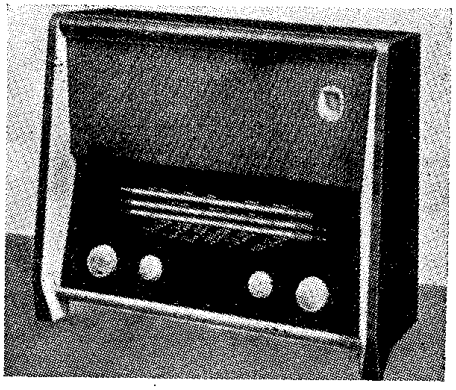
Test Report

McMICHAEL model FM55

a.m.-f.m. radio receiver

R82 McMICHAEL FM55



THIS is a 7-valve receiver covering long, medium and f.m. wavebands, fitted with internal ferrite rod aerials for a.m. and a balanced folded dipole for f.m. A p.m. elliptical speaker 10in. by 6in. is fitted and provision is made for the addition of an external 3-ohm speaker. Gramophone pick-up sockets are provided.

CIRCUIT DETAILS

For a.m. reception a conventional 4+1 superhet circuit is used; for f.m. an additional two-stage front end is switched in. A magic-eye valve is used as tuning indicator.

F.M. Circuit

The f.m. front end is mounted on a separate sub-chassis. It is built round V1, an ECC85, one triode section of which functions as an r.f. amplifier with combined grounded-grid/grounded-cathode input. The second triode is used as a self-oscillating additive mixer; the oscillator frequency is lower than the signal frequency.

The r.f. signal is injected into the oscillator circuit by means of a bridge network consisting of 1C7, 1C8, 1C5 and Ca-k, the valve capacitance. The trimmer 1C5 is variable so that it is possible to balance for minimum oscillator voltage across the r.f. circuit. This method of connection, together with the system of input-to-r.f. amplifier coupling, ensures low oscillator radiation. 1L3 and 1C11 comprise an i.f. filter trap to provide additional rejection of i.f. signals from the aerial.

Damping of 1L7, due to the valve, is compensated by i.f. feedback through 1C7, 1C8 and 1L5 to the grid of the mixer. The degree of compensation depends on the values of 1C6, 1C9 and 1C12. The presence of 1C6 tends to stabilise the performance of the oscillator and it is important to note that the physical position of this component must not be altered considerably.

Core tuning of r.f. and oscillator circuits is used, the cores being operated by a cam attached to the main tuning spindle. The position of this cam on the spindle must *not* be altered.

The f.m. 10.7 Mc/s i.f. output is coupled, via the section F2 of the waverange switching, to the grid of the hexode section of V2. In the circuit diagram the waverange switching is shown in the "f.m." position. The amplified signal is coupled via the i.f. transformer T1 to V3 where the signal undergoes further amplification and is coupled via T3 to the ratio detector.

Two frequency conscious voltages are supplied by T3 to two diodes of V4, the diodes being so connected that the sum of the rectified voltages appears across R23, the diode load. This voltage is stabilised against a.m. by the shunt capacitor C43 and is available for a.g.c. Additionally, a voltage appears across C36 (in series with a tertiary winding on T3) which is proportional to the difference between these two voltages, the current flowing through the tertiary winding and the diodes in opposition. At centre frequency the voltage across C36 is half that across R23 and it varies at a.f. above and below this value as the frequency deviates either side of centre frequency. De-emphasis is obtained by R10/C32, which also serves to filter i.f. frequencies. The demodulated signal is then amplified at a.f.

A.M. Circuit

The triode-hexode V2 is used in a conventional tuned-grid oscillator and mixer arrangement. The medium and long-wave aerial coils are mounted on ferrite rods acting as internal aerials. Provision is made for the addition of external aerial and the signal is, in this case, bottom-end capacitance coupled by C12 via the i.f. trap circuit L1/C2.

The a.m. 470 kc/s i.f. signal is coupled by T2 to the i.f. amplifier V3 and thence by T4 to the signal diode of V4. The a.m. and f.m. i.f. transformers are connected in series to their respective valves, each acting as negligable impedance to the other. The primary of T1 is shorted on a.m. to prevent amplification of interfering voltages, notably harmonics of the oscillator triode of V2. The tuning indicator, a.f. and a.g.c. are switched by the same contacts, C39 and C41 being blocking capacitors. A.g.c. is supplied by the signal diode.

The Audio Stages

Signals are amplified by the triode section of V4, the grid resistor R20 forming the manual volume control. The valve is self biased by R21/C42. The amplified signal is r.c. coupled to the output valve V5. Tone control is carried out by selective negative feedback, the coupling being effected from the secondary of the output transformer via C45 to the variable grid resistor R25. The tone control is ganged with the mains on-off switch.

Power Supply

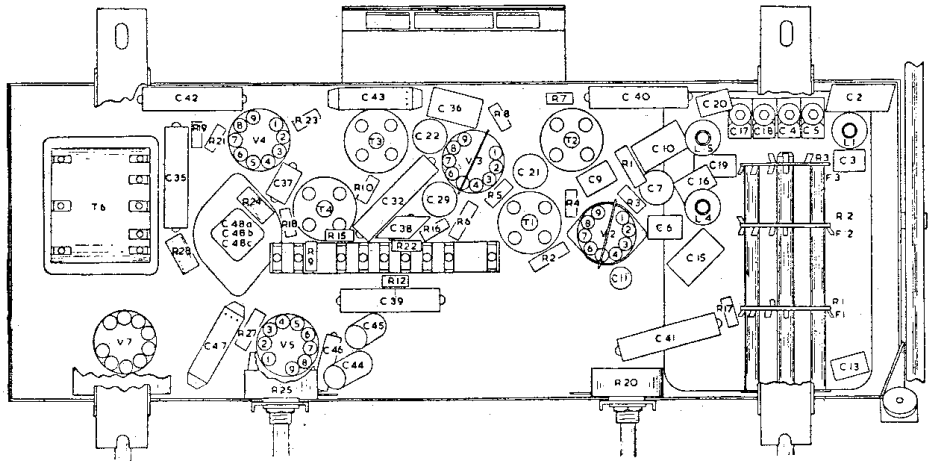
Power is derived from a full-wave mains rectification circuit, smoothing being effected by the three capacitors comprising C48, R24, R28 and part of the output transformer primary. The hum bucking tapping on the output transformer reduces residual hum. A 15-watt lamp is connected across the mains input.

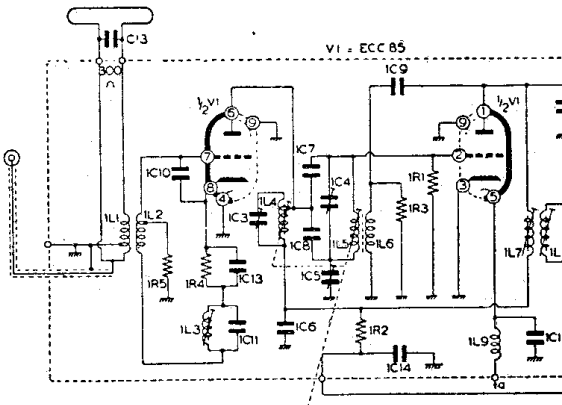
REMOVAL OF CHASSIS

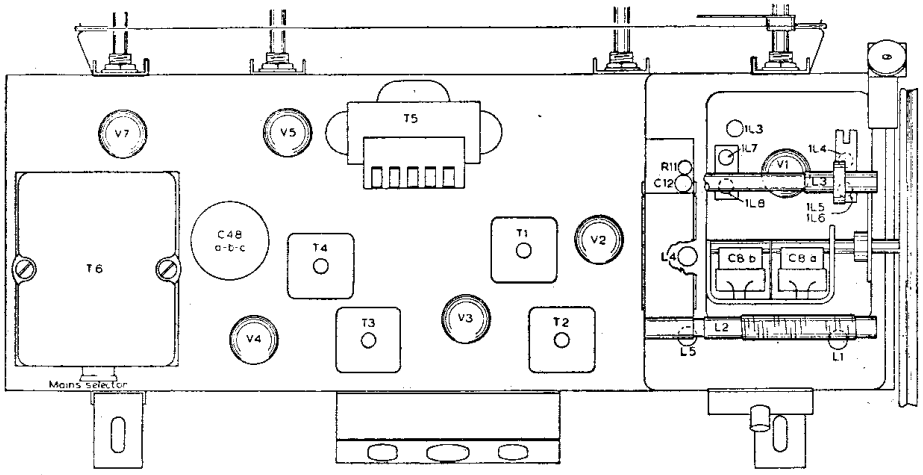
To remove chassis from cabinet, unsolder the speaker leads, remove control knobs and scale lamp assembly. Unscrew two fixing screws at rear of chassis. It may then be withdrawn.

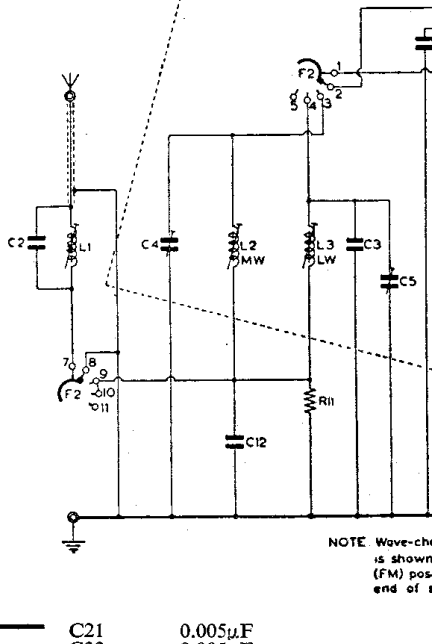
SERVICE SNAPS FOR THE McMICHAEL MODEL FM55

Valves: ECC85 (r.f., f.c.), ECH81 (a.m. f.c.), EF85 (i.f.), EABC80 (a.m. f.m. dets., a.f. amp), EL84 (output), EM80 (tuning indicator), EZ80 (f.w. rec.).
Intermediate Frequency: F.M.—10.7 Mc/s. A.M.—470 kc/s.
Volume Control: 1MΩ log.
Tone Control: 150kΩ log.
Electrolytics: 32+32+16μF. 350V; 50μF, 12V; 5μF, 50V.
Wavebands: Long—900-2,000m; Medium—190-540m; F.M.—88-95 Mc/s.
Input Voltages: 190-260V 40-100 c/s a.c.









ABOVE.—Underchassis view showing layout of components. Adjustments for C4, C5, C17, C18, L1, L4 and L5 are made from below chassis. BELOW.—View of topside of chassis showing location of components, including L2 and L3. The f.m. section is located around the valve V1.

VOLTAGE AND CURRENT READINGS

Valve	Anode			Screen			Cathode		
	pin	V	mA	pin	V	mA	pin	V	mA
V1 ...	6	140	6				8	1.9	6.0
...	1	135	5.5						
V2 ...	6	205	2.0	1	62	4.4			
...	8	50–100*	5.2-3.5*						
V3	7	205	7.8	8	85	1.6	1	1.0	9.0
V4	9	65	0.7						
V5	7	253	36	9	210	4.0	3	6.0	4.0
V6 ...	9	210	1.5						
...	7	30	0.4						
V7	1/7	260 a.c.					3	290	

**non-oscillating and oscillating*

H.t.
Unsmoothed (across C48a)—290V
1st smoothed (across C48c)—260V.
2nd smoothed (across C48b)—210V.
Total h.t. consumption—65mA.
Total power consumption—70 watts at 235V.

Above measurements made with input of 235V (voltage tapping 225-250V). Receiver switched to m.w., no signals, volume control at maximum and tone control set for maximum top.

COMPONENT LIST

Resistors

IR1	1MΩ
IR2	4.7kΩ
IR3	2.2kΩ
IR4	220Ω
IR5	120Ω
R1	33kΩ
R2	33kΩ
R3	1MΩ
R4	47kΩ
R5	220Ω
R6	82kΩ
R7	150kΩ
R8	100Ω
R9	220Ω
R10	47kΩ
R11	1kΩ
R12	1MΩ
R15	47kΩ
R16	1MΩ
R17	1MΩ
R18	100kΩ
R19	100kΩ
R20	1MΩ
R21	10MΩ
R22	2.2MΩ
R23	33kΩ
R24	2kΩ
R25	250kΩ
R26	470kΩ
R27	150Ω
R28	500kΩ
R29	12kΩ

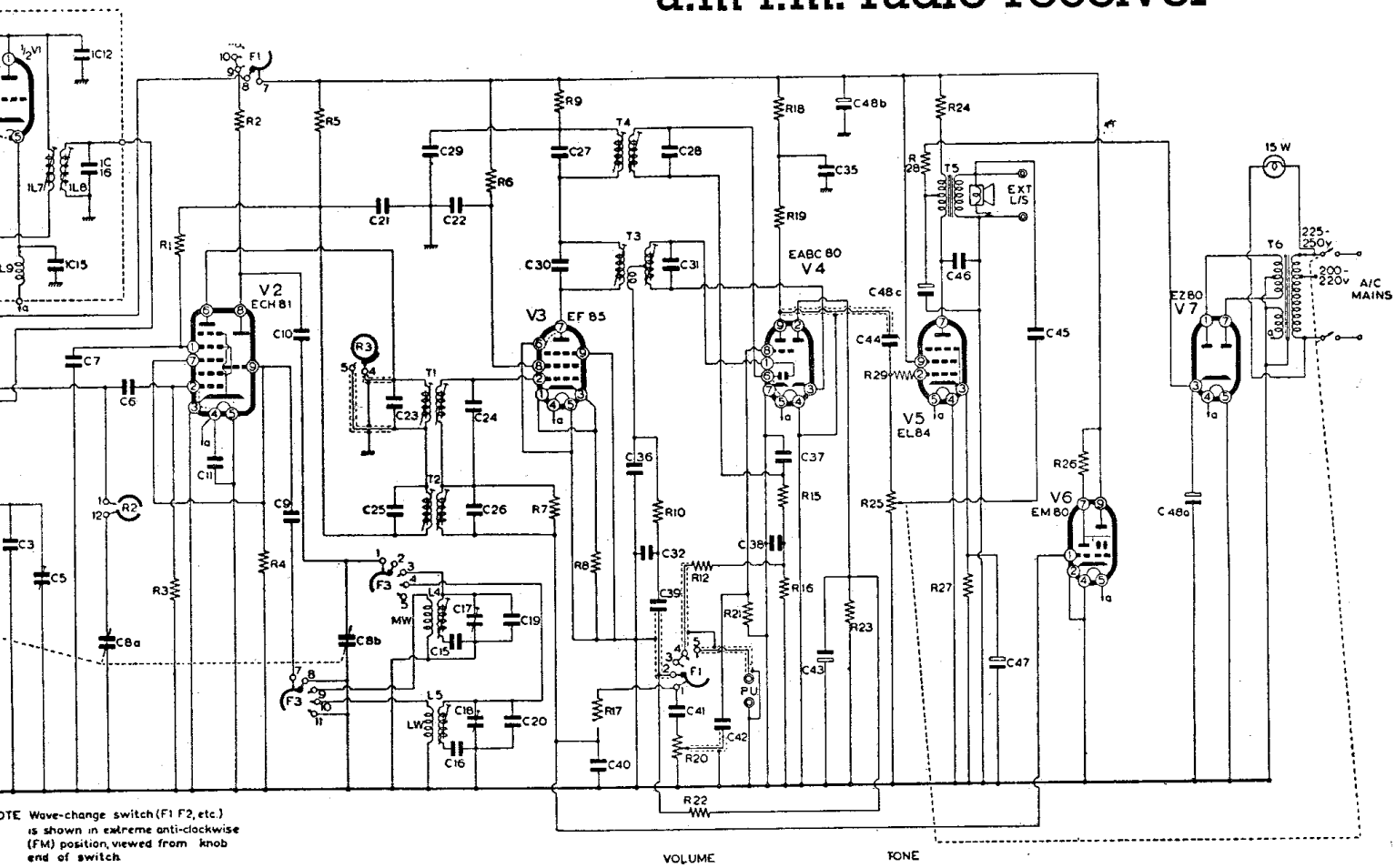
Capacitors

IC3	30pF
IC4	30pF
IC5	30pF
IC6	570pF
IC7	39pF
IC8	39pF
IC9	18pF
IC10	8.2pF
IC11	47pF
IC12	12pF
IC13	0.001μF
IC14	0.0022μF
IC15	0.0022μF
IC16	15pF
C2	0.0015μF
C3	30pF
C4	3-30pF
C5	3-30pF
C6	100pF
C7	0.005μF
C8	14.5-532pF
C9	50pF
C10	500pF
C11	0.001μF
C12	0.005μF
C13	15pF
C15	580pF, 2%
C16	200pF, 1%
C17	3-30pF
C18	3-30pF
C19	20pF
C20	100pF
C21	0.005μF
C22	0.005μF
C23	50pF, 5%
C24	50pF, 5%
C25	60pF, 2%
C26	100pF, 2%
C27	100pF, 2%
C28	180pF, 2%
C29	0.005μF
C30	10pF ± ½pF
C31	30pF ± ½pF
C32	0.001μF
C35	0.1μF
C36	300pF
C37	100pF
C38	100pF
C39	0.05μF
C40	0.05μF
C41	0.05μF
C42	0.02μF
C43	5μF
C44	0.05μF
C45	0.01μF
C46	0.001μF
C47	50μF
C48a	32μF
C48b	32μF
C48c	16μF

Valves

V1	ECC85
V2	ECH81
V3	EF85
V4	EABC80
V5	EL84
V6	EM80
V7	EZ80

Circuit diagram of the McMichael Model FM55 a.m-f.m. radio receiver



Alignment Procedure

As the normal tuning scale is mounted in the cabinet, reference is made to calibration marks on the drive drum in conjunction with the auxiliary pointer. These calibration marks are as follows:

A—190m, 900m, 95 Mc/s.	
B—500m.	C—2,000m.
D—Datum mark.	
E—88 Mc/s.	F—91 Mc/s.

Before alignment, check mains tapping plug, check that the auxiliary pointer coincides with the mark D, with gang capacitor fully meshed.

A.M. ALIGNMENT

Disconnect speaker and substitute a 3-ohms output meter, turn volume and tone controls fully clockwise.

I.F. circuits: Connect signal generator direct to the junction of C6/switch and chassis. Inject a signal of 470 kc/s at 200mW, with receiver tuned to m.w. (mid position) and tune T2 and T4 for maximum output. Inject a signal of 470 kc/s via a dummy aerial to aerial and earth sockets and adjust i.f. trap coil L1 for minimum output.

To measure i.f. sensitivity the local oscillator should be rendered inoperative (by shorting C8b). Sensitivity should be 20μV (2mV at signal grid of the EF85). Sensitivity of the i.f. trap should be 8mV.

Medium Wave: Connect signal generator between aerial and earth sockets (via a dummy aerial) and inject a signal of 1,580 kc/s. Set tuning drive to calibration mark A and tune C17 and C4 for maximum output. (Sensitivity 60μV). Re-tune signal generator to 600 kc/s, set tuning to calibration mark B, and adjust L4 and L2 for maximum output. (Sensitivity 45μV).

Long Wave: Switch receiver to long wave, adjust to calibration mark A, inject signal of 333 kc/s and adjust C18 and C5 for maximum output (sensitivity 70μV). Inject signal of 150 kc/s, adjust receiver to calibration mark C, and tune L5 and L3 for maximum output. (Sensitivity 100μV).

Note: Sensitivity figures given are design centre figures and allow for a production tolerance of ±3dB.

A.G.C.: To measure a.g.c., inject signal of 1 Mc/s via a dummy aerial, tune receiver. Adjust the volume control for 2.5W output, with inputs of 100mV, 10mV and 1mV.

input reduction	output reduction
100mV—10mV	4dB
10mV—1mV	6dB
1mV—100μV	16dB
Total 60dB	Total 26dB

Note: Oscillator grid current measured with microammeter in series with R4 (chassis end). M.W.—210-230μA. L.W.—190-240μA.

F.M. ALIGNMENT

I.F. Circuits: Connect signal generator direct to the junction of C6/switch and chassis. Connect testmeter across R23 (positive to chassis) as output indication. Using accurately tuned signal generator, inject a signal of 10.7 Mc/s (unmodulated). Carefully adjust T1 and T3 for maximum output, keeping output indication at about 3 volts.

The band width can be checked by swinging signal generator frequency each side of the

—(*continued on page 4*).

ALIGNMENT PROCEDURE —Continued

10.7 Mc/s until the output drops 3dB (3V to 2.1V). Band width should be ±100 kc/s. Retune the i.f.t's if necessary. Connect two accurately matched resistors (of about 100kΩ) and connect in series across R23. Connect meter from junction of the two resistors and the junction of R10/C32. Tune the secondary of T3 for zero output.

Note that the core position on tune is approximately level with the base of its former. Starting with the core well out, a peak occurs in one direction. On screwing the core in, the output goes through zero to a peak in the opposite direction. The tune position is for zero output. A centre-zero meter is of help here, but the operation is best done in conjunction with a wobbulator.

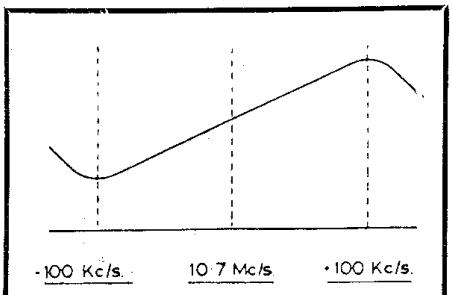
Connect signal generator direct to aerial input terminals. Short-circuit the i.f. trap IL3 (two tags near IL9). Tune IL8 and IL7 for maximum output. The input from signal generator will have to be increased to force i.f. signal through the r.f. circuits. Remove short-circuit and tune IL3 for *minimum* output.

R.F. Adjustment: Set receiver to calibration mark E on drive drum. Connect output meter across R23. Inject signal of 88 Mc/s and adjust IC4, then IC3, for maximum output. Check that 95 Mc/s coincides with position A on drive drum and if necessary correct by separating or closing IC7/IC8. This should be the only adjustment necessary.

If, however, further correction is required, proceed as follows:

Set receiver to position F, inject 91 Mc/s and tune IC4 for maximum output. Check that 88 Mc/s coincides with mark E and 95 Mc/s with mark A. If 95 Mc/s position only is inaccurate, correct by separating or closing IC7/IC8.

If both 88 Mc/s and 95 Mc/s positions are incorrect, adjust the oscillator coil IL5 by rotating the lacquer-sealed screw. One turn of the core equals approximately 150 kc/s of adjustment. If the oscillator core is altered, recheck the i.f. coils IL7 and IL8.



Curve to be expected when checking ratio detector by wobbulator and oscilloscope. Trace should be linear within 100 kc/s each side of the 10.7 Mc/s i.f. signal.

Radiation: To ensure minimum oscillator radiation, set the receiver to minimum frequency and adjust IC3 and IC4 to centre position. Connect a valve voltmeter to the junction of IC7/IC8 and chassis. Tune IC5 for minimum reading. If two minimum positions are found, the correct one is for minimum capacitance.

Wobbulator: To check setting of ratio detector by means of a wobbulator, inject an r.f. signal to the receiver aerial sockets. Connect oscilloscope input leads across the volume control and an output meter across R23. Modulate the wobbulator ±150 kc/s and tune receiver for maximum reading on output meter. Adjust input to give 3V on output meter. Tune secondary of T3 for linear output as viewed on the oscilloscope.

Sensitivity: The overall sensitivity for 200mW output is 15μV 3dB. This is measured with the speaker disconnected, volume and tone controls at maximum. The r.f. signal is injected into the 300-ohm aerial sockets and is frequency modulated ±25 kc/s at 1,000 c/s output. Output meter is 3-ohm.

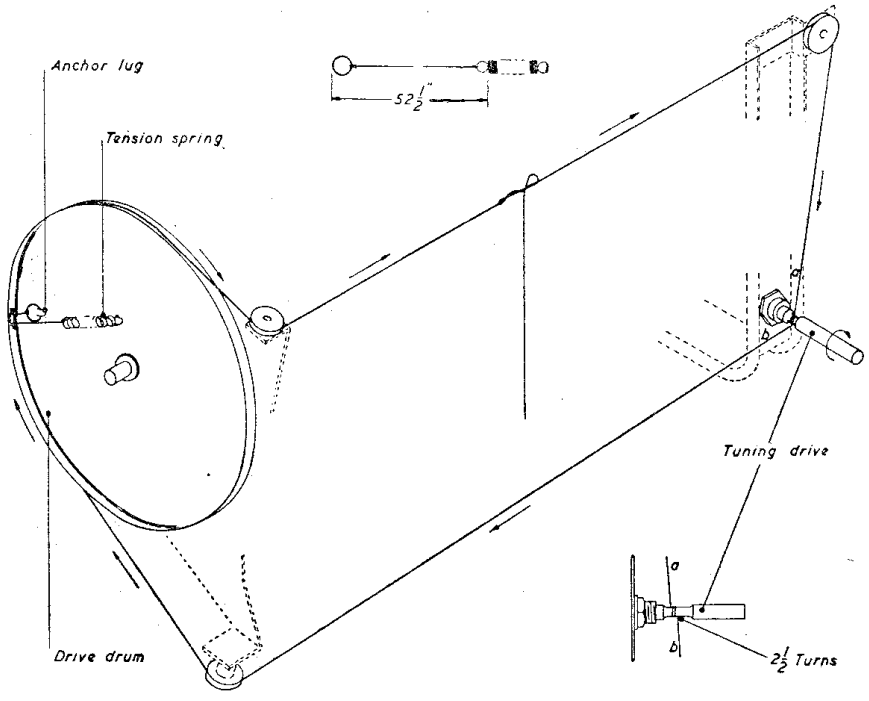
Required input at 10.7 Mc/s into modulating grid of the EF85 to give 3V across R23 is 50mV. Into modulating grid of the ECH81, required input is 5mV. In both cases, measurements are taken with signal generator unmodulated and with the a.g.c. line shorted out.

A.G.C.: To check a.g.c., inject signal of 91 Mc/s into the 300-ohm aerial sockets. Modulate generator ±25 kc/s at 1,000 c/s. Adjust signal generator to give output of 50mV and volume control to give 2.5W output as measured on a 3-ohm output meter substituted for the speaker. Input is then reduced to 10mV and subsequently to 1mV and 100μV. Output reduction reference to 2.5W output is as follows:

input reduction	output reduction
50mV—10mV	2dB
10mV—1mV	6dB
1mV—100μV	8dB
Total 54dB	Total 16dB

DRIVE CORD REPLACEMENT

Cut the replacement cord to the length specified, attach one end to the anchor-lug on drive pulley and proceed as indicated in the accompanying dlagram. Knot the free end to loop of tension spring and secure in position.



F.M. RECEPTION

The inbuilt f.m. aerial consists of a 300-ohm folded dipole mounted on the cabinet interior. If this is insufficient, a similar aerial could be tried fixed, say, to a picture rail. The feeder can be 300-ohm line, constructed similar to the built-in aerial, mounted horizontal and with the total length of the horizontal section 60in. In bad reception areas an outdoor aerial must be used.

Provision is made for a 300-ohm balanced feeder line from a folded dipole of 75-ohm coaxial feeder from a standard dipole. If an external aerial is used, stow the internal aerial in the " dummy " sockets.

OTHER MODELS

The FM55 radio chassis as described in this *Test Report* is virtually the same as that used in McMichael Models 255 and 255S console radio receivers and the Model 555 bureau radiogram. It is also used in the television Model C417R/FM.

The circuit as used in the Models 255, 255S and 555 differs from the FM55 circuit in two respects. The tone control is replaced by individual bass and treble controls, the bass control circuit being in the V5 grid return circuit and the treble control circuit in the V5 output circuit.

In the radio detector circuit, a 100-ohm resistor is inserted in series between the T3 tertiary winding and the junction of R10/C36. The capacitor C32 from the junction of R10/C39 to chassis is omitted.

Circuit diagram of the McMichael Model FM55

a.m-f.m. radio receiver