WAVEMETER OUTFIT GN

WAVEMETER G73

FRONT VIEW

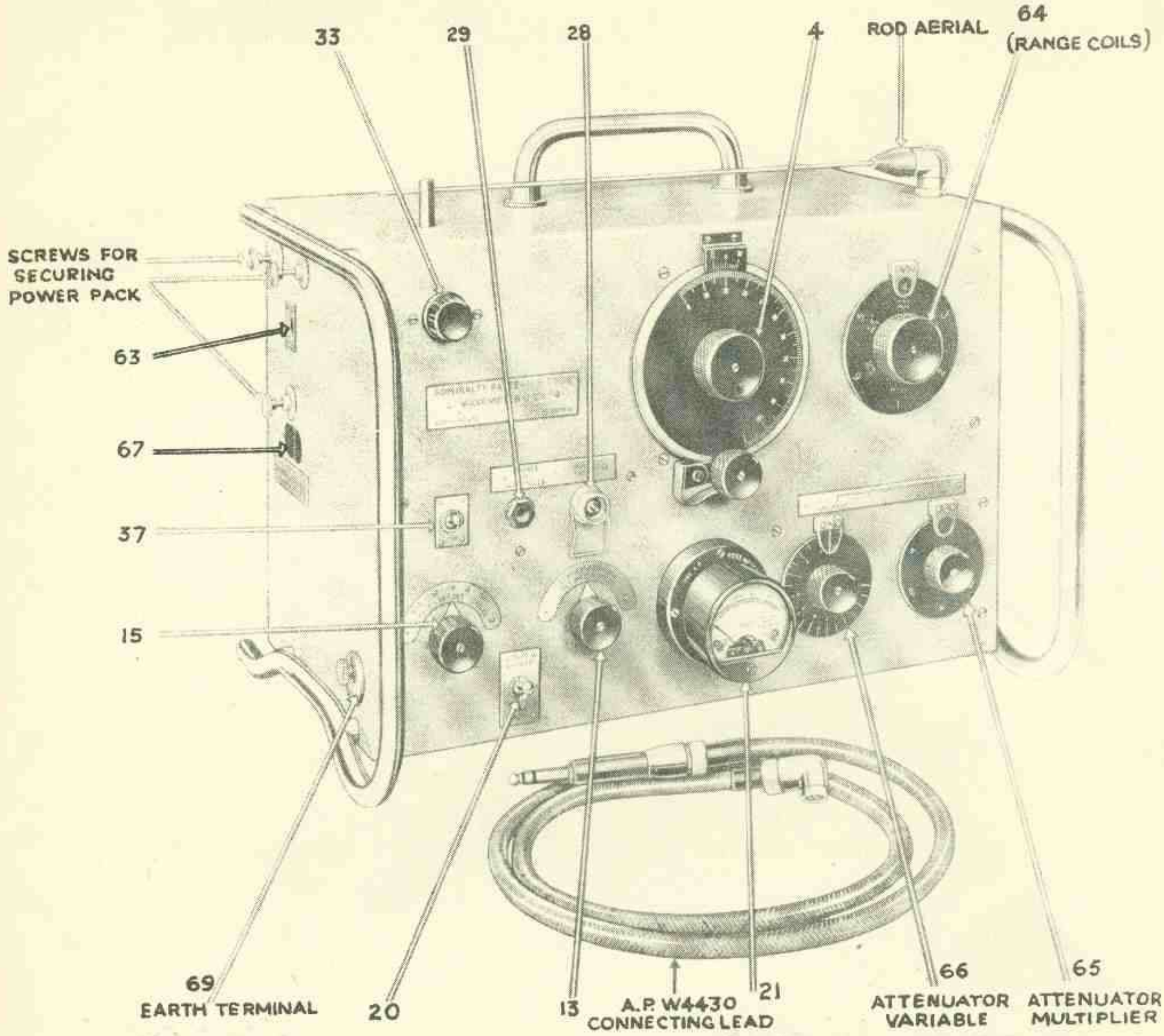

FIG. a

1. GENERAL.

Wavemeter G73 is a component of Wavemeter Outfit GN and has been designed as a portable wavemeter having a frequency coverage of 100 to 25,000 Kc/s.

DATE OF DESIGN :-		1941.
FREQUENCY RANGE :-		100/25,000 Kc/s.
FUNCTION :-	(i)	Portable heterodyne wavemeter.
	(ii)	Signal generator.
	(iii)	Audio frequency test oscillator.
POWER SUPPLY :-	(i)	Batteries. Using three 2-volt accumulators for heater supply and 99 volts dry battery for H.T. supply.
	(ii)	A.C. Supply mains. Single phase A.C. supply at 50/60 cycles, having a voltage of 115, 125, 200 or 230 volts may be used.
VALVES USED :-		R/F Oscillator 1 NR49 or VR56 (CV1056) Modulator 1 NR49 (CV1056) or 6J7G, (CV1074) (CV1936). Attenuator diode 1 VR92 (CV1092).
WHERE SUPPLIED :-		Destroyers and above. May also be supplied to corvettes and frigates.
CALIBRATION CHART :-		The curve supplied with the wavemeter has an accuracy within ± 2½% over the whole frequency range.

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The wavemeter may be used :-

(i) As a C.W. or M.C.W. local oscillator for setting a receiver to a desired frequency.

(ii) As a heterodyne wavemeter in conjunction with a receiver to measure the frequency of an incoming signal.

(iii) As a heterodyne wavemeter to measure the frequency of a local transmitter.

(iv) As a heterodyne oscillator for transferring to a receiver, or transmitter, an exact frequency obtained from a wavemeter outfit J35, G61 or G62.

(v) For supplying a modulated or C.W. R/F signal of known magnitude for receiver measurements and tests.

(vi) For supplying a 400 cycle voltage to audio frequency amplifiers for testing purposes.

A photograph of the instrument is shown in Fig a and a simplified circuit diagram in Fig. c.

2. - CONSTRUCTION.

The instrument is designed as a portable wavemeter and will be used, normally, when mounted on a bench or table.

The assembly is built on the unit principle, the four units, comprising the wavemeter, being built into a metal case measuring 12 x 16½ x 11 inches overall. The R/F Unit, Modulator Unit and A.C. Mains Unit are each screened, the Attenuator Unit being assembled without full screening.

Provision is made for an additional unit to be fitted, this consisting of a Crystal Oscillator G42.

When the wavemeter is operated from a battery supply, the mains Unit can be removed and the H.T. dry battery fitted in the space now provided, the accumulators for the heater supply being kept in a wooden box.

On the top of the instrument there is a stowage position for a small rod aerial.

3. CONTROLS.

TUNING DIAL (4) — Varies the capacity of the R/F circuit tuning condenser. The dial is calibrated from 0/100 divisions. A vernier scale is fitted and by means of a slow motion control accurate adjustments can be read to a tenth of a degree. Used to adjust the radio frequency circuit of the wavemeter.

RANGE SWITCH (64) — A six-position switch that operates a turret drum connecting the requisite coils into the R/F circuit to cover the desired frequency band.
Used in conjunction with TUNING DIAL 4, to set the required radio frequency.
The frequency coverage of the coils are as follows :-

1. 100 - 290 Kc/s.
2. 280 - 900 Kc/s.
3. 820 - 2400 Kc/s.
4. 2 - 6.4 Mc/s.
5. 6 - 12 Mc/s.
6. 12 - 25 Mc/s.

OPERATIONAL SWITCH (15) — A four-pole three-way switch marked

(A) MOD. OUTPUT.
(B) C.W. HET. DET.
(C) 400 CYCLES.

With the switch in position (A), the R/F output of the wavemeter is modulated by an A/F oscillator; Position (B), the R/F output of the wavemeter is C.W. and the connections of the Modulator Valve are altered to allow it to operate as a heterodyne detector; Position (C), the H.T. supply to the R/F valve is disconnected. The Modulator Valve provides an output voltage of approximately 2 volts R.M.S. at 400 cycles.

ATTENUATOR MULTIPLIER SWITCH (65). — A single-pole, five-position switch marked 10K, 1K, 100, 10 and 1. It forms a rough adjustment of the attenuator multiplier and is operated in conjunction with the ATTENUATOR VARIABLE CONTROL (66). The markings on the switch refer to the value of the attenuator output voltage in microvolts.
To calculate the voltage available the position of the two controls must be considered jointly. The symbol K means 1000.

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ATTENUATOR VARIABLE CONTROL (66). Varies the value of the potentiometer (39) thus forming a fine control of the attenuator output voltage. The control is marked from 10 to 1 corresponding to the fraction in tenths, of the voltage across the potentiometer, which is applied to the attenuator multiplier. Used as a control of the attenuator output voltage in conjunction with the ATTENUATOR MULTIPLIER SWITCH (65).

CARRIER CONTROL (13). Varies the H.T. voltage applied to the R/F oscillator valve (1). By means of a microammeter (21) and the METER SWITCH (20), placed in the "READ CAR" position, the R/F voltage, induced in coupling coil (7), and rectified by the diode valve (45), can be measured and kept at a constant value. Any alteration made to this control after a frequency has been set will vary the frequency of the R/F oscillator circuit.

METER SWITCH (20). A double-pole double-throw switch marked READ CAR. and READ MOD. Used to introduce a microammeter to read
- (i) the output of the R/F oscillator
- (ii) the depth of modulation being applied to the R/F oscillator valve.

H.T., L.T. ON-OFF SWITCH (37). A double-pole switch for controlling the H.T. and L.T. supply to the wavemeter.

TELEPHONE JACK (29).
- (1) Is the telephone connection from the output of valve (14) when used as a heterodyne detector.
- (2) Is the output jack for the 400 cycle A/F voltage when the OPERATIONAL SWITCH (15) is in the "400 CYCLE" position.

INPUT FREQUENCY SOCKET (28). The rod aerial is normally plugged into this socket. Used to couple the input frequency to the grid of valve (14) when used as a heterodyne detector.

ATTENUATOR OUTPUT SOCKET (43). Provides an output voltage of 1 to 100,000 microvolts at the frequency of the R/F oscillator. This voltage may be C.W. or M.C.W. depending upon the position of the OPERATIONAL SWITCH (15). The magnitude of the voltage will depend upon the position of ATTENUATOR MULTIPLIER SWITCH (65) and ATTENUATOR VARIABLE CONTROL (66).

METER (21). A 0/500 microammeter used to measure the rectified output of the R/F oscillator and also the output of the modulator circuit.

INDICATOR LAMP (33). Is supplied in parallel with the valve heater circuit. Used to indicate that the wavemeter is switched ON.

MAINS SUPPLY ON-OFF SWITCH (63). A double-pole switch situated on the left-hand side of the wavemeter. When using A.C. supply unit completes the supply from the A.C. PLUG (67) to the mains transformer.

A.C. SUPPLY PLUG (67). A two-pin plug used to connect A.C. supply mains to the supply unit.

SET ZERO CONTROL (49). Varies the bias voltage applied via the meter circuit to adjust meter zero, only necessary after fitting a new valve or after many hours use.

EARTH TERMINAL (69). Used to "EARTH" the case of the wavemeter. Always connect to nearest "earthed" point.

SET MODULATION CONTROL (16). Varies the cathode bias resistance of the modulator valve. Used to control the depth of modulation applied to the R/F oscillator valve (1). Adjustment is only necessary when a new modulator valve is fitted or after many hours of use.

4. HETERODYNE WAVEMETERS.
INTRODUCTION.

The principle of heterodyne reception is explained in section D26 and D27 of Admiralty Handbook of Wireless Telegraphy 1938, Vol. II.

When this system is applied to frequency measurement the wavemeter consists of a calibrated local oscillator, a detector and telephones.

When the oscillator is first switched on, the frequency varies rapidly due to the valve and associated circuits warming up. The frequency variation gradually decreases and after about five minutes, it becomes a comparatively slow steady drift. In the Wavemeter G73 this drift is such, that the total change in frequency during 30 minutes, after the initial warming-up period of 5 minutes, does not exceed 5 Kc/s at a frequency of 20,000 Kc/s, with proportional changes at other frequencies.

The frequency variation of oscillators is discussed in section K37 of the Admiralty Handbook of Wireless Telegraphy 1938, and it is pointed out, that in addition to the steady frequency drift, caused by slow changes of temperature, variation of the anode or heater voltage will cause appreciable frequency changes especially at the higher frequencies.

It is possible by special design to reduce these frequency changes to a minimum but the requirements are too elaborate for a portable instrument, such as wavemeter G73.

The difficulty of non-permanence of calibration is overcome by checking the calibration immediately prior to use.

This is done by :-

(i) Reference to wavemeter outfit G35, G61 or G62.

(ii) Reference to harmonics of Crystal Oscillator G42.

5. OPERATION.

(a) From the above INTRODUCTION it will be realised that when using Wavemeter G73 the following points must be remembered :-

(i) The calibration scales are only correct within ±2½%.

(ii) The calibration curve, although accurate at the time of calibration, requires checking frequently.

(iii) The instrument should be switched on at least five minutes before any attempt is made to check the calibration.

(iv) The measurement should be made as soon as possible after the check calibration.

(v) Any change in anode or heater voltage made after the check calibration has been made will alter the frequency. Consequently the CARRIER CONTROL (13) must not be altered after a check calibration and, if batteries are being used, they must be in good condition.

(b) Plug in the microammeter (21) into its socket, and assuming that an A.C. supply unit is being used, complete the supply to the unit by making the MAINS SUPPLY ON-OFF SWITCH (63) and the H.T.-L.T. ON-OFF SWITCH (37). The INDICATOR LAMP (33) will light indicating the heater supply is completed.

Place the OPERATIONAL SWITCH (15) to "MOD. OUTPUT" or "C.W. HET. DET" and the METER SWITCH (20) to READ CARRIER, and with the CARRIER CONTROL (13) in the mid position a reading should be obtained on the METER (21).

(c) Allow at least five minutes for the instrument to reach its working temperature.

(d) Before carrying out any measurements, check :-

(i) The meter zero is correctly adjusted.
With the OPERATIONAL SWITCH (15) in position "400 CYCLES" the meter should read ZERO.
If not, move the SET ZERO CONTROL (49) until meter ZERO is obtained.

(ii) The MODULATION CONTROL is correctly adjusted.
With the OPERATIONAL SWITCH (15) in position "MOD. OUTPUT" and the R/F OSCILLATOR CIRCUIT set to a frequency of 12,000 Kc/s, and the METER SWITCH (20) set to READ CARRIER, the METER (21) shows a reading of 120 microamps. If this reading is not obtained vary CARRIER CONTROL (13) until meter reads 120 microamps.

Set METER SWITCH (20) to position marked "READ MODULATION" and meter should read 120 microamps. If this is not so adjust to this reading by the SET MODULATION CONTROL (16).

When checking modulation remove telephone plug from TELEPHONE JACK (29) as insertion of plug automatically breaks the meter circuit when METER SWITCH (20) is in "READ MOD." position.

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REAR VIEW WITH R/F SCREENING BOX AND VARIABLE ATTENUATOR SCREENING CAN REMOVED

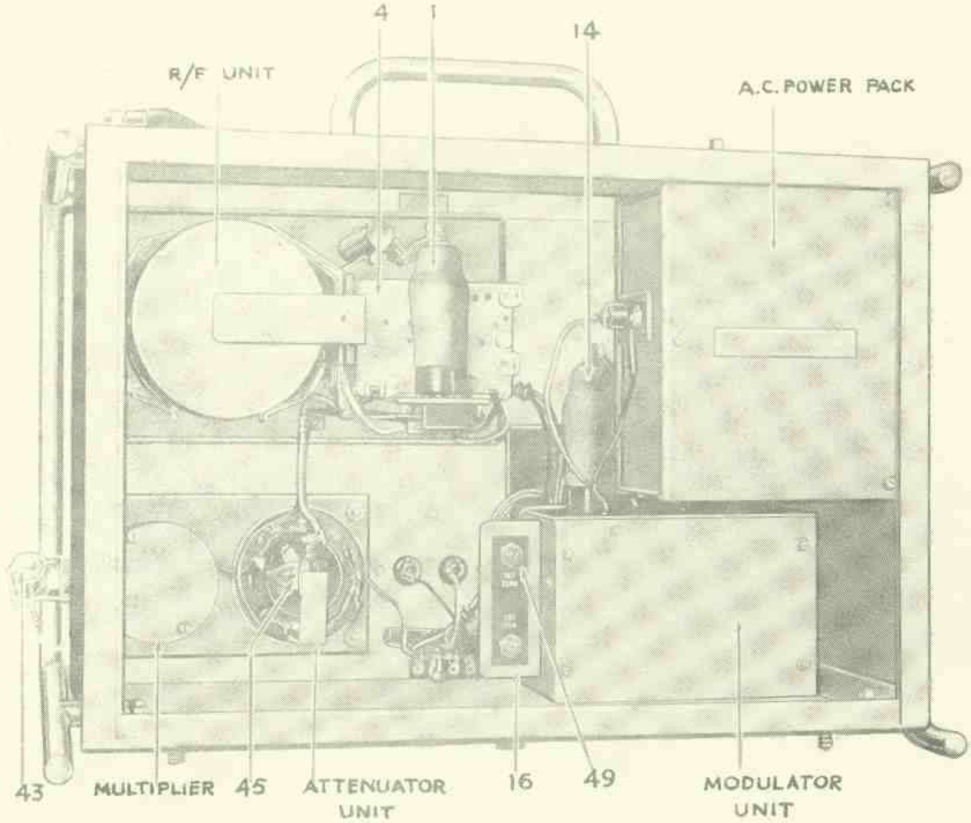

FIG. b

WAVEMETER G73 & OSCILLATOR G42 WITH BATTERY SUPPLY

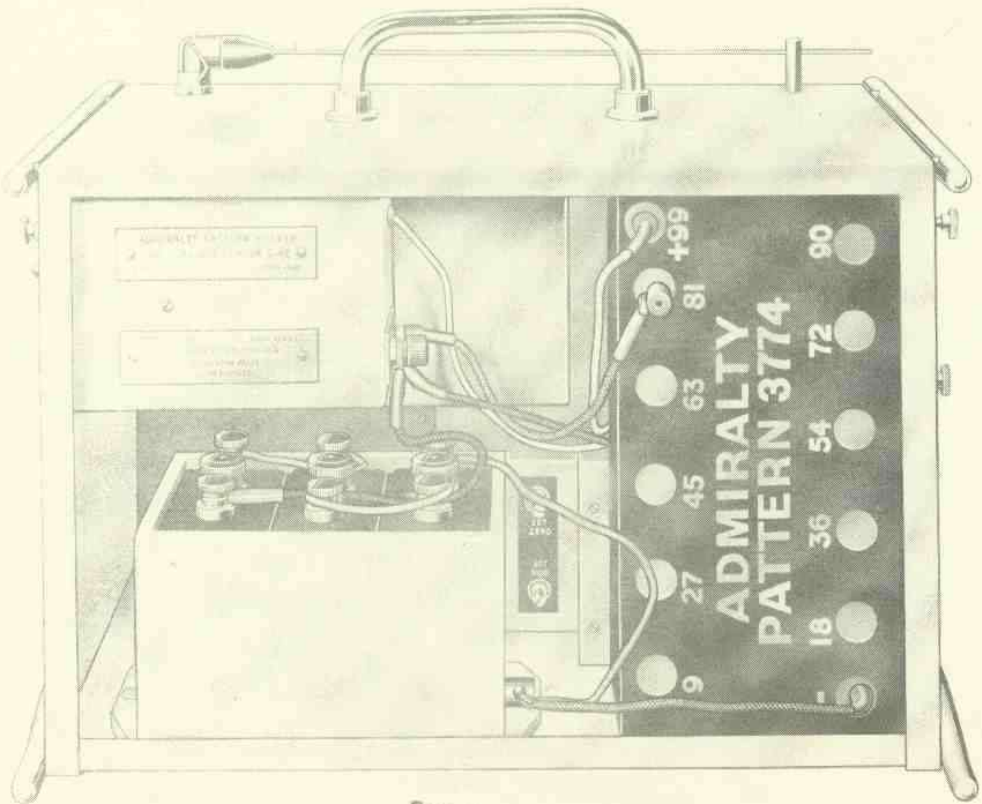

FIG. c

WAVEMETER OUTFIT GN

WAVEMETER G73

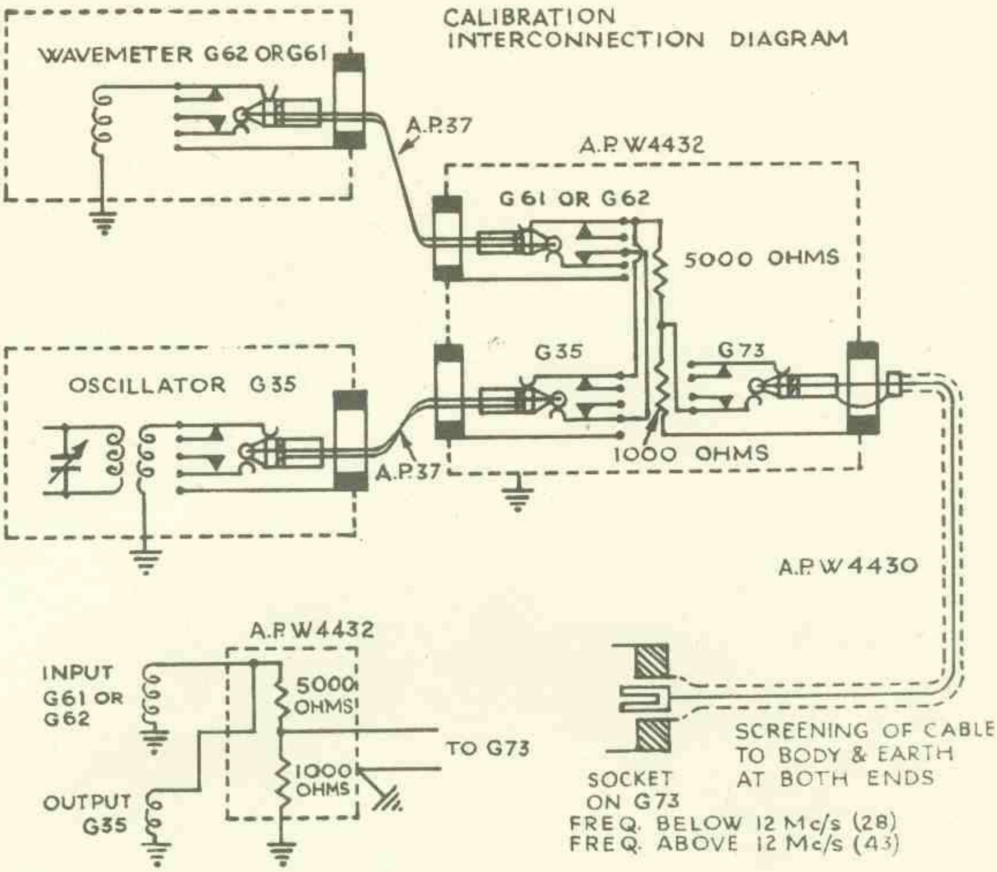

Fig. d

(e) Frequency Calibration.

(i) By G35, G61 or G62.

Connect the wavemeters as shown in Fig. 'd'. The three-way junction box should be secured permanently to the rack containing the crystal wavemeters.

Set the OPERATIONAL SWITCH (15) to "C.W. HET. DET" and METER SWITCH (20) to "READ CAR." Set the G73 to the frequency it is desired to check by means of the calibration curve, TUNING DIAL 4 and RANGE SWITCH 64. Adjust by means of CARRIER CONTROL 13 until the meter reading is 120 microamps. Plug telephones into the TELEPHONE JACK 29.

Set the desired frequency on OSCILLATOR G35 (making SURE the MODULATION SWITCH IS OFF) and check by means of the WAVEMETER G61 or G62 according to the frequency being used. (See pages GC12 and GD17). Using the telephones of the G73 carefully tune the wavemeter G73 by TUNING DIAL (4) until the pitch of the beat note, heard in the telephones is reduced to zero. The Wavemeter G73 is thus accurately adjusted to the frequency of the Oscillator G35.

When using frequencies above 12 Mc/s the load imposed on the R/F circuit of the G73, when the ROD AERIAL is inserted in the INPUT FREQUENCY SOCKET (28), differs from that imposed, when the connecting lead A.P. 4430 is inserted. This would have the effect of changing the frequency slightly after the wavemeter G73 has been calibrated.

To prevent this, when using frequencies above 12 Mc/s, the connecting lead A.P. 4430 is plugged into the ATTENUATOR OUTPUT SOCKET (43) and the telephones shifted to the OSCILLATOR G35 TELEPHONE JACK (47) (See Page GC10).
The oscillator G35 is tuned to the desired frequency, as before, and then by listening to the beat note in the telephones, the output frequency of the G73 is varied by TUNING DIAL (4) until the beat note is reduced to zero. The attenuator controls (65) and (66) should be adjusted to give a sufficiently loud beat note.

NOTE 1. At the higher frequencies the load on the Oscillator G35 differs in the two cases :-

(i) G35 connected direct to G61.

(ii) G35 connected to G61 via the box, junction, A.P. W4432.

It is therefore emphasised that the Oscillator G35 must be set to the required frequency with all connections made, as shown in Fig. 'd'.

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(ii) By Crystal Oscillator G42.

When Oscillator G42 is supplied with Wavemeter G73 a special set of calibration curves is supplied. On these curves are marked crystal check points. These are frequencies at which harmonics of the crystal will cause a beat note to be heard in the telephones when the wavemeter is adjusted to this particular frequency.

To check the calibration curve, switch on the Wavemeter G73 as described in para. 5(b) (c) and (d). Switch on the Crystal Oscillator G42 by means of the CRYSTAL ON-OFF SWITCH (68).

On tuning over the ranges of G73, heterodyne beat notes will be heard in the telephones. The loudest of these are used as check points. In general the calibration will only vary by one or two vernier divisions.

The method of correction is shown in the following example :-

It is required to set the wavemeter to 3150 Kc/s. From the calibration curve this is RANGE 4, TUNING DIAL 52·7, and the two nearest crystal check points are 3000 Kc/s, which is shown as 49·0, and 3500 Kc/s which is shown as 60·8. Tune the Wavemeter G73 by means of TUNING DIAL (4) until the heterodyne beat note heard about 49 divisions is reduced to zero beat. Suppose this gives a dead space at 49·2 divisions. Then tune the Wavemeter G73 to the heterodyne beat note about 60 divisions, that is, to 3500 Kc/s until zero beat is obtained in the telephones. Assume this gives a dead space at 61·0 divisions. The calibration has thus changed by +0·2 divisions and the correct setting for 3150 Kc/s is 52·9 divisions.

(f) WAVEMETER G73 AS A HETERODYNE WAVEMETER.

TUNING A TRANSMITTER.

Carry out the initial adjustments as detailed in para. 5(b), (c) and (d) and check calibration as set out in para. 5(e) (i) or 5(e) (ii).

Place the OPERATIONAL SWITCH (15) in the C.W. HET. DET. position and connect the ROD AERIAL to the INPUT FREQUENCY SOCKET (28). Set the desired frequency on Wavemeter G73, applying the correction, if any, and place the wavemeter near the transmitter. Switch on and key the transmitter and with telephones plugged into TELEPHONE JACK (29) listen for the beat note produced by the transmitter frequency beating with that of the wavemeter.

Vary the TUNING DIAL (4) until zero beat is heard in the telephones and read off frequency from calibration curve applying correction according to check calibration.

Care must be taken that the beat note is caused by the fundamental frequency of both transmitter and Wavemeter G73.

(g) WAVEMETER G73 AS A C.W. OR M.C.W. LOCAL OSCILLATOR.

(i) SETTING A RECEIVER TO A DESIRED FREQUENCY.

Carry out the initial adjustments as detailed in para. 5(b), (c) and (d) and check calibration as set out in para. 5(e) (i) or 5(e) (ii).

Set the desired frequency on Wavemeter G73, and place OPERATIONAL SWITCH (15) in the "MOD. OUTPUT" position. Connecting lead A.P.4430 is plugged into the ATTENUATOR OUTPUT SOCKET (43) and the other end into the top-most jack, of the Aerial Exchange, for the appropriate aerial. If Aerial Exchange is not being used the connecting lead may be plugged into the "Aerial Jack" of the receiver.

Tune the receiver until a modulated note is heard in the receiver telephones, the magnitude of the signal being adjusted as required by the ATTENUATOR MULTIPLIER SWITCH (65) and MULTIPLIER VARIABLE CONTROL (66).

Having roughly tuned the receiver to the Modulator Signal change the position of the OPERATION SWITCH (15) to position C.W. HET. DET. and tune the receiver accurately to the C.W. signal now being injected into the receiver. When the beat note heard in the telephones is reduced to zero beat the receiver will be tuned to the frequency of the Wavemeter G73.

(ii) MEASURING THE FREQUENCY OF AN INCOMING C.W. SIGNAL.

Assuming that initial adjustments and check calibration has been carried out.

The connecting lead A.P. 4430 is plugged into the ATTENUATOR OUTPUT SOCKET (43) and the other end to top-most jack of Aerial Exchange for the appropriate aerial. The OPERATIONAL SWITCH (15) is set to "C.W. HET. DET" and the approximate frequency, obtained from the Range Coils in use on the receiver, set on the Wavemeter G73.

Vary the TUNING DIAL (4) until the double beat note, caused by the B.F.O., in the receiver, and the wavemeter, beating the incoming signal, is heard in the receiver telephones. Then switch off the B.F.O. and by means of TUNING DIAL (4) tune the beat note to zero beat.
Read off the frequency from calibration curve applying correction as necessary.

(iii) TO MEASURE THE FREQUENCY TO WHICH A RECEIVER IS SET.

The wavemeter connections and position of OPERATIONAL SWITCH are as for g(ii) above. Approximate frequency is set on the wavemeter and the B.F.O. in receiver is kept ON.

Vary the TUNING DIAL (4) until a beat note is heard in the receiver telephones and then continue the adjustment until the beat note is reduced to zero beat. The wavemeter is then accurately adjusted to the frequency of the receiver. Read off frequency from calibration curve and apply correction.

(h) WAVEMETER G73 AS A SIGNAL GENERATOR.

SUPPLYING A C.W. OR M.C.W. R/F VOLTAGE OF KNOWN MAGNITUDE FOR RECEIVER ALIGNMENT, MEASUREMENTS AND TESTS.

Carry out the initial adjustments as detailed in para. 5(b), (c) & (d), and check calibration as set out in para. 5(e) (i) or 5(e) (ii).

Set the OPERATIONAL SWITCH (15) to "C.W. HET. DET." for a C.W. output or to "MOD. OUTPUT" for M.C.W.

Adjust the RANGE SWITCH (64) and TUNING DIAL (4) to the required frequency. Plug Connecting lead A.P. 4430 into ATTENUATOR OUTPUT SOCKET (43) and connect EARTH TERMINAL (69) to "earth".

Adjust the ATTENUATOR MULTIPLIER SWITCH (65) and ATTENUATOR VARIABLE CONTROL (66) to give the required output level. The ATTENUATOR MULTIPLIER SWITCH (65) is marked 10K, 1K, 100, 10 and 1. The symbol K represents a 1000. The switch markings refer to the output voltage in microvolts. The ATTENUATOR VARIABLE CONTROL (66) is marked from 10 to 1, corresponding to the fraction in tenths, of the voltage across the control potentiometer, that is applied to the attenuator. If switch 65 is at 10K and control 66 at 10 then the output will be 10,000 x 10 = 100,000 microvolts.

Change switch 65 to 100 and control 66 to 7 and the output will be 700 microvolts.
Having set the required output level the signal generator is now ready for use. Details of the tests for any receiver will be found in the appropriate receiver handbook.

(i) WAVEMETER G73 AS AN AUDIO FREQUENCY OSCILLATOR.

Set the OPERATIONAL SWITCH (15) to "400 CYCLES" and plug the output lead, connected to a three-point plug, into the TELEPHONE JACK (29). This lead is not supplied with the wavemeter but the A.P.37 lead is quite suitable. The output is designed to work into a load resistance of 600 ohms and will supply a voltage of approximately 2 volts R.M.S. The output voltage cannot be varied.

6. BRIEF TECHNICAL DESCRIPTION.

A simplified diagram of the wavemeter is shown in Fig e and photographs of the instrument in Figs. a, b and c.

The four main units consist of :-

(i) R/F Unit.
(ii) Modulator Unit.
(iii) Attenuator Unit.
(iv) Mains Unit.

Any of the units can be detached from the carrying case without disturbing the others.

(i) R/F UNIT.

The R/F pentode valve NR49, 1, is connected as a triode with a tuned circuit between grid and earth, the cathode being connected to a tap on the coil 6.

The six range coils are contained in a turret drum and it is arranged by switching that the coils not in use are short circuited. On the two highest frequency ranges, a fixed condenser (5) is inserted in series with the variable tuning condenser (4).

A coupling coil (7) is wound on the same former as the tuning inductance (6), coupling being arranged, for a maximum output of 100,000 microvolts, from the attenuator, on any of the frequency bands covered by the wavemeter.

H.T. supply to the R/F oscillator valve is obtained from a potentiometer (13) marked CARRIER CONTROL, situated in the Modulator Unit, and can be varied to maintain a standard output irrespective of the frequency being used.

A R/F filter circuit consisting of resistance (8) and condensers (9) and (10), by-pass R/F voltages to earth, thus preventing their appearance in the modulator circuit.

The grid leak (3) and condenser (2) provide grid bias for valve 1.

One side of the heater supply is earthed and the condenser (11) forms an R/F by-pass from the other heater lead to earth. A further R/F by-pass condenser (12) is connected between the heater lead and earth at a point where the heater lead enters the R/F unit.

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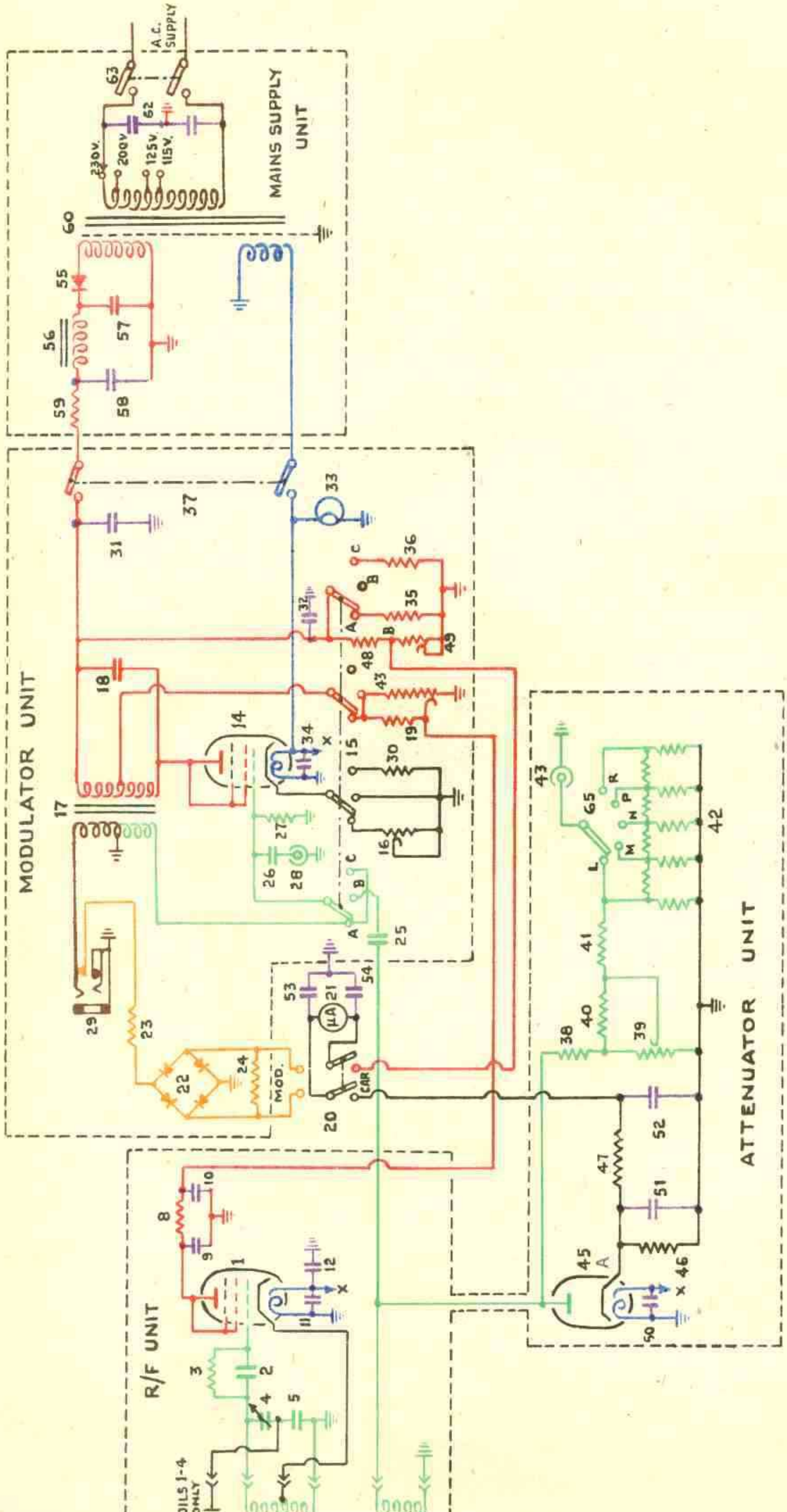

FIG. e.

(ii) MODULATOR UNIT.

The NR49 pentode valve (14) is connected as a triode. By means of a 3-position 4-pole switch (15) the circuit of this valve can be altered so that the valve operates :-

(i) As an A/F oscillator to modulate the R/F valve (1).
(ii) As a heterodyne detector.
(iii) As an A/F oscillator.

With the OPERATIONAL SWITCH (15) in position "A" the H.T. supply to the R/F valve (1) is in series with tuned anode circuit of the Modulator Valve (14). This circuit is tuned to 400 c/s, thus the H.T. supply to the R/F valve (1) will be modulated at this frequency. The grid contact of the switch (15) introduces a portion of the modulation transformer (17) to act as the grid feed-back coil and being coupled to the anode circuit will maintain oscillations.

The cathode contact of switch (15) introduces a variable cathode resistance (16) by means of which the grid bias of the Modulator Valve (14) can be controlled, and thus the magnitude of the oscillations in the anode circuit. This will decide the depth at which the H.T. to the R/F valve (1) is modulated.

The next contact connects the H.T. potentiometer (13) in circuit. This controls the value of the H.T. supply to the R/F valve (1) and so allows the voltage applied to the Attenuator rectifier valve (45), by the coupling coil (7), to be kept at a standard value irrespective of the frequency being used. The resistance (19) is connected between the sliding contact, and the positive end of potentiometer (13) in order to add additional load to the modulator valve (14), to compensate for the drop in load due to reduced anode current in the R/F valve (1). Thus the load on the modulator valve remains fairly constant and the change in modulation depth, due to adjustment of carrier level is restricted to about 10%.

The last contact of the switch connects resistance (35) from the H.T. positive line to earth. This resistance together with resistance (36) serves to keep the load on the H.T. supply approximately constant in any of the three positions of the switch.

Fixed resistance (48) and variable resistance (49) provide a bias voltage to compensate for the standing current passed by rectifier valve (45) when no R/F voltage is applied to its anode by coupling coil (7). (See Attenuator Circuit).

The measurement of modulation voltage is obtained by setting the METER SWITCH (20) to the "READ MOD." position. The meter (21) is then connected across the metal rectifier (22) which is connected in series with a resistance (23) across the telephone winding of the modulation transformer (17). The meter reads R.M.S. volts and the resistance is adjusted by the meter shunt resistance (24) so that the meter reads 120 microamps for 30% modulation.

With the OPERATIONAL SWITCH (15) in position B the valve (14) operates as a heterodyne detector.

The grid contact of switch (15) connects the Coupling Coil (7), via the coupling condenser (25) to the grid of valve (14). The rod aerial, being plugged into the INPUT FREQUENCY SOCKET (28), is also capacity coupled to the grid of valve (14) by condenser (26).

When measuring an incoming frequency, say from a transmitter, the grid of valve (14) will have two frequencies applied to it. One from the R/F circuit of the wavemeter via the coupling coil (7) and the other from the transmitter via the rod aerial. Any difference between these two frequencies will appear in the anode circuit of valve (14) in the form of a beat note. When the two frequencies are sufficiently close together to make the beat note audible, it will be heard in the telephones plugged into the TELEPHONE JACK (29), which is connected via the earth connections, across a portion of the secondary of transformer (17). If the transmitter circuit, being measured, is altered in frequency so that the difference frequency becomes less the beat frequency heard in the telephones becomes lower in pitch. When the transmitter frequency is exactly the same as that applied to the grid of valve (14) from the R/F circuit of the wavemeter, then there will be no difference frequency and thus no beat frequency to be heard in the telephones. This condition is called the "DEAD SPACE" or "ZERO BEAT" and is the condition obtained when the two frequencies are exactly synchronised.

The cathode contact of switch (15) joins the cathode of valve (14) direct to earth.

The H.T. supply to the R/F Valve (1) is unchanged, and both H.T. loading resistances (35) and (36) are disconnected.

With the OPERATIONAL SWITCH (15) in position "C" the valve (14) operates as an A/F oscillator.

The grid contact of switch (15) connects a portion of the secondary winding of transformer (17) to operate as a grid feed back coil, as in position "A".

The cathode contact introduces a fixed cathode bias resistance as the output of the circuit, in this condition, is a fixed FIXED VALUE

The H.T. supply to the R/F oscillator valve is broken, and the H.T. loading resistance is connected across the H.T. supply.

The 400 c/s output is taken from a plug connected into the TELEPHONE JACK (29).

Condensers (31) and (34) are R/F by-pass condensers for the H.T. and heater supply respectively, the resistance (27) acting as a grid leak for the modulator valve.

WAVEMETER OUTFIT GN

(iii) ATTENUATOR UNIT.

This unit contains the necessary circuits for varying and also for measuring the output voltages.

The circuits have been designed to conform to the following requirements:-

(i) To give an output voltage that may be varied between 1 and 100,000 microvolts.

(ii) That the output voltage will remain constant, at a desired value, over the frequency range of 100 Kc/s to 25,000 Kc/s.

(iii) That the load, on the R/F oscillator, will be constant irrespective of output voltage or frequency, within the limits of (i) and (ii).

(iv) Provide the output voltage across a given load of 100 ohms.

To obtain the above requirements it is necessary to use a complex network of resistances. This network can be considered in two parts, "Variable" and "Multiplier", controls to which are brought out on the front panel, being (66) and (65) respectively.

The load on the R/F oscillator consists of the fixed resistance (38) and the potentiometer (39) in series. The control of the slider of the potentiometer is the ATTENUATOR VARIABLE CONTROL (66) and varies the amount of the voltage across (39) which is passed on to the subsequent circuit. The fixed resistance (40) has the effect of reducing changes in the load on the R/F oscillator, with different positions of the slider, and the consequent alteration in frequency of the R/F oscillator is reduced to a very small percentage change.

The resistances (41) and (42) form a potential divider and the values are such that a maximum output of 100,000 microvolts is obtained at the OUTPUT SOCKET (43).

The ATTENUATOR MULTIPLIER SWITCH (65) has five positions - L, M, N, P and R and is connected to a series of "L" section potential dividers each with a ratio of 10 to 1.

The output voltage of the attenuator is governed by the voltage developed across the R/F load resistances (38) and (39) and to calibrate the output of the attenuator, this voltage is measured and adjusted to be at a constant value.

A diode rectifying valve (45) is joined across the R/F load resistances (38) and (39) and by measuring the D.C. rectified by valve (45) the required voltage can be maintained at a pre-determined value. The measurement of R/F output voltage at any frequency or at any setting of the attenuator is thus reduced to the setting of the CARRIER CONTROL (13) so that the D.C. microammeter (21) reads a given current. In the case of the G73 this is 120 microamps.

A small current flows across the diode valve (45) when no R/F voltage is applied to the anode and advantage is taken of this by connecting the cathode to earth by resistance (46), to provide bias which allows the valve to operate at a suitable point on the characteristic curve of the valve. This standing current would also appear as a reading in the meter (21), but to avoid complication, the microammeter is connected to the cathode "A" via a fixed resistance (47) and also to be point "B" on the H.T. potentiometer formed by resistances (48) and (49). By adjusting the resistance (49) the potential at "B" can be made equal to that at "A" (with no R/F volts applied to valve 45) and the current in the meter (21) will then be zero.

Having adjusted points "A" and "B" to the same potential, so that no current flows in the meter (21) an R/F voltage applied to the diode valve will cause, by rectification, the potential at "A" to alter and current will flow through the microammeter. This current will depend on the voltage applied and the values of the resistances in the attenuator network are such, that the correct voltage is applied when the microammeter reads 120 microamps.

Condensers (51) and (52) operate as R/F by-pass condenser and a similar condenser (50) is connected to the diode heater supply. Resistance (47) acts as part of an R/F filter to prevent R/F passing to the meter circuit. The meter is also further isolated from R/F voltages by the by-pass condensers (53) and (54).

(iv) MAINS UNIT.

The mains unit is designed to supply 100 volts H.T. and 6·3 volts for the heater circuit. The mains transformer 60 has primary tappings for 115, 125, 200 or 230 volts supply.

A double-pole ON-OFF switch (63) controls the supply to the transformer. The R/F by-pass condensers (61) and (62) are connected across the input to the transformer, and the centre point earthed, to prevent R/F voltages leaking to the supply mains.

A half wave selenium rectifier (55) is used and the smoothing circuit consists of the smoothing choke (56) and series resistance (59) and two smoothing condensers (57) and (58). A further smoothing condenser (31) is fitted in the Modulator Unit.

One side of the heater circuit and negative H.T. are both earthed.

WAVEMETER OUTFIT GN

OSCILLATOR C42

INTERIOR VIEW

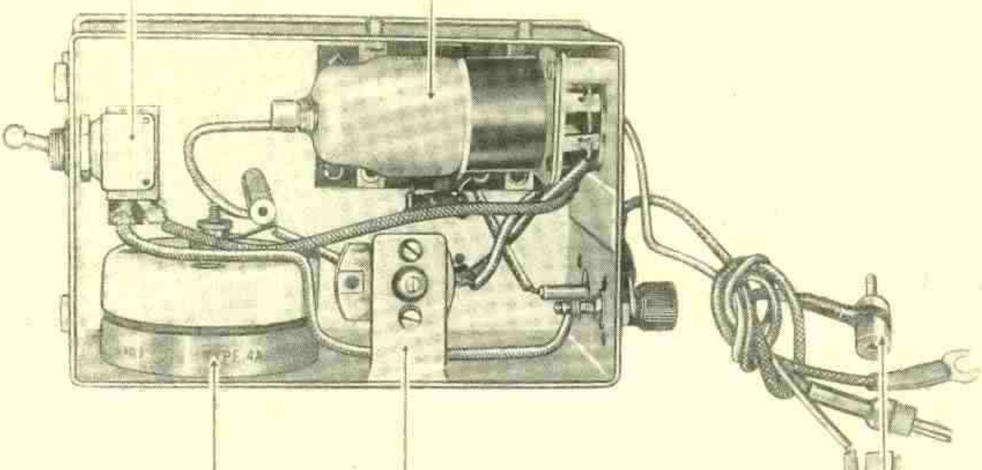

FIG. f

7. GENERAL.

Oscillator C42 has been designed to provide a means of checking the calibration of WAVEMETER G73 when a standard wavemeter outfit is not available.

It is a crystal oscillator, with a fixed frequency and operates at a frequency of 1000 kc/s.

When Oscillator G42 is supplied with Wavemeter G73 a special set of calibration curves is supplied. On these calibration curves are marked crystal checkpoints. The checkpoints indicate the exact frequency at which harmonics of the crystal frequency beat with harmonics of the Wavemeter R/F circuit.

The power supply for the oscillator is obtained from the A.C. Mains Unit, or Batteries, supplying Wavemeter G73. A photograph of interior view is given in Fig. f and simplified circuit diagram in Fig. g.

8. CONSTRUCTION.

The components of the oscillator are built into a small metal box, the whole comprising the Oscillator Unit. Three securing screws are provided and by means of these, the unit is secured inside the case of the Wavemeter. The metal box provides the necessary screening for the Oscillator Unit.

9. CONTROLS.

CRYSTAL ON-OFF SWITCH (68). A single pole switch fitted in the heater supply lead. Used to complete the heater supply to the oscillator valve, when it is required to use the Crystal Oscillator.

10. OPERATION.

See Wavemeter G73, Frequency Calibration.

11. BRIEF TECHNICAL DESCRIPTION.

The crystal oscillator uses a NR49 or VR56 pentode valve connected as a triode. A crystal (78) is joined between grid and cathode and is accurately set to a frequency of 1000 kc/s by means of a small pre-set condenser, (70). Resistance (71) is the grid leak.

Coupling between the tuned anode circuit, consisting of coil (75) and condenser (76) and the grid circuit is by the anode-grid capacity of the valve.

The H.T. supply is reduced to a suitable value by the anode decoupling resistance (73) which is by-passed to earth by the R/F by-pass condenser (74).

WAVEMETER OUTFIT GN

One heater lead is connected to "earth" and in the other supply lead, the CRYSTAL ON - OFF SWITCH (68) is connected. This switch protrudes through a small hole on the left-hand side of the wavemeter case, when the oscillator is secured in position, and is used as the control switch for the oscillator.

The coupling between the Crystal Oscillator and the wavemeter is by the coupling condenser (77). This condenser (77) is terminated with a special lead which has a valve clip, with an extension piece, fitted at the end. To connect, remove normal grid connection to the detector valve, and place the lead from the oscillator on the grid cap. Then place the normal grid connection on the extension piece provided.

12. POWER SUPPLY.

The oscillator obtains its power supply from the wavemeter. Mounted on a small insulated panel is:-

(i) A black terminal which is + L.T.

(ii) A socket which is + H.T.

Short leads are supplied to connect (i) and (ii) to the appropriate terminals on the A.C. MAINS UNIT or batteries.

When using batteries the H.T. supply to WAVEMETER G73 should be 99 volts and the H.T. supply to OSCILLATOR G42 81 volts, to avoid two plugs in one socket of the H.T. battery.

The "earth" connection for L.T. -, and H.T.-, which are common, is made by the screws securing the oscillator to the case of the wavemeter.

SIMPLIFIED CIRCUIT DIAGRAM

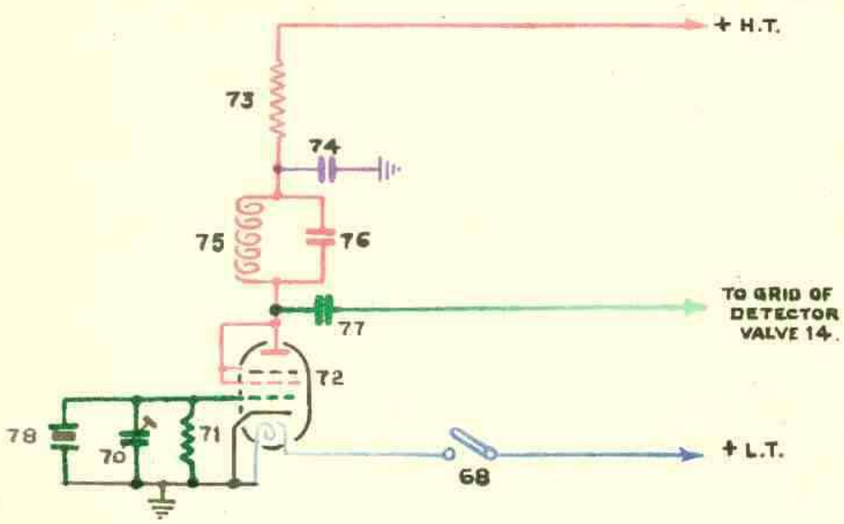

FIG. 9.