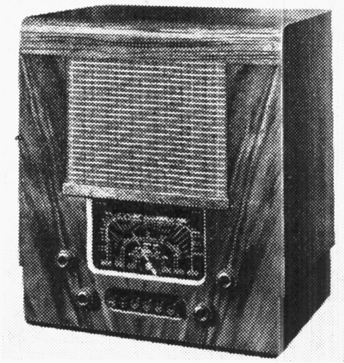
Supplement to The Wireless & Electrical Trader, Dec. 16, 1939.

"TRADER" SERVICE SHEET

440

McMICHAEL 394

3-BAND AC SUPERHET



THE McMichael 394 is a 4-valve (plus valve rectifier) AC 3-band table superhet for use on 200-250 V, 50-100 C/S mains. The SW range is 18.5-50 m.

The receiver is fitted with a mechanical press-button unit for six stations, and it is provided with a 4-position combined tone and selectivity switch.

Release date: August, 1939.

CIRCUIT DESCRIPTION

Aerial input via coupling coil **L2** (SW), coupling coil **L3** (MW) and condensers, **C3, C4** (MW and LW). On MW, coupling is modified by inclusion of small "top" capacity **C2.** IF filtering by **C1, L1** across aerial circuit.

First valve **(V1, Mazda metallised TH41)** is a triode heptode operating as frequency changer with internal coupling. Triode oscillator anode coils **L9** (SW), **L10** (MW) and **L11** (LW) are tuned by **C42**; parallel trimming by **C43** (SW), **C40** (MW) and **C15, C41** (LW); series tracking by **C12** (SW), **C13** (MW) and **C14** (LW). Reaction by grid coils **L7** (SW) and **L8** (MW and LW).

Second valve **(V2, Mazda metallised VP41)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **C44, C8, L13, L14, C9, C45** and **C46, L16, L17, C47.**

Intermediate Frequency 465 KC/S.

Provision is made to vary the coupling between the primary and secondary windings of the first IF transformer to obtain variable selectivity. The coupling is modified by connecting **L12** and **L15** alternatively into circuit via the control switches **S17, S18.**

Diode second detector is part of double diode triode valve **(V3, Mazda metallised HL41DD).** Audio frequency component in rectified output is developed across load resistance **R16** and passed via AF coupling condenser **C24,** limiting resistance **R13** and manual volume control **R14** to CG of triode section, which operates as AF amplifier. IF filtering by **C20, R12** and **C21.**

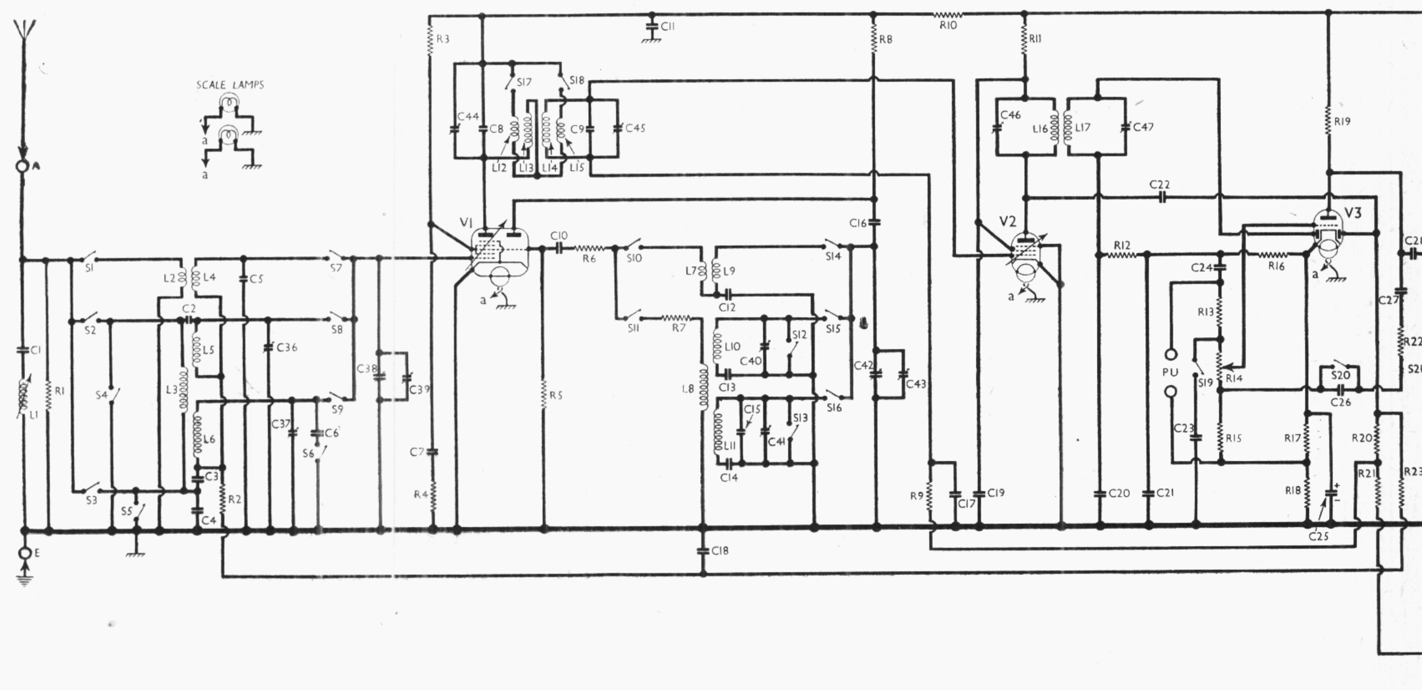
Some of the output at **V3** triode anode is fed back via **C27, R22** and **C26** (or **S20**) to the coupling resistance **R15** in the grid circuit to provide negative feed-back. **S19** connects **C23** between the top of **R14** and chassis. **S19** and **S20** are tone control switches, and are ganged with the variable selectivity switches **S17, S18.**

Provision for connection of gramophone pick-up across **R13, R14** and **R15.**

Second diode of **V3,** fed from **V2** anode via **C22,** provides DC potentials which are developed across load resistances **R20** and **R21** and fed back through decoupling circuits as GB to FC and IF valves, giving automatic volume control. Delay voltage, together with GB for triode section, is obtained from drop along resistances **R17, R18.**

Resistance-capacity coupling by **R19, C28** and potential divider **R24, R25** between **V3** triode and beam tetrode output valve **(V4, Mazda Pen 45).** Negative feed-back coupling via **R29, C29** and coupling resistance **R26** between anode and grid circuits. Provision for connection of low impedance external speaker across secondary of internal speaker input transformer **T1.** Switch **S21,** connected directly across the input circuit to the control grid, mutes the receiver when a press-button is operated.

HT current is supplied by IHC full-wave rectifying valve **(V5, Mazda metallised UU6).** Smoothing by speaker field **L20** and dry electrolytic condensers **C32, C34. C33** and **C35** provide RF filtering.

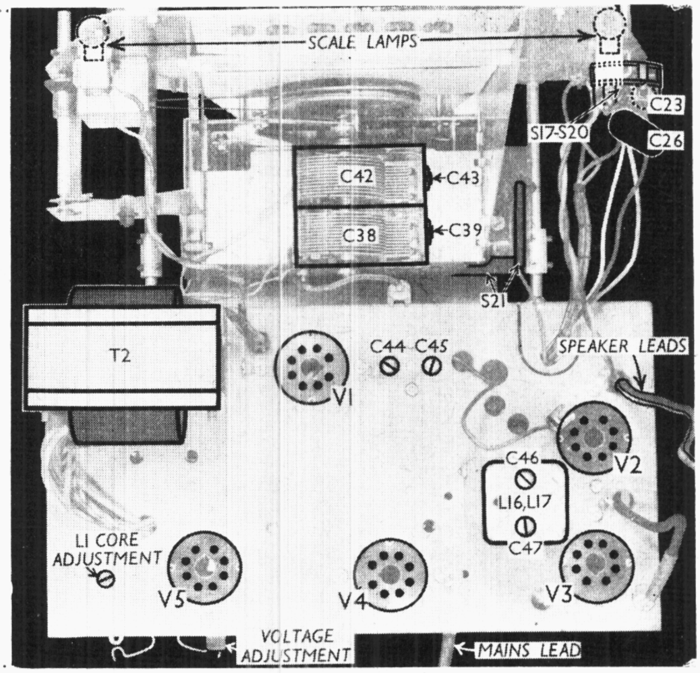


Fixed GB for **V1** and **V2** is obtained from drop along automatic GB resistance **R30** in negative HT lead to chassis.

COMPONENTS AND VALUES

	CONDENSERS	Values (μF)
C1	Aerial IF filter tuning ...	0·0004
C2	Part aerial MW coupling ...	0·000006
C3	Aerial MW and LW coupling condensers	0·1
C4		0·004
C5	Aerial SW fixed trimmer ...	0·00002
C6	L6 muting on MW	0·001
C7	V1 SG decoupling	0·1
C8	1st IF transformer fixed trimmers	0·00005
C9		0·00005
C10	V1 osc. CG condenser ...	0·0001
C11	HT circuit RF by-pass ...	0·1
C12	Osc. circuit SW tracker ...	0·0035
C13	Osc. circuit MW tracker ...	0·0005075
C14	Osc. circuit LW tracker ...	0·000168
C15	Osc. circ. LW fixed trimmer	0·00005
C16	V1 osc. anode coupling ...	0·0001
C17	V2 CG decoupling	0·1
C18	AVC line decoupling ...	0·01
C19	V2 SG and anode decoupling	0·1
C20	IF by-pass condensers ...	0·0001
C21		0·0001
C22	Coupling to V3 AVC diode	0·0001
C23	Part of tone control ...	0·001
C24	AF coupling to V3 triode ...	0·01
C25*	V3 cathode by-pass ...	50·0
C26	Parts of feed-back feed ...	0·015
C27		0·1
C28	V3 triode to V4 AF coupling	0·01
C29	Part of feed-back feed ...	0·005
C30*	V4 cathode by-pass... ...	50·0
C31	Fixed tone corrector ...	0·002
C32*	HT smoothing condenser ...	16·0
C33	V5 cathode RF by-pass ...	0·01
C34*	HT smoothing condenser ...	16·0
C35	Mains RF by-pass	0·002
C36‡	Aerial circuit MW trimmer	—
C37‡	Aerial circuit LW trimmer	—
C38†	Aerial circuit tuning ...	—
C39‡	Aerial circuit SW trimmer	—
C40‡	Osc. circuit MW trimmer ...	—
C41‡	Osc. circuit LW trimmer ...	—
C42†	Oscillator circuit tuning ...	—
C43‡	Osc. circuit SW trimmer ...	—
C44‡	1st IF trans. pri. tuning ...	—
C45‡	1st IF trans. sec. tuning ...	—
C46‡	2nd IF trans. pri. tuning ...	—
C47‡	2nd IF trans. sec. tuning ...	—

* Electrolytic. † Variable. ‡ Pre-set.

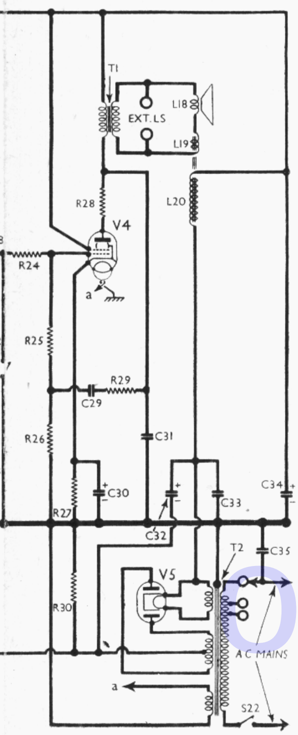


Plan view of the chassis. A diagram of **S17-S20** (top right hand corner) is overleaf. **C44** and **C45** are the first IF transformer adjustments. The core adjustment of **L1** is also indicated.

	RESISTANCES	Values (ohms)
R1	Aerial circuit shunt... ...	2,000
R2	V1 heptode CG decoupling	500,000
R3	V1 SG HT feed	40,000
R4	V1 SG stabiliser	40
R5	V1 osc. CG resistance ...	50,000
R6	V1 osc. CG stabiliser ...	100
R7	Oscillator MW and LW reaction stabiliser	2,000
R8	V1 osc. anode HT feed ...	40,000
R9	V2 CG decoupling	500,000
R10	V1 HT feed resistance ...	1,000
R11	V2 anode and SG HT feed	2,500
R12	IF stopper	50,000
R13	Diode output limiter ...	500,000
R14	Manual volume control ...	1,000,000
R15	Feed-back coupling... ...	15,000
R16	V3 signal diode load ...	500,000
R17	V3 triode GB and AVC delay resistances	1,300
R18		1,800
R19	V3 triode anode load ...	50,000
R20	V3 AVC diode load resistances	500,000
R21		500,000
R22	Part feed-back feed... ...	40,000
R23	AVC line decoupling ...	500,000
R24	V4 CG potential divider resistances	100,000
R25		500,000
R26	Feed-back coupling... ...	25,000
R27	V4 fixed GB	180
R28	V4 anode stopper	50
R29	Part feed-back feed... ...	250,000
R30	V1, V2 fixed GB resistance	40

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial IF filter coil ...	2·1
L2	Aerial SW coupling coil...	0·3
L3	Aerial MW coupling coil	18·5
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	2·9
L9	Osc. circuit SW tuning ...	Very low
L10	Osc. circuit MW tuning...	2·3
L11	Osc. circuit LW tuning ...	9·0
L12	Variable selectivity coil...	0·4
L13	1st IF trans. Pri. ...	11·0
L14	1st IF trans. Sec. ...	11·0
L15	Variable selectivity coil...	0·4
L16	2nd IF trans. Pri. ...	11·0
L17	2nd IF trans. Sec. ...	11·0
L18	Speaker speech coil ...	2·5
L19	Hum neutralising coil ...	0·15
L20	Speaker field coil	1,000·0

	OTHER COMPONENTS (Continued)	Approx. Values (ohms)
T1	Speaker input trans. Pri. ...	280·0
	Speaker input trans. Sec. ...	0·25
T2	Mains trans. Pri., total... ...	31·0
	Mains trans. Heater sec. ...	0·05
	Mains trans. Rect. heat. sec. ...	0·1
	Mains trans. H.T. sec., total ...	330·0
S1–S16	Waveband switches ...	—
S17, S18	Variable selectivity switches	—
S19	Tone control switch ...	—
S20	Negative feed-back control switch	—
S21	Press-button muting switch	—
S22	Mains switch, ganged R14	—



Circuit diagram of the McMichael 394 3-band AC superhet. Note the arrangement of the first IF transformer for variable selectivity. Switches **S17**, **S18** are ganged with **S19**, **S20**, the tone control switches.

DISMANTLING THE SET

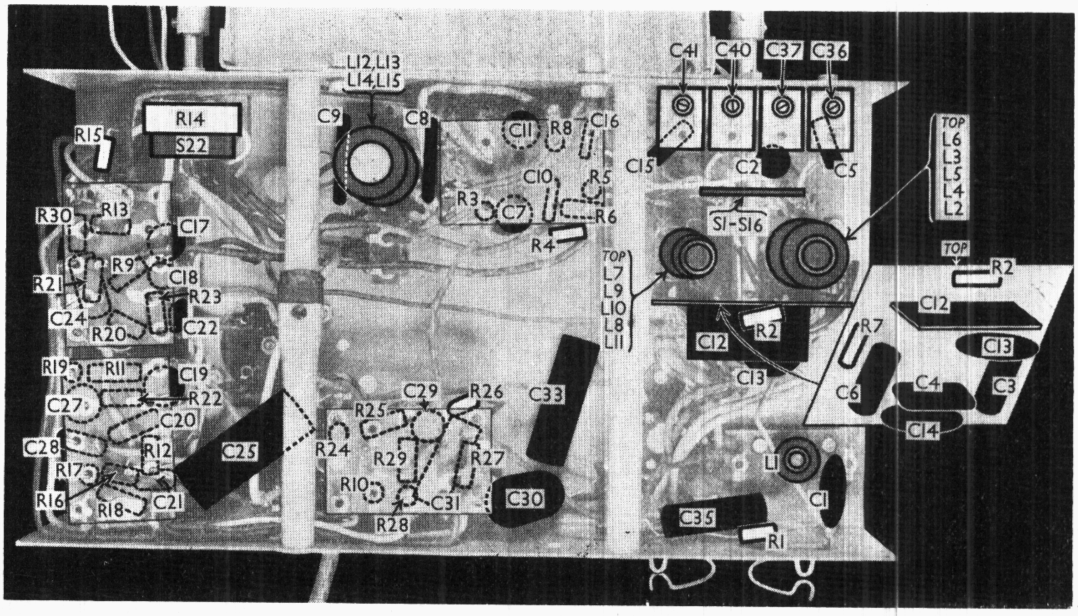
Removing Chassis.—Remove the four control knobs (recessed grub screws) and the three bolts (with large metal washers) holding the chassis to the bottom of the cabinet, when the chassis may be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free the chassis entirely, unsolder from the electrolytic condenser and speaker, which are both mounted on the sub-baffle, the five leads connecting them to the chassis.

When replacing, connect the blue lead to the black spotted tag on the electrolytic condenser; the brown lead to the red spotted tag on the condenser and the bottom tag on the speaker connecting panel; the red lead to the remaining tag on the condenser and the middle speaker tag; the black lead to the tag on the condenser mounting clip and the earthing tag on the speaker frame; and the yellow lead to the top speaker tag.

When replacing the valves, note that **V2** and **V3** are fitted with push-on screening caps.

Removing Speaker.—Unsolder the three leads from the connecting panel on the speaker transformer and a fourth from the earthing tag on the speaker frame, and remove the four nuts holding the speaker to the sub-baffle.



Under-chassis view. Many of the components are beneath paxolin connection panels, and so are dotted in the illustration. A drawing of the components on the vertical panel is inset on the right. A diagram of the **S1 - S16** unit is below.

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

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 230 V using the 240 V tapping on the mains transformer. The receiver was tuned to the lowest wave-length 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 TH41	207	1·6	57	3·6
	Oscil	lator		
	62	3·8		
V2 VP41	190	9·0	190	2·0
V3 HL41DD	102	2·1	—	—
V4 Pen45	206	31·0	218	5·5
V5 UU6	256†	—	—	—

† Each anode, AC.

GENERAL NOTES

Switches.—S1—S16 are the waveband switches, in a single rotary unit beneath the chassis. This is indicated in our under-chassis view, and shown in detail in the upper diagram in col. 2, where it is drawn as seen looking from the rear of the underside of the chassis. The table (col. 3) gives the switch positions for the three control settings, starting from fully anti-clockwise. A dash indicates open and **C**, closed.

S17—S20 are the variable selectivity, tone, and negative feedback switches, in a single rotary unit mounted on the left-hand scale bracket (looking at the front of the set). It is indicated in our plan chassis view, at the top right-hand corner, and shown in detail in the lower diagram in col. 2, where it is drawn as seen looking from the rear of the chassis. The lower table (col. 3) gives the switch positions for the four control settings, starting from fully anti-clockwise. A dash indicates open, and **C**, closed.

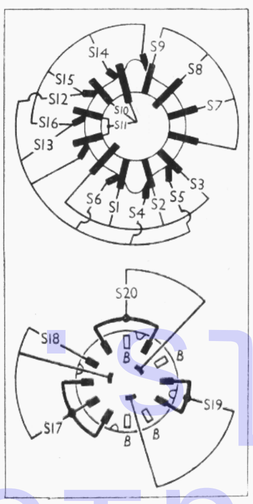
S21 is the press-button muting switch indicated in our plan chassis view. It is formed of a flat spring contact and a hinged contact plate, operated by any of the press-buttons. Its action is to connect the junction of **C28, R24** to chassis, thus muting radio, whenever a press-button is operated.

S22 is the QMB mains switch, ganged with the volume control **R14**.

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-L15** is an unscreened unit beneath the chassis, while the second IF transformer **L16, L17** 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.



Diagrams of the switch units. **Top,** the **S1-S16** unit seen from the rear of the underside of the chassis. **Bottom,** the **S17-S20** unit, seen from the rear of the top of the chassis.

Scale Lamps.—These are two Ever Ready M.E.S. types, rated at 6.2 V, 0.3 A.

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

Condensers C32, C34.—These are two 16μF (450 V working) dry electrolytics in a single tubular metal can, fitted in a clip mounted on the speaker baffle. They are not shown in our chassis pictures. The black coded tag is the negative of **C32,** and the red coded tag the positive of **C32;** the can is the negative of **C34,** and the plain tag the positive of **C34.**

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	Fid.	Norm.	Bass	Foreign
S17	—	C	C	C
S18	C	—	—	—
S19	—	C	—	C
S20	—	—	C	C

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.

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 **C44, C45** and **C46, C47** 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.

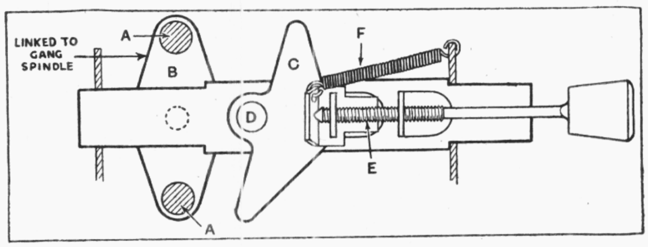
SW.—Switch set to SW, turn gang to minimum, feed in an 18.5 m (16.2 MC/S) signal and adjust **C43** for maximum output. Feed in a 19.6 m (15.3 MC/S) signal, tune to 19.6 m on scale, and adjust **C39** for maximum output.

MW.—Switch set to MW, turn gang to minimum, feed in a 190 m (1,580 KC/S) signal, and adjust **C40** for maximum output. Tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C36** 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 **C41**, then **C37** for maximum output.

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

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



Tackling Intermittent Faults

OF all the types of faults encountered in a radio receiver, it is fairly safe to say that the intermittent fault is the type more productive of wasted time and lost temper than any other.

Faced with a fault of this nature, the best thing to do is first of all to ascertain that the trouble is not due to anything outside the set, such as an intermittent aerial or earth connection, intermittently shorting loud-speaker extension wires, bad mains connection, faulty mains switch (if any) outside the set, or any similar fault.

If, as is probable, all these faults are ruled out, the next thing to do is to get an accurate description of the symptoms and times of appearance of the trouble.

A fault which appears fairly consistently, for instance, at a roughly regular interval after switching on, is not too hard to find. In this case it can regularly be made to reveal itself, and armed with weapons such as meters in various key circuits, the engineer can usually run it to earth. Faults such as intermittent breaks in transformer, coil or speaker windings, which make contact when the set is cold, but open when it warms up in use, come in this category.

Incidentally, if the chassis is tested outside its cabinet, the fault may never appear, since the ambient temperature will not reach the value it has when the set is working normally. The best thing to do is to free the chassis, but leave it in the cabinet, with the back in position, and arrange that the chassis can be quickly withdrawn for continuity testing.

The worst kind of intermittent fault is that which appears at irregular intervals, and without apparent cause. The best plan in this case is first of all to have a good probe round the wiring and components, coil screens, earthing tags, soldered joints, and so on. For this purpose an insulated prod should be employed, while any suspected "dry" soldered joints (and even those which look sound) should be "waggled" in an effort to reveal a fault. Valves should be rocked in their holders, switch contacts checked, and all likely earthing points, such as coil screens to chassis, metal-cased condensers to chassis and variable condenser frames to chassis, should be examined.

If nothing in the way of shaking, probing or otherwise agitating the set is effective in showing up the fault, it will be necessary to fall back on a "soak" test, which involves leaving the set running until the fault appears of its own accord. Since this may mean that the set has to run several hours before the fault appears, the noise from the speaker is liable to interfere with other test work. It is no use switching out the speaker unless some other indicator is provided. One which is commonly used is a flash-lamp bulb across the speaker transformer secondary, the speaker speech coil having been disconnected. While signals are coming through, the lamp glows, and when they cease, it goes out. A change from good to poor sensitivity, and *vice-versa*, can also be detected.

The input to the set for this test should be a steady one, and a modulated oscillator is suggested for this. Then any change in intensity of the light from the lamp indicates that the fault has appeared.

It may not be generally known that E.M.I. Service, Ltd. make an intermittent fault test device which gives both visible and audible warning of a fault, and will deal with three receivers simultaneously. It contains its own signal source, a multivibrator giving a band of signals ranging from 600 C/S to 1.5 MC/S without the need for tuning. Green lights show the sets to be operating correctly, while red lights and the ringing of the bell indicate that faults have appeared.

The warning device consists of a valve and relay combination to operate the lights and the bell. The input to this device is obtained from the secondary of the output transformer of the set under test, and is applied via a transformer to the grid of the valve, in whose anode circuit is connected the relay.

When the receiver is operating normally the anode current of the valve assumes a certain set value, and the relay switches on a green light. If the signal drops in value, the voltage on the grid of the valve drops, the anode current rises, and the relay closes, switching off the green light and switching on the red light (and the bell, if desired).

E.M.I. Service, Ltd., state that 97 per cent. of intermittent faults cause a fall in signal strength, and will therefore cause the device to operate.

Printed in Great Britain by ST. CLEMENTS PRESS, LTD., Portugal Street, Kingsway, London, W.C.2.