ELECTRICAL AND MECHANICAL
ENGINEERING REGULATIONS
(By Command of the Army Council)

TELECOMMUNICATIONS
Z 354

OSCILLATOR, TEST, NO 2

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

Errata

Note: These pages 0 and 01 will be filed immediately in front of page 1 Issue 1 dated 3 Dec 56.

1. The following amendments will be made to the Regulation.

2. Page 7, para 15,

(a) heading,
Delete: 'lever'
Insert: 'level'

(b) line 7,
Delete: '1000pF'
Insert: '1000μF'

Distribution - Class 930. Code No 6

(c) line 11,
Delete: '1000pF'
Insert: '1000μF'

(d) line 17,
Delete: '1000pF'
Insert: '1000μF'

3. Page 9, para 17, line 2,
Delete: '10mW'
Insert: '10mV'

ELECT. WING

OSCILLATOR, TEST, NO 2

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

Introduction

1. This Regulation details the procedure to be adopted when repairing Oscillator, test, No 2 in field or base workshops. Operating instructions are given in Tels Z 351 and technical description, circuit diagram and component layout diagrams are given in Tels Z 352. Other Regulations referred to are Tels Z 561 (Calibrator, output, signal generator, No 5), Tels M 631 (Apparatus, seal testing) and Tels M 601 (Ovens, drying, telecommunications, 240V, a.c.).

2. The test oscillator is a sealed equipment and must not be opened except by those workshops equipped with Ovens, drying, telecommunications, 240V, a.c. or its equivalent. This limits repairs, other than to the connecting leads or the terminating unit, to workshops so equipped. Many of the tests can, however, be performed without opening the instrument, and may, therefore, be carried out at any level of repair where the appropriate test equipment is available.

Test equipment required

3. (a) Field workshops:-

Z3/ZD	Ovens, drying, telecommunications, 240V, a.c.
W3/WC 53340	Apparatus, seal testing
Z4/ZD 00198	Oscillator, B.F., No 8
Z4/ZC 00193	Test set, deviation, F.M., No 2
Z3/ZC 1411	Frequency meter, SCR 211
Z4/10S/631	Oscilloscope, type 13A
Z4/ZD 00207	Instrument, testing, Avometer, universal, 50-range, Mk 2
Z4/ZD 00617	Instrument, testing, electronic, multi-range, No 1

(b) Base workshops will require the following items in addition to those listed in (a) above:-

Z4/WY 0706	Galvanometer, unipivot, 240µA, No 1
Z4/WY 0708	Multiplier, current/voltage, 9/7 range, a.c., No 1
Z4/WD 4100	Calibrator, output, signal generator, No 5
Z4/ZD 00425	Signal generator, No 15
Z4/WD 3519	Unit, decade, resistance, 1,111Ω, No 1
Z4/WY 2800	Unit, decade, resistance, 11,110Ω, No 2
Z4/WY 3052	Unit, decade, resistance, 111,000Ω, No 1
	Wave Analyser
	A d.c. amplifier to the circuit of Fig 5(b)

Mechanical

4. To remove the instrument from its case, undo the 12 screws on the front panel. Turn the instrument face down and lift away the case. It may be necessary to insert a screwdriver between the case and the front panel in order to break the seal. With the instrument out of its case (Fig 1) the dial lamp, fuses, mains adjustment panel and valves V5, V6 and V7 are accessible. Valves V1, V2, V3 and V4 can be reached after removal of the top screen from the oscillator box.

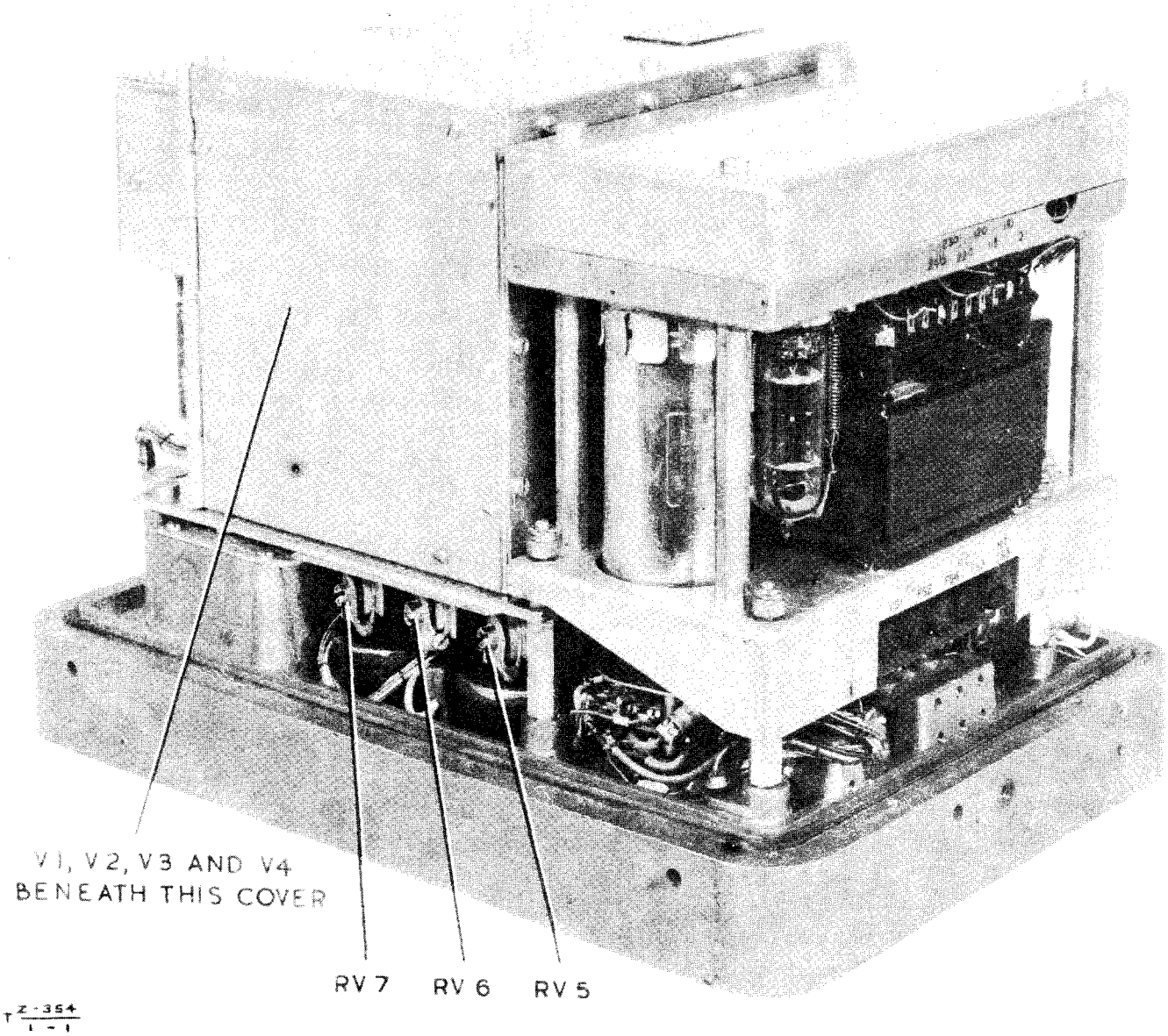


Fig 1 - General view of equipment removed from its case

5. To change the vibrator, the power supply unit sub-assembly must be removed from the main chassis (Fig 2). Ensure that the interconnecting cable is not strained during this operation, and before replacing the sub-assembly examine the cable for frayed or damaged leads.

6. The remainder of the front panel components and the dial and dial drive can be reached by removing the oscillator box sub-assembly (see Fig 3). It should be noted that there is a screening collar around the oscillator coupling from the oscillator box to the attenuators. Ensure that this is not lost and that it is correctly aligned with the socket when reassembling. As in para 5 great care must be taken to see that no strain is placed on the interconnecting cable, and the opportunity should be taken of checking the cables, and in particular the lead marked X in Fig 3 for any fraying of the insulation.

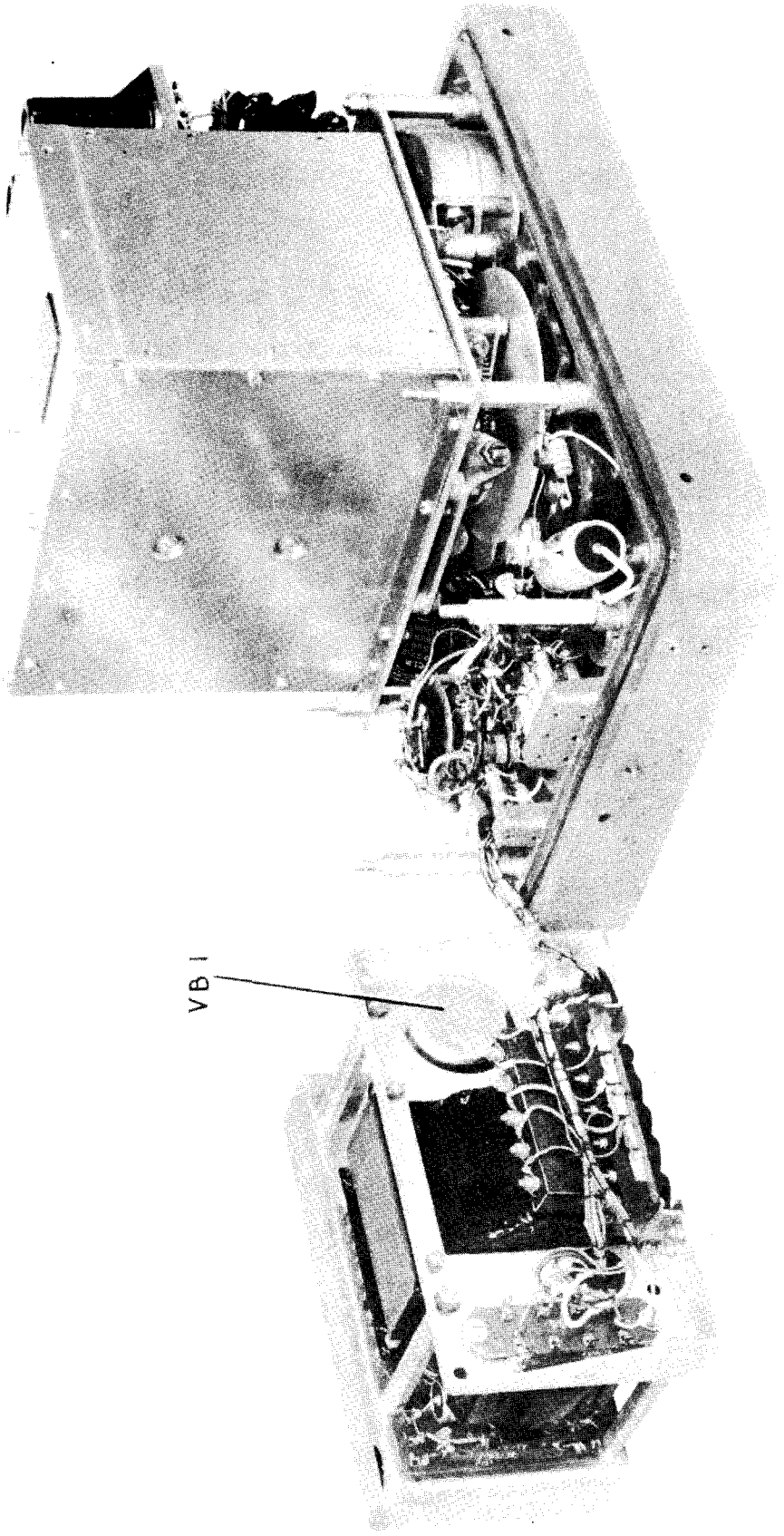


Fig 2 - Equipment with p.s.u. removed

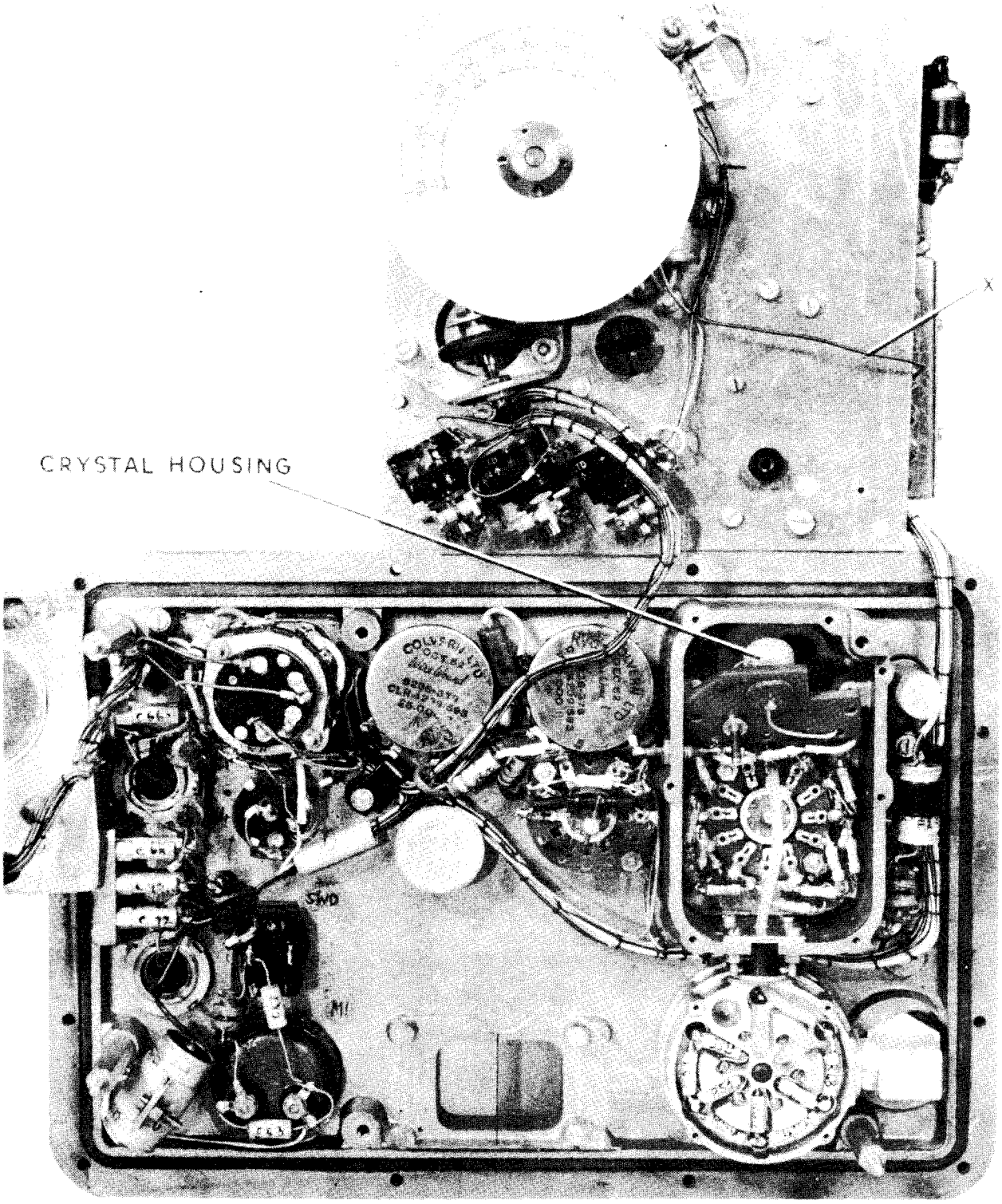


Fig 3 - Rear view of front panel with attenuator covers removed showing MR2 mounting

7. Should the carrier level checks be outside specification it may be necessary to change MR2, which is located inside the fine attenuator. The sub-panel on which the crystal holder is mounted must be lifted very carefully, to avoid damage to the attenuator components, and any such components which are moved during this process must be returned to their original positions after changing MR2. High stability resistors must be handled extremely carefully to avoid damage to the resistive spiral. In particular they must not be allowed to touch each other, or press against the side of the box. Removal of the coarse attenuator should normally only be necessary in order to clean the switch contacts, which are located in the lower half of the cast housing. The co-axial lead from the fine attenuator must first be unsoldered at the fine attenuator switch, and the four screws securing the earth braiding plate removed. These screw-heads are inaccessible with a normal screwdriver and so a small angled screwdriver should be locally manufactured. Next, remove the coarse attenuator control handle, and the nuts securing the outlet plug and the attenuator. The coarse attenuator control handle is mounted on a bakelite spindle and has occasionally been found difficult to remove. Care must be taken to pull the handle off in a direction at right angles to the panel; otherwise there is a grave risk of snapping the spindle. The attenuator and the output plug must be removed as one unit.

8. Removal of components from the front panel involves breaking the front panel seal. A small quantity of Compound, Kingsnorth (Y3/MB 4159) should be applied during reassembly to assist in reforming the seal. When replacing the fine attenuator switch the locating device, which controls the switch plate position relative to a boss on the inside of the panel, must be correctly assembled. Ensure that it does not come between the sealing ring and the panel or serious leakage will occur. This precaution also applies in the case of the range switch.

Power supply

9. Set up the instrument for a.m. operation at 60Mc/s. On a.c. operation the h.t. voltage must be 260V ±15V: on d.c. operation the h.t. voltage must be 230V ±15%, measured with the SET MOD and SET CAR controls at maximum. The a.c. ripple across C52, measured on a valve voltmeter, must not exceed 0.75V. The stabilized h.t. voltage across C25 must be between 145V and 160V.

Reactance modulator

10. Check that the output level can be adjusted to the CAL mark over the whole frequency range with the instrument switched to CW. Switch to FM and check that the meter can be set up to the CAL mark at 20Mc/s at both MOD and CAR positions of SWD, with the SET MOD control not more than 225° from its minimum position. This check must be performed with the attenuators set for 80mV output.

11. Connect the 75Ω terminals of the terminating unit to the LOW INPUT plug of the deviation test set. Check that the actual deviation is within 10% of that indicated by the DEVIATION kc/s control at the four scale marks provided. Repeat the test at 40Mc/s on Range 1. If the actual deviation differs from that indicated turn the SET MOD control until agreement is reached. Reset the meter to the CAL mark by means of RV5, the f.m. preset potentiometer. Any large adjustment of RV5 will necessitate a further resetting of the SET MOD control to correct the f.m. level. Use RV5 to spread the error so that the 10% tolerance can be met at both ends of the band.

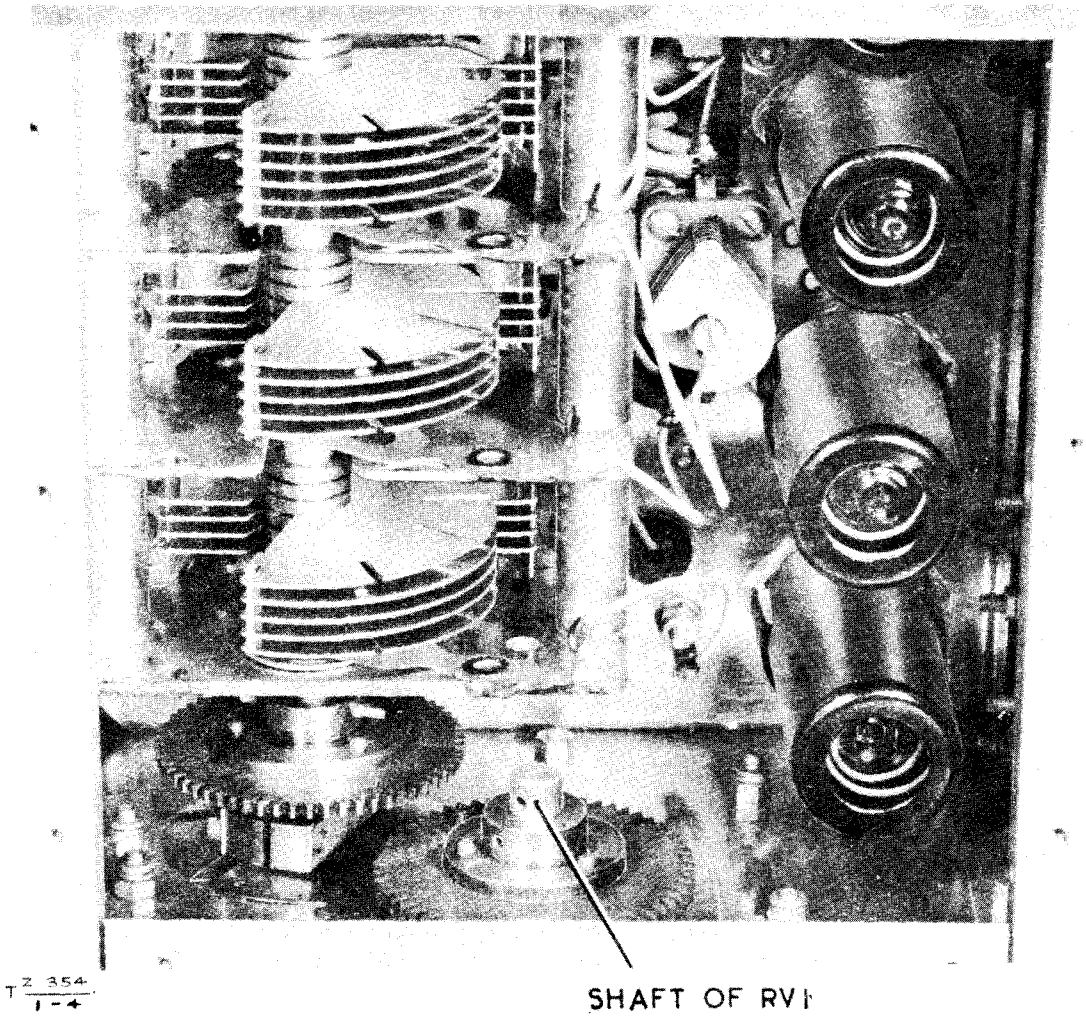


Fig 4 - Gear drive to RV1 (disengaged position)

12. Should there be a wide variation between the actual deviation at 20Kc/s and 40Kc/s on Range 1, the setting of RV1, which is ganged to the main tuning assembly, must be altered. To do this, remove the top screen of the oscillator box (Fig 4) and remove the pin holding the fibre gear to the shaft of RV1. A pencil mark should be made across the meshed gears before adjustment so that it is possible to see the amount of change made. Drop the gear out of mesh, and rotate the shaft of RV1 a few degrees in either direction. Remesh and pin the gear, and then repeat the test. By trial and error a position for RV1 can be found such that the deviation at each end of the low frequency range is very nearly the same. RV5 should now be readjusted as in para 11, using the 40kc/s position of the DEVIATION kc/s control, with the test oscillator set up for 30Mc/s. If RV1 is adjusted it is important to ensure that the drive-stops operate at the ends of the ranges before RV1 reaches its stops.

13. Switch to Range 2 and check the deviation at each end of the range. If this is about four times the value obtained on Range 1, the connections to SWC may have been reversed during repair. Any small difference in actual deviation may be compensated for by changing the values of R9, R10, or R71; eg if the deviation on

Range 2 is greater than that on Range 1, increase the value of R9 until the two deviations correspond.

Master oscillator (V2) Amplifier-doubler (V3) and Output (V4)

14. Switch to CW and check that the meter can be set to the CAL mark over the whole frequency range with the SET CAR control rotated not more than 225° from its minimum position. Loosely couple the output from the test oscillator to the ANT terminal of an SCR 211 and check that the tuning dial reads within 0.5% of the actual emitted frequency over the whole frequency range. If the calibration errors are greater than 0.5% check firstly to see if all the errors are in the same direction. If they are it is possible that the dial may have moved relative to the drive spindle. This may be corrected as follows:-

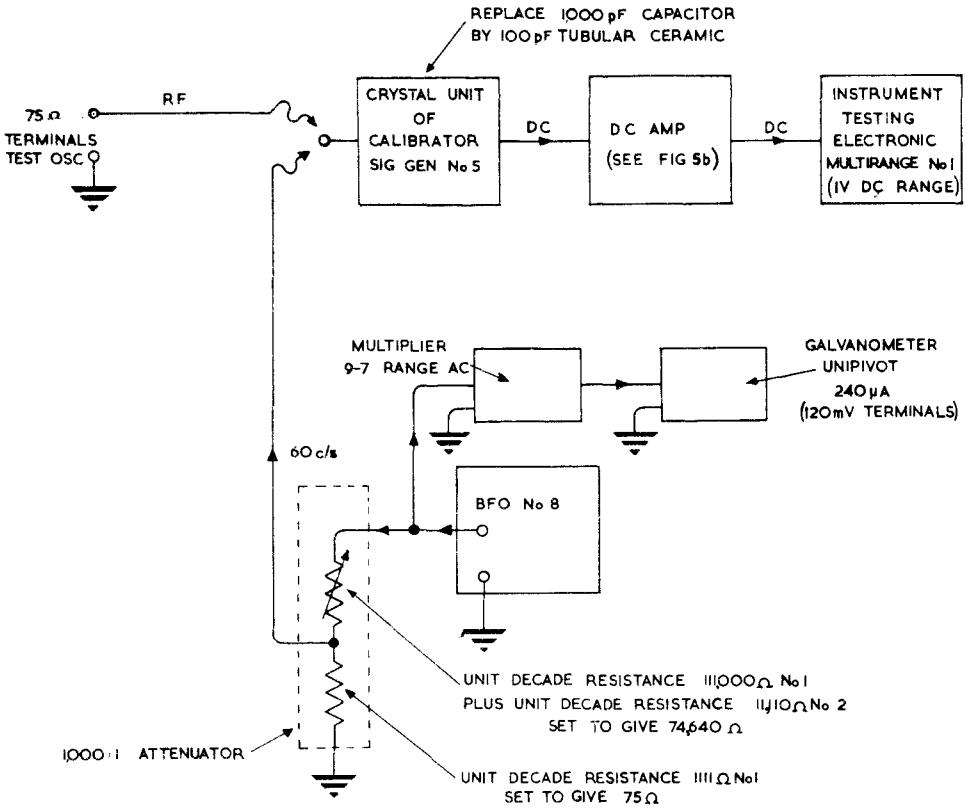
(a) Set the scale to zero beat against the wavemeter at 21Mc/s and carefully slacken the grub screws holding the dial to the spindle

(b) Rotate the dial so that the 21Mc/s mark is behind the cursor and tighten the grub screws. It is advisable to keep the wavemeter coupled to the instrument during this operation so that any movement of the spindle may be detected.

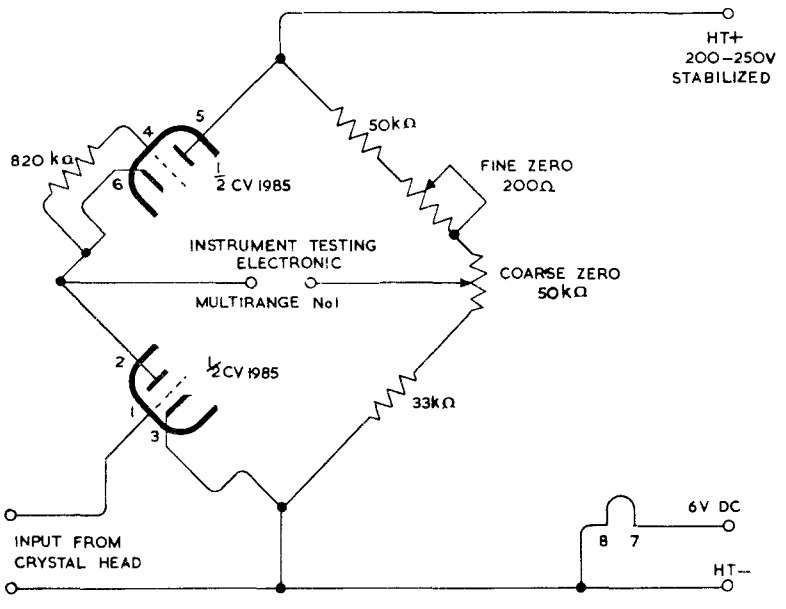
If a Signal generator No 13 is available, it may be used to identify the 21Mc/s point on the SCR 211. If the calibration errors are not all in the same direction set the instrument to 21Mc/s on the low frequency range and adjust L1 for zero beat against the wavemeter. Retune the test oscillator to 39Mc/s and adjust C44 for zero beat against the SCR 211 at this frequency. Repeat until the calibration is within tolerance over the low frequency band. Switch to Range 2 and adjust L4 and L5 to give the maximum output on the front panel meter with the instrument tuned to 80Mc/s. The tuning is heavily damped, so no sharp peak will be found, and in some cases it may be necessary completely to remove the core of L4. If a tuned circuit will not tune up it may be because the switch and decoupling capacitor leads are too long, if these have been changed during servicing. Switch to Range 1 and at 40Mc/s trim L2 and L3 for maximum output.

Setting up carrier lever

15. The Calibrator, output, signal generator, No 5 does not give a very sensitive indication for an input of 50mV. The crystal unit of the calibrator is therefore used, in conjunction with the d.c. amplifier circuit of Fig 5(b), in the test circuit of Fig 5(a). Set the b.f.o. to 60c/s (this avoids beating with any hum voltages that may be present) and, with the output voltage at zero, set zero on the Instrument, testing, electronic, multi-range, No 1 and on the d.c. amplifier. Connect a 1000pF capacitor across the crystal unit d.c. terminals and adjust the input to the 1000:1 attenuator to 10V. Note the reading on the multi-range meter for this input, and also for 9V and 11V inputs. Replace the 60c/s input to the crystal unit by the r.f. output from the 75Ω terminals of the test oscillator, set up for 100mV at 20Mc/s c.w., and remove the 1000pF capacitor. Adjust the SET CAR control on the test oscillator until the multi-range meter reads the same as with 10V l.f. input to the 1000:1 attenuator, then adjust RV7 to bring the test oscillator meter to the CAL mark. Tune quickly through both r.f. ranges, adjusting SET CAR to keep the test oscillator meter on the CAL mark. The multi-range meter must not read outside the 9V and 11V l.f. points. At the completion of this run, replace the r.f. by the l.f. source, (not forgetting the 1000pF capacitor) and check the 9V and 11V limit points. If these have altered, the test must be repeated. A reduction of h.t. may reduce excessive drift in the d.c. amplifier.



(a) BLOCK DIAGRAM OF TEST CIRCUIT



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(b) CIRCUIT OF DC AMPLIFIER

Fig 5 - Setting up carrier level

Attenuator checks

16. Use the Calibrator, output, signal generator, No 5 to check:-

(a) that the error in the fine attenuator, with the coarse attenuator set at any position other than X1, does not exceed ±0.5dB in any position.

(b) the coarse attenuator error. Measured at 20Mc/s, the overall attenuation must be 80dB ±2dB, and the errors of each position, other than the X1 position, must not exceed ±0.5dB. The error in the X1 position must not exceed ±1dB. Repeated at 80Mc/s, the tolerances are: overall, 80dB ±2.5dB; each position other than X1, 20dB ±1dB; X1 position, 20dB ±1.5dB.

(c) the terminating unit error. The voltage across the X0.1 terminals must be between 0.094 and 0.106 times that obtained across the X1 terminals at both 20Mc/s and 80Mc/s.

Harmonic content

17. Connect the 75Ω terminals of the terminating unit to the aerial terminals of the R308 in the calibrator, and set the test oscillator to give 10mV at 20Mc/s c.w. Set the R308 to the second harmonic, ie 40Mc/s, and tune it for a maximum reading on the valve voltmeter about this frequency. Use the receiver r.f. gain control to produce some convenient reading, taking care not to overload the receiver. Replace the test oscillator by the Signal generator, No 15, set to 40Mc/s c.w. and, without altering the receiver controls, obtain the same reading on the valve voltmeter as before, by tuning the signal generator for a maximum and then adjusting its attenuator. The signal generator attenuator must not read greater than -46dB, ie it must not read between 0 and -46dB. Repeat the test at 40Mc/s on both ranges and at 70Mc/s on Range 2. Determine also the sub-harmonic (oscillator frequency) content at 40Mc/s and 70Mc/s on Range 2. The signal generator attenuator must not read greater than -46dB at any check point.

Note: The requirement is that the harmonic content shall be 20dB down on the fundamental at all frequencies. 10mV on the test oscillator corresponds to 80dB up on 1μV; the reading of -46dB on the signal generator corresponds to 46dB down on 200mV; ie 1mV. The dB ratio of 1mV to 10mV is 20dB. It is incorrect, therefore, to subtract the two attenuator readings, as would be possible were both instruments calibrated in the same way.

Audio oscillator

18. Switch to AM and check that the meter reads to the CAL mark with the SET MOD control less than 225° from its minimum position. Compare the output across the MOD TONE terminals with that from a b.f.o. of known frequency accuracy. It must be between 900c/s and 1100c/s and C24 may be altered to achieve this. The output, measured on the 100V range of the Avometer, must not be less than 30V.

19. Feed the output from the MOD TONE terminals to a Wave Analyser. The r.m.s. sum of the harmonic content must not exceed 2%.

Amplitude modulation

20. Connect the output of the test oscillator set up for a.m. at 20Mc/s, to the aerial terminals of the R308. Measure the amplitude modulation depth by the trapezium method, using the i.f. output of the receiver connected to A1 with the c.r.o. switched to 2A1HF, and the output from the MOD TONE terminals connected to the X terminal as a timebase. Repeat the test at 4Mc/s on both bands and at 8Mc/s. The modulation depth must be between 25% and 35%. To achieve this, adjust the SET MOD control until the pattern on the c.r.o. screen shows a modulation depth within these limits and then adjust RV6 until the meter reads to the CAL mark.

Spurious modulation - f.m. on a.m.

21. Set up the test oscillator to give 100mV, amplitude modulated, at 20Mc/s. Connect the 75Ω terminals of the terminating unit to the LOW INPUT plug of the deviation test set, and measure the spurious f.m. It must not exceed 400c/s. Repeat the test at 8Mc/s. The spurious f.m. must not exceed 1kc/s.

Backlash in tuning drive

22. After the instrument has been reassembled, check that the tuning drive runs smoothly and that the end stops operate in the correct position. Check that there is negligible backlash in the drive by feeding the output of the test oscillator switched to CW to a receiver with its b.f.o. switched on. By rotating the tuning handle of the test oscillator alternately clockwise and anti-clockwise through the tuning point, ensure that zero beat is obtained at the same dial position each time. If backlash is evident check that the worm gear spindle has no end or side play. Take up any such play by tightening down the upper bearing until the play just disappears.

Frequency drift

23. This test must be performed in a draught-free room. Secure the test oscillator in its case and switch on from cold. After 10 minutes, measure the emitted frequency and repeat the measurement at five minute intervals over the next thirty minutes. The drift must not exceed 0.04%. For the next eighty minutes measure the frequency at ten minute intervals. The extra drift must not exceed 0.04% during this period.

Hermetic sealing

24. Increase the internal air pressure of the instrument to 10lb/sq.in. and immerse it in water. There must be no air leakage. In accordance with Tels M 631 the time constant must be at least 100 hours with a starting pressure of 5lb/sq.in.

Final sealing

25. After all tests are completed, dry out the instrument and fill with dry air at normal temperature and pressure. Fit an active dessicator.

Field repairs

Permitted Repairs

26. All components may be changed in any field workshop with the following exceptions:-

Resistors R25-52 and R61-64, inclusive
Variable resistors RV6 and RV7
Inductor L12
Metal rectifier MR2
Switches SWB and SWE
Meter M1
Capacitor C48

27. In addition to the above, those field workshops not holding Test set, deviation, F.M., No 2 must not change the following components:-

Resistors R6-11 inclusive, R13, R59 and R71
Variable resistors RV1 and RV5
Capacitor C35
Metal rectifiers MR1 and MR3
Valve V1

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END

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