AMENDMENT RECORD SHEET

To record the incorporation of an Amendment List in this publication, sign against the appropriate A.L. No. and insert the date of incorporation.

A.L. No.	AMENDED BY	DATE
1	Jv	21/11/55
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3	Jv	12/12/55
4	Jv	15/2/56
5	Jv	13/12/55
6	Jv	10/5/56
7	J. Moore	3/6/57
8	J. Moore	12/2/58
9	J. Moore	26/8/58
10	J. Moore	26/8/58
11	J. Moore	26/8/58
12	J. Moore	9/10/58
13	J. Moore	2/5/60
14	J. Moore	2/5/60
15	J. Moore	2/5/60
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NOTE TO READERS

The subject matter of this publication may be affected by Defence Council Instructions, Servicing schedules (-4 or -5) or 'General Orders and Modifications' leaflets in this A.P., in the associated publications listed below, or even in some others. If possible, Amendment Lists are issued to correct this publication accordingly, but it is not always practicable to do so. When an Instruction, Servicing schedule or leaflet contradicts any portion of this publication, the Instruction, Servicing schedule or leaflet is to be taken as the overriding authority.

The inclusion of references to items of equipment does not constitute authority for demanding the items.

Each leaf, except the original issue of preliminaries, bears the date of issue and the number of the Amendment List with which it was issued. New or amended technical matter will be indicated by triangles, positioned in text thus:— ◀......▶ to show the extent of amended text, and thus:— ▶◀ to show where text has been deleted. When a Part, Section, or Chapter is issued in a completely revised form, the triangles will not appear.

◀The reference number of this publication was altered from A.P.2897NB, Vol. 1 to A.P.115K-1102-1 in December, 1969. No general revision of page captions has been undertaken but the code number appears in place of the earlier A.P. reference on new or amended leaves issued subsequent to that date.▶

IFF Mk. 3 *is now obsolete and the IFF facilities described in this Volume are no longer used.*

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LIST OF ASSOCIATED PUBLICATIONS

	A.P.
Radar Type 13 (*Mk.* 6 *and* 7) *and* 14 (*Mk.* 7, 8, 9, 10 *and* 11) *RVT*500, 501, 502 *and static versions*	115H-{1300 / 1400}-1
Information generator for radar stations	115Z-1102-1
Test equipment for mobile and static radar stations	2527D
Information generation and distribution for static radar stations	115Z-1101-1
Static radar stations, Type CHEL	2527F
Static radar stations, Type CEW	2527G
Static radar stations, Type GCI	2527H
Radar convoys	2527J
◀*Marker unit (video map) Type* 30	115N-0200-1
Consoles Type 60 *and* 60*A*	115K-1101-1
Mobile operations room Type 1 (*RVT*.510)	116K-0129-1
Fixed coil PPI display systems for ground radar stations ..	115K-0300-1▶

CONTENTS OF VOLUME 1

PART I

LEADING PARTICULARS AND GENERAL INFORMATION

LIST OF CHAPTERS

Note.—*A list of contents appears at the beginning of each chapter*

Chapter 1

PRINCIPLES AND APPLICATION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Purpose of chapter

1. This chapter deals in broad outline with the principles and application of the console Type 61 as an introduction to the detailed description given later in the Volume. Console Type 61A is very similar to console Type 61; the differences are briefly described in para. 95-102. ◀ Console Type 61B is a development of Console 61, designed to provide more accurate height readings. It is described in Part 2, Chap. 10. ▶

CONSOLE TYPE 61

General arrangement of console

2. The console Type 61 consists of a mild steel framework divided into three racks; additionally, two control panels and an indicating unit are mounted in such a manner as to form a control desk extending the full width of the console, as shown in fig. 1. Fig. 2 shows the nomenclature and arrangement of panels on the console.

Operational features

Applications

3. Console Type 61 is a height/range console, generally used in conjunction with the PPI console Type 60. It is primarily intended for installation in the mobile operations room Type 1 (radio vehicle Type 510) but may also be used in static radar stations such as CEW and CHEL. It may be used in two ways; firstly, to give an elevation-scan presentation of responses from radar Type 13 variants, or alternatively, to give a range/deflection display of responses from radar Type 14, 15 or 54. When used at Type 15 stations, an external multivibrator unit Type 52 must be used to provide height-finding facilities using the "split" (K-scope) technique. This multivibrator is usually fitted in the associated information generator, since no accommodation is available on the console itself.

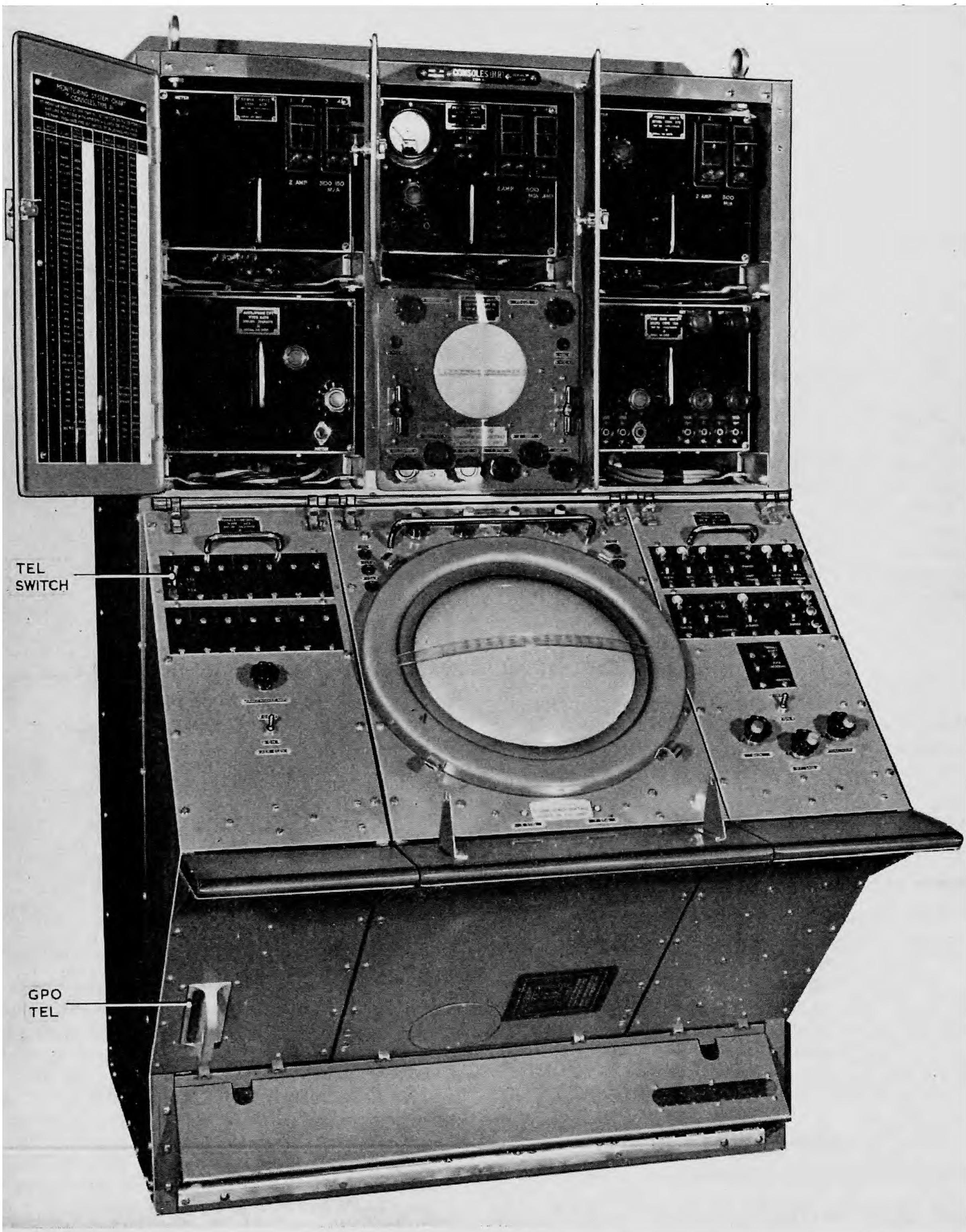


Fig. 1. Console Type 61, front view with doors open

4. In the Type 13 application, the signals are applied to the c.r.t. as intensity modulation, the vertical deflection plates being used to produce the elevation scan. In effect, the tube is used in a similar manner to an expanded sector PPI display, except that the sector is scanned in elevation instead of in azimuth.

5. In all other applications, the signals are presented on the c.r.t. as vertical deflections of a horizontal timebase (blips) together with a small amount of intensity modulation which brightens the trace over the extent covered by the blip.

6. The console is arranged to give the desired type of presentation (*i.e.* elevation-scan or range/deflection) by changing over a pair of links on the indicating unit (CRT) Type 32. These links are readily accessible through a covered aperture in the sloping underside of the indicating unit.

7. The console also provides facilities for the display of A-band IFF (Mk. 3) responses but these facilities are no longer used because IFF Mk. 3 is now obsolete. Radar responses derived from the radar video output on the associated PPI console may also be presented on the IFF display. Range marks for the IFF display are derived from the information generator rack, but reach the console Type 61 via the PPI console.

8. The radar video and range marks outputs from the PPI console are at too high a level for direct use, and an attenuator is fitted in each circuit, between the two consoles. Thus the radar video amplitude is reduced to about 560 mV (peak) and the range marks amplitude to about 370 mV (peak) at the input panel of the H/R console.

9. A strobing system is provided for range correlation between the PPI console and the IFF display. Where Type 13 radar is part of the installation, a separate elevation strobe causes the trace to flash every 5 deg. as the aerial sweeps in elevation. Where suitable external arrangements are made, the same circuits may be used to flash the trace when the aerial sweeps through a predetermined azimuth (azimuth strobe), or alternatively, to flash the trace at the will of the PPI operator, who uses a key switch marked H/R STROBE for this purpose. A key switch on the H/R console, marked PPI STROBE, provides means for flashing the PPI trace at the will of the H/R operator.

10. The console contains two complete displays: one for radar only, and the other (not now used) for A-band IFF presentation with radar for range correlation. The radar display has its own i.f. amplifier, video amplifier, range marks generator, range and elevation timebase units, and cathode-ray tube; the IFF display has its own video amplifier, timebase unit, and cathode-ray tube.

Anti-jamming devices

11. Certain anti-jamming devices are incorporated in the radar signals chain. These are:—

(1) A narrow bandwidth unit in the i.f. chain.
(2) A short time-constant in the video chain.
(3) A low-pass filter in the video chain.

In certain circumstances, the narrow bandwidth unit referred to above may be used to improve the signal-noise ratio even if deliberate jamming is not experienced. Normally however, all three devices are cut out of circuit by suitable switching arrangements.

Note . . .

If the radar input to the IFF display is derived from the H/R console, it is equally affected by the use of the above a.j. devices. If derived from the PPI, it will be affected by any a.j. precautions applied to the PPI display.

Elevation-scan display.

12. The elevation-scan display is used only with centimetric height-finding equipment such as radar Type 13. In this application, a normal timebase is applied to the X-plates of the c.r.t., but the video signals are introduced in the form of intensity modulation of the beam. The aerial array radiates an r.f. beam which scans continuously in a vertical plane. The amount of angular movement of the beam in the vertical plane is from —1 deg. to +20 deg., the horizontal being considered as zero. The aerial sweeps over this range ten times per minute, so that the time of a complete sweep is six seconds. These sweep limits are shown in fig. 3(a).

13. The Y-plates of the c.r.t. receive a linear sawtooth waveform, produced by the elevation-scan timebase. The amplitude of the timebase sweep is controlled by a magslip, driven by the aerial scanner. The timebase so produced pivots about a point at the lower left-hand side of the tube face, and moves in synchronism with the motion of the aerial. At any given instant, therefore, the trace is inclined to the X-axis by an amount which is related to the elevation of the beam at that instant.

14. If the radiated beam sweeps over an aircraft, the trace is brightened by the effect of the video response, which is applied to the c.r.t. beam as intensity modulation. As a result, a bright vertical line appears on the tube face, the position depending upon the height and range of the aircraft (*fig.* 3(*b*)).

15. From the above description, it will be seen that the elevation scan display resembles an expanded sector PPI display to some extent, except that the sector scanned is in the vertical instead of the horizontal plane. There is however one important difference, in that on the elevation-scan display, the slant range is given by the distance along the X-axis, instead of the distance along the trace as in the PPI display. The horizontal on the c.r.t. face, corresponds with an angle of transmitted radiation of —1 deg.; allowance for earth curvature is made in the calibration.

16. In early marks of radar Type 13, a height-range graticule was provided on an engraved window fitted in front of the c.r.t. face, giving ranges up to 75 miles and heights up to 40,000 feet, as shown in fig. 3(c). In practice however, the use of a window was found to give rise to parallax errors and was therefore discontinued. In operational installations using console Type 61, the graticule is produced partly by electronic methods; the vertical range lines, at 5 or 10 ◀data▶ mile spacing, and the tilt angle strobe lines, at 5 deg. spacing, are produced in this manner. The constant height lines on the other hand, are painted directly upon the face of the c.r.t. during the final stages of installation. A window carrying a graticule is used, however, for preliminary testing purposes at manufacturer's works and Maintenance units.

17. The azimuthal beam width of the Type 13 aerial is about 6 deg. It is necessary therefore to set the bearing of the aerial accurately before the height of an aircraft can be obtained. This is done by using an associated PPI console as a 'putter-on'. In mobile installations the console Type 60 will normally be used for this purpose. In static applications either the console Type 60A or Type 64 may be used. The PPI console is fitted with an azicator driven from a selsyn associated with the Type 13 aerial turning gear. The console 60 or 60A azicator consists of a radial cursor which indicates upon the PPI azimuth scale the bearing upon which the Type 13 aerial is trained. (On the console 64 an electronic azication marker is used).

18. The type 13 aerial turning gear is controlled by the PPI operator, and therefore he is able to train the aerial until the cursor line intersects the response of which the target height is required. The H/R operator then reads off the range and height, the range serving to correlate the response with that on the PPI in the event of more than one response appearing on the same bearing. The strobing facilities assist in this correlation. Modification CA654/2 provides for a number of consoles Type 61 to be fitted with a housing (c.r.t.) 10AR/935 together with adaptor (c.r.t.) 340 (10AD/3311). This enables the c.r.t. from indicator unit Type 32 to be positioned above console 64, thereby permitting the PPI operator to act as H/R operator as well.

A-band IFF

19. The A-band IFF interrogator is no longer fitted to the Type 13 radar head and the console IFF units are redundant for their main purpose, but the timebase unit (IFF) 135 still provides the trigger pulse for the A-scope timebase in console 61A. Modifications CA670/1 and CA676/2 provide for a vertical strobe line on the console 61, controlled from the console 64. The expansion brightener pulse from timebase unit 135 is con-

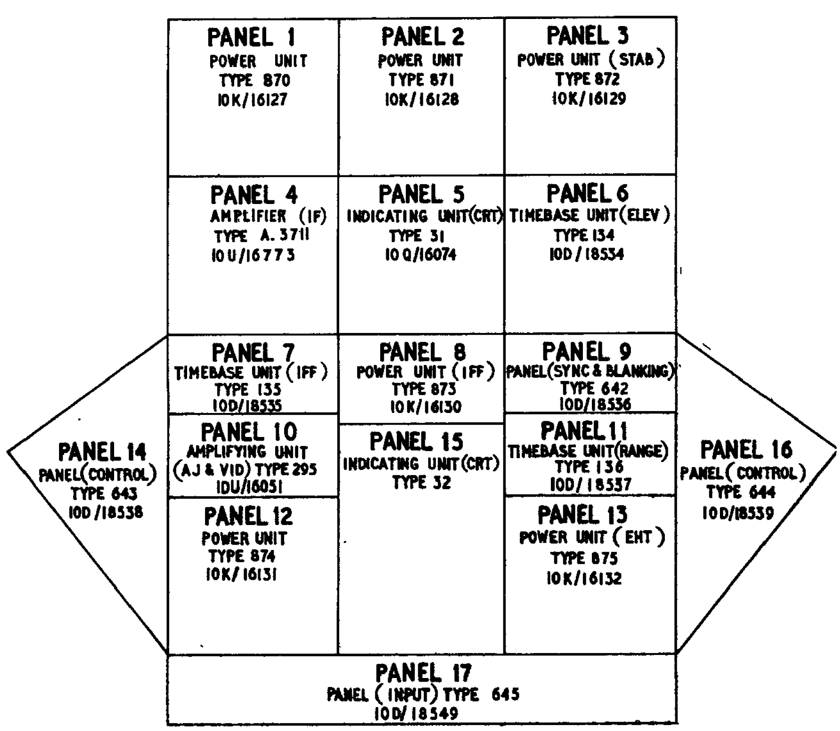


Fig. 2. Nomenclature of panels

nected to the screen grid of V5 in the timebase unit 136 via an additional 0·1 μF capacitor.

20. The IFF display system forms an integral portion of the console, having its own timebase unit and indicating unit, but deriving most of its power supplies from the power units provided for the main radar display. One additional power unit is included however in the IFF equipment. IFF video signals are no longer applied to the IFF c.r.t. but radar signals may be displayed, derived either from the H/R console itself or from an associated PPI console. The display is locked from the same source as the PPI console. The IFF units are described in para. 65—77. These paragraphs are retained to explain the presence of the units in the console. ▶

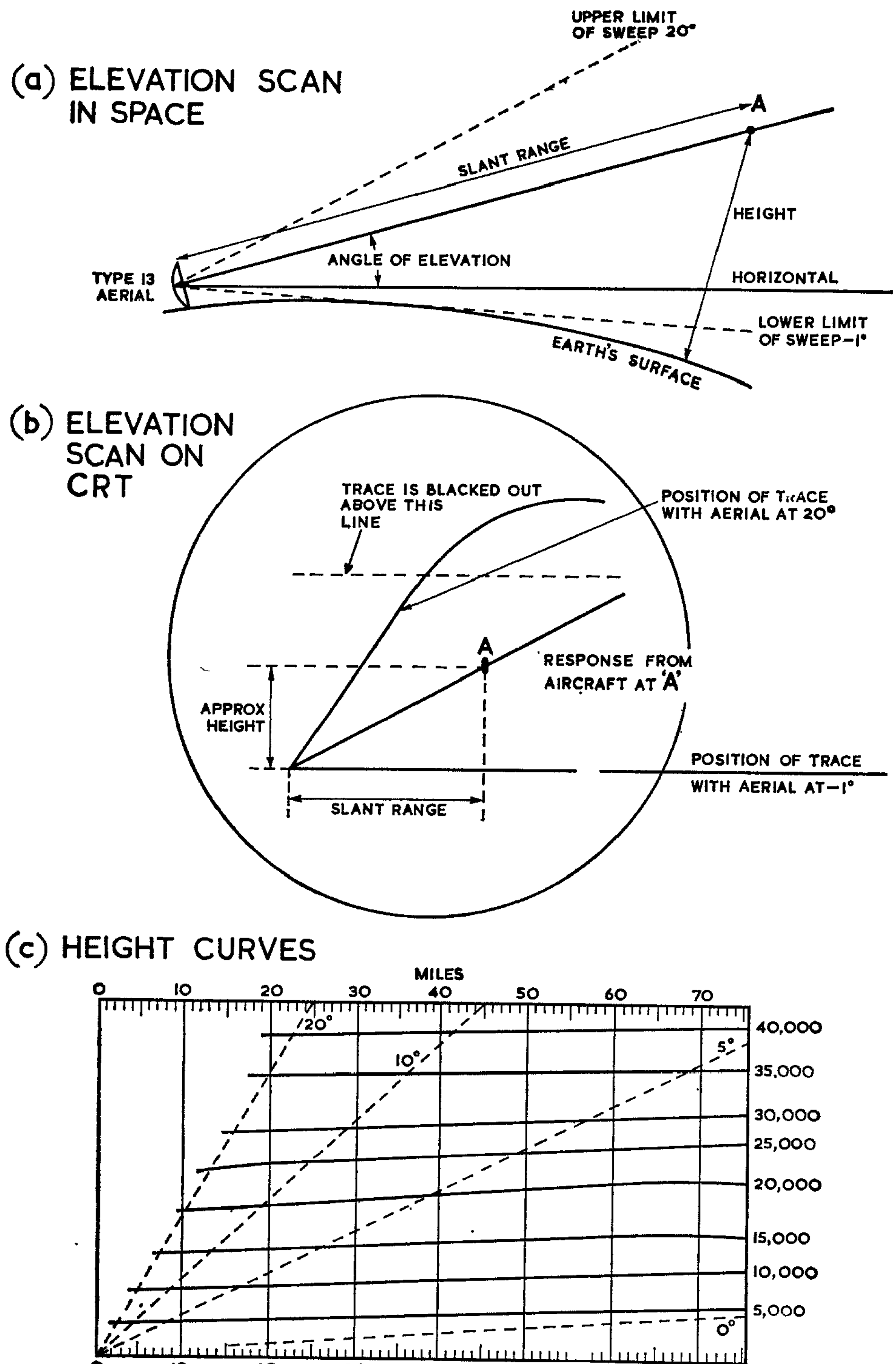


Fig. 3. Explanatory diagram of elevation scan ◀ *(Not used operationally)* ▶

21. ▶◀

◀ Facilities are provided as follows: — ▶

(1) Both main radar and IFF responses ◀ may be ▶ displayed on the IFF indicating unit.

(2) Two separate traces are presented upon the IFF c.r.t., one above the other. The upper one ◀ was formerly ▶ synchronized by the IFF sync pulse, and the lower by the radar sync pulse, but the origins of the two traces lie precisely in line, owing to the action of certain circuits in the IFF timebase unit.

(3) A vertical electronic cursor line is provided for accurate alignment of responses on the two traces, and the trace itself is brightened and expanded over a range of two or three miles.

IFF strobe

22. When the radar signals on the IFF display are derived from a PPI console, the IFF strobing system is used to facilitate the range correlation between the IFF display and the PPI display. A strobe pulse (generated in the A-band timebase unit) appears on the PPI display at a range determined by the setting of a control on the PPI indicating unit; as the PPI trace rotates therefore, the strobe pulse paints a fine circle on the PPI tube. The PPI operator adjusts the strobe control until the circle intersects the response to be interrogated. On the indicating unit Type 31, a small portion of the trace is brightened and expanded, and the beginning of this portion is marked on the IFF trace by a narrow vertical deflection which acts as an electronic cursor. This cursor is set by the PPI strobe control to a range corresponding with the position of the strobe pulse on the PPI display.

PPI and H/R strobes

23. On the associated PPI console, there is a key marked H/R STROBE, and when this key is closed, the H/R trace is brightened by changing the screen potential on a valve in the range timebase unit (panel 11) on the H/R console, through the agency of a relay; the latter obtains its 48-volt supply from the power unit Type 871 (panel 2). Similarly, on the H/R console, there is a key switch marked PPI STROBE; this operates a relay in the associated PPI console, through a link in the inter-console wiring. When the link is in the "PPI strobe" position, the PPI trace is flashed when the PPI STROBE key is pressed. The other position of the external link permits a change of circuit by which the PPI trace may be flashed by the azimuth indicator switch on one of the aerial systems, where such a facility is required. In certain applications, arrangements may be made by which the H/R tube trace may be flashed by the azimuth indicator switch on the aerial system instead of the PPI trace.

Special GCI facilities

24. Mobile GCI installations such as radar Type 15 Mk. 5 require certain facilities on the H/R console which are not necessary in other installations. These are: —

(1) Height-finding (without an ancillary radar Type 13)

(2) Gap-filling

(3) Small p.r.f. shift.

The method whereby these facilities are provided is explained below. It must be understood that the mobile GCI aerial array actually consists of two separate aerials, mounted one above the other. The electrical centres of the two aerials are spaced approximately one wavelength apart, and the electrical centre of the whole array is approximately two wavelengths above earth. If a signal is received from an aircraft at a given height and range, the resultant output of the upper aerial will differ from the resultant output of the lower aerial, and the ratio between these signal strengths is a function of the angle of elevation of the target as viewed from the electrical centre of the array.

Height-finding

25. The actual technique of GCI height-finding therefore consists of comparing the strength of the response received on the upper aerial with that received on the lower. The comparison is made by switching the feed to the receiver from one aerial to the other. The result is displayed on the H/R tube in the following manner (generally known as "split").

26. Two traces are produced on the H/R tube, superimposed upon each other and displayed alternately. Being superimposed, however, they appear visually to be a single trace. The response from the upper aerial is displayed upon one of the traces, and that from the lower aerial upon the other. If the origins of the traces were the same, the responses would also be superimposed. To separate the responses, so that their amplitudes may be compared, a shift voltage, synchronized with the aerial switching, is applied to the X-plates of the tube, so displacing the alternate traces by a small amount. The height of the target is then computed from the ratio of the left-hand to the right-hand response. The method of doing so is a matter of operational organization and is outside the scope of this publication.

27. The switching from upper to lower aerial takes place at the one-half transmitter p.r.f. When height-finding is not required, the shift voltage is switched off and the responses from upper and lower aerials are combined, showing a single "blip" on the trace.

28. The switching referred to above is performed electronically, and is controlled by a key switch marked HEIGHT-PHASE-NORMAL, mounted on the right-hand control desk. In the NORMAL position, the shift voltage is suppressed, and the responses from the two aerials are combined as already stated. In the HEIGHT position, the aerials are switched to the receiver alternately, and a shift voltage applied to alternate traces on the c.r.t. In the PHASE position, the amplitude of the signal on the lower aerial alone is compared with the amplitude of the signal received on both aerials. This enables the operator to resolve certain ambiguities which occur when the switch is in the HEIGHT position.

Gap-filling

29. When the upper and lower aerials of the radar Type 15 aerial array are energized in phase with each other, so as to give maximum range at low angles above the earth's surface, the vertical polar diagram has a first lobe, having a maximum at an angle of about 6 deg., and a second lobe having a maximum of about 17 deg. Between these there is a minimum (theoretically a complete null) at an angle of about 13 deg. When the upper and lower aerials are fed in anti-phase, however, the first lobe has a maximum at about 13 deg. and the second at about 37 deg., with a minimum between them at about 20 deg.

30. Provision is therefore made to energize the aerials either in phase or in anti-phase, so that responses can be obtained from targets at all angles of elevation. This is known as gap-filling. The technique entails the provision of switching devices by which the input to one aerial can be syn-phased or anti-phased at will, with respect to the other. The actual feeder switching is controlled by relays operated from the control desk of the H/R console. The switch fitted for this purpose is called the gap-filling switch, and is marked TOP-PHASE-ANTIPHASE. The legend TOP refers to a condition in which only the upper aerial is energized. This condition may sometimes be employed where the radar Type 15 Mk. 5 is employed on a cliff site for surface watching purposes only.

Small p.r.f. shift facility

31. The small p.r.f. shift facility is provided primarily for use with radar Type 15 Mk. 5, and the object is as follows. When propagation conditions are unusually favourable (as sometimes occurs in tropical or sub-tropical climates) or even in normal conditions when a high p.r.f. is in use, it is possible to obtain a response displayed at short range, e.g. 40 miles, from a target at a distance very much greater than the maximum range shown on the timebase actually in use. Such a response may be caused by a transmitter pulse one or even two repetition periods before the one associated with the scan upon which the response actually occurs. The phenomenon cannot be detected by visual means alone, but such responses can be classified by a small change in the p.r.f.

32. To take a hypothetical example, suppose the timebase range scale to be 0-80 miles, and the p.r.f. to be 500 c/s. For simplicity, the wave velocity may be taken as 1 mile per $6\frac{1}{4}$ microseconds, so that 1 mile "range" equals $12\frac{1}{2}$ microseconds. Then the duration of the whole timebase cycle, including scan and black-out, is 2,000 microseconds, of which the actual scanning time is 1,000 microseconds.

33. If a response is obtained as the result of a particular transmitter pulse, from an object 200 miles away, the response is received 2,500 microseconds after the originating transmitter pulse, that is, 500 microseconds after the succeeding transmitter pulse and the commencement of the corresponding scan time of the timebase. The response therefore appears upon this scan as a blip at an apparent range of 40 miles.

34. A change of p.r.f. causes a change in the position of the blip. For example, if the p.r.f. is changed to 506 cycles per second, so that the timebase cycle takes 1,975 microseconds, a response from a target at 200 miles is received 525 microseconds after the succeeding transmitter pulse, and the blip appears on the trace at an apparent range of 42 miles. This change of position with change of p.r.f. shows that the range indicated by the blip is anomalous.

Mechanical features

35. The mechanical design of the console is based on the requirement that the equipment shall be completely accessible from the front. The control panels and main radar indicating unit are pivoted on the front of the main frame and may be tipped forward to give access to panels mounted behind them. The use of flexible cable-forms for all connections between units enables access to be obtained to all panels except the EHT power pack while the console is in operation, and the use of plug and socket connections throughout enables any panel to be quickly removed. Co-axial connections are made by F & E or Pye plugs and sockets, others by Jones plugs and sockets.

36. Fig. 1 shows the console with the front doors open, but with the control panels and main indicating unit (panel 15) in the normal positions, while fig. 4 shows the control panels and indicating unit lowered, in order to give access to the panels housed behind them. All units housed in the racks (except panels 5, 9 and 17) are held in position by spring-loaded bars which engage with niches cut in the panel chassis runners and prevent the panel from moving. To remove the panel, the associated bar must first be depressed; the panel will then slide forward over the bar.

37. Panel 5 (the IFF indicating unit) is held in place by two latches, one on each side of the unit; the handles of these latches can be used to withdraw the unit from the rack and, if necessary, to transport the unit for short distances. The latch is secured in the operating position by a captive screw which must be slackened off before the latch handle can be turned. Panel 9 (which carries only the sync. inputs, the sync. selector switch and the blanking switch) is secured in position by screws, as is also panel 17, the main input panel. The control desks (panels 14 and 16) and the main indicating unit (panel 15) are secured in the operating position by cadmium-plated clips mounted upon bars. To operate these, first slacken off the knurled screw, and turn the clip upwards. To secure the panels in the operating position, reverse the process.

38. Access to panels 1, 2, 3, 4, and 6 is obtained merely by opening the doors and sliding the unit forward after depressing the retaining bar. The remaining panels (except panels 5, 9, and 17 as

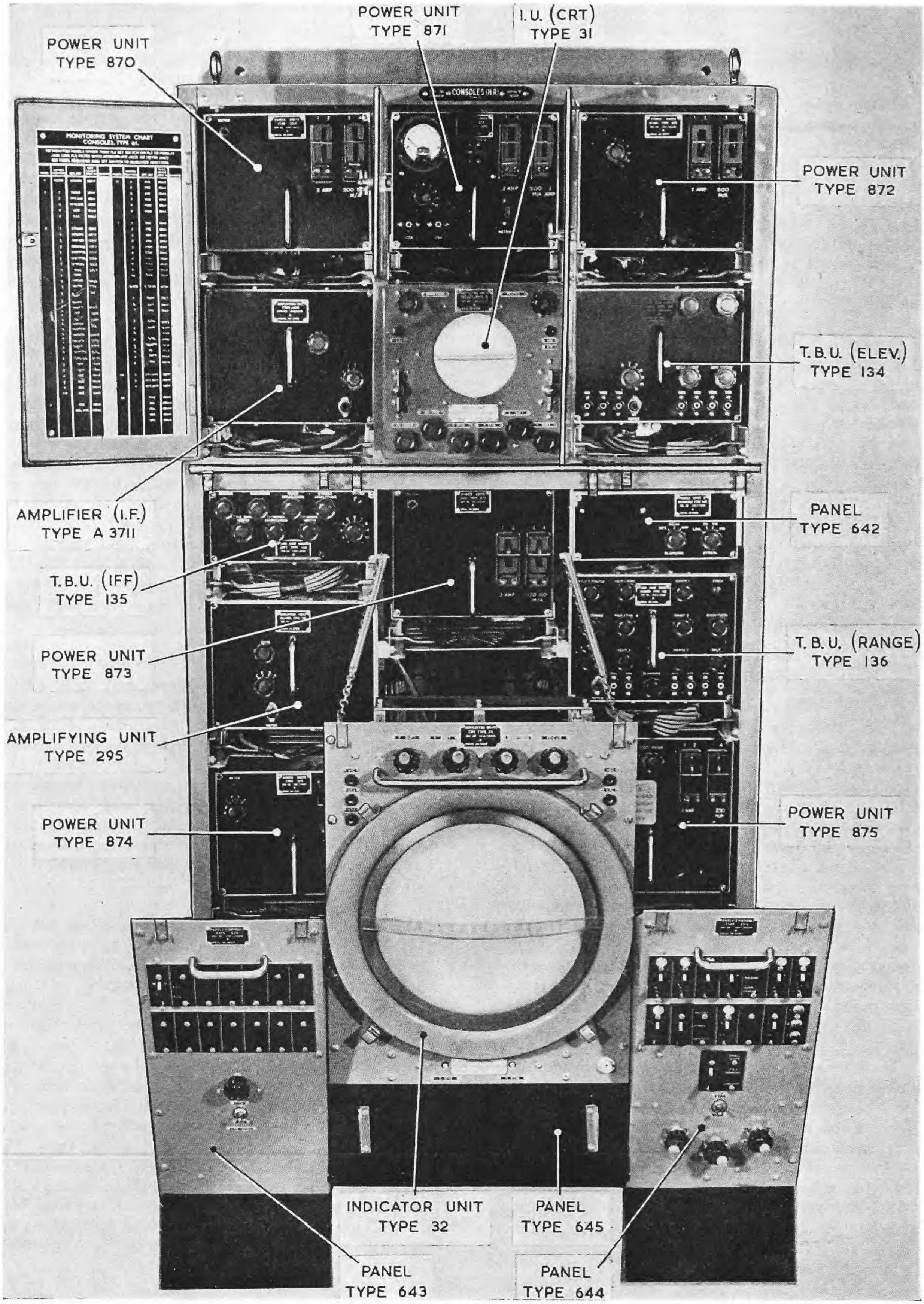


Fig. 4. Console Type 61 with front panels lowered

already explained) can be withdrawn in the same manner after tipping forward the control panels and main indicating unit. To remove panels 7, 10, or 11, one supporting chain must be detached from the indicating unit, while to remove panel 12 or 13, both supporting chains must be detached from the indicating unit, which then must be carefully lowered to ground level. The flexible connections fitted to Jones plugs A and B must be removed entirely before disconnecting the chains, otherwise these connectors may be damaged. It will be observed that spiral springs are fitted to the chains in such a manner that their ends, when hanging loosely after the indicating unit has been removed, cannot foul the Jones plugs on panel 17, in the event of the cover being absent.

39. Before attempting to remove the EHT power unit (panel 13) the console main a.c. supply must be switched off on the right-hand control desk and the Jones plug at the rear of the unit must be removed. This Jones plug carries only the a.c. mains supply. It is accessible through the space normally occupied by the tipped-up indicating unit. Before removing any panel completely, all coaxial plugs and Jones sockets must be removed from the unit.

Electrical layout

40. Fig. 5 is a block schematic of the console display system showing the principal functions of the various parts of each panel and the most important controls. It should be referred to as necessary when reading the following description.

Radar display system

Amplifier (IF) Type A.3711

41. The IF input from the aerial head amplifier is taken through a coaxial connection on the console input panel into amplifier (IF) Type A, 3711, which consists of three separate amplifying units; for brevity, these are generally referred to as units A, B, and C respectively. The full nomenclature of these units is as follows:—

Unit A	..	Amplifying unit (IF) Type 294
Unit B	..	Amplifying unit (IF) Type 296
Unit C	..	Amplifying unit (IF) Type 302

42. Of these, unit C is the first in the signal chain, and is a two-valve pre-amplifier feeding directly into unit A. Unit A is a unity gain, narrow band-width amplifier, into which are fed the 45 MHz IF signals. It is designed to eliminate interference at frequencies differing from the transmitter frequency. This is done by mixing the 45 MHz signals with a 65 MHz signal generated by a local oscillator, in order to produce a new frequency of 20 MHz. The signals at the latter frequency are then passed through a series of narrow pass-band circuits which greatly attenuate frequencies outside the pass-band, and are then finally mixed with the original 65 MHz from the local oscillator to produce an IF signal at 45 MHz, free from unwanted responses.

43. Normally, unit A is completely bypassed, but is thrown into circuit when required by operating a key switch NBW IN on the right-hand control desk. The bandwidth of unit A does not exceed 500 kHz, the centre of the band being adjustable over a limited range by a control marked NBW TUNE, also on the right-hand control desk.

44. Unit B consists of a wide-band amplifier V1-V4, followed by a diode detector V5, an IF filter, and a cathode-follower V6. The bandwidth is not less than 4 MHz for 6 dB voltage ratio. The 45 MHz signals are amplified and then rectified by the detector, the output of which is fed into cathode-follower V6. V6 provides a low-impedance output to amplifying unit Type 295 (panel 10). The gain of V1 and V2 in unit B is controlled by an adjustable resistor marked IF GAIN on the control desk.

Amplifying unit (AJ and video) Type 295

45. Amplifying unit Type 295 consists of a valve V1 associated with a short time-constant input circuit, followed by a low-pass filter. Under normal conditions both the short time-constant valve and the filter are bypassed by relays, operated by key switches on the right-hand control desk, and the signal is fed directly into primary limiting valve V3. The limiting level is controlled by a potentiometer marked AMP. LIMIT. When properly set up, this control limits the signal at 10 times noise level.

46. If desired, the radar video supply to the IFF display can be taken from the output of this unit. Where an associated PPI console is installed however, the radar video supply is generally taken from the console so that the IFF responses are directly correlated in range and azimuth with the PPI responses.

Indicating unit (CRT) Type 32

47. Indicating unit Type 32 carries the cathode-ray tube for the height/range display; it contains circuits for applying limited signals to the control electrode of the CRT for intensity modulation, and also those required to give vertical deflection. When radar Type 13 is being displayed, the vertical deflection circuits are used to apply the elevation-scan waveform from timebase unit Type 134. With other radar types these circuits are used to display the radar responses as blips.

48. The signal input to the indicating unit is derived from cathode-follower V4 in amplifying unit (AJ and video) Type 295. These are fed into video amplifying valve V1. Range marks from calibrator valves V12-V15 in timebase unit Type 136 are fed into a separate input valve V101, and the range marks and radar video are combined in an anode circuit common to V1 and V101. The amplitude of the range marks is controlled by a potentiometer marked R.M. AMP., mounted on the left-hand control desk (panel 14).

49. When the links are set for range/deflection display, the combined video and range marks output is applied to phase-splitting amplifier V2, V3, the output of the latter being applied to the

Y-plates to produce a balanced deflection. The combined output of V1 and V101 is applied also to the control electrode of the CRT to produce intensity modulation, after limiting in secondary limiter V6, V7.

50. When the links are set for elevation scan, Y-amplifiers V2, V3 are used to amplify the elevation timebase waveform, and the output from the video stage is used only to produce intensity modulation.

51. For the range/deflection display, only a small amount of intensity modulation is required, but the elevation-scan display requires a much larger amount. The output of V6, V7 therefore is controllable by a preset potentiometer marked MOD. AMP. by which the output to the control electrode may be varied between zero and 40V peak. The pulse should then limit at 40V. This control is set up in conjunction with a limiting control marked SET LIMIT.

52. DC restoration is provided for both the intensity-modulated input at the control electrode and the timebase input to the X-plates.

Timebase unit (range) Type 136

53. Timebase unit Type 136 produces the range scan on the CRT. It incorporates a triggered blocking oscillator V1 which, in conjunction with pulse-shaping valves V2, V3, provides both positive-going and negative-going outputs for various purposes.

54. The timebase generator proper is of the sanatron type, the Miller valve being V9, and the timing or regulating valve V7. By special circuit arrangements, Miller valve V9 is made to operate in conjunction with V10 as a paraphase push-pull amplifier. V11 is a clamping diode in the HT supply circuit of V9; its function is to shorten the fly-back time. Diodes V8a, V8b and V16 are a bias clamp on V9, preventing the control-grid potential from rising above earth.

55. The timebase unit also contains brightening pulse generator V4a, V5, and five valves V4b, V12 to V15 which produce calibration or range marks on the CRT. Calibration marks are at 5 ◀data▶ mile intervals on the two lower ranges, and at 10 ◀data▶ mile intervals on the highest range. Valve V6 is provided to permit the production of a split waveform, by varying the screen potential of V9 on alternate traces. This facility is required only in mobile GCI applications (*para.* 25).

56. Arrangements are made for brightener valve V5 to accept a blanking waveform, either from an external source or from the elevation timebase. No present requirement exists for external blanking, which is provided only for possible future contingencies. The elevation scan blanking is always required in radar Type 13.

57. The synchronizing pulses for the timebase are normally derived from the transmitter (or master trigger unit in static installations) and are taken through panel Type 642 (sync. and blanking) so that where more than one transmitter is installed, the timebase may be synchronized from any one. A local sync. is provided, for use when the transmitter is not in operation, and it is necessary to operate the display system for servicing purposes. This local sync. is generated by valves V2, V3, V4, in the local pulse oscillator, which is part of power unit Type 871 (panel 2).

58. Either a positive or a negative sync. pulse can be used, the amplitude being not less than 12V. Negative-going sync. pulses are fed direct to the anode of V1. Positive-going pulses, however, are fed in via a coupling winding on transformer T1. Links are provided on the latter for making the necessary connections.

Timebase unit (elevation) Type 134

59. Timebase unit Type 134 consists of three parts. The first part, valves V1 to V5, produces a d.c. voltage which varies in magnitude with the angle of elevation of the Type 13 aerial array. This is done by feeding a sine-wave of fixed amplitude, at a frequency of approximately 3 kHz, to a magslip mounted on the aerial array. The sine-wave is generated by a resistance-capacitance (phase-shift) oscillator consisting of V1, V2, V3.

60. The magslip is similar to a radio-goniometer (angle measure) but is wound for a low-frequency (3 kHz) input. It consists of two stator coils and a rotor coil. When an alternating current of fixed magnitude is fed into the stator, a voltage is induced in the rotor coil, the magnitude of which depends upon the angle between the direction of the stator field and the axis of the rotor coil. Actually, the output is proportional to the cosine of this angle, and is zero when the axis of the rotor is at right angles to the stator field.

61. The output of the magslip is returned to the timebase unit, where it is amplified by V4, rectified by V5, and smoothed, producing a d.c. voltage which is (over the working range of about 21 deg. of the magslip) a function of the displacement of the aerial.

62. The output of V5 is used to control the output of the elevation scan generator which is the second of the three parts. It consists of a Miller timebase V6, V8, driven by a positive pulse from pulse-shaping valve V3 in timebase unit Type 136, and d.c.-restored by a diode V7. The amplitude of the output of V8 (i.e. the Miller run-down) is controlled by the control-grid voltage of V6, which as referred to in the preceding paragraph, is derived from V5. The scanning waveform is taken into indicating unit Type 32 at the links as described in para. 47 to 50.

63. The function of the third portion is to limit the visible Y-deflection by blacking out the trace when the deflection exceeds a certain amount. This is done by generating a blanking waveform which is introduced into the brightening pulse circuits of timebase unit Type 136. The valves used for this purpose are V9, V10 and V11. The onset of the blanking pulse is controlled by a preset potentiometer marked SCAN LIMIT.

64. All HT voltages on the unit are stabilized by the valve V12, the level being set by the ADJ. STAB. control.

IFF display system

65. The two units primarily concerned with the IFF display are the timebase unit (IFF) Type 135 (panel 7), and the indicating unit (IFF) Type 31 (panel 5).

Timebase unit (IFF) Type 135

66. The IFF timebase unit receives a locking pulse from the radar transmitter; this is fed into the lock mixer consisting of V1, V2, V3A. Either a positive or a negative lock can be accepted, links being provided by which the lock can be supplied either to the control-grid or cathode of V1. The valves V1 and V2 share a common anode load. The square pulses developed at the common anodes are used to trigger the timebase phantastron V6, V7.

67. From the cathode of V7, negative pulses are fed to the control-grid of V8, and the latter produces pulses at both cathode and anode. The negative pulse at the cathode is fed into the indicating unit Type 31 to lock the timebase. The anode pulses are differentiated and the positive-going peaks removed by the diode V23; the negative peaks remaining are used to lock a divider V9, V10.

68. The divider can be set to divide by 2, 3, 4, 5, or 6, by the adjustment of a control marked DIVIDER. In most applications the division ratio is 6 to 1. The pulses at the reduced p.r.f. are fed back into V1, and pass through the gate diode V4, so triggering the transitron V5. The latter produces positive pulses which are fed into the aerial cabin to trigger the IFF transmitter. The divider waveforms are fed into the video signal chain for purposes described later.

69. The IFF transmitter (interrogator) feeds back a return lock to the display, at the control-grid of V2. This causes the total output at the common anode of V1 and V2 to be of the full radar p.r.f., but (assuming a division ratio of 6 to 1) with five pulses locked to the radar transmitter and one to the interrogator by the return lock.

70. The interrogator is switched on or off by the A-band key on the control desk. A servicing lock is provided by feeding the transitron V5 output through links to the control-grid of V2, for use when a transmitter is not available.

71. The strobe circuits consist of a delay phantastron V15, V16, V3b, which is triggered from the timebase phantastron. The delay phantastron then controls the expansion flip-flop, V17, V18, and the latter in turn drives a strobe pulse generator V19, V21, which produces a pulse which is fed out of the console into the associated PPI console. The strobe pulse is also fed into the IFF indicating unit. Provision is made for expanding the strobed portion of the trace to cover a range of about three miles (*para.* 22).

Video circuits

72. There are three video inputs to the IFF display system, viz., IFF responses, radar video (which may be from the radar video output of panel 10, or from the associated PPI console) and range marks, which are always fed in from the PPI console. Both the radar video signals and the range marks are positive-going, and are applied to the two control-grids of the double-triode valve V24, the calibration mixer. The output of the latter is a mixture of radar video and range marks, all negative-going; it is amplified by V11, DC restored by V12, and fed into the video mixer valves V13, V14.

73. V13 and V14 share a common anode load resistor; radar video and range marks are fed to V13, and IFF video to the cathode of V14. These valves do not conduct simultaneously, but are switched by divider waveforms from V9, V10. Assuming a division of six to one, V13 will conduct during five out of every six sync. cycles, and V14 for the other one.

74. While V13 is conducting, the mixed radar responses and range marks appear as negative signals at the common output terminal, and during the time V14 is conducting, the IFF responses appear as positive signals. These are fed into the video amplifying valves on the IFF indicating unit.

75. Two separate traces appear on the IFF indicating unit, the upper one being initiated by the IFF sync. pulse, and the lower by the radar sync. pulse. The distance between these traces can be controlled by a preset potentiometer marked TRACE SEPARATION. The IFF responses appear upon the upper trace, and the radar/range marks mixture upon the lower one.

Indicating unit (IFF) Type 31

76. The indicating unit Type 31 carries a six-inch CRT; it contains a timebase generator, V1-V5, the video amplifier V6, V7, already referred to, and high voltage smoothing circuits. The timebase generator is of the Miller type and is similar to that used in the radar timebase unit. The valves V8 and V9 are DC restorers.

77. The high voltage supply for the CRT is obtained from the power unit Type 875 (panel 13). A 300-volt positive supply for the timebase unit is obtained from the power unit Type 871 (panel 2) and a negative 350-volt supply from the power unit Type 874 (panel 12). Power unit Type 873 (panel 8) provides heater current for all the valves in the IFF timebase and indicating units, and also 750V positive HT for the timebase and video output valves. It also provides an 800-volt floating supply for X-shift and X-stig. circuits.

Power supplies

78. The power unit Type 870 provides the following supplies:—

HT.3	..	950V positive to panels 11 and 15
HT.4	..	1,000V floating supply for stigmatism and shift voltages on panel 15
LT.4	..	6·3V to X-plate DC restorer valve V4 in panel 15

LT.5 .. 6·3V to X-plate DC restorer valve V5 in panel 15
LT.6 .. 6·3V to diode V11 in panel 11
LT.7 .. 6·3V to the Y-amplifiers V2, V3, and diode V10, in panel 15
LT.17 .. 4·0V to V1 and V2 and thermal delay in panel 1
LT.18 .. 2·0V to V3 in panel 1.

79. The power unit Type 871 provides the following supplies:—

HT.8 .. 300V positive to V2, V3, V4 in panel 2 (via the MAINT SYNC position of switch SI on panel 9), to V2 and V4 in panel 10, to V7 in panel 15, and to certain valves in panels 5 and 7. It is also available for external use from Jones plug D1 on panel 17
LT.13 .. 6·3V to V2, V3, V4 in panel 2, and to the illuminating lamps in panel 15
LT.23 .. 5·0V to the rectifier valve V1 and thermal delay in panel 2
LT.14 .. 6·3V to V9 in panel 6.

In addition, the unit provides a 48-volt DC supply for the operation of various relays, and a 17-volt supply for the indicating lamps on the control desk. The power unit also incorporates an oscillator which generates a sync. pulse for routine servicing. The 48-volt supply is available for external use at A9 on panel 17.

80. Power unit Type 872 provides the following supplies:—

HT.5 .. 280V stabilized to panel 11
HT.6 .. 300V stabilized to panel 11
HT.7 .. 380V positive to panel 6
STB.1 .. 280V positive to the screening-grids of V1 and V2 in panel 4A and to V12 in panel 11
STB.2 .. 210V positive to the screening-grid of V4 in panel 4B
STB.3 .. 140V positive to the screening-grids of V1, V2, V3, in panel 4B, via the CAL key on panel 16
LT.8 .. 6·3V to V1, V4-V10, V12-V15 in panel 11
LT.9 .. 6·3V to V2, V3, and V5 in panel 11
LT.10 .. 6·3V to V1-V8, V10, V11, in panel 6 also to V5 and V6 in panel 3
LT.19 .. 5·0V to V1 and thermal delay in panel 3
LT.20 .. 6·3V to V2 in panel 3
LT.21 .. 6·3V to V3 in panel 3.

81. Power unit Type 873 provides the following supplies:—

HT.10 .. 750V positive for panel 5, timebase and video valves
HT.11 .. 800V floating for X-shift and stigmatism circuits on panel 5
LT.24 .. 6·3V to valves on negative rail of panel 7
LT.25 .. 6·3V to V16 on panel 7
LT.26 .. 6·3V to V1-V4 on panel 5, and to valves returned to earth on panel 7, also CRT heater transformer in PL.5
LT.27 .. 6·3V to V5 on panel 5
LT.28 .. 6·3V to V6, V7 on panel 5
LT.29 .. 6·3V to DC restorer V8, panel 5
LT.30 .. 6·3V to DC restorer V9, panel 5
LT.31 .. 2V to V1 on panel 8
LT.32 .. 4V to V2, V3 and thermal delay on panel 8.

82. Power unit Type 874 provides the following supplies:—

HT.1 .. 300V positive, super-smoothed, for video circuits in panels 10 and 15
HT.2 .. 315V positive to panel 4
HT.9 .. 350V negative to panel 7
LT.1 .. 6·3V to V6, V8 panel 4B, V2, V4 in panel 10 and V7 in panel 15
LT.2 .. 6·3V to panel 4 (one side earthed), i.e. V1-V8 in panel 4A, V1-V5 in panel 4B, and V1-V2 in panel 4C
LT.3 .. 6·3V to V1, V3, in panel 10 and V1, V101, V6, in panel 15
LT.15 .. 5·0V to V1 and its thermal delay on panel 12
LT.16 .. 5·0V to V2 and its thermal delay on panel 12.

83. The power unit Type 875 can be arranged to give either a 4 kV or a 5·0 kV output, and gives the following supplies:—

LT.11 .. 4·0V to V9, the CRT in the indicating unit (CRT) Type 32
LT.12 .. 6·3V to V8 in the above unit
EHT.1.. 5·5 kV to the radar CRT (panel 15) with tapped-down focus and first anode voltages
EHT.2.. 5·0 kV for the IFF indicating unit (panel 5).

Control panel Type 644

84. The right-hand control desk is known as panel Type 644. It carries eleven G.P.O. key switches, an ON-OFF switch for the console, and three potentiometer controls. The key switches, reading from left to right on the top row are:—

S1—NBW IN This key operates relays on the amplifying unit (IF) Type 294, and so switches the narrow bandwidth unit into circuit when the key is operated. An opal lamp is lit when the narrow bandwidth unit is in circuit.

S2—STC IN This key operates a relay in the amplifying unit (AJ and video) Type 295, switching into circuit an input network and an additional cathode-follower before the primary limiting valve. An opal lamp is lit when this relay is energized.

S3—LPF IN A relay in the amplifying unit Type 295 is energized when this key is operated. This relay causes a low-pass filter (cut-off frequency 500 kc/s) to be inserted into the video chain between V2 and V3 on panel 10. An opal lamp is lit when the filter is in circuit.

S13—TOP PHASE ANTI-PHASE This is the gap-filling key, and is used on radar Type 15 only. Its use is explained in para. 30.

S7—ELEV. STROBE — This key is used to produce an elevation strobe where radar Type 13 is a portion of the installation. In certain conditions it may be re-labelled AZIM. IND., where an azimuth indicator strobe is used on the H/R tube (*para.* 9).

S12—PPI STROBE — This key operates a relay in the associated PPI console, causing the timebase to be flashed. This facility is used for radar range correlation between the PPI and H/R operators.

85. The keys on the second row are:—

S5—CALIB. — The calibration pips are always fed into the main radar display, where they are normally mixed with the video signals at low amplitude. The CALIB. key removes the normal radar video signals from the display and increases the amplitude of the calibration signals (i.e. range marks) when these are required alone on the display. An opal lamp lights when the switch is ON.

S10—HEIGHT PHASE NORMAL — This switch is used in conjunction with radar Type 15 only, as explained in para. 25 to 28.

S9—A-BAND ON — This key is ineffective because IFF Mk. 3 is no longer fitted to the radar heads.

S6—RANGE — This key switch enables the operator to select the required one of the three ranges available on timebase unit Type 136, the appropriate circuit changes in this unit being effected by relays. The three ranges are:—

Medium Red lamp lit Short Amber lamp lit Long Green lamp lit	The range on the indicating unit must be read from the correspondingly coloured scale

86. Below the second row of key switches is a further key switch S11 labelled P.R.F. (SMALL SHIFT/NORMAL/HALVED) and below this an ON-OFF switch for the console (S8). The p.r.f. switch provides a choice of two p.r.f., viz. 250 or 500 Hz. the choice being dictated chiefly by local operational considerations. A third position marked SMALL SHIFT is for use on radar Type 15 only. An explanation of its necessity is given in para. 31 to 34.

87. Near the bottom of the panel are three potentiometer controls, R15, IF GAIN, R16, N.B.W. TUNE, and R5, I.F.F. GAIN control. R15 gives a variation of about 40dB in the gain of the i.f. unit Type 294. The N.B.W. TUNE control is used to adjust the middle of the passband of the narrow bandwidth unit, and the I.F.F. GAIN control is ineffective due to the removal of the associated equipment.

Control panel Type 643

88. This is the left-hand control desk of the console. It carries the following controls:—

(1) An ON-OFF switch for the elevation control motor.
(2) A potentiometer control RANGE MARKS AMP. which controls the amplitude of the range marks (calibration).
(3) A non-locking key switch operating with the GPO telephone circuits. This has a reversible label, one side being marked 'SPEAK F.T.—SPEAK F.T.2', and the other 'SPEAK T.C.—CALL T.C.'. It also carries two telephone jacks, which are wired in parallel, and connected by twisted pairs to the GPO 64-pole socket on the floor of the panel.

Panel (sync and blanking) Type 642

89. This is an interconnection board situated in the space between panels 6 and 11; it is screwed into position, as it has no internal settings to be made. It carries two switches, namely:—

(1) S1—SYNC switch. This has four positions:—

(*a*) Servicing sync. (Negative), marked L.P.O.
(*b*) Type 11 sync. (Negative), marked T11
(*c*) Type 13 sync. (Positive), marked T13
(*d*) Type 14 sync. (Positive), marked T14.

Normally, the console display is initiated by a sync. pulse from one of the above transmitters, but when servicing is required and the transmitter is switched off, the servicing sync. is used. In this case the sync. pulse is obtained from the local pulse oscillator in power unit Type 871. In the other positions of the switch the h.t. supply to the l.p.o. is interrupted, and a dummy load is thrown upon the power unit to prevent voltage rise. Modification CA799/1 has been carried out to enable the negative sync. from the l.p.o. to be switched into timebase unit 136, to suit modifications CA670/1, 671/1 and 672/2.

(2) S2—BLANKING switch. This switch has three positions:—

(*a*) EXTERNAL.
(*b*) ELEVATION SCAN.
(*c*) OFF.

In the EXTERNAL position the console display is suppressed at certain instants by the application of a negative waveform. In the ELEVATION-SCAN position, the switch is used to feed into timebase unit Type 136 a blanking waveform generated in timebase unit Type 134. This limits the visible implitude of the upper part of the trace on the c.r.t. which otherwise would bend over like the top of a sine wave. In the OFF position the wiper blade of the switch is earthed.

Input panel Type 645

90. The input panel is the main termination panel of the console, and is placed at the bottom, below the indicating unit (CRT) Type 32 and control desks. It is screwed into position and carries the following components:—

(1) 16 coaxial sockets.
(2) Five 12-way Jones plugs, lettered A to E.
(3) Two 3-pole, 5-amp mains sockets wired to the mains supply via fuses F3, F4, for soldering irons, inspection lamps, etc.
(4) Four pairs of mains fuses:—
F1, F2—regulated mains, to ON/OFF switch S8 on panel 16, F3, F4, and mains sockets.
F5, F6, F7, F8 not used.

91. All the radar external connections are made through either the coaxial sockets of Jones plugs A, C, D and E. Jones plug B is not at present used.

Illumination of display

92. Rear illumination of the c.r.t. is provided by four lamps disposed symmetrically around the flare of the tube, the intensity of the lighting being controlled by a rheostat on the indicating unit. The range scale on the indicating unit is illuminated by two lamps, one at each end of the scale.

93. The lamps are fed from a 6·3V supply on power unit Type 871 (panel 2). The wiring of all lamps is balanced to earth to reduce the hum field caused by the current in the wiring. The wiring is earthed only at one point.

Thermostat temperature control

94. The thermostat has a pair of contacts which are closed when the ambient temperature is below a predetermined figure, and is open when the temperature is exceeded. The thermostat is wired to the input panel, Jones plug C, pins 11, 12. This circuit can be used to control an a.c. relay, and the latter in turn can be used to regulate the heating and ventilation system of the console. The exact arrangements differ in mobile and static applications.

CONSOLE TYPE 61A

95. In certain static applications, e.g. in CHEL stations, a console Type 61A is fitted for the detailed examination of responses over a limited range of about 10 miles upon the azimuth on which the aerial array is laid. When used in this manner, the console is generally referred to as the A-scope. The information is presented upon the main indicating unit, indicating unit (CRT) Type 32.

96. The A-scope is invariably associated with a PPI console, the timebase of which is sweeping from zero to a predetermined maximum range in the normal manner. The limited portion of this sweep which it is desired to examine in detail by the A-scope is selected by the PPI operator. This is done simply by setting the STROBE control on the PPI to the range at which the A-scope sweep is to commence.

97. The console Type 61A is therefore, to all intents and purposes, a console Type 61 from which the timebase unit (range) Type 136 has been removed, and a timebase unit (A-scope) Type 139 fitted in its place. The sync. switch on the sync. and blanking panel is also labelled differently, the positions being:—

(1) L.P.O. (servicing sync.).
(2) Negative sync.
(3) Positive sync.
(4) A-scope sync.

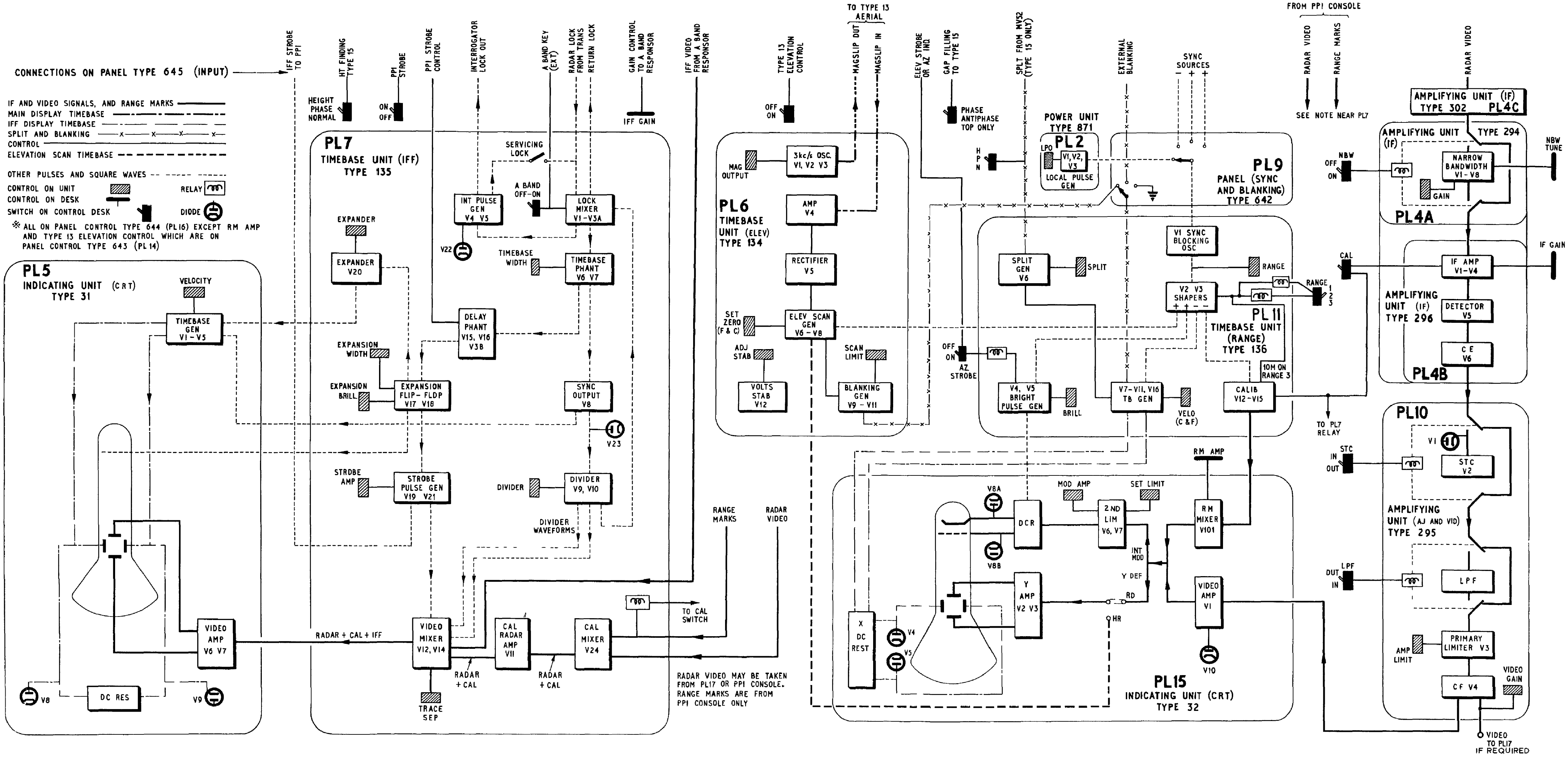
98. The A-scope timebase is triggered by the strobe pulse produced in timebase unit (IFF) Type 135, and the duration of the timebase stroke is sufficient only to give a range of about 10 ◀data▶ miles. Since the instant of occurrence of the strobe pulse can be set at will at any range on the timebase of the associated PPI, the operator can select any portion of the sweep for detailed examination by the A-scope.

99. The radar trace on IFF timebase unit Type 135 is triggered by a pulse from one of the delay units Type 31 in the master trigger unit (rack assembly Type 180). The PPI timebase is triggered from another delay unit in the same rack assembly. The delay units are adjusted in such a manner that both timebases start to sweep at the instant that the first ground return reaches them.

100. The sync. pulse from delay unit Type 31 is fed into the A-scope console at coaxial plug P13, and thence to Jones termination A4 on IFF timebase unit Type 135. This triggers the upper (IFF) trace on the IFF display tube.

101. The strobe pulse leaves the A-scope console at coaxial plug P2, for display on the PPI console. P2 is also linked inside the A-scope input panel to coaxial plug P16, which is connected by a coaxial jumper lead to coaxial plug P4 on the input panel. P4 in turn is connected internally to the A-scope SYNC. position of the sync. switch on panel Type 642 (sync. and blanking). When the switch is in this position therefore, the strobe pulse is fed into the A-scope timebase unit at termination A4 and initiates the 10-mile timebase for the main radar c.r.t.

102. A calibrator circuit in the A-scope timebase produces range marks at 1 ◀data▶ mile intervals upon the expanded A-scope display.



Console Type 61, block schematic

Fig. 5

Chapter 2

INSTALLATION

LIST OF ILLUSTRATIONS

Fig. 2. Console Type 61 in RVT 510

Installation at fixed ground radar stations

1. Consoles Type 61A and Type 61 are installed in certain types of static radar stations, console Type 61A being used where the requirement is for the "A-scope" role. They are located in the track telling room, control cabin, intercept cabin, etc., as applicable to the particular function of the station. Each of these rooms is fitted with a false floor supported on girders above the main floor. The space between the two floors is utilized to accommodate an air supply duct and an air exhaust duct, and all the permanent wiring to and from the consoles is also run in this space.

2. Each console is mounted on a metal plinth which stands on a sub-plinth consisting of a rectangular piece of multi-ply board; this is perforated to admit the cables and the air supply and exhaust fittings. The attenuators referred to in para. 11-13 are fitted inside the metal plinth.

3. A sectional view showing the method of fitting the air supply and exhaust is given in fig. 1.

4. All electrical supplies for the console, with the exception of co-axials, are taken into the console by connectors consisting of cable-forms terminated at each end by a Jones plug or socket. Each of the latter is marked with its distinguishing letter. The permanent wiring is run on perforated channel plating and, except in the case of coaxial cables, is terminated on Jones sockets mounted in a cable outlet box. Coaxial cables are unbroken however, being wired from the console to the destination in a single length.

5. As the input panel is on the outside of the console, it is not necessary to take any special precautions to secure airtightness where the cables pass through the false floor.

Installation in mobile operations room Type I (RVT. 510)

6. Two consoles Type 61 are normally installed in the RVT.510 at the rear end of the container, as shown in fig. 2. The floor of the personnel space is fitted above the bottom of the container, the space between them being called the under-floor cavity. This cavity is used to supply air to the personnel space through large metal grilles in floor, and the two H/R consoles are mounted over two of these grilles, on large shock absorbers.

7. The metal channels in which the various cables are run are also installed in the under-floor cavity. The cooling air for the consoles is supplied by a blower (called the instrument fan) housed in a compartment over the drivers cab. The air trunk from the fan runs down the fore off-side corner of the container and into the under-floor cavity, branches being then provided for the information generator, PPI consoles, and H/R consoles. Air from the appropriate branch enters the console through a large rectangular duct at the front end of the metal grille already referred to. The cable entry is immediately in front of this duct.

8. Two heaters each rated at 6·07 kW are fitted on the vertical portion of the air trunk with the heating element inside the trunk. These heaters are controlled by a humidity detector in such a manner that power cannot be applied to the radar

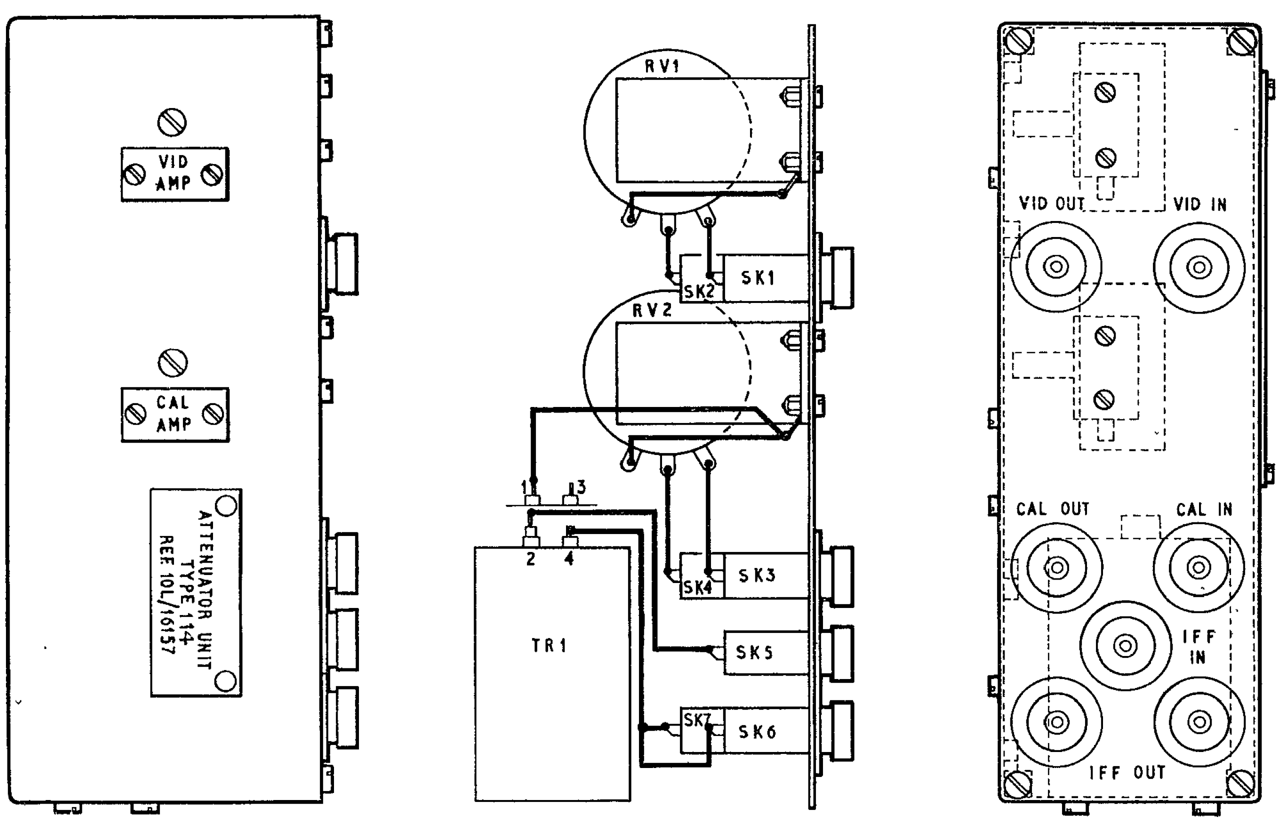


Fig. 3. Attenuator unit Type 114

equipment until the relative humidity inside the consoles has fallen below 60 per cent. An overriding control is however, provided for use in the event of a defect in the humidity detector system.

9. Two additional 2·4 kW heaters are fitted in the air branch supplying the two H/R consoles. These are controlled by two overheat thermostats in the heaters themselves, in series with a local heat thermostat in each H/R console.

10. The heated air from each console leaves at the top, and passes through a short trunk shaped somewhat like an inverted L. A shutter is fitted in this trunk to permit the console to be operated in one of two conditions, i.e. either completely exhausting to the outer air, or completely exhausting into the personnel space. There is no intermediate setting, and the shutter must be latched in the selected position.

Attenuation devices

11. In both static and mobile applications, the consoles Type 61 and 61A derive their radar video, IFF video, and range marks inputs (for supply to the indicating unit CRT (IFF) Type 31) from an associated PPI console. The level of the radar video and range marks inputs is too high for the console requirements, and the IFF input is not correctly matched. It is therefore necessary to introduce an attenuator into each of the radar video and range marks inputs, and an auto-transformer into the IFF input circuit.

12. In RVT.510, the necessary attenuators and auto-transformer are mounted in distribution panel No. 1 and 2 which are installed beneath trapdoors in the floor, in proximity with the H/R consoles with which they are associated. These panels are described in A.P.2897Q, Vol. 1 dealing with the mobile operations room, Type 1 (RVT 510). Although the method of mounting is different, the individual items are identical with those used in static applications. In the static application however, the items are mounted inside a small unit known as attenuator unit Type 114 (Stores Ref. 10L/16157), which is fitted inside the metal plinth.

13. A front view, side view, and circuit schematic of this unit are given in fig. 3. The unit consists basically of a small case containing two potentiometers, and auto-transformer, and seven sockets for connection to the external circuits. The unit is fitted inside the front of the plinth on which the console stands, at the left-hand side. The plinth is perforated to permit screwdriver adjustment of the potentiometer settings.

Chapter 3

PREPARATION FOR USE AND SETTING-UP INSTRUCTIONS

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LIST OF ILLUSTRATIONS

APPENDIX

GENERAL NOTES ON SETTING-UP

Range/deflection display

1. The range/deflection display is capable of use on three ranges:—

Range 1	0 to 75 ◀data▶ miles
Range 2	0 to 150 ◀data▶ miles
Range 3	0 to 260 ◀data▶ miles

All three scales are engraved upon a single perspex strip affixed to the c.r.t. spinning so that the scale lies across the horizontal diameter of the tube screen. Range 1 scale is coloured red, Range 2 amber, and Range 3 green, corresponding with the colours of the indicating lamps associated with the RANGE switch.

2. The transmitting equipments associated with these consoles usually transmit either on 500 Hz or 250 Hz p.r.f. The setting of the PRF switch must agree with the setting on any associated PPI console displaying the same radar information. The p.r.f. in use has an important bearing upon the maximum range actually obtainable in any position of the RANGE switch. The waveforms in timebase unit (range) Type 136 are given in Part 2, Chap. 3, fig. 8 of this Volume, the appropriate ones in the present discussion being those at V9 and V10 anodes. On RANGE 1, the ratio of the forward scan to the total timebase period is shown to be about 1 to 2; taking the velocity of electromagnetic waves at ◀163,000 data▶ miles per second, with a p.r.f. of 500 Hz, the maximum possible range on RANGE 1 is 80 ◀data▶ miles, so that the full red scale can be covered at this p.r.f. On RANGE 2, the ratio is about 4 to 5, so that at 500 Hz the maximum obtainable range is only about 130 ◀data▶ miles. It follows therefore that to fill the amber scale (150 ◀data▶ miles) the p.r.f. must be reduced to 250 Hz. Similarly, with a p.r.f. of 500 Hz, RANGE 3 would give only about 135 ◀data▶ miles range, but with a p.r.f. of 250 Hz, about 270 ◀data▶ miles could be obtained.

3. As a result, when operating at a p.r.f. of 500 Hz (PRF key at NORMAL), if the RANGE switch is thrown to RANGE 2 and the trace is lengthened beyond about 130 ◀data▶ miles, the timebase will start to trigger at half the transmitter p.r.f., *i.e.* 250 Hz. This is not a stable condition and should not be allowed to persist. Similar considerations of course apply to any attempt to use RANGE 3 on 500 Hz p.r.f.

4. From the foregoing remarks, it follows that as a rule, the console should be set up to operate either upon 500 Hz (NORMAL) or 250 Hz (HALVED) according to the requirements of the associated PPI console, and no attempt made to change the p.r.f. during operation. There are certain exceptions, *e.g.* where the H/R console has its own individual aerial head. Command or Unit Orders must be consulted in this respect.

Elevation-scan display

5. Before setting up for elevation-scan display, the console should be set up for range/deflection display, with the range switch set to the range upon which it is intended to work, and with the PRF switch set to correspond. The displayed signal may be obtained from the Type 13 head, with the beam elevation set between—1 deg. and zero deg. (including squint angle, *para.* 9) and the azimuth set to a bearing giving suitable permanent echoes. Since the height lines must be drawn upon the face of the tube according to the instructions given in Part 3, it is quite impossible to change the operating range without either changing the tube or completely erasing the height lines on the existing tube. In either case a complete recalibration is necessary.

Note . . .

A link has to be set in timebase unit (elevation) Type 134 according to the range required. The marking of this link is somewhat ambiguous, and care should be taken that on RANGE 1, *the* 3·3 *megohm resistor R*81 *is short-circuited, or on* RANGE 2, *the* 1·5 *megohm resistor R*45. *This link is shown in illustrations in Part* 2, *Chap.* 4. (*In timebase unit* 134*A*, *R*45 *is* 680*K and R*81 *is* 1·5*M*).

6. When used in RVT.510, the putting-on (PPI) console is a Type 60. This console has only two ranges, *viz.* RANGE 1, 0 to 130 miles approx., using a p.r.f. of 500 Hz, and RANGE 2, 0 to 260 miles approx., using 250 Hz p.r.f. It is convenient therefore to operate with a p.r.f. of 500 Hz, using RANGE 1 on the PPI console, and on the H/R console, either RANGE 1 (0 to 75 miles) or, preferably RANGE 2, with the range limited to 130 miles to avoid triggering at half p.r.f. (*para.* 3). In the latter case, both PPI and H/R consoles will be working to the same maximum range, *viz.* 130 miles. In static stations the putting-on console will normally be a Type 64, with approximately the same working ranges as the Type 60. Both the PPI and H/R consoles will then normally operate on 250 Hz p.r.f. for RANGE 2.

7. The H/R console embodies its own timebase calibration system, and it is desirable that this should agree with the putting-on PPI range calibration. The PPI calibration is (in current installations) derived from a marker unit Type 27 in the information generator rack. An output from the marker unit can also be fed into the radar video channel of the H/R console, so that calibration marks appear on the trace in the form of bright spots; the calibration oscillator on H/R console timebase (range) unit Type 136 can then be adjusted so that the normal (*i.e.* vertical deflection) calibration marks coincide with the bright spots, after which the marker unit input is removed and the normal radar video input restored to the H/R console.

'Nodding' arrangements on Type 13 aerial

8. Referring to Part 1, Chap. 1, para. 12 to 18, and

Part 2, Chap. 4, para. 9 to 11, the Type 13 aerial is driven mechanically over an arc of 21 deg. by an arm pivoted at the aerial and attached to a rotating crank mounted upon a vertical shaft. The length of the driving arm is preset (*para.* 14). The vertical shaft is in turn driven by a motor inside the aerial cabin.

9. The radar beam is not projected perpendicularly to the face of the aerial reflector, but makes a small downward angle, referred to as the 'squint' angle. This angle varies with frequency over a range of about $2\frac{3}{4}$ to $5\frac{3}{4}$ deg. (The relation between frequency and squint angle is shown graphically in *fig.* 1).

10. Although in practice the height of a particular aircraft at a stated range is read directly from a height line (or by interpolation between two height lines), what is actually measured is (i) the slant range and (ii) the angle of elevation of the radar aerial at which a response is obtained from the aircraft. It can be shown that a given error in measurement of the angle of elevation gives a corresponding error in height measurement which increases directly with the slant range. The degree of accuracy of height measurement aimed at is 'not exceeding 500 feet at 100 ◀data▶ miles' and to keep the error within this limit, the total error in measurement of elevation must not exceed 0·25 deg. It is essential therefore that the whole of the setting-up procedure should be performed with the utmost care.

Brief description of indicator, mechanical, Type 101

11. Indication of the angle of tilt of the Type 13 aerial system is provided by an attachment to the latter, known as the indicator, mechanical, Type 101. This is a water-tight metal case mounted upon the right-hand support frame of the aerial.

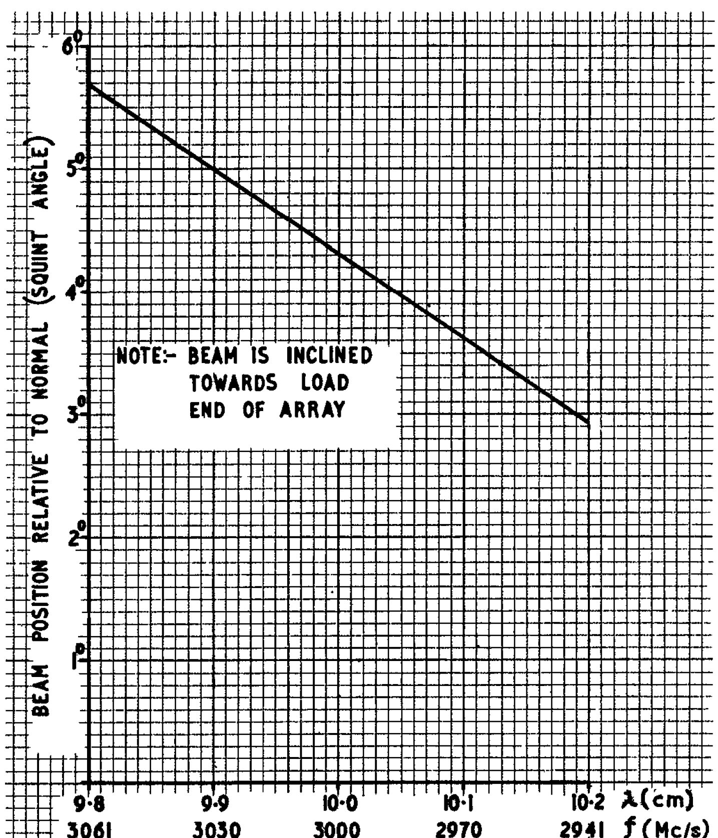

Fig. 1. Squint angle versus frequency

It contains an assembly of gearing, driven through an Oldham coupling from the trunnion upon which the reflector pivots. This gearing in turn drives (i) a magslip acting as a variable-voltage transformer and (ii) a five-point rotary switch.

12. The magslip primary windings are supplied with a single-phase a.c. voltage at 3 kHz, derived from the MAGSLIP OUT terminals of timebase unit (elevation) Type 134. The magslip secondary voltage is at the same frequency, but varies in amplitude according to the angle of tilt; it is fed back into the elevation timebase at the MAGSLIP IN terminals. This voltage is then used to produce the Y deflection on the c.r.t. screen.

13. The five-point rotary switch is connected in a 50V d.c. circuit, and on passing each contact in the upward direction, as the aerial nods, a relay in timebase unit (range) Type 136 is energized, so producing strobe brightening pulses at 0 deg., 5 deg., 10 deg., 15 deg., and 20 deg. on the elevation-scan display.

14. From the foregoing, it follows that although the arc through which the aerial nods is always 21 deg., and the arc through which the radar beam swings is always from —1 deg. to 20 deg., the latter are not the angles between which the reflector actually nods. In fact, compensating adjustments are necessary to both the driving arm (*para.* 8) and the magslip coupling (*para.* 11 and 12), to allow for the variation of squint angle with frequency. The driving arm is fitted with a turnbuckle-type adjuster so that the initial angle of tilt can be adjusted when setting up zero reference reading (A.P.2527B).

Red spot indicators

15. As described in A.P.2527B there have been several versions of indicator, mechanical, Type 101 but by the time this amendment is in print all radars Type 13 should be fitted with jig-set indicators. These have been introduced to give greater accuracy of height indication and to make it possible to interchange indicators without recalibration of the H/R c.r.t.

Note . . .
An indicator which has been set up on a radar head with long connecting lines to the associated console may not give the same results if transferred to a head with short lines. It is advisable therefore to note on which type of head the indicator has been set up and to transfer it only to a similar type head.

16. A jig-set indicator is identifiable by a red spot painted close to the squint angle knob on the gear assembly panel (just above the magslip body). The indicator is assembled using jigs which ensure that there are already 10 deg. of coupling on the magslip when the aerial starts its upward sweep. The operational arc of 21 deg. is then on the most linear part of the magslip characteristic. This provides optimum accuracy in the height readings.

Height calibration

17. Before attempting the height calibration of the console the radar Type 13 aerial reflector and the indicator, mechanical, Type 101 must be set up in accordance with the instructions given in A.P.2527B. The calibration of height lines on the console can then be carried out, following the instructions given in Part 3, Chap. 4 of this Volume.

SETTING-UP FOR RANGE/DEFLECTION DISPLAY, CONSOLES TYPE 61 AND 61B

Preliminary adjustments

18. Make the following preliminary adjustments:—

(1) Adjust the tapping on the e.h.t. transformer (power unit Type 875) for 5·5 kV working.

(2) Connect the links on the indicating unit (c.r.t.) Type 32 for range/deflection display. These links are accessible through a cover plate on the underside of the unit. Remove the lower of two screws securing the circular cover plate, and swing the latter sideways, so exposing the links. For range/deflection working, the links must be placed between the middle and the right-hand clips.

(3) Ensure that the following keys on the right-hand control desk are OFF: AZIM. IND., NBW, STC, LPF, A-BAND. Set the PRF key to NORMAL (500 Hz) or HALVED (250 Hz) as required (*para.* 2) and the HEIGHT/PHASE/NORMAL switch to NORMAL.

(4) Turn the BRIGHTNESS control on the indicating unit fully counter-clockwise, and the RANGE MARKS AMP. control on the left-hand control desk fully clockwise, then rotate the latter counter-clockwise through 90 deg.

◄(5) Lower the right-hand control desk to give access to the sync. and blanking panel and timebase 136. Place the BLANKING switch on the sync. and blanking panel in the OFF position, the SYNC. switch to L.P.O. and the TEST/OP switch on the timebase unit to TEST. The latter operations prepare the local pulse oscillator in power unit Type 871 for use when the console is switched on.►

(6) Return the control desk to normal position and close all switches in the power supply system, outside the console. Finally, switch the console on by the ON/OFF switch on the control desk.

(7) Wait at least five minutes for the console to warm up.

(8) Monitor the cathode current of the stabilizer valve in power unit Type 872. This is done by putting the monitoring selector switch on power unit Type 871 into position 8, and connecting a jumper lead between the jack on power unit Type 871 and the jack on power unit Type 872.

The switch on the latter should then be set to position 11. The cathode current of the stabilizer valve should be 20 mA. If incorrect, adjust by preset potentiometer ADJUST STAB., mounted just behind the front panel of power unit Type 872.

Setting-up the indicating unit c.r.t.

WARNING

At all times, great care must be exercised when turning up the BRIGHTNESS control, since the screen of the c.r.t. may be damaged if excessive beam current is permitted.

19. The indicating unit is set up as follows:—

(1) Adjust the p.r.f. of the local pulse oscillator to 500 or 250 Hz, as required. This is done by means of the control marked L.P.O. FREQ. on power unit Type 871.

(2) Set the CALIB. key on the control desk to ON, then lower the desk.

(3) Turn the BRIGHTNESS control on the timebase unit (range) fully counter-clockwise.

(4) Adjust the BRIGHTNESS control on the indicating unit c.r.t. until the trace is just blacked out.

(5) Return to the timebase unit (range) and turn the BRIGHTNESS control clockwise until the trace is of normal brilliance.

Note . . .
This control should not require any further adjustment, any future variation of brilliance being obtained by adjustment of the BRIGHTNESS *control on indicating unit (c.r.t.) Type* 32.

(6) Adjust the X-STIG. and Y-STIG. controls to obtain a sharply defined trace. These controls are located at the bottom of the indicating unit panel and are adjustable through two apertures, by a $\frac{1}{4}$ in screwdriver. The manual calculator panel must be swung forward on its hinges to obtain access. This necessitates slacking off two knurled nuts, one on each side, and withdrawing the coaxial plug for the lamp circuit. These must be replaced after the adjustment has been made.

Note . . .
The X-STIG. *control should first be moved over a few degrees, then adjust the* FOCUS *control, observing the focusing of the calibration pips at the end of the trace. Repeat this process until the best over-all focus is obtained. Similarly, adjust the* Y-STIG *and* FOCUS *controls, this time watching the focus at the tips of the calibrator pips. After each movement of the stig. controls, a slight pause should be made before making any further adjustment, as there is a short delay before the effects become apparent. When the over-all focus is as sharp as possible, replace the manual calculator and its lighting circuit.*

Adjustment of power unit Type 875

WARNING

Great care must be taken when dealing with all power supplies; in particular, power unit Type 875 should be disconnected and the filter capacitors allowed to discharge for at least half a minute before touching any electrical connection on the unit. The input power supply may be removed from the power unit, without affecting other units, by disconnecting Jones plug A. This should always be done before touching the small cableform between the power unit and indicating unit (c.r.t.) Type 32.

20. If, after carrying out the foregoing procedure, it is obvious that the over-all focusing is below an acceptable standard, it will be necessary to alter the tappings on power unit Type 875. The latter is located behind the right-hand control desk, which must be lowered to ground level and the power unit removed from the rack. The focus potentiometer may be connected across links 3 and 4, or 4 and 5 (counting from the earthy end of the chain), so that there is always only one 330 K resistor in parallel with it. The first anode voltage must not exceed 2 kV.

21. When the focus potentiometer is across links 3 and 4, the first anode potentiometer should be across links 1 and 2; similarly, when the focus potentiometer is across links 4 and 5, the first anode potentiometer should be across links 2 and 3. In this way, the same voltage difference is maintained between the first anode and the second (focusing) anode. If it is found that the best focus is obtained at the extreme end of the focus control, the short-circuiting link should be removed from position A at the front of the tagboard, to position B at the rear, or vice versa. The usual position for the first anode potentiometer is across R19, i.e., between links 1 and 2, and the second anode potentiometer is then connected across links 3 and 4.

Timebase adjustment

22. With the exception of the X-SHIFT control (on the front panel of the indicating unit) and the range switch on the control desk, all the controls referred to in this and the following paragraphs are mounted on the front panel of timebase unit (range) Type 136.

23. All three ranges may be set up by l.p.o. sync., subject to checking with normal transmitter sync. as instructed in para. 28. For range 1 the p.r.f. should be set to 500, and for ranges 2 and 3 to 250.

24. The timebase is set up as follows:—

(1) RANGE 1.

(a) Switch to RANGE 1 on control desk.

(b) Adjust the RANGE 1 control to supply the correct number of pips, *i.e.* 15. Note that the first pip corresponds to 5 miles, not zero.

(c) By alternative adjustment of the X-SHIFT control and VELO 1 COARSE SWITCH arrange that the first and last but one pips lie on the correct range scale divisions, with the remainder of the pips as nearly aligned as possible. (Since the extreme end of the trace may be slightly non-linear, the last but one pip is used in preference to the last one).

(d) Using the VELO 1 FINE and X-SHIFT controls alternately, line up the range marks exactly with the scale, up to the last but one.

(2) RANGE 2.

(a) Switch to RANGE 2 on control desk.

(b) Repeat the procedure as for range 1, but using the RANGE 2, VELO 2 FINE controls to make the 5-mile range marks correspond with the divisions on the 150-mile scale. A slight X-shift adjustment may be found necessary.

(3) RANGE 3.

(a) Switch to RANGE 3 on control desk.

(b) Repeat the procedure given under RANGE 1, but using the RANGE 3 and VELO 3 controls so that the 10-mile range marks correspond with the divisions on the green scale.

To set up the radar receiving chain

25. If the radar receiving chain has to be set up or checked at an operational site (or elsewhere where an aerial head is available), the operation is best performed by observing the responses from a fixed reflector at a suitable distance, i.e. a so-called permanent echo (p.e.). In certain circumstances reflector plate Type 102 could be used for this purpose, although its primary purpose is to set up an azimuth reference for the aerial vehicle.

Note . . .

Before proceeding on console 61*B, refer to para.* 29.

26. The procedure when using the aerial head is as follows. It is assumed that the transmitter has been switched on, and the aerial head trained on the p.e. or reflector plate bearing, so that the responses are displayed upon the monitoring receiver in the aerial head.

(1) Lower the right-hand control desk and set the SYNC. switch on panel Type 642 in the correct position (T14 on console Type 61, POSITIVE SYNC. on console Type 61A). ◀On the timebase 136, place the TEST/OP switch to OP.▶

(2) Set the BLANKING switch on the same panel fully counter-clockwise (i.e. blanking off).

(3) Replace the control desk. See that the CALIB. switch is off and the RANGE MARKS AMP. control is turned fully counter-clockwise.

(4) Turn the i.f. GAIN control to maximum. Ground wave and responses should now be seen.

(5) Lower the radar indicating unit and withdraw amplifier (A-J) and video) Type 295. Adjust the AMP. LIMIT control (just above the Jones plug) until the ground wave deflection is 6 cm. Then return the amplifier to the normal position.

(6) Adjust the i.f. GAIN control so that the noise level is between 3 and 5 mm.

(7) On the main indicating unit, turn the MOD. AMP. control fully clockwise.

(8) Connect the Y1 plate of oscilloscope Type 13A to the cathode of V7 and adjust the SET LIMIT control so that all signals are limited at the peaks of the noise. A suitable point for connecting the oscilloscope is the metal can of one of the high voltage capacitors C17, C18.

WARNING

The top terminals of these capacitors are at 5·5kV to earth, and great care must be taken during this operation.

(9) Turn the MOD. AMP. control counter-clockwise until the leading edge of the ground wave just disappears. Then disconnect the oscilloscope lead, taking the necessary precautions as in the previous sub-para.

27. The narrow bandwidth unit in the video chain should be adjusted (while receiving a suitable response) as follows:—

(1) Switch the N.B.W. unit in, and set the N.B.W. TUNE control in the midway position.

(2) Withdraw amplifier (IF) Type A.3711, and identify OSCILLATOR control C7, which is between V1 and V2 as seen from the left-hand side of amplifying unit (IF) Type 294. Tune the oscillator for maximum response amplitude on the display, with a non-saturating pulse.

(3) Switch off the N.B.W. key and observe the effect on the displayed signal. If the signal increases in amplitude, adjust the gain control on the front panel of amplifying unit (IF) Type 294 and recheck. Adjust this control as necessary until no change of signal amplitude is observed as the N.B.W. key is thrown on and off.

Final check

28. After the video chain is set up, the stabilizer in power unit Type 872 should be again monitored, and if necessary reset to 20 mA. The calibration should also be checked on all three ranges. The control desk should be lowered and BLANKER control on the timebase unit (range) Type 136 set as necessary to cut out the ground clutter.

Variations on console 61B

29. The setting-up procedure for console 61B is the same as for console 61 to the end of para. 26 (4). Thereafter, read as follows : —

(5) Lower the radar indicating unit and the left-hand control panel. Withdraw the amplifier (A-J and video) Type 295.

(6) On the indicating unit set the VIDEO AMP. control fully clockwise.

(7) On the right-hand control desk set the CALIB. key to ON. Adjust the SET LIMIT control on the indicating unit until the calibration marks are of even brilliance. Return the CALIB. key to OFF.

(8) On the a-j and video unit adjust the AMP. LIMIT control until the amplitude of the displayed signal is 6 cm.

(9) Adjust the i.f. GAIN control so that the noise level is between 3 and 5 mm.

The "Warning" para. does not apply but para. 27 and 28 do.

PREPARATION FOR ELEVATION-SCAN DISPLAY

Console 61

30. The principal difference between the setting-up for deflection display and elevation-scan display on console 61, so far as the video circuits are concerned, is in the setting of the second limiter, *i.e.* the MOD. AMP. control. The link referred to in "Note" to para. 5 must be correctly set for the working range.

Video circuits

31. Assuming that the initial setting-up procedure has been performed as described in para. 18-28, the first subsequent action is to reset the limiters on the indicating unit. This must be done very carefully as follows: —

(1) Turn the i.f. GAIN control on panel 16 to maximum (fully clockwise), then back to just below saturation.

(2) Turn the second limiter (R43, marked MOD. AMP.) to maximum (fully clockwise).

(3) Connect Y1 of the oscilloscope to the cathode of V7 and turn the first limiter (R3, marked SET LIMIT) so that all signals are limited at the peaks of the noise. Para. 26, sub-para. 8 refers: note the warning appended thereto.

(4) Adjust the MOD. AMP. control to give a convenient amount of intensity modulation, i.e. approximately 30 volts peak-to-peak.

(5) Lock the i.f. GAIN control.

32. With the CALIB. switch "off" turn the range marks up to a medium brightness by the RANGE MARKS AMP. control, and operate the Y-SHIFT control to check that the trace moves up and down the tube face. With the Type 13 aerial set to -1 deg. elevation, leave the trace set about 6 cm. below the horizontal diameter of the tube face. Then switch off the console and connect the links on the indicating unit for elevation scan display (*para.* 18 (2) *refers*).

33. Set the SCAN LIMIT control on the timebase unit (elevation) Type 134, fully clockwise.

34. Recheck the stabilizing valve currents, with the trace horizontal (*i.e.* the Type 13 aerial array at -1 deg.). The console is now ready for the actual height calibration. It should be allowed to warm up for at least one hour before starting to calibrate.

Console 61B

35. Assuming that the initial setting-up procedure has been performed as described in para. 29, the first subsequent action is to reset the limiter and gain controls for the i.f. amplifier and on the indicating unit. This must be done very carefully as follows: —

(1) On panel (control) Type 644 turn the i.f. GAIN control to maximum (fully clockwise).

(2) On the indicating unit (c.r.t.) Type 32A turn the SET LIMIT control (R113) to maximum (fully clockwise).

(3) On the oscilloscope Type 13A connect terminal A2 to earth and Y1 to the cathode of V7 in the indicating unit. Adjust the VIDEO AMP. control R1 on the indicating unit until the signals and noise display are just not limiting. A suitable point for connecting the c.r.o. is the metal can of one of the high voltage capacitors C17, C18.

WARNING

The top terminals of these capacitors are at 5·5 kV to earth and great care must be taken in this operation.

(4) Adjust the SET LIMIT control so that the signals are limited to 33V.

(5) Adjust the i.f. GAIN control so that the signal level is 30V.

(6) Lock the i.f. GAIN control.

36. Switch OFF the console and connect the links on the indicating unit for elevation scan display (*para.* 18 (2) *refers*). Switch ON the console and, with the CALIB. key OFF, turn the range marks up to a medium brilliance by the RANGE MARKS AMP. control. Operate the Y-SHIFT control to check that the trace moves up and down the tube face. With the radar Type 13 aerial set to −1 deg. elevation, leave the trace about 6 cm. below the horizontal diameter of the tube face. On the timebase unit (elevation) Type 134A, set the SCAN LIMIT control fully clockwise. Recheck the stabilovolts (*para.* 34).

Note . . .
In the timebase unit 134A a link has to be set according to the range required. The marking of this link is somewhat ambiguous and care should be taken that on RANGE 1 *the* 1·5 *megohm resistor R*81 *is short-circuited, or on* RANGE 2 *the* 680*K resistor R*45.

HEIGHT CALIBRATION PROCEDURE

37. Full information on the procedure for height calibration is given in Part 3, Chap. 4, which should be read in conjunction with A.P.2527B, Vol. 1, (2nd Edn.), Part 2, Sect. 2, Chap. 6. This method of setting-up the radar Type 13 and associated console Type 61 will permit measurement, to within 0·25 deg., of the angle of elevation of an aircraft and thus result in accurate height-finding up to a range of 100 nautical miles. The procedure ensures that: —

(1) The magslip is working on the straight part of its characteristic and the associated component parts are set up correctly.

(2) The aerial head levelling is within the tolerance allowed.

(3) All angular measurements are referred back to a single reference point, for ease of checking.

(4) Certain variables (*i.e.* backlash, cable insulation, etc.) which could affect angular accuracy are eliminated.

(5) The c.r.t. face is calibrated to eliminate the individual characteristics of certain components which could affect angular accuracy.

38. This chapter contains additional information as follows: —

(1) Initial calibration (*para.* 39-55), applicable on first installation, and after a change of c.r.t. or indicator, mechanical, Type 101. These operations take two fitters one working day to complete.

(2) Procedure after replacement of a magnetron (*para.* 56-60). The whole operation takes two fitters approximately 1½ hours to complete.

Initial work at aerial head

Indicator cable

39. Remove the cable connecting the radar cabin to the indicator Type 101 and, with a 500-volt Megger, check the insulation resistance of each lead to earth; this should not be less than 10 megohms. Examine both Niphan and Plessey plugs for internal deterioration, and replace if necessary.

Slip-ring unit

40. It is essential that the aerial head slip-ring resistance should be as low as possible. Slip-rings No. 5 and 41 should be polished and the brushes checked to ensure that they are properly bedded. If the original types of slip-ring brush springs and brushes are fitted, it is recommended that the aerial head should be continuously rotated for at least 1½ hours before attempting to calibrate the H/R display.

Note . . .
*Modification No. CA.*511 *replaces the original type of brush by a silver-carbon type (Stores Ref.* 10*AD*/862) *and increases the brush tension. The rotation period may then be reduced to half an hour.*

WARNING
In static applications using fixed coil PPI presentation, when the head is in continuous rotation for this purpose alone, the associated azication resolver selsyn must be switched off to avoid damage to the sin/cos potentiometer.

Checking cabin level

41. The cabin level must be checked as described in A.P.2527B, On static sites this may involve re-shimming the aerial cabin. On mobile heads the hydraulic jacking system must be adjusted. The subsequent drill may be summarized as follows: —

(1) Place a clinometer on the base plate of the pivot mount in the aerial cabin, rotate the cabin by hand and measure the angular variation from the horizontal at 10 deg. intervals of rotation throughout 360 deg. of rotation of the aerial head. The pivot mount should not vary from true level by more than 2 min over a complete revolution (on mobile sites 6 min may be acceptable).

(2) Observe the outward-looking bearing that gives zero minutes deviation from true level and

record it in the Log in the form *"True level on bearing . . . degrees"*.

(3) Switch the control unit (training) Type 602 in the aerial cabin to LOCAL and (in static applications) the selector unit (training) Type 100 to CABIN. Then, with the turning gear fully run up, set the aerial head to the true level bearing and switch off the turning gear.

WARNING

All the safety precautions must be taken regarding entry to or exit from the aerial cabin; these depend to some extent upon the type of installation, and are the subject of local orders at all stations.

Checking aerial system verticality

42. Modification CA. 365 provides a clinometer plane on the reflector assembly. A.P.2527B contains information on reflector checking using a clinometer and either alignment jig SG47A or a plumb-line.

Indicator, mechanical, Type 101

43. Check the indicator as follows: —

(1) Ensure that the interior of the unit is clean and dry.

(2) Ensure that there is no backlash in the Oldham coupling between the reflector and the indicator.

(3) Examine the magslip brushes, which must be clean, of reasonable length, and bedding properly (*i.e.* no high spots showing on the contact surfaces).

(4) Examine the elevation strobe switch contacts, to ensure that the roller contact is rolling smoothly, and not sliding over, the fixed contacts. With the reflector assembly set to the zero reference reading, ensure that the roller is either on, or just about to make contact with, the zero deg. marker contact.

44. The magslip on the red spot type of indicator, mechanical, Type 101 must be off-set exactly 10 deg. *i.e.*, when the aerial is at −1 deg. the magslip must have 9 deg. of coupling in the direction of rotation. Then, when the aerial is at maximum elevation (*i.e.* +20 deg.), the magslip will have 30 deg. of coupling. This is achieved by using jig SG78A as described in A.P.2527B. Jig SG79A is used to ensure the correct relationship of the indicator, mechanical, Type 101 to the trunnion on the aerial frame assembly.

45. Ensure that the MAG IN and MAG OUT cables are correctly terminated on the magslip; a careful check is necessary as it is possible to reverse these inadvertently during previous servicing. A simple check is to measure the resistance of the respective circuits after disconnecting each one, in turn, at the H/R console (panel, input, Type 645). The MAG OUT cable should be removed from SK.P7 on the input panel and the resistance between inner core and earth measured. After replacing the cable on SK.P7, the MAG IN cable should be removed from SK.P6, and its resistance measured as before. For typical resistance values see Appendix 1.

Note . . .

At the aerial head, MAG OUT *is connected to the magslip via slip-ring No.* 5, *and* MAG IN *via slip-ring No.* 41. *A reversal of these may result in a* 500 *c/s ripple being picked up. Prior to the incorporation of Modification No. CA.*516, *these connections were reversed; wiring diagrams issued prior to this modification will therefore show the original connections and should never be used.*

46. Switch the radar transmitter on, ensuring that the transmitter waveguide matching plunger is set to the correct position and securely locked. Then measure the frequency of the transmitter and switch the radar transmitter off.

Note . . .

*Complete setting-up instructions for the transmitter will be found in the progressive servicing schedules for static stations. A.P.*2527*B, Vol.* 1, *also refers.*

47. Refer to fig. 1 to obtain the squint angle for the particular magnetron frequency.

48. With the clinometer clamped on the reference plane mentioned in para. 42 adjust the push rod turnbuckle so that, at the lower limit of travel, the reflector makes an angle to the vertical equal to "squint angle minus one deg.". Lock the push rod turnbuckle at this setting, and note the reading of the clinometer.

49. Set the reflector by means of the hand control to the ZERO reference level plus the angle observed on the clinometer in the previous operation. The true direction of radiation from the reflector should then be zero deg., i.e. horizontal. The squint knob should be adjusted (A.P.2527B) so that the squint angle control shows the squint angle, reading from its own scale.

Console

50. Assuming that the operations in para. 31-37 have been performed, and that the console has been warmed up for not less than one hour, the following checks should be made : —

(1) All meter readings to be within the allowed tolerances.

(2) The BRILLIANCE, FOCUS, ASTIG, and FIRST ANODE controls function correctly.

(3) The definition and persistence of the c.r.t. are good. If in doubt replace the c.r.t.

51. Check the internal range calibration of the console as follows : —

(1) Switch the console OFF.

(2) Set the console to Y-scan display.

(3) Disconnect the cable from SK.P15 on the console input panel and connect it to SK.P9 instead. This applies external calibration from the marker unit (range) Type 27 to the video input termination of the console.

(4) Switch the console ON.

(5) Switch the CAL. key on the associated PPI console to FINE and the CALIB. key on the H/R console to CAL.

(6) On the H/R console, turn the GAIN control on amplifier unit Type 295 fully counter-clockwise, and the R.M. AMP. control on the left-hand control desk (panel Type 643) fully clockwise. The internal calibration marks should now be displayed as vertical deflection, and the external calibration marks as intensity modulation (*para.* 7).

(7(a)) *Static applications only*. Make the first marker from the H/R console coincide with the second marker from the marker unit Type 27 by adjusting the appropriate delay unit Type 31 control on the rack assembly Type 182.

(7(b)) *Mobile applications*. It is not possible to shift the relative phases of the external and internal calibration marks, and the following coincidence estimation must be made visually.

(8) If necessary, adjust the frequency of the internal oscillator by means of C59 on the timebase unit (range) Type 136, until (in static applications) the marks are coincident along the whole trace, or (in mobile applications) so that the same number of range marks are distributed over equal lengths of trace.

(9) Replace the external calibration cable on SK.P15, switch the console back to elevation-scan. Then switch on again.

Console and aerial head

52. During the operation of marking out the tube face, continuous telephone contact between the aerial head and the console is essential.

Marking the c.r.t. face

53. Height lines should be drawn on the tube face following the instructions given in Part 3, Chap 4. When the lines have been drawn and are thoroughly dry, the face of the tube should be coated with clear lacquer paper or sprayed with a suitable varnish. Brush application is found to be unsatisfactory.

Blanking setting

54. The blanking input from the timebase unit Type 134 or 134A must be set so that the Y elevation scan is blacked out a short distance above the uppermost height line. To do this : —

(1) Set the aerial to 20 deg. elevation and turn the blanking switch on the panel (sync and blanking) Type 642 to ELEV. SCAN.

(2) Adjust the SCAN LIMIT control on the timebase unit (elevation) Type 134 until the elevation scan is blacked out a little above the uppermost range line.

55. Again check the currents of the power unit stabilizer valves, with the aerial stationary at −1 deg.

Note . . .
That this current may vary with elevation, and the stabilizers should never be adjusted except when the timebase trace is horizontal.

Procedure after replacement of magnetron

56. When a magnetron is replaced the following procedure is necessary before the aerial head is reported as serviceable. After setting-up the transmitter as detailed in the progressive servicing schedule (if applicable) or in A.P.2527B if no progressive servicing schedule is available, the magnetron frequency is noted for determination of the appropriate squint angle.

57. Turn the aerial head to the true level bearing (*para.* 41) and set the reflector to the lower limit of travel. Clamp the clinometer on the reference plane (*para.* 42). The clinometer reading should be "zero reference reading plus old squint correction minus one degree".

58. Raise the reflector assembly by hand control by one degree, checking by the clinometer which should then read "zero reference reading plus old squint correction".

59. From fig. 1 determine the squint angle corresponding with the frequency of the transmitter Then adjust the turnbuckle on the push rod of the reflector assembly to either raise or lower the reflector, until the clinometer reading is "zero reference reading plus new squint angle". Ensure that the hand control in the aerial cabin is not moved during this operation.

60. Loosen the two locking pins in the indicator mechanical Type 101, and carefully adjust the squint angle control to give the new squint angle. Tighten the locking pins. Replace the indicator cover and tighten down.

SETTING-UP THE IFF UNITS

61. Although the IFF display is not used for its original purpose it is necessary to set up the IFF units because they provide waveforms for the primary radar units. Before commencing to set up the IFF display check the following adjustments : —

(1) Verify that the range scale is fitted across the face of the IFF c.r.t.

(2) Place the A-band key on the right-hand control desk to OFF.

(3) Lower the left-hand control desk and withdraw the timebase unit (IFF) Type 135. A link panel is fitted on top of the chassis, just behind the front panel. Verify that the SYNC. links are in the appropriate position (+VE or −VE) according to the transmitter in use. The link immediately adjacent should be in the IFF position. Then return the unit to the rack and replace the control desk.

(4) Ensure that the external connections are made, including the services to and from the associated PPI console. On the latter, see that the range marks are switched on and supplied to the H/R console, also that the strobe gain is set so that the strobe is turned into the middle of the display.

(5) Returning to the H/R console, set the IFF GAIN control to minimum.

62. Two traces should now be visible on the tube, but they will probably be intermittent. Proceed as follows : —

(1) Adjust the controls on the front panel of the indicating unit (IFF) Type 31 in the following order : —

(a) BRIGHTNESS (to operating level)

(b) Y STIG and FOCUS

(c) X STIG and FOCUS

repeating as necessary until a clear well-defined double trace is obtained. If a clear trace is not obtainable verify that the h.t. tappings are correct (refer to Part 2, Chap. 6 of this Volume for details of these tappings).

(2) Set up the timebase unit as follows : —

(a) Ensure that the radar transmitter is operating at a p.r.f. of 500.

(b) Withdraw the IFF timebase unit and make connections to the oscilloscope from the links on the lock link panel (*para.* 61 (3) *refers*) so that the radar lock-in wave-form is applied to the Y1-plate, and the interrogator lock-out waveform to the Y2-plate.

(c) Adjust the DIVIDER control on the front panel of the timebase unit, so that a stable division ratio of 6 to 1 is obtained, with the edges of the divider waveform coinciding with the negative edges of the waveform on Y1. The two traces should now be steady.

63. The final adjustments on the indicating unit and timebase unit (IFF) are now made in the following manner : —

(1) Turn the EXPANSION BRIGHTNESS control fully clockwise.

(2) Adjust the TRACE SEPARATION and Y-SHIFT controls on the indicating unit (IFF) Type 31 until the two traces lie above and below the range scale. If necessary, withdraw the indicating unit, turn the c.r.t. slightly so that the traces are horizontal and then replace and lock the unit in place.

(3) Obtain the correct number of range marks on the lower trace by operation of the TIMEBASE WIDTH control. There should be 15 for 75 miles range and 30 for 150 miles range; the first mark is at 15 miles, not zero.

(4) Align the range marks with the range scale, using the X-SHIFT and velocity controls. The VELO COARSE control is a two-way switch, and the VELO FINE control is a potentiometer, both being mounted just behind the front panel.

(5) Turn the STROBE control on the associated PPI console until the bright strobe lies on a range mark near the middle of the timebase trace.

(6) Adjust the EXPANSION WIDTH control until the width of the expanded (*i.e.* brightened) portion occupies a range of three miles. Then adjust the EXPANSION control so that the three-mile strobe takes up one centimetre of trace.

(7) Re-adjust the BRIGHTNESS control on the indicating unit (IFF) so that the normal trace is at operational brilliance, then adjust the EXPANSION BRIGHTNESS so that the expanded portion is a little brighter than the remainder.

Final adjustments

64. Re-check the current in the stabilizer valves. Replace all units, and close the console doors. This may change the internal temperature level, and after a few moments the focusing, calibration, and brilliance may need slight re-adjustment. Switch off the CALIB. key.

65. Adjust the radar video level (by means of the external attenuator) so that the noise level on the lower trace of the IFF display is about 2 mm. Then adjust the IFF GAIN control to give about 1 mm. of noise on the upper trace (*para.* 61 (5) *refers*).

66. Trimming adjustments may be necessary after half-an-hour's running, with all console doors and panel covers in place on all consoles. The doors and covers must always be kept closed during operation.

SETTING-UP THE A-SCOPE DISPLAY, CONSOLE TYPE 61A

67. The console Type 61A differs from the console Type 61, so far as setting-up is concerned, in that the radar display on the indicating unit (c.r.t.) Type 32 is locked from the IFF timebase unit, and therefore it is necessary to set up the IFF display before attempting to set up the radar display.

68. Before attempting to set up, check that all the necessary external connections are made, including the A-scope sync input, and the jumpering lead between P4 and P16 on the console input panel. The 0-10 mile range scale must be fitted to the radar display tube, and the SYNC switch on the panel (sync and blanking) Type 642 put to A-SCOPE SYNC.

69. Set the STROBE control on the associated PPI console to give a reasonable range on the H/R console IFF tube, say midway along the trace. Then set up as for console Type 61 on range/deflection display.

70. To ensure correct range correlation, the i.f. input to the radar display must be derived from the same source as that supplied to the associated PPI console.

GENERAL PRECAUTION

71. All the doors on the console must be closed after performing adjustments, etc., and kept closed during operation, otherwise the console temperature control equipment will function erratically, and this may react upon other associated equipment.

Appendix 1

Point-to-point Connections of MAG. OUT and MAG. IN Lines

1. After the completion of modifications CA.516 and CA.517 or CA.518, the expressions MAG. OUT and MAG. IN should be used with respect to the H/R console only, and never with respect to the Type 13 aerial head, or the magslip in the indicator, mechanical, Type 101, mounted thereon. The result of CA.516 is to introduce a "cross-over" between terminals F and D on the pivot mount and panel junction at the aerial head. In case of doubt, either line can be positively identified by open-circuiting it and checking the resistance in both directions. The approximate values of resistance to be expected if the open-circuit is at the pivot mount are:—

MAG. OUT line.	Resistance	in direction of console	infinity
		in direction of magslip	15 ohms.
MAG. IN line.	Resistance	in direction of console	1,000 ohms.
		in direction of magslip	4 ohms.

2. When the resistance is measured at a point nearer the console, the actual resistance in direction of magslip will depend upon the slip-ring resistance and the length of cable to the aerial head. (Obviously the reduction in length of cable will make little difference in direction of console.) At the console input panel, the MAG. OUT line in direction of magslip may be between 24 and 40 ohms, and the MAG. IN line in the same direction, between 8 and 10 ohms.

3. The following list of checking points shows where such measurements may be made, e.g. after disconnection during servicing or after any future modifications.

A. STATIC STATIONS

	Location of checking point	Checking point MAG. OUT line	Checking point MAG. IN line
Console Type 61	Timebase unit Type 134	A/7	A/9
	Panel input Type 645	P/7	P/6
Radar Office	Internal cabling	4·1	4·2
	Patching panel	A/6	A/7
	(according to channel)	B/6	B/7
		C/6	C/7
		D/6	D/7
		E/6	E/7
Underground lines	Coaxial cable No.	35	36
Plinth	Termination board	SK.G	SK.H
	mating with	PL.8	PL.7
Radar Type 13 head	Slip-ring unit Type 100	SR.5	SR.41
	Pivot mount	SK.1/F	SK.1/D
	Panel junction	D	F
	Indicator, mechanical, Type 101 ...	D	F
	Magslip	2A	Y

B. MOBILE STATIONS

Console Type 61	Timebase unit Type 134	A/7	A/9
	Panel input Type 645	P 7	P 6
Vehicle wiring	Console No. 1 to PD.4	017	015
	Console No. 2 to PD.5	005	004
Vehicle panels	PD.4	SK.2	SK.1
	PD.5	SK.2	SK.1
Intervehicle	Coaxial Cable No.	2	1
Radar Type 13 head	Amplidyne termination box	SK.2	SK.1
	Slip-ring unit Type 100	SR.5	SR.41
	Pivot mount	SK.1/F	SK.1/D
	Panel junction	D	F
	Indicator, mechanical, Type 101 ...	D	F
	Magslip	2A	Y

Chapter 4

OPERATING INSTRUCTIONS

LIST OF CONTENTS

Range/deflection display, console Type 61

1. It is assumed that the console has already been set-up in accordance with the instructions contained in the previous chapter. Subsequently, the console can be brought into operation as follows:—

(1) See that all external switches controlling the power supply to the console are closed, and that the console air supply system is in operation.

(2) Check that the following supplies, etc., are being fed into the console :—

(a) Sync. pulse

(b) 230-volt supply

(c) Radar video signal.

(3) See that the following switches are OFF, viz., AZIM. IND, NBW, STC, LPF, and that the p.r.f. key is in the correct operational position i.e., 250 or 500 according to the maximum working range.

(4) Switch on the console by the ON/OFF switch on the right-hand control desk, and wait at least five minutes for the console to warm up.

(5) Turn up the BRIGHTNESS control on the main indicating unit until a trace, or signs of a trace, appears. If a steady trace does not appear, verify that the sync. switch is in the correct position, according to the type of installation, and adjust the BRIGHTNESS control on the timebase unit (range) Type 136 until the trace appears. It is necessary to lower the right-hand control desk for this purpose.

(6) Switch on the CALIB key and check the range calibration on all three ranges. Examine the range marks for correct focus and sharpness (astigmatism) and if necessary re-adjust as explained in the setting-up instructions. The focus and astig. controls should not however require re-setting at this stage if the original setting-up has not been interfered with.

(7) Adjust the position of the trace, if necessary, by the X-SHIFT and Y-SHIFT controls.

(8) Switch off the CALIB key. The range marks will still appear on the trace but at an amplitude controllable by the RANGE MARKS AMP. potentiometer on the left-hand control desk. Noise should now appear on the trace. Adjust the GAIN control to give about 3 mm. of noise.

(9) In static installations, where the sync. pulse is obtained from a master trigger unit, all the above steps can be performed without running the transmitter. In mobile installations, where the sync. is obtained from the transmitter, the latter must be in operation before carrying out step (4).

(10) With the transmitter operating, turn the aerial slowly until a P.E. response is obtained (known P.E.'s will usually be noted immediately after installation, after comparison with a map or chart.)

(11) Check the setting of the GAIN control and then lock it.

(12) Switch on the NBW key and adjust the NBW TUNE control for maximum signals. Lock the control by the knurled knob and return the NBW key to OFF, unless operational conditions indicate otherwise.

(13) Turn the RANGE MARKS AMP. control fully counter-clockwise, so removing the range marks from the trace.

A-band IFF display, consoles Type 61 and 61A

2. On console Type 61, the IFF display is usually brought into operation after the main radar display is working satisfactorily. On console Type 61A, however, the A-band display is adjusted first. To bring into operation :—

(1) See that the IFF interrogator is switched on. This is not controlled from the H/R console as the A-band key controls the production of the interrogator locking pulse only. In some installations, the interrogator is switched on in the aerial cabin.

(2) Check that the following services are being fed into the console, in addition to those detailed in para. 1, sub-para. (2).

(a) A-band lock in

(b) A-band lock out

(c) A-band video

(d) Radar video for IFF display, from PPI console

(e) Range marks from PPI console.

(3) Set the A-BAND and CALIB keys in the ON position, and turn up the BRIGHTNESS control as necessary so that two traces, or signs of traces, are seen. If two clear traces are not obtained, the setting-up procedure detailed in the preceding chapter should be repeated.

(4) Check that the two traces lie above and below the range scale.

(5) Put the CALIB switch to ON. Range marks should then appear on the lower trace. See that these are aligned with the range scale; on ranges 1 and 2 the first mark should be at 5 miles, not zero, and on range 3 at 10 miles. The trace should extend to the full operational range. When this is satisfactory, switch off the CAL switch.

(6) Check that the strobe position is clearly defined; if not, adjust the EXPANSION BRIGHTNESS control on the timebase unit (IFF) Type 135. Check that the bright portion of the trace extends over a range of about 3 miles, and is about 1 cm. long.

(7) See that the strobe marker is of sufficient amplitude to cut the lower trace, and that the strobe can be moved over the whole length of the trace. Adjust the radar video gain so that about 2 mm. of noise appears on the radar trace.

(8) Adjust the IFF GAIN control so that about 1 mm. of noise appears on the IFF trace.

Note . . .
In radar Type 13 installations the IFF gain is preset in the aerial cabin.

Elevation scan display, console Type 61

3. It is assumed that the console has already been set-up for elevation scan display in accordance with the instructions contained in the previous chapter. Subsequently, the console can be brought into operation as follows :—

(1) See that all external switches controlling the power supply to the console are closed, and that the console air supply system is in operation.

(2) Check that the following supplies etc., are being fed into the console :—

(a) Sync. pulse

(b) 230-volt supply

(c) Radar video signal

(d) Magslip in and out connections on P6 and P7 respectively, on the coaxial plug board of the panel (input) Type 645.

(3) See that the NBW, STC, and LPF switches are off, and that the p.r.f. key is in the correct operational position. Check that the SYNC switch on the panel (sync. and blanking) Type 642 is on T14 (i.e. positive sync.) and that the blanking switch is at ELEV. SCAN.

(4) Switch on the console by the ON/OFF switch on the right-hand control desk, then wait at least five minutes for the console to warm up.

(5) The range marks should now appear, as a row of spots on the CRT screen. Check that the range key is in the correct position, according to the range for which the height lines are painted. The range marks should line up with the painted marks on the base line; if not, adjust by the X-SHIFT control. If necessary, adjust the range marks to the painted scale by using the VELO controls for the particular range (this control is on the timebase unit (range) Type 136).

(6) Switch on the Type 13 elevation gear by the switch on the left-hand control desk. Switch on the ELEV. STROBE switch and observe that the strobe markers appear as the aerial tilts.

(7) Noise, and possibly aircraft responses, should now appear. If painting is unsatisfactory adjust the GAIN control as necessary. If satisfactory painting cannot be obtained, it may be necessary to check the setting of the limiters as explained in the previous chapter.

(8) Check the operation of the NBW key, and if necessary adjust the NBW TUNE control.

4. The calibration of the elevation scan (Y deflection) should not be interfered with until the console has been running for at least half an hour. If it is operationally convenient, the aerial tilting should then be stopped and the basic setting-up data checked. These are :—

(1) Range 1

(a) Length of trace, 18 cm. for 75 miles.

(b) Height of 20 deg. trace, 8 cm. above the base line at 20 miles.

(c) Height of 5 deg. trace, 8·8 cm. above the base line at 75 miles.

(2) Range 2

(a) Length of trace, 21·5 cm. for 130 miles

(b) Height of 20 deg. trace, 11 cm. above the base line at 40 miles.

(c) Height of 5 deg. trace, 11·3 cm. above the base line at 130 miles.

If the display is significantly in error, the MAGSLIP OUTPUT and SET ZERO controls must be adjusted as in the setting-up instructions. Before assuming the setting-up to be at fault, however, check the whole elevation-scan system outside the console, particularly checking the level of the Type 13 aerial mounting. The importance of the latter is dealt with in the preceding chapter.

A-scope display, console Type 61A

5. The A-scope is brought into operation in the same manner as the console Type 61 on range/deflection display, except that the A-band IFF must be brought into operation before attempting to operate the main radar display. The latter should present an expanded trace of the ten miles immediately following the range at which the PPI strobe is set on the associated console Type 60A, the Type 14 or Type 54 head being stationary while a particular azimuth is being examined.

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PART 2

TECHNICAL INFORMATION

Note.—*A list of contents appears at the beginning of each chapter*

Chapter 1

CONSOLE FRAMEWORK AND INTER-UNIT CABLING

LIST OF ILLUSTRATIONS

LIST OF TABLES

1. The console Type 61 consists of a steel framework, comprising three racks into which are fitted the six power units, three timebase units, and small (IFF) indicating unit; these units are to be described in the following chapters. Two fixed panels (sync. and blanking Type 642, input Type 645) are also fitted. In front of the three racks are mounted the two control desks with the main indicating unit between them. A wooden shelf extends across the front of the three last-mentioned units, forming a desk.

2. The control panels and main indicating unit are pivoted on the front of the framework and can be tipped forward to give access to the panels behind. With the exception of the two fixed panels and the IFF indicating unit referred to in para. 1, all units mounted in the racks are held in position by spring-loaded bars which engage with niches cut in the front framework. To remove such a unit the bar must be depressed, and the panel can then be slid forward.

3. In the operating position the IFF indicating unit is held in place by two latches, secured by screws; to turn the latches, these screws must be slackened off. The control desks and main indicating unit are secured in position by chromium-plated cams mounted upon shafts. To operate these, first slacken off the knurled screw, and then turn the cam upwards. To remove the IFF timebase unit, the left-hand control desk and the main indicating unit must be tipped forward. To remove the IF amplifying unit (on the left-hand side) of the range timebase unit (on the right-hand side) the main indicating unit and the appropriate control desk must be tipped forward; the supporting chain on the side concerned must be also removed. To remove either of the two bottom panels (power units) it is necessary to remove completely the main indicating unit and the appropriate control desk.

4. A complete list of all the cables in the main cableform is given in Table 1. Five different types of cable are used, and are denoted in the table as A, B, C, D, and E.

Cable A is 23/·0076-in. tinned copper, covered black PVC.

Cable B is 40/·0076-in. tinned copper, covered black PVC.

Cable C is 70/·0076-in. tinned copper, covered black PVC.

Cable D is Uniradio No. 32.

Cable E is 14/·0076-in. tinned copper, covered black PVC (6 m.m. O/D) EHT.

5. Table 2 lists the additional connectors which are not in the main cableform. These additional connectors include a subsidiary cableform (numbered 1 to 9 in Table 2) between the power unit (EHT) Type 875 (PL13) and the indicating unit (CRT) Type 32 (PL15). Various other connectors (10 to 14 in Table 2) are run separately to provide signal and lamp connections. Fig. 1 shows the route of the main cableform. Fig. 2 gives the wiring diagram for consoles 61 and 61A, and fig. 3 shows the route of the longest of the separate connectors. Fig. 4 gives the interconnections for consoles 61, 61A and 61B. For further information on the console 61B, refer to Chapter 10.

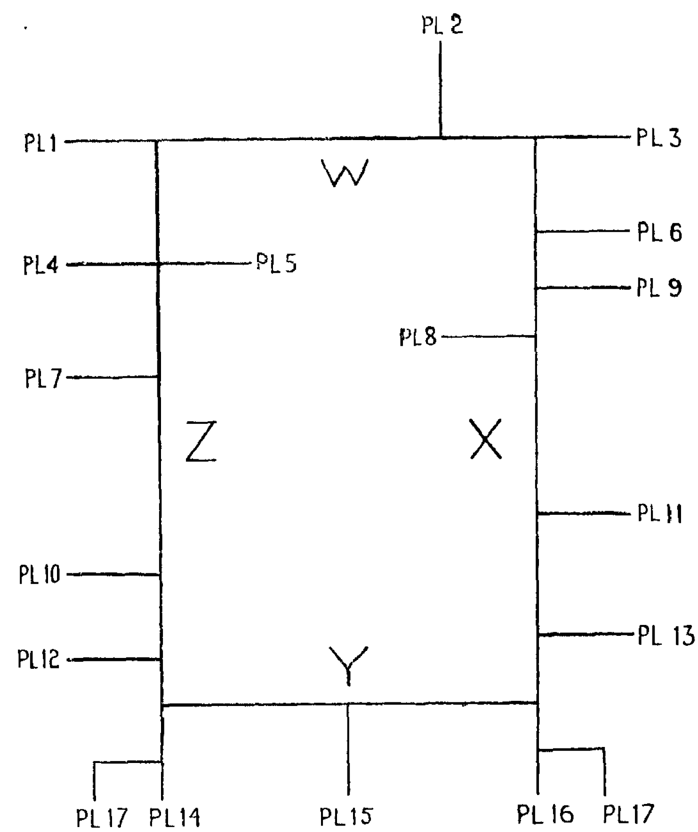


Fig. 1. Cableform routeing

TABLE 1—MAIN CABLEFORM

The letters in the "Route" column refer to the sides of the cableform as shown in fig. 1.

Connection No.		From	To	Route	Cutting Length	Wire type
1/1	..	PL 15A/1	PL 12/6	Y-Z	6′ 6″	A
/2	..	PL 12/6	PL 10/2	Z	8′ 6″	A
2/1	..	PL 15A/2	PL 10/1	Y-Z	7′ 0″	A
/2	..	PL 10/1	PL 7B/1	Z	9′ 0″	A
/3	..	PL 7B/1	PL 5A/1	Z	9′ 0″	A
/4	..	PL 5A/1	PL 2/6	Z-W	9′ 6″	A
/5	..	PL 2/6	PL 9/8	W-X	8′ 6″	A
/6	..	PL 9/8	PL 17D/1	X	9′ 0″	A
3	..	PL 15A/3	PL 1B/3	Y-Z	9′ 3″	B
4	..	PL 15A/4	PL 1B/4	Y-Z	9′ 3″	B
5/1	..	PL 2/7	PL 15A/5	W-X-Y	10′ 3″	A
/2	..	PL 15A/5	Earth	Y	2′ 6″	B
6	..	PL 15A/6	PL 6A/12	Y-Z-W-X	11′ 9″	D
7	..	PL 15A/7	PL 6A/3	Y-X	9′ 9″	A
8/1	..	PL 15A/8	PL 12/4	Y-Z	6′ 6″	B
/2	..	PL 12/4	PL 10/3	Z	8′ 6″	B
9/1	..	PL 15A/9	PL 12/8	Y-Z	7′ 0″	B
/2	..	PL 12/8	PL 10/4	Z	8′ 6″	B
10/1	..	PL 15A/10	PL 12/10	Y-Z	7′ 0″	B
/2	..	PL 12/10	PL 10/6	Z	8′ 6″	B
/3	..	PL 12/10	PL 4A/9	Z	10′ 6″	C
11/1	..	PL 15A/11	PL 12/12	Y-Z	6′ 6″	B
/2	..	PL 12/12	PL 10/7	Z	8′ 6″	B

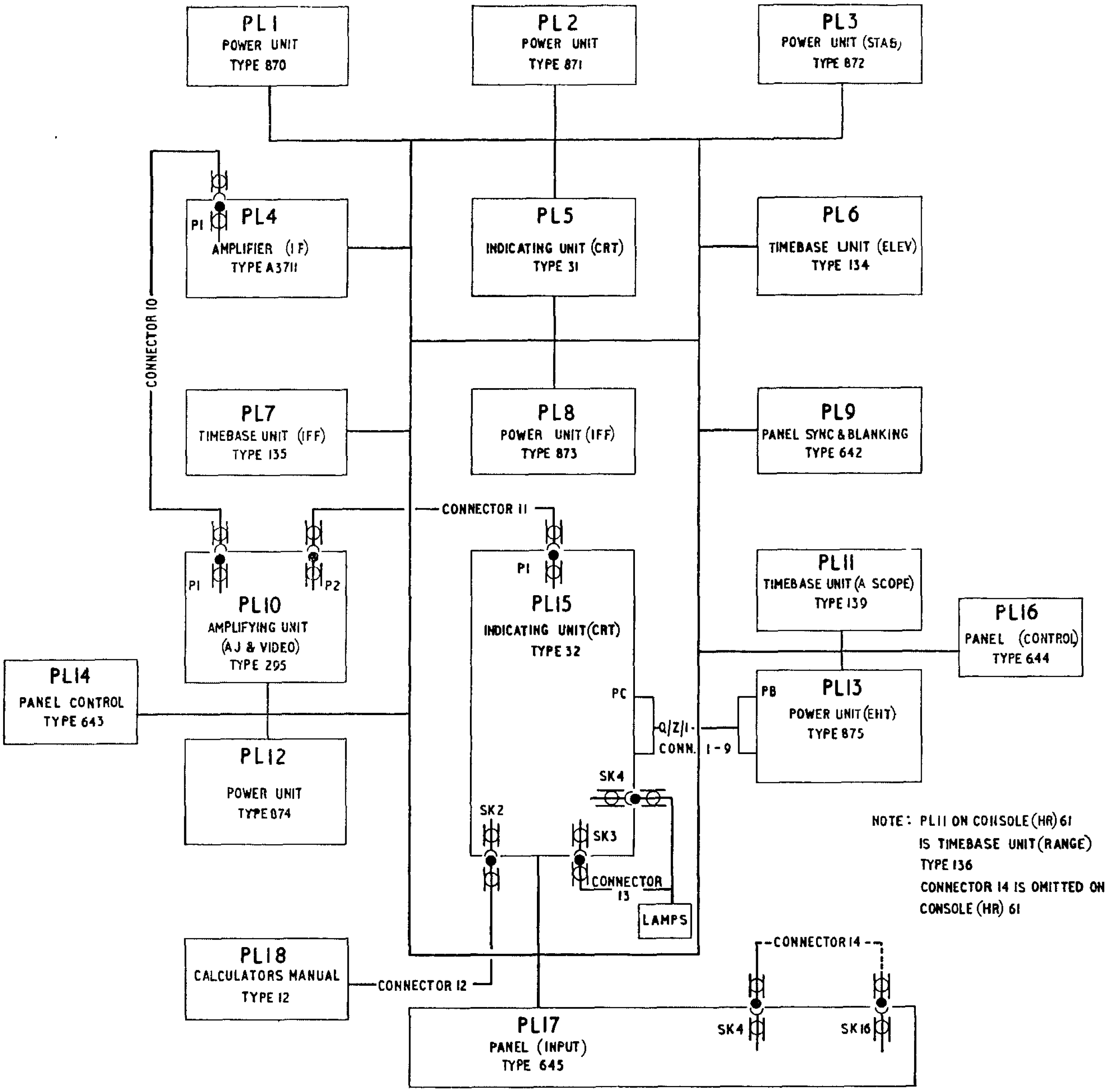


Fig. 2. Consoles 61 and 61A: wiring diagram

TABLE 1—MAIN CABLEFORM *(continued)*

Connection No.		From	To	Route	Cutting Length	Wire type
11/3	..	PL 12/12	PL 4A/10	Z	10′ 6″	C
12	..	PL 15A/12	PL 11A/1	Y-X	8′ 6″	D
13	..	PL 15B/1	PL 1B/6	Y-Z	9′ 9″	A
14	..	PL 15B/2	PL 1B/5	Y-Z	9′ 9″	A
15	..	PL 15B/3	PL 1A/11	Y-Z	10′ 0″	B
16	..	PL 15B/4	PL 1A/12	Y-Z	10′ 0″	B
17	..	PL 15B/5	PL 1A/9	Y-Z	10′ 0″	B
18	..	PL 15B/6	PL 1A/10	Y-Z	10′ 0″	B
19	..	PL 15B/7	PL 11A/7	Y-X	8′ 6″	D
20	..	PL 15B/8	PL 11A/8	Y-X	8′ 6″	D

TABLE I—MAIN CABLEFORM (*continued*)

Connection No.		From	To	Route	Cutting Length	Wire type
21/1	..	PL 15B/9	PL 1A/8	Y-Z	10′ 0″	A
/2	..	PL 1A/8	PL 11A/3	W-X	12′ 3″	A
22	..	PL 15B/10	PL 2/8	Y-X-W	10′ 0″	A
23	..	PL 15B/11	PL 11B/11	Y-X	8′ 9″	D
24/1	..	PL 15B/12	PL 16B/1	Y	6′ 3″	A
/2	..	PL 16B/1	PL 7A/12	Y-Z	10′ 6″	A
25	..	PL 17/P1	PL 4/P1	Z	11′ 0″	D
26	..	PL 17/P2	PL 7A/11	Z	10′ 3″	D
27	..	PL 17/P3	PL 9/1	Y-X	10′ 0″	D
28	..	PL 17/P4	PL 9/2	Y-X	10′ 0″	D
29	..	PL 17/P5	PL 9/3	Y-X	10′ 3″	D
30	..	PL 17/P6	PL 6A/9	Z-W-X	13′ 9″	D
31	..	PL 17/P7	PL 6A/7	Z-W-X	13′ 9″	D
32	..	PL 17/P8	PL 11B/12	Y-X	10′ 3″	D
33	..	PL 17/P9	PL 10/12	Y-Z	9′ 6″	D
34	..	PL 17/P10	PL 7A/6	Y-Z	10′ 6″	D
35	..	PL 17/P11	PL 7B/4	Y-Z	10′ 3″	D
36	..	PL 17/P12	PL 7A/3	Y-Z	10′ 6″	D
37	..	PL 17/P13	PL 7A/4	Y-Z	10′ 9″	D
38	..	PL 17/P14	PL 7B/3	Y-Z	10′ 6″	D
39	..	PL 17/P15	PL 7A/10	Y-Z	10′ 9″	D
40	..	Framework Earth Bolt	PL 17 Earth Bolt			Earthing Braid
41/1	..	PL 12/1	PL 1A/1	Z	11′ 0″	A
/2	..	PL 1A/1	PL 2/1	W	9′ 0″	A
/3	..	PL 2/1	PL 3A/1	W	8′ 6″	A
/4	..	PL 3A/1	PL 8A/1	X	10′ 3″	A
/5	..	PL 8A/1	PL 13A/1	X	6′ 6″	A
/6	..	PL 13A/1	PL 16B/7	X	4′ 9″	A
42/1	..	PL 12/2	PL 1A/2	Z	13′ 0″	A
/2	..	PL 1A/2	PL 2/2	W	9′ 0″	A
/3	..	PL 2/2	PL 3A/2	W	8′ 6″	A
/4	..	PL 3A/2	PL 8A/2	X	10′ 3″	A
/5	..	PL 8A/2	PL 13A/2	X	6′ 6″	A
/6	..	PL 13A/2	PL 16B/9	X	4′ 9″	A
43	..	PL 12/3	PL 4A/3	Z	10′ 6″	B
44	..	PL 12/5	Earth	Z	4′ 6″	B
45	..	PL 12/7	PL 4A/2	Z	10′ 6″	A
46	..	PL 12/9	PL 7B/2	Z	9′ 6″	A
47	..	PL 10/5	Earth		4′ 3″	B
48	..	PL 10/8	PL 16A/6	Z-Y	8′ 9″	A
49	..	PL 10/9	PL 16A/7	Z-Y	8′ 9″	A
50	..	PL 7A/1	PL 5A/11	Z	9′ 3″	D
51	..	PL 7A/2	PL 5A/8	Z	9′ 3″	D
52	..	PL 7A/5	Earth		5′ 6″	B
53	..	PL 7A/7	PL 5A/7	Z	9′ 3″	D
54	..	PL 7A/8	PL 17D/2	Z-Y	10′ 9″	A
55	..	PL 7A/9	PL 17D/3	Z-Y	10′ 9″	A
56/1	..	PL 7B/5	PL 5A/10	Z	9′ 0″	A
/2	..	PL 5A/10	PL 8A/12	Z-W-X	11′ 6″	A
57	..	PL 7B/6	PL 5A/6	Z	9′ 0″	D
58/1	..	PL 7B/7	PL 8B/1	Z-W-X	12′ 3″	C
/2	..	PL 8B/1	PL 5B/1	X-W-Z	11′ 0″	C
59/1	..	PL 7B/8	PL 8B/2	Z-W-X	12′ 3″	C

TABLE 1—MAIN CABLEFORM (*continued*)

Connection No.		From	To	Route	Cutting Length	Wire type
116	..	PL 11A/5	Earth		5′ 3″	B
117	..	PL 11A/12	PL 16A/10	X	8′ 9″	A
118	..	PL 11B/7	◀PL 16A/11▶	X	8′ 6″	A
119	..	PL 11B/9	PL 16A/12	X	8′ 6″	A
120/1	..	PL 11B/10	PL 16B/2	X	8′ 9″	A
/2	..	PL 11B/10	PL 17E/11	X	9′ 0″	A
121	..	PL 13A/5	Earth		2′ 0″	B
122	..	PL 16A/5	Earth		4′ 0″	B
123	..	PL 16A/8	PL 17D/4		3′ 6″	A
124	..	PL 16A/9	PL 17A/6		4′ 0″	A
125	..	PL 16B/3	PL 17A/10		4′ 3″	A
126	..	PL 16B/5	PL 17 Fuse 1		4′ 0″	A
127	..	PL 16B/6	PL 17 Fuse 2		4′ 0″	A
128	..	PL 16B/12	PL 17D/5		3′ 9″	A
129	..	PL 17A/5	Earth		4′ 9″	B
130	..	PL 16D/2	PL 17E/4		4′ 6″	A
131	..	PL 16D/3	PL 17E/7		4′ 6″	A
132	..	PL 16D/4	PL 17E/6		4′ 6″	A
133	..	PL 16D/5	PL 17E/8		4′ 6″	A
134	..	PL 16D/6	PL 17C/1		4′ 6″	A
135	..	PL 16D/7	PL 17E/9		4′ 6″	A
136	..	PL 16D/8	PL 17E/10		4′ 6″	A
137	..	PL 16D/9	PL 17D/6		4′ 6″	A
138	..	PL 16D/10	PL 17D/7		4′ 6″	A
139	..	PL 16D/11	PL 17D/8		4′ 6″	A
140	..	PL 16D/12	PL 17D/9		4′ 6″	A
142	..	PL 14/1	PL 15D/1	Y	6′ 9″	A
143	..	PL 14/2	PL 15D/2	Y	6′ 9″	A
144	..	PL 14/3	PL 15D/3	Y	6′ 9″	A
145	..	PL 14/4	PL 17C/6	Y	8′ 3″	A
146	..	PL 14/7	PL 17C/9	Y	8′ 3″	A
147	..	PL 16C/1	PL 11B/8	X	9′ 3″	A
148	..	PL 16C/2	PL 17C/2		4′ 6″	A
149	..	PL 16C/3	PL 17C/3		4′ 6″	A
150	..	PL 16C/5	PL 17C/5		4′ 6″	A
151	..	PL 13/P1	PL 5/P1	X-W-Z	10′ 6″	E
◀Modification CA676/2	..	PL 5A/11 (*not shown on fig.* 4)	PL 11A/6	Z-W-X	As required	A▶

TABLE 2

Additional Connectors

No. (fig 2)	Detail	From	To	Service
1	Connector F/301/20/AT394 10HA/17425 Specially insulated for 6kV	PL 13/B2	PL 15/C2	Anode 2 potentiometer
2		PL 13/B3	PL 15/C3	Anode 1
3		PL 13/B5	PL 15/C5	Anode 2 potentiometer
4		PL 13/B6	PL 15/C6	LT.11, 4.0V
5		PL 13/B7	PL 15/C7	
6		PL 13/B8	PL 15/C8	LT.12, 6·3V
7		PL 13/B9	PL 15/C9	
8		PL 13/B11	PL 15/C11	CRT cathode
9		PL 13/B12	PL 15/C12	CRT grid
10	Connector 9634 (10HA/14259)	PL 4/P1	PL 10/P1	IF amp. connection
11	Connector 9633 (10HA/14258)	PL 10/P2	PL 15/P1	Video to indic. unit
12	Coax connector	PL 18/P1	PL 15/SK2	Manual calculator lights
13	Linear scale assembly TR/B765512	PL 15/SK3	PL 15/SK4	Scale lights
14	Connector D/270/10/A/T395	PL 17/SK4	PL 17/SK16	Console 61A sync.

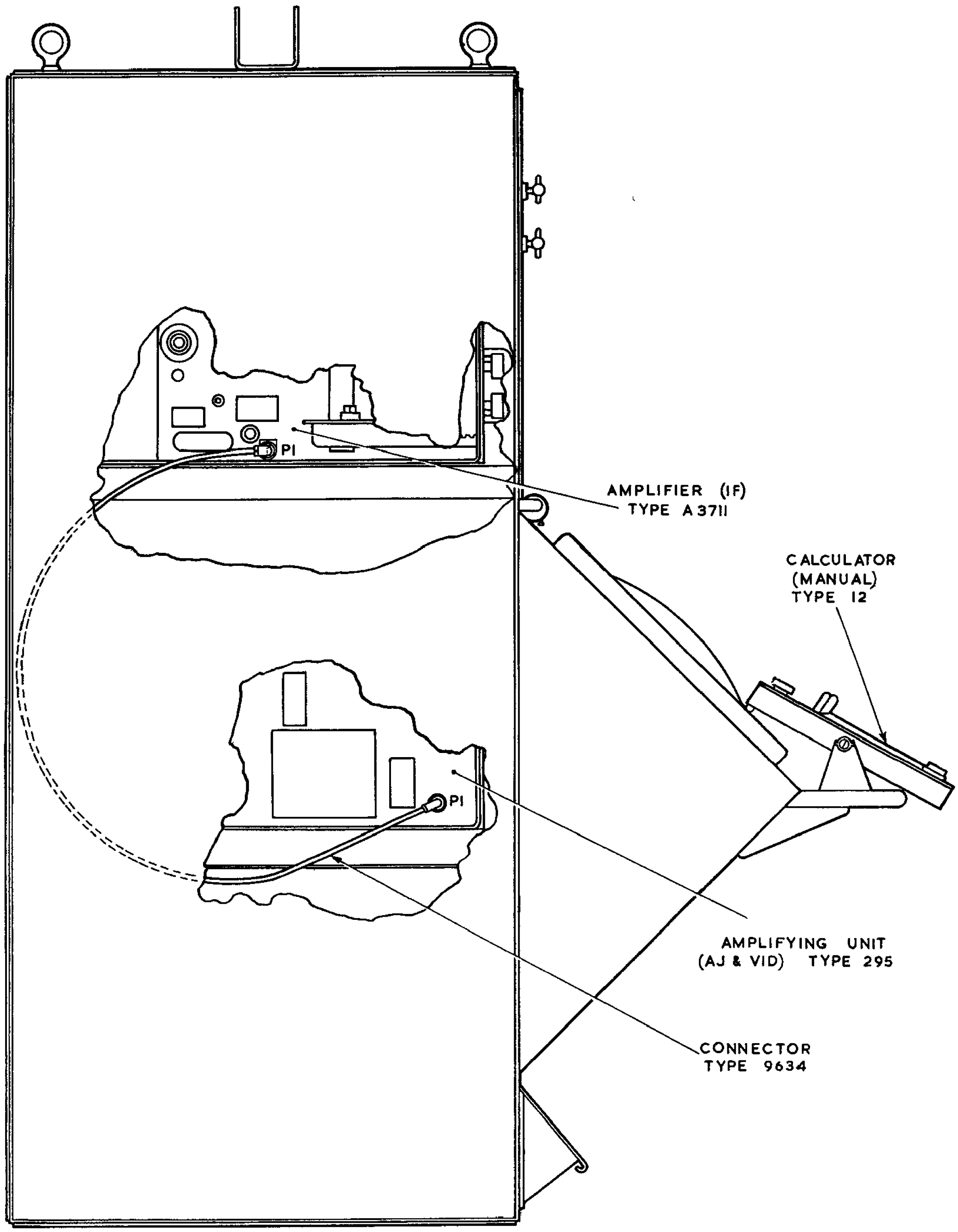


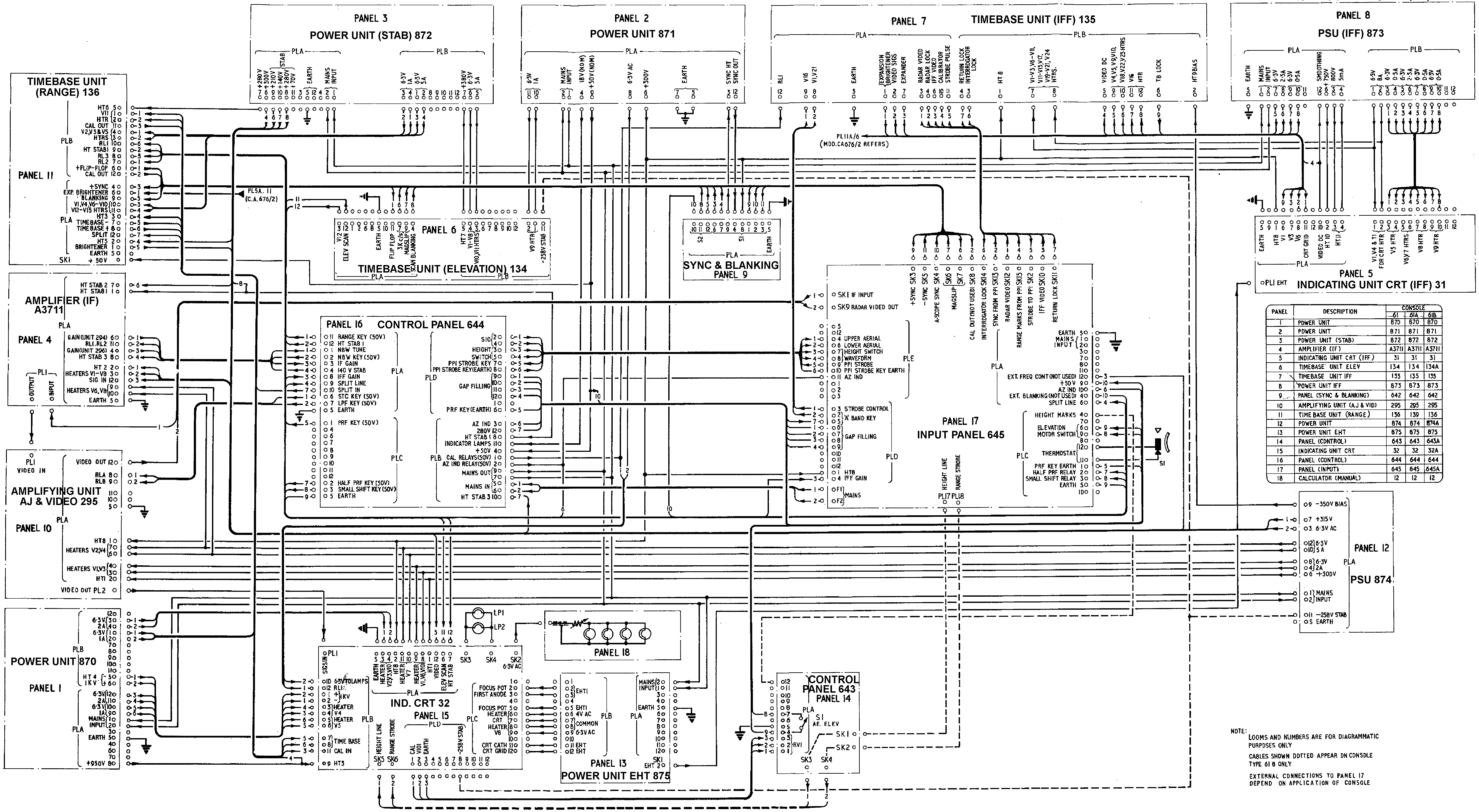
Fig. 3. Console side view

TABLE 1—MAIN CABLEFORM (*continued*)

Connection No.		From	To	Route	Cutting Length	Wire type
59/2	..	PL 8B/2	PL 5B/2	X-W-Z	11′ 0″	C
60	..	PL 7B/9	PL 8A/7	Z-W-X	12′ 9″	A
61	..	PL 7B/10	PL 8A/8	Z-W-X	12′ 9″	A
62	..	PL 7B/11	PL 8A/9	Z-W-X	12′ 9″	A
63	..	PL 7B/12	PL 8A/10	Z-W-X	12′ 9″	A
64/1	..	PL 4A/1	PL 3A/8	Z-W	10′ 0″	A

TABLE 1—MAIN CABLEFORM (*continued*)

Connection No.		From	To	Route	Cutting Length	Wire type
64/2	..	PL 3A/8	PL 16B/8	X	11′ 3″	A
65	..	PL 4A/4	PL 16A/3	Z-Y	11′ 0″	A
66	..	PL 4A/5	Earth		5′ 6″	B
67	..	PL 4A/6	PL 16A/1	Z-Y	11′ 0″	A
68	..	PL 4A/7	PL 3A/9	Z-W	10′ 0″	A
69	..	PL 4A/8	PL 16A/4	Z-Y	11′ 0″	A
70	..	PL 4A/11	PL 16A/2	Z-Y	11′ 0″	A
71	..	PL 4A/12	PL 17A/12	Z-Y	11′ 9″	D
72	..	PL 5A/2	PL 8A/6	Z-W-X	11′ 6″	A
73	..	PL 5A/3	PL 8A/3	Z-W-X	11′ 6″	A
74	..	PL 5A/4	PL 8A/4	Z-W-X	11′ 6″	A
75	..	PL 5A/5	Earth		4′ 3″	B
76	..	PL 5B/3	PL 8B/3	Z-W-X	11′ 0″	A
77	..	PL 5B/4	PL 8B/4	Z-W-X	11′ 0″	A
78	..	PL 5B/5	PL 8B/5	Z-W-X	11′ 0″	A
79	..	PL 5B/6	PL 8B/6	Z-W-X	11′ 0″	A
80	..	PL 5B/7	PL 8B/7	Z-W-X	11′ 0″	A
81	..	PL 5B/8	PL 8B/8	Z-W-X	11′ 0″	A
82	..	PL 5B/9	PL 8B/9	Z-W-X	11′ 0″	A
83	..	PL 5B/10	PL 8B/10	Z-W-X	11′ 0″	A
84	..	PL 1A/5	Earth		4′ 3″	B
85	..	PL 1B/1	PL 11B/1	W-X	11′ 3″	B
86	..	PL 1B/2	PL 11B/2	W-X	11′ 3″	B
87	..	PL 2/3	PL 9/9	W-X	8′ 6″	A
88	..	PL 2/4	PL 16B/11	W-X	10′ 6″	A
89	..	PL 2/5	Earth		4′ 3″	B
90/1	..	PL 2/9	PL 11/P1	X	10′ 6″	A
/2	..	PL 2/9	PL 16B/4	W-X	10′ 6″	A
/3	..	PL 16B/4	PL 17A/9		4′ 3″	A
91	..	PL 2/10	PL 6B/1	W-X	9′ 3″	B
92	..	PL 2/11	PL 6B/2	W-X	9′ 3″	B
93	..	PL 2/12	PL 9/4	W-X	8′ 9″	D
94	..	PL 3A/5	Earth		5′ 3″	B
95	..	PL 3A/6	PL 11A/2	X	11′ 9″	A
96	..	PL 3A/7	PL 11B/5	X	11′ 6″	A
97	..	PL 3A/10	PL 16B/10	X	11′ 3″	A
98	..	PL 3B/1	PL 11A/10	X	11′ 3″	C
99	..	PL 3B/2	PL 11A/11	X	11′ 3″	C
100	..	PL 3B/3	PL 11B/3	X	11′ 0″	B
101	..	PL 3B/4	PL 11B/4	X	11′ 0″	B
102	..	PL 3B/5	PL 6B/3	X	9′ 6″	B
103	..	PL 3B/6	PL 6B/4	X	9′ 6″	B
104	..	PL 3B/7	PL 6B/5	X	9′ 6″	A
105	..	PL 6A/4	PL 9/11	X	8′ 9″	D
106	..	PL 6A/5	Earth		5′ 3″	B
107	..	PL 6A/11	PL 11B/6	X	10′ 3″	D
108	..	PL 9/5	Earth		4′ 3″	B
109	..	PL 9/6	PL 11A/4	X	8′ 9″	D
110	..	◀Not used▶				
111	..	PL 9/10	PL 17A/4	X	9′ 6″	A
112	..	PL 9/12	PL 11A/9	X	8′ 9″	D
113	..	PL 17C/11	Thermo 1	X	8′ 6″	A
114	..	PL 17C/12	Thermo 2	X	8′ 6″	A
115	..	PL 8A/5	Earth		5′ 0″	B



PANEL	DESCRIPTION	CONSOLE 61	CONSOLE 61A	CONSOLE 61B
1	POWER UNIT	870	870	870
2	POWER UNIT	871	871	871
3	POWER UNIT (STAB)	872	872	872
4	AMPLIFIER (IF)	A3711	A3711	A3711
5	INDICATING UNIT CRT (IFF)	31	31	31
6	TIMEBASE UNIT ELEV	134	134	134A
7	TIMEBASE UNIT IFF	135	135	135
8	POWER UNIT IFF	873	873	873
9	PANEL (SYNC & BLANKING)	642	642	642
10	AMPLIFYING UNIT (AJ & VID)	295	295	295
11	TIME BASE UNIT (RANGE)	136	139	136
12	POWER UNIT	874	874	874A
13	POWER UNIT EHT	875	875	875
14	PANEL (CONTROL)	643	643	643A
15	INDICATING UNIT CRT	32	32	32A
16	PANEL (CONTROL)	644	644	644
17	PANEL (INPUT)	645	645	645A
18	CALCULATOR (MANUAL)	12	12	12

NOTE:
LOOMS AND NUMBERS ARE FOR DIAGRAMMATIC PURPOSES ONLY

CABLES SHOWN DOTTED APPEAR ON CONSOLE TYPE 61 B ONLY

EXTERNAL CONNECTIONS TO PANEL 17 DEPEND ON APPLICATION OF CONSOLE

Fig. 4 Consoles Types 61, 61A & 61B: interconnections Fig. 4

(A.L.16, Dec. 69)

D840740 820 8/70 956/3 A(W)LTD 630M

Chapter 2

AMPLIFIER (IF) TYPE A.3711
AND
AMPLIFYING UNIT (A.J. AND VIDEO) TYPE 295

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

AMPLIFIER TYPE A.3711

Amplifying units Type 302, 294 and 296

1. The radar signals are fed into the console Type 61 at an intermediate frequency of 45 Mc/s, the conversion from the original RF having already been made in a head amplifier in the aerial cabin. In the console Type 61, the IF, detector, and video output stages are all contained in the amplifier Type A.3711 (panel 4). This panel, however, consists of three units which are separate items for stores accounting purposes; for brevity, these are generally referred to as unit A, unit B, and unit C. The nomenclature of these units is as follows:—

Unit A	..	Amplifying units (IF) Type 294 (Stores Ref. 10U/16050).
Unit B	..	Amplifying units (IF) Type 296 (Stores Ref. 10U/16053).
Unit C	..	Amplifying units (IF) Type 302 (Stores Ref. 10U/16059).

2. Of these, unit C is the first in the signal chain, and is normally in circuit, i.e., it cannot be switched in or out at will. It can, however, be omitted from the signal chain, if not required, by removing the termination of the coaxial cable (coming from the input panel) from its normal position on P1, the input to unit C, and placing it on P1, the input to unit A. Unit C consists of a two-valve pre-amplifier, the purpose of which is to raise the general level before the signal is passed through unit A. The latter consists of a unity-gain, narrow bandwidth amplifier designed to eliminate interference on frequencies adjacent to the operating frequency.

3. Normally, the IF signals from unit C are received at the input termination of unit A, but pass directly to the output termination via contacts on two relays REL.1 and REL.2 (*fig.* 1). These relays are controlled by the NBW key switch on the right-hand control desk of the console. When the narrow bandwidth amplifier is switched in, the relays are operated and the signal is made to pass through the appropriate stages of unit A before reaching unit B.

4. Unit B consists of a wideband IF amplifier, detector, and cathode follower, the video output of which is passed on to the amplifying unit (A.J. and video) Type 295. The bandwidth of unit B, for a 6 dB voltage drop, is 4 Mc/s.

Action of NBW circuit

5. The high degree of selectivity in unit A is obtained by mixing the 45 Mc/s signals with a 65 Mc/s signal generated by a local oscillator, and so producing a new intermediate frequency of 20 Mc/s. The signals at this frequency are then passed through an IF amplifier having a series of narrow band-pass circuits which greatly attenuate frequencies outside the pass band. The output from this IF amplifier is again mixed with the 65 Mc/s output from the local oscillator and the difference-frequencies are selected, in a second frequency changer, to give a new IF output. The original "wanted" signals will thus be restored to their original frequency, 45 Mc/s, but the interfering signals will be outside the pass band of the IF amplifier. The "wanted" (45 Mc/s) signals will therefore be substantially freed from unwanted responses.

Constructional details

6. A top view of the complete amplifier Type A.3711 is given in fig. 2. This shows the manner in which unit B is attached to unit A; the former

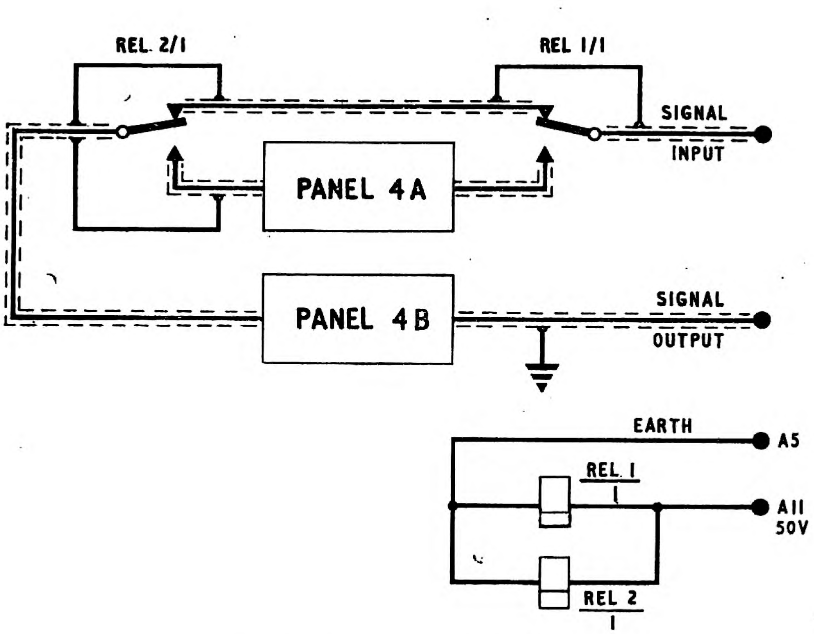


Fig. 1. Action of NBW relays

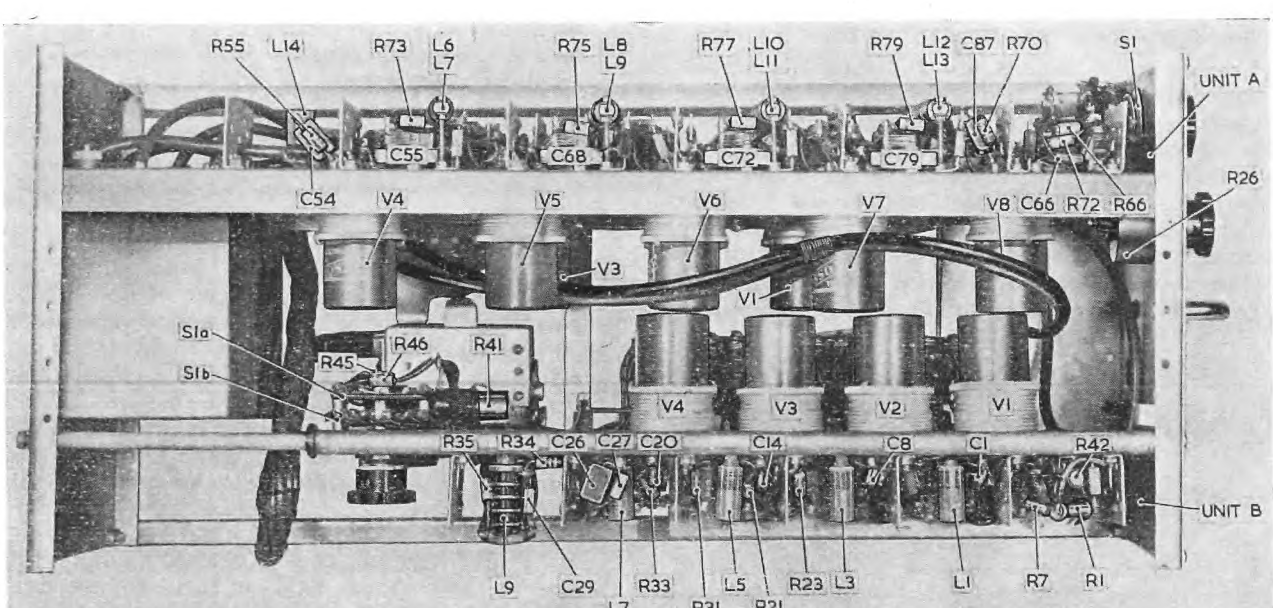


Fig. 2. Amplifier (IF) Type A.3711, top view

is hinged upon a bar, so that it can open upwards. When folded down into its normal position, the CV1091 valves in unit B are inverted and the tops of the valve cans are adjacent to the tops of the valve cans on unit A. All the external connections (except the signal line) are made by the Jones plug A on unit A. Terminations 1, 2, 3, 4, 7, 8, 9 and 10 on this plug are used for supplies to units A and B, a cableform of eight cores, fitted with a Jones socket, being used where necessary to carry the circuits to Jones plug B on unit B. These connections are shown in the circuit diagram of unit A. Fig. 3 and 4 show the location of components on the sides of unit A and B respectively.

7. Unit C is a small panel, 8½ in. long, 1½ in. wide, and approximately 3 in. deep, which is attached to unit B by hinges and captive screws, its location being shown in fig. 4.

Circuit details

Unit C (pre-amplifier)

8. The circuit of the pre-amplifier is shown in fig. 5. The IF signal enters the console at the

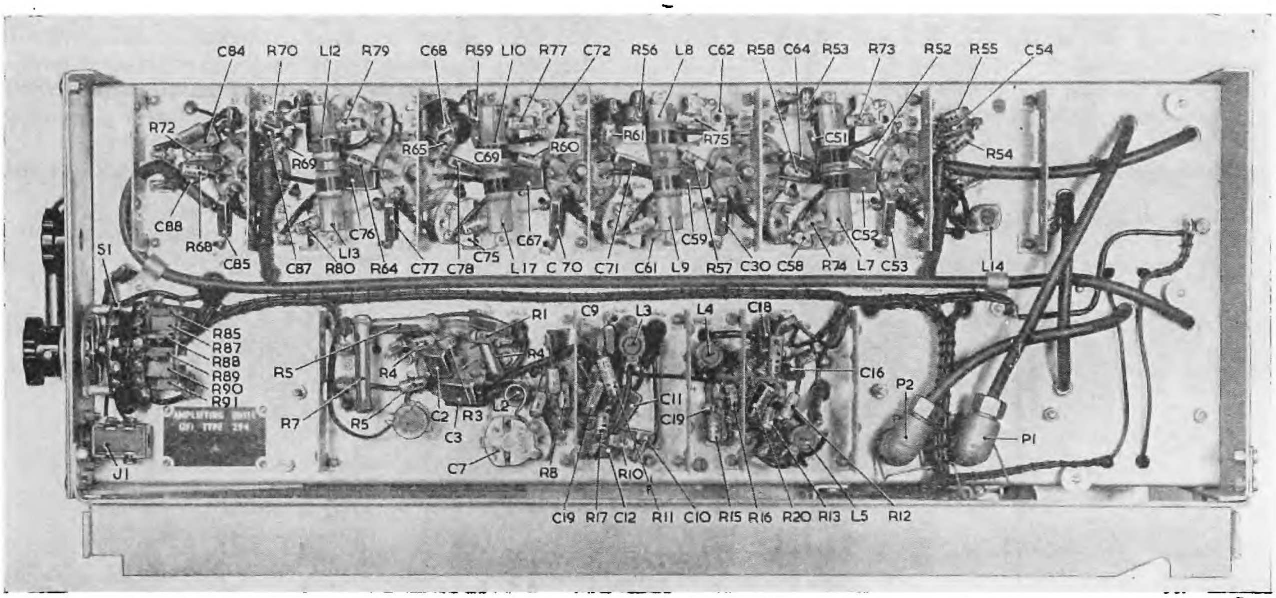


Fig. 3. Amplifying unit (IF) Type 294, rightside view

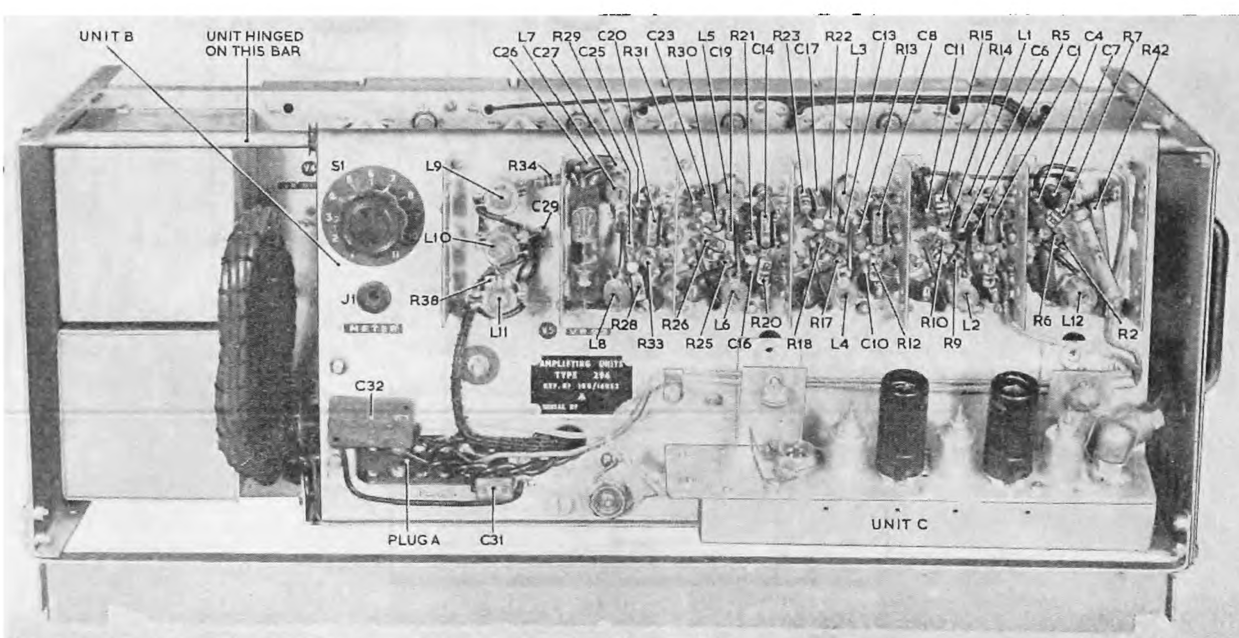


Fig. 4. Amplifying unit (IF) Type 296, left side view, with amplifying unit (IF) Type 302

input panel (PL.17) on coaxial plug P1. The latter is connected inside the console to a coaxial cable terminating in a coaxial socket which is normally attached to plug P1 on the pre-amplifier unit, and thence feeds the primary of an RF transformer L1. The secondary of this transformer is connected to the control-grid of the first IF valve V1, and the latter is coupled to the second IF valve V2 by a choke L2 and capacitance C4. The output of V2 is transformer-coupled, and is fed from a coaxial plug P2 on the pre-amplifier unit to the input plug P1 on unit A. The screening-grids are returned to the HT positive side of the anode load in each case, V2 being decoupled from V1 by R4 and C5.

9. The HT supply is obtained from the 210-volt stabilized rail on unit B. The heaters of V1 and V2 are fed from the heater (pin 1) of V1 on unit B, through an RF filter C7, L4, C8, fitted on the underside of the pre-amplifier unit. A condenser of 820 pF is shunted across each heater, close up to the valve. This method of feeding is adopted to reduce the possibility of positive feedback between the output of unit B and the pre-amplifier.

Unit A (narrow bandwidth)

10. Referring to the circuit diagram, fig. 6, the valves V4-V8 and their associated circuits form the narrow bandwidth amplifier. The valves V5, V6, V7 are normal amplifiers, and V4, V8 are frequency changers. V2 is a local oscillator, which feeds the control-grid circuit of the second frequency changer V8 from a transformer in its anode circuit; the first frequency changer V4 is fed from a transformer in the anode circuit of the buffer valve V3. The valve V1 is a reactance valve which provides remote control of the frequency generated by the oscillator valve V2.

11. The mid-point of the pass-band can be preset to any frequency in the pass-band of unit B (43-47 Mc/s), by means of the condenser C7. It is normally set to 45 Mc/s. The bandwidth of the unit is adjusted during manufacture to 500 kc/s, as this figure gives a reasonable compromise between high selectivity under interference conditions, and fidelity of pulse reproduction. With such a narrow bandwidth, it is absolutely necessary to incorporate a tuning device under the control of the operator, to counteract frequency drift of the

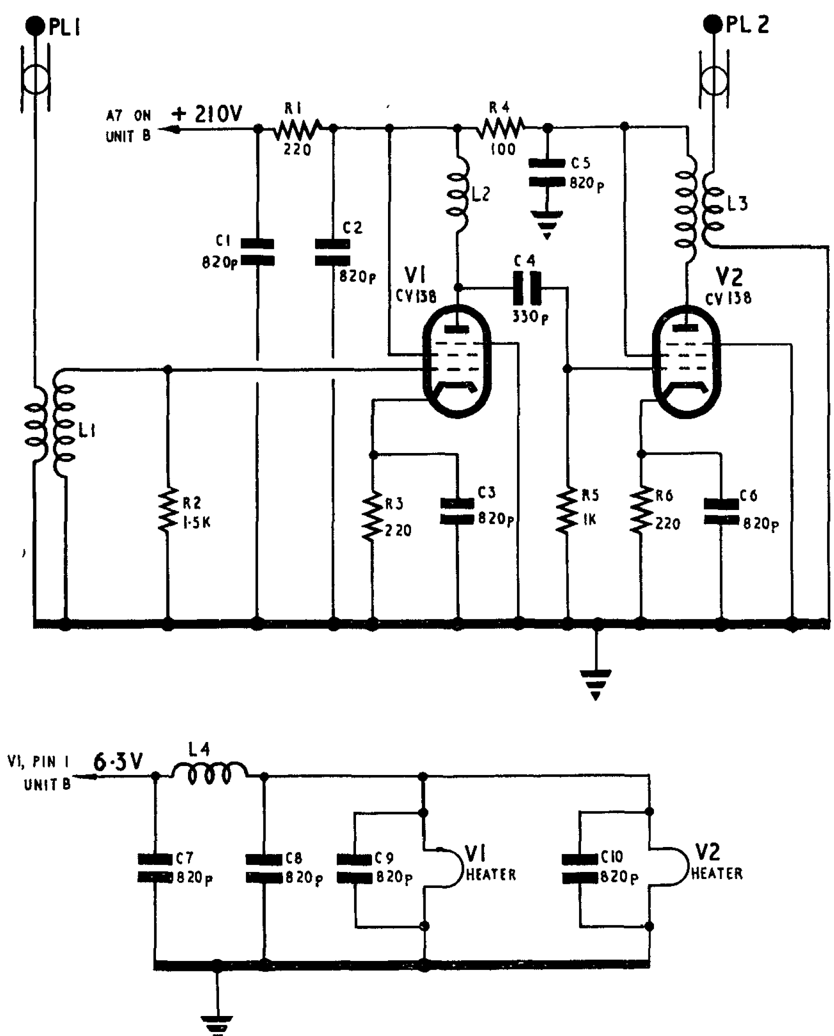


Fig. 5. Amplifying unit (IF) Type 302, circuit

radar transmitter and the local oscillator in the head amplifier. A tuning control is therefore provided on the right-hand control desk (PL.16). This gives a remote control of the frequency of the oscillator valve V2, and permits a fine adjustment for the mid-frequency of the pass-band.

12. The reactance valve V1 is a pentode, the anode being connected to the control-grid by R3 and C2 in series. The latter is merely a DC blocking condenser, and offers negligible reactance at the oscillator frequency. Variations in the anode voltage, after suffering a phase change by R3 and the stray capacitance to earth, are fed into the control-grid. The resulting fluctuations of control-grid potential cause changes in the anode current which are out of phase with the anode voltage. As the current changes at the anode lag upon the voltage changes which originally produced them, the anode-to-cathode path of the valve behaves as an inductance. Since this virtual inductance is in effect shunted across a portion of L2, which is part of the oscillatory circuit of V2, the frequency of the oscillation can be controlled by varying the value of the virtual inductance formed by V1 and its associated components.

13. The value of this virtual inductance can be controlled by varying either the control-grid bias or the cathode bias of V1. The cathode bias is controlled by a variable resistor, the NBW TUNE control, on the right-hand control desk. The control-grid is connected to a termination on the input panel of the console to provide facilities for remote control of the frequency. This facility is provided because, in certain installations, aerial switching pulls the transmitter frequency. Remote frequency control is not, however, used on current installations.

14. The oscillator valve V2 operates by cathode feed-back, a cathode tap being effected by the grid-cathode capacitance and the stray capacitance between cathode and earth. The frequency can be varied over the range 60 to 70 Mc/s, by the condenser C7, while V1 gives a fine control over a range of 1 Mc/s. Normally, the oscillator frequency is set at 65 Mc/s. The anode circuit is tuned by a dust-core trimmer L3, and the output (OSC. FEED 2) is taken to the cathode of the frequency changer V8 by a low-impedance coupling coil.

15. Since the purpose of unit A is to exclude signals outside its pass-band, it is essential that break-through from the input to the output be reduced to a minimum. The buffer valve V3 is therefore employed to feed the 65 Mc/s output of the oscillator valve V2 to the frequency changer V4. If the two mixers V4 and V8 were fed from the same source, a ready path would be provided for signal break-through. The anode of V3 is tuned by a dust-core trimmer L5 and its output is taken to the cathode of V4 via a low-impedance coupling coil.

16. When the NBW key switch is operated, the 45 Mc/s input from the head amplifier (direct or via unit C) is fed via P1 to the control-grid of the first frequency changer V4. This valve is operated with low screening-grid voltage and a large cathode bias, and the anode current changes due to the input occur over the curved portion of the valve characteristic. The 65 Mc/s output from the buffer valve V3 is injected at the cathode of V4 at an amplitude of 1 to 2V RMS. The mixture of 45 Mc/s and 65 Mc/s signals produces signals having a frequency of 20 M/cs, which are fed to the narrow bandwidth amplifier V5, V6, V7.

17. The valves V5, V6, V7 are biased to the linear part of their characteristic curve. The band-pass circuits, each of which consists of a pair of air-cored coils with preset coupling tuned by air dielectric trimmer condensers, are designed to give a reasonably flat response over a pass-band of 500 kc/s, centred on 20 Mc/s. These valves give a certain amount of gain which is not desired. To counteract this, the control-grid of each valve is tapped near the end of the tuning inductance. Valves V6 and V7 have a cathode bias GAIN control R62, by which the overall gain of the amplifier can be set to unity.

18. The second frequency changer, V8, receives the 65 Mc/s output from the oscillator on its cathode, and the 20 Mc/s output from the amplifying chain on its control-grid. These are mixed in the valve to produce a 45 Mc/s video signal stripped of interference. This output is fed to the input circuit of unit B.

Unit B (45 Mc/s IF amplifier)

19. Unit B contains a four-stage IF amplifier operating at 45 Mc/s, followed by a diode detector and a cathode-follower. The circuit is shown in fig. 7. The IF signal is fed to the control-grid of the first IF amplifier V1 via the plug P1. The valves V2, V3, V4 are also IF amplifiers; all the coupled circuits used between stages consist of IF transformers with adjustable dust cores, resonating with the stray capacitance. The anode loading of each stage is also adjustable by the dust-core coil in series with the transformer. The overall band-width is adjusted to 4 Mc/s by slight staggering of the resonant frequencies of the different stages.

20. The voltage of the screening-grid supply to each of these valves is stabilized, to improve the performance of the amplifier under interference conditions. For simplicity, consider an interfering CW signal, superimposed upon the normal pulses. With an unstabilized supply the effect of the additional input is to cause both the anode and screening-grid currents of each valve to increase, and the screening-grid voltage to fall, resulting in a reduction in the overall gain; also, the handling capacity of the amplifier is reduced by the reduction of screening-grid voltage. This effect is avoided to a great extent by stabilizing the screening-grid voltage supply.

21. The screening-grids of V1, V2, and V3 are operated at 140V obtained from power unit Type 872 (PL.3), the supply being switched by the

CALIB key on the right-hand control desk, so that the IF amplifier can be muted while the timebase is being set up. The screening-grid of V4 is operated at 210V (stabilized), also obtained from PL.3.

22. Manual gain control is introduced at the cathodes of V1 and V2, and is effected by varying the cathode bias. The bias voltage is developed across the IF GAIN control resistor R15 on the right-hand control desk, and is partly due to a bleeder current from the HT rail, via R1, and partly to the cathode current of the controlled valves. This gives a reasonably smooth control over a range of about 40 dB. The valves V3 and V4 are biased by 47-ohm and 150-ohm resistors in the cathode circuit. The time-constants of the cathode de-coupling are made sufficiently short to avoid paralysis trouble.

23. The detector is a diode, V5, which is followed by a three-stage IF filter feeding into the cathode-follower V6. The rectified output of V5 is taken from the cathode and is therefore positive-going. For normal operation with the pre-amplifier in use, the noise level at the input Terminal P1 will be about 10mV RMS, producing a rectified output of about 3V RMS. The unit will handle signals up to 20 times noise without overloading the output stage. The output of the cathode-follower V6 is fed to the amplifying unit (A.J. and video) Type 295 through a short length of coaxial cable.

External connections

24. The IF input from the head amplifier is received at the console on coaxial plug P1 on the console input panel (PL.17). A coaxial cable carries the signal to P1 on the amplifying unit (IF) Type 302 (or direct to P1 on the amplifying unit (IF) Type 294 (*para.* 2). The video output of the amplifying unit (IF) Type 296 is taken from plug P2 to plug P1 on the amplifying unit (A.J. and video) Type 295. The remainder of the external connections are made via the Jones plug A on unit A. These are as follows:—

A1	STB.1, 280V, unit A	from PL.3, A8
A2	HT.2, 300V, units A and B*	from PL.12, A7
A3	LT.2, 6·3V, earth return. V1-V8 in unit A, V1-V5 in unit B, V1-V2 in unit C*	from PL.12, A3
A4	IF gain control, unit B*	to PL.16, A3
A5	Bus bar earth*	
A6	NBW tune (local frequency control, unit A)	to PL.16, A1
A7	STB.2, 210V, unit B (V4 screening-grid), unit C (V1 and V2 HT)* ..	from PL.3, A9
A8	STB.3, 140V, unit B, V1, V2, V3 screening-grids, switched for muting*	from PL.16, A4
A9	LT.1, 6·3V } unit B, V6*	from PL.12, A10
A10	LT.1, 6·3V }	from PL.12, A12
A11	DC supply to NBW relay, unit A	from PL.16, A2
A12	External frequency control, unit A	to PL.17, A12

*taken to unit B via cableform and Jones socket (*para.* 6)

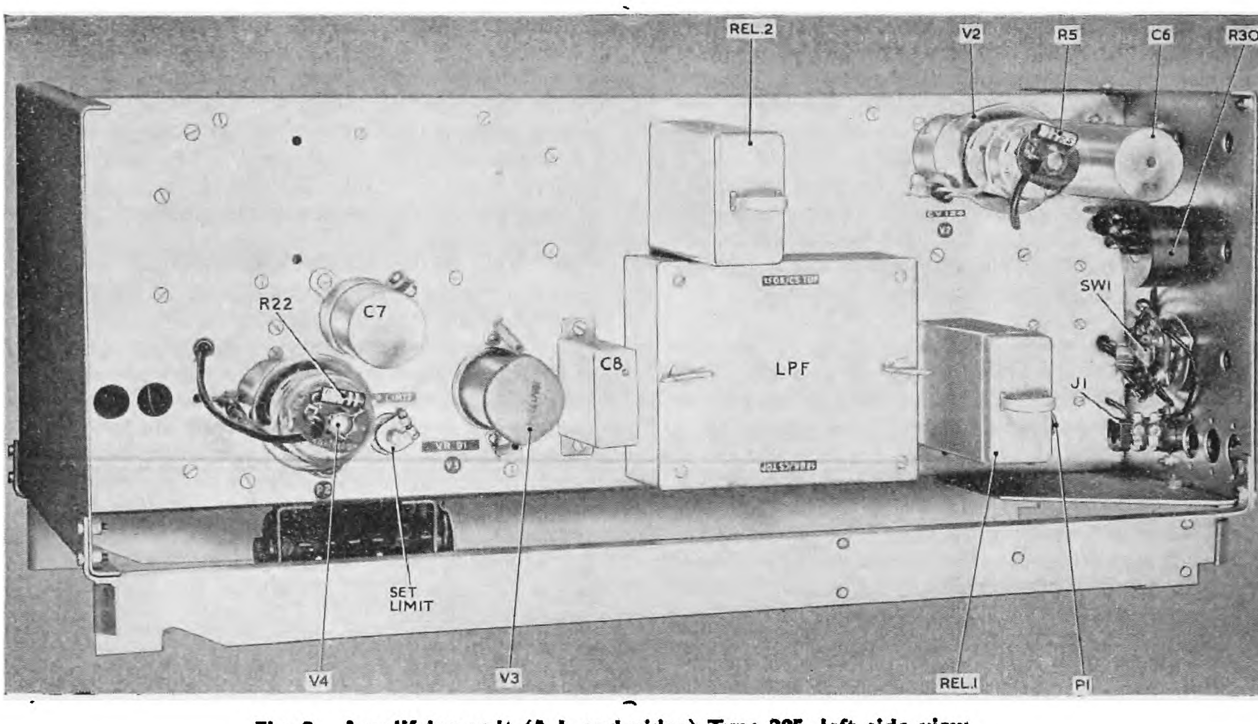


Fig. 8. Amplifying unit (A.J. and video) Type 295, left side view

AMPLIFYING UNIT (A.J. AND VIDEO) TYPE 295

General arrangement

25. The amplifying unit (A.J. and video) Type 295 consists of a cathode-follower having a short time-constant (generally referred to as the STC circuit), a low-pass filter, a limiting stage, and an output cathode-follower which gives two separate outputs. The bandwidth of the unit is 4 Mc/s at 6 dB voltage drop.

26. Two relays are fitted, one of which, REL.A, cuts out the STC circuit, and the other, relay REL.B, cuts out the low-pass filter (LPF circuit). These relays are operated by key switches on the right-hand control desk (PL.16).

27. The video signal from the amplifying unit Type 296 is normally fed directly to the limiting stage; the latter then limits the amplitude of the signals to prevent overloading of the subsequent stages. When interference is present, however, either the STC circuit, the LPF circuit, or both, can be switched into circuit, and the effect of interfering signals is thus minimized.

28. The limiting stage feeds a cathode-follower, the full output of which is fed to the video stages on the main radar indicating unit. A variable fraction of this output is also tapped off and fed to the console input panel; this may be connected to the IFF timebase unit so that the same radar signal may be displayed on the IFF indicating unit for range correlation.

29. Fig 8 and 9 show two views of the amplifying unit, and the circuit diagram is given in fig. 10.

Circuit details

30. When the STC and LPF circuits are by-passed, the video input from P1 is fed directly to the cathode of V3, and this point is therefore directly connected to the cathode of the cathode-follower V6 in unit B of PL.4. This valve normally takes about 30 mA, so that the cathode of V3 stands at about 29V positive to earth. The voltage on the control-grid of V3 is adjusted by the potentiometer R19, the AMP LIMIT control, to be slightly less than this, with the valve taking about 14 mA anode current.

31. When a video input is being received, the positive voltage on the cathode of V3 is increased and the valve takes less current, so producing a positive video output at the anode. When the input exceeds a certain value, V3 will be cut off, and further increases of input amplitude will cause no increase of output amplitude. The AMP LIMIT potentiometer controls the peak output at the anode, and is normally set to limit the signal level at 10 times the noise level.

32. The output from V3 is fed to the control-grid of V4, which is a cathode-follower with a fixed

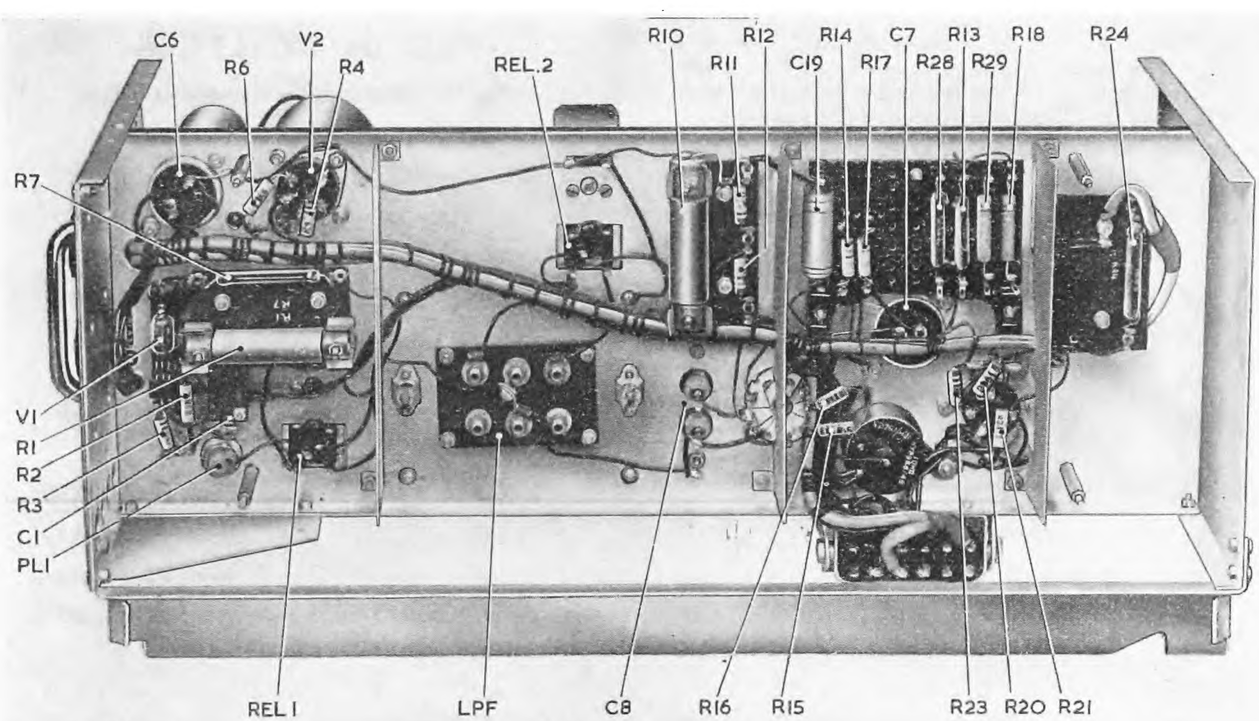


Fig. 9. Amplifying unit (A.J. and video) Type 295, right side view

resistor R24 and a potentiometer R30 in series as the output load. The main video output is taken across the whole load (i.e. from P2) and the tapped-down output from R30 is available at Jones termination A12. The overall gain of the panel is approximately unity.

STC and LPF circuits

33. The effect of a large CW overload is to produce a positive DC output from the amplifying unit Type 294. If this voltage is large enough, it follows from para. 30-32 that V3 will be cut off and all signals lost. This effect is avoided by interposing the STC circuit between the input at P1, and V3. The condenser C1 insulates the control-grid of V2 from the cathode of V6 in PL.4B, so far as the DC output is concerned, and the time-constant of the discharge circuit of C1 is kept short to reduce pulse shape distortion as much as possible. The diode V1 is fitted to limit the negative-going tail at the end of each square pulse, caused by the introduction of the condenser C1 and resistor R2.

34. The valve V2 is operated under exactly the same conditions as V6 in PL.4B, so that when the STC circuit is in use, the feed to the limiter is the same as in normal circumstances.

35. Operation of the LPF key switch on the right-hand control desk (PL.16) changes over the contacts of relay REL.B and so introduces the low-pass filter into circuit, before the control-grid circuit of the limiter V2. This filter cuts off all frequencies above 500 kc/s, and therefore must cause some distortion of pulse shape, but under certain interference conditions its use proves advantageous.

External connections

36. The input to the amplifying unit is taken, from P2 on PL.4B, by a short length of coaxial cable. The main output is taken from P2 on the amplifying unit to P1 on the radar indicating unit (CRT) Type 32. The remainder of the connections are made via Jones plug A as follows:—

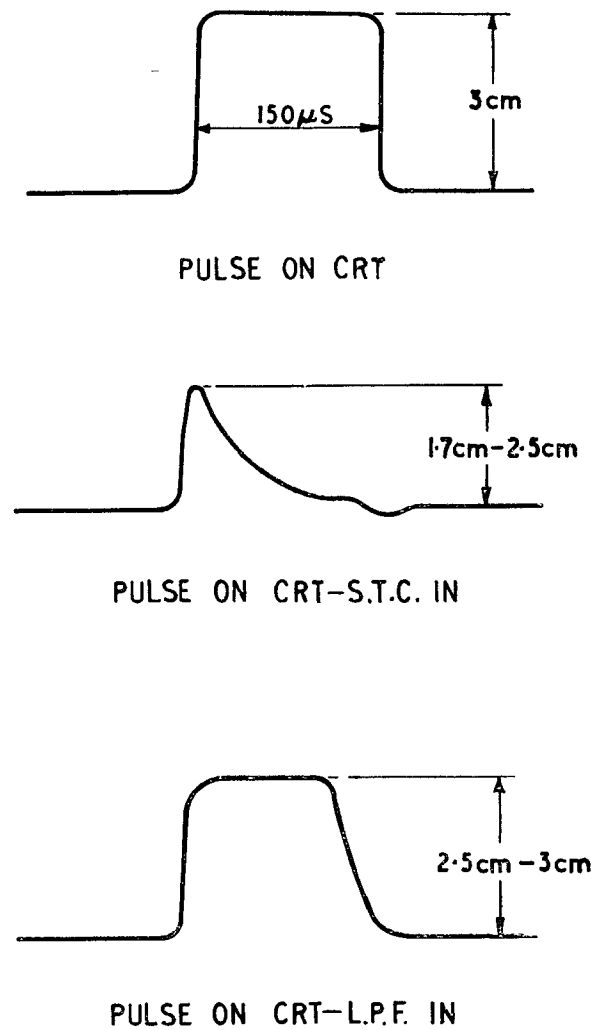


Fig. 11. Oscilloscope waveforms (PL.10)

A1	HT.8, 300V	from PL.2, A6
A2	HT.1, 320V	from PL.12, A6
A3	LT.3, 6·3V } (V1, V3, centre tap earthed)	from PL.12, A4
A4	LT.3, 6·3V } (V1, V3, centre tap earthed)	from PL.12, A8
A5	Bus bar earth	
A6	LT.1, 6·3V } (V2, V4, centre tap 70V above earth)	from PL.12, A10
A7	LT.1, 6·3V } (V2, V4, centre tap 70V above earth)	from PL.12, A11
A8	50V DC to STC relay	from PL.16, A6
A9	50V DC for LPF relay	from PL.16, A7
A10	not used	
A11	not used	
A12	Video to A band IFF display	to PL.17, P9

Waveforms

37. The effects of the STC and LPF circuits, taken separately, are illustrated by the waveforms given in fig. 11. The first waveform shows a long pulse (150 microsecond) displayed on the oscilloscope, with the STC and LPF arrangements out of circuit. This is the waveform normally used for testing purposes; its duration is considerably greater than the time-constant of the STC circuit. The effect of the latter upon the waveform is therefore as shown in the second picture. The waveform is, in effect, differentiated, and the amplitude falls to nearly zero before the input pulse is cut off. The negative swing of the waveform, when the cut off occurs, is clipped to a comparatively small undulation in the curve; in the absence (or operational failure) of V1, this swing would be of the same order of magnitude as the positive swing. It will be seen that the introduction of the STC circuit causes only a small fall in amplitude.

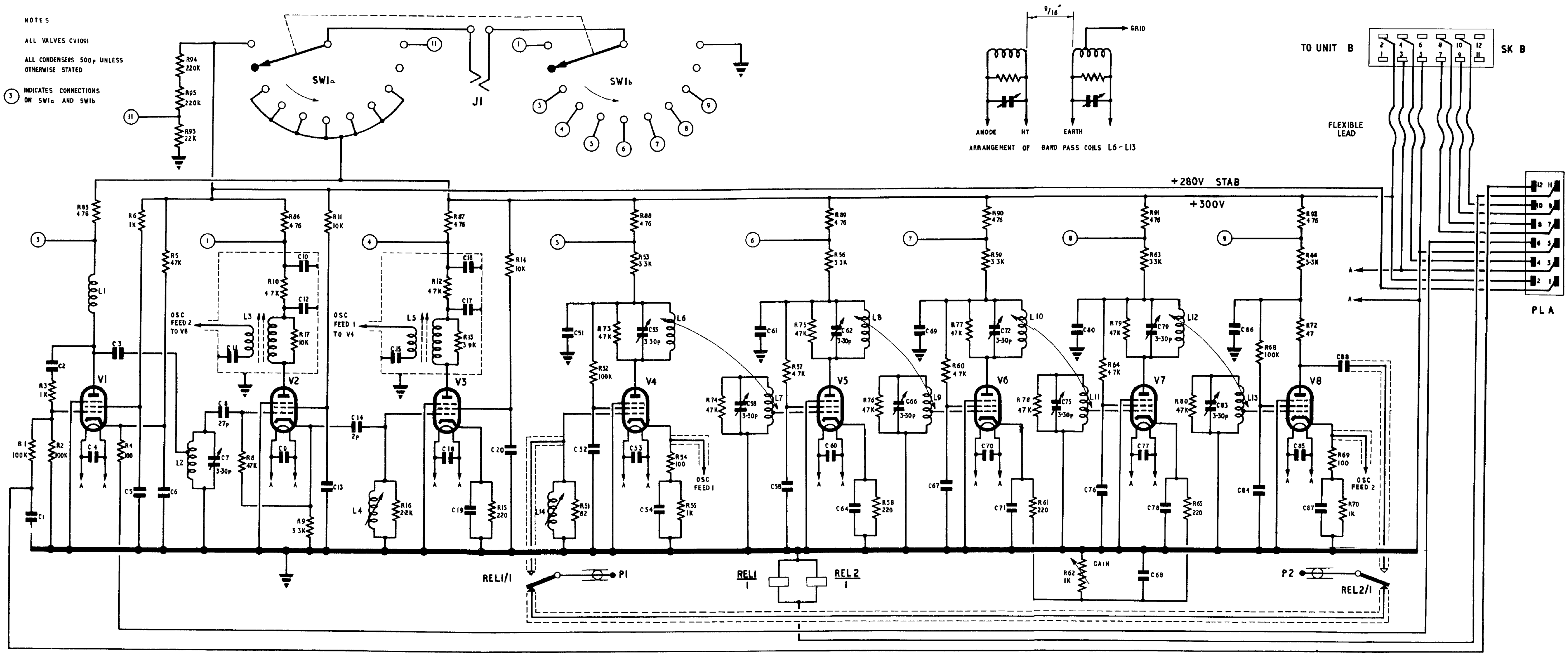
38. The effect of switching in the LPF circuit is shown in the third picture of fig. 11. These effects are (*a*) a hardly noticeable reduction in the slope of the leading edge and (*b*) a distinct reduction in the slope of the trailing edge. Both these results are as would be anticipated, *viz.*, a tendency to convert a square waveform into a half sine-wave. Little or no attenuation should follow the introduction of the LPF.

NOTES

ALL VALVES CV1091

ALL CONDENSERS 500p UNLESS OTHERWISE STATED

(3) INDICATES CONNECTIONS ON SW1a AND SW1b



AIR DIAGRAM 6112B/MIN.

ISSUE | PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY A.M. NISTRY

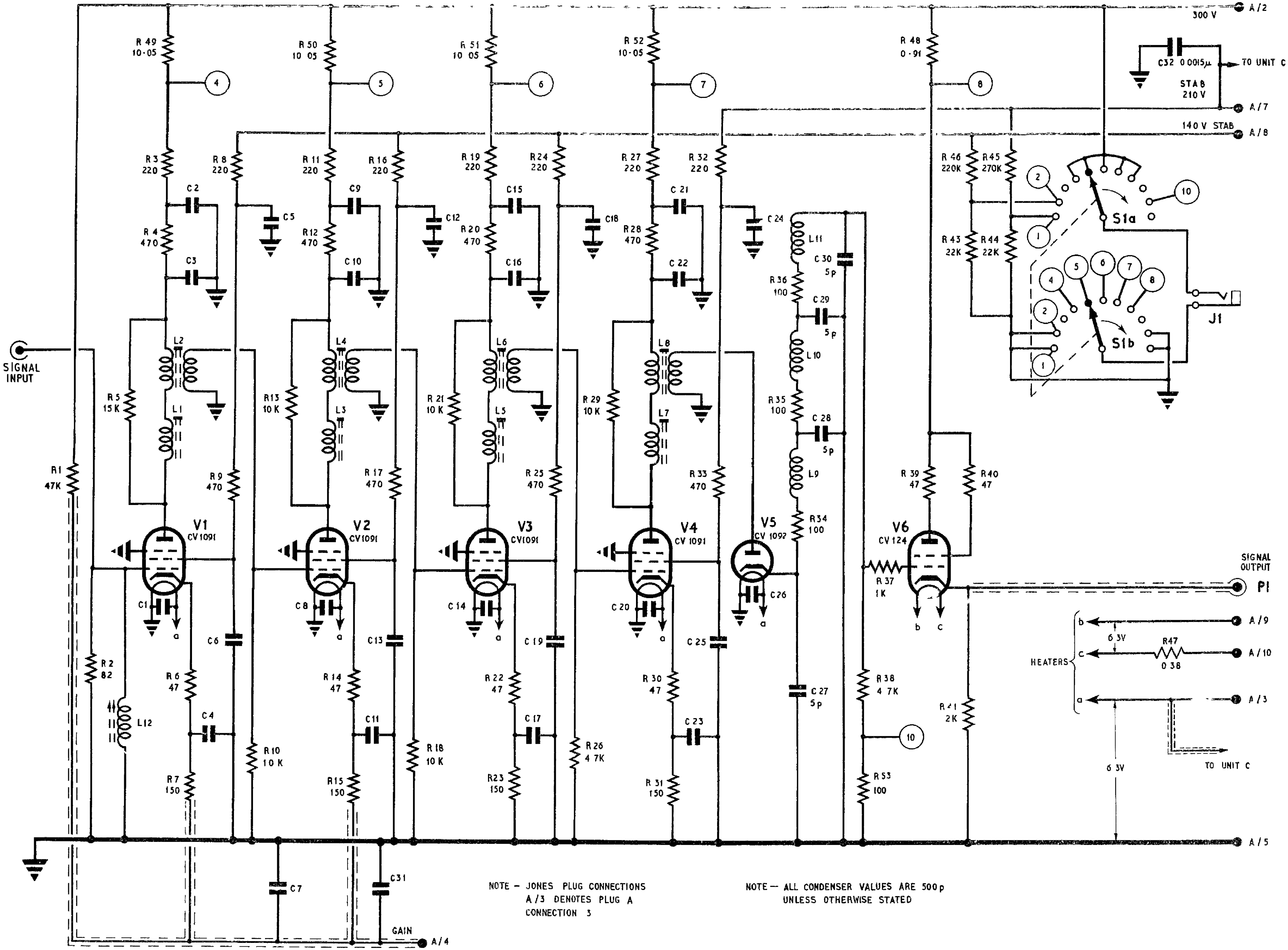
544965 3187 625 8 55 BBLd Gp 979

[Consoles Type 61 & 61A]

Amplifying unit (IF) Type 294 – circuit

Fig. 6

(A.L. 3 Apr 55)



AIR DIAGRAM 6112C/MIN.

ISSUE | PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

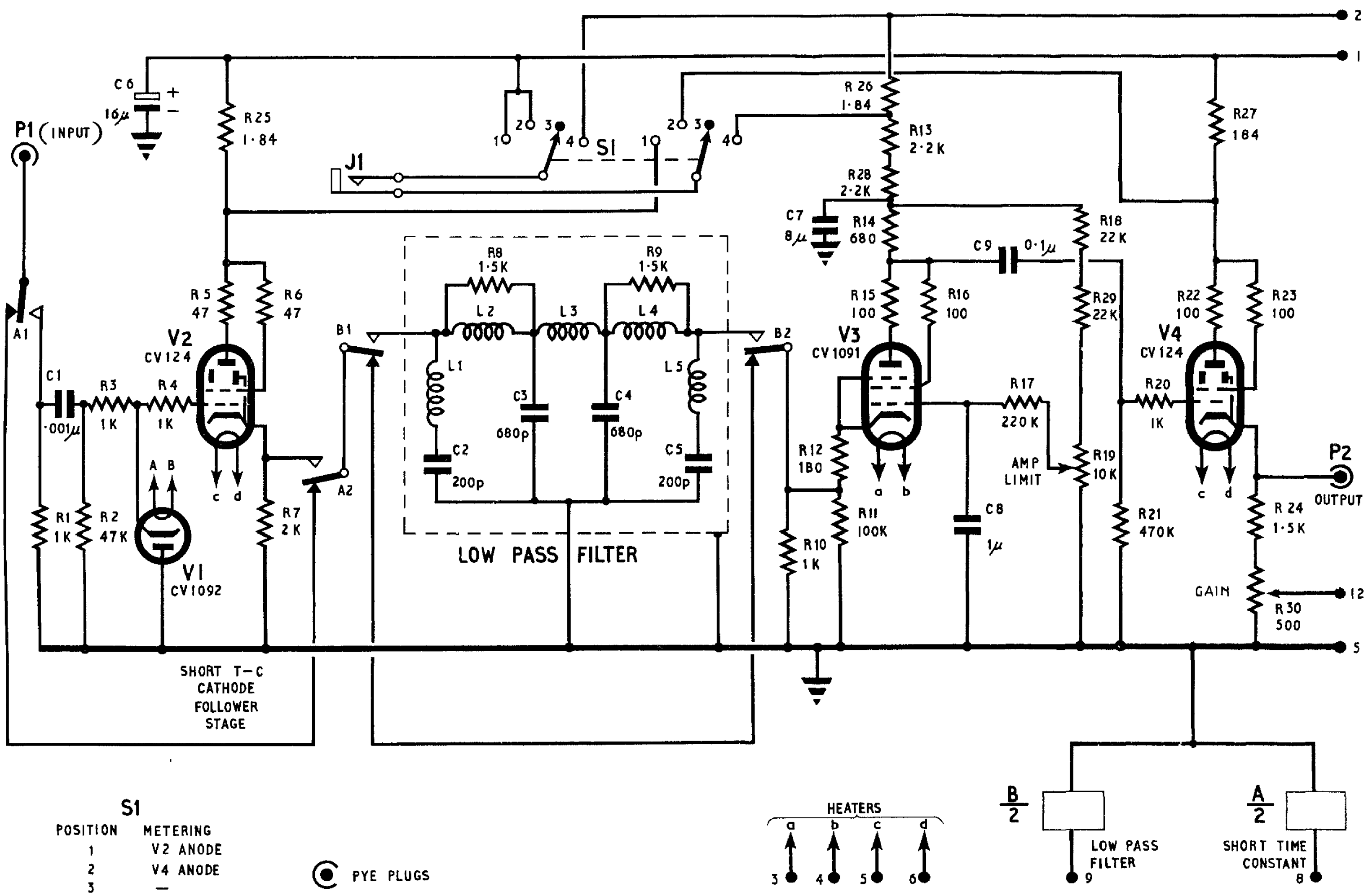
Consoles Type 61 & 61A

IF unit Type 296-circuit

Fig. 7

(A.L.3 Apr 55)

544965 / 3187 625 8/55 6819 Gp 979



S1

POSITION	METERING
1	V2 ANODE
2	V4 ANODE
3	—
4	V3 ANODE

PYE PLUGS

● 3 DENOTES CONNECTIONS ON JONES PLUG A

Fig.10 Amplifying unit Type 295 – circuit Fig.10

[Consoles Type 61 & 61A]

AIR DIAGRAM 6112D/MIN.	
ISSUE	PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MIN STPY

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Chapter 3

TIMEBASE UNIT (RANGE) TYPE 136

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Circuit description

1. Timebase unit (range) Type 136 incorporates a blocking oscillator V1, two clipping amplifiers V2, V3, a brightening pulse generator V4, V5, a 'split' generator V6, a sanatron timebase V7-V11, V16, and a calibrator V12-V15. Three views of the unit are given to assist in the location of components (*fig*. 1, 2 *and* 3). The circuit diagram is given in fig. 4. Waveforms obtained during acceptance tests at the manufacturer's works are given in fig. 8.

Sync. pulse (fig.5)

◀**2.** The sync. pulses are positive-going and are normally derived from either (a) the transmitter in mobile applications, or (b) the master trigger unit at static stations. Provision is, however, made for local sync. pulses to be used for routine servicing etc. These are provided by a special oscillator in power unit Type 871 (PL2). The sync. pulses enter the unit at termination A4 and are fed to the wiper of OP/TEST switch SW4. During normal operation, SW4 to OP, the pulses are fed to the anode of V1 via C60 and the coupling winding on pulse transformer T1. During routine servicing, SW4 to TEST, the pulses are fed via C61 direct to V1 anode.▶

3. Valve V1 and pulse transformer T1 form a triggered blocking oscillator. The timing elements for this oscillator consist of C5, C6, in association with a resistor chain appropriate to the selected range, e.g. RL.3.2, RL.2.2, R15, R14 for RANGE 1. The cathode of the valve is held at about twice the cut-off voltage by resistor chain R118, R119, and R120. The control-grid is returned to the HT rail through the timing resistor chain; it is howev prevented from rising appreciably above earth the diode action between control-grid and catho of V3.

Square wave circuit

4. V2 is normally cut off and V3 is norma conducting; on the arrival of the sync. pulse, V1 set into oscillation with high intial amplitude b this oscillation is heavily damped by the norn blocking action, timing capacitance C5, or C5 a C6, being abruptly charged to —300V. V1 and therefore, are cut off, and the anode voltage of rapidly rises to HT rail potential; this forms t positive-going edge of the output pulse of V3. the same time, the screening grid of V3 also swir positive, and this potential is communicated C2 to the control-grid of V2, which then starts conduct. The anode potential of V2 then starts fall negatively from HT rail potential, forming t negative-going edge of the output pulse of V2. Tl negative-going edge is steepened by the superi position of the very short negative-going pu from the anode of V1.

5. When the timing capacitance has discharg through the timing resistance (RANGE contrc to nearly earth potential, V3 again becon conductive. This cuts off V2 and so ends both t positive-going and negative-going output puls At the same time V1 is returned to its norn condition in readiness for the reception of the n sync. pulse.

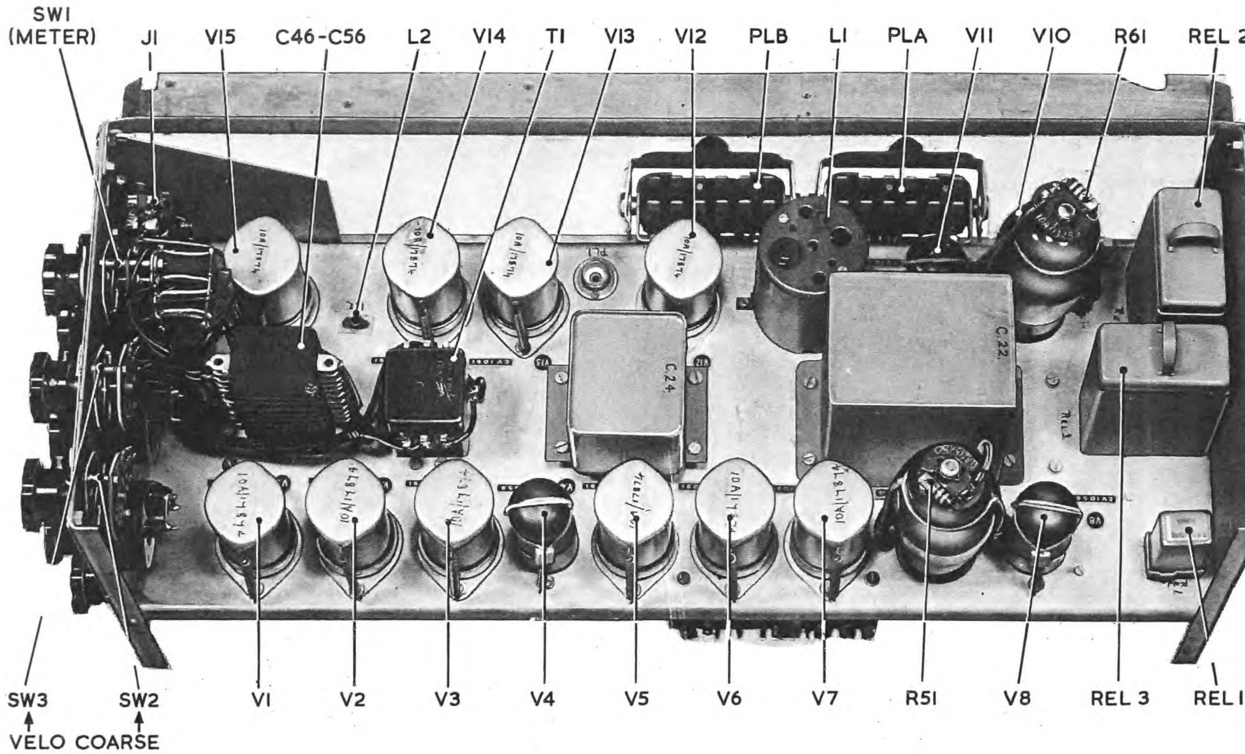
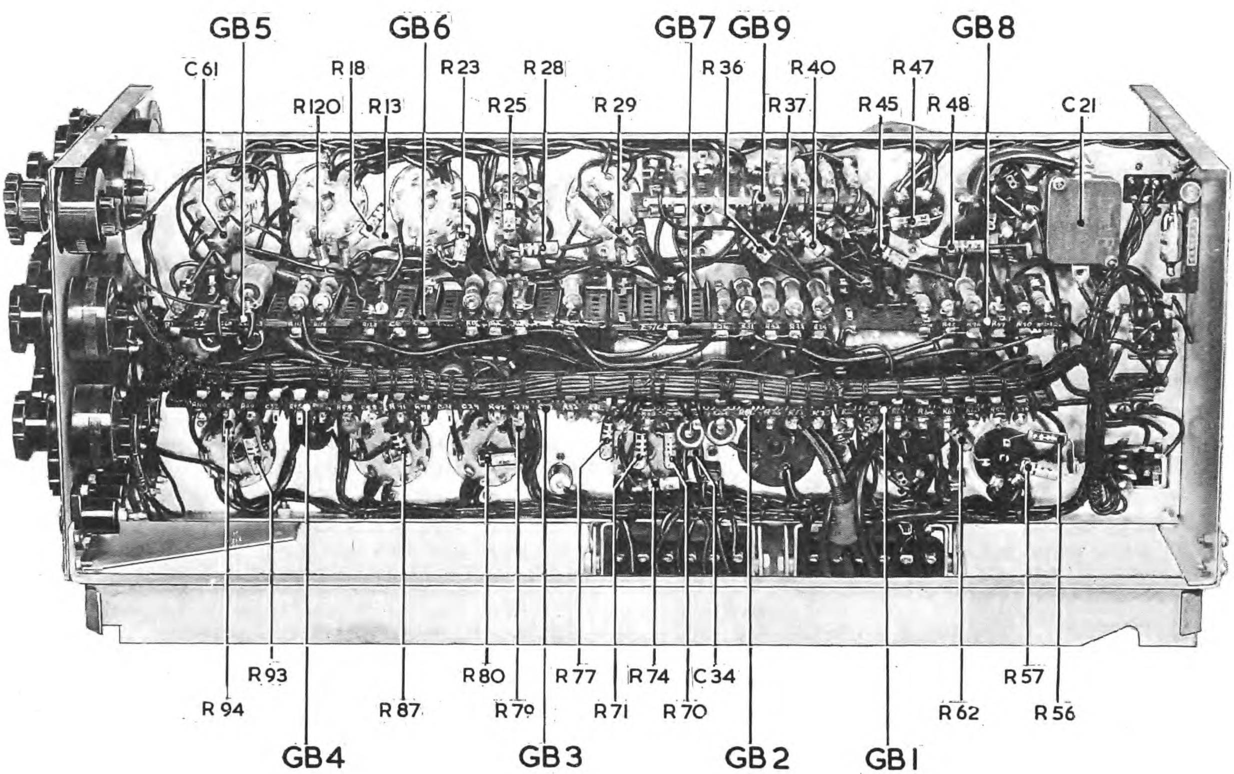


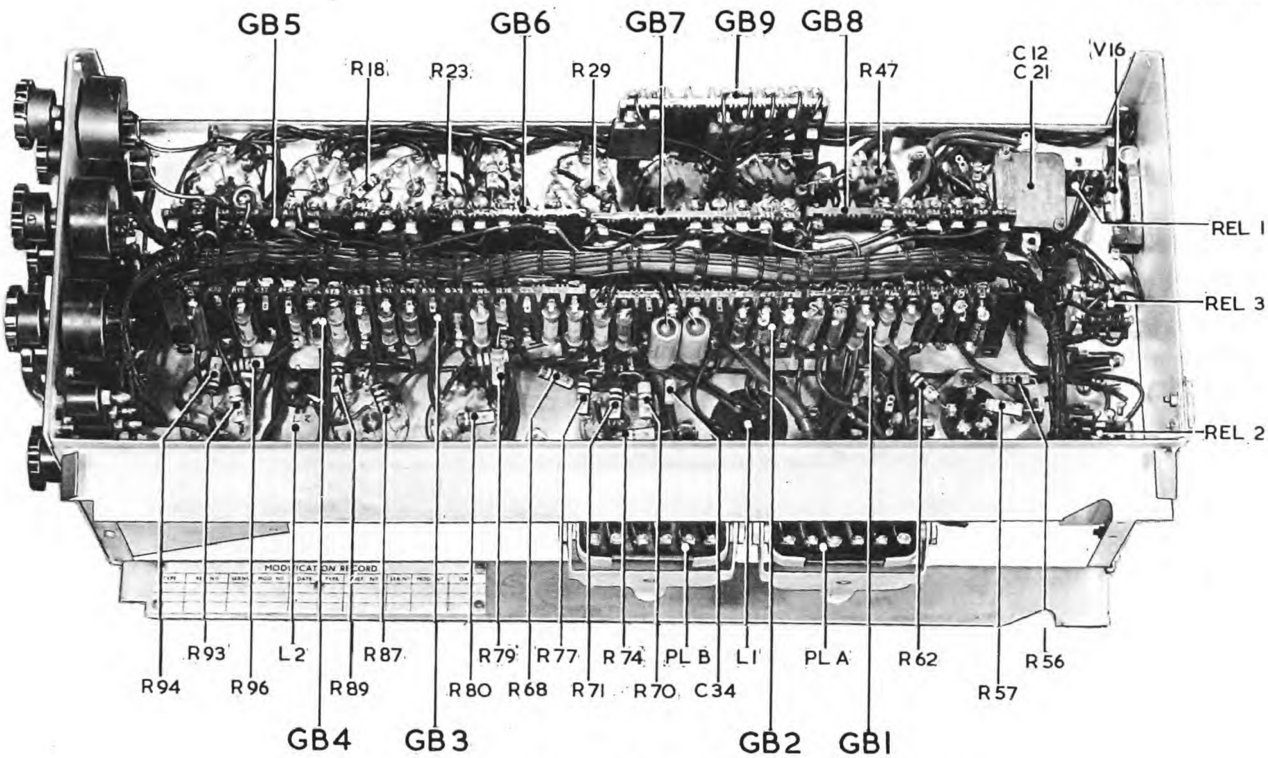
Fig. 1. Timebase unit (range) Type 136, left side view



COMPONENTS ON GROUP BOARDS

GB.1:—R67, R66, R65, R63, R60, R59, R58
GB.2:—R86, R85, —, C23, C26, —, R75, R73, R72. ON BACK, R84, R69, R76
GB.3:—R91, R90, —, —, R92, R78, —, R82, R81. ON BACK, C31, C29, C27
GB.4:—R100, —, R99, —, R95, R97, R88, C28. ON BACK, C30, C32, C33
GB.5:—R123, —, R119, R118, —, C62, C60, —, R1. ON BACK, C3, C2
GB.6:—R122, —, R121, R117, R15, —. ON BACK, C5, C6
GB.7:—R35, R33, R32, R31, R24. ON BACK, C7, C8
GB.8:—R102, R50, R49, R46, R42, R39 AND R34. ON BACK, C10, C11, R12.
GB.9:—R43 AND R52, R115 AND R116, R125 AND R117, R122, R113. ON BACK, C57, C45

Fig. 2. Timebase unit (range) Type 136, right side view



◀Fig. 3. Timebase unit (range) Type 136, right underside view▶

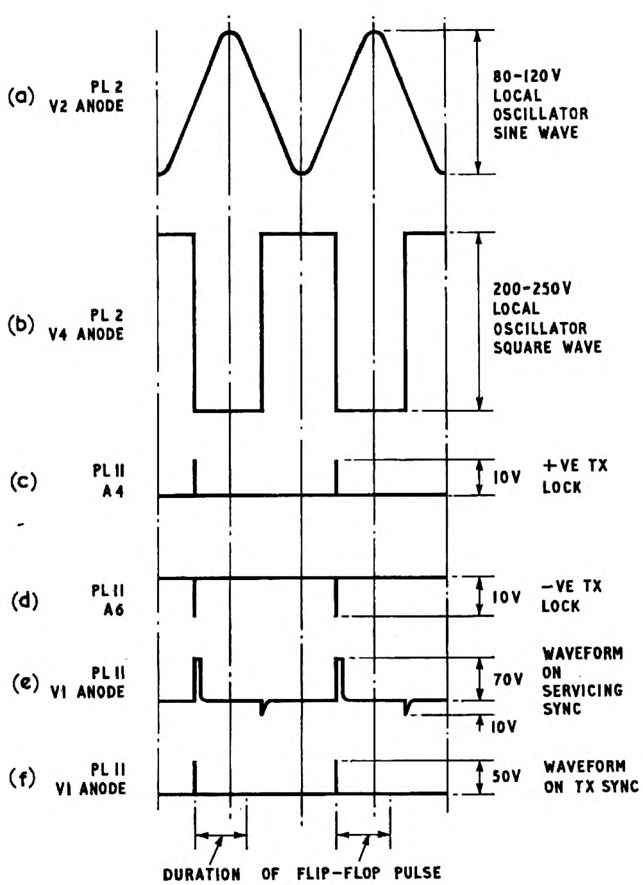


Fig. 5. Sync. waveforms (PL.11)

6. A feature of this mode of operation is that the cathode of V1 is held at a constant potential to earth (i.e. about 12·5V or twice cut-off) in spite of the heavy current which flows through R120 during the blocking oscillator pulse. This is obtained by shunting resistor R120 by C62 and C3.

7. The negative-going pulse at the anode of V2 drives the timebase generator and also the calibrator. The positive-going pulse at the anode of V3 is used to drive the brightening pulse generator.

Note . . .

It will be seen that in effect, the action of V2 and V3 is somewhat similar to a conventional flip-flop circuit and in subsequent paragraphs their outputs are referred to as flip-flop pulses.

Timebase

8. The timebase generator consists of V6, V7 V9 and V10, the fundamental valves being V7 and V9. V10 is a paraphase amplifier and V6 is the 'split' wave generator. Valves V9 and V10 produce the full deflection voltage, the anodes being supplied from a positive 950V source.

9. Valve V9 is a Miller valve, driven by V7. Referring to the simplified diagram (fig. 6) V7 is normally conducting and its anode voltage is

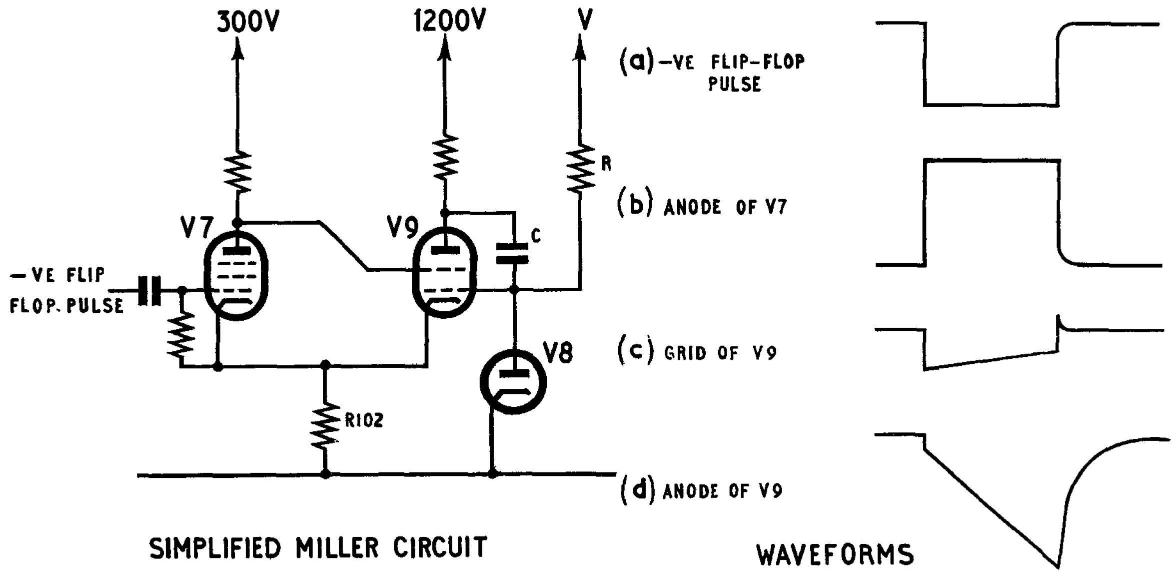


Fig. 6. Action of sanatron timebase

low, thus holding the screening-grid of V9 (which is connected to it) at a low potential so that the control-grid base of V9 is short. The control-grid of V9 is prevented from rising above earth potential by diode V8. V7, V9 and V10 share a common cathode resistor R102, and the space current of V7 develops sufficient bias across this resistor to cut off V9.

10. When V7 is cut off by the negative flip-flop pulse applied to its control-grid, its anode voltage rises, taking with it the screening-grid potential of V9; also the cathode bias of V9 is removed. V9 then becomes highly conductive and its anode potential falls sharply. Since the anode is connected to the control-grid by condenser C (*fig*. 6) the control grid potential follows that of the anode, until it reaches the anode cut-off point. In this way a negative step is produced at the anode and control-grid, the amplitude of which is equal to the grid base of the valve.

11. The control-grid potential of V9 is now free to go positive, and condenser C charges through resistor R. The anode potential falls in a corresponding manner, performing the characteristic Miller run-down. The condition for the run-down to be exactly linear is that condenser C should be charged by a constant current. As all the charging current passes through R, the current is constant only if the voltage across R is constant. The voltage across R is the difference between charging voltage V and the control-grid voltage. Voltage V is constant, but the control-grid voltage goes slightly positive during the run-down. However, valve V9 has a high gain and the percentage change of current is thus kept very low, so that the anode waveform is practically linear (*fig*. 6(d)). At the end of the flip-flop pulse, V7 once more becomes conducting and V9 is cut off. The anode potential of V9 then rises exponentially to its original value.

12. The actual circuit of timebase generator V7, V9, differs from the simple circuit in the following respects:—

(1) The charging circuits are switched by relays REL.2 and REL.3, which select one of three ranges, as described in para. 42.

(2) On ranges 1 and 2, the velocity of the trace can be controlled by switches S2 (VELO 1 COARSE) and S3 (VELO 2 COARSE) in conjunction with resistors R54 (VELO 1 FINE) and R55 (VELO 2 FINE). Only one velocity control (VELO 3 FINE) is provided for range 3.

(3) The anode of diode V11 is connected to the anode of V9. The cathode of this valve is connected to a fixed potentiometer R66, R67, across the 950-volt HT supply. This is done to reduce the flyback time. Between traces, the anode voltage of V9 is caught at about 640V, and the timebase waveform is generated from the voltage. At the end of the trace, the anode voltage rises towards 250V (i.e. more steeply than it would with a 640V HT rail) but is again caught at 640V when the diode becomes conductive.

(4) The charging resistances (i.e. the 'velo. fine' resistor chains) are returned to a tap in the anode load of V10 instead of to the HT rail. This increases the linearity as explained later (*para*. 16).

Paraphase amplifier

13. Valve V10 is driven from the anode of V9 and produces a waveform at its anode which is equal and opposite to the waveform at V9 anode. This is shown in fig. 7(c). The negative waveform at the anode of V9 tends to drive the control-grid ırough condenser C12. The anode potential of V10 then rises and tends to counteract the fall in control-grid from condenser C21. The net result of this is that the control-grid potential of V10 remains practically constant, actually going slightly negative. Since the anode of V9 goes negative and that of V10 positive, the condensers C12, C21, are charged.

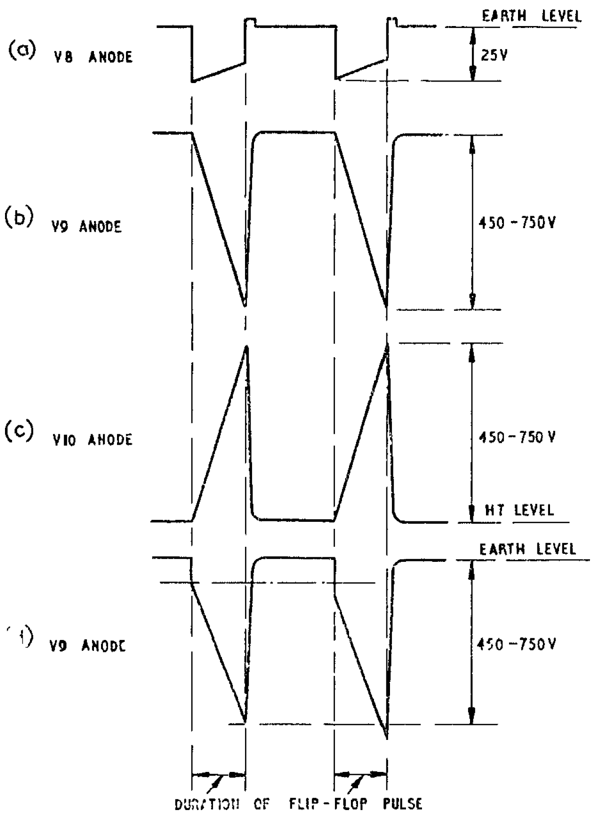


Fig. 7. Waveform in paraphase amplifier, showing production of "split" (PL.11)

14. As there is a high impedance between the control-grid of V10 and earth, the current which charges C12 passes through C21; since the two capacitances are equal, the voltages developed across the two condensers are equal. The potentials at the anodes of V9 and V10 must, therefore, always change by equal and opposite amounts.

15. For this equality to be preserved, it is desirable that C12 and C21 should be a matched pair, identical in capacitance and also in leakage resistance.

16. Since the waveform at the anode of V10 is a positive-going saw-tooth, and the charging voltage for V9 is returned to a tap in its anode chain, the charging resistance of the Miller capacitance increases slightly towards the end of the charging period. This compensates for the slight rise in control-grid voltage (*para.* 11) and keeps the voltage across the charging resistance constant. A very linear waveform is thus obtained at the anode of V9.

Brightening valve

17. The positive flip-flop pulse derived from the anode of V3 is used to drive the brightener valve V5. The pulse is fed to the control-grid, and is partially DC restored, so that V5 is brought on for the duration of the trace, but cut off between traces. The grid stopper R29 causes the grid pulse to square off near its root, and so produces a more rapid "bright-up." This rapid bright-up is only effective when the BLANKER control R114 is fully counter-clockwise. This resistor is part of a long time-constant circuit connected between control-grid of V5 and earth. The capacitor C45 in this chain charges exponentially from the pulse, and consequently the first portion of the trace (i.e., that occupied by the ground wave) can be blanked off by suitable adjustment of the BLANKER control.

18. The pulse at the anode of V5 is negative-going (*fig.* 8, righthand side) and its amplitude is controlled by R26, the BRIGHTNESS control. This pulse is fed from termination A1 to the cathode of the CRT in the indicating unit Type 32, so that the trace is brightened during the forward strike and blacked out during the flyback.

Blanking

19. When displaying radar Type 13 information, the suppressor-grid of the brightener valve V5 is fed with a blanking waveform from the timebase unit (elevation) Type 134; this is fed through condenser C7 and is DC restored by the diode V4. When the blanking waveform is negative, V5 is cut off on its suppressor-grid, and no brightening pulse is produced.

20. The blanking pulse from timebase unit (elevation) Type 135 is fed into the sync and blanking panel Type 642 (PL.9) at termination A11. A three-way switch on the latter, when in the ELEV. SCAN position, allows the blanking pulse to reach termination A12 on the panel, and the latter point is connected to termination A9 on the timebase unit (range) Type 136. The other two positions on this switch are an OFF position, and an EXTERNAL blanking position. In the OFF position, the blanking input terminations A9 on the timebase unit (range) is earthed, and V5 then functions merely as a brightener.

Azimuth strobe

21. The screening-grid voltage of the valve V5 is controlled by the relay REL.1. When the relay is operated, its contacts close and short-circuit the resistor R52. This raises the screening-grid voltage and so increases the amplitude of the brightening pulse. This is done to produce a strobe on the CRT. The facility can be used either as an azimuth strobe, or (in radar Type 13 applications) as an elevation strobe. The relay is a fast-operating one, and is fed from the 50-volt DC supply through a condenser (C1 in PL.16) shunted by a 68K resistor. When the circuit is completed, the condenser charges on the short time-constant consisting of the capacitance of C1 and the relay coil resistance; the relay then operates, but falls off again as the charging current falls below the "release" value. This causes the trace to "flash" momentarily when the key circuit is completed externally. The condenser remains charged so long as the circuit is closed, but, when opened, the condenser discharges through the shunt resistors.

22. For use as a normal azimuth indicator, giving a "flash" on the CRT as the aerial array sweeps through a specified azimuth (e.g. North), the circuit is as follows. A 50-volt supply from PL.2, A9, is taken into the timebase unit (range) at P1, through the relay coil, and out at B10. The circuit is then carried into the right-hand control desk (PL.16) at termination B2, through the time-constant circuit and the AZIM. IND. key switch S7, and out at B3. From B3 on PL.16 the circuit continues to the input panel PL.16, termination A10. The circuit is then taken outside the operations (or radar) room in a manner depending upon the particular type of installation, and through a trip switch on the aerial turntable (or pivot mount if so fitted), returning to the power unit, PL.2, by an earth return.

23. The brightening waveforms on the anode of V5 are shown on the extreme right of fig. 8. It must be noted that in order to observe the waveform with the azimuth indicator switch ON, the capacitor C1 on the control panel Type 644 must be short-circuited, otherwise the waveform will merely be 'flashed' on and off as described in para. 21.

Elevation strobe

24. In radar Type 13 applications, arrangements are made to brighten the H/R trace when the aerial array tilts through certain predetermined angles of elevation, usually the basic "setting-up" lines every 5 deg. of elevation. The circuit from the 50-volt supply (PL.2, A9) to the input panel (PL.17, A10) is as already described in para. 22. From the latter point the circuit is taken through a multi-contact switch associated with the tilting mechanism, and returns to earth on the H/R console at PL.17, A11.

25. The circuit is controlled by the switch S7 on the control desk. A label marked ELEV. STROBE is provided, and should be fitted when the switch is used for this purpose.

H/R strobe

26. The brightening valve can also be used as an operational strobe to enable the PPI operator to "flash" the H/R CRT at any time. To do this, an additional lead is taken from termination B10 in PL.11 direct to termination E11 on the input panel. The circuit then continues over to the power unit the H/R strobe switch, and returns to the power unit in the H/R console by an earth return. The H/R trace is then brightened during the time the H/R STROBE key is pressed.

Split facility

27. The split facility is used in GCI applications (e.g. in radar Type 15, Mk. 5) in which the response amplitude of two separate aerials has to be compared. The comparison is made by switching the feed to the receiver from one aerial to another, electronically. Two traces are produced upon the screen of the H/R CRT, and displayed alternately. Being superimposed, the two traces appear visually as a single trace.

28. The responses from the upper aerial are displayed upon one trace, and those from the lower aerial upon the other. If the origins of both traces were the same, the responses would be superimposed. To separate the responses so that their amplitudes can be compared, a shift voltage, synchronized with the electronic aerial switching, is applied to the timebase plates of the CRT, so that alternate traces are displaced laterally, and responses from the two aerials are presented side-by-side.

29. The electronic switching of the aerials is performed through the agency of a square wave generated in the multivibrator unit Type 52 (mounted upon the information generator rack). The switching wave is fed into the H/R console at the input panel, terminations E7 and E8; and thence to the HEIGHT-PHASE-NORMAL switch on the right-hand control desk. At the same time, the split waveform for the timebase displacement is fed from the multivibrator unit to termination A6 on the console input panel, and thence to termination A9 on the control desk.

30. When the HEIGHT-PHASE-NORMAL switch is in the NORMAL position, neither the split nor the switching waveforms are fed into the timebase unit; signals are then received from both aerials, and displayed upon a single trace. When in the HEIGHT position, the square switching waves are fed to the electronic switches in the aerial cabin, and at the same time, the split waveform is fed into the timebase unit (range), causing the timebase trace to shift its origin on alternate sweeps.

31. As already explained, the step at the anode of V9 is equal to the grid base of the valve. The trace displacement can, therefore, be obtained by varying the grid base on alternate traces as shown in fig. 7(d). The grid base is altered by varying the voltage on the screening-grid of V9. The split waveform is fed in via termination A12 to the control-grid of V6. When this wave is negative, V6 is cut off and in consequence, the screening-grid voltage of V9 (which is taken from the anode of V6) rises to a higher potential. The result is that a longer grid base, and hence a deeper step, is obtained.

Calibrator

32. The valves V12, V13, V14, V15 provide calibrator signals (range marks). V12 is an oscillator having a stabilized 280-volt HT supply. This runs continuously, and range marks are always available at the main radar display on indicating unit Type 32, the amplitude being controlled by the R.M.AMP. potentiometer on the left-hand control desk. When the CALIB. switch S5 on the right-hand control desk is set to ON, however, a 50V supply reaches calibrator relay REL.1 in the indicating unit, via termination B1 on the control desk and B12 on the indicating unit. This overrides the potentiometer and the range marks are presented at full amplitude. Range marks are also supplied to the IFF indicating unit (PL.5).

33. The CALIB. switch, when in the ON position, also interrupts the stabilized 140V supply to amplifying unit Type 296, removing the screening-grid supply from the IF valves and so muting the amplifier.

5-mile range marks

34. The action of the calibrator circuit is as follows. Between successive timebase traces, valve V12 takes anode and screening-grid current. Its suppressor-grid is connected through C23 to the anode of V2, and therefore it receives the negative flip-flop pulses (*para.* 7). When a negative pulse is received, the anode current is cut off and the screening-grid current increases.

35. Tuned circuit L1, C25, C58, C59, in the anode circuit is coupled to the control-grid by condenser C34, and to the screening-grid by a coupling coil embodied in L1. The control-grid regulates both anode and screening-grid currents, so that the coupling introduces feedback into the tuned circuit by two methods; firstly, by the control of anode current (which is effective only when the suppressor is on) and secondly, by means of the control over screening-grid current, changes in the latter being fed into the tuned circuit via the coupling coil.

36. The feedback from the screening-grid is greatest when the suppressor is off, because a small change in the control-grid voltage then makes a large change in screening-grid current. The feedback through the anode has a damping effect on the tuned circuit, but the coupling coil is so connected that the screening-grid feedback has a regenerative effect.

37. The negative flip-flop pulse cuts off the anode current at the beginning of the trace, and the tuned circuit in the anode of V12 rings at ◀16·39▶ kHz. The screening-grid regeneration is effective, and the ring is not damped but persists so long as the suppressor is off. As soon as the suppressor is on, the negative feedback comes into effect and the oscillation is quickly suppressed.

38. The sine wave thus produced at the anode of V12 is fed to the control-grid of V13; this valve is normally conductive since the control-grid is returned to HT positive via R78. The positive peaks of the sine wave are cut off owing to grid stopper R79, and the negative peaks cut the valve off, so that a square wave is produced at the anode. The negative edge of this wave is steep, since the valve is being brought on and all stray capacitance is rapidly discharged. The positive face is much less steep, since the valve is cut off and the stray capacitances discharge through R81 and R82.

39. The negative edge of the wave rings inductance L2 and cuts off V14 for a quarter of the period of the ringing circuit, thus producing a narrow positive pulse at its anode. This pulse is fed to the control-grid of V15.

40. Valve V15 is a phase splitter, and is normally cut off by cathode bias derived from fixed potentiometer chain R99, R110, R101, R97, R98. When energized as explained above, positive pulses are produced at the cathode, and are fed into the main radar indicating unit, from termination B11, producing range marks at intervals of 5 ◀data▶ miles. Negative pulses produced at the anode of V15 are fed out from termination B12 to termination P8 on the input panel (PL.17).

10-mile range marks

41. The action of the calibrator valves, when producing 10-mile range marks, is exactly as described above, except that the fequency of the tuned circuit in the anode circuit of V12 is reduced to ◀8·195▶ kHz by the addition of condenser C57 in parallel with C25. This condenser is switched in automatically by relay REL.3 when the range switch on the right-hand control desk is put to RANGE 3.

Range change relays

42. The timebase range is controlled by a key switch S6 on the right-hand control desk (PL.16); this has three positions, numbered 1, 2, 3. On range 1, neither relay is operated, a 2K resistor load being thrown upon the 50V supply instead. In position 2, which is the middle or normal position of the switch, relay 2 is energized. This relay has four sets of contacts. The first set connects C5 in parallel with C6, and the second set connects R16, R17 (instead of R14, R15) in the control-grid circuit of V3. The effect of these changes is to give a suitable value to the time-constant of the flip-flop.

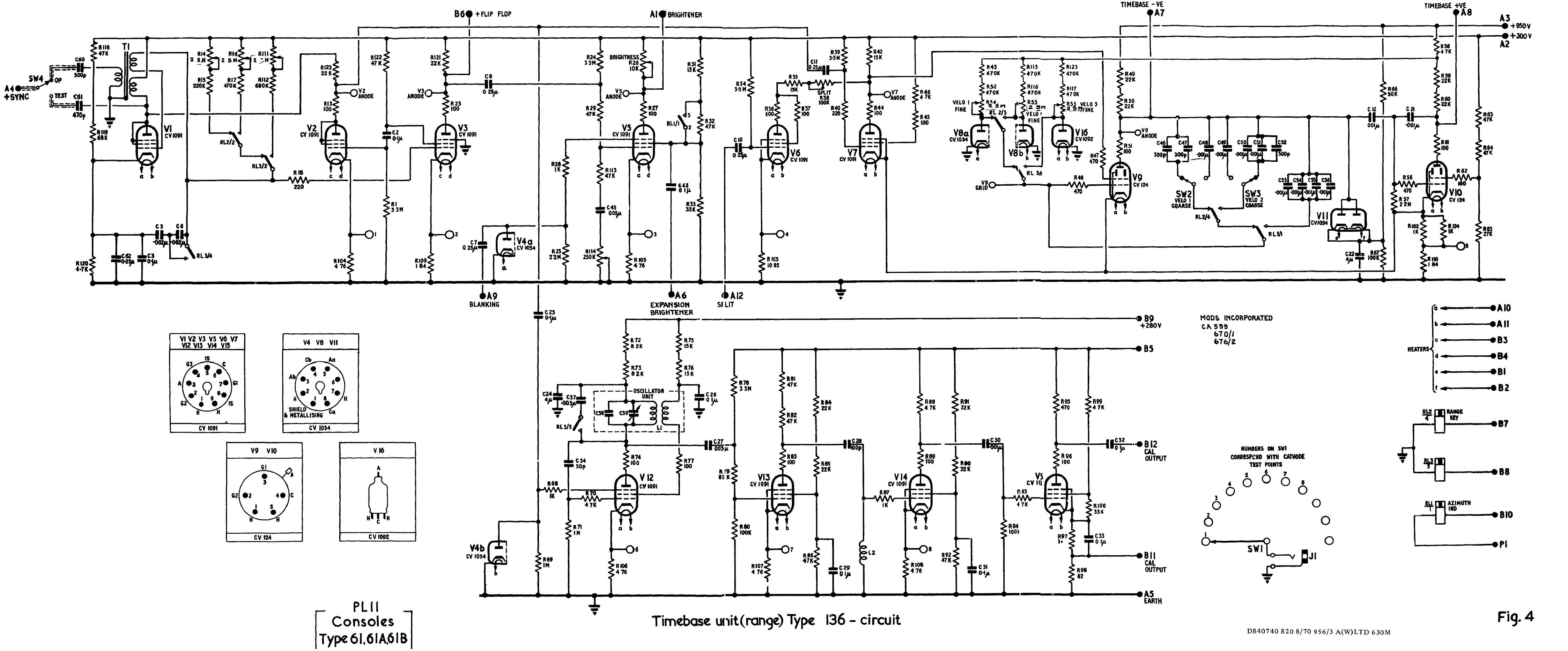
43. The third set of contacts connects the VELO. 2 FINE resistor chain (through contacts on relay REL.3) in the charging circuit of the Miller capacitance associated with V9, and the fourth set switches into circuit condensers C49-C52, which form the Miller capacitance for this range. Either C49, or C50, C51, C52, can be selected by S2, the VELO.2 COARSE control.

44. When the RANGE switch is in position 3, relay REL.2 is not energized, and relay REL.3 is energized. This relay has five sets of contacts. The first set changes the Miller capacitance associated with V9, C53-C56 being used instead of C49-C52; there is, however, no coarse velocity control on this range. The second and fourth sets vary the time-constant of the flip-flop circuit by substituting R111 and R112 for R16, R17, and also paralleling C44 with C6. The third set introduces the appropriate VELO.3 FINE resistor chain in the Miller charging circuit. The fifth set increases the capacitance of the calibrator circuit as explained in para. 41.

External connections

45. There are two Jones plugs on the timebase unit (range) and one coaxial socket P1. The latter is connected to termination A9 on power unit Type 871 (PL.2) and carries the 50V d.c. supply to azimuth indicator relay REL.1. The connections made by the Jones plugs and sockets are as follows:—

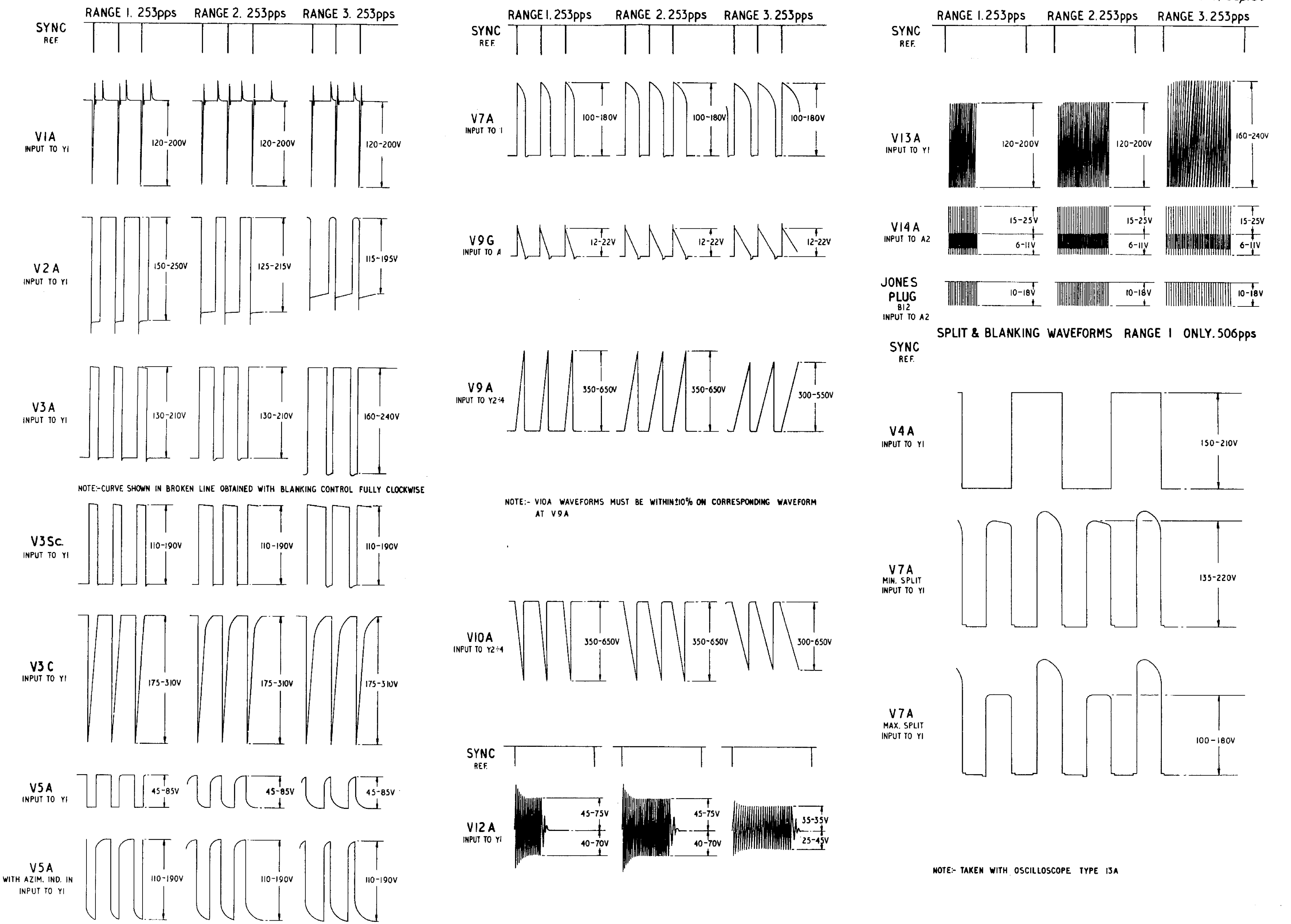
A1	Brightener pulse	to PL.15, A12
A2	HT.5, 300V (V1, V2, V3, V5, V6, V7)	from PL.3, A6
A3	HT.3, 1,200V (V9, V10)	from PL.1, A8
A4	Positive sync. line	from PL.9, A6
A5	Busbar (earth)	
A6	Negative sync. line	from PL.9, A7
A7	Negative timebase	to PL.15, B7
A8	Positive timebase	to PL.15, B8
A9	Blanking line	to PL.9, A12
A10	LT.8, 6·3V (V1, V4-V10, V12-V15)	from PL.3, B1
A11	LT.8, 6·3V (V1, V4-V10, V12-V15)	from PL.3, B2
A12	Split	from PL.16, A10
B1	LT.6, 6·3V (V11)	from PL.1, B1
B2	LT.6, 6·3V (V11)	from PL.1, B2
B3	LT.9, 6·3V (V2, V3)	from PL.3, B3
B4	LT.9, 6·3V (V2, V3)	from PL.3, B4
B5	HT.6, 300V (V13, V14, V15)	from PL.3, A7
B6	Positive flip-flop	to PL.6, A11
B7	50V d.c. for REL.2	to PL.16, A11
B8	50V d.c. for REL.3	to PL.16, C1
B9	Calibrator HT, 280V Stab.	from PL.16, A12
B10	Azim. indicator or elevation strobe (as requisite)	from PL.16, B2 & to PL.17, E11
B11	Range marks pulse	to PL.15, B11
B12	Calibrator output, external	to PL.17, P8



Timebase unit (range) Type 136 - circuit

Fig. 4

D840740 820 8/70 956/3 A(W)LTD 630M



AIR DIAGRAM 6112R/MIN.	
ISSUE 3	PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

CONSOLES TYPE 61 & 61A

Oscilloscope waveforms (PL.II)

Fig. 8

Chapter 4

TIMEBASE UNIT (ELEVATION) TYPE 134

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Elevation scan display

1. In radar Type 13, the console Type 61 is used to give a direct indication of the height and range of an aircraft. The radar Type 13 aerial scans in a vertical plane and swings from —1 deg. to +20 deg. in elevation. The aerial makes six sweeps per minute, so that the time taken by one complete sweep is ten seconds.

2. In the elevation scan method of presentation, the "range" timebase on the CRT is produced by the timebase unit (range) Type 136, but instead of the trace being stationary across the horizontal diameter of the tube, as in other applications, it is caused to pivot about a point at the bottom left-hand side of the tube face, moving up and down in synchronism with the tilting of the aerial. This motion of the range trace is produced by a scanning waveform generated in the timebase unit (elevation) Type 134.

3. Aircraft responses are received on the radar aerial, and the resulting video signals are applied to the CRT as intensity modulation. The face of the CRT thus represents a vertical section of the sky, similar to a sector PPI display, except that the slant range is given by the distance along the X-axis, and not by the distance along the trace; the slant range can thus be read directly from a "range marks" scale on the CRT face. The time-base trace is blacked out, except when a video signal causes the beam to "paint." The Y-plate deflection is proportional to the angle of elevation of the aerial, so that if a response "paints" upon the tube face, the height is given by its vertical distance above the X-axis. Over the range of elevation used, the Y-deflection is practically linear; the non-linear portion of the elevation scan is blanked out.

4. The timebase unit (elevation) Type 134 consists of an oscillator V1, V2, the output of which is fed through a cathode-follower V3 to a magslip on the Type 13 aerial mounting. An output from the magslip is returned to the timebase unit to an amplifier V4, and the amplified voltage is rectified by a diode V5. This rectified output is used to control the amplitude of a timebase voltage developed by V6, V7 and V8. The valves V9, V10 and V11 produce a blanking waveform which is fed into the range timebase unit to cut off the brightening pulse over the non-linear portion of the elevation scan. The HT voltages are stabilized by V12.

5. Three views of the unit are given in fig. 1, 2 and 3, to assist in component location. The circuit diagram is given in fig. 9. Theoretical waveforms are given in fig. 4-7; oscilloscope waveforms with amplitudes actually obtained during test are given in fig. 8.

Circuit description

6. Referring to the circuit diagram, V1 is a phase-shift oscillator operating at approximately 3 kc/s. The diode V2 controls the amplitude of oscillation in such a manner that the peak amplitude of the sine wave is practically equal to the standing bias on its cathode. For, suppose that the amplitude of oscillation is less than this bias; the sine wave will then be DC restored by V2, so that the positive peaks are at the same level as the cathode potential, and the mean level slightly positive. A positive

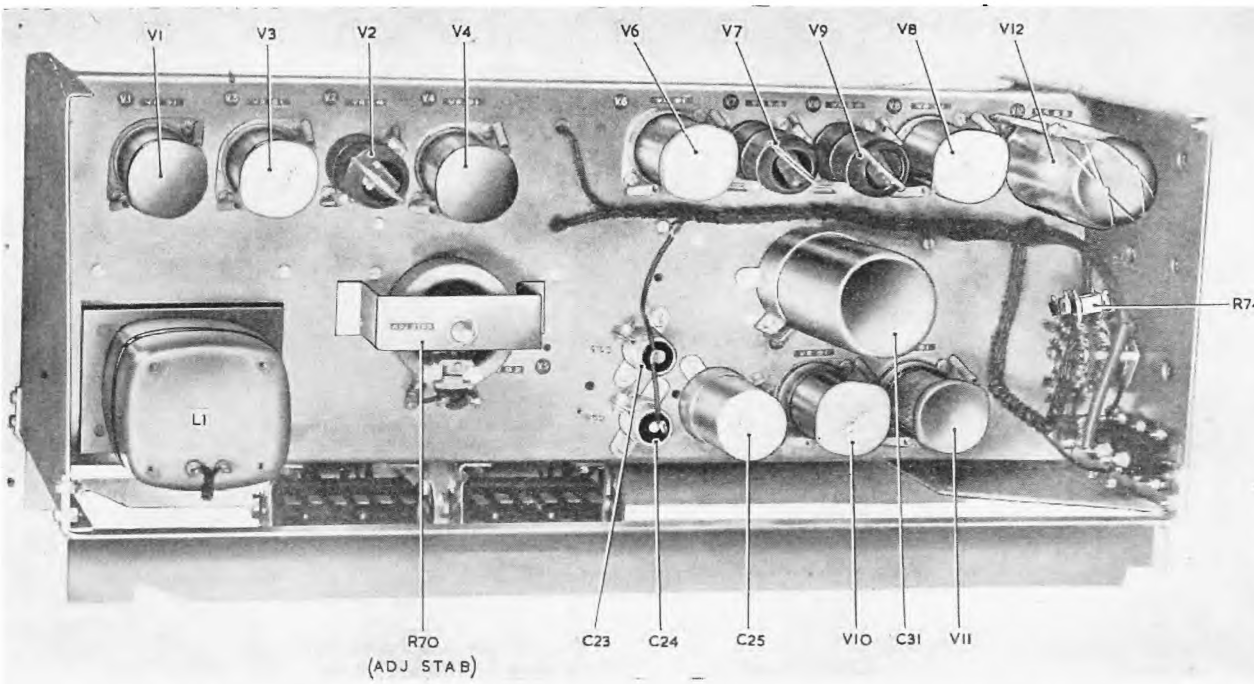
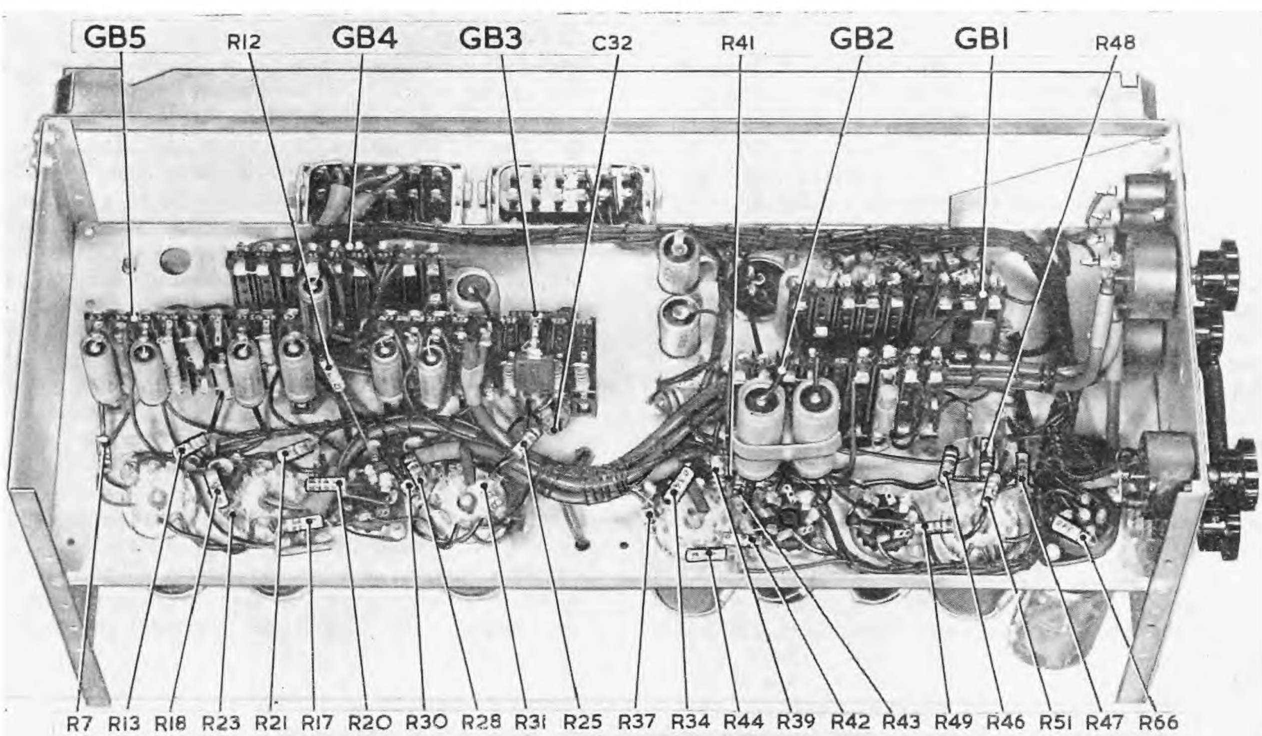


Fig. 1. Timebase unit (elevation) Type 134, top view



COMPONENTS ON GROUP BOARDS

GB.1:—R65, —, —, R63, R73, R58, R55, C21. ON BACK, C20, C30.

GB.2:—R67 AND R68, R54, R81 AND R45, R50, R52, —, —, R72, R40. ON BACK, C18, C19, AND LINK SHORT-CIRCUITING R45 OR R81.

GB.3:—C10, R14 AND R15, C12, R22, —, R24, C13, R26, R86. ON BACK, C11 HELD BY CLIP.

GB.4:—R84 AND R33, R90, R89, R88, R87, —, C14, R29, R71. ON BACK, C22.

GB.5:—C9, R8, C7, R1 AND R2, R3, R4, C6, R6 AND R13, C8. ON BACK, C1, C2, C3, C4, C26, C27, C28, C29.

Fig. 2. Right side view No. 1

bias will then be applied to the control-grid of V1 via the smoothing network R6, C6, and the amplitude of the oscillation will increase.

7. If however the amplitude of oscillation is more than the bias on the cathode of V2, the mean level at the anode is negative, and a negative bias will be applied to the control-grid of the oscillator, tending to decrease the amplitude. The general tendency is therefore as stated, viz., to keep the amplitude of oscillation constant and equal to the standing bias at the cathode of V2.

8. The stabilized output of V1 is fed to the stator of the magslip on the aerial mounting by the cathode-follower V3, the output being controlled by the potentiometer R16 (the MAG. OUTPUT control). Waveforms in V1, V2, and V3 are shown in fig. 4 (a), (b) and (c).

9. The magslip is a special form of transformer, consisting of a stator coil and a rotor coil; the latter is turned by the movement of the Type 13 aerial as it sweeps in elevation. When a voltage of a given amplitude is fed into the stator coil, a voltage is induced in the rotor coil, the magnitude of which depends upon the magnetic linkages between the stator and rotor windings. Actually, the rotor voltage (*i.e.* the magslip output) is proportional to the cosine of the angle between the rotor and the stator coils, and is zero when the rotor winding is perpendicular to the stator field.

10. The rotor voltage of the magslip is returned to the termination A9, and thence is fed to the control-grid of V4. This valve is a linear amplifier, giving an output having the waveform in fig. 5 (d). The sinusoidal output of V4 is fed to the diode rectifier V5, which produces a negative d.c. voltage at its anode, the magnitude being directly proportional to the amplitude of the magslip output. This voltage is added to a positive d.c. bias produced across the resistor chain R85, R87, R88, R89, R90, R86, which form a fine and coarse SET ZERO control. The sum of the voltages is applied as bias to the control-grid of V6.

11. When the magslip coils have zero coupling no voltage is developed, and therefore no bias voltage is developed by V5. This position of the magslip is taken as 0 deg. The aerial swings in elevation from −1 deg. to +20 deg., ◀ but the magslip is off-set so that the rotor turns between +9 deg. and +30 deg. as the aerial swings. ▶ This ensures that the output voltage from the diode is never zero, and only the linear portion of the diode characteristic is utilized.

12. The d.c. bias voltage on the control-grid of V6 can thus be set, by the SET ZERO COARSE and SET ZERO FINE controls, and R16, the MAG. OUTPUT control, to swing from one preset positive value to another as the rotor of the magslip moves from one extreme position to the other. The variations of amplitude of the sine wave from the magslip, and the corresponding d.c. output from V5, are shown in fig. 5 (b) and (c), for one sweep of the Type 13 aerial (*fig.* 5 (a)). Note the time scale, in seconds, at the foot of the diagram. This applies to the aerial sweep and the variation of bias voltage, and also to the envelopes of the waveforms at (b), (d) and (e), but the individual waveforms inside the envelopes are not to scale.

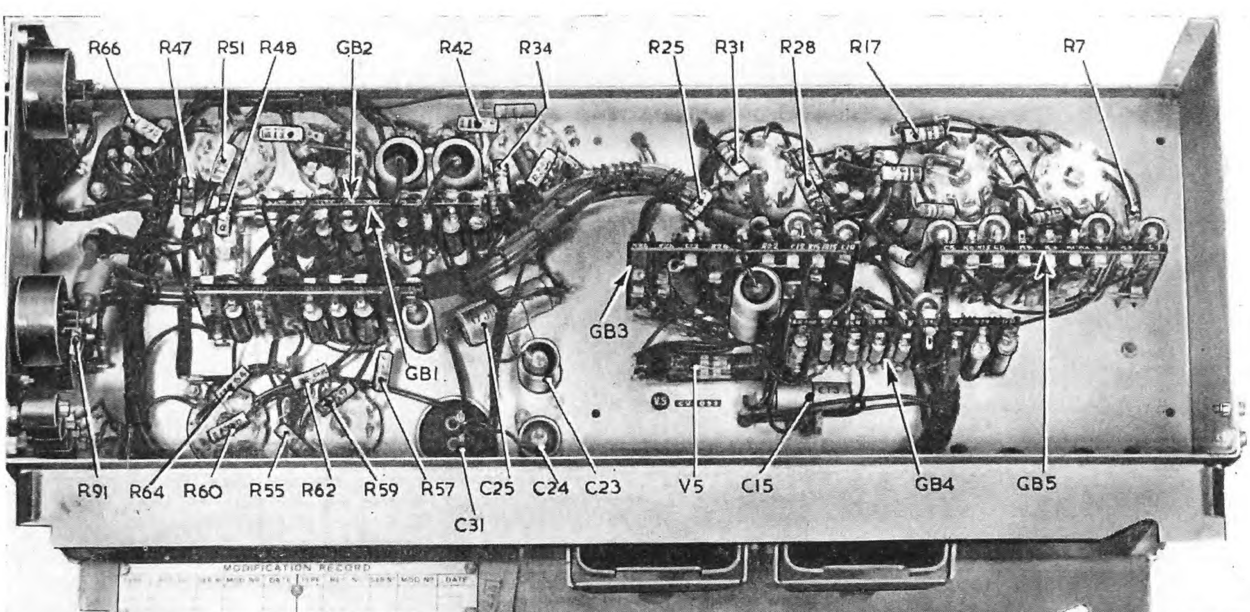


Fig. 3. Right side view No. 2

Scanning waveform

13. The vertical scanning waveform is produced by the valves V6, V7, V8. The amplitude of this waveform is controlled by the d.c. voltage on the control-grid of V6; fig. 5 (e) shows its variation as the aerial swings in elevation. Since this voltage is applied to the Y-plates of the c.r.t. while the range timebase voltage from PL.11 is applied to the X-plates, the effect is to tilt the range timebase trace to an angle corresponding with that through which the aerial has swept.

14. The positive flip-flop pulse from the range timebase unit (PL.11) is fed to the suppressor-grids of V6 and V8, one half of V7 being connected to prevent the suppressor-grid of V6 from rising above earth potential, and the other half preventing the suppressor-grid of V8 from rising above its cathode potential. The valves V6 and V8 are both cut off between the range timebase periods and conduct during the range timebase period.

15. When V6 conducts, a negative pulse is produced at its anode; this starts from h.t. rail level and falls to a value determined by the control-grid potential, i.e. upon the bias produced across the set zero resistor chain. The suppressor-grid and anode waveforms of V6 are shown in fig. 4 (e) and (f), and the variation in amplitude of the anode waveform with angle of elevation in fig. 5 (d).

16. V8 is a Miller timebase valve; when it receives the positive flip-flop pulse, fig. 6 (a), on its suppressor-grid, it produces a negative-going waveform of the same duration as the flip-flop pulse, but with a velocity dependent upon the charging rate of the Miller capacitance. The charging rate

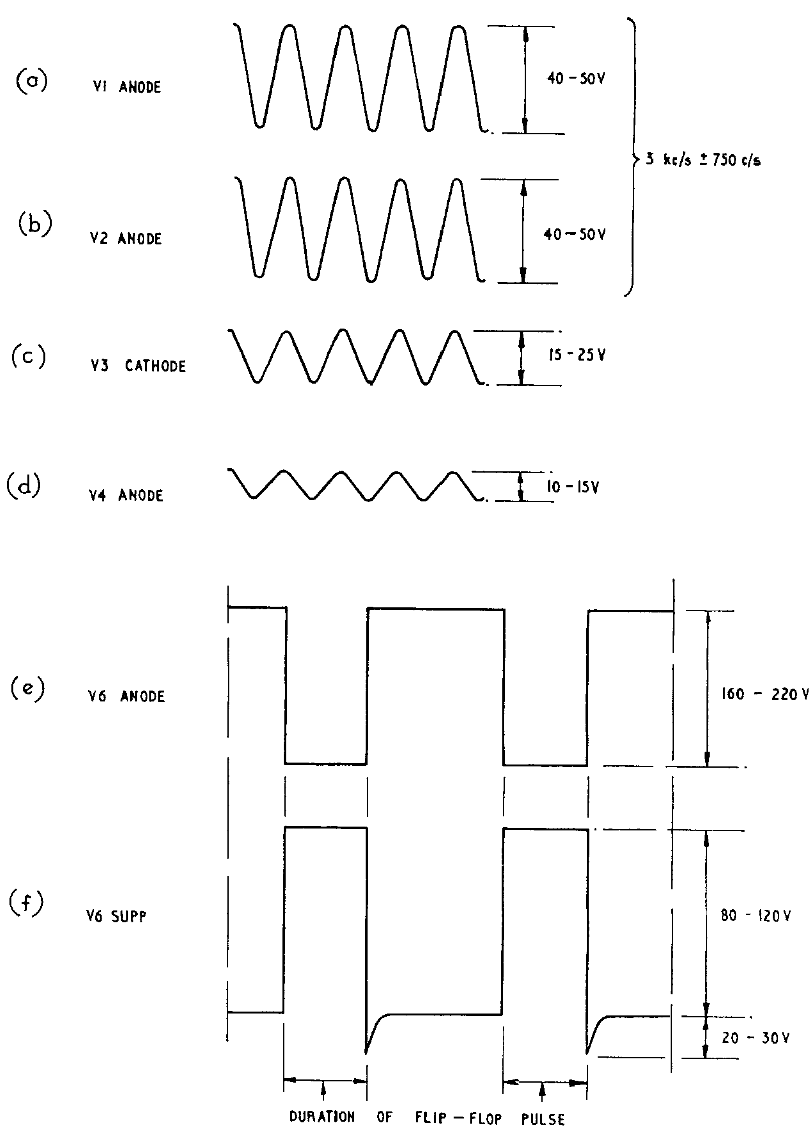


Fig. 4. Oscillator and flip-flop waveforms (PL.6)

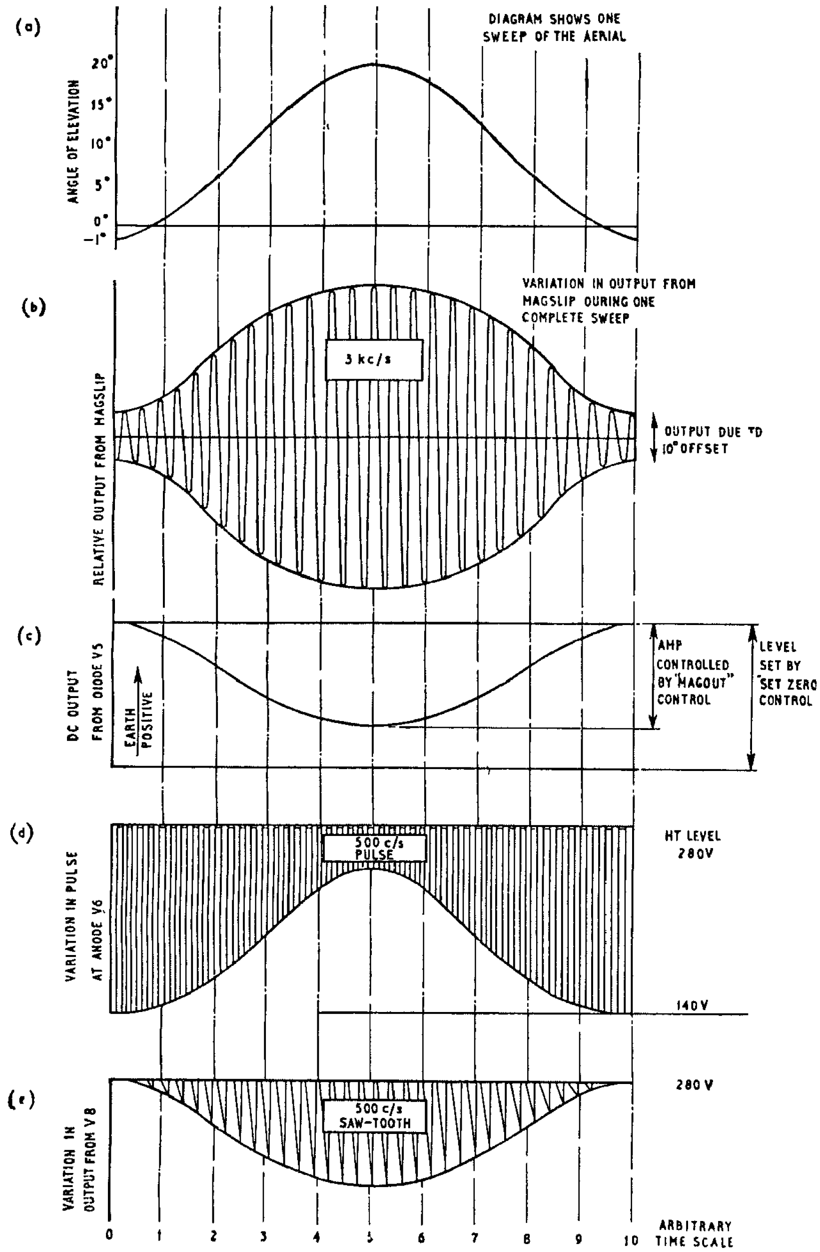


Fig. 5. Variation of magslip output

is determined by R45, the capacitors C20 and C30, and the charging voltage. The latter is the voltage at the anode of V6 during the range time-base period, and is therefore dependent upon the control-grid voltage of V6 (*para.* 15). As the latter varies with the elevation of the aerial, so does the amplitude of the Miller run-down at the anode of V8. The relation between the amplitude and the elevation is shown in fig. 5 (e). The suppressor-grid waveform at V8 is shown in fig. 6 (a), and the variation of anode waveform with angle of elevation of −1 deg., +10 deg., and +20 deg, in fig. 6 (b), (c) and (d).

*Y-amplifier in PL.*15

17. The output from V8 (termination A12) is fed to the Y-amplifier on the indicating unit Type 32 (PL.15) at termination A6, and is directly coupled to the control-grid of V2 in that unit by one of the elevation scan links. The bias on the control-grid of V3, in PL.15, is returned via the other link and termination A7 (PL.15) to termination A3 in the timebase unit (elevation). It is important that the bias voltage for valves V2 and V3 (PL.15) are derived from the same source; otherwise, small variations in h.t. levels may cause the trace to shift.

18. The Y-amplifiers V2, V3, in PL.15, produce an amplified version of the waveform at the anode of V8 (PL.6) and apply this waveform to the Y-plates of the c.r.t. as a balanced deflection voltage.

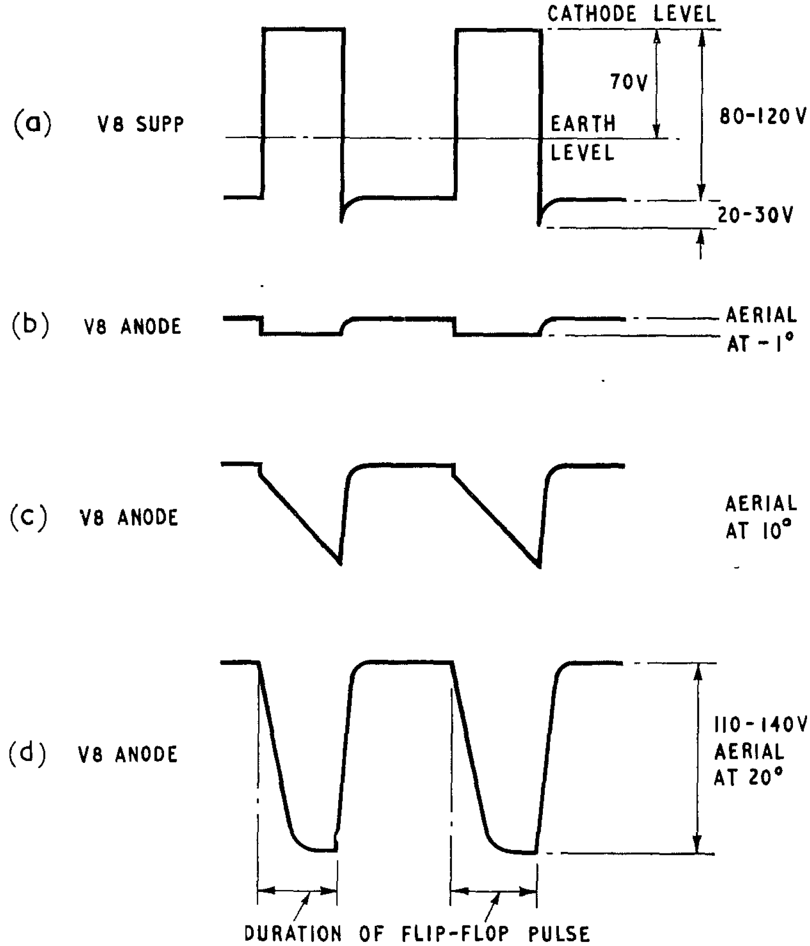


Fig. 6. Elevation timebase waveforms PL.6

Blanking

19. When the drive from V6 is large, the output of V8 is sufficient to overload the Y-amplifiers, causing the high elevation traces to curve over, but this is of no importance, as only the linear portion of the trace is required. In order to avoid the distracting effect of the non-linear portion, it is blacked out by applying a blanking waveform to the brightener valve on PL.11. This waveform is produced by valves V9, V10, V11, in the elevation timebase unit.

20. To produce the blanking waveform, the output from V8 is also applied to the cathode of the diode V9, the anode of which is held at a predetermined potential set by the SCAN LIMIT control, R53. The anode voltage of V8 swings downward from the h.t. rail potential (280 volts) but so long as the anode potential of V8 is above that on the anode of V9, the diode is non-conductive, *i.e.* no output passes to V10. If however the cathode potential of V8 swings below that of its anode (set by R53) the diode conducts and the output from V8 is applied, through the diode and C21, to the control-grid of V10.

21. The negative pulse at the control-grid of V10 cuts the anode current off, and a positive pulse is produced at the anode. The latter is directly coupled to the control-grid of V11. Normally, V10 is conducting, and the control-grid of V11 is held at about 50 volts positive to earth, but the cathode is returned to a positive 70-volt line from the stabilovolt (*para.* 23) so that the valve is cut off. When V10 receives the elevation scan waveform (output of V8) on its control-grid, and is cut off, its anode voltage rises, taking with it the control-grid voltage on V11. If the rise is sufficient to lift the bias, V11 produces a negative waveform at its anode. This waveform terminates when the elevation scan waveform terminates; it is used to blank off the brightener valve V5 in the range timebase unit (PL.11).

22. The foregoing action is illustrated by waveforms in fig. 7. Fig. 7 (a) shows the anode swing on V8, with the aerial at +20 deg. The diode V9 conducts just before the end of the run-down, applying a saw-tooth voltage to the control-grid of V10, bringing V10 full on (*fig.* 7 (b) and (c)), and consequently cutting V11 full off (*fig.* 7 (d)). The last-named waveform is fed into PL.11 at termination A9, and is applied to the suppressor-grid of V5. This valve receives a positive flip-flop

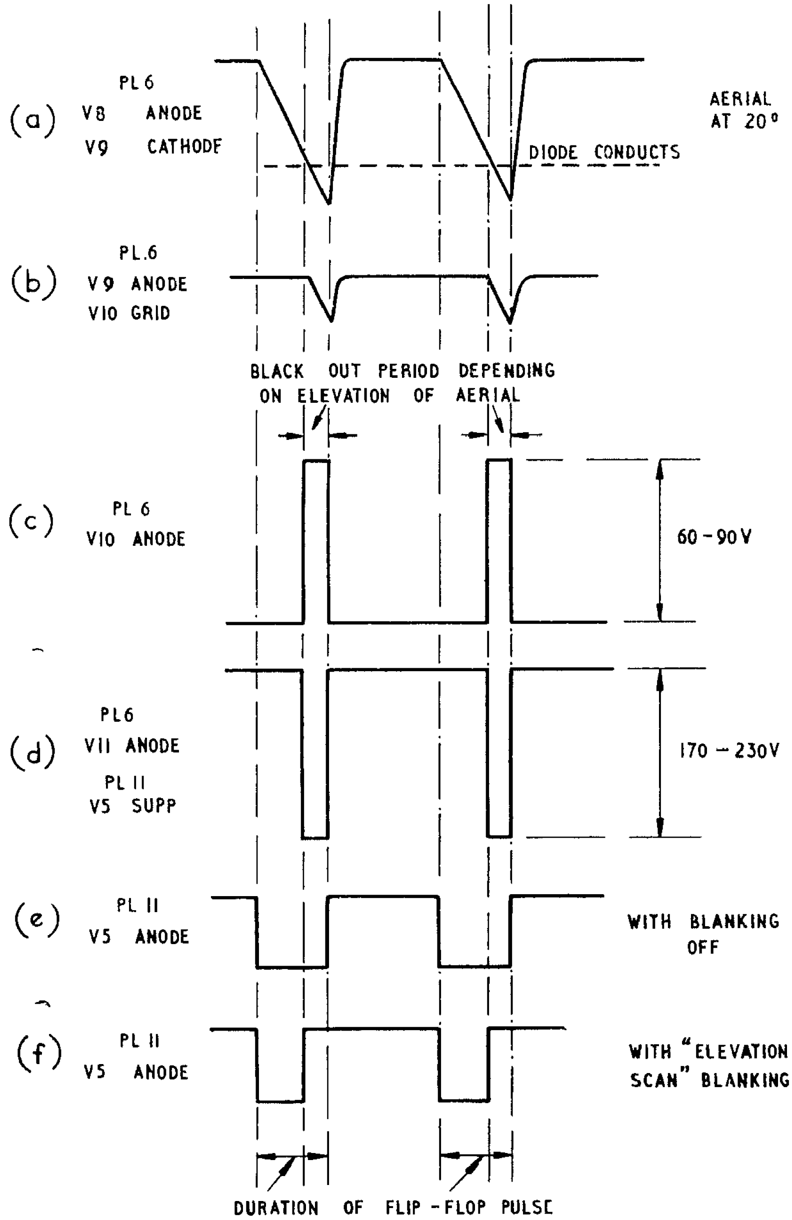


Fig. 7. Blanking waveforms (PL.6 and PL.11)

pulse, and normally produces a negative waveform (*fig.* 7 (e)) of the same duration. When the blanking waveform is applied to the suppressor-grid, however, the anode current is cut off, and therefore the brightening pulse terminates when the blanking pulse commences (*fig.* 7 (f)).

Stabilizer

23. All the HT voltages on this unit are stabilized by the valve V12, which has a 2,000-ohm variable resistor in series to adjust the total current. This control (marked ADJ. STAB) must be adjusted when setting up, by monitoring the cathode current, which should be 20 mA. This should if possible be done when the console has attained full working temperature. In any event, the console should be switched on for at least five minutes, before monitoring.

24. The available stabilized voltages are:—

280V .. HT rail, also bias for V3 in PL.15 (*para.* 17).

210V .. not used. Electrode returned to 280V via R66.

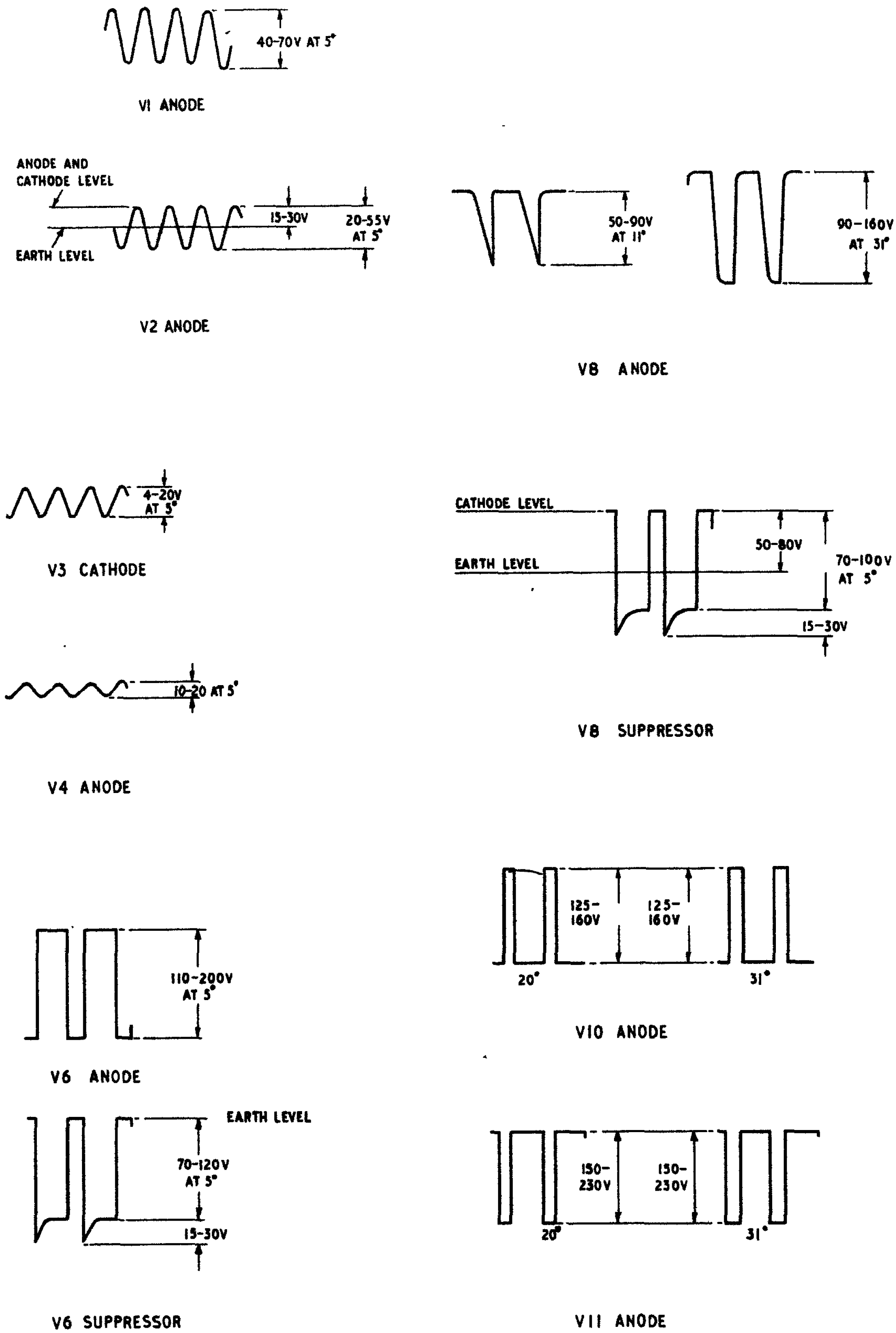
140V .. Screening-grid rail.

70V .. Cathodes of V7b, V8, V11, V2, and SET ZERO bias.

External connections

25. The unit is fitted with two Jones plugs, by which the following external connections are made.

A1	Not used	
A2	Not used	
A3	280V (stab.) bias for V3	to PL.15, A7
A4	Elevation scan blanking switch	to PL.9, A11
A5	Earth on busbar	
A6	Not used	
A7	V3 output to magslip	to PL.17, P7
A8	Not used	
A9	Input from magslip to V4	from PL.17, P6
A10	Not used	
A11	Positive flip-flop	from PL.11, A6
A12	Elevation scan waveform	to PL.15, A6
B1	LT.14, 6·3V (V9)	from PL.2, A10
B2	LT.14, 6·3V (V9)	from PL.2, A11
B3	LT.10, 6·3V (V1-V8, V10, V11)	from PL.3, B5
B4	LT.10, 6·3V (V1-V8, V10, V11)	from PL.3, B6
B5	HT.7, 420V (stabilized at 280V by V12)	from PL.3, B7
B6 to B12	Not used	



Oscilloscope waveforms (PL.6) Fig.8

[Consoles Type 61 & 61A]

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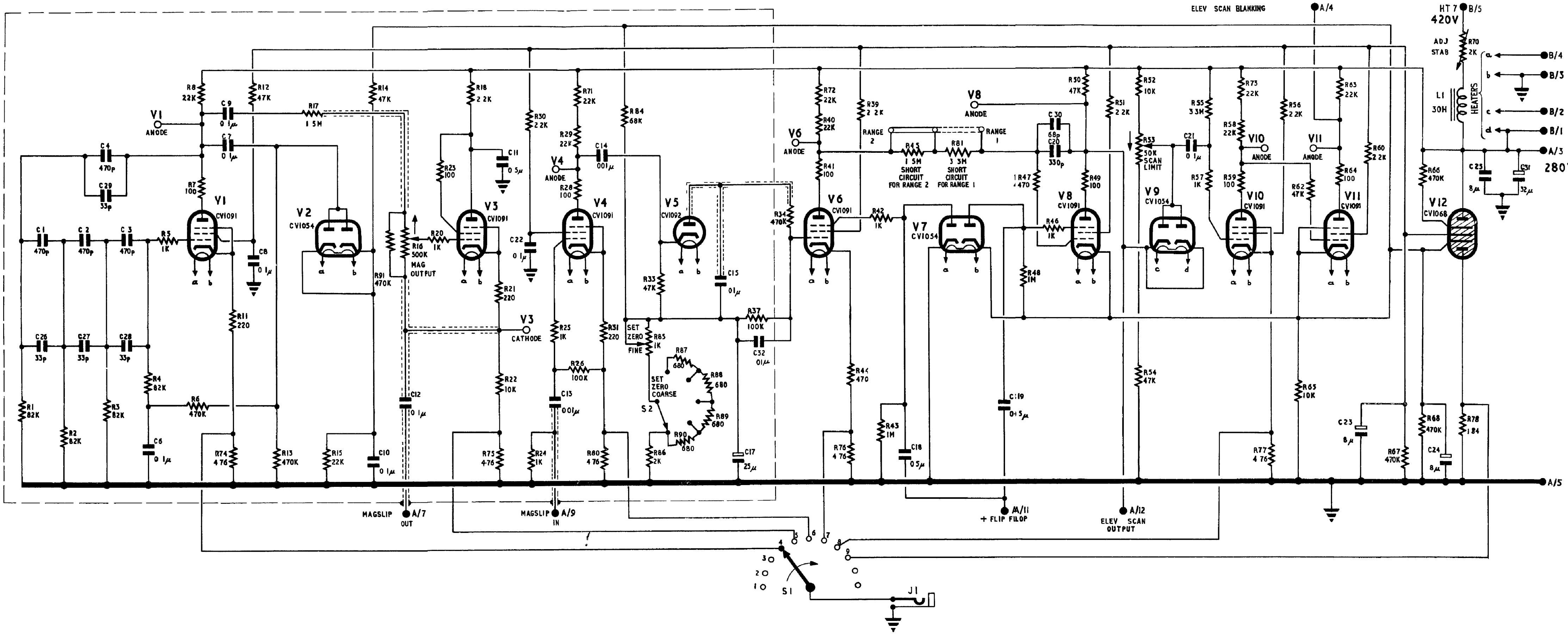

Consoles Type 61 & 61A

Timebase unit (elevation) Type 134 - circuit

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Fig. 9

Chapter 5

INDICATING UNIT (CRT) TYPE 32

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General description (*fig. 1, 2, 3 and 4*)

1. The indicating unit (CRT) Type 32 is used for presenting the main radar responses, either as Y-deflection ("blips") upon a linear horizontal timebase trace when presenting radar Type 14, or 15, or as intensity modulation upon an elevation scan as in radar Type 13.

2. The indicating unit is mounted in the middle of the console, with the face of the tube inclined at an angle. The unit is hinged at its lower edge, and secured by special cams at its upper edge. To inspect the interior, these cams are eased off and the unit drawn forward and downward by the handle fitted at the upper edge; it is prevented from falling to ground level by chains fitted at each side. These chains can easily be disengaged, and the unit may then be lowered to ground level, detached from the lower hinges, and completely removed from the console. See Note on fig. 1.

WARNING

Before easing off the cams, the main ON/OFF switch on the right-hand control desk should be switched off. For servicing purposes, the power may be restored by the switch, but the utmost care must then be exercised when touching any components, since some of these are at 5·0 kV above earth, while others are at potentials of the order of 1,000 volts above earth. The main ON/OFF switch must always be opened, and the four Jones sockets removed from their plugs, before the unit is removed from the console. The coaxial plug must also be removed from P1.

3. The front panel of the unit (*fig.* 1) carries the following controls, etc. Along the upper edge are the X SHIFT, Y SHIFT, BRIGHTNESS, and FOCUS controls; these are of the potentiometer type, and when set to the optimum value can be locked by a milled nut forming part of the knob. At the lower edge are two preset controls, X STIG. and Y STIG. Three telephone type jacks, J1, J2, J3, are fitted in the upper left-hand corner, and two similar jacks, J6, J7, in the corresponding position on the right-hand side. These are used in conjunction with the console current monitoring meter (fitted in PL.2) to monitor the currents at the following points:—

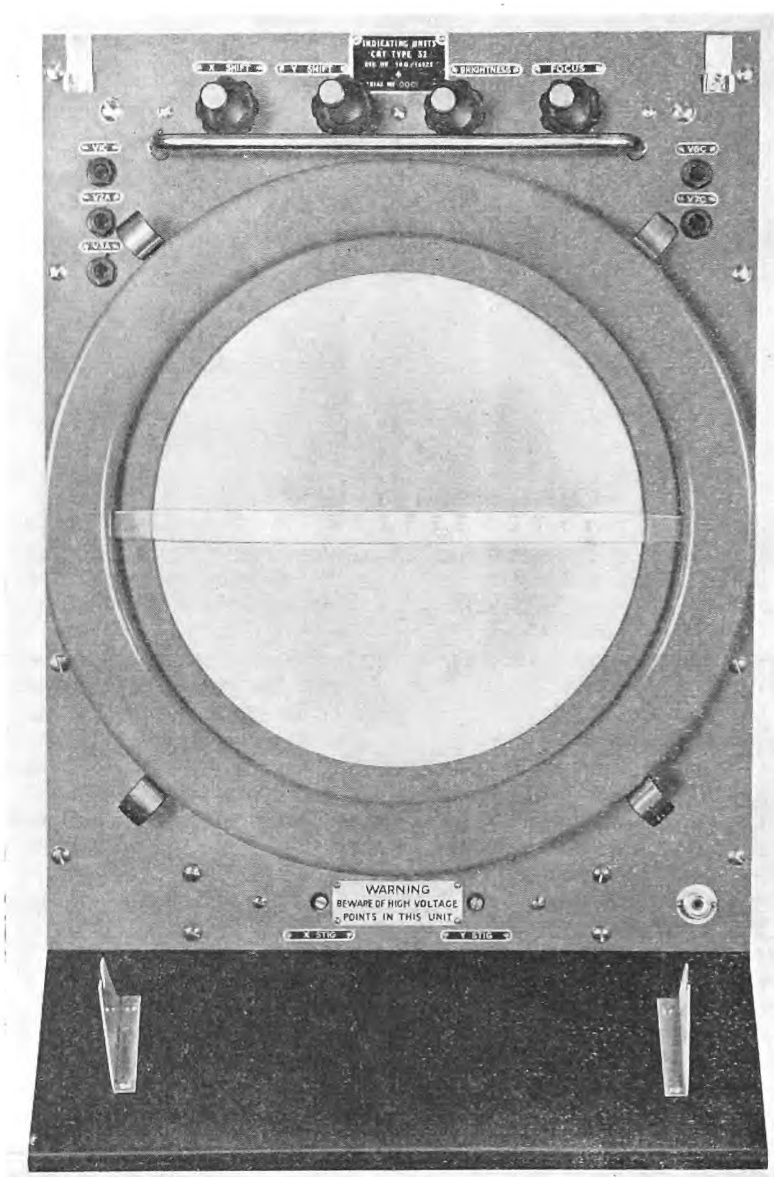
- J1 Cathode current of video amplifier V1 (20 mA)
- J2 Anode current of Y-plate amplifier V2 (100 mA)
- J3 Anode current of Y-plate amplifier V3 (100 mA)
- J6 Cathode current of limiter valve V6 (20 mA)
- J7 Cathode current of modulation amplifier V7 (50 mA).

4. A transparent strip carrying three range scales can be fitted across the horizontal diameter of the tube; these scales are graduated in nautical miles, Range 1 being engraved in RED, Range 2 in AMBER, and Range 3 in GREEN. The desired range is selected by a switch S6 on the right-hand control desk (PL.16), upon which an indicating lamp of corresponding colour is illuminated. The scale is illuminated by a lamp at each end; four lamps are also fitted to provide a low level illumination of the CRT screen.

5. When elevation scan presentation is required, the above-mentioned scale is not fitted. The working range is pre-determined, and a corresponding height-range graticule is produced, partly by electronic means, and partly by direct painting upon the face of the CRT. The vertical range lines and sloping 5 deg. elevation strobes are produced electronically, and the constant height lines are painted. For test purposes at manufacturer's works, maintenance units, etc., however, a special window is supplied, engraved with a typical height/range graticule (*Part* 1, *Sect.* 2, *Chap.* 1 *refers*). This is suitable for use on both ranges. The switch S6 on the control desk must of course be set to agree with the pre-selected working range.

Circuit description

6. The indicating unit includes a video amplifying chain, a mixer by which range marks are integrated into the video information, a balanced amplifier by which Y-deflection voltages can be applied to the CRT, and DC restoring circuits. When used to



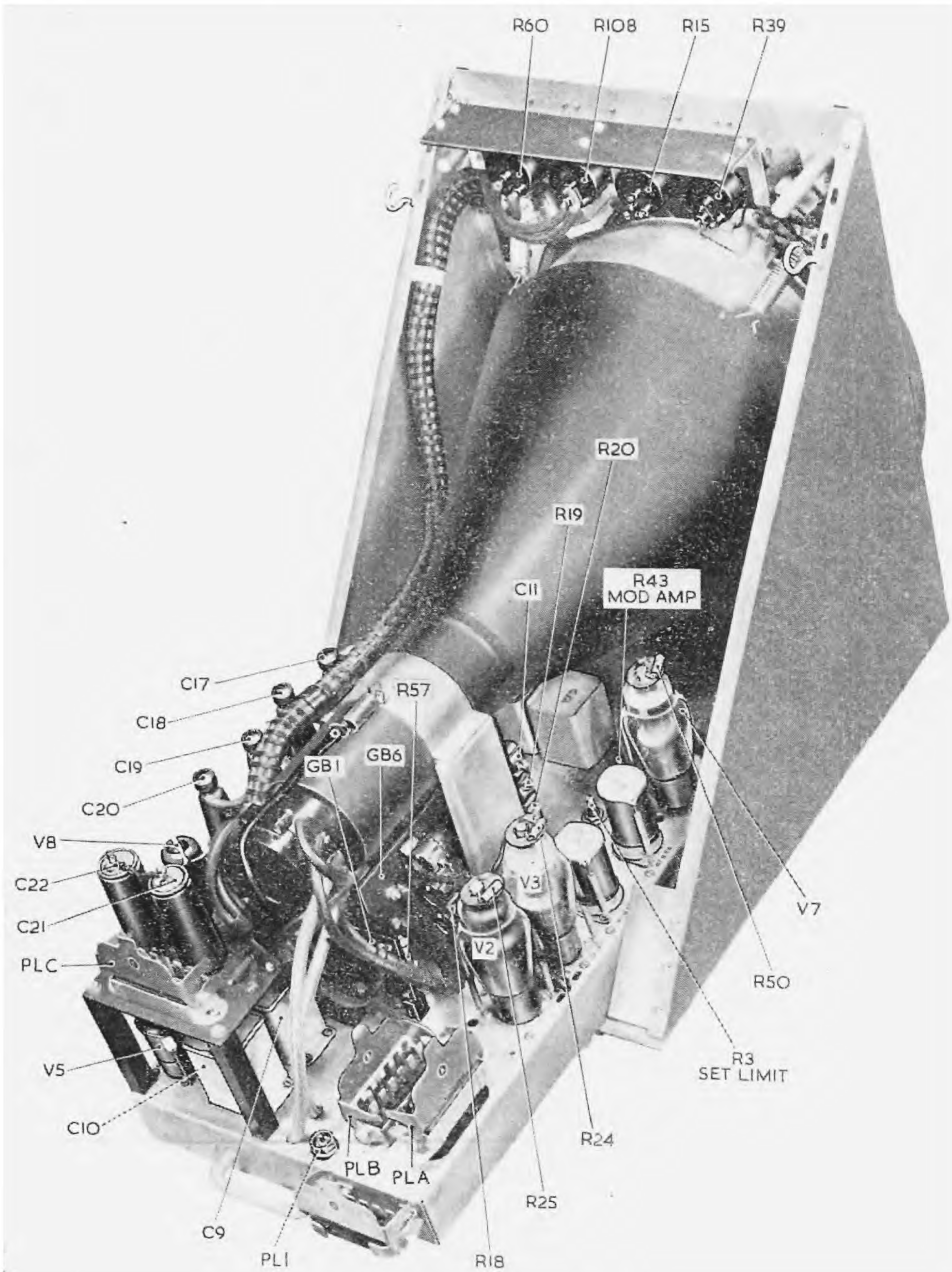
WARNING

The flexible connectors fitted to Jones plugs A and B MUST be removed before disconnecting chains when about to lower to ground level, otherwise these connectors may be damaged.

Fig. 1. Front panel

display Radar Type 13 information, the video signals are applied to the control electrode of the CRT after passing through a limiting stage, and the Y-plate voltages are obtained from the time-base unit (elevation) Type **134**. When used with other types of radar, e.g. Type 14, the video signals are applied to the Y-plates, with a small fraction diverted via the limiting stage to the control electrode, to brighten the trace during the actual reception of a video pulse. In both types of presentation the X-plates receive a sweep voltage from the timebase unit (range) Type **136**. The circuit will be described with reference to fig. 5.

7. The video circuits in the indicating unit consist of V1, V2, V3, V6, V7, and V10, together with their associated components. The radar video input is derived from the amplifying unit (A.J. and video)

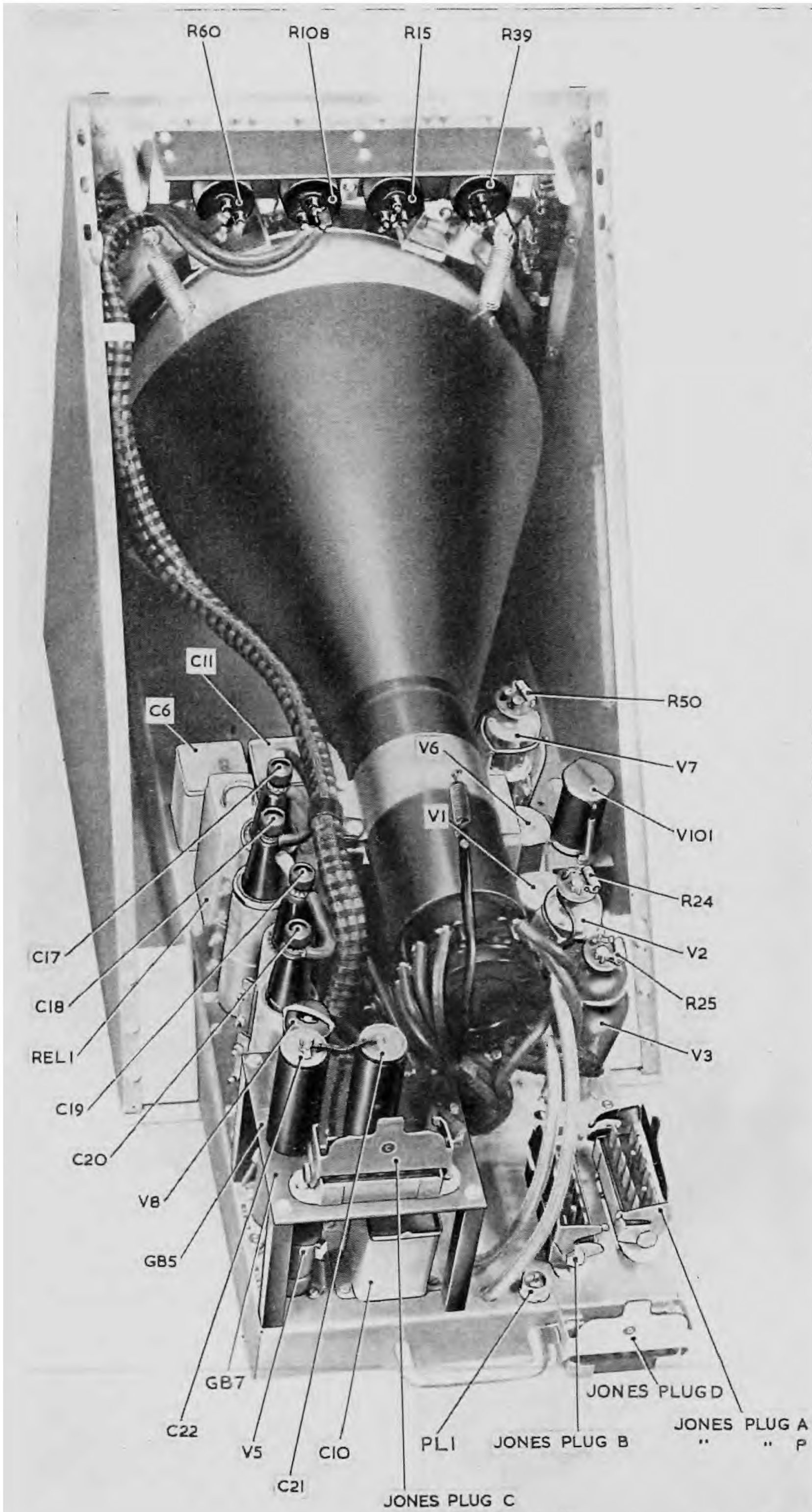


COMPONENTS ON GROUP BOARDS

G.B.1:—R57, R59, R61.
GB.6:—FRONT R19, R20, R18.
REAR R22, R23.

Fig. 2. Top (left) view

Type 295 (PL.10) and a range marks input is supplied by the calibrator valves in the timebase unit (range) Type **136** (PL.11). The video input from the amplifying unit (A.J. and video) Type 295 is received on the coaxial socket P1, which is connected to a fixed contact on the relay REL.1. When this relay is in the normal, i.e. unenergized condition, the signal then passes to the control-grid of V1 via the condenser C1. The action of the relay is dealt with later (*para.* 29).



COMPONENTS ON G.B.7

TOP C21, C22, V8, JONES PLUG C.
UNDERSIDE, R67, R68, R63, R64, C18.

Fig. 3. Top (right) view

8. The video signals are positive-going, and are amplified by V1, the output of the latter being negative-going signals of about 40 volts peak amplitude. The output from the anode of V1 may be selected, by links at the control-grid of V2, to feed the valves V2 and V3, which are used to produce Y-plate deflection of the trace on the CRT, for all applications other than radar Type 13.

9. Either a fraction, or the whole, of the output of V1 can be tapped off from the potentiometer R3—the SET LIMIT control—and fed to the control-grid of V6. The valves V6 and V7 provide limited signals for intensity modulation; only a fractional portion of the V1 output is used for this purpose when Y-deflection is in use, but for elevation scan presentation the output of V6 is increased so that the maximum usable amount of intensity modulation is obtained.

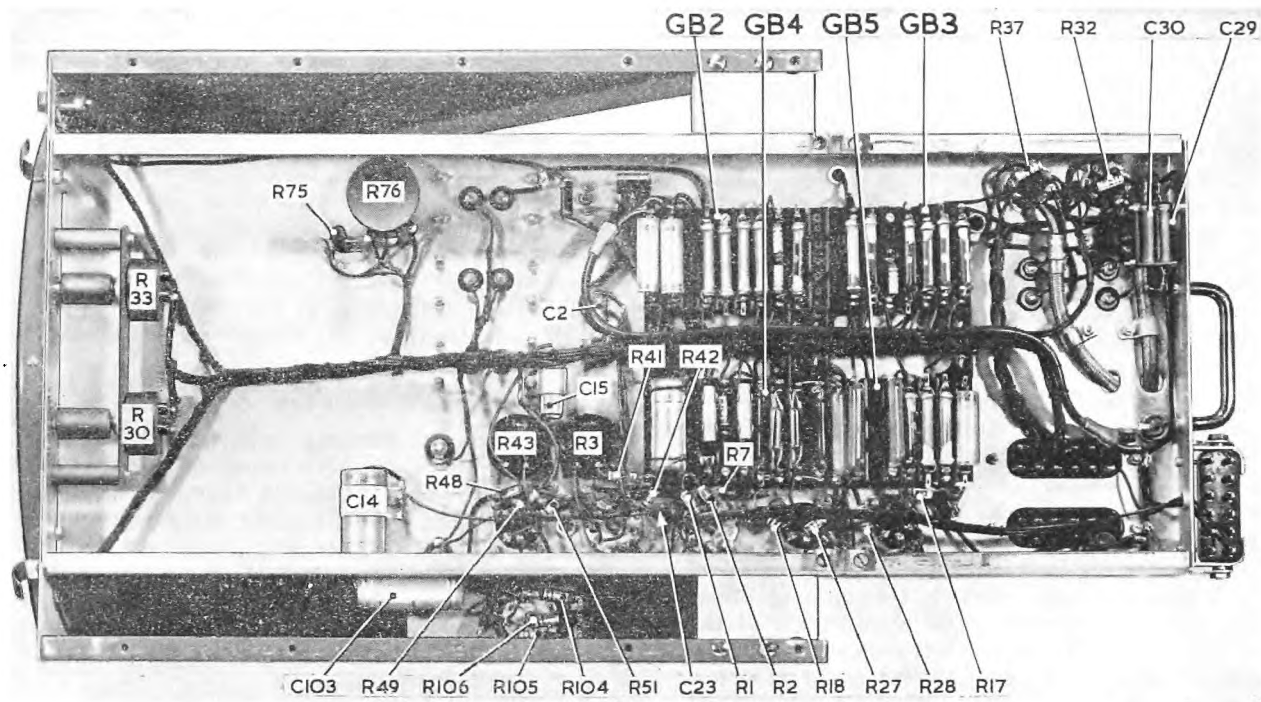
at a certain level, and video signals at about five times the noise level.

11. The output of V6 can be controlled by R43—the MOD. AMP. control. When the display is used for range/deflection presentation, this output is set to a small value, so that it brightens the CRT beam during the reception of responses. When using the elevation scan presentation, the output is increased to give a good "paint" upon the CRT.

12. For the best results, the SET LIMIT control R3 and the MOD. AMP. control R43 must be very carefully set up according to the instructions given in Part 1, Sect. 2.

Y-deflection presentation

13. The valves V2 and V3 are used to supply balanced Y-plate deflection voltages to the CRT. These voltages may be video signals from the anode of V1, or the elevation scan waveform from the timebase unit (elevation), Type 134 (PL.6). The elevation-scan/range-deflection links are mounted upon group board 3 (*fig.* 4) and are accessible through a circular aperture in the underside cover. A swinging cover plate is fitted. A diagram plate adjacent to this aperture shows the method of placing the links for either type of display. When video signals are to be displayed as Y-deflection "blips" the links are placed as shown; dotted line



COMPONENTS ON GROUP BOARDS

GB.2:—C4, C5,—R45, R47, R46, R44, R13 AND R12, R14.
GB.3:—R31, R34, R58, R32, R35, R36, R40.
GB.4:—C25,—,C28, R21, LINK, R11, LINK, C13, ON UNDERSIDE, C1
GB.5:—C3,—, R10, R9, R8, R5, R4, R26, R29.

Fig. 4. Underside view (cover removed)

Limiting

10. If R3, the SET LIMIT control, is adjusted to give maximum output, the signals on the control-grid of V6 consist of about 5 volts of noise and 40 volts of video signal. The grid base of V6 is about 5 volts, so that the output of this valve will consist of noise and video, limited at noise level. If, however, R3 is adjusted so that the video amplitude is reduced to about 10 volts, the noise will be reduced in the same proportion, i.e. to about 1 volt. The output of V6 will then consist of noise in fig. 5. The diode V10, shunted across R11 which is virtually part of the control-grid biasing arrangement of V2 and V3, gives restoration of the DC level at the control-grid of V2.

14. The control-grid of V2 is connected, through the stopper R16 and R11, to the mid-point tapping between R12 and R13. The two latter resistors, in turn, are shunted across R15 and R107, in series. R15 acts as a Y-shift control as explained later (*para.* 16-17). The upper end of R107 is connected, through one of the links, and R58, to the positive HT rail (HT.1, 320 volts). As a result, the control-grid bias on V2 is about 220 volts positive, and that of V3 is adjustable above and below this value, by R15.

15. The signals from the anode of V1, DC restored to the biasing point of V10, are fed to the control-grid of V2, but no signals are fed directly to V3. If V2 and V3 control-grids are adjusted to the same potential, the valves will take equal anode currents, and their anodes will be at the same potential. Since the anodes are directly connected to the Y-plates of the CRT, the trace will pass through the horizontal diameter of the screen.

16. When a negative-going pulse is received on the control-grid of V2, the current through that valve is reduced and its anode current rises, while that of its cathode falls. The fall in cathode voltage causes the current through V3 to increase, so that its anode voltage falls. The component values associated with the two valves are so chosen that a balanced deflection is obtained, the Y-plates being connected to R22 in the anode circuit of V2, and R23 in the anode circuit of V3.

17. Variations of the bias voltage at the control-grid of V3 produce a similar effect, so that R15 acts as a Y-SHIFT control, which can move the trace above and below the central position.

18. Since the output from the anodes of V2 and V3 is practically balanced, the mean potential of the Y-plates is approximately constant, at about 750 volts above earth. The third anode of the CRT is returned to a point between earth and the positive 1,200-volt supply. This point is determined by R33, the Y-STIG. control. Adjustment of this control varies the difference between the potential of the third anode and the mean potential of the Y-plates.

Elevation scan presentation

19. When the links are in the elevation scan position, the elevation timebase waveform from the timebase unit (elevation) Type 134 (PL.6) enters the indicating unit at termination A6, and is fed directly to the control-grid of V2. The feed to the upper end of R15 is now connected to termination A7, and thence to termination A3 on the elevation timebase unit, the latter termination being connected to the HT rail (280 volts, stabilized) of the timebase unit. It is important that the bias voltages for V2 and V3 are derived from a stabilized source, as otherwise small variations in HT level may cause the trace to shift.

20. The Y-SHIFT control V15 is adjusted in such a manner that the trace, when horizontal, lies along the baseline of the elevation scan grid on the window of the CRT, i.e. about 6 cm. below the horizontal diameter of the tube.

21. Details of the elevation scan waveform and its production are given in Chapter 4.

X-deflection

22. The X-STIG and X-SHIFT voltages are derived from a floating 1,000-volt HT supply (HT.4) derived from the power unit Type 870 (PL.1). This is fed into terminations B1 and B2 of the indicating unit. The timebase deflecting waveforms from timebase unit (range) Type 136 are fed in at terminations B7 and B8, and are DC restored by the diodes V4 and V5. Shift and stig. voltages are applied at the decoupled electrodes of these valves, i.e. at the cathode of V4 and the anode of V5. The shift voltage is the potential difference between these points, and is controlled by the X-SHIFT control R39. The stig. voltage is the difference between the potential of the third anode and the mean potential of the X-plates. This is adjusted by the X-STIG. control R30, which determines the point at which the floating supply is returned to the third anode.

DC restorer

23. As already stated, the third anode of the CRT is operated at a potential of about 750 volts above earth. The cathode and control electrode are at about 5·0 kV below earth. The feeds to these two electrodes are each taken through two 0·02 microfarad condensers in parallel (C17+C18 and C19+C20), and are DC restored by the diode V8.

24. The operation of the diode V8 is as follows. It receives on its cathode the trace brightening pulse from the timebase unit (range) Type 136 (PL.11) which is negative during the forward stroke of the timebase. Provided that the brightness control on the indicating unit and the brightener control on the timebase unit (range) are correctly set up, the diode and the CRT do not conduct at the same time; during the forward stroke, the CRT conducts, but the diode is cut off, while during the flyback and waiting period, the CRT is cut off, and the diode conducts.

25. The BRIGHTNESS control (R62) and FOCUS control (R60) function in the conventional manner. The focus (second anode) potentiometer R60 is a fine control only, coarse adjustment of the second anode voltage being provided by tappings on the power unit Type 875 (PL.13).

Cathode-ray tube

26. The cathode-ray tube is a CV1085, which has a Type BYL screen (blue trace, yellow after-glow, long persistence).

Range marks

27. The calibrator valve chain in the timebase unit (range) Type 136 (PL.11) runs continuously, and the range marks (calibration) output from B11 in PL.11 is received on the indicating unit at termination B11. The latter is connected to termination D1, from which point a cable is taken to termination A1 on the left-hand control desk, and thence to one end of a potentiometer R1, the R.M.AMP. control, the other end being connected to A3 on the control desk; the latter termination is cabled to D3 on the indicating unit, which is earthed. This potentiometer is therefore in effect connected across the output of the calibrator valve chain.

28. The wiper of the potentiometer is connected to A2 on the left-hand control desk, and cabled to D2 on the indicating unit. The latter termination is taken to the control-grid of the range marks mixer valve V101, which shares a common anode load (R3, the SET LIMIT control) with the video amplifying valve V1. The output from R3 therefore consists of mixed video and range marks, as stated in para. 3. The level of the range marks must be adjusted by means of the R.M.AMP. control, after the SET LIMIT and MOD. AMP. controls have been adjusted. For Y-deflection display, once the timebase has been set up, the range marker amplitude may if desired be turned down to zero, since an external range scale is fitted to the CRT. For elevation scan display, the range marks (bright spots of intensity modulation) are continuously displayed, moving vertically up and down the tube face when the aerial is tilting, and so forming part of the elevation scan graticule (*para.* 5).

29. If the switch S5 (CALIB) key on the right-hand control desk (PL.16) is moved to ON, the relay REL.1 in the indicating unit is energized. The video signals received from the amplifying unit (A.J. and video) Type 295 are then removed from the display and the range marks are presented at full amplitude. At the same time the 140-volt supply to the screening-grids of the IF valves in the amplifying unit (IF) Type 296 is removed, so muting the IF amplifier.

30. The CALIB switch is used in this manner when setting up the RANGE VELOCITY and LINEARITY controls on the timebase unit (range), so that the range marks may be aligned accurately with the engraved marks on the scale.

Manual calculator

31. The manual calculator is a board used for operational purposes in connection with radar Type 15 Mk. 5 only. It is mounted by means of bolts with wing nuts on small brackets on the elbow desk of the indicator (fig. 1). The lamps in the boards are fed from the heater supply of the indicator via the plug P2 (fig. 4). The general arrangement of the calculator is shown in fig. 6.

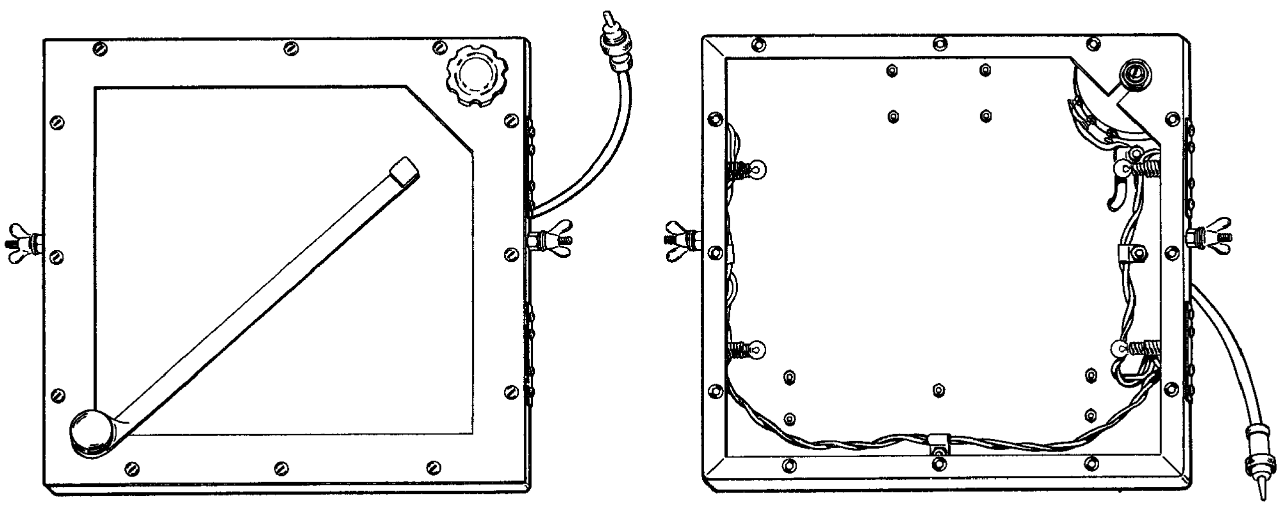


Fig. 6. Manual calculator

External connections

32. There are three Jones plugs on the indicating unit, and one coaxial socket. The latter receives the radar video signal from P2 on the amplifying unit (A.J. and video) Type 295. The connections made by the Jones plugs are as follows:—

A1	HT.1, 320V (V1, V101, V6)	from PL.12, A6
A2	HT.8, 300V (V7)	from PL.2, A6
A3	LT.7, 6·3V (V2, V3, V10)	from PL.1, B3
A4	LT.7, 6·3V (V2, V3, V10)	from PL.1. B4
A5	LT.13, 6·3V (scale and rear lamps)	from PL.2, A7
A5	Earth to bus bar	

A6	Elevation scan waveform	from PL.6, A12
A7	280V, stabilized (V2, V3 bias)	from PL.6, A3
A8	LT3, 6·3V (V1, V101, V6)	from PL.12, A4
A9	LT.3, 6·3V (V1, V101, V6)	from PL.12, A8
A10	LT.1, 6·3V (V7)	from PL.12, A10
A11	LT.1, 6·3V (V7)	from PL.12, A12
A12	Brightener pulse	from PL.11, A1
B1	HT.4, 1,000V floating	from PL.1, B6
B2	HT.4, 1,000V floating	from PL.1, B5
B3	LT.4, 6·3V (V4)	from PL.1, A11
B4	LT.4, 6·3V (V4)	from PL.1, A12
B5	LT.5, 6·3V (V5)	from PL.1, A9
B6	LT.5, 6·3V (V5)	from PL.1, A10
B7	Timebase waveform	from PL.11, A7
B8	Timebase waveform	from PL.11, A8
B9	HT.3, 1,200V (V2, V3, Y-STIG)	from PL.1, A8
B10	LT.13, 6·3V (scale and rear lights)	from PL.2, A8
B11	Range marks input	from PL.11, B11
B12	50V DC to relay REL.1	from PL.16, B1
C1	—	
C2	Second anode potentiometer	from PL.13, B2
C3	Third anode	from PL.13, B3
C4	—	
C5	Second anode potentiometer	from PL.13, B5
C6	LT.11, 4V to CRT heater	from PL.13, B6
C7	LT.11, 4V to CRT heater	from PL.13, B7
C8	LT.12, 6·3V to DC restorer V8	from PL.13, B8
C9	LT.12, 6·3V to DC restorer V8	from PL.13, B9
C10	—	
C11	Cathode, 5·0 kV	from PL.13, B11
C12	Control electrode, 5·0 kV	from PL.13, B12
D1	R.M.AMP. control	from PL.14, A1
D2	R.M.AMP. control	from PL.14, A2
D3	R.M.AMP. control	from PL.14, A3
D4 to D12	not used.	

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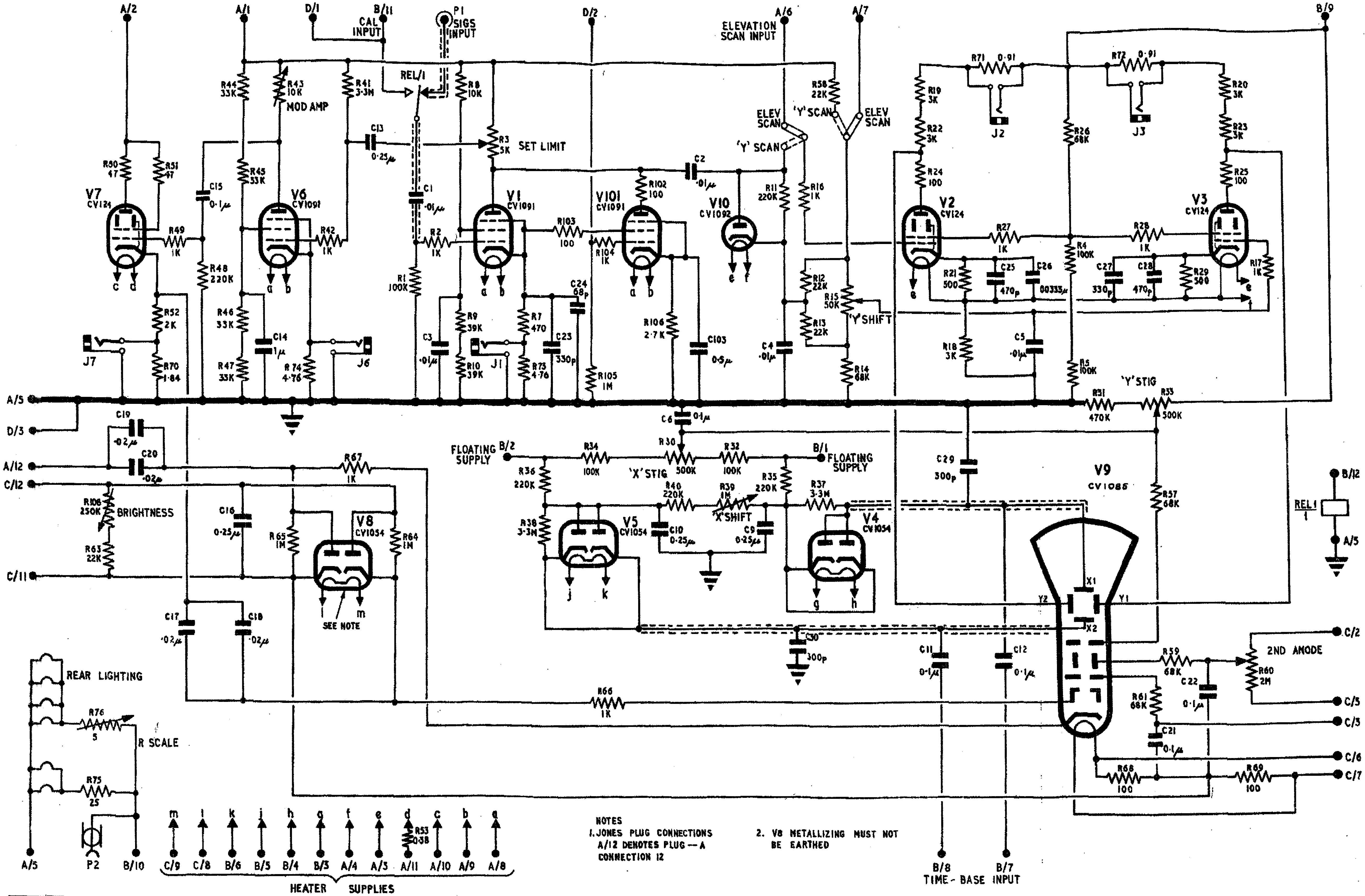

AIR DIAGRAM 6112Q/MIN.

ISSUE 1 PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Indicating unit (CRT) Type 32—circuit

Fig. 5.

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Chapter 6

TIMEBASE UNIT (IFF) TYPE 135

AND

INDICATING UNIT (IFF) TYPE 31

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LIST OF ILLUSTRATIONS

*At end of chapter

A-Band IFF display

1. The timebase unit (IFF) Type 135 and indicating unit (IFF) Type 31 together form a display system for the presentation of IFF Mk. 3 A-Band responses. Because of the intimate relationship between the two units, it is impossible to visualize completely the action of either unit without reference to the other, and it is therefore advisable to describe them concurrently. This course has been adopted in the present chapter.

2. The IFF responses are displayed upon a six-inch cathode-ray tube fitted in the indicating unit. The presentation is given upon a double timebase trace, one of which shows the IFF responses, and the other the main radar responses; this is done to facilitate range correlation between the IFF and the radar. The radar responses may be derived from the amplifying unit (A.J. and video) Type 295, on the H/R console itself, or from an associated console Type 60 or 60A, the latter being the more usual practice. Calibration pips (range marks) derived from the information generator, but fed via the associated PPI console, can also be displayed for setting-up purposes.

3. The timebase unit receives a locking pulse from the radar transmitter and generates a locking pulse at a reduced p.r.f. which triggers the IFF interrogator. A return lock from the interrogator is used to initiate the IFF trace upon the CRT, while the main radar locking pulse initiates the radar trace. The latter locking pulse is usually taken from the SYNC. OUT plug on the PPI console, but in some installations it may be taken direct from the master trigger unit through its own delay unit Type 31.

4. A strobing system is incorporated in the display system, for use when the A-Band IFF signals are to be correlated with the radar display on the PPI console. A strobe pulse appears on the PPI screen at a range determined by the setting of a potentiometer (the STROBE control) on the PPI indicating unit. As the PPI trace rotates, the strobe pulse paints a fine circle upon the PPI screen, and the PPI operator adjusts the STROBE control until the circle intersects the response which is to be interrogated.

5. The movement of the STROBE control on the PPI causes a strobe indication to move to the corresponding range on both traces of the IFF indicating unit. At this point, a small portion of each trace is brightened and expanded, the beginning of the expanded portion being marked by a vertical "ruler line" which cuts both the traces, and so marks the range corresponding in position with the strobe pulse on the PPI display.

Note . . .

On console Type 61A, the strobe pulse is also fed back into the H/R console, and then into the A SCOPE SYNC. *position on the panel Type 642 (sync. and blanking). With the* SYNC. *switch in this position, the main radar display is fired by the strobe pulse, and the trace commences at the range set by the PPI strobe control. This trace is produced by the A-scope timebase unit Type 139, and covers a range of ten miles, with one-mile range marks. Further details of this application will be found in Chapter 9 of this Section.*

General arrangement

6. The circuit of the timebase unit is given in fig. 1, and that of the indicating unit in fig. 2. These are placed at the end of the chapter for ease of reference. The locking pulse for the interrogator, the driving pulse for the timebase generator, and the complex video waveform which is applied to the video valves in the indicating unit, are generated in the timebase unit (IFF) Type 135. This panel also contains the strobing circuits.

7. In addition to the CRT itself, the indicating unit carries the timebase generator, the video output stage, and the high voltage smoothing circuits.

8. The EHT voltage for the CRT is obtained from the power unit Type 875 (PL.13). A 350-volt positive supply for the timebase unit HT rail is obtained from power unit Type 871 (PL.2), and a 300-volt negative bias supply from the power unit Type 874 (PL.12). All other supplies for the IFF display are obtained from power unit Type 873 (PL.8). These include a 750-volt HT rail supply for the timebase and video output valves in the indicating unit, and a floating 800-volt supply for X-shift and X-stig. circuits. Further details of the power supplies are given in Chapter 7 of this Section.

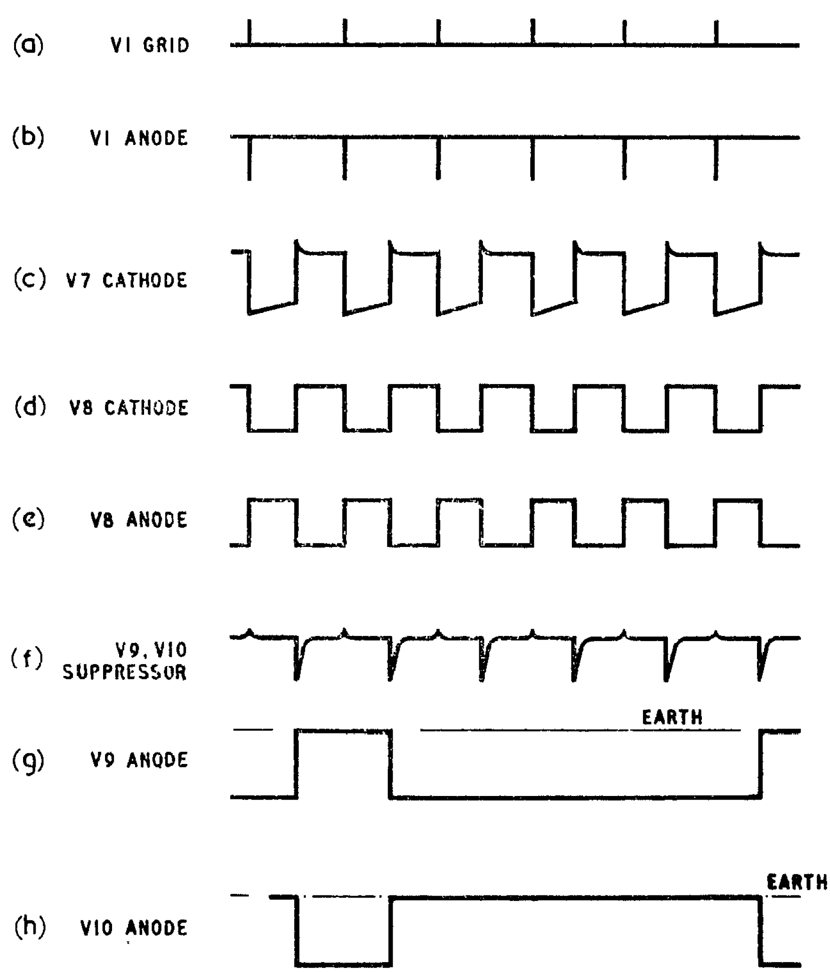


Fig. 3. Waveforms of locking circuit with V1 suppressor-grid earthed

Locking circuits in the timebase unit

9. Referring to fig. 1, the suppressor grid of V1 is taken to termination A8, and the latter is connected to the A-Band ON/OFF switch, on the control desk of the H/R console, through an external link between D2 and D5 on the input panel (PL.17). When the A-Band key is ON, the suppressor-grid of V1 is earthed, but when it is OFF, the suppressor-grid is connected to a positive 280-volt supply.

Note . . .

The waveforms given in fig. 3-9 are theoretical ones. actual oscilloscope waveforms are given in fig. 18 and 19 (para. 65 refers).

10. The locking pulse from the radar transmitter is fed into the timebase unit at termination A4; links are provided so that either a positive or a negative sync. pulse can be utilized. The return lock pulse from the interrogator is, under normal operational conditions, received upon termination B4 and fed through a link to the control grid of V2.

11. The valves V1 and V2 function as a lock mixer. With the A-Band key ON, the suppressor-grid of V1 is connected to earth, but V1 and V2 are both cut off by a negative bias voltage obtained from the negative 300-volt bias rail. The control-grid of V1 receives a sequence of narrow locking pulses from the radar transmitter; these drive the control-grid up to cathode potential, further rise being prevented by the grid-stopper R3. At the common anodes of V1 and V2, a sequence of negative pulses is therefore produced (*fig.* 3 (a) and (b)).

12. Each of these pulses triggers the phantastron valve V7, via the condenser C9 and the diode V6A. The phantastron has two outputs, from the cathode and screening-grid respectively, both being approximately square waves. The screening-grid output is used to trigger the delay phantastron as described later (*para.* 36). The pulse from the cathode (*fig.* 3(c)) is fed into the control grid of V8, which produces square pulses of the same duration at its anode and cathode, the cathode pulse being negative and the anode pulse positive.

13. The negative pulse (*fig.* 3(d)) is fed to termination B6 (TB lock) and thence to the indicating unit Type 135, where it is used to drive the timebase generator.

14. The positive pulse at the anode (*fig.* 3(e)) is differentiated by the time-constant circuit C12, R37, R38, and the positive peaks removed by the diode V23. The residue therefore consists of a sequence of negative-going pulses synchronized with the rear edge of the pulse at the cathode of V7.

15. These pulses are used to synchronize a divider stage which employs the valves V9, V10. This divider is a multi-vibrator in which the sync. pulse is applied to the suppressor-grids of both valves. The time-constants are so chosen that the positive-going and negative-going portions are of different duration, e.g., at the anode of V9 the positive-going portion has a duration equal to the time interval between two consecutive sync. pulses, while the negative-going duration of the negative-going portion is 2, 3, 4, 5, or 6 times as great, according to the setting of the DIVIDER control R54. The edges of the divider waveform will coincide with the rear edge of the phantastron waveform, that is, with the ends of the timebase periods. The waveforms at the anodes of V9 and V10 are shown in fig. 3 (f), (g), (h).

16. In the foregoing, the action of V1 has been explained without reference to any connection on the suppressor-grid other than the "earth out" at A8. The suppressor-grid is, however, also connected to the anode load of V10. The cathodes of the valves V9 and V10 are returned to the negative 300-volt rail, and their anodes, via the appropriate anode load resistor, to earth. The suppressor grid of V1 is, therefore, at earth potential during the period when V10 is not conducting, and at about 150 volts negative to earth when V1 is conducting, i.e., if the divider ratio is set at 1 in 5, it is at earth potential for four periods in every five.

17. The total cathode current through V1 will remain sensibly as if the suppressor-grid is continuously earthed, i.e., the waveform will remain as in fig. 3 (b) but during four periods it will be drawn mainly from the anode, and during the fifth, entirely from the screening-grid. Thus there is no pulse at the anode when the suppressor-grid is highly negative, so that the first of each group of five pulses will be eliminated. The waveforms at V1 control-grid, suppressor-grid, and screening-grid, are, therefore, as shown in fig. 4 (a) to (d). *It will be seen that the pulses at the screening-grid are of different amplitudes; when the suppressor-grid is at earth potential, the pulse amplitude is less than the cathode bias on the diode V4, but when the suppressor-grid is at 150 volts negative, the amplitude is approximately double the bias voltage (fig. 4 (d)).*

18. The screening-grid waveform is applied to the cathode of V4 via condenser C4. The cathode is biased positively with respect to its anode by the resistor network R4, R5, and the diode is normally cut off. The bias is such that the large amplitude pulses (*para.* 17) will cause the diode to conduct and develop pulses across R13, but it will remain non-conductive during the pulses of small amplitude, i.e., it "gates" the larger amplitude pulses only. The pulses passing through the gate (*fig.* 4 (e)) trigger the transitron V5.

19. When triggered, the transitron produces, at its anode, positive pulses of 50 microseconds duration. A fraction (about one-sixth) of the pulse voltage is tapped off from R16 and fed to termination B3. This is fed over a co-axial line to the transmitting cabin to trigger the interrogator. When the interrogator fires, it sends a return locking pulse to the IFF display; this is a fast positive pulse of about 10 micro-seconds duration. It is received at termination B4, and fed to the control-grid of V2, causing V2 to conduct and so produce a negative pulse at its anode, which is common to V1. The full number of pulses is, therefore, restored at this point, four of the pulses being accurately timed by the radar transmitter pulse, and one by the interrogator pulse. This method of locking avoids the necessity for introducing a variable correction in the timing of subsequent circuits to compensate for the delay in the firing of the interrogator.

Action of A-Band switch

20. The above description assumes that the A BAND key is in the ON position. In the OFF position, the termination A8 is connected to a 280-volt positive supply. It is then impossible for the waveform at the anode of V10 to drive the suppressor-grid of V1 negative, and the diode V3 prevents the suppressor-grid potential from going positive, so that it is rigidly held at earth potential. All the radar locking pulses are passed through and subsequent circuits work normally, but since all the pulses at the screening-grid of V1 are of smaller amplitude than the bias voltage on V4, none pass the gate and the transitron is not triggered. The interrogator lock pulse is, therefore, absent, and the action is exactly as described in para. 3.

Servicing lock

21. In order that the operation of the locking circuits may be checked without actually triggering the interrogator, provision is made by means of a link, to feed the output of the transitron directly into the control-grid of V2, instead of the return lock. Since this facility is used mainly for routine servicing, it is generally referred to as the servicing lock. The link itself is (incorrectly) labelled MAINT. LOCK (*A.P.3162, Sect. 18M, and Sect. 21S, refer*).

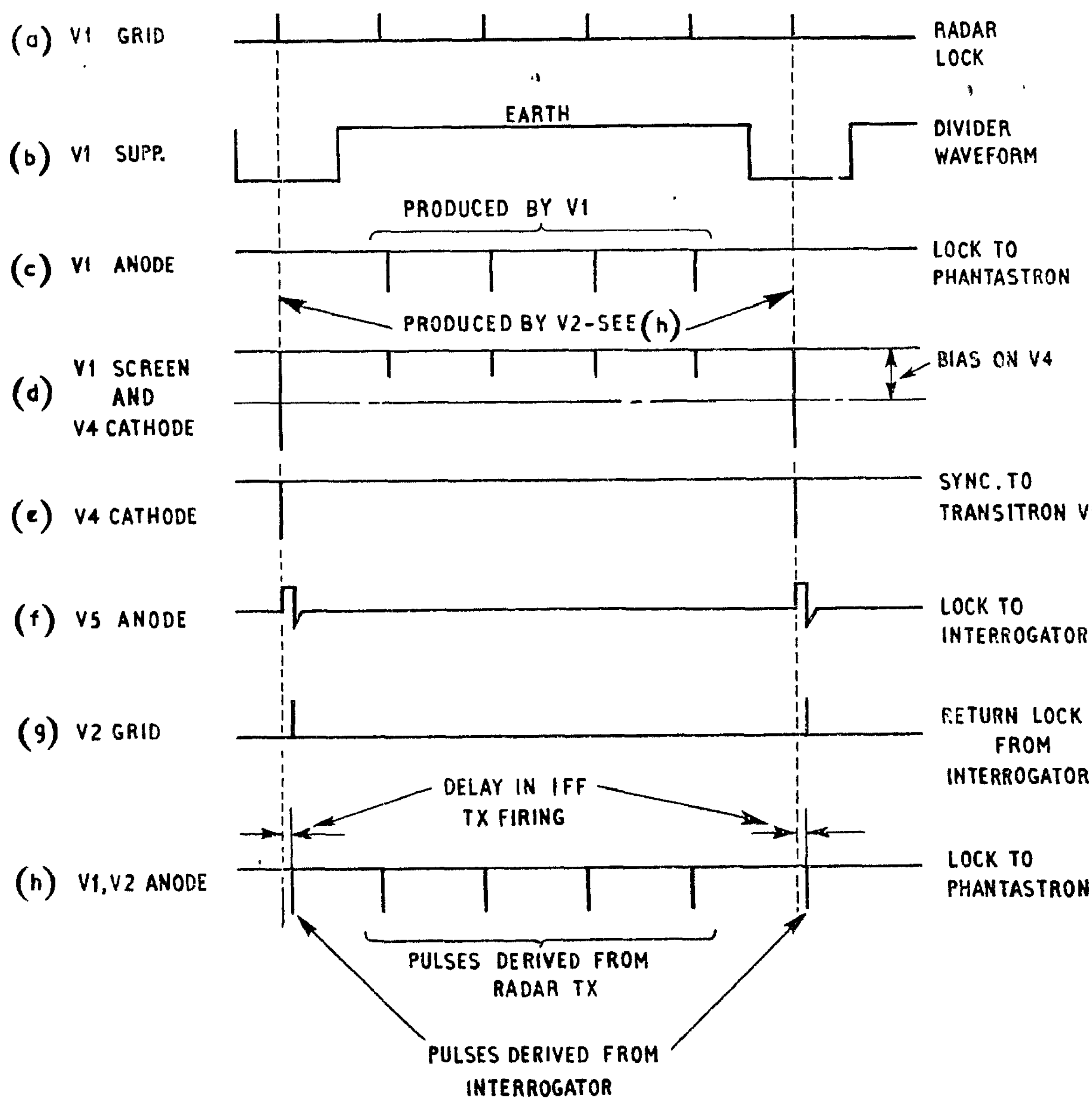


Fig. 4. Waveforms of locking circuit in normal operation

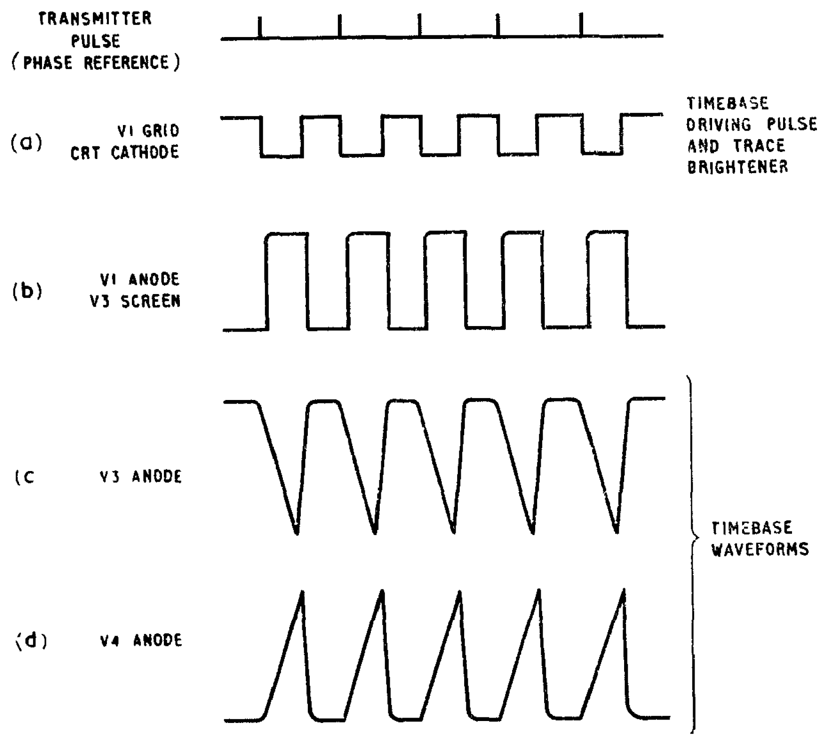


Fig. 5. Timebase waveforms in indicating unit

Timebase circuits in the indicating unit

22. The negative pulse produced at the cathode of V8 in the timebase unit is fed into the indicating unit Type 31 at the termination A6. It is then taken through C17 and R65 to the cathode of the CRT to brighten the trace during the timebase period. Another feed from A6 is taken to the control-grid of V1.

23. The valves V1 to V5 form a balanced Miller timebase generator similar in principle to that used in the timebase unit (range) Type 136 (*Chap. 4 of this Section*). Only two switched ranges are provided, and since the required output is less, the HT supply is only 750 volts. The balanced deflection voltages are taken from the anodes of V3 and V4, through condensers C9, C10, to the two X-plates, DC restored by V8 and V9. The timebase waveforms are given in fig. 5.

24. The Y-stig. voltage is derived from the 750-volt supply, the tapping on the potentiometer R46 being taken to the third anode via R61. The X-stig. and X-shift voltages are derived from a floating 800-volt supply, and the Y-shift voltage is given by the balanced video output stage, as explained in para. 32.

Video circuits

25. Before explaining details of the range strobing and expansion circuits, it is necessary to deal with the video circuits; these are associated with valves V24, and V11 to V14, on the timebase unit, together with V6 and V7 on the indicating unit. The video circuits on the timebase unit receive three inputs, namely:—

(1) IFF signals from the A-Band responsor. These will normally come from the aerial cabin via a co-axial line (or lines) with matching transformers at each end. These transformers are not provided with the display equipment and are fitted externally.

(2) Radar video signals These are usually derived from an associated PPI console, but may be taken from the radar video amplifier on the H/R console itself (*para.* 1). In para. 26 et seq. it is assumed that the PPI video is used, since the H/R video is muted when the calibrator switch is at ON.

(3) Range marks, which are derived from the calibrator which supplies range marks to the associated PPI console. The coil of the calibrator relay REL.1 is connected in parallel with the coil of the calibrator relay in the main radar timebase, so that both relays are controlled simultaneously by the key switch S5 on the right-hand control desk (PL.16). Range marks are, therefore, displayed, on the IFF tube, only when the key switch is on (unlike the main radar display, upon which range marks at controllable amplitude are always available). In the following description, range marks are assumed to be present.

Note . . .

The PPI radar video output is of the order of 1·5 volts and the calibrator output from the PPI is 3-20 volts. An attenuator is therefore fitted externally in each lead between the consoles, so reducing the radar video input to about 600 millivolts, and the range marks to about 370 millivolts.

26. The radar video and range marks pulses are both positive-going. The radar video signals are received at termination A3 on the timebase unit and are fed into one control-grid of the double-triode valve V24. Range mark signals are received at termination A10 and applied to the other control-grid of V24. The latter, therefore, functions as a radar/range-marks mixer; the output being negative-going radar video and range marks, which is amplified by V11 and DC restored by V12. The DC restoration takes place at a high level and the restored signals are applied to the potentiometer network R57, C19, R56, by which they are reduced in level prior to mixing with the IFF video signals. The condenser C19 is shunted across R57 to preserve the frequency response of the network.

27. The radar and range marks video is applied to the control-grid of V13, and the IFF video signals are received at termination A6 and applied to the cathode of V14. These valves share a common anode load R60, but do not conduct simultaneously; they are switched by divider waveforms taken from the anodes of V9 and V10, direct connections being possible because the anode loads of the multivibrator valves are returned to earth. Assuming, as previously, that the divider ratio is one in five, the radar valve V13 is conductive during four radar cycles, and the IFF valve V14 is conductive during the remaining IFF cycle. The timebase sweep voltages corresponding to these cycles are shown in fig. 6(a).

28. During the four radar cycles during which V13 is conductive, the radar and range marks appear as negative-going signals at the anode load, R60. During the IFF period, the IFF signals applied to the cathode of V14 are amplified and appear as a positive-going signal at the anode load, R60. Large IFF signals cut off the anode current of V14, so that the peak amplitude at the anode of V14 is limited, and radar signals are limited by the grid base cut-off in V11.

29. The standing current in V14 is fixed, but that of V13 can be adjusted by varying the control-grid bias. The potentiometer R61 is used for this purpose, and is labelled TRACE SEPARATION. The current taken by V13 is thus adjusted to be slightly greater than that of V14, and the resultant waveform across the common anode load is as shown in fig. 6(b).

30. Referring now to the circuit diagram of the indicating unit (*fig.* 2) the valves V6 and V7 are the video output valves, connected as a cathode-coupled balanced amplifier. The output from R60 is taken from termination A2 in the timebase unit to termination A8 in the indicating unit, and thence to the control-grid of V6. The control-grid potential of V7 is adjusted by the potentiometer R43, so that it lies at the mid-point of the voltage swing of the control-grid of V6. The anodes of V6 and V7 are directly connected to the Y-plates of the cathode-ray tube.

31. When the voltages on the control-grids are equal, the valves V6, V7, will take equal anode currents, the anodes will be at the same potential, and the trace on the CRT will lie along the horizontal diameter of the CRT. If the control-grid voltage of V6 is raised, the valve will take more current and its anode voltage will fall, but its cathode voltage will rise. The voltage at the cathode of V7 rises correspondingly, so that V7 will take less current, and its anode voltage will increase. When the mixed video waveform (radar, range marks, and IFF) from the timebase unit is applied to the control-grid of V6, therefore, equal and opposite waveforms of the same shape and duration will be produced at the anodes of V6 and V7 (*fig.* 6 (c) and (d)). The resulting appearance of the CRT screen is as shown in fig. 6 (e).

32. The high potential end of the potentiometer R43 is taken to termination A10, which is labelled VIDEO DC in fig. 2. This point is connected to termination B5 in the timebase unit, and also to termination A12 in the power unit Type 873 (PL.8). In the latter, this connection is taken to a 32 microfarad decoupling condenser, the associated resistor being R49 in the timebase unit. This resistor is fed from the positive 300-volt rail (HT.8) and therefore the VIDEO DC connection also carries HT.8 into the indicating unit at termination A10 to feed the high potential end of the potentiometer R43, which acts as a Y-SHIFT control.

Range strobing circuits

33. The strobing facility is provided to give range correlation between the PPI console and the IFF display. A strobe control, which varies the position of a narrow strobe pulse on the PPI display, is fitted on the control desk of the PPI console; this pulse paints a fine circle on the tube screen as the radial trace rotates. A corresponding strobe appears at the corresponding range on the IFF tube, where it takes the form of a brightened portion of the trace; this portion is also expanded to make the range correlation still easier. The beginning of the brightened and expanded portion is marked by a sharp narrow pulse, like a ruler line, which projects downward from the IFF trace and cuts the radar trace (*fig.* 6(c)).

34. The circuits providing the strobing facility are incorporated in the timebase unit (IFF) Type 135. They consist of a phantastron delay circuit which determines the range of the strobe, a flip-flop from which the brightening and trace-expanding waveforms are derived, and a strobe pulse generator. The latter produces the strobe pulse which is fed into the PPI console, and also the marker pulse at the beginning of the expanded portion of the trace, on the IFF display.

35. The delay phantastron, V15, is triggered on its suppressor-grid, as explained later, and the width control is effected by varying the voltage from which the Miller run-down starts, instead of by varying the charging rate. The anode current is normally cut off by suppressor-grid bias, and the anode voltage rises only to that at the cathode of V16. It will be noted that this cathode is connected to the termination A9 (labelled STROBE CONTROL in *fig.* 2). This is taken via D3 on the input panel (PL.17) to the strobe control potentiometer on the PPI console. The latter is fed from a positive 300-volt supply (normally HT.8, which is fed to the potentiometer via termination D1 on PL.17).

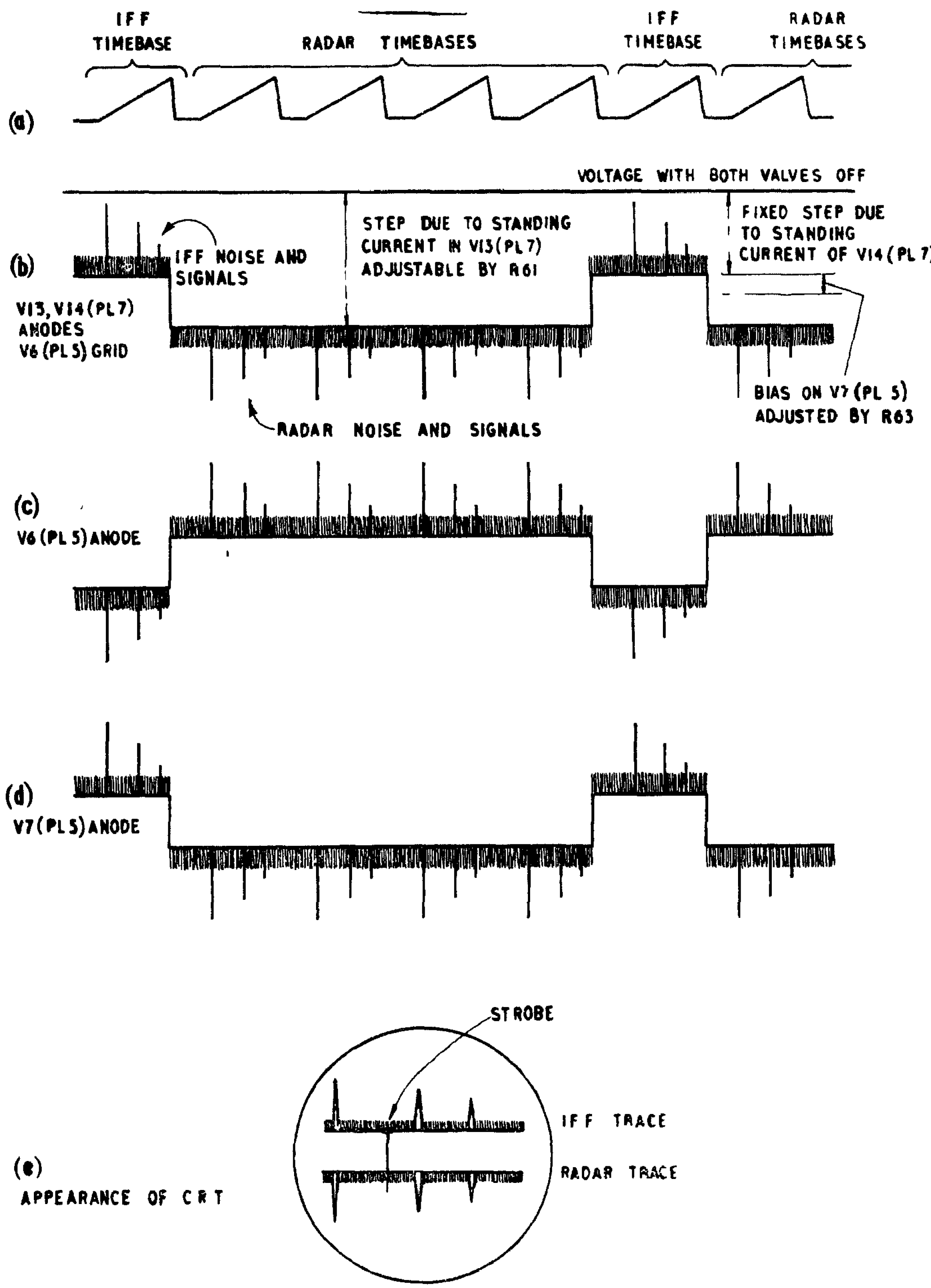


Fig. 6. Mixed waveforms in indicating unit

36. The phantastron is triggered by a pulse obtained by differentiating the waveform at the screening-grid of the timebase phantastron. This pulse causes anode current to flow, and so produces a fall in potential at the anode. The diode V16 is then cut off and has no further effect. The control-grid potential changes in the same manner as that of the anode, since the charge on the condenser C22 remains substantially constant. The phantastron then functions in the normal manner, the anode potential performing a Miller run-down until earth potential is approached, at which point the run-down ceases and the anode potential returns exponentially to its normal value.

37. The duration of the phantastron pulse is determined by the time taken for the anode potential to fall from that of the cathode of V16 to (approximately) earth, and since the charging rate of C22 is fixed, this is controlled by the setting of the strobe control potentiometer on the PPI console. This method of control permits a very small minimum range to be obtained.

38. The waveforms at V7 suppressor-grid, and V15 suppressor-grid are shown in fig. 7 (a) and (b). The manner in which the strobe potentiometer controls the width of the phantastron waveform is shown in fig. 7 (c), for two values of voltage on the cathode of V16.

39. The strobe pulse, and the expansion and brightening waveforms, are developed from the rear edge of the pulse at the screening-grid of V15, so that the width of this pulse determines the range at which the strobe appears.

Expansion flip-flop

40. The positive pulse at the screening-grid of V15 is differentiated by C24, and the rear edge, which is negative-going, triggers a flip-flop formed by the valves V17 and V18. The valve V17 is normally cut off by control-grid bias provided by the network R77, R79, and V18 is normally conducting, since its control-grid is returned to earth through the resistors R80, R81 (note that its cathode is returned to the negative 300 volts rail). The negative portion of the differentiated waveform from the anode of V17 forces the control-grid potential of V18 negative, through the coupling condenser C26. The valve is then cut off and its screening-grid voltage rises, taking with it the control-grid potential of V17, to which it is coupled through C28.

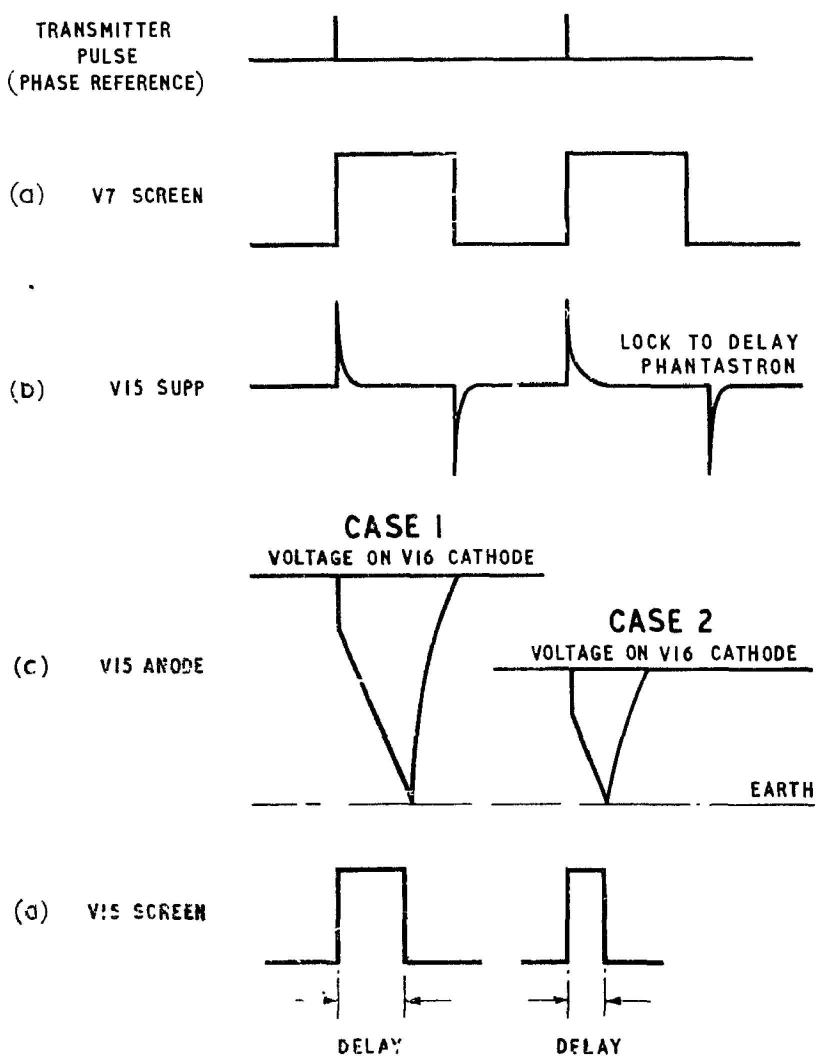


Fig. 7. Waveforms in delay phantastron

41. The valve V17 is thus held in a conductive state and its anode potential falls below normal, so that the control-grid of V18 is also driven negative. The condenser C26 is then charged by current flowing through R80 and R81, causing the control-grid potential of V18 to rise. Eventually, therefore, V18 becomes conductive, and its screening-grid voltage falls, cutting off V17 and so restoring the circuit to its original condition. The time-constant of C28 and R78 is long compared with the flip-flop period.

42. A negative pulse is thus obtained at the anode of V17 and positive pulses at both anode and screening-grid of V18. The width of these pulses is determined by the time taken for the control-grid of V18 to recover to earth potential, that is, by the values of R80, R81, and C26. Of these, R80 is variable; this is the EXPANSION WIDTH control. When setting up, it is so adjusted that the width is about 30 microseconds, corresponding with a range expansion of about three miles.

43. The operation of the flip-flop is illustrated by the waveforms in fig. 8 (a), (b) and (c). The main pulse at the anode of V18 produces the timebase

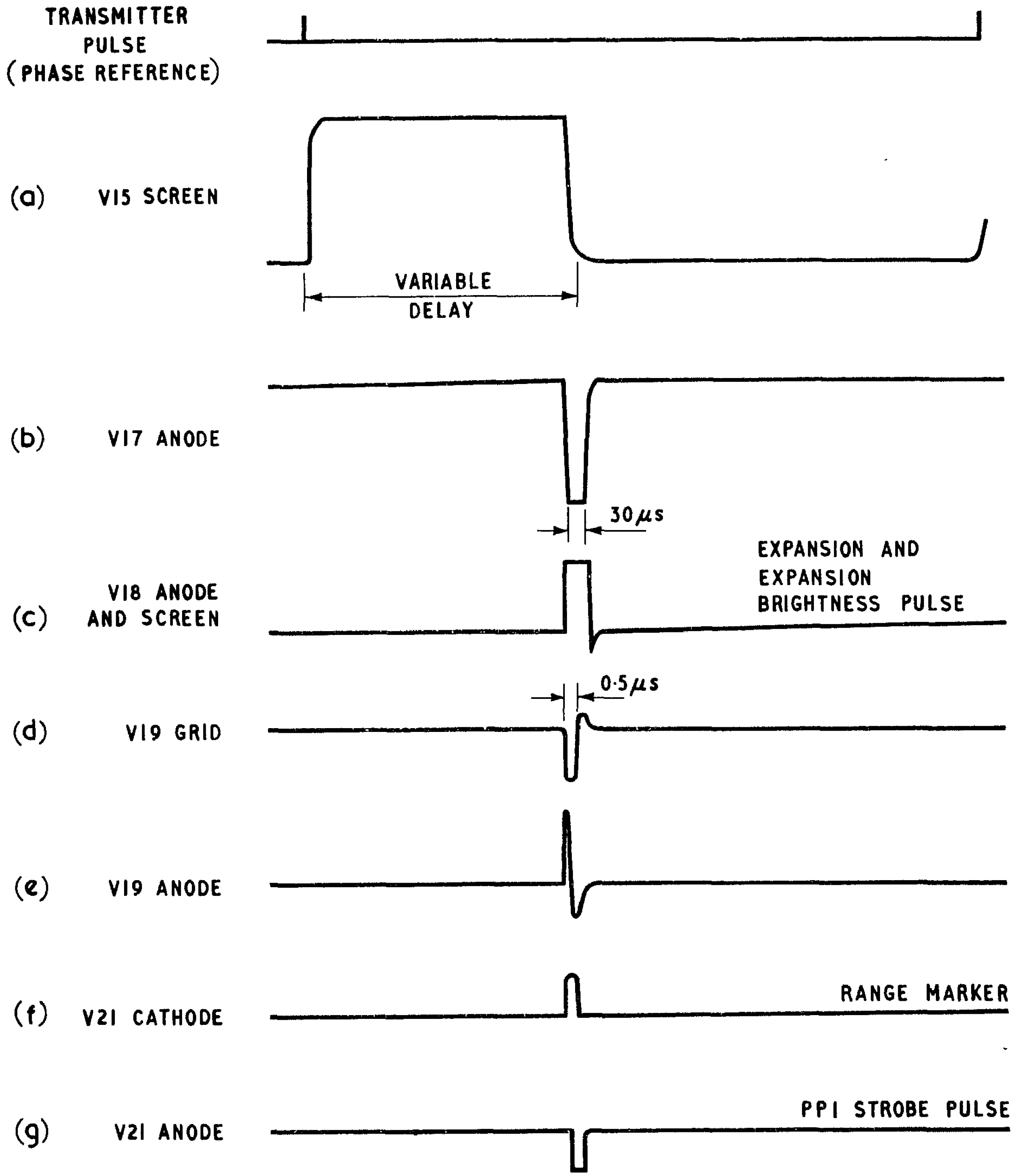


Fig. 8. Waveforms in flip-flop, expansion, and strobe valves

expansion, as explained in para. 44. A portion of the waveform at the anode of V18 is tapped off by the potentiometer R18 (EXPANSION BRIGHTNESS) and taken via termination A1 to the indicating unit Type 31, where it is applied to the control-electrode of the CRT to brighten the trace over the strobe interval.

Expansion circuit

44. The action of the expansion circuit will be described with reference to the simplified circuit diagram shown in fig. 9 (a). The expansion flip-flop pulse from the anode of V18 is fed through C29 and is DC restored by the diode V20A; the cathode of the latter is fed from a tapping between R87 and R89, 100K and 680K respectively, through R88 (1 megohm). Its normal potential is thus about 45 volts below earth, and its anode is at the same potential. During the pulse, however, the cathode of V20A is driven positive; this point is connected through R92, R93, and the diode V20B to the control-grid of the Miller valve V3 on the indicating unit, via termination A7 on the timebase unit and A7 on the indicating unit.

45. The waveform at the cathode of V20A, and at the control-grid of V3 in the indicating unit, is shown in fig. 9 (b). Normally, V20B is cut off, so that the expansion circuit is cut off from the Miller valve, and does not affect its behaviour. During the expansion pulse, however, the anode of V20B is driven positive, current flows through R92, R93, and the diode V20B, into the Miller charging condenser C2 on the indicating unit. During the pulse, therefore, the charging rate of C2 is increased, causing the timebase to be speeded up; by this means, the trace is expanded over a range of about three miles.

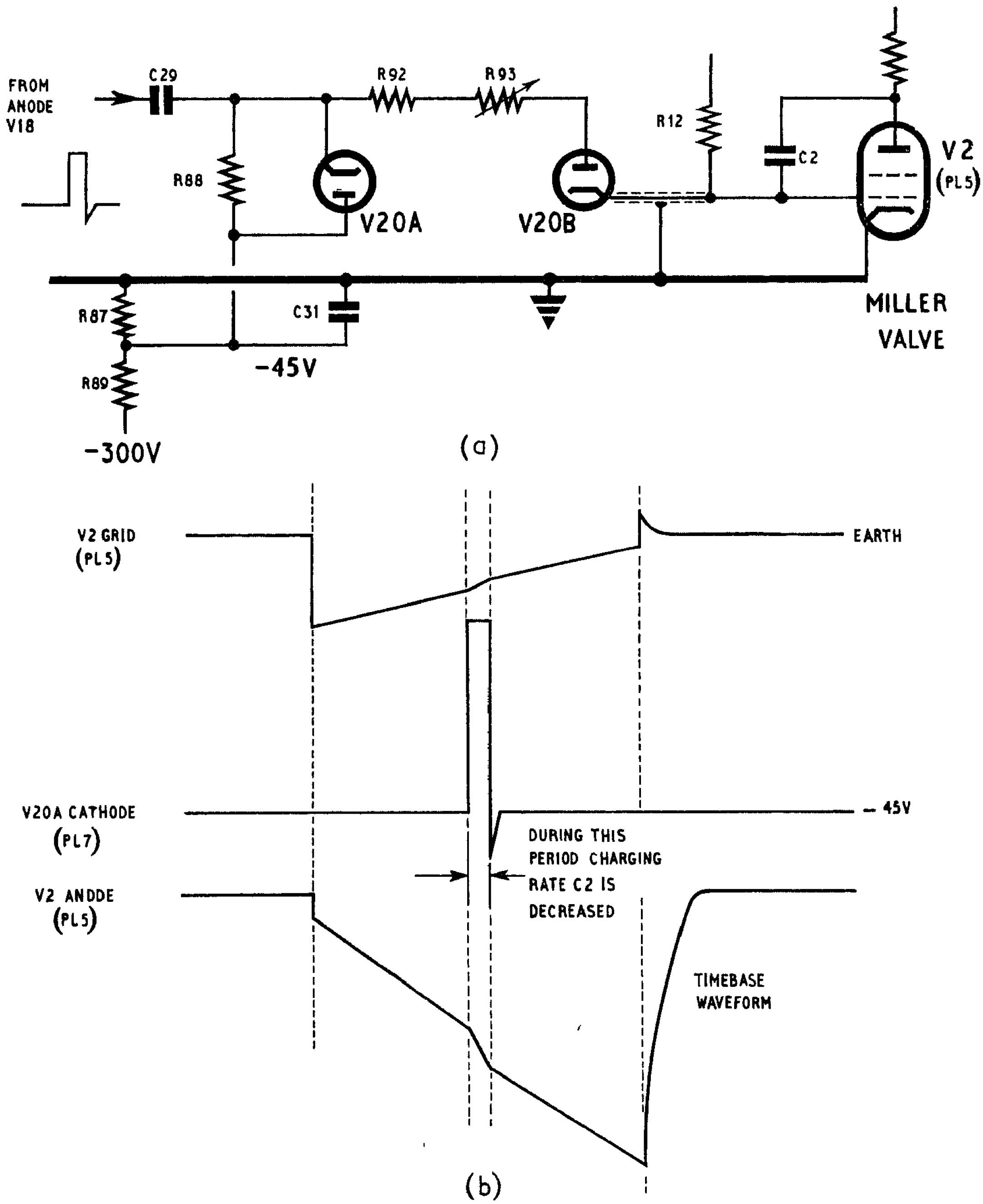


Fig. 9. Expansion circuit simplified, with waveforms

Strobe pulse generator

46. Fig. 8 also shows the waveforms of the strobe pulse generator formed by the valves V19 and V21. The control-grid of V19 receives the differentiated waveform from the anode of V17. The valve is normally conducting, since the control-grid is returned to cathode via the inductor L1. In conjunction with the stray capacitances L1 forms an oscillatory circuit. The differentiated pulse received at the control grid has a very sharp negative-going leading edge which rings the oscillatory circuit and cuts off V19 for a period determined by the natural frequency of the oscillatory circuit, producing a narrow pulse at the anode of V19 (*fig.* 8 (c) and (d)).

47. The valve V21 is normally cut off by control-grid bias produced by R90, R91, but is made conducting by the positive pulse received via C30, from the anode of V19. A positive pulse is thus produced across R96 in the cathode circuit, and a negative pulse across R95, in the anode circuit, the width of these pulses being about half a microsecond.

48. The potentiometer R95 is labelled STROBE AMPLITUDE. From it, a fraction of the anode pulse voltage is fed through C32 to termination A11, and thence to P2 on the input panel (PL.17). It is then fed into the PPI console to produce the strobe marker referred to in para. 34. The pulse at the cathode is fed back into the control grid of V14 to produce the "ruler line" marker on the IFF trace. This pulse is amplified by V14 during IFF periods, and appears as a negative pulse at its anode, thus producing a downward deflection from the IFF trace.

Note . . .

The plug P2 is internally strapped to plug P16. On console Type 61A, the strobe pulse is also fed externally from P16 to P4. From the latter, it is taken into the sync. and blanking panel (PL.9) and is used as a sync. pulse for the timebase unit (A-scope) Type 139.

49. One of the multivibrator waveforms (i.e., from the anode of V10) is applied to the suppressor-grid of V21, to remove the anode pulse during the IFF period. This is necessary because during the IFF period, the delay phantastron is triggered from the interrogator, whereas the PPI timebase is triggered from the radar transmitter, or master trigger unit as the case may be.

Setting up the display

50. In mobile applications, the sync. pulse for the IFF display is obtained from the radar transmitter, and the latter must be operating before the display can be set up. In static applications, the sync. pulse will generally be obtained from the master trigger unit. Normally, the IFF interrogator should also be working, but by placing the LOCK link in the timebase unit (IFF) Type 135 in the servicing (MAINT) position, this can be dispensed with.

51. To set up the indicating unit, verify that the appropriate range scale is fitted across the face of the CRT, and place the A-BAND key on the right-hand control desk to ON. Lower the left-hand control desk and set the LOCK link to the servicing sync. side, then replace the unit in the rack. Check the external connections, bearing in mind the video, calibration, and strobe connections to the associated PPI console. Then proceed as follows.

52. Set the STROBE control fully clockwise. On the H/R console, turn the IFF GAIN control to minimum (fully counter-clockwise) (*see note*). Two traces should appear on the IFF tube, but they will probably be jittery and incoherent. Adjust the CRT controls, in the order BRIGHTNESS (to operational level) X-STIG, FOCUS, Y-STIG, FOCUS, X-STIG, FOCUS, so that optimum overall focus is obtained at each stage. If after this procedure the astigmatism and focus are still bad, it may be necessary to change the focus tappings.

Note . . .

The IFF GAIN *control on the console is not used in radar Type 13; in this installation, the gain must be pre-set in the aerial cabin.*

53. The focus tappings are found on the right-hand side of the IFF indicating unit, at the rear of a tag-board. Three positions are available, but the leads should always be connected across adjacent terminals so that only one 330K resistor is shunted across the focus potentiometer. If the focus control, at optimum focus, is very near one of its extreme positions, the link at the end of the EHT chain should be changed from one end to the other, i.e. from R86 to R72 or vice versa.

54. When the CRT is correctly focused, set up the divider circuit in the timebase. To do this, ensure that the radar transmitter is operating. Withdraw the timebase unit, and using a double-beam oscilloscope, apply the waveform from V8 anode to Y1, and the waveform at the junction of R47, R48 to Y2. Adjustment of the DIVIDER control will then alter the ratio between the upper and lower waveforms on the CRO. The usual setting is 6 to 1, i.e., with a radar p.r.f. of 500, the IFF p.r.f. is 83⅓.

55. If a suitable oscilloscope is not available, the adjustment can be made as follows. Turn the DIVIDER control fully clockwise. Near the end of the travel, the trace should be steady, and this state will correspond with a division ratio of 6 to 1. Turn the control counter-clockwise, watching the top trace. It will be seen to pass through an unstable stage and then become steady again. The ratio will then be 5 to 1.

56. As a check, continue to turn counter-clockwise until the trace again becomes unstable, then still further until it becomes steady one more. The ratio will then be 4 to 1. Return the control to the 6 to 1 position.

57. Turn the EXPANSION BRIGHTNESS control fully clockwise, and adjust the TRACE SEPARATION and Y-SHIFT controls until the traces lie above and below the range scale. If necessary, turn the tube slightly so that the traces are horizontal.

58. Obtain the correct number of range marks on the radar trace by using the TIMEBASE WIDTH control. The first pip corresponds with 5 miles, so there are 15 marks for 75 miles and 30 for 150 miles. Then align the marks with the range scale, using the X SHIFT and VELOCITY controls as requisite. The two VELOCITY controls, COARSE and FINE, are behind the front panel at the left-hand side of the chassis.

59. The two controls EXPANSION and EXPANSION WIDTH are set up as follows. The EXPANSION BRIGHTNESS is first set to give a definite identification of the strobe position, and the latter is then adjusted until the beginning of the strobe coincides with the position of a calibration pip near the middle of the trace. The EXPANSION WIDTH control is then adjusted so that the width of the brightened portion occupies a range of approximately three miles. This is judged by comparing the unexpanded portion of the trace, up to the next range mark, with the distance between the latter and the following range mark. Then adjust the EXPANSION control so that the expanded portion occupies about one centimetre of trace. Finally, adjust the normal BRIGHTNESS control for suitable operating conditions, and the EXPANSION BRIGHTNESS so that the strobe is a little brighter than the remainder of the trace.

60. The radar input to the IFF display should be adjusted so that there is one to two mm. of noise on the lower (i.e., radar) trace, and the IFF GAIN control on the H/R console (*see Note to para. 52*) should be set in such a position that the same amount of noise appears on the upper (IFF) trace. Then trim the BRIGHTNESS and FOCUS controls, and check the calibration, with all doors on the console closed, and all cover panels on the PPI console in place.

Constructional details

Timebase unit (IFF) Type 135

61. The general construction of the timebase unit can be seen from fig. 10, 11, and 12. Most of the components are mounted on group boards on the underside. In fig. 11, one of the sync. links is in the positive position, and the other is in the negative position. For operation, both links must be in either the positive or the negative positions, depending upon the polarity of the sync. The servicing lock link in the servicing position in fig. 11, must also be placed in the IFF position for operational use.

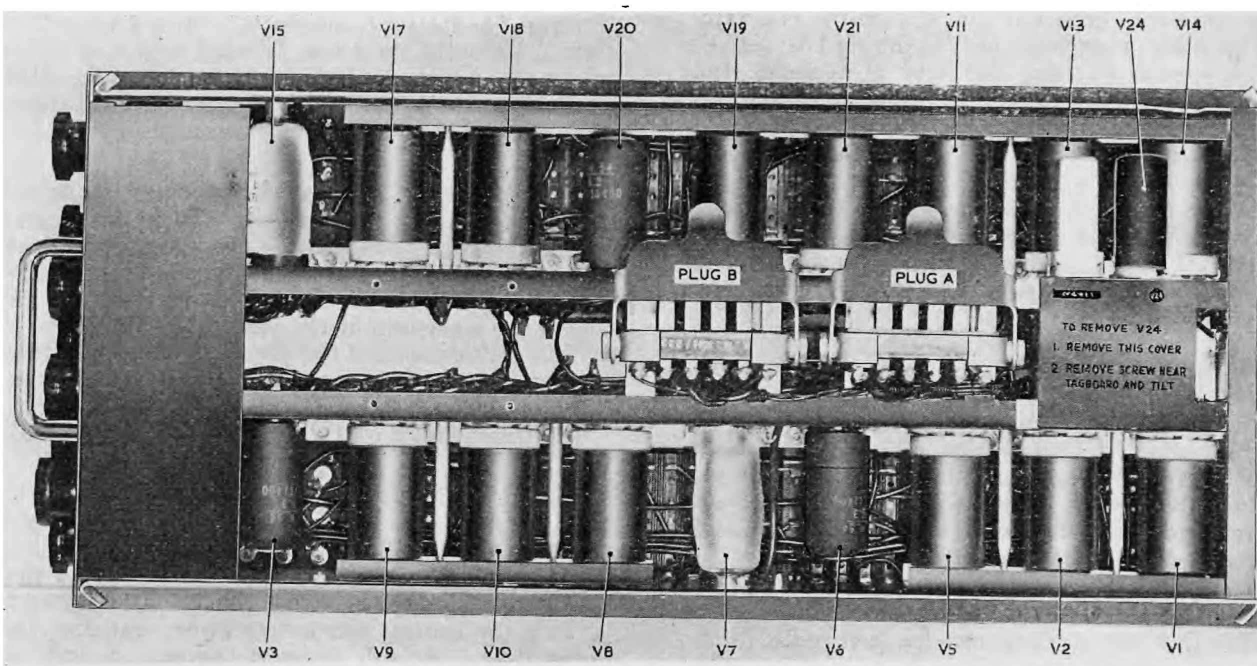
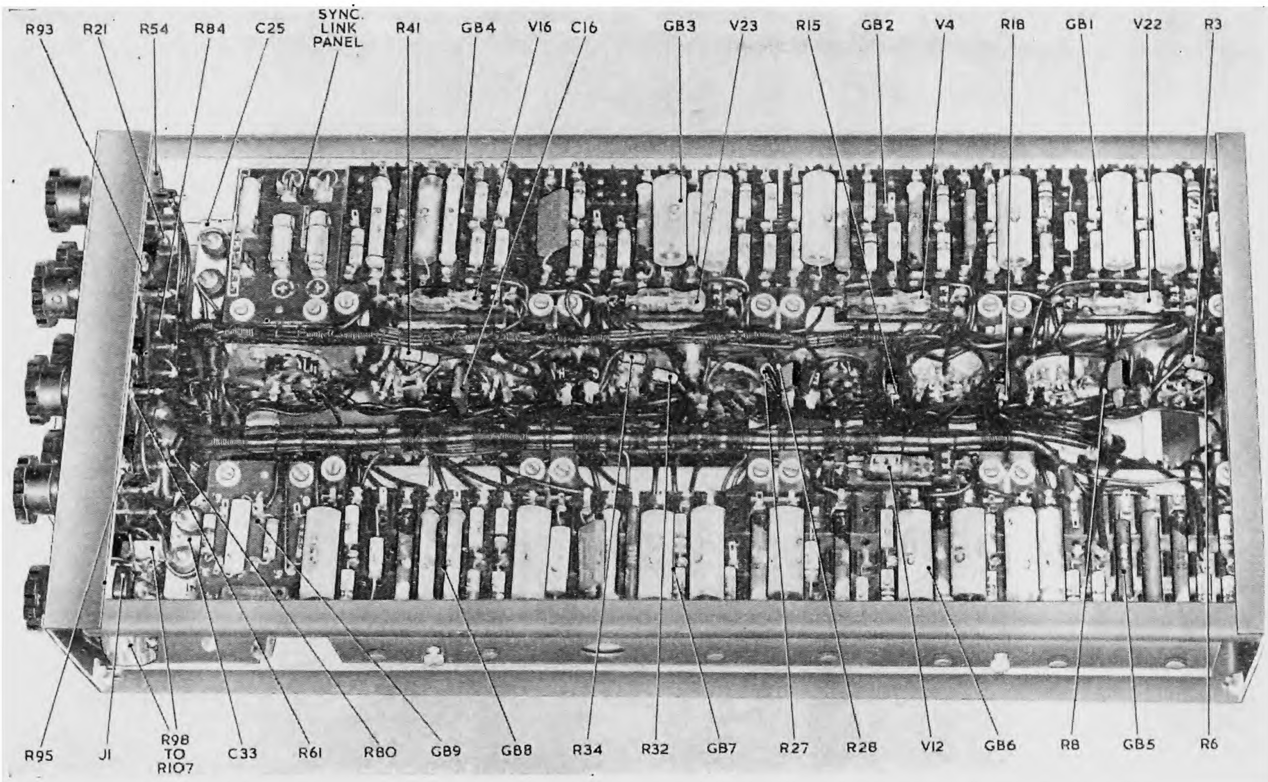


Fig. 10. Timebase unit (IFF) Type 135, top view



COMPONENTS ON GROUP BOARDS

G.B.1:—C11, R20 and R19, C7, R9 and R12, C4, R11 and R10, C2, R1 and R2, C1.
G.B.2:—R53 and R25, C3, R4, R13, C5, R14, R16 and R17, C6, R5 and R7.
G.B.3:—R33 and R35, R30, R29, R31, C8, C10, C9, R22, R26, R23 and R24.
G.B.4:—R46, R39, R40, C15, R52, R47 and R48, R38 and R37, –, C12.
G.B.5:—R64 and R65, R58, R51, R50, R49, R63, R60, C32, C17.
G.B.6:—R57 and R59, C13, R45, C18, R90 and R91, C30, R86, R83, C20.
G.B.7:—R62, R89, C31, R88 and R87, C29, R85, R82, C26, C24.
G.B.8:—C28, R77 and R79, R75 and R76, R66, R71, R74, R67, R69 and R68, C21.
G.B.9:—R70, C22, R72, R73, C23.

Fig. 11. Timebase unit (IFF) Type 135, underside view No. 1

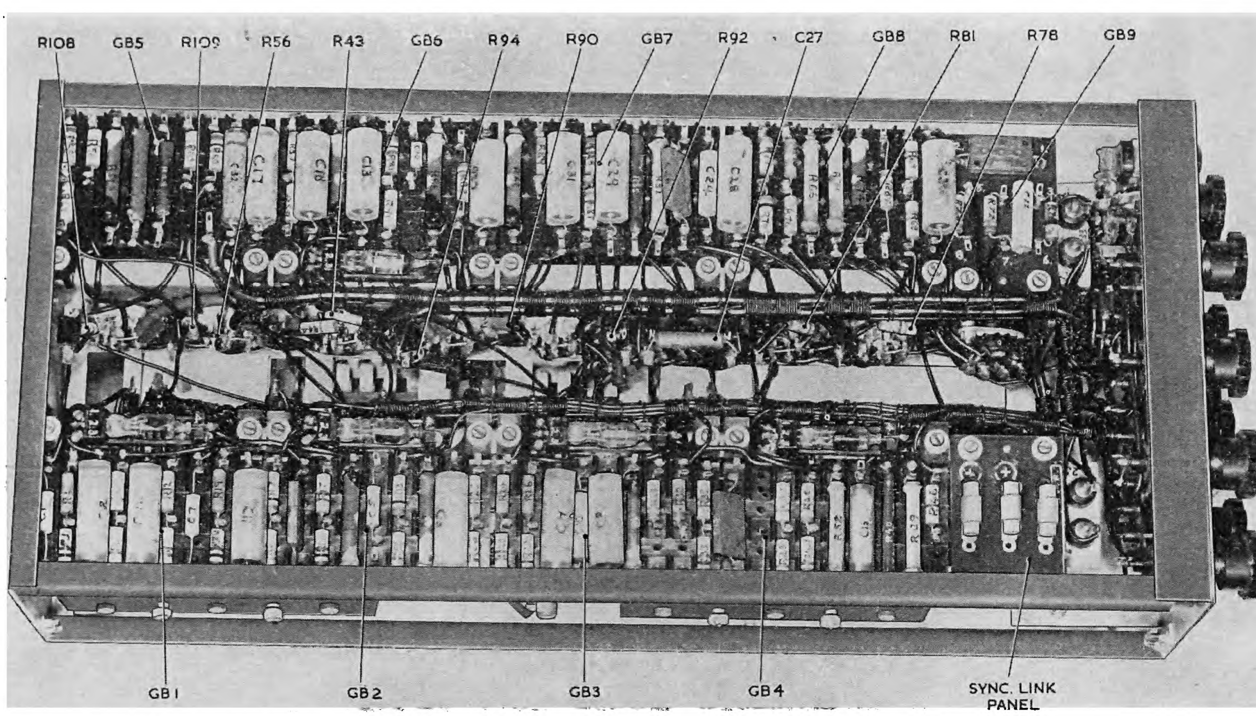


Fig. 12. Timebase unit (IFF) Type 135, underside view No. 2

62. Fig. 13 to 17 show the general layout of the indicating unit. The diodes V2 and V5 are mounted on the upper side of the chassis, beneath the tube screen. Other components are mounted on group boards on the upper side of the chassis (*fig.* 13), and on the underside.

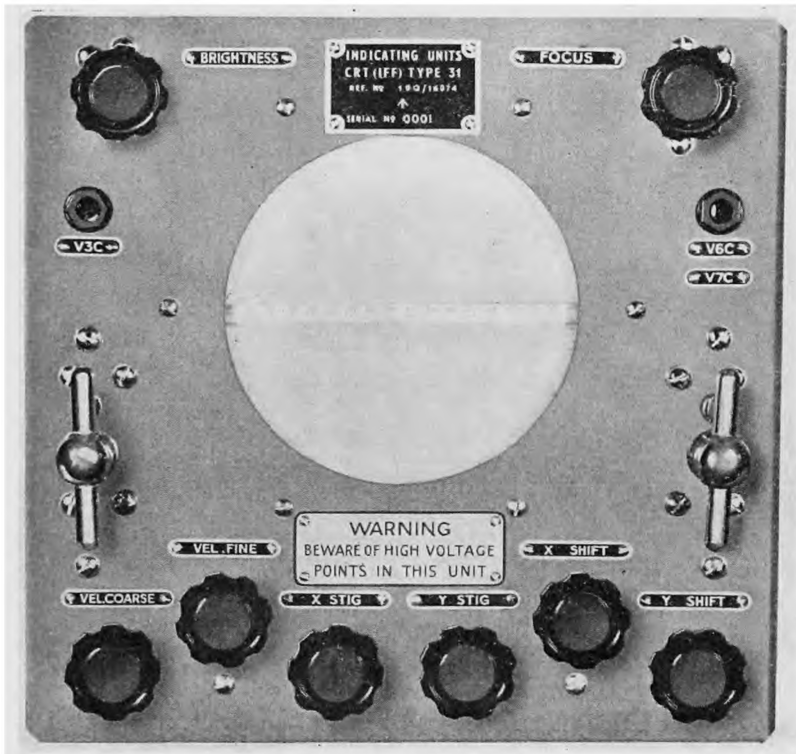
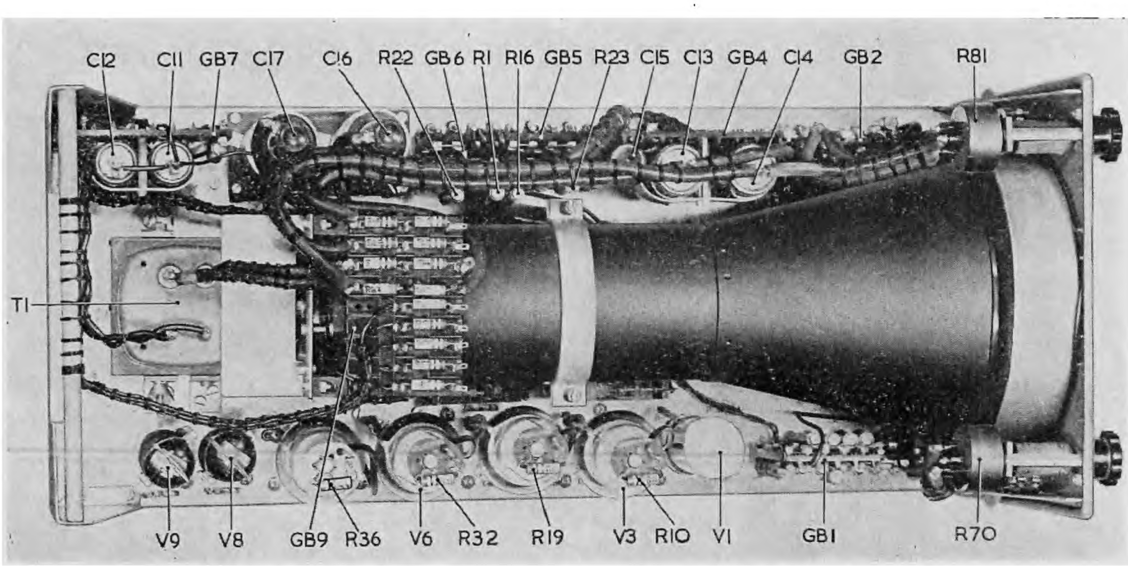


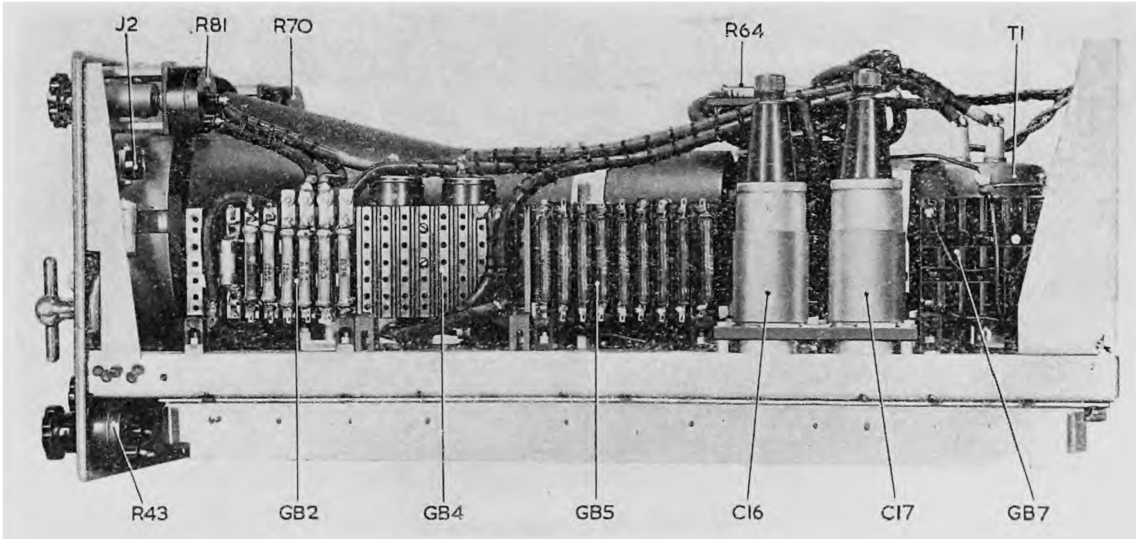
Fig. 13. Indicating unit (IFF) Type 31, front panel



COMPONENTS ON GROUP BOARDS

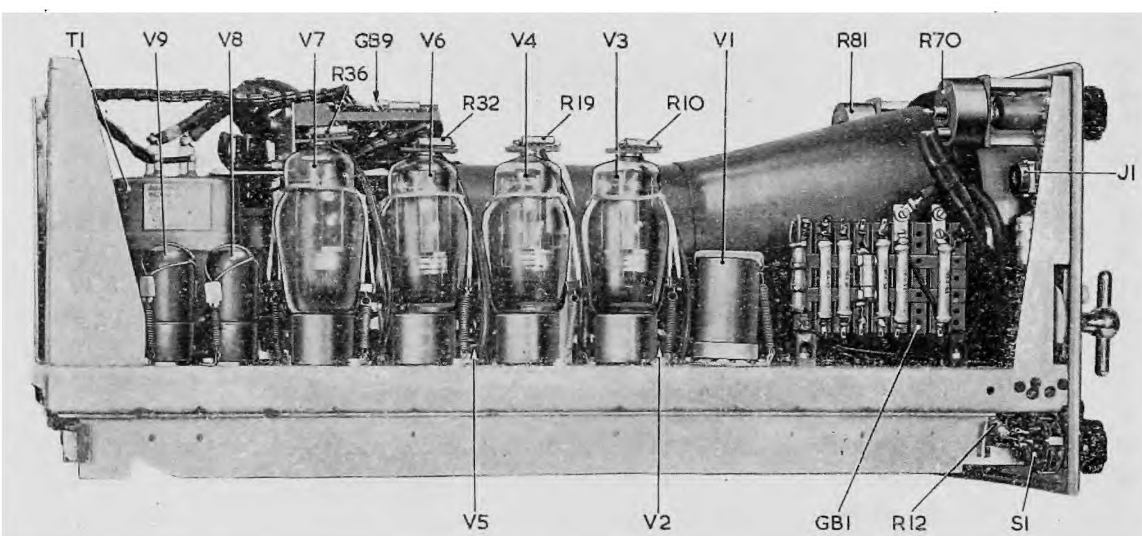
G.B.9:—Left-hand row, R68, R69, R67, R62.
Right-hand row, R64, R65, R66, R63, R61, R57, R58, R59, R60.
G.B.6:—R21, R22, R4, R1, R16, R9, R8, R23, R24.

Fig. 14. Indicating unit (IFF) Type 31, top view



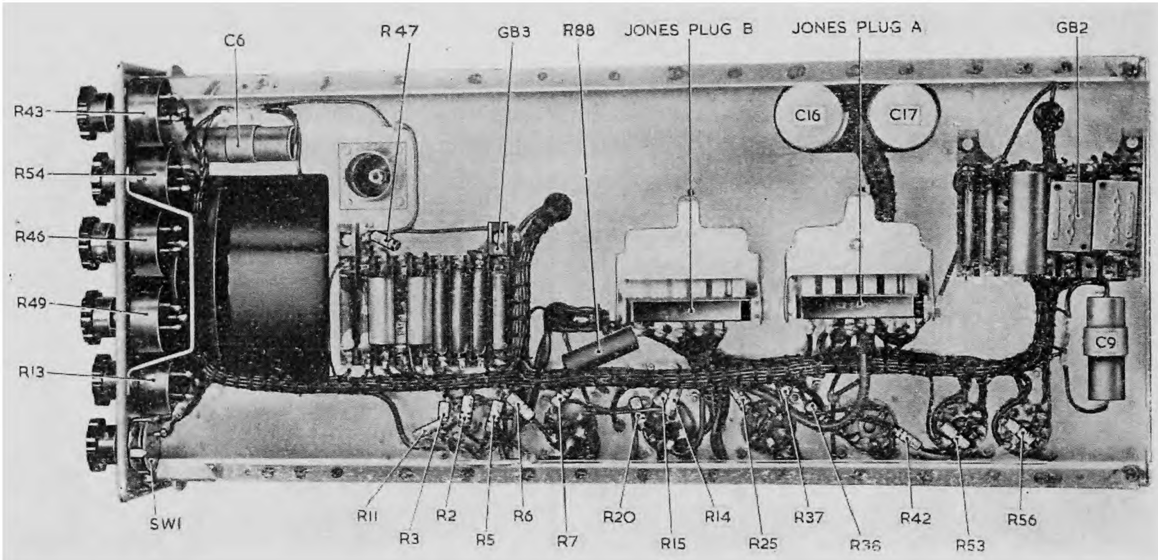
COMPONENTS ON GROUP BOARDS
G.B.2:—R71, R87, LINK, R86, R85, R83, R82, R80, R79. On back, R84.
G.B.4:—C15, C13, C14.
G.B.5:—R26, R27, R28, R29, R30, R31, R35, R34, R33.
G.B.7:—R51, C11, C12, R52, R55 (ALL ON BACK).

Fig. 15. Indicating unit (IFF) Type 31, right side



COMPONENTS ON GROUP BOARD GB.1
R94, R93, R73, LINK, R75, R76, R77, R78. On back, R92, R74, R72.

Fig. 16. Indicating unit (IFF) Type 31, left side



COMPONENTS ON GROUP BOARDS
G.B.3:—R44, R39, R40, R41, –, R45, C1, R50, R48.
G.B.8:—C20 and C2, C3 and C4, C10, –, R18, R17.

Fig. 17. Indicating unit (IFF) Type 31, underside view

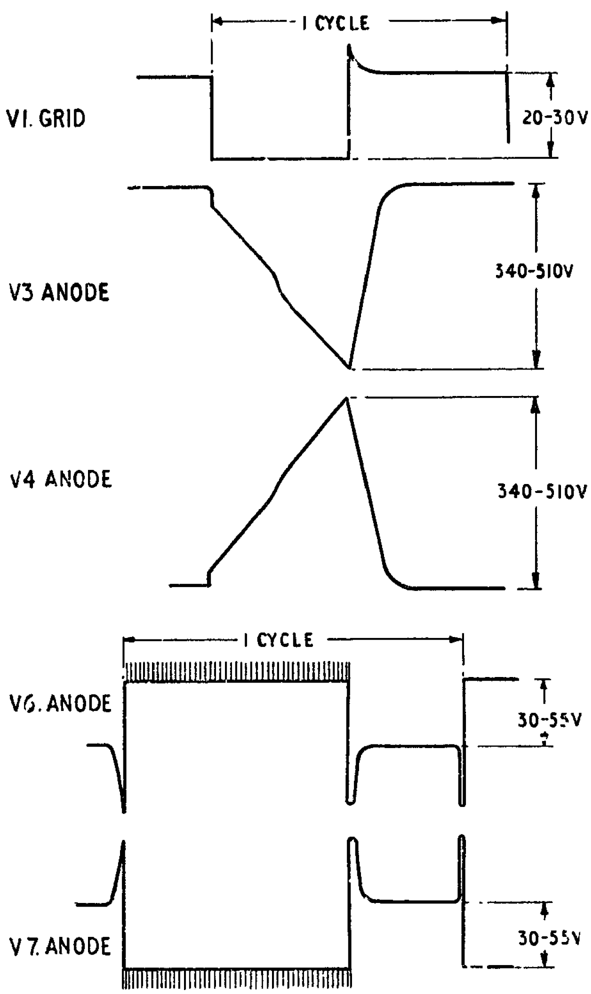
External connections

63. The connections made on the timebase unit (IFF) Type 135 are as follows:—

A1	Expansion brilliance	from PL.5, A11
A2	Video output	to PL.5, A8
A3	Radar video in	from PL.17, P2
A4	Radar lock	from PL.17, P13
A5	Earth on bus bar	
A6	A-Band video in	from PL.17, P10
A7	Expansion	to PL.5, A7
A8	A-Band key	to PL.17, D2
A9	Strobe control	to PL.17, D3
A10	Calibration	from PL.17, P15
A11	Strobe pulse out	to PL.17, P2 and P16
A12	50 volts to cal. relay	from PL.16, B1
B1	HT.8, 300 volts positive HT rail	from PL.2, A6
B2	HT.9, 300 volts negative bias	from PL.12, A9
B3	Interrogator lock	to PL.17, P14
B4	Return lock	from PL.17, P11
B5	Video decoupling	to PL.5, A10 and PL.8, A12
B6	Timebase lock	to PL.5, A6
B7	LT.26, 6·3 volts } V1-V3, V6-V8, V11-V15, V17, V19-V21, V24	from PL.8, V1
B8	LT.26, 6·3 volts	from PL.8, B2
B9	LT.24, 6·3 volts } V4, V5, V9, V10, V18, V22, V23	from PL.8, A7
B10	LT.24, 6·3 volts	from PL.8, A8
B11	LT.25, 6·3 volts } V16	from PL.8, A9
B12	LT.25, 6·3 volts	from PL.8, A10

64. The external connections on the indicating unit (IFF) Type 31 are as follows:—

A1	HT.8, 300 volts	from PL.2, A6
A2	HT.10, 750 volts	from PL.8, A6
A3	HT.11, 800 volts floating positive	from PL.8, A3
A4	HT.11, 800 volts floating negative	from PL.8, A4
A5	Earth on bus bar	
A6	Timebase lock	from PL.7, B6
A7	Expansion	from PL.7, A7
A8	Video input	from PL.7, A2
A10	Video decoupling	from PL.7, B5
A11	Expansion brilliance	from PL.7, A1
B1	LT.26, 6·3 volts } V1-V4	from PL.8, B1
B2	LT.26, 6·3 volts	from PL.8, B2
B3	LT.27, 6·3 volts } V5	from PL.8, B3
B4	LT.27, 6·3 volts	from PL.8, B4
B5	LT.28, 6·3 volts } V6, V7	from PL.8, B5
B6	LT.28, 6·3 volts	from PL.8, B6
B7	LT.29, 6·3 volts } V8	from PL.8, B7
B8	LT.29, 6·3 volts	from PL.8, B8
B9	LT.30, 6·3 volts } V9	from PL.8, B9
B10	LT.30, 6·3 volts	from PL.8, B10



NOTE:- DIFF NOT TO EXCEED 10%. ACTUAL AMP DEPENDS ON CRT

Fig. 19. Oscilloscope waveforms (PL.5)

Waveforms

65. The waveforms illustrating the descriptive matter in para. 9-49 are somewhat idealized, being partly derived from prototype equipment and partly drawn from theoretical considerations. Waveforms obtained from actual equipment, during acceptance tests at the manufacturer's works, are given in fig. 18 and 19. The waveforms in the chain-line box on fig. 18 are those used for setting-up the divider ratio as explained in para. 54. (Fig. 18 is placed at the end of the Chapter, following fig. 2, for ease of reference).

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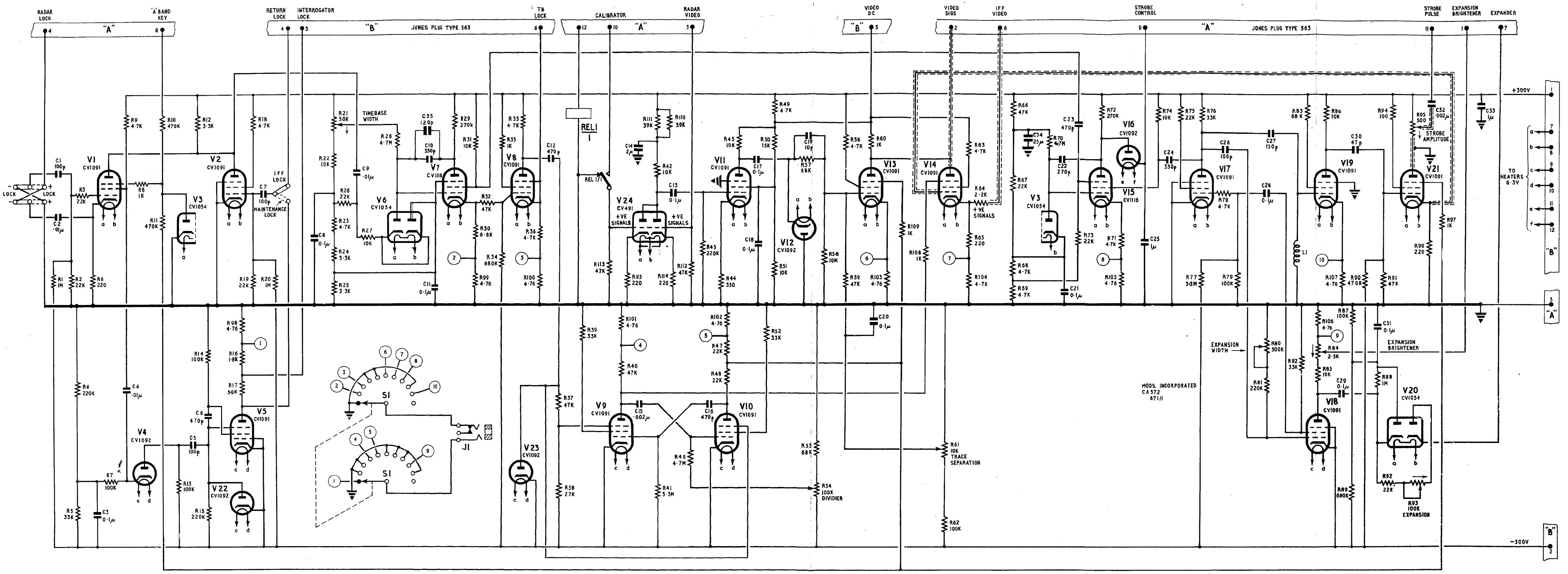
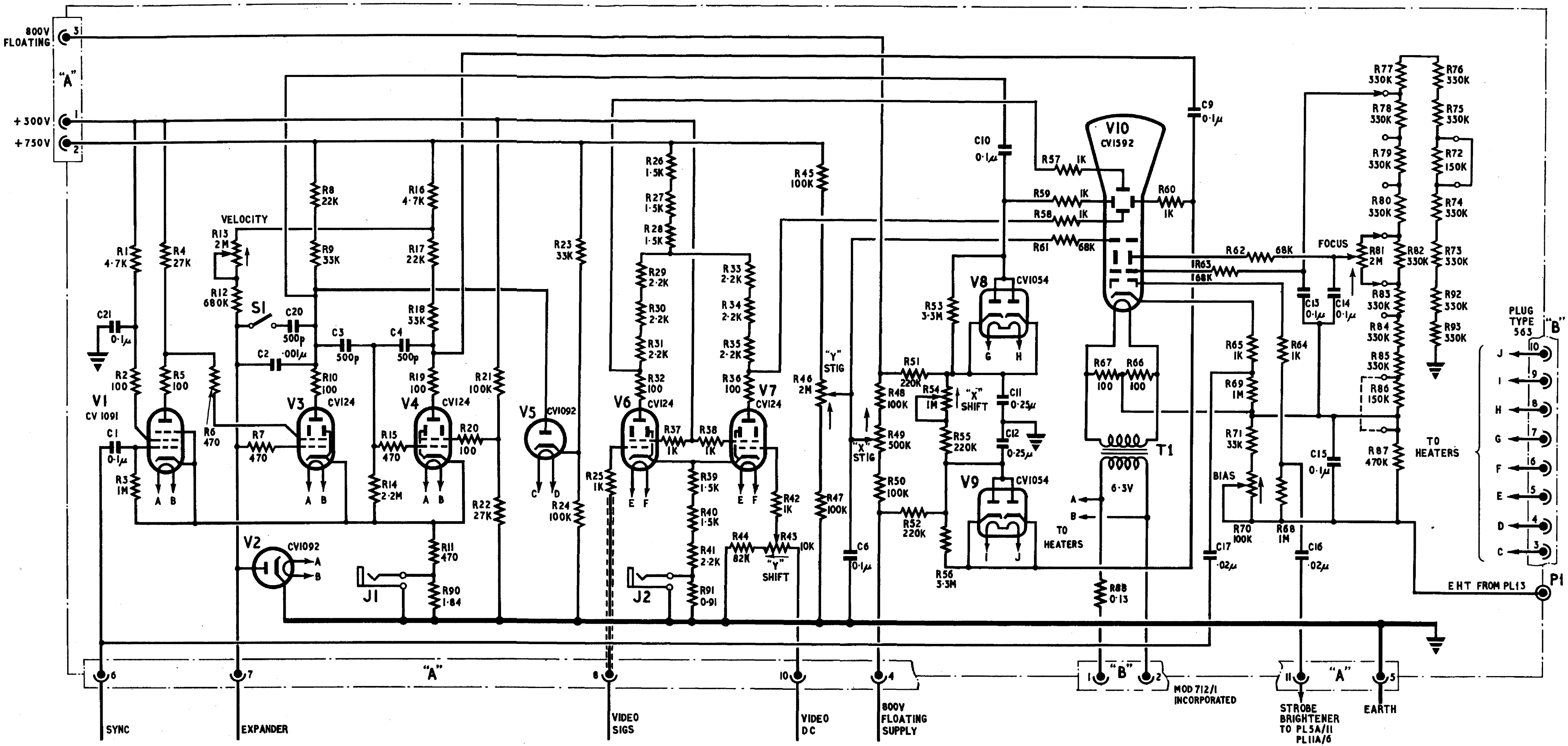


Fig. 1. Timebase unit Type 135 (PL7)- circuit Fig. 1.

D840740 820 8/70 956/3 A(W)LTD 630M

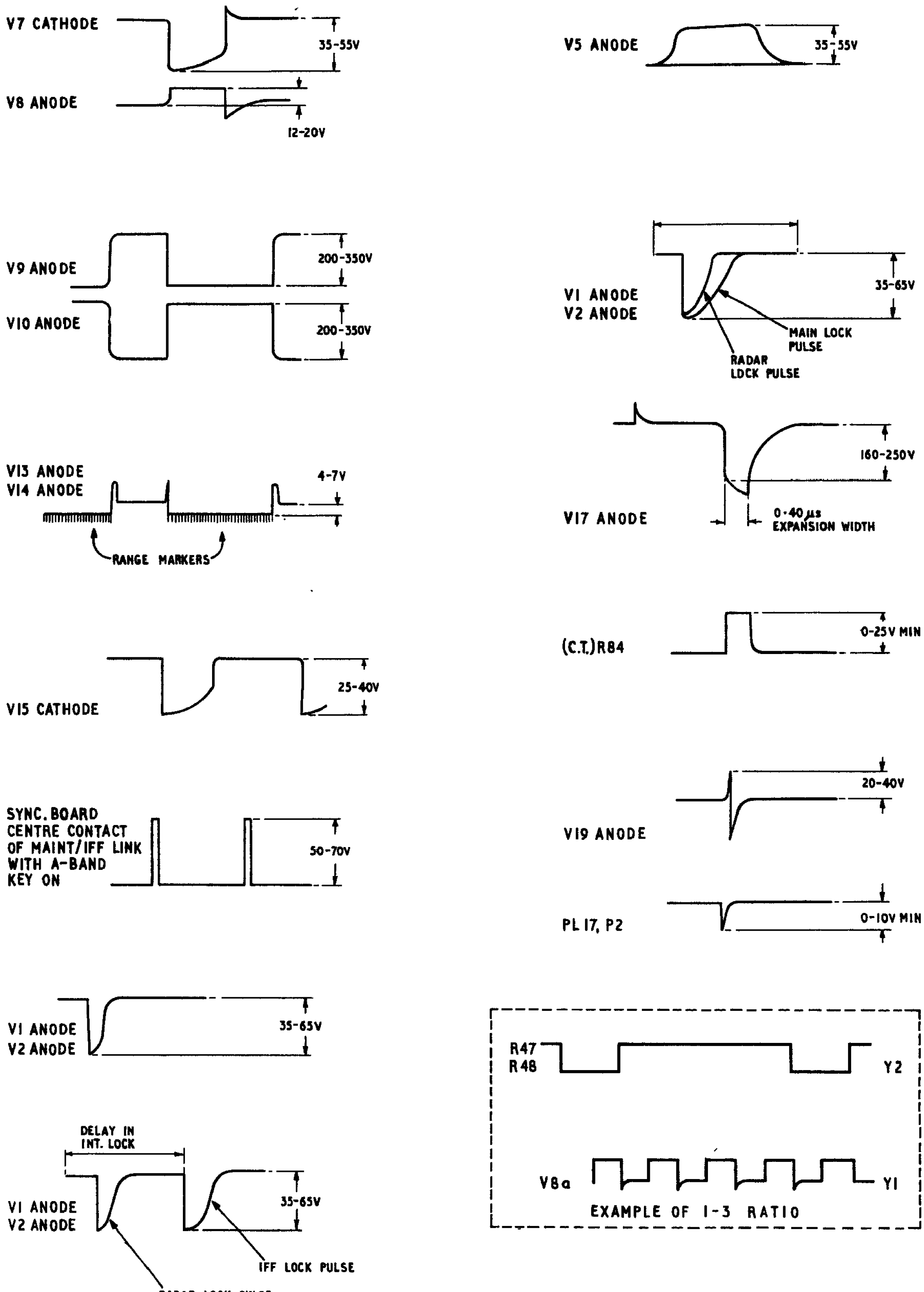


AIR DIAGRAM 6112W/MIN.

ISSUE 2 PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Indicating unit Type 31, circuit (PL5)

Fig. 2.



Oscilloscope waveforms (PL.7) Fig. 18

[Consoles Type 61 & 61A]

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Chapter 7

PANELS TYPE 642, 643, 644, 645

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Panel (sync and blanking) Type 642 (*fig.* 1)

1. The panel (sync and blanking) Type 642 is fitted in the space between PL.6 and PL.11, and is not intended to be regularly withdrawn for routine inspection and testing. It is therefore screwed into position. The panel carries two switches, namely, S1, the SYNC. switch, and S2, the BLANKING switch. Two resistors, acting as artificial loads, are mounted behind the panel.

2. The SYNC switch S1 has four positions. In console Type 61 these are labelled as follows:—

(1) LPO ..... Servicing sync (negative)

(2) T11 ..... Type 11 sync (negative)

(3) T13 ..... Type 13 or Type 14 (positive)

(4) T14 ..... Not used.

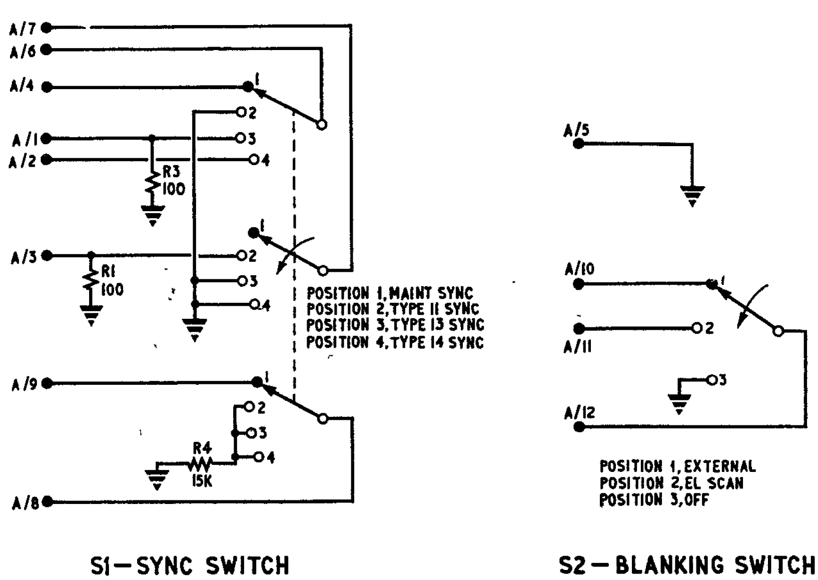


Fig. 1. Panel (sync and blanking) Type 642, circuit

◀ To allow a vertical range strobe to be displayed on indicating unit (CRT) Type 32, it has been found necessary to remove the negative pulse facility. Connections are now made so that the positive edge of the l.p.o. pulse is used. Modification CA799/1 refers. ▶ Radar Type 15, Mk. 5, generates a positive locking pulse, and the switch should be placed in the T13 position when the display is to be synchronized from this installation. Position 4, being unterminated, is not now suitable for its original function (Type 14 sync).

3. At certain static installations, where the console Type 61A is used as an "A"-scope, position 2 is labelled −VE SYNC, position 3 +VE SYNC, and position 4 A-SCOPE SYNC.

4. The servicing sync position provides a means of running the display system when the transmitter is not in use. The sync pulse for the timebase unit (range) Type 136 is then obtained from the local pulse generator in the power unit Type 871 (PL.2). This generator is switched on by completing the h.t. circuit to the oscillator valve; the h.t. supply is derived from HT.8 (termination A6) in PL.2. This enters the sync and blanking panel at A8, passes through the switch S1, leaves the panel at A9, and returns to the power unit, PL.2, at termination A3. This termination supplies the oscillator h.t. rail. On the other three positions of the switch, a dummy load resistor, R4, is connected to the h.t. source to prevent any voltage rise. Two of the three sync inputs are terminated by 100-ohm resistors to avoid pulse shape distortion.

5. The BLANKING switch has three positions, namely: —

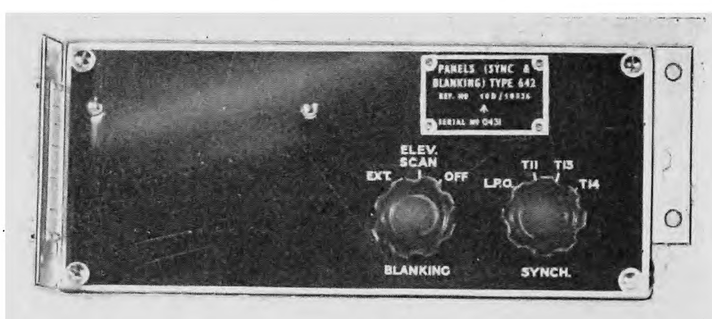
EXT.	External blanking
ELEV. SCAN.	Blanking for radar Type 13 display
OFF.	

The wiper of this switch is connected to termination A12; the latter is connected to termination A9 in the timebase unit (range) Type 136, and thence to the suppressor-grid of V5. In the position EXT. the c.r.t. trace can be blanked off by a black-out pulse generated in some source external to the console; this facility has however no application at present. The ELEV. SCAN position is used to blank off the non-linear portion of the elevation scan display from radar Type 13, as described in Chap. 4 of this Section. In the OFF position, the suppressor-grid of V5 in the timebase unit Type 136 is earthed, so that the brightening circuits function normally.

External connections

6. The following external connections are made to this panel: —

A1 Positive sync T13 or T14	from PL.17, P3
A2 Unterminated. "A"-scope sync in console Type 61A	from PL.17, P4



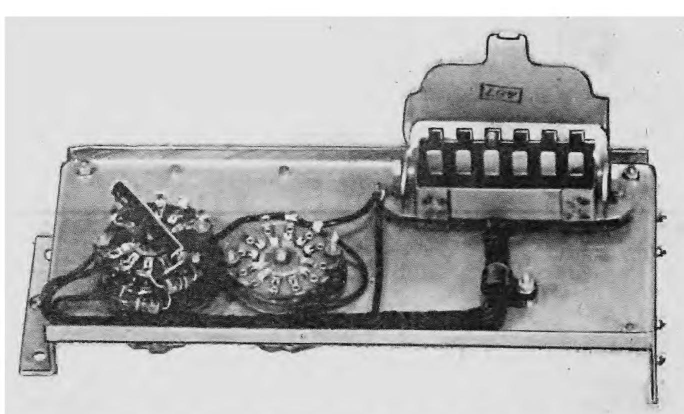


Fig. 2. Panel (sync and blanking) Type 642

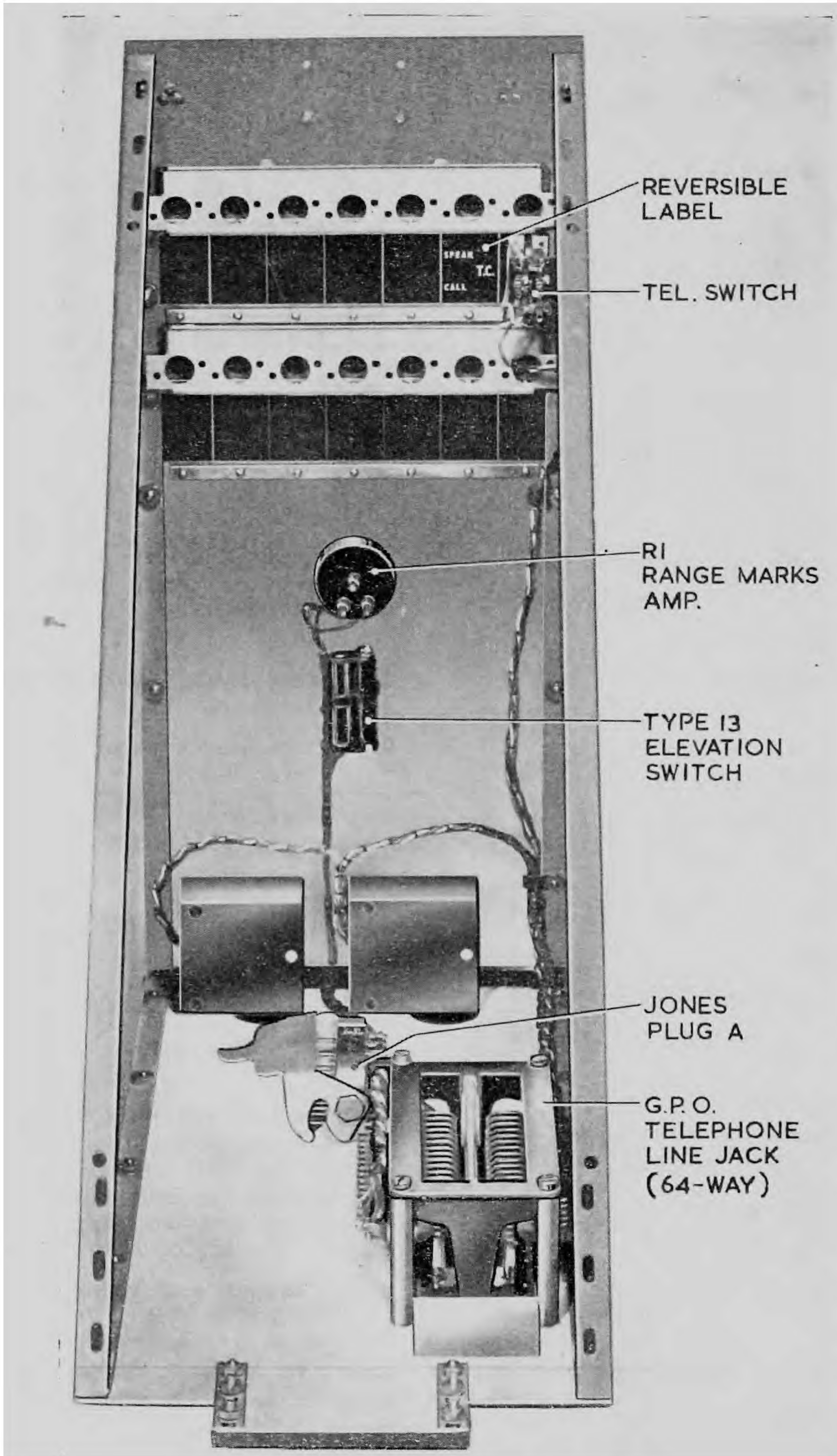


Fig. 3. Panel (control) Type 643, rear view

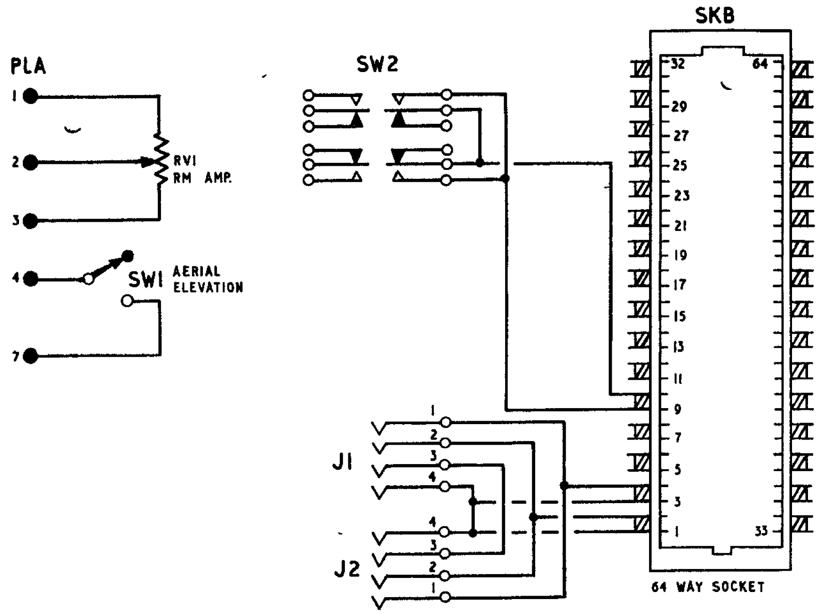


Fig. 4. Panel (control) Type 643, circuit

A3	Negative sync. T11 ..	from	PL.17, P5
A4	Servicing sync.	from	PL.2, A12
A5	Earth on bus bar		
A6	Positive sync. to timebase unit (range)	to	PL.11, A4
A7	Negative sync. to time-base unit (range) ..	to	PL.11, A6
A8	HT.8, 300 volts supply line to switch S1 ..	from	PL.2, A6
A9	HT.8, 300 volts return from switch S1 ..	to	PL.2, A3
A10	External blanking ..	from	PL.17, A4
A11	Elevation scan blanking	from	PL.6, A4
A12	Blanking line	to	PL.11, A9

Panel (control) Type 643 (*fig. 3 and 4*)

7. The panel (control) Type 643 (the left-hand control desk) carries the range marks amplitude potentiometer (knob marked RANGE MARKS AMP.) and an ON-OFF switch for starting and stopping the tilting motor for the Type 13 aerial mounting. The first P.O. key switch is wired to the GPO socket in order to provide telephone communication facilities. This key is of the non-locking type and is provided with a reversible label, one side being marked SPEAK F.T.—SPEAK F.T.2 and the other SPEAK T.C.—CALL T.C. Two telephone jacks, wired in parallel, are fitted to the panel and are wired to the GPO socket as shown in fig. 3. A GPO telephone terminal block is fitted inside the panel, and also one Jones plug.

8. Provision is however made for future developments; any number up to thirteen additional switches can be accommodated on the upper part of the panel, and there is room for three more potentiometers. The following external connections are made on the Jones plug:—

A1	Range marks potentiometer (end)	from PL.15, D1
A2	Range marks potentiometer (tap)	from PL.15, D2
A3	Range marks potentiometer (end) earthy ..	from PL.15, D3
A4	Elevation control switch	from PL.17, C6
A5	Earth on bus bar	
A6	Not used	
A7	Elevation control switch	from PL.17, C9
A8 to A12	Not used.	

Panel (control) Type 644 (*fig. 5, 6 and 7*)

9. The panel (control) Type 644 is the right-hand control desk. The panel carries two rows of GPO key switches, the main ON-OFF switch S8 for the console regulated mains supply, and three potentiometers. Dealing first with the latter, they are:—

GAIN — This provides a control of about 40 dB in the amplification of the IF amplifier

NBW TUNE — This controls the mid-point frequency of the pass-band of the narrow bandwidth IF amplifier

IFF GAIN — This potentiometer is used as a remote gain control for the IFF responsor in the aerial cabin, except when Type 13 A-band IFF is being displayed. In the Type 13 installation the IFF gain is pre-set in the aerial cabin.

10. The following key switches are fitted on the top row, reading from left to right:—

S1, NBW IN This switch operates two relays in PL.4A, and so throws into circuit the narrow bandwidth unit. An opal lamp is lit when the switch is "on"

S2, STC IN This switch operates a relay in PL.10, and so switches into circuit the short time-constant valve between the cathode-follower V6 in PL.4B and the primary limiter in PL.10. An opal lamp is lit when this switch is "on"

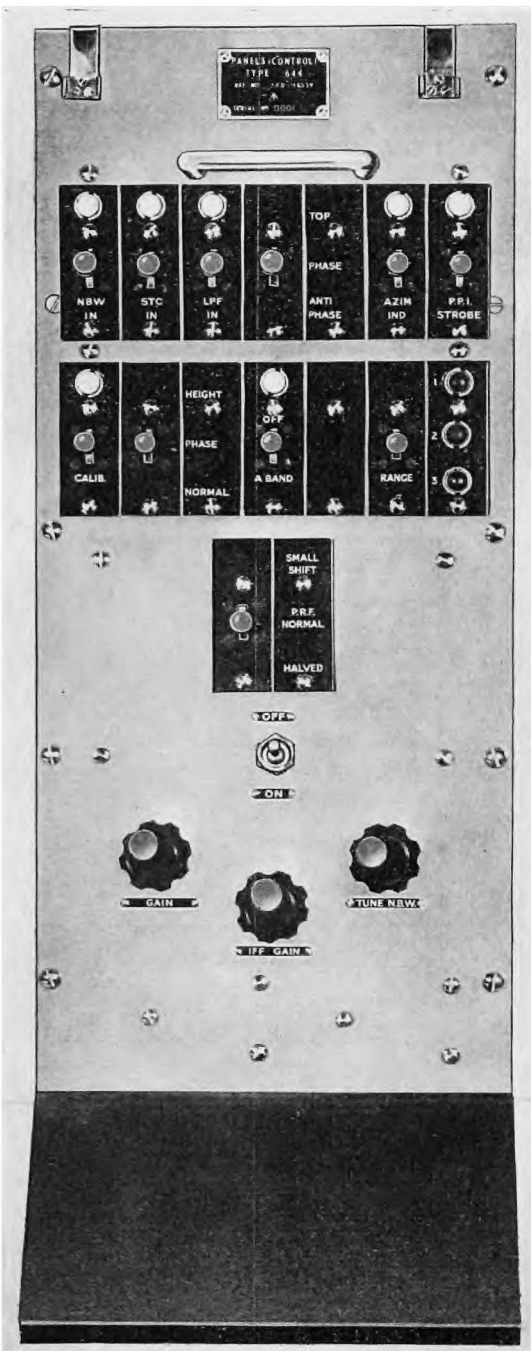


Fig. 5. Panel (control) Type 644, front view

S3, LPF IN This switch operates a relay in PL.10, by which a low-pass filter (cut-off frequency 500 kc/s) is inserted into the video chain between V6 on PL.4B and V3 on PL.10. An opal lamp is lit when the switch is "on"

S13, TOP PHASE ANTI-PHASE This switch is used for gap-filling in mobile GCI installations only. Its use is dealt with in para. 13.

S7, AZIM. IND. or ELEV. STROBE This switch may be used for two different purposes.

(*a*) In certain installations where the aerial is normally in continuous rotation, to switch on an azimuth strobe, by which the trace is "flashed" each time the aerial passes through a specified azimuth. This provides a check on the correct rotation of the aerial

(*b*) Where radar Type 13 is part of the installation, to switch on an elevation strobe. In this application, a multiple contact switch is fitted on the tilting gear of the Type 13 aerial. This switch is connected in series with S7 on the control desk, and a relay in the range time-base unit (PL.11). The CRT trace is then "flashed" every five degrees of tilt, so giving a check on the correct performance of the tilting mechanism. An opal lamp is lit when this switch is "on"

S12, PPI STROBE When this switch is closed, the amplitude of the brightening pulse on an associated PPI console is increased, and the PPI trace is "flashed". An opal lamp is lit when the switch is "on".

11. The switches on the bottom row are:—

S5, CALIB When this switch is "off," calibration marks are presented on the main radar display only, the amplitude being controlled by the RANGE MARKS AMP. potentiometer on PL.14. When the switch is "on," the range marks are shown at full amplitude on both the main radar and the IFF displays. At the same time, the radar IF amplifier is muted by interrupting the 140-volt stabilized supply to the screening-grids of the first IF stages

S10, HEIGHT PHASE NORMAL This switch is used for height-finding purposes in mobile GCI installations only. Its function is described in para. 15-21.

S9, A BAND This switch is used to switch on the A BAND interrogator in the aerial cabin. In the "on" position, it applies an earth to the suppressor-grid of V1 in the IFF timebase unit (PL.7). In the "off" position, it applies 280V positive to the suppressor-grid. The switch S9 is connected to D5 on the console input panel (PL.17) and also to the 280-volt supply from PL.3, A8. The suppressor-grid of V1 on PL.7 is taken out via termination A8, to D2 on the console input panel. D2 must therefore be directly jumpered to D5, to complete the circuit from PL.7 to the switch S9 on the control desk.

S6, RANGE This switch has three positions, numbered 1, 2 and 3. The normal position of the switch is range 2, in which an amber lamp is lit. A red lamp is lit on range 1, and a green lamp on range 3. Note that these colours correspond with those in which the three ranges on the CRT scale are engraved. The switch operates the relays REL.2 and

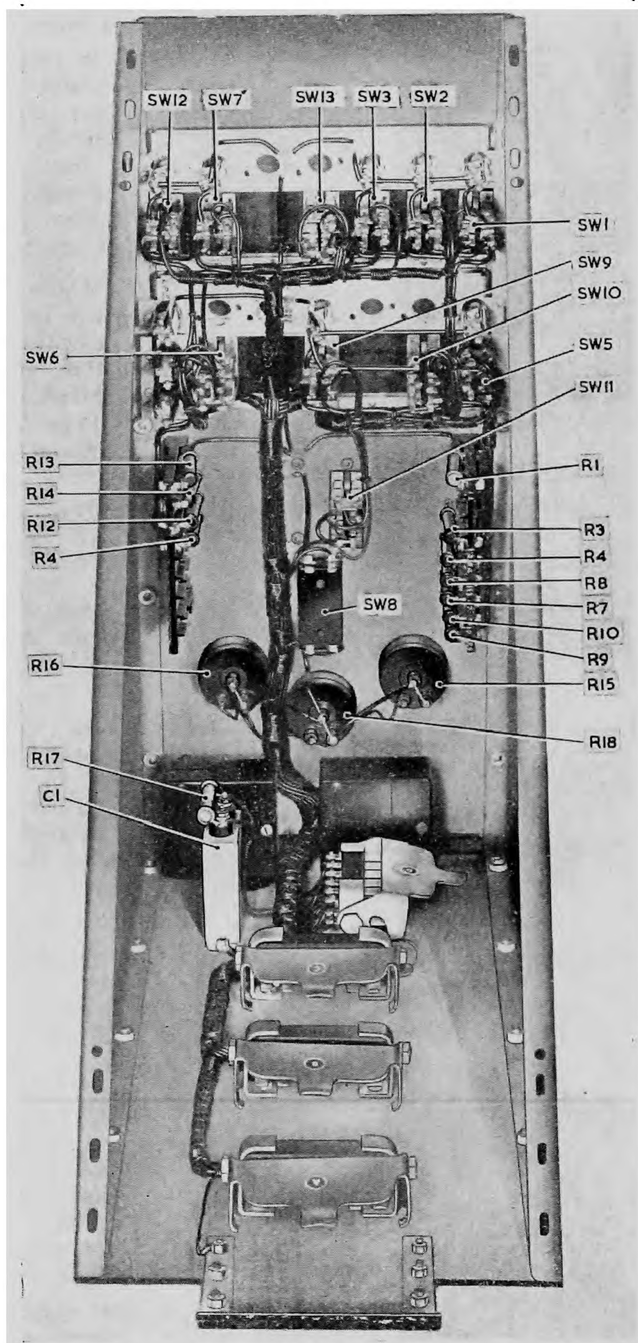


Fig. 7. Panel (control) Type 644, rear view

REL.3 in the range timebase unit (PL.11). On range 1, neither relay is energized, and a dummy load (R13, R14) in the control panel is thrown on the 50-volt DC supply. On ranges 2 and 3 respectively, the relays REL.2 and REL.3 are energized. The relay contacts alter the constants of the timing circuits in PL.11; relay REL.3 also changes the constants of the calibrator circuit so that 10 (nautical) mile range marks are substituted for 5 (nautical) mile marks

S11, PRF — This switch is mounted singly, below the bottom row, and has three positions, namely—

- HALVED — The transmitter is switched, by a relay outside the console, so that the p.r.f. is one-half the normal, i.e., is reduced to 250 c/s
- NORMAL — The transmitter runs at the normal p.r.f., i.e., 500 c/s
- SMALL SHIFT — A small change of p.r.f. is introduced by a relay fitted in the multivibrator unit on the information generator rack. This application is described in para. 22-25.

GCI facilities

12. From the foregoing it will be seen that switches S12, S10 and the SMALL SHIFT facility on S11, are provided for use in installations where mobile GCI (radar Type 15, Mk. 5) is included. This installation is described in a separate publication. The general principles of these facilities are however described here, to avoid unnecessary cross-reference.

Gap filling

13. In radar Type 15 (all marks) the radar aerial array actually consists of two separate aerials, arranged one above the other with a specified separation, and at a specified height above ground. If the two aerials are fed in phase, the vertical polar diagram of the combined aerial has several lobes, the maxima being at predetermined angles with a theoretical null between each pair of adjacent maxima. The spacing and height of the two aerials are so chosen that when the upper and lower aerials are fed in antiphase, the positions of the low angle maxima and minima are interchanged, and so the gaps in the "in phase" vertical polar diagram can be filled by reversing the phase of the feed to one of the aerials. In practice, therefore, the aerials are normally fed in phase (S13 in PHASE position), giving cover from 0 deg. to about 10 deg. in elevation. In the ANTIPHASE position, a 180 deg. reversal of phase is introduced into the feed to the lower aerial, giving cover from about 8 deg. to 16 deg. In the TOP position, the upper aerial only is energized, an impedance transformer being introduced into the feeder so that the transmitter loading and matching is not changed. This facility is not used for gap-filling, but gives extra low cover, suitable for coast watching from a high cliff site.

14. The aerial feeder switching is performed by a number of VHF changeover switches, electrically operated through a relay system. The relays are energized in certain combinations, according to the position of the switch S12.

Height-finding

15. The switch S10 is fitted to control the height-finding facility in radar Type 15, Mk. 5. The method of height-finding consists, briefly, of comparing the amplitudes of responses received on the upper and lower aerials respectively. When this facility is not required, S10 is maintained in the normal position, and signals are then received from both aerials simultaneously. The comparison is made by throwing the switch to HEIGHT, thus separating the feeds from the upper and lower aerials to the head amplifier, at the repetition rate of the transmitter p.r.f. Two thermionic (diode) switches are used for this purpose. The amplitudes of the responses from the two aerials can then be compared visually.

16. A complete account of the switching action cannot be given in this document; the principles are however described in A.P.2912F, Vol. 1 (2nd Ed.), Chap. 2, and details of the apparatus used in radar Type 15, Mk. 5, will be found in the appropriate publication. In brief, however, it may be said that one diode switch is associated with each aerial, and the switch can be made conductive or non-conductive, according to whether a positive-going or negative-going potential is applied to the cathode. To render the diodes conductive or non-conductive at the repetition rate of the transmitter, a square wave is applied to the cathode of each, in antiphase. The displayed responses from alternate transmitter pulses will then be those received from the upper and lower aerials, respectively.

17. So that the alternate pulses can be distinguished visually, a "split" waveform is introduced into the range timebase unit; this causes alternate traces to be displaced horizontally, and the responses from the two aerials are displayed side by side instead of being superimposed. This switching system is effective when S10 is in the HEIGHT position.

18. The PHASE position of S10 is used to eliminate certain ambiguities which arise in height-finding. In this position, the amplitude of the signal on the lower aerial alone is compared with that of the signal received on both aerials. The manner in which this information is used is outside the scope of this publication.

19. The switching waveform and split waveform are generated in a unit known as multivibrator unit Type 52, which is mounted on the information generator rack. The square switching waves are received at terminations E7 and E8 of PL.17 and are fed into the control desk at D3 and D5, entering the switch S10 on contacts 4 and 1 respectively. The split waveform is received at PL.17, A6, and is fed into the control desk at A9, reaching S10 on contact 24.

20. When the switch S10 is in the NORMAL position, a 280-volt supply (entering the control desk at B8) is applied to the upper aerial diode switch via contacts 5 and 6 on S10, and also to the lower aerial diode switch via contacts 3 and 2 on S10. These voltages (applied to the valve cathodes) bias off both diode switches, which are then non-effective, and signals from both upper and lower aerials are transmitted along a common feeder to the head amplifier. Also, the split waveform is cut off at the "open" contacts 24 and 25. When the switch S10 is in the HEIGHT position, however, contacts 24 and 25 are closed, and the split waveform is fed into the timebase unit, causing the trace displacement already referred to, on alternate cycles of the radar p.r.f. One of the height switching waves, received at D3, passes through the closed contacts 4 and 5 on S10, and is fed out, via D2 on the control desk and E4 on PL.17, to the upper aerial diode switch, while the other switching wave, received at D5, passes through contacts 1 and 2 on S10 and is fed out to the lower aerial diode switch via D4 on the control desk and E6 on PL.17. The 280-volt DC bias is switched off at contacts 3 and 2.

21. When the switch S10 is at PHASE the split waveform reaches the timebase unit (range) as in the HEIGHT position. The switching wave from D3 is also applied to the upper aerial diode switch as explained above, but the switching wave from D5 is interrupted at contacts 1 and 2 and does not reach the lower aerial diode switch, the latter being biased off by the 280-volt DC supply reaching D4 via contacts 2 and 3. Thus signals from both aerials are received upon the normal trace, and from the lower aerial only upon the trace displaced by the split waveform.

Small shift p.r.f.

22. The locking pulse for the radar Type 15, Mk. 5 transmitter is generated in a free-running multivibrator which determines the p.r.f. of the transmitter; in effect, the change of p.r.f. is effected by varying the bias on the control-grids of the valves. This bias is derived from a potentiometer chain across the HT supply; with normal bias, the p.r.f. is 500 c/s. By putting the switch S11 to HALVED, the bias is changed and the p.r.f. is reduced to 250 c/s.

23. When working at the normal p.r.f., a small change can be made in the p.r.f. by putting S11 to the SMALL SHIFT position. This puts an earth on the circuit of a relay REL.1 in the multivibrator unit, which is then energized, short-circuiting a portion of the resistance in the potentiometer chain.

24. The object of the small p.r.f. shift is to discriminate against what are sometimes called "spurious" responses. For under certain propagation conditions, responses may be received from a target beyond the range setting of the timebase, by the reflection of a transmitter pulse two or three cycles earlier than that corresponding to the trace upon which they are displayed. They can be distinguished by the fact that the apparent range changes with a change of p.r.f. whereas the range of normal responses is invariant with such a change.

25. Such responses are therefore detected by noting the apparent range of the response, with the p.r.f. key at NORMAL, and then throwing the switch to SMALL SHIFT while watching the "blip." Any "blip" which jumps between two ranges as the switch is rocked between NORMAL and SMALL SHIFT should be disregarded.

External connections

26. The following connections are made to the panel Type 644 (PL.16):—

A1	NBW TUNE control ..	to	PL.4,	A6
A2	NBW relay	to	PL.4,	A11
A3	IF GAIN control	to	PL.4,	A4
A4	STB.3, 140 volts for IF muting	to	PL.4,	A8
A5	Earth on bus bar			
A6	50 volts for STC relay ..	to	PL.10,	A8
A7	50 volts for LPF relay ..	to	PL.10,	A9
A8	IFF GAIN control ..	to	PL.17,	D4
A9	Split line	to	PL.17,	A6
A10	Split in, to timebase unit	to	PL.11,	A12
A11	50 volts for REL.2(range)	to	PL.11,	B7
A12	STB.1, 280 volts for calibrator valves ..	to	PL.11,	B9
B1	50 volts for calibrator relays	to	PL.15, PL.7,	B12 A12
B2	50 volts for azimuth indicator relay ..	to	PL.11,	B10
B3	Azimuth indicator or E/S marker	to	PL.17,	A10
B4	50 volts supply	from	PL.2,	A9
B5	Mains in	from	PL.17,	fuse 1
B6	Mains in	from	PL.17,	fuse 2
B7	Mains out to all power units (PL.1, 2, 3, 8, 12 and 13)			A1
B8	STB.1, 280 volts ..	from	PL.3,	A8
B9	Mains out to all power units (PL. 1, 2, 3, 8, 12 and 13)			A2
B10	STB.3, 140 volts ..	from	PL.3,	A10
B11	25-volt DC supply to indicating lamps ..	from	PL.2,	A4
B12	280 volts for A-band key	to	PL.17,	D5
C1	P.R.F. key, 50 volts ..	to	PL.11,	B8
C2	Half-p.r.f. relay ..	to	PL.17,	C2
C3	Small shift relay ..	to	PL.17,	C3

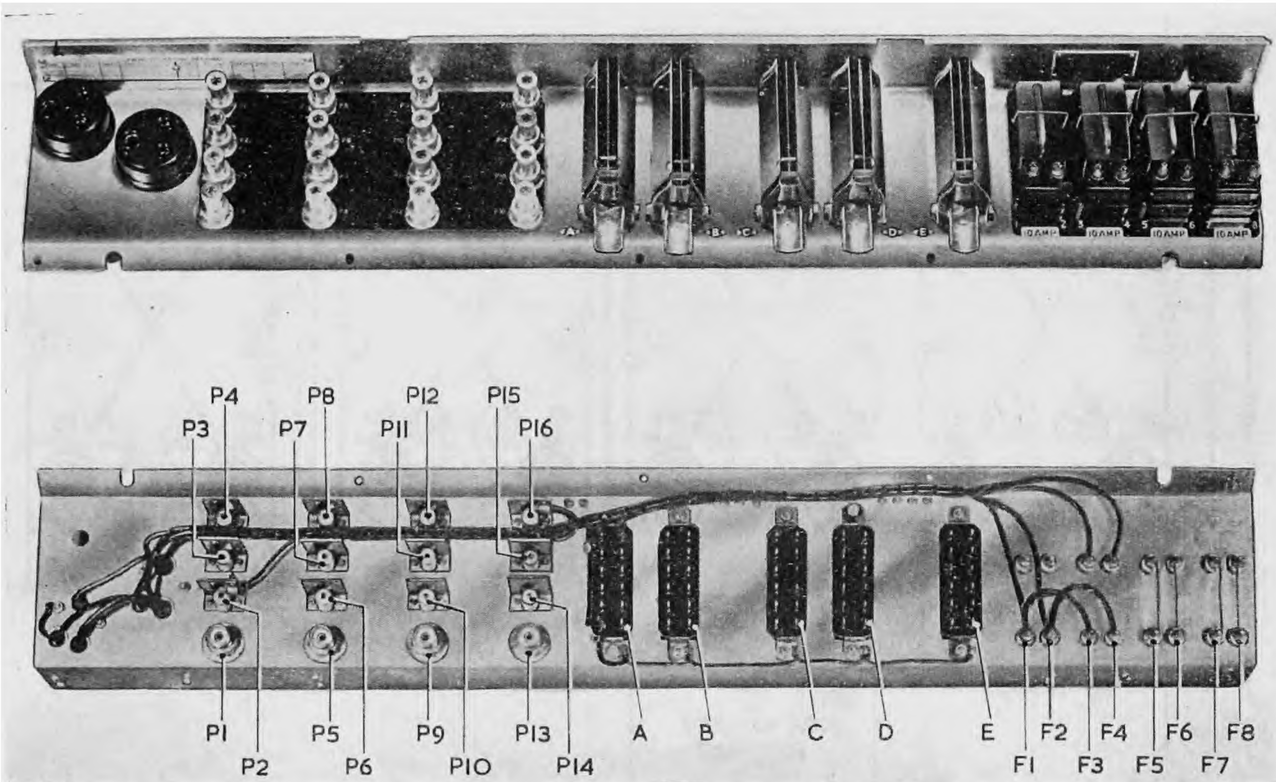


Fig. 8. Panel (input) Type 645

C5	Earth	to	PL.17,	C5
D2	Upper aerial diode switch	to	PL.17,	E4
D3	Height switching wave-form (1) from MV.52 ..	to	PL.17,	E7
D4	Lower aerial diode switch	to	PL.17,	E6
D5	Height switching wave-form (2) from MV.52 ..	to	PL.17,	E8
D6	P.r.f. key earth	to	PL.17,	C1
D7	PPI strobe key	to	PL.17,	E9
D8	PPI strobe key earth ..	to	PL.17,	E10
D9	Gap filling	to	PL.17,	D6
D10	Gap filling	to	PL.17,	D7
D11	Gap filling	to	PL.17,	D8
D12	Gap filling	to	PL.17,	D9

Panel (input) Type 645 (*fig. 8 and 9*)

27. The panel (input) Type 645 is fitted across the whole width of the console, just above the base, and is screwed into position since its removal is rarely necessary. It carries five Jones plugs and sixteen coaxial plugs, by which the console is connected to the remainder of the installation.

28. The regulated mains supply (230 volts, 50 c/s, single phase) enters the console on Jones plug A, terminations 1 and 2, and divides into two branches. One branch, fused by F3 and F4 for a 10-ampere load, supplies two power sockets which may be used for soldering iron and inspection lamp. The other branch is also fused for 10 amperes (fuses F1, F2), and from these the mains are taken directly to the ON/OFF switch on the right-hand control desk. The fuses are fitted with neon lamp indicators similar to those fitted on the various power units.

29. The console thermostat, which is fitted in the upper part of the console, is wired directly to the input panel, so that it may be used to control the console ventilating equipment. The precise arrangement depends upon whether the console is in use for a static or a mobile application, and details will be found in the appropriate publication.

Connections on input panel

30. The following connections are made internally, between the Jones plugs on the input panel and the remainder of the panels on the console:—

A1	Mains	into	fuse F1	
A2	Mains	into	fuse F2	
A4	External Blanking (not used)	to	PL.9,	A10
A5	Earth on bus-bar			
A6	Split line	to	PL.16,	A9
A9	50-volt supply, external	from	PL.2,	A9

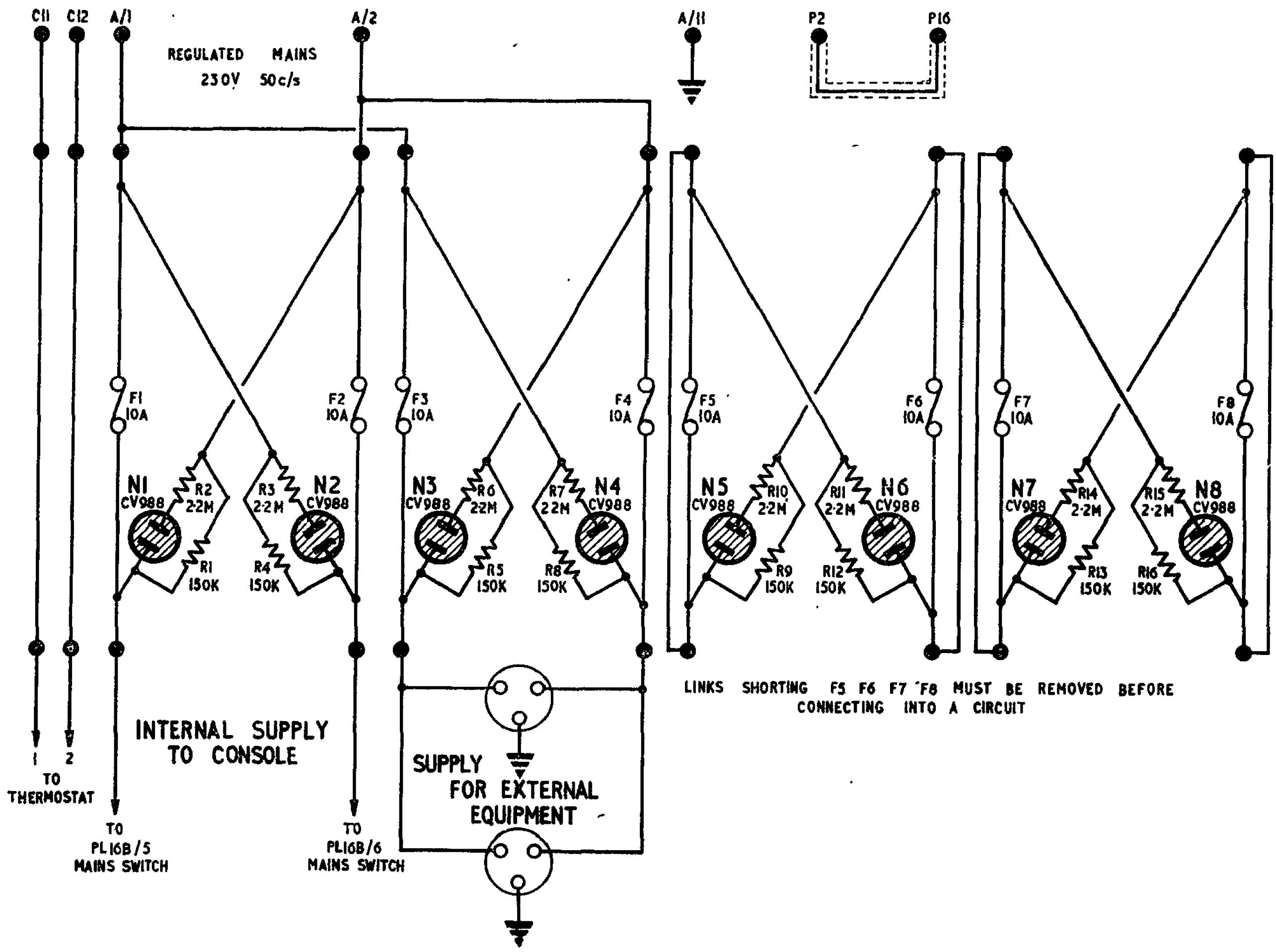
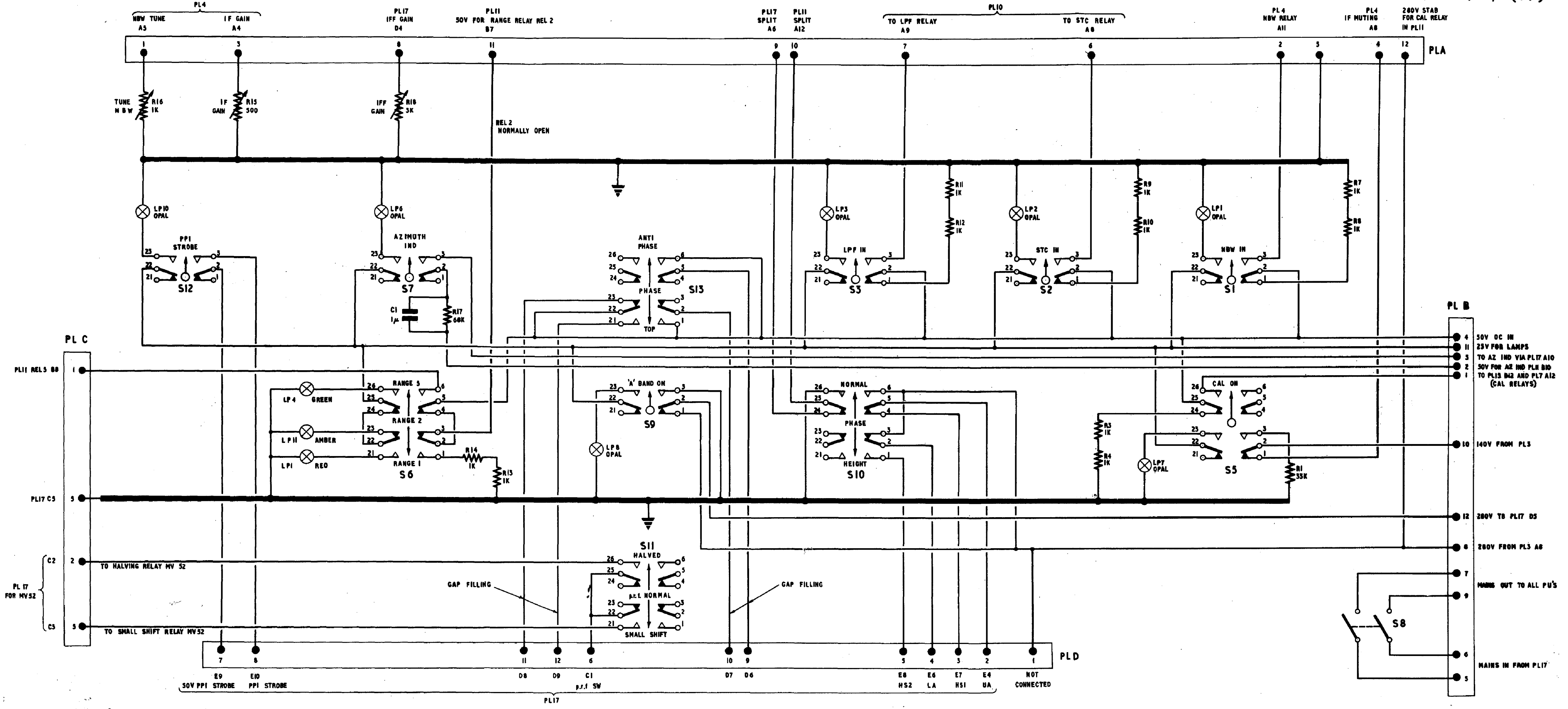


Fig. 9. Panel (input) Type 645, circuit

A10	Elevation scan marker (5 deg. marks) (or azimuth indicator) ..	to	PL.16, B3
A11	Earth for E/S marker		
A12	External frequency control (not used) ..	to	PL.4, A12
C1	PRF key —50V ..	to	PL.16, D6
C2	PRF key, half p.r.f. ..	to	PL.16, C2
C3	PRF key, small shift ..	to	PL.16, C3
C5	Earth	to	PL.16, C5
C6	Elevation motor switch..	to	PL.14, A4
C9	Elevation motor switch..	to	PL.14, A7
C11	Thermostat 1		
C12	Thermostat 2		
D1	HT.8, 300 volts for strobe potentiometer ..	to	PL.2, A6 via PL.9, A8
D2	A-band key	to	PL.7, A8
D3	Strobe control potentiometer	to	PL.7, A9
D4	IFF gain control ..	to	PL.16, A8
D5	A-band key	to	PL.16, B12
D6	Gap filling	to	PL.16, D9
D7	Gap filling	to	PL.16, D10
D8	Gap filling	to	PL.16, D11
D9	Gap filling	to	PL.16, D12
E4	Upper aerial diode switch	to	PL.16, D2
E6	Lower aerial diode switch	to	PL.16, D4
E7	Height switching 1 ..	to	PL.16, D3
E8	Height switching 2 ..	to	PL.16, D5
E9	PPI strobe key	to	PL.16, D7
E10	PPI strobe key (earth) ..	to	PL.16, D8
E11	H/R strobe key ..	to	PL.11, B10
—	Fuse F1	to	PL.16, B5
—	Fuse F2	to	PL.16, B6

31. The functions of the sixteen coaxial inputs are as follows: P1 carries the IF input from the aerial head amplifier to the pre-amplifier IF unit PL.4C; P2 carries the strobe pulse output from PL.7, A11, to the PPI console. P2 is also strapped to P16 internally, for use with the A-scope application. P3 is now used for all positive sync. inputs which require a 100-ohm termination, e.g., Type 13 or Type 14, while P4 is used only on console Type 61A for the A-scope sync. which does not require a matching termination. P5 is provided for use with negative sync. inputs. P6 and P7 carry the magslip connections from the Type 13 aerial to PL.6, A9 and A7 respectively. P8 is connected to PL.11, B12, to provide an external negative-going calibration output, which, however, is not at present used. Similarly, P9 provides an external radar video from PL.10; this may, if required, be jumpered over to P12 to provide a radar video signal on the IFF display (*para.* 32). P10 takes IFF video signals from a matching transformer, for use in PL.7.

32. P12 carries the radar video from the PPI console into the IFF display PL.7, A3. This signal passes through an attenuator unit fitted outside the consoles. This is generally preferable to the use of the H/R console video from P4. P13 carries the sync. signal from the PPI console to the IFF display (PL.7 A4) while P14 carries the IF interrogator lock out pulse from PL.7, B3, to the aerial cabin. P15 is used to carry range marks from the PPI console to the IFF display (PL.7, A10). These signals are also attenuated by an external unit. As previously stated, P16 is strapped to P2. In console Type 61A it is jumpered over to P4 to supply the strobe pulse, as a sync. input, to the timebase unit (A-scope) Type 139 (*Chap.* 9).



AIR DIAGRAM 6112M/MIN.

ISSUE

PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Consoles Type 61 & 61A

Panel (control) Type 644 — circuit

544965 / 3187 625 8/55 BBLtd. Gp. 979

Fig. 6

(A.L.3 Apr 55)

Chapter 8

POWER UNITS TYPE 870, 871, 872, 873, 874, AND 875

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

* *At end of Chapter*

Power units, general

1. The power supplies for the various timebase units, indicating units and control panels on the console are derived from six power units, namely:—

Power unit Type 870 (10K/16127) ..	PL.1
Power unit Type 871 (10K/16128) ..	PL.2
Power unit (stab.) Type 872 (10K/16129)	PL.3
Power unit (IFF) Type 873 (10K/16130)	PL.8
Power unit Type 874 (10K/16131) ..	PL.12
Power unit (EHT) Type 875 (10K/16132)	PL.13

2. A point-to-point inter-connection diagram showing the distribution of all power supplies is given in fig. 1, which for ease of reference is placed at the end of the chapter.

Power unit Type 870 (PL.1)

3. Power unit Type 870 provides the following supplies:—

(1) HT.3 950V positive to the timebase unit (range) Type 136 and the indicating unit (CRT) Type 32

(2) HT.4 1,000V floating supply for astigmatism and shift voltage on the above-named indicating unit

(3) LT.4 6·3V to the X-plate DC restorer V4 in the indicating unit

(4) LT.5 6·3V to the X-plate DC restorer V5 in the indicating unit

(5) LT.6 6·3V to the diode V11 in the timebase unit (range)

(6) LT.7 6·3V to the Y-plate amplifiers V2, V3 and the diode V10 in the indicating unit.

The general arrangement of the power unit and the location of the principal components are shown in fig. 2 and 3; the circuit is given in fig. 4.

4. Transformer T1 provides the whole of the output supplies. The first HT secondary gives an AC output to the two half-wave rectifying valves V1, V2, which are connected to form a full-wave rectifier, giving a 950-volt output at 120 mA smoothed by a capacitance input filter C2, C3, L1, L2, C7, C8, C9 and C10. A bleeder chain R13, R14, R15, is connected across the filter output. Provision is made for metering the HT.3 output voltage, via the jack J1. The rectifying valves are directly-heated with the winding of a thermal delay relay connected in parallel with the filaments.

5. A second HT winding provides a floating supply of 1,000V at 5 mA from the half-wave rectifying valve V3, the output being smoothed by a capacitance input filter C1, R10, R11, C4, C5 and C6.

6. The transformer has four 6·3-volt secondaries giving the LT.4, LT.5, LT.6 and LT.7 supplies as detailed in para. 1. Two other LT secondaries provide the filament voltages for the rectifying valves.

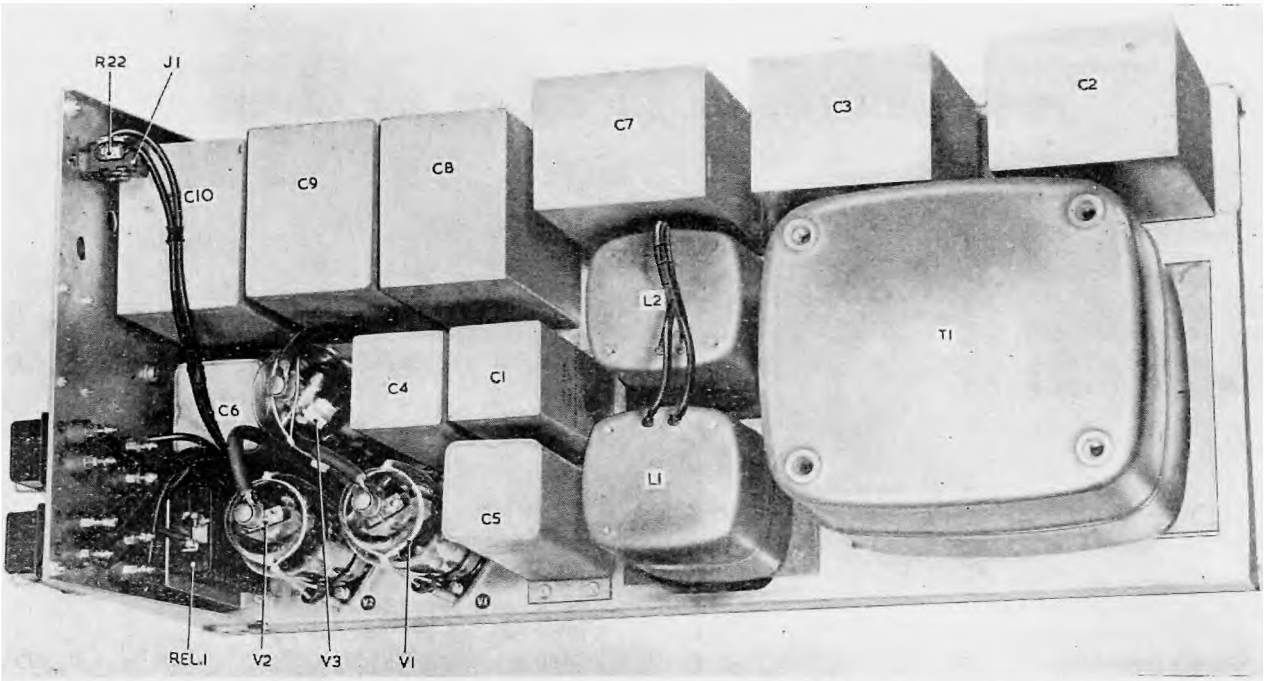
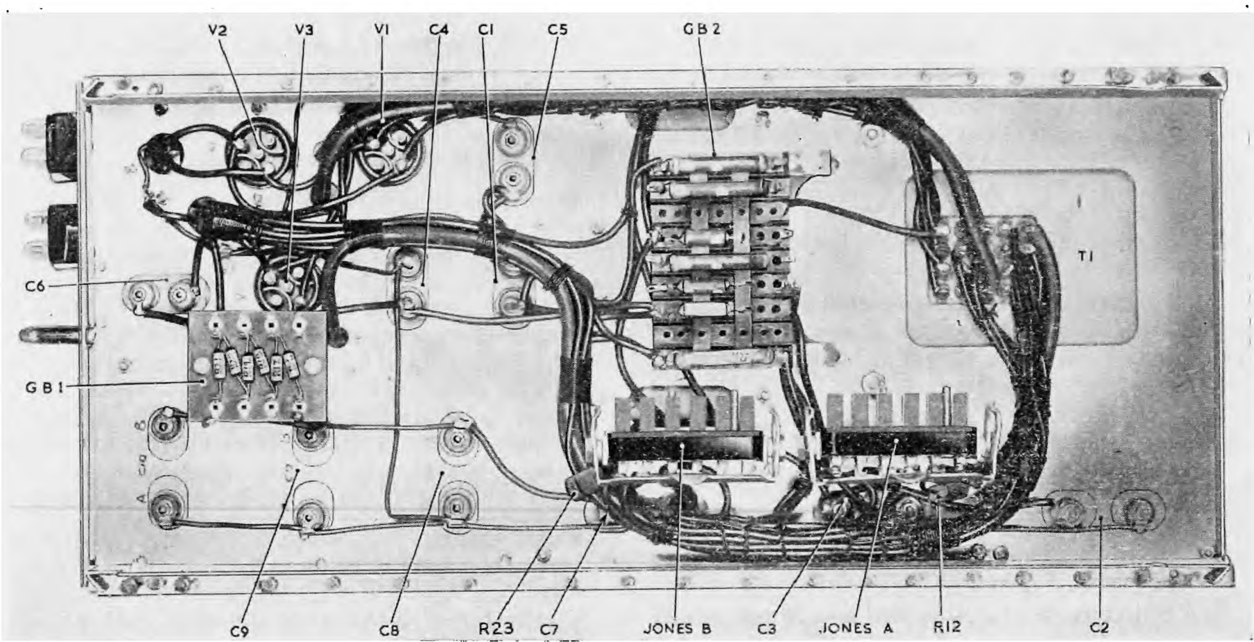


Fig. 2. Power unit Type 870, top view



GB.1, LEFT TO RIGHT. R21, R20, R19, R18, R17, R16.

GB.2, TOP TO BOTTOM. R7, R8, R13, R10, R14, R15, — R11

Fig. 3. Power unit Type 870, underside view

Power unit Type 871 (PL.2)

7. Power unit Type 871 provides a 50-volt DC supply for the operation of various relays in the console, and a 17-volt DC supply for the indicating lamps on the control desk. It also includes an oscillator which generates a synchronizing pulse for the purpose of routine servicing when the transmitter sync. pulse is not available. Views of the unit are given in fig. 5 and 6, and the circuit diagram in fig. 7.

8. The monitoring meter for all power supplies is mounted in this power unit, and a chart giving the normal meter readings of all valves in the console is fitted on the door of the console enclosing the unit.

9. The unit also provides the following power supplies:—

(1) HT.8 300V positive to the servicing sync. oscillator, via the sync. switch on the panel (sync. and blanking) Type 642; also to the cathode followers in the amplifying unit (AJ and video) Type 295, and to V7 in the indicating unit CRT Type 32

(2) LT.13 6·3V to the scale lamps in the indicating unit Type 32. (LT.13 also supplies V2, V3, and V4 in the power unit itself)

(3) LT.14 6·3 volts to V9 in the timebase unit (elevation) Type 134.

10. The power unit portion includes transformer T1, the primary winding of which is fused for 2A and is fitted with the usual neon indicators. The HT secondary is wound for 350-0-350V at 225 mA. This supplies both anodes of the full-wave rectifying valve V1. The HT output is smoothed by a two-stage filter C1, L2, C2, L1, C7, giving a 300-volt output.

11. A 70-volt secondary winding supplies the bridge rectifying circuit W1, the output of which is fused for 1A and filtered by C3, C4, C5, C6. This output feeds all the relays on the various panels. A 17-volt tap on the secondary winding feeds the indicating lamps on the control panels.

12. The valve V2 operates as a resistance-coupled phase-shift oscillator, the frequency of which is variable between about 200 and 600 c/s. The diode V3 controls the amplitude of the oscillation in such a manner that the peak amplitude of the sinusoidal output of V2 is more or less stabilized at a level which is practically equal to the standing bias on the cathode of V3.

13. If the amplitude of oscillation is less than the standing bias on the cathode of V3, the sine wave will then be DC restored by V3 so that the positive peaks are at the same potential as its cathode; the mean level is then slightly positive. A positive bias will therefore be applied to the control-grid of V2, via the smoothing network R25, C12, which will tend to cause the amplitude of oscillation to increase. If, however, the amplitude of the oscillation is greater than the standing bias on the cathode of V3, then the mean level at this point will be negative and a negative bias will be applied to the control-grid of the oscillator tending to decrease the amplitude of oscillation. The result of these two opposing tendencies is to keep the amplitude approximately constant and equal to the standing bias at the cathode of V3, i.e. about 60V.

14. The sine wave from V2 is fed into the control-grid of V4 which functions as a grid-current limiter. This valve is operated with only a small negative bias, and is consequently driven into the grid current region; V4 then saturates and the output at the anode is thus a square wave. This output is fed into the panel (sync. and blanking) Type 642 where it becomes available as a sync. pulse for the timebase unit (range) Type 134, when the transmitter sync. is not available.

Power unit Type 872 (PL.3)

15. Power unit Type 872 provides the following supplies:—

(1) HT.5 300V, valve stabilized, to the timebase unit (range) Type 136

(2) HT.6 280V, valve stabilized, to the above timebase unit

(3) HT.7 420V positive to the timebase unit (elevation) Type 134

(4) STB.1 280V positive for the screening-grids of V1 and V2 in the amplifying unit (IF) Type 294, and also for V12 in the timebase unit

(5) STB.2 210V positive to the screening-grid of V4 in the amplifying unit (IF) Type 296

(6) STB.3 140V positive to the screening-grids of V1, V2, V3, in the above-mentioned amplifying unit

(7) LT.8 6·3V to V1, V4-V10, and V12-V15 in the timebase unit (range) Type 136.

(8) LT.9 6·3V to the flip-flop V2, V3, in the range timebase unit

(9) LT.10 6·3V to V1-V8, V10, and V11, in the timebase unit (elevation) Type 134. Certain internal supplies are taken from this source (*para.* 22)

16. The general arrangement of the power unit, and the location of the principal components is shown in fig. 8 and 9. The circuit diagram is shown in fig. 10.

17. Transformer T1 provides the whole of the output supplies, the primary winding being provided with fuses and neon indicators. The high voltage secondary supplies 450-0-450V at 200mA to the full-wave rectifying valve V1, the output of which is smoothed by a capacitance input filter C1, L1, C2. The output arrangements include a thermal delay relay, HT fuse, and neon valve indicator.

18. The output from the smoothing filter is fed directly to termination B7, and also via stabilizing valves V2 and V3 to terminations A6 and A7 respectively. Each stabilizing circuit employs two valves, i.e. V2 and V5 for the A6 output, and V3, V6, for the A7 output.

19. The action of the stabilizing circuits will be described with reference to the A6 output. The output from the final filter condenser C2 is applied to a chain consisting of R11, the anode-cathode

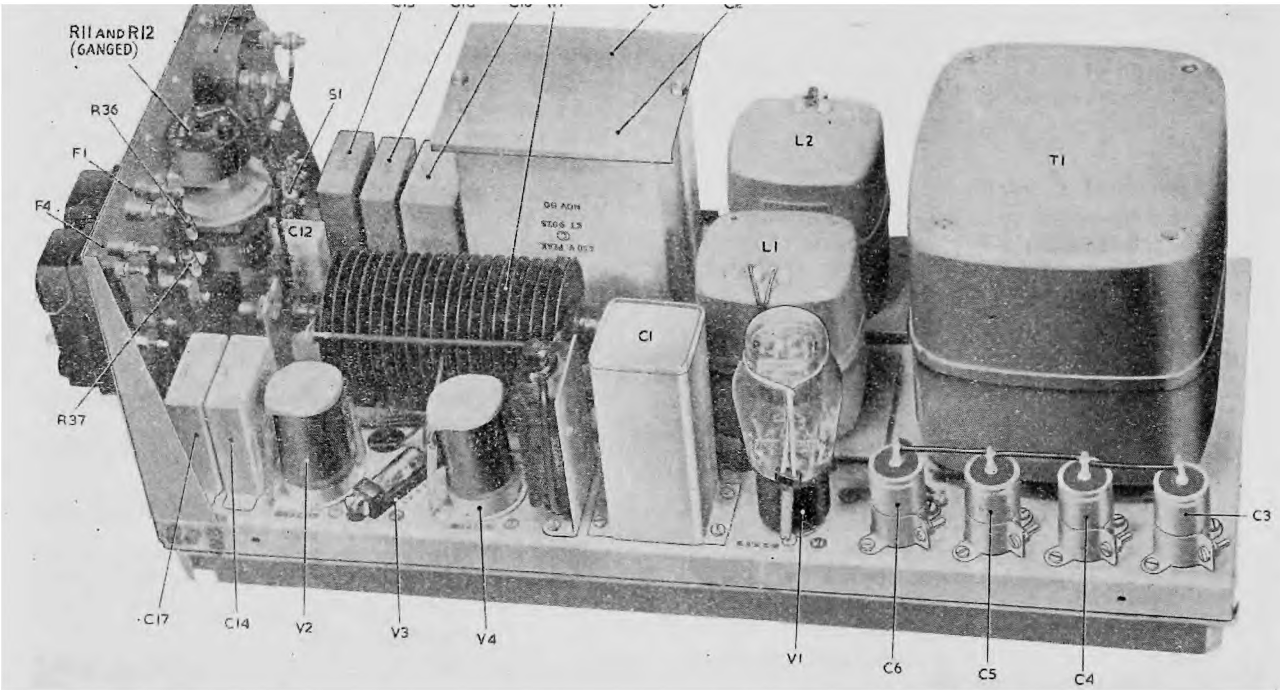
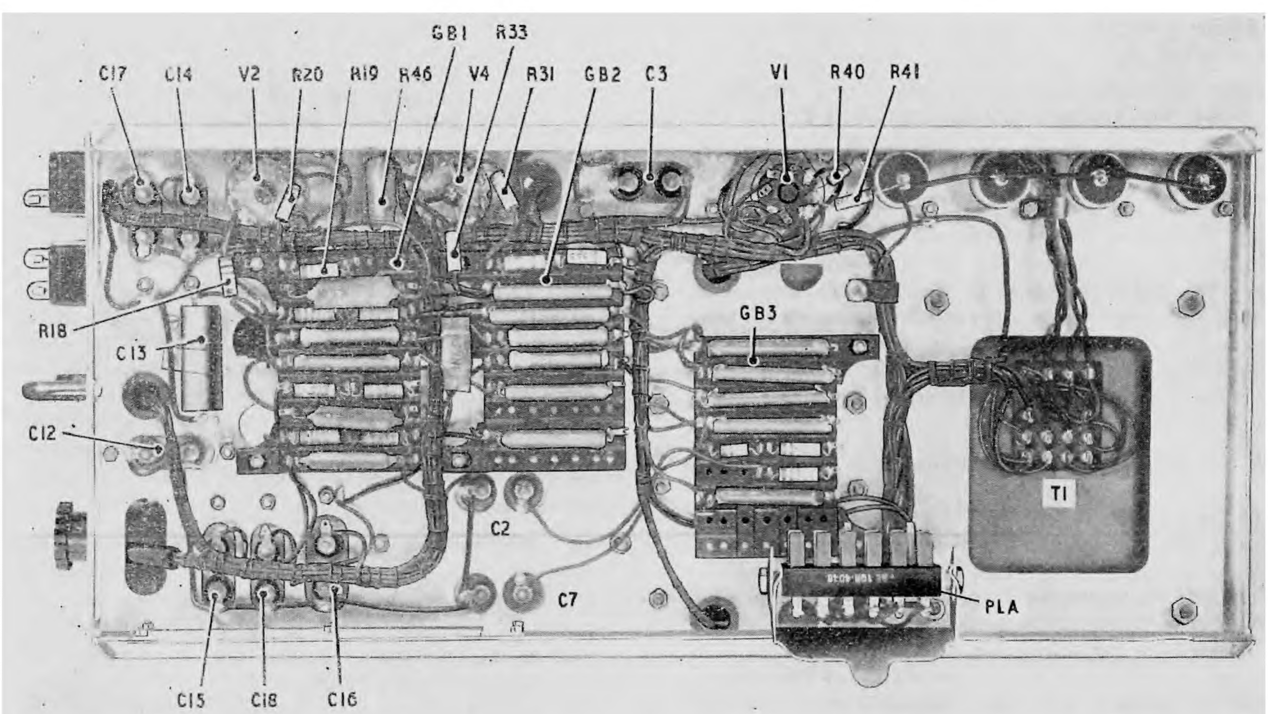


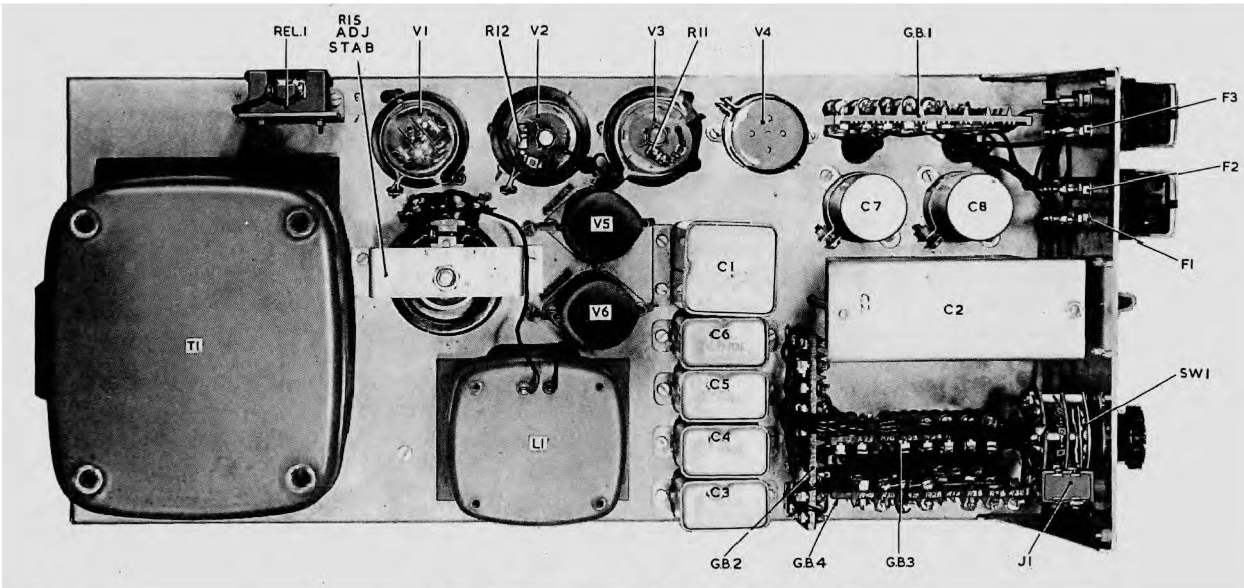
Fig. 5. Power unit Type 871, top view



GB.1, TOP TO BOTTOM. R19, C11, R17, R25, R21, R24, R15 AND R16, C9, R13 AND R14, C8. C10 ON REAR.

GB.2, TOP TO BOTTOM. R30 AND R26, R32, R34, R35, R29, R27, R22.
GB.3, TOP TO BOTTOM. R5, R6, R10, R9, R39, R43, R42, R8.

Fig. 6. Power unit Type 871, underside view



◀Fig. 8. Power unit Type 872, top view▶

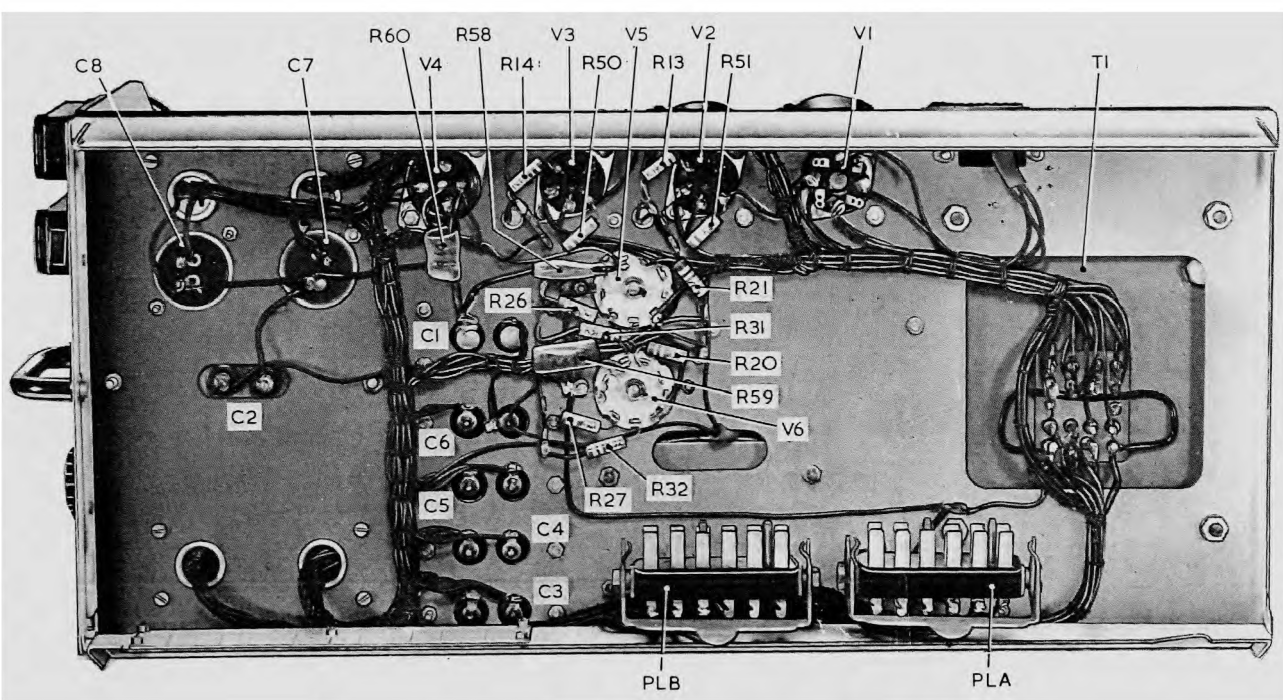


Fig. 9. Power unit Type 872, underside view

resistance of V2, and R51, R55, R44. Output terminal A6 is connected to the cathode of V2. If the current taken from A6 falls, the potential of A6 will rise, together with that of the cathode of V2. This increase of potential is applied to the control-grid of V5 through condenser C3 and the anode potential of V5 falls accordingly.

20. The anode of V5 is coupled through C5 to the control-grid of V2, and when the anode potential of V5 falls, the control-grid of V2 is driven negative. In effect, this increases the effective anode/cathode resistance of the valve and the potential difference across the valve increases. Since rectifier V1 maintains the potential at C2, a greater p.d. across the valve can only be provided by a fall of potential at A6. The effect of the action is, that within certain predetermined limits, the potential of A6 maintained sensibly constant with varying current drain from A6.

21. The ◀diode chain▶ V4 gives three additional stabilized supplies, as detailed in *para.* 15 (4), (5) and (6). ◀The current through this chain should▶ be 20 mA; it can be adjusted by turning the preset screwdriver control (marked ADJ. STAB.) adjacent to the meter switch on the chassis. This control is marked R15 in the circuit diagram. A switch is provided by which all HT supplies can be monitored through jack J1.

22. Supply LT10 has one side earthed. In addition to the outputs detailed in *para.* 15 (9), it supplies the heaters of V5 and V6 on the power unit itself. Supply LT.9 is centre-tapped, the tapping being taken to earth. LT.8 is quite conventional, one side being earthed.

Power unit Type 873 (PL.8)

23. Power unit Type 873 provides heater current for all the valves used in the IFF display, a 750V supply for timebase unit IFF Type 135 and the video amplifier in indicating unit (CRT) Type 31, together with an 800V floating supply for the X-shift and X-stig circuits in the latter.

24. In detail, the above supplies are:—

(1) HT.11	800V floating to CRT, X-shift and X-stig, in the IFF indicating unit.
(2) HT.10	750V positive HT for valves in the IFF indicating unit.
(3) LT.24	6·3V to valves in IFF timebase unit, V4, V5, V22, V23, V9, V10, V18.
(4) LT.25	6·3V to V16 in IFF timebase unit.
(5) LT.26	6·3V to V1-V4 in the IFF indicating unit; also to all valves in the IFF timebase unit not mentioned in (3) and (4).
(6) LT.27	6·3V to V5 in the IFF indicating unit.
(7) LT.28	6·3V to V6 and V7 in the IFF indicating unit.
(8) LT.29	6·3V to V8 in the IFF indicating unit.
(9) LT.30	6·3V to V9 in the IFF indicating unit.

Note . . .
The IFF CRT (V10) requires a 4V supply. This is obtained from the 6·3V supply LT.26 by a small 1·6 to 1 step-down transformer fitted in the indicating unit.

25. The general arrangement and location of components is shown in fig. 11 and 12, and the circuit diagram in fig. 13. The unit contains two transformers, T1 and T2, the primaries of which are fed in parallel through mains fuses fitted with the usual neon indicators. The balanced 800V supply is fed through a resistance-capacitance filter, with its own fuse and neon indicator. The 750V supply has a thermal

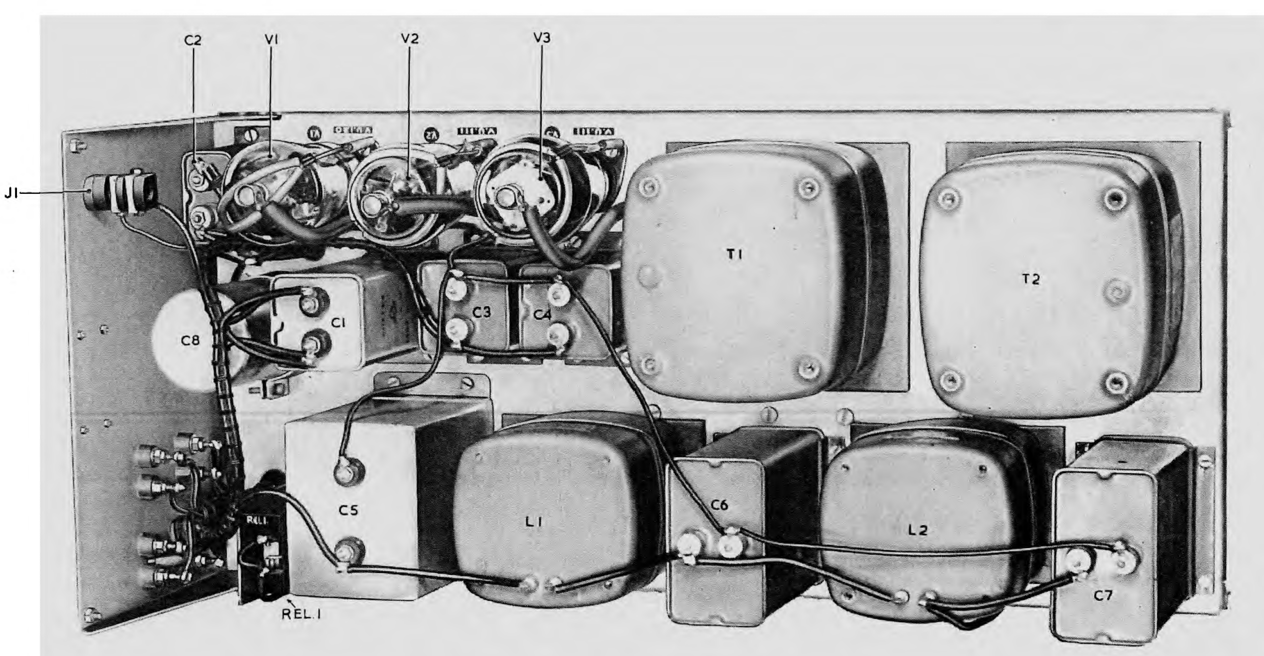


Fig. 11. Power unit Type 873, top view

delay relay, fuse and neon indicator; the output is fed via a two-stage filter C5, L1, C6, L2, C7, with a bleeder resistance across the last condenser. Provision is made for monitoring the output voltage at jack J1.

26. The condenser C8 is of importance and is apt to be overlooked. It is connected to terminal A10 on PL.5, and terminal B5 on PL.7. The effect of this connection is to return the end of the Y-shift potentiometer in P.L5 to the positive 300-volt rail on PL.7, and C.8 acts as a decoupling condenser, hence its designation VIDEO DC.

Power unit Type 874 (PL.12)

27. Power unit Type 874 provides the following supplies:—

(1) HT.1 320V positive, super-smoothed, to the video circuits in the amplifying unit (AJ and video) Type 295, and the indicating unit (CRT) Type 32

(2) HT.2 340V positive to the amplifier Type A.3711

(3) HT.9 320-volt negative bias line for the timebase unit (IFF) Type 135

(4) LT.1 6·3V for cathode followers in the amplifier Type A.3711 (unit B), the amplifying unit (AJ and video) Type 295, and the indicating unit (CRT) Type 32

(5) LT.2 6·3V to amplifier Type A.3711 (V1-V8 in unit A, V1-V5 in unit B, V1-V2 in unit C)

(6) LT.3 6·3V to the video valves in the AJ and video amplifying unit Type 295 and the indicating unit (CRT) Type 32.

28. The general arrangement of the power unit, and the location of the principal components, is shown in the photographs, fig. 14 and 15. The circuit diagram is given in fig. 16.

29. Transformer T1 provides the whole of the output supplies. The first HT secondary gives an AC output of 325-0-325V with a maximum current of 200mA; this is fed to the full-wave rectifying valve V1. The HT.1 output is smoothed by a two-stage filter consisting of L3, C5, L4, C6, and the HT.2 output by a single stage filter L2, C4. C1 is the reservoir capacitor feeding both filters. The feed into the reservoir is taken through a 500 mA fuse F3; a neon lamp N3, in series with a ballast resistor R5, is connected across the reservoir condenser to serve as an indicator.

30. The resistor chain R14, R13, R15, provides a load which produces a voltage drop across R7 and R8 during the period in which the valves in the panels supplied by the power unit are warming up. Under normal operating conditions, this chain takes a steady current of about 7 mA and the positive end of R15 is therefore about 70 volts above earth potential. A centre-tap on one of the LT windings is connected to this point (*para.* 33).

31. The second HT secondary is wound for 350-0-350 volts, 50 mA. It feeds a full-wave rectifying valve V2, the circuit being arranged to give a negative DC output, through the filter L1, C2, C3. The arrangements for thermal delay, neon lamp indication, and overload fuse are similar to those for V1.

32. Provision is made for metering the HT voltages by means of a meter fitted in the power unit Type 871. A monitoring lead, fitted with a telephone type plug at each end, is provided; this is inserted into the jack J1, on power unit Type 874, and into the jack J1, on power unit Type 871. The switch S1 on power unit Type 871 is placed in the JACK position. The three HT output voltages on power unit Type 874 can then be monitored by placing the switch S1 on this unit in the appropriate positions.

33. The LT.1 supply is taken from a centre-tapped secondary winding, the tapping of which is maintained at 70V above earth as explained in *para.* 30. This is to minimize hum in the video circuits on PL.15 and PL.10. The current rating is 3A. The LT.3 winding is also centre-tapped, but the tap is at earth potential. LT.2 is a single winding with one end earthed, the output rating being 5A.

Power unit Type 875 (PL.13)

34. Power unit Type 875 is the EHT power pack, and provides the following supplies:—

(1) EHT.1 5·5 kV to the CRT in the indicating unit (CRT) Type 32

(2) EHT.2 5·0 kV to the CRT in indicating unit (IFF) Type 31

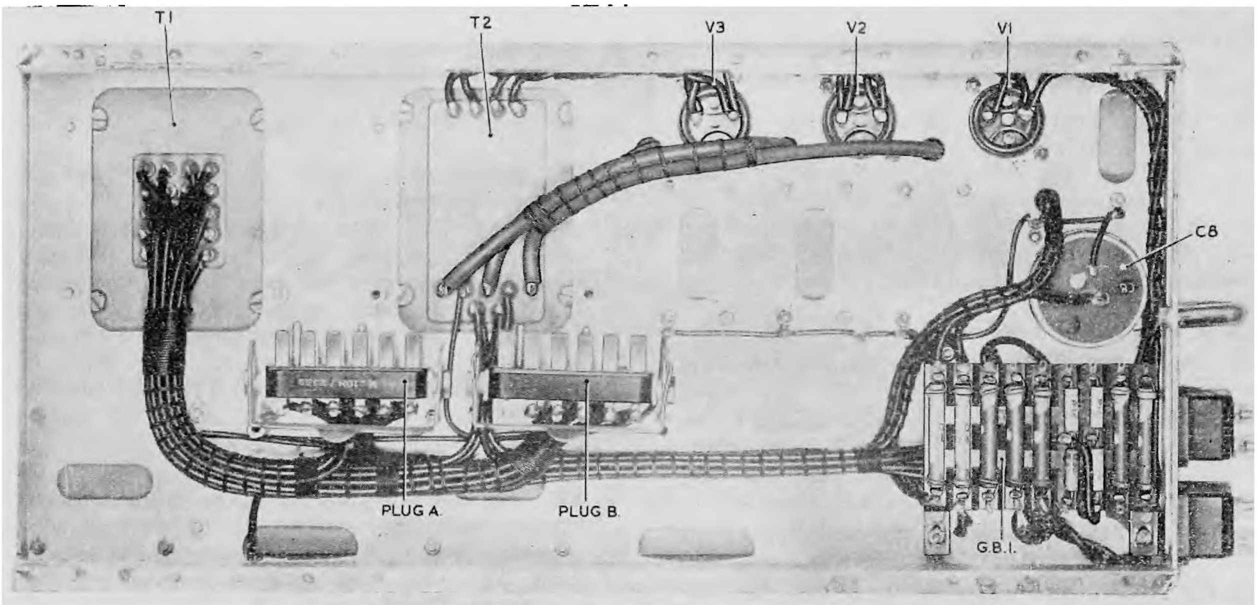
(3) LT.11 4V to the heater of the first-named CRT

(4) LT.12 6·3V to the DC restorer diode in the indicating unit (CRT) Type 32

35. The general arrangement of the power unit, and the location of the principal components, is shown in fig. 17. The circuit diagram is given in fig. 18.

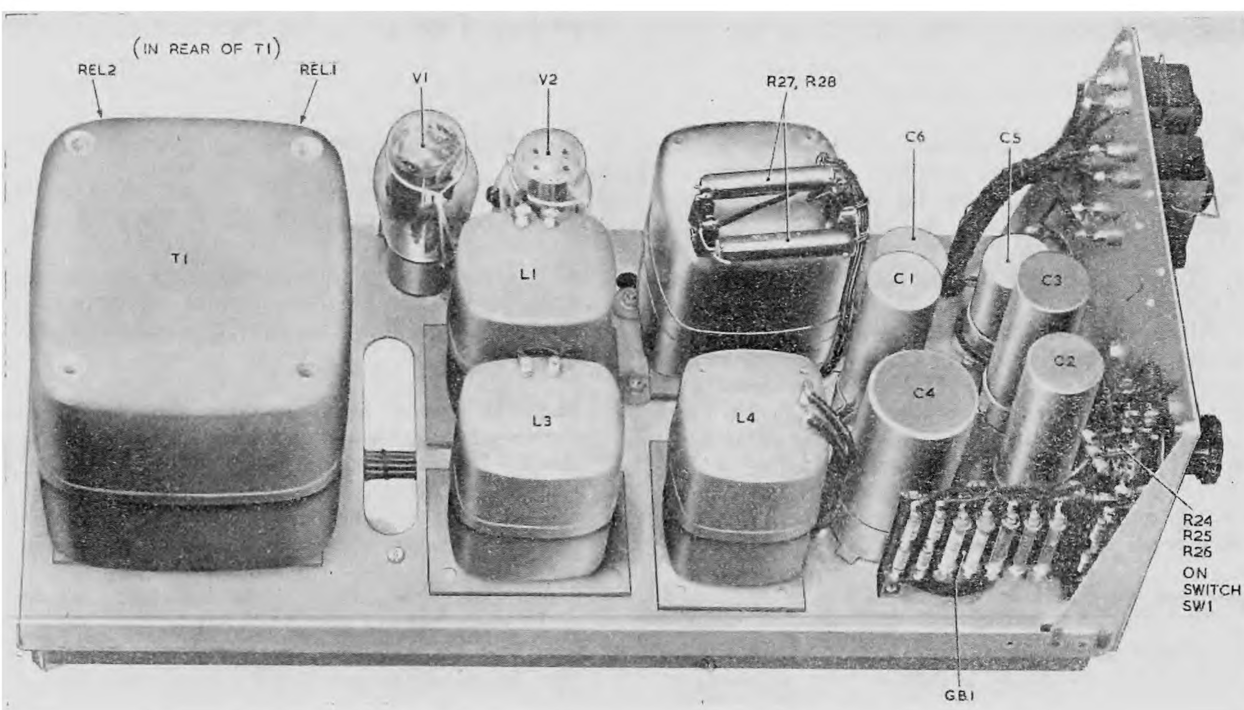
36. The power unit includes two sealed oil-immersed transformers T1 and T2. T1 provides the EHT and HT voltages, while T2 provides the LT supplies, including a 2-volt supply LT.22, for the filament of the rectifying valve V1. The primary winding of T1 is fused for 1A in each input lead, the fuses F1, F2 being fitted with the usual neon indicators. The primary winding of T2 has a 250 mA fuse F4 in one lead.

37. Each of the two EHT outputs has its own resistance-capacitance filter. That for the IFF display, i.e. to indicating unit (IFF) Type 31, is taken from a coaxial socket and plug P1, to a resistance chain in the indicating unit. The other EHT supply (EHT.1) feeds a resistance chain in the power unit itself, from which are tapped the various voltages for the indicating unit (CRT) Type 32.



GB.1, LEFT TO RIGHT. R7, R6, R11, R10, R9, R15 AND R14, R16 AND R17, R13, R12.

Fig. 12. Power unit Type 873, underside view



GB.1, LEFT TO RIGHT. R21 AND R20, R19 AND R18, R17, R16, R15, R14, R13, R22 AND R23.

Fig. 14. Power unit Type 874, top view

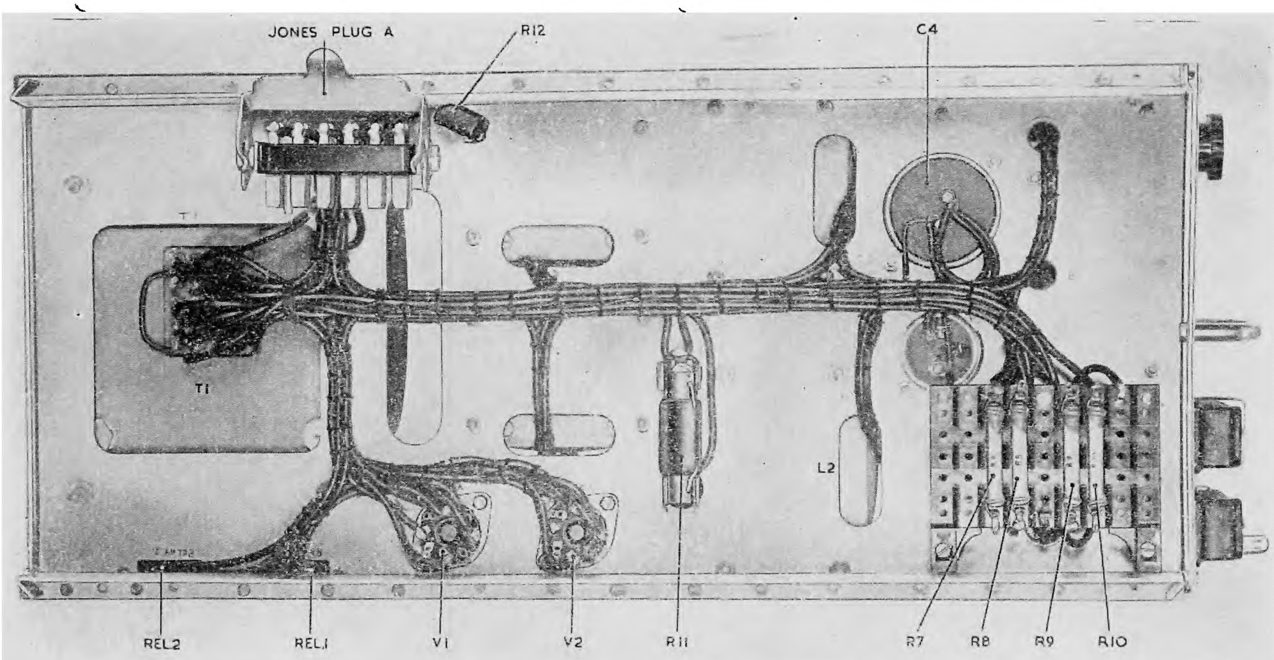
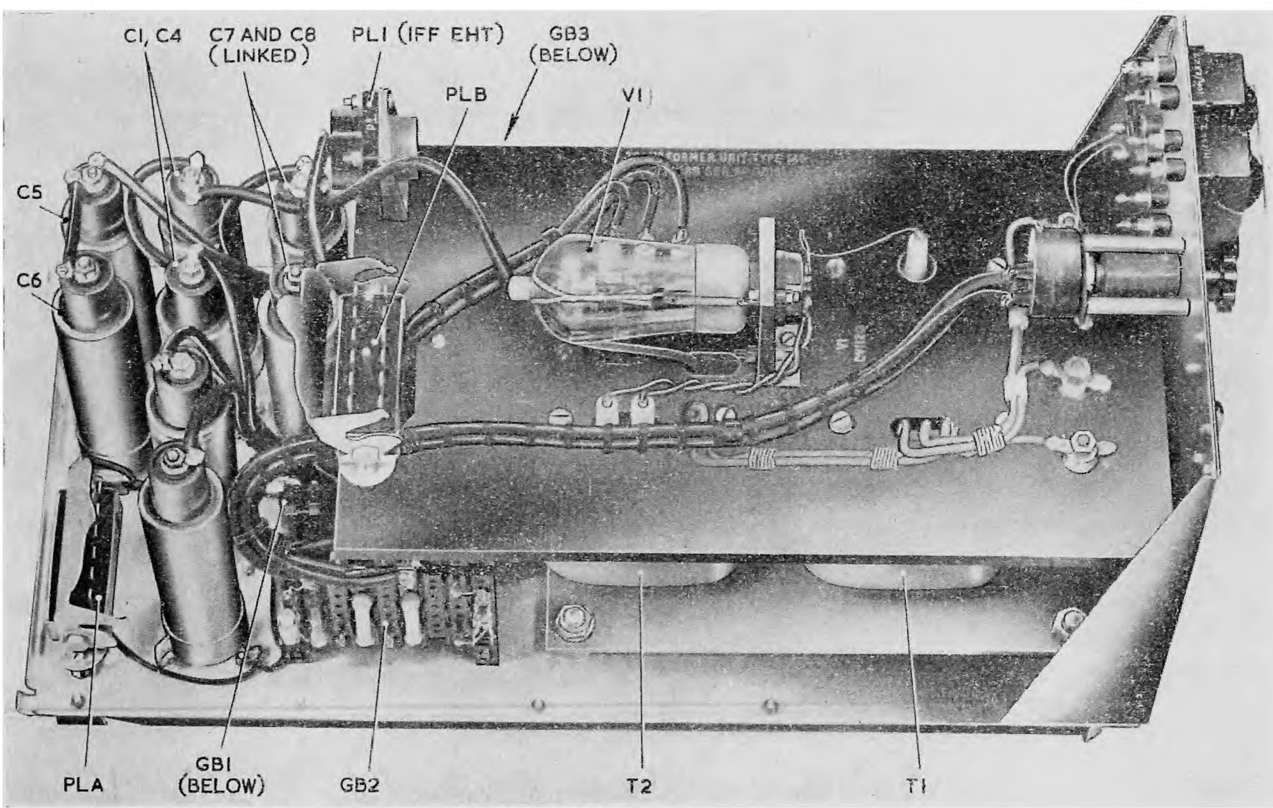
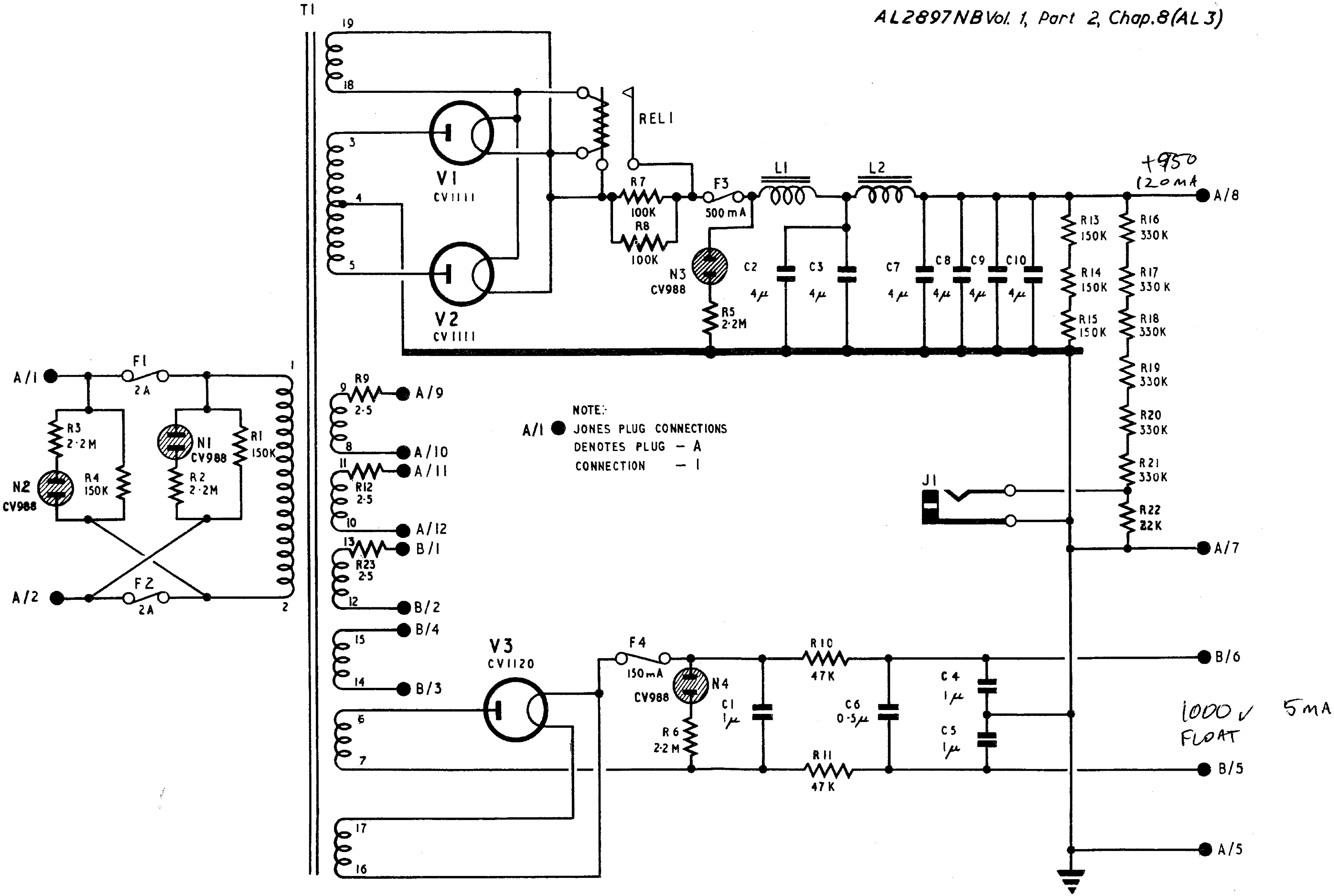


Fig. 15. Power unit Type 874, underside view



GB.1, LEFT TO RIGHT. R27, R25, –, –, R17, R16, R14, R18, R11.
GB.2, LEFT TO RIGHT. LINK CLIP, R26, R19 ON REAR, R22, R23 ON REAR, R24, R21 ON REAR, LINK CLIP.
GB.3, LEFT TO RIGHT. R30, R29, R28, R12, R15 ON REAR, R18.

Fig. 17. Power unit Type 875, top view from left



AIR DIAGRAM
6112F/MIN.

ISSUE | PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Power unit Type 870 (PL.1) circuit
[Consoles Type 61 & 61A]

Fig. 4

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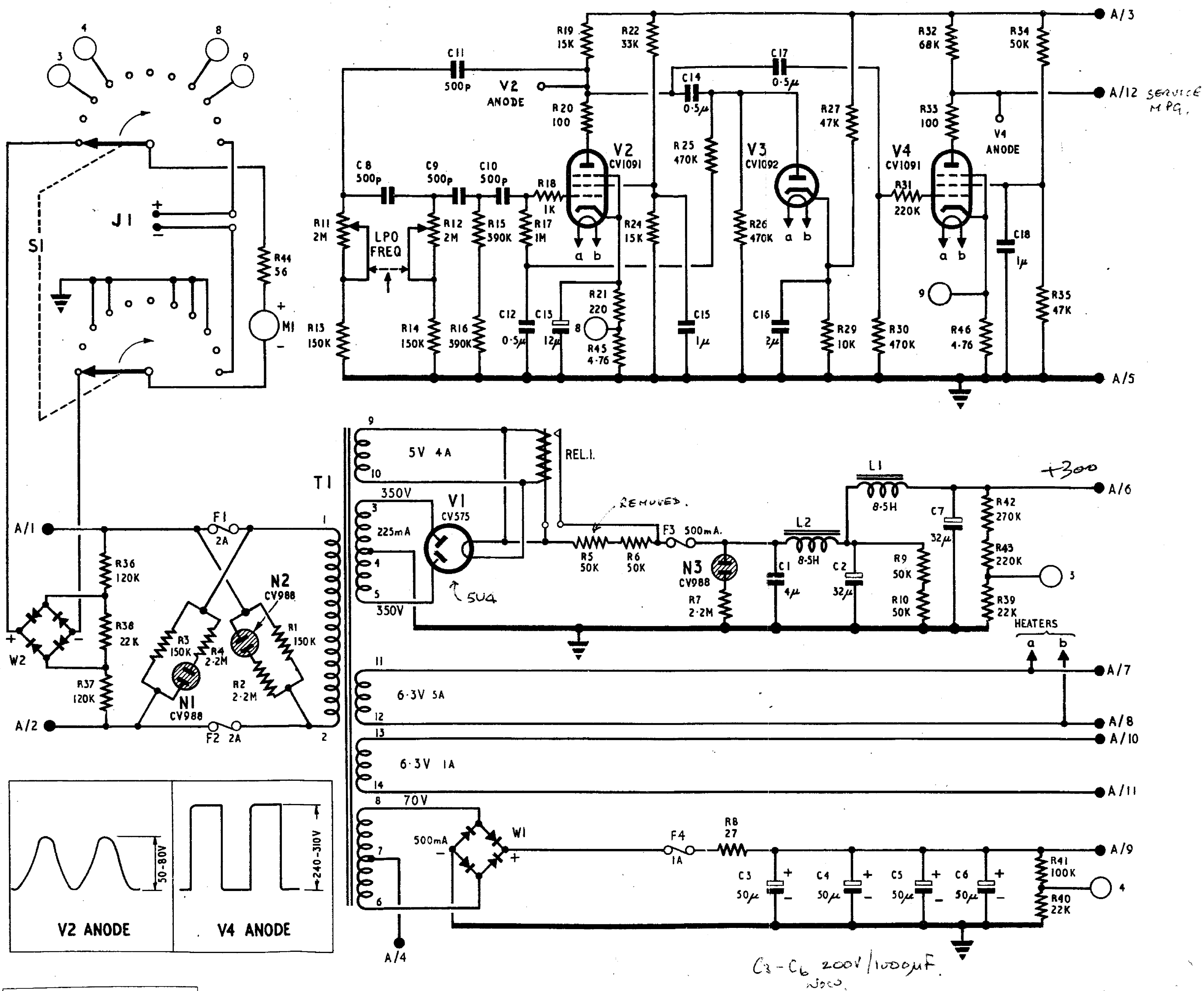


AIR DIAGRAM
6112G/MIN.

ISSUE 1

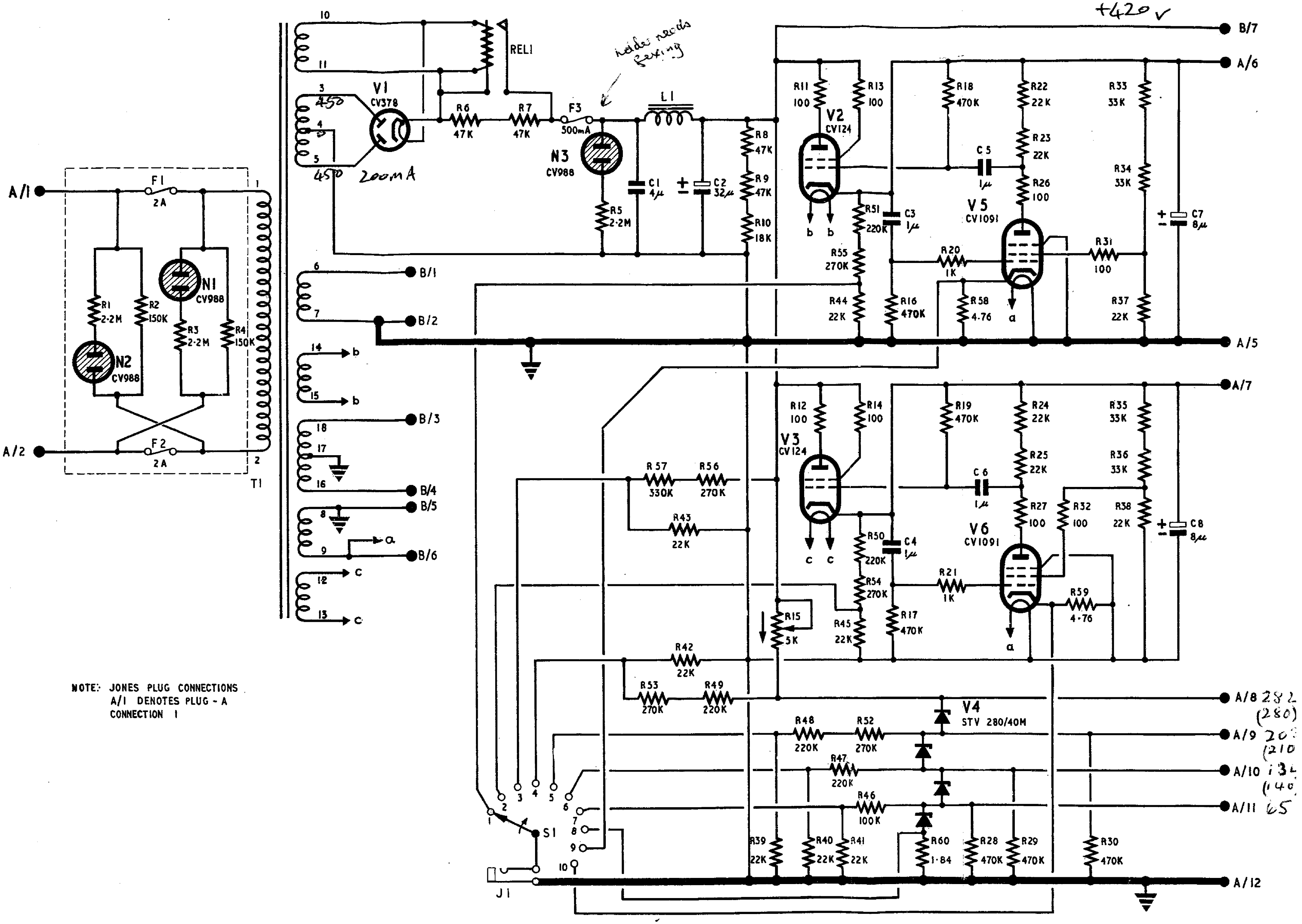
PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Power unit Type 871 (PL2) circuit
[Consoles Type 61 & 61A]

Fig. 7

544965 / 3187 625 8/55 B.B.Ltd. Gp. 979

(A.L.3 Apr. 55)

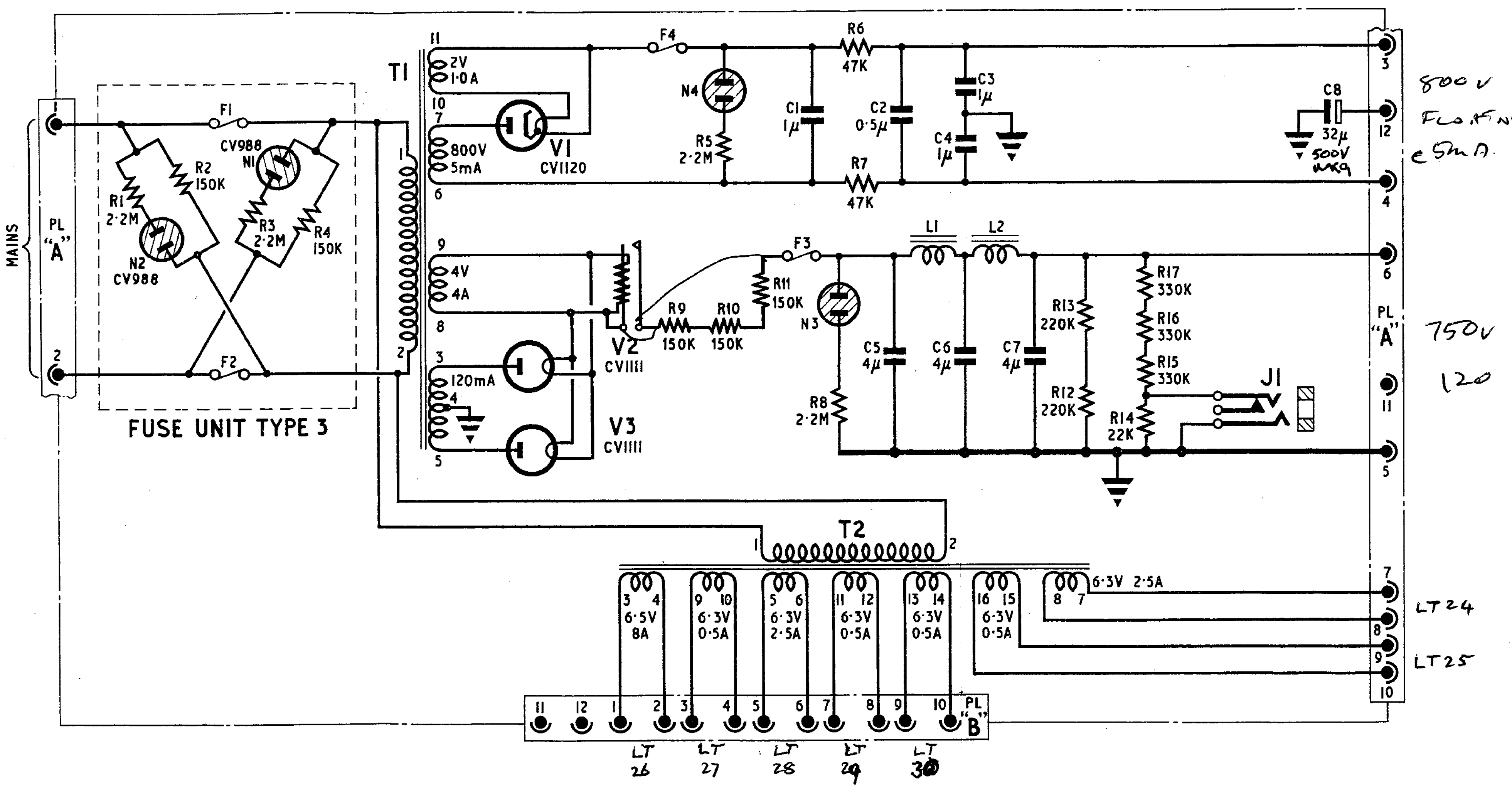


NOTE: JONES PLUG CONNECTIONS A/1 DENOTES PLUG - A CONNECTION 1

Fig. 10

Power unit Type 872 (PL3) circuit
[Consoles Type 61 & 61A]

Fig. 10



Power unit Type 873 (PL8) – circuit

Consoles Type 61 & 61A

AIR DIAGRAM 6112J/MIN.

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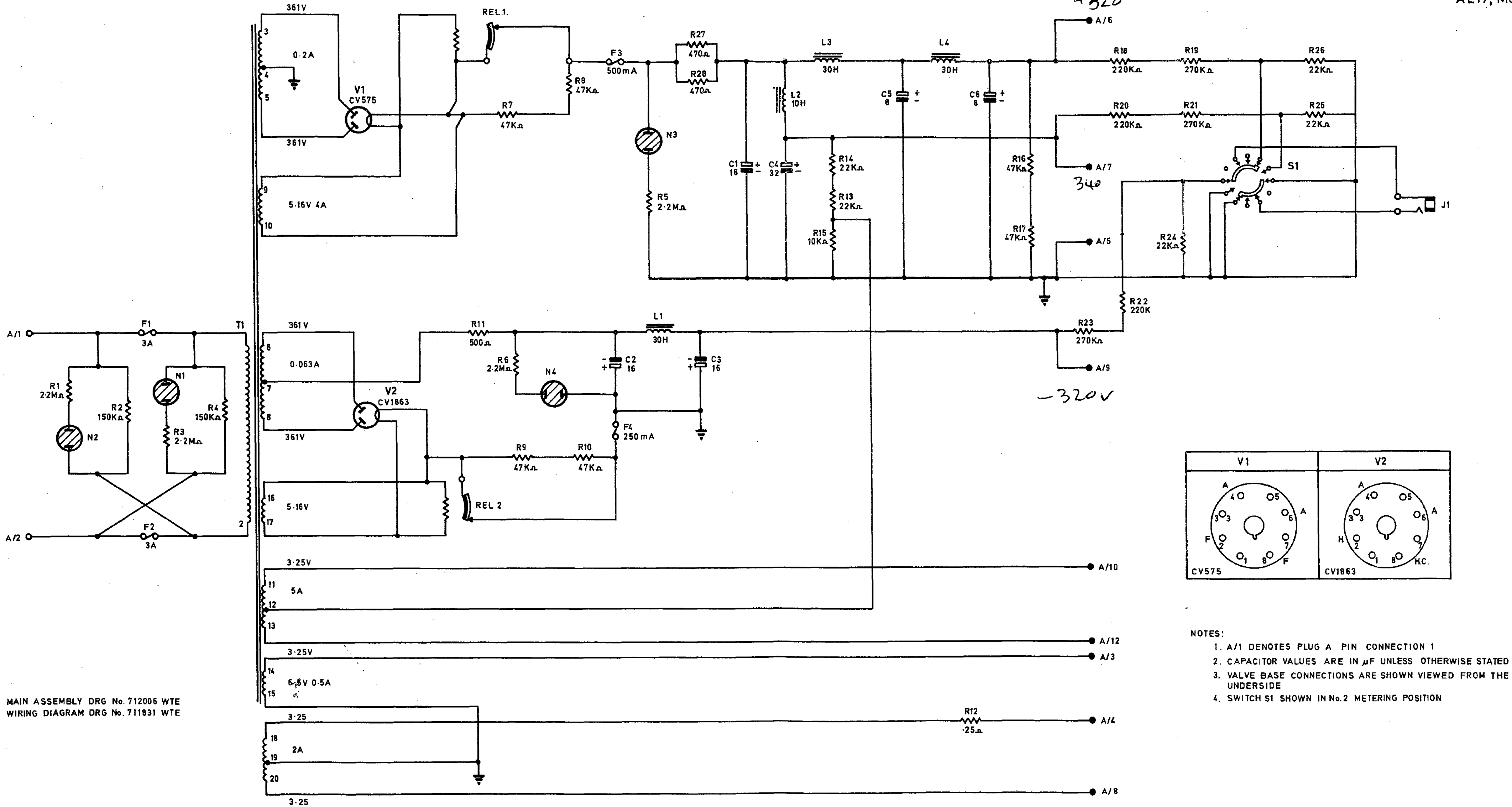
Fig 13

(A.L.3 Apr. 55)



NOTES:

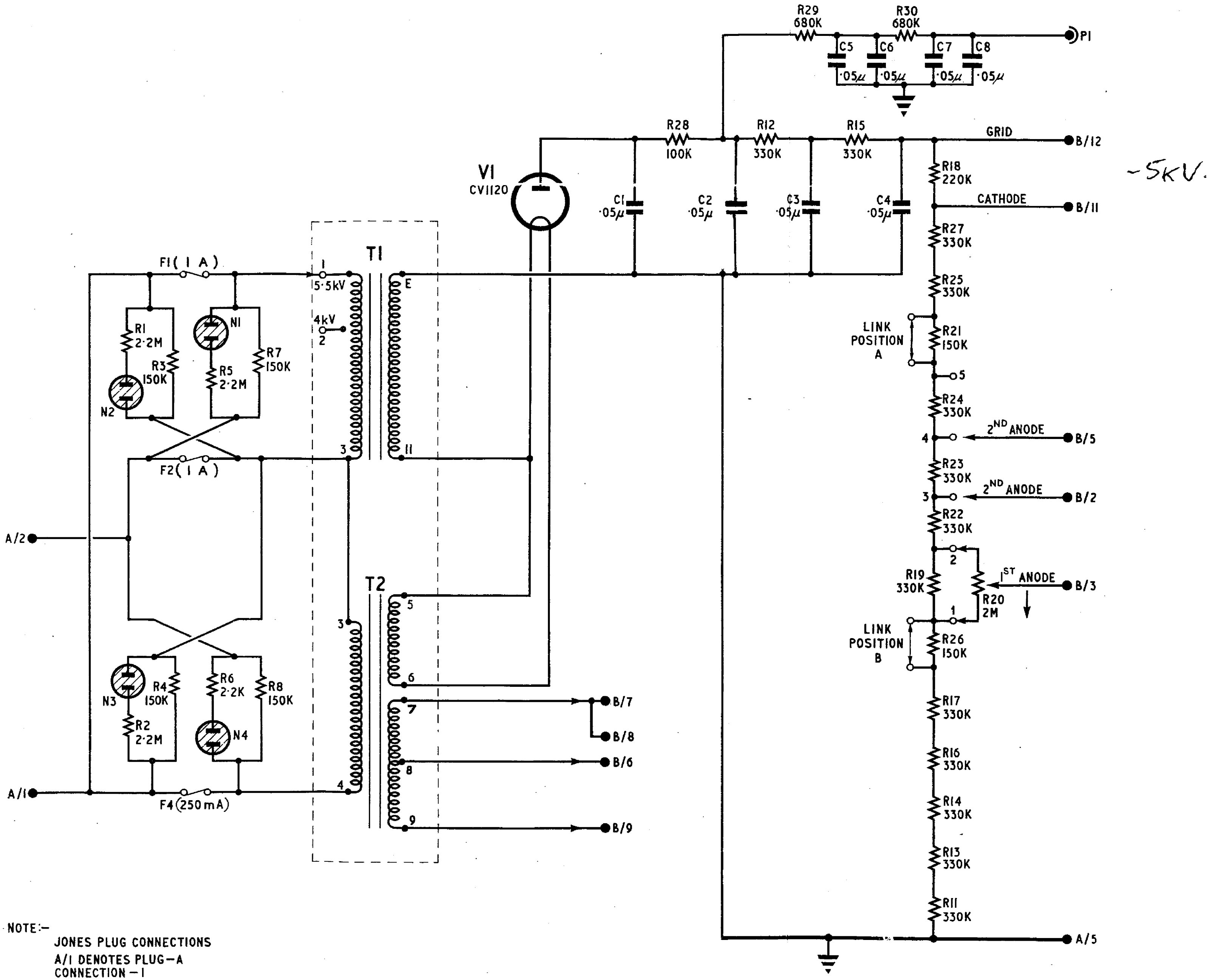
1. A/1 DENOTES PLUG A PIN CONNECTION 1
2. CAPACITOR VALUES ARE IN μF UNLESS OTHERWISE STATED
3. VALVE BASE CONNECTIONS ARE SHOWN VIEWED FROM THE UNDERSIDE
4. SWITCH S1 SHOWN IN No.2 METERING POSITION

MAIN ASSEMBLY DRG No. 712006 WTE
WIRING DIAGRAM DRG No. 711831 WTE

EXTRACTED FROM
712007WTD. ISS.V3.
Fig 16

Power unit Type 874 (PL 12) circuit
(Consoles Type 61 & 61A)

Fig 16



NOTE:–
JONES PLUG CONNECTIONS
A/1 DENOTES PLUG–A
CONNECTION – 1

AIR DIAGRAM 6112L/MIN.	
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Power unit Type 875 (PL13) circuit
[Consoles Type 61 & 61A]
RESTRICTED

Fig. 18

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(A.L.3 Apr. '55)