** for maximum output.

LW.—Switch set to LW, tune to 1,100 m, feed in a 1,100 m (273 KC/S) signal, and adjust **C37,** then **C33** for maximum output.

There are no tracking adjustments, as tracking is fixed on all bands.

PRESS-BUTTON UNIT

A mechanical press-button unit is employed for automatic tuning. The diagram below shows a sectional view of one of the press-button movements.

The gang condenser spindle is connected up by means of a bell-crank and a system of connecting links to a framework consisting of two rigid parallel rods, A, A, held in end plates B, and the whole frame is arranged to pivot on two bearings.

Rotation of the frame is transmitted to the gang spindle via the crank and connecting links.

Each press-button (of which there are six) actuates a plunger carrying a metal contact plate C, and when the plunger is depressed this plate moves forward until it encounters one or other of the rods in the frame. Further movement of the plunger causes the plate C to push the rod and so rotates the frame (and the gang) until the plate also comes into contact with the other rod.

When this is the case, pressure on the plunger will cause no further rotation of the frame, and the gang is accurately positioned. When the plunger pressure is released, a return spring F carries it back to its normal position, but the frame does not move until another plunger, adjusted for a different station, is pressed.

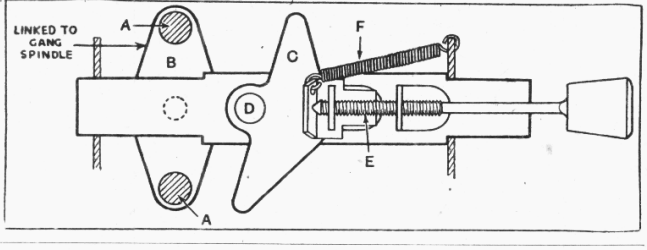
The final position of the frame, and hence the selection of stations, is achieved by making the metal contact plate rotatable, which adjusts the angle of its contact edge relative to the axis of the plunger.

The plate is pivoted at D, and can be clamped in any position by a screw device E, which is locked by screwing up the actual press button.

To adjust for a particular station, the button which is to receive it is unscrewed a turn or so, and the station is tuned in by the manual drive. The button is then fully depressed, and since the metal contact plate C is now free, it takes up its correct position relative to the parallel rods A, A of the frame, without rotating the frame. The button is now screwed up, and the contact plate is firmly locked in position, so that future operation of the particular button will always rotate the frame to the correct angle for the reception of the chosen station.

At the same time as a button is depressed, the same hinged plate which rotates and closes **S21** to mute radio, also operates a lever which releases the manual slow-motion drive, and allows the gang to be rotated easily by the press-button. To re-engage the manual drive, the tuning control knob must first be pressed in.

Diagram showing the essential parts of the mechanical press-button system employed.



MORE ABOUT THE AC/TP SUBSTITUTE

PYE RADIO have added their quota to the recommendations for substitutes for the Mazda AC/TP. They do not suggest making any alteration to the receiver, except to replace the valve-holder, and they recommend a Mullard valve, the TH4B, which is fitted with a standard English seven-pin base. Their instructions are as follows:

"The TH4B requires a seven-pin valve-holder in place of the nine-pin and should be wired according to the base connections published by the manufacturers. On the AC/TP the suppressor, metallising and cathode are brought out to separate pins and all the wiring connected to the corresponding sockets should be taken to the cathode sockets of the TH4B valve-holder.

"A 'screened' type of grid cap should not be used or it must be insulated so as not to short-circuit the cathode to chassis.

"In the SP/AC receiver the head room is restricted and it is necessary to fit the seven-pin valve-holder below the surface of the chassis by means of grommets or other suitable spacers."

Several dealers have written to us to say that they have experienced difficulty in getting hold of the Mazda TH41, and have enquired whether another type of valve can be used instead.

One of these dealers, S. H. Watts, of Cheltenham, wrote a very constructive letter on the subject, and in the hope that it might be of interest to other dealers, we have decided to publish it. Here is what Mr. Watts has to say:

"I am a service engineer at an establishment with a Murphy agency. Thus, seeing your articles on 'Substituting New Valves for Old,' I am prompted to write this letter about the AC/TP, for we change one or two a week normally.

"Faced with half a dozen sets requiring AC/TP's or TH41's, and unable to obtain supplies, I had to consider how a different valve could be employed without impairing the efficiency of the receivers.

"Apart from the TH41 and AC/TP, there is no 4-volt frequency changer with more than seven pins. This means that no other valve has its metallising joined to a separate pin; it is joined internally to the cathode. There was no reason, however, why the metallising should not be disconnected from the cathode by scraping off a thin strip, about 1/10 of an inch wide, right at the bottom of the metallising, and then earthed by means of a shielded top cap fitted with brass strips, sprung so as to make good contact. Alternatively, some other method could be used to earth it. (It must be borne in mind at this point that in early Murphy circuits the cathode was live to RF.)

"A Mullard TH4B was chosen as the valve to be tried; the set was an A34. A seven-pin valve-holder was wired up, a 0.01 μF condenser was connected between screen and cathode, the common anode and screen feed resistance was replaced by one of 15,000 ohms, the valve was inserted in the holder, and everything worked perfectly. It was subsequently found that the resistance could be raised as high as 50,000 ohms, with a consequent saving in current, without noticeably affecting the signal strength, although it was necessary in some cases also to lower the value of the GB resistance.

"The modification was successful in every case in which it was tried, and in some cases it was unnecessary to earth the metallising independently, although it was done in each case for additional safety.

"The TH4B seems to be a lucky strike, because other types, triode hexode, heptode, etc., were tried, but none worked well at all. Some refused to oscillate, some gave no gain; no pentagrid would work. The Brimar 20A1 and the X41, both unmetallised, refused to work satisfactorily. Results with Mazda AC/TH1 were, however, as good as those with the TH4B.

"I have substituted the TH4B successfully in the following Murphy receivers so far: A24, A26, A28, A30, A34, A36 and A40. I submit the idea as the only alternative, while the present Mazda valve shortage continues, and hope it may interest other dealers."

Printed in Great Britain by The Cornwall Press Ltd., Paris Garden, London, S.E.1

★