CONFIDENTIAL

I.F.F. Mk. III G.R.

RECEIVERS, TYPES R.3120 & R.3121

AMENDMENT RECORD SHEET

Incorporation of an Amendment List in this publication is to be recorded by inserting the Amendment List number, signing in the appropriate column, and inserting the date of making the amendment.

SEE A.P. 2462A. PAGE 12 — "AMENDMENT LISTS AND HOW TO AMEND PUBLICATIONS"

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I.F.F. Mk. III G.R.

RECEIVERS, TYPES R.3120 & R.3121

INTRODUCTION

1. I.F.F. Mk.IIIGR is an airborne equipment intended to give automatic identification to all normal interrogators of the I.F.F. Mk.III identification system. In addition, identification can be given to G.C.I. stations direct and beacon facilities ("Rooster") are provided for aircraft fitted with search equipment operating on 1.5 metres.

2. The above facilities are obtained by the use of two oscillator units. One operates on the A band with all facilities as in I.F.F. Mk.III (R.3090/67). The second unit gives either the G band operating in the frequency band 200-210 Mc/s or the R band, 172 - 182 Mc/s.

3. By means of remote switching some or all (according to the type of installation) of the following functions are obtainable:-

(i) Normal I.F.F. Mk.III identification only, as required by bomber aircraft.

(ii) Automatically switched A and G facilities for the G.C.I. control of fighters, lasting approximately 35 seconds.

(iii) As (ii) but with the addition of a manual switch for sustained A to G switching.

(iv) As (ii) or (iii) but with the addition of a manual switch to give distress signals (MAY DAY) on the G band.

(v) Uninterrupted working on 177 Mc/s as an airborne beacon only, as required by Coastal Command, with reversion to normal A band by manual switch.

(vi) As in (v) but controlled by a telegraph key for communication purposes.

(vii) As in (ii), (iii) or (iv) but on F.A.A. frequency (179 Mc/s) for controlled interception by F.A.A. fighters (equivalent to G.C.I. working).

(viii) Is a combination of (ii) and (vi).

(ix) Is a combination of (iii) and (vi) or (iv) and (vi).

The method of wiring for all the above installations is given in fig.11.

GENERAL DESCRIPTION

4. The equipment comprises the receiver, type R.3120 or R.3121 for 12-volt or 24-volt supplies respectively. The particular receiver installed will be used in conjunction with the control units, types 89 and 90. The two control units when mounted together from the

control unit assembly, type 1.

5. The apparatus is capable of receiving a small R.F. pulse from the interrogating transmitter and of consequently retransmitting a more powerful pulse at substantially the same frequency. For identification purposes on the A band, the retransmitted pulse can be coded by varying its duration (or width) and by varying the sequence in which pulses of different widths are retransmitted. Normally, two pulse widths are used, namely "narrow" pulses of 4 to 9 microseconds duration and "wide" pulses of 15 to 35 microseconds. In addition, distress signal pulses of 60 to 100 microseconds duration can be transmitted. The A band is from 157 to 187 Mc/s, and the apparatus sweeps over this band in a period of 2.5 seconds with a rapid "flyback", the interval between successive return signals being 2.8 seconds observed on any one responsor receiving apparatus.

6. The G band operates on a fixed frequency within the band 200 - 210 Mc/s previously adjusted to the frequency of the controlling G.C.I. station. The apparatus will continuously sweep the A band until it is required to give identification to a ground station. At the request of the controller, the pilot presses a button switch which brings the A and G oscillators into operation alternately; the A band for from 1/10 to 1/15 second and G band for from 1/15 to 1/25 second, the complete operation occurring at the rate of five times per second. A thermal-delay relay holds these conditions for 35 seconds, and at the end of this period, automatically drops out. Thus, during these 35 seconds, the equipment continues to give identification to all interrogators operating in the A band, and in addition, a response direct to the G.C.I. station. At the end of the 35 second period, the set reverts to uninterrupted A band operation.

7. In an emergency a fighter under the control of a G.C.I. station may transmit a MAYDAY response by closing a switch, which actuates the G oscillator unit continuously thus producing solid or unchopped painting on the P.P.I. The A band is inoperative during this condition.

8. "Rooster" operation is controlled by a selector switch at the operator's station. This switch gives a choice of normal A band operation or "Rooster"; in the latter position of the switch a telegraph key and a send-receive switch control the GR oscillator. The send-receive switch merely short-circuits or open-circuits the telegraph key. "Rooster" provides A.S.V. beacon and W/T communication facilities.

9. The I.F.F. Mk.IIIGR may be used to replace other I.F.F. receivers in existing installations and will give the same facilities as the other receiver with the exceptions listed below:-

British Mk.III ----------------	all functions
American Mk.III (ABK) ----------	all functions
American Mk.IIIG (SCR695) ------	all functions, except timed A/G switching and G/D. To retain these facilities, the installation will require modification as detailed in para.39.
American Mk.IIIGR (AN/APX-1)----	all functions, except timed A/G. Switching to "G TIME" or "G ON" produces sustained A/G switching which can be broken only by interrupting the main L.T. supply. The "G TIME" facility may be recovered by a minor installation modification as detailed in para.39.

American Mk.IIIGR with INT./RES. (AN/APX-2) --- The Mk.IIIGR cannot be used in an AN/APX-2 installation but an AN/APX-2 receiver with adaptor can replace a British Mk.IIIGR.

Circuit layout

10. A block schematic diagram is given in fig.1, and the theoretical circuit is given in fig.2. The valves V1, V2, V3, V4, V8 and V9 comprise the main A band circuits which are similar to the Mk.III equipment (R.3067 or R.3090). The valves V6, V4, V5, V7a, V8 and V9 comprise, in effect, a separate receiver for the G or R operation, working on the same basic principles of Mk.III.

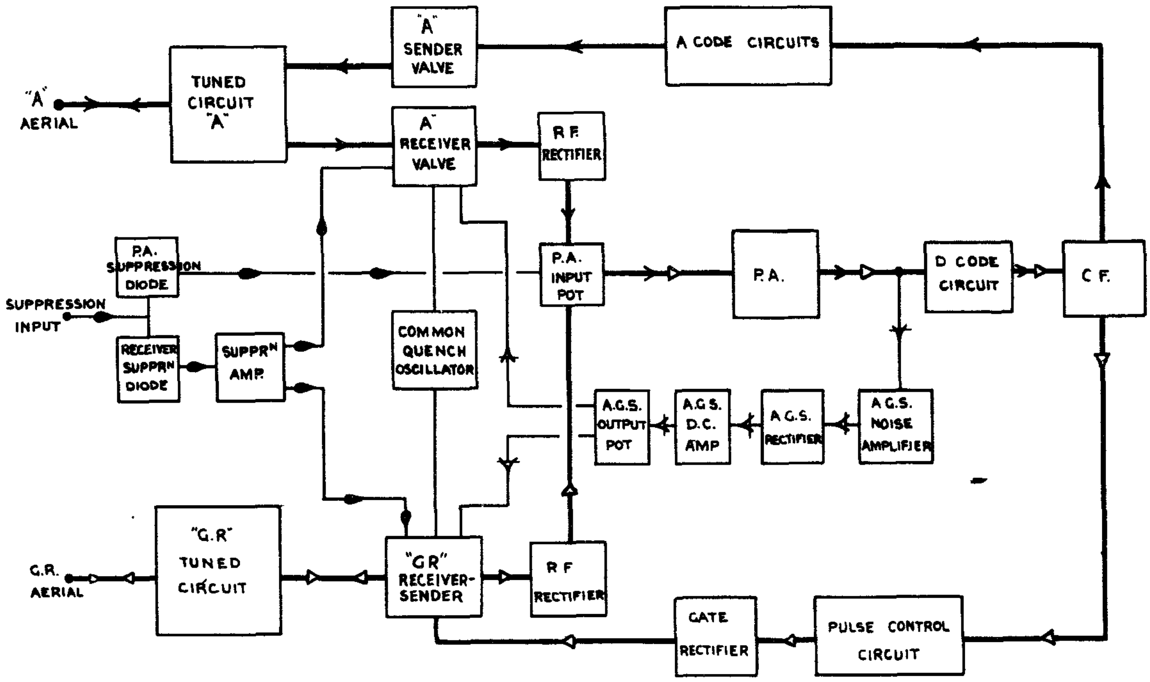


FIG. 1 BLOCK SCHEMATIC DIAGRAM

11. On the A band, the valves V3 and V2 comprise a super-regenerative receiver; V4 is a quench oscillator, V8 is a pulse amplifier and V9 is a cathode follower. The output of V9 drives the transmitting valve V1 and the tuned circuit L5 - C9 is common to both receiver and transmitter valves.

12. In the GR oscillator unit, the valve V6 is used as a sender-receiver and the diode V5 is an R.F. rectifier. V8 and V9 have the same function on the GR band as on the A band. The diode V7a is a gate diode, the function of which is explained in the detailed circuit description.

13. Automatic Gain Stabilising circuits, common to the A band receiver and to the GR receiver are built around the valves V12, V10b and V13. Common suppression circuits comprise the valves V10a, V7b and V11.

14. It should be noted that the diodes referred to as V7a and V7b together form a double-diode valve type V.R.54. This also applies to the diodes V10a and V10b.

15. Either oscillator unit is brought into operation by switching cathode-bias from one R.F. valve to the other.

16. Each R.F. unit has its own aerial plug which may connect to separate aerials or may be commoned by means of an inter-connecting link to a single aerial unit.

17. H.T. supply is obtained from a rotary transformer which also drives the frequency sweeping mechanism and cam-operated switches through a gear box. Both H.T. and L.T. voltages are controlled by a carbon-pile voltage regulator (CPR).

18. TABLE OF VALVE FUNCTIONS

Ref. in circuit	Function	Type No.
V1	A band sender	VR135
V2	A band R.F. rectifier	VR92
V3	A band receiver	CV6 or VR135
V4	Quench oscillator	VR67 or 6J5G
V5	GR band R.F. rectifier	VR92
V6	GR band receiver/sender	VR135
V7a	GR band gate diode	VR54
V7b	Suppression diode	
V8	Pulse amplifier or trigger valve	VR65A
V9	Cathode follower	VR65A
V10a	Suppression diode	VR54
V10b	A.G.S. noise rectifier	
V11	Suppression amplifier	VR67 or 6J5G
V12	A.G.S. noise amplifier	VR65A
V13	A.G.S. D.C. amplifier	VR65A

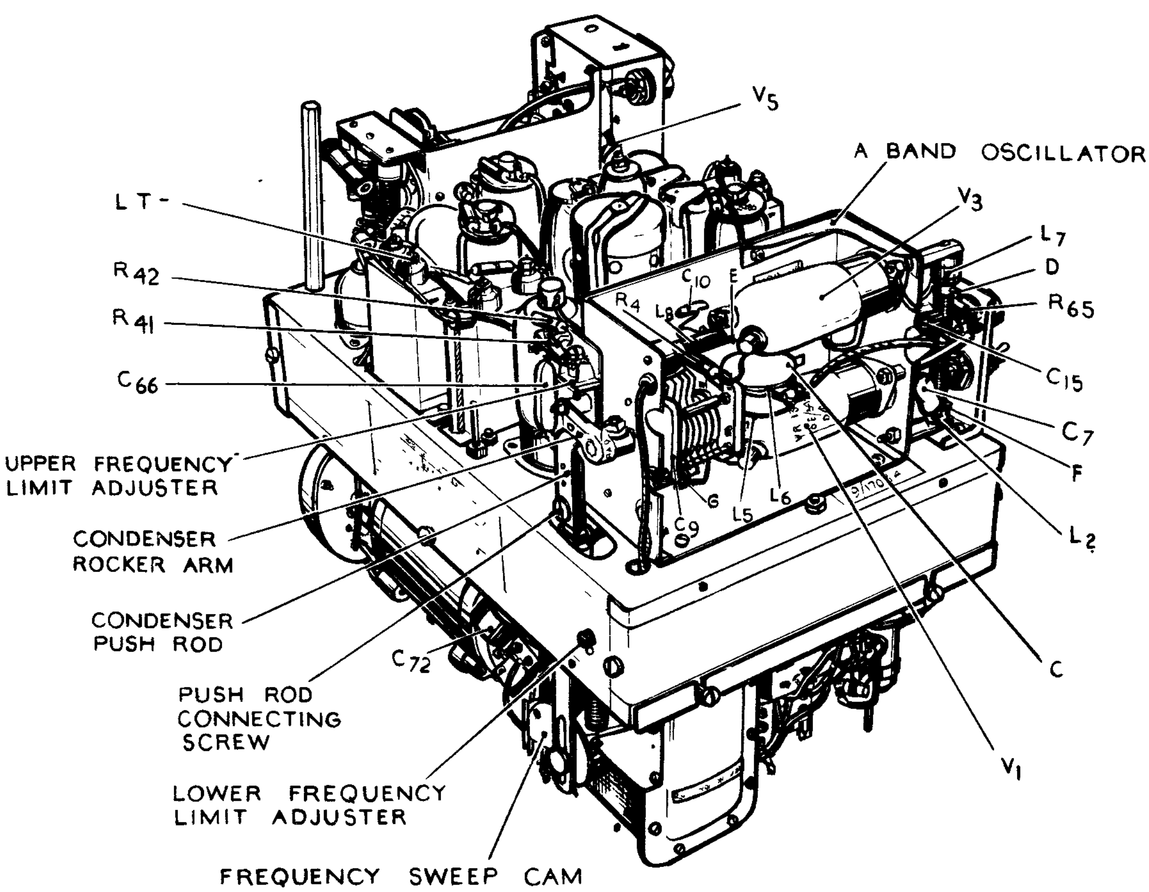


FIG. 3 "A" BAND OSCILLATOR ON TOP CHASSIS

MECHANICAL CONSTRUCTION

A Band R.F. Unit

19. The illustration in fig.3 shows the position of the oscillator unit type 74 or 98 (depending upon supply voltage). This is the A band oscillator and carries the receiver and sender valves and the tuning circuit within a copper screen with the R.F. rectifier V2 mounted on the reverse side of the screen. The receiver valve V3, mounted at the top of the unit, may be either a type CV6 or a VR135, but it is essential to use only a VR135 as the sender valve V1 which is mounted beneath V3.

20. The variable condenser C9 is rocked over the frequency band by a push rod driven from a spiral cam mounted on the rotary transformer unit. As the push-rod moves upwards it sweeps the condenser over the band from low frequency to high. The limits of the frequency sweep are adjustable at each end of the band. Control of the upper limit is provided by a screw which effectively alters the length of the push-rod, thus raising or lowering the rocker arm of the condenser; this adjusting screw has a ratchet lock and can be adjusted by inserting a screwdriver through a hole in the top of the dust cover (fig.4). The extent of the downward movement of the push rod is controlled by an arrestor comprising a projection from one side of the push rod which comes up against a stop carried on a movable plate which is adjusted by means of a screw in a slot at the rear of the mid-chassis (fig.3). Thus the condenser rests at the required low frequency setting whilst the cam completes its cycle.

21. To make it possible to remove the upper from the lower chassis the push rod is made in two parts which are held together by dowel pins and a coin-slotted screw (fig.3).

G Band R.F. Unit

22. Figs. 5 and 6 illustrate the oscillator unit, type 131. It carries a single valve V6 acting as both receiver and transmitter, and the diode V5. The tuning circuit comprises a U-shaped loop L23 whose electrical constants are varied by means of a blade of silvered-copper which is hinged across the closed end of the loop to mesh between its arms. The U-shaped loop is capacity-loaded at the open end by means of a plug-on variable trimmer condenser. There are two such trimmer condensers, C30 and C31, one covering the G band frequencies and the other the R band frequencies. The oscillator is preset on the ground to the required operating frequency, the condenser not in use being housed on stowage pins in the oscillator unit. Fine tuning is provided by the blade which is controlled from the front panel.

23. The magnetic field surrounding the arms of the loop L23 induces a current in the tuning blade; since the polarity of the magnetic field is reversed on the two long edges of the blade the fields cancel out at the centre of the blade, which thus operates as a short-circuited turn. The induced current flowing in the short-circuited turn sets up a field which tends to oppose the primary field. The effective inductance of the main loop L23 is thereby reduced as the blade meshes in. The wedge-shape of the blade provides a linear tuning curve.

24. The G band R.F. unit is removable from the chassis, the electrical connections being made by plug P8 and socket SK7. Removal of this unit will not disturb the functioning of the equipment on the A band, but another plug Ref. No. 10H/13464, fitted with one 33 ohm 2 watt resistor in parallel with a 18 ohm 3 watt resistor between poles 1 and 7 and a 42 ohm, 2 watt resistor between poles 2 and 7 must be inserted in SK7 to load the heater network correctly.

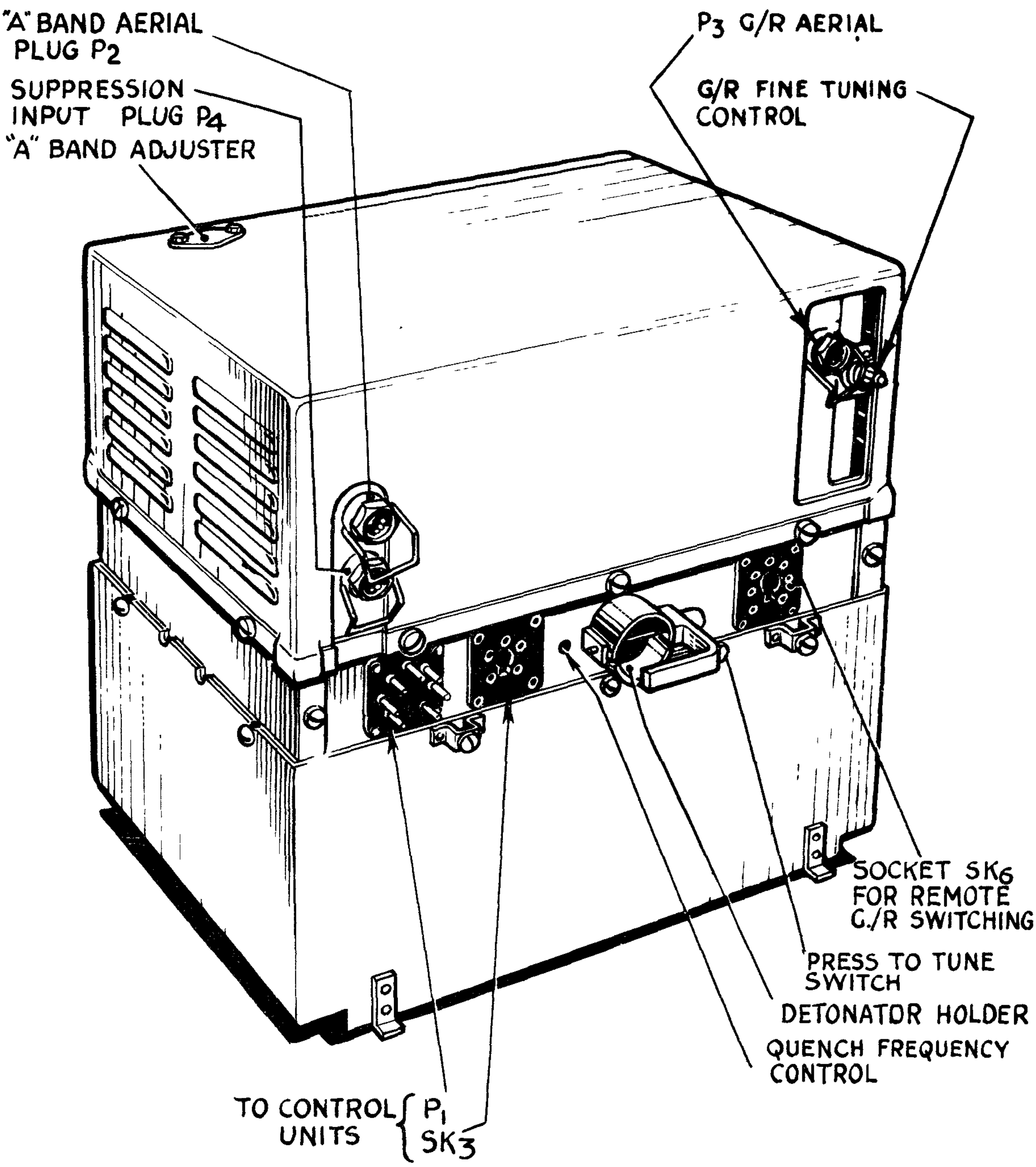


FIG. 4 EXTERIOR OF RECEIVER

25. In consideration of a possible future development, the resistance R67 is fitted in parallel with the heater of V6. The intention is to drain a sufficiently heavy current through the heater supply network to allow for the use of a replacement oscillator unit using a different type of valve. The forward screen in the oscillator unit it cut away to give access to the valve V6.

Press to tune switch

26. This is spring return push switch (fig.4) which brings the G unit into operation and suppresses the A unit for purposes of adjusting the G frequency when setting up.

Quench frequency control

27. Immediately to the left of the detonator holder (fig.4) is an aperture giving access to the slotted spindle of a small variable condenser in the quench oscillator circuit. Adjustment of this condenser provides up to an 8 Kc/s shift, either way, of the oscillator

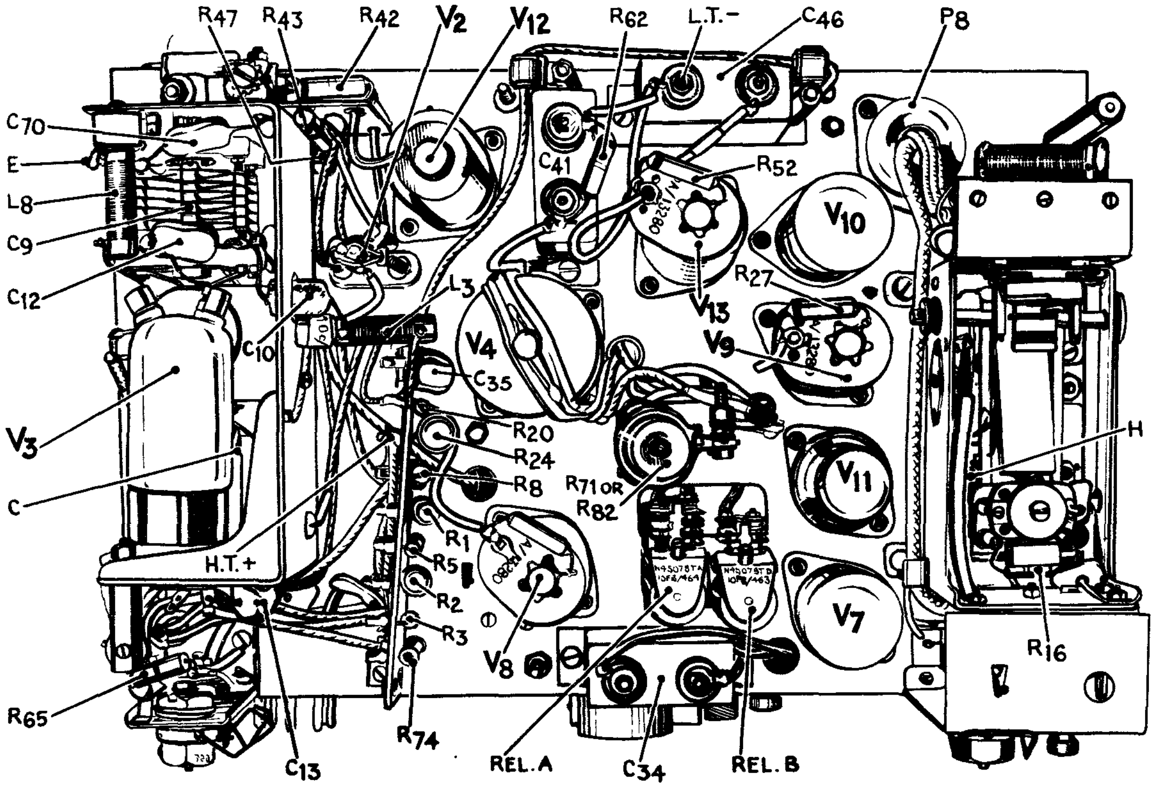


FIG. 5 TOP OF UPPER CHASSIS

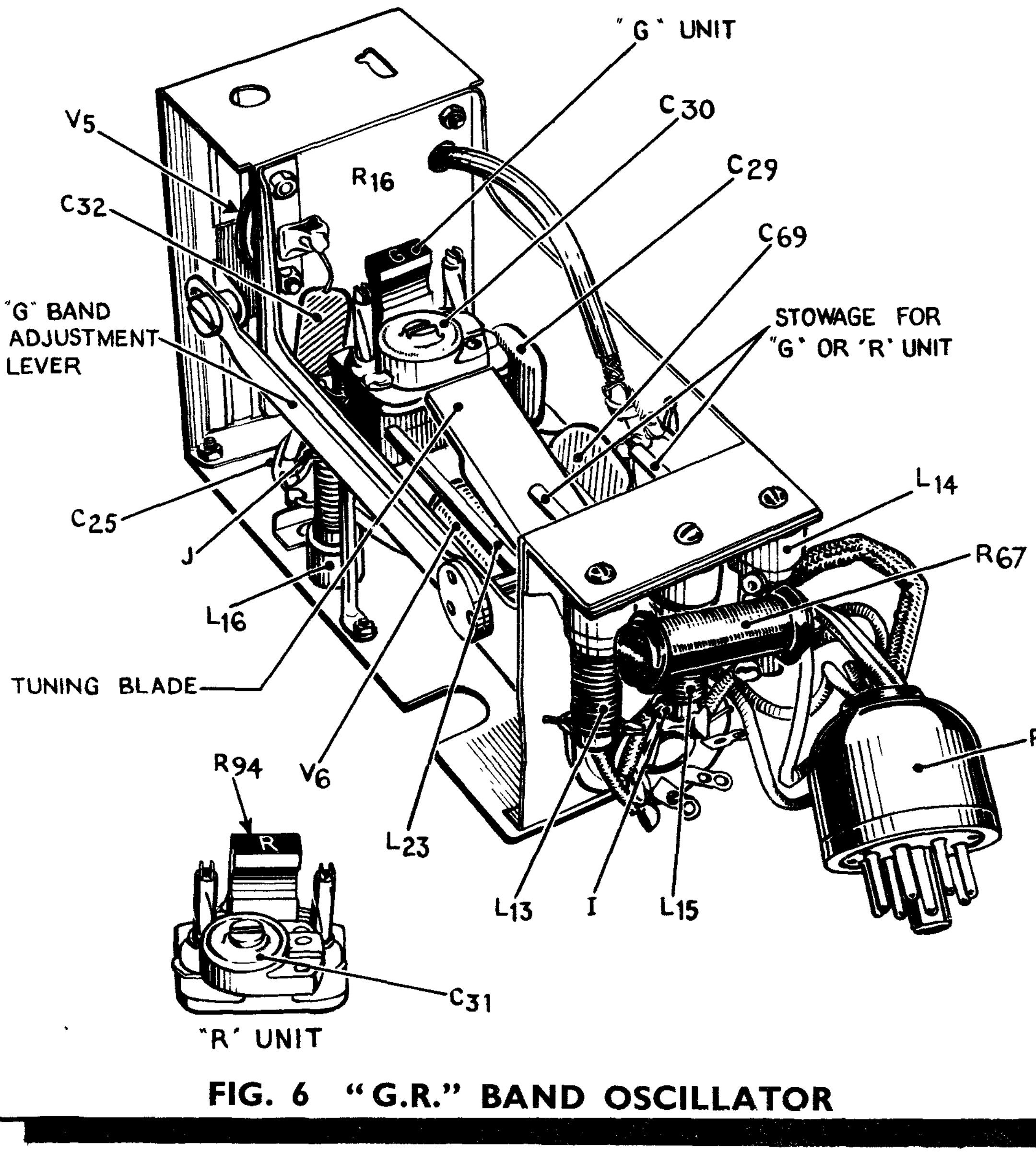


FIG. 6 "G.R." BAND OSCILLATOR

frequency to enable interfering heterodyne notes heard in neighbouring communication receivers to be rendered inaudible.

Gear box and switch cams

28. Sectional views of the gear box are given in fig.7. The shaft of the rotary transformer extends into the gear box; this shaft terminates in a steel worm (6) which drives the worm wheel and pinion assembly (7), which in turn drives the spur gear (3) and striker wheel (5) assembly. The shaft on which the latter assembly is mounted (2) extends outside the gear box and is knurled to take the spiral cam (frequency sweep cam, fig.3); this cam operates the spring-loaded push-rod coupled to the A band tuning condenser. The striker wheel carries a striker peg meshing with a geneva wheel (4) on the shaft (1) which carries the coding switch cams situated outside the gear box. The worm (6) turns at 3800 to 4000 r.p.m. and the condenser-driving shaft (2) runs at about 21.5 r.p.m. (i.e. one revolution per 2.8 seconds). The geneva wheel moves through 90 degrees once every revolution of the cam-shaft, the movement taking place in one-third second and coinciding with the flyback of the tuning-condenser push-rod. Thus the coding-switch cams, which are mounted on the geneva-wheel shaft, move in jerks, resetting the coding switches at the end of every tuning-condenser sweep. A study of figs.2 and 26 will show that H.T. to the A band oscillator is interrupted during this cam movement, i.e. during the condenser fly-back period. The intermediate gear shaft (8) is extended outside the gear box and carries a three-node cam which operates, continuously, the A to G time-sharing switch S9. The speed of revolution of this shaft is approximately 100 r.p.m., thus the switch cycle is completed in one-fifth of a second.

Detonator

29. Provision is made for rendering the purpose of the equipment unrecognizable and/or unusable, in the event of it falling into enemy hands, by incorporating in the receiver a removable detonator which is, when necessary, electrically fired, either by press buttons or automatically by an impact switch (fig.7a). The detonator (demolition electric No. D.64, Mark III or IV) is illustrated in fig.7b.

30. When the detonator is inserted into the receiver a pin (1) inside the holder on the receiver passes down a channel (2) on the side of the detonator. This channel is brought round at an angle near the top of the detonator, necessitating a small rotation, the pin thus having a securing action. This rotation of the detonator causes another pin (3) in the collar on the receiver to seat in a small recess (4) provided in the wall of the large slot on the top of the detonator in which the terminal pins are situated. When the supply socket is inserted in the detonator, it acts as an obstruction to this pin and thus prevents the withdrawal of the detonator prior to the removal of the supply socket. A screwed pin with a knurled head passing through the collar on the holder and the detonator, locks the detonator in position; a right-angle piece carried on the locking pin secures the supply socket. Index marks are mounted in the holder on the receiver and in the detonator. These marks should be aligned before attempting insertion of the detonator.

Thermal delay switch

31. This switch appears in the circuit diagram as Relay C the mechanical details and switch circuit are given in fig.8, this diagram shows the position of the contacts when no current flows through the relay.

32. The mechanical details of the thermal-controlled section of the switch are shown in fig.8(a). The bi-metal strip A is heated by a close-wound coil of nichrome wire which is housed inside the hemi-

cylindrical tube H; the tube is riveted to the bimetal strip. As the temperature rises the strip A bends upwards and eventually reaches a certain position at which the bowed phosphor-bronze strip P on which it presses becomes almost straight and then springs away from A and snaps against the contact 25; the bowed strip P forms part of the contact 24. This "snap" movement of P takes place about 35 seconds after switching

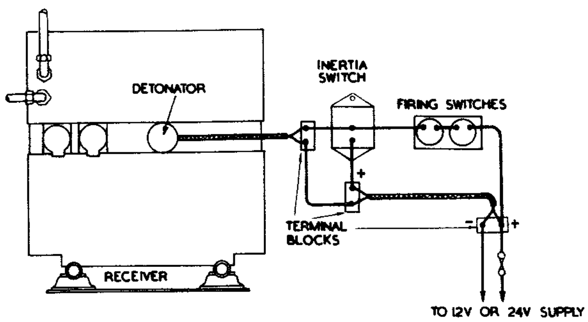


FIG. 7A DETONATOR FIRING CIRCUIT

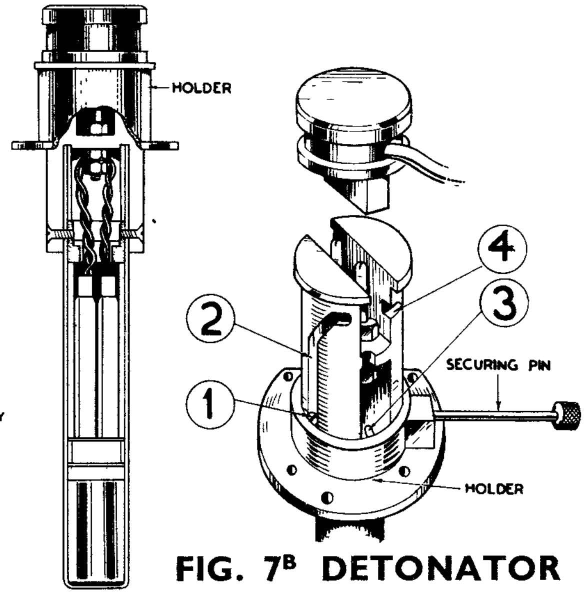


FIG. 7B DETONATOR

the supply to the heater. The opening of contacts 22 and 24 interrupts the heater circuit and the bimetal strip commences to cool and move downwards and back to its initial position bringing with it the bracket B which pulls the contact 25 in the same direction. The bowed strip P is pushed by contact 25 until it snaps back into its original position against the bimetal strip A. The strip C is also of bimetal and rests on the bracket B; it provides ambient temperature compensation. The bracket B is insulated from the strip C and the contact 25.

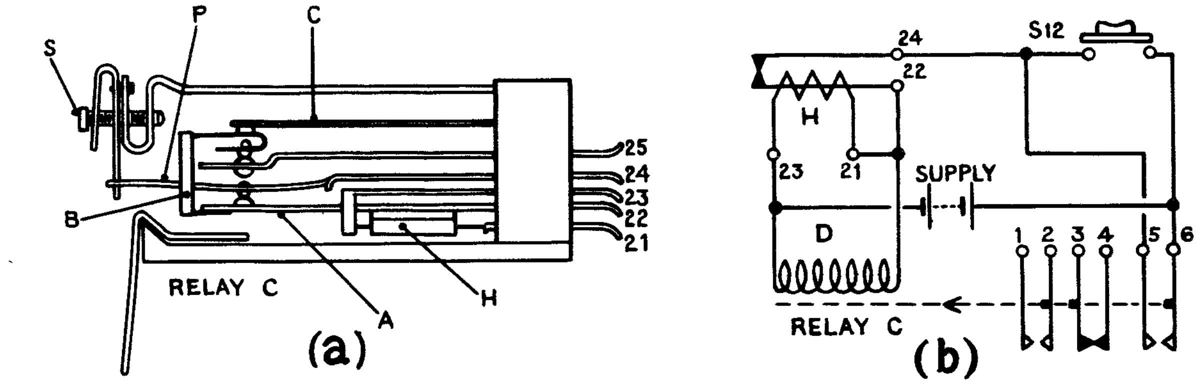


FIG. 8 THERMAL DELAY SWITCH

33. Reference should now be made to the circuit in fig.8(b). Momentary pressure is applied to the switch S12 (G AUTO) and energy is transferred from the supply to the relay coil D. The relay armature is attracted and the contacts 5 and 6 are closed forming a parallel circuit with the switch S12; these circuit-locking contacts hold the armature when S12 is released. The attraction of the armature also closes the contacts 1 and 2 and opens the contacts 3 and 4, the connection of these is shown in the main circuit diagram in fig. 2. When the movement of the bimetal strip A breaks the heater circuit after the given time (35 seconds) known as the "thermal delay time", the coil D is de-energised by the opening of the contacts 22 and 24 and the circuit is returned to its original condition as shown in fig.8(b); the contacts 22 and 24 re-make as the bimetal strip cools and approaches ambient temperature. The circuits associated with the contacts 1 and 2, and 3 and 4 are therefore closed and opened, respectively, for the duration of the thermal delay time. The thermal delay time can be varied within fine limits by adjustment of the screw S which controls the endwise compression on the bowed spring P.

Control unit assembly, type 1

34. This comprises:-

(i) Control unit, type 89, which carries the code selector switch and the 5-pole connecting socket.

(ii) Control unit, type 90, which carries the telephone jack used for monitoring purposes, the ON-OFF and DISTRESS (D) switches, together with one 7-pole socket, one 7-pole plug, and one 5-pole plug. An interior view of both control units is given in fig.9.

(iii) Mounting plate, type 158. This is provided so that both control units may be mounted together in the mounting, type 40, which in many cases is already installed in the aircraft. In future installations the control units may be fitted separately.

(iv) L.T. supply connector, type 510/1.

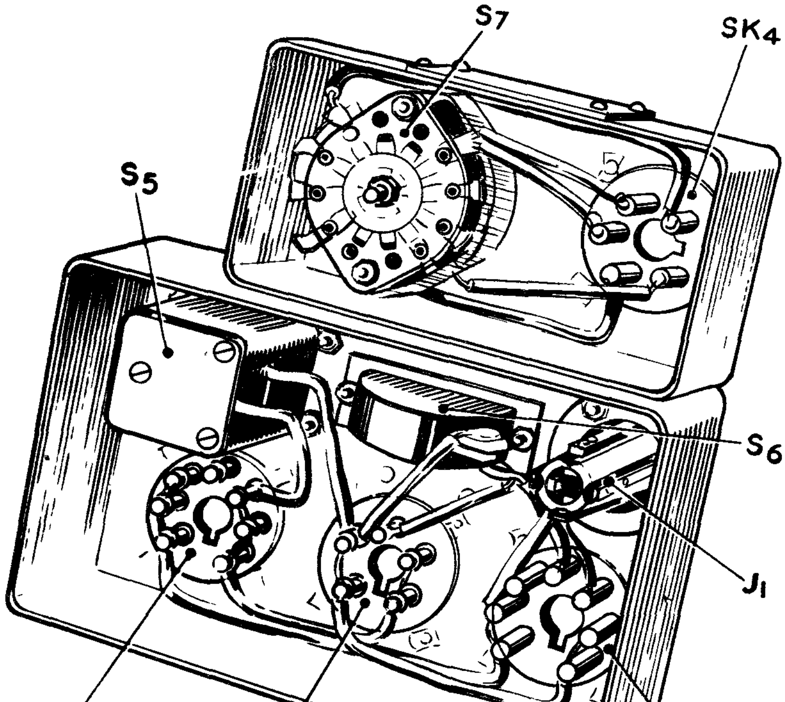


FIG. 9 INTERIOR VIEW OF CONTROL UNIT ASSEMBLY TYPE I

INSTALLATION

INSTRUMENTS

35. The position occupied by the receiver in the aircraft is governed by consideration of the space available and the distribution of the weight. A diagram showing the interconnection of units is given in fig.10. The control units must be accessible for ground testing and mounted, if possible, in the pilot's cockpit in single-seater aircraft. If the control units are not accessible in flight, the remote ON-OFF and "D" switches etc. are fitted adjacent to the detonator firing switches. In multiseat aircraft the control units are mounted so that they are accessible to the W/T operator, remote switches being provided in the pilot's position. The detonator firing switches must be covered with a protecting flap labelled DANGER.

CONNECTIONS TO PLUGS AND SOCKETS (COVERS REMOVED)

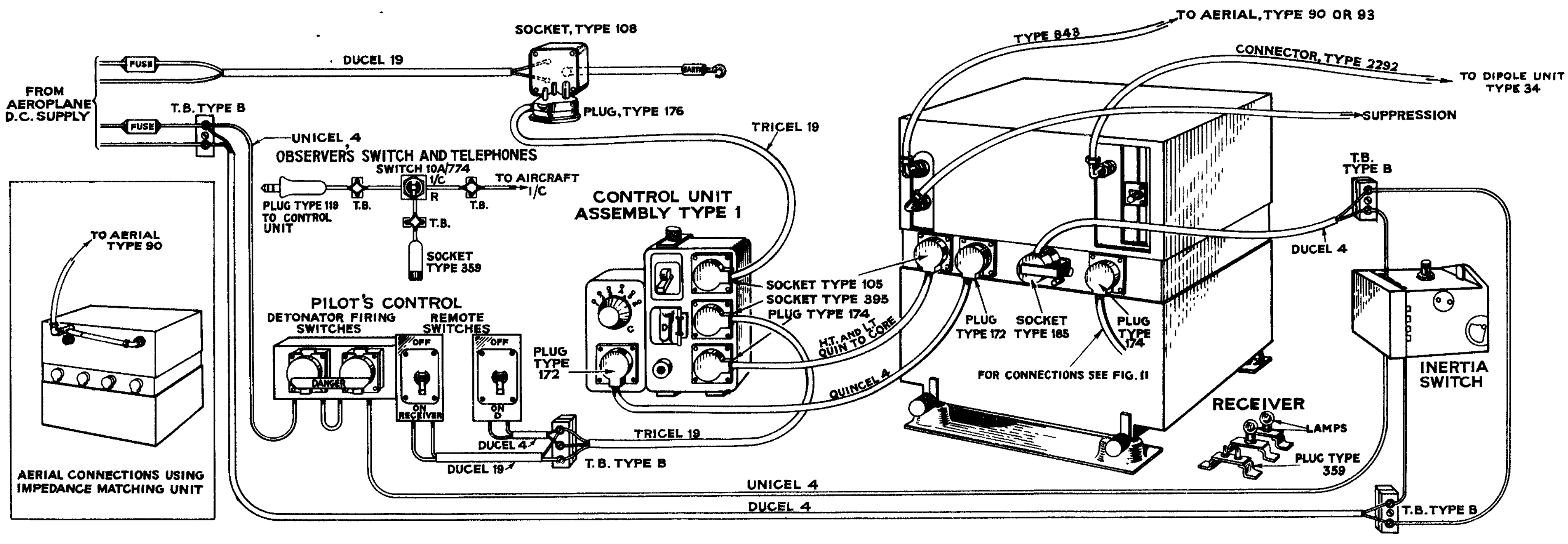


FIG. 10 INTERCONNECTION OF UNITS

36. The L.T. supply connector formed a direct replacement for the L.T. cable attached to the I.F.F. Mk.II control unit. In some aircraft this link, plug and socket, are replaced by an uninterrupted cable run from the L.T. distribution board to the control unit type 90. The short blade aerial, type 90 or 93 is mounted to give a maximum range in all directions.

COMMAND REQUIREMENTS

37. Various methods of identification and distress signalling are required by R.A.F. Commands and the F.A.A. This demands the use of switches of varied types and installation wiring differences. The methods are illustrated in fig.11 and detailed below.

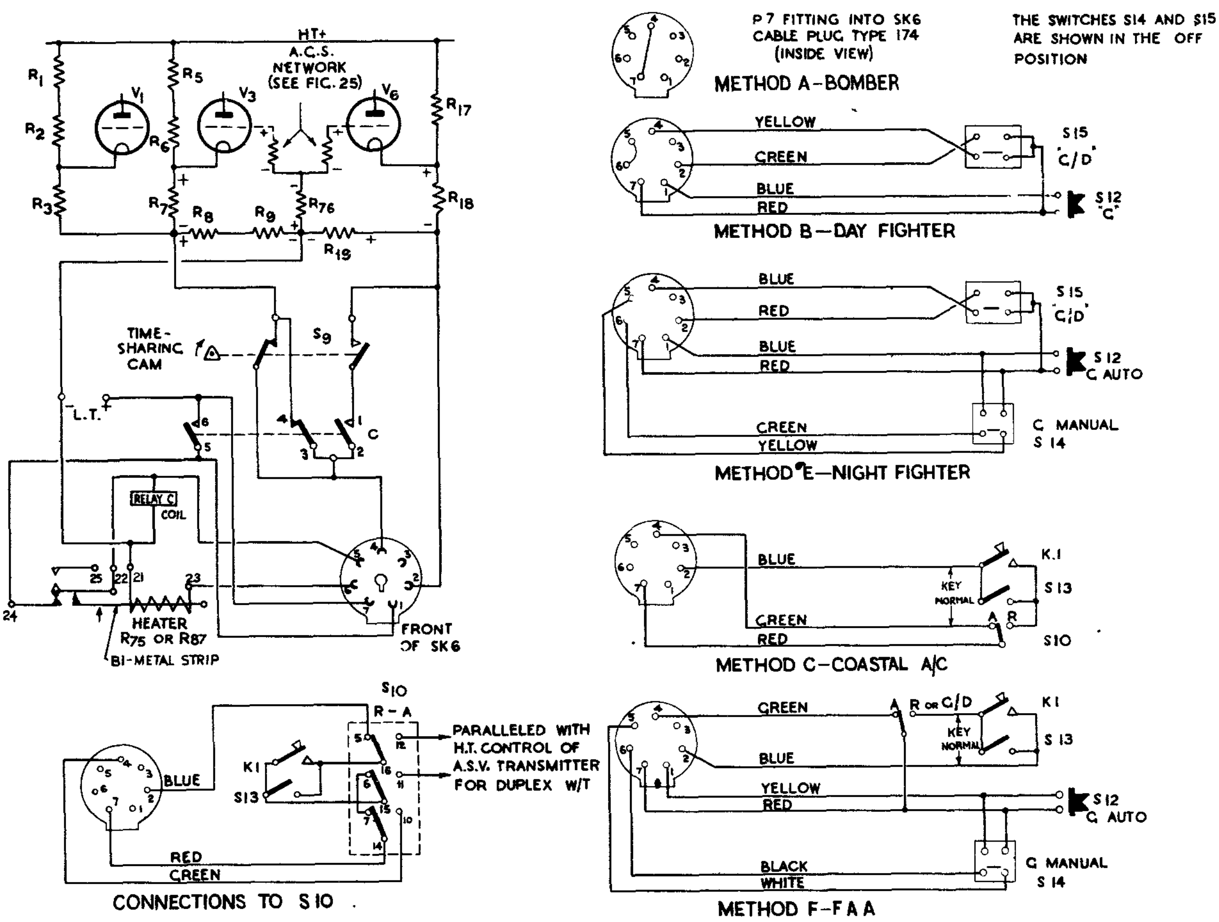


FIG. 11 SIMPLIFIED DIAGRAM OF REMOTE SWITCHING

(i) Method A. For use in Bomber aircraft where A band working is required. The plug type 174 (P7) is inserted into the socket, SK6, on the receiver. P7 is wired across as shown in fig.11. In this condition it is possible to remove the GR oscillator unit, type 131, but its connecting plug P8 on the top chassis must be replaced by a special plug unit which completes the heater circuit of the remaining valves (see para.24).

(ii) Method B. For use in day-fighter aircraft of Fighter Command. A spring-loaded push-switch S12 (labelled "G") is connected between poles 1 and 7 of the plug P7 and a switch type 170, S15 is connected as shown, for the purpose of switching pole 7 to pole 4 or to pole 2. The switch must be mounted so that with the toggle depressed for ON, the switch connects between poles 7 and 2. N.B. The switch blade moves in the direction opposite to the toggle movement. S15 is the G/D switch which gives uninterrupted G responses as a distress signal to G.C.I. stations, and is installed close to the G button in the pilot's cockpit.

For Methods C and D see below.

(iii) Method E. For use in night-fighter aircraft. This is Method B with an additional switch S14 labelled "G MANUAL" installed together with the other two G switches. The push switch S12 is now labelled "G AUTO". The G MANUAL switch (type 170) when ON, short-circuits the G AUTO switch and open circuits, the Relay C heater via poles 5 and 6 on P7. A to G switching thus being sustained until S14 is put to "OFF".

(iv) Method C. For use on aircraft of Coastal Command. Two control switches and a telegraph key are installed in the wireless operator's cabin. The switch S10 is a 3-pole changeover switch and connects pole 7 to pole 4 of P7 for A working, or pole 7 to pole 2 via the telegraph key for Rooster (airborne beacon) working. The switch S13 is wired across the telegraph key K_1 to short-circuit it for NORMAL Rooster working and to free it for W/T signalling. The 3-pole switch S10 is arranged to connect the telegraph key into the H.T. control circuit of the A.S.V. Mk.II transmitter when switched to "A" to permit two-way W/T working. Where this facility is not required it is possible to replace the selector switch with a single-pole, single-throw switch, as indicated in fig.11.

(v) Method F. For use on aircraft of F.A.A. This is virtually a combination of Methods C and E providing for A/G working as a controlled fighter with the G unit adjusted to the frequency of the associated ship-borne "G.C.I.", or Rooster working when the aircraft is employed on reconnaissance patrol.

(vi) Method D. This method is a combination of Methods C and B.

Notes.

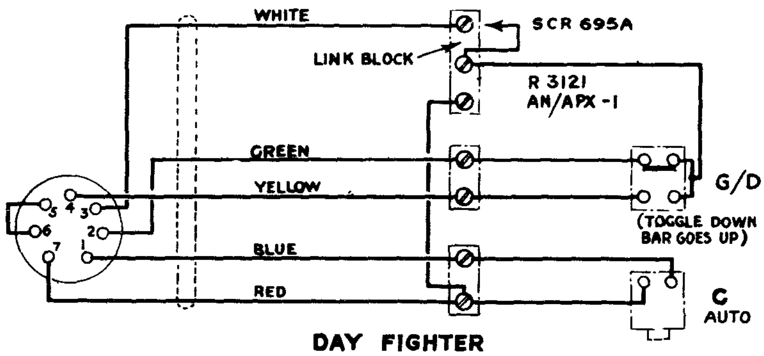
(i) In the Methods F and D no separate G/D switch is provided, this facility being obtained by putting the A - R selector switch in the R position. This switch is, in consequence, labelled "R or G/D - A".

(ii) In Method C, where two-way W/T communication via the Rooster and A.S.V. channel is provided for, arrangements must be made to connect the wireless operator's headset to a change-over switch to give him alternative connection into the I/C circuit or into the I.F.F. control unit. This necessitates also an I/C call-light.

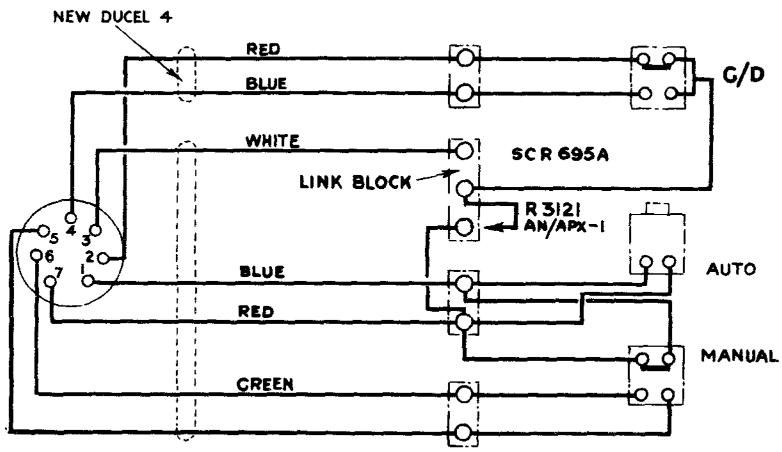
BRITISH AND AMERICAN INTERCHANGEABILITY

38. The American airborne I.F.F. equipment AN/APX-IX (12V) or AN/APX-I (24V) has been so designed that any of the removable units are interchangeable with the equivalent British unit. These equivalents are given below.

British		American Equivalent
Receiver type R3120 ..	Installation AN/APX-IX;	Receiver type RT-23/APX-IX
Receiver type R3121 ..	Installation AN/APX-I;	Receiver type RT-22/APX-I



DAY FIGHTER



NIGHT FIGHTER

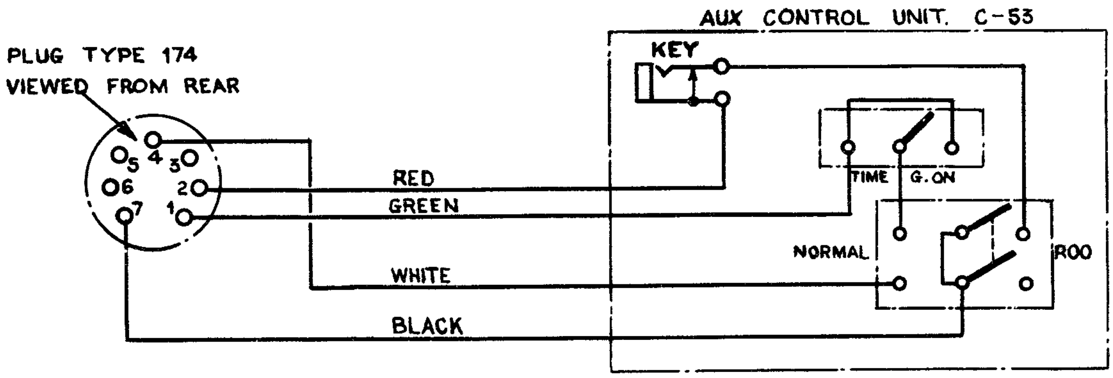
FIG. 12 INSTALLATION PROVIDING INTERCHANGEABILITY OF SETS

39. In some Units it is desirable to provide interchangeability of R3120/1, AN/APX-1/-IX and SCR695-AZ/-A in the one aircraft installation. In the first two sets the G/D facility is obtained by disconnecting the junction of poles 7 and 4 on the plug P7 and connecting instead poles 7 and 2. In the SCR695-AZ/-A, G/D can be obtained only by joining poles 2 and 3. It is therefore necessary to include in the installation a two-way link block (as shown in fig.12) to be adjusted according to the type of I.F.F. set being fitted in the installation.

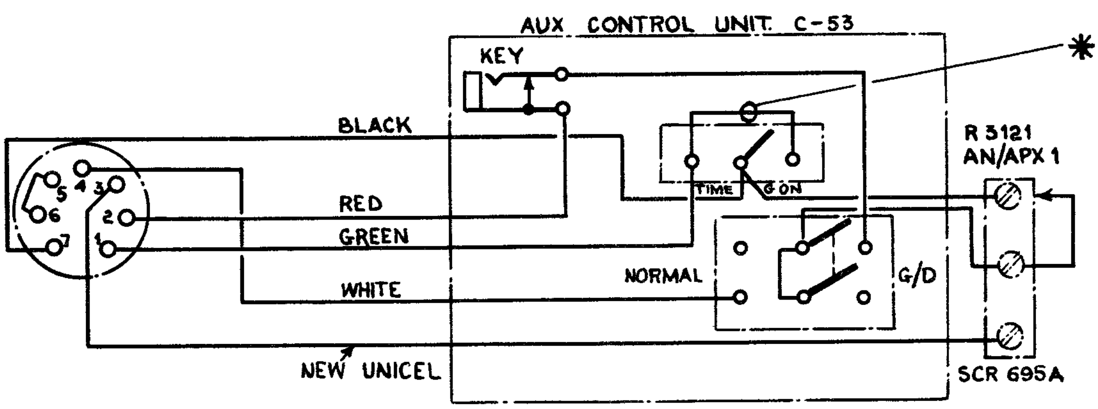
Note. Further particulars of interchangeability are given in para.9.

AMERICAN INSTALLATION

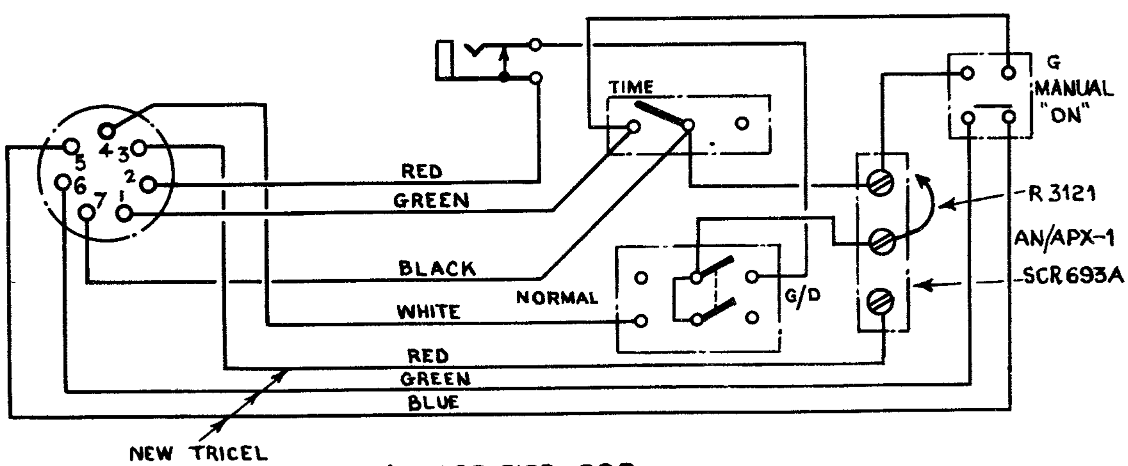
40. To provide for interchangeability of sets in American AN/APX-1/-IX installations, the link block as referred in para.39 above, must be incorporated. This necessitates partial re-wiring of the auxiliary control unit type C53 (American), the details being shown in fig.13. The circuits of fig.13(b) provide all facilities from all three types of I.F.F. sets except G MANUAL ("G ON") when the link connection marked with an asterisk is omitted. The link may be fitted to give G MANUAL where only AN/APX-1/-IX or SCR695-AZ/-A is to be used. It is important to include the connection between poles 5 and 6 of the 7-pole plug. If R3120/1 is required to be used and to give G MANUAL, the G MANUAL changeover switch shown in fig.13(c) must be fitted.



(a) CONNECTIONS OF AN/APX-1



(b) MODIFIED TO PERMIT USE OF AN/APX I
OR S.C.R. 695A OR R 3121 (C AUTO ONLY)



(c) MODIFIED FOR
INTERCHANCEABILITY OF FULL FACILITIES

FIG. 13 ALTERNATIVE CONNECTIONS IN AMERICAN INSTALLATION

AERIALS

41. In general one vertical blade aerial type 90 or type 93 (light-weight) is used for both A and GR bands, the two aerial plugs P2 (natural) and P3 (green) being connected together by the external coupling unit. In wooden aircraft such as the Mosquito, the green aerial plug is sometimes connected to a separate horizontal dipole unit type 34 which is installed within the fuselage. Precautions should be taken to ensure that vertical metal surfaces (e.g. metal-cased apparatus) are not placed nearer than three feet from the aerial rods.

OPERATION

42. The Mk.IIIGR like the Mk.III is entirely automatic in operation: the provision of automatic voltage control and automatic sensitivity control (AGS) renders manipulation unnecessary. A telephone jack is provided on the control unit type 90, connected to the pulse amplifier valve anode circuit so that it is possible to check the functioning of the equipment by listening to the pulse repetition frequency of an interrogating transmitter, or by the behaviour of the receiver as follows:-

(i) NORMAL sensitivity in the absence of a signal: crackling noises will be heard as the set is triggered off by spikes of random interference.

(ii) Insensitivity: absolute silence except for H.T. switching clicks.

(iii) Squitter: If the AGS fails to control, the equipment may go into a state of self oscillation recognisable by a high pitched squeal.

CONTROLS

43. (i) The tuning control of the GR unit is adjusted before take-off and <u>must not</u> be interfered with during flight.

(ii) The code-selector switch on the control unit type 89 is set before take-off and may need to be reset at specified times during the flight according to the orders of the day.

(iii) The G AUTO push switch or the G MANUAL switch (where fitted) will be operated only on instructions from the ground controller.

(iv) In certain commands <u>two</u> emergency signals are available, the switches being labelled D and G/D, When an aircraft is co-operating with a G.C.I. station or F.D. ship, the G/D switch should be used to make a DISTRESS signal to that particular station: otherwise the D switch will be used, notifying all stations.

(v) Although the equipment should have been correctly adjusted by the ground crew before the flight, it may chance that the wireless operator suffers heterodyne interference in his communications receiver due to beating of the I.F.F. quench frequency and that of the incoming carrier wave or the local oscillator. The quench frequency may be shifted slightly by screwdriver manipulation of the variable condenser located immediately to the left of the detonator holder on the I.F.F. set. <u>WARNING</u>. This adjustment should only be attempted when communication becomes impossible, because shifting the quench condenser may result in heterodyning of other carrier waves, and it is a lengthy process to clear them all with one setting.

SETTING UP INSTRUCTIONS

SETTING UP A BAND ON THE BENCH

44. Plug a temporary connection between poles 7 and 4 (counting anti-clockwise) of the 7-way socket on the receiver; this will give A band working alone. Plug in an indoor aerial type 90. Set up the test set type 74 as described in C.D.0850A, Chap.2. Switch on the I.F.F. set and the test set, pull out the test set aerial, place the switch marked RECURRENCE to N, and switch on the SENDER and RECEIVER and adjust these to about 170 Mc/s.

(i) Put the code selector switch to position 4, observe the trace of the test set. Observe the deflections on the trace, (see fig.14) which should be at the left-hand side and move upwards about every 2¾ seconds. Increase the "Receiver Gain" control until the top right-hand corner of the "Narrow" pulse touches the sloping line which is engraved on the left-hand side of the perspex window; it must touch somewhere along this line. Check that the "Wide" pulse falls within the quadrilateral on the perspex scale and note that the successive deflections follow the characteristic coding cycle.

(ii) If no deflections are observed plug the telephones into the control unit assembly; a moderately loud high-pitched note should be heard. If this note is not present change the receiver and re-check the aerial system.

(iii) Check the frequency limits:-

(a) The receiver is correctly adjusted before leaving the factory to sweep the specified band of frequencies when coupled to a 46-ohm resistive load.

(b) An aircraft aerial and feeder system cannot be expected to simulate a 46-ohm resistance at all frequencies and it must be remembered that any reactance injected into the receiver tuned circuit alters its natural resonance frequency.

(c) It is therefore most important to check the frequency limits of the receiver after installation in an aircraft. This applies every time a set is taken from store and fitted in an aircraft.

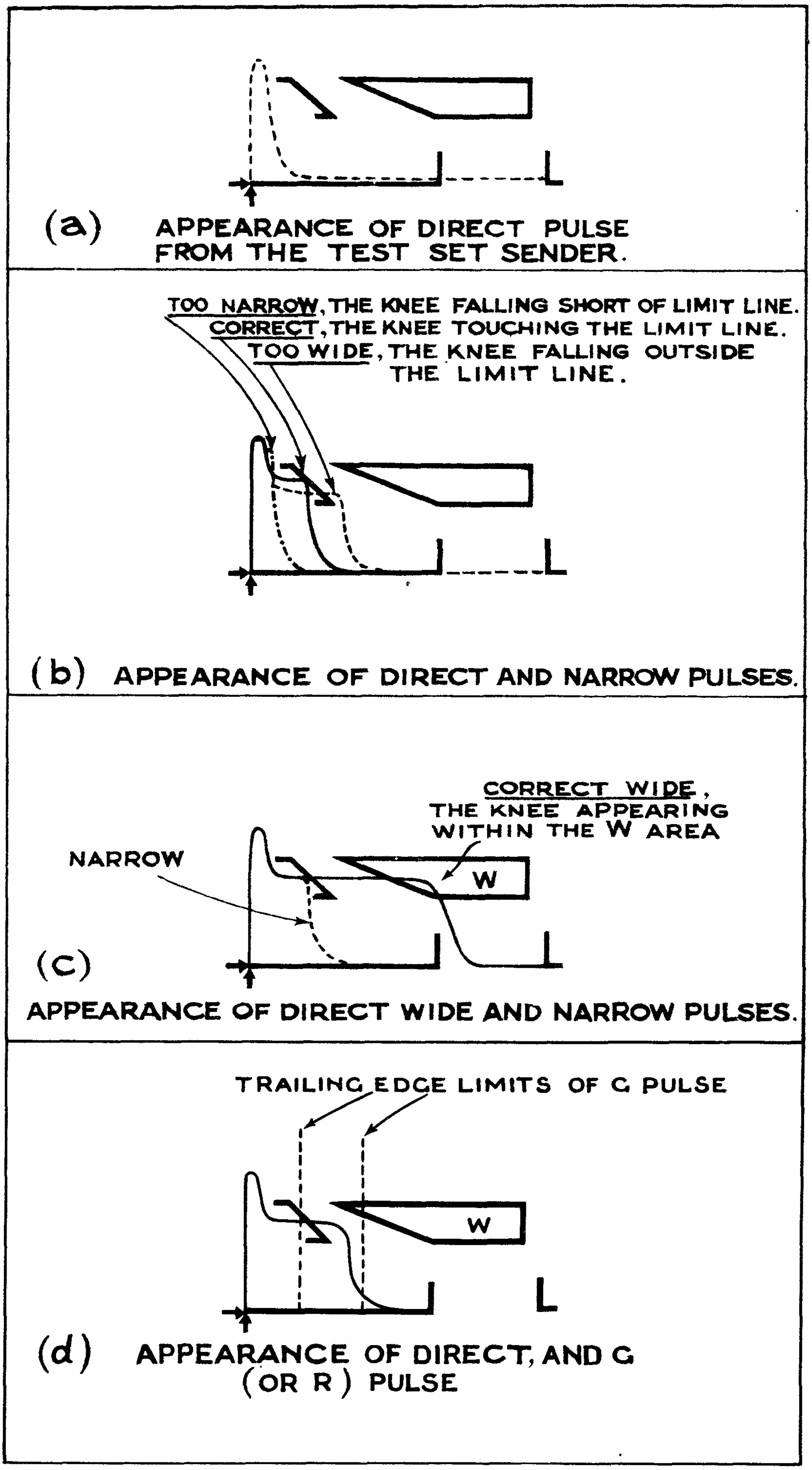
(d) The measurement should be made with the aid of Wavemeter, type W.1310 or W.1432 and test set type 74.

(e) If readjustment is necessary, it must be done with the dust covers fitted in position since this also affects the frequency. A swivelling lid is provided on the top of the upper dust cover for access to one adjusting screw (fig.5). This controls the upper limit of frequency.

(f) The tuning condenser rocker arm can be moved up or down the driving rod by means of this adjusting screw which thus controls the extent of travel of the condenser. A ratchet is provided for locking the screw (fig.3).

(g) The screw should be turned counter-clockwise to increase the frequency of the upper limit of the band and vice versa.

(h) The adjusting screw for the other limit is on the rear of the mid-chassis. The screw should be loosened and lowered in the slot to reduce the frequency or raised to increase it.



(a) APPEARANCE OF DIRECT PULSE FROM THE TEST SET SENDER.

(b) APPEARANCE OF DIRECT AND NARROW PULSES.

(c) APPEARANCE OF DIRECT WIDE AND NARROW PULSES.

(d) APPEARANCE OF DIRECT, AND G (OR R) PULSE

FIG. 14 OSCILLOGRAMS IN TEST SET TYPE 74

(iv) In addition to the connection between the poles 7 and 4 of the 7-way socket on the receiver make another temporary connection between the poles 7 and 1. This should give interruption of the A response at the rate of five times per second which is to be checked on the test set type 74. Switch off the main L.T. to stop the interruption. (The thermal relay will then unlock itself).

SETTING-UP GR BAND ON THE BENCH

45. Remove both temporary connections from the 7-way socket on the receiver and insert instead a connection between poles 7 and 2 in order to give uninterrupted working on the GR oscillator.

(i) Adjust the test set to -209 Mc/s for G working, (or as allocated) or 177 Mc/s for Rooster working.

(ii) Tune the I.F.F. set by means of the sliding control on the right side of the front panel and check that there is an uninterrupted response of good shape and about 7 to 15 μS long.

(iii) Remove the connection from the 7-pole socket and replace those between poles 7 and 4 and between 7 and 1.

(iv) Check that the response is now interrupted five times per second.

Note. It is desirable that the wavemeter to be used for setting up the G or R frequency should be taken to the Radar station with which the aircraft will have to work in order to obtain a calibration point for setting up purposes. Thus the airborne I.F.F. set will work on exactly the same frequency as its complementary ground equipment.

GENERAL NOTES ON PROCEDURE FOR TUNING I.F.F. RECEIVERS.

46. (i) First tune the transmitter portion of the test set type 74 to the required frequency.

(ii) Using either the type W1310 or W1432 wavemeter:-

(a) Connect the plug marked WAVEMETER on the test set to the plug on the wavemeter marked INPUT, using the lead supplied in the power unit type 195.

(b) Set the wavemeter dial to the required frequency.

(c) Tune the test set sender to this frequency by adjusting for maximum deflection on the wavemeter indicator.

(d) Mark the ivorine dial of the sender frequency control on the test set with a pencil against the index line.

(iii) Plug a headset into the control unit and listen for the characteristic note (2,000 p.p.s. with the test set on N, 400 p.p.s. on D). Be warned that triggering may be caused by interrogating stations other than the test set and any signals should be checked by switching the test set.

(iv) Adjust the appropriate control on the I.F.F. receiver till the note is strong and clear.

(v) Switch on the wavemeter and position the probe lead as near as possible to the aerial without actually touching it. Tune the wavemeter to the transmitted signal. As the wavemeter is tuned a flicker will be seen in the indicator. Tune to maximum deflection and note

the frequency. If this is not the required frequency readjust the I.F.F. tuning control and check the frequency again, and so on.
N.B. The final check of frequency must be made with the covers on the receiver and an aerial connected.

(vi) The receiver portion of the test set should be tuned to its sender (to maximum direct pulse) in order to observe the response signals on the oscilloscope.

N.B. Although this completes the setting up on the bench, it is essential, before flight, to carry out a complete check of the receiver when installed in the aircraft. This check is detailed in paras.47 to 75.

DAILY INSPECTION

GENERAL

47. In view of the special importance of the application of this equipment it is essential that it receives a functioning test before flight. The test equipment required is a test set type 74 and a wavemeter type W1432 or W1310 or W1433. The test set type 74 (described in C.D.0850A, Chap.2) comprises a sender, a receiver and a cathode ray tube indicator in one unit; it obtains its power supply either from a.c. mains, or from 24 volts d.c. supply via a rotary converter unit, power unit type 195. These are normally carried on anti-vibration mountings in a van or on a trolley for use at dispersal points. The wavemeters W1310 and W1433 require a.c. mains supply; the W1432, which is supplied by self-contained batteries, is therefore the most suitable for use at aircraft dispersal points. The supply lead of the power unit type 195 is clipped on to the aircraft-starter trolley or other source of 24 volt d.c. supply external to the aircraft.

Note: The tests described below apply equally to aircraft operating from airfields or from the flight decks of ships.

AERIALS

48. Inspect the aerials. Check that they are undamaged and perfectly secure. Examine the cables connecting the aerial or aerials to the receiver and ensure they are undamaged. Where one aerial type 93 or type 90 is used for both A and G, or A and R, working, ensure that the aerial coupling unit is fixed to the front of the set and that the aerial feeder is plugged into the coupling unit. What is more important where the aircraft is fitted with separate aerials for the two functions, the coupling unit must be removed and the two aerial feeders must be fitted to their appropriate sockets on the receiver.

PLUGS & SOCKETS.

49. Check that all the plugs fitting into the receiver and control unit fit securely into their sockets. Pay particular attention to the 3-pin plug which connects the control unit, type 90, to the aircraft battery system. If necessary, clean the pins and make certain of good contact, by opening the split pins with a knife-blade. If a suppression cable is not used, ensure that the spring trigger on the bottom left plug makes good contact to the centre pin; otherwise there is a possibility of one or two low amplitude, short-duration pulses being radiated after the main response.

FUNCTIONAL TESTS.

50. (i) Switch on the receiver, type R.3120 or R.3121.

(ii) Put the telephone plug in the jack in the control unit, type 90.

(iii) Allow a minute for the set to warm up.

Normally nothing should be heard in the telephones except an occasional crackle, and a click approximately every two and a half seconds. If, however, the aircraft installation which is being tested is located near to one of the ground or airborne equipments with which it is designed to work, the characteristic sounds of this equipment will be heard in the telephones, superimposed on the other sounds described above. It will be necessary for the operator to learn to identify these sounds and to distinguish between them and the peculiar "squeal" which is characteristic of a faulty installation. It will be found that adjacent aircraft on the ground will all pick up the same signals.

FUNCTIONAL TESTS WITH TEST SET, TYPE 74 AND POWER UNIT, TYPE 195.

51. (See C.D.0850A, Chap.2 for setting up instructions). Make sure that the A.C. volts supplied to the test set by the rotary converter are up to the standard 230 volts. Place the test set 10 to 20 yards away from the aircraft aerial arranged so that there is an uninterrupted path between the test set aerial and the aerial type 90, on the aircraft. It is important that personnel should not walk about near the aircraft aerial or the test set during these tests.

52. Switch on the test set and adjust "Focus" and "Brilliance" controls. It will be necessary to screen the cathode ray tube from strong light with the visor normally housed in the power unit, type 195.

53. Pull out the test set aerial and place the switch marked "Recurrence" to "N". Switch on the Sender and Receiver. Adjust the Sender frequency to 170 Mc/s approx. (already marked on the ivorine dial). Reduce the "Receiver Gain" control and tune in the receiver to maximum amplitude of the direct pulse on the indicator.

54. In the aircraft set the pilot's G switch (Fighter) to OFF or the operator's rotary selector switch (Coastal) to "A". Switch on the I.F.F. receiver.

55. If responses are now observed on the indicator of the test set, continue with the tests given in paras.56 to 69. If not, plug a headset into the I.F.F. control unit and listen for the test set sender p.r.f. (2,000 p.p.s.) to prove that signals are being received. In the absence of such signals it must be assumed that either the receiver or the aerial system is out of order. Changing the receiver will leave only the aerial system suspect. If signals are heard, but not seen on the test set, the sender of the I.F.F. set may be giving low or zero output and this can be proved by placing the test set nearer to the aircraft aerial. A faulty receiver must be replaced.

56. When responses are seen in the test set, the I.F.F. equipment should be tested for correct coding responses at each position of the code selector switch (see fig.14).

57. The test set having been previously calibrated for frequency, test the A band at near limit frequencies (158 and 186 Mc/s).

58. Switch on the switch "D" on the control unit and set the test set "RECURRENCE" knob to the position "D". Check that the distress pulse lies beyond the indicated limit marked "D" on the perspex window.

Switch off "D" in the aircraft and adjust the knob "C" to the position ordered for the flight.

FIGHTER AIRCRAFT.

59. Switch the test set "RECURRENCE" control to "N", and press the pilot's "G" switch. Check that the A band response is interrupted at the rate of five times per second for a period of about 35 seconds (not more than 50) and then becomes normal.

60. Adjust the test set to the "G" frequency, press the pilot's "G" switch again and check that responses are obtained, and that these are interrupted five times per second and continued for approximately 35 seconds. The width should be as shown in fig.14(d).

61. In the case of the night-fighter where the pilot has a "G MANUAL" switch in addition to a "G AUTO" push switch, the operation of both must be checked.

62. See that the "G" switches are OFF and close the "G/D" switch. Observe that the responses on the test set indicator are no longer interrupted.

63. With the aid of the wavemeter and the test set, ensure that the frequency of response is absolutely correct.

COASTAL AND F.A.A. AIRCRAFT.

64. Turn the rotary selector switch to position "R" and set the "ROOSTER" toggle switch to NORMAL. Adjust the test set to the "Rooster" frequency and check that an uninterrupted response of width a little more than the widest NARROW for A band is obtained (see fig.14(a)).

65. With the aid of the wavemeter and the test set, ensure that the frequency of response is absolutely correct.

66. Put the "ROOSTER" toggle switch to "KEY" and check that the response can be interrupted by manipulation of the telegraph key.

TESTS TO BE PERFORMED IF THE AIRCRAFT IS FITTED WITH OTHER AIRBORNE RADIO INSTALLATIONS (RADAR OR COMMUNICATION).

67. These tests will have to be done with the help of the radio mechanics who are responsible for the maintenance of the other equipments.

(i) Switch on the Radar equipment and examine the response on the appropriate indicator unit.

(ii) Switch the I.F.F. on at the control unit assembly, type 1, and check that this has no effect on the indicator unit of the other airborne radio installation.

(iii) Switch the Radar off and the communications gear on. Listen on all channels allocated for the flight, for heterodyne notes caused by beating of the quench oscillator with the carrier waves. It may be necessary to ask for special transmissions to be made to carry out this test. If heterodyning is heard on any channel, shift the I.F.F. quench condenser (situated to the left of the detonator) a small amount until the frequency of the note rises to inaudibility. Then check again on the other channels; if interference has appeared on any of these, readjust the quench condenser and repeat the process until all channels are clear. Particular attention should be paid to the D/F channel where an interference note might well be mistaken for a legitimate signal.

68. Finally set all switches, "G" or "ROOSTER" (selector and key),

"G/D", "D", coding selector switch and remote "ON/OFF" to the positions required for the flight.

Note. If the receiver fails to pass any of the above tests it should be replaced. The defective set is to be examined as specified in the "Thirty-hour Inspection" under the direction of the Signals Officer or a Senior N.C.O.

TESTING OF DETONATOR CIRCUIT

69. The detonator is described in para.29 and the firing circuit is given in fig.7a.

70. EXTREMELY IMPORTANT PRECAUTIONS. Unless the following precautions are meticulously observed, bodily harm may result. The socket on the front of the receiver fits on the pins of a removable detonator which should be handled with all the care necessary for such devices. On landing, the clamp holding the socket in position should be released and the socket removed. In no circumstances must it ever be reconnected until the aircraft is ready to take off. Care must be taken before connecting up to see that no voltage exists across the pins of the socket. The pins of the socket should be tested by a meter or test lamp to make quite sure that there is no danger of firing the detonator on plugging in to the detonator on the receiver. If the receiver is ever removed from the aircraft the detonator must be removed from the receiver and placed in the armament store. In no circumstances must work ever be done on the receiver with the detonator in position.

Note. If the receiver has to be sent away from the Service Unit for repair A.M.O. "A" 856/42 must be complied with; this states that a certificate signed by the appropriate Technical Officer, or senior N.C.O., to the effect that the detonator has been removed, is required before acceptance by the repair unit.

71. With reference to fig.7a the detonator and pilot's firing switches (to be found beneath the hinged cover marked DANGER), are connected across the aircraft's d.c. supply. The switches are in series and the circuit is completed when they are depressed simultaneously. In addition, the inertia switch is connected in parallel with the firing switches. All personnel handling the equipment must be absolutely certain that they know how to make the detonator firing circuit safe when the aircraft is on the ground, and how to make it ready when the aircraft is going to take off. The following instructions must be carried out, two persons being required for this purpose.

To make safe.

72. On landing, remove the socket from the detonator pins on the receiver and place the sockets on the dummy pins provided (see fig.10).

To make ready for firing.

73. Before taking off, carry out the following instructions strictly in the order given:-

(i) Examine the dummy pins to make certain that the socket for the detonator is on these and not on the detonator pins. IF OTHER EQUIPMENT FITTED WITH DETONATORS IS INSTALLED IN THE AIRCRAFT IT IS EXTREMELY IMPORTANT TO REMOVE THE SOCKETS FROM THE APPROPRIATE DETONATORS BEFORE PROCEEDING WITH THIS TEST.

(ii) Test across the dummy pins with meter or test lamp to check that there is no voltage across them.

(iii) Press the pilot's firing switches and ensure that the voltage is indicated across the dummy pins.

(iv) Turn the knob on the top of the inertia switch until the arrow on the knob points to TRIP. Now trip the switch and ensure that a voltage is indicated across the dummy pins.

(v) Turn the knob on the top of the inertia switch until the arrow on the knob points to "SET". THE KNOB MUST BE IN THIS POSITION AT ALL TIMES EXCEPT WHEN APPLYING THE TEST DESCRIBED IN (iv) ABOVE. Now reset the inertia switch (see para. 74). Give the side of the switch a slight tap with the knuckles to ensure that it is set correctly. The switch should not thereby be released; reset if necessary. Ensure that no voltage is indicated across the dummy pins.

(vi) Finally remove the socket from the dummy pins. Plug it on the detonator pins on the front of the receiver, and secure with the clamp.

SUMMARY OF "TO MAKE READY FOR FIRING"

Operation	Detonator socket	Pilot's firing switches	Inertia switch	Indication
(i)	On dummy pins, with voltmeter across pins.	-	-	No voltage indicated
(ii)	On dummy pins, with voltmeter across pins.	Press	-	Voltage indicated
(iii)	On dummy pins, with voltmeter across pins.	Release	Trip switch	Voltage indicated
(iv)	On dummy pins, with voltmeter across pins.	-	Reset the switch	No voltage indicated
(v)	Remove from dummy pins and secure to detonator.	-	-	-

Tripping and resetting the inertia switch

74. Tripping and resetting of the inertia switch is done in the following way:-

(i) In order to trip the mechanism, rotate the knob on the top of the switch until the arrow points to TRIP.

(ii) Press the knob down and the switch will trip (all contacts closed).

(iii) To re-set the switch, turn the setting handle in a clockwise manner as far as it will go (about 120 deg.)

(iv) Hold the handle in this position and rotate the knob until the arrow points to SET.

(v) Keep the knob firmly pressed down and release the handle in order to allow the pendulum to engage with the co-acting pin.

(vi) The knob may then be released and the switch will be set (all contacts open).

(vii) The handle should then be approximately horizontal.

SUMMARY OF "TRIPPING AND RESETTING THE INERTIA SWITCH"

Operation	Knob	Setting handle	Result
(i)	Turn to trip	-	-
(ii)	Press down	-	Switch will trip
(iii)	-	Turn clockwise and hold in this position	-
(iv)	Turn to set	-	-
(v)	Press down	Release	-
(vi)	Release	-	Setting handle horizontal switch set.

Inertia Switch quadrant position.

75. The quadrant on the side of the inertia switch should be examined to see that the setting screw passes through the correct hole, The correct setting hole for aircraft in the various Commands is as follows:-

Fighter Command 8
Bomber Command 6
Coastal Command 6
Fleet Air Arm 8

Note. - American type inertia switches are set at 9 except for the Beaufighter aircraft where it is set at 8.

THIRTY HOUR INSPECTION

General

76. Inspect the aerial, its mounting and connecting cable for mechanical defects.

77. With a test meter type D or H, measure for continuity between the braiding of the aerial connector and any convenient part of the frame of the aircraft.

78. Remove the aerial connector(s) from the I.F.F. receiver, and where an aerial coupling unit is used on the receiver, remove the coupling unit with the aerial connector. Measure for continuity between the aerial and the centre conductor of the aerial connector at the receiver points. Concentric cable sockets are known to give considerable trouble and it is essential to see that the inner conductor and the outer screening make good permanent contact with the appropriate part of the socket. The nipple or sleeve must be soldered to the inner conductor and it is important to ensure at each inspection that the securing screw within the socket is driven well home. The outer gland nut should grip the screening tightly.

79. Measure the insulation resistance between the aerial, and the body of the socket. It should not be less than 5 megohms. Where accessible inspect inside of aerial bollard and ensure that it is sealed off with Bostick filling.

80. Measure the insulation resistance between L.T. negative on the receiver and the receiver case. This should be of the order of 100,000 ohms. L.T. negative can be picked up on the lower right-hand pin of the 7-pole plug on the front of the receiver. Measure the

insulation resistance between (i) L.T. negative on the receiver and the receiver case, (ii) H.T. positive and the receiver case. The insulation resistance in each case should be of the order of 100,000 ohms. L.T. negative can be picked up on the lower right-hand pin of the 7-pole plug on the front of the receiver. To reach H.T. positive, join poles 2 and 3 on the 5-pole SK3, and apply the megger to one of these.

Receiver inspection

81. (i) Withdraw all plugs and sockets from the receiver and control units. Make a thorough inspection of the installation and test all cables and wiring for insulation and continuity. The various plugs and sockets of the installation, the 3-pin plug connected to the L.T. supply and the socket into which it fits should be examined for cleanliness and reliable contact. If they require cleaning, this should be done by means of a piece of cloth moistened with carbon tetrachloride. The split pins of the multi-way plugs should be carefully opened with a knife blade. Remove the covers of the plugs and sockets and inspect the soldered joints for fraying or breakage.

(ii) Remove the receiver from the aircraft. Take off the upper and lower dust covers using the following method. First lift off the top cover; invert the set so that it stands on the R.F. units; release the captive screws of the bottom cover and slacken the intermediate screws - do not remove them - and lift the cover off. In replacing the covers follow the procedure in reverse, i.e. with the set upside down slip the lower dust cover on, taking care not to damage the thermal delay relay and other components, tighten screws, right the set and continue with the top cover.

(iii) Examine the valve bases and caps. See that they are clean and free from corrosion. See that all valves are pushed well home and are firmly retained in their holders and that all joints and connections are mechanically sound.

(iv) Remove the dust from upper and lower compartments of the receiver, especially from the variable condenser vanes. Do not interfere with the adjustment of the relays or the cam-operated switches, but see that the switch rollers are lightly greased.

(v) Examine the commutators of the rotary transformer and if necessary clean the commutators with rag sparingly soaked in petrol or carbon tetrachloride. Renew the brushes if necessary. Ensure that the filters are replaced and firmly screwed down.

(vi) Voltage regulator test for R.3121.

(a) Connect the receiver to its control unit and the latter to a 28-volt battery supply. With a test meter, type D, F or H, measure the voltage across the brass caps of the commutator brushes, at the end of the rotary transformer nearest the gear box (see fig.15). The voltage should read between 17 to 19 volts.

(b) Reduce the applied voltage to 22. The regulated voltage should still lie within the limit 17 to 19. If the voltage reading is outside these limits the procedure in sub-para. (viii) below should be adopted.

(vii) Voltage regulator test for R.3120. The same procedure is to be followed for adjusting the carbon pile regulator as in the case of R.3121 except that the input voltage to the rotary transformer, i.e. across the brass brush caps of the rotary transformer, should read between 8.5 to 9.5 volts, when the voltage across the battery is set to 10.25 and 13.5 approximately. The method of adjustment, if the reading is outside these limits, is given in sub-para.(viii).

Note:- The adjustments of the applied voltage referred to in the above tests may be found by tapping on the accumulator, or it may be more convenient to use the rheostate and voltmeter of a redundant I.F.F. Mk.II control unit. It will be necessary to reverse the "L" and "N" connections to the 3-pole supply plug of this control unit and when this is done a modification label must be attached. The control unit should be used in place of the control unit assembly type 1 for this test. Any of the following control units may be used:-

12 volts	Type 17	- 10LB/3
	Type 82	- 10LB/85
	Type 108	- 10LB/110
24 volts	Type 18	- 10LB/4
	Type 83	- 10LB/86
	Type 109	- 10LB/111

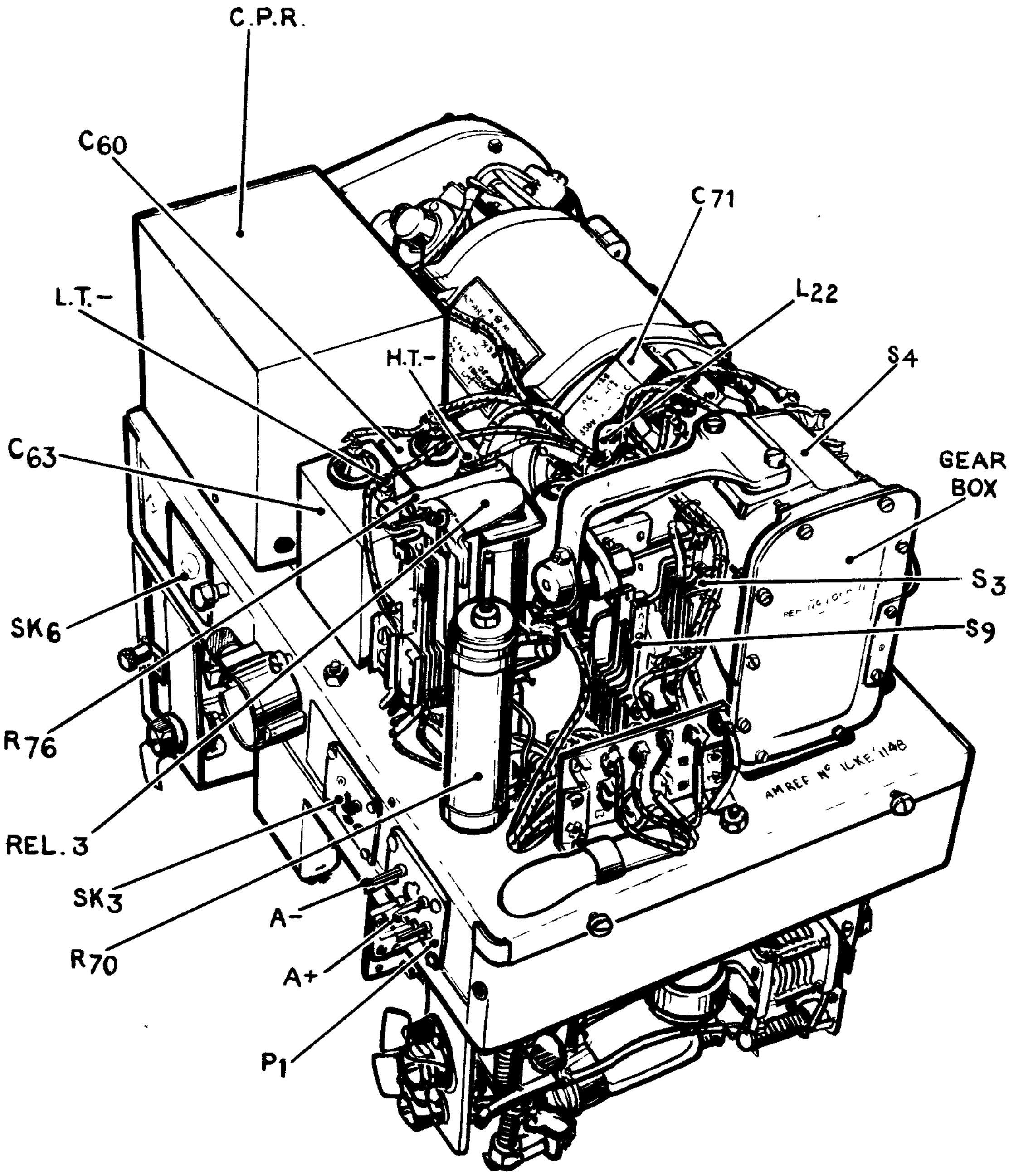


FIG. 15 TOP OF LOWER CHASSIS

(viii) Procedure for adjustment of voltage regulator (see (vi) and (vii) above.

(a) Remove the small circular cover plate of the carbon pile regulator, which is to be found on the under chassis near the cooling fan.

(b) Slacken the two locking screws and rotate the core, which is provided with a screwdriver slot, clockwise to reduce the voltage and counter-clockwise to increase it. It is emphasized that a very small movement of the core will vary the voltage by a considerable amount.

(c) After setting to the correct voltage, tighten the two locking screws. Re-check the voltages to see that they are between the limits specified.

(d) Replace the cover plate.

(e) If the regulator "hunts" as indicated by fluctuation of the controlled voltage, the pile compression is inadequate. To correct for this, the end cap which is secured by three captive screws must be removed, the locking screw slackened and the pile compression screw turned clockwise until the fluctuation ceases. The compression screw may now be turned a further quarter-turn and locked. Changing the setting of the compression screw necessitates the resetting of output voltage to the correct value by adjustment of the core as in (b).

(f) If the correct voltage cannot be obtained from re-adjustment, replace the carbon pile voltage regulator, ballast resistor R64 and diverter resistance R70 or R81 by a complete kit, regulator, power, type 15 (12V, Ref. No. 10FB/430) or type 16 (24V Ref. No. 10FB/431).

(ix) Check the H.T. voltage supplied by the rotary transformer. This will be found to vary between 400 and 425 volts, when the set is operating normally. A convenient place to measure this voltage is across the H.T. smoothing condenser adjacent to the rotary transformer.

(x) Replace the dust covers on the receiver. Replace the receiver in the aircraft and check carefully that all the plugs fit securely.

(xi) Carry out the normal functional tests on the receiver, turn the control knob "C" on control unit to each of the positions 1 to 6 successively and operate all the other controls as detailed under "DAILY INSPECTION". Verify that the proper responses are obtained in each case on the test set, type 74.

DETAILED CIRCUIT DESCRIPTION

A BAND RECEIVING CIRCUIT

82. A simplified diagram of the A band circuit is given in fig.16. The incoming R.F. signal at the aerial plug P_2 is fed via the coupling loop L6 on to the tuning coil L5, tuned by the condenser C9. The R.F. signal developed across this tuned circuit is amplified by V3, which acts as a supersonically quenched R.F. amplifier, with a gain of more than 10,000.

83. The quenching is obtained by applying an A.C. voltage to the grid of V3 from the quench oscillator stage. This is a feed back oscillator

comprising V4, a tuned circuit L9, C20 and C68 and a feed back grid coil L10 coupled inductively to L9, the two being over-wound on the same former. The frequency of this oscillator is 300 kc/s, with a variation of plus and minus 8 Kc/s provided by C68. The output from the quench oscillator is taken to the grid of the receiving valve V3, via C18 and R10. The voltage at V3 has a peak to peak value of approximately 14 volts. The choke L8 effective over the R.F. band (157 to 210 Mc/s) serves to keep R.F. out of the quench circuits.

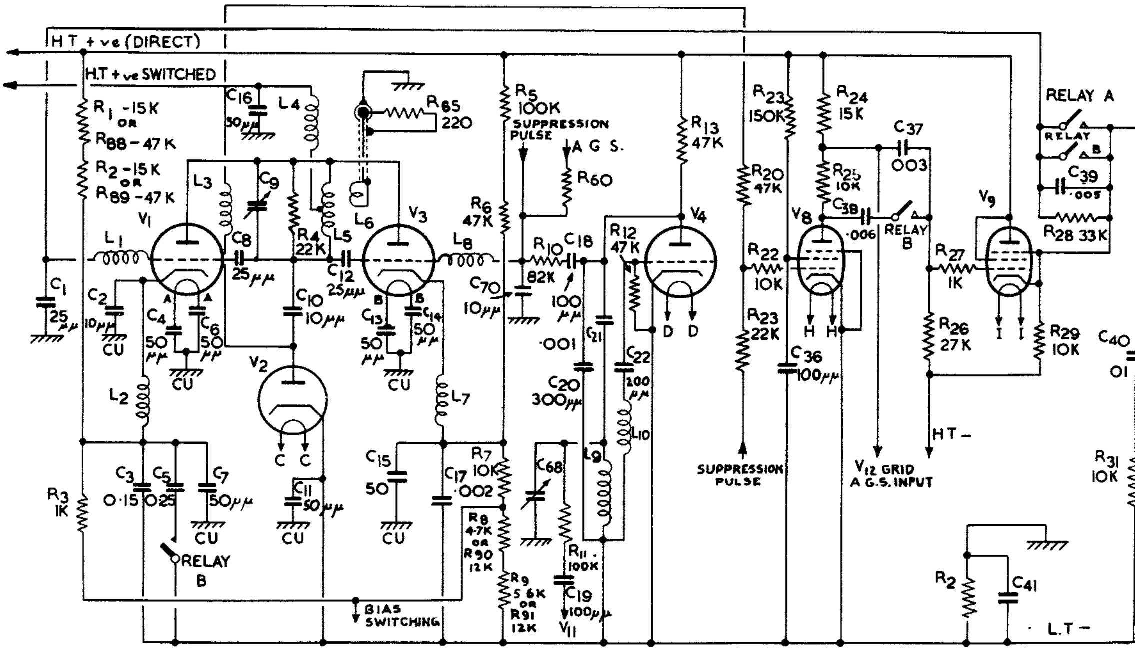


FIG. 16 SIMPLIFIED "A" BAND CIRCUIT

84. The valve V3 and its associated circuits form an oscillator which is prevented from oscillating by the cathode positive bias derived from the junction of R6 and R7 which are connected in series with R5, R8 and R9 across the H.T. supply; additional bias is obtained by connecting the lower end of R7 to L.T. positive. The actual potential difference between the cathode of V3 and negative line is not the effective grid/cathode bias as will be seen from the following paragraph.

85. The grid of V3 is returned to its cathode via the network R60, R59, R57, R58, R76, R9, R8 and R7 (see fig.2) and there is a voltage drop across the resistances R57 and R58 which makes the grid of V3 positive with respect to the negative line, therefore the nett grid cathode bias of V3 is the difference between this voltage and the cathode bias. The positive volt drop is the AGS voltage described in para.116. The resistance R76 is connected between the common negative line and H.T. - and the majority of the H.T. feed currents pass through it producing a volt drop of approximately 24 volts. The grid of V3 is returned via the A.G.S. network as above to H.T. - and thus carries this 24 volts as negative bias (see fig.25(b)).

86. The amplitude of "quench" voltage at the grid of V3 is sufficient to cause the valve to pass anode current during positive peaks of quench voltage only. When anode current flows, oscillations commence to build up in the associated circuit and as the quench voltage swings negative these oscillatory currents die away.

87. It is important that these free oscillations die away completely before the next positive excursion of the quench occurs. This is

accomplished by the loading of the tuned circuit with the aerial coupling and R4 and by the limit set to the amplitude of quench voltage.

88. Other conditions being constant the series of bursts of oscillations will produce a constant but low mean level of oscillation in the circuit L5, C9.

89. In the presence of a signal at P2 a burst of oscillation is allowed to rise to a greatly increased amplitude and enlarged voltages across the tuned circuit L5, C9 are available for rectification and amplification.

THE A BAND RECTIFIER AND AMPLIFYING CIRCUITS.

90. Referring again to the simplified circuit in fig. 16. The R.F. voltage across the circuit L5, C9, is taken off the grid and via the coupling condenser C10 to the diode V2, where it is rectified thus producing a small negative pulse for application via the R.F. choke L3, the poteniometer R20, R21 and the series resistance R22 to the grid of V8. The negative pulse is illustrated in fig. 17(a).

Note:- The oscillograms shown represent the condition where the sender valve is being triggered as described in para. 94, and where the shapes are controlled by the coding circuits within the receiver. The initially received signal throughout the chain of circuits is generally similar to these waveforms but is not necessarily of the same width and is of much lower amplitude.

91. The valve V8 acts as a pulse amplifier or trigger valve and produces a positive pulse at its anode many times larger than the negative one fed to its grid by V2 (fig.17(b)). The rise in potential at the anode of V8 causes a current to flow through the coupling condenser C37 and the grid-stopper resistance R27 into the grid of the cathode-follower valve V9.

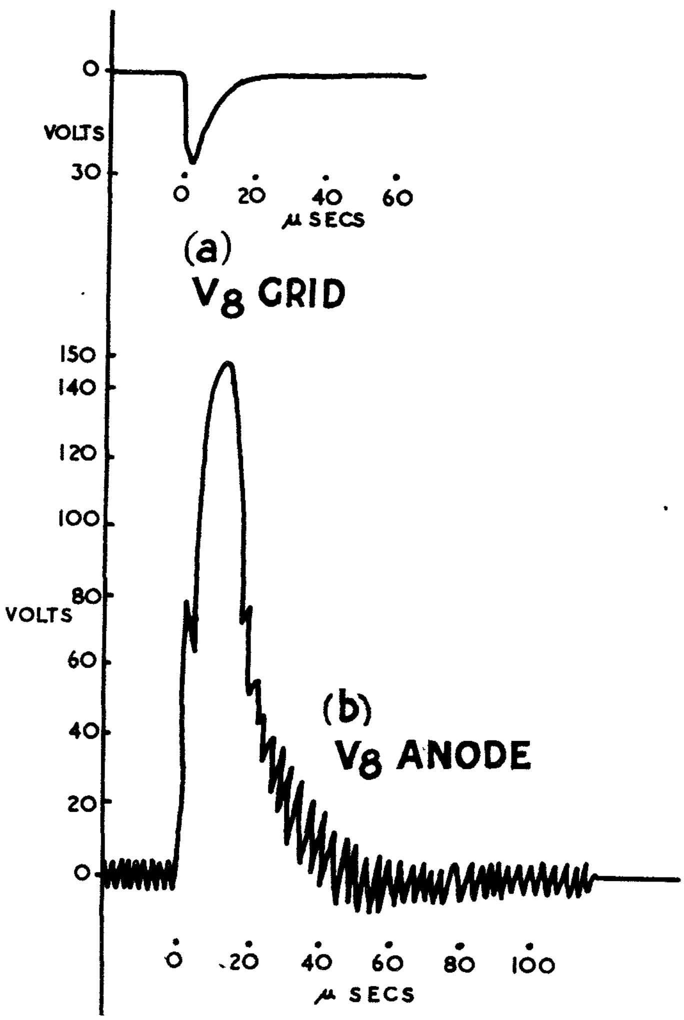


FIG. 17 "A" BAND P.A. (NARROW)

92. The signal appearing at the cathode of the valve V9 is almost identical with that on V9, grid, (Fig.18(a) (b)), but is developed across the low output impedance of the V9 cathode circuit and is used to drive the grid of the transmitting valve V1 in a positive direction. (fig.18(c)). Thus the negative grid bias of V1 is overcome and the valve goes into oscillation.

93. Since V1 and V3 are connected to the common tuned circuit L5, C9 it follows that the frequency of transmission is substantially the same as that of the received

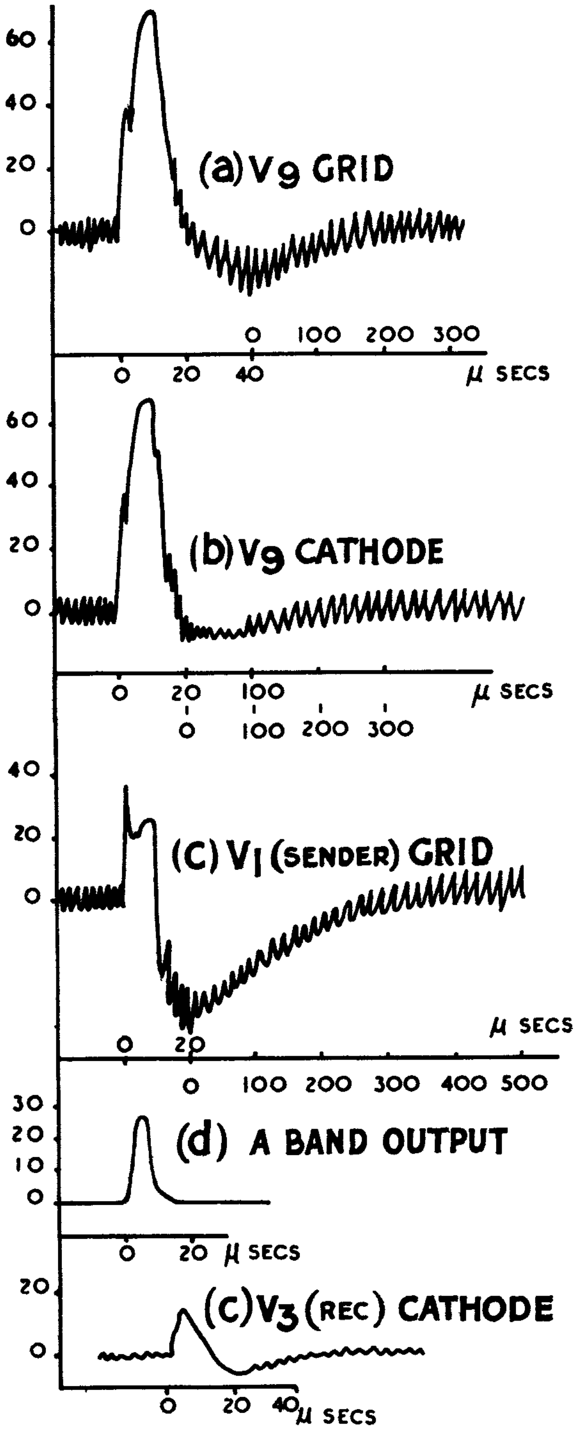


FIG. 18
"A" BAND OUTPUT (NARROW)

signal causing the re-transmission.

A BAND TRANSMITTER TRIGGERING

94. Consider for the moment the circuit with Rel. A and Rel. B open. When a signal is received and a negative voltage is applied to the grid of V8 the resultant positive potential applied to the grid of V9 causes an increased current to be drawn by it resulting in a rise in potential at the cathode of V9. This rise in potential produces a charging current in the feed back condenser C39 a current which is in effect the grid current of the transmitting valve V1. The valve now passes current and bursts into oscillation causing very much larger voltages to be applied to V2, V8 and V9 and consequently the oscillation in V1 becomes very violent. The R.F. energy is radiated via the coupling coil L6 and the aerial which is plugged into P2. Thus the same aerial serves for reception and re-transmission. It should be noted, however, that a certain minimum input is required to trigger V1 since it is normally biased beyond anode current cut-off. This "limit signal" is approximately 100 microvolts at the aerial plug. The triggering sensitivity is set by the V8 grid tap on the potentiometer R20, R21.

95. The violence or amplitude of this oscillation is limited by various factors. These are:-

(i) The grid of V1 is driven positive with respect to its cathode by the combined action of the R.F. oscillation and the drive from V9. This causes grid current damping of the oscillation.

(ii) The cathode of V1 rises in potential due to the heavy anode and grid currents of this valve during transmission, which charges the condenser C3.

(iii) The voltage drop across the resistance R29 in the cathode of V9 and the reactance of the condenser C39 limit the amount of grid current in V1 and consequently the positive excursion of the grid.

(iv) The H.T. supply available to V1 is a little over 400 volts.

A BAND SENDER OUTPUT

96. The re-transmitted pulses are substantially rectangular in shape (fig. 18(d)) and the "instantaneous power" output is about 4 watts

(i.e. the peak voltage across a 46-ohm load is approximately 20 volts).

PULSE DURATION ON THE A BAND

97. The factors outlined in para. 95 which limit the R.F. amplitude developed across L5, C9 during transmission of a pulse of R.F. are of such a nature that they also serve to determine the time during which the violent oscillation may be maintained. Treating these factors separately, we can form the following conclusions:-

(i) The grid of V1 is driven positive and grid current flows. Therefore, if this grid can be maintained positive by V9, oscillation can persist indefinitely (assuming no change in the V1 cathode potential). The grid drive, however, falls off as the condenser C39 becomes charged until ultimately the voltage across the condenser equals the voltage drop across R29.

(ii) The charging of the cathode condenser C3 progresses at a definite rate, which is determined by the total of the anode and grid currents flowing in V1. Therefore after a certain time, this cathode will be more positive than the V1 grid and eventually will be so far positive that V1 will be unable to maintain oscillation. After cessation of oscillation C3 will discharge through R3, R8, R9, R1 and R2 until the cathode achieves a steady potential determined by these resistances which form a potential divider across the H.T. supply.

(iii) The events described above, the falling grid and the rising cathode potentials (together with the natural backlash of the oscillator) cause a very sudden cut-off of oscillation thus giving a steep falling edge to the NARROW pulse.

98. To obtain the WIDE pulse Rel.A is closed, short circuiting the feed-back condenser C39. When a sufficiently large negative signal is fed to the grid of V8 (fig. 19(a)), the latter is biased well back (ultimately to cut-off) and its anode rises to H.T. positive potential (fig. 19(b)). The condenser C37 then charges via R24 and the grid/cathode impedance of V9 (in parallel with R26). The size of C37 therefore, determines the time during which the V9 grid current can be supplied, for ultimately, C37 will become charged so that it has H.T. on one plate and zero potential on the other. When this condition is reached the valve current through R29 and the resultant positive grid drive to V1 (C39 being short circuited) fall off and this, together with the effect described in para. 97 determines the duration of the wide pulse.

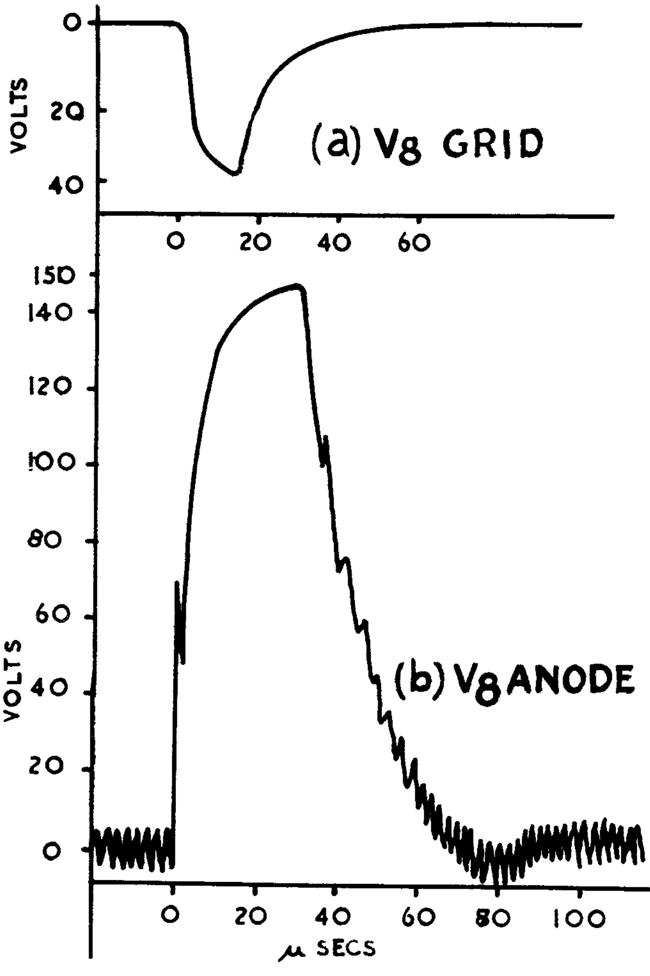


FIG. 19 "A" BAND P.A. (WIDE)

99. A very wide pulse (DISTRESS) is obtained by closing REL.B, which (i) short-circuits the "Narrow"

condenser C39, (ii) switches in parallel with the "Wide" condenser C37 a larger condenser C38 (iii) switches C5 in parallel with the V1 cathode condenser C3 and (iv) connects H.T. permanently to V1 and V3 thereby ensuring the transmission of a "distress" response continuously. The DISTRESS pulses appear at V8 as shown in fig. 20 (a) (b).

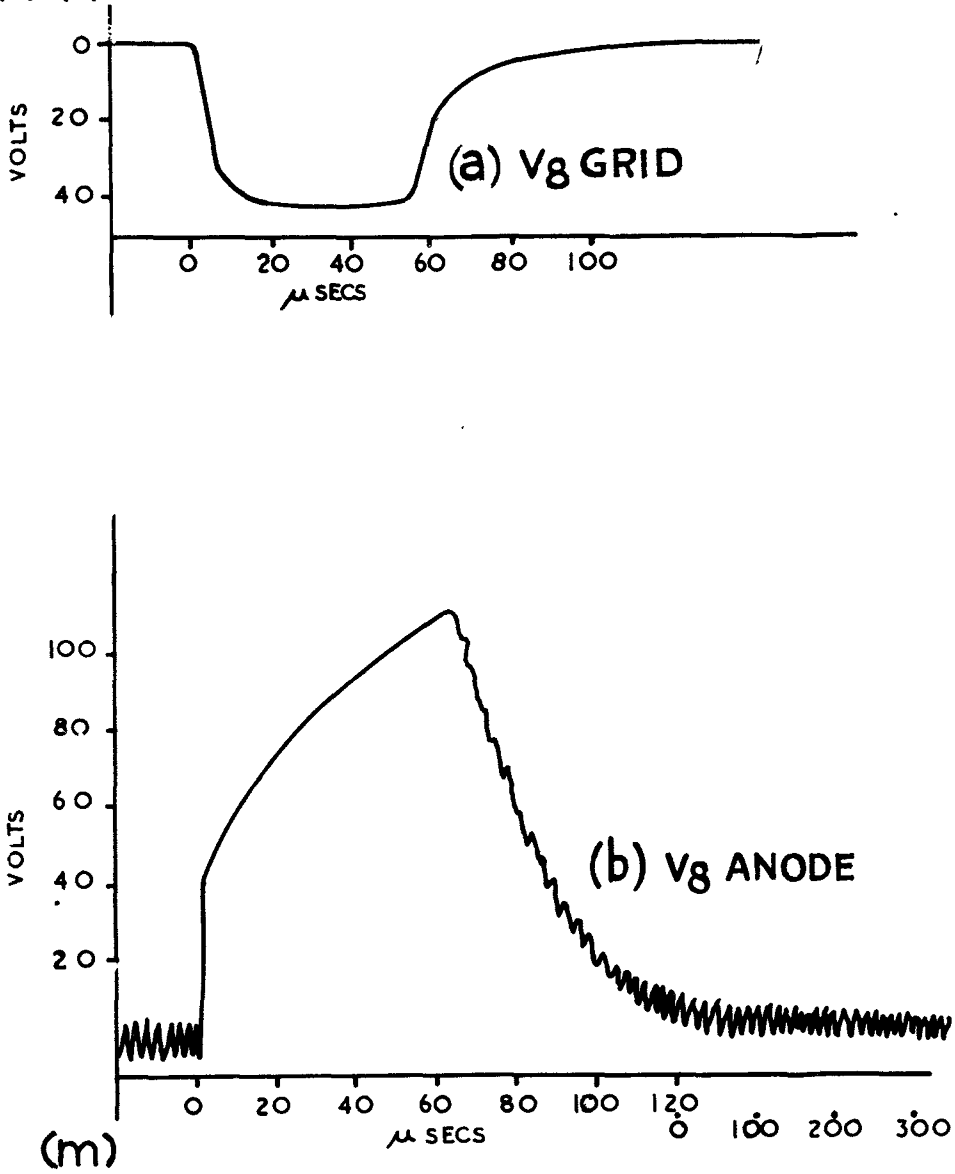


FIG. 20 "A" BAND P.A. (DISTRESS)

RECOVERY PERIOD

100. When oscillation ceases due to a combination of the effects described in the foregoing paragraphs the triggering cycle cannot be repeated until the circuit condensers have been discharged. This limits the maximum rate at which the equipment will respond to interrogation, the maximum recurrence frequency being of the order of 2,000 per second. In the case of NARROW pulse transmission.

(i) The feed back condenser C39 discharges into R28.

(ii) The cathode condenser C3 discharges into R3 etc.

(iii) The coupling condenser C37 discharges into R24, R26, R25, V8, V9 and R29 and this time constant corresponds to that of (i). The charge on C37 is small because of the short duration of the charging time (N).

After a WIDE pulse transmission (ii) and (iii) apply. Recovery from DISTRESS pulse transmission is longer since C37 has C38 in parallel and C5 is switched across C3. At the cessation of oscillation the grid of V9 rises momentarily since, in the absence of R.F. on the V1 grid, the cathode of V9 can rise without being loaded by the V1 grid current. Subsequently, as the grid of V8 rises, its anode falls and C37 discharges through R25, V8, R24, R26, V9 and R29 thus making the grid of V9 negative. C37 reaches its normal condition as fixed by the steady potential at the junction of R24 and R25. At the same time C3 is discharging through R3 etc. These condensers (C37 and C3) take some time to reach their normal conditions. During this recovery period the cathode of V1 is relatively positive, and the grid of V9 is relatively negative. Hence, during this recovery period, the sensitivity of the equipment will be sub-normal, i.e. a larger received signal will be required to trigger V1 into transmission. The receiving valve V3 and all other parts of the circuit recover much more quickly, and therefore the restoration of normal sensitivity depends upon C37, C3 and their associated resistances.

RESOLVING POWER

101. The period of recovery to normal sensitivity mentioned in para. 100 is important for the following reason. The normal sensitivity and power output of the equipment are such that if two equipments are airborne and approximately in tune at 15 miles (or less) apart, they may inter-oscillate, the output of the one being received and transmitted by the other and so on, in succession. The frequency of repetition of such oscillation depends upon the separation of the two equipments, being for example, 6.6 kc/s, when the separation is 15 miles. This inter-oscillation would produce much unwanted signal at ground stations if many equipments were in the air at the same time and within close range of each other. It is therefore prevented by delaying the return to normal sensitivity (after one transmission) by a period of approximately 200 microseconds. At greater ranges than 15 miles the ordinary attenuation with range of the transmitted signal is adequate to prevent this inter-oscillation. This characteristic, termed the "resolving power" is adjusted by choosing the correct values for R3, R26 and R28.

GR BAND RECEIVER-SENDER CIRCUIT

102. A simplified diagram of the GR Band circuit is given in fig. 21. The incoming R.F. signal at the plug P3 is fed to the tuned loop L23. The R.F. signal developed across this tuned circuit is amplified by the valve V6 which is also quenched by the valve V4. The quench voltages are applied to the grid of V6 via R11, C19 and the choke L16.

103. The valve V6 and its associated circuit form an oscillator which is prevented from oscillating by the cathode positive bias derived from the junction of R17 and R18 which with R19 forms an H.T. potential divider. The grid of V6 is returned to its cathode via R61, R58, R76, R19 and R18 (see fig.25(c)); there is a voltage drop across the resistance R58, which makes the grid of V6 positive with respect to the negative line, therefore the nett grid/cathode bias of V6 is the difference between this voltage and the cathode bias.

104. The amplified R.F. signals are rectified by the diode V5 and the output of this valve is fed to V8 via the potentiometer R14 and R21. The function of V8 and V9 is the same as for the A band. but on the GR band only one pulse width is required, 7 to 15 μ secs.(fig.23(e)). The oscillograms for V8 and V9 on the GR band are given in figs 22 and 23.

105. When the potential of the cathode of the cathode-follower valve V9 rises, current flows through C40 and the diode V7a into the grid of the oscillator valve V6, the charging time of C40 determining the duration of the pulse. The diode V7a provides a unidirectional

path for the grid drive of V6, necessary for cutting off the negative

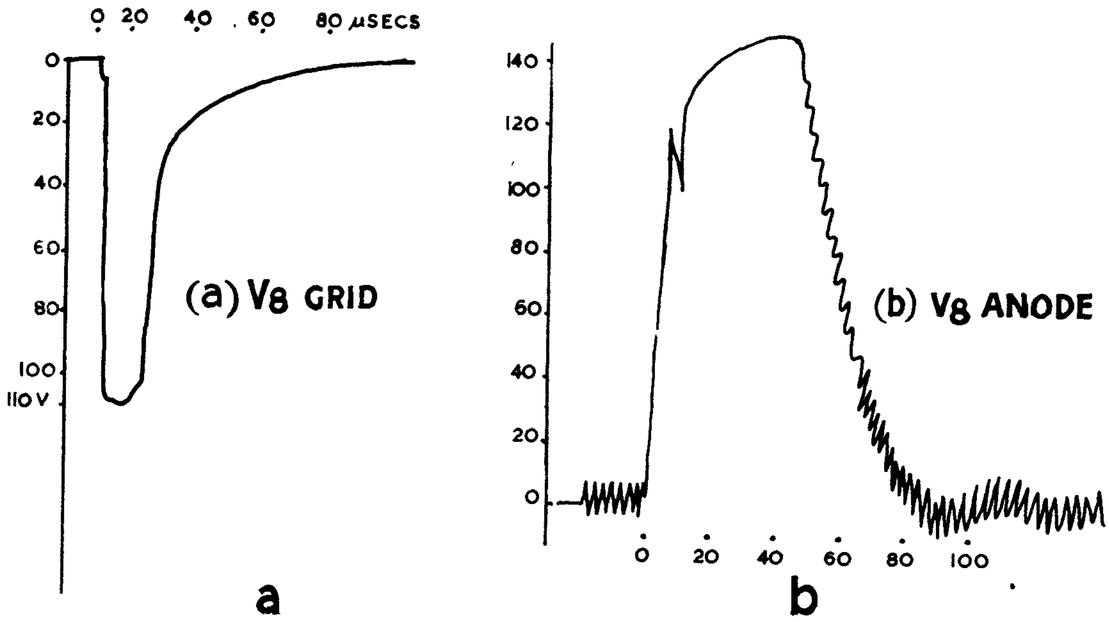


FIG. 22 "G" BAND P.A.

overswing of the V9 cathode voltage which results from the sudden fall of grid volts at the termination of the R.F. pulse. This permits an earlier recovery of the V6 grid (c.f. fig. 21(c) and (d)).

RECOVERY PERIOD ON GR BAND

106. The recovery period is determined by the discharge time of the condenser C40 into the resistors R29, R76 (fig. 2) and R31, and the discharge time of the condenser C34 into R18.

G.R. BAND OUTPUT

107. The instantaneous power during the pulse is of the order of 2 to 3 watts, producing a peak voltage of approximately 15 across the normal load of 46 ohms.

BAND SWITCHING

108. To clarify the link-up of the separate receiver circuits mentioned above, reference should be made to fig.11. The valve V3 is the A band receiver valve with cathode bias obtained from the potential divder comprised of the resistors R5, R6, R7, R8 and R9. V6 is the GR receiver valve with bias resistors R17, R18, and R19. The amount of bias provided is sufficient to render both receiver entirely insensitive. The cam-operated switch S9 is arranged to short-circuit either R8 and R9, or R19 bringing the appropriate valve into normal operation. Relay C has contacts which in the normal rest position provide for the continuous operation of V3 with V6 held biased back. The external switch S10 in the "A" position leaves V3 operating as just described, but in the "R" position open circuits R8 and R9 rendering V3 inoperative, and short-circuits R19 to bring V6 into the normal receive conditions.

109. G band operation has been briefly explained in para. 6. At the request of the controller at the G.C.I. station the fighter pilot presses a push switch S12 which actuates Rel.C. This brings into circuit the switch S9 which is operated by a cam driven on a shaft

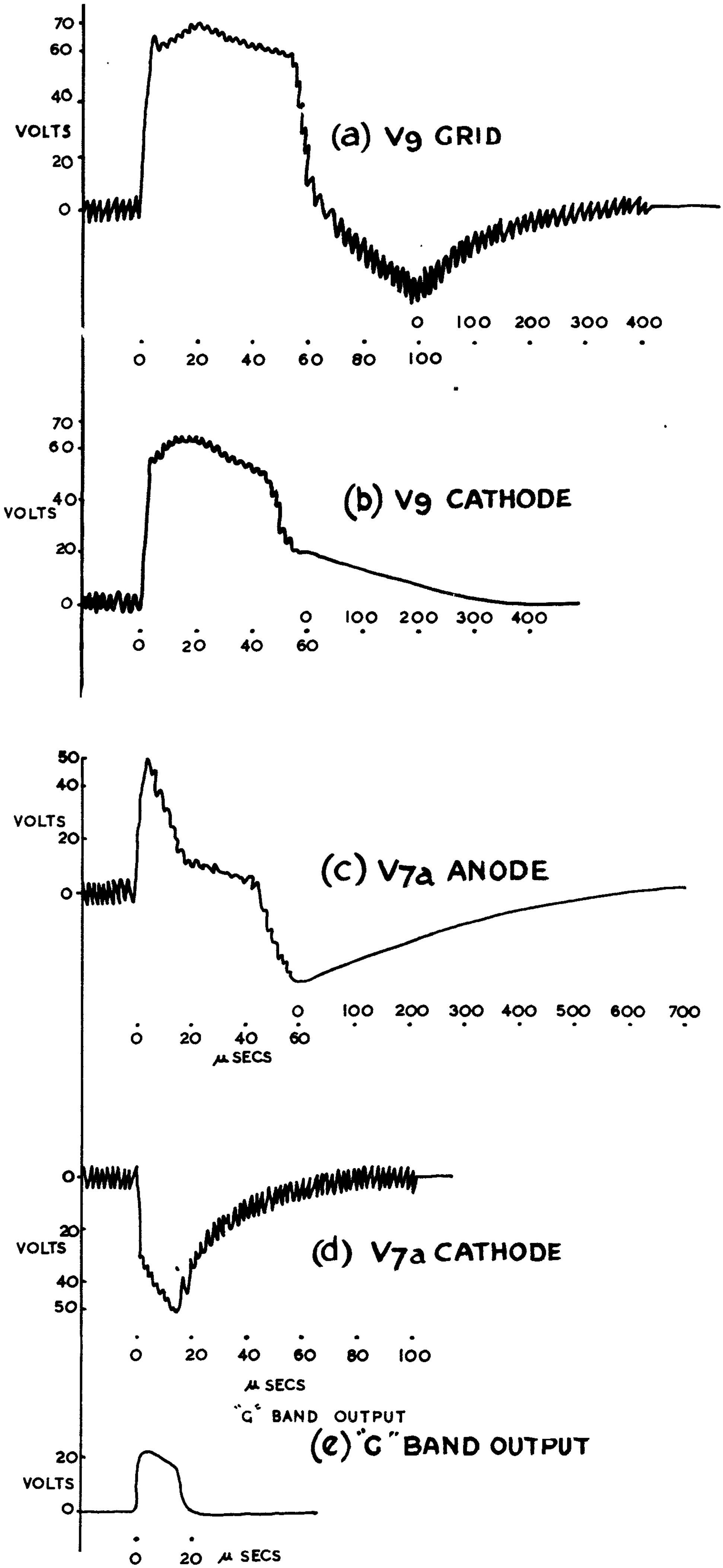


FIG. 23 "G" BAND OUTPUT

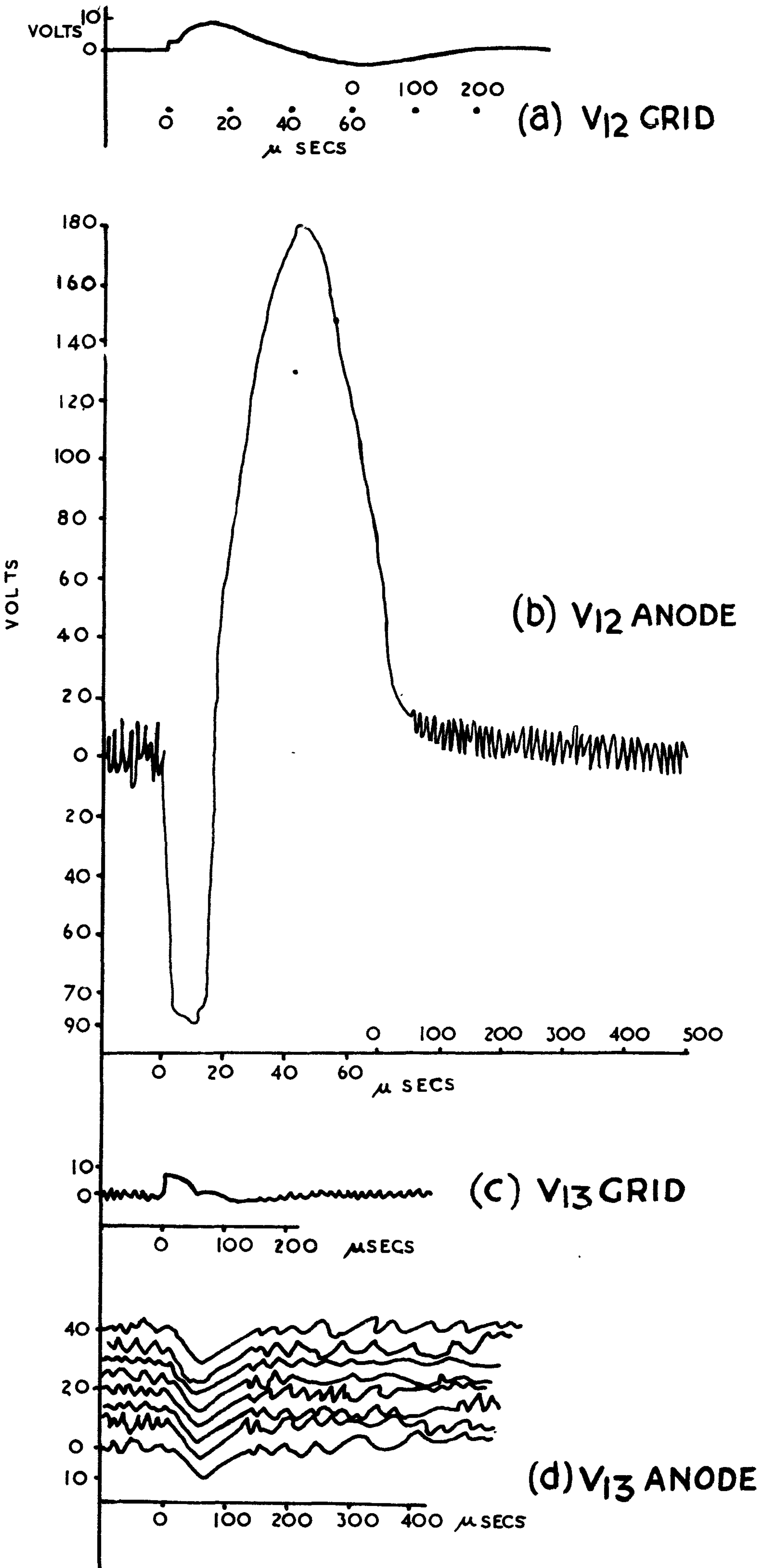


FIG. 24 "A" BAND A.G.S. (NARROW)

protruding from the gear box. The switch S9 brings the A and G oscillators into operation alternately; A band for approximately 1/15 sec. and G band for approximately 1/25 sec., the complete operation occurring five times per second. Rel.C is a thermal-delay relay which automatically drops out after approximately 35 seconds. Thus, during these 35 seconds, the equipment continues to give identification to all interrogators operating in the A band, and in addition, a response direct to the G.C.I. station. At the end of this 35 second period, the set reverts to uninterrupted A band operation. The push switch S12 is known as the G AUTO switch.

110. Operation on the G band for an indefinite period can be obtained by switching on the G MANUAL switch S14. This short-circuits S12 and disconnects the supply to the heater of the thermal-delay relay to prevent the latter from switching itself off at the end of the 35 secs. Since the thermal-delay relay carries a self-holding contact, it is necessary to interrupt the main L.T. supply to the relay energising coil and this is achieved by reconnecting the heater at the OFF position of the switch S14, the interruption thus occurring 35 seconds later.

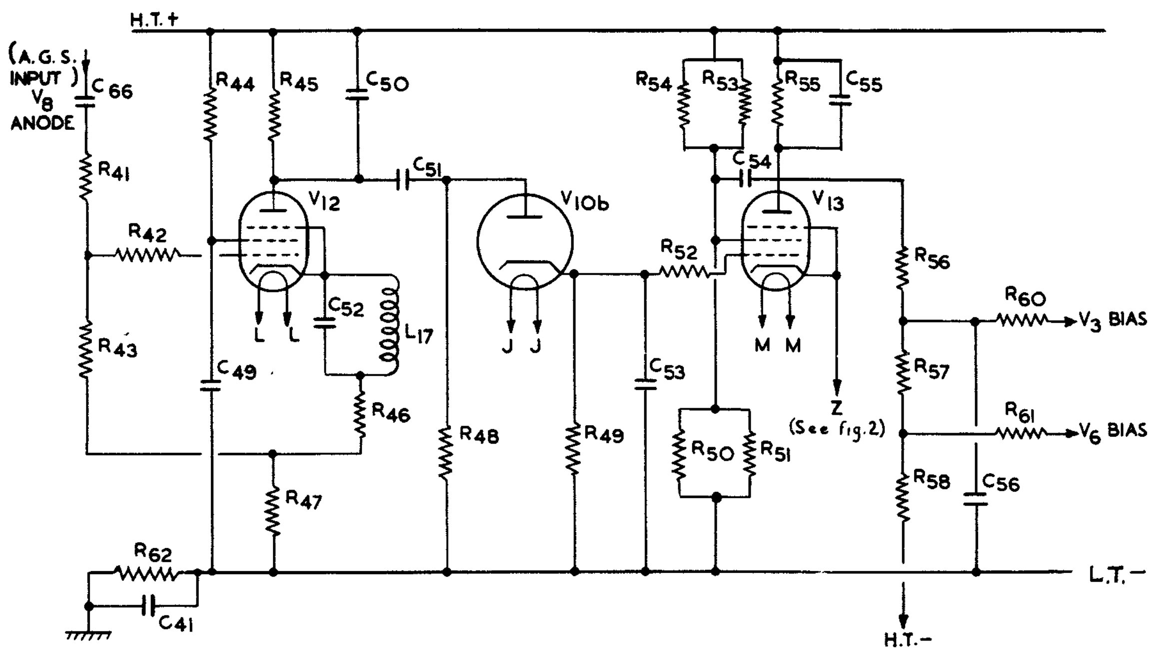
111. "MAYDAY" signals on the G band are obtained by transmitting "un-chopped" responses at the expense of A band. This is done by closing the G/D switch S15 which, in opening the link 7 to 4 on the plug P7 and joining 7 to 2, open circuits the V3 bias resistors R8, R9 and short-circuits R19, thus bringing V6 on continuously.

AUTOMATIC GAIN STABILIZATION

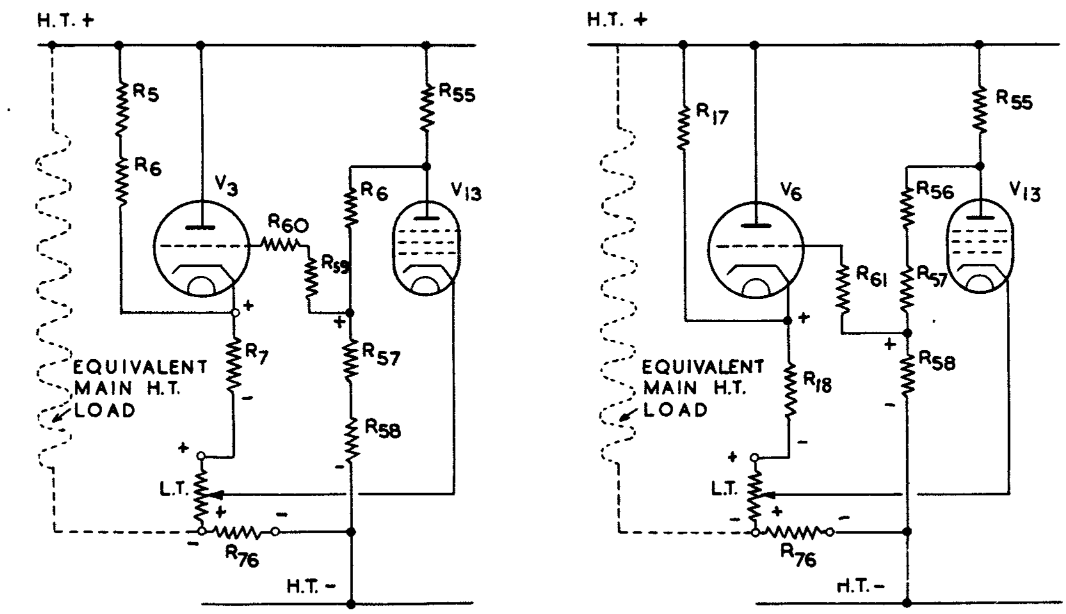
112. The original A.G.S. system of receivers, type R.3067 and R.3090 functioned on the selection of the quench frequency component of the modulation envelope of the R.F. oscillations in the receiver tuned circuit. That system was found to be very susceptible to interference from C.W. signals. It should be remembered that a super-regenerative receiver is used and when an in tune C.W. signal is received a sympathetic oscillation is set up in the tuned circuit which provides a new threshold level from which the voltages build up at every positive quench half-cycle. Thus the quench component, used for A.G.S. purposes, has a false amplitude and the receiver valve is biased back to a less sensitive condition.

113. To overcome this weakness the A.G.S. circuit in receivers, types R.3120 and R.3121 is made to control on the average amplitude of random noise in the receiver circuit. The spectrum of noise frequencies used ranges from 20 kc/s to 200 kc/s, in this way avoiding the fundamental and harmonics of the quench oscillator (300 kc/s). A simplified diagram of the A.G.S. circuit is given in fig.25(a). The noise modulated R.F. oscillations in the receiver circuit are rectified by the appropriate diode V2 or V5 and amplified by the common pulse amplifier V8. From the anode of V8 the resultant voltages are fed to the grid of the noise amplifier V12 fig.24(a). A quench-tuned circuit L17 - C52 in the cathode of V12 provides degeneration for the quench fundamental frequency contained in the input signal, whilst C50, a 50 $\mu\mu$F condenser across the anode load of V12, reduces the amplification at quench first harmonic frequency. The ill effects of the very high voltages on the anode of V8, consequent upon the triggering of one of the sender valves, are limited by the high resistance R42 in the grid of the noise amplifier V12.

114. The noise voltages at the anode of V12 (fig.24(b)) are capacity fed to the anode of the noise rectifier V10b and the resultant D.C. voltage appearing across the diode load resistor R49 is applied to the grid of the D.C. amplifier V13 (fig.24(c)). The time constant of the diode load R49 and its smoothing condenser C53 is kept as low as



(a) SIMPLIFIED A.G.S. CIRCUIT



(b) TOTAL BIAS NETWORK ON V_3

(c) TOTAL BIAS NETWORK ON V_6

FIG. 25 SIMPLIFIED A.G.S. CIRCUIT

possible consistent with reasonably efficient rectification (it is actually 20 - 30 μ secs.) to avoid integration of the high voltages of re-transmitted signals which would produce a considerable negative bias on V12 with increasing signal repetition frequency.

115. Obviously a fairly smooth D.C. bias at the grid of the receiver valves V3 or V6 is required from the A.G.S. circuit. Smoothing of the A.G.S. volts is therefore carried out at the anode of the D.C. amplifier V13 by means of the condenser C55.

116. To obtain the utmost gain from the D.C. amplifier V13, the load is connected in the anode rather than in the cathode circuit; the nett gain is about 100. The applied anode potential of V13 is about 90 volts. The biasing voltage required for the receiver valves is about 50 volts and this is obtained from the potentiometer R56, R57, and R58. The D.C. amplifier is biased by the cathode being returned to a 4-volt positive point in the heater network, the grid being returned by R52 and R49 to the negative line. Back-coupling from anode to screen grid by C54 tends to hold up the potential of the screen grid, thus improving the G of the valve.

117. From the above it can be seen that a noise oscillation of increasing amplitude in the R.F. circuit (i.e. a more sensitive receiving condition) produces a falling positive voltage at the grid of the receiving valve and vice versa. Of course, the receiver valves are biased with a standing potential from bleeder resistors, see fig. 25(b) and (c). The level of sensitivity which is obtained in this manner is 100 μV. This refers to the amplitude of received signal required to trip the sender valve at every received pulse.

A BAND CODING SYSTEM.

118. The system of coding on the A band uses retransmitted pulses of two widths, 4 to 9 microseconds and 15 to 35 microseconds (0.75 and 3 miles on the ground display tubes), in a selection of different sequences. It is arranged that the wide pulse is more than 2½ times the duration of the narrow pulse at any time. The minimum recognition time for any code is its tuning condenser cycles i.e. 3 times 2.8 seconds (8.4 seconds) after first seeing a signal and during this time, therefore, a maximum of 4 return signals (from the aircraft) may be observed. The basic codes are as follows:-

(1) N N N N N N N N

(2) N - N - N - N -

(3) N N N - N N N -

The N indicates a condenser cycle during which a narrow pulse is re-transmitted. The dash indicates a blank cycle during which the apparatus is non-operative and therefore no return can be observed. The derived codes involving alternate widths are also three in number making a total of six different codes. To achieve these the apparatus is made to follow the law,

N N W W

For all the derived codes whilst still conforming to the codes (1), (2) and (3) above, W indicates a tuning-condenser cycle during which a wide pulse is transmitted. The result being as follows:-

(4) N N W W N N W W

(5) N - W - N - W -

(6) N N W - N N W -

All codes are repetitive after four condenser cycles, and it can be seen that wherever an observer breaks into a train of responses the particular code in use cannot be confused with any other code.

119. These codes are selected from a six-point switch on the external control unit, type 89.

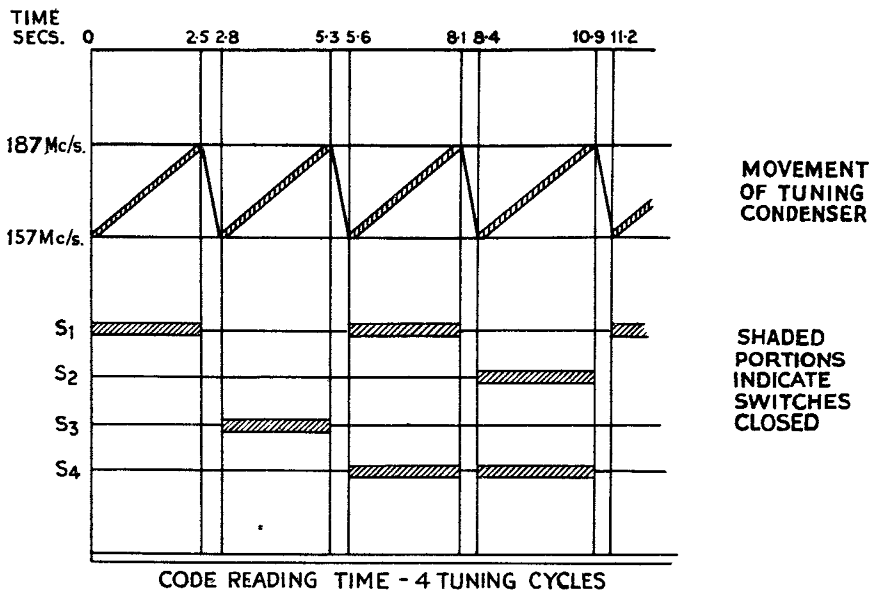


FIG. 26 "A" BAND SWEEP CONDENSER TIMING

120. The diagrams (figs.26 and 7) show the mechanism by which these results are achieved and should be studied in conjunction with the complete circuit diagram. The switches S1, S2, S3 which control H.T. supply to V1 and V3 determine which condenser cycles are operative. The switch S4 controls the L.T. supply to Relay A which switches the wide pulse. These four switches are operated from the rotary transformer in the set through suitable reduction gearing and also through a geneva wheel mechanism (of the ordinary cinematrograph type) so that they are stationary whilst the tuning condenser sweeps the band and change over during the flyback. With reference to fig.26 we see that S1 applies H.T.+ to V1 and V3 during cycles (1) and (3); S2 and S3 apply H.T.+ to the code selector switch S7 during cycles (4) and (2) respectively. The selector determines whether or not this H.T. is transferred to V1 and V3 according to which code is required. Switch S4 applies L.T. to the selector switch during cycles (3) and (4). The selector switch then determines, according to the code, whether or not this L.T. is transferred to Relay A (for wide pulses).

A BAND DISTRESS SIGNALLING

121. A switch S6 is fitted to the control unit, type 90. When "ON" this switch feeds L.T. to Relay B. This relay has four separate contact units, all of which close when the relay is energized. The circuit switching has been described in para.99.

GR BAND SIGNALLING

122. There is no coding on the G or R bands, one pulse width 7 to 15 u secs serving all purposes. For distress signalling on the G band, an unchopped response is radiated as described in para.111, and on R band emergency signals may be sent out by means of the telegraph key.

SUPPRESSION CIRCUITS

123. Other Radar equipments which may be installed in the aircraft

would, if precautions were not taken, trip the I.F.F. sender with consequent interference on the Radar display. To avoid this the I.F.F. receiver is suppressed during the period of the Radar transmission and for a short time afterwards by means of a priming pulse taken from the Radar equipment. For example:-

(i) Duration 18 µS. Amplitude 30 volts positive. In this case the I.F.F. receiver is enabled to ignore an R.F. on-tune signal of 4 volts amplitude (at the I.F.F. aerial plug) and 5 µS duration. This interfering signal would normally emanate from airborne interrogators associated with A.I. equipments.

(ii) Duration 300 µS. Amplitude 30 volts positive. This comes from the A.I. Mk.VIII interrogator which would interfere to the extent of a 2-volt signal lasting 5 µS.

(iii) Duration 1200 µS. Amplitude 15 volts positive. This is obtained from the brightening circuit of the indicator unit and of long range search equipments or interrogator's and ensures that the I.F.F. receiver circuit does not radiate quench modulated R.F. signals during the range time of the other equipment.

(iv) A combination of (ii) and (iii) obtained from Lucero class of equipment.

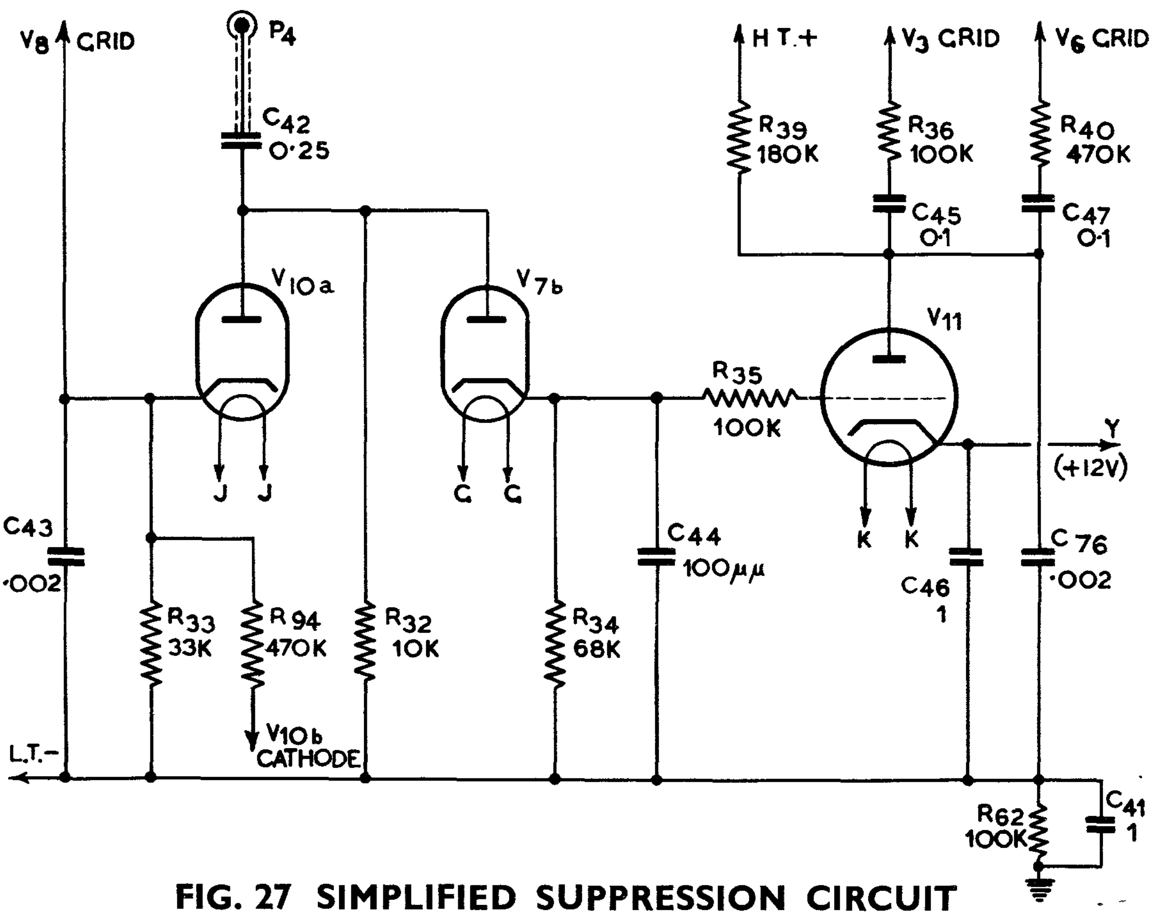


FIG. 27 SIMPLIFIED SUPPRESSION CIRCUIT

124. A simplified diagram of the suppression circuit is given in fig. 27. The incoming suppression pulses are fed via the plug P4 to the commoned anodes of diodes V10a and V7b, fig.28(a). The separate cathode circuits C43, R33 and C44, R34, serve to elongate the incoming rectangularly shaped waveforms, producing a flat top and a long tail as shown in fig.28(b & c). The cathode of V7b feeds the grid of the suppression triode amplifier V11 (fig.28(d)), and produces a large

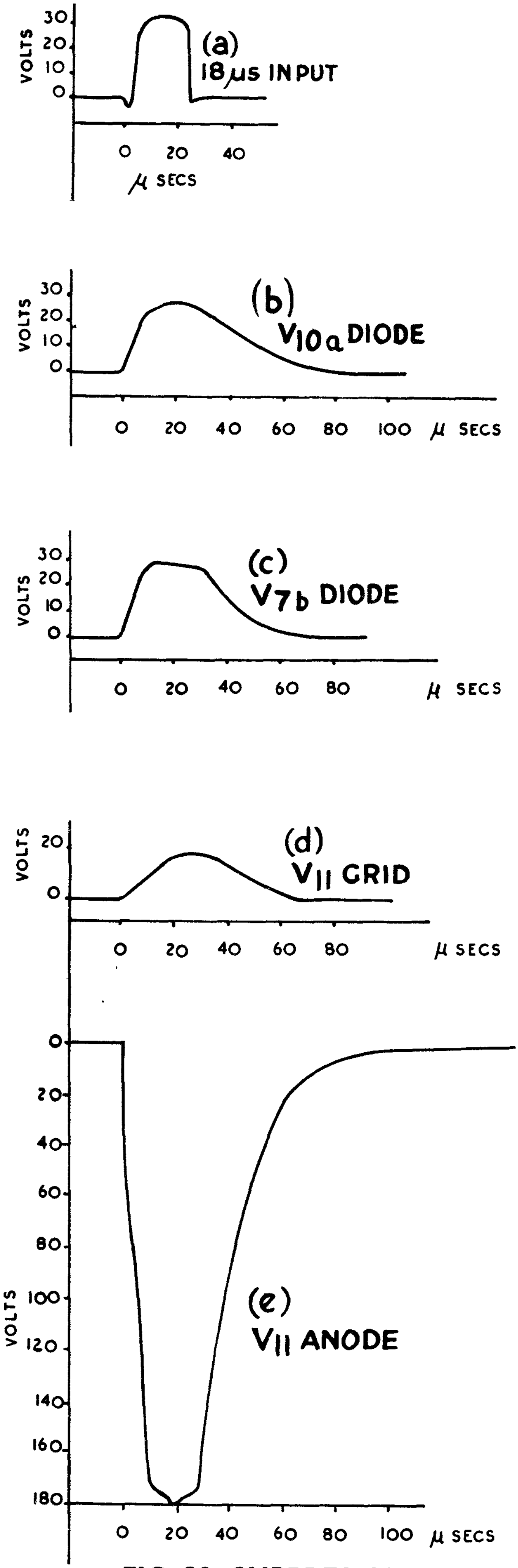


FIG. 28 SUPPRESSION

negative signal at its anode (fig.28(e)). The amplifier V11 is biased so that in the absence of suppression input the valve is just at cut off; this is accomplished by returning the cathode to a 12 volt positive point in the heater circuit. The reason for this cut-off condition is to prevent the anode potential from over-swinging in the positive direction during recovery, since such over-swing would apply positive bias to the receiver valve causing increased sensitivity and tendency to trigger off at the end of each suppression period.

125. The large negative signal at the anode of V11 is applied to the A band receiver valve V3 via C45 and R36. The signal applied to the grid of V3 has an amplitude of at least 120 volts negative. The cathode of this valve is normally held at about 70 volts positive, therefore during this suppression signal the bias of V3 is the difference between 120 and 70, i.e., 50 volts negative which is sufficient to ensure that it will not amplify even a large R.F. signal applied to the tuned circuit.

126. The negative going pulse at the anode of V11 is also applied to the grid of the GR band oscillator V6 via the condenser C47 and the resistance R40. The balance of the bias voltage and the applied negative pulse will be approximately the same as for the A band receiver.

127. The pulse from the cathode of V10a feeds the grid of the pulse amplifier V8 thus holding its anode voltage at a low level during the suppression pulse duration.

Power Supplies

128. As illustrated in fig. 29 the power supply is obtained from the aircraft battery with a nominal

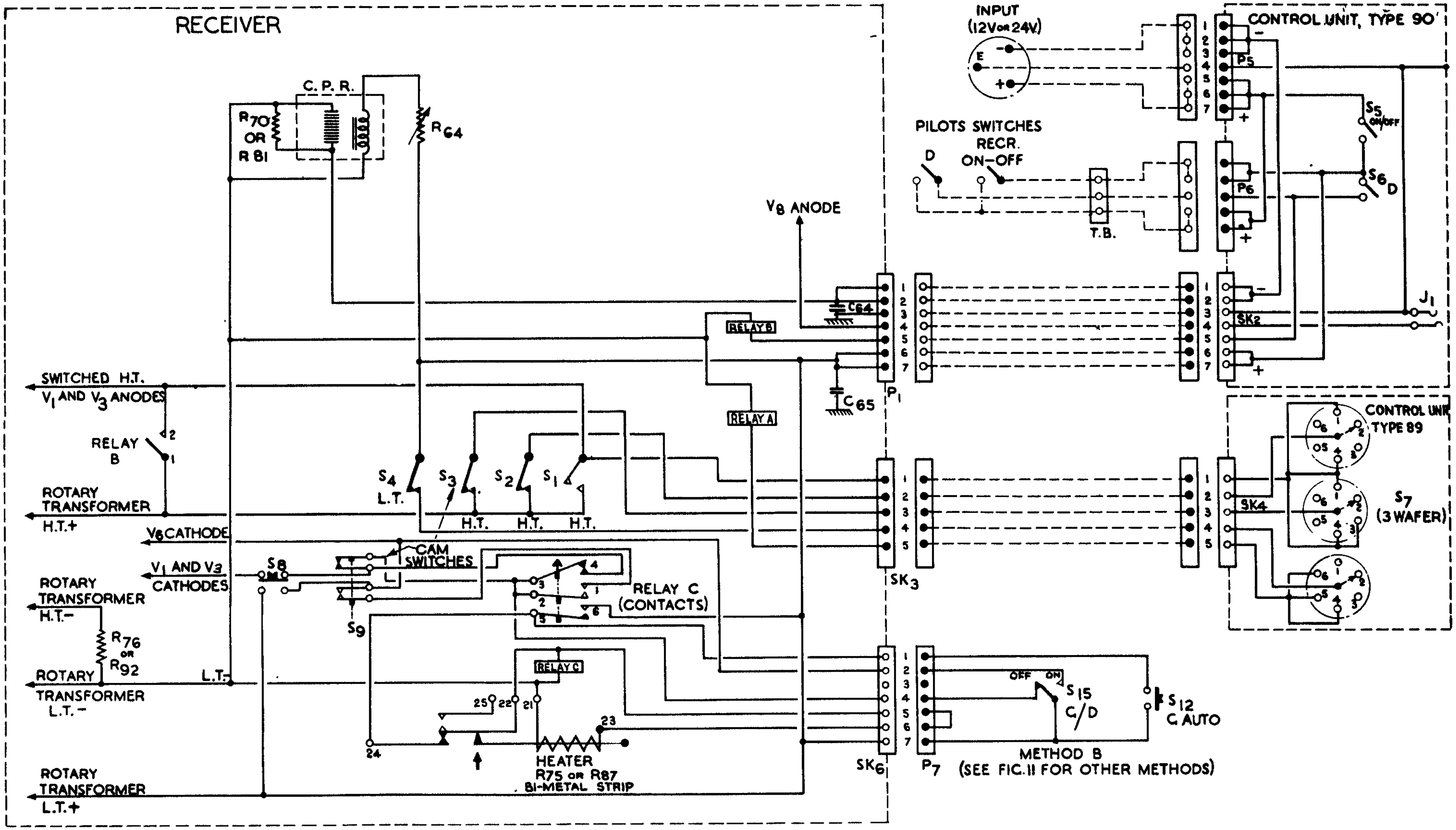


FIG. 29 THEORETICAL DIAGRAM OF CODE, CAM AND CONTROL SWITCHING

voltage of 12 or 24 volts (according to type of aircraft) and is picked up by the tricel 19 cable which plugs into the top right plug on control unit, type 90. After passing through the main L.T. switch on the control unit it is fed to the receiver via the 7-pole socket and the 7 pole plug on the receiver. In order to compensate for variations in battery voltage, a carbon pile regulator is included in the power units in the receivers for automatic control of the input voltage to the rotary transformer. This gives an approximately constant voltage of 9.0 volts for receiver, type R.3120, and 18 volts for receiver type R.3121. These stabilized L.T. voltages are also used for all the valve heaters. The coil L18 surrounds a spring-loaded steel core which presses on the carbon pile. The diverter resistance R70 serves to reduce the minimum resistance of the carbon pile and to share the input current, safeguarding the C.P. from overload. It has a value of 1 ohm in the receiver, type R.3120 and 4 ohms in the receiver, type R.3121. The magnetic pull on the core due to the current in L18 balances the spring loading when the voltage across L18 and R64 in series with it is 9.0 volts in the one case and 18.0 volts in the other (R64 is preset to give this balance and should not be disturbed), the regulator is therefore very sensitive to fluctuations in these voltages. The coil L18 is connected to the controlled voltage side of the regulator to obviate "hunting". A rotary transformer of suitable input voltage rating and giving 400 - 430 volts H.T. for the receiver forms part of the power unit.

129. The rotary transformer is fitted with filters both at the input to the motor and at the output of the generator (see fig.2). The condenser C74 and the choke L22 forms a filter unit, type 110; the condenser C73 and the choke L21 form a unit of the same type. Two other filter units, type 111, consist of C58, L20 and C61, L19 respectively. C60 acts as a low impedance return between H.T.+ and H.T.- for all pulse frequency currents and ripple. R76 is the bias resistance referred to in para.85, C63 is its smoothing condenser. In accordance with British practice the L.T. supply lines are insulated from the airframe but the L.T. negative is made earthy by means of the leak resistance R62 with C41 in parallel.

130. The current consumption of the equipment at 12 or 24 volts is 11 or 6 amps., respectively, of this 4.5 or 2 amps are taken by the heater and relay circuits and 6.5 or 4 amps by the rotary transformer which runs at 47 per cent efficiency, the total H.T. current being 60 milliamps.

SERVICING

131. The following apparatus is used for carrying out tests on the equipment when removed from the aircraft:-

(i) Testmeter, type F (Avometer, Model 7), or testmeter, type D (Avometer, Model 40)

(ii) Wavemeter, type W1310 or W.1432

(iii) Test set, type 74.

(iv) Test set, type 163.

Note.- Test set, type 163 is described in C.D.0850E. It is designed to give the following facilities:-

(a) A C.R.T. oscilloscope with two trace speeds of 70 µS and 700 µS.

(b) A negative going pulse at the commencement of the trace for triggering the I.F.F. receiver pulse amplifier.

(c) A positive going pulse for triggering a signal generator.

(d) Two positive pulses, 20/uS and 300/uS for suppression of the I.F.F. receiver.

(e) An R.F. oscillator tripped by the trailing edges of (d) for producing interfering signals.

(f) Dummy load and R.F. rectifier for viewing the output of the I.F.F. sender.

INITIAL SURVEY

132. When an I.F.F. set is in for repair, the following questions will help to locate the fault.

(i) Is the L.T. input of correct voltage and polarity?

(ii) Is the regulated L.T. of the correct voltage?

(iii) Is the H.T. voltage correct?

(iv) Is the receiver portion working? e.g. Is the set insensitive or noisy; can signals be heard in the headset?

(v) Is the sender portion working? With a pulse applied to the P.A. grid (V8) is the sender valve triggered? (see para.131 Note (b)). If not, will a pulse at the cathode follower grid (V9) trip it?

FAULT-FINDING TABLE.

133. The table of test voltages given in para.134 and in the oscillograms in figs.32 and 33, should be referred to when making the tests below. Some of the test points given below are shown in fig.30 which is a view of the underside of the top chassis.

Sympton	Probable fault	Treatment
(i) Incorrect regulated voltage.	C.P.R.	Adjust C.P.R. (see para. 81) Check R70 and R64.
(ii) Incorrect or zero H.T. voltage.	L.T. input reversed; L.T. volts low; or H.T. switches faulty.	Check as (i) above. Measure volts at generator and at L4. If no volts at L4, check action of S1, S2, continuity through SK3 and SK4, continuity of L21 and L22.
(iii) No sound in headset.	L.T. reversed; receiver insensitive on both bands; (no A.G.S. volts)	Check voltages at test points M.N. and O. these should be in accord with para.134. If much different change V13, V10, V12 and V8. Check quench voltage at L8 (test point E), if lower than 6 volts peak change V4.

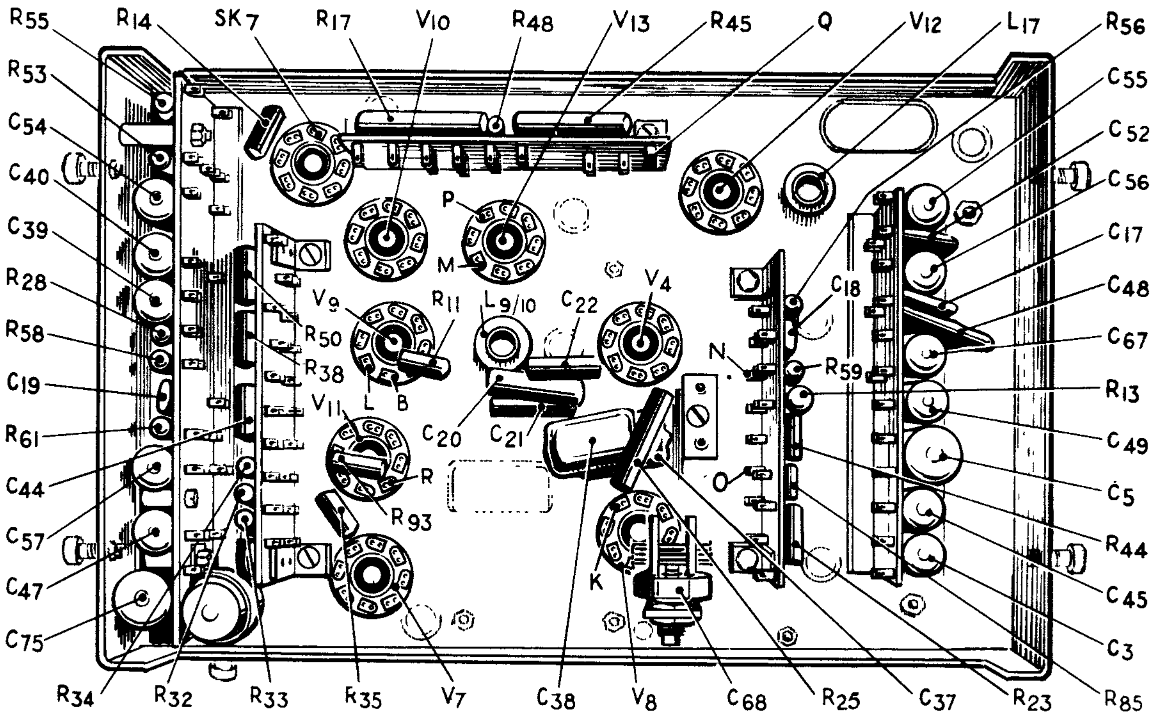


FIG. 30 UNDERSIDE OF TOP CHASSIS

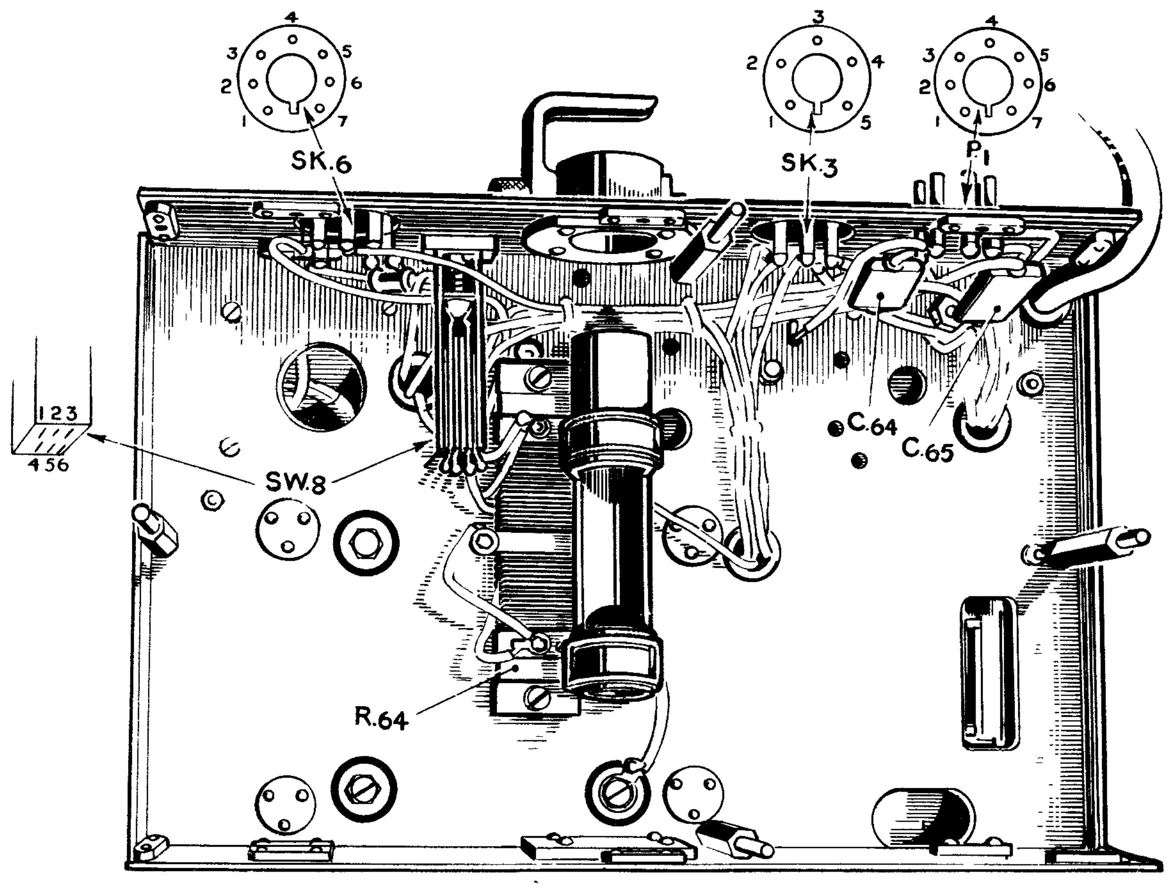


FIG. 31 UNDERSIDE OF LOWER CHASSIS

Symptom	Probable fault	Treatment
(iv) Triggering at one end of A band only.	Condenser drive loose; Condenser push rod jamming.	Tighten draw bolt on condenser spindle. Straighten bent rod, move collar on cam shaft outwards to reduce friction between rod and cam.
(v) Double pulsing at ends of A band or two responses every 3 secs.	No fly-back suppression on band sweeping.	Slacken sweep cam and refix so that fly back occurs coincident with the movement of the bakelite switch cams. Slow running can be obtained with reduced L.T.
(vi) Squittering or screeching all over either band. Set very noisy, i.e. super-sensitive.	A.G.S. not working. Switches S1, S2 and S3 arcing.	Measure voltages at test points M.N.O and P. Change valves V13, V10, V12 and V8. Check that S1, S2 and S3 are closing properly.
(vii) No output on A band.	Faulty sender valve. Damaged uniradio 32 aerial feeder inside set.	Change V1. Replace with feeder having exactly the same length.
(viii) No output on GR band.	Faulty R.F. valve. Damaged feeder inside set.	Change V6. Replace with feeder having exactly the same length.
(ix) No output on either band.	Faulty P.A. or C.F. valves. Damaged resistance R76(R92).	Apply negative trigger pulse at grid of V8. Check waveforms against fig.31, change V8 or V9. Measure voltages between H.T. - and L.T. (i.e. across R76 see fig.15). Renew R76.
(x) Low output power with or without bad pulse shape.	Faulty sender valve	Change V1 or V6.
(xi) Bad pulse shape.	Weak R.F. oscillations, or weak drive. High impedance suppression input.	Check waveforms, change valve at which distortion first seen. Clean short-circuiting spring trigger on P4.
(xii) Pulses all wide or all narrow.	Coding relay A stuck.	Check movement of blades, check continuity of relay coil, check continuity through SK3, SK4 and S7. Check movement of S4.
(xiii) Narrow pulse too narrow.	Insufficient charging current for C39.	Check waveforms, change V1, V9 or V8.

Symptom	Probable fault	Treatment
(xiv) Pulses all very wide.	Coding relay B stuck down.	Check movement of blades, check no voltage between poles 5 and 1 on P1.
(xv) No distress pulses.	Coding relay B stuck open.	Check movement of blades, check continuity of relay coil, check voltage across coil when external switch S6 is closed. Check continuity through SK2.
(xvi) GR band not working although A band working correctly.	Faulty connection of P8 and SK7.	Examine connection of plug and socket, clean pins if necessary.
(xvii) Interference with associated Radar equipment.	No suppression. Self-triggering on recovery from suppression.	Check feeder between plug and valves. Check waveforms, change V10, V7 or V11 according to where distortion occurs. Check voltages at test points D, E, I, J, N, and O.
(xviii) No A to G switching.	Bad connection in control circuit.	Open up pins of P7 and clean if necessary.
	Open-circuited coil of Relay C.	Measure resistance between pin 1 on SK6 and L.T. Should be approximately 250 ohms.
	Faulty switch S9	Check contacts making and breaking; check switch rollers following cam profile.
(xix) Very short, prolonged, or no A to G switching.	Distorted contact strip on Relay C	Remove adjusting screw, end bracket and phosphor-bronze spring bow, straighten by stroking and replace. Carefully adjust screw until spring-bow presses against bi-metal strip, and will spring across when latter is deflected a little less than 1/32 in.
(xx) Permanent A to G switching.	External connections or open circuited heater on Relay C.	On G AUTO measure voltage between pin 6 on SK6 and L.T. - If full L.T. voltage present suspect open circuited heater R75 (or R87), disconnect Relay and measure. If no L.T. check continuity of external control circuit.

TEST VOLTAGES

134. The following table of test voltages was taken from typical receivers with no signal input. Some voltages will vary slightly during the sweeping of the frequency range. The tests were made with a testmeter, type F and the voltages given should be regarded as approximate to allow for differences in some receivers.

Test	Pins linked on SK6	Test Point	Range on Testmeter	R3121 (Volts)	R3120 (Volts)
Rotary transformer Input	4 & 7	A	100	22½	12
H,T. volts L.T.- to H.T.+	"	B	1000	430	380
H.T.+ to H.T.-	"	B	1000	460	410
Bias volts across R76	"	R76	100	28	32
Heaters			10	(V1 =6.8, (V2 =6.15 (V3 =6.8, (V4 =6.1, (V5 =5.6, (V6 =6.1, (V7 =5.6, (V8 =3.8, (V9 =4, (V10=6.1, (V11=5.9, (V12=3.5, (V13=3.3	(V1 =6.6, (V2 =5.8, (V3 =6.65, (V4 = 6.2, (V5 =5.8, (V6 =6.3, (V7 =5.75, (V8 =3.8, (V9 =3.7, (V10=5.75, (V11=5.85, (V12=3.4, (V13=3.3.
H.T. to A Band (Dead end of L4 and L.T.-)	4 & 7	C	1000	420	375
Cathode A Rec. V3 (Dead end L7 and L.T.-)	"	D	1000	180	150
Cathode V1 (Dead end L2 to L.T.-)	"	F	400	22	21
H.T. to GR unit (Dead end L12 to L.T.-)	2 & 7	H	1000	395	360
Cathode V6 (L15 to L.T.-)	"	I	1000	70	55
Grid V6 (L16 to L.T.-)	"	J	1000	60	14½
V6 grid to cathode	2 & 7	R	1000	22	
Anode of V8 to L.T.-	4 & 7	K	1000	210	170
Cathode of V9 to H.T.-	"	L	400	15	8.5
Anode V13 to L.T.-	"	M	1000	200	260
Cathode of V13 to L.T.-		P	1000	4.5	4.5
Anode of V12 to L.T.-		Q	1000	170	150
Anode of V11 to L.T.-		R	1000	220	175

Notes.- For test points see appropriate illustrations. The pins on socket SK6 referred to in Column 2 are to be connected by a conductor before making the test. Other types of testmeter may be used when making the above tests, but it should be remembered that the resistance of different meters will have an effect on the readings. The highest possible range should be used always.

APPENDIX I
NOMENCLATURE OF PARTS

The following list of principal parts is issued for information only. In ordering spares the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature	Qty.	Circuit Ref.	Remarks
	ITEMS COMMON TO ALL INSTALLATIONS			
10BB/1617	Aerial Aircraft, type 133	1		High speed to fit on skin of aircraft.
10BB/879	Aerial Aircraft, type 93	1		
10BB/867	Aerial Aircraft, type 90	1		
10LB/137	Control unit assembly, type 1	1		
	Comprising:-			
10LB/90	Control unit, type 89	1		Coding
	Consisting of:-			
10H/253	Socket, type 104	1	SK4	5 pole
10FB/468	Switch, type 891	1	S7	Rotary, 3 wafer;
10AB/1629	Knob, type 179	1		
10LB/91	Control unit, type 90	1		Switching
	Consisting of:-			
10H/255	Plug, type 173	1	P5	7-way
10H/13078	Plug, type 456	1	P6	5-way
10H/9586	Ring, clicking	1		For use with sockets, type 401.
	Control unit assembly, type 1			
10H/13137	Socket, type 401	1	J1	
10H/257	Socket, type 106	1	SK2	7-way
5C/543	Switch box, general purposes. type B, 1 unit	1	S5	S.P. ON-OFF
10FB/372	Switch, type 766	1	S6	5 amp.
10AB/949	Mounting plate, type 158	1		

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10H/14059	Connector, type 510/1	1		
10DB/569	RECEIVERS, TYPE R.3120			12 volts
	Consisting of:-			
10C/12574	Condensers, Type 4018	3	C34, C41 C.46.	1.0 µF., ± 15% 250V D.C. wkg. Terminals, tin case.
10AB/3915	Covers, Type 375	1		For Receiver.
10AB/778	Covers, Type 85	1		For Power Unit
10C/794	Condensers, Type 845	1	C.48	.006 µF., ± 15%, 2250V D.C. test, silvered mica, waxed, wire ends.
10C/5786	Condensers, Type 3173	1	C.37	.003 µF., ± 15%, 2250V D.C. test, silvered mica, waxed wire ends.
10C/793	Condensers, Type 844	1	C.21	.001 µF., ± 15%, 2250V D.C. test silvered mica, waxed wire ends.
105C/5802	Condensers, Type 3189	1	C.20	300 µµF., ± 10%, 2250V D.C. test silvered mica, waxed wire ends.
10C/4991	Condensers, Type 2681	1	C.22	200 µµF., ± 10%, 350V D.C. wkg., silver mica, waxed wire ends.
10C/13149	Condensers, Type 4231	1	C.68	3.3 µµF.,-15 µµF., 4 moving 5 fixed vanes, spindle .25" dia. x 3/16" long. S.D. slot.
10C/12995	Condenser Units, Type 119			
	Fitted with:-			
10C/12398	1 Condenser, Type 3919	-	C.3	.15 µF., ± 10%, 350V D.C. wkg. paper, tubular.
10C/11126	1 Condenser, Type 3362	-	C.45	.1 µF., ± 20%, 350V D.C. wkg. paper, tubular.
10C/11128	1 Condenser, Type 3364	-	C.5	.25 µF., ± 20%, 350V D.C. wkg., paper, tubular.
10C/11123	1 Condenser, Type 3359		C.67	.01 µF., ± 25%, 1000V D.C. wkg. paper, tubular.

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/794	1 Condenser, type 845	-	C.48	.006 µF., ± 15%, 750V D.C. wkg., silvered mica, waxed wire ends.
10C/11125	2 Condensers, Type 3361	-	C.55 C.56	.05 µF., ± 20%, 500V D.C. wkg., paper, tubular.
10C/11124	1 Condenser, Type 3360	-	C.49	.02 µF., ± 20%, 750V D.C. wkg., paper, tubular.
10C/3443	1 Condenser, Type 1694	-	C.17	.002 µF., ± 15%, 750V D.C. wkg., silvered mica, waxed wire ends.
10C/11099	1 Condenser, Type 3353	-	C.52	500 µµF., ± 10%, 750V D.C. wkg., silvered mica, waxed wire ends.
10A/13092	Caps, Valves, Type 16.	1		Brass silver plated grid clip looped 11/32" x 5/16" for .358" top cap.
10A/13025	Caps, Valve, Type 13	6		Top cap valve with semi-circ. spring.
10A/13280	Caps, Valve, Type 22. or	4		Spring Brass Grid cup, mounted in tropical grade bakelite plate 1-¼" x 1".
10A/14470	Caps, Valve, Type 53	4		Anode cap mtg.on S.R.B.P. 1-3/16" x 1" x 1/16" tk.with soldering tags 9 m/m top cap.
10H/491	Holders, Valve, Type 72	4		British Octal, moulded with metal insert.
10H/493	Holders, Valve, Type 73.	5		International Octal, moulded with metal insert.
10C/893	Inductance, Type 66.	1	L.9 L.10	Quench,1550 µH.300 turns of No.39 D.S.C.
10C/13147	Inductance, Type 907	1	L.17	A.G.S. Coil 195 turns of No.39 D.S.C.
10VB/92	Oscillator Units, Type 131	1		
	<u>Consisting of</u>:-			
10C/4476	Condensers, Type 2303	1	C.2	10 µµF.± 1 µµF. 2250V D.C. test, silvered mica, waxed wire ends.

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/12450	Condensers, Type 3948	2	C.33 C.69	3 µµF.± 15%, 2250V D.C. test, silvered mica, waxed wire ends.
10C/4479	Condensers, Type 2305	1	C.8	25 µµF. ± 10% 2250V D.C. test silvered mica, waxed wire ends.
10C/4481	Condensers, Type 2307	8	C.4, C.6 C.7, C.11 C.13, C.14 C15 C.16	50 µµF.± 10%, 2250V D.C. test silvered mica, waxed wire ends.
10C/5741	Chokes, H.F. Type 332	6		22 turns of No.30 SWG wire on 5/16" dia.ins. Rod.
10H/150	Holders Valve, Type 40	1		Diode
10H/493	Holders Valve, Type 73	1		International Octal Moulded metal plate insert.
10C/14613	Inductance, Type 1175	1		No.10 SWG. x 1 turn.
10H/528	Plug, Type 229	1		Marked Green 1 point R.A. entry.
10H/13464	Plug, Type 488	1		8 pin with central location spigot moulded.
10A/17845	Retainers Valve, Type 199	1		Spun glass cord harness 5/8" long, 2 springs each 3/8" long.
10C/1342	Resistance, Type 1342	1	R.15	220 ohms ± 10%, ¼ watt carbon rod.
10W/15976	Resistance, Type 4653	1	R.86	18 ohms ± 5%, wire wound 3 watt
10VB/126	Tuning Arm Unit	1		Flat Plate ½" wide x 5" long with elongated slot with spindle at one end 3/16" dia. x 2½" long.
10VB/97	Trimmer Assembly	1		Bakelised moulded ⅞" x 1¼" x ½".Marked Green.
	Fitted with:-			
10C	1 Condenser, Type 3947	-	C.30	2 µµF - 9 µµF. Variable
10VB/98	Trimmer Assembly	1		Bakelised moulded ⅞" x 1¼" x ½".Marked Red

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
	<u>Fitted with:-</u>			
10C/12449	1 Condenser, Type 3947	-	C.31	2 μμF - 9 μμF Variable.
10C/1008	1 Resistance, Type 1008		R.16	56000 ohms ± 10%, ¼ watt, carbon rod.
10VB/95	Oscillator Units, Type 137	1		This is Type 74 with modified resistance condenser unit. (12v)
10C/5741	Chokes, H.F., Type 332	6		22 turns of 30 S.W.G. wire on 5/16" dia.rod
10C/5980	Condensers, Type 3289	1		5 μμF. - 15 μμF. variable air.
10VB/70	Coil Units	1		Aerial Coil and Tuned Coil on bakelised holder.
10C/4476	Condensers, Type 2303	3	C.2, C.10 C.23.	10 μμF. ± 10%,2250V D.C. test, waxed end wires, silvered mica.
10C/4479	Condensers, Type 2305	3	C.18 C.12 C.32	25 μμF.± 10%,2250V D.C. test waxed end wires, silvered mica.
10C/4481	Condensers, Type 2307	8		50 μμF.± 10%,2250V D.C. test, waxed end wires, silvered mica.
10VB/71	Cranks	1		Insulated, for condenser.
10H/493	Holders Valve, Type 73	2		International octal. Moulded with metal plate insert
10H/150	Holders Valve, Type 40	1		Diode
10C/12994	Resistance-Condenser Units, Type 297.	1		Bakelised paper panel.
	<u>Fitted with:-</u>			
10C/5788	1-Condenser, Type 3175	-	C.66	100 μμF.± 10%,2250V D.C. test, waxed end wires, silvered mica.
10C/11691	2-Resistances, Type 525	-	R.42 R.43	100,000 ohms ± 10%, ½ watt carbon rod.
10C/27	1-Resistance, Type 544	-	R.47	10,000 ohms ± 10%, ½ watt carbon rod
10C/539	1-Resistance, Type 805	-	R.41	47,000 ohms,± 10%, ½ watt carbon rod
10A/11379	Resistance, Type 475	1	R.4	20,000 ohms,± 10%, ¼ watt, carbon rod

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10A/17845	Retainers, Valve, Type 199	1		(Diode) Spun glass cord harness $\frac{5}{8}$" LH 2 springs each $\frac{3}{8}$" LG
10KB/1146	Power Units, Type 356	1		12 volts
	Consisting of:-			
10C/793	Condensers, Type 844	2	–	1000 u uF. ± 15%, 2250V.D.C. test, waxed, wire ends, silvered mica.
10C/2922	Condensers, Type 1399	2		1 uF. ± 15%, 1000V.D.C. working, rectangular metal case.
10AB/1588	Covers, Type 157	1		For regulator power, $3\frac{1}{8}$" x $4\frac{3}{8}$" x $3\frac{7}{8}$" x .022" M.S.
10KB/1147	Motor Generator Unit, Type 4	1		12 volt.
	Consisting of:-			
10C/4481	Condensers, Type 2307	4		50 u uF. ± 10%, 2250V. D.C. test, silvered mica, waxed, wire ends.
10KB/565	Blowers, Air, Type 19	1		Centrifugal fan, within housing, for assembly on frame of rotary transformers type 46 and 47
	Fitted with:-			
10KB/574	1-Ring, Spring	-		Wire spring ring, for retaining filter cloth
10KB/558	Cams	1		Metal, condenser, operating cam
10KB/1150	Gear Box, Type 23	1		Supplied with primary worm (Ref. No.10KB/586) (loose in canvas bag.)
10KB/412	Rotary Transformer, Type 47	1		9 volt input
10FB/129	Filter Units, Type 110	2		HT Filter
10FB/130	Filter Units, Type 111	2		LT Filter
10FB/871	Switch Units, Type 152	1		Bracket, containing 4 units 3 of 3 make and break blades and 1 double make and break

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10FB/466	Switch Units, Type 103	1		Bracket, containing 1 unit of 3 make and break blades
34A/2	Grease, Yellow	As Reqd.		For gear Box.
10KB/1041	Collar	1		
	Fitted with:-			
10A/15269	Grub Screw	1		No.4 B.A. x 3/16"
10KB/1376	Cams	1		
10KB/1377	Drawbolt	1		
10FB/430	Regulators Power, Type 15	1		Carbon pile, supplied with ballast resistance 5U/1028 and diverter resistance 10C/7640
10C/9787	Resistance, Type 2998	1	R76	560 ohms ± 10%, 2 watt, carbon rod
10H/255	Plug, Type 173	1		7 pole
10H/253	Sockets, Type 104	1		5 pole
10H/257	Sockets, Type 106	1		7 pole
10DB/891	Link Assembly	1		Link between generator and condenser.
10DB/1152	Screw 14/10404	1		For Link Assembly
10KB/1042	Retainers, Plug	1		
10F/498	Switch, Type 447	1		Press Button Non-Locking 2 Make 2 Break
10FB/890	Relays, Magnetic, Type 607	1		250V.1 Break, 2 Make, 18 ohms.
10FB/463	Relays, Magnetic, Type 402	1	Relay A	2 make Unit, 250 ohms, coil.
10FB/464	Relays, Magnetic, Type 403	1	Relay B	4 make Unit, 250 ohms coil.
10C/13001	Resistance Condenser Unit, Type 303			
	Fitted with:-			
10C/5788	2 Condensers, Type 3175		C.18, C.36	100 µµF.± 10%, 2250V.D.C. silvered mica, waxed wire ends

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks.
10C/1592	2 Resistances, Type 1592		R23 R60	150,000 ohms, ± 10%, ½ watt, carbon rod.
10C/11691	3 Resistances, Type 525		R36, R44,R57	100,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1653	1 Resistance, Type 1653		R46	220 ohms, ± 10%, ½ watt, carbon rod.
10C/539	2 Resistances, Type 805		R12,R59	47,000 ohms, ± 10%, ½ watt, carbon rod.
10C/589	1 Resistance, Type 827		R56	270,000 ohms, ± 10% ½ watt, carbon rod.
10C/29	Resistance, Type 546	1	R10	82,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1812	Resistance, Type 1812	1	R13	47,000 ohms, ± 10%, 1 watt, carbon rod.
10C/12997	Resistance Condenser Unit, Type 299.	1		
	Fitted with:-			
10C/4481	2 Condensers, Type 2307		C50, C53	50 µµF., ± 10%, 2250V.D.C. test, silvered mica, waxed wire ends.
10C/5787	1 Condenser, Type 3174		C51	150 µµF., ± 10%, 2250V D.C. test, silvered mica, waxed wire ends.
10C/1812	1 Resistance, Type 1812		R45	47,000 ohms, ± 10%, 1 watt, carbon rod.
10C/7316	1 Resistance, Type 30		R17	100,000 ohms, ± 10%, 1 watt, carbon rod.
10C/11691	1 Resistance, Type 525		R48	100,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1592	1 Resistance, Type 1592		R49	150,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1482	1 Resistance, Type 1482		R19	27,000 ohms, ± 10%, ½ watt, carbon rod.
10C/991	1 Resistance, Type 991		R18	6,800 ohms, ± 10%, ½ watt, carbon rod.
10C/12998	Resistance Condenser Unit, Type 300	1		
	Fitted with:-			
10C/5788	1 Condenser, Type 3175		C44	100 µµF., ± 10%, 2250V D.C. test, silvered mica, waxed wire ends.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/11270	1 Condenser, Type 3435		C43	.002 μF., $\pm$ 10%, 750V D.C. wkg., silvered mica, waxed wire ends.
10C/11691	2 Resistances, Type 525		R50, R51	100,000 ohms, $\pm$ 10%, $\frac{1}{2}$ watt, Carbon rod.
10C/27	3 Resistances, Type 544		R29,R32 R38	10,000 ohms $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/300	2 Resistances, Type 726		R33	33,000 ohms $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/752	1 Resistance, Type 890		R39	180,000 ohms $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod
10C/6321	1 Resistance, Type 6321		R34	68,000 ohms, $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/1592	1 Resistance, Type 1592		R37	150,000 ohms, $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/1482	1 Resistance, Type 1482		R26	27,000 ohms, $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/12999	Resistance Condenser Unit, Type 301.	1		
	<u>Fitted with:-</u>			
10C/11123	2 Condensers, Type 3359		C54 C40	.01 μF., $\pm$ 25%, 1000V D.C. wkg., paper, tubular.
10C/11135	1 Condenser, Type 3371		C39	.005 μF., $\pm$ 10%, 1000V D.C. wkg., paper, tubular.
10C/12398	1 Condenser, Type 3919		C57	.15 μF., $\pm$ 10%, 350V D.C. wkg., paper, tubular.
10C/11126	1 Condenser, Type 3362		C47	.10 μF., $\pm$ 20%, 350V D.C. wkg., paper, tubular.
10C/11128	1 Condenser, Type 3364		C42	.25 μF., $\pm$ 20%, 350V D.C. wkg. paper, tubular.
10C/5788	1 Condenser, Type 3175		C19	100 $\mu\mu$F., $\pm$ 10%, 2250V D.C. test, silvered mica, waxed wire ends.
10C/7316	1 Resistance, Type 30		R55	100,000 ohms, $\pm$ 10%, 1 watt, carbon rod.
10C/11691	2 Resistances, Type 525		R53 R54	100,000 ohms, $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks.
10C/300	1 Resistance, Type 726		R28	33,000 ohms, ± 10%, ½ watt, carbon rod.
10C/27	1 Resistance, Type 544		R31	10,000 ohms ± 10%, ½ watt, carbon rod.
10C/589	1 Resistance, Type 827		R58	270,000 ohms ± 10%, ½ watt, carbon rod.
10C/1592	1 Resistance, Type 1592		R61	150,000 ohms, ± 10%, ½ watt, carbon rod.
10C/577	1 Resistance, Type 824		R40	470,000 ohms ± 10%, ½ watt, carbon rod.
10C/13002	Resistance Condenser Units Type 304.			
	Fitted with:-			
10C/12070	1 Condenser, Type 3743		C35	5 $\mu\mu$F., ± 1 $\mu\mu$F., 350V D.C. wkg., silvered mica, waxed wire ends.
10C/15388	1 Resistance, Type 4097		R74	2.0 ohms, ± 5%, 3 watt.
10C/27	1 Resistance, Type 544		R7	10,000 ohms, ± 10%, ½ watt.
10C/1744	1 Resistance, Type 1744		R9	5600 ohms, ± 10%, ½ watt.
10C/6006	3 Resistances, Type 6006		R1, R2, R24.	15,000 ohms, ± 10%, 2 watt.
10C/11691	1 Resistance, Type 525		R5	100,000 ohms, ± 10%, ½ watt.
10C/1614	1 Resistance, Type 1614		R21	22,000 ohms, ± 10%, ½ watt.
10C/539	2 Resistances, Type 805		R6,R20,	47,000 ohms, ± 10%, ½ watt.
10C/11678	1 Resistance, Type 512		R3	1000 ohms, ± 10%, ½ watt.
10C/753	1 Resistance, Type 891		R8	4,700 ohms, ± 10%, ½ watt
10C/27	Resistances, Type 544	2	R14 R15	10,000 ohms ± 10%, ½ watt.
10C/813	Resistance, Type 919	1	R25	10,000 ohms, ± 10%, 1 watt.
10C/11678	Resistance, Type 512	2	R27,R52	1000 ohms, ± 10%, ½ watt

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/15206	Resistance, Type 3915	1	R71,R72 R73	2.1 ohms, ± 5% tapped at .55 ohms ± 10%, .940 ohms ± 5% wire wound vitreous enamelled.
10C/1342	Resistances, Type 1342	2		220 ohms, ± 10%, ¼ watt.
10C/577	Resistance, Type 824	1		470,000 ohms, ± 10%, ½ watt, carbon rod.
10DB/1151	Screws	20		For covers
10A/12239	Retainers, Valve, Type 4	1		For quench valve screen
10C/11691	Resistance, Type 525	3	R11,R35, R62	100,000 ohms, ± 10%, ½ watt
10AB/1626	Screens, Type 55	1		Quench valve cover alum., cylindrical 2 sections.
10DB/1580	Bracket Assembly	1		
	Fitted with:-			
10H/528	1 Plug, Type 229			
10H/18197	1 Plug, Type 655.			Type 229 modified with milled slot in top nut.
10AB/4582	1 Springs, Tension, Type 81			7-¼ turns of No.19 S.W.G. st. wire close wound.
10H/5374	Connector, Type 2212	1		10" long. Fitted with 1 Socket Ref. No.10H/702 1 Socket Ref. No.10H/2439
10E/348	Valves, 6J5G. or	2		
10E/11448	Valves, V.R.67.	2		Specn.DCD.WT.1022
10E/392	Valves, VR.135	3		Specn.DCD.WT.1228
10E/105	Valves, VR.92	2		Specn.DCD.WT.1117
10E/149	Valves, VR.65A	4		Specn.DCD.WT.1131
10E/11400	Valves, VR.54	2		Specn.DCD.WT.1005
10DB/570	RECEIVERS.TYPE R.3121			24 volts
	Consisting of:-			
10C/12574	Condensers, Type 4018	3	C34,C41 C46	1.0 uF., ± 15%, 250V. D.C.wkg. terminals tin case.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks
10AB/3915	Covers, Type 375	1		For Receiver
10AB/778	Covers, Type 85	1		For Power Unit
10C/794	Condenser, Type 845	1	C38	.006 μF. ± 15%, 2250V D.C. test, silvered mica, waxed wire ends
10C/5786	Condenser, Type 3173	1	C37	.003 μF., ± 15%, 2250V D.C. test, silvered mica, waxed wire ends.
10C/793	Condenser, Type 844	1	C21	.001 μF. ± 15%, 2250V.D.C. test, silvered mica, waxed wire ends.
10C/5802	Condenser, Type 3189	1	C20	300 μμF. ± 10%, 2250V D.C. test, silvered mica, waxed wire ends
10C/4991	Condenser, Type 2681	1	C22	200 μμF. ± 10%, 350V D.C. wkg silvered mica, waxed wire ends
10C/13149	Condenser, Type 4231	1		3.3 μμF.-15 μμF. 4 moving, 5 fixed vanes spindle. 25" dia.x 3/16" 1 g.variable air S.D. slot.
10C/12995	Condenser Units, Type 119			
	Fitted with:-			
10C/12398	1 Condenser, Type 3919	-	C3	.15 μF. ± 10%, 350V D.C. wkg., paper, tubular.
10C/11126	1 Condenser Type 3362	-	C45	.1 μF. ± 20%, 250V. D.C. wkg., paper, tubular.
10C/11128	1 Condenser, Type 3364	-	C5	.25 μF., ± 20%, 350V D.C. wkg., paper, tubular.
10C/11123	1 Condenser, Type 3359		C67	.01 μF., ± 25%, 100V D.C. wkg., paper, tubular.
10C/794	1 Condenser, Type 845	-	C48	.006 μF., ± 15%, 750V D.C. wkg. silvered mica, waxed wire ends.
10C/11125	2 Condensers. Type 3361	-	C55 C56	.05 μF., ± 20%, 500V D.C. wkg., paper, tubular.
10C/11124	1 Condenser, Type 3360	-	C49	.02 μF., ± 20%, 750V D.C. wkg. paper, tubular

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks.
10C/3443	1 Condenser, Type 1694	-	C17	.002 μF., ± 15%, 750V D.C. wkg. silvered mica, waxed wire ends.
10C/11099	1 Condenser, Type 3353	-	C52	500 $\mu\mu$F., ± 10%, 750V D.C. wkg. silvered mica, waxed wire ends.
10A/13092	Caps, Valve, Type 16	1		Brass S.P1. Grid clip looped 11/32" x 5/16" for .358" top cap.
10A/13025	Caps, Valve, Type 13	6		Top cap valve with Semi-circ. spring.
10A/13280	Caps, Valve, Type 22	4		Spring brass grid clip mounted in tropical grade BAK
10A/14470	Caps, Valve, Type 53	4		Anode cap mounting on SRBP 13/16" x 1" x 1/16" d. with soldering tags 9 m/m top cap
10H/491	Holders, Valve, Type 72	4		British octal moulded with metal insert
10H/493	Holders, Valve, Type 73	5		International octal, moulded with metal insert.
10C/893	Inductance, Type 66	1	L9 L10	Quench 1550 μH. 300 turns of No.39 D.S.C.
10C/13147	Inductance, Type 907	1	L17	A.G.S. coil 195 turns of No.39 D.S.C.
10VB/92	Oscillator Units, Type 131	1		
	<u>Consisting of</u>:-			
10C/4476	Condensers, Type 2303	1	C2	10 $\mu\mu$F. ± 1 $\mu\mu$F. 2250V D.C. test, silvered mica, waxed wire ends.
10C/12450	Condensers, Type 3948	2	C69 C33	3 $\mu\mu$F. 15%, 2250V D.C. test, silvered mica, waxed wire ends.
10C/4479	Condensers, Type 2305	1	C8	25 $\mu\mu$F., 10%, 2250V D.C. test silvered mica, waxed wire ends
10C/4481	Condensers, Type 2307		C4, C10, C7, C11 C13, C14 C15, C16.	50 $\mu\mu$F., ± 10%, 2250V D.C. test, silvered mica, waxed wire ends

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/5741	Chokes, H.F. Type 332	6		22 turns of No.30 SWG wire on 5/16" dia ins. Rod.
10H/150	Holders Valve, Type 40	1		Diode
10H/493	Holders Valve, Type 73	1		International Octal Moulded metal plate insert.
10C/14613	Inductance, Type 1175	1		No.10 SWG.x 1 turn
10H/528	Plug, Type 229	1		Marked Green 1 point R.A. entry.
10H/13464	Plug, Type 488	1		8 pin with central location spigot moulded
10A/17845	Retainers, Valve, Type 199	1		Spun glass cord harness $\frac{5}{8}$" long, 2 springs each $\frac{3}{8}$" long.
10C/1342	Resistance, Type 1342	1	R15	220 ohms $\pm$ 10%, $\frac{1}{4}$ watt carbon rod.
10W/15976	Resistance, Type 4653	1	R86	18 ohms $\pm$ 5%, wire wound 3 watt.
10VB/126	Tuning Arm Unit	1		Flat Plate $\frac{1}{2}$" wide x 5" long with elongated slot with spindle at one end 3/16" dia. x $2\frac{1}{2}$" long.
10VB/97	Trimmer Assembly	1		Bakelised moulded $\frac{7}{8}$" x $1\frac{1}{4}$" x $\frac{1}{2}$" Marked Green
	Fitted with:-			
10C	1 Condenser, Type 3947	-	C30	2 $\mu\mu$F. - 9 $\mu\mu$F. Variable
10VB/98	Trimmer Assembly	1		Bakelised moulded $\frac{7}{8}$" x $1\frac{1}{4}$" x $\frac{1}{2}$". Marked Red.
	Fitted with:-			
10C/12449	1 Condenser, Type 3947	-	C31	2 $\mu\mu$F. - 9 $\mu\mu$F Variable
10C/1008	1 Resistance, Type 1008		R16	56000 ohms $\pm$ 10%, $\frac{1}{4}$ watt, carbon rod.
10VB/96	Oscillator Units, Type 138	1		This is type 98 with modified resistance condenser unit.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks.
10C/5741	Chokes, H.F. Type 332	6		22 turns of 30 SWG. wire on 5/16" dia. rod.
10C/5980	Condensers, Type 3289	1	C9	5 $\mu\mu$F. - 15 $\mu\mu$F. variable, air. Spindle 3/16" dia. x 1.0" long, 6 moving 6 fixed vanes
10VB/70	Coil, Units	1		Aerial coil and tuned coil on bakelised holder.
10C/4476	Condensers, Type 2303	3	C2, C10, C23	10 $\mu\mu$F $\pm$ 10%, 2250V D.C. test, waxed end wires, silvered mica.
10C/4479	Condensers, Type 2305	3	C18, C12 C32	25 $\mu\mu$F. $\pm$ 10%, 2250V D.C. test, waxed end wires, silvered mica.
10C/4481	Condensers, Type 2307	2	C6, C7	50 $\mu\mu$F., $\pm$ 10%, 2250V D.C. test, waxed and wires, silvered mica.
10VB/71	Cranks	1		Insulated, for condenser
10H/493	Holders, Valve, Type 73	2		International octal, Moulded with metal plate insert.
10H/150	Holders, Valve, Type 40	1		Diode
10C/12994	Resistance Condenser Units, Type 297	1		Bakelised paper panel.
	Fitted with:-			
10C/5788	1 Condenser, Type 3175	-	C66	100 $\mu\mu$F., $\pm$ 10%, 2250V D.C. test, waxed, end wires, silvered mica.
10C/11691	2 Resistances, Type 525	-	R42, R43	100,000 ohms $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/27	1 Resistance, Type 544	-	R47	10,000 ohms $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/539	1 Resistance, Type 805	-	R41	47,000 ohms, $\pm$ 10%, $\frac{1}{2}$ watt, carbon rod.
10C/11379	Resistance, Type 475	1	R4	20,000 ohms, $\pm$ $\frac{1}{4}$ watt, carbon rod.
10A/17845	Retainers, Valve, Type 199	1		Spun glass cord harness $\frac{5}{8}$" long 2 springs each $\frac{3}{8}$" long.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks
10KB/1148	Power Units, Type 357			24 volts
	Consisting of:-			
10C/793	Condensers, Type 844	2	C64, C65	1000 $\mu\mu$F., ± 15%, 2250V D.C. Test.
10C/2922	Condensers, Type 1399	2	C60, C63	1 μF., ± 10%, 1000V D.C. wkg., rectangular metal case.
10AB/1588	Covers, Type 157	1		For regulator power, type 16 $3\frac{1}{8}$" x $4\frac{3}{8}$" x $3\frac{7}{8}$" .022 M.S.
10KB/1149	Motor Generator Units, Type 5.	1		24 volts.
	Consisting of:-			
10C/4481	Condensers, Type 2307	4		50 $\mu\mu$F. ± 10%, 2250V D.C. test, silver mica, waxed, wire ends.
10KB/565	Blowers, Air, Type 19	1		Centrifugal fan, within housing for assembly on frame of rotary transformer type 46 and 47.
	Fitted with:-			
10KB/574	1 Rings, Spring	-		Wire spring ring, for retaining filter cloth.
10KB/558	Cams	1		Metal, Condenser, operating cam.
10KB/1150	Gear Box, Type 23	1		Supplied with primary worm (Ref.No. 10KB/586) (Loose in canvas bag) Drg.14/1.0048.
10KB/409	Rotary Transformer, Type 46.	1		18 volts, input.
10PB/129	Filter Units, Type 110	2		H.T.Filter
10PB/130	Filter Units, Type 111	2		L.T.Filter
10FB/871	Switch Units, Type 152	1		Bracket containing 4 units 3 of 3 make and break blades and 1 double make and break.
10FB/466	Switch Units, Type 103	1		Bracket, containing 1 unit of 3 make and break blades.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks
34A/2	Grease Yellow	As Reqd.		For gear box.
10KB/1041	Collar	1		
	Fitted with:-			
10A/15269	1 Screw, Grub	-		No.4 B.A. x 3/16" approx.
10KB/1376	Cams	1		
10KB/1377	Drawbolt	1		
10FB/431	Regulators, Power, Type 16	1	R81 R87	Carbon pile, supplied with ballast resistance, 5U/1015 and diverter resistance 10C/7641.
10C/9788	Resistance, Type 2999	1	R92	680 ohms, ± 10%, 2 watt, carbon rod.
10C/6412	Resistance, Type 6412	1	R80	47 ohms, ± 10%, ½ watt, carbon rod.
10H/255	Plug, Type 173	1		7 pole
10H/253	Sockets, type 104	1		5 pole
10H/257	Sockets, Type 106	1		7 pole
10DB/891	Link Assembly	1		Link between Gen. and Condenser.
10DB/1152	Screw, 14/10404	1		For link assembly
10KB/1042	Retainers, Plug	1		
10F/498	Switch, Type 447	1		Press button non-locking 2 make, 2 break.
10FB/891	Relay, Magnetic, Type 608	1		250 V.1 break 2 make 72 ohms.
10FB/463	Relays Magnetic, Type 402	1		2 make unit, 250 ohms coil.
10FB/464	Relays, Magnetic, Type 403	1		4 make unit, 250 ohms coil.
10C/12996	Resistance Condenser Units Type 298			
	Fitted with:-			
10C/5788	2-Condensers, Type 3175		C18 C36	100 μμF. ± 10%, 750V.D.C.wkg., silvered mica, waxed wire ends.

Ref. No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/1592	2-Resistances, Type 1592		R23 R60	150,000 ohms, ± 10%, ½ watt, carbon rod.
10C/11691	3 Resistances, Type 525		R36 R44,R57	100,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1653	1-Resistance, Type 1653		R46	220 ohms, ± 10%, ½ watt, carbon rod
10C/539	2-Resistances, Type 805		R12 R59	47,000 ohms, ± 10%, ½ watt, carbon rod.
10C/589	1-Resistance, Type 827		R56	270,000 ohms, ± 10%, ½ watt, carbon rod.
10C/7091	1-Resistance, Type 7091		R85	68 ohms, ± 10%, ½ watt, carbon rod.
10C/29	1-Resistance, Type 546		R10	82,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1812	1-Resistance, Type 1812		R13	47,000 ohms, ± 10%, 1 watt, carbon rod.
10C/12997	Resistance Condenser Units Type 299			
	<u>Fitted with:-</u>			
10C/4481	2 Condensers, Type 2307		C50 C53	50 $\mu\mu$F., ± 10%, 750V D.C. silvered mica, waxed wire ends.
10C/5787	1 Condenser, Type 3174		C51	150 $\mu\mu$F., ± 10%, 750V D.C. wkg, silvered mica, waxed wire ends.
10C/1812	1 Resistance, Type 1812		R45	47,000 ohms, ± 10%, 1 watt, carbon rod.
10C/7316	1 Resistance, Type 30		R17	100,000 ohms, ± 10%, 1 watt, carbon rod.
10C/11691	1 Resistance, Type 525		R48	100,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1592	1 Resistance, Type 1592		R49	150,000 ohms ± 10%, ½ watt, carbon rod.
10C/1482	1 Resistance, Type 1482		R19	27,000 ohms, ± 10%, ½ watt, carbon rod.
10C/991	1 Resistance, Type 991		R18	6,800 ohms, ± 10%, ½ watt, carbon rod.
10C/12998	Resistance Condenser Units Type 300	1		

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks.
	Fitted with:-			
10C/5788	1 Condenser, Type 3175		C44	100 μμF., ± 10%, 750V D.C. wkg silvered mica, waxed wire ends.
10C/11270	1 Condenser, Type 3435		C43	.002/uF., ± 10%, 750V D.C. wkg. silvered mica, waxed wire ends.
10C/11691	2 Resistances, Type 525		R50, R51	100,000 ohms ± 10%, ½ watt, carbon rod.
10C/27	3 Resistances, Type 544		R29, R32, R38	10,000 ohms, ± 10%, ½ watt, carbon rod.
10C/300	1 Resistance, Type 726		R33	33,000 ohms ± 10%, ½ watt, carbon rod.
10C/752	1 Resistance, Type 890		R39	180,000 ohms ± 10%, ½ watt, carbon rod.
10C/6321	1 Resistance, Type 6321		R34	68,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1592	1 Resistance, Type 1592		R37	150,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1482	1 Resistance, Type 1482		R26	27,000 ohms, ± 10%, ½ watt, carbon rod.
10C/12999	Resistance Condenser Units, Type 301			
	Fitted with:-			
10C/11123	2 Condensers, Type 3359		C54 C40	.01 μF., ± 25%, 1000V D.C. wkg., paper, tubular.
10C/11135	1 Condenser, Type 3371		C39	.005 μF., ± 10%, 100V D.C. wkg., paper, tubular.
10C/12398	1 Condenser, Type 3919		C57	.15 μF., ± 10%, 350V D.C. wkg., paper, tubular.
10C/11126	1 Condenser, Type 3362		C47	.10 μF., ± 20%, 350V D.C. wkg., paper, tubular.
10C/11128	1 Condenser, Type 3364		C42	.25 μF., ± 20%, 350V D.C. wkg., paper, tubular.
10C/5788	1 Condenser, Type 3175		C19	100 μμF., ± 10%, 750V D.C. wkg., test, silvered mica, waxed wire ends.

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/7316	1 Resistance, Type 30		R55	100,000 ohms, ± 10%, 1 watt, carbon rod.
10C/11691	2 Resistances, Type 525		R53 R54	100,000 ohms, ± 10%, ¼ watt, carbon rod.
10C/300	1 Resistance, Type 726		R28	33,000 ohms, ± 10%, ½ watt, carbon rod.
10C/27	1 Resistance, Type 544		R31	10,000 ohms, ± 10%, ½ watt, carbon rod.
10C/589	1 Resistance, Type 827		R58	270,000 ohms ± 10%, ½ watt, carbon rod.
10C/1592	1 Resistance, Type 1592		R41	150,000 ohms ± 10%, ½ watt, carbon rod.
10C/577	1 Resistance, Type 824		R40	470,000 ohms ± 10%, ½ watt, carbon rod.
10C/13000	Resistance Condenser Units, Type 302			
	Fitted with:-			
10C/12070	1-Condenser, Type 3743		C35	5 μμF. ± 1 μμF. 350V D.C.wkg., silver mica.
10C/15011	1-Resistance, Type 3720		R86	18 ohms, ± 5%, 1 watt, carbon rod.
10C/27	1-Resistance, Type 544		R7	10,000 ohms ± 10%, ½.watt, carbon rod.
10C/1744	1-Resistance, Type 1744		R9	5600 ohms, ± 10%, ½ watt, carbon rod.
10C/6006	3-Resistances, Type 6006		R1 R2,R24.	15,000 ohms, ± 10%, 2 watt, carbon.
10C/11691	1-Resistance, Type 525		R5	100,000 ohms, ± 10%, ½ watt, carbon rod.
10C/1614	1-Resistance, Type 1614		R51	22,000 ohms, ± 10%, ½ watt carbon rod.
10C/539	2-Resistances, Type 805		R6,R30	47,000 ohms, ± 10%, ½ watt, carbon rod.
10C/11678	1-Resistance, Type 512		R3	1000 ohms, ± 10%, ½ watt, carbon rod.
10C/753	1-Resistance, Type 891		R8	4,700 ohms ± 10%, ½ watt, carbon rod.
10C/11691	Resistances, Type 525	3	R11,R35, R62	100,000 ohms, ± 10%, ½ watt, carbon rod
10C/27	Resistances, Type 544	2	R14,R15	10,000 ohms, ± 10%, ½ watt, carbon rod.

Ref.No.	Nomenclature	Qty	Circuit Ref.	Remarks
10C/813	Resistance, Type 919	1	R25	10,000 ohms, ± 10%, 1 watt, carbon rod
10C/11678	Resistances, Type 512	2	R27,R52	1000 ohms, ± 10%, ½ watt, carbon rod
10C/15205	Resistances, Type 3914	1	R82,R83 R84	13.8 ohms, ± 1.8 ohms + 8.3 ohms, ± 5% vitreous enamelled wire wound.
10C/1342	Resistances, Type 1342	2	R15 R46	220 ohms, ± 10%, ¼ watt, carbon rod
10C/577	Resistances, Type 824	1		470,000 ohms ± 10%, ½ watt, carbon rod.
10A/12239	Retainers, Valve, Type 4	1		For Quench Valve Screen
10AB/1626	Screens, Type 55	1		Quench valve cover alum. cylindrical 2 sections
10DB/1580	Bracket Assembly	1		
	Fitted with:-			
10H/528	1-Plug, Type 229			
10H/18197	1-Plug, Type 655			Type 229 mod.with milled slot in top nut
10AB/4582	1-Spring Tension, Type 81			7¼ turns of No.19 S.W.G. St wire close wound.
10H/5374	Connector, Type 2212	1		10" long fitted with 1 Socket, Ref. No. 10H/702, 1 Socket, Ref.No.10H/2439
10C/1008	Resistance, Type 1008	1		56,000 ohms, ± 10%, ¼ watt, carbon rod
10C/751	Resistances, Type 889	2	R90 R91	12,000 ohms, ± 10%, ½ watt, carbon rod.
10E/348	Valves, 6J 5G	2		
	or			
10E/11448	Valves, VR.67	2		Spec. DCD.WT.1022.
10E/392	Valves, VR.135	3		Spec. DCD.WT.1228
10E/105	Valves, VR.92	2		Spec. DCD.WT.1131
10E/11400	Valves, VR.54	2		Spec. DCD.WT.1005

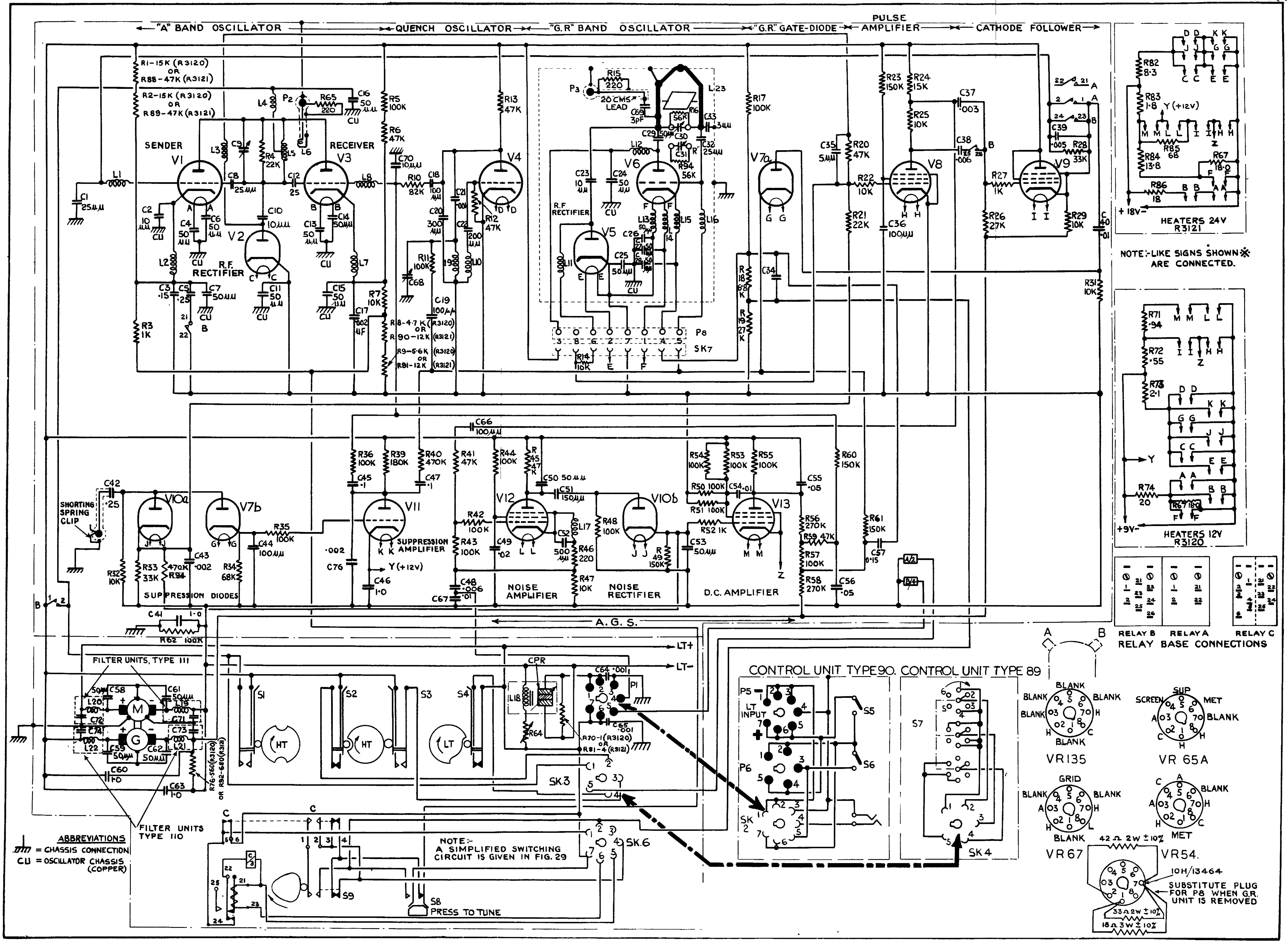


FIG. 2 R3120 AND R3121 CIRCUIT DIAGRAM

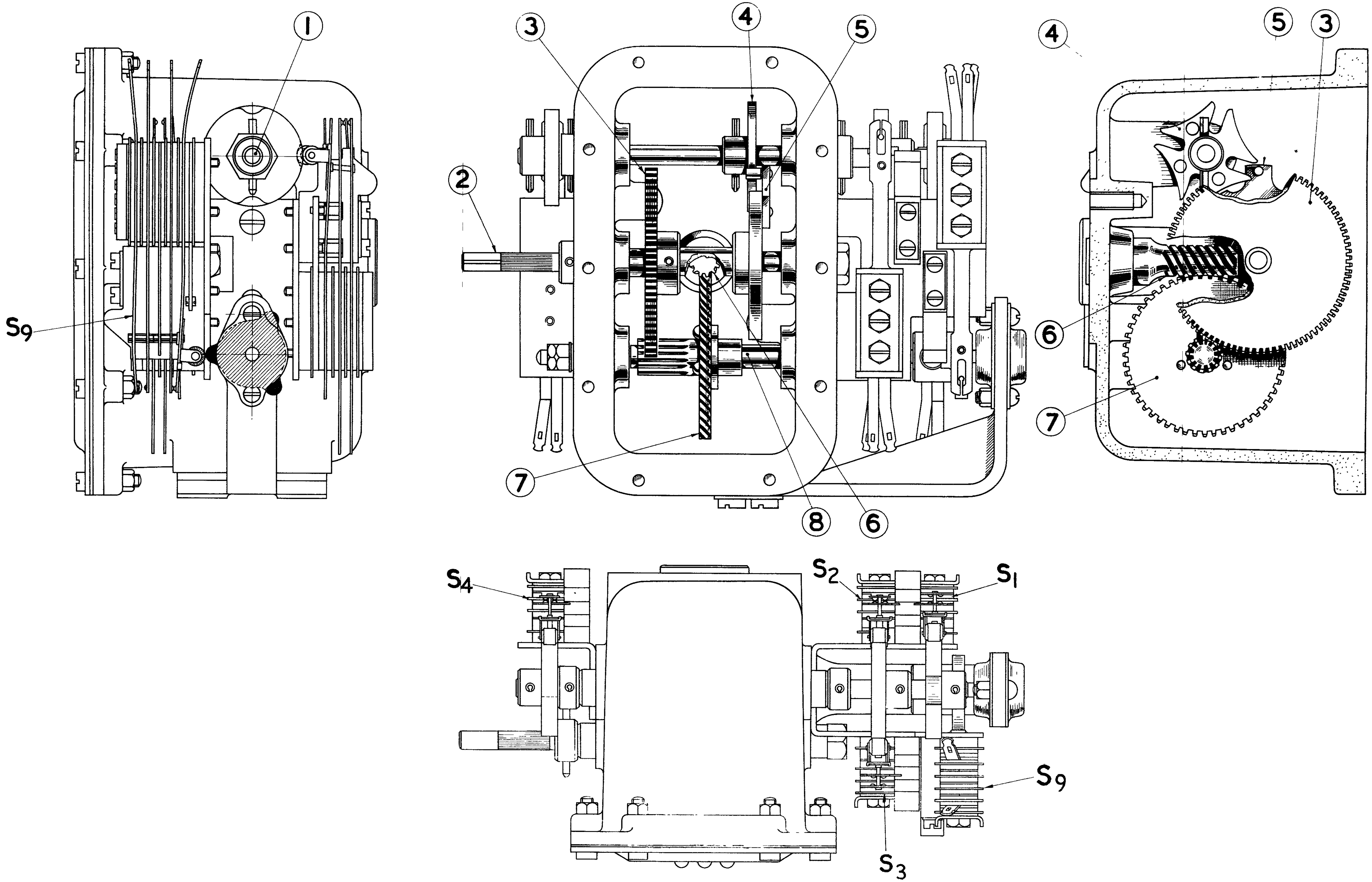


FIG. 7 GEAR BOX AND CODING SWITCHES

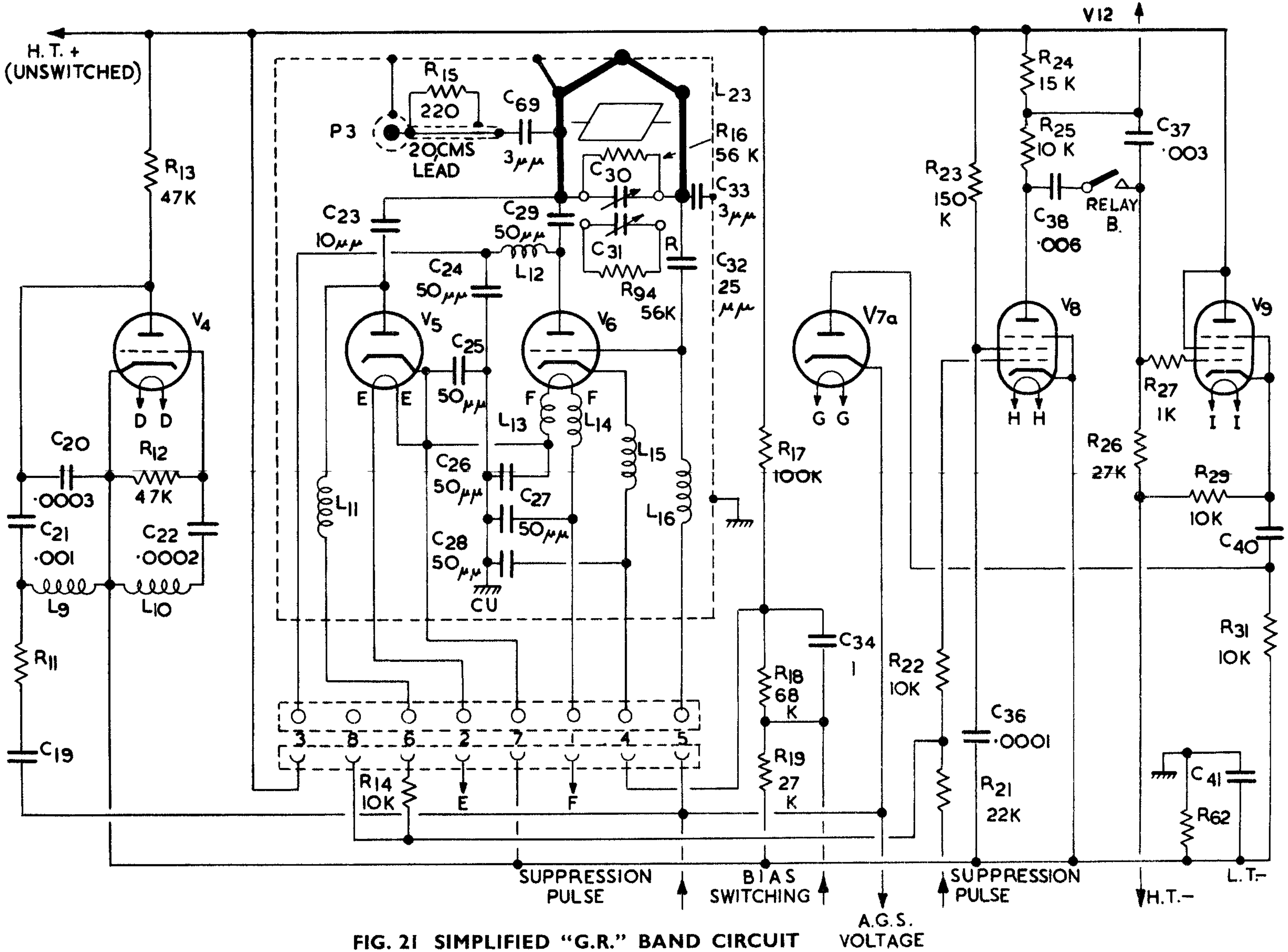
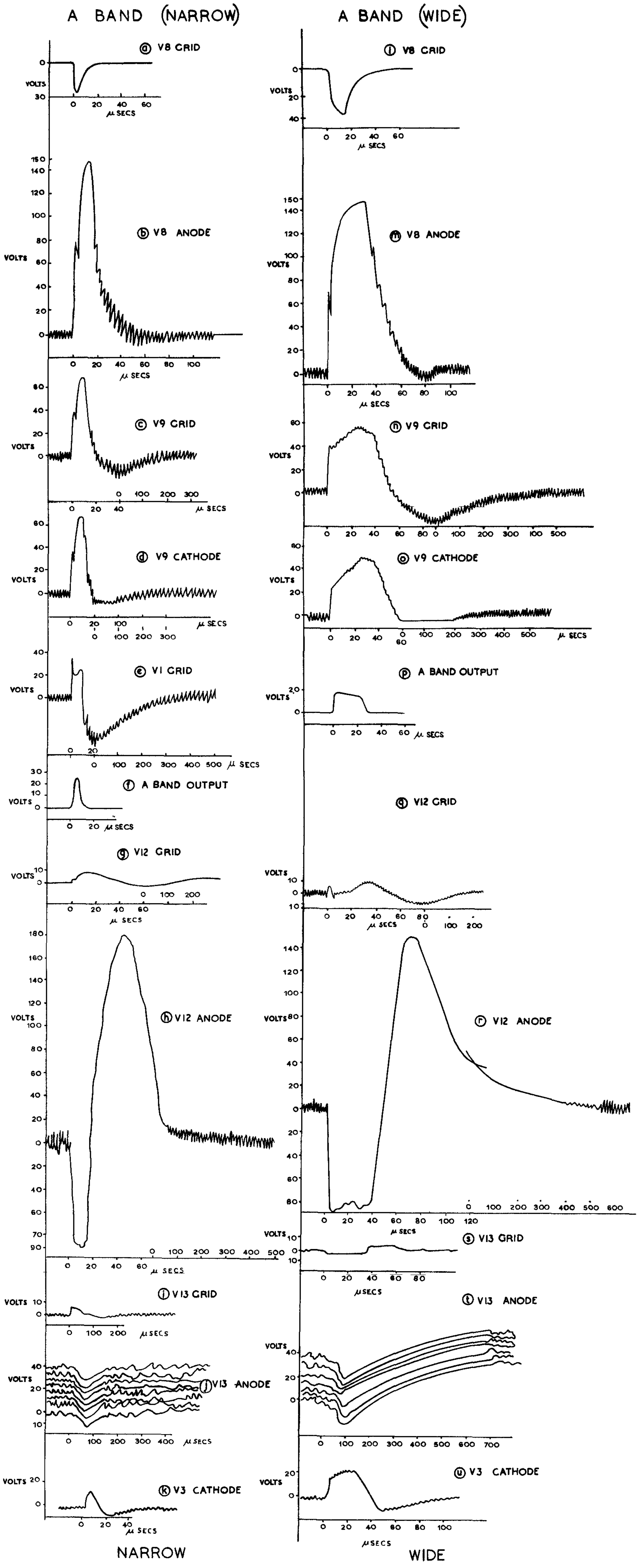


FIG. 21 SIMPLIFIED "G.R." BAND CIRCUIT



"A" FIG. 32 'A' BAND OSCILLOGRAMS

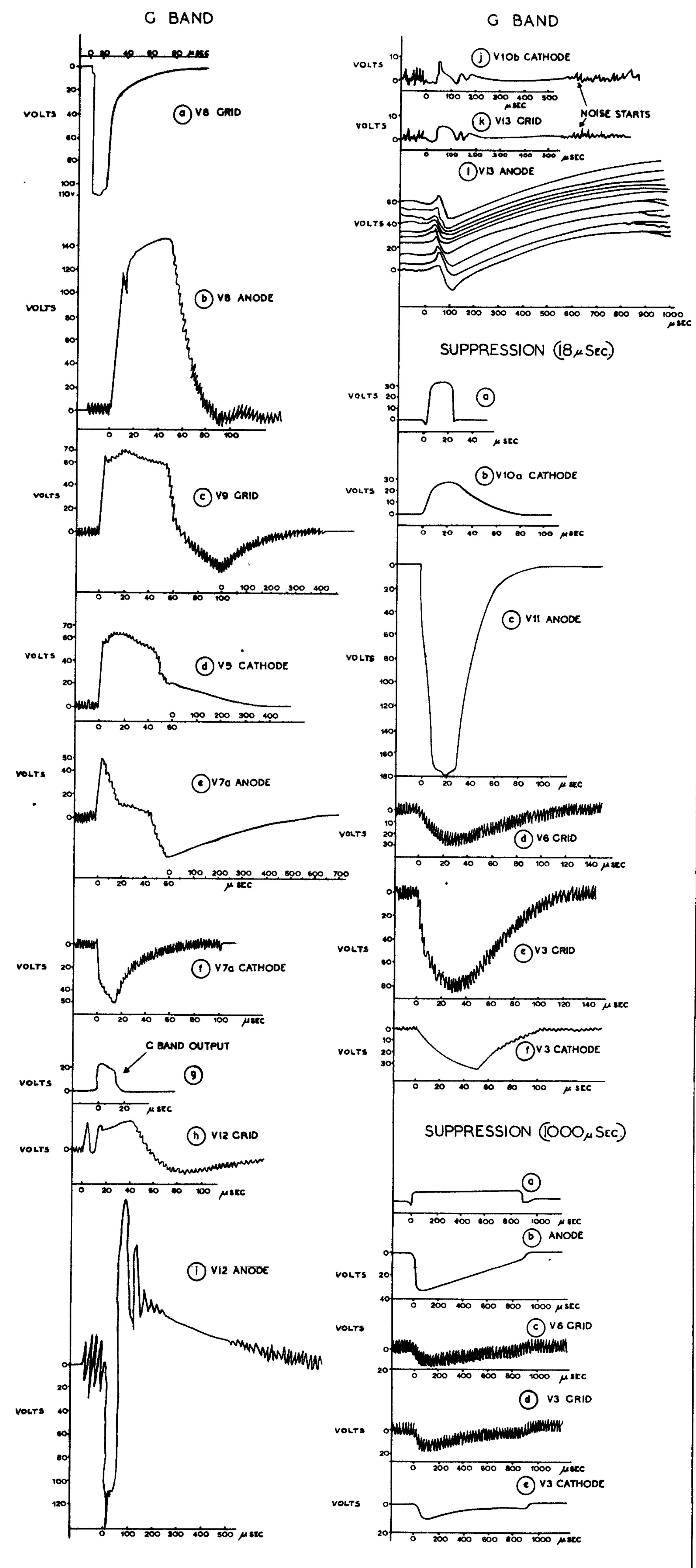


FIG.33 'G' BAND AND SUPPRESSION OSCILLOGRAMS