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REBECCA AND EUREKA EQUIPMENT

CHAPTER 2 – A.R.I. 5506

PREPARED BY DIRECTION OF THE MINISTER OF AIRCRAFT PRODUCTION

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PROMULGATED BY ORDER OF THE AIR COUNCIL.

A W Street

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AIR MINISTRY
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REBECCA AND EUREKA EQUIPMENT

CHAPTER 2 - A.R.I. 5506

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INTRODUCTION

1. The Rebecca Mark II (A.R.I. 5506) and Eureka Mark II (T.G.R.I. 5509) equipments have been developed from and supersede the Rebecca Mark I and Eureka Mark I equipments described in Chapter 1 of S.D. 0338. These equipments have been designed to permit the navigator of an aircraft to determine the range of his aircraft from a ground beacon, and to home on to the beacon. The airborne equipment is known as Rebecca, and the ground beacon, which is transportable, is known as Eureka. Each equipment comprises a transmitter and a receiver.

2. The principle of operation is that a pulse radiated by the aircraft is transmitted to a beacon on the ground. After a delay of approximately ½ microseconds, the beacon emits an answering pulse. This is received by a directional aerial system on the aircraft, thus enabling the navigator to obtain a rough bearing on the beacon. The pulse technique employed enables the time interval between the emission of the pulse from the aircraft and the reception of the answering pulse from the beacon to be measured. Since this time interval is proportional to the distance from aircraft and the beacon, the range of the beacon can be determined.

3. The pulses are displayed on the screen of a cathode ray tube in an indicating unit. A range selector switch is provided, giving three time base speeds, representing full-scale ranges of 9, 36 and 90 miles respectively. The range is obtained by reading off the position of the pulse with respect to a scale mounted over the face of the cathode ray tube. The accuracy of range measurement is determined by the calibration of the time base, and for practical purposes should be within 10 per cent. Thus, with a range indication of 50 miles, the range should be known to within a distance of 5 miles. The minimum range at which the beacon can be clearly received depends upon the duration of the pulse radiated by the aircraft and by the delay in the beacon.

4. In practice, the minimum range is approximately 1,000 feet. If the aircraft is flying at a height greater than 1,000 feet, the minimum range will be greater than 1,000 feet, and will be governed by the height of the aircraft. The maximum range of the equipment used over flat ground is indicated by the curves of fig.1. It will be seen to vary with the height of the aircraft, and the height of the beacon aerial. The site upon which the beacon is placed also affects the maximum range, the ideal site being high open ground.

5. The navigator can estimate the direction of the beacon by comparing the amplitudes of the signal picked up by the right-looking and the left-looking receiving aerials. The aerial terminal of the receiver is connected alternately to the right-looking and left-looking aerials twenty times per second by a rotary switch which synchronously connects the receiver output to the right and left-hand side of the trace on the cathode ray tube. In this way, signals picked up by the right-looking and left-looking aerials are simultaneously displayed on opposite sides of the vertical time base. Only a rough estimate of the bearing of the beacon can be formed, but by correcting the heading of the aircraft until the two signals appear equal, and maintaining them equal, the navigator can home on to the beacon to an accuracy of better than ± 5 degrees.

6. A limitation in the operational use of Rebecca Mark I and Eureka Mark I is imposed by the fact that only one frequency channel is available between the interrogating aircraft and the responding beacon. Any one beacon can handle only approximately forty aircraft at one time. A substantial increase in this number leads to the complete paralysis of the beacon. Another difficulty inherent in a system employing only one frequency channel is that any one aircraft, when transmitting, will trigger all the beacons within range of that aircraft. Although the correct beacon may be selected by observation of the coding that can be provided on the beacon return, more than approximately forty aircraft transmitting at one time will paralyse all the beacons within range. These factors limit the number of aircraft that can home to one area to approximately forty irrespective of the number of beacons available.

7. The logical development of Rebecca Mark II and Eureka Mark II has therefore included multi-frequency operation. Both equipments can transmit and receive on any one of five spot frequencies, which are equally spaced 5 Mc/s apart in the frequency spectrum, from 214 to 234 Mc/s. These frequencies are referred to by code letter only, the key being as follows:-

214 Mc/s	A
219 Mc/s	B
224 Mc/s	C
229 Mc/s	D
234 Mc/s	E

Thus, an aircraft selected to transmit on 224 Mc/s and receive on 234 Mc/s is spoken of as being on 'C-E' working. The beacon which is to respond to the above aircraft must obviously be set to receive on 224 Mc/s and transmit on 234 Mc/s. A beacon so set is also referred to as being on C-E working, i.e. the aircraft transmitter frequency is always quoted first for both equipment.

8. Selection of frequency in the aircraft equipment is by means of a control unit which incorporates push-button type selector switches. There are two rows of five push-buttons, one row for the transmitter and the other for the receiver. Although five push-buttons are provided for each selector motor, owing to limitations in the rotating mechanism involved, only four frequencies are available for selection once the equipment is airborne. Which four are to be made available can be pre-set by adjustment in the workshop before the equipment is installed.

9. On the front panel of the ground beacon are mounted two five-position switches. These switches are used to change the frequencies of the beacon receiver and transmitter. There are no limitations to frequency selection, any of the five on the switch being available.

10. The cycle of operation is started by the aircraft, which emits a pulse of 300 watts peak power and 4 microseconds duration on the selected frequency. This pulse is repeated 300 times per second. Provided that the beacon receiver is set to the aircraft transmitter frequency, the pulse is picked up by the beacon receiver, the output of which is used to trigger the beacon transmitter. The sensitivity is such that a signal of approximately 100 microvolts on the aerial feeder will give one hundred per cent triggering of the beacon transmitter.

11. The beacon transmitter is triggered approximately ½ microsecond after the arrival of the signal from the aircraft, and returns a pulse on the selected frequency. The power output of the beacon is approximately 12 watts, and the duration of the pulse is approximately 4.5 microseconds. The aircraft receiver must be selected to the beacon transmitter frequency, then this pulse will be received in the directional aerial system of the aircraft. The aircraft receiver is tuned to four of the five frequencies, the total band width in each case being 3 Mc/s. The sensitivity is such that an input of 10 microvolts on the aerial feeder will produce a signal equal to twice noise level.

12. The beacon returns can be coded for identification purposes. This coding appears on the cathode ray tube as an increase in the pulse width and can be read by the operator.

GENERAL DESCRIPTION

AERIAL SYSTEM

13. (i) Transmitting aerial. The transmitting aerial system is of the same form for all types of aircraft, and consists of a quarter wave length end fed aerial with one director. The aerial system is mounted on the nose of the aircraft, in such a position that radiation is obtained over a wide angle in front of the aircraft as indicated in fig.2. The feeder from the transmitter to the aerial is a length of Uniradio 4, which has an impedance of 47 ohms. The aerial is matched into the feeder by means of capacity plates at the mounting of the transmitter aerial system. There are two types of aerial that may be fitted. One is aerial type 165, Stores Ref. 10BB/2051, and has an insulator made from 'Permali' material; the other is aerial type 186, Stores Ref. 10BB/2173, which has a moulded bakelite insulator. Both aerials are completely interchangeable. The director used is the same in both cases, and is the director type 15, Stores Ref. 10BB/2175. The aerial type 165 plus director type 15 or the aerial type 186 plus director type 15 comprise aerial system type 308, Stores Ref. 10BB/2172.

(ii) Receiving aerials. The receiving aerial system is directional in azimuth and consists of a half wave dipole, with one director, mounted on either side of the nose of the aircraft. Such a system provides overlapping polar diagrams as shown in fig.2. This aerial system, type 184, Stores Ref. 10BB/2171, consists of a dipole unit type 13, Stores Ref. 10BB/2174, and a steelwork incorporating the director unit, see fig.2B. The aerial system presents a balanced impedance of approximately 50 ohms at the dipole. Uniradio No.4 feeder is again used, and a Pawsey type balance to unbalance transformer is incorporated to match the dipole into the feeder. For simplicity in replacement, the complete system is held by 4 bolts only. When these have been removed, the system may be dismounted for inspection.

TRANSMITTER-RECEIVER T.R. 3173

14. The transmitter-receiver T.R. 3173 is built on the unit, or "brick" construction. Each separate unit is mounted on its own chassis, and these units are then assembled on the main chassis A terminal block is provided under the main chassis for the connections from each unit, and the interconnections between the terminal blocks are made up into a cableform. The transmitter unit and the receiving unit are screened, and a protective cover is provided for the complete assembly. Destructors are provided in the transmitter unit and in the receiving unit.. A block schematic diagram is given in fig.3, circuit diagrams of the units are given in figs.4 to 10, and fig.11 shows the wiring between the units.

15. Since some of the aircraft into which the equipment is fitted have a 24V. D.C. supply, a transmitter-receiver T.R. 3173A has been introduced. T.R. 3173A differs from T.R. 3173 only in those units consisting of components which take power from the aircraft D.C. supply. A list of the units utilised in T.R. 3173 and T.R. 3173A is appended, together with their type and reference numbers.

Unit	T.R. 3173 (12V.)		T.R. 3173A (24V.)	
	Type	Ref. No.	Type	Ref. No.
Transmitter unit	45	10RB/16	45A	10RB/6001
Receiving unit	61	10PB/73	61A	10PB/6004
Amplifying unit	178	10UB/185	178	10UB/185
Modulator unit	66	10DB/1029	66	10DB/1029
Power unit	286	10KB/772	286	10KB/772
Switch unit	116	10FB/569	115	10FB/556
Chassis Assembly	12	10DB/1028	12	10DB/1028

TRANSMITTER UNIT, TYPE 45

16. The transmitter (fig.4) utilises push-pull oscillators V_1 and V_2 (both CV 63) with the tuned circuit in their anode leads, and R.F. chokes in their cathode leads. These valves are series modulated by V_3 (CV 73) and during the pulse they receive a total input of 2000 volts at 1.0 amp. for 4 microseconds. The pulse repetition frequency is 300 pulses per second. The power output to the aerial is not less than 300 watts. The filament voltage on valves V_1 and V_2 is 6.3 volts, and on V_3 is 4.2 volts. These voltages are provided by separate windings on the transformer T_1, the input to which is 6.3 volts from the main heater winding in the power unit.

17. A 47-ohm load R_2, in series with an R.F. choke, is provided in the anode lead common to V_1 and V_2. When V_1 and V_2 are oscillating, a negative going pulse of some 50 volts amplitude is developed across R_2. This serves as a marker pulse and is fed into the modulator unit.

18. The valve V_3 switches the H.T. negative line on to the cathodes of the transmitter, and functions as a series modulator. In the quiescent state V_3 is non-conducting due to the negative bias of 200 volts developed across the cathode resistor R_7. On receiving a positive-going pulse of 250 volts on the grid, the valve V_3 conducts, and 2000 volts is developed across the transmitter. When the pulse is removed, the valve V_3 is again cut off, and the H.T. is switched from the transmitter across V_3. A total mean current of 2 mA. is taken by the transmitter and the bleeder system R_3, R_4, R_9, R_7. The resistor R_8 acts as a grid stopper, and reduces the damping that occurs across the ringing circuit in the modulator unit when the valve V_3 conducts. C_2 and C_3 are decoupling condensers. The normal working voltages are as follows:-

Line volts	-	2500 volts to ground
Voltage across C_3		200 volts
Voltage across C_2		400 volts

19. The transmitter can be made to operate on any four spot frequencies in the band 214 to 239 Mc/s, the choice of frequency being effected by pressing the appropriate push button in the control unit, type 222. Four trimmers are provided, one for each spot frequency. These trimmers are mounted on a rotatable turret driven by a selector motor. When one of the push buttons is depressed, the selector motor moves the turret to a position in which the corresponding trimmer is automatically connected across the tuned circuit of the transmitter. The control unit has five push buttons, designated A, B, C, D and E, but only four of these can be connected at any one time.

20. Selector switch. A pictorial view of the selector switch is given in fig.12A, and a schematic diagram is given in fig.12B. The description of the operation of the selector switch should be followed with reference to both illustrations. The turret A, the disc B, the ratchet wheel C and the ring D are mounted on a common shaft. The disc B has three common contacts as shown, and the ring D has slots at 90 deg. intervals. Initially, suppose the switch to be in the position shown in fig.12B, namely with the blank in the disc B opposite the contact S_a. In this position, the spring contacts F are able to break contact since they are opposite a slot in the ring D.

21. The pressing of a button in the control unit connects the positive terminal of the aircraft battery to whichever contact is wired to that push-button. Suppose the push-button selected connects the positive terminal of the battery to contact S_d. The interrupter contacts S_{dm} are normally made, and the winding G is energised. The armature H is attracted, causing the pawl J to move up over one of the teeth on the ratchet wheel. The restraining spring prevents the ratchet wheel from rotating when the pawl moves up. The projection K on the arm of the pawl lifts one of the interrupter contacts, and the circuit is broken. The retractor springs L return the armature to its stop, pulling down the pawl, which in turn engages with the ratchet and rotates the wheel. The restraining spring prevents the ratchet wheel rotating any further than the downward travel of the pawl. As the projection K is withdrawn, the interrupter contacts are now allowed to make again, and the winding is once more energised. The armature is attracted as before, the whole process is repeated, and the system commences to rotate.

22. The ring D rotates with the ratchet wheel and immediately a cam-like action closes the contacts F. This connects the positive terminal of the battery to the electro-magnet winding G, so that although contact S_d is broken, owing to the rotation of the disc B, an alternative supply path is available, and rotation is maintained. After 90 deg. has been turned through, the contacts F are opposite another slot, and the contact is broken. By this time, however, another contact on the disc B has come opposite the contact S_d. The supply to the winding is therefore maintained and rotation continues. Rotation ceases when the break in the disc B comes opposite the contact S_d. In this position the contacts F are broken since they are opposite a slot, and the circuit via the contact S_d is incomplete since S_d is opposite a break in the disc B. The turret remains in this position until another push-button is selected. The condenser C_1 is connected across the interrupter contacts to prevent sparking, and the resistor R_1 is placed in series with it to prevent high surge currents.

MODULATOR UNIT, TYPE 66

23. The circuit diagram of the Modulator unit, type 66, is shown in fig.5. The valves V_1 (VR 65) and V_2 (6V6G) form a multi-vibrator circuit and provide the waveforms given in fig.6. The action of the circuit is as follows.

24. Suppose, initially, that V_1 is conducting and that V_2 is cut off due to a charge on C_2 making its grid very negative. Since V_1 takes a low anode current, and since V_2 is cut off, the cathode potential of V_2 is low. Now the negative charge on C_2 decreases through R_7 and the grid potential of V_2 rises until V_2 conducts. As a result, the cathode potential of V_2 rises, and with it the cathode of V_1 since the resistor R_3 is common to both cathodes. The grid of V_1 is held down to earth potential by the condenser C_1, hence there is a decrease in anode current through V_1 and a consequent rise in anode potential. This rise in potential is instantaneously communicated through C_2 to the grid of V_2, causing V_2 to conduct still more. The cathode potentials are now further increased, the effect being cumulative until V_1 is cut off, and C_2 is held at H.T. potential. The cathode potential of both valves now remains constant and the condenser C_1 charges up through the resistor R_1 until V_1 conducts again. The flow of anode current through V_1 reduces the anode potential, which in turn reduces the grid potential of V_2. The current through V_2 is now reduced and the cathode potential falls taking down the cathode of V_1, thereby turning on the anode still more. The anode potential is thus successively reduced and the valve V_2 is biased off. The negative charge on C_2 now decreases through R_7 and the process repeats itself.

25. The time constant C_2 R_7 and the potential to which R_7 is returned determine the length of time for which V_1 is conducting, and hence the pulse repetition frequency. It can be varied between 250 and 450 pulses per second by R_8, the normal setting being at 300 pulses per second. The duration of the positive pulse on the cathode of V_2 is determined by the time constant C_1 R_1, values are chosen such that it is of 20 microseconds duration. This 20 microsecond pulse is taken via the cathode follower V_3 (VR 65), and is used to provide the synchronising pulse for the time base in the Indicating unit, type 6E. The amplitude of the pulse is approximately 80 volts.

26. In the anode circuit of V_2 is a coil L_1 which forms a resonant circuit with its stray capacities. The tuned circuit so obtained is heavily damped by R_{10} such that a single negative ring is obtained when V_2 is switched on, and a single positive ring when V_2 is switched off again. The positive-going ring is used to trigger the transmitter. The coil has a variable iron core, which allows the transmitter pulse width to be varied between 3.5 and 5.5 microseconds. The normal setting is 4 microseconds. The inductance L_1 may be switched into the circuit by operating the relay $\frac{A}{1}$, which causes spring contacts A1 to close. The relay switch is used as the transmitter on-off switch and is mounted on the Control unit.

27. In order to provide an identical indication for all settings of the control unit, a marker pulse is provided at the beginning of the range scale. This pulse is obtained across the anode load in the transmitter as explained in para.17. The marker pulse is fed into the video stage of the amplifying unit, and to allow for the delay in the receiving and amplifying units, is fed through a delay network. This network is mounted on the modulator unit, and comprises four sections. The delay introduced is 1 microsecond.

RECEIVING UNIT, TYPE 61

28. Fig.7 shows the circuit diagram of the receiving units, types 61 and 61A. Signals from the port and starboard aerials are fed through separate screened cables to the switch unit. The output from the switch unit is connected via a short 45-ohm cable to the inductance L_2 through the small condenser C_3. The condenser matches the cable to the R.F. stage and, with the inductance L_2, forms a rejector circuit to the intermediate frequency (13½ Mc/s). The R.F. valve V_2 (CV 66) is a grounded grid triode with low noise resistance. It is tuned by the variable inductance L_4 which covers the band 214 to 234 Mc/s and which can be preset with the insulated tool provided. The local oscillator valve V_1 (VR 91) is connected as a triode and is tuned by the variable inductance L_1, which can also be preset. The tuning range is from 113 to 124 Mc/s, the second harmonic being used in the mixer stage. The tuning inductances are mounted in separate turrets driven by a common shaft. The principle of operation is the same for the switch mounted in the transmitter unit, and frequency selection is controlled from the control unit. The connection to the grid of the oscillator valve V_1 through the resistor R_1 is incorporated for use when the receiving unit is utilised in another equipment, and plays no part in the present circuit.

29. The oscillator output is fed to the first detector V_3 (VR 92) through a screened lead and the blocking condenser C_{10}. The first I.F. stage V_4 (VR 65) is tuned to 13½ Mc/s by the coil L_7 which has an adjustable iron core. The damping resistor R_7 is connected across the tuned inductance to give a wide bandwidth. This bandwidth is subsequently maintained by staggered tuning. The output circuit comprises a second inductance L_8, tuned to 15 Mc/s, from which the output lead is tapped to give an optimum coupling of 100 ohms into the amplifying unit. Extensive decoupling is provided in the R.F. and I.F. stages.

30. The gain control for the receiver is mounted in the indicating unit and comprises a variable resistor. This resistor controls the screen potential of the first I.F. stage (V_4 in the receiving unit) and the succeeding two stages (V_1 and V_2 in the amplifying unit). For this reason the screen lead is brought out to a separate terminal.

31. The normal working conditions of the receiving unit, type 61 are as follows:-

H.T. Voltage	230 volts to ground
Anode current V_1	7.5 mA.
Anode current V_2	10 mA.
Bias on V_3	1 volt
Total current V_4 (max. gain)	10 mA.

AMPLIFYING UNIT, TYPE 178

32. The output from the receiving unit is connected through a short length of 100-ohm screened cable to the input plug on the amplifying unit, the circuit diagram of which is given in fig.8. This input is tapped on to the inductance L_1. The valves V_1, V_2, V_3 and V_4 (all VR 65's) form four intermediate frequency amplifiers. The inductances L_1, L_3 and L_6 are tuned to 12 Mc/s, and inductances L_2 and L_4 are tuned to 15 Mc/s. The bandwidth is further widened by the resistors R_2, R_6, R_{14}, R_{21}, and R_{24} and R_{28} in parallel. Although these resistors function as the anode loads to the respective valves, they are effectively connected across the tuned circuit of the next stage. The bandwidth is approximately ± 2 Mc/s for a 6 db. loss in sensitivity. Extensive decoupling is provided, particularly in the last I.F. stage V_4, when two stages of decoupling are utilised. As already mentioned, the screens of V_1 and V_2 are taken to the midpoint of a 20K resistor R_{17}, and a variable 20K resistor in the indicating unit. This provides the gain control.

33. The resistors R_7, R_{16}, R_{22} and R_{29} are anode stoppers to prevent parasitic oscillations. R_8, R_{12}, R_{23} and R_{31} are decoupled cathode bias resistors, the decoupling condensers being C_3, C_{11}, C_{17} and C_{23} respectively. The diode second detector (VR 92) rectifies the intermediate frequency pulses and produces
A.L.1. negative D.C. pulses across the resistors R_{32} and R_{40}. L_7 and C_{33} form an intermediate frequency rejector circuit, and the pulses are applied to the grid of valve V_6 (VR 65) through C_{29} and R_{42}. C_{29} is a blocking condenser, and R_{42} a grid stopper. The valve is normally operated with a bias of approximately one volt. The output takes the form of positive pulses which are applied through grid stoppers R_{43} and R_{44} to the valves V_7 and V_8 (both VR 65's). The valves act as cathode followers, with the load connected in the cathode circuit and the anode connected directly to H.T. positive. The changes in potential then appear at the cathode, and follow the voltage waveform applied to the grid. Two valves are used in parallel to reduce the output impedance. R_{39} is the bias resistor, and R_{41} is the cathode load.

34. The function of the cathode follower circuit is to minimise the shunting effect of the capacitance of the cable which is used to carry the positive pulses to the indicating unit. The output is developed across R_{41} and is fed through the condenser C_{36} via a screened cable to the switch unit.

35. The negative marker pulse is applied, after the delay introduced in the modulator unit, across R_{40}, when it biases off the video stage V_6. A large positive pulse is thus produced at the anode, and provides a constant marker pulse for the zero of the range scale. In this way, a pulse of constant amplitude and width is provided, which is independent of the frequency settings of the transmitter and the receiver.

POWER UNIT, TYPE 286

36. The power supplies for the transmitter, the receiver and the indicator are housed in the power unit, type 286, (fig.9). The input to the transformers is 80V. A.C., 1300 to 2600 c/s. An additional tap is provided on the input to accommodate 115V., 800 c/s supply as utilised on certain types of U.S. aircraft. The transformer T_1 supplies 6.3 volts at 15 amperes for the heaters. One secondary winding on the transformer T_2 supplies the half-wave rectifier V_2 (VU 111), volts for the heater being tapped off the H.T. winding. The rectifier V_2 provides the E.H.T. supply for the transmitter and the C.R.T., 2,500 volts at 2 mA. being developed across condenser C_2. The resistor R_2 drops the voltage to 1,800 for the C.R.T. at 0.6 mA.

37. The normal H.T. supplies are provided by the transformer T_3, one H.T. secondary winding supplying the full wave rectifier V_1 (5U4G) providing 420V H.T. at 70 mA. The output is smoothed by the choke L_1 and the condenser C_1. The resistance R_1 and the condenser C_3 drop the voltage to 250 volts at 68 mA. The heater current is supplied by a separate winding.

SWITCH UNIT, TYPE 115 AND TYPE 116

38. The aerial and output switches are of the telephone relay type, and are operated by cam-driven spring-loaded push rods. Two identical sets of switches are provided, driven from a common cam-shaft, but one set only is used in this equipment. The contacts from the other set of switches are connected to a terminal block mounted on the underside of the unit. These connections are then brought out to a 6 pin W-plug on the front panel via a second terminal block which may be pressed into the spring clips mounted in the first terminal block. A circuit diagram and a chart showing the angles at which switching takes place are given in fig.10.

39. The cam shaft is driven through a worm reduction gearing of 6 to 1 by a small D.C. motor. The power for the motor is obtained from the aircraft battery. The switch unit, type 115, runs from 24 volt and switch unit, type 116, from a 12-volt supply. A suppressor is included in the D.C. input circuit to the motor, and two small condensers C_1 and C_2 are connected between each input terminal and frame. The speed of the motor is restricted to 3600 r.p.m. by means of a centrifugal governor mounted at the end of the motor spindle. When the speed exceeds this value, two spring-loaded shoes are moved out by centrifugal force and exert a braking action against the inner rim of a cylinder fixed to the bearing-pedestal. When this braking action causes the speed to fall below 3600 r.p.m., the centrifugal force is reduced and the shoes are drawn in by the action of the springs. The braking action is thereby removed, allowing the speed to rise again, and should it increase above 3600 r.p.m. the braking action is again brought into play.

40. The cam shaft speed is 10 revs/sec., and complete switching takes place twice every revolution of the cam shaft. The upper bank of contacts comprise the aerial switch (see fig.10). The central spring is brought into contact with the outer springs in turn. The port and starboard aerials are connected to the outer springs and the input lead to the receiving unit is connected to the central spring. To allow for complete discrimination between the input signals, there is a complete break between the switching from one aerial to the other.

41. The switching in the output circuit is driven from a separate cam mounted on the same shaft, and is synchronised to the aerials switch. To avoid the "christmas-tree" effect in the indicating unit, the contacts are made to overlap. This period of overlap corresponds to the period when there is complete open circuit in the aerial switch. The contact angles will be found by reference to fig.10.

CONTROL UNIT, TYPE 222

42. The control unit houses the push-button switches which select the transmitter and receiver frequency settings. The main on/off and the transmitter on/off switches are also mounted on the control unit. A circuit diagram is given in fig.13. The push-buttons are arranged in two rows of five, the push-buttons in each row being labelled A, B, C, D and E.

43. Each push-button switch has three contacts, '1', '2' and '3'. In the normal position, '1' and '2' are connected, and when the push-button is pressed down, '2' and '3' are connected together. In each row, contact 2 on switch A is connected to contact 1 on switch B; contact 2 on switch B is connected to contact 1 on switch C, and so on. The '2' terminal~~s are all connected~~ on switch E is, ~~being~~ returned to tag 14 on the 18 pin W-plug. AL.1. Tag 14 is connected through the Main switch via the 18 way cable to the positive line of the aircraft D.C. supply. The negative line is connected to tag 13 on the W-plug, and between tag 13 and each terminal '3' is connected a pilot lamp. Each terminal '3' is also connected to a separate pin on the 18-way W-plug, and thence via the cable to the appropriate terminal on the terminal block, in the transmitter unit or the receiving unit, (see fig.11). The control unit, type 222 is for use with a 12-volt supply, and the control unit, type 222A with a 24-volt supply. The rows of push-buttons are so constructed that when a fresh button is depressed, it is held down, and the one originally selected returns to its normal position.

44. The selecting of one of the buttons (say A) connects the positive terminal of the battery to the '3' terminal of the push-button, which is the function required to set off the selector motor (see para.21). At the same time, the pilot lamp opposite push-button A is connected across the D.C. supply and lights up. This gives an immediate indication of which push-buttons are selected. For use at night, a shutter is provided which puts a blue filter over the pilot lamps.

45. The MAIN ON-OFF switch, when closed, energises the relay B/2 which is mounted behind the front panel on the main chassis assembly. The relay closes two sets of contacts which switch the 80 volts A.C. and the aircraft D.C. supply to the remainder of the equipment. The closing of the TRANSMITTER ON-OFF switch energises the relay $A/_1$ mounted in the modulator unit. This switches the coil into the anode circuit of V_2 in that unit, producing the modulating pulse for the transmitter.

INDICATING UNIT, TYPE 6E

46. The indicating unit employed is a type 6A modified to include a destructor. A circuit diagram is given in fig.14. The cathode ray tube V_7 is a V.C.R. 97, and is of the electro-static deflection type. Deflection of the beam to the right and to the left is obtained by applying the signal voltages to the Y plates. The time base voltage is applied to the X plates, the tube being turned through 90 deg. to give a vertical trace on the tube. If the indicating unit, type 6E has input circuit modified to operate from a negative pulse, refer to "appendix 3". A.L.1.

47. The signals from the switch unit are fed direct to the Y plates through the condensers C_{14} and C_{15}. The valve V_8 (V.R.54) is a double diode, and provides D.C. restoration for the Y plates. The diode paths are shunted across the resistors R_{28} and R_{30}.

48. The time base circuit produces a voltage which, when applied to the X plates, moves the spot from the bottom to the top of the face of the cathode ray tube. This movement is linear and takes place in a specified time, commencing when the transmitter pulse is emitted. Three scales are provided, representing ranges of 9, 36 and 90 land miles. Now the velocity of propagation of electro-magnetic waves in 186,000 miles/second, and hence the time taken by a wave to traverse 1 mile is 5.37 microseconds. Neglecting the delay of ¼ microsecond in the beacon, 10.74 microseconds will elapse between the emission of the pulse from the aircraft and the return of the beacon signal when the beacon is at a range of 1 mile from the aircraft. The required time bases, therefore, are of 97, 387 and 970 microseconds duration for the 9, 36 and 90 mile ranges respectively. After each sweep, the spot is returned to the beginning of the trace, ready to be triggered again.

49. The nucleus of the time base circuit is shown in fig.15A. Suppose the grid of valve V_1 (VR 91) is held slightly positive, then the valve passes a relatively large anode current, and the voltage across the condenser C_4 is small. If, now, the potential of the grid is suddenly made about 40 volts negative, the valve V_1 is cut off. The condenser C_4 then commences to charge up towards H.T. potential through R_3. As long as C_4 is allowed to charge up to about only one-tenth of the H.T. voltage, (i.e. 40 volts in 400 volts), the curve of volts across C_4 against time is approximately a straight line, which is the required condition At the end of its charging period, C_4 is left with a positive charge, and it is necessary to discharge this condenser before another time base sweep can be made. To effect this discharge, the grid of V_1 has to be held positive for some finite period, which is carried out by returning the top end of R_2 (diagram B) to an adjustable positive voltage (up to 90 volts).

50. The positive voltage pulse from the modulator unit, type 66, is fed through the resistance R_1 to the condenser C_1. While the voltage is positive going, C_1 charges up through the grid current of V_1, which restricts the grid potential to about 3 volts. At the end of the input pulse, the condenser C_1 cannot discharge into the grid of V_1, and receives a negative charge, which drives the grid of V_1 very negative, (see diagram C). The valve V_1 is now cut off, and the condenser C_4 commences to charge up towards H.T. voltage. This instant, i.e. the end of the synchronising pulse, corresponds to the start of the time base sweep, and to the start of the pulse from the transmitter. The charge on C_1 leaks away through the resistance R_2 until the grid of V_1 runs positive again, and the condenser C_4 is discharged, ready for another scan. The time base speed is controlled by the capacitance of the condenser C_4, and the range switch S_1 selects the appropriate capacitance for the range required.

51. The time which is allowed before C_4 discharges must be adjusted to be not less than 1000 microseconds after the start of the transmitter pulse, as otherwise the scan on the 90-mile range would be shortened. The recurrence frequency is 300 pulses per second, i.e. 3300 microseconds between pulses. This means that the time

before C_4 discharges must not be greater than 2500 microseconds, to allow sufficient time to discharge C_4 before the commencement of the next pulse. The time constant R_2C_1, the negative potential to which C_1 is charged, and the potential to which R_2 is returned, are the factors involved. The potential to which R_2 is returned is controlled by the potentiometer VR_2, labelled TIMING. The amplitude of the synchronising pulse controls the negative charge produced in C_1, and the diode V_2 (right half) is employed to limit this synchronising pulse to a fixed amplitude. This is effected by maintaining the cathode of V_2 at a fixed potential of about 37 volts by means of the bleeder system R_5 and R_6. When the input pulse exceeds this value, the diode conducts, maintaining the potential constant. C_5 acts as a decoupling condenser.

52. Reference to the complete circuit diagram, fig. 5, will show that the performance of the circuit has been traced from the synchronising pulse input to the anode of V_1. The waveform at this anode consists of a linear rising wave, which continues to rise after the requisite scan has been made. It is the function of V_3 (VR 91), and the second half of the diode V_2 (VR 54) to limit this scan in time, and to provide means of adjusting the length of scan to fill the usable portion of the cathode ray tube screen. The diode V_2 acts as a D.C. restorer on the beginning of the trace, that is to say, the forward sweep of the time base voltage always starts from the potential of the anode of V_2 (left half), i.e. zero volts.

53. After the requisite interval the scan is stopped by V_3 running into grid current. This interval is adjusted by varying the cathode potential of V_3 by means of VR_6, VR_7 or VR_8, according to the range. These
AL/. potentiometers are labelled CAL. It will be seen that resistors VR_6 and VR_7 are not decoupled. Variation of these resistors therefore produces a change in the negative feed back, and consequently a change in the gain of the valve V_3. To compensate for this change, as between the ranges, potentiometers VR_3, VR_4 and VR_5 are introduced into the anode circuit of V_3. Adjustment of these does not alter the time taken for the spot to complete one trace, but alters the length of the scan. These potentiometers are therefore labelled AMPLITUDE. It will clearly be seen from the foregoing, that it is necessary to adjust the CAL potentiometers before the AMPLITUDE potentiometers when setting up each range.

54. Potentiometers VR_3, VR_4 and VR_5 adjust the amplitude of the voltage applied to the X plates of the cathode ray tube, and hence they control the length of the scan. The resistor R_{36} has a shorting switch S_2 to provide a coarse adjustment of scan length for use with cathode ray tubes of high sensitivity.

55. The voltage at the anode of V_3 is applied through the condenser C_7 to one of the X plates X_1 of the cathode ray tube. Another lead is taken from the anode of V_3 through the condenser C_8 and the resistor R_{11} to the grid of valve V_4 (VR 91). V_4 functions as a phase reversing valve, the input resistors R_{11} and R_{12}, the anode load R_{13} and the cathode feed back resistor R_{14} being chosen such that the output voltage from V_4 is equal in amplitude to the input from V_3. The output from V_4 is applied via the condenser C_9 to the other X plate, X_2, of the cathode ray tube. The phase reversing valve is incorporated because, while a positive potential is applied to the X_1 plate to attract the electrons in the beam, it is also necessary to apply a negative potential on the opposite plate X_2 at the same instant to repel the beam in order to prevent blurring of the traces, (astigmatism, i.e. the mean potential of the spot remains at zero volts during the sweep). The double diode V_6 (VR 54) provides D.C. restoration for the X plates, the diode paths being shunted across the resistances R_{20} and R_{21}.

56. The valve V_5 (VR 91) is employed as a suppressor to render the fly back stroke, and intervals between scans, invisible. During the scan stroke, the anode of V_3 feeds a negative bias through the condenser C_{10} to the control grid of V_5. In the absence of a scan stroke, V_5 passes current and the anode voltage of V_5 is about 365 volts. When the scan starts, the bias produced on the grid cuts off V_5, and its anode potential rises to about 400 volts. A positive bias of about 35 volts with respect to the cathode of the cathode ray tube is thus applied to the grid of the tube. The tube is normally biased back to black out, and the spot therefore becomes visible during the scan stroke. When the scan ceases, the negative charge rapidly leaks off the condenser C_{10}, and V_5 again conducts. Its anode potential falls once more to about 365 volts, and the positive bias is removed from the cathode ray tube. Owing to the variation of the relative lengths of time that the spot is suppressed or turned on, there will be a variation in the general brightness level of the trace on different ranges. Hence an adjustment of the BRILLIANCE control, VR_{10}, which governs the mean potential of the grid of the tube, may be necessary on changing from one range to another. The potentiometer VR_{11}, adjusts the potential of the second anode of the cathode ray tube and constitutes the FOCUS control.

57. The potentiometers VR_9 and VR_{12} make up the vertical and horizontal shifts respectively. Their function is to adjust the mean potentials of the Y plates and of the X plates, which move the trace bodily up or down, or to the right or to the left respectively.

58. The GAIN control, as previously described, is mounted in the indicating unit, and takes the form of the potentiometer VR_1.

POWER SUPPLIES

59. The equipment is supplied with power by an engine-driven generator which gives an output at 80 volts A.C. The frequency varies with engine speed, and the voltage is maintained constant by a control panel, type 3, which incorporates a carbon pile regulator. The generator fitted to Halifax aircraft using Merlin engines is type R, Stores Ref. 5U/1271. It supplies 500 watts at 80 volts A.C. It is designed to run at speeds between 3000 and 6000 r.p.m. and the frequency varies between 1,300 and 2,600 c/s.

CONTROL PANEL, TYPE 3

60. The control panel, type 3, performs two functions. Firstly, it houses the voltage regulator which maintains the output voltage of the alternator sensibly constant through variations in engine speed. Secondly, the control panel functions as a distribution point for the A.C. and D.C. supplies to the equipment. A circuit diagram, and a wiring diagram of the control panel are given in fig. 16. The A.C. output from the generator is fed to a full wave metal rectifier W_1, the output current from which is limited by the resistance R_1. This current energises the solenoid L_1, and mechanical pressure is applied to the carbon pile in such a way that an increase in current through the solenoid results in an increase in the resistance of the carbon pile. In this way, the field excitation current is reduced, and the output voltage is maintained at 80 volts. The maximum variation of output voltage from the generator should not exceed 2 volts.

61. On account of the high internal reactance of the type R and type S generators, a condenser C_1 is included in the control panel. This condenser has two sections of 5 μF and 3 μF respectively. By means of a connecting link, its capacity can be set to 5 μF when the type R generator is used, and to 8 μF when the type S generator is used. The condenser is short circuited, when the control unit is used in conjunction with a type Q generator. Some control panels are fitted with a 5 μF condenser only. These are labelled "12 volts" and must not be used in conjunction with the type S generator.

62. A condenser C_2 is connected across the D.C. supply to the generator field in order to limit the voltage rise when the circuit is interrupted. A suppressor is included in the D.C. input circuit to prevent feed back of interference to the aircraft electrical services. The D.C. input circuit is provided with a single pole switch and pilot light. In the OFF position the switch interrupts the excitation to the generator field, and has the effect of breaking both the D.C. and A.C. supplies to the output plugs of the panel, since the generator will give no output when its field is not excited.

DESTRUCTORS

63. Three destructors are provided within the aircraft equipment to allow demolition of the apparatus in the event of a forced landing in enemy territory. Two of these destructors are mounted within the transmitter-receiver, and the third in the indicating unit. One destructor serves to destroy the valve V_3 in the transmitter unit, and the other to destroy the valve V_2 and to damage the rotating turrets in the receiving unit. These destructors are wired in parallel to a two-pin W-plug mounted on the front panel of the TR chassis. This plug is termed the initiating plug. The third destructor is intended to destroy the cathode ray tube, and to damage the potentiometers VR_3, VR_4 and VR_5. A small type M two-pin plug on the front panel of the indicating unit is connected to the destructor. A twin lead connects this to a similar plug in the aircraft firing circuit, which in turn is connected in parallel with the initiating plug. The initiating plug is normally blanked off by a cap and the stowage for the supply socket is provided by a dummy plug mounted beside the transmitter-receiver.

64. A diagram of the destructor wiring circuit is given in fig.30 Three pairs of firing switches are connected in series with the supply to the destructors and the initiating plug. These switches are all connected in parallel, and are intended for operation by the pilot, the navigator and the wireless-operator. An inertia switch, in series with a tumbler switch, is also connected in parallel with the pairs of firing switches. The tumbler switch, mounted in the navigator's position, is labelled SAFE in the open position, and LIVE in the closed position. Two pilot lamps in parallel are connected in series with the inertia switch across the supply. From the circuit, it will readily be seen that it is necessary to place the tumbler switch to LIVE before the inertia switch will detonate the destructor. The closing of any one pair of firing switches however, will fire the destructors irrespective of the position of the tumbler switch. When the destructors are fired by the inertia switch, the pilot lamps light up. They will only light on the depressing of a pair of firing switches when the tumbler switch is closed.

CONSTRUCTION

TRANSMITTER-RECEIVER T.R. 3173

65. The transmitter receiver T.R. 3173 is built on the unit principle of construction. Views of the complete assembly and of the individual units are given in figs. 17 to 27. The majority of the components have been annotated and the references are the same as those used in the circuit diagrams. Details of the dimensions and weights of the various units are given in Appendix 1.

INDICATING UNIT, TYPE 6E

66. Two views of the indicating unit, type 6E are given in fig.28. The indicating unit, type 6E is ~~same as the indicating unit, type 6 with the addition of a detonator~~ similar to the indicating unit, type 6A with the same circuit modifications except the addition of a detonator. A.L.I.

CONTROL UNIT, TYPE 3

67. An illustration of the control unit, type 3 is given in fig.29. The fuses and spares are mounted immediately behind the front panel. They are accessible through a removable cover plate.

OPERATION IN THE AIR

68. The following instructions are of a general nature and are intended as a guide to the correct procedure for the use of the equipment. To ensure maximum efficiency being obtained from the system, specialised training is required for both operators and pilots in the operation envisaged.

69. A diagram of the interconnexions for the A.R.I. 5506 is given in fig.30. The disposition of the apparatus in a typical aircraft installation is given in fig.30A. Before take off ensure that the tumbler switch on the navigators panel is in the SAFE position. Connect the detonator supply sockets to the initiating plugs. The power supply should never be switched on until the aircraft is airborne, and must be switched off before landing. The power supply to the equipment should be switched on at the control panel, type 3.
Note:- If the control panel is mounted in an inaccessible position, an alternator ON-OFF switch will be provided and this switch should be used. The control panel may then always be left in the ON position. Check that the tumbler switch is in the SAFE position.

70. Switch on the equipment at the control unit, type 222, by means of the MAIN switch. After allowing about two minutes for warming up, observe the screen of the indicating unit. A vertical time base should be visible. If there is no indication, adjust the BRILLIANCE control until the time base appears. Next adjust the FOCUS control until the indication is sharp and distinct. Check that there is an indication for each position of the RANGE switch.

71. Start the transmitter by means of the TRANSMITTER switch on the control unit, and set the RANGE control to 90 miles i.e. fully counter-clockwise. The indication should then appear as in fig.31. Check that the indication is the same for the four settings of transmitter frequency available at the control unit. When transmitter and receiver are set to the same frequency some ground returns may be visible beyond the marker pulse. The extent of these returns will depend on the height of the aircraft. If the aircraft is flying over the sea the returns will be reduced. Set the frequencies of the transmitter and the receiver at the control unit according to the setting of the beacon it is required to interrogate. Ensure that the RANGE switch is in the 90-mile position and switch off the transmitter.

72. When the aircraft is within about 100 miles of the target beacon switch on the transmitter, turn up the GAIN control fully clockwise and examine the indication for signs of the beacon. Do not leave the transmitter on all the time as this will involve unnecessary risk of detection of both ground and air equipment. Switch on the transmitter at the control unit every few minutes, leaving it on long enough only to examine carefully the time base.

73. When the beacon return appears give azimuth directions to the pilot for heading the aircraft towards the beacon by keeping the signals equal on both sides of the time base. Note: When the larger signal is on

the left of the time base it is necessary to turn to PORT to bring the signals equal and vice versa. Typical indications are given in figs.31. As the aircraft approaches the beacon, read off the range from the scale and repeat it to the pilot so that he may gradually lose height, and be at the required height on arrival over the target. When the aircraft is within about 30 miles of the beacon, change over to the 36 mile range. As the beacon is approached the signals will increase in amplitude, and the GAIN control should be successively turned down to maintain the signals at about 1 inch on either side of the time base.

74. It should be possible to confine the operation of the transmitter to short periods until the aircraft has approached to within a range of approximately 15 miles. At this range keep the transmitter on continuously and give repeated corrections for the heading of the aircraft. The smallest noticeable inequality of signals should be corrected, for this point cannot be overstressed. The gain control should be used to maintain the signals steady at one of the vertical lines drawn over the face of the tube. The pilot should also be kept frequently informed of the range. When the aircraft has approached to within a range of approximately 8 miles, switch over to the 9 mile range. The beacon response should move rapidly down the time scale towards the bottom end and if the aircraft is flying low it will merge into the marker pulse as the aircraft passes over the beacon. When the beacon has been located switch off the transmitter.

75. On returning home, change the settings of the control unit to those of the station homing beacon. Switch the transmitter on again when about 100 miles from base, and repeat the procedure for homing on to the station beacon. Before landing, switch off at the control unit and at the control panel, type 3, (or at the alternator on-off switch where fitted). Ensure that the tumbler switch is in the SAFE position and replace the detonator supply sockets in their respective stowages.

76. If, during flight, the operator has cause to leave his position, the tumbler switch should be set to LIVE, and switched back to SAFE when he returns. In the event of abandoning the aircraft or being forced down over enemy territory or the sea, the pilot, navigator, and wireless operator are all required to press their respective twin firing switches.

MAINTENANCE

TEST EQUIPMENT

77. The following test equipment is suggested for servicing the apparatus. The list should be regarded as provisional only.

Stores Ref.	Nomenclature	Quantity
T.G.R.I.5509	Test instrument T.G.R.I.5509	1
10T/546	Wavemeter, type W.1432	2
10T/547	Wavemeter, type W.1433	1
10SB/169	Test set, type 138	2
10SB/150	Signal generator, type 51	1
10SB/193 or 110	Test set, type 165 or type 76	2
10SB/74	Test set, type 43	1
10S/10613	Test meter, type E or	3
10S/46	Test meter, type H (universal avometer)	3
5A/1021	Megger	2
40Y/2	Petrol-electric set	2
5J/2294	Accumulator 12 volts 25 Ah.	6
5A/2023 to 2057	Tester generator, bench type	1
5U/1273 - 4	Generator, type RC (12V, 500W DC and 80V 500W AC)	1
5J/2284	Accumulator 12 volts 40 Ah.	1
42Y/200	Thermal meter	3
5C/1268	Control panel, type 3	2
10AB/6	Extracting tool, type 2	2
1H/6	Contact cleaner No.1	2
	Test lamp for detonator 12V	6
	Test lamp for detonator 24V	6
1H/51	Spring adjuster No.1	2
1H/52	Spring adjuster No.2	2
10SB/113	Switch tester	2
10H/6226	Bench test connecting set, type A.R.I.5506	1
	Comprising	
	Connector,	
10H/6219	1. Type 1676 Sextomet 4, 1 socket W.154	1
10H/6220	2. Type 1677 Dumet 19, 1 socket W.165	1
10H/6221	3. Type 1678 Quadrumet 4, 2 sockets W.310	1
10H/6222	4. Type 1679 Quadrumet 4, 2 sockets W.310	1
10H/6223	5. Type 1680 Cable Form 7, 2 sockets W.160	1
10H/6224	6. Type 1681 Uniradio 4, 2 sockets Pye 213	6
10H/6225	7. Type 1682 Uniradio 1, 2 sockets Pye 214 (for Eureka only)	
10H/6389	8. Type 1717 Cable Form 5, 2 sockets W.164	[illegible]

DAILY INSPECTION

78. Before commencing the daily inspection, examine the S.E. log for details of performance on the last flight and take note of any defects reported. A daily inspection report form (see specimen, fig.32) should be obtained from the Signals Officer (R.D.F.). As the tests are made, the Daily Inspection Report form must be filled in, after the manner indicated in the specimen.

Item tested	Procedure	Action
(i) Aerials	(a) Inspect supports and bollards. Check that aerials are straight, clean and rigid, and that bollards are clean, and the sealing intact. (b) Remove co-axial sockets from RED, GREEN and MAUVE plugs on transmitter-receiver, and megger sockets between inner and outer. It is desirable that the insulation resistance should be better than 10 megohms, but an insulation resistance of 2 megohms is allowable.	Repair if damaged.
(ii) Control panel	(a) See that the fuses in the control panel, type 3 are intact, and that two spare fuses are in their holders. Disconnect sockets SK_1, and SK_2, see fig.30, from the control panel, type 3, and connect the leads from the external accumulator and the petrol electric set. WARNING. The aircraft battery must not be used for these tests.	Replace blown fuses.
(iii) Cables	(a) Check that the remainder of the cables are connected according to the colour code. (b) Check that cable grips (Stores Ref.10H/1774) are in position and tightened up on all co-axial sockets. Check that end rings, and locking rings on all W-type plugs are firmly locked, and that the cable is in a good condition where it enters the plug.	Make good any defects.
(iv) Fixings	(a) See that all the units are firmly held in the trays.	Tighten any loose retainers.
(v) Volts	(a) Start up the petrol electric set. Switch on the equipment at the control panel and at the control unit and allow one minute for warming up. Using test meter, type H, check the D.C. voltage across pins 3 and 4 of the spare 4-pin plug on the control panel. Voltage should be 24 volts ± 2 volts or 12 volts ± 1 volt. (b) Using the thermal voltmeter, type 42Y/200, check A.C. voltages across pins 1 and 2 of the 4-pin plug on the control panel type 3. Voltage should be 80 volts ± 1 V. Vary the speed of the petrol electric set and check that the A.C. voltage does not vary by more than 2 volts in either direction. Disconnect meter.	If A.C. voltage is not correct replace voltage control panel. If a rectifier instrument is used, such as an avometer, the reading should be 79 V ± 1 V. Rectifier instruments should be checked weekly against a thermal meter for accuracy of calibration. The tests must always be made with the control panel on load i.e. equipment switched on.
(vi) Control unit type 222	(a) With the MAIN switch on, check that the appropriate lamps light up, and that the selector motors in transmitter-receiver rotate when successive buttons are depressed.	Replace all lamps which do not light, using the extracting tool provided. Stores Ref.10AB/6. Should selector motor fail to rotate, replace the control unit, type 222.
	(b) Check that operation of transmitter on-off switch does switch on and off the transmitter. Leave the transmitter on.	If the switch fails to switch on or switch off the transmitter, replace the control unit. If operation is still unsatisfactory, replace the remainder of the equipment.

Item tested	Procedure	Action
(vii) Indicator	(a) Check operation of blue, yellow and red control knobs, and adjust preset controls where necessary. Check that indication is normal for all positions of white selector switch.	If large errors are present, remove indicator unit and transmitter-receiver to test bench for adjustment. NOTE: Wherever possible, the same transmitter-receiver and indicator should be kept together, i.e. if one or the other is unserviceable, both should be replaced, and bench tested together.
	(b) Place T.G.R.I. 5509 in line ahead and check that indications are exactly symmetrical.	If not, re-examine aerials and leads.
(viii) Transmitter-receiver	(a) Check that switch-motor is running evenly and that valves are alight.	
	(b) Check that transmitter is operating by observing presence of marker on indicator for all positions of control unit.	If absent, remove equipment (except control unit) for bench test.
(ix) R.F.	(a) Using wavemeter W.1432 check frequency for all settings of control unit, this must be correct to ½ division. For setting up the W.1432 see notes para.98. AL.1. Frequency must be checked after 10 minutes warming up.	If frequency not correct adjust with tool provided.
(x) Destructors	(a) Remove the supply sockets from their respective stowages and connect a test lamp across each in turn. Check each pair of firing switches in turn. The lamp should light only when the firing switches are depressed. Replace the sockets in their respective stowages.	If the lamp fails to light, or lights when the switches are not depressed, a careful check of the switches and wiring must be made and all defects repaired.
	(b) Place tumbler switch in LIVE position. Turn the knob on top of the inertia switch to TRIP and trip the switch. The pair of pilot lamps should light. Turn the knob on top of the inertia switch to SET and reset the inertia switch. Place the tumbler switch to the SAFE position.	If the lamps fail to light, change the lamps. Should this have no effect the wiring and the switches should be minutely examined and all defects repaired.
	(c) Disconnect leads from accumulator and petrol electric set and reconnect as in fig.1.	
	(d) Finally, run up the engines of the aircraft and re-check the voltages and indications.	

Complete the daily inspection report form and return it to the Signals Officer R.D.F.

MINOR INSPECTION

79. Remove the following units from the aircraft and set up for bench tests as described below:-

Control Panel
Transmitter-receiver
Control unit
Indicating unit

80. Make an especial check of all aerial structures, with particular attention to cracks, flaws and bends in the aerials or their supports. Replace or repair any suspected portion, and renew protective coverings. Clean the aerial rods, and coat with D.T.D./279, Stores Ref. 33C/584-585-576.

81. Check the connection of all co-axial and multiple sockets to ensure that they are firmly attached to the cable and that locking nuts and grips (Stores Ref. 10H/1774) are correctly assembled.

82. Use the insulation resistance tester, and testmeter, type H (avometer) to check insulation and continuity of all interconnecting leads. Insulation should be:-

Co-axial leads	20 megohms
Multicore cables	10 megohms

83. Replace any cables whose insulation after treatment is lower than the above values.

84. Replace a serviceable set of units in the aircraft and make a complete daily inspection.

85. Flight test the apparatus, the functioning of the equipment being checked in flight by an officer or senior N.C.O.

MAJOR INSPECTION

86. Repeat minor period inspection.

87. Carry out full test using the T.G.R.I.5509 in various positions.

88. Make a thorough check of all aerials and feeders, and change any that show signs of damage. If overall performance test shows an installation to be defective, or if an installation has been reported poor in performance, and it is known that the instruments are in good order and correctly adjusted, it is evident that the fault lies in the aerials or the cabling. Tests made with meggers, and tests for D.C. conductivity of cables do not always give a reliable guide to performance on R.F.

89. An overall performance test of a complete cabling and aerial installation is therefore a much more reliable check on the conditions of cables than megger and continuity tests on the cables themselves.

90. In the absence of any other means a rough check may be made on a transmitter by holding a screw-driver to the end of the transmitter aerial element. A good spark should be obtained. No shock will be felt. If the spark is weak compared with that obtained on other aircraft, and the installation has been in service for six months or more, it is advisable to replace the Uniradio 4 cable. If the overall performance is down, but the transmitted signal is strong, and the instruments are known to be in good order, and correctly aligned with each other, the receiving aerial system should be carefully examined for deterioration. Stubs or radiators should be disconnected as necessary, and megger and conductivity tests should be made to isolate the defective sections.

91. Details of dimensions of aerials and feeder cables for various aircraft are given in the document entitled AIRBORNE AERIAL AND CABLING INSTALLATIONS.

GENERAL NOTES ON INSTALLATION

92. It is of the utmost importance to efficient operation of the equipment that the following general procedure should be followed in installing and maintaining the aerials and feeder cables. The cables used are Uniradio No.4 (equivalent to PT5M or PT5C).

(i) Polystrene cement or durofix should be used throughout the installation for sealing connection ends of the Uniradio No.4 cables. It is prepared by dissolving clean distrene (swarf may be used) in XY101 Xylene or benzene. Open ends of the cables should be sealed after cutting to prevent the absorption of moisture.
(ii) Compound 998 (Stores Ref.10AB/721) should be used for filling all aerial bollards and insulators except where special cable terminations are used. Compound 667A (Stores Ref.10AB/1124) should be used for sealing the flanges of bollards and filling bolt holes, crevices, etc.
(iii) Connection ends of feeder cables should be tinned before assembly where practicable, care being taken to avoid melting and damaging the dielectric.
(iv) Coaxial (Pye) type plugs and sockets should be well coated with lanolin (woolfat) around spigot faces after assembly.
(v) Uniradio No.4 cables need not be bonded, but should be protected by means of tape from abrasion where cleated to the aircraft frame. Sharp bends should be avoided.
(vi) Aerial supports should make good electrical contact with aircraft skin.
(vii) All cable sleeves are to be sealed and covered with Pernax tape, to prevent moisture penetration on to the cable.

W-PLUGS AND SOCKETS

93. Trouble has been experienced in special installations due to the ingress of water into W-type plugs and sockets causing corrosion.

94. This defect can be avoided by filling the plug and socket with either lanolin (woolfat) (Stores Ref.33C/511) or Berry Wiggins' compound 998 (Stores Ref.10AB/721). In view of the difficulty in packing compound 998 around the plug, the following method is recommended.

(i) Plug - The front of the plug is to be half filled with lanolin.
(ii) Socket - Unscrew the end ring of the socket to allow access to the cable form connection to the socket spills. Pack compound 998 firmly around these spills and replace the end ring. Screw up firmly C-spanner or strap wrench.
(iii) Assembly. Screw the socket on to the plug, thus forcing the lanolin into the socket openings. Remove all excess lanolin from the exterior of the plug and socket.

95. In tropical climates, where temperatures in excess of 30 deg.C may be encountered, it may be found necessary to fill the plug with compound 998, due to the tendency of the lanolin to run out under such conditions.

96. A C spanner should be used for firmly tightening the end rings. Should this not be available a strap wrench should be used.

BENCH TESTS

97. In the maintenance of this equipment, log books recording the history of each installation must be kept.

98. Calibration of signal generator, type 51, and wavemeter W.1432 against the W.1433. Before proceeding with the testing of Rebecca Mk.II it is desirable to check the calibration of the signal generator, type 51 and the wavemeter type W.1432 against the crystal checked wavemeter W.1433. This may be done as follows:-

Signal generator, type 51

(i) Connect the output lead from the signal generator, type 51 to the socket provided on the wavemeter, type W.1433.
(ii) On the W.1433, set the CRYSTAL switch to the ON position, set the C.W./M.C.W. switch to TRANSMIT C.W. and RECEIVE. Turn the PHONES switch to the appropriate position according to the impedance of the phones employed. Set the MAINS switch to ON.
(iii) Let us suppose that the spot frequency required is 214 Mc/s. By reference to the calibration chart supplied with the W.1433 turn the dial of the wavemeter to the approximate setting for 212 Mc/s. The exact dial setting can now be found by listening to the crystal 'pip' on the telephones and tuning to zero beat. The crystal calibrating 'pips' should be heard at intervals of 4 Mc/s. This tuning procedure should next be repeated for a frequency of 216 Mc/s. The wavemeter dial setting for the spot frequency required i.e. 214 Mc/s may now be obtained by interpolation. Turn the CRYSTAL switch to the OFF position.
(iv) Switch on the signal generator, type 51, and set the modulation selector switch to the C.W. ON position. When the tuning dial of the signal generator is adjusted to a position giving zero beat in the telephones, the output frequency should be 214 Mc/s. Note any change in the calibration of the signal generator.
(v) A similar procedure should now be employed to check the calibration of the signal generator at the other spot frequencies of 219, 224, 229 and 234 Mc/s.

Wavemeter, type W.1432

(a) Connect the lead from the input plug on the W.1432 to the plug on the W.1433.
(b) Set the MAINS and the CRYSTAL switches on the W.1433 to the ON position and switch on the W.1432.
(c) Using the crystal check oscillator, adjust the W.1433 to give frequencies of 214 Mc/s etc. and note the corresponding positions on the dial of the W.1432.

NOTE:- During these operations the ATTENUATOR control on the signal generator and the SENSITIVITY control on the W.1432 should be adjusted to positions giving the most accurate indication of resonance.

99. The units removed from the aircraft should be set up on the bench for test purposes. A petrol electric test set may be used as a source of power.

100. Remove the dust covers and detonators from the units. Inspect for any visual signs of deterioration and accumulation of dust. See that the fuses in the control panel are intact, and that there are two spares in the holders.

101. Check that the alternator used on the petrol electric test set is of the same type as that used in the aircraft. Start up the petrol electric set, switch on the apparatus at the voltage control panel and at the control unit. See that the valves light up and that the switch motor is running. Listen for any indication of irregular running of the motor.

102. Check the voltage on pins 3 and 4 of the spare W-plug on the control panel. It should be 12 or 24 volts ± 10 per cent with pin 4 positive. Measure the A.C. voltage between pins 1 and 2 by plugging in thermal meter. It should read 80 volts ± 1 volt. If the voltage is not correct adjust as follows:-

103. Control panel, type 3. IN NO CIRCUMSTANCE SHOULD THE (COMPRESSION PLUG), (SEE FIG.33) AT THE END OF
A.L.1. THE PILE FURTHER FROM THE TERMINAL BLOCK ON THE REGULATOR BE ADJUSTED, EXCEPT IN THE CASE DESCRIBED IN PARA.104

(i) By means of a very short screwdriver remove the stop screw (if fitted) located in the centre of the end of the carbon pile nearest the panel.
(ii) Slacken the two locking screws and rotate the core (which is provided with a screwdriver slot). Clockwise rotation will reduce the voltage, and counter-clockwise will increase it. (Note that a small movement of the core will vary the voltage by a considerable amount).
(iii) After setting to the correct voltage tighten the two locking screws.
(iv) Cut off the unthreaded portion of the stop screw and replace it.

104. The output voltage will tend to rise over a running period of 250 to 300 hours, due to shrinkage in the pile. If this is found to be the case, the cover of the pile should be removed thus exposing two screws, the larger of which is the compression screw (provided to take up pile wear) and the smaller is the locking screw. The locking screw should be slackened, and the compression screw rotated clockwise until the correct A.C. voltage is obtained. (Only a small movement is needed, not exceeding one tenth of a turn). The locking screw should be tightened and the cover replaced. The various cable connections should be examined to see that they are sound and tight. IN NO CIRCUMSTANCE SHOULD THE CONTROL PANEL BE RUN WITH A LOAD LESS THAN ABOUT 120 WATTS.

105. Control unit, type 222. The control unit should be removed from its case, and all connections and contacts inspected. Check that all lamps are intact, replacing those that are unserviceable.

106. Transmitter-receiver. A close mechanical inspection should be made of all units, particular attention being paid to the wiring to the terminal blocks on the underside of the chassis. All coaxial sockets should be firmly held in their respective plugs. Check that the retainers are in position. An inspection for deterioration in the cables should be made particularly where the cables enter the sockets. Check that all units are fixed rigidly on to the assembly chassis.

107. Marker pulse. If it is required to remove the marker pulse, this should be done by connecting the marker pulse lead to earth. For this purpose, tag 1 on the terminal strip M is earthed. To remove the marker pulse therefore, disconnect the lead from tag 2, and re-connect to tag 1.

108. Selector switch. Should the turret mechanism fail to operate correctly, and it is known that the control unit is functioning properly, the selector switch should be examined. Before attempting to remove the selector switch, it should first be inspected for any obvious defects, i.e. any of the rotating parts fouling the supports, or "play" between the turret and the driving shaft. If further investigation is required, it will be necessary to remove the selector switch from the unit in which it is housed. First remove the unit concerned from the main assembly chassis, and substitute a serviceable one.

109. The procedure for removing the selector switch is different for the transmitter unit and the receiving unit.

(i) Transmitter Unit: Remove the modulating valve V3 and unscrew the bracket supporting the condenser C1. Unscrew the six screws on the bracket supporting the selector switch. The switch may now be withdrawn rearwards.
(ii) Receiving Unit: Remove the top and both side covers, all of which are retained by four screws. Remove the six screws on the bracket supporting the selector switch, which may now be withdrawn from the underside.

110. The switch should first be examined, particular attention being paid to the rotating parts and all soldered joints. A check that the mechanical operation of the switch is correct may be made by pushing the armature up against the winding and then releasing it. The ratchet wheel should move round one tooth at a time. If the pawl remains engaged with the same tooth all the time so that the wheel oscillates when the armature moves up and down, the restraining spring is not preventing backward rotation and should be adjusted. If the mechanical operation is found to be correct, the fault may be in the contact springs or the other components. The following table gives a guide to probable causes of the symptoms observed in a defective switch.

Symptom	Possible cause	Action
(i) Switch fails to rotate	(a) Interrupter contacts not making	Reset with spring adjuster.
	(b) Coil burned out	Check with avometer. Substitute new selector switch if coil is discontinuous.
	(c) Condenser C_1 down	Check with avometer. Replace condenser if faulty.
	(d) Discontinuity in wiring	Check with avometer. Repair any defects.
(ii) Switch rotates few degrees only	Contacts F failing to make	Adjust with spring adjuster.
(iii) Switch fails to stop	Contacts F failing to break	Adjust with spring adjuster.

111. After repair, the switch should be carefully replaced in its unit, and the unit mounted on an otherwise serviceable chassis. Connect up the complete set and check that the operation is correct.

Switch unit, type 115

112. General. NO ONE SHOULD ATTEMPT TO ADJUST OR DISMANTLE A SWITCH UNLESS HE HAS THOROUGH WORKING KNOWLEDGE OF THE PROCEDURE. If any doubt is felt, it is better to fit a new one.

113. Contacts. Remove cover and examine all contacts carefully. The rounded contacts should sit squarely on one another. The contacts should be clean and not contaminated with oil, graphite or flux. If the contacts require cleaning use a contact cleaner No.1, Ref. No.1H/6. This tool is provided with a spoon shaped end, the internal surface of which is slightly roughened to remove dirt and oxide from the contacts. The tool should be inserted between the contacts with the roughened surface over the contact to be cleaned and moved backwards and forwards. A solvent to help remove dirt may be used with advantage; suitable solvents are carbon tetrachloride, or aviation spirit.

114. Cams and push rods. The cams should not be overlubricated as otherwise oil is likely to be deposited on the contacts. The lubricant to be employed is a mixture of anti-freezing oil (to specification D.T.D.201) and graphite oil dag. The push rods should be clear in the holes in those springs etc. through which they pass. If there is fouling the switch should be replaced.

115. Springsets. The adjustment of the springsets is especially delicate and tedious; it should be undertaken with great care, and in general, only if replacements cannot readily be had. The first requirement in adjusting the springsets is for the two moving springs in each set, which are not operated directly by the push rods, to sit on the insulating buffer blocks when not making contact with the actuated springsets, and to be lifted clear of the block when making contact. In general, this will ensure that adequate contact pressure is being maintained. If this condition is not found to be correct, the springs concerned should be adjusted with the spring adjusters; bending should be done by moving the tool smoothly with a stroking motion along the spring blade.

116. The second requirement is that the angles over which contact is made shall be right for the springsets. The aerial contact should "make" for a period corresponding to 80 - 85 deg. of rotation of the camshaft, and the output contacts for 100 - 110 deg. of rotation. This means that the output springs are both "making" together for 10 - 20 deg. of rotation. During this overlap period the aerial contact must change over. To measure the angles of contact the switch must be removed from T.R.3173 by unscrewing the four bolts holding it to the front panel of the unit, and disconnecting the feeder from the transmitter socket. Switch tester, Ref. No.10SB/113, is supplied for testing the contact angles; it consists of a plate marked in degrees from 0 to 360 deg. with the necessary screws for fixing it, and a small transparent pointer, on to the switch. The black markings in the middle are for a stroboscopic check of the switch speed but normally will not be used on switch 115 where the speed is not critical. The engraved plate is fixed to the end of the camshaft on the side remote from the feeder outlet and held in position by the 8 B.A. screw supplied. The pointer is screwed on to the switch frame and spaced from it by the special collar also supplied. The closing and opening of the contacts should be observed on an Avometer on its resistance range 0 to 1,000 ohms, or by a battery and lamp continuity tester. The switch should be slowly rotated by hand always in the same direction and the angles of contact noted down in the form of a table; the two angles connected by a dash in the table below, of results of a typical test, indicate a closed or "make" period in each case.

	4th Quad.	1st Quad.	2nd Quad.	3rd Quad.	4th Quad.	Differences
Red		80———163		260———342		(83, 82)
Green	350———73		170———253		350 ——→	(83, 83)
Q2	338 ———	82,160 ———		264,338 ———	——→	(104, 104)
Q3		68		176 248	355	(108, 107)

One revolution of camshaft.

The contact angles of the other spring sets are not important in T.R.3173 as they are not used. It will be seen by inspection of these results taken on a typical switch, that the contact periods given by the differences in the end column are within the limits 80 to 85 deg. for aerial contacts, and 100 to 110 deg. for output contacts. Moreover, it will be seen that the aerial changeover is completed within the output overlap. This is emphasized by the way the figures within the dotted lines are spaced out.

117. If a switch does not pass this test the contact angles should be adjusted by suitably bending the springs with the spring adjusters. No attempt should be made to unlock the cams on the camshaft; if adjustment of the spring sets does not give the right results a new switch should be obtained, and the old one returned in exchange.

118. Governor. This requires no adjustment or oiling, and should not be tampered with.

119. Bearings. The two ball races on the mainshaft and the bearings on the camshaft should be lubricated, when necessary, with anti-freezing oil (D.T.D.201).

120. Worm wheel. One or two drops of oil dag may be placed on the worm wheel when required. Only the minimum necessary quantity of lubricant must be used, and care taken that it does not get on to the contacts.

121. Motor. The motor may be removed for inspection or replacement by removing the four countersunk bolts securing it to the frame of the switch. The motor can then be withdrawn. The insulating coupling may then fall out on some models of the switch; this should be put aside for assembly later.

122. In general it is not recommended to adjust or service the motor. Where this is attempted it should be by skilled persons, and a motor that has been serviced should be replaced by a new one at an early date. The following procedure is described for emergency use only.

123. The driving shaft of the motor should rotate freely and there should be no rough spots or stiffness; equally there should be no undue side or endplay in the shaft. Before dismantling the motor inspect the commutator and carbon brushes. The carbon brushes are mounted at the end remote from the shaft either in paxolin or bakelite holders. In either case they are removed by undoing a screw. After withdrawing the brushes inspect the commutator through the hole using a good light e.g. bright daylight or an electric torch. If the commutator requires cleaning it is often possible to do this with a small piece of rag soaked in carbon tetrachloride introduced on a match stick. Alternatively, very small strips of glass paper may be used. Emery paper is not recommended. When replacing, take care that the brush is put in so that the concavity worn in it fits back again in to the commutator. When replaced, the brushes should move freely in their holders and not chafe on the sides. The brush holder itself should not touch the commutator.

124. To dismantle the motor for lubrication or to check the internal wiring undo the nuts AA securing the end plate. The armature and end plate can then be withdrawn. To separate the armature from the end plate, push out the small pin through the driving shaft, to allow the shaft to be drawn through the bearing. In performing this operation collect the balls from the ball race which usually fall out. The dismantling should preferably be performed over a large sheet of black paper or cloth. To lubricate the ball races use a very small quantity of high melting point grease. Vaseline must not be used as it melts far too easily.

125. When reassembling, make sure the brushes have been removed before fitting the armature, in position. The end plate should be tightly done up and the pin through the shaft replaced. Finally, the brushes should be reinserted. When putting the motor back into the switch assembly make sure that the pin through the shaft engages correctly with the insulating coupler, which is keyed to accept it. It is important too, that the contacts on the motor make firm contact with the springs which supply the current.

126. Suppressor unit. This should be checked against the circuit diagram in fig.10 using an Avometer. Any condensers in the interference suppressor which have broken down should be replaced.

Frequency calibration of transmitter.

127. The equipment should be set up on the bench and connected as shown in fig.34. Connect the transmitter output plug either to the correct aerial or to a 47-ohm terminating resistor. Couple the pick-up probe of the W.1432 as loosely as possible to the transmitter consistent with obtaining a satisfactory reading and observe the frequency directly on the calibrator dial. If necessary, tune the transmitter turret condenser by means of an insulated tool provided but always re-check the frequency after tuning.

NOTE:- During these tests, it is essential that the pick-up probe should be held rigidly.

Measurement of transmitter power output and observation of pulse shape

128. The layout of test equipment for the measurement of power output of T.R.3173 is shown in fig.35. The transmitter output is led through a length of Uniradio No.4 cable to the 47 ohms input plug of the test set 138. The range selector switch of the test set should be at RANGE II 47 ohms. The output from the test set consists of a triangular pulse which can be viewed on the test set, type 43. In order to measure power, the WATTS potentiometer is turned in a clockwise direction until the triangular pulse just disappears. The power output of the pulse can then be read off directly on RANGE 2. The reading should be at least 300 watts. The test should be repeated for all settings of transmitter frequency available at the control unit, type 222.

129. The transmitter pulse shape can be checked by turning the range selector switch on the test set, type 138 to PULSE SHAPE - the connexions being unaltered. The envelope of the pulse can then be observed on the test set, type 43 and its width read off the scale. It should be about 0.5 miles wide, calibration pips being provided from the test set, type 165. The transmitter pulse width can be set by adjusting the iron core of L. in the modulator unit. The GAIN control of the test set, type 138 should not be advanced beyond the point where V_3 (in the test set) overloads.

Frequency adjustment of receiver

130. When the receiver is correctly aligned the local oscillator stage should be tuned to a frequency such that its second harmonic is exactly 13½ Mc/s above the frequency of the incoming signal. Two methods are available for adjustment of the receiver, depending on the type of test gear available. Method 1 is the more accurate since it ensures that the local oscillator is tuned to the mid-point of the I.F. response and not to one of the peaks. A source of C.W. at 13½ Mc/s may be obtained from the signal generator, type 51 and the R.F. source for adjusting the oscillator may be obtained from the wavemeter W.1433. The signal generator, type 51 should be used for aligning the R.F. stage.

131. Method 1

(i) Oscillator stage. Set up the apparatus on the bench as indicated in fig.36, connect the power supply and switch on. Press the button on the control unit corresponding to the spot frequency required. Adjust the gain of the receiver to normal with approximately 1 cm. of noise. Loosely couple a source of C.W. at
A.L.1. 13½ Mc/s to the grid of the valve V_1 on the [illegible] unit. Feed into the aerial plug unmodulated R.F. from the W.1433 at the spot frequency required and adjust the oscillator trimmer (screw P) by means of the insulated tool until zero beat frequency is obtained between the 13½ Mc/s signal and the I.F. frequency. Always check resonance after tuning by varying the frequency of the signal generator. The position of resonance is ascertained by observing the receiver output on the indicating unit. As resonance is approached a sinusoidal output is seen falling in frequency and rising in amplitude until a sudden dip at null frequency occurs at the resonance point. In general, the adjustment is too critical to obtain a setting exactly at this point but a setting at the minimum frequency will give an accuracy of better than 10 Kc/s. This completes the alignment of the oscillator stage. Remove the source of 13½ Mc/s.

132.

(ii) R.F. stage. The apparatus should next be arranged and connected as indicated in fig. 37. A pulse at the required frequency is fed into the R.F. stage from the signal generator, type 51. Tune the R.F. trimmer (screw Q) until a maximum signal is obtained, as viewed on the indicating unit. Check frequency after tuning.

133. Method 2. Oscillator stage. If it is found that the signal generator, type 51 does not provide the desired frequency of 13½ Mc/s, it will be necessary to align the receiver using conventional methods, taking especial care to set the local oscillator to give a maximum signal in the middle of the I.F. response curve. A pulsed R.F. signal at the required spot frequency is fed into the aerial input plug, and the oscillator tuning adjusted to give maximum signal output. Shift the R.F. signal frequency above and below the spot frequency until the signal output falls to 6 db. down on its maximum value, noting the two frequencies at which this occurs. If these frequencies are symmetrical with respect to the spot frequency, the oscillator is adjusted to the mid-point of the I.F. response. If the frequencies are not symmetrical the oscillator should be re-adjusted until the frequencies for 6 db. down on the spot frequency output are symmetrical about that output.

134. R.F. stage. Align the R.F. stage as indicated in para. 132.

Measurement of receiver sensitivity

135. Fig. 37 shows the layout of the test equipment for the measurement of the receiver sensitivity. The test set, type 138, is selected to positive SYNC, the triggering pulse being taken from the transmitter. This pulse is also used to trigger the time base in the indicating unit. The delayed pulse from the test set, type 138, is used to modulate the signal generator, type 51, which must previously have been set up as described in S.D.0338, Chap.7 to give 0.1 volts output at the required frequency. The signal generator output is fed to the port aerial terminal (RED) on the receiver, the receiver outputs being connected to the indicating unit in the normal way. The DELAY control, on test set, type 138, should be adjusted so that the receiver output is displayed at a convenient position on the time base, and then the ATTENUATOR control in the signal generator turned clockwise until the blip on the indicating unit is just equal to twice noise level The GAIN on the indicating unit should be successively turned up as the attenuation is increased. When the signal just equals twice noise level the input should be less than 10 microvolts i.e. the total attenuator reading should be greater than ~~86 dB. below 0.2 volts.~~ The test should be repeated with the R.F. input to the receiver taken via the starboard aerial terminal (GREEN). The complete procedure should be repeated for each available receiver frequency, in each case the signal generator, type 51, being set up to the appropriate frequency. The sensitivity should be approximately the same in each case. A.L.1.

Range calibration of indicating unit

136. The layout for range calibration of the indicating unit, type 6E is given in fig. 38. For the setting up of modified indicating units, type 6E refer to Appendix 3. AL 1.

(i) Connect the lead from the yellow plug of the transmitter-receiver to the yellow or orange plug on the indicator.

NOTE: The indicator should always be checked with the transmitter receiver with which it is intended to be used.

(ii) Connect the other yellow lead from the transmitter-receiver to the orange plug on the test set, type 165 or type 76.
(iii) Connect the + OUTPUT of the test set, type 165 or type 76 to either the black or blue plug on the indicator.
(iv) Connect the required power supply to the test set and adjust brilliance and focus controls on the indicating unit to normal settings.
(v) Turn right-hand knob of indicator to 9, put test set on position 3.
(vi) Turn VR_2, VR_3, VR_4 and VR_5 fully counter-clockwise and turn VR_2 until the zero mark is at the commencement of the trace.
(vii) Set VR_9 so that the beginning of the trace is at zero.
(viii) Set VR_6 so that the 9th mark is on the end of the trace.
(ix) Set VR_3 so that the 9th mark is opposite 9 on the scale.
(x) If the indication does not reach the end of the scale, operate the switch S_2.
(xi) Set the right-hand knob to 36 and test set 165 to position 4 on RANGE II. Turn VR_7 so that the 9th mark is on the end of the trace.
(xii) Set VR_4 so that the 5th mark is opposite 20 on the scale the 9th mark should then be opposite 36 on the scale.
(xiii) Turn right-hand knob to 90, and switch test set 165 to position 5 on RANGE II. Adjust VR_8 until 9th mark appears just at the end of the trace. If the 9th mark cannot be brought on to the trace, VR_2 should be adjusted.
(xiv) Adjust VR_5 so that the 9th pip is opposite 90 on the scale.
(xv) Tighten locking screws on all controls.
(xvi) Set VR_{12} so that indication coincides with vertical scale line.

NOTE: If a visor is used in the aircraft these adjustments should be made with the visor in position.

FAULT FINDING

137. When an installation becomes defective, the first step in tracing the source of the trouble is to determine whether the fault is in the instruments or the cables. Much can be deduced from indications obtained, and tests should follow a logical sequence.

138. Faults are more likely to occur at points which are subject to handling or movement than in components or connections which are not disturbed in the instruments themselves.

139. The following tables give the normal working voltages on the various valves in the units. Variations of as much as 25 per cent may occur between different units. Where two readings are given these are taken with the GAIN control at its maximum and minimum positions.

TABLE OF VOLTAGES

Transmitter receiver T.R.3173 and T.R.3173A

UNIT	VALVE	V_H	V_A	V_S	V_c
Modulator	V_1	6.3	70	Strapped to anode	6.9
	V_2	6.3	410	300	6.0
	V_3	6.3	410	Strapped to anode	7
Receiver	V_1	6.3	165 180	Strapped to anode	Connected to chassis
	V_2	6.3	200 230		.8 1.0
	V_4	6.3	160 230	140 0	1.0 0.1
Amplifier gain max. min.	V_1	6.3	185 230	140 0	1.0 0.1
	V_2	6.3	180 230	140 0	1.0 0.1
	V_3	6.3	160 180	200 220	1.5 1.6
	V_4	6.3	90 160	200 220	1.4 1.6
	V_6	6.3	140 110	200 220	1.4 1.6
	V_7 & V_8	6.3	200 230	Strapped to anode	30 40

UNIT	Strip P Terminal No.	Voltage
Power unit	1	Connect to chassis
	2	6.3 a.c.
	3	230
	4	410
	5	80 V. a.c. across 5 and 6
	6	
	7	
	8	
	9	1,800 - ve to earth
	10	2,500 - ve to earth

Indicating unit, type 6E

VALVE	V_H	V_A	V_S	V_c
V_1	6.3	15 to 20	75	Connected to chassis
V_3	6.3	180	Strapped to anode	16 to 20
V_4	6.3	300	Strapped to anode	5
V_5	6.3	360	50	Connected to chassis

Note. Heater voltages measured with a thermal voltmeter should be 6.3V. Measured with an avometer, the indicated voltage may be 5.8 to 6.1 volts.

APPENDIX 1

CONCISE DETAILS OF A.R.I. 5506

Radio frequency	5 spot frequencies 214, 219, 224, 229 and 234 Mc/s.
Pulse repetition frequency	300 pulses per second.
Pulse duration	4 microseconds.
Transmitter peak power output	Not less than 300 watts.
Receiver sensitivity	An input of 10 μ V on the aerial feeder produces a signal equal to twice noise level.
Indicating unit, ranges	3 ranges, 0 to 9 miles, 0 to 36 miles and 0 to 90 miles.
Power supplies	TR.3173* 80V, 1000 to 3000 and 12 volts D.C. TR.3173A* 80V, 1000 c/s and 24 volts D.C.
Power consumption	200 watts A.C. and 15 watts D.C.

Table of weights and dimensions

Apparatus	Wt. in lb.	Approximate overall dimensions in inches		
		Height	Width	Depth
T.R.3173	47	8	13½	18
Control unit, type 222	3	6½	4½	4 AL. I.
Indicating unit, type 6E	18	7⅞	9	18
Control panel, type 3	17	8	9	13

Overall wt. installed in aircraft, including aerials and connectors.................................160 lb.

* A tapping is also included for operation from supplies of 115 V., 800 c/s. for use in certain types of American aircraft.

APPENDIX 2

LIST OF PRINCIPAL COMPONENTS
(PROVISIONAL)

Reference should be made to AIR PUBLICATION 1086 for a complete list.

	Stores Ref.	Description	Ref. in fig.8
		A.R.I. 5506	
		Comprising:-	
	10UB/185	Amplifying Unit, type 178	
		Consisting of:-	
	10A/13527	Cap, valve for VR65	
AL.1.	10A/13280	Cap, valve for VR65 including grid stopper.	
		Condenser	
	10C/5683	10 pfd.	C_{32}
	10C/5649	25 pfd.	C_{33}
	10C/4762	50 pfd.	C_8, C_{12}, C_{18}, C_{24}
	10C/4236	200 pfd.	C_4, C_{13}, C_{19}, C_{26}
	10C/2875	0.01 mfd.	C_2, C_3, C_9, C_{11}, C_{16}, C_{17}, C_{22}, C_{23}, C_{28}
	10C/11123	0.01 mfd.	C_1, C_7, C_{14}, C_{21}, C_{27}, C_{31}, C_{38}
	10C/11125	0.05 mfd.	C_{36}, C_{34}, C_{29}
	10C/11127	0.1 mfd.	C_6
	10C/11131	0.5 mfd.	C_{37}
	10BB/2504	Cores for inductances	
	10H/491	Holder, valve. British octal	
	10H/150	Holder, valve. Diode holder, including top clip	
	10AB/1623	Hook, diode retaining	
		Inductance	
	10C/12364	18 turns copper wire on former ½ in. dia. x 1½ in. long	L_6
AL.1	10C/12365	16 turns copper wire on former ½ in. dia. x 1½ in. long	L_3
	10C/12366	19 + 2 turns copper wire on former ½ in. dia. x 1½ in. long	L_1
	10C/12545	12 turns copper wire on former ½ in. dia. x 1½ in. long	L_2, L_4
	10C/12546	1-5 mH	L_7
	10H/528	Plug, S.P. coaxial panel mounting	
		Resistance	
	10C/9487	27 ohms	R_7, R_{16}, R_{22}, R_{29}
	10C/9484	100 ohms	R_8, R_{12}, R_{23}, R_{31}, R_{37}
AL.1.	10C/9495 ~~10C/9483~~	180 ohms	R_{39}
A.L.1.	10C/948	470 ohms	R_{42} to ~~R_{45}~~ R_{44}
A.L.1.	10C 9503 ~~10C/9494~~	470 ~~600~~ ohms	~~R_{43}~~ R_{40}.
	10C/9486	1K	R_3, R_4, R_{11}, R_{13}, R_{18}, R_{19}, R_{26}, R_{27}, R_{33}
AL.1.	10C/9491	3.3K	R_6, ~~R_{40}~~ R_{45}.
	10C/10575	3.9K	R_{32}
	10C/9490	4.7K	R_{14}, R_{21}, R_{41}
	10C/9215	4.7K	R_2
	10C/10579	10K	R_{17}
	10C/9489	15K	R_{24}, R_{28}

Stores Ref.	Description	Ref. in fig.8
	A.R.I. 5506 (Contd.)	
	Comprising (Contd.)	
10UB/185	Amplifying unit, type 178 (Contd.)	
	Consisting of (Contd.)	
	Resistance (Contd.)	
10C/9671	18K	R_{36}
A.L.1 10C/9492 ~~10C/10576~~	100K	R_{34}, R_{38} A.L.1.
10A/13685	Retainer, valve, rubber strap, tropical	
10E/11446	Valve, VR65 screened pentode	V_1 to V_4. V_6 to V_8
10E/105	Valve, VR92 diode	V_5
	Chassis assembly, type 12	Ref. in fig.11
	Consisting of:-	
10H/6263	Connector, type 1694, 3½ in. uniradio 32 Fitted with:-	
10H/NIV	2 sockets, S.P. right-angled entry	
10H/4118	2 sockets, S.P. right-angled entry	
10H/6264	Connector, type 1694, 13 in. uniradio 32	
	Fitted with:-	
10H/NIV	2 sockets, S.P. right-angled entry with metal sleeve for P.T. I.M.	
10H/4118	2 sockets, type 537, S.P. right-angled entry with rubber sleeve for P.T. I.M.	
10H/6265	Connector, type 1696, 5 in. uniradio 4 Fitted with:-	
10H/701	2 sockets, type 213, S.P. right-angled entry	
10H/6266	Connector, type 1697, 15½ in. uniradio 4 Fitted with:-	
10H/701	1 socket, type 213, S.P. right-angled entry	
10H/392	Plug, type W.199, 6 pole, panel mounting (2)	
10H/396	Plug, type W.203, 18 pole, panel mounting	
10H/394	Plug, type W.201, 6 pole, H.T. panel mounting	
10H/391	Plug, type W.198, 4 pole, panel mounting	
10H/389	Plug, type W.196, 2 pole, panel mounting	
10H/528	Plug, type 229, S.P. coaxial, panel mounting (3)	
10H/628	Plug, type 246, S.P. for front and back mounting on panel, coaxial	
10FB/816	Relay, magnetic, 12 - 24 volts operation. 1 pair of contacts make:- 24V. D.C. 2A, or 12V. D.C.4A 1 pair make 80 V. A.C. 3A.	B/2 A.L.1.
10DB/6074	Screw, captive, 1¼ in. long OBA	
10LB/310	Control unit, type 222, push button control for 12 volts working	Ref. in fig.13
	Consisting of:-	
10H/11561	Jack, lamp, type A	
5L/1141	Lamp, filament, 12 volts, jack, type	
10H/396	Plug, type W.203, 18 pole	
10C/10580	Resistance, 100 ohms	
10F/10338	Switch, type 152, single pole, change-over	
10F/716	Switch, type 564, 5 digit switch with push buttons	
	Associated Equipment	
10AB/6	Extractors, type 2, for jacks, lamp	

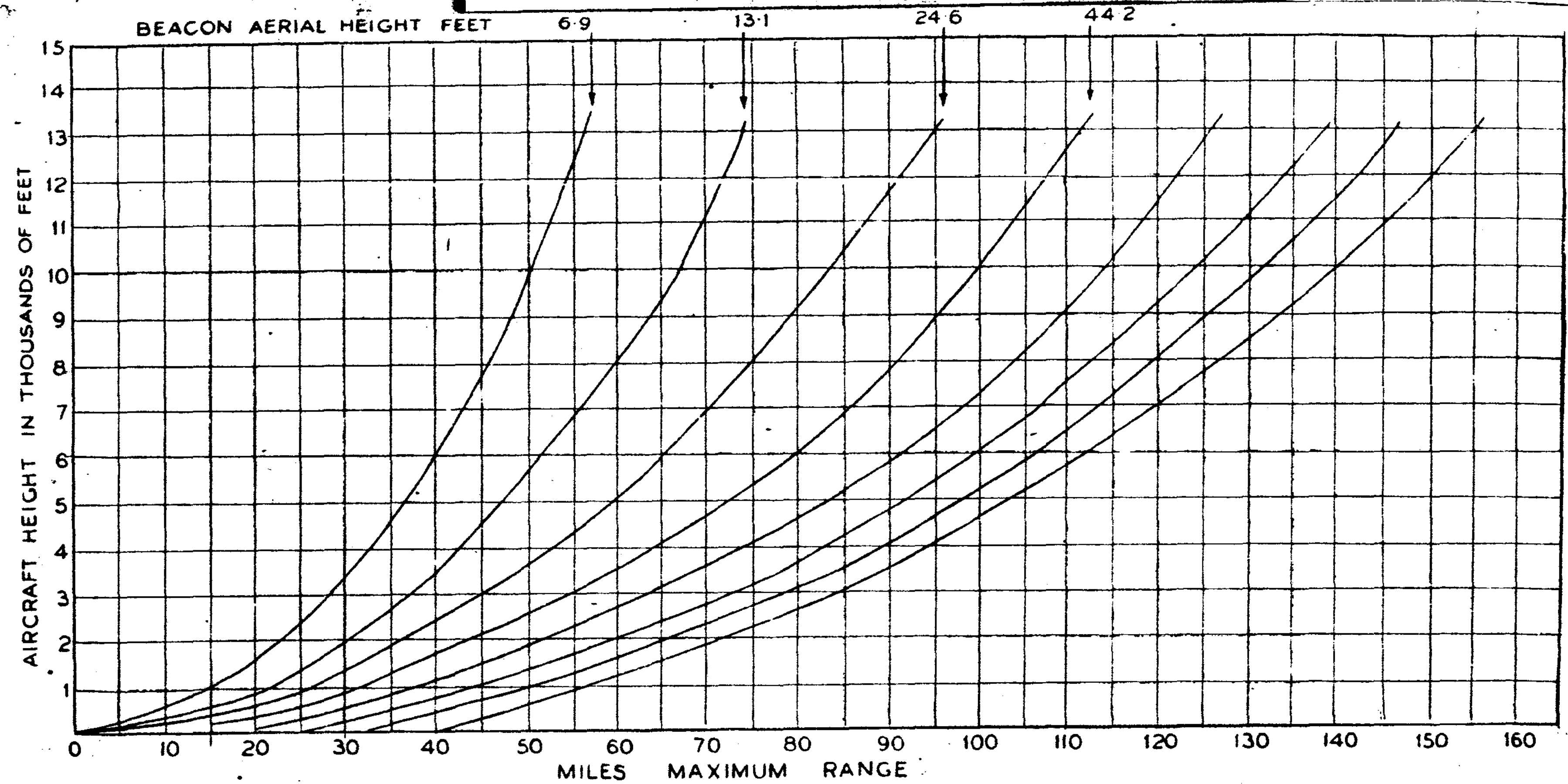
	Stores Ref.	Description	Ref. in fig. 13
	10LB/6010	A. R. I. 5506 (Contd.) Comprising (Contd.) Control unit, type 222A, push button control for 24 volts working Consisting of:- (Contd.)	
	10H/11561	Jack, lamp, type A	
	5L/1702	Lamp, filament, 24 volts, jack type	
	10H/396	Plug, type W.203, 18 pole	
	10C/10580	Resistance, 100 ohms	
	10F/10338	Switch, single pole, change-over (2)	
	10F/716	Switch, type 564, 5 digit switch	
		<u>Associated Equipment</u>	
	10AB/6	Extractor, type 2 for lamps, jack	
	10QB/141	*Indicator unit, type 6E	
			<u>Ref. in fig. 5</u>
	10DB/1029	Modulator unit, type 66 Consisting of:-	
	10A/13280	Cap, valve for VR65	
		Condenser	
	10C/11120	0.001 mfd.	C_2
	10C/11123	0.01 mfd.	C_1, C_5
	10C/11125	0.05 mfd.	C_6
	10C/11127	0.1 mfd.	C_3, C_4
	10C/12368	Inductance - condenser unit, 500 ohms impedance, 2 micro-seconds delay	C_7 to C_{10}
	10C/12367	Inductance	L_1
	10H/491	Holder, valve, British octal	
	10H/493	Holder, valve, International octal	
A.L.I.	10FB/815	Relay, magnetic. 12 - 24 volts operation 1 pair of contacts make:- 24V. D.C. 2A or 12V. D.C. 4A	A_1
		Resistance	
A	10C/9493	220 ohms	R_2
	10C/9488	470 ohms	R_4, R_9, R_{13}
	10C/9494	680 ohms	R_3, R_{17}
	10C/9580	1.5K	R_1
	10C/9496	4.7K	R_{15}
	10C/9217	10K	R_{10}
	10C/10096	47K	R_5
	10C/10428	47K	R_{16}
A	10C/	50K, ± 10 per cent, variable, linear	R_8
	10C/10429	68K	R_{11}
A	10C/9497	270K	R_6, R_{12}
A	10C/9499	1M	R_{14}
	10C/9498	4.7M	R_7
	10AB/3237	Tag boards, type 256. Bakelite 5½ in. x ½ in. x 1/16 in.	
A	10E/11446	Valve, VR65. British octal, screened pentode, top grid	V_1, V_3
	10E/349 or	Valve, 6V8G. International octal, output tetrode	V_2
	110E/90		
	5U/1269	ø Panel, control type 3	

* For list of components see S.D.

ø For list of components see S.D.

Stores Ref.	Description	Ref. in fig.9
	A.R.I. 5506 (Contd.) Comprising:- (Contd.)	
10KB/772	Power unit, type 286	
	Consisting of:-	
10A/12351	Cap, valve, type 2 for VU111	
10C/12369	Choke, L.F. Smoothing, 0.86 henries, 180 mA, 1,000 c/s	L_1
10C/5709	Condenser, 0.1 mfd. ± 15 per cent, 2,500 V.	C_2
10C/11130. ~~[illegible]~~	Condenser, 0.5 mfd. ± 20 per cent, 500 V.	C_3 AL. I.
10C/5799	Condenser, 2 mfd.	C_1
10H/329	Holder, valve. British 5 pin, used as 4 pin	
10H/493	Holder, valve. International octal	
10C/1241	Resistance, 2.5 K.	R_1
10C/7908	Resistance, 1M.	R_2
10A/13510	Retainer, valve, ⅛ in. bakelised canvas ring	
10KB/1016	Transformer, E.H.T. 2½ kV. at 2½ mA. Rectifier heater 4V. 1A Primary: 115V; 80V. at 1,000 c/s.	T_2
10KB/1017	Transformer, heater transformer, 80V. input; 6.5 V. 15A. output, 1,000 c/s.	T_1
10KB/1018	Transformer, 80V. input. Secondary: 450-0-450V., 180mA. Heater: 5V. 3A for rectifier, 1,000 c/s	T_3
10E/146	Valve, VU111. British 4 pin; top anode, half wave rectifier	V_2
10E/373	Valve, ~~[illegible]~~ 5U4G International octal. Full wave rectifier	V_1 AL. I.
		Ref. in fig.7
10PB/73	Receiving unit, type 61, for 12 V. operation	
	Consisting of:-	
10A/13527	Cap, valve, grid clip for English valves, silver plated brass ⅜ in. dia. for VR65	
	Condenser	
10C/3671	2 pfd.	C_8, C_{10}
10C/16	10 pfd.	C_3, C_1
10C/978	15 pfd.	C_7
10C/5649	25 pfd.	C_2
10C/4762	50 pfd.	C_{14}
10C/4760	100 pfd.	C_4
10C/4236	200 pfd.	C_9, C_{13}
10C/2875	0.01 mfd.	C_6, C_{11}, C_{12}
10C/11126 ~~[illegible]~~	0.1 mfd.	AL. I.
10PB/6010	Frequency changing turret	L_1
10PB/6011	Frequency changing turret	L_4
	Holder, valve	
10H/3237	Loctal, ceramic body, 9 pins	
10H/491	British octal for VR65	
10H/150	Diode holder, including top clip for VR92	
10C/4858	Inductance	L_7
10C/12547	Inductance	L_8
10H/528	Plug, type 229, S.P. coaxial, panel mounting	
5X/750	Plug, type M, 2 way, 4 amp.	
	Resistance	
10C/9484	100 ohms	R_4, R_9
10C/9486	1K.	R_{11}
10C/9490	4.7K.	R_8
10C/9496	4.7K	R_6, R_7
10C/9509	10K	R_3, R_{10}
10C/9217	10K	R_{10}
10C/9492	100K	R_2

Stores Ref.	Description	Ref. in fig.7
	A.R.I. 5506 (Contd.) Comprising:- (Contd.)	
10A/13094	Retainer, valve type 19 spring steel for VR91 and CV66	
AL.1. 10PB/6018 ~~[illegible]~~	Selector drive unit, ~~[illegible]~~ for 12 volts operation	
	Valve	
10E/92	VR91, 9 pins and spigot, screened pentode	V_1
10E/11446	VR65, British octal, top grid	V_4
10E/CV66	CV66	V_2
10E/105	VR92, Diode	V_3
		Ref. in fig.4
10RB/16	Transmitter unit, type 45 for 12 volts working Consisting of:-	
	Cap, valve	
10A/13092	Grid clip	
AL.1. 10PB/6019 ~~10AB/~~	Tuning tool. ~~[illegible]~~	
10A/14442	American clip	
	Condenser .	
10C/707	0.01 mfd.	C_1
10C/11123	0.01 mfd.	C_2
10C/11126	0.1 mfd.	C_3
AL.1. 10RB/6019	Frequency changing turret	
10H/493	Holder, valve, type 73. International octal	
10H/353	Holder, valve. English 7 pin.	
5X/750	Plug, type M, 2 way, 4 amp.	
10H/528	Plug, type 229. S.P. coaxial panel mounting	
	Resistance	
10C/9500	47 ohms	R_2
10C/9486	1K	R_1
10C/9217	10K	R_8
10C/7805	100K	R_7
10C/9492	100K	R_6
10C/7802	1M	R_9
10C/10577	1.8M	R_3, R_4
10A/13510	Retainers, valve, type 42. 1⅛ in. bakelised canvas ring 1-9/16 in. I.D. with 2 tension springs	
10D/374	Selector drive unit, type 443 for 12 volts operation, uniselector	
10KB/1054	Transformer, type 1220. 6.3V input. 6.3V. 2A and 4.2V, 1A output	T_1
10E/CV63	Valve CV63	V_1, V_2
10E/CV73	Valve CV73	V_3



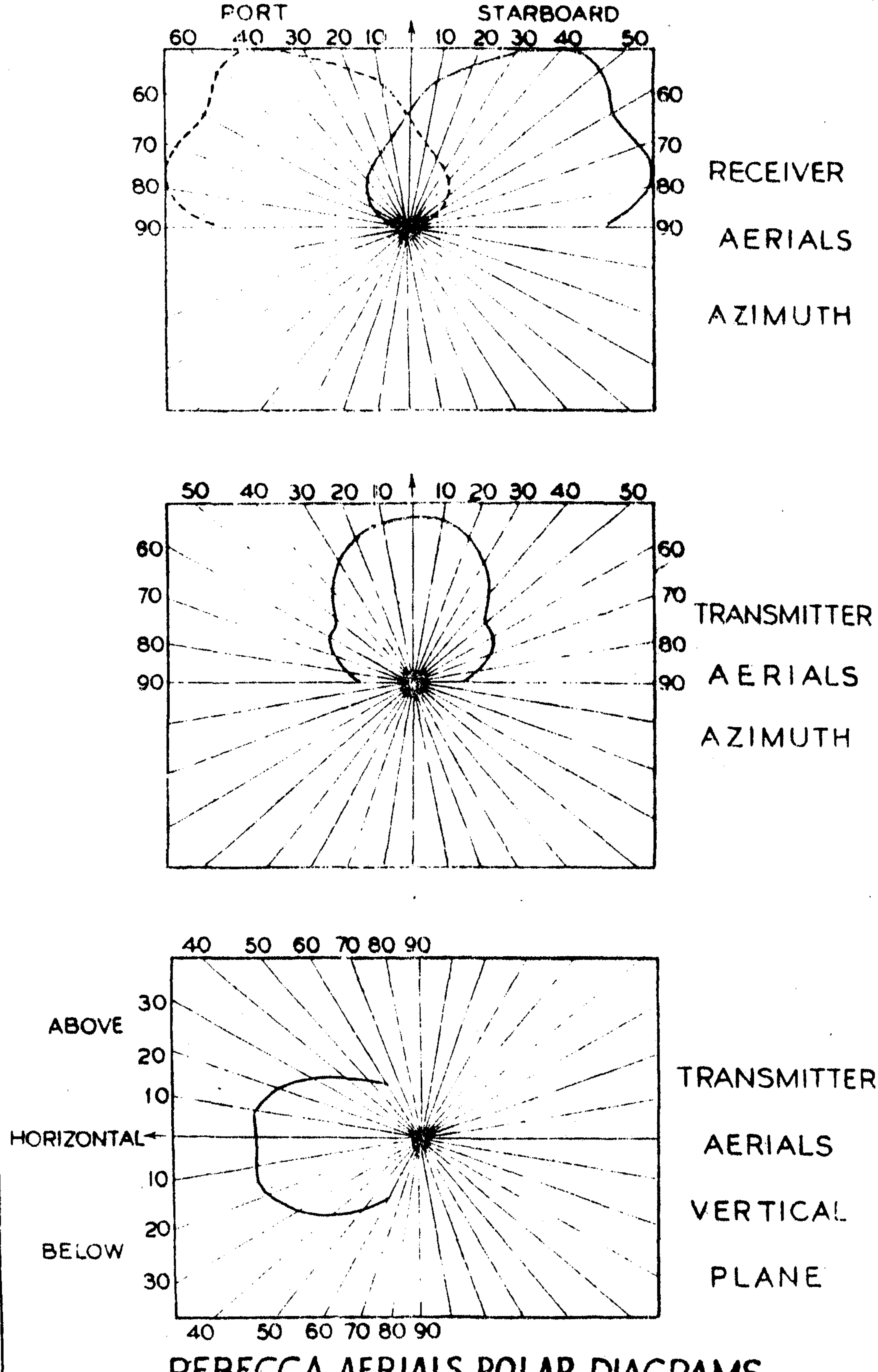
CURVES SHOWING THE MAXIMUM RANGE AT WHICH AN AIRCRAFT CAN LOCK A BEACON

THE BEACON TAKES 100μ VOLTS APPROX. ON 80 OHMS TO TRIGGER. IT HAS AN AERIAL HEIGHT SHOWN ON CURVES

THE AIRCRAFT RADIATES 350 WATTS APPROX. ON 1·4 METRES WAVELENGTH.

MAXIMUM RANGE CURVES

FIG. 1

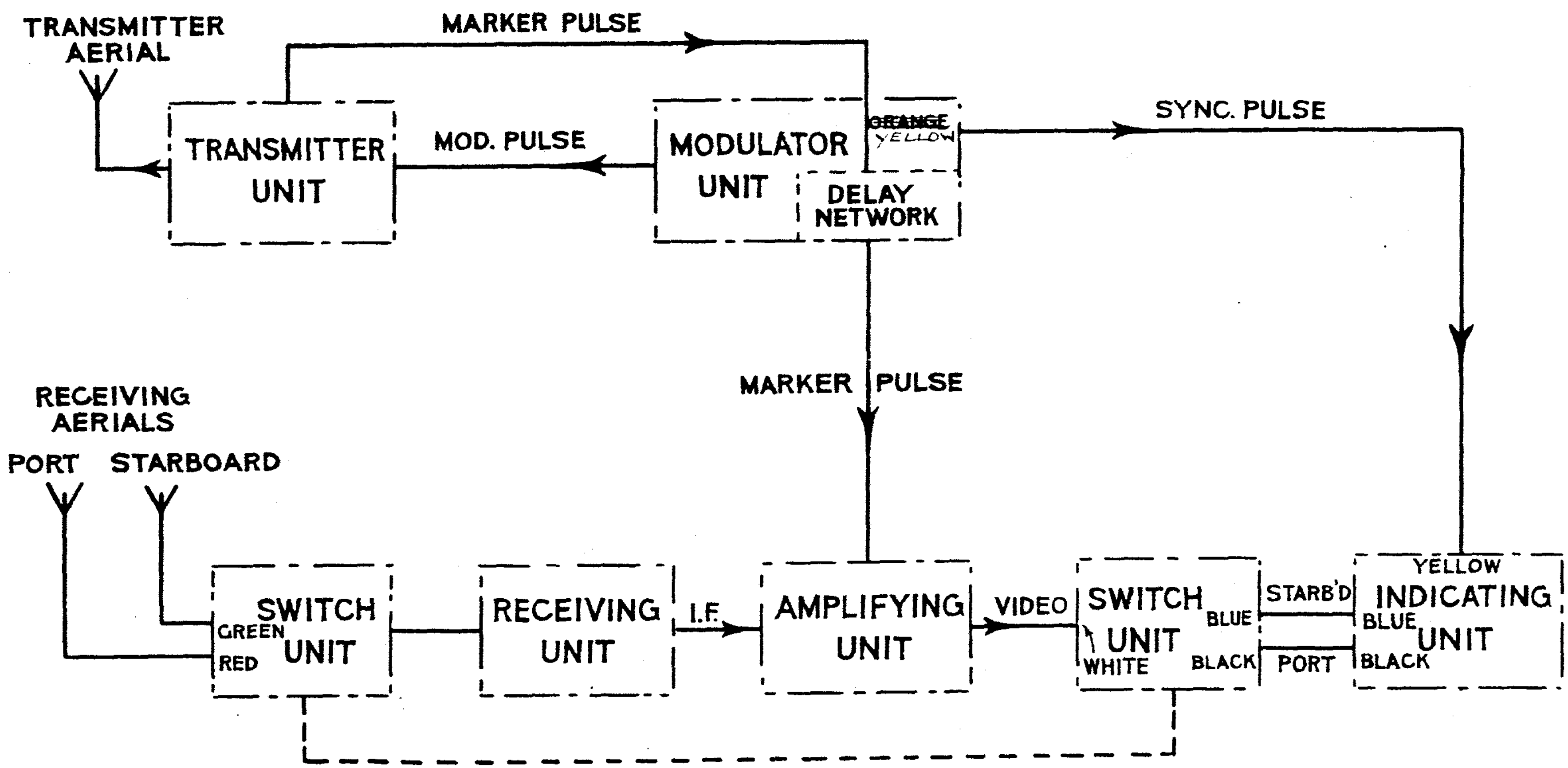


REBECCA AERIALS, POLAR DIAGRAMS

FIG. 2

FIG. 2

A.L. 1



BLOCK SCHEMATIC DIAGRAM

FIG. 3

FIG. 3

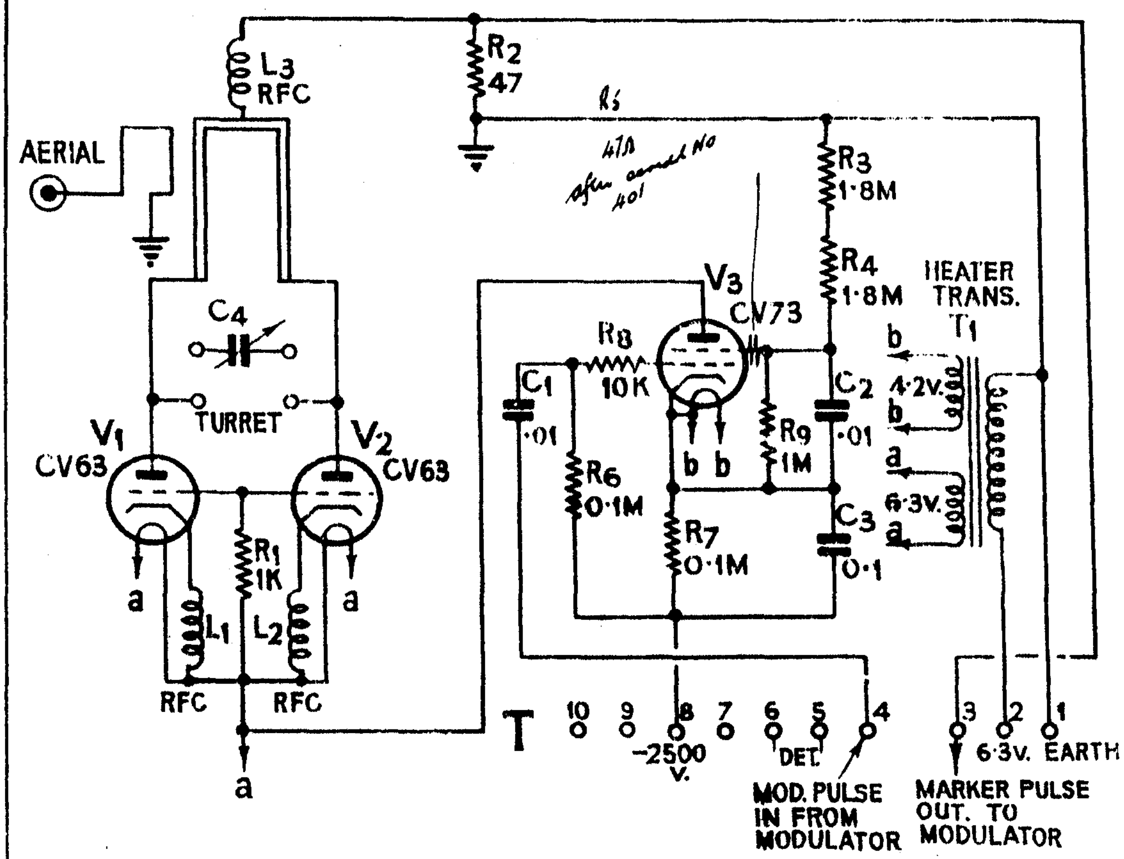


FIG. 4–TRANSMITTER UNIT CIRCUIT

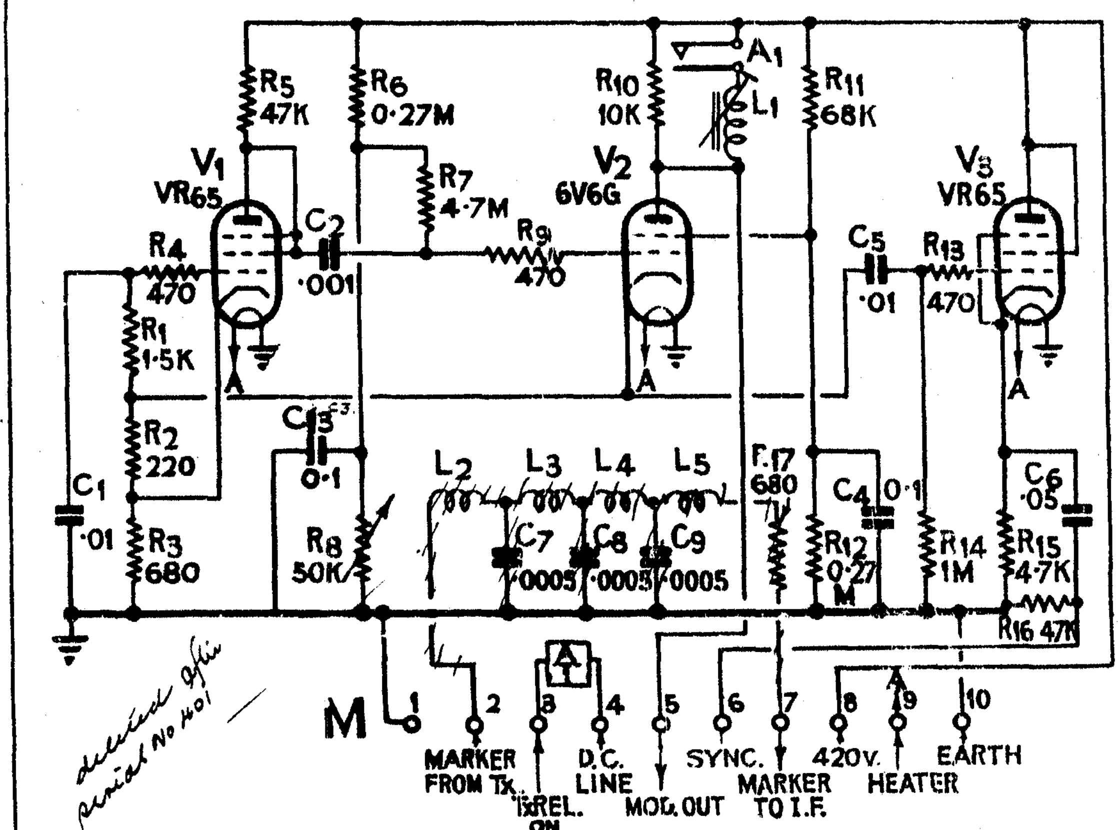
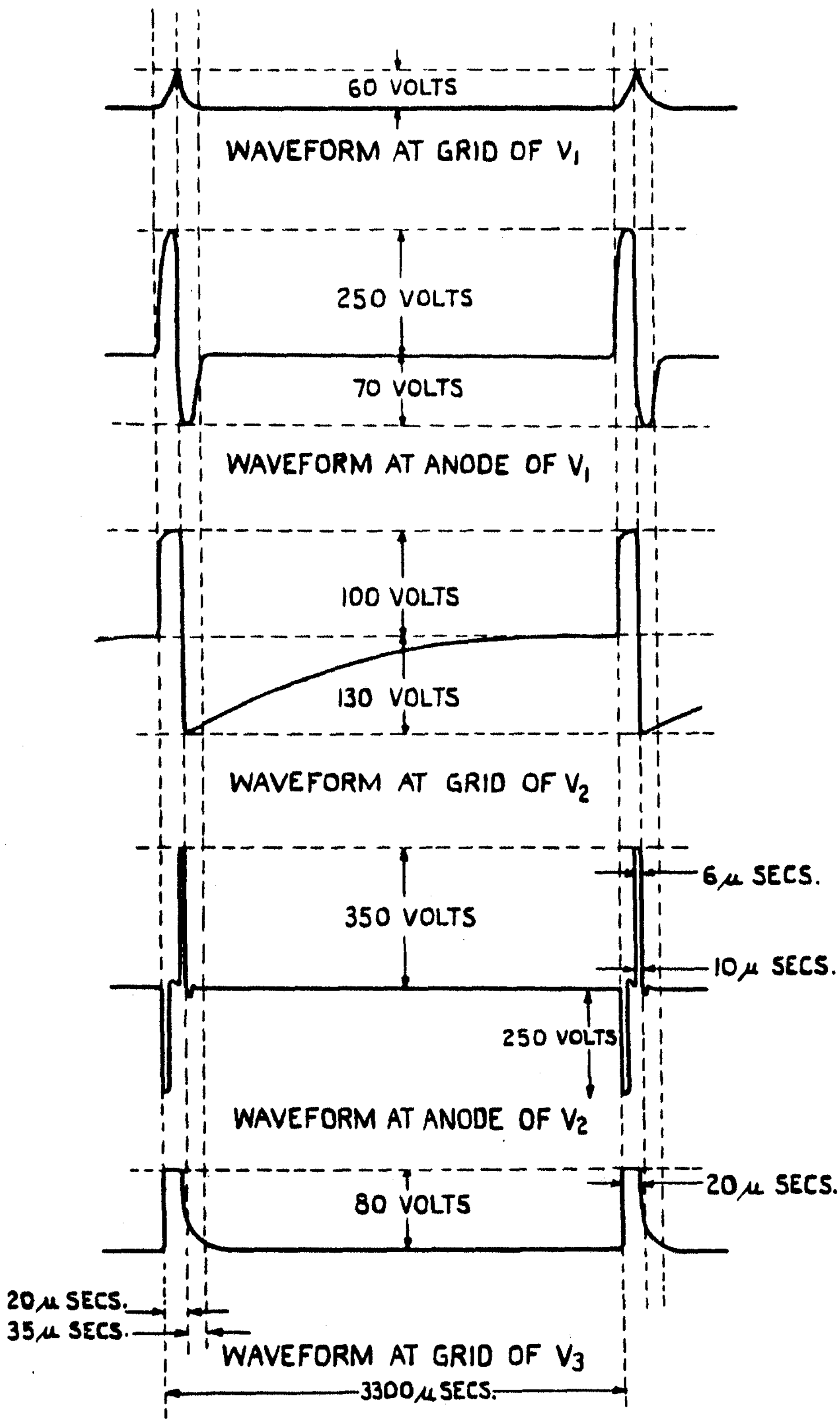


FIG. 5 MODULATOR UNIT CIRCUIT



WAVEFORMS FOR MODULATOR UNIT

FIG. 6

FIG. 6

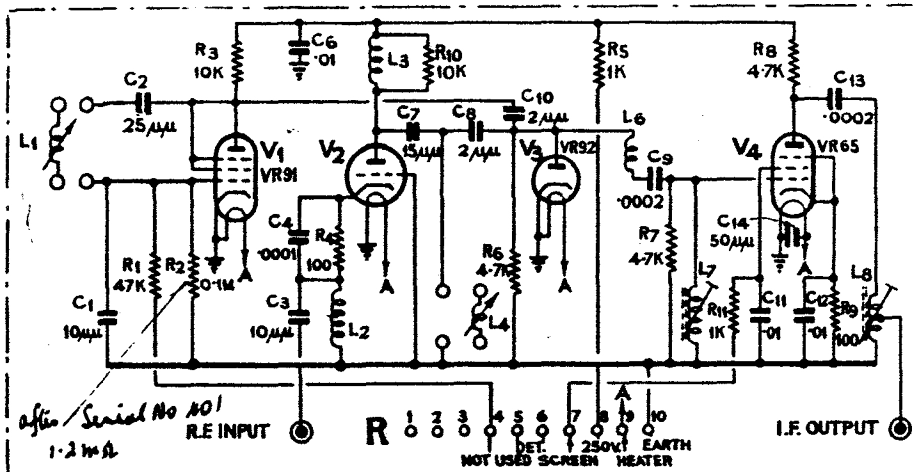


FIG. 7 —— RECEIVING UNIT CIRCUIT

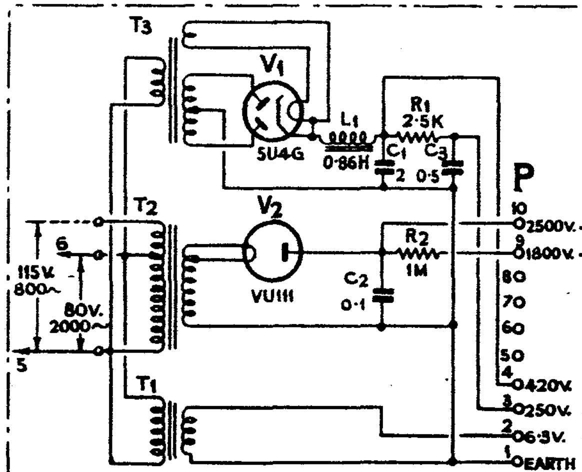


FIG. 9 — POWER UNIT CIRCUIT

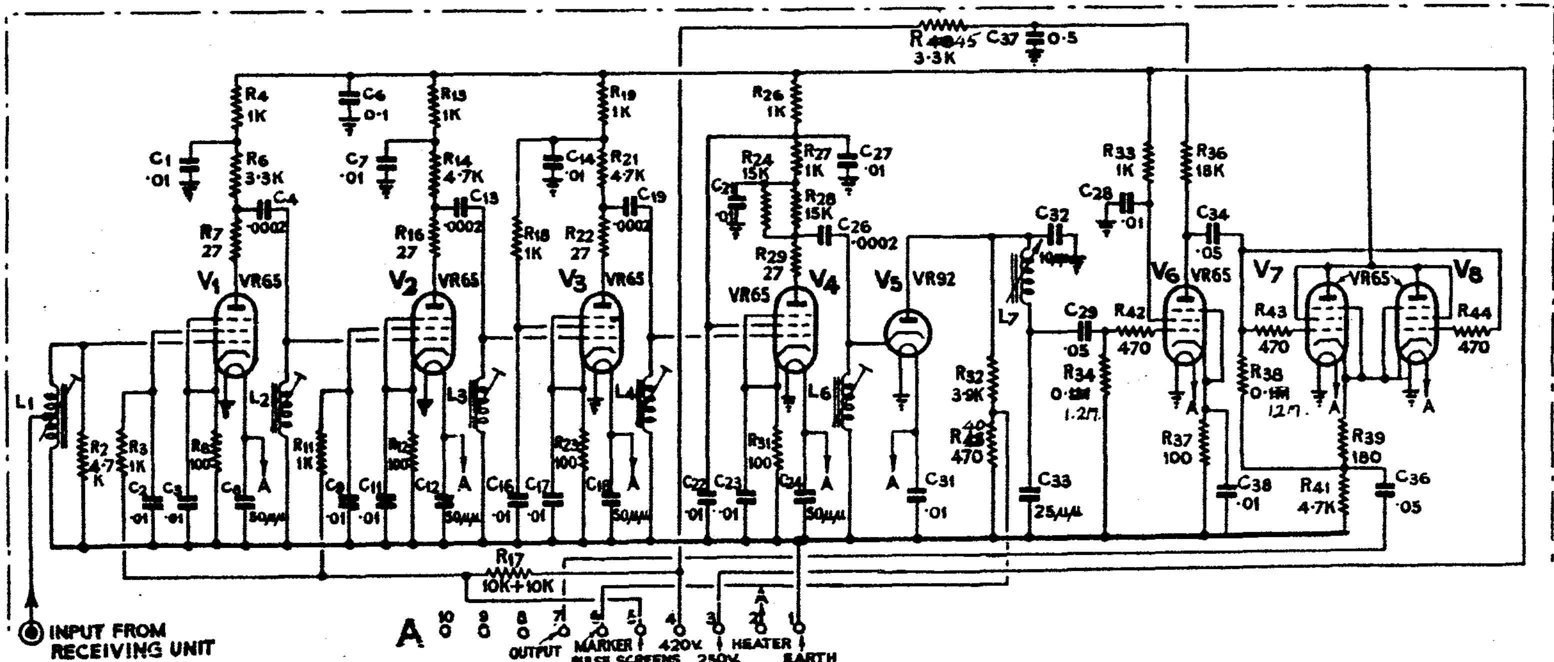
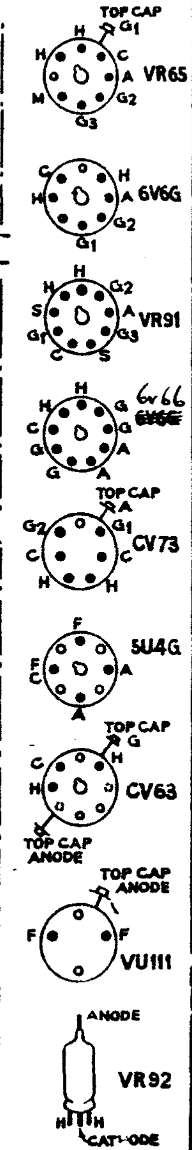


FIG. 8 — AMPLIFYING UNIT CIRCUIT



A.L. 1.

A.L. 1.

FIGS. 7, 8 & 9

Receiving Unit Type 61A.   Fig. 7A

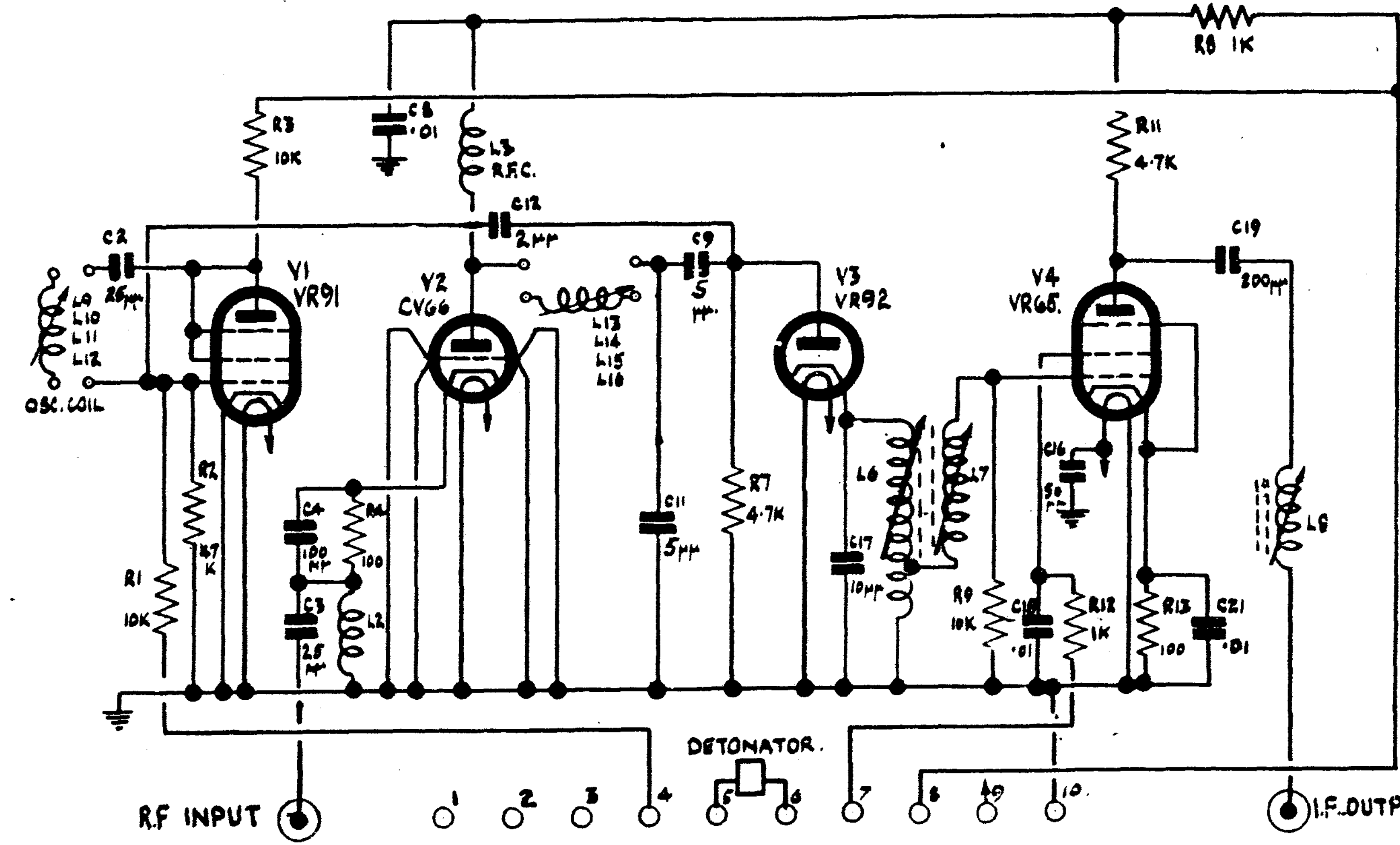
Oscillator circuit.	Grid leak R_2 reduced to 47k. Resistor R_1 10k introduced between grid and terminal R_4 for use in Rebecca II B. Anode load R_3 returned to 250V line direct.
R.F. Stage	Anode tuned circuit redesigned to increase frequency coverage and to improve Signal/Noise sensitivity.
Mixer Stage	The detector signal at IF is taken from the cathode of the diode instead of the anode and passed through a band pass coupled stage instead of the single tuned circuit to the grid of the VR 65.

The purpose is to improve the band width and Signal/Noise ratio of the Receiver.

The output circuit of the IF valve now consists of a π network matching into the Uniradio 32 cable connection to the IF Unit.

FIG 7A

CD0338-B AL 2



RECEIVING UNIT TYPE 61A

FIG 7A

Amplifying Unit Type 178. Fig. 8A

The changes include the incorporation of a π input circuit to the grid of V_1. The gain control system has been revised to reduce the overall gain of the set and to provide a smoother operation of the gain control for very strong signals received at close range. To achieve this the screen of V_3 is connected to the variable gain voltage, to which the screen of V_1 and V_2 are returned via a 15k resistor, R_{15}. The function of this resistor is to diminish the effective screen volts of V_1 and V_2 at high gain levels by virtue of the screen current of V_1 and V_2 thus reducing the effective gain variation.

The vitreous resistors R_{17}, R_{18} are normally returned to the 420V line, but if the receiver gain is excessive, it may be connected to the 250V line, thereby reducing the variation in gain at low levels thus enabling an adequate control of the level of strong signals at minimum range.

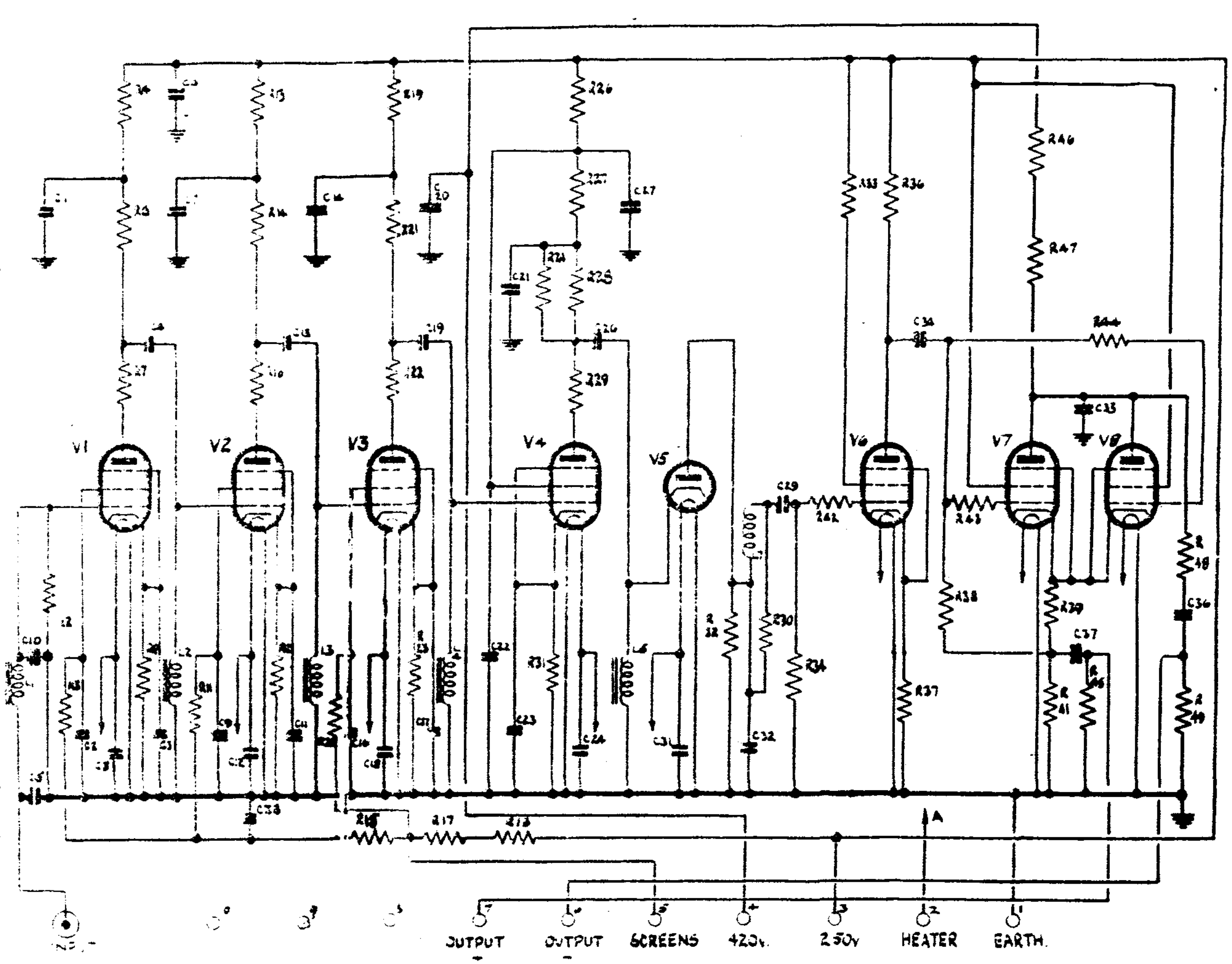
In order to prevent differentiation of the wide pulses used in Eureka BA the condenser on the screen and cathode of V_6 is deleted, and R_{34} and R_{49} increased in value.

To meet the requirement for negative receiver output for Rebecca II U the cathode follower circuit has been redesigned to provide positive and negative output signals which are obtained from the cathode and anode of V_7 - V_8 respectively.

The marker pulse has been deleted as there is now no operational requirement for it.

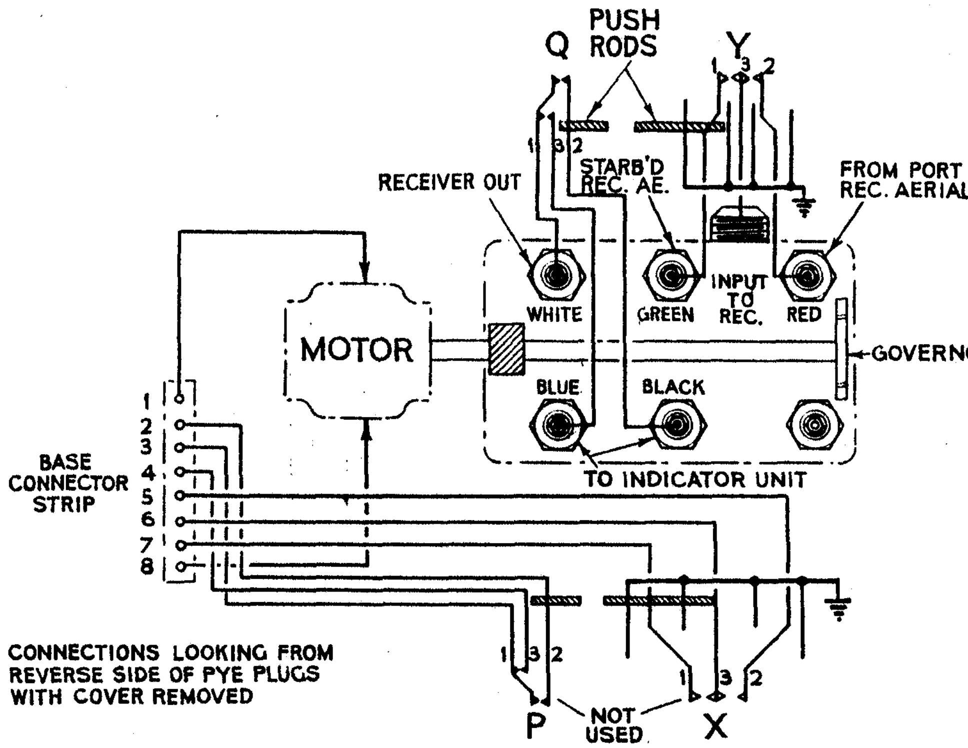
CD.0338-B. AL2.

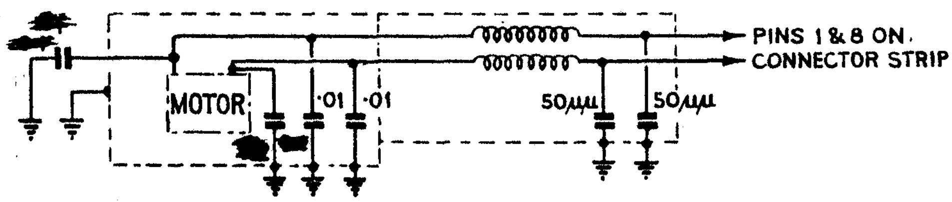
CCT REF	DESCRIPTION	VALUE	RATING	TOL.	CCT REF	DESCRIPTION	VALUE	RATING	TOL.
R	RESISTOR				[illegible]	CONDENSER	[illegible]	350v	25%
R2		4.7K	[illegible]	20%	[illegible]		[illegible]	350v	20%
R3		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	25%
R4		1K	[illegible]	[illegible]	[illegible]		[illegible]	350V	20%
[illegible]					[illegible]		50		25%
R6		3.3K	[illegible]	[illegible]	[illegible]				
R7		27K	[illegible]	[illegible]	[illegible]		[illegible]		25%
R8		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
R9					[illegible]				
R10					[illegible]		[illegible]	350V	25%
R11		1K	[illegible]	20%	[illegible]				
R12		100K	[illegible]	10%	[illegible]		[illegible]	350v	20%
R13		1K	[illegible]	20%	[illegible]		40	350	20%
R14		[illegible]	[illegible]	[illegible]	C33				
R15		33K	½W	[illegible]	C34		[illegible]	350V	[illegible]
R16		[illegible]	[illegible]	[illegible]	[illegible]				
R17		[illegible]	[illegible]	10%	[illegible]		[illegible]	350	[illegible]
R18		[illegible]	30W	[illegible]	[illegible]		[illegible]	50W	20%
R19		1K	[illegible]	20%	[illegible]		[illegible]		
R20		[illegible]	[illegible]	[illegible]					
R21		[illegible]	[illegible]	[illegible]					
R22		[illegible]	[illegible]	[illegible]	[illegible]	VALVE	VR65		
R23		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		
R24		[illegible]	[illegible]	[illegible]	[illegible]		VR92		
R25					[illegible]		VR56		
R26		1K	[illegible]	20%	[illegible]		VR92		
R27		[illegible]	[illegible]	10%	[illegible]		VR65		
R28		[illegible]	[illegible]	[illegible]	V7		VR65		
R29		27K	[illegible]	10%	V8		VR65		
R30		[illegible]	¼W	[illegible]					
R31		[illegible]	[illegible]	[illegible]					
R32		[illegible]	[illegible]	[illegible]	[illegible]	[illegible] I.F. COIL			
R33		[illegible]	[illegible]	[illegible]	[illegible]	[illegible] I.F. COIL			
R34		[illegible]	[illegible]	[illegible]	[illegible]	[illegible] I.F. COIL			
R35					[illegible]	[illegible]			
R36		[illegible]	[illegible]	10%	[illegible]				
R37		[illegible]	[illegible]	[illegible]	[illegible]	[illegible] I.F. COIL			
R38		[illegible]	[illegible]	20%	[illegible]	I.F. REJECTION			
R39		[illegible]	[illegible]	[illegible]		COIL			
R40									
R41		3.3K	2W	10%					
R42		10K	[illegible]	20%					
R43		470K	[illegible]	[illegible]					
R44		470K	[illegible]	[illegible]					
R45		100K	¼W	20%					
R46		3.3K	2W	10%					
R47		3.3K	2W	[illegible]					
R48		[illegible]	[illegible]	[illegible]					
R49		[illegible]	[illegible]	[illegible]					
R50									
C1	CONDENSER	[illegible]	350V	20%					
C2		[illegible]	350	25%					
C3		[illegible]	350V	25%					
[illegible]		200		[illegible]					
[illegible]		50		[illegible]					
[illegible]		[illegible]	350	[illegible]					
[illegible]		·01MF	350V	20%					
[illegible]		50		[illegible]					
[illegible]		[illegible]	350	25%					
[illegible]		[illegible]		[illegible]					
[illegible]		[illegible]	350	20%					
[illegible]		[illegible]		[illegible]					
[illegible]		200		20%					
[illegible]		[illegible]	350	20%					
[illegible]									
[illegible]		·01MF	350	20%					
[illegible]		[illegible]	350	25%					
C8		50		25%					
C9		200		[illegible]					



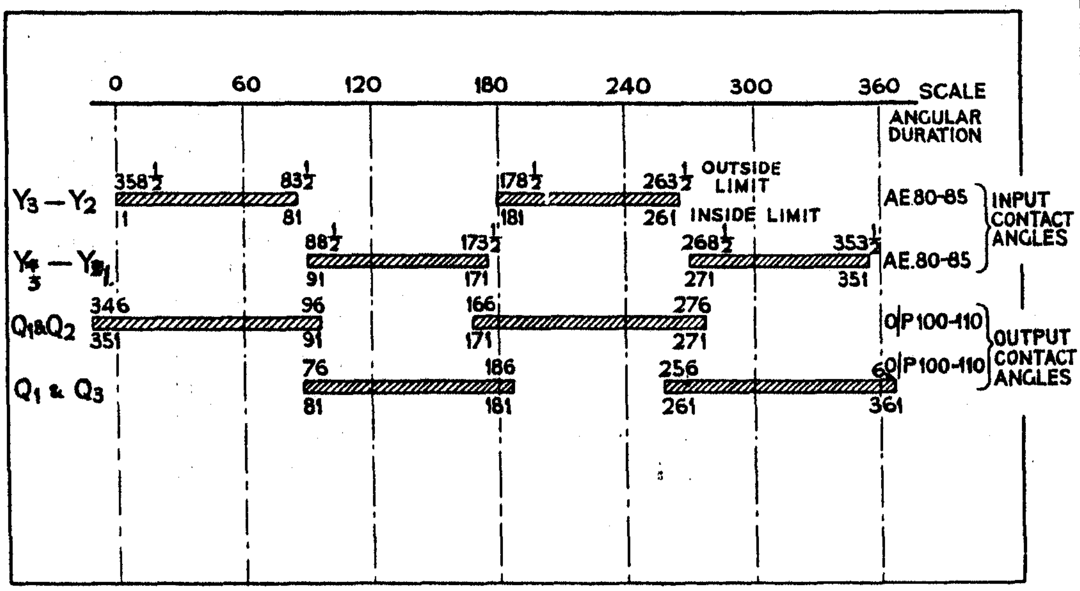
AMPLIFYING UNIT TYPE 178

FIG 8A





INTERFERENCE SUPPRESSION



SWITCH UNIT, TYPE 115, AND 116

FIG. 10 FIG. 10

Chassis Assembly Type 12. Fig. 11

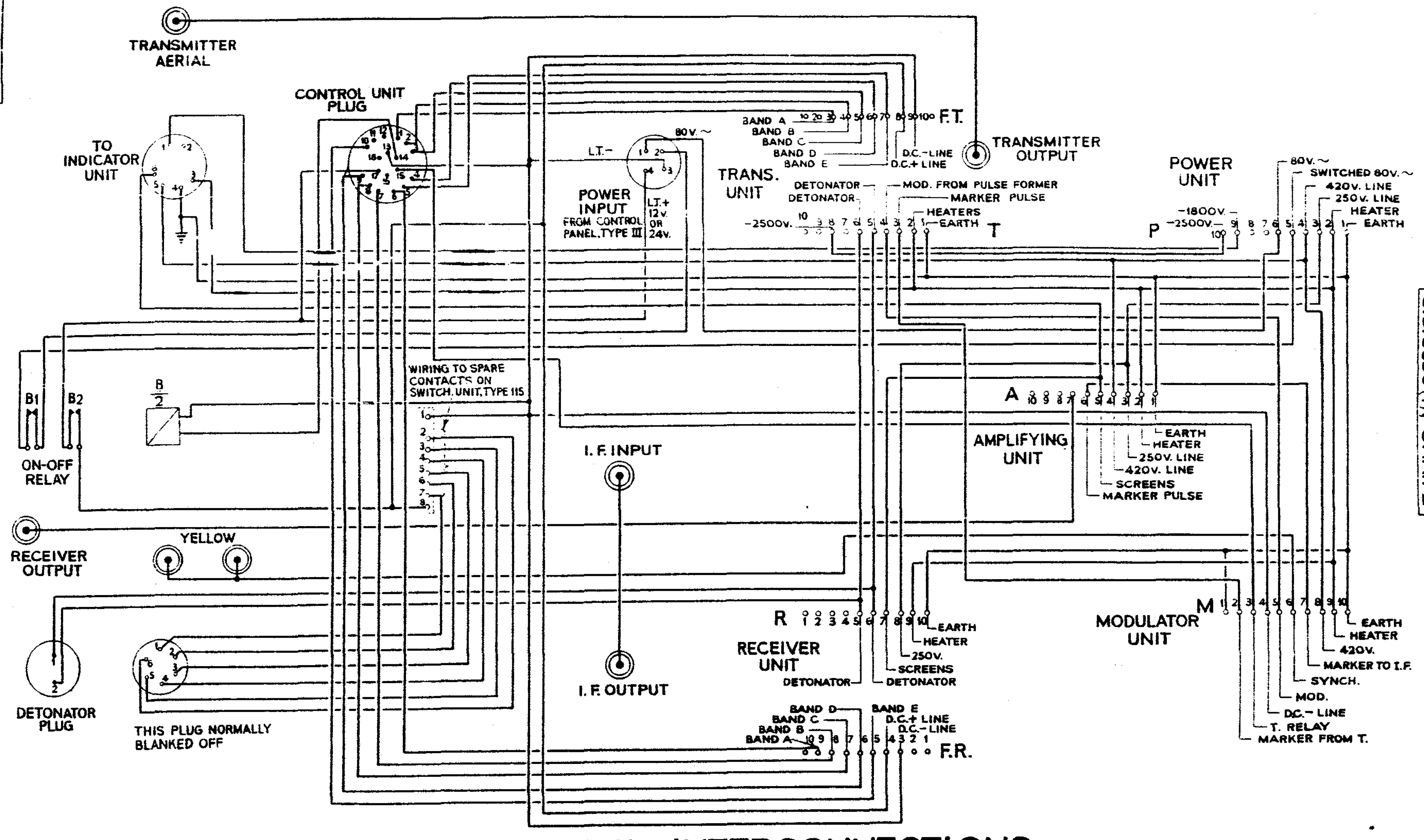
A few wiring changes have been made to the cable form for use with Rebecca II B and II U but do not affect the Rebecca II system.

Pin 6 on the large 6 way W plug is connected to pin 18 on the 18 way plug since the gain control in Rebecca II U will be located in the associated control unit.

Pin 16 on the 18 way plug is connected to M2 on the Modulator unit and in Rebecca II U will provide a Transmitter delay control.

Pin 4 in the small 6 way plug is connected to FT.3 to provide aerial change-over facilities on Rebecca II B.

The DC -ive line to the switch unit is taken to pin 6 of the small 6-way plug and the switch motor is connected to pin 5; on serial numbers 401 - 650 pins 5 and 6 on the small 6 pin plug are shorted together behind the front panel to switch on the Switch Unit Type 115. On subsequent models a detachable socket will be provided for the plug to facilitate the switching on and off of the motor.

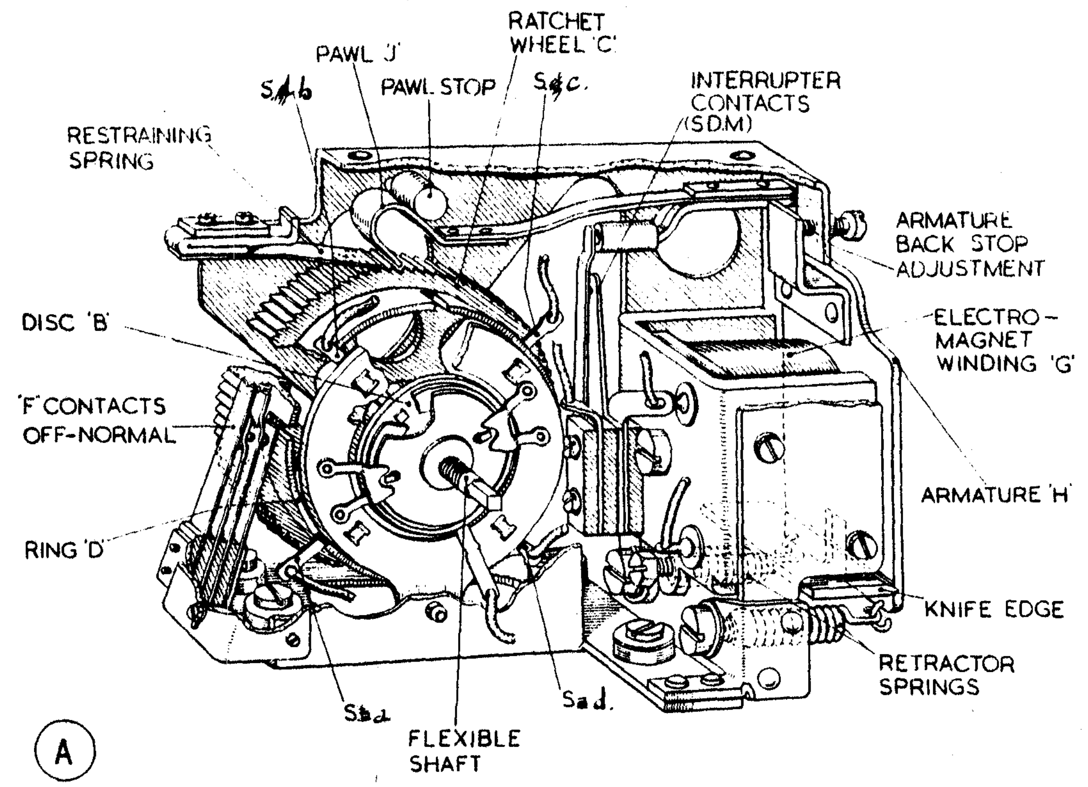


CHASSIS ASSEMBLY INTERCONNECTIONS

FIG. 11

FIG. 11

AL1



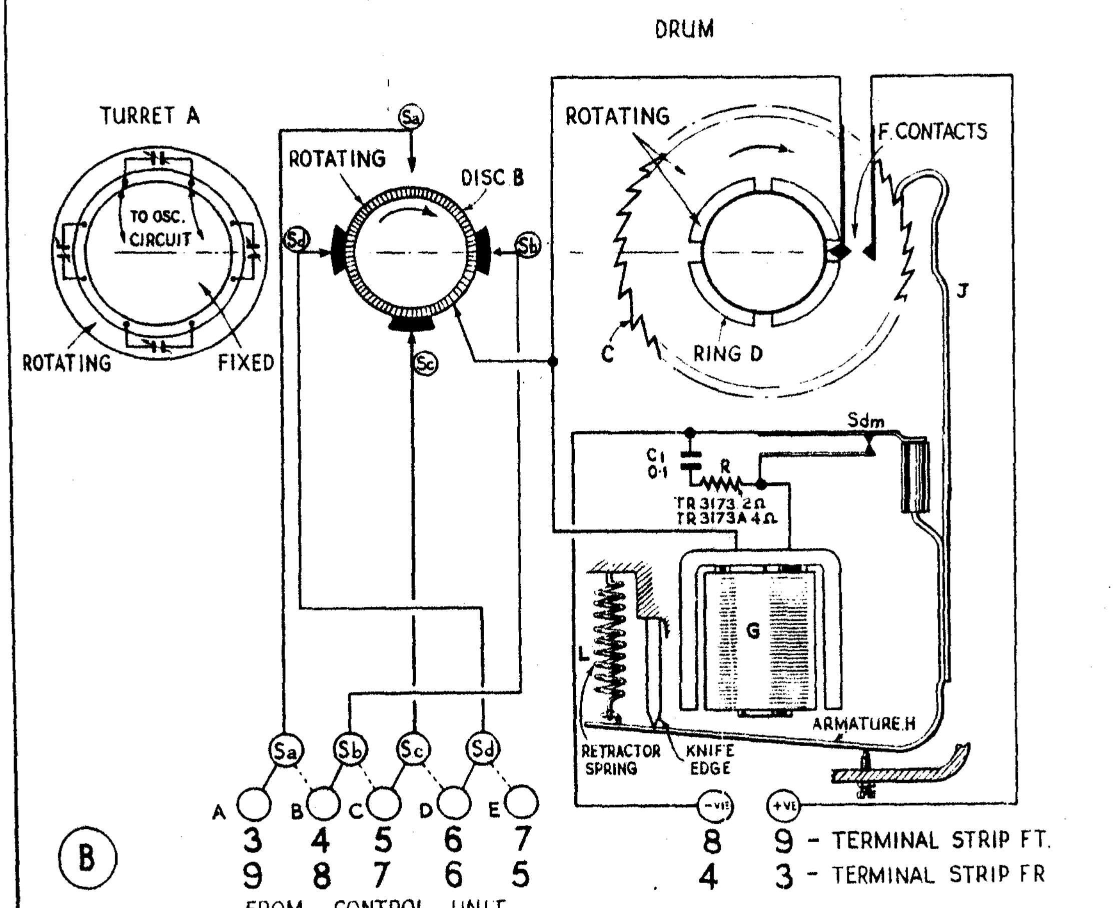
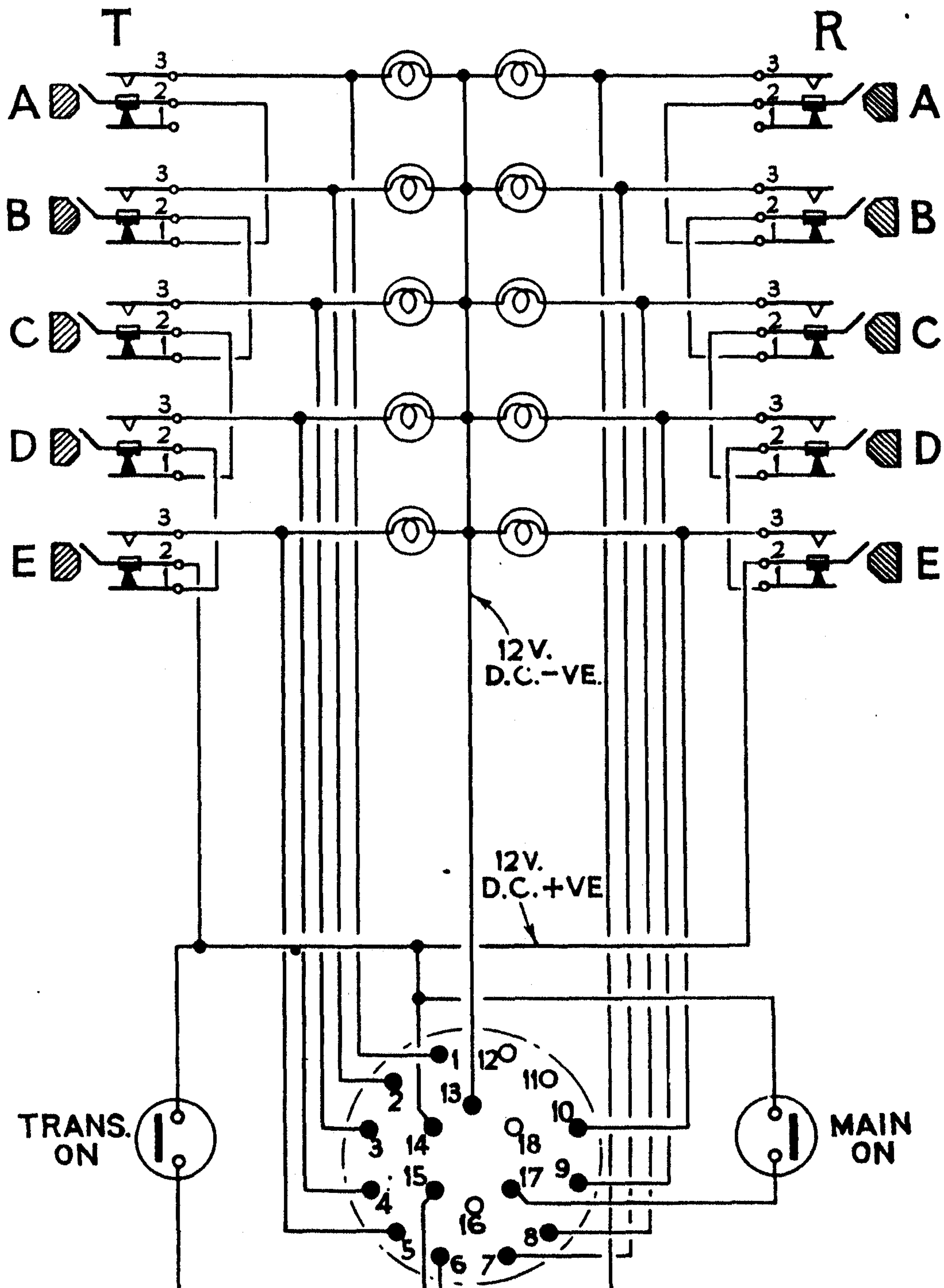


FIG.12 SELECTOR SWITCH, SCHEMATIC DIAGRAMS FIG.12

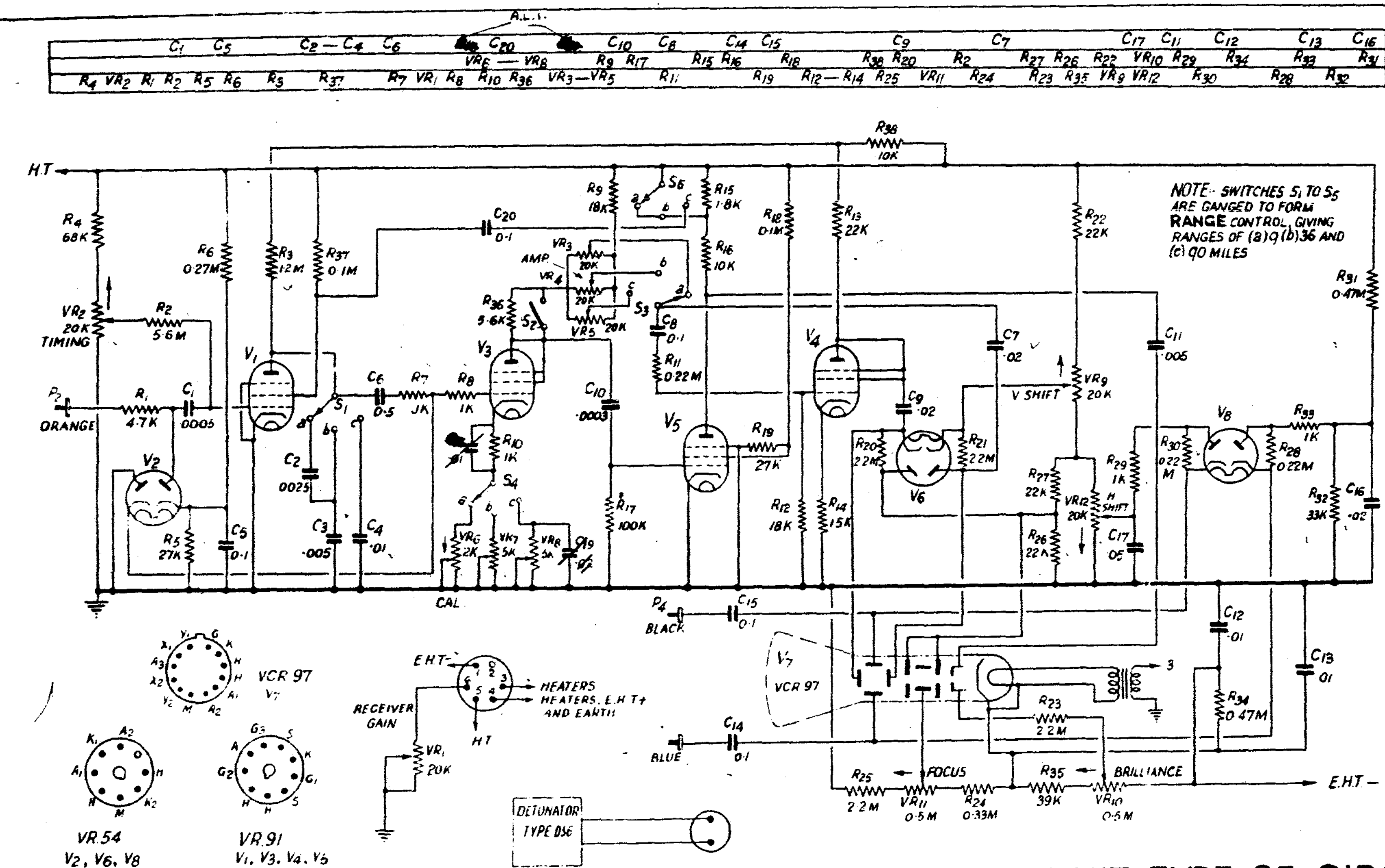


CONTROL UNIT, TYPE 222, CIRCUIT

FIG. 13

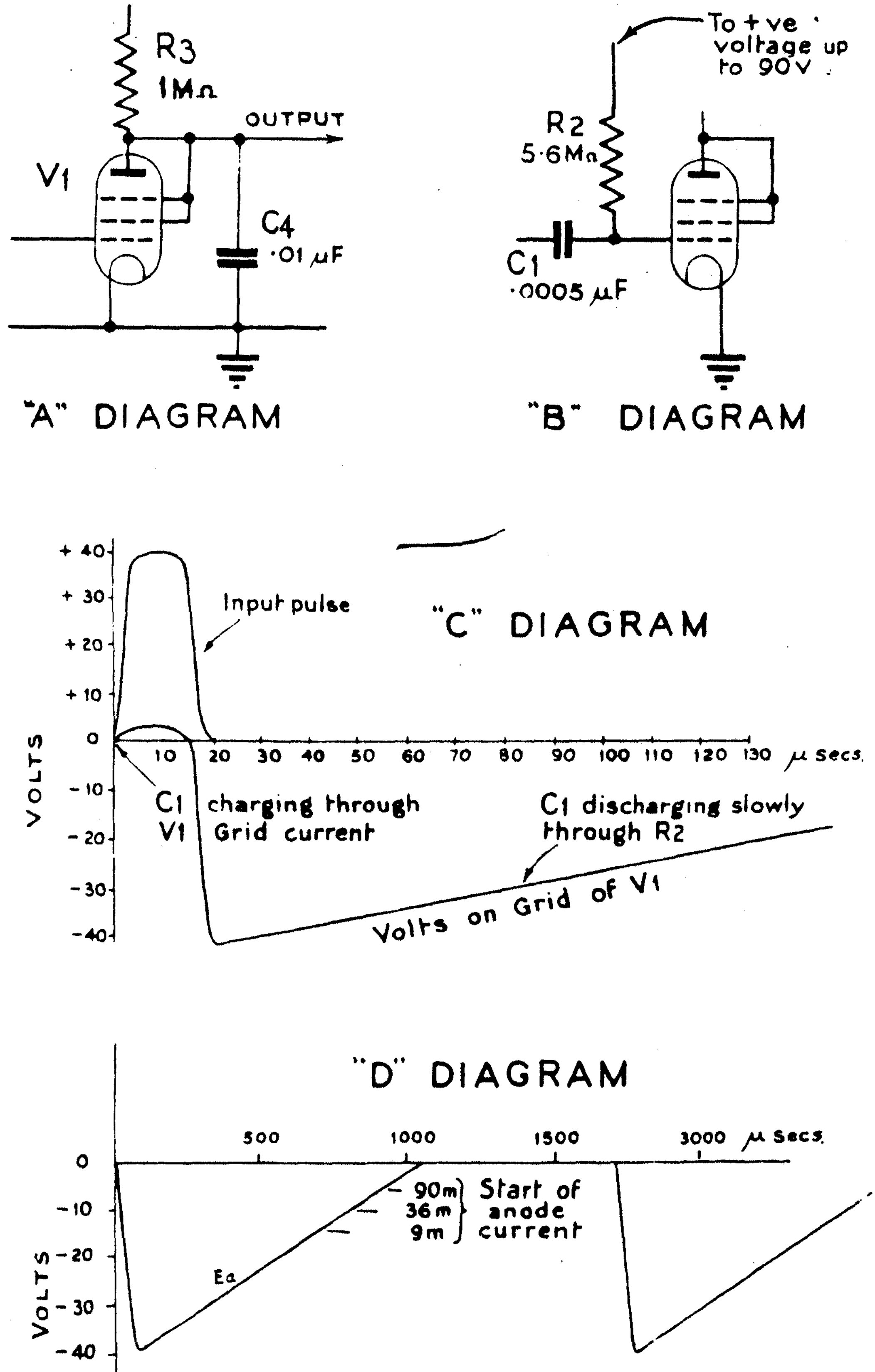
FIG. 13

FIG. 14



INDICATING UNIT, TYPE 6E-CIRCUIT

FIG. 14

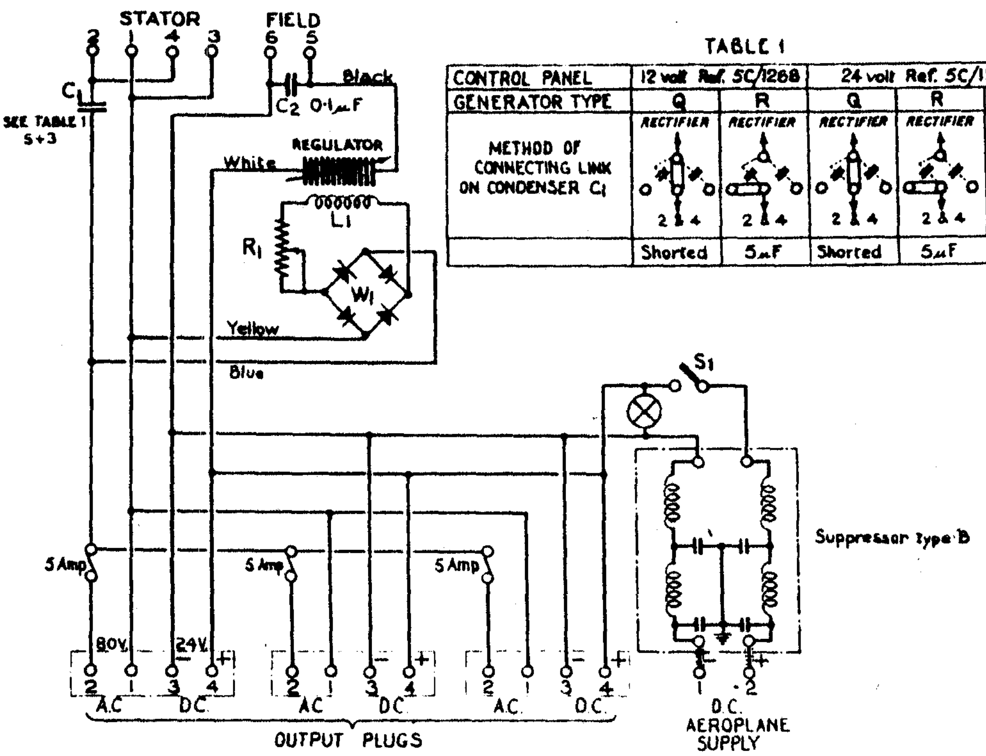


INDICATING UNIT, TYPE 6E,
TIME BASE SIMPLIFIED

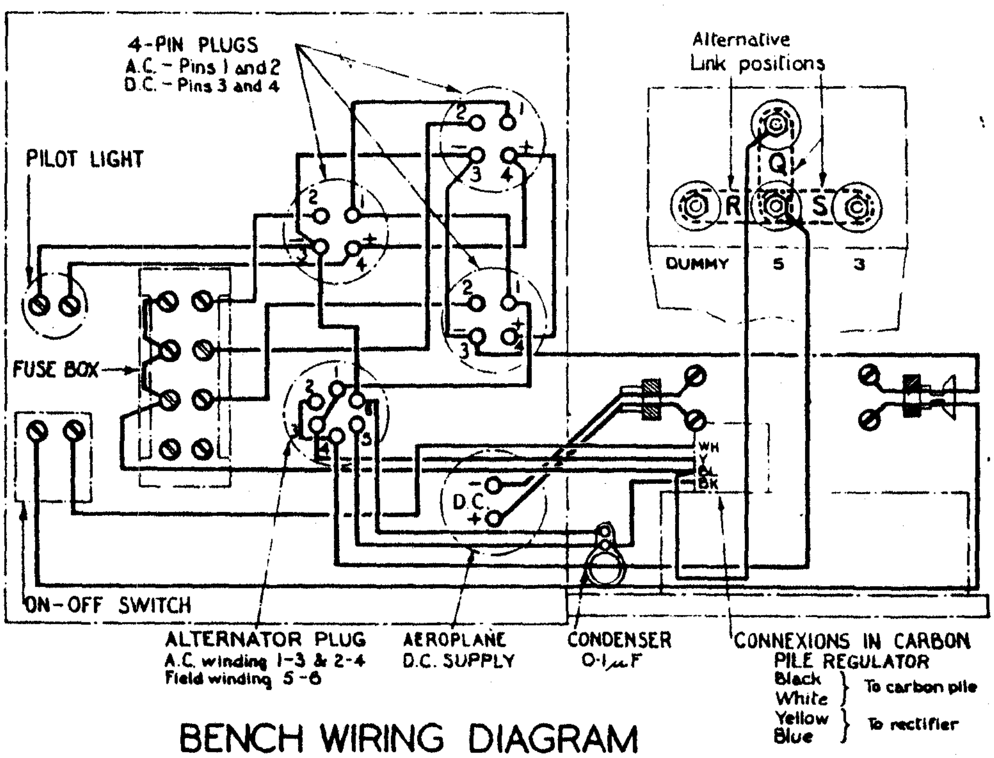
FIG. 15 FIG. 15

TABLE 1

CONTROL PANEL	12 volt Ref. 5C/1268		24 volt Ref. 5C/1269		
GENERATOR TYPE	Q	R	Q	R	S
METHOD OF CONNECTING LINK ON CONDENSER C_1	RECTIFIER 2 & 4	RECTIFIER 2 & 4	RECTIFIER 2 & 4	RECTIFIER 2 & 4	RECTIFIER 2 & 4
	Shorted	5μF	Shorted	5μF	8μF



CIRCUIT

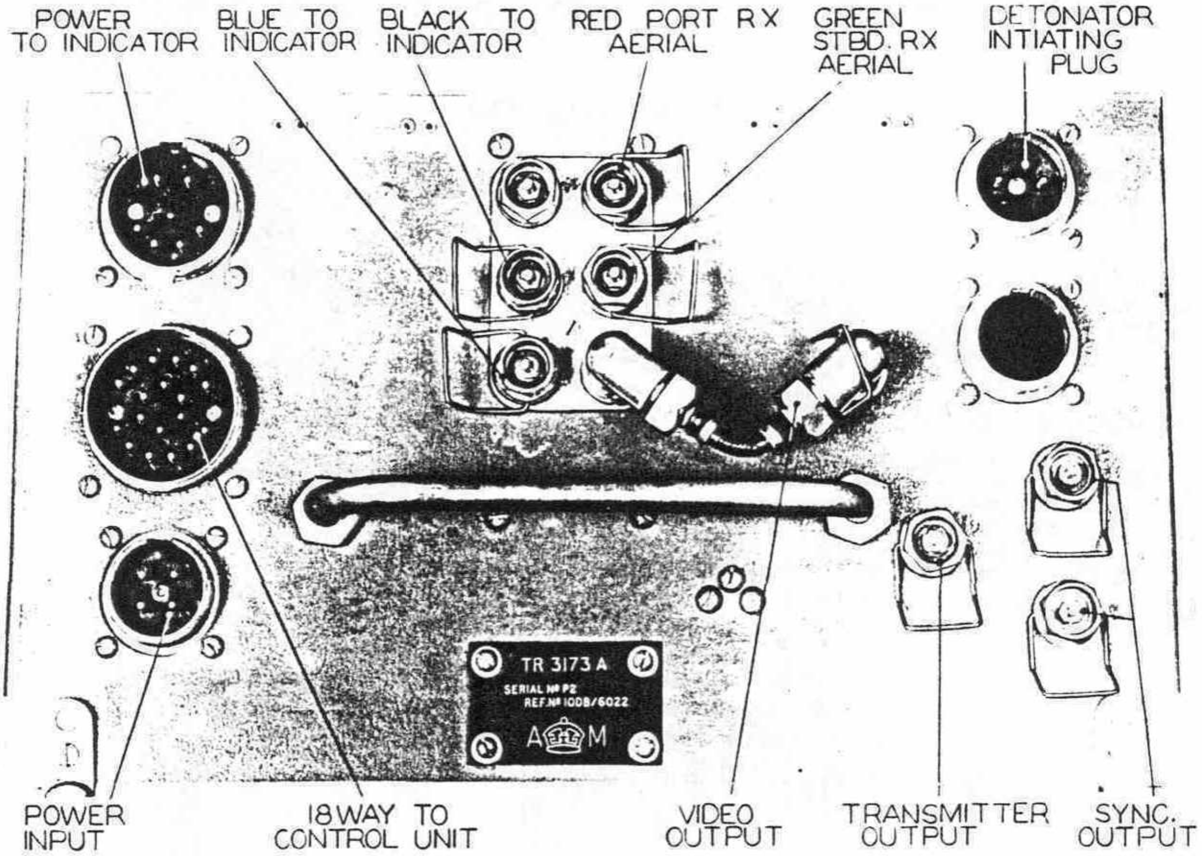


BENCH WIRING DIAGRAM

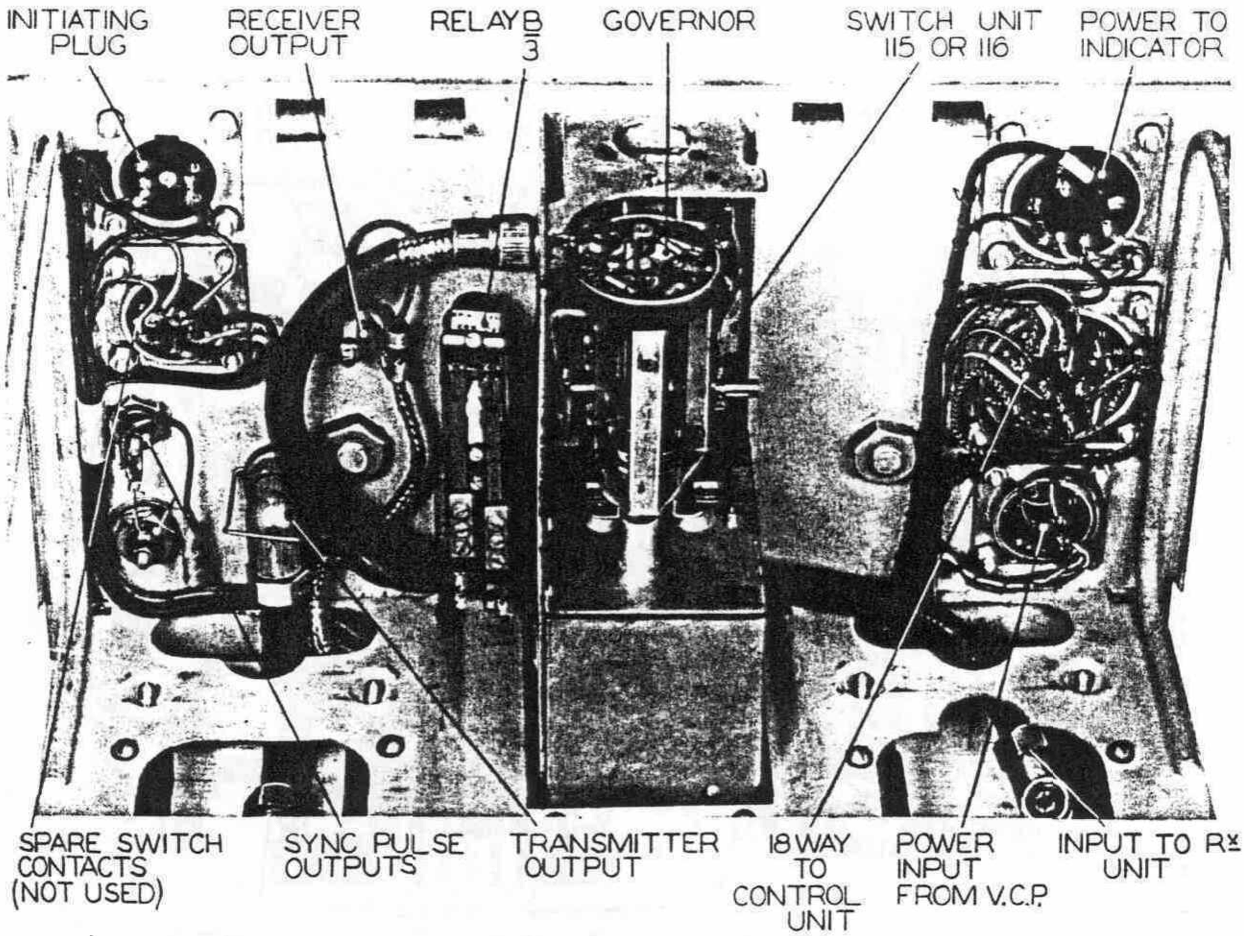
CONTROL PANEL TYPE 3

FIG. 16

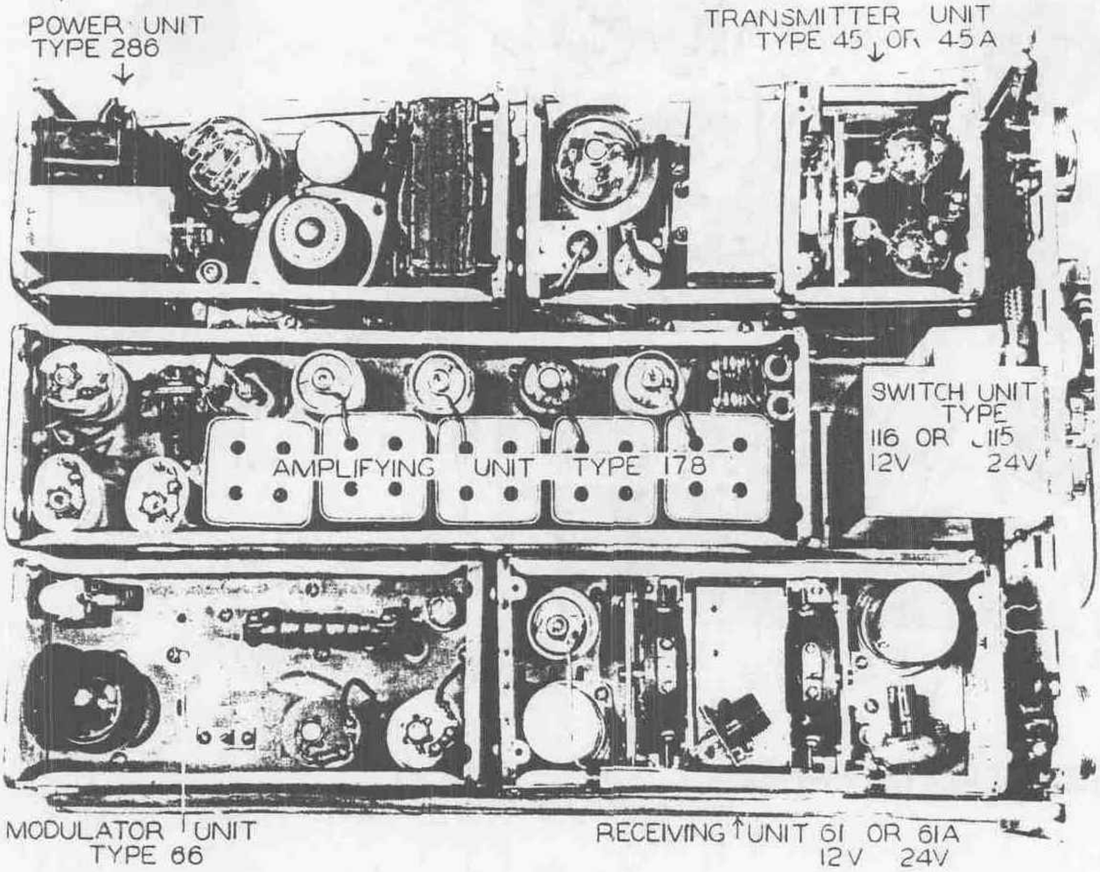
FIG. 16



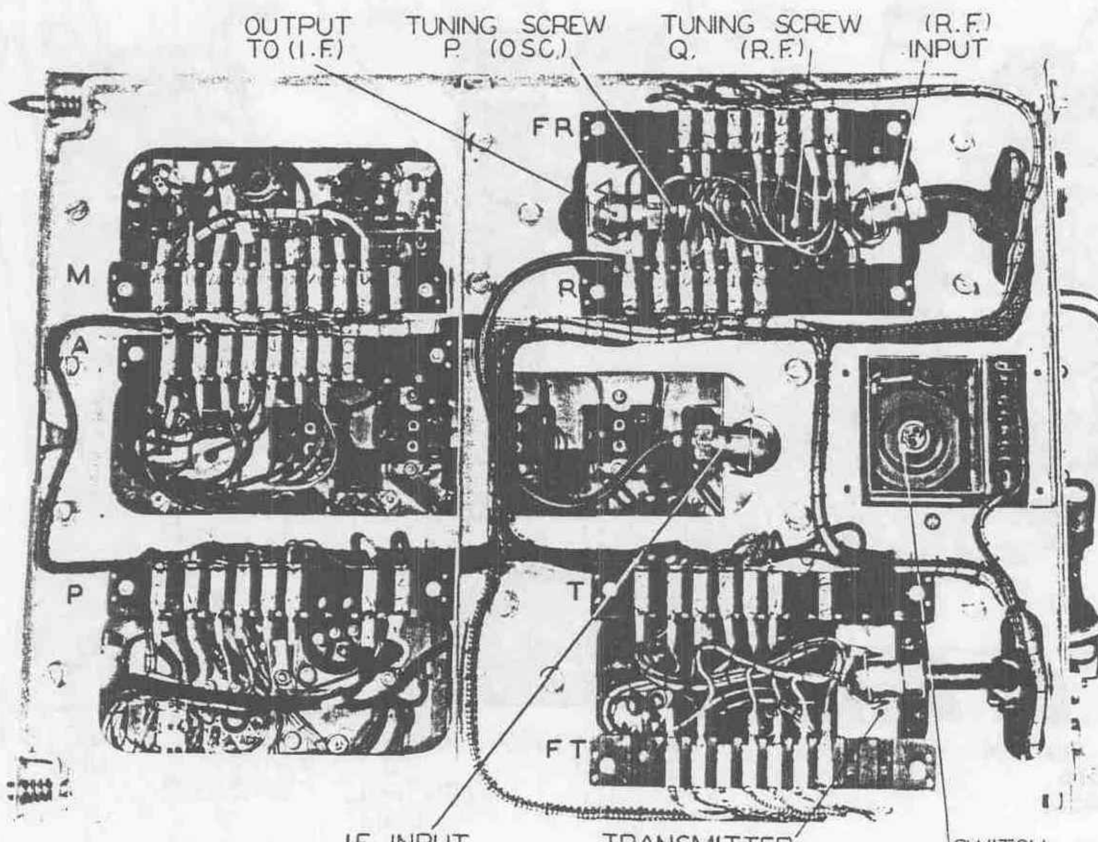
TR 3173A FRONT PANEL FIG.17



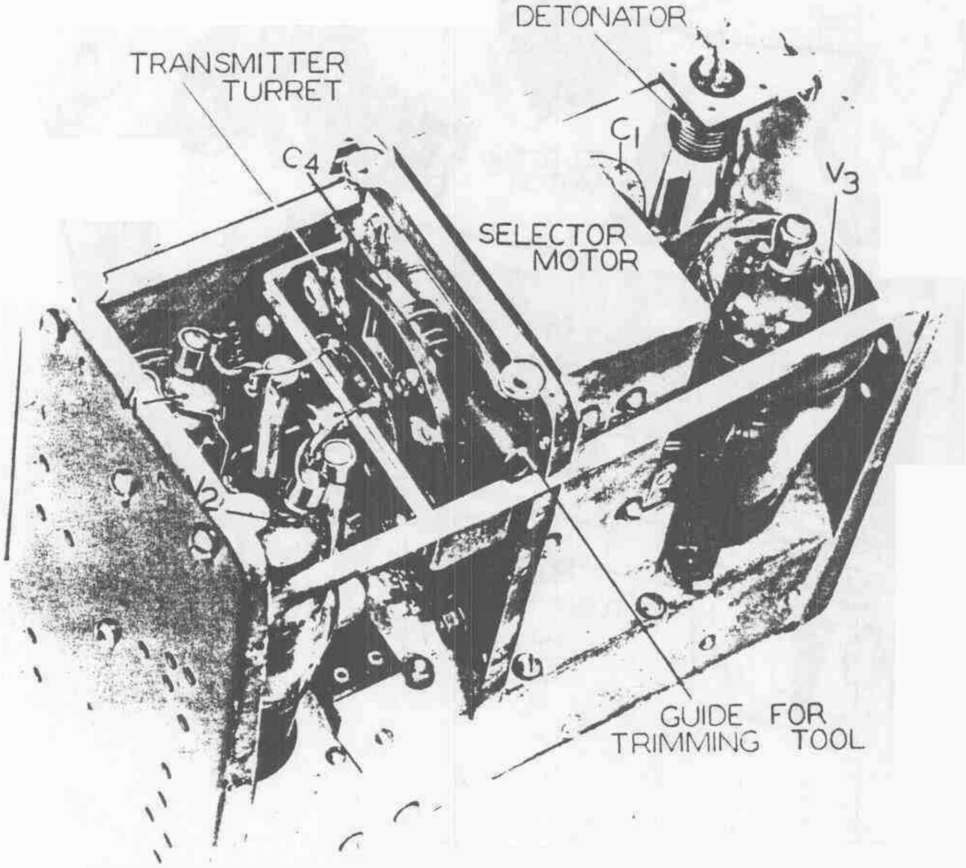
TR 3173A REAR OF PANEL WITH UNITS REMOVED FIG.18

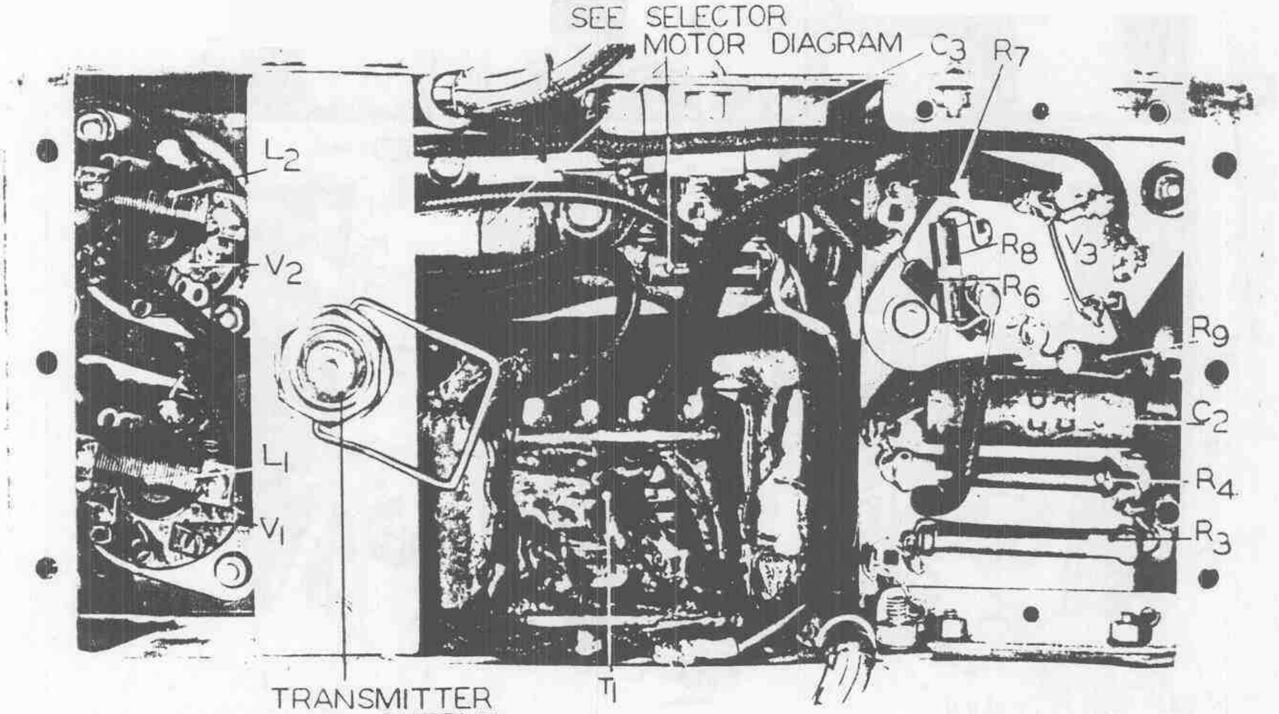


TR 3173 TOP OF CHASSIS FIG 19



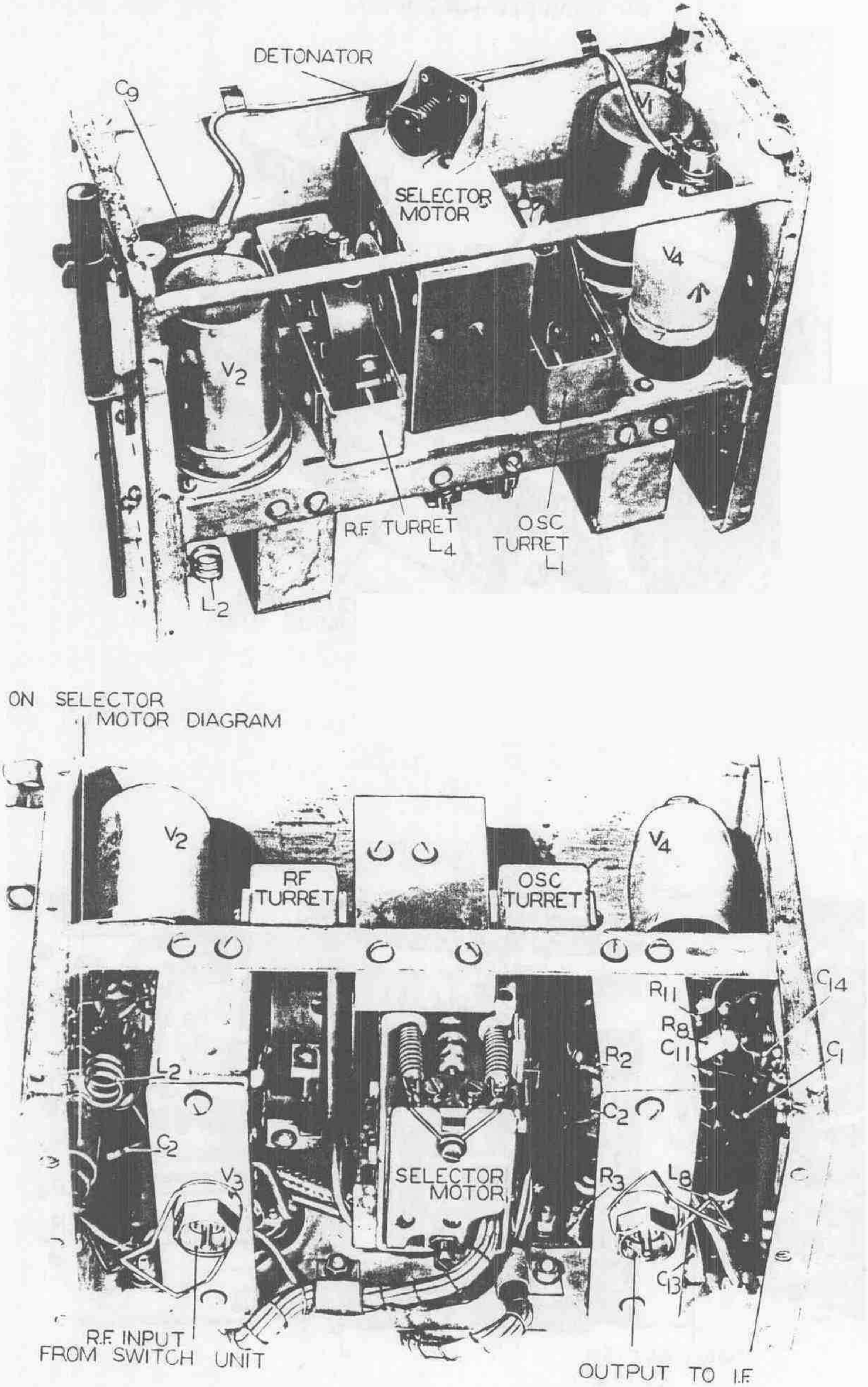
TR 3173 . UNDERSIDE OF CHASSIS FIG 20



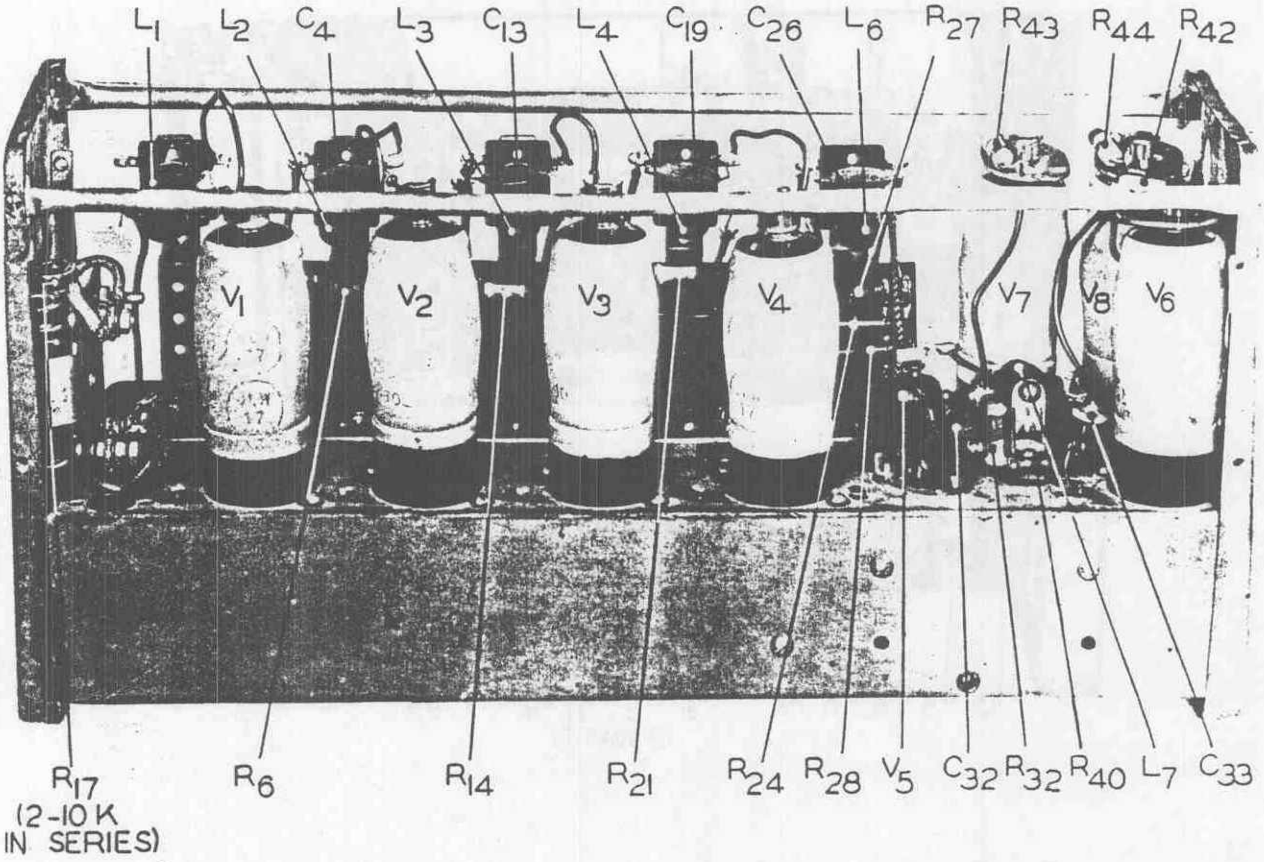


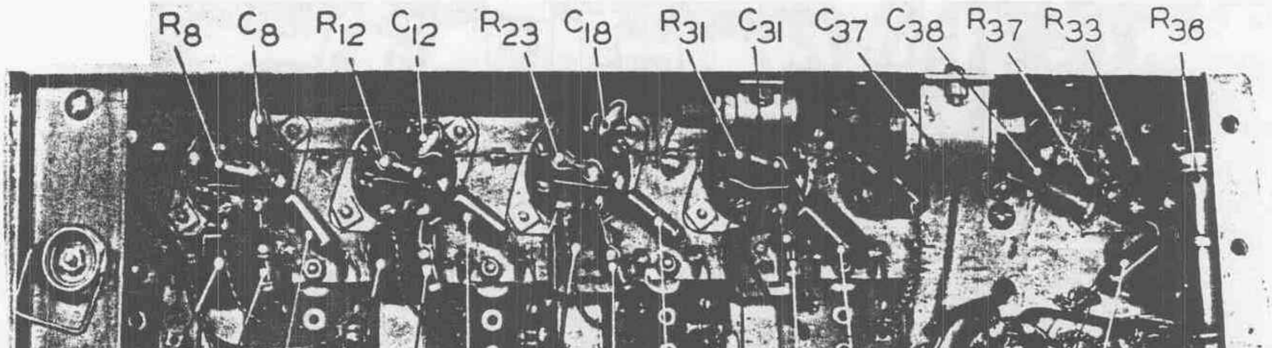
TRANSMITTER UNIT TYPE 45
TOP AND UNDERSIDE VIEWS

FIG 21

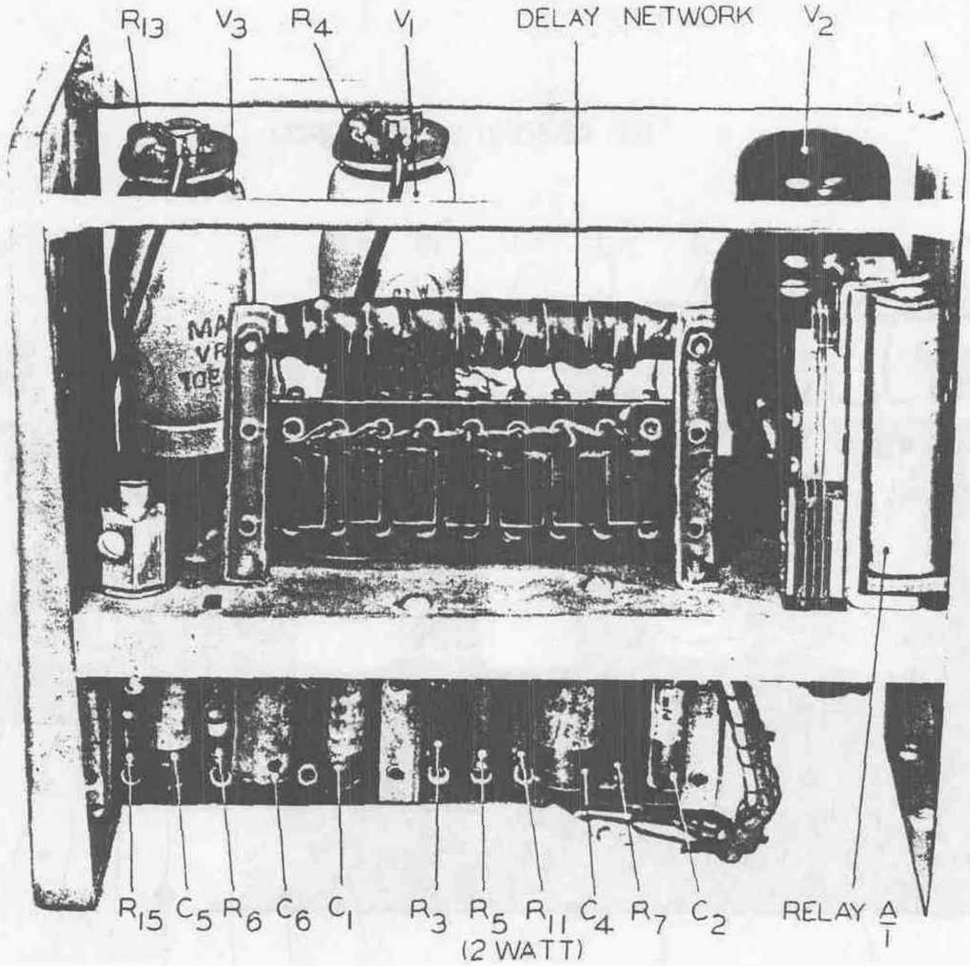


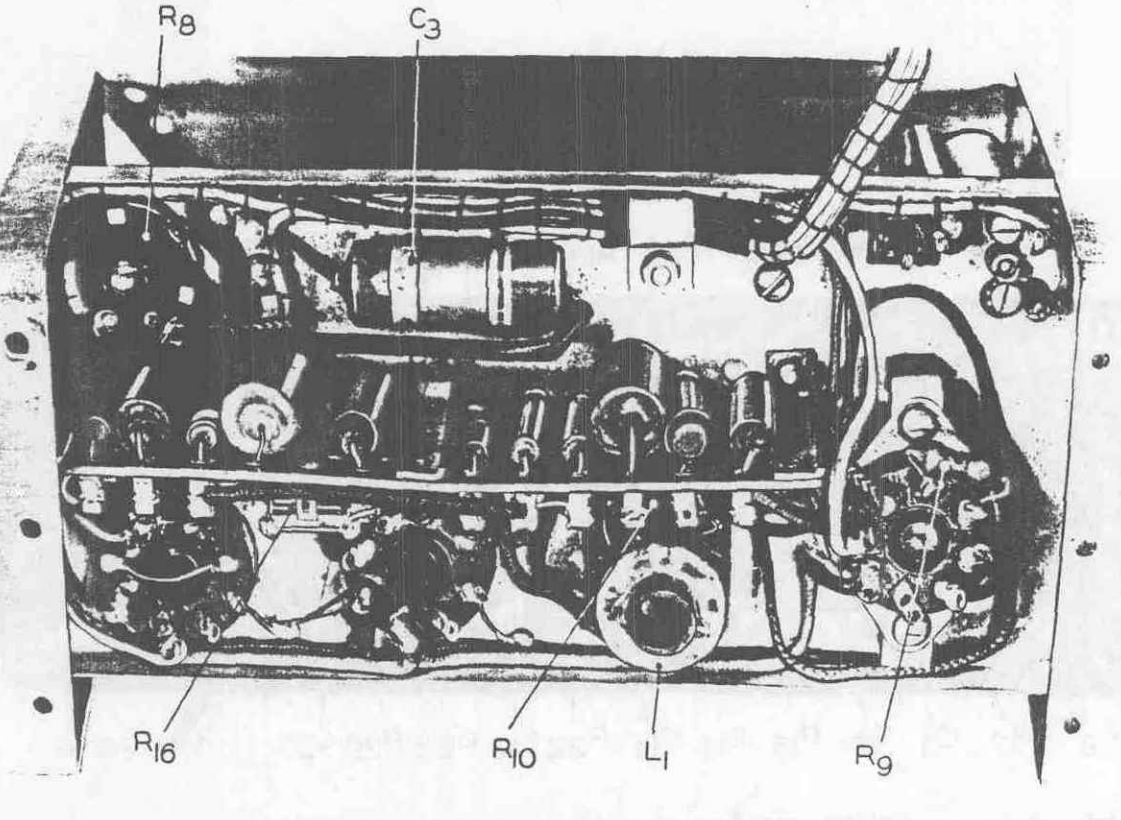
RECEIVING UNIT TYPE 61 - TOP AND UNDERSIDE VIEWS FIG. 2.2



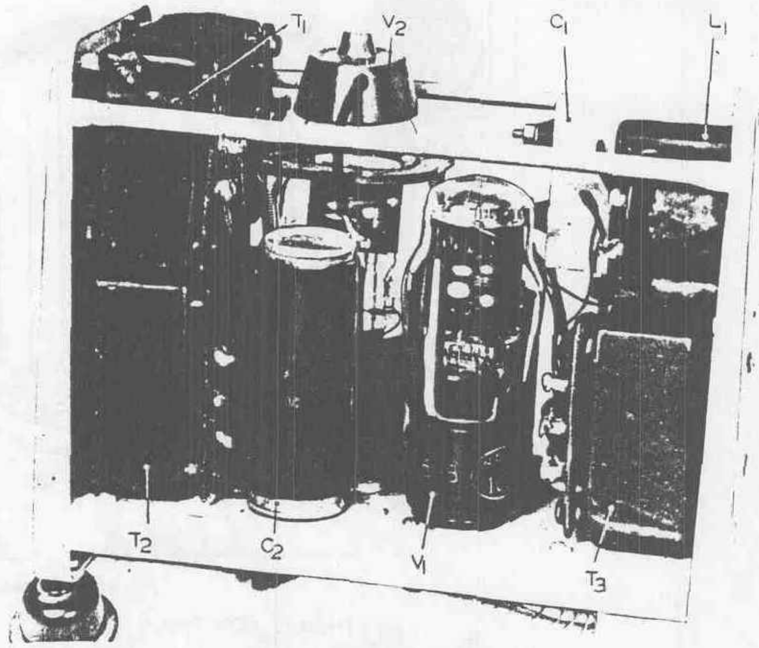


AMPLIFYING UNIT TYPE 178 GENERAL VIEWS FIG 23

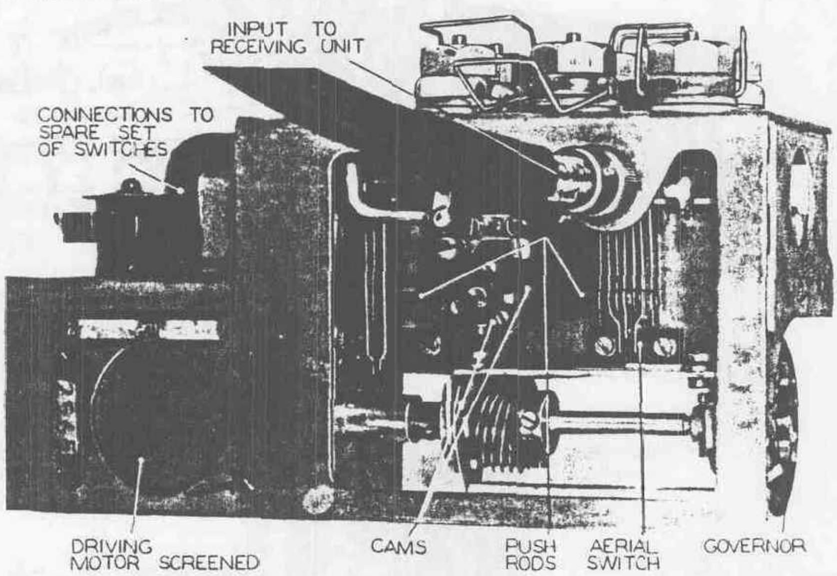




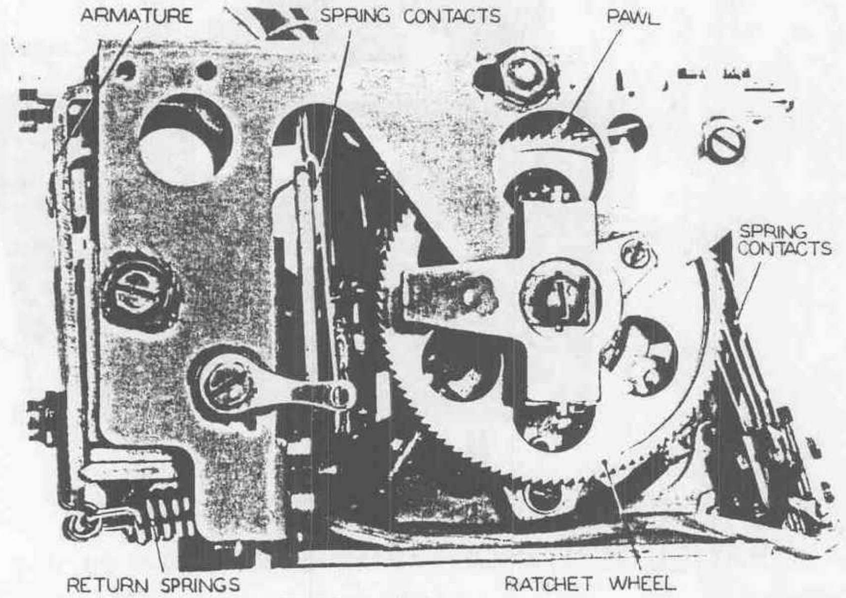
MODULATOR UNIT TYPE 66 GENERAL VIEWS FIG.24



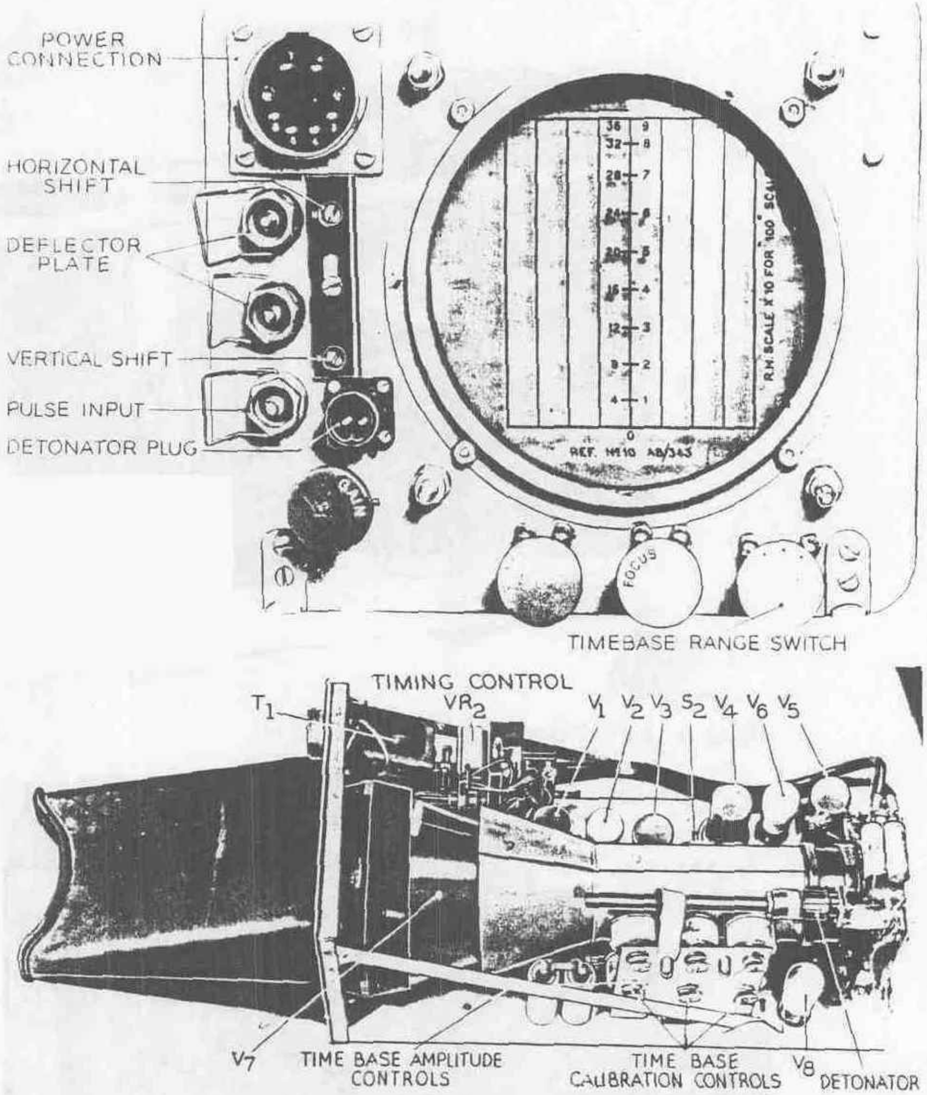
POWER UNIT TYPE 286 GENERAL VIEW FIG 25



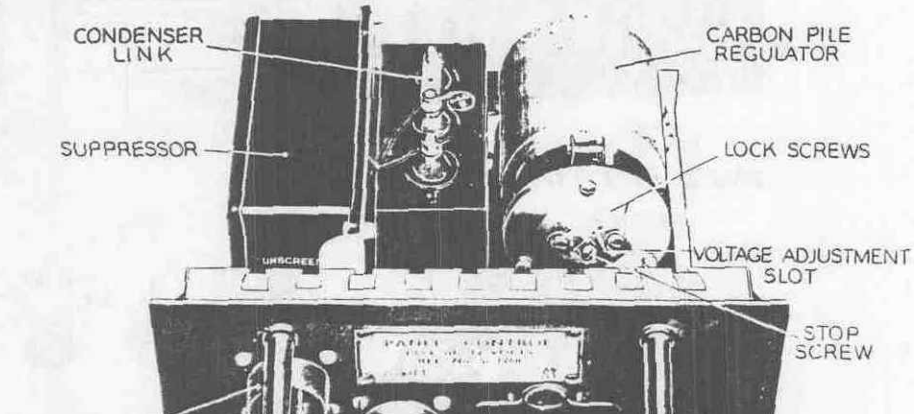
SWITCH UNIT TYPE 115 FIG 26



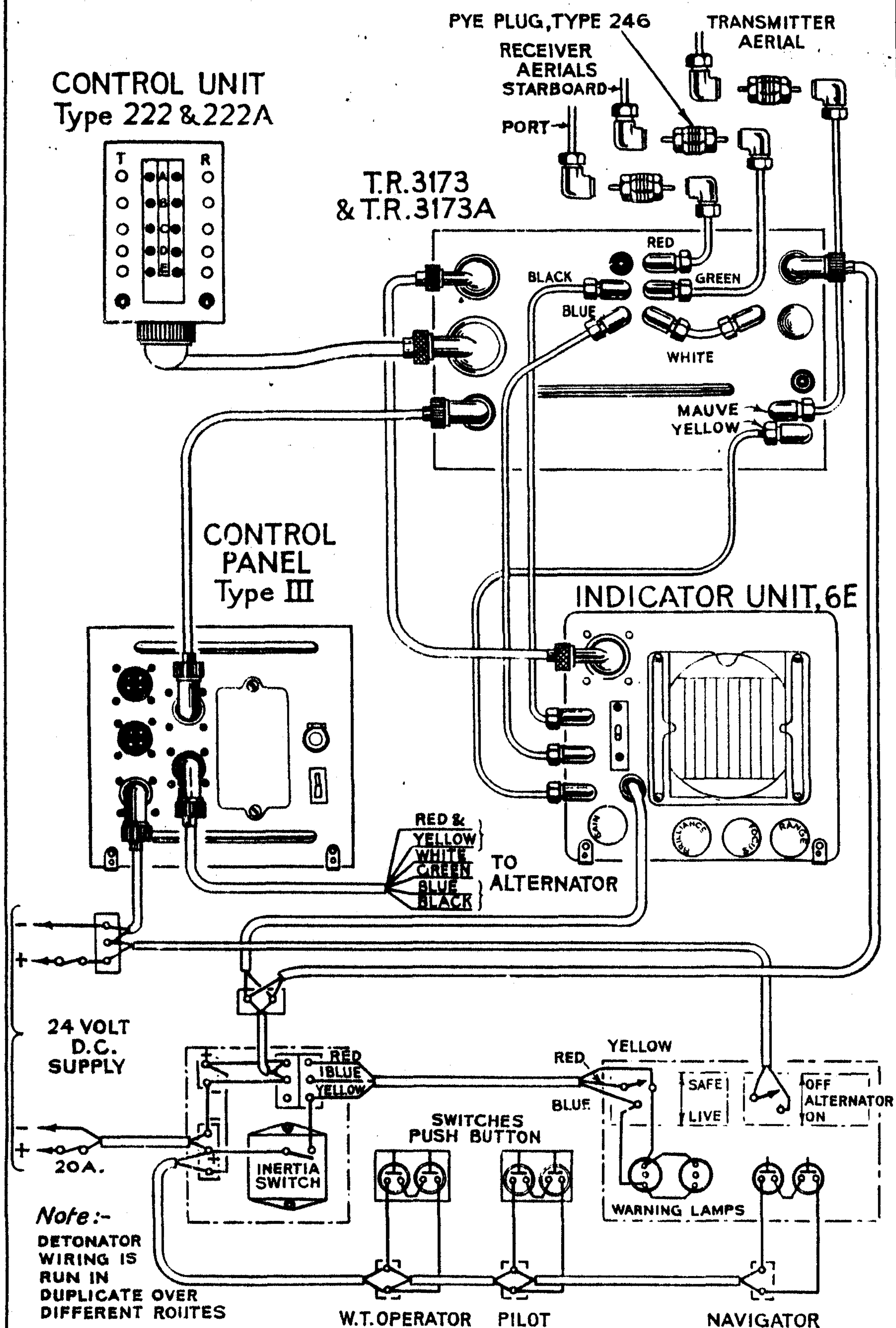
SELECTOR MOTOR GENERAL VIEW FIG 27



INDICATING UNIT TYPE 6E FRONT AND TOP VIEWS FIG.28



PANEL, CONTROL TYPE 3 COVER REMOVED FIG.29

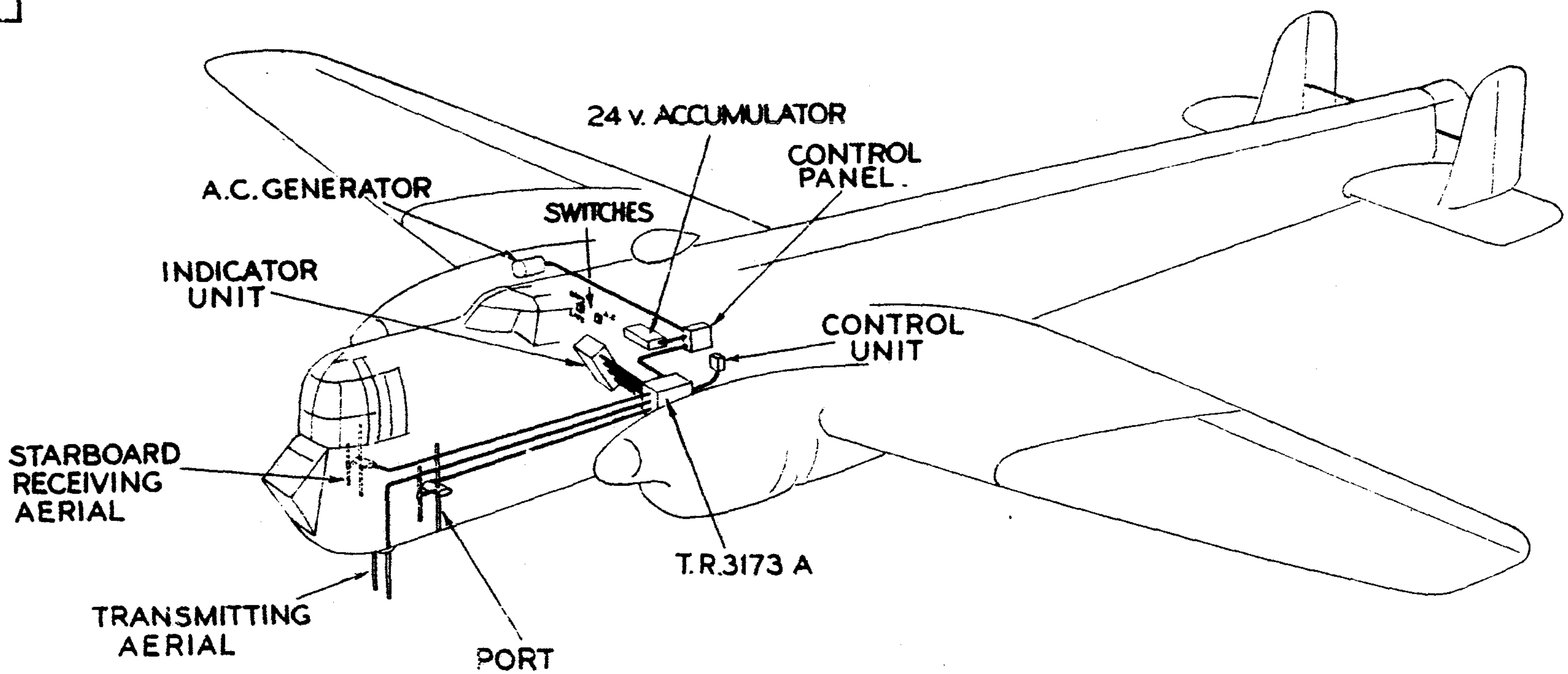


Note:-
DETONATOR WIRING IS RUN IN DUPLICATE OVER DIFFERENT ROUTES

INTERCONNECTIONS AND DETONATOR FIRING CIRCUIT

FIG. 30

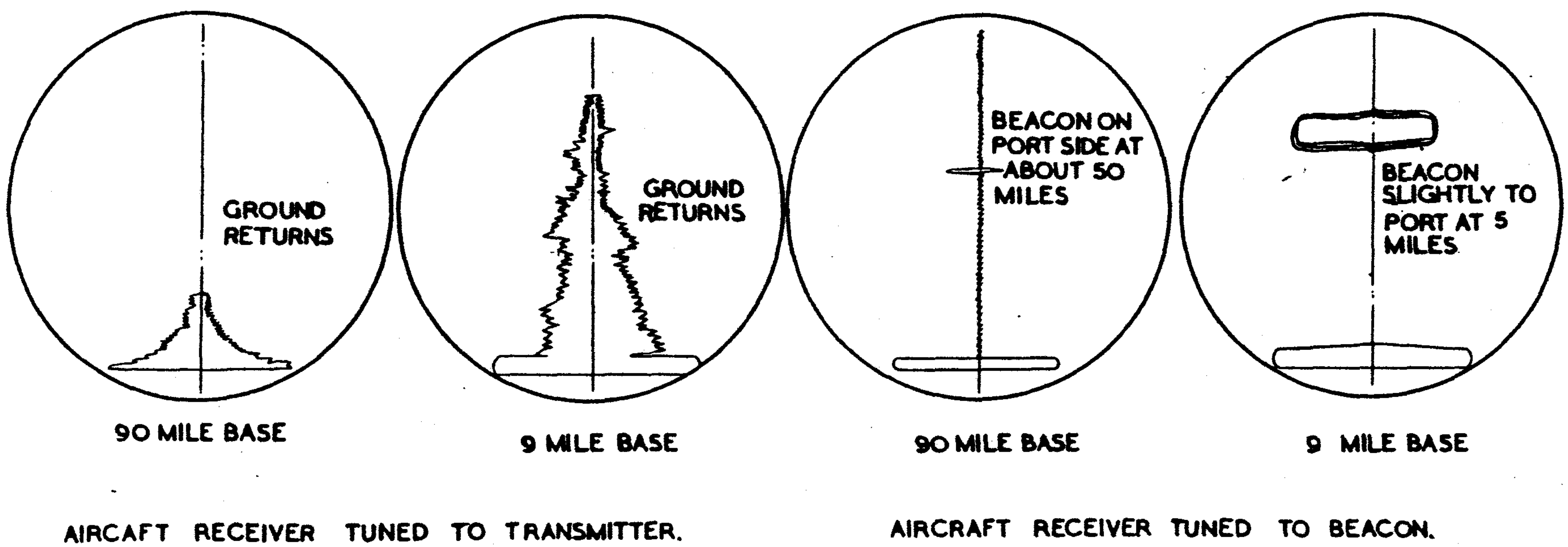
FIG. 30



TYPICAL INSTALLATION
WHITLEY AIRCRAFT

FIG. 30 A

FIG. 30 A



TYPICAL INDICATIONS

FIG. 31

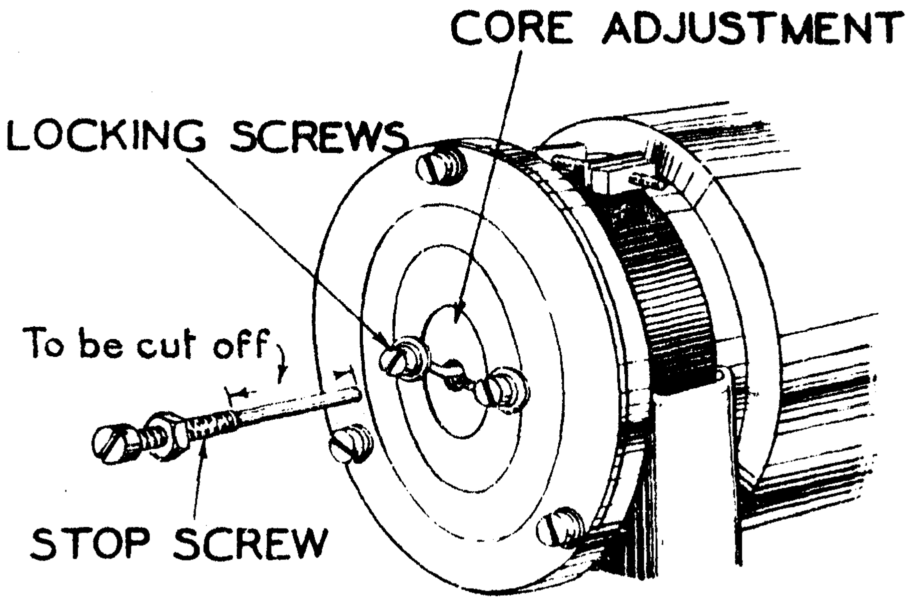
FIG. 31

DAILY INSPECTION REPORT (________ AIRCRAFT No. ______)

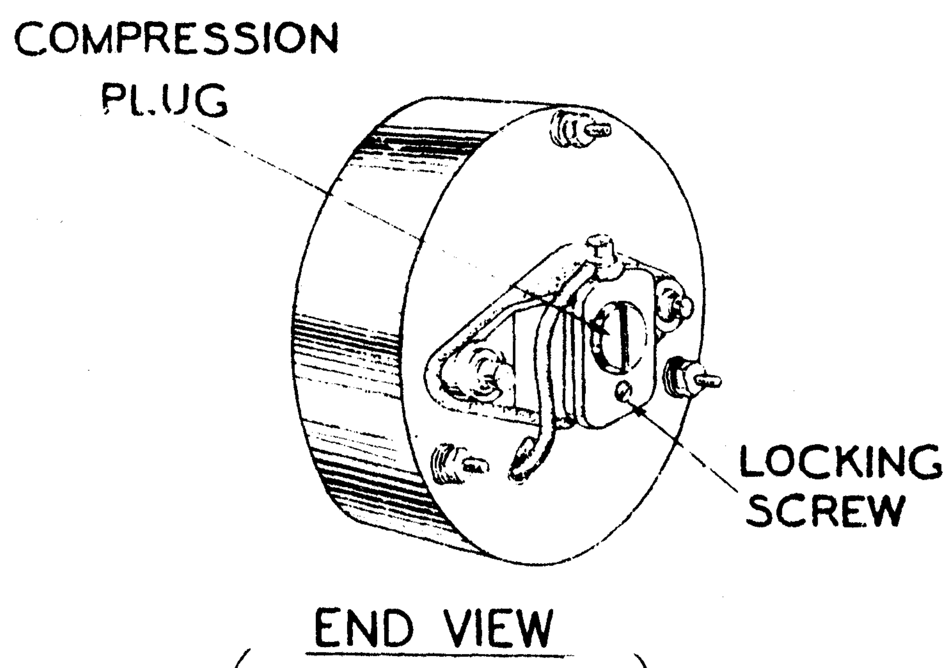
ITEM		TEST	BEFORE INSP'N	AFTER INSP'N	BEFORE INSP'N	AFTER INSP'N	BEFORE INSP'N	AFTER INSP'N	BEFORE INSP'N	AFTER INSP'N	BEFORE INSP'N	AFTER INSP'N	BEFORE INSP'N	AFTER INSP'N	BEFORE INSP'N	AFTER INSP'N
AERIALS	T	INSPECTION	OK	✓												
		INSULATION RES.	Inf.	✓												
	R. STARD	INSPECTION	Bent	✓												
		INSULATION RES.	7M	✓												
	R. PORT	INSPECTION	OK	✓												
		INSULATION RES.	Inf.	✓												
CABLES, CHECK		(I) FROM DIAGS.	OK	✓												
		(II) PLUGS & SKTS.	*	Indented for												
CONTROL PANEL		VOLTS	83	80												
CONTROLLER		LAMPS	3 Blown	✓												
		SWITCHES	OK	✓												
INDICATOR		CONTROLS	OK	✓												
		INDICATION	OK	✓												
TRANSMITTER RECEIVER		SWITCH MOTOR	Running unevenly	Replaced												
		VALVES ALIGHT	OK	✓												
		MARKER	OK	✓												
		R.F. ERROR (Tx)	+5	✓												
		FREQUENCY (Rx)	OK	✓												
DESTRUCTORS		FIRING SWITCHES	OK	✓												
		INERTIA SWITCH	Lamp Blown	Replaced												
REMARKS			* 3 Grips Missing													
RADIO MECHANIC'S SIGNATURE																
DATE																

FIG. 32

FIG. 32



FRONT VIEW

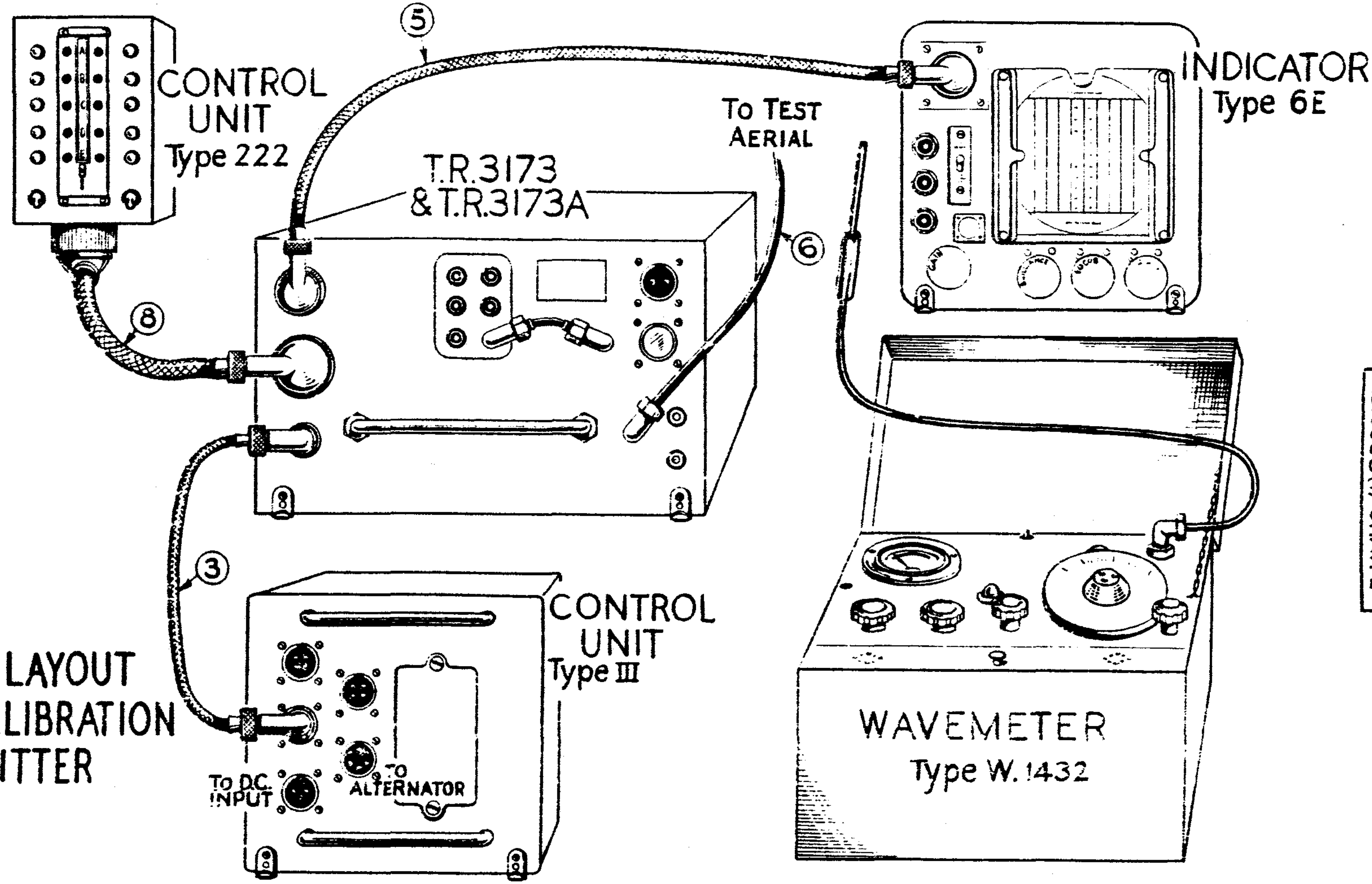


END VIEW
(With cover removed)

FIG. 33 ADJUSTMENT OF VOLTAGE REGULATOR TYPE E

FIG. 33

FIG.34



BENCH TEST LAYOUT
FREQUENCY CALIBRATION
OF TRANSMITTER

Note:— FOR DETAILS OF CABLING SEE PARA. 77

FIG.34

A.L.1.

BENCH TEST LAYOUT FOR POWER OUTPUT AND PULSE SHAPE MEASUREMENT

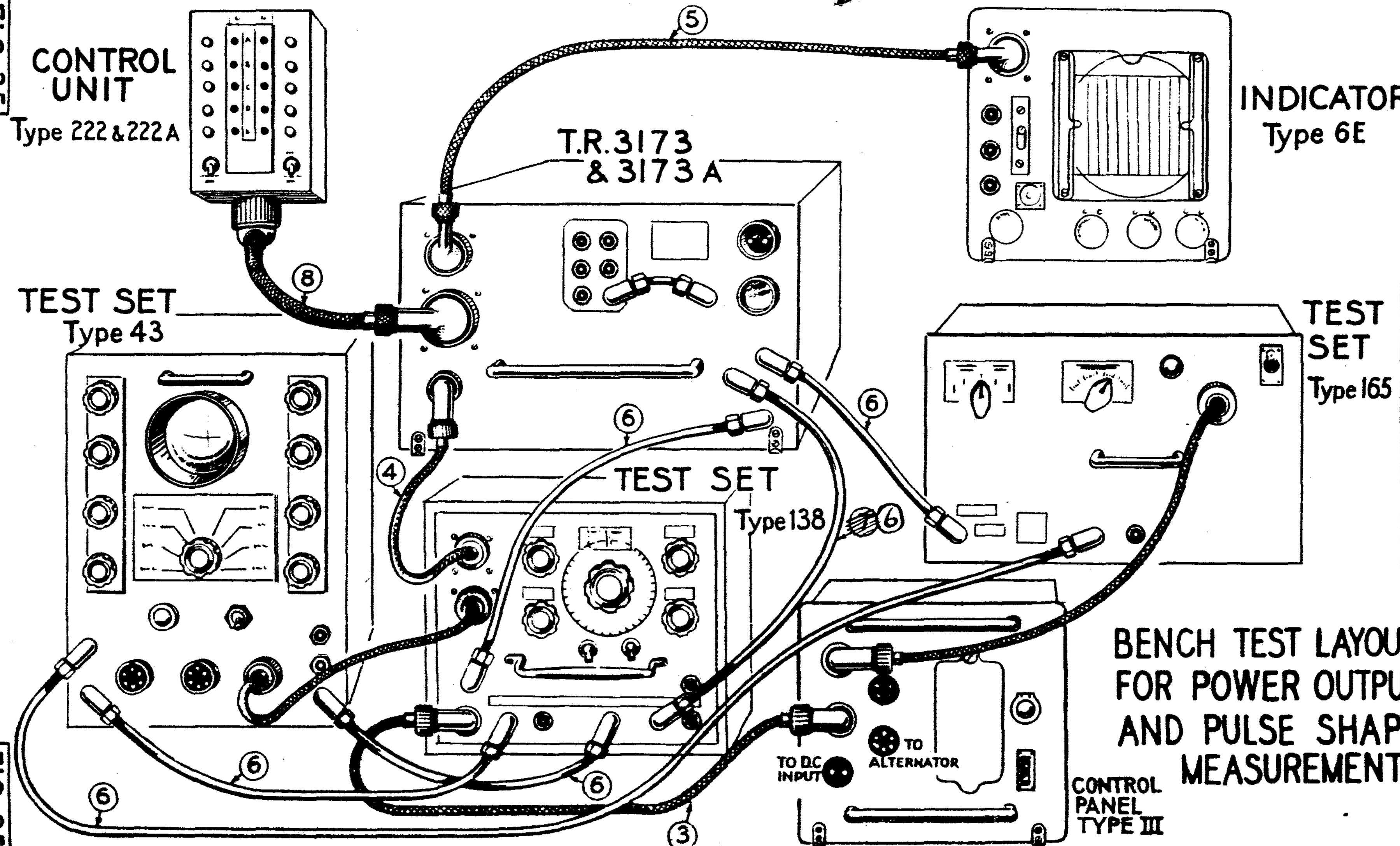


FIG. 35

FIG. 35

FIG.36

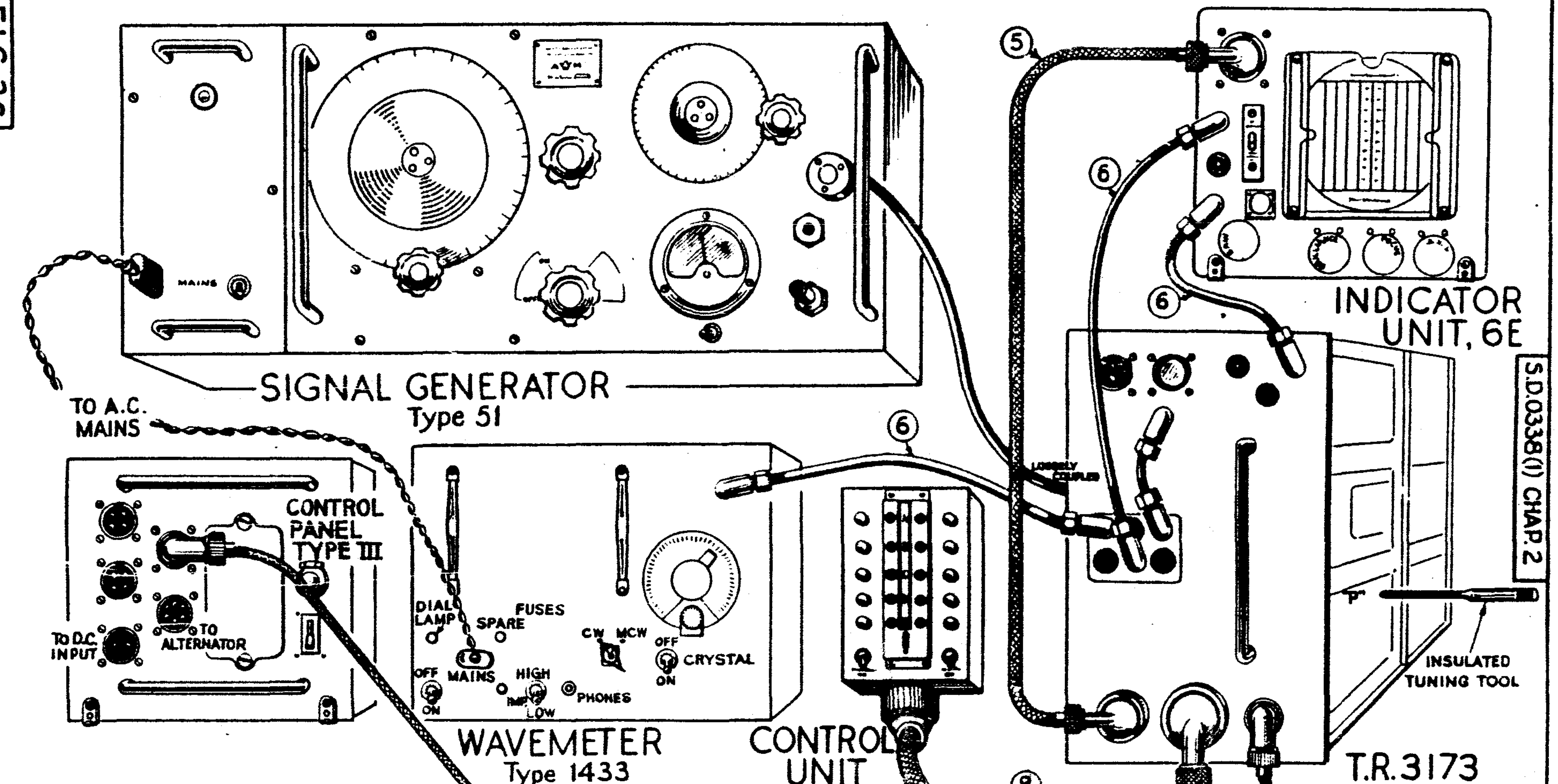


FIG.36

BENCH TEST LAYOUT
FREQUENCY CALIBRATION
OF RECEIVER LOCAL OSCILLATOR

Note:— FOR DETAILS OF CABLING SEE PARA. 77

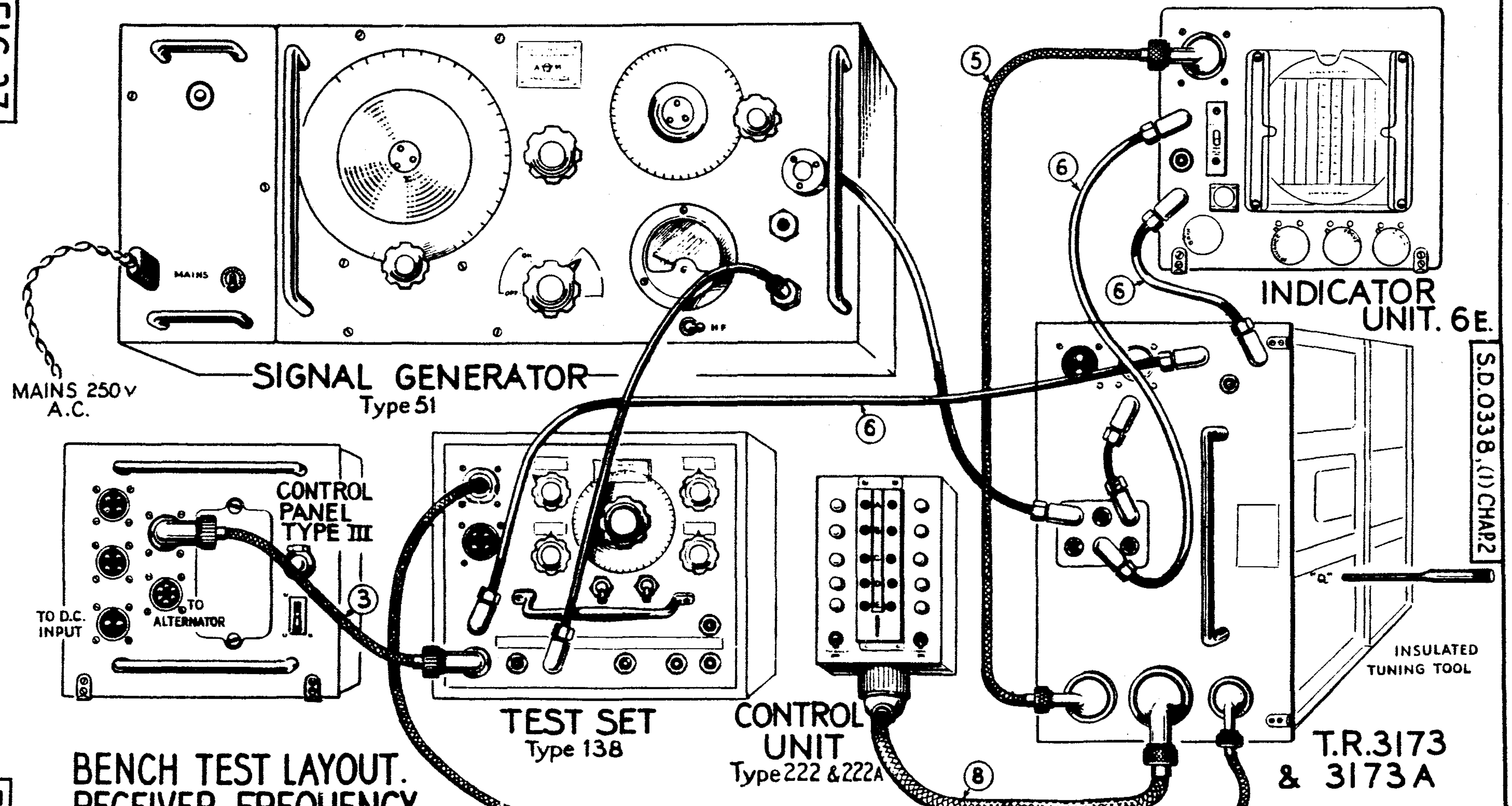


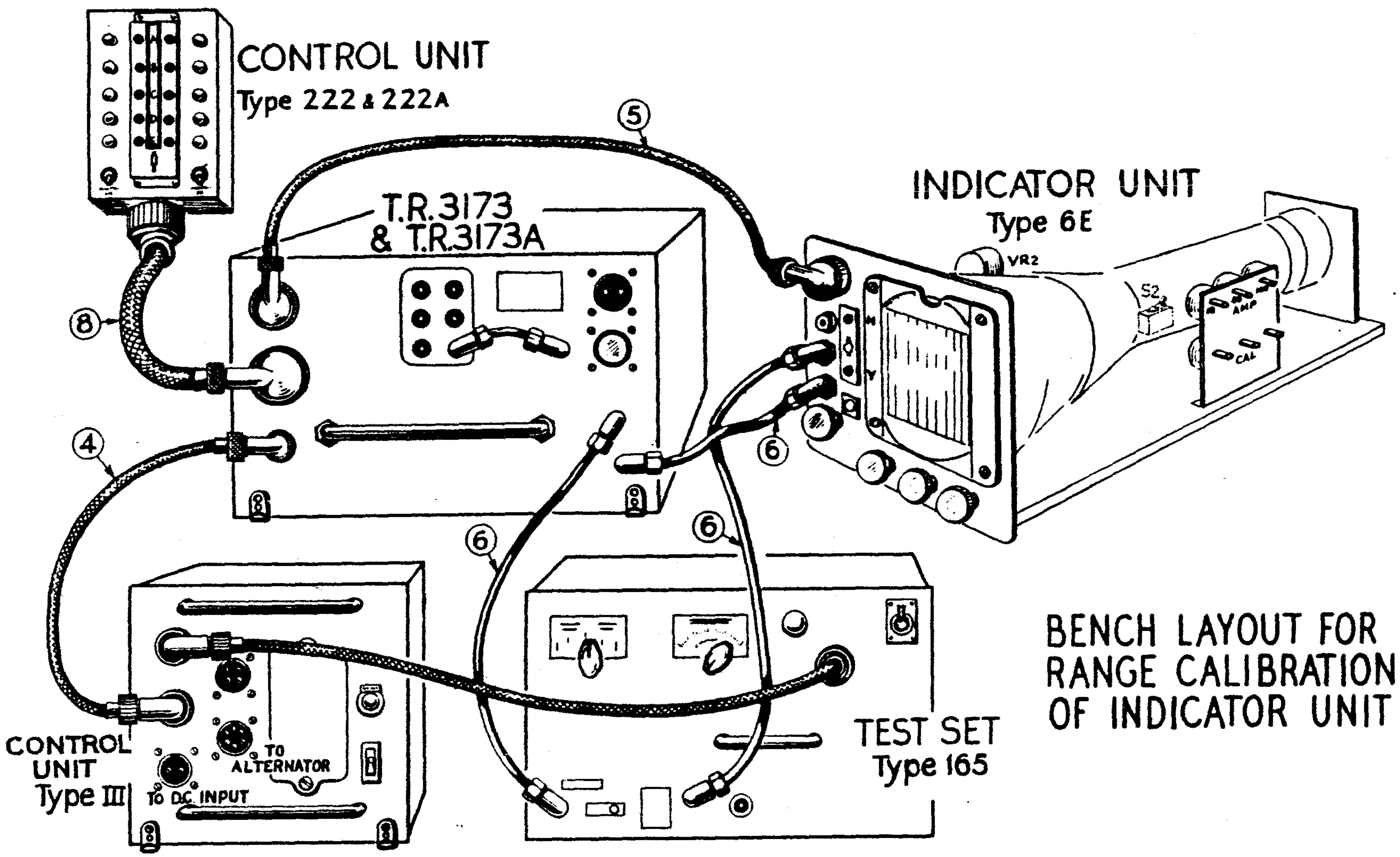
FIG. 37

BENCH TEST LAYOUT.
RECEIVER FREQUENCY.
CALIBRATION & SENSITIVITY

Note:— FOR DETAILS OF CABLING SEE PARA. 77

FIG. 37

FIG. 38



BENCH LAYOUT FOR RANGE CALIBRATION OF INDICATOR UNIT

Note :— FOR DETAILS OF CABLING SEE PARA. 77

FIG. 38