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# 426

# McMICHAEL 903 AND 390 AC MODELS

The McMichael 903 radiogram.

THE McMichael model 903 is a 3-valve (plus rectifier) 3-band superhet table radiogram. The SW range is 18·5-50 m, and the receiver is suitable for mains of 200-250 V, 50-60 C/S.

When the instrument is used as a gramophone, the IF valve operates as an AF amplifier.

A similar chassis is employed in the model 390 table receiver, but the additional components which are brought into use in the model 903 for gramophone operation are omitted, and one or two other divergencies occur. The mains frequency range is extended to 50-100 C/S.

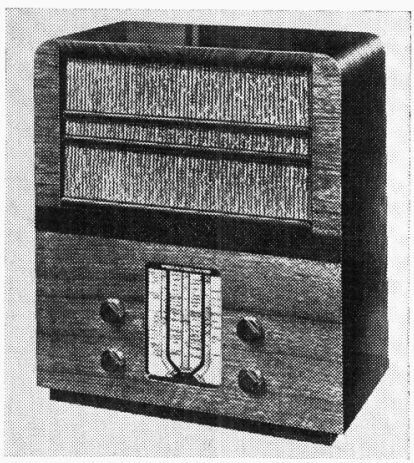
The differences are explained under "General Notes," and a supplementary diagram shows the modified circuit.

*Release dates:* 903, *July*, 1939; 390, *June*, 1939.

## CIRCUIT DESCRIPTION

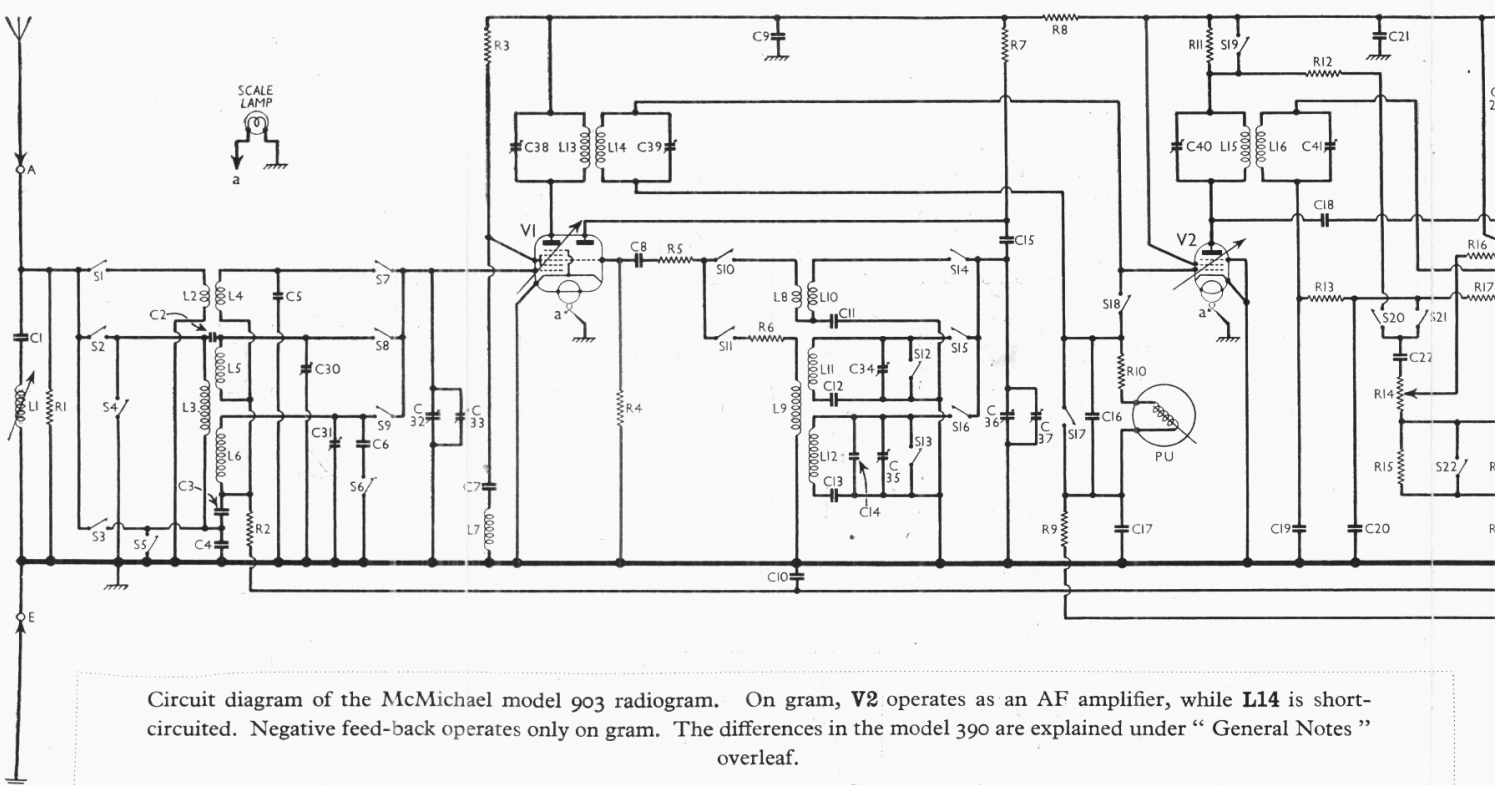
Aerial input is via coupling coils **L2** (SW) and **L3** (MW and LW) to single-tuned circuits **L4, C32** (SW), **L5, C32** (MW) and **L6, C32** (LW). Coupling is augmented by small "top" coupling condenser on MW, and "bottom" coupling condensers **C3** and **C4** on MW also. An IF filter, **L1, C1,** whose coil has an iron-dust core, is shunted across the aerial input circuit together with **R1.**

First valve (**V1, Mazda metallised TH41**) is a triode heptode operating as frequency changer with internal coupling. Triode oscillator anode coils **L10** (SW), **L11** (MW) and **L12** (LW) are tuned by **C36;** parallel trimming by **C37** (SW), **C34** (MW) and **C14, C35** (LW); series tracking by **C11** (SW), **C12** (MW) and **C13** (LW). Reaction by grid coils **L8** (SW) and **L9** (MW and LW).

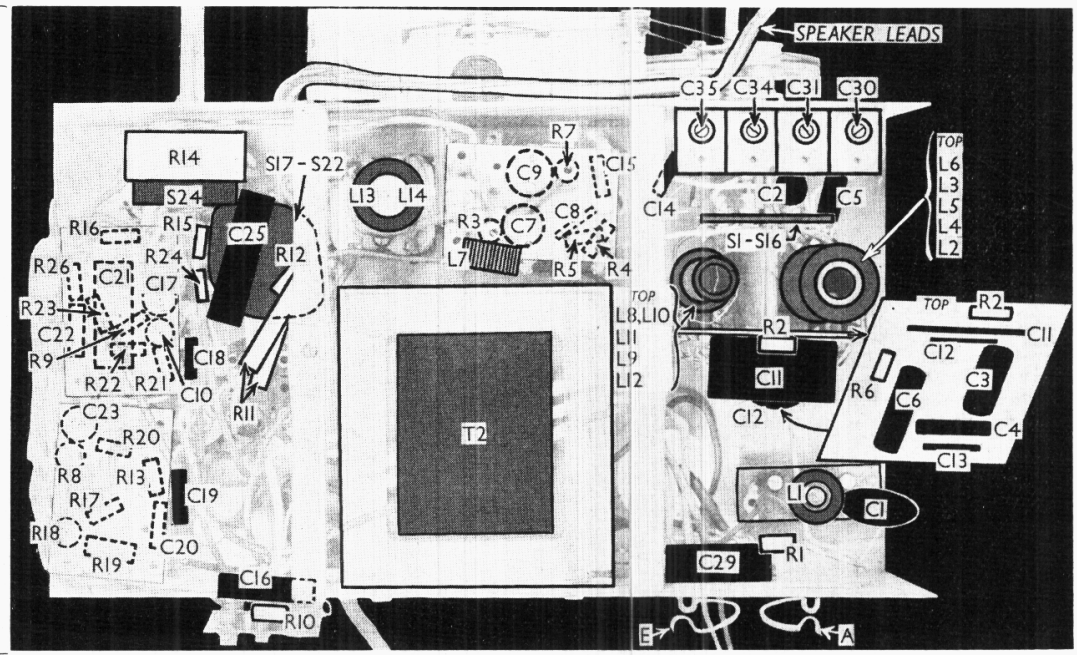


The McMichael 390 table receiver.

Second valve (**V2, Mazda metallised VP41**) is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **C38, L13, L14, C39** and **C40, L15, L16, C41.**



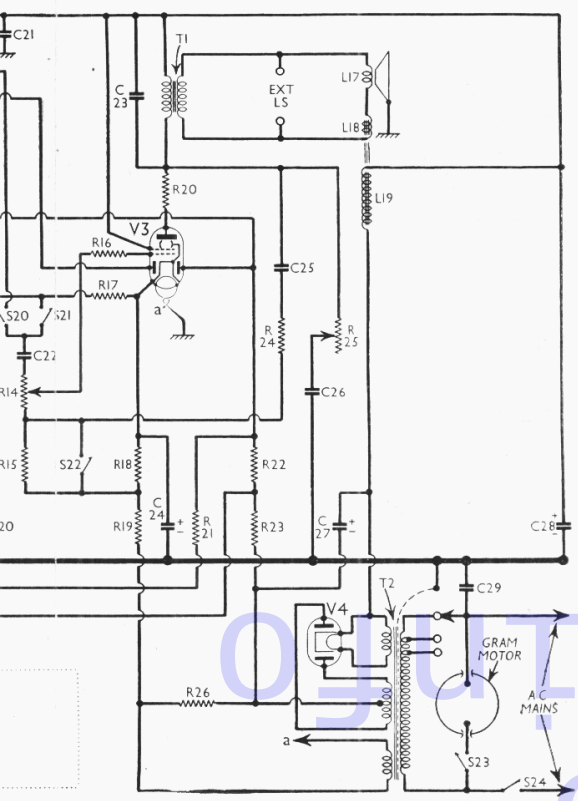

Circuit diagram of the McMichael model 903 radiogram. On gram, **V2** operates as an AF amplifier, while **L14** is short-circuited. Negative feed-back operates only on gram. The differences in the model 390 are explained under "General Notes" overleaf.




Under-chassis view. The redrawn panel extending beyond the right of the chassis shows the positions of components which would otherwise be obscured by **C11**. In the switch diagrams overleaf, the **S17-S22** unit is drawn as seen here. The other unit is drawn as seen from the rear of the chassis.

**Intermediate frequency 465 KC/S.**

Diode second detector is part of double diode beam tetrode output valve (**V3, Mazda AC5/Pen.DD**). Audio frequency component in rectified output is developed across load resistance **R17** and passed via switch **S21** (which is closed on radio as are also **S17, S19** and **S22**), AF coupling condenser **C22,** manual volume control **R14** and grid stopper resistance **R16** to CG of tetrode section, which provides sole AF amplification on radio.




IF filtering by **C19, R13** and **C20.** Fixed tone correction by **C23** in anode circuit. Variable tone control by **R25, C26,** also in anode circuit. Provision for connection of low impedance external speaker across secondary of internal speaker input transformer **T1**.

The foregoing circuit arrangement is considerably modified when the radio/gramophone control is turned to the gramophone position. **S17** opens and **S18** closes, so that the pick-up is connected directly between **V2** control grid and, via **C17,** chassis, while **L14** becomes short-circuited. **S19** opens, **R11** forms the load resistance, and thus **V2** becomes an AF amplifier. Coupling between **V2** and the tetrode section of **V3** is effected by **R11, C22** and **R14** via **R12, S20** (which closes, while **S21** opens to mute radio) and **R16. R12,** together with **C22** and **R14,** forms a potential divider across the output of **V2** in order that **V3** shall not be overloaded when **R14** is adjusted to maximum. **R10** and **C16,** which are connected across the pick-up output, function as a tone corrector circuit.

**S22** opens, so that **R15** is common with **V3** tetrode control grid circuit. Since **C25, R24** and **R15** form a potential divider across the output of **V3** tetrode, **R15** is common to both circuits and a negative feed-back coupling is established. While this feed back is operative, the variable tone control will have a negligible effect, whatever the setting of **R25** slider. The feed-back components **C25, R24** remain in circuit during radio operation, but will then have no influence upon reception except, perhaps, as a fixed tone corrector circuit. **R15** is short-cuited on radio.

Second diode of **V3,** fed from **V2** anode via **C18,** provides DC potentials which are developed across load resistances **R22** and **R23** and fed back through decoupling circuits as GB to FC and IF valves, giving automatic volume control. Delay voltage, together with GB for tetrode section, is obtained from drop along resistances **R18** and **R19** in the cathode lead to chassis.

HT current is supplied by IHC full-wave rectifying valve (**V4, Mazda metallised UU6**). Smoothing by speaker field **L19** and dry electrolytic condensers **C27** and **C28.**

Fixed negative GB potential for **V1** heptode section and **V2** is obtained from drop along **R26** in negative HT lead to chassis, and fed via the AVC line. This voltage must, of course, be added to the AVC delay potential.

## 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 tap on the mains transformer. The receiver was tuned to the lowest wavelength on the medium 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 .. | 212 (Oscillator) 52 | 2·2 3·4 | 75 | 3·8 |
| V2 VP41 | 222 | 12 | 222 | 2·5 |
| V3 AC5PenDD | 210 | 30 | 222 | 5·3 |
| V4 UU6 .. | 262 † | — | — | — |

† Each anode, AC

## DISMANTLING THE SET

**Removing Chassis.**—Remove the four control knobs (recessed grub screws) from the front of the cabinet, the radio/gram change switch knob (recessed grub screw) with its associated metal guide plate (two countersunk head wood-screws) from the motor board, and the terminal cover of the gramophone motor; free the motor leads, unsolder the speaker leads and the leads to the smoothing condenser block, release the four leads connected to the pick-up input panel, and

withdraw the four bolts (with metal washers) holding the chassis to the bottom of the cabinet. Next, withdraw the wedge-shaped runners from beneath the chassis, and it will be found that if the chassis is now tilted forward it can be withdrawn from the cabinet together with the gram change switch spindle by sliding it down the fixed wooden runners, towards the back of the cabinet.

Care should be taken when removing the receiver not to allow the glass tuning scale to fall out of its frame as it is only a push-in fit.

*When replacing*, connect the leads to the pick-up connecting panel as follows:—red from pick-up to top right-hand terminal; black from pick-up to bottom right-hand terminal; and the black lead from the metal foil on the side of the cabinet together with the lead from the pick-up screening to the top left-hand terminal. The red motor lead should be connected to the right-hand terminal on the motor, and the black lead to the left-hand terminal. The speaker leads should be connected as follows, numbering the tags from bottom to top: 1, brown from receiver and yellow from smoothing condenser; 2, red from receiver and red from smoothing condenser; 3, yellow from receiver. The brown lead from the smoothing condenser should be joined to the blue lead from the receiver, and then soldered to the tag screwed to the bottom of the cabinet, and the black lead from the smoothing condenser should be joined to the black lead from the receiver and then soldered to the frame of the speaker.

**Removing Speaker.**—The speaker may be removed from the cabinet by unsoldering its leads, and unscrewing the four hexagon nuts holding it to the sub-baffle.

*When replacing*, connect the leads to it as indicated above, with the transformer on the right, and do not forget to solder the black lead from the receiver and the black lead from the smoothing condenser to the speaker frame.

## COMPONENTS AND VALUES

| | RESISTANCES | Values (ohms) |
|---|---|---|
| R1 | Aerial circuit shunt resistance | 2,000 |
| R2 | V1 heptode CG decoupling | 500,000 |
| R3 | V1 SG HT feed resistance | 40,000 |
| R4 | V1 osc. CG resistance | 50,000 |
| R5 | V1 osc. CG stabiliser | 100 |
| R6 | V1 osc. MW and LW reaction stabiliser | 2,000 |
| R7 | V1 osc. anode HT feed resistance | 40,000 |
| R8 | V1 HT feed resistance | 1,000 |
| R9 | V2 CG decoupling | 500,000 |
| R10 | Pick-up series resistance | 5,000 |
| R11 | V2 anode (gram.) load resistance | 13,000* |
| R12 | V2 output limiting resistance | 250,000 |
| R13 | IF stopper resistance | 50,000 |
| R14 | Manual volume control | 1,000,000 |
| R15 | Negative feedback coupling resistance | 25,000 |
| R16 | V3 tetrode grid stopper | 100,000 |
| R17 | V3 signal diode load resistance | 500,000 |
| R18 | V3 tetrode GB; AVC delay | 180 |
| R19 | | 350 |
| R20 | V3 tetrode anode stopper | 50 |
| R21 | AVC line decoupling | 500,000 |
| R22 | AVC diode load resistances | 500,000 |
| R23 | | 500,000 |
| R24 | Negative feedback feed | 50,000 |
| R25 | Variable tone control | 50,000 |
| R26 | V1, V2 fixed GB resistances | 40 |

* Two 26,000 Ω resistances in parallel.

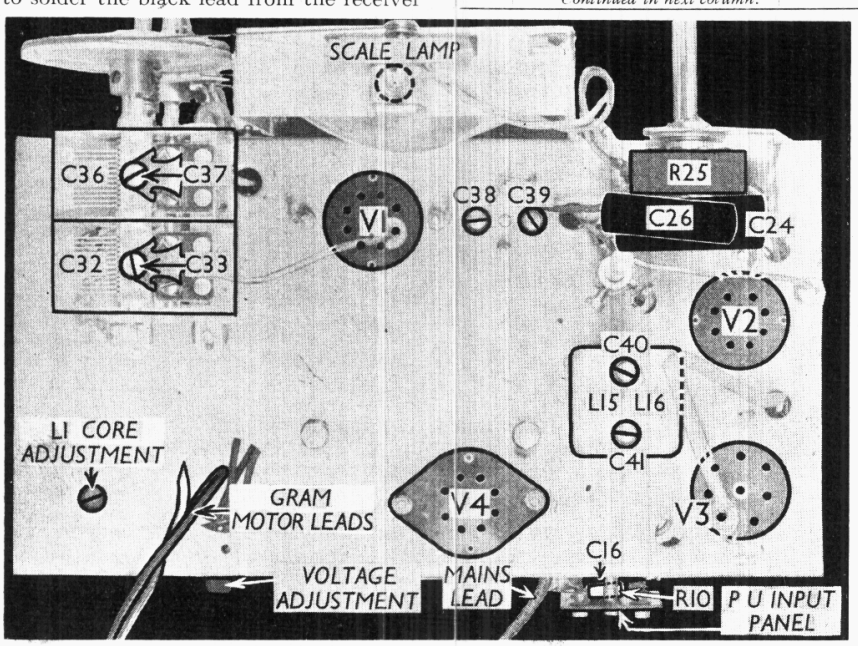
| | CONDENSERS | Values (μF) |
|---|---|---|
| C1 | Aerial IF filter tuning | 0·0004 |
| C2 | Part aerial MW coupling | 0·000006 |
| C3 | Part aerial MW and LW coupling | 0·1 |
| C4 | | 0·004 |
| C5 | Aerial circuit SW fixed trimmer | 0·00002 |
| C6 | L6 muting on MW | 0·001 |
| C7 | V1 SG decoupling | 0·1 |
| C8 | V1 osc. CG condenser | 0·0001 |
| C9 | V1 HT circuit RF by-pass | 0·1 |
| C10 | AVC line decoupling | 0·01 |
| C11 | Osc. circuit SW tracker | 0·0035 |
| C12 | Osc. circuit MW tracker | 0·0005075 |
| C13 | Osc. circuit LW tracker | 0·000168 |
| C14 | Osc. circuit LW fixed trimmer | 0·00005 |
| C15 | V1 osc. anode coupling | 0·0001 |

*Continued in next column.*

| | CONDENSERS (*Continued*) | Values (μF) |
|---|---|---|
| C16 | Gram. pick-up shunt | 0·003 |
| C17 | V2 CG decoupling | 0·1 |
| C18 | Coupling to V3 AVC diode | 0·0001 |
| C19 | IF by-pass condensers | 0·0001 |
| C20 | | 0·0001 |
| C21 | V2, V3 HT circuit RF by-pass | 0·1 |
| C22 | AF coupling to V3 tetrode | 0·002 |
| C23 | Fixed tone corrector | 0·002 |
| C24* | V3 cathode by-pass | 25·0 |
| C25 | Part of negative feed-back | 0·005 |
| C26 | Part of variable tone control | 0·03 |
| C27* | HT smoothing condensers | 8·0 |
| C28* | | 16·0 |
| C29 | Mains RF by-pass | 0·002 |
| C30‡ | Aerial circuit MW trimmer | — |
| C31‡ | Aerial circuit LW trimmer | — |
| C32† | Aerial circuit tuning | — |
| C33‡ | Aerial circuit SW trimmer | — |
| C34‡ | Osc. circuit MW trimmer | — |
| C35‡ | Osc. circuit LW trimmer | — |
| C36† | Oscillator circuit tuning | — |
| C37‡ | Osc. circuit SW trimmer | — |
| C38‡ | 1st IF trans. pri. tuning | — |
| C39‡ | 1st IF trans. sec. tuning | — |
| C40‡ | 2nd IF trans. pri. tuning | — |
| C41‡ | 2nd IF trans. sec. tuning | — |

* Electrolytic. † Variable. ‡ Pre-set.

| | OTHER COMPONENTS | Approx. Values (ohms) |
|---|---|---|
| L1 | Aerial IF filter coil | 2·1 |
| L2 | Aerial SW coupling coil | 0·3 |
| L3 | Aerial MW and LW 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 | V1 stabilising choke | Very low |
| L8 | Oscillator SW reaction | 0·4 |
| L9 | Oscillator MW and LW reaction | 2·9 |
| L10 | Oscillator circuit SW tuning | Very low |
| L11 | Oscillator circuit MW tuning | 2·3 |
| L12 | Oscillator circuit LW tuning | 9·0 |
| L13 | 1st IF trans. Pri. | 12·0 |
| L14 | 1st IF trans. Sec. | 12·0 |
| L15 | 2nd IF trans. Pri. | 12·0 |
| L16 | 2nd IF trans. Sec. | 12·0 |
| L17 | Speaker speech coil | 2·2 |
| L18 | Hum neutralising coil | 0·2 |
| L19 | Speaker field coil | 1,000·0 |
| T1 | Speaker input trans. Pri. | 290·0 |
| | 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. HT sec., total | 340·0 |
| PU | Gramophone pick-up winding | 1,800·0 |
| Gram. motor | Collaro AC7A, total | 800·0 |
| S1-S16 | Waveband switches | — |
| S17-S22 | Radio/gram change switches | — |
| S23 | Gramophone motor switch | — |
| S24 | Mains switch, ganged R14 | — |




Plan view of the chassis. All the IF trimmers are indicated, as is also the core adjustment of **L1**.

## GENERAL NOTES

**Switches.**—**S1-S16** are the waveband and **S17-S22** the radio/gram change switches, in two independent rotary units beneath the chassis.

The two units are indicated in our under-chassis view, and shown in detail in col. 4. The table (col. 5) shows the switch positions for the various control settings of the **S1-S16** unit, starting from fully anti-clockwise. A dash indicates *open*, and **C**, *closed*.

As seen in our under-chassis view, the **S1-S16** unit is in the upper right-hand corner, and the **S17-S22** unit is between the **L13, L14** unit and the group of components beneath the **V2** connecting panel.

**S23** is the gram motor switch. It forms part of the gramophone unit assembly and is automatically operated by movement of the pick-up arm. This switch is not shown in our chassis views.

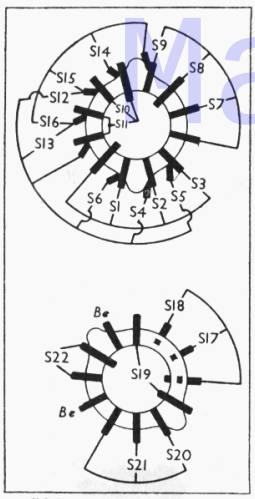



Diagram of the switch units. Above, as seen in the direction of the arrow in the under-chassis view. Below, directly as seen in that view.

**S24** is the QMB mains switch, ganged with the volume control **R14.** It is shown in our under-chassis view.

**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 **L8-L12** 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.

**L7** is mounted on **V1** connecting panel.

The first IF transformer **L13, 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.

**Scale Lamp.**—This is an Ever Ready lamp with a round bulb and an MES base. It is 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 C27, C28.**—These are two dry electrolytics in a single carton. They are mounted on the side of the cabinet, near the loud-speaker, and are not seen in our chassis illustrations.

The red and black leads are the positive and negative leads respectively of **C28** (16 $\mu$F), and the yellow and brown leads are those of **C27** (8$\mu$F). Both condensers are rated at 450 V (peak) working.

**Chassis Divergencies.**—The aerial IF filter circuit **L1, C1,** was not shown in the makers' diagram. Neither was **R1,** which shunts the aerial circuit.

In a diagram of the plan view of the chassis, which is fixed inside the cabinet and shows the valve positions, **V4** is shown near the rear left-hand corner of the chassis, as in the table model 390, which is referred to later. Actually, **V4** valve-holder is situated near the centre of the rear of the chassis, as indicated in our plan view.

## TABLE MODEL 390 MODIFICATIONS

Model 390 employs a similar chassis to that of the model 903, but **V4** valve-holder is fitted in a different position. Instead of being mounted near the centre of the rear of the chassis it occupies the hole near the left-hand corner at the rear of chassis ; in the model 903 the gramophone motor leads emerge through this hole from the chassis.

| Switch | SW | MW | LW |
|---|---|---|---|
| S1 | C | — | — |
| S2 | — | C | — |
| S3 | — | — | C |
| S4 | 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 |

Electrically, the circuit of the model 390 is similar to that of the 903 in the aerial and oscillator circuits. The diagram (below) shows the rest of the circuit, from which it will be seen that the differences consist mainly of the omission of those components which are switched out of circuit in the model 903 when it is switched over to radio operation.

The pick-up and motor are of course omitted, together with **C16, R10, R11, R12, R15, C25** and **R24,** but a pair of sockets is provided for connection of an external pick-up. These sockets are connected to the junctions of **R13** and **R17,** and **R18** and **R19** respectively, so that the pick-up output is virtually applied across **R14 ;** a crystal type pick-up would be required to provide an adequate signal.

Other differences, not obvious in the diagram, are the substitution of an "eight plus eight" condenser block for **C27** and **C28** and, in our chassis, the omission of **L1, C1** and the substitution of a 10,000 O resistance in the place of **R1.**

## 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 **C38, C39** and **C40, C41** 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 (model 903 only) for *minimum* output.

**RF and Oscillator Stages.**—See that the glass scale panel is firmly pressed into position in the scale assembly, then turn gang to maximum. The red line forming the pointer should now be beyond the calibrated extremities of the three tuning scales, leaving a small space (about 1/32 of an inch) between the line and the black border at the tops of the scales.

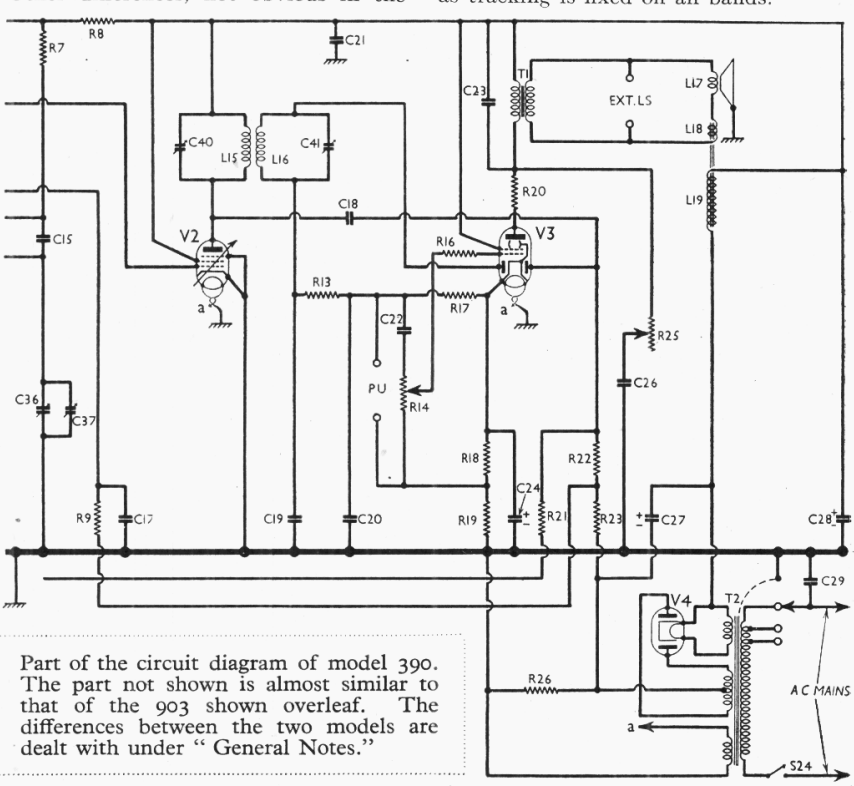
Connect the signal generator to the **A** and **E** clips, via a suitable dummy aerial.

**SW.**—Switch set to SW, turn gang to minimum, feed in an 18·1 m (16·2 MC/S) signal and adjust **C37** for maximum output. Feed in a 19·6 m (15·3 MC/S) signal, tune to 19·6 m on scale, and adjust **C33** for maximum output.

**MW.**—Switch set to MW, turn gang to minimum, feed in a 190 m (1,580 KC/S) signal, and adjust **C34** for maximum output. Tune to 214 m on scale, feed in a 214 m (1,400 KC/S) signal, and adjust **C30** 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 **C35,** then **C31** for maximum output.

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




Part of the circuit diagram of model 390. The part not shown is almost similar to that of the 903 shown overleaf. The differences between the two models are dealt with under "General Notes."

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