MARCONI'S WIRELESS TELEGRAPH CO., LTD.

CHELMSFORD

MARCONI-FRANKLIN VALVE MASTER OSCILLATOR

MAINTENANCE INSTRUCTIONS

REFERENCE NO. T/1672

VALVE MASTER OSCILLATOR

MAINTENANCE INSTRUCTIONS

Technical Handbook

Ref. T.1672

Amendment No.1

NOTE:- T.1672 plus this amendment constitutes T.1672/1

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED,
CHELMSFORD.

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ERRATA

VALVE MASTER OSCILLATOR MAINTENANCE INSTRUCTIONS

REF. No. T.1672.

Page 1, eighth line from bottom:- Delete "4V DC or".

Page 2. The third line of the final paragraph above the heading "REMOVAL OF OSCILLATOR UNIT FROM TRANSMITTER PANEL" should read:- "meter coil to the ML6 master oscillator valves)", etc. Alter last sentence of same paragraph to read:- The master oscillator frequency range is from 1000 to 1333.333 kc/s.

Page 2. Para.6 of numbered paragraphs:- After "right hand side", insert:- (Right hand (RH) assembly edition of the master oscillator). At end of Para.6 add:- In the case of the left hand (LH) assembly edition of the oscillator, the HT terminal is on the left hand side.

Drawings.

Theoretical Diagram of Connections. Sk.WZ.676, Sh.1.

Issue 4 of this drawing supersedes Issue 3, the alterations on the new issue being as follows:-

(i) Anode to grid blocking condenser changed from .002µF to .0002µF.

(ii) Output coupling condensers:- After .00005µF the following note has been added:- (2 in series) .000025µF effective.

(iii) LC tuned circuit of oscillator:- Lower end of inductance connected to the tapping and to earth so that the unused turns at the earthy end of the winding are short-circuited instead of being open-circuited.

General Arrangement of Oscillator Unit. Dwg. 65011, Sh.1.

Diagram of Connections for RH Oscillator:-

The bonded ends of the two 80,000Ω grid resistances have been connected to the earth strip. This connection had been inadvertently omitted. The new issue of this drawing is Issue 14.

Photographs. Amend the following errors:-

Photographs Nos. 13610 and 13611.

(i) Alter "ANODE HT TERMINAL" to read GRID TERMINAL.

(ii) Alter "FILAMENT LT TERMINAL" to read FILAMENT LT TERMINALS.

(iii) Add to title:- RH ASSEMBLY.

Photograph No.13614:- Add to title:- RH ASSEMBLY.

ADDENDA

VALVE MASTER OSCILLATOR MAINTENANCE INSTRUCTIONS

REF. No. T.1672

Additional Drawings.

Recalibration of Valve Master Oscillator on site, by means of 10-way Crystal Oscillator, P.S.10463/A, B or D	WZ.5756/B Sh.1
Operating Data for Harmonic Amplifier Coils. SWB.8E and SWB.8W Transmitters	Sk.Z.1217 Sh.2

Page 2. Insert the following at end of last paragraph above the heading, "REMOVAL OF OSCILLATOR UNIT FROM TRANSMITTER PANEL":-

In order to extend the radiated frequency band on certain transmitters, an edition of the master oscillator is available covering a frequency band of 1000 to 1500 kc/s.

Page 3. GENERAL ASSEMBLY OF OSCILLATOR UNIT. At the end of this paragraph, add:-

Two arrangements of the oscillator are available, - RH assembly and LH assembly - depending on the mounting position in the transmitter panel. This affects the position of terminals and components as shown on Dwg.65011 Sh.1.

Page 7. Add the following to the paragraph headed "RECALIBRATION OF MASTER OSCILLATOR":-

In the case of transmitters fitted with a crystal oscillator in addition to the valve master oscillator, the crystal oscillator may be used as an alternative means of checking the calibration, as described in the subsequent paragraph headed "RECALIBRATION OF MASTER OSCILLATOR WITH UNSELECTED VALVES TO NORMAL COMMERCIAL LIMITS".

Page 7. Insert the following new paragraph immediately below the paragraph headed "RECALIBRATION OF MASTER OSCILLATOR":-

CALIBRATION OF MASTER OSCILLATOR AND EFFECT OF CHANGING VALVES.

When the master oscillator is first calibrated, the working and spare Type ML6 valves are carefully selected, in order to ensure that changes of frequency, caused by changing the valves, are very small and within the specified tolerance for overall mean frequency stability.

The valves have a very long life, but the need for recalibration or periodical frequency checks will be obviated by the provision of a sufficient quantity of selected spare valves when the oscillator is ordered.

The normal procedure regarding the oscillator valves, which is carried out before despatch, and the routine which should be adhered to by operating staff at the station, will now be described.

The selected valves are in pairs and must be changed as such. The valve bases are marked with the instrument number of the master oscillator to which they apply. The working valves are also marked "Working valve 1" and "Working valve 2". The former valve must be used in valve holder No.1 and the latter in holder No.2. The valves of a selected pair must not be interchanged in the two valveholders.

Spare pairs are similarly marked "Spare valve 1A" and "Spare valve 2A", "1B" and "2B" and so on.

Summary of Rules to be observed when changing Valves.

(i) Only selected and marked valves bearing the instrument number of the master oscillator should be used.

(ii) The valves must be used in pairs. When one valve fails, both valves must be removed and a new pair substituted.

(iii) The valves of a selected pair must not be interchanged in the two valveholders.

(iv) The storage of spare Type ML6 valves at the station should be so arranged that the specially selected and marked valves are kept separate from normal valves to commercial limits, which may be used in other circuits of the transmitter. (Note oscillator for frequency modulation, monitoring rectifier, etc.).

The observance of the foregoing rules will permit the overall mean frequency stability, and hence the frequency calibration, to be maintained to within $\pm$ 1 in 20,000.

RECALIBRATION OF MASTER OSCILLATOR WITH UNSELECTED VALVES TO NORMAL COMMERCIAL LIMITS.

When selected and marked spare valves are not available, the radiated frequency should be checked by an external frequency monitoring station, as previously described for the case of recalibration.

Alternatively, in cases where a crystal oscillator is also supplied, this unit may be used to calibrate the valve master oscillator.

Tests have shown that unselected replacement valves will give satisfactory operation as regards reliable oscillation and level of output, but to ensure that frequency adjustment is within the required limits of accuracy, recalibration is essential. For frequency adjustment to be within the guaranteed limits of $\pm$ 1 in 20,000 a recalibration check against the crystal oscillator should be made on each of the eight switched ranges of the valve master oscillator, if suitable crystals are available to give one point on each range. Otherwise, readings should be taken for each of the allocated frequencies for which a crystal is supplied.

The method about to be described is simple and accurate. The description is written especially for application to Type SWB.8X and SWB.11X transmitters, but is applicable to other types of transmitter, although there may be minor differences in setting up in such cases. The following simple apparatus is required:-

One wavemeter with crystal rectifier, a DC microammeter or galvanometer of any available range between 250 and 1000 microamperes full scale deflection, and a pair of high resistance headphones.

The meter and headphones should be shunted by a capacitor of about .1 μF (see diagram WZ.5756/B Sh.1).

A few yards of insulated wire with which to form a single turn coupling coil with leads, for coupling the crystal oscillator RF output to the wavemeter.

In the absence of a wavemeter a simple tuned circuit may be improvised and connected up to the other components as the circuit need not be calibrated. All that is required is a sensitive indicator covering the frequency range of the crystal and valve oscillators, namely, 1000 to 1333·33 or 1000 to 1500 kc/s depending on the editions of the oscillators supplied.

Take as many frequency checks as the number of crystals available will permit, the method of recalibration being as follows:-

In the case of transmitters employing both a crystal oscillator and a variable valve master oscillator, (VMO) as alternative drives, the output of the crystal oscillator is earthed when the drive changeover switch is set to the VMO position. For recalibration, it is necessary to operate both oscillators simultaneously. The co-axial cable carrying the RF output from the crystal oscillator should therefore be detached from the pin of the 5-point plug and connected directly to the leads from the single turn wavemeter coupling coil, as shown on diagram WZ.5756/B Sh.1. The AC supply for the crystal oscillator may then be taken through the 5-way plug and socket in the normal manner and the crystal oscillator output earth connection at the changeover switch will be isolated.

The method employed is to set up the VMO to the same frequency as the output frequency of the crystal oscillator by means of its existing calibration chart and pick up both outputs in the wavemeter circuit. The calibration error of the VMO due to the use of unselected Type ML6 valves will give rise to an audible beat frequency in the headphones. By careful adjustment of the VMO tuning condenser over a range of about four vernier divisions the beat frequency can be reduced approximately to zero, first by reducing the beat frequency below the audible limit in the headphones, and finally by reducing the swing of the microammeter needle to approximately zero. By careful adjustment, the oscillations of the meter pointer can easily be reduced to one swing per second.

In the absence of an isolator stage, it is inadvisable to couple the wavemeter directly to the VMO output, as the oscillator will not be correctly loaded and moreover there is a risk of pulling the oscillator frequency when tuning the wavemeter. The VMO should therefore be coupled to the harmonic amplifier in the normal manner, and the wavemeter coupled to the 1st HA stage anode circuit, using the "A" coil in the case of transmitters Types SWB.8 and SWB.11. With this coil, the 1st HA stage covers the same frequency range as the VMO.

Adequate coupling can be obtained by standing the wavemeter so that its coil is opposite the tuning slot of the 1st HA stage. Set up the VMO and the 1st HA stage to the crystal oscillator <u>output</u> frequency, (which is five times the crystal frequency, for crystal oscillators marked P.S. 10463/A, /B or /D), using the existing calibrations for VMO and 1st stage HA. The remaining HA stages should be set up using the coil selection chart and calibrations provided in the transmitter handbook. The harmonic and radiated frequency however, must be chosen so as to satisfy certain conditions. An example based on the Type SWB.8W transmitter will illustrate the method of setting up, the appropriate harmonic amplifier coil chart being Sk.Z.1217, Sh.2.

The HA coil chart shows the correct coil for each stage for the various radiated frequency ranges of the 4th stage anode circuit and the appropriate harmonic (or overall frequency multiplication) for any given frequency range.

For any given crystal, the overall frequency multiplication chosen, must give a radiated frequency which falls within the 4th stage frequency range shown on the chart for that harmonic, and must also involve the use of coil "A" in the 1st stage.

Example

Suppose the crystal frequency, fc = 205 kc/s
Then the crystal oscillator output frequency, f1 = fc x 5
Therefore f1 = (205 x 5) = 1025 kc/s
Let the radiated frequency in the 4th stage anode circuit = fr and let the overall frequency multiplication in the harmonic amplifier = M
Then fr = f1 x M
Now refer to the coil chart Sk.Z.1217 Sh.2 and find a value of M which satisfies the two following conditions for the chosen crystal:-

(i) 1st stage coil must be coil A.
(ii) Radiated frequency produced in the 4th stage must fall within the 4th stage output frequency range in column 2 of the chart.

Try M = 10   fc = 205 kc/s and f1 = 1025 kc/s
fr = 1025 x 10 = 10250 kc/s

It will be seen from the chart that although coil A is used in stage 1, the resultant value of fr = 10250 does not come within the frequency band 10345-12765 in column 2.

Similarly, the use of the 6th harmonic gives a value of fr = (1025 x 6) = 6150 kc/s which is also outside the band 6250-8000 kc/s.

The 5th harmonic makes fr = 5125 kc/s which is also outside the band 5172-6250 kc/s.

The 4th, 3rd and 2nd harmonics, however, give values of fr = 4100, 3075 and 2050 kc/s respectively, each of which is within the relevant frequency band in column 2. Any one of these harmonics would therefore be suitable for this hypothetical case and the appropriate set of coils for each of these harmonics is shown on the chart.

Summarizing the setting up of the VMO and HA, the required adjustments are as follows:-

Set the VMO range switch and tuning condenser so that the frequency is the same as the crystal oscillator output frequency.

Insert the correct set of HA coils as previously described.

Using the calibration charts for the HA stages, set the tuning condenser scales for the radiated (4th stage) frequency chosen by the method just described.

Set the VMO/crystal oscillator changeover switch to the VMO position.

The crystal oscillator AC supply switch should be left "on" as the crystal oven requires about 4 hours to reach stable operating temperature but the oscillator switch on the crystal unit should be switched "off".

Switch on the filament supplies for the VMO, HA and main transmitter filaments and the grid bias supply for HA and main stages of the transmitter. Switch on the VMO and HA anode supply and make final adjustments of the four HA tuning condensers.

Now tune the wavemeter, and adjust its position in front of the open tuning slot of the 1st HA stage in order to obtain a suitable deflection of the microammeter needle. Switch off the VMO and HA anode supply.

Place the single turn coupling coil, which is connected to the RF output co-axial cable from the crystal oscillator, close to the wavemeter coil. Set the crystal selector switch to the correct position for the crystal which is to be used for calibrating the VMO. Close the crystal oscillator switch and observe the wavemeter microammeter. Tune the wavemeter for maximum deflection on the microammeter and adjust the position of the single turn coupling coil to give about the same deflection as was obtained with the VMO.

Now switch on the VMO and HA anode supply so that the wavemeter is picking up the RF output from both oscillators and producing a beat frequency. If this beat frequency is not already audible in the headphones, carefully adjust the VMO tuning condenser over a range of about four vernier divisions, using the tuning aperture in the door of the compartment. On finding the beat note turn the control knob in the direction which reduces the beat frequency and continue until the pitch of the note in the headphones is reduced below the audible limit. On reaching this point, the beat frequency should be sufficiently low to give a visual indication on the microammeter. Continue the adjustment of the VMO tuning condenser until the oscillations of the meter pointer disappear, or are as slow as possible. It is possible to reduce the oscillations of the meter to at least one per second without any difficulty.

Now record the settings of the VMO range switch and tuning condenser main scale and vernier against the crystal oscillator output frequency (i.e. fc x 5) in kc/s.

Repeat the foregoing process, taking as many checks of the VMO calibration as possible, depending on the number of crystals available. In each case, set up the harmonic amplifier as previously described, in order to find a suitable harmonic for the harmonic amplifier and the corresponding set of coils for HA stages 2, 3 and 4 and the radiated frequency which is within the frequency range of the 4th stage for the chosen harmonic (see coil chart for the transmitter). Remember that coil A must be used in the 1st HA stage and the frequency of that stage must be the same as the crystal oscillator output frequency, that is, five times the crystal frequency.

Finally, make a new calibration chart for the VMO from the new readings obtained,by plotting curves from the existing tabulated calibration, adding the new calibration check points and then drawing the new curve parallel to the old curve through the new points obtained.

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VALVE MASTER OSCILLATOR

MAINTENANCE INSTRUCTIONS

GENERAL REMARKS

If the master oscillator should cease to function, the station engineer is left with a temporary expedient of self-exciting the 2nd stage of the harmonic amplifier, and the method of doing this is mentioned in the instructions which accompany the transmitter.

This procedure can be briefly described as follows:-

A mica condenser of approximately 0.001 μF. capacity, 500 volts test, should be connected between the output terminal of the 2nd stage and the control grid of the VT.60A (or RCA 807) valve in the 2nd harmonic amplifier stage.

The tuning condenser of the 2nd stage should then be adjusted to give the maximum grid current to the 3rd stage with the tuning condenser of the 3rd stage at the normal position for the required wavelength.

Providing that the tuning condensers of the 3rd and 4th stages remain at their normal positions for the given wavelength and only the 2nd stage condenser is varied, the emitted frequency can be relied upon to be within commercial tolerance and the stability should be sufficient to enable a service to be maintained pending repairs to the master oscillator unit.

At a convenient moment the overhaul of the master oscillator can be undertaken.

DESCRIPTION OF MASTER OSCILLATOR UNIT

It must be fully understood that the construction of this unit is of the highest workmanship and every effort must be made to avoid dismantling as this would undoubtedly affect the stability of the oscillator.

The theoretical diagram of connections is shown in Dwg.No.WZ.676.

The circuit can best be described as a 2-valve resistance-coupled amplifier in a state of "end-to-end" oscillation. The natural frequency of oscillations is that of the low decrement L.C. circuit which has its high potential end capacity coupled to both the input and output of the amplifier, the low potential end being grounded.

The unit consists of an outer and an inner case, the cases being separated by a thick felt lining.

The L.C. combination and associated components are mounted within the inner case and they are thus protected thermally and mechanically from external disturbances.

The valves and their circuit components are assembled on the outer case. Two ML.6 valves are used, the supplies being 4 v. D.C. or 6.3 v. A.C. for L.T. and 220 v. D.C. for H.T.

An additional component of considerable importance is the frequency modulation condenser. The vane of this condenser is capacity coupled to the inductance within the inner case, the stem of the condenser passing through both cases to an insulated cover on the side of the unit.

Frequency compensation for changes of ambient temperature is obtained by winding the inductance on a loaded ebonite former which has a fairly linear coefficient of expansion. A change of temperature will produce a change in the length and diameter of the former which in turn will cause a change in the value of the inductance.

A compensating condenser is provided for balancing the frequency change by producing a differential change in the capacity of the inductance to frame and ground.

The result of a change in temperature, therefore, will be to vary the value of the inductance, at the same time the capacity of the compensating condenser is inversely varied, thus the natural frequency of the L.C. combination is maintained substantially constant.

After assembly and before calibration the oscillator unit undergoes a process of "ageing". This continues for nearly a fortnight during which time the unit is subjected to cycles of approximately eight hours heating and sixteen hours cooling. This treatment is intended to remove any undesirable strains or stresses in the assembly, windings, etc., and this condition must be satisfied before attempts are made at thermal compensation.

Frequency compensation is made for thermal changes of 30°C. The process is laborious and is mainly one of repeated and protracted observation i.e. trial and error. This is necessary owing to minute variations in the thermal behaviour of the materials used, the tension and the method of winding, etc.

It should now be apparent that repairs should only be undertaken by competent mechanics who have thoroughly familiarised themselves with the technicalities involved

Before disconnecting the Master Oscillator from the transmitter, checks should be made with the station hack wavemeter (by coupling the wavemeter coil to the MT Master Oscillator valves), to ascertain that no oscillations are being produced by the Master Oscillator. The Master Oscillator frequency range is between 980 to 1350 k/cs.

REMOVAL OF OSCILLATOR UNIT FROM TRANSMITTER PANEL

When it has been established that the oscillator unit is faulty, it should be carefully removed from its cradle mounting in the drive unit. The correct procedure is as follows:-

1. Remove side screen from the drive unit.
2. Remove the two lower horizontal perforated shelves which screen the 1st and 2nd harmonic amplifier stages.
3. Disconnect the two socket connections which carry the output leads from the oscillator and 1st harmonic amplifier stages.
4. Remove the 1st harmonic amplifier stage completely from its mounting. This operation is described in detail in the main transmitter instructions.
5. Disconnect the filament leads. These leads are flexible and usually maconite covered and should be handled from the front of the panel.
6. Disconnect the H.T lead from the terminal on the right hand side. This is done from the front of the unit.
7. Disconnect the two braided flexible "earth" leads by removing the nuts off the screws mounted on the cradle. These leads are on either side of the case and should be handled from the side of the unit.
8. Disconnect the socket carrying the lead from the frequency modulation condenser to the diode control valve. This is done from the side of the unit.
9. The entire unit can now be slid forwards out of its mounting cradle.

The unit must not be dismantled or the seals on the outer case and frequency modulation condenser broken until a sequence of tests described below has definitely located the fault to be inside the case.

GENERAL ASSEMBLY OF OSCILLATOR UNIT

Dwg. No.65011, Sheets 1 and 2, and the accompanying photographs give full details of the construction and layout of the unit.

The principle components have been given numerical references on the drawings and are referred to by these numbers, e.g. 1, 14 etc., in the photographs and the following notes.

SERVICING INSTRUCTIONS BEFORE OPENING CASE

The troubles due to faults in the oscillator unit can be classified under the following headings:-

(a) Non-oscillation
(b) Intermittent or unstable oscillation.
(c) Frequency instability.
(d) Frequency instability when range-switch is operated.
(e) Change in calibration.
(f) Unwanted radiation.

The recommended procedure for dealing with these troubles is as follows:-

(a) Non-oscillation.

1. Check applied voltages at oscillator terminals.
2. Check valve feeds. The two ML.6 valves should together pass a total current of 28-36 mA. when oscillating and 56 mA. when not oscillating. This is a rough check of the valves but will not necessarily indicate a "soft" valve. See that both filaments are alight when testing.
3. Check the circuit continuity of all resistances and chokes.
4. Check the circuit continuity of the 16 volts. 3 w. "anti-squigger" lamp 118. See that the lamp is screwed home in its socket and that its tip is making good contact. Do not use undue force when turning the lamp, otherwise the glass bulb may be loosened or detached from its screw cap.
5. Check circuit continuity of all wiring. Look for broken or dry soldered joints, making good any that are doubtful.
6. See that the flexible copper connecting wires are properly soldered to the two brass contact pins 30, which connect the valve circuits to the L.C. circuit in the inner case.
7. Test all condensers with a "Megger".
8. Check that the valve pins make good contact in the sockets and that the valves engage firmly in the holders. The valve "banana" pins should be slightly opened with a knife blade if necessary.
9. If oscillations are still unobtainable, as shown by the valve feed being about 56 mA., one or both of the valves may be "soft" and new valves should be fitted.
10. In humid climates or damp situations atmospheric moisture may cause failure of the oscillator. The remedy will be to thoroughly dry the unit either in the hot sun or in a slow oven.

The foregoing list covers all possible causes of non-oscillation that are likely to be due to external faults.

(b) Intermittent or unstable oscillation.

(c) Frequency instability.

These two troubles may have similar origins.

1. Using a reliable voltmeter, check the stability of the voltage across the oscillator terminals.

2. Observe valve feeds for jumps and variations.

3. Make checks 3, 4, 5, 6, 7 and 8 mentioned in the previous section on "Non-oscillation".

These checks cover all possible causes of trouble under headings (b) and (c) that are likely to be due to external faults.

If the checks mentioned have failed to locate the fault as being outside the case or, if the trouble experienced is either

(d) Frequency instability due to operation of range-switch
(e) A change in calibration
(f) Unwanted radiation

then it will be necessary to open the case.

OPENING OSCILLATOR CASE

Extreme care should be exercised when opening the oscillator. The inductance former, and particularly its winding, should not be handled.

The bench used must be free from dust, metallic and otherwise. A particle of solder or other metal, settling on the inductance may partially or totally short-circuit adjacent turns, giving rise either to instability. a change in calibration or perhaps failure to oscillate.

Every effort should be made to prevent moisture and any form of dirt settling on the former and the range switches associated with it.

The correct procedure for opening the case is as follows:-

1. Remove seals at rear of outer case and from the frequency modulation condenser at the side of the case.

2. Remove screws holding the cover of the frequency modulation condenser on the side of the case.

3. Loosen small hexagonal lock-nut exposed in (2) above.

4. Using a screw-driver, unscrew as far as possible the stem of the frequency modulation condenser. This condenser cannot be completely withdrawn and force must not be used.

5. Set range-switch to mid-way position between "range 1" and range 8".

6. Remove three 6BA countersunk screws which retain the end-cap 3 at rear of oscillator.

7. The end-cap 189 may now be removed and also the felt disc 186 behind it.

   Note: The large hexagonal nut in the centre of the brass end-plate must on no account be moved.

8. Remove three 6BA countersunk screws 93, which hold the locating ring 187. This ring has two 2BA screwed holes, 180° apart, for inserting two screws to act as "draw pins" for easy removal of the ring.

9. Unsolder the flexible copper connections attached to the two brass contact pins 30 and remove the pins by unscrewing with a screwdriver.

10. Remove four 4BA countersunk screws 11.

11. Firmly grasp the brass end plate 188 and slowly withdraw the inductance unit from the inner case 8.

   Note: In no circumstances should the winding on the inductance former be handled during inspection.

ASSEMBLY OF INNER CASE

The assembly comprises:-

1. An inductance tapped at eight positions, the tappings being connected to an 8-position cam-operated switch 64.
2. A variable condenser 34 operated by a worm drive.
3. A pre-set fixed condenser for neutralising the thermal effects on the inductance.
4. An attachment with gold contacts for connecting the "L.C." combination to the valves etc., - this attachment offers little restraint to thermal expansion.

The switch contacts are made of a non-tarnishable gold alloy. The spring contact blades have wiping contacts of considerable tension and normally no trouble should be experienced with them.

The switch-cam operating spindles are spring-loaded by powerful leaf-springs, screwed to the brass end-cap to ensure that the contact resistance to ground of the spindles should remain constant. These spindles are in the field of the coil and any changes in their electrical resistance to ground will produce frequency disturbances and perturbations.

In addition to the components already mentioned, there is also the frequency modulation condenser which has been mentioned previously.

The inductance former having been removed, it is now possible to examine the windings and the switch-gears for faults causing

(d) Frequency instability due to operation of range-switch, i.e. "non-repeatability".

(e) Changes in calibration.

1. Examine windings closely in a good light and with the aid of a magnifying glass if possible. Remove any metallic or other particles that may be seen.
2. Still using a magnifying glass, and in a good light, examine the soldered joints on the switch and inductance tappings. Make sure that the tappings on the inductance are not short-circuiting adjacent turns.
3. Examine the gold contact faces of the switches and switch blades for general cleanliness and freedom from foreign matter. e.g. resin flux etc.
4. Slowly rotate the switch cams by gripping the brass click plates 72 between the thumb and finger. The action of each of the phosphor-bronze switch blades may now be seen and the tension between each of the contacts can be carefully tested with the finger nail. Force should not be used in this test otherwise the switch blade tested may assume a permanent set and the correct pressure between the contacts will be reduced.
5. The pressure between each of the contacts and blades will usually be found to be considerable and, as the contact is self-cleaning by virtue of its wiping action, it is unlikely that trouble due to switch contact resistance will be experienced.
6. The phosphor-bronze contact springs, with their gold contacts, used for obtaining connection between the L.C. circuit and the valve maintaining circuits, occasionally become bent due to excess pressure by the contact pins. If this is so the phosphor-bronze spring blades attached to the mica ring should be carefully lifted until the contacts on the ends project slightly above the mica ring.
7. Should the presence of damp be suspected, the complete unit, including the felt lining should be dried by exposure to hot sun or a fire. The felt is highly absorbent and may take up large quantities of moisture in a damp situation.

<u>Note:</u> (i) On no account should the screws be removed which hold the inductance former to the brass end-plate or condenser stator. The inductance former must remain rigidly fixed to the end-caps. It is tightly screwed into the brass pieces by screw-threads, the screws round the periphery being merely locking screws.

(ii) The setting of the temperature compensating condenser should not be altered, i.e. the large hexagonal nut on a fine thread in the centre of the end brass casting must not be disturbed.

The foregoing notes should have proved helpful in exploring the cause of the master oscillator trouble and in clearing the fault.

RE-ASSEMBLING MASTER OSCILLATOR UNIT

The order of assembly should be as follows:-

<u>1</u>. Check that none of the switch contacts are in operation, i.e. the inductance is "all in", that the large brass operating cam <u>77</u> (in the centre between the switch spindles and click plates) has its operating teeth on the <u>lower</u> and not on the top side, also that the scratch markings 1 and 2 on the faces of the switch click plates correspond with similar markings on the brass end casting.

<u>2</u>. The range switch knob on the front of the outer brass case should now be set at the white dot mid-way between ranges 1 and 8.

<u>3</u>. Place the phosphor-bronze coil spring <u>149</u>, with its two locating washers on the brass compensating rod at the condenser stator end of the inductance unit.

<u>4</u>. Insert the inductance former into the inner case by gripping the brass end casting firmly and sliding the inductance former into position.

<u>Note:</u> It will be necessary to lever the inductance unit upwards slightly whilst holding it, in order to locate the far end of the brass compensating rod into its housing inside the inner case. Some slight resistance may be noticed due to the phosphor-bronze spring, but the sense of touch should indicate when the inductance unit lines up with its retaining screw holes, and also if the range switch is still in the centre of the neutral position between ranges 1 and 8. If the switch knob is not in this position, the inductance unit should be slightly withdrawn, the switch knob placed in its proper position and the switch gears then re-engaged.

<u>5</u>. Insert the four 4BA screws which hold the inductance unit and screw them tightly home.

<u>6</u>. Replace the locating ring <u>187</u> in the case and fasten it by screws round the periphery.

<u>7</u>. Replace the two gold tipped brass contact screw pins <u>30</u> which connect the valve circuits to the inductance.

<u>Note:</u> These should be screwed down until some definite resistance is felt when it may be assumed that the screw-pins are in contact with the gold-surfaced phosphor-bronze springs attached to the inductance former inside the case.

<u>8</u>. Re-solder the two flexible connecting wires to the pins.

9. Screw down, with a screw-driver, the small disc condenser (frequency modulation condenser) in the side of the outer case until contact is just made with the winding inside the inner case.

   Note: A galvanometer, or other detector, connected to the blade of the screw-driver and to the frame of the unit will indicate the precise position at which contact occurs.

10. Mark with a pencil the position of the screw-driver slot in relation to the outer case.

    Now unscrew the condenser precisely six turns and lock it in position with the hexagonal nut provided.

11. Replace condenser cover plate.

12. If frequency modulation is not used on the transmitter, the frequency modulation condenser should be grounded to the frame by means of a short piece of 20 SWG copper wire.

REPLACEMENT OF OSCILLATOR UNIT IN TRANSMITTER PANEL

The procedure outlined for removing the oscillator should be followed in the reverse order.

RECALIBRATION OF MASTER OSCILLATOR

The oscillator will require re-calibrating after being re-assembled. It is recommended that frequency checks should be made at two or three points on each range, using a checking station capable of measurements with an accuracy of at least 1 in 100,000.

In this way correction curves could be prepared for the original calibrations.

FREQUENCY MODULATION

The principles of frequency modulation are briefly described in the transmitter instructions.

The general assembly of the condenser is shown in Dwg. No. 64673, Sheet 1, a copy of which accompanies these instructions.

The oscillator is calibrated before despatch with this condenser in a definite position. To open the case for inspection, the setting of the condenser has to be disturbed. After the case is closed, the re-setting of the condenser stem to six turns out (as described above) is only a rough approximation and, to regain the original performance of the oscillator, checks with a high-grade station are essential.

RESETTING OF RANGE SWITCH GEAR WHEELS

A few cases have occurred of damage to the Range Switch mechanism due to exceptionally rough handling in transit. Sometimes the control knob only is broken, but occasionally the screws securing the housing of the driving pinion on the end of the range switch control spindle are sheared so that the gear wheels become disengaged. Unless this mechanism is carefully re-assembled so as to restore the correct relationship between the position of the control knob, pointer, spindle, and the various gears, the frequency calibrations for the various settings of switch knob and tuning condenser will be completely deranged.

In the instructions which follow, reference should be made to Drawing 65011 sheet 2, on which all part references are shown. All necessary steps will be covered, those to be taken depending on the extent of the damage.

OPENING OSCILLATOR CASE

> WARNING. Before opening the oscillator case, special attention should be given to the cautionary notes on the following pages of these instructions.

PAGE 1 - GENERAL REMARKS. These cover operation of the transmitter while servicing the master oscillator.

PAGE 1 - DESCRIPTION OF MASTER OSCILLATOR UNIT. Refer to first paragraph.

PAGE 4 - OPENING OSCILLATOR CASE. Cautionary notes immediately under this heading, also the note at the bottom of page 4.

1. To inspect the gears, remove the seals at rear of outer case.
2. Remove the three 6.B.A. countersunk screws, Ref.3, which retain the end cap at rear of oscillator.
3. Remove the end cap, Ref.186, and the felt disc, Ref.189 behind it.
4. NOTE:- The large hexagonal nut, Ref 32, in the centre of the brass end plate <u>must on no account be moved</u> or the critical adjustment of the compensating condenser will be upset.
5. Now examine the left hand and right hand locating plates which are screwed to the cam gears (Ref.72), which operate the inductance tapping switches. These are marked 1 and 2 respectively on the locating plate and on the support, either by scriber marks or with paint. Set <u>each</u> cam gear so that corresponding numbers on locating plate and support register with one another, i.e. both switches in the "off" position.
6. Check that the operating gear, Ref.77 (in the centre between the two cam gears) is set so that its toothed sector is on the <u>lower</u> side and not on the top side.
7. Now set the toothed sector of this gear accurately in the mid position with respect to the two cam gears by locking it with a 1/16" diameter pin passed through the locating holes in bearing plate, Ref. 75 and operating gear, Ref.77.
8. It is assumed that the idler pinion, Ref.78, is already mounted on the bearing plate, Ref.75 and meshed with the operating gear, Ref.77. See that the driving pinion, Ref.79, on the range switch shaft, Ref.80, is disengaged from the idler pinion by removing the two screws Ref.84 and slightly raising the housing Ref.81.

9. Check that the driving pinion is securely pinned to the shaft. If necessary inspect by removing the cover plate of the housing, thus exposing the pinion.

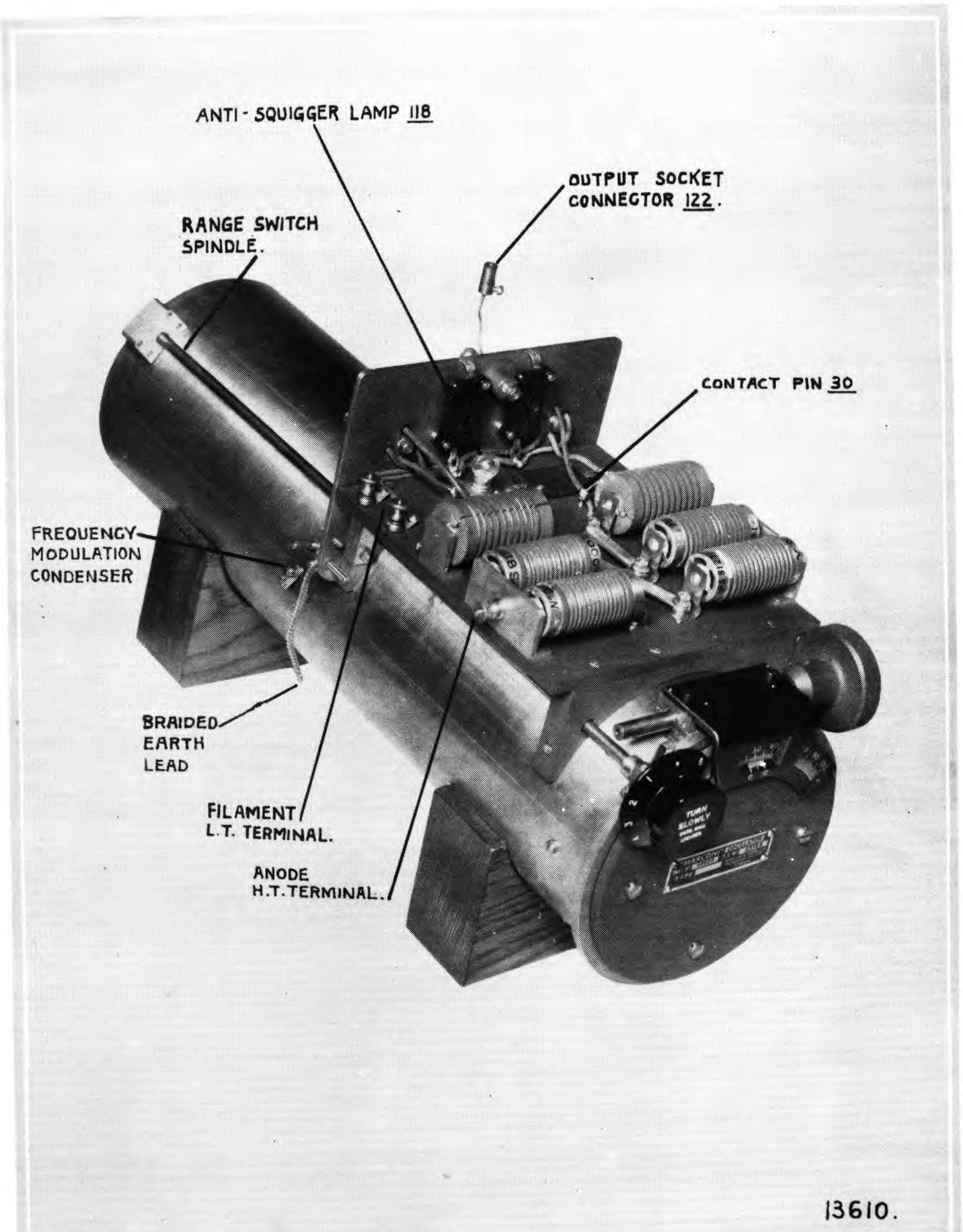
10. Fit the new range switch knob Ref.87 to the shaft and see that the pin engages in the groove in the back of the knob. Tighten the grub screw which locks the knob on the shaft.

11. Now set the knob so that the engraved white dot (midway between engraving divisions 1 and 8 on the knob) coincides with the pointer.

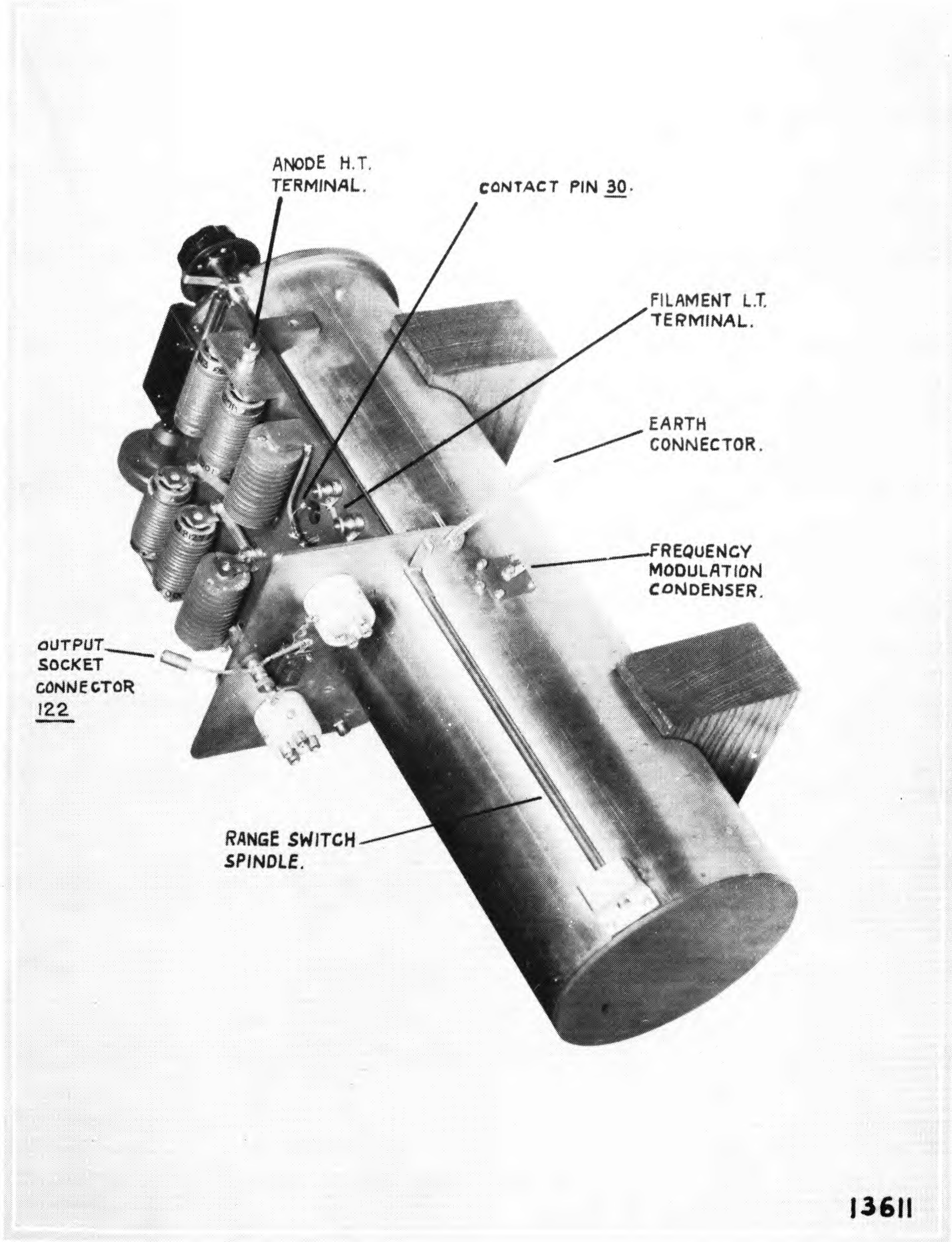
12. Re-assemble housing of driving pinion, mesh the latter with the idler pinion, and screw housing to master oscillator case with the two screws Ref.84.

13. Don't forget to remove the 1/16" locating pin, which was used to lock the operating gear Ref.77 to the bearing plate, Ref.75.

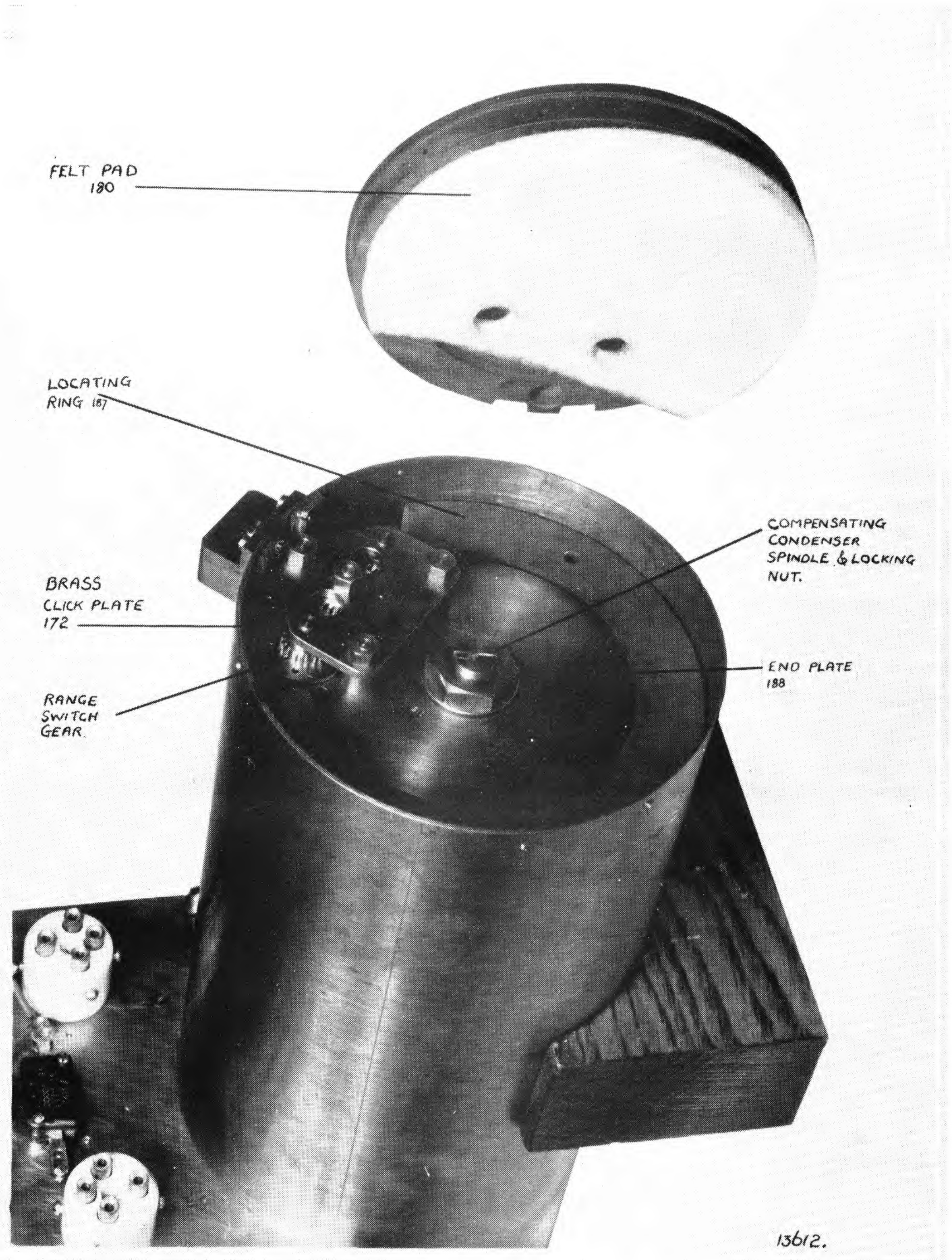
14. Finally replace felt disc Ref.189, end cap, Ref.186, and the three screws which retain the end cap.



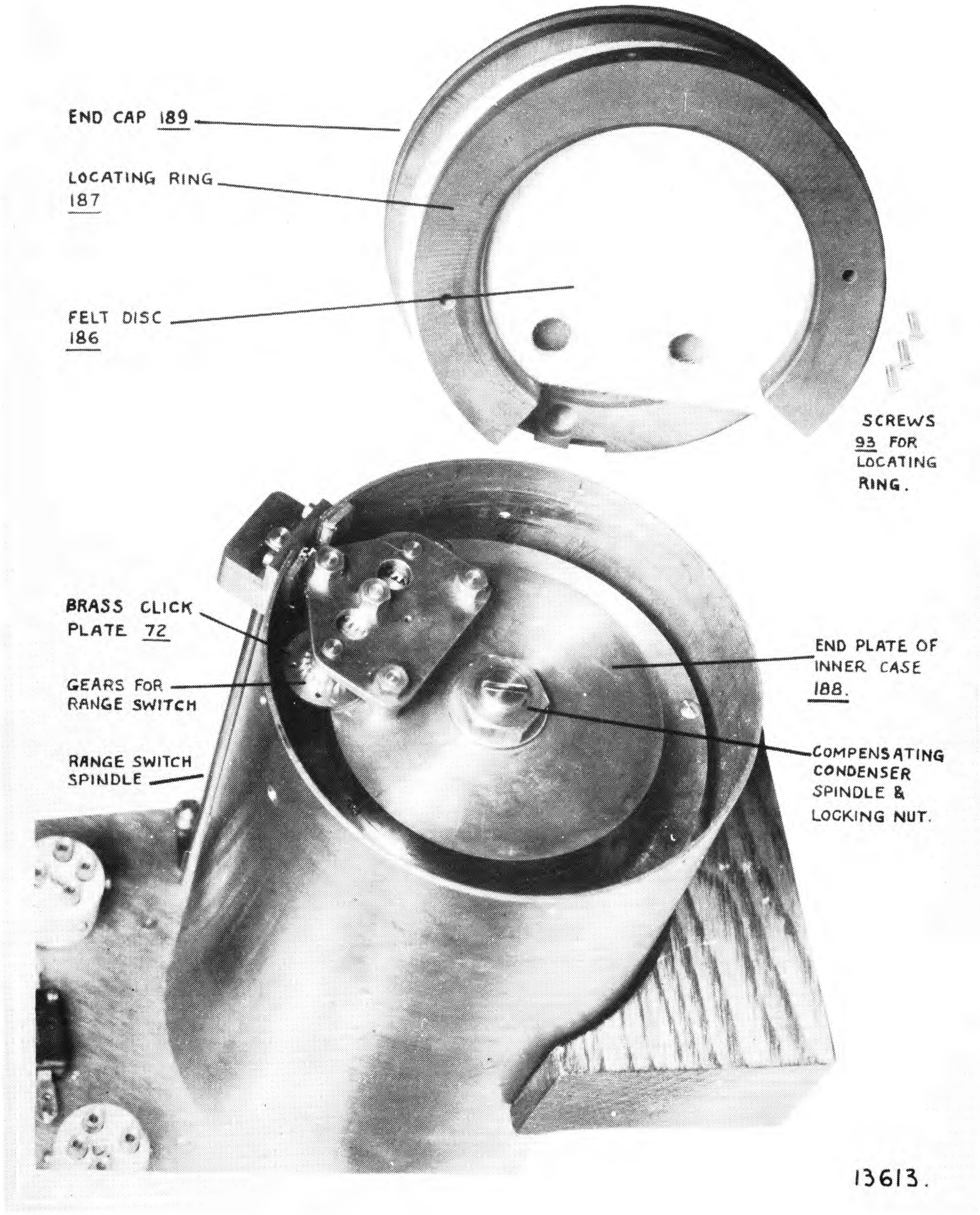
EXTERNAL ELEVATION



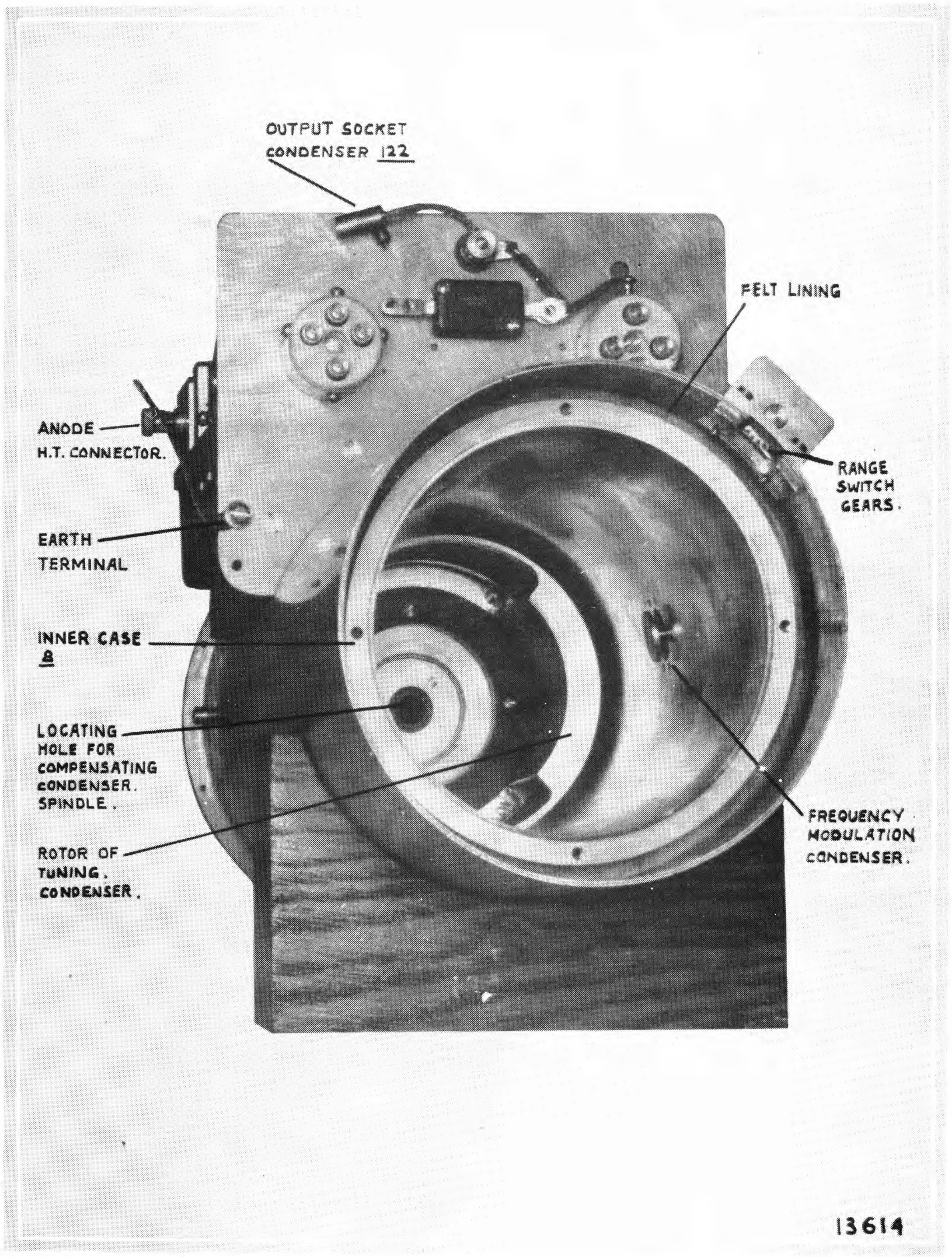
EXTERNAL PLAN



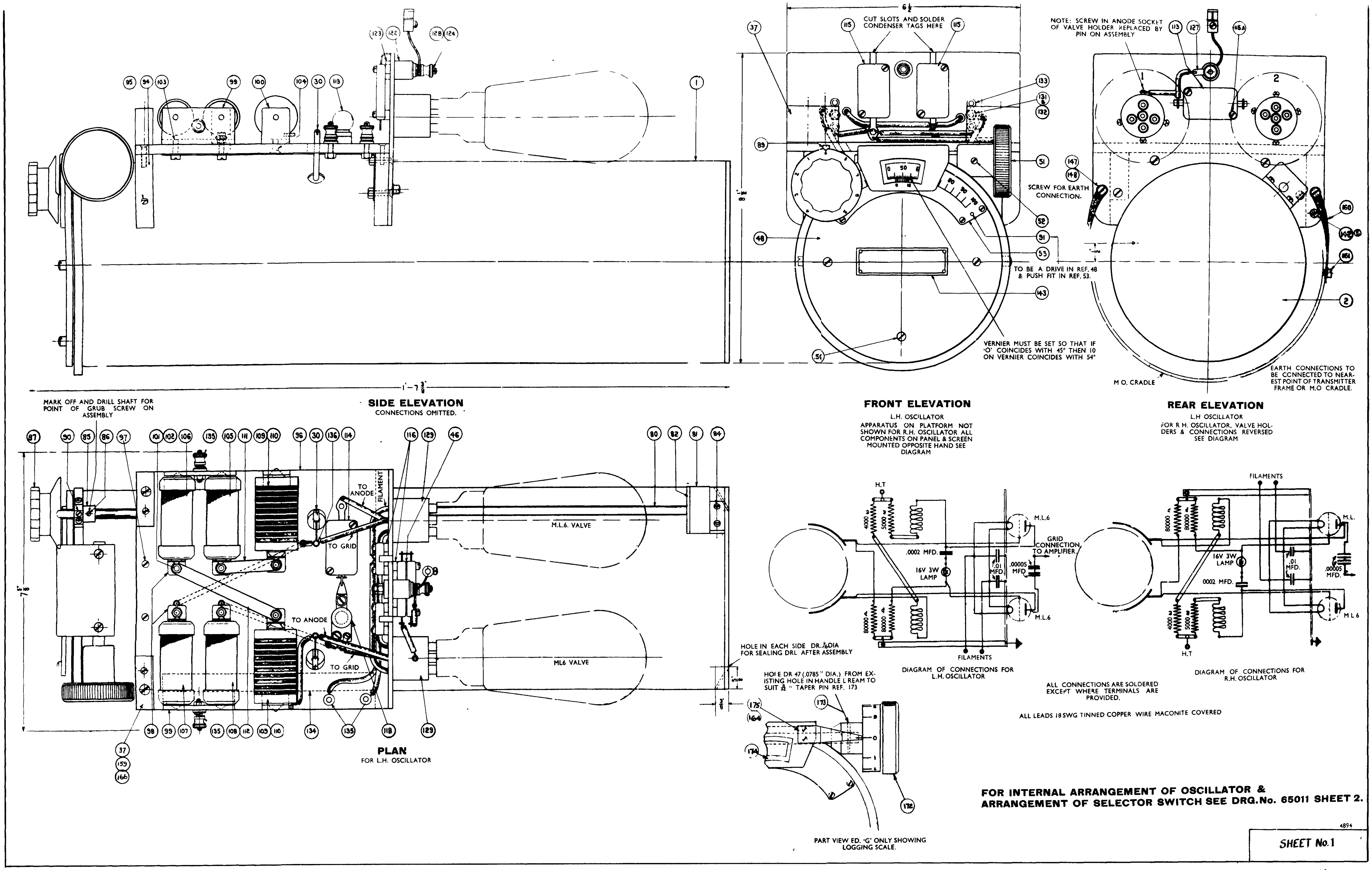
REAR VIEW WITH END CAP REMOVED



REAR VIEW WITH END CAP AND SUPPORT RING REMOVED

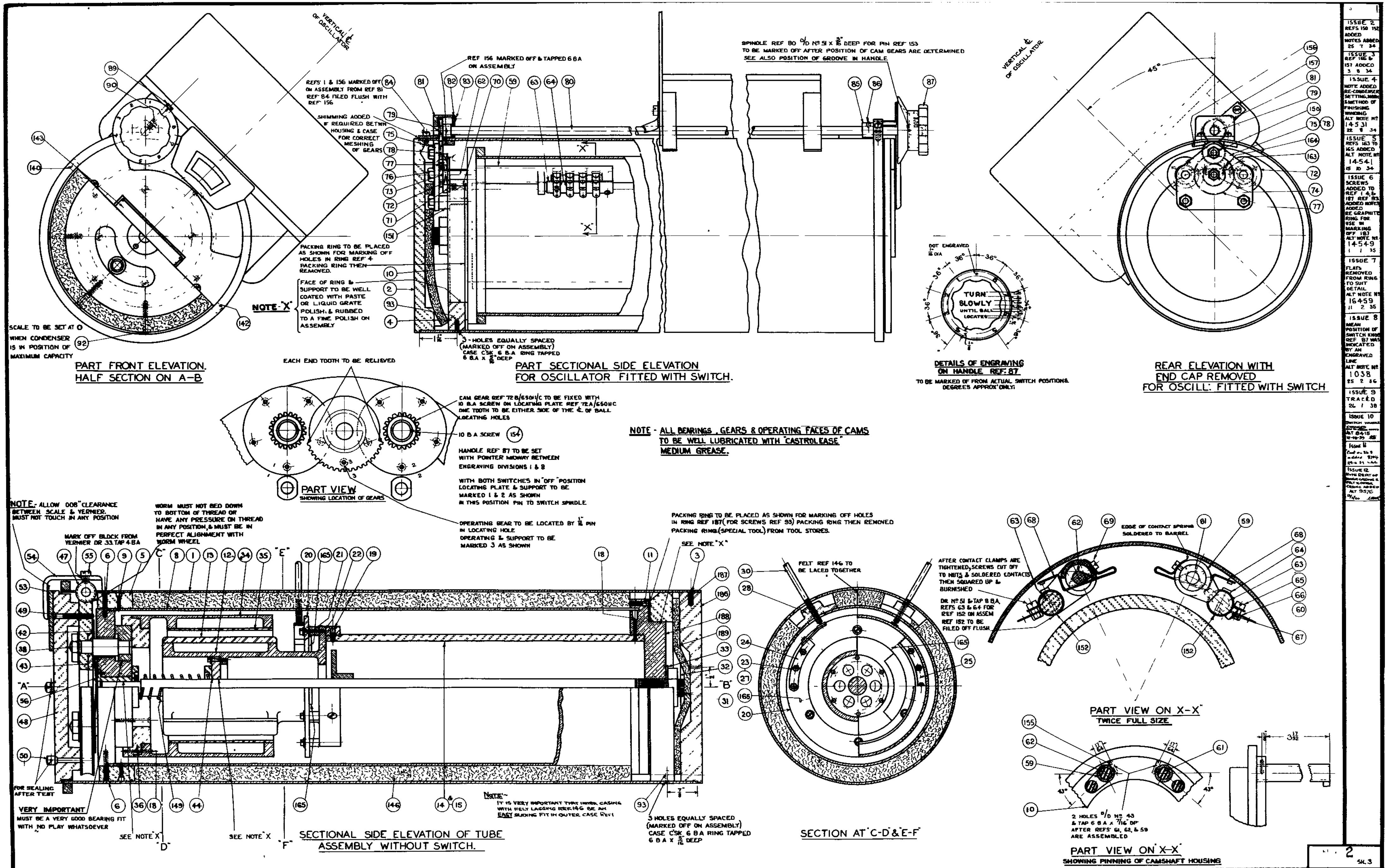


REAR VIEW OF INNER CASE SHOWING VARIABLE CONDENSER
AND FREQUENCY MODULATION CONDENSER VANE.



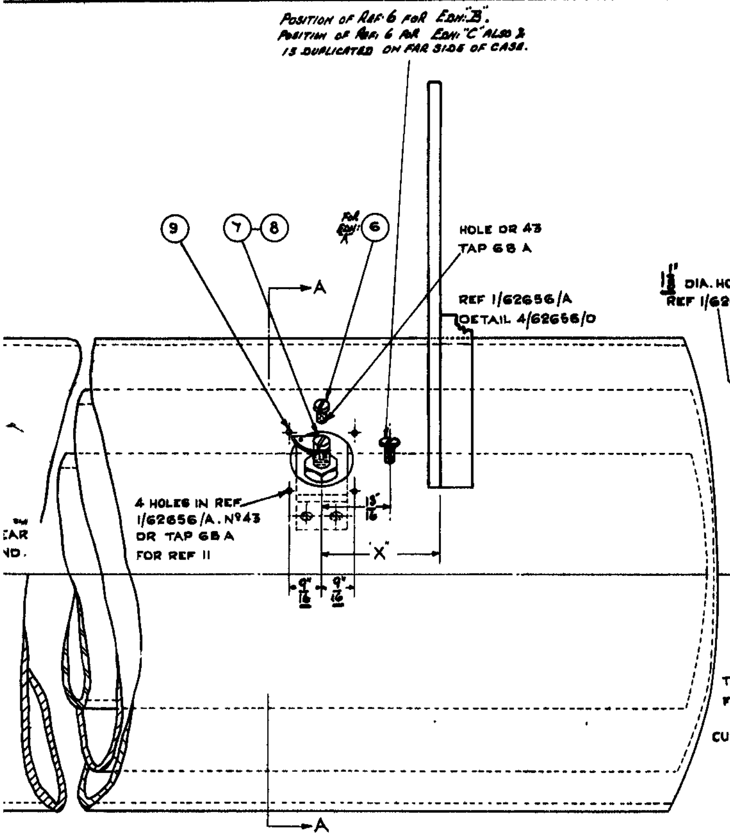
G.A. OF MASTER OSCILLATOR

DRG. No. 65011

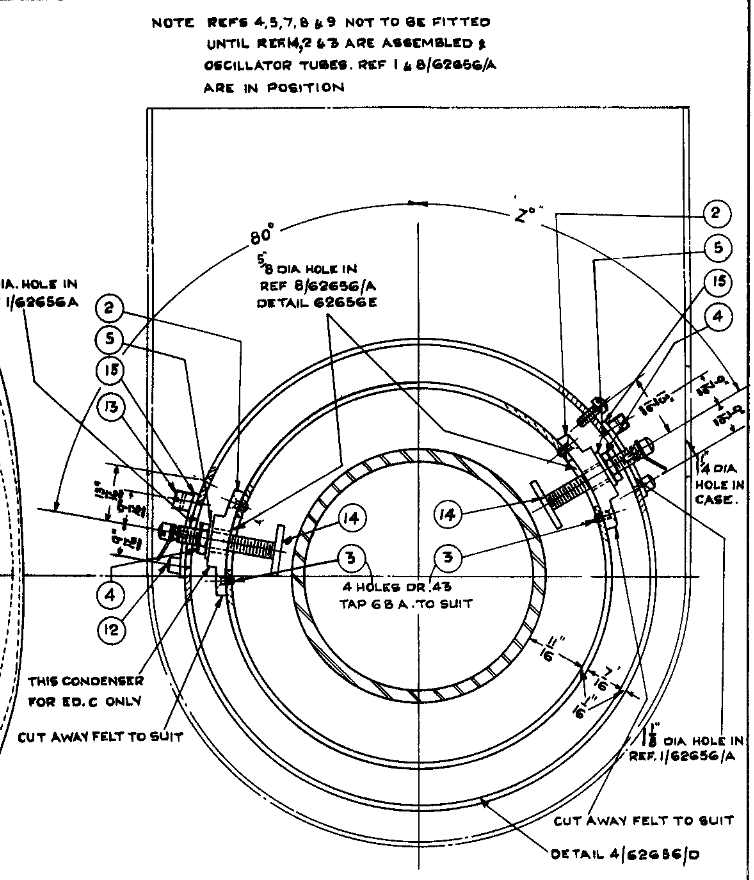


ASSEMBLY OF 8 TAP SWITCH, FITTED TO OSCILLATOR & INTERNAL ARRANGEMENT.

DY N 65011

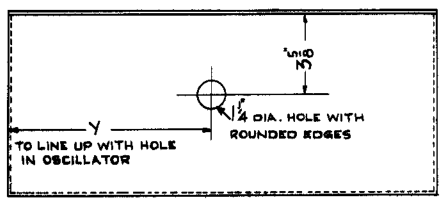


PART SIDE ELEVATION



SECTIONAL ELEVATION ON A-A

SCALE FULL SIZE



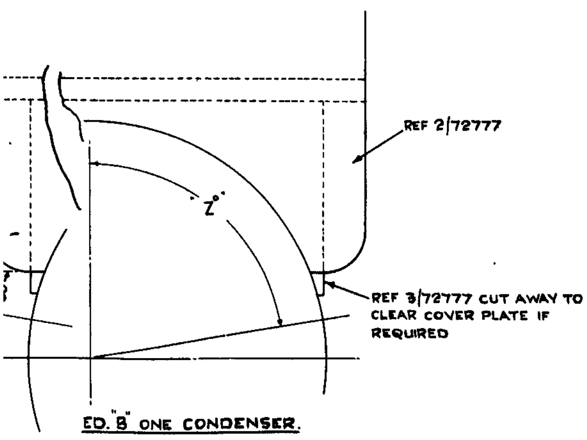
SIDE ELEVATION OF OSCILLATOR CASE DRG. Nº 71076

SCALE 3" = 1 FT

NOTE:- DIMENSION "X" TO BE MARKED OFF TO BRING CENTRE OF CONDENSER 5/16 FROM ACTUAL END OF WINDING (THIS DIMENSION WILL VARY BETWEEN COILS & EDNS)

TEST NOTE:- FOR CALIBRATION CONDENSER REF. 1.

1. TO BE ADJUSTED ON TEST TO GIVE A 400~ SWING BETWEEN 0·4 M.A. & 1·5 M.A. OF THE DIODE FEED.
2. AFTER THE ABOVE ADJUSTMENT, THIS CONDENSER SHOULD BE EARTHED TO CASE, WHEN FREQUENCY MODULATION IS NOT REQUIRED, BEFORE CALIBRATING OSCILLATOR



ED. "B" ONE CONDENSER.

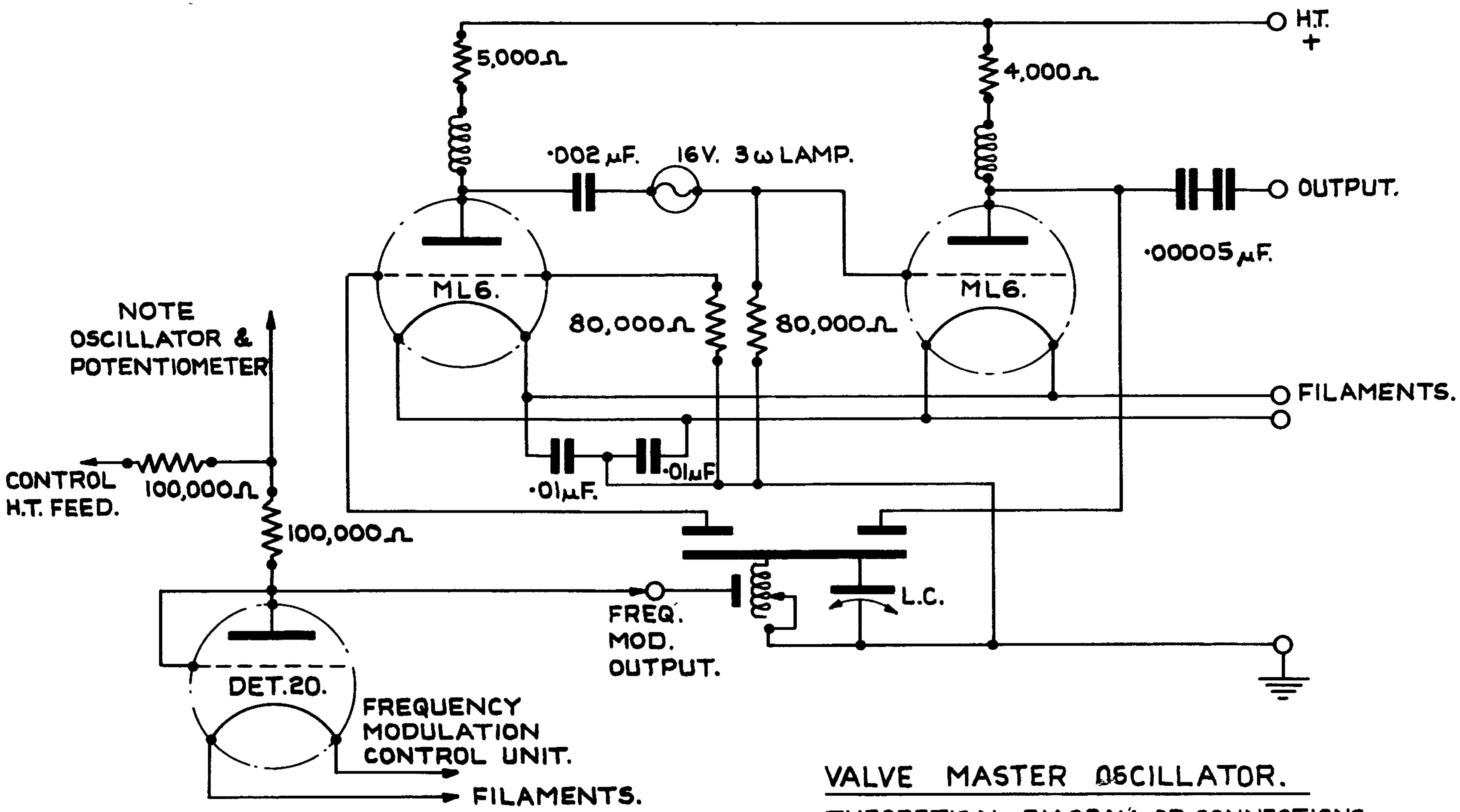
ED. "C" TWO CONDENSER.

EDITION	"Z°"	REMARKS
A	60°	FOR M O.I.A OSCILLATOR
B	80°	REF. 3/72777 CUT AWAY TO CLEAR COVER PLATE WHEN NECESSARY
C	80°	REF. 3/72777 CUT AWAY TO CLEAR COVER PLATES WHEN NECESSARY

G.A. OF WAVE CHANGE CONDENSER FOR FREQUENCY MODULATION.

4394		
B.W	22 1 48	FULL SIZE UNLESS STATED OTHERWISE
TO FILE COPY ISSUE 12 [signature]	16-11-48	64673

1

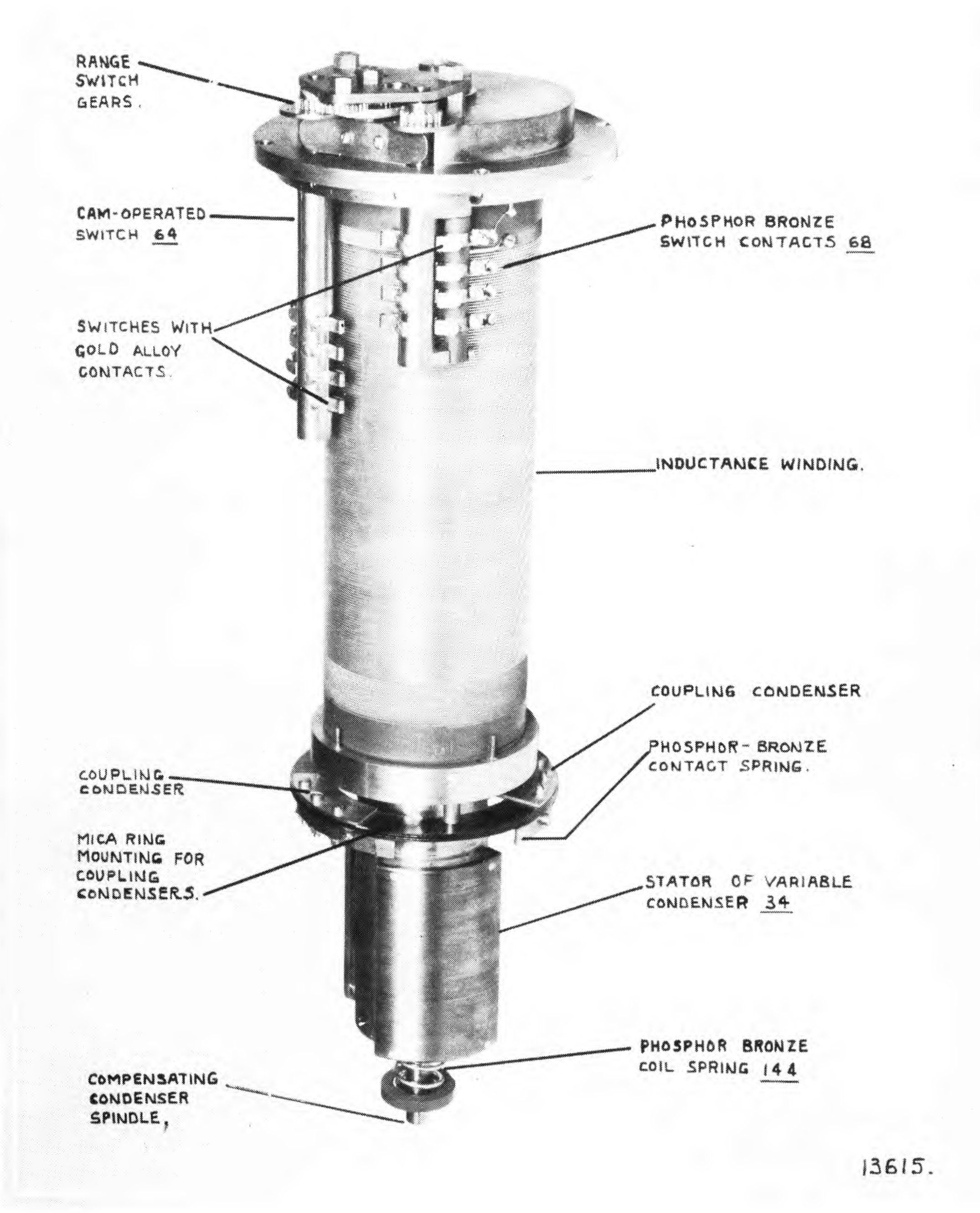


VALVE MASTER OSCILLATOR.

THEORETICAL DIAGRAM OF CONNECTIONS.

VALVE MASTER OSCILLATOR
THEORETICAL DIAG. OF CONNECTIONS.

W.Z. 676.



INDUCTANCE FORMER WITH SWITCH MECHANISM

MARCONI-FRANKLIN VALVE MASTER OSCILLATOR.

39) Diode Anode Control.

40) Stage 4 Input Circuit Tuning Control (used only on SSB)

Assembly

The transmitter unit comprises the following sub-assemblies:-

1) Franklin Master Oscillator (FMO).

2) MO change-over switching circuit for crystal oscillator.

3) Harmonic Amplifier (HA) (4 stages).

4) Stage 5.

5) Stage 6.

6) Output Circuit.

7) Relay Drawer and Drive Keying Circuit.

8) Monitoring Unit.

9) Frequency Modulation Equipment.

10) Partial Absorber and Signal Curbing Equipment.

The crystal oscillator forms a separate external unit.

TRANSMITTER CIRCUITS

The complete diagram of the transmitter is given in W.25628 and a theoretical diagram in W.25627. The transmitter is designed for either CW or SSB working, but the equipment to which this handbook applies does not include the additional units necessary for SSB working. The various circuits are described in turn below. Throughout the following text the letters RCU are used as an abbreviation for rectifier and control unit.

Master Oscillators.

A crystal oscillator, provided as standard equipment has a high degree of frequency stability, and provides a number of spot frequencies. It is fitted externally on a stand.

An LC oscillator is also provided on account of its extreme flexibility and is accommodated at the bottom of the FMO and HA compartment. The type used is the well-known Franklin Master Oscillator. A switch is provided for changing over from the internal drive to the external drive, the switch being mounted in the bottom of the MO and HA compartment on the right hand side of the FMO.

A link is fitted in the rear of the MO and HA compartment behind the lower left hand rear door, and has two positions marked EXT. DRIVE 1 and EXT. DRIVE 2. The link is normally kept at the former position where it connects the crystal oscillator via a tuned terminating unit to the HA. The link is only put to EXT. DRIVE 2 when a FSK unit Type FSO.1 (used in connection with a FMO) is supplied. The RF plug EXT. DRIVE 2 and the six-pin plug near the link are only used for connection to a FSO.1 and not when a FSK unit Type HD.12 is supplied for use with the crystal oscillator.

The RF output from the crystal oscillator is connected direct to the terminal EXT. DRIVE 1 on the link board. The connection is made to the back of the board after removing the protecting brass strip which is secured by two screws. A new type of FSK for use with the crystal oscillator is normally provided when this facility is called for.

Franklin Master Oscillator

The Franklin Master Oscillator is provided with automatic compensation for frequency drift due to temperature variation. This is achieved by a compensating condenser which is adjusted so that an increase in the inductance of the coil is offset by a suitable decrease in the capacity of the condenser, and vice versa. The oscillating circuit and compensating condenser are mounted in and screened by a double cylindrical brass case which is lagged to prevent rapid rises in the temperature of the internal parts. Two ML.6 valves are used, which are mounted on the outside of the case.

The precautions adopted ensure that the FMO has a high degree of frequency stability, of 1 in 20,000.

The circuits are shown in the theoretical diagram W.25627 Sh.1.

The inductance coil has eight tappings which can be selected by a switch in front of the unit. The change of inductance, together with the variation of the capacity, enables the oscillator to cover continuously the range of 1500 - 1000 kc/s (200 - 300 metres).

The capacitor scale viewed through the left hand window has 30 divisions. The logging scale on the tuning control has 100 divisions and makes a complete revolution during the movement of one division on the main scale, thus providing 100 sub-divisions for each division on the latter.

Independent supplies are provided for the FMO so that it can be switched on and reach a stable condition prior to switching on the transmitter as a whole. The supply unit is mounted in the RCU and provides 240V DC and 6.3V AC.

The FMO works directly into the first stage of the harmonic amplifier.

Crystal Oscillator

The crystal oscillator employs three valves, Types KTW.61, ECC.32 and L.63 respectively, and ten crystals are available for output frequencies between 1000 and 1500 kc/s (200 to 300 metres), the selection being made by a switch on the front of the oscillator.

Ten pre-determined spot frequencies are thus provided within the radiated frequency band of 2-27 Mc/s. If additional frequencies are required, it will be necessary to interchange the new crystals (in their holders) with those not wanted in the oscillator unit.

Although the output frequency range of the crystal oscillator is the same as in the case of the FMO, the actual crystal frequency range is from 200 kc/s to 300 kc/s, as there is a frequency multiplication of 5 in the crystal oscillator itself.

A terminating unit used in conjunction with the crystal oscillator or the frequency keyed oscillator, is mounted at the rear of the FMO and HA compartment in a small case with a removable cover, held by two screws. A tuning capacitor in this unit has a control with a white scale mounted in the front of the compartment just above and to the left of the FMO.