CHAPTER 27

WAVEMETER W.1191 AND W.1191A

1. **Purpose.**—The initial setting up, and subsequent frequency checking of ground or airborne transmitters and receivers. (Crystal check available giving 0·1 per cent. accuracy.)

2. **Frequency Range.**—100 kc/s to 20 Mc/s.

3. **Valves.**—Directly heated—not specially selected.

V.R. 82 triode-heptode; triode portion—T.R.F. "Hartley" oscillator, heptode portion—mixer.

V.T.50 triode—leaky grid detector.

V.R.19 triode—untuned "Pierce" oscillator.

V.T.50 triode—audio frequency oscillator or amplifier.

The Pierce oscillator performs two functions :—

(i) Supplies a source of crystal controlled energy.

(ii) Operates as a crystal frequency check for the T.R.F. oscillator.

4. **Spare Valves.**—Carried in transit case—V.R.82, two; V.T.50, one; V.R.19, one.

5. **Crystal.**—A 1,000 kc/s crystal is incorporated, for crystal check purposes.

6. **Power Supplies.**—H.T., 60-volt dry battery.

L.T., 2-volt—7 amp. hrs., accumulator. Carried at an angle of 45 degrees to prevent acid leakage during use.

7. **Aerial System.**—Rod aerial supplied as part of the equipment.

8. **Circuit Details.**—Block schematic (fig. 109) shows functioning of the stages for each method of operation.

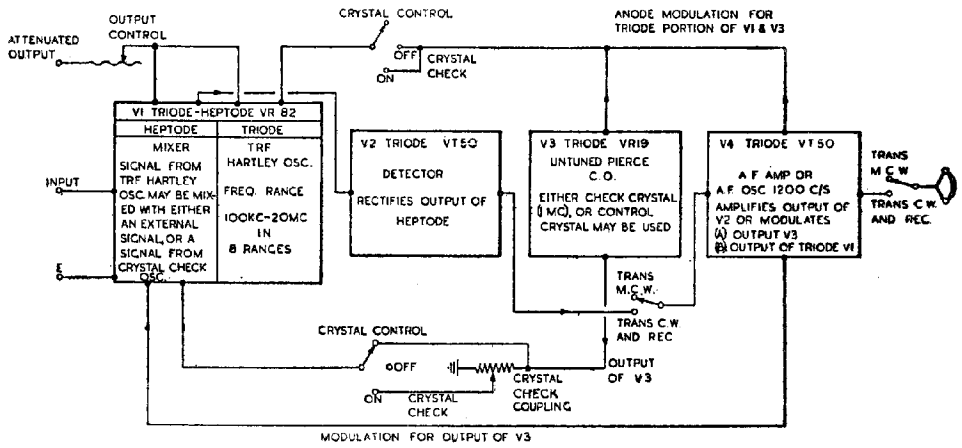


FIG. 109.—BLOCK SCHEMATIC WAVEMETER W1191

9. **Setting Up.**—(i) *As heterodyne wavemeter to set up a transmitter, using the Hartley circuit as a local oscillator.* In this case the Hartley circuit must be tuned to the desired fequency with the aid of the crystal check oscillator and calibration chart, as follows :—

(*a*) Plug rod aerial into " input " position.

(*b*) Trans/rec. switch to " Trans. C.W." and " Rec." position.

(*c*) Crystal switch to crystal check " On " position.

(*d*) From calibration chart, find approximate range and set range switch.

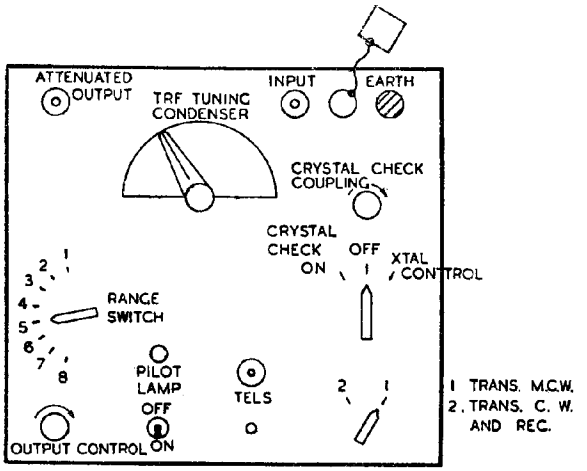
(*e*) Find nearest check point above the required frequency, and set oscillator tuning condenser approximately to check frequency marked on dial.

(*f*) Switch on wavemeter, plug in 'phones, tune for dead space. This is obtained because T.R.F. oscillator (fundamental frequency or a harmonic) is beating with the fundamental or a harmonic of the check crystal, both oscillators being " mixed " in the heptode portion of V.1, detected by V.2 and the resultant A.F. voltages amplified by V.3.

Note.—Set crystal check coupling so that beat note is only just heard.

(*g*) Look down column 1 of calibration chart from " Crystal check " frequency and see if required frequency is shown. If so, increase tuning condenser reading by number of divisions given in column 2. If not, number of divisions to be added must be calculated.

e.g. Suppose frequency required is 5,840 kc/s. From calibration chart, the nearest check frequency above is 6,000 kc/s, and since 5,840 kc/s lies between 5,900 and 5,800 kc/s the number of divisions to be added to the condenser setting must lie between 4·18 and 8·00, and will be less than 8·00 by the number of divisions corresponding to 40 kc/s.



SECTION OF A CALIBRATION CHART

W.1191 SERIAL No.199 RANGE 6	
MC/SEC.	INCREMENTAL DIAL DIVISIONS
6.0	CRYSTAL CHECK
5.9	4.18
5.8	8.00
5.7	11.51
5.6	14.87
5.5	18.05
5.4	21.10
5.3	24.06
5.2	26.94
5.1	29.73
5.0	CRYSTAL CHECK
4.9	2.70

FIG. 109A.—FRONT PANEL W1191

For 5,800 kc/s condenser reading increased by 8·00 divisions.
" 5,900 " " " " " 4·18 "
" 100 " " " " " 3·82 "
" 1 kc. " " " " ·0382 "
" 40 kc/s " " " " ·0382 × 40 divisions = 1·528 divisions.

So that for 5,840 kc/s, condenser reading must be increased by 8·00–1·528 = 6·472 divisions.

(*h*) Crystal switch to crystal check " Off " position.

(*j*) Tune transmitter for dead space in W.1191 telephones.

(ii) *As a heterodyne wavemeter to set up a transmitter, using crystal oscillator as local oscillator.*

(*a*) and (*b*) as in (i).

(*c*) Plug in crystal of required frequency in external socket.

(*d*) Crystal switch to " crystal control " position.

(*e*) Switch on W.1191 and transmitter. Tune transmitter for dead space.

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

(*a*) and (*b*) as in (i).

(*c*) Crystal switch to crystal check " Off " position.

(*d*) Switch on wavemeter and plug in 'phones.

(*e*) Switch on transmitter.

(*f*) Tune triode oscillator for dead space, using main tuning control, and making final adjustment with vernier control.

(*g*) Note carefully position of range switch and reading of tuning condenser.

(*h*) Switch off transmitter.

(*j*) Crystal switch to crystal check " On " position.

(*k*) Set coupling to " Max ". Rotate tuning condenser anti-clockwise until a beat note is heard, and then reduce coupling until beat can just be heard. Set at dead space.

(*l*) Note carefully reading of tuning condenser and frequency of crystal check point from dial.

(*m*) Subtract (*l*) from (*g*) and calculate from chart provided, the frequency to be deducted from crystal check.

(iv) *As a signal generator, to set up a C.W. or R/T receiver, using T.R.F. oscillator.*

(*a*) Plug rod aerial into " attenuated output " position. Output control to " maximum ".

(*b*) to (*h*), as for (i).

(*j*) Trans/rec. switch to " Trans. C.W." position for C.W. receiver or " Trans. M.C.W." for R/T receiver.

(*k*) Plug 'phones in receiver and tune for dead space (C.W.), or maximum signal (R/T receiver). Make use of attenuator for final setting-up.

(v) *As a signal generator to set up a C.W. or R/T receiver, using crystal oscillator.*

(*a*) Plug rod aerial into " attenuated output " position. Output control to " maximum ".

(*b*) Plug in external crystal of desired frequency.

(*c*) Crystal switch to " crystal control " position.

(*d*) Trans/rec. switch to " Trans. C.W." position for C.W. receiver or " Trans. M.C.W." for R/T receiver.

(*e*) Plug 'phones in receiver and tune for dead space (C.W.) or maximum signal (R/T receiver). Make use of attenuator.

10. **Precautions in Use and Servicing.**—(i) Ensure calibration chart has same serial number as wavemeter.

(ii) Wavemeter must be handled with great care, as it is a precision instrument.

(iii) H.T. battery must be tested frequently on load, and discarded when the voltage falls below 40.

(iv) L.T. accumulator must be inspected frequently, tested on load, and changed when voltage falls below 1·85 volts. Terminals to be kept greased and free from corrosion.

(v) When changing V.R.82, adjust preset condenser across main tuning condenser by means of insulated screwdriver, so that main crystal check beats agree with approximate markings on dial.

11. **Wavemeter W.1191A.**—Similar in appearance, circuit and functions to Wavemeter W.1191, with an additional trimmer control situated above the main frequency control. The trimmer control is connected—by means of a flexible shaft—to a 4$\mu\mu$F. variable condenser in parallel with the main tuning condenser, and it is used for correcting the calibration. The method of setting up differs slightly from that employed for the W.1191.

12. **Setting Up.**—(i) *As a signal generator, using T.R.F. oscillator.*

(*a*) Plug rod aerial into " attenuated output " socket. Output control to maximum.

(*b*) Trans/rec. switch to " Trans. C.W. & Receive ".

(*c*) Range switch to appropriate range.

(*d*) Crystal switch to crystal check " on " position.

(*e*) Find from calibration chart the crystal check point nearest to required frequency. Set main frequency control *accurately* to the calibration given, using vernier adjustment.

W.1191 A. SERIAL NO. 234.

RANGE I.

KC/S	DIAL. DIVS.	KC/S	DIAL. DIVS.
200 CRYSTAL	8·53	150	48·72
197·5	10·96	147·5	50·60
195	13·31	145	52·49
192·5	15·57	142·5	54·35
190	17·76	142·5	54·35
190	17·76	140	56·22
187·5	19·90	137·5	58·11
185	21·96	135	60·00
182·5	24·00	133·3 CRYSTAL	61·28
181·8 CRYSTAL	24·55	132·5	61·90
180	25·00	130	63·81
177·5	27·96	130	63·81
175	29·90	127·5	65·74

CALIBRATION CHART, W.1191A

(*f*) Switch on wavemeter, plug in 'phones, allow 10 minutes to warm up and reach a condition of stable operation, then rotate trimmer control until heterodyne whistle is brought to " dead space ". Crystal check coupling should be reduced to lowest setting which will give a comfortably audible beat note. The calibration will now be correct for the part of the scale in use.

(*g*) Find from the calibration chart the setting for the required frequency and adjust the main frequency control accordingly. If the frequency is not listed, the setting is worked out as follows :—

e.g., to set wavemeter to 196 kc/s.

Refer to chart, and note the readings corresponding to the two calibrated frequences nearest to 196 kc/s., i.e., 195 kc/s and 197·5 kc/s.

195 kc/s is given by a reading of 13·31 divisions.
197·5 kc/s is given by a reading of 10·96 divisions.

$$\therefore \text{ No. of divisions per kc/s.} = \frac{13{\cdot}31 - 10{\cdot}96}{2{\cdot}5}$$
$$= 0{\cdot}94 \text{ division.}$$

Required frequency is 1 kc/s above 195 kc/s.,
$\therefore$ Setting for 196 kc/s = 13·31 − 0·94.
= 12·37 divisions.

(ii) *As heterodyne wavemeter to measure frequency of transmitter, using T.R.F. oscillator.*

(*a*) Plug rod aerial into " input " position.

(*b*) and (*c*) as for (i).

(*d*) Crystal switch to crystal check " off " position.

(*e*) Plug 'phones into wavemeter, switch on and allow 10 minutes to warm up.

(*f*) Switch on transmitter.

(*g*) Rotate main frequency control of wavemeter until a beat note is heard. Tune to " dead space " and note dial reading.

(*h*) Switch off transmitter.

(*i*) Refer to calibration chart and find crystal check point nearest to reading obtained. Set main frequency control *accurately* to this crystal check calibration, and switch on crystal check. Without moving main control, rotate trimmer until "dead space" is obtained. The calibration of this part of the range is now correct.

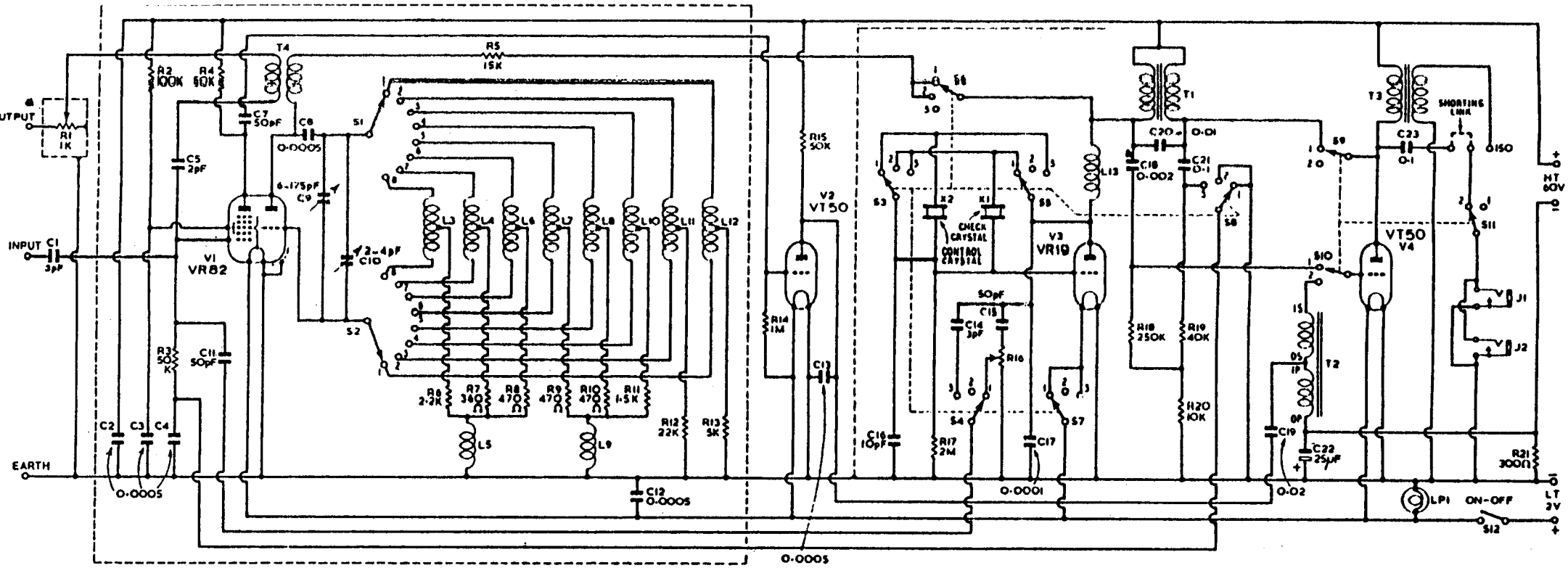
(*j*) Switch off crystal check.

(*k*) Switch on transmitter and find "dead space" again with main frequency control and vernier. Note the dial reading.

(*l*) Using this last reading, refer to the chart and find the two nearest calibration readings on each side of it, and calculate the transmitter frequency.

Note.—If the coupling between the transmitter and wavemeter appears to be excessive, plug the aerial into the "attenuated output" socket and adjust the output control as necessary.

The positions of the various controls for other functions of the W.1191A are as already given in the notes on setting up for the W.1191.


OUTPUT
R1 1K
R2 100K
R4 50K
T4
R5 15K
C7 50pF
C8 0·0005
S1
C5 2pF
6-175pF C9
INPUT C1 3pF
V1 VR82
S2
C10 2·2-4pF
L3 L4 L6 L7 L8 L10 L11 L12
R3 50K
C11 50pF
R6 2·2K
R7 340Ω
R8 470Ω
R9 470Ω
R10 470Ω
R11 1·5K
L5 L9
R12 22K
R13 5K
C2 C3 C4
0·0005
EARTH
C12 0·0005
R15 50K
V2 VT50
R14 1M
C13
0·0005
S6
S0
T1
C20 0·01
C18 0·002
C21 0·1
L13
S3
S8
K2
K1
CHECK CRYSTAL
CONTROL CRYSTAL
V3 VR19
50pF
C15
C14 3pF
R16
S4
S7
C16 10pF
R17 2M
C17
0·0001
R18 250K
R19 40K
R20 10K
S9
T3
SHORTING LINK
C23 0·1
150Ω
S10
T2
C19
0·02
C22 25µF
S11
J1
J2
R21 300Ω
HT 60V
LT 2V
LP1 ON-OFF
S12

The W1191-A