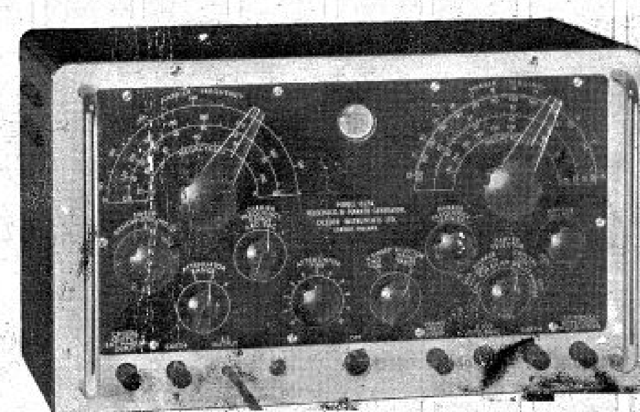
COSSOR

telecheck & marker generator



model 1323A

Cossor Telecheck and Marker Generator

Model 1323A

COSSOR INSTRUMENTS LIMITED
(THE INSTRUMENT COMPANY OF THE COSSOR GROUP)
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Cables: Cossor, London
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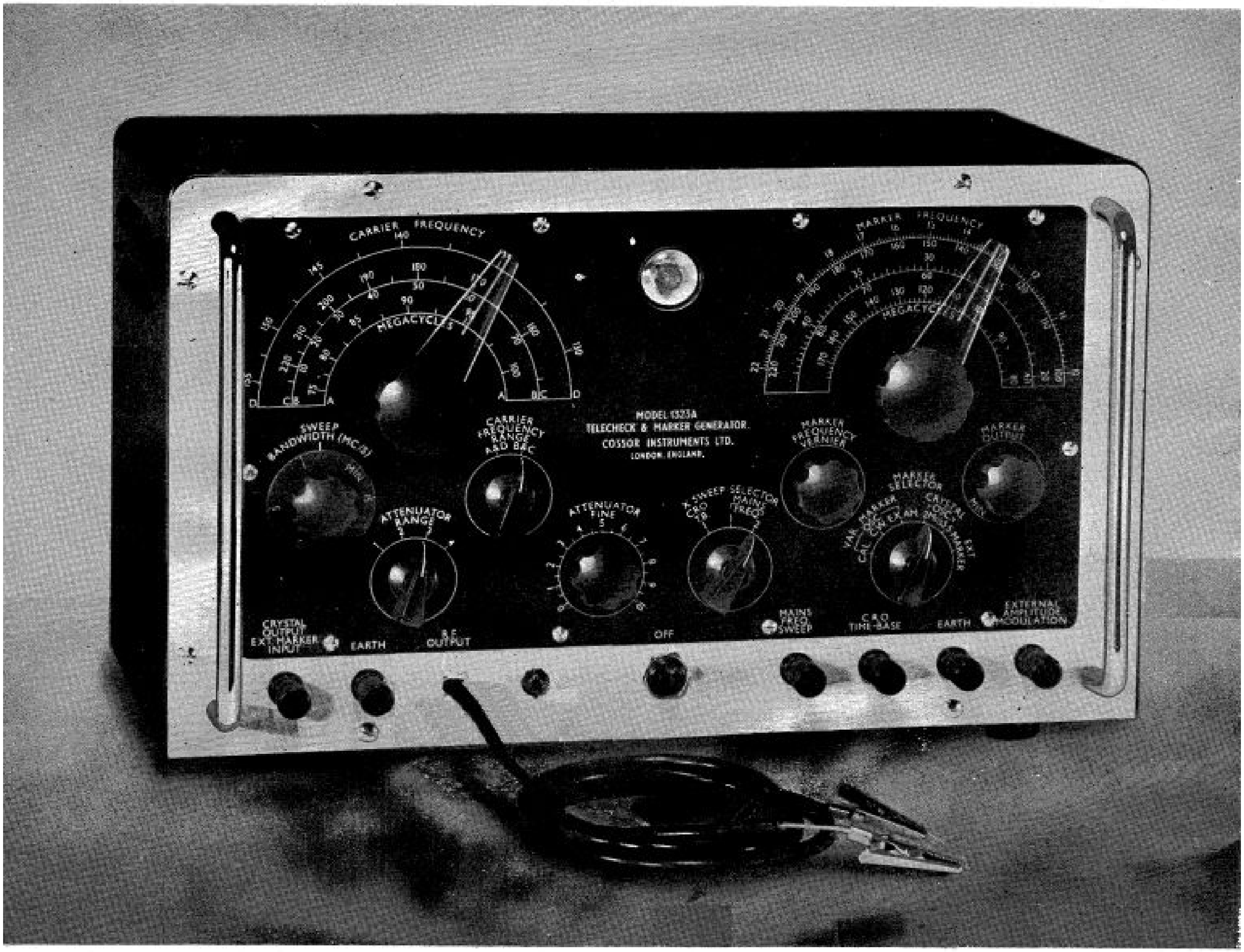
contents


CARRIER FREQUENCY
MEGACYCLES
MODEL 1323A
TELECHECK & MARKER GENERATOR.
COSSOR INSTRUMENTS LTD.
LONDON, ENGLAND.
MARKER FREQUENCY
SWEEP BANDWIDTH (MC/S)
CARRIER FREQUENCY RANGE A&D B&C
ATTENUATOR RANGE
ATTENUATOR FINE
SWEEP SELECTOR
MARKER FREQUENCY VERNIER
MARKER SELECTOR
MARKER OUTPUT
CRYSTAL OUTPUT EXT. MARKER INPUT
EARTH
R.F. OUTPUT
OFF
MAINS FREQ. SWEEP
C.R.O. TIME-BASE
EARTH
EXTERNAL AMPLITUDE MODULATION

introduction

The Cossor Telecheck and Marker Generator provides an r.f. output at any frequency in the ranges 5 to 75 Mc/s, 75 to 100 Mc/s, 130 to 155 Mc/s or 155 to 225 Mc/s and this may be frequency-modulated either by the time base voltage from an oscillograph or from an internal mains frequency source, when two anti-phase outputs for feeding an oscillograph X amplifier are available. The frequency-modulated r.f. output fed to a receiver provides a voltage at the detector which, applied to the oscillograph Y amplifier, will display the frequency response curve of r.f. and i.f. circuits in the receiver. This curve may be calibrated using a Marker Generator in the Telecheck to provide a reference frequency pip on the display. An internal Crystal Oscillator enables the Marker Generator fundamental frequency to be checked to an accuracy of $\pm 0{\cdot}01\%$ at 2 Mc/s intervals; a Magic Eye indicator is provided for this purpose.

Receivers may be quickly and accurately aligned with the aid of such displays and if a double beam oscillograph is used, sound and vision response curves can be displayed simultaneously, when any interaction between the two channels will be immediately apparent.

Model 1323A incorporates a second crystal holder and when the additional crystal is fitted, the 2 Mc/s or alternative frequency is switch selected as a marker or for external calibration purposes. Markers from an external signal source may be used in addition to either crystal or marker generator output and the latter may be amplitude modulated by an external voltage at frequencies up to 1 Mc/s.

specification

Carrier Frequency	5 to 75 Mc/s (Range B). 75 to 100 Mc/s (Range A). 130 to 155 Mc/s (Range D). 155 to 225 Mc/s (Range C). All ranges continuously variable. Calibration accuracy ±2 Mc/s. Two-position switch selects Ranges A & D or B & C.
Frequency Modulation (of Carrier) ...	Linear from CRO time base (100 to 300 volts) or sinusoidal from internal source, when either of two anti-phase 6·3 volt outputs is available for feeding to oscillograph X amplifier. Total sweep range continuously variable from 300 kc/s to 15 Mc/s. Amplitude variation less than 10%.
RF Output Voltage ...	Minimum 25 microvolts. Maximum 40 millivolts. Coarse and fine attenuator controls, arbitrarily calibrated. Nominal reductions: **1**—800:1. **2**—80:1. **3**—8:1. **4**—1:1. On sinusoidal f.m. of carrier, output is cut off every alternate half-cycle of mains.
Output Impedance ...	80 ohms (Atten. range 1, 2 or 3). 0–90 ohms (Atten. range 4).
Marker Generator	Oscillator covers 10 to 22 Mc/s, calibrated for fundamental and harmonic ranges. Tuned by slow-motion dial with double-engraved anti-parallax cursor. Variable output up to 50 mV (max) for fundamental.
Amplitude Modulation (of Marker) ...	External signals from 50 c/s up to 1 Mc/s may be used. Input impedance for external a.m. approx. 10 kilohms. 20 volts r.m.s. at 400 c/s gives 30% modulation. The oscillograph time base output may be applied as amplitude modulation provided that a suitable series resistance is inserted between source and EXTERNAL AMPLITUDE MODULATION terminal.
Crystal Oscillator ...	Fitted with 2 Mc/s crystal (accuracy ±0·01%). Second holder fitted for additional crystal (upper frequency approximately 10 Mc/s). Escutcheon marked 5·5 Mc/s
Calibration	Output from either crystal available for external use or markers. Marker Generator has vernier control for setting to crystal accuracy at 2 Mc/s intervals with aid of a Magic Eye. Markers from external source may be used.
Power Supply ...	105-115, 120-130, 200-215, 216–234, 236–252 volts AC 50 to 100 c/s Consumption
Dimension	15″ x 9″ x 8″
Finish	

technical description

A block schematic diagram of the instrument is shown in Fig. 1, the circuit diagram in Fig. 4 and a layout diagram in Fig. 5. It will be seen that the r.f. output is obtained by heterodyning two oscillators.

REACTANCE VALVE V1

An r.f. voltage from the sweep oscillator V2 is coupled to R45 L1 by the anode-grid capacity of the two paralleled sections of V1, and the r.f. current flowing in the grid circuit leads the anode voltage by nearly 90 degrees. The grid-cathode potential is given by the product of this current and the impedance of R45 L1, and leads the anode voltage such that the resultant anode current leads the anode voltage by 90 degrees and so the stage behaves as a capacitance. The value of this capacity is determined by the magnitude of the anode current and this is governed by the voltage fed to the grid of V1 via the X SWEEP SELECTOR (S1).

Five controls are associated with the reactance valve. The setting of the X SWEEP SELECTOR switch determines whether the reactance valve is to be controlled by the scanning voltage from an oscillograph, fed to the CRO TIME BASE terminal on the Telecheck, or by a voltage derived from the h.t. winding via the potential divider R9 R7. The latter applies in positions 1 AND 2 of MAINS FREQ settings of the X SWEEP SELECTOR. The 6·3 volts r.m.s. available at the MAINS FREQ SWEEP terminal for feeding to an oscillograph amplifier is, in one switch position in phase with the voltage controlling the reactance valve and, in the other position, in anti-phase to it.

A pre-set potentiometer P1 and the SWEEP BANDWIDTH potentiometer P3 provide attenuation of the voltage fed to V1 grid such that the effective capacitance of the stage varies over a range sufficient to tune the sweep oscillator through 15 Mc/s (maximum). P2 provides optimum bias for the particular valve used as V1, whilst L1, in providing phase correction, also minimises amplitude variation of the sweep oscillator voltage.

SWEEP OSCILLATOR V2

This stage uses a triode valve type A1714 and a tuned circuit consisting of the centre-tapped inductor L2 and the effective capacitance of the reactance valve. Conventional oscillator grid bias is provided by C8 R11. The core of L2 is adjusted so that the sweep oscillator centre frequency is 115 Mc/s, frequency modulation occurring either side of this.

BUFFER STAGE V3

The grid of this stage, employing one section of a valve type 6J6, is directly coupled to the grid of V2. The anode voltage is coupled by C13 R16 to the mixer section of V4. The second section of V3 is not used.

VARIABLE OSCILLATOR AND MIXER V4

One section of the 12AT7 valve is connected as a oscillator, the tuned circuit consisting of L4 or L (depending upon the CARRIER FREQUENCY RANGE) and C21. This is a split stator capacitor adjusted by the CARRIER FREQUENCY control to give a range of 15–40 Mc/s (Ranges A & D) or give a range of 40–110 Mc/s (Ranges B & C). Grid bias is obtained from C20 R20 the oscillatory voltage is coupled to the mixer by C17. On MAINS FREQ SWEEP the sweep oscillator is rendered inoperative every alternate half cycle from the h.t. winding of the mains transformer via R15 R17 C16 and R14. Across R19, the anode load of the mixer stage, appear the sum and difference frequencies of the sweep and variable oscillator voltages.

With L4 in circuit the variable oscillator fundamental frequency range is 40–110 Mc/s and this is mixed with the 115 Mc/s voltage from the fixed oscillator. Their frequency difference provides the Range B coverage of 5–75 Mc/s and their sum the Range C coverage of 155–225 Mc/s.

With L5 in circuit the variable oscillator fundamental frequency range is 15–40 Mc/s and this is mixed with the 115 Mc/s voltage from the fixed oscillator. Their difference provides the Range A coverage of 75–100 Mc/s and their sum the Range D coverage of 130-155 Mc/s.

These voltages are coupled by C19 to the output attenuator network.

ATTENUATOR

The voltage input to the attenuator is controlled by the ATTENUATOR FINE control, P4. This is followed by a four-position switch S4, ATTENUATOR RANGE, giving nominal reductions of 800:1, 80:1, 8:1 and 1:1. In position 1 the attenuation is less than 800:1 due to by-passing effects of stray capacities. The attenuator controls bear only arbitrary calibration. The signal after attenuation is fed to the RF OUTPUT socket.

MARKER GENERATOR V5

A triode-connected 6AM6 operating as a Colpitts oscillator is tuned by C27, the MARKER FREQUENCY control, over the fundamental frequency range of 10 to 22 Mc/s. The output is taken from the valve cathode via C23 R32, these components assisting in preserving the harmonic output at a satisfactory level. The potentiometer P5 is the MARKER OUTPUT control and trimmer C29 is the MARKER FREQUENCY VERNIER control. With the MARKER SELECTOR set to CAL or CW, this stage is fed directly from the h.t. supply of the Telecheck but on EXT AM, the 10 kilohm load R24 is interposed and any signal applied to the EXTERNAL AMPLITUDE MODULATION terminal will become effective.

CRYSTAL OSCILLATOR AND DETECTOR AMPLIFIER V6

One section of a double triode valve type 12AT7 is connected as a Pierce oscillator operating with a 2 Mc/s (or alternative) crystal. The bias is obtained mainly from C32 R37, the prime function of R38 being to provide a low impedance source for tapping off the voltage. This voltage and that from the Marker Generator (S3 on CAL) are fed to the grid of the second half of the valve, which is connected as a leaky grid detector. Across the anode load of this stage will appear the beat voltage representing the difference in frequency between the marker Generator fundamental and the nearest 2 Mc/s crystal harmonic.

MAGIC EYE V7

The alternating voltage at the anode of V6 is coupled by C36 R42 to the grid of a tuning indicator valve type 64ME. The ‘ V ’ shadows of this stage become smaller

operation

NOTE.—It is important that the correct mains transformer tapping is used, since an appreciable drop in the internal supply voltages will cause amplitude modulation of the output signal. The instrument should be allowed about five minutes warming-up time before use.

Alignment procedures recommended by manufacturers will vary according to the circuit employed in any particular receiver: instructions given here should therefore be used only as a general guide.

Methods of connecting the Telecheck to an oscillograph and television receiver are shown in Figs. 2 and 3. The oscillograph time base repetition frequency should be set between 50 and 100 c/s and if a d.c. potential is present with the oscillograph scan voltage, connection to the X terminal of the Telecheck should be made via a capacitor of 0·25 mfd. Most types of oscillograph have a negative-going scan voltage which will result in the Telecheck output sweeping from lower to higher frequencies.

An alternative method of display, not dependent upon the availability of the oscillograph scan voltage, is obtained by switching the X SWEEP SELECTOR to MAINS FREQ. (1 or 2). In this case the oscillograph time base should be switched off and the X plates fed via an amplifier from the MAINS FREQ. SWEEP terminal on the Telecheck. Positions 1 and 2 of MAINS FREQ. provide alternative anti-phase outputs of 6·3 volts r.m.s., enabling the response curve displayed to be reversed from left to right if required. The r.f. output is cut off every alternative half-cycle of the sweep, giving a baseline to the curve displayed.

The coaxial RF OUTPUT cable from the instrument has two short leads fitted with crocodile clips to provide easy connection to the test points selected. This cable should be terminated with an 80-ohm resistor unless connection is made to a circuit with this value of input impedance. When applying the output to a bias or h.t. point a blocking capacitor of 0·001 mfd must be connected in series with the RED lead. The Telecheck output may be fed to any i.f. or r.f. stage grid or the aerial socket of the receiver.

The output from the receiver may be taken from the vision detector load, the video amplifier anode or the test point recommended by the manufacturer. In any case, connection to the receiver should be made via a resistor of the order of 50 kilohms and a screened cable used. The resistor is included as a precaution against instability due to feedback from output to input of the r.f. circuits. When suffcient gain is available in the oscillograph amplifier, connection to the detector load is to be preferred. If the alternative connection to the video amplifier anode is used, trouble may be experienced due to hum from the h.t. line of the receiver; the circuit of Fig. 3 is designed to overcome this. The response curve will be inverted on changing the oscillograph amplifier connection from the detector to the video stage anode. The capacitor across the oscillograph amplifier terminals should be of the order of 0·002 mfd and its function is to reduce the width

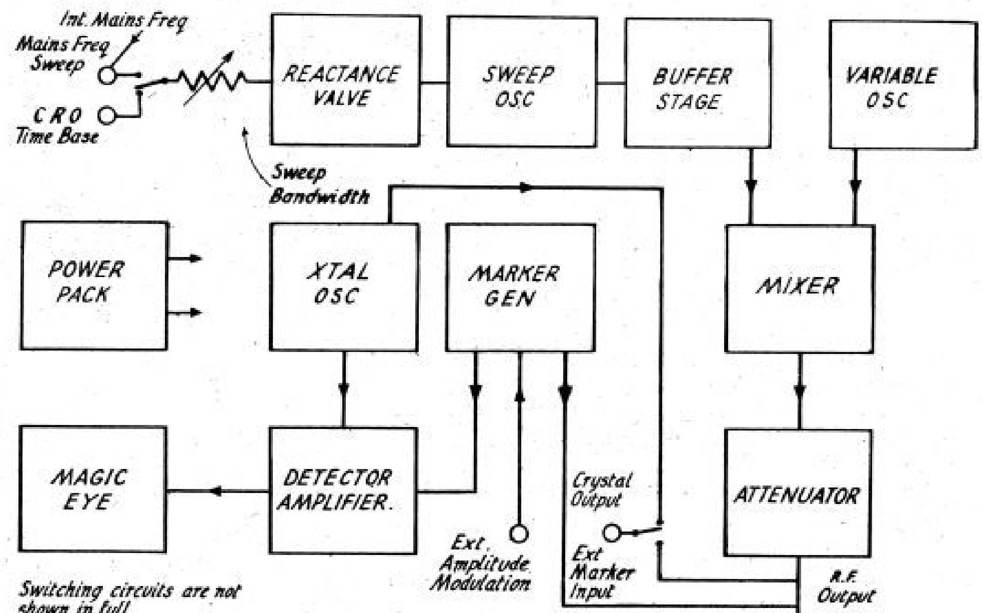
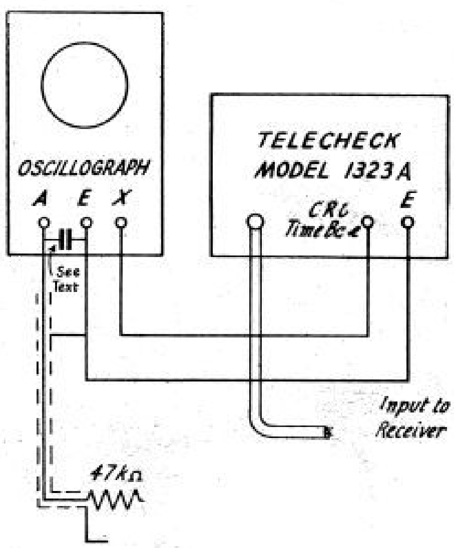
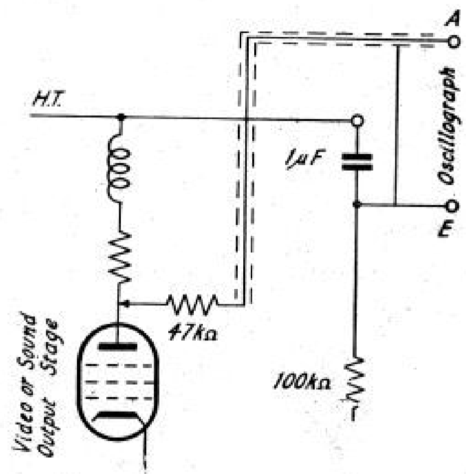

Int. Mains Freq
Mains Freq Sweep
CRO Time Base
Sweep Bandwidth
REACTANCE VALVE
SWEEP OSC
BUFFER STAGE
VARIABLE OSC
POWER PACK
XTAL OSC
MARKER GEN
MIXER
MAGIC EYE
DETECTOR AMPLIFIER.
Crystal Output
ATTENUATOR
Ext. Amplitude Modulation
Ext Marker Input
R.F. Output
Switching circuits are not shown in full.

Fig. 1


OSCILLOGRAPH
A E X
See Text
TELECHECK MODEL 1323A
E
Input to Receiver
47kΩ


H.T.
A
1μF
Oscillograph
E
47kΩ
Video or Sound Output Stage
100kΩ

While adjusting the CARRIER FREQUENCY control to obtain a response curve, the MARKER OUTPUT should be set to MIN, as otherwise it may overload the receiver and make initial location of sweep signal difficult.

Alignment of i.f. circuits will normally precede that of r.f. circuits, unless the former are known to be in order. The SWEEP BANDWIDTH should be set at the required value for alignment of the vision channel circuits and at 1 Mc/s for the sound channel circuits. The initial setting-up procedure for P1 is described under " Service and Maintenance."

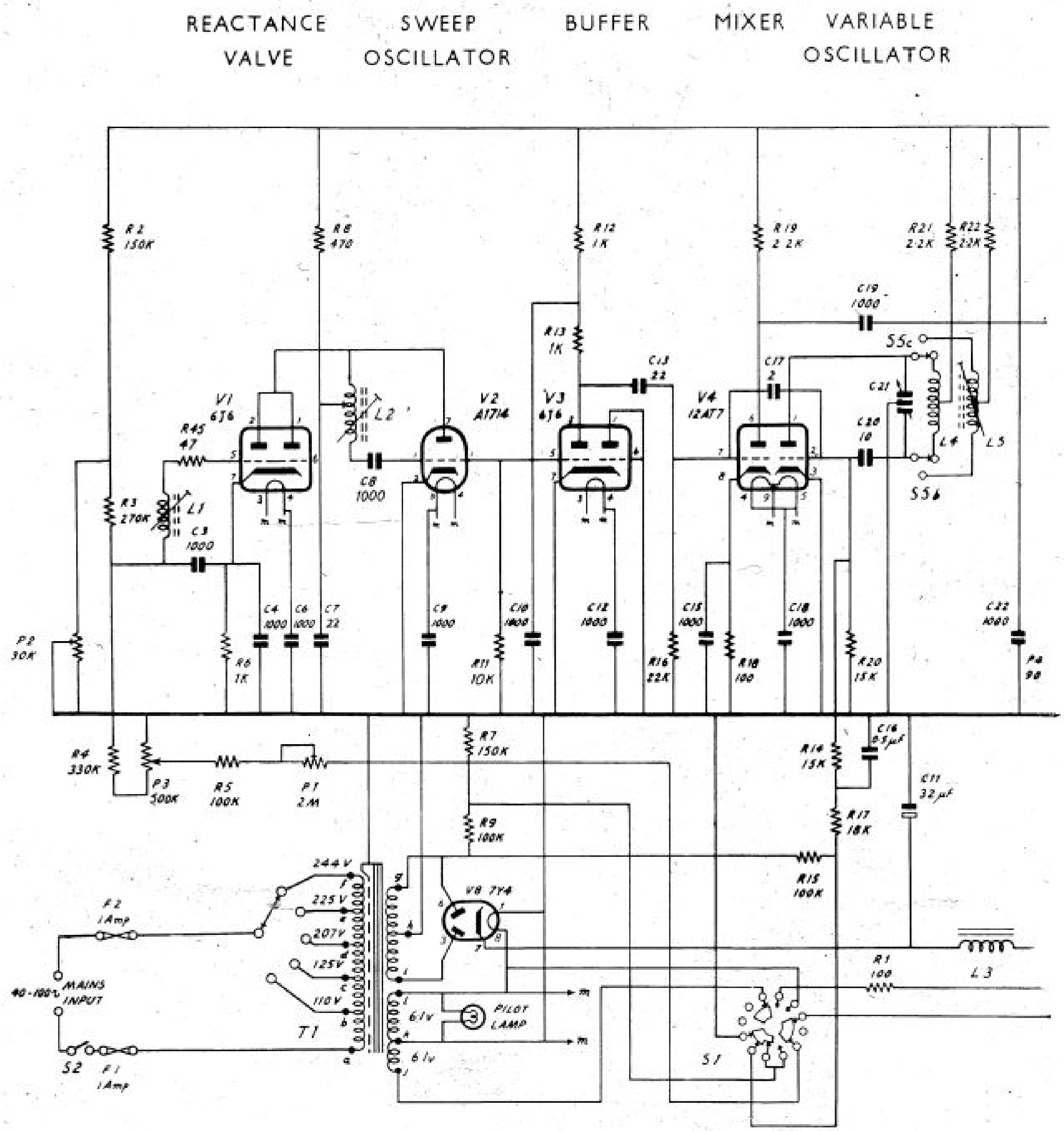
When sound and vision i.f. circuits are in order, the ATTENUATOR controls on the Telecheck should be set for minimum carrier frequency output (position 1 of the ATTENUATOR RANGE switch) and the MARKER SELECTOR switched to EXT AM. Apply an audio frequency voltage (approximately 20 volts r.m.s.) to the EXTERNAL AMPLITUDE MODULATION terminal (see " Amplitude Modulation " under Specification). Set MARKER FREQUENCY cursor to the sound carrier of the required channel and tune the oscillator in the receiver for maximum audio output. The final adjustments to r.f. circuits can now be made using the CARRIER FREQUENCY output in conjunction with a marker (c.w.). Care should be taken that the CARRIER FREQUENCY is set correctly as a response curve may be obtained from the image frequency. The marker may be moved to check the frequency spectrum of any curve.

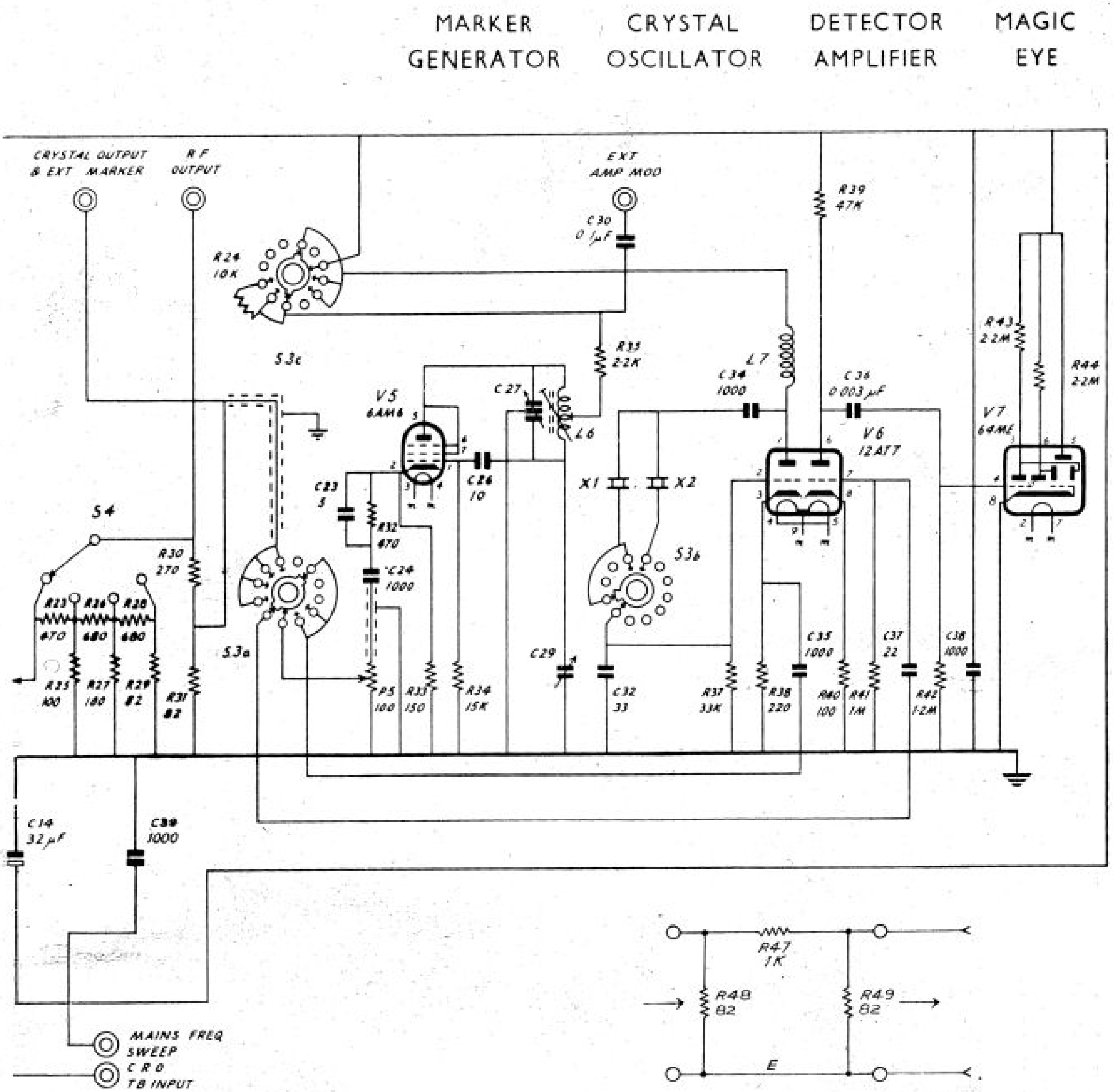
The MARKER SELECTOR set to EXT MARKER switches off all internal markers and enables a marker from an external source to be used, the input impedance at the CRYSTAL OUTPUT EXT MARKER INPUT terminal being 80 ohms. This same terminal may alternatively provide the output from either crystal when the MARKER SELECTOR is set to the appropriate position. Note that in this case, the MARKER OUTPUT control should not be fully anti-clockwise and that the crystal frequency will appear also in the r.f. sweep output as markers. When the internal Marker Generator is amplitude modulated by an external r.f. voltage, two additional marker pips, representing the sidebands, will be obtained.

During alignment a normal signal level input should be used. Too large an input will cause overloading and the resultant response curve displayed will be misleading. It is therefore advisable to reduce the input while looking at any response curve to observe if the curve changes shape. If it does, overloading is probably occurring. This may be because the original input was too great, in which case the signal should be reduced. A similar effect may be due to overloading the oscillograph amplifier. Alternatively, there may be a fault in the receiver which must be located before proceeding further.

On Range C operation the minimum output from the Telecheck may be effectively greater than 25 microvolts due to earth currents and due allowance should be made for this. From November 1955, however, an external attenuator will be supplied for every instrument, free of charge, to give some 20 dB reduction of output. Connection to the attenuator is by the clips terminating the Telecheck R.F. OUTPUT cable, further clip leads from the attenuator being used to connect to the receiver. This will enable satisfactory alignment to be undertaken of fringe-area receivers.

It will be found that with some receivers there is a variation of the response curve with change of contrast setting. If so, the contrast control should be set to the point at which a picture containing a reasonable range of black and white is obtained from the aerial signal before attempting to realign the receiver.

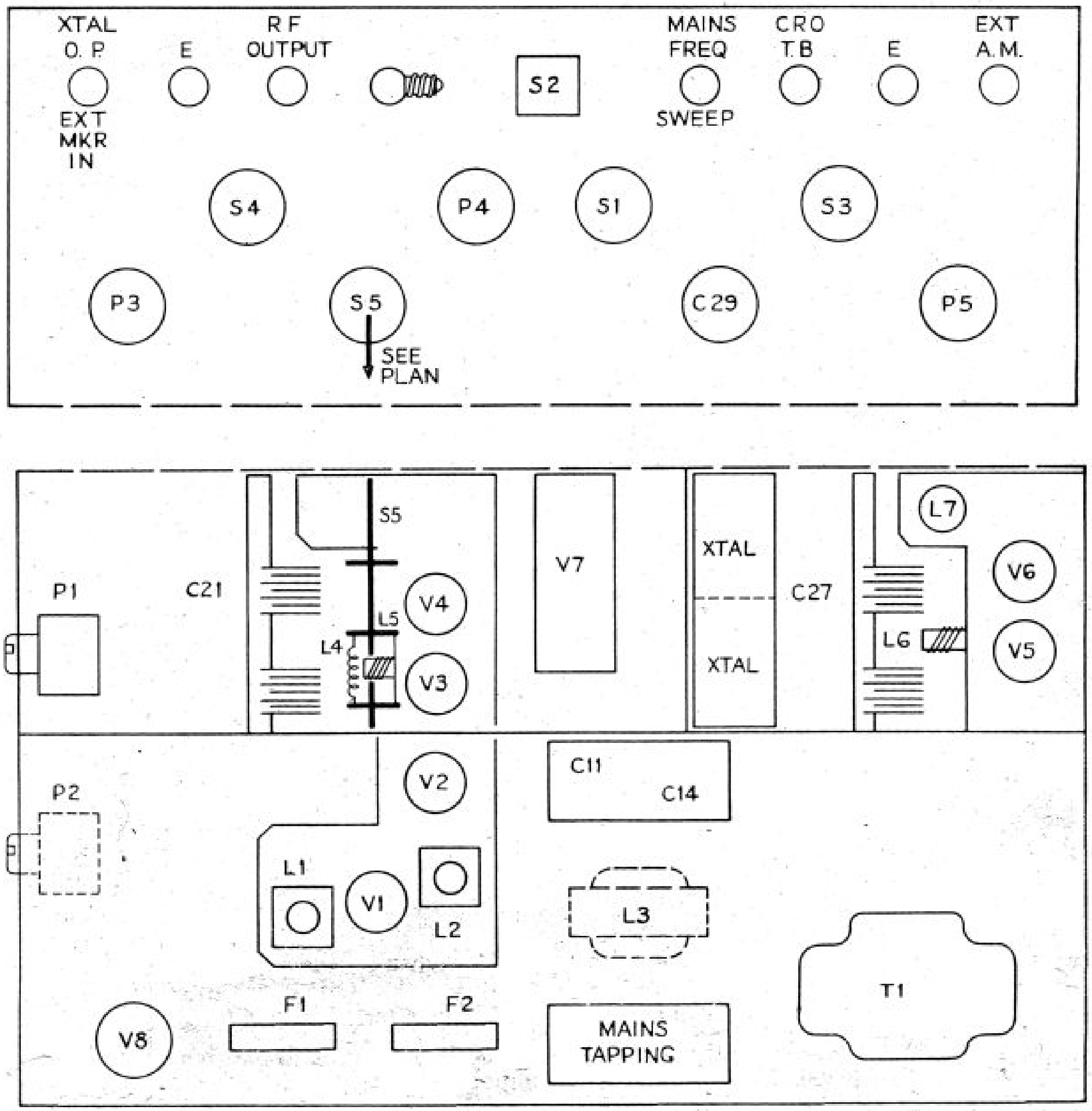

REACTANCE VALVE
SWEEP OSCILLATOR
BUFFER
MIXER
VARIABLE OSCILLATOR
R2 150K
R8 470
R12 1K
R19 2.2K
R21 2.2K
R22 22K
C19 1000
R13 1K
C13 22
C17 2
S5c
V1 6J6
V2 A1714
V3 6J6
V4 12AT7
R45 47
L2
L1
C8 1000
C21
C20 10
L4
L5
S5b
R3 270K
C3 1000
C4 1000
C6 1000
C7 22
C9 1000
C10 1000
C12 1000
C15 1000
C18 1000
C22 1000
P2 30K
R6 1K
R11 10K
R16 22K
R18 100
R20 15K
P4 90
R4 330K
P3 500K
R5 100K
P1 2M
R7 150K
R9 100K
R14 15K
C16 0.5μF
C11 32μF
R17 18K
R15 100K
244V
225V
207V
125V
110V
F2 1Amp
40-100~ MAINS INPUT
T1
V8 7Y4
6.1V
PILOT LAMP
6.1V
S2
F1 1Amp
R1 100
L3
S1



EXTERNAL ATTENUATOR

NOTE : ALL SWITCHES SHOWN IN ANTI-CLOCK WISE POSITION VIEWED FROM SPINDLE END

In Fig. 10 is shown the simultaneous presentation of the sound and vision response curves using a Cossor model 1035 Double Beam Oscillograph. The vision output was connected to the A1 terminal and the sound output to the A2 terminal. This form of presentation is particularly valuable as any interaction between the two channels will not always be apparent when these are tuned independently. This example shows the effect when the sound rejector circuit in the vision strip is mistuned. A group of the vision modulating frequencies is completely cut off. In Fig. 11 the sound rejector is correctly aligned, as is the whole vision strip, but the sound tuning is incorrect, a double hump being visible.



service and maintenance

TYPICAL CURRENT AND VOLTAGE READINGS

*Taken on a prototype instrument set on the 207 volt tap, operating from a 200 volt supply. Avo Model 7 on lowest suitable range except readings marked * where 1000 V DC range is used.*

Primary current	190 mA
Heaters	6·1 volts
HT Winding	158–0–158 volts r.m.s.
DC Potential across C11	165 volts
DC Potential across C14	158 volts
Ripple across C11	7 volts peak to peak
DC Potential across R6 C4 (dependent on P2 setting)	10–20 volts
Total HT current (on 'CAL')	48 mA
V1 anodes (pins 1 or 2)	148 volts
V3 anode (pin 2)	136 volts
V4 anode (1st section, pin 6)	145 volts
V4 cathode (1st section, pin 8)	0·5 volt
V4 anode (2nd section, pin 1)	141 volts
V5 anode (pins 5, 6 or 7)	140 volts
V5 cathode (pin 2)	0·7 volt
V6 anode (1st section, pin 1)	152 volts
V6 cathode (1st section, pin 3)	0·3 volt
V6 anode (2nd section, pin 6)	67 volts*
V6 cathode (2nd section, pin 8)	0·2 volt
V7 anode 1 (pin 3)	22 volts*
V7 anode 2 (pin 6)	15 volts*

INITIAL ADJUSTMENT OF P1

This pre-set potentiometer is accessible through the *foremost* aperture in the left side of the instrument case. The Telecheck, a TV receiver and an oscillograph should be connected as shown in Fig. 2 and SWEEP BANDWIDTH set at 15 Mc/s. P1 should then be adjusted to provide this range of frequency sweep, measured by the method described in part (*b*) of para. 8 on "Calibration of Sweep Oscillator and Reactance Valve Stages." No other control should require adjustment when setting up a new instrument. A scanning voltage greater than 30C volts will require additional attenuation externally by means of a resistor in series with the CRO TIME BASE

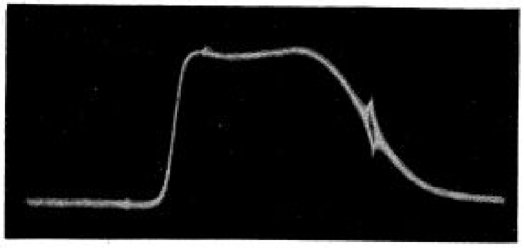


Fig. 6

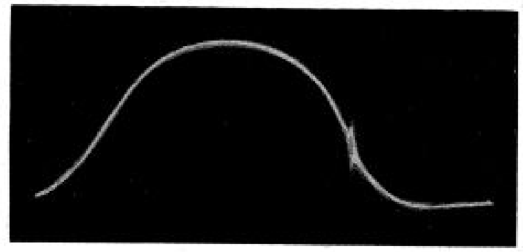


Fig. 7

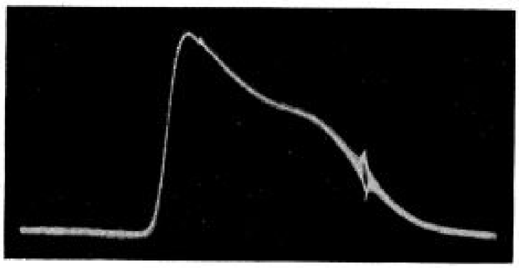


Fig. 8

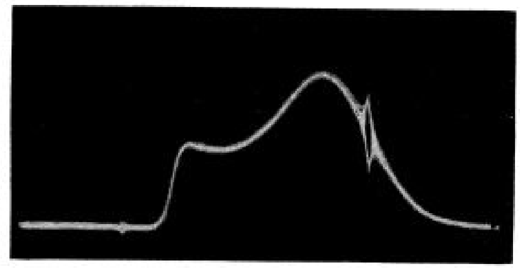


Fig. 9

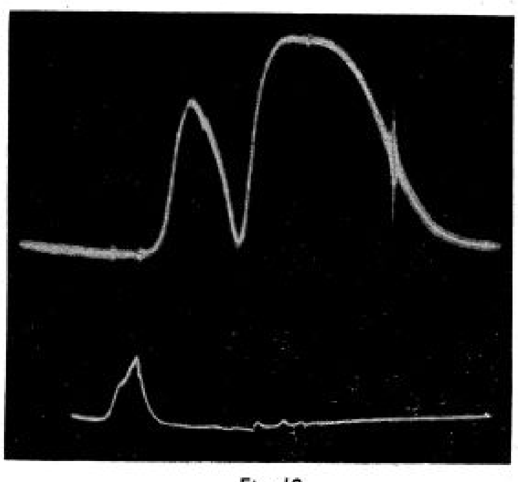


Fig. 10

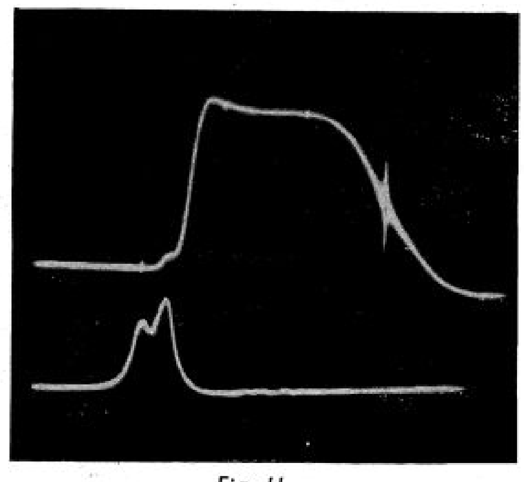


Fig. 11

CALIBRATION OF MARKER OSCILLATOR

1 Remove instrument from case and switch on.

2 Set MARKER SELECTOR to EXT AM, apply an audio signal to the appropriate terminal and set MARKER OUTPUT to MAX.

3 Set MARKER FREQUENCY cursor to 10 Mc/s and MARKER FREQUENCY VERNIER to its mid-position.

4 Place a lead from the aerial socket of a radio receiver tuned to 10 Mc/s (30 metres) in the vicinity of the Marker Oscillator chassis and adjust the iron dust core in L6 (see Fig. 5) until the modulated signal is detected by the receiver.

5 Remove the lead and switch off the receiver.

6 Set MARKER SELECTOR to CAL and re-adjust L6, using a non-metallic screwdriver, until zero beat is indicated on the Magic Eye.

Having set up the 10 Mc/s calibration point, check the calibration every 2 Mc/s up to 22 Mc/s using the Magic Eye. Adjustment of the MARKER FREQUENCY VERNIER control should enable zero beat to be obtained at all these points.

The receiver used for part 4 of the alignment should be accurately tuned, as otherwise it is possible that L6 would be adjusted to 8 or 12 Mc/s when using the Magic Eye as the final indicator.

CALIBRATION OF VARIABLE OSCILLATOR

When the Marker Oscillator calibration is known to be accurate, it can be used to check the frequency of the Variable Oscillator.

1 Remove instrument from case, set ATTENUATOR controls for maximum output (position 4) and remove 2 Mc/s crystal from holder.

2 Set: MARKER SELECTOR to CAL.
MARKER OUTPUT to MAX.
MARKER FREQUENCY cursor to 20 Mc/s.
CARRIER FREQUENCY RANGE to B & C.

3 Connect the Y amplifier terminal of an oscillograph to the grid of the Magic Eye (pin 4).

4 Set CARRIER FREQUENCY cursor to approximately 55 Mc/s, such that a slow beat is indicated on the CRO. The calibration should be adjusted (by opening or closing the turns of L4) only if the cursor setting lies beyond 2 Mc/s either side of 55 Mc/s. Similar checks can be made at 15 Mc/s and 75 Mc/s (keeping the Marker Oscillator on 20 Mc/s) and L4 adjusted to distribute any calibration error evenly over the scale.

CALIBRATION OF SWEEP OSCILLATOR AND REACTANCE VALVE STAGES

(The following procedure assumes that the Variable Oscillator is correctly set up).

1 Remove instrument from case and V1 and V2 from their holders.

2 Connect a signal generator to V3 grid (pin 5) via a capacitor of the order of 100pF and adjust its output to 100mV at 115 Mc/s, 30% amplitude modulated by an audio frequency.

3 Connect the Telecheck output to a TV receiver tuned to a frequency in the region of 50 Mc/s and adjust CARRIER FREQUENCY control for maximum sound output. Note the ***exact*** setting of this control.

4 Disconnect signal generator and replace V1 and V2.

5 Unscrew the cores in L1 and L2 (anti-clockwise) to give minimum inductance.

6 Connect the Telecheck and TV receiver to an oscillograph in a similar manner to that shown in Fig. 2, taking the receiver output from the SOUND detector load.

7 Short circuit P1 and set SWEEP BANDWIDTH to 15 Mc/s.

8 Increase the inductance of L2 until a response curve appears on the screen. A continual slow rotation of the CARRIER FREQUENCY control will move this curve along the trace, providing the following information:

(*a*) Non-linearity of frequency modulation will be indicated by a change in width of the curve as it is moved across the screen.

(*b*) Sweep bandwidth will be indicated by the difference in the two frequency settings obtained from the carrier tuning control when a point on the curve (e.g. a Marker pip) is positioned at each end (in turn) of the range of linear modulation obtained from para. (*a*).

(*c*) Amplitude modulation will be indicated by variation in the height of the peak of the curve as it is moved across the screen.

9 Increase the inductance of L1 until the frequency modulation is approximately linear over a bandwidth of not less than 15 Mc/s and check that the amplitude modulation accompanying this sweep does not exceed $\pm 10\%$. During the adjustment of L1 it will be necessary to return the CARRIER FREQUENCY cursor to the exact setting previously noted (para. 3) and re-position the curve in the centre of the screen by adjusting the core in L2.

parts list

Ref.	Value	Tolerance	Rating	Part Number
R1	100	±20%	$\frac{1}{4}$ watt	DR09/10120
R2	150K	±10%	$\frac{1}{2}$ watt	DR08/15410
R3	270K	±10%	$\frac{1}{8}$ watt	DR16/27410
R4	330K	±10%	$\frac{1}{8}$ watt	DR16/33410
R5	100K	±10%	$\frac{1}{2}$ watt	DR08/10410
R6	1K	±10%	$\frac{1}{4}$ watt	DR09/10210
R7	150K	±10%	$\frac{1}{2}$ watt	DR08/15410
R8	470	±10%	$\frac{1}{4}$ watt	DR09/47110
R9	100K	±10%	$\frac{1}{2}$ watt	DR08/10410
R10	—	—	—	—
R11	10K	±10%	$\frac{1}{4}$ watt	DR09/10310
R12	1K	±10%	$\frac{1}{4}$ watt	DR09/10210
R13	1K	±10%	$\frac{1}{2}$ watt	DR08/10210
R14	15K	±10%	$\frac{1}{4}$ watt	DR09/15310
R15	100K	±10%	$\frac{1}{2}$ watt	DR08/10410
R16	22K	±10%	$\frac{1}{8}$ watt	DR16/22310
R17	18K	±10%	$\frac{1}{4}$ watt	DR09/18310
R18	100	±10%	$\frac{1}{8}$ watt	DR16/10110
R19	2·2K	±10%	$\frac{1}{4}$ watt	DR09/22210
R20	15K	±10%	$\frac{1}{8}$ watt	DR16/15310
R21	2·2K	±10%	$\frac{1}{4}$ watt	DR09/22210
R22	2·2K	±10%	$\frac{1}{4}$ watt	DR09/22210
R23	470	±10%	$\frac{1}{8}$ watt	DR16/47110
R24	10K	±10%	$\frac{1}{2}$ watt	DR08/10310
R25	100	±10%	$\frac{1}{8}$ watt	DR16/10110
R26	680	±10%	$\frac{1}{8}$ watt	DR16/68110
R27	100	±10%	$\frac{1}{8}$ watt	DR16/10110
R28	680	±10%	$\frac{1}{8}$ watt	DR16/68110
R29	82	±10%	$\frac{1}{8}$ watt	DR16/82010
R30	270	±10%	$\frac{1}{8}$ watt	DR16/27110
R31	82	±10%	$\frac{1}{8}$ watt	DR16/82010
R32	470	±10%	$\frac{1}{8}$ watt	DR16/47110
R33	150	±10%	$\frac{1}{8}$ watt	DR16/15110
R34	15K	±10%	$\frac{1}{8}$ watt	DR16/15310
R35	2·2K	±10%	$\frac{1}{4}$ watt	DR09/22210
R36	—	—	—	—
R37	33K	±10%	$\frac{1}{8}$ watt	DR16/33310
R38	220	±10%	$\frac{1}{8}$ watt	DR16/22110
R39	47K	±10%	$\frac{1}{8}$ watt	DR16/47310
R40	100	±10%	$\frac{1}{8}$ watt	DR16/10110
R41	1M	±10%	$\frac{1}{8}$ watt	DR16/10510
R42	1·2M	±10%	$\frac{1}{4}$ watt	DR09/12510
R43	2·2M	±10%		DR09/22510
R44	2·2M	±10%		DR09/22510
R45		±10%		
R46		±10%		
R47	1K	±10%		
R48	82	±10%		
R49	82	±10%		

Ref.	Value	Tolerance	Rating	Part Number
C1	—	—	—	—
C2	—	—	—	—
C3	1000 pF	±20%	—	M129544
C4	1000 pF	±20%	—	M129544
C5	—	—	—	—
C6	1000 pF	±20%	—	M129545
C7	22 pF	±10%	—	M129579/55
C8	1000 pF	±10%	—	M129545
C9	1000 pF	±20%	—	M129545
C10	1000 pF	±20%	—	M129544
C11	32 μF	+50%—20%	250 volts	M131579
C12	1000 pF	±20%	—	M129545
C13	22 pF	±10%	—	M129579/55
C14	32 μF	+50%—20%	250 volts	(with C11)
C15	1000 pF	±20%	—	M129545
C16	0.5 μF	±25%	150 volts	M129616/3
C17	2 pF	±20%	—	M129633
C18	1000 pF	±20%	—	M129545
C19	1000 pF	±20%	—	M129544
C20	10 pF	±10%	—	M129579/3
C21	115 pF (2) (Split-stator)	—	—	M127525/2
C22	1000 pF	±20%	—	M129544
C23	5 pF	±10%	—	M129579/52
C24	1000 pF	±20%	—	M129544
C25	—	—	—	—
C26	10 pF	±10%	—	M129579/3
C27	80 pF (2) (Split-stator)	—	—	M127525
C28	—	—	—	—
C29	3–10 pF (Vernier Trimmer)	—	—	M128516
C30	0.1 μF	±20%	350 volts	KU92716/46/70
C31	—	—	—	—
C32	33 pF	±10%	—	M129579/37
C33	—	—	—	—
C34	1000 pF	±20%	—	M129544
C35	1000 pF	±20%	—	M129544
C36	0.003 μF	±20%	350 volts	M129613
C37	22 pF	±10%	—	M129579/55
C38	1000 pF	±20%	—	M129544
C39	1000 pF	±20%	—	M129544
L1	(Reactance Coil)		—	MC430444
L2	(F.M. Oscillator Coil)		—	MC430443
L3	(Smoothing Choke)		—	MC4[illegible]029
L4	(Oscillator Coil: air spaced)		—	MC4[illegible]51
L5	(Oscillator Coil: iron cored)		—	MC4[illegible]
L6	(Marker Oscillator Coil)		—	MC430[illegible]
L7	(H.F. Choke)		—	MC41402[illegible]

Mc/s and che[illegible]

Ref.	Value	Tolerance	Rating	Part Number
P1	2 M		—	M158571
P2	30 K		—	M158513/9
P3	500K (Sweep Bandwidth)		—	M158548/10
P4	90 (Non-inductive)		—	M158573/25
P5	100 (Marker Output)		—	M158573
S1	(X Sweep Selector)		—	M153610
S2	(On/Off)		—	M153606
S3	(Marker Selector)		—	M153611
S4	(Attenuator Range)		—	M153609
S5	(Carrier Frequency Range)		—	M153612
F1	Fuse	—	1 Amp	M157503/5
F2	Fuse	—	1 Amp	M157503/5
V1	6J6	—	—	—
V2	A1714	—	—	—
V3	6J6	—	—	—
V4	12AT7	—	—	—
V5	6AM6	—	—	—
V6	12AT7	—	—	—
V7	64ME	—	—	M199522
V8	7Y4	—	—	—
T1	(Mains Transformer)		—	MC413061
X1	(Crystal) Freq. 2000 Kc/s$\pm$0·01%		—	M199786
X2	Supplied by customer			
Pilot Bulb	6·5 volts		0·3 Amp	M201505
External Attenuator				MC408264

spares and service

To assure the prompt despatch of Spare Parts, it is essential that the Order includes the Model number of the instrument, the description of the Part or Parts, their Part number and the quantity required.

Whilst every effort is made by Service Departments to maintain an adequate supply of Spares, a delay in despatch must usually be tolerated on those Parts not ordinarily expected to require replacement.

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Highbury Grove,
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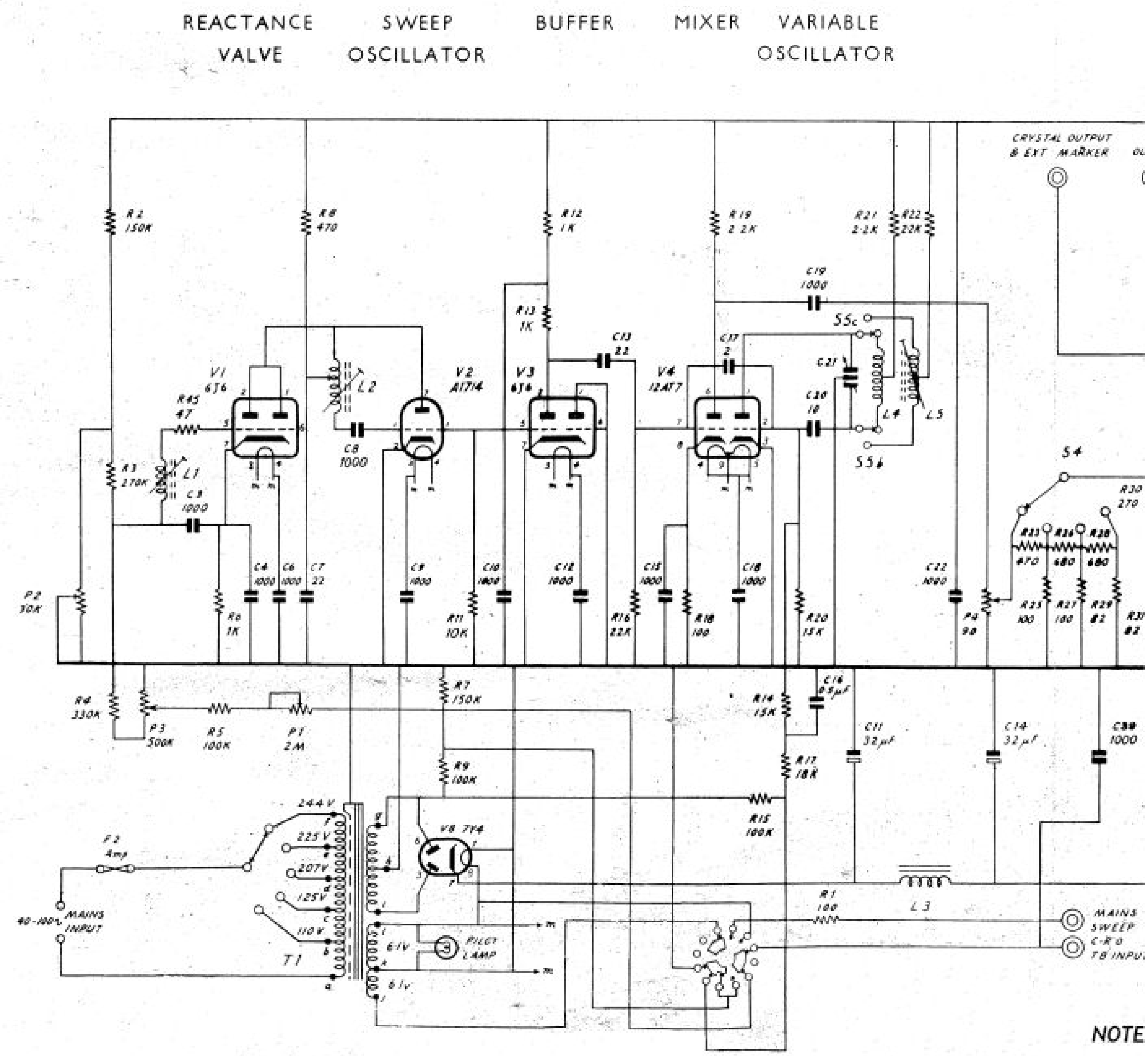
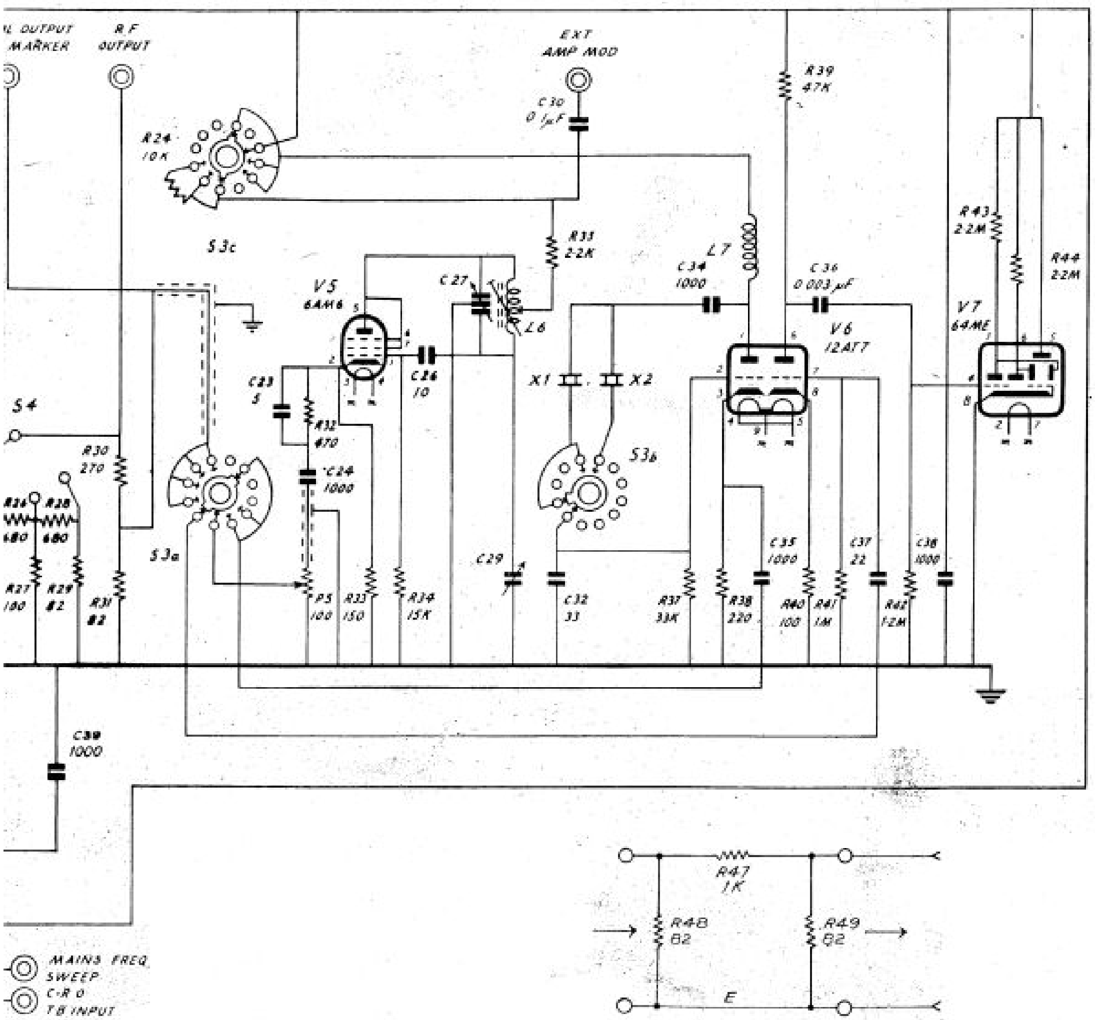

REACTANCE VALVE
SWEEP OSCILLATOR
BUFFER
MIXER
VARIABLE OSCILLATOR
CRYSTAL OUTPUT & EXT MARKER
V1 6J6
V2 A1714
V3 6J6
V4 12AT7
V8 7Y4
L1
L2
L3
L4
L5
T1
S4
S5c
S5b
PILOT LAMP
MAINS INPUT
40-100~
F2 4 amp
244V
225V
207V
125V
110V
6·1v
MAINS SWEEP C-R-O T B INPUT
NOTE

MARKER GENERATOR | CRYSTAL OSCILLATOR | DETECTOR AMPLIFIER | MAGIC EYE



EXTERNAL ATTENUATOR

NOTE : ALL SWITCHES SHOWN IN ANTI-CLOCK WISE POSITION VIEWED FROM SPINDLE END

PRICE 5/- NETT

M174318