(*A.P.113, Sect. 6D*)

RESTRICTED

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2897NA
VOLUME 1

CONSOLE TYPE 60

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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(Ministry of Defence)

FOR USE IN THE ROYAL AIR FORCE

(Prepared by the Ministry of Aviation)

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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.

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(Continued overleaf)

DANGER-HIGH VOLTAGE

Never leave the console with the top panel cover off unless the safety switch is restored to "safe."

Remove power supply Jones socket before removing any side panel or panels. Do not restore power supply unless panels are replaced.

APPARATUS IS SAFE - *ONLY IF YOUR APPROACH IS CORRECT*

NOTE TO READERS

The subject matter of this publication may be affected by Defence Council Instructions, Servicing schedules (Volume 4 and 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 black 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.

LIST OF ASSOCIATED PUBLICATIONS

	A.P.
◀*Radar Type* 13 (*Mk.* 7) *and* 14 (*Mk.* 7, 8, 9, 10 *and* 11)	2527*B*▶
Information generator for radar stations	2527*C*
Test equipment for mobile and static radar stations	2527*D*
Information generation and distribution for static radar stations ...	2527*E*
▶◀	
Radar convoys	2527J
Marker unit (video map) Type 30	2527*R*
Mobile operations room Type 1 (*RVT*.510)	2897*Q*
Consoles Type 61, 61*A and* 61*B*	2897*NB*

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

LEADING PARTICULARS

Purposes of equipment	Type 60 is a PPI display console primarily for use in radio vehicle Type 510.▶◀
Signal input	Video frequency derived from an associated receiving chain on the information generator rack assembly. Range marks from an external calibrator unit, and azimuth marks (or a video map) can also be displayed.
Type of display	Normal PPI with provision for off-centring up to one radius of the CRT. On-centre PPI display for putting-on purposes in conjunction with radar Type 13. The orientation of the Type 13 aerial is shown by an azicator cursor upon a scale graduated in degrees with an auxiliary scale by which the cursor indication can be estimated to within $\frac{1}{8}$ deg.
Power supplies	(*a*) 230 volts, 45–60 c/s, maximum current 1·5A, plus power for turning gear control, timebase, and azicator selsyns; the power consumption of these selsyns is dependent upon operating conditions. (*b*) 50 volts, DC, maximum current 1A, for relay operation.
Weight	812 lb.
Dimensions	27 in. by 31 in. by 49½ in. overall.
Cooling	Air cooled, supply through an aperture in base, exhaust from side panel in mobile or rear panel in static installations.
Air flow requirement	125 cu. ft./min., at a pressure of 1 in. water gauge.
Principal components	Indicating unit CRT, Type 30, Stores Ref. 10Q/16071, embodies PPI tube, scan coil and azicator selsyns and EHT power pack for CRT giving 8 kV at 1mA. Timebase unit Type 129, Stores Ref. 10D/18327, embodies timebase circuits and video amplifying strip. Power unit Type 742, Stores Ref. 10K/16093, provides 350-volt 250 mA (max.) positive HT and 300-volt 200 mA (max.) negative bias. Control units (training) Type 910 and 911, optical assembly right-hand, Stores Ref. 10AT/528, and left-hand, Stores Ref. 10AT/527, for aerial position laying. ▶◀
Finish	Grey to B.S.S. 381/C, No. 632.

INTRODUCTORY

1. This chapter deals with the console Type 60 in broad outline, from functional and operational aspect. The principles underlying certain features of the equipment are explained in detail, but the precise method of applying these principles is left for consideration in later portions of the Volume.

Purpose of equipment

2. A general view of the console Type 60 is given in fig. 1. The console is a display unit for the PPI presentation of radar and IFF information, with inherent range and azimuth correlation between the radar and IFF responses. The console accepts radar video and IFF video signals and must be used in conjunction with other equipment by which the radar and IFF radio-frequency responses are converted, first to intermediate frequency, and then into video signals.

3.◀The console has been designed primarily for use in mobile radar operations room known as radio vehicle Type 510. The console is specifically required to operate in the mobile installations radar Type 14 Mk. 10, Type 14 Mk. 11, Type 15 Mk. 5 and certain combinations of these. It is adapted to be used as a "putting-on" console for radar Type 13 Mk. 7, the responses from this equipment being, however, displayed upon an associated H/R console, normally the console Type 61. It is also adapted to provide IFF Mk. 3 range information on its own PPI and the IFF display of console Type 61, but, since the advent of IFF Mk. 10, this facility is not used. ▶

Construction

4. The console consists of a metal framework, of which the top, back and sides are enclosed by metal panels. The principal removable units are three in number, namely, the indicating unit (CRT) Type 30, the timebase unit Type 129, and the power unit Type 742. In addition to these, certain components are mounted directly upon the console framework; these comprise two complete sets of turning gear controls, the two controls selsyns for the turning gear, and certain relays. A number of electrical controls of the potentiometer type and several G.P.O. key switches are mounted upon the control desk in front of but immediately below the face of the CRT. The timebase unit also contains a video amplifying strip; to help to keep this in mind it will sometimes, in this chapter, be referred to as the timebase and video amplifying unit.

5. The indicating unit is mounted in the upper part of the console in such a manner that the CRT screen slopes backward at an angle of about 20 deg. It is fitted with four trunnions by which the weight is supported in a cradle. This cradle has two side members each of which is telescopic and has three sections; one of these is fixed to the console framework, the other two members are extensible. When the indicating unit is in the operating position, the three members are telescoped one inside the other. The rear lower member of the indicating unit carries a fork which engages with a lug upon a carriage supported by two bars, the carriage being movable along the bars by a lead screw. The indicating unit can therefore be moved forward and upward along the bars, by rotating the lead screw. A handle is provided for this purpose; when not in use it is stowed inside the console. A safety switch is incorporated in the assembly in such a manner that the mains supply to the console is opened when the indicating unit has moved forward a few inches. The supply circuit so opened is automatically closed when the indicating unit is returned to the operational position (*para.* 86).

6. All incoming and outgoing cables are taken to an input panel at the rear of the console, below the indicating unit. This panel carries eight 12-way Jones plugs (recessed into wells) and 22 co-axial plugs (F and E type). Jones plugs L and M carry cables to No. 1 turning gear control, J and K carry cables to No. 2 turning gear control, and Jones plug N carries the cables to the two turning gear selsyns. Jones plug O carries the cables for the deflection coil selsyn and the azicator selsyn, and also one lead into the auto-alignment cam (*para.* 43).

7. Jones plug P carries cables for two phase potentiometers associated with No. 1 and 2 turning gear controls, the mains input to the console, and certain operational services. Jones plug Q carries operational services only. A point-to-point diagram of the inter-connections between the input panel and other panels is given in fig. 10.

OPERATIONAL FEATURES

8. The principal operational features of the console are as follows:—

(1) Selection of any desired azimuth as the centre line of an expanded sector display. For this application, the timebase origin can be off-centred up to one radius of the CRT by means of an off-centring coil assembly. The off-centre distance and the centre bearing of the sector can be set independently by controls mounted on the indicating unit.

(2) Special switching permitting the console to be used with a twin-aerial system, in which the two aerials rotate synchronously, but with the aerials looking in directions 180 deg. apart at all times. Responses received over an operational arc of up to 180 deg. are received alternately from each aerial and are displayed upon the CRT as a single picture owing to the long afterglow of the PPI tube.

(3) Switching by which the IFF signals may be displayed or removed at will.

(4) A self-aligning system whereby the timebase selsyn recovers its alignment with the aerial selsyn, if it is for any reason disturbed. An electronic heading (or azimuth indication) marker is provided to check the alignment of the timebase with respect to the aerial array.

(5) Provision for the display of information from three different radar aerials, either separately, or in certain combinations of two, as in sub-para. (2) above, ◀and for the employment of the corresponding sync. pulse, range-marks generator and azimuth-marks generator.▶

(6) In some applications, an electronic map of the operational sector may be displayed, instead of the range and azimuth marks referred to in sub-para.(5).

(7) Provision was made for range correlation between radar responses on the PPI display and the IFF Mk. 3 display on an associated console Type 61.

Turning controls

9. Reference has been made to the use of console Type 61 in conjunction with radar Type 13 Mk. 6 and 7. The latter are height-finding equipments, radiating a fan-shaped beam fairly wide in azimuth but subtending only a few degrees in elevation. The Type 13 aerial sweeps in elevation, but does not normally sweep in azimuth, being directed on to any required bearing by the PPI operator. The operation is usually known and has already been referred to in para. 3, as "putting-on."

10. Console Type 60 is therefore fitted with two entirely independent sets of turning gear control. One set is of course used to control the aerial system or systems giving the PPI display. The other set is then available for the turning gear of the Type 13 aerial so that the PPI operator can direct the height-finding aerial on to any bearing he desires. AZ. IND. and H/R strobes are provided to assist in the identification of the desired response during this operation, and are described in para. 65—67.

11. The turning controls are designed for use with both mobile and static versions of the BTH amplidyne turning gear. Each set of controls comprises a TURNING CONTROL, a SPEED control and a SWEEP ANGLE control, fitted upon the control unit (training) Type 910 or 911, together with a manual position control and a phase control, mounted just below the control desk of the console. The manual position control is a hand-wheel which controls the angle of the rotor of the turning gear control selsyn relative to the stator windings. The phase control is a pre-set potentiometer and is used to adjust the phase of the turning gear motor for reasons explained later in connection with twin aerial sweeping (*para.* 37).

12. The four positions of the TURNING CONTROL switch permit any of the following methods of sweeping to be used:—

Position	Setting	Method
Position 1 POSITION CONTROL		For laying to a definite azimuth, by means of the manual position control.
Position 2 SECTOR SWEEP	...	The extent of arc to be swept is governed by the SWEEP ANGLE control, and the middle of the swept arc is controlled by the setting of the manual position control. The maximum arc is 120 deg.
Position 3 CLOCK Position 4 ANTI-CLOCK	CONT-ROT.	Continuous sweeping in either the clockwise or counter-clockwise direction.

The normal speed of sweeping is six r.p.m., speeds slightly in excess of this being possible. Arcs of less than 120 deg. are swept at a reduced speed which must not exceed 16 deg. per second. The SPEED and SWEEP ANGLE controls are geared together in such a manner that when sweeping a restricted arc, the permitted maximum rate of sweep cannot be exceeded.

13. When the TURNING CONTROL switch is in position 1, the aerial system may be position-layed on any desired bearing by the use of the hand-wheel underneath the control desk. A fine reading of the bearing is afforded by an optical system which projects an enlarged image of a portion of a scale showing the bearing upon an opal glass screen fitted on the training control unit. The scale is graduated at intervals of one-half of a degree, and as each interval, when projected, extends over a length of $\frac{1}{4}$ in., it is possible to estimate the bearing to within (approximately) one-eighth of a degree. The SPEED and SWEEP ANGLE scales are illuminated by rear lamps when the TURNING CONTROL switch is in position 2, but the SPEED scale only is illuminated when the switch is at position 4. The lamp in the optical projector is switched off in positions 2, 3 and 4. The principle of the optical system is shown in fig. 2.

Note . . .

Safety devices are fitted to the POSITION CONTROL *hand-wheel and the turning control switch, to prevent the aerial being turned while personnel are working on the aerial or in its immediate vicinity. Details are given in Chap.* 3 *para.* 10 *of this Part.*

Azicator

14. The bearing upon which the height-finding aerial is trained at any instant is shown by a glass cursor, carried upon a rotatable ring mounted around and outside the face of the PPI tube. This cursor has three parallel lines engraved radially, to enable the operator to avoid parallax errors in reading, with short perpendicular lines near the inner end. The intersection of the middle cursor line and middle short line indicates the mechanical centre of the display. The cursor is carefully aligned during initial assembly in such a manner that the intersection referred to remains dead central when the cursor is rotated; care must be taken not to disturb this alignment. The cursor is edge illuminated by a lamp mounted in a housing on the cursor mounting assembly. A special jig is provided for aligning the cursor, so that in the event of breakage, a new cursor may be fitted with the required degree of precision.

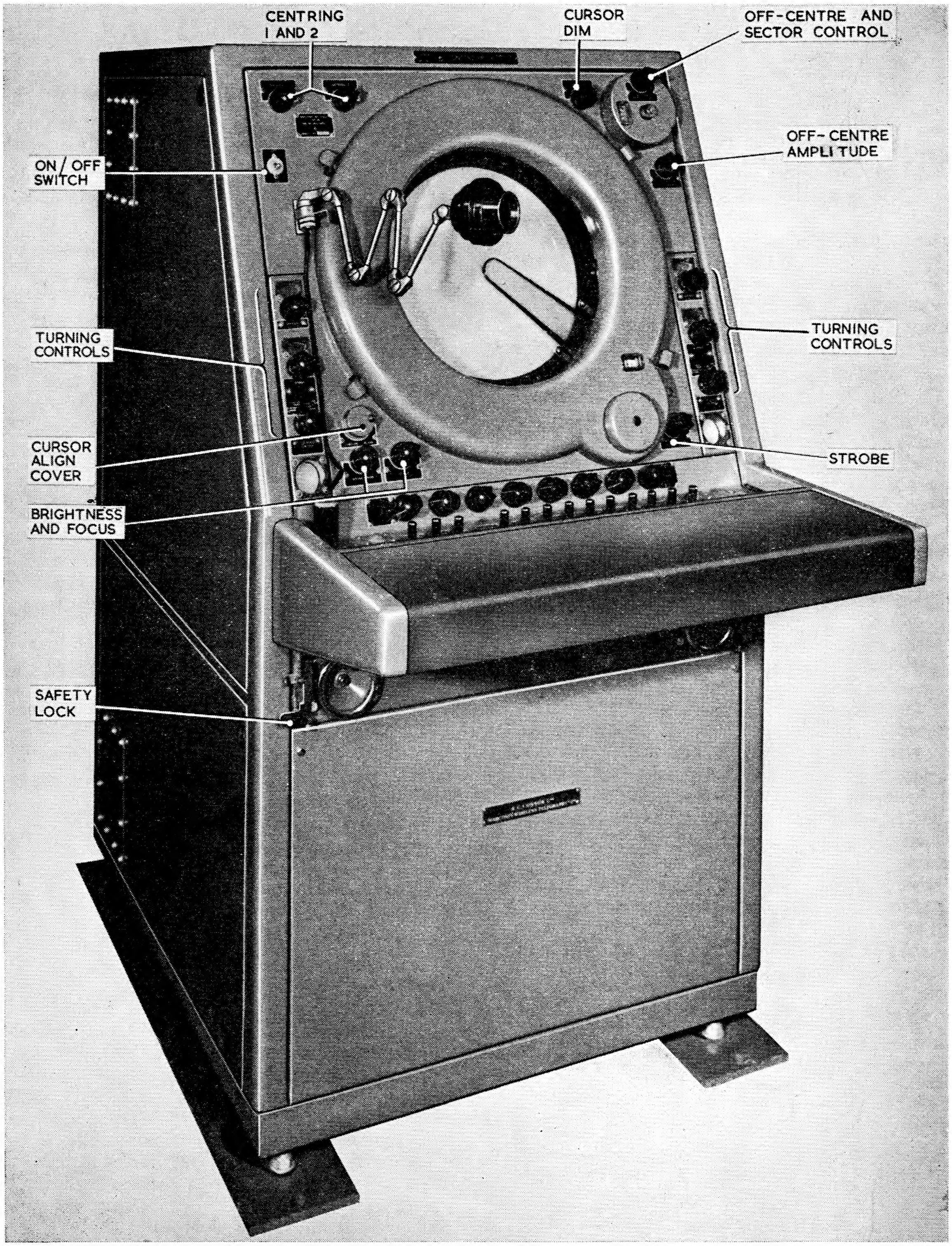


Fig. 1 Console Type 60, general view

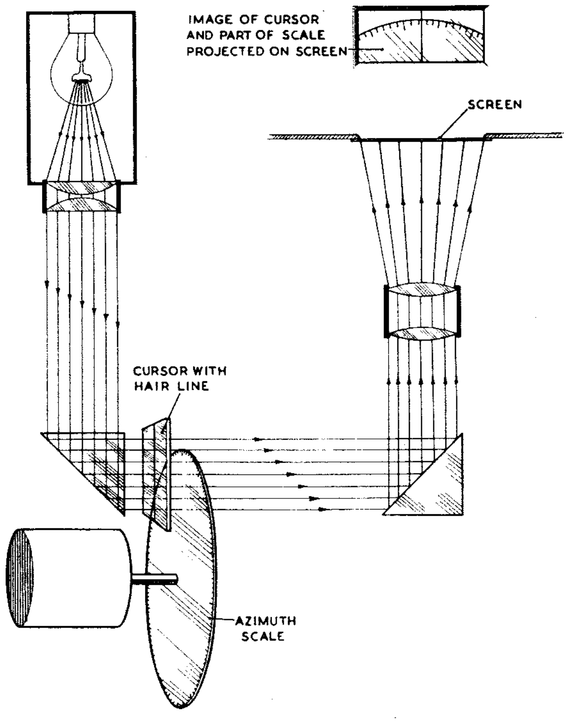


Fig. 2 Turning gear control, optical projector system

15. A selsyn transmitter, carried upon the rotating aerial structure and driven by the aerial rotation, is connected phase by phase to a receiving selsyn in the PPI mounting. The rotatable ring previously referred to is driven by the receiving selsyn through a train of gear wheels. Provided therefore that the selsyn system is properly aligned, the cursor line shows the bearing upon which the height-finding aerial is actually trained. The glass cursor is usually referred to as the azicator and the rotatable ring as the azicator ring.

16. Where the Type 13 height-finding equipment is not installed (e.g., in radar Type 15 Mk. 5) the azicator is not required and provision is made for folding it back out of the way. Special arrangements are made to allow the PPI tube to be removed for replacement without any danger of fouling the azicator.

Video signal arrangements

17. In most practical applications the conversion from radar RF to the intermediate frequency (45 Mc/s) is performed in a head amplifier mounted in close proximity to the radar aerial system, the intermediate frequency signals being then conveyed to the receiving point by low-loss co-axial cables. The signals are converted from IF to video frequency at the receiving point and are then fed into the console Type 60. As a rule, the conversion of radar IF to radar video signals is made by units of a rack assembly known as the information generator to which further reference will be made. A suitable control unit is used to control the narrow bandwidth amplifier, short time constant circuit, and low-pass filter circuits, in the signal chain of the I.G. Although housed in different units, these elements of the signal chain are basically similar to those used in the signal chain of console Type 61.

18.◀In contrast, the IFF Mk. 10 responses are converted directly into video signals by a separate head amplifier in the vicinity of the IFF aerial system, and after decoding by equipment in RVT 511, are conveyed to the display point by co-axial cable.▶

19. Suitable distribution boards are fitted to permit the distribution of both radar and IFF video signals to the consoles upon which the signals are to be presented.

Range and azimuth marks

20. Neither range nor azimuth marks are generated in the console and if these are required they must be provided by suitable marker units which are usually housed in the information generator.

21. In static applications, however, azimuth marks may not be used to determine the positions of responses relative to the radar station. Instead, a map will be provided upon the face of the PPI tube; this will be painted electronically in the manner briefly described below. Since the electronic input for this purpose is at video frequency, the map is usually referred to as the video map.

Video map presentation

22. Detailed information regarding the production of the video map will be found in A.P.2897R, entitled "Marker unit (video map) Type 30." The following brief outline is given here to avoid cross reference where only the basic principles are required to be known. The marker unit (video map) Type 30 is often referred to for brevity as the video mapping console, and this term will be used in what follows.

23. The basic principle of the video mapping console is shown in fig. 3. The deflection coils of a cathode-ray tube are rotated about the axis of the tube by a selsyn motor which is controlled by a similar selsyn on the aerial turning gear, the system being to all intents and purposes a duplicate of the coil rotating mechanism of the console Type 60. The deflection coils are fed from a timebase unit which is synchronized from the same source as the console Type 60. As a result, a rotating radial trace (synchronized and aligned in azimuth with the trace on the PPI tube) appears on the mapping CRT. This trace is not modulated by signals of any kind, and so appears on the screen of the mapping CRT as a bright line, rotating at the speed of the aerial system.

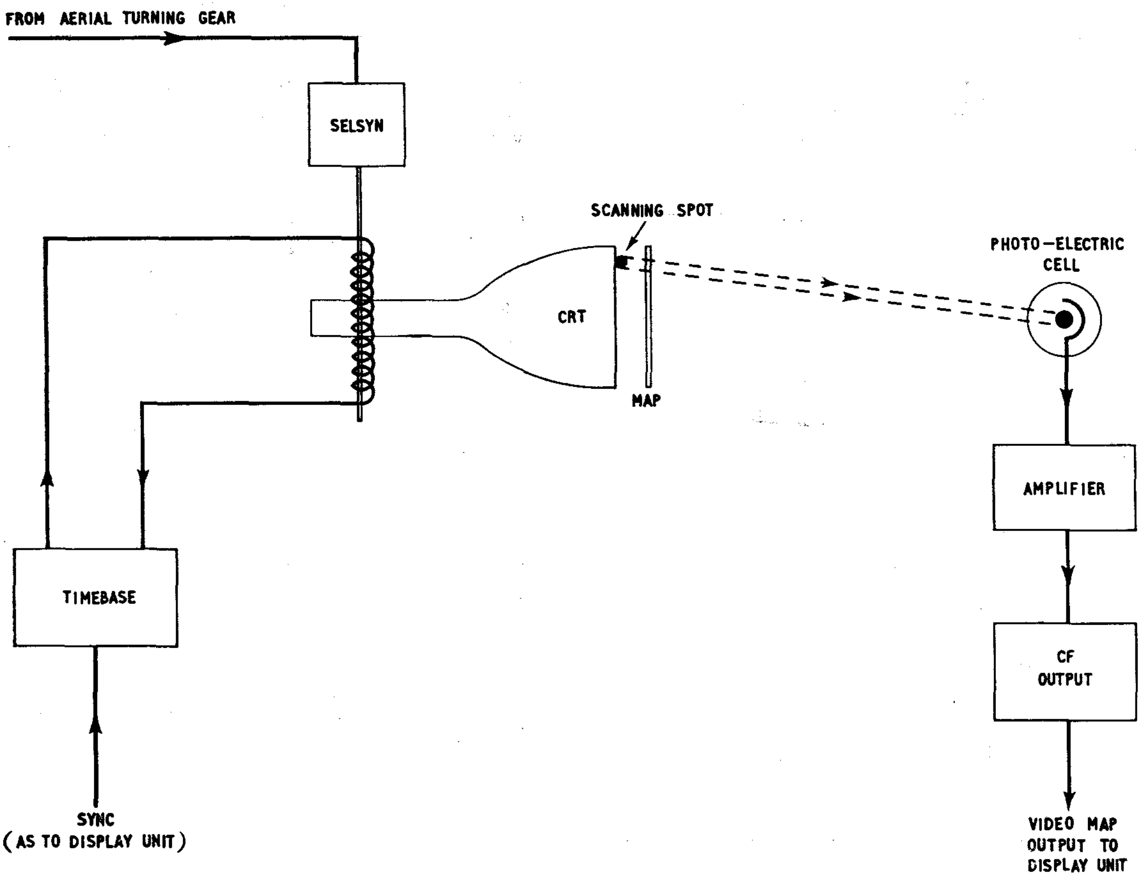


Fig. 3 Principle of video mapping system

24. A photo-electric cell is placed in such a position that the light from the CRT screen can be focused upon it by a suitable optical system (not shown in *fig.* 3), and the map which it is required to produce upon the PPI tube is placed in front of the screen of the mapping CRT. The map is in the form of a photographic negative, the detail being formed of transparent lines upon an opaque ground. The photo-electric cell is therefore modulated by the map pattern as it is scanned by the rotating trace of the CRT, and the output from the photo-electric cell will consist of a series of pulses having an amplitude proportional to the intensity of the light passing through the map at any given point in the trace.

25. As already stated, the map consists of clear lines upon a very dense field and, consequently, the pulses will be of sensibly equal amplitude. The PE cell output is amplified (actually a photo-electric multiplier is employed for this purpose) and the amplified video output is applied as positive-going pulses to the control electrode of the PPI tube. As a result, the video map paints the face of the latter just as any other intensity-modulated signal would do. In practice, the video map signals are mixed with the radar and IFF video signals (*para.* 71–77) so that the latter are applied to the PPI tube in exactly the same manner.

26. The actual video mapping console contains several refinements not mentioned above, the most important being the provision of duplicate maps. It will be appreciated that the video map, in general, consists of an outline of any coastline, country boundaries and the like in the area covered, together with a "grid" by which the position of any response can be reported without reference to bearings and distances from the radar aerial. If the reference is to be made with high accuracy, e.g., to the nearest half mile, the structure of the grid must be correspondingly fine, and may tend to mask responses, particularly those at long ranges. It may, therefore, be convenient to provide one map gridded only to five or ten mile squares, and a second map gridded to half-mile or one-mile squares.

Three-channel switching facility

27. The console Type 60 is provided with switching facilities by which any one of the three different channels may be selected. The following inputs are provided for each channel:—

(1) Radar video.

(2) IFF video.

(3) Range marks (calibration rings at 5-mile intervals)

(4) Range marks (calibration rings at 10-mile intervals).

(5) Video map (or radial azimuth marks where the video map is not provided).

(6) Sync. pulse.

28. It should be noted that the sync. pulse associated with a particular channel not only synchronises the timebase in console Type 60, but is also used to synchronize the range marks generator and video mapping console associated with the same channel.

29. The three channels of radar video are referred to as RADAR VIDEO 1, RADAR VIDEO 2 and RADAR VIDEO 3, with corresponding nomenclature for the IFF video, range marks, video map and azimuth marks.

30. The switching between channels is accomplished by a number of relays, the general principle being shown in fig. 4. It will be seen that relays REL. 10 and REL. 11 are connected in parallel and always operate together. Relays REL. 2, REL. 5 and REL. 6 are also connected in parallel and, therefore, always operate together. Relay REL. 6 is the trace reversing relay; its function is explained later (*para.* 37–40).

31. The relays are controlled by switches in such a manner that any one of the three channels can be connected to the appropriate points in the timebase and video amplifier unit or, alternatively, certain combinations of two channels can be used for twin aerial sweeping as explained later. When none of the relays is operated, RADAR VIDEO 1, IFF VIDEO 1, VIDEO MAP 1, etc., are all connected to the appropriate inputs. When only relays REL.

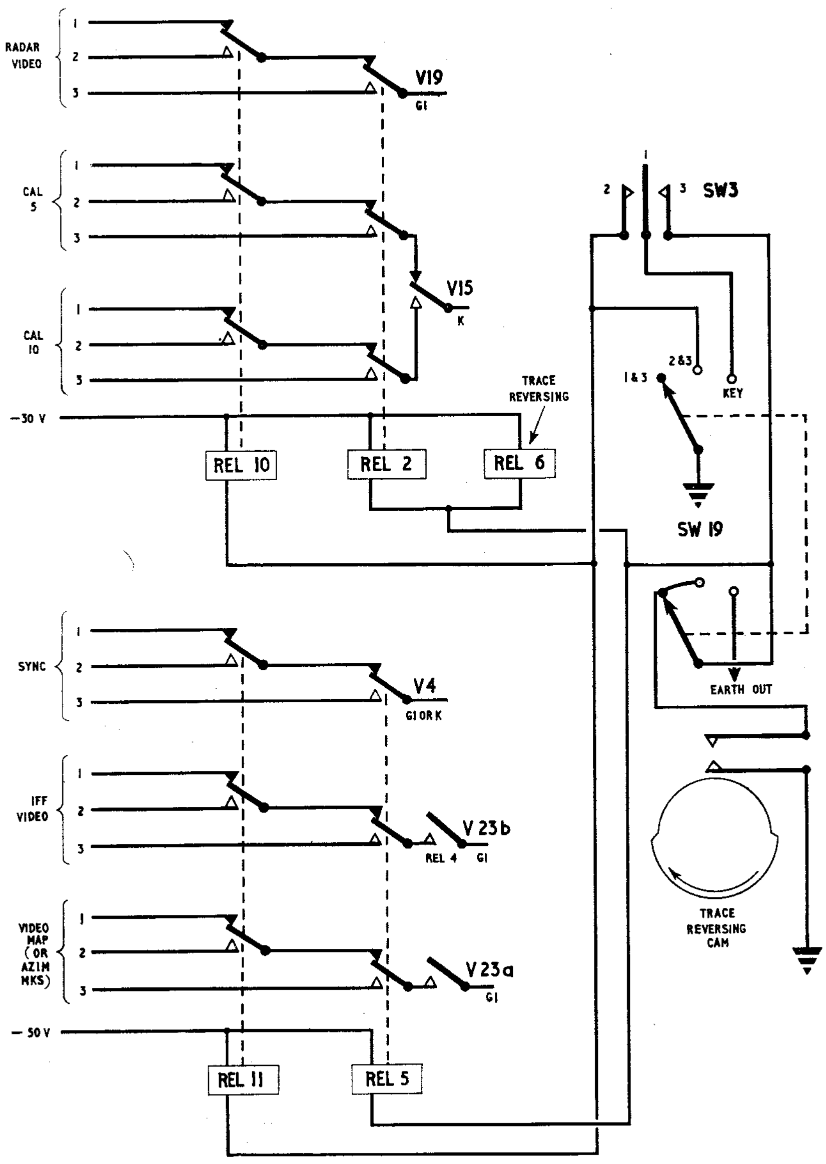


Fig. 4 Three-channel switching system

10 and REL. 11 are energized, all channel 2 services are connected. Similarly, when only REL. 2, REL. 5, and REL. 6 are energized, all channel 3 services are connected and the direction of the timebase stroke is reversed.

32. The combinations of two channels which are available are:—

(1) Channels 1 and 3

(2) Channels 2 and 3

The two-channel switching is performed by a cam—subsequently referred to as the trace reversing cam—which is mounted at the front end of the tube carrying the PPI deflection coils and rotates with the latter. This cam operates a pair of contacts forming a part of the relay operating circuit. The contacts are carried on an insulating block which is mounted upon a large gear wheel: the latter also carries the off-centring coils. This wheel can be rotated through a train of gearing by means of a hand-wheel fitted on the front panel of the indicating unit. The arrangement is shown diagrammatically in fig. 5.

33. The switches referred to in para. 31 are two in number. One of these is of the three-position selector type, and is called the AERIAL COMBINATION switch, SW19. The three positions are marked KEY, 1 AND 3, and 2 AND 3. The other switch is of the three-position G.P.O. key type, and is called the AERIAL SELECTOR switch, SW3. The mid position is marked 1, the rear position 3 and the forward position 2, the numbers referring to the three channels. The switch is locking in both forward and rear positions.

34. When the aerial combination switch is in the KEY position, the required channel is selected by placing the key switch in the appropriate position. It will be seen from fig. 4 that the trace reversing relay REL. 6 is operated only when the key is in position 3.

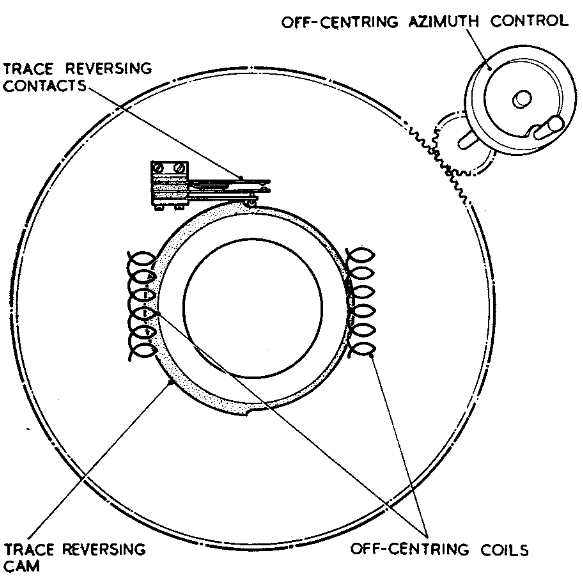


Fig. 5 Trace reversing cam and contacts on off-centring coil pinion

35. When the aerial combination switch is in the position 1 AND 3, however, either channel 1 or channel 3 services are connected to the display, according to the relative positions of the trace reversing cam and trace reversing contacts. If the cam is in a position in which the contacts are closed, relays REL. 2, REL. 5, and REL. 6 are operated, and channel 3 is connected to the display, otherwise the channel 1 services are connected. Similar considerations apply when the aerial switch is placed in the position 2 AND 3, except that channel 2 services are connected when the trace reversing contacts are open, and channel 3 services are substituted when the contacts are closed.

36. From the foregoing, it will be seen that whenever the channel 3 services are in use, the relay REL. 6 is operated. The reason for this provision is explained below.

Twin aerial sweeping

37. The necessity for the trace reversal arises from the provision of the twin aerial sweeping facility. Radar Type 14 Mk. 10 and Mk. 11 are complementary to each other, in that Mk. 10 gives an extra low cover, while Mk. 11 gives a low to medium high cover. The current practice, when using these equipments on the same installation, is to site them as close together as practicable, and to arrange for the aerial arrays to be rotated in synchronism but looking in opposite directions. Since in practice it is not usually required to cover a sector of more than 180 deg. it is possible to arrange for the responses from the two separate radio transmitters to be displayed alternately upon the same console.

38. As an example, consider a mobile station where one radar Type 14 Mk. 10 (extra low cover) is used in conjunction with one Type 14 Mk. 11 (low to medium high cover) and one radar Type 15 Mk. 5. Then the No. 3 channel of the display would be associated with the Type 14 Mk. 10 equipment, and the other two channels would be used for the other two equipments. In the radio vehicle Type 510, the special facilities required for radar Type 15 Mk. 5 are provided on channel 1 only, hence radar Type 14 Mk. 11 would naturally use channel 2. The aerial heads for Type 15 Mk. 5 and Type 14 Mk. 11 would be lined up and synchronized looking in the same direction, but this will be exactly opposite to that in which No. 3 is looking.

39. Assuming now that the aerial combination switch is in the position 1 AND 3, the manner in which the twin aerial sweep operates is shown diagrammatically in fig. 6. In fig. 6(a) No. 1 aerial is just beginning to sweep the 180 deg. operational sector from left to right, and the trace on the PPI tube is sweeping in the corresponding direction on the screen. It will be observed that the trace reversing contacts are open.

40. Fig. 6(b) shows the conditions at the mid-line of the operational sector; they are substantially, the same as in fig. 6(a). In fig. 6(c), however, No. 1 aerial has just completed sweeping the operational sector and No. 3 aerial is just about to commence to sweep the same arc. At this point it is necessary to reverse the direction of the timebase trace sweep on the PPI tube, otherwise it would sweep in the direction corresponding with that in which No. 1 aerial is looking. This is done by the trace reversing cam and its contacts, the latter closing just as No. 3 aerial starts to sweep the operational sector.

Phasing control

41. When using the twin aerial sweep it is of the utmost importance that the pictures displayed by the high-looking and low-looking aerials should be perfectly superimposed, so far as permanent echoes, range marks, azimuth marks, video map, etc., are concerned. It is not possible, in practice, to site the aerial systems in such a manner that this requirement is inherently fulfilled. This is because the two aerials have to be sited at some little distance from each other, e.g., up to 400 yards apart. The procedure adopted is to align the aerial systems so that they rotate approximately 180 deg. apart in space phase, having due regard to the horizontal displacement of the aerials, and to perform a final adjustment of the phase of rotation by means of the phase control of the turning gear.

Expanded sector sweep

42. Again referring to fig. 5, the trace reversing contacts are mounted upon the large gear wheel in such a manner that the trace reversal occurs at the azimuth perpendicular to the direction of the off-centring. The direction and magnitude of current through the off-centring coil (and therefore the off-centre distance) is controlled by a potentiometer knob on the front panel of the indicating unit. The trace origin can be off-centred to about one radius of the tube. The direction of off-centring is controlled by rotating the large gear wheel, using the off-centring azimuth control on the front panel. When using a two-aerial combination, continuous rotation must be used so that trace reversal will occur at the correct bearing (i.e., perpendicular to the mid-azimuth of the operational sector). The arc can be swept either clockwise or counter-clockwise. When sweeping with one aerial only, a restricted arc can be swept (*para.* 11).

Auto-alignment

43. The principle of the auto-alignment device is shown in fig. 7. The PPI deflection coils are driven

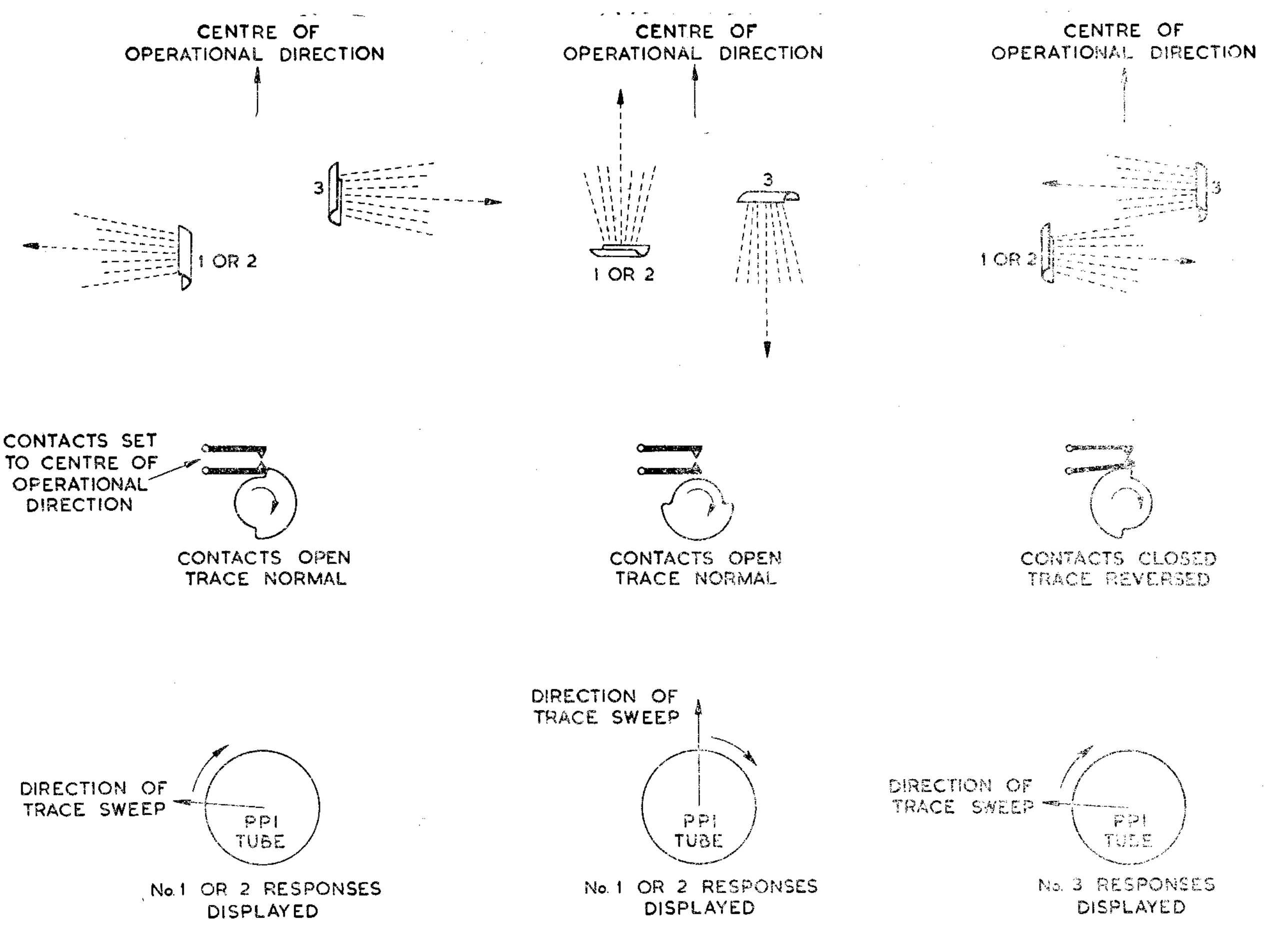


Fig. 6. Twin aerial sweep, showing trace reversal

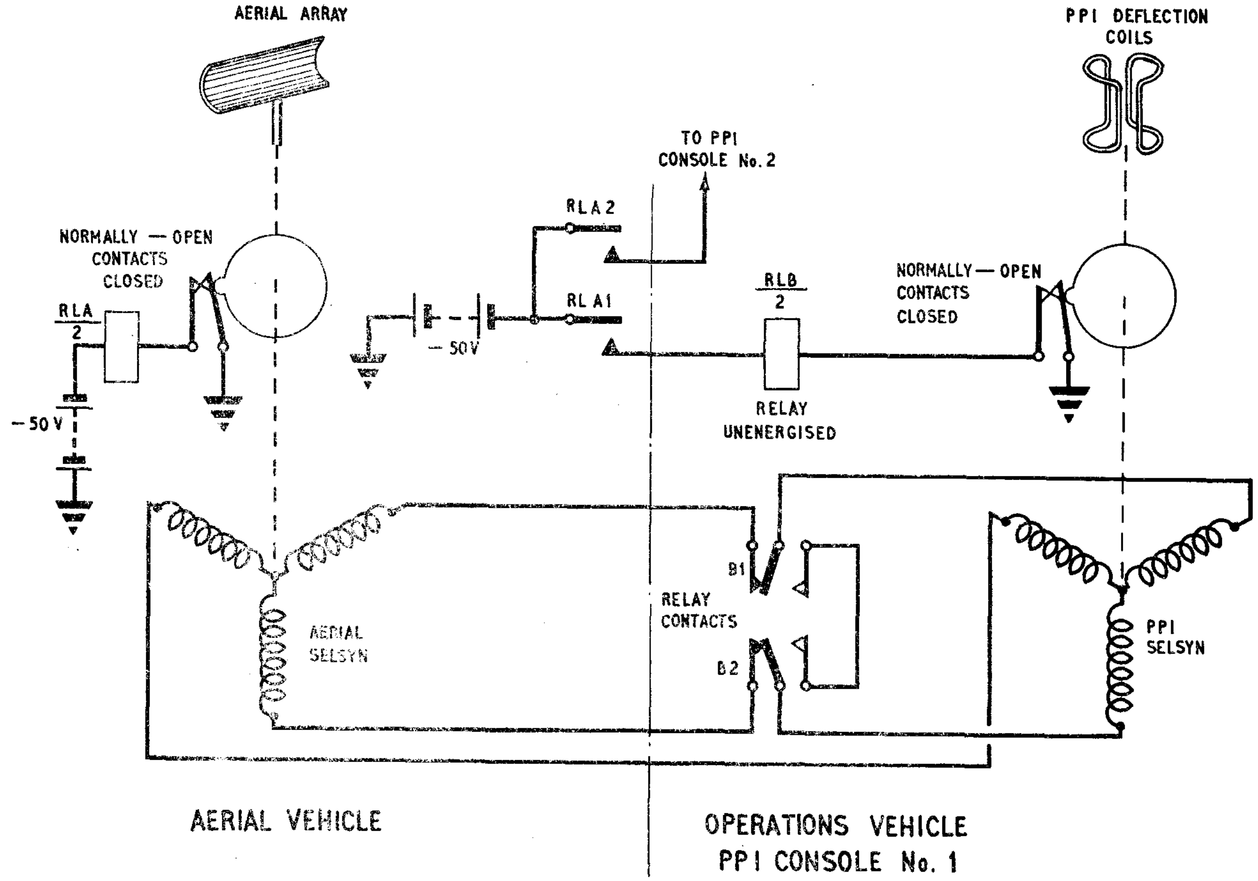


Fig. 7. Principle of auto-alignment system

in the usual manner by a receiving selsyn through a gear train (omitted for simplicity). The receiving selsyn in turn is rotated in synchronism with a transmitting selsyn geared to the main rotating system of the aerial (this may be either of the turntable type, or a pivot mounting). Driven through a one-to-one gearing from the turntable or pivot mounting is a cam, the contour of which is circular except for a projection at one point. A pair of contacts is associated with this cam; these are always open except when the projection causes them to close momentarily.

44. A similar cam is mounted in the coil rotating mechanism of the PPI. This cam rotates in one-to-one relationship with the deflecting coils; the contacts associated with this cam open and close simultaneously with those in the aerial cabin so long as the aerial and PPI coils are in alignment.

45. The contacts of the cam in the aerial cabin are connected in series with a relay A/2, on a 50-volt DC supply. This relay has a number of normally-closed contacts, one pair for each PPI driven from the aerial system. The pair A1 are in series with the cam contacts on No. 1 PPI console, the circuit being continued through a second relay B/2 and a 50-volt DC supply. This relay is fitted with two pairs of change-over contacts, arranged in such a manner that when the relay operates, two phases of the receiving selsyn are disconnected from their lines and short-circuited upon themselves.

46. The action of the auto-alignment circuit is as follows. So long as the selsyns remain in alignment, the circuit to relay B/2 is never completed, because the relay A/2 opens its normally-closed contacts when the cam contacts close. Suppose, however, that the alignment is disturbed, e.g., by a short duration failure of the AC supply to the rotor of the PPI selsyn. When this supply is restored, the PPI selsyn will resume its rotation but it will no longer be in alignment with the aerial selsyn.

47. The rotation will continue, however, only until the PPI cam contacts close; at this instant, the aerial cam contacts will open and the contacts on relay A/2 will be closed, consequently relay B/2 will be energized. The contacts of this relay then disconnect two phases of the PPI selsyn from line, and short-circuit the phase windings upon themselves as already explained. Under these conditions the rotor of the PPI selsyn is rigidly locked in a stationary position with the cam contacts still closed.

48. This condition will persist until the aerial cam contacts close. The aerial and PPI selsyns are at this instant in alignment. When the aerial cam contacts close, relay A/2 will be energized and its contacts open, interrupting the circuit of relay B/2. The contacts of the latter then revert to normal, removing the short-circuit between the two phase windings and connecting the latter to their respective lines. The PPI selsyn then starts to rotate in phase with the aerial selsyn and will continue to do so unless again disturbed.

49. It will be seen that the time interval between the loss and restoration of the selsyn alignment cannot be greater than the time taken for one revolution of the aerial system.

DISPLAY FEATURES

CRT and timebase

50. The console is fitted with a 12-in. diameter cathode-ray tube having a long after-glow (of the order of one minute in complete darkness). The tube has a fluoride screen, aluminium backed, and is operated with the cathode near earth potential, so eliminating the necessity for high-voltage insulation of the heater and cathode circuits. Electromagnetic deflection is employed, the deflection coils being rotated (through reduction gearing) by a selsyn motor driven from the aerial system in the normal manner. The focusing is electrostatic, and the tube has three anodes, the first operating at about 1·7 kV, the second (focusing electrode) at about 2·2 kV, and the third, which is a post-deflection accelerator, in the region of 12 kV. A simplified circuit of the CRT supplies and controls is given in fig. 8.

51. The timebase generator and associated circuits have been designed to meet the following requirements:—

(1) A range control which does not alter the physical length of the trace.

(2) An amplitude control which determines the physical length of the trace quite independently of the setting of the range control.

(3) Linear trace brightness compensation giving constant brightness along the whole length of the trace.

(4) Provision for "strobing" between the PPI console and an associated H/R console in both directions, so that either operator can direct the other's attention to any particular response.

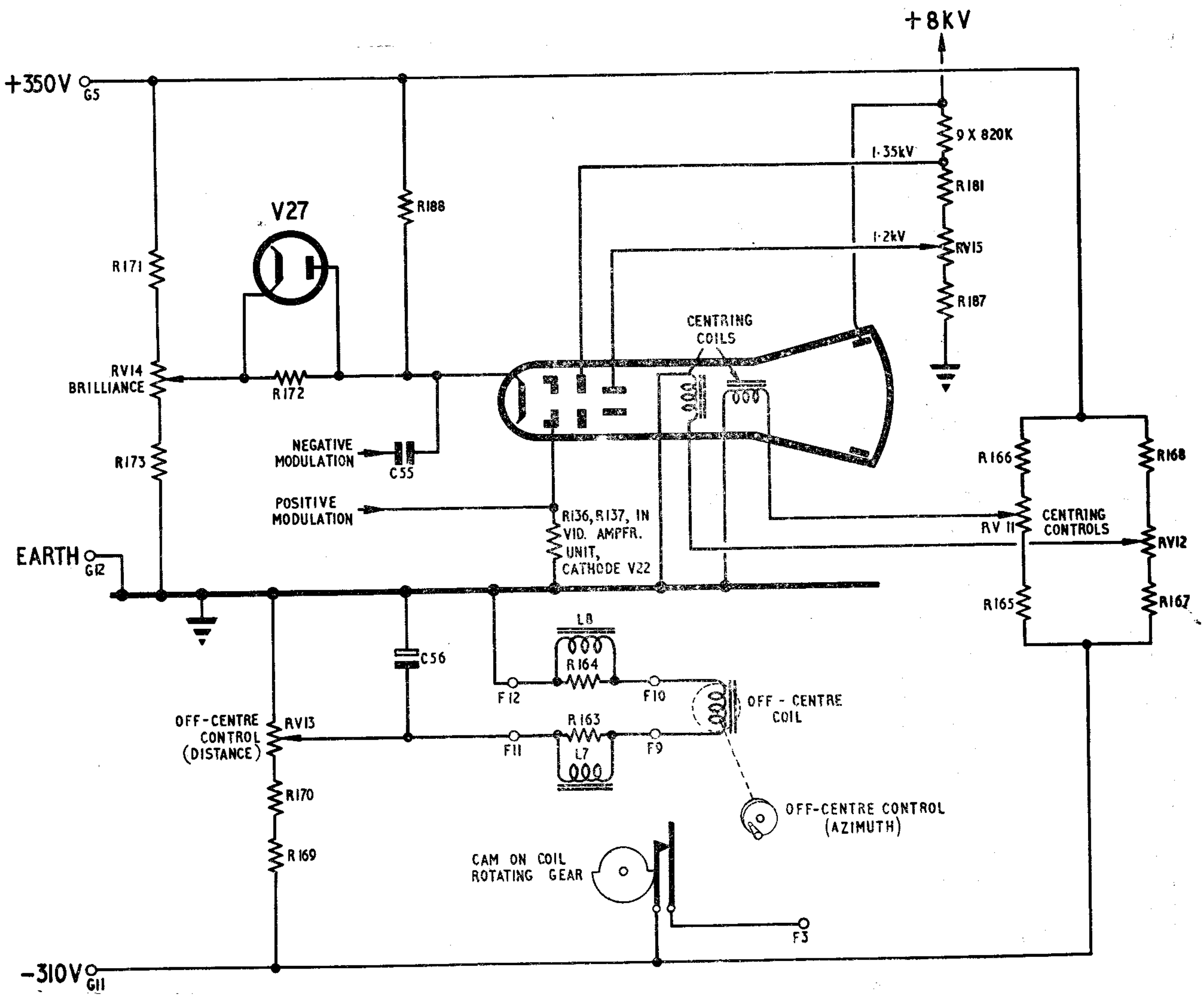
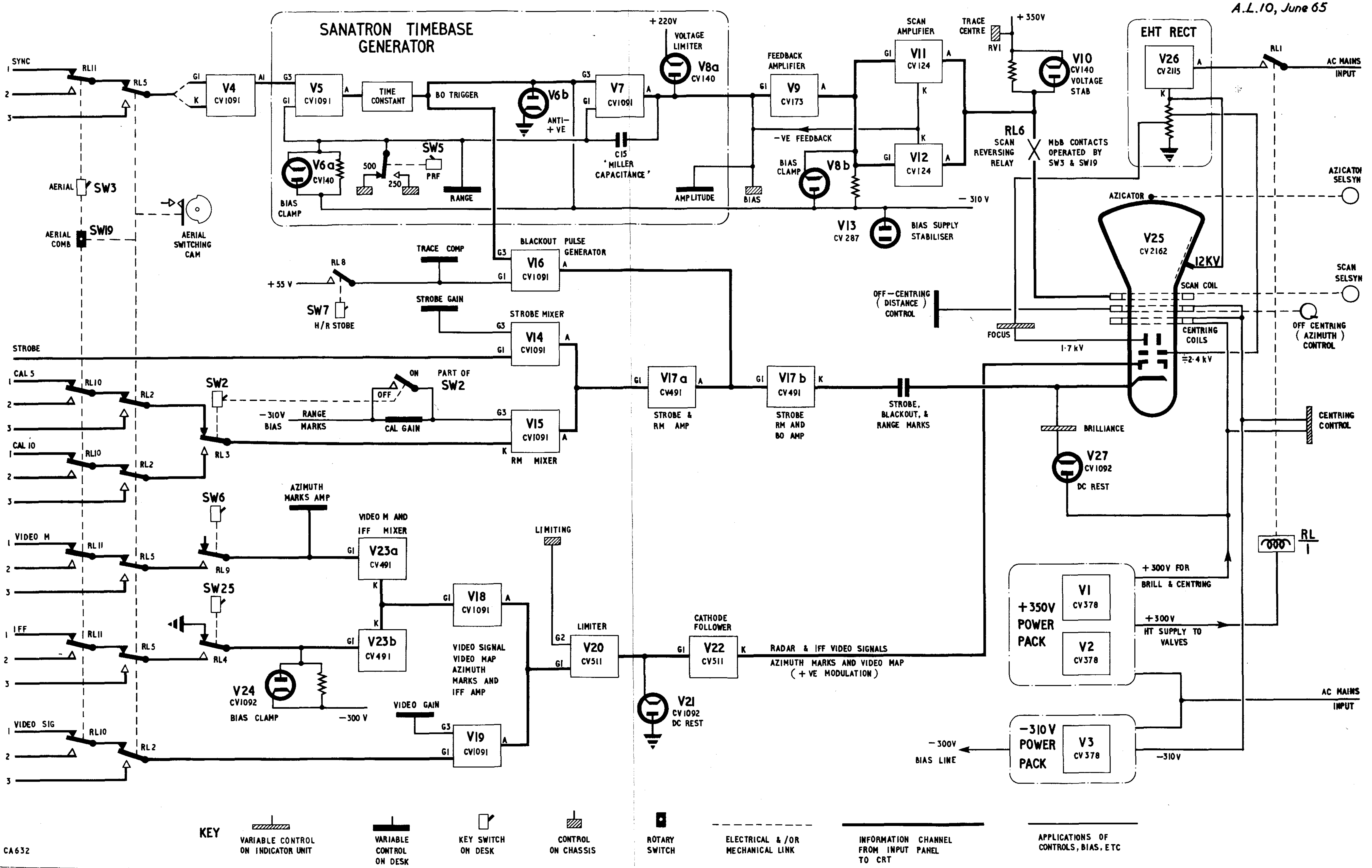


Fig. 8. CRT power supplies and controls, simplified



CA632

AIR DIAGRAM 6111A/MIN.

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

REPRINTED NOVEMBER 1958

Console Type 60 — block schematic

Fig. 9

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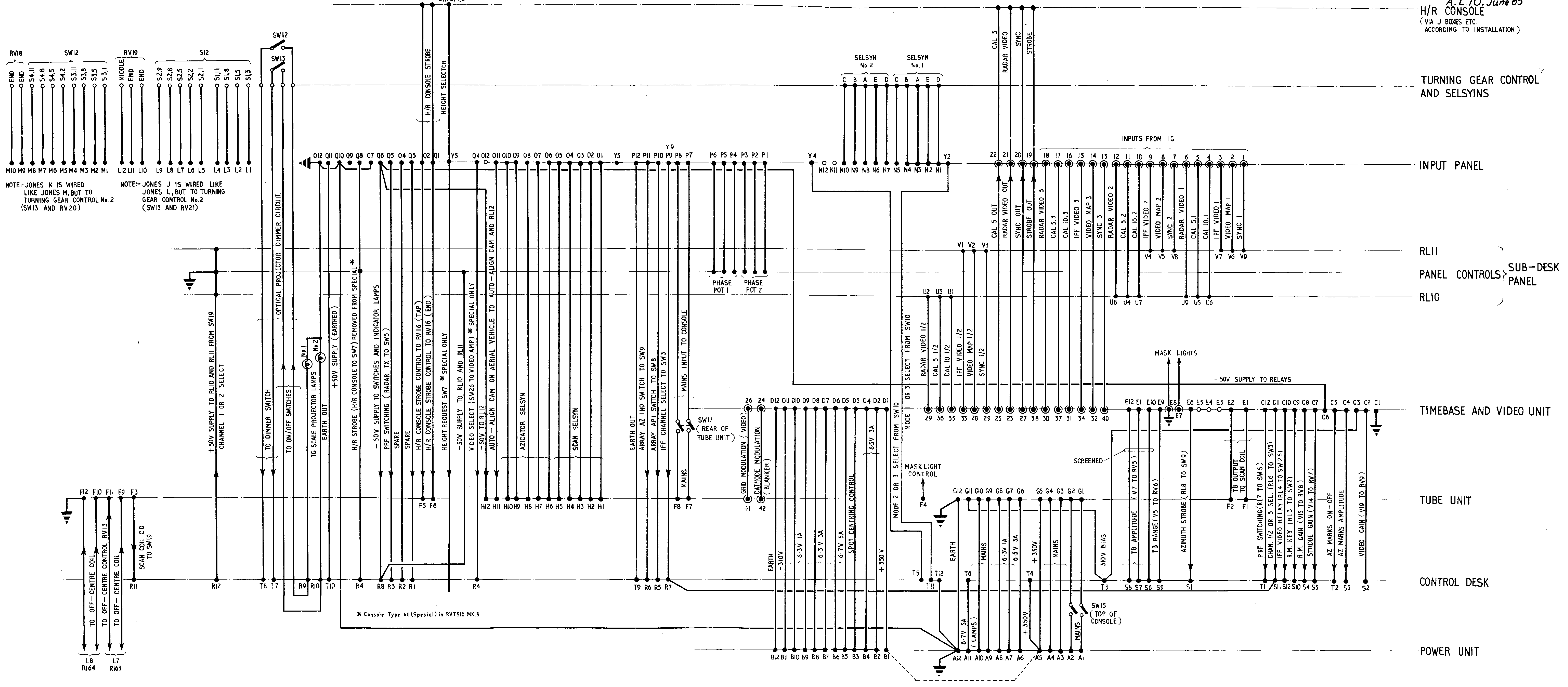
RESTRICTED



Point to point connections. Console Type 60

RESTRICTED

Fig. 10

Sanatron timebase generator

52. The principal features of the timebase will be described with reference to fig. 9. The selected sync. pulse is applied to V4, the amplitude being of the order of 15 volts. The pulse may be either positive-going or negative-going, since arrangements are made to apply it either to the control-grid or to the cathode of V4. The gain of the valve is substantially the same in each case, and the output is a negative pulse of about 30 volts amplitude. In addition to amplifying the sync. pulse, V4 acts as a buffer amplifier, isolating the sync. source from the sanatron timebase generator.

53. The sanatron timebase generator consists primarily of the pentodes V5 and V7, with subsidiary diodes V6A, V6B, and V8A. A detailed account of the action will be given elsewhere in this Volume. In brief, V7 is a Miller timebase valve giving the normal voltage run-down when triggered, while V5 introduces the necessary change of feedback conditions which are necessary for cyclic operation.

54. The controls associated with the timebase generator are three in number, viz., the RANGE control, which determines the duration of the Miller run-down, and two pre-set controls by which the sanatron is adapted for running at a suitable p.r.f. according to the working range. For working out to maximum range a p.r.f. of 250 c/s is used, but for ranges up to somewhat less than the maximum it is possible to operate with a p.r.f. of 500 c/s.

55. The p.r.f. change-over is operated by a relay REL.7, the latter in turn being controlled by a switch SW.5 (labelled PRF 250/500) on the control desk of the console. The RANGE control is of the potentiometer type and is also mounted on the control desk.

56. The diodes associated with the sanatron fulfil the following duties. V6A is a bias clamp, holding the bias on V5 at approximately —6 volts. V6B is an "anti-positive" clamp, preventing the suppressor-grid of V7 from rising above earth potential when triggered by V5. V8A clamps the anode voltage of V7 at a potential set by a fixed potential divider, approximately 220 volts.

57. The saw-tooth waveform generated by the valve V7 is fed into the timebase amplifier, which is in two stages. V9 is an amplifier with feedback from the cathode of the following output stage. The latter consists of V11 and V12 in parallel, so that the deflector coil current, which is the anode current of these two valves, will be adequate. Regulated negative feedback is applied from the common cathode circuit into the control-grid of the preceding stage V9.

58. The controls associated with the timebase output amplifier stages are three in number, viz., the AMPLITUDE control, regulating the physical length of the CRT trace, and two pre-set controls CV124 BIAS and SCAN CENTRE. The AMPLITUDE control is of the potentiometer type and is mounted upon the control desk. The other two are pre-set and are mounted on the front panel of the timebase unit. The scan centre control is actually returned to a potential slightly above the HT rail potential; its function is to "back off" the very small standing anode current which flows even when the valves V11, V12 are normally resting beyond the cut-off point of their Ia-Vg characteristics. Although extremely small, this current would otherwise prevent the timebase origin from resting at the electrical centre of the display.

59. The bias line for the timebase generator and amplifiers is fed from a negative 310-volt line, stabilized by the tube V13. Suitable fixed potential dividers are used except for V11 and V12, which share a pre-set potentiometer, the CV124 bias control already mentioned.

60. The diodes associated with the output stage are, first, the bias clamp V8B for V11 and V12, and the double diode V10 which is in effect shunted across the deflection coils in the output circuit of V11, V12. This valve is dealt with later (*para.* 62).

61. The output from the final stage V11, V12, is a saw-tooth waveform of some 100 to 200 volts amplitude (depending on the setting on the RANGE and AMPLITUDE controls) with a reverse swing of about one-third the amplitude of the forward stroke. This waveform is developed across the deflector coils of the PPI tube (which are shunted across the anode feed resistance chain of the output valves) through the contacts of a relay REL.6. The latter has two pairs of make-before-break contacts, which are connected in such a manner as to act as a reversing switch. The object of this reversal of scan direction has already been explained.

62. The deflection coils (with the associated self-capacitances) form a tuned circuit, which would tend to "ring" at the beginning of the forward stroke, and also, with considerably greater amplitude, upon the flyback which has a much greater rate of change of current. The forward stroke oscillation is damped out by shunting the coils with a 33K resistor (R53). This value is, however, too great to suppress the oscillation at the flyback, and appreciable reduction of the resistance would cause a loss of deflection power, owing to diversion of the forward stroke current. A double diode V10 is therefore used as a further shunt. This acts as a delayed clipper and reduces the overshoot on the flyback without affecting the power output during the forward stroke.

Cathode modulation circuits

Brightening pulse generator

63. The brightness of the timebase trace is normally set well below the threshold of visibility by means of a BRILLIANCE control, mounted on the indicating unit front panel. At the beginning of the timebase stroke, therefore, the trace must be brightened to a degree depending upon local conditions, but usually somewhere between "just below" and "just above" the threshold. When the trace is in rotation, the linear velocity of any point in the trace is directly proportional to its distance from the timebase origin. If the trace is of uniform brightness throughout the stroke, therefore, the "paint" will be fainter at the circumference of the tube than at the centre. Since what is desired is a uniform degree of painting over the whole face of the tube (so far as this is compatible with varying strength of response) it is advantageous to increase the trace brilliance as the trace moves from the centre outwards. This effect is called trace compensation.

64. The brightening pulse is generated by the valve V16 which is a Miller valve triggered on its suppressor-grid by the valve V5. The rate of Miller run-down is controlled by a potentiometer on the front panel of the indicating unit, marked TRACE COMP (trace compensation). When this is set at MIN., the Miller run-down is so slow that the output of V16 is, to all intents and purposes, merely an inversion of the suppressor-grid input waveform which is a positive square wave, so that a negative square wave of timebase duration is applied to the cathode of the CRT. If the Miller run-down is set to operate at higher speed, however, a negative saw-tooth is superimposed upon this square wave. In the former case, the brilliance of the trace falls off somewhat as the spot approaches the circumference of the screen. By suitable adjustment of the TRACE COMP control, the trace can be made to appear of uniform brightness along its whole length.

Azimuth Indication strobe

65. The valve V16 is also used to produce an azimuth strobe, i.e., the radial trace is additionally brightened along its whole length when the rotating aerial array passes through a pre-determined azimuth. The bright line is obtained by increasing the rate of Miller run-down in V16; to do this the control-grid bias is lifted by means of the relay REL. 8. The facility can be removed from the display, when not required, by opening the switch SW. 9 (marked AZ. IND.) on the control desk. When the switch is closed, the circuit to REL. 8 (from a 50-volt supply) is completed through a switch on the aerial turntable or pivot mount each time the aerial passes through the pre-determined azimuth. This is used for correlating the aerial azimuth with an azimuth scale fitted round the circumference of the PPI tube. The brightened line is sometimes called the heading marker.

66. Alternatively, the azimuth strobe facility may be used as follows. The azimuth indicator switch SW. 9 is left permanently ON, the circuit being extended to a switch SW. 12 (marked PPI STROBE) in the associated H/R console. The bright line on the PPI display may then be produced at will by the H/R operator.

H/R Strobe

67.◀The facility called H/R strobe must not be confused with the one just described. The operation of the H/R STROBE key switch SW. 7 causes the trace of the H/R display to brighten. See A.P.2897NB Vol. 1, Part 1, Chap. 1, para. 23 and Part 2, Chap. 3, para. 26.

Note . . .

When the console Type 60 is modified for use with a 'U' Convoy (console Type 60, special), this key is labelled HEIGHT REQUEST *and is rewired to light a lamp on the H/R console. The light flashes until the H/R reader connects the height finder to the PPI concerned. Thus two PPI's can share one height-finder.*

IFF Strobe

68. The IFF strobe displayed on the PPI was a marker ring showing the range at which a short strobe marker appeared on the IFF Mk. 3 display in console Type 61. The range on both tubes was controlled by a potentiometer marked STROBE CONTROL on the PPI indicator. This facility is no longer used, but circuit and controls remain in situ. The IFF strobe was obtained by feeding a negative-going pulse from the H/R console to the control grid of V14. The gain of this valve is controlled by the STROBE AMP potentiometer on the control desk. Range marks derived from a range marks (calibrator) unit in the information generator are fed to V15. These two signals were mixed in a common anode—load resistor, and amplified before reaching the CRT cathode, as explained later. The IFF strobe thus appeared similar to a range ring, but at the range set by the control referred to above.▶

Range marks

69. The range marks input consists of positive-going calibration pips at either 5 or 10 mile intervals as selected by the relay REL. 3. The latter is fed through a key switch SW. 2 marked RANGE MARKS on the control desk. In the 5 MILE position, the relay is unenergized and 5-mile interval pips are fed into the cathode of V15, but in the 10 MILE position the relay is energized, causing the 10-mile interval pips to be fed in. In both these positions, the control-grid can be varied from about −26 volts to −3 volts, giving a range of brilliance between full and zero. When the switch is in the OFF position, however, a 33K resistor R148 is introduced into the bias line, and the control-grid is then biased off about 90 volts negative, which is well beyond cut-off. *This action is suggested schematically in fig. 9, but the diagram must not be interpreted literally.*

70. After mixing in the common anode load, the outputs of V14 and V15 (consisting of positive-going signals) are amplified in the normal manner by V17A (half a double triode), the output consisting of negative-going signals. These are mixed in the anode load circuit of V17A, which is common to the anode of V16 and applied to the control-grid of V17B (the other half of the double triode). This section operates as a cathode-follower, giving a negative-going output which is applied through a series condenser to the cathode of the CRT, via a co-axial termination (No. 24) on the timebase unit termination panel.

Grid modulation circuits

71. The grid modulation circuits permit the mixing of the radar video signal, the IFF signal (if required) and azimuth marks or video mapping signals (if required), the combined modulation being applied directly to the control electrode of the CRT.

72. Either the video mapping signals or the azimuth marks (according to the particular installation) are applied to the input panel of the console and are fed into the timebase unit only when the switch SW. 6 is in the ON position. This switch is marked AZ. INF. and is mounted on the control desk; it controls a relay REL. 9 in the timebase unit. These signals are positive-going and are applied to the control grid of V23A (half a double triode). This shares a common cathode load with the other half of the triode V23B.

73.◀Similarly, the IFF video signals, if switched on by putting the DISPLAY SELECT switch (SW. 25) on the control desk to IFF+ RADAR or IFF ALONE and so energizing the relay REL. 4, are applied to the control grid of V23B. These signals are DC restored at the control grid by the diode V24. The positive-going signals at the common cathode load are fed to the control grid of V18, which shares a common anode load (having inductive compensation) with V19. ▶

74. The brilliance of the azimuth marks or video map is controlled by the AZ. MARKS AMPLITUDE control on the control desk. The IFF video amplitude is controlled by a pre-set potentiometer (IFF GAIN control) on the front panel of the timebase and video amplifier unit.

Radar video

75. The positive-going radar video signals are fed into the control-grid of V19, which is an amplifier and inverter; the gain is controlled by a potentiometer marked VIDEO GAIN, on the control desk. The mixed output of video map (or azimuth marks), IFF video and radar video developed across the common anode load of V18 and V19, is applied to the control-grid of the limiting valve V20.

76. The limiting valve is a tetrode, the gain of which is controlled by a pre-set potentiometer marked LIMIT. This will normally be set up during the initial setting up on site and should not require further adjustment unless the limiting valve is changed. The anode circuit is inductively compensated. The output, consisting of positive-going signals, is applied to the control-grid of V22, the level being DC restored by a diode V21. The output of the cathode-follower V22 is taken from the co-axial plug 26 to the grid of the CRT.

77. Arrangements are made for monitoring the cathode current of all valves in the timebase unit with the exception of the diodes. Each valve has a series resistor in the cathode circuit, one end being earthed and the other connected to a point on a 16-way selector switch. The latter permits a milliammeter and series resistor to be connected across the selected resistor and the milliammeter deflection is a measure of the cathode current. The 15th point on the switch permits the 350-volt HT rail voltage to be checked, and the 16th provides similar facilities for measuring the voltage of the 310-volt negative bias rail.

Power supply

78. The timebase and video amplifier unit requires a HT supply at 350 volts for the valve anodes, a supply about 10 volts above HT rail potential for the backing off control (SCAN CENTRE) and a negative 310-volt supply for biasing purposes. These supplies are provided by two separate power packs built into the power unit Type 742. The CRT brilliance control circuit is also fed from the positive 350-volt power pack. The off-centring coil is also fed from the negative 310-volt power pack through an off-centring distance control mounted on the front panel of the indicating unit, while the centring coil potentiometers are connected across the positive and negative power packs in series, the mid-point of the coils being at earth potential.

79. The EHT voltage for the CRT anodes and the low voltage supply for the CRT and EHT rectifier heaters are provided by power packs mounted in the indicating unit itself. All the power packs derive their input from a 230-volt, 45–60 c/s source.

80. Fig. 10 is a point-to-point wiring diagram of the console, including the power supplies. The mains supply is connected at P7, P8 on the input panel and four switches must be closed before the transformers TR1 and TR2, in the main power circuit, are energized. The first switch, SW17, is mounted on a bracket at the rear of the indicating unit (*para.* 84 *also refers*). The second switch SW16, is on the front panel of the indicating unit, the third SW15 is associated with the top cover panel, and the fourth, SW18 is of a similar type to the third, but is mounted on the front panel of the power unit in such a manner that power must be switched off before the unit can be drawn forward for internal inspection. After the unit has been drawn forward the power supply can be restored, subject to the safety precautions detailed in para. 83–85.

81. The heater voltage for the timebase valves V4 to V12 is taken from a 6·7 volt secondary on transformer TR1. A 350–0–350 volt winding on TR1 feeds the anodes of the positive HT rectifier. The cathode modulation chain V14, V15, V16 and V17 and the video mapping mixer valves, V23 and V24 derive their heater voltage from a 6·3 volt winding on the same transformer. The heater voltage for valves V18 to V22 is taken from a 6·3 volt secondary on transformer TR2. A 310–0–310 volt winding on TR2 feeds the anodes of the negative bias rectifier.

82. The mains supply to the transformer TR4 in the indicating unit, which feeds the EHT rectifier, is taken through a pair of contacts on a relay REL. 1 in the power unit Type 742. The coils of this relay are energized by the output current of the positive 350-volt rectifier, thus ensuring that the EHT transformer primary is not switched on before the timebase unit is operating and the CRT bias (brilliance control) is applied.

83. An earthed 6·7 volt supply on transformer TR2 is used to supply the turning gear scale illuminating lamps and projector lamps (*para.* 13) and an earthed 6·5-volt supply on TR1 supplies the scale lamps, azicator cursor (*para.* 14) and other control lamps in the indicating unit. Another winding on TR2 supplies 6·5 volts for the mask lights on the indicating unit.

Safety switches and fuses

84. The 350-volt HT supply has a fuse (FS2) connected between the rectifier filaments and the reservoir condenser of the filter circuit, so that it will blow in the event of a fault in the smoothing unit as well as in the event of an external fault. The negative 310-volt rectifier is fused in a similar manner, the fuse (FS5) being fitted between the reservoir condenser and the centre tap on the HT secondary. The EHT fuses (FS3, FS6) are in the primary side of the transformer TR4. One pair of mains fuses (FS1, FS4) protects the primary windings of both TR1 and TR2.

85. Provision is made for access to the power unit when the latter has been partly withdrawn from the console, but with the power still applied, so that tests and measurements may be made. To withdraw the unit, the power must first be switched off at the switch on the front of the unit, otherwise the latch securing it in position cannot be turned. Once the unit is withdrawn, however, the power can be restored by first turning the latch, so allowing the safety switch to be placed in the ON position. Thus the power can only be applied to the unit by deliberate action on the part of the person concerned.

86. The panel on top of the console covering the rear portion of the indicating unit is fitted with a similar safety switch and latch and the above remarks also apply. A safety switch of slightly different type is fitted on a bracket at the rear of the console, just below the indicating unit. This switch is operated by a toggle associated with the carriage on the lead screw by which the indicating unit is raised before removal (*para.* 5). If the lead screw is rotated by the handle provided, so moving the indicating unit upward and forward preparatory to removal, the movement of the carriage trips the toggle and throws the switch to the OFF position.

87. If it is desired to operate the console with the indicating unit in this position, the switch can be restored to ON by turning the toggle manually, access being obtained through a hole provided for this purpose. If now the handle is rotated to bring the indicating unit back to its normal position, the toggle will again engage, throw the switch to the OFF position and then, as the normal position is reached, restore the switch to ON.

WARNING . . .

Any person restoring the supply to the console units by operating any safety switch with a unit partially withdrawn, or with the top panel unlatched, must be personally responsible for opening the switch or switches so operated before leaving the vicinity of the console, even for a few seconds. This precaution is absolutely essential since another person, unaware of the condition of the equipment, may handle parts which would normally be safe to touch with the units exposed or withdrawn. The console should not be operated with any of the side panels removed.

50-volt supply

88. The 50-volt DC supply for the various relays is derived from an external source, normally the rectifier unit Type 15, mounted on the I.G. rack.

89.◀The console was designed to permit its adaptation to use in static operations rooms. Since channel selection in this application is made externally, only one input channel (channel 3) would be necessary and so tagboard arrangements to RL2, RL5, RL6 (fig. 11) have been made to allow the transference of the link from RL6 tag to the earth tag 4. Thus the simultaneous operation of the trace reversing relay RL6 would be prevented, and the channel 3 relays RL2, RL5, would be permanently operated. The console's use in this application is, however, no longer envisaged.▶

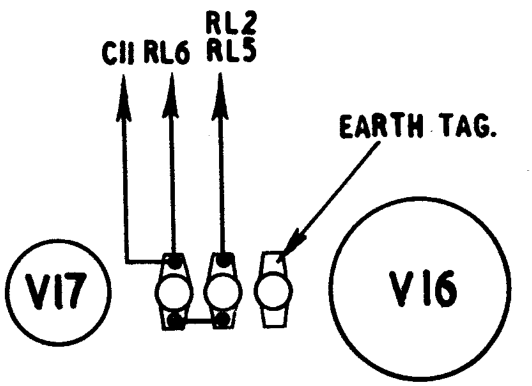


Fig. 11 Relays 2, 5, 6, tag board

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Chapter 2

(Completely revised)

INSTALLATION

LIST OF ILLUSTRATIONS

Installation in mobile operations room

1. In the mobile operations room (RVT. 510) two consoles Type 60 are fitted, one on each side; that on the near side is called PPI No. 1, and that on the off side, PPI No. 2. The positions, with respect to the remainder of the equipment, are shown in fig. 1. The container is fitted with a floor raised above the bottom of the container, so forming what is called an under-floor cavity, and it is also used to supply air from the personnel space blower to the main body of the container through metal grilles.

2. The PPI consoles are mounted over two of these grilles, large anti-vibration mountings being used. Cooling air for the radar equipment (i.e., information generator, PPI consoles, and H/R consoles) is provided by another blower, generally called the instruments fan. This supplies air to a rectangular metal trunk which is installed in the under-floor cavity; two branches feed the information generator and the two H/R consoles.

3. The air supply enters the console through a rectangular duct approximately in the middle

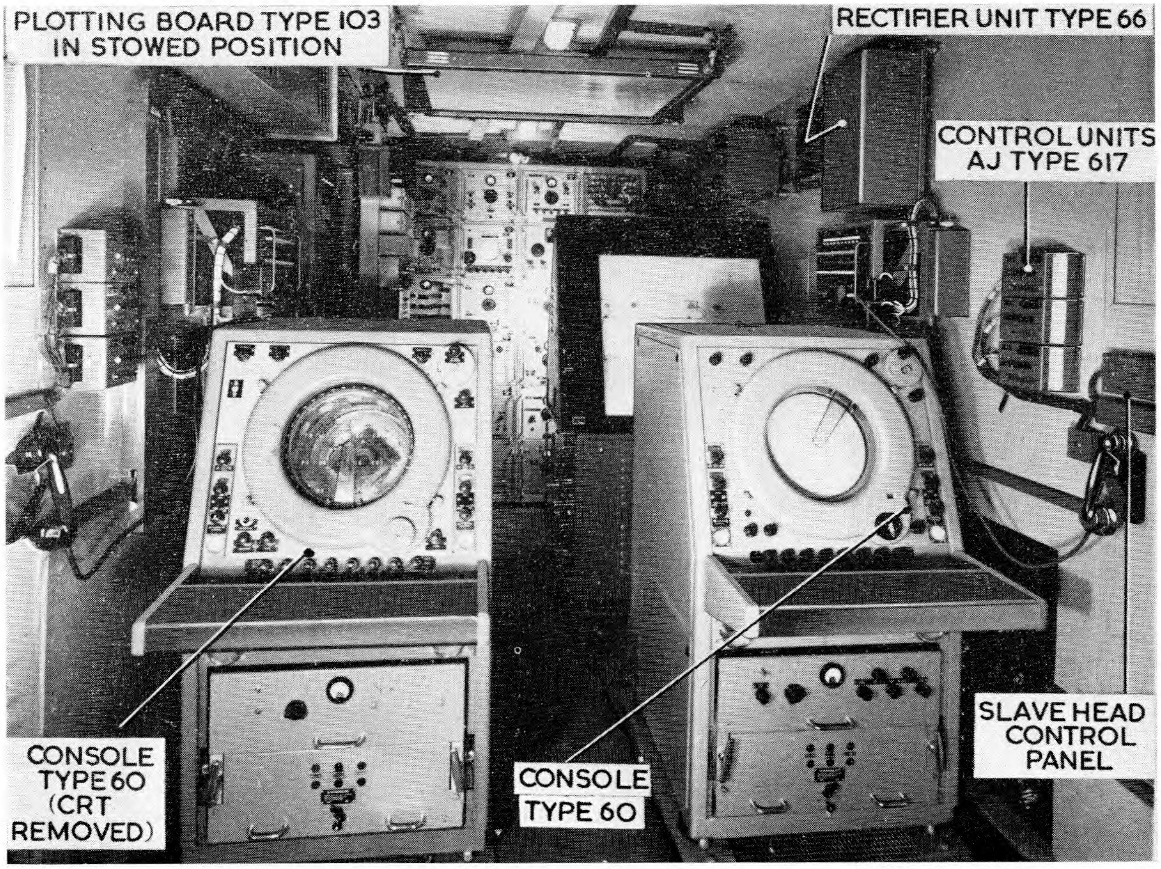


Fig. 1. RVT.510 Mk. 1 and 2 Interior showing PPI consoles

of the grille. After circulating round the console, the air leaves by an orifice near the top, on the side nearest the container wall. This orifice communicates with the outer air through a short rectangular trunk, a shock-absorbing pad being fitted. A shutter is fitted in each trunk to permit the console to be operated in one of two conditions, i.e., either exhausting completely to the outer air, or completely into the personnel space. There is no intermediate setting, and the shutter must be latched in the required position.

4. The air ducting from the instrument fan to the underfloor air trunk is at the fore off-side end of the container. Two heaters are mounted on the outside so that the heating elements are inside the trunk. These are each rated at 6·07 kW; they are fitted with thermostats which are set to cut off the power supply if the heater temperature rises above 350 deg. F. Special precautions are taken to prevent the equipment being started up if the relative humidity exceeds 60 per cent, although this control can be overridden if necessary, e.g. in the want of a breakdown in the humidity detector system.

5. The under-floor cavity also houses the trunking in which the cables to and from the consoles are carried. The cable entry to each PPI console is immediately adjacent to the incoming air duct. These cables are taken to the input panel at the rear of the console. Details of the circuits in the RVT.510 are given in A.P.2897Q, Vol. 1.

6. Installation of the console Type 60 (special) into the RVT.510 Mk. 3 is described in the Marconi Technical Handbook, T.P.3832.

Chapter 3

PREPARATION FOR USE AND SETTING-UP INSTRUCTIONS

LIST OF CONTENTS

FUNCTIONS OF CONSOLE TYPE 60

1. The console Type 60 is used in mobile installations, and is designed to provide a plan position presentation with any range up to 280 miles from the centre. In addition, with the same timebase velocity, there is available a facility for off-centring the display in any desired azimuth, up to one radius of the tube face.

2. Information may be displayed from any one of three aerial heads by manual selection, or displayed from two aerial heads alternately for a sector of 180 deg. The switching between the aerials in this case is automatic, one aerial being arranged 'back-to-back' with the other, and the traces are superimposed over the 180 deg. sector being swept. The orientation of this sector is effected by the off-centre control, and is so arranged that the bearing indicated on the off-centre control dial occupies the mid-point of the sector being displayed.

3. In addition to the radar video signals a number of information signals may be displayed; these are (a) IFF, (b) 5- or 10- (data) mile range rings, (c) either azimuth marks, which are radial lines at 10 deg. intervals, or a video map from the marker unit (video map) Type 30. These information displays may be switched on individually at a preset level of intensity and appear concurrently with the radar signals.

4. Facilities are included on the console for rotational control of two independent aerials by means of two turning control panels, in conjunction with two hand-wheels mounted below the control desk. Each turning control is associated with an aerial head or heads, and permits the associated aerials (a) to be laid to a required bearing which is optically indicated, (b) to sweep over a pre-determined sector at a required speed, or (c) to be continuously rotated at a speed up to six r.p.m.

5. Normally, the left-hand control panel will govern the movements of the rotating head or heads producing the PPI scan, and the right-hand panel will control the bearing of a height-finding aerial (radar Type 13 variant). A 'repeat back' selsyn system for the latter aerial drives a radial cursor over the tube face. By this means the height-finding aerial may be aligned on any particular target displayed on the PPI.

6. ◀ ▶

DISPOSITION AND PURPOSES OF CONTROLS, CONSOLE TYPE 60

7. The controls may be divided into three groups, as follows:—

(1) Controls set on the sloping front panel of the console.

(2) Controls set on the control board in the well of the desk unit.

(3) Pre-set controls on the front panel of the timebase unit.

All controls are identified by labels.

Group 1 controls

8. *Centring controls.* These are two controls labelled CENTRING 1 and CENTRING 2, at the top left-hand corner of the sloping panel. Their purpose is to provide centring for the origin of the trace which, when in the normal operating position, should be beneath the centre cross of the cursor. The controls cause movement of the spot in directions mutually perpendicular.

9. ON/OFF *switch and safety switches.* The ON/OFF switch is the main switch for the equipment and is situated below the centring controls. It is in series with three safety switches; the first of these is on the top of the console, and must be switched off prior to removing the top panel for inspection. The second is at the rear of the indicating unit, and is automatically operated when the unit is driven forward by the lead screw. The third is on the power unit and must be operated before the power unit and timebase unit can be withdrawn for servicing.

10. *No.* 1 *turning control.* This panel controls the PPI scanning aerial and is below the ON/OFF switch on the left-hand side of the sloping front panel. The components of this control are described in sub-para. (1), (2), (3), (4) below.

(1) SWEEP ANGLE *control.* This is the upper one of three knobs with its associated dial. It governs the arc through which the aerial will turn when the turning control switch is set to SECTOR SWEEP.

(2) SPEED *control.* This is the middle one of the three controls and governs the speed of rotation of the aerial. The scale on the dial is in two colours, the upper (green) scale showing the speed during continuous rotation, and the lower (red) scale the speed during a sector sweep. The control is interlocked with the sweep angle control to limit the speed at low angles of sweep.

(3) TURNING CONTROL SWITCH AND AERIAL SAFETY CATCH. This is the lower one of the three knobs and drives a four-position rotary switch. The positions on the latter are labelled:—

(a) POSITION CONTROL.

(b) SECTOR SWEEP.

(c) CONT. ROT. CLOCK (continuous rotation, clockwise).

(d) CONT. ROT. ANTI-CLOCK (continuous rotation, counter-clockwise).

The switch may be locked at POSITION CONTROL by means of a safety catch. This is underneath the turning control label and operates by pressing down the small catch on the left-hand side of the label. To release the safety lock, the small catch on the left-hand side of the label must be lifted, and simultaneously, the small catch on the right-hand side must be withdrawn towards the right (the necessity for simultaneous operation of two catches is designed to prevent accidental operation). The purpose of the safety catch is to lock the aerial head at one position while servicing is being carried out at the aerial.

WARNING

On no account must this catch be released until the reason for its application has been ascertained, and the state of all aerial heads investigated. The aerial heads must be cleared of all servicing personnel before the safety catch is released.

(4) *Position control scale and hand-wheel.* The position of the aerial when operating in POSITION CONTROL is indicated on a round screen below the turning control switch. This scale is projected from a graticule on the shaft of the aerial control selsyn, which may be turned by means of the turning control hand-wheel. The latter is the large hand-wheel immediately below the scale, underneath the desk. Since operation of this hand-wheel, with the switch at POSITION CONTROL, will cause the aerial to turn, the hand-wheel is also fitted with a safety catch, which locks it in a fixed position when it is necessary to service the aerial heads. To apply the safety catch, rotate the hand-wheel until the knob is hard over to the extreme left. Then lift the hinged flap so that the knob is located in the slot provided. Ensure that the flap clicks home in the upper position. To release, withdraw the small catch to the left and fold down the flap.

WARNING . . .

On no account must this catch be released until the reason for its application has been ascertained, and the state of all aerial heads investigated. The aerial heads must be cleared of all servicing personnel before the safety catch is released.

11. BRIGHTNESS *control.* To the right of the left-hand position control indicating screen are two knobs. The left-hand one is the brightness control for the CRT.

12. FOCUS *control.* This is to the right of the BRIGHTNESS control and controls the focus of the CRT.

13. CURSOR ALIGN. This button switch is immediately above the brightness control and is provided with a cover which must be hinged back to obtain access. The switch breaks the rotor circuit of the azicator 'repeat-back' selsyn thus decreasing the torque and allowing the cursor assembly to be moved manually to another bearing, should the cursor be out of line with the Type 13 aerial.

14. OFF-CENTRE AND SECTOR *control.* This control is the knob mounted upon a round scale at the top right of the sloping panel. The control determines the sector to be shown when the trace is off-centre, and the scale below it shows the bearing which will occupy the middle of the 180 deg. sector displayed.

15. OFF-CENTRE AMPLITUDE *control.* This control is below the off-centre scale, and determines the extent by which the trace is off-centred.

16. CURSOR DIM *control.* This control is to the right of the off-centre scale and is a dimmer for the cursor illumination.

17. *No. 2 turning control.* This control is on the right-hand side of the panel and is identical with the No. 1 turning control in operation. It is, however, used to control the Type 13 aerial laying. The instructions regarding the safety catch on the position control hand-wheel differ slightly in that the knob should occupy the right-hand position when locking the flap; the small catch is withdrawn to the right to release.

18. STROBE *control.* This control is at the bottom right of the sloping panel. Its function was to vary the range of the strobe ring, and with it the strobe range on the IFF Mk. 3 display. With the advent of IFF 10, this facility is no longer used.

19. *Azicator control.* This control is beneath a round cover at the bottom right of the large round front cover. Its function is to control the position of the cursor should this not be used in a repeat-back role.

20. *Azicator scale.* Above the small round cover mentioned above is a scale indicating the position of the cursor in degrees. The position to within 10 deg. must be taken from the large azicator scale surrounding the tube face.

Group 2 controls

21. In all cases gain and amplitude controls are conventionally at maximum when fully clockwise. At the back of the control desk is a row of eight controls sloping in line with the front panel. These are dealt with in the following paragraphs, in order from left to right.

22. CONTROL LAMPS DIM. This rotary three-position switch gives three levels of brilliance for the optical projection lamps illuminating the position control scales.

23. T.B. AMP. This controls the amplitude or length of the timebase and is normally adjusted to give a scan one tube radius long. This must be increased when the scan is off-centred.

24. T.B. RANGE. This controls the range or velocity of the timebase and is adjusted to a suitable working value with reference to range marks on the trace.

25. VIDEO GAIN. This controls the gain of the video amplifier and hence the level of the radar signals at the control-grid of the CRT.

26. AZ. INF. AMP. This controls the brightness of the azimuth information displayed which in the case of the console Type 60 is azimuth marks from a generator unit on the information generator rack.

27. CAL. AMP. This controls the brightness of the range marks on the display.

28. ◀STROBE AMP. This control (not now used) varied the brightness of the IFF strobe ring, generated in the console Type 61, on the display.▶

29. AERIAL COMB. This rotary three-position switch controls the aerials selected for off-centred working. In the position marked KEY the choice of aerials rests with the AERIAL SELECTOR key. In the position marked '2 & 3,' signals from aerials No. 2 and 3 are displayed alternately for a 180 deg. sector, the switch bringing about the 180 deg. switching of the timebase trace. Number 3 aerial is always the one which is 'back-to-back' with the other two. In the position marked '1 & 3,' signals from aerials No. 1 and 3 are alternately displayed.

30. Thirteen key switch controls are fitted on the control panel. These are dealt with in the following paragraphs, in order from left to right.

31. RT. This is a key for control operation and causes the RT equipment to switch from receive to transmit or vice versa. It is spring loaded in the receive position.

32. ◀MON. This telephone key provides a facility by which the controller may speak to the monitoring operator in an R.T. vehicle.▶

33. I. COMM. This telephone key is for calling the Chief Controller or Fighter Marshal. It has two positions marked CC and FM respectively, and also an 'off' position.

34. AE. SEL. (aerial select). This is a three-position key giving selection of display from one of three aerials, when pressed in the directions '1' or '3'. The middle position is '2'. The key is locking in any direction set.

35. AZ. IND. (azimuth indicator). This is an on/off key giving a facility for checking whether the trace is correctly aligned with the aerial head. When depressed the key closes a circuit associated with the 'north align' switch at the aerial head, and if the trace is correctly aligned a bright flash will appear on the face of the CRT as the rotating aerial passes through due North. With the switch to OFF, and the aerial head in the position-controlled condition, an associated indicator lamp will light when the aerial is stationary at due North.

36. A.P. IND. The array position indicator key carries out a similar function to the above in the case of the Type 13 height-finding aerial. When the key is to ON and the aerial stationary at North, the indicating lamp adjacent to the key switch will light. This provides the only check of the correct position and the alignment of the azicator (cursor) with the Type 13 aerial head.

37. H.R. STROBE. This key is used only in conjunction with a console Type 61, working with a radar Type 15 aerial head on the GCI role. When this key is pressed, the timebase trace on the main radar display tube of the console Type 61 is brightened, and hence the trace can be 'flashed' as the scan passes over the particular aircraft whose height is to be found. This system of indication avoids the confusion with other aircraft which may be giving indications at the same range but on different bearings.

◀**Note . . .**

In the case of the console Type 60 (special), which is modified for use in the RVT.510 Mk. 3 (see Marconi Technical Handbook TP.3832), the switch in the position normally occupied by the H.R. STROBE *switch is occupied by the* HEIGHT REQUEST *switch. Its function is to operate a lamp on a shared console Type 61 to indicate that H/R information is required.* ▶

38. AZ. INF. This key is the on/off control for the azimuth information channel, by which the azimuth marks may be switched on at a predetermined level.

39. P.R.F. This key controls the selection of pulse recurrence frequency at either 500 per second or 250 per second. The key also changes the timebase range of the PPI and that of the associated range marks generator. Two signal lights are fitted adjacent to the key; these are labelled 250 and 250 EXT. respectively. The first-named lamp lights when the key is pressed to 250, giving ready indication, in the dark, that the key is so switched. The 250 EXT. lamp lights if some other console sharing the same aerial switches to 250 p.r.f. This will mean halving the repetition rate of the timebase traces, but no change to the existing range setting of the PPI.

40. RANGE MARKS. This is a three-position key, the position being labelled 5M, OFF, 10M, and giving a choice of 5-mile (data) or 10-mile (data) range marks. These are displayed at a predetermined level.

◀**41.** DISPLAY SELECT. This is a three-position key (IFF + RADAR, RADAR ALONE, IFF ALONE) giving a choice of displayed information as indicated by the key marking.

42. MODE SELECT. This key switch is associated with the IFF 10 equipment and is a three-position switch selecting Modes 1, 2 or 3. For further information see A.P.2906K.

43. The remaining switch SW26, although wired to DISPLAY SELECT SW25 for use in providing possible additional facilities which may be required in the future, is not at present used, except in the case of the console Type 60 (special). In this application, SW26 is labelled VIDEO SELECT and is disconnected from SW25. It is a three-position switch marked LOG-LIN-LOG whose function is to route the appropriate video input to the video amplifier Type 4748A by the operation of a relay in that unit. ▶

Group 3 controls

44. These controls are fitted on the front panel of the timebase unit.

45. IFF GAIN. This is the upper screwdriver slot control on the left, and governs the level of the IFF signals displayed.

46. VIDEO LIMIT. This is the lower left-hand pre-set control and governs the maximum signal value which may be passed to the control grid of the CRT.

47. *Monitoring switch and meter.* This switch is situated at the left centre of the panel, the meter being mounted on the centre line. The switch and meter, together, are used to monitor the valve circuits in the timebase unit.

48. SCAN CENTRE. This is the lower left control of the five at the right of the panel. It is used when setting up the timebase and controls the reversing potential across the scan coil to counter the tail current of the scan output valves.

49. 500 P.R.F. RANGE LIMIT. This controls the maximum range available by means of the RANGE control on 500 p.r.f.

50. CV124 BIAS. This controls the bias setting of the scan output valves and is used when setting up the timebase.

51. 250 P.R.F. RANGE LIMIT. This controls the maximum range available with the RANGE control at 250 p.r.f.

52. TRACE COMP. This varies the brightness of trace with range and is adjusted to give uniform overall brightness on the CRT.

53. *Phasing controls.* These are two screwdriver controls on the panel below the desk unit. They are used during the synchronization of the turning gear of two aerials, with a master aerial.

54–58 ▶◀

SETTING-UP INSTRUCTIONS

Cursor setting

59. A periodical check of cursor centring should be carried out, to ensure that no shift has occurred in the clamping of the cursor. A check may be made as follows. With range marks switched on, and the aerial stationary, the range marks appear as a row of dots across the radius of the tube. Using the centring controls, bring a sharply focused range mark exactly underneath the cursor cross. Move the cursor round (using the CURSOR ALIGN button to unlock the selsyn, and the manual control to drive the cursor ring) in 90 deg. steps, and check that the cross lies over the spot in each position. Should the cursor be out of position or have been replaced, it must be aligned as explained in para. 75.

Cursor sub-scale alignment

60. The cursor sub-scale alignment is initially set up in production and should not subsequently be changed.

Adjustment of azicator to Type 13 aerial

61. The cursor must be lined up with the Type 13 aerial as follows:—

(1) Switch the API key to 'on'.

(2) Set the No. 2 turning control switch to POSITION CONTROL and rotate the aerial head slowly until the API indicator lamp lights.

(3) The cursor should now indicate a bearing somewhere between 356 deg. and 4 deg. Should this not be so, open the cover of the CURSOR ALIGN button, press the button and move the cursor to 0 deg. Release the button and check again by means of the API lamp.

Setting up timebase

62. The following procedure must be carried out with the timebase in rotation, and all information gain controls turned to minimum, i.e., fully counter-clockwise.

(1) Turn the OFF CENTRE AMP. control fully counter-clockwise.

(2) Adjust the centring controls to the middle of their respective sweeps.

(3) Adjust the T.B. AMP. control until the trace extends almost to the edge of the tube face.

(4) Turn the SCAN CENTRE control fully counter-clockwise.

(5) Adjust the brightness control until the trace is just visible.

(6) Switch on the 10-mile range marks and adjust the level until they do not 'bloom'.

Note . . .

'Bloom' is a defocusing effect, difficult to describe but easily recognizable when it occurs, which is when the intensity of any input to the CRT control-grid is too high.

(7) Adjust the focus control for best position.

(8) Turn CV124 BIAS control clockwise until the inner end of the trace rotates in a circle of about $\frac{1}{4}$ in. radius.

(9) Switch to 500 p.r.f. and turn the T.B. RANGE control fully clockwise.

(10) Adjust 500 PRF RANGE LIMIT control until 15 10-mile range marks are visible.

Note . . .

It will now be seen that the trace centre is not a firm spot.

(11) Adjust the 500 PRF RANGE LIMIT control to decrease range until the trace centre hardens into a firm spot. This should occur between 120 and 130 miles range. The range limit control should be left at the maximum range possible, at which a hard centre can be obtained.

(12) Switch on the 5-mile range marks and adjust the T.B. RANGE control to give a range of 80 miles. Turn the CAL. GAIN control clockwise until the mark at the origin is visible.

(13) Adjust the CV124 BIAS control to reduce the radius of the centre circle until the first 5-mile ring approaches the centre spot. Turn back the control to the point where the first 5-mile ring commences to decrease, and leave the control set at this position.

(14) Adjust the SCAN CENTRE control with care until the centre spot is in its most stationary position. The spot shift should then be of the order of 1 millimetre, but can usually be reduced below this figure.

(15) Set the centre spot by means of the centring controls, so that it lies directly below the cursor cross.

(16) Switch to 250 p.r.f. and switch on 10-mile range marks.

(17) Turn T.B. RANGE control fully clockwise.

(18) Adjust the 250 P.R.F. RANGE LIMIT control until the range displayed is about 320 miles, then decrease range until the centre spot hardens as before. This should occur at about 280 miles. Leave the control set at this position.

(19) Switch to 500 p.r.f. and adjust the TRACE COMP. control to give an even illumination of the trace.

Check of off-centre working

63. Turn the OFF CENTRE AMP. control until the centre spot is at the edge of the tube. The bearing of the spot on the azicator bearing scale should differ by about 180 deg. from the reading of the OFF CENTRE AND SECTOR bearing scale. If this 180 deg. difference is more that 5 deg. in error, set the OFF CENTRE AND SECTOR bearing scale correctly by loosening the grub screw on the central metal knob, moving the scale as requisite, and tightening the grub screw.

Setting up centring controls

64. The centre spot must always lie under the central cross of the cursor during central operation. The positioning is effected by the CENTRING 1 and CENTRING 2 controls. The position of the spot must always be checked on reverting to central operation from an off-centred role.

SETTING UP OPERATING CONDITIONS FOR RADAR VIDEO

65. Two main systems of setting up the video controls may be adopted, depending on the character of the display required (para. 67 refers). The controls affected are:—

(1) Video bias on amplifier (IF and Video) Type A.3680 at the information generator.

(2) IF gain on the above amplifier.

(3) Brilliance setting on the indicating unit.

(4) Video gain setting on the control desk.

Of these, the first item determines the peak value of the signal volts, and the second item determines the proportion of noise passed to the CRT. Their combination determines the limiting value of peak signal to noise; values between 1·3 and 3·5 to 1 are commonly used, and can be measured by means of the oscilloscope Type 13A. The third item determines the drive required on the CRT before a visual picture is obtained, and the fourth item adjusts that drive.

66. Although as mentioned above there are two main systems of setting up, the fact that there are four controls allows an infinite number of variations in the settings. The choice of a particular condition is determined by the role of the PPI, and the preferences or requirements of the operator or Controller. The systems outlined below may be taken as the two extreme conditions of operation.

System 1

67. This system allows a response to be seen at a greater range than System 2, but the display itself is lacking in contrast, so that, for very weak responses, it is necessary to know the expected position before the response is recognizable as such. The system is especially useful in following a known target out to maximum range, or for finding a distant target whose approximate position is known.

Setting up

68. (1) Adjust T.B. RANGE to a suitable operational value.

(2) Turn information gain controls at the console fully counter-clockwise, or (preferably) remove them from the display by the control keys.

(3) Adjust the video bias at the information generator for 2-volt peak signal output, and adjust the IF gain to give a limiting ratio of from 3 : 1 to 3·5 : 1, as measured on the oscilloscope Type 13A.

(4) With the trace rotating, turn the brilliance control on the indicating unit clockwise, until the trace is just visible, then turn it back again until the trace just disappears.

(5) Adjust the video gain control until the noise paints the whole screen a medium to faint brilliance.

(6) Set VIDEO LIMIT control so that strong signals just 'bloom'.

69. The result should now be a fine-grain 'sandpaper' paint by noise over the whole screen. Strong and medium responses should not bloom and have good afterglow tails. Weak responses will be visible but will not have good tails.

System 2

70. In this system very weak responses and the lower noise peaks are suppressed, and all other signals are, in effect, accentuated to peak values. Any responses which the system accepts are immediately obvious and all responses accepted are, roughly, equally displayed and have good afterglow tails.

Setting up

71. (1) Adjust T.B. RANGE control to a suitable operational value.

(2) Turn all information gain controls on the console fully counter-clockwise, or (preferably) remove them from the display by the control keys.

(3) Adjust the video bias at the information generator for maximum signal output, and the IF gain to give a peak limiting value of about 1·5 : 1 as measured by the oscilloscope Type 13A.

(4) Turn the brilliance fully counter-clockwise, video gain control fully clockwise, then turn the brilliance slowly clockwise until the peak values of noise paint on the screen. Successive adjustments of gain and brilliance are now necessary to reach a state in which the signals are painting hard, without blooming and the peak noise level only appears on the screen.

72. The result should be a mainly black screen with a sparse paint of noise. Responses should paint hard with good contrast and good afterglow tails.

Setting up information controls

73. Having set up the console for radar video display in the required system, the information channels, i.e., azimuth information, range marks, IFF, and strobe, should be adjusted to give a faint but readily discernible paint by means of their respective amplitude controls. These should then be switched to 'off' by their switches until they are required upon the display. The strobe ring has no switch, but may be turned into the centre. Alternatively, if the PPI does not work with an associated H/R console, the strobe gain control may be left at minimum setting.

Cursor dim setting

74. The CURSOR DIM control should be set up to give clear illumination of the cursor lines without detracting from the contrast of the display.

Cursor jig

75. A jig is provided for re-aligning the azicator cursor, in the event of the latter being replaced by a new one, or if the check described in para 59 reveals a loss of alignment. The jig is a metal bar which can be fitted horizontally across the azicator ring assembly, the bar being fitted with legs which are secured to the ring by two captive 2 BA screws. This bar is perpendicular to the cursor when the latter is in its normal operational position.

76. A second, and shorter, bar is rigidly secured to the first by pillars, in such a manner that when in position for checking the alignment, the glass cursor lies between the two bars. To fit the jig, therefore, the cursor must be swung sideways into the non-operational position (a photograph showing this position will be given in Part 2, Chap. 3) before the jig is placed in position and secured.

77. Small circular apertures are drilled in each of the two bars, and when the cursor is properly aligned, the cross on the cursor will lie in the centre of the apertures, both holes being used for sighting to avoid parallax error. The cursor is set up to its proper position by means of the large hexagon-headed collars which are eccentric to the bolts upon which they are mounted, and the bolts are then tightened.

78. In detail, the procedure is as follows:—

(1) Check that the cursor registers accurately without play in the working position.

(2) Loosen the clamping bolts on each side of the cursor holder, and adjust the eccentrics until the square formed by the top engraved lines just frames the small hole in the lower part of the jig.

(3) Tighten the clamping bolts finger tight only, then check that the small hole is still framed by the square when the bottom lines of the cursor appear central in the upper pair.

(4) Tighten the clamping bolts and recheck.

return it to the operating position, pull lightly on the polished knob; the cursor will then swing over the tube face and automatically locate in its control position.

To check the alignment of the cursor

13. If the turning gear is switched off and the aerial moved, the cursor may be misaligned with the Type 13 aerial head. To correct this, proceed as follows:—

(1) Switch the API key to ON.

(2) Rotate the Type 13 aerial by the position control handwheel until the API lamp (beside the API key) is illuminated.

(3) If the cursor is now within plus or minus 4 deg. of 0 deg., the system is aligned, since the apparent error will disappear immediately the aerial is set in rotation.

14. If, however, the error is greater than plus or minus 4 deg., the system is misaligned. To correct this, hinge back the cover of the CURSOR ALIGN button and press the latter, then move the cursor by gentle pressure on the cursor mount until it indicates North, with the API lamp still illuminated. Hinge the cursor align button cover back into place and the cursor alignment is complete.

Off-centre operation

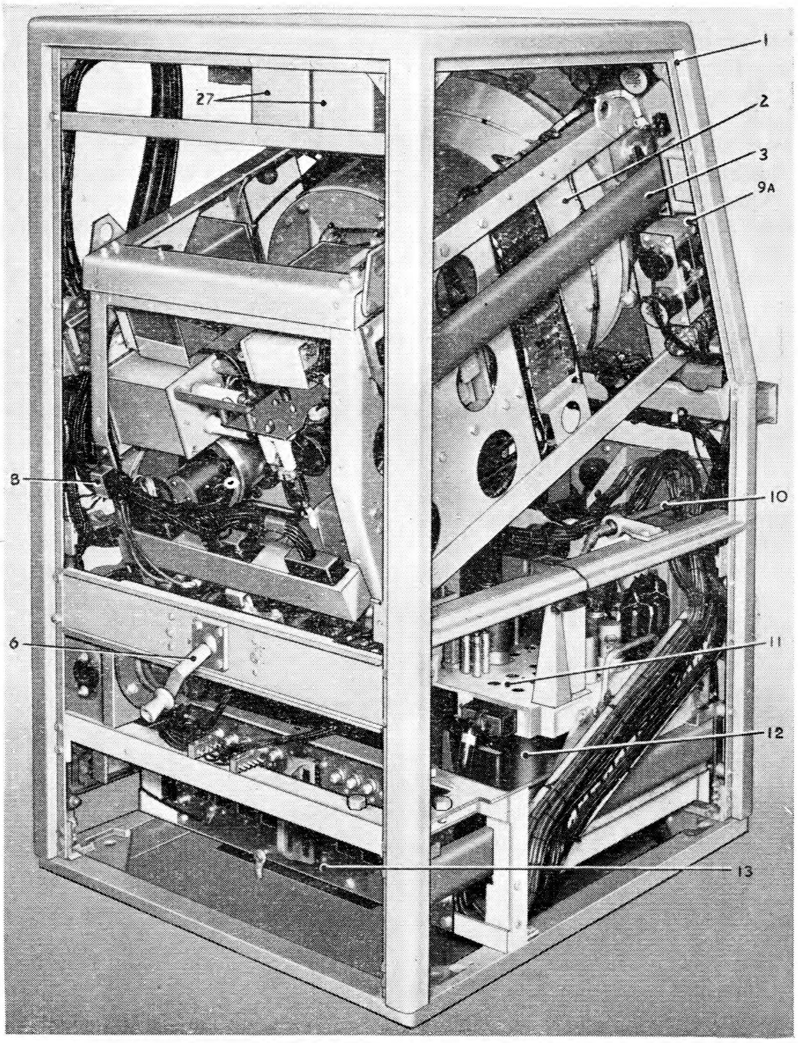
15. For off-centre operation the centre of the scan may be displaced by up to one radius of the tube face, i.e., the trace origin may be moved to the edge of the tube face. To operate under off-centre conditions, first adjust the OFF CENTRE AND SECTOR control to read the bearing at the middle of the sector to be examined. Next, adjust the OFF CENTRE AMP. control until the trace origin is in the required position. If this is at the edge of the tube, alternate scanning the required sector by two aerials may be obtained by switching the AERIAL COMB. switch to the required position, i.e., '1 & 3' or '2 & 3'. Adjust the T.B. AMP. control to give the correct length of trace.▶◀

16. To return to central operation:—

(1) Turn the OFF CENTRE AMP. control fully counter-clockwise.

(2) Adjust the T.B. AMP. control to give the correct length of trace.

(3) Adjust CENTRING 1 and CENTRING 2 controls to bring the origin of the trace under the cursor cross.



1 CONSOLE FRAMEWORK
2 INDICATING UNIT (CRT) TYPE 30
3 TELESCOPIC MOUNTING FOR INDICATING UNIT
6 HANDLE FOR TURNING LEAD SCREW
8 CLEAT ON INDICATING UNIT CABLEFORM
9A LEFT-HAND TURNING GEAR CONTROL PANEL
10 LEFT-HAND SELSYN DRIVE SHAFT
11 TIMEBASE UNIT
12 POWER UNIT
13 INPUT PANEL

Fig. 2. Rear left side view with cover panels removed

mounted a sliding carriage fitted with a tongue (fig. 3 and 4). The sliding carriage can be moved along the rods by turning a lead screw, the lead screw being fitted with a detachable handle for this purpose. With the cradle in the extended position and the carriage fully forward, as in fig. 3, the indicating unit is placed in position on the cradle with the tongue on the carriage engaging a forked projection carried upon the lower transverse member of the indicating unit chassis.

Removal and replacement of indicating unit

6. Owing to the considerable size and weight of the indicating unit, special arrangements are made for its removal and replacement in the console. These arrangements include the provision of:—

(1) A conveyor beam by which the unit may be transported from a position immediately adjacent to the console, to the exit door of the compartment (or vice versa).

(2) A special hoisting tackle, which is of the self-sustaining type and has a safe working load of 5 cwt.

(3) A special lifting frame, to which the unit is attached at four points before hoisting.

7. The lifting frame consists of a mild steel plate with drilled lugs for attachment to the indicating unit; it is stiffened longitudinally on its upper surface by a steel plate perpendicular to the main plate. A hole is provided in the stiffening plate by which the hook of the lifting tackle may be

PART 2

TECHNICAL INFORMATION

LIST OF CHAPTERS

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

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Chapter 1

CONSOLE FRAMEWORK AND INTER-UNIT CABLING

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General arrangement

1. The assembly of the console Type 60 (*fig.* 1) may be considered to consist of four portions, three of which are entirely self-contained assemblies mounted on separate chassis, namely, the indicating unit (CRT) Type 30, the timebase unit Type 129, and the power unit Type 742. These three units are described in subsequent chapters of this section. This chapter is devoted to the remaining portion of the console, namely, the framework itself and those components mounted directly thereon, or mounted on panels which are not intended for routine removal. A diagram showing the connections between all units on the console is given at the end of the chapter (*fig.* 9). This should be referred to as requisite throughout the chapter.

2. The console consists of a mild steel framework in which the indicating unit Type 30 is supported by a special cradle as described later, while the power unit and timebase unit take the form of drawers which are removable from the front. When ready for operational use, the sides, rear, and top of the console framework are enclosed by sheet metal panels, held in position by captive bolts with slotted heads. Fig. 2 shows the console with these panels removed, but otherwise complete except that the turning gear selsyn in the side nearest the viewer has been removed, together with the associated optical projector system. The positions occupied by the power unit and timebase unit are indicated in this illustration.

Note . . .

The top cover panel is associated with a safety switch and is easily removable. The side and rear panels should not be removed except for the execution of repairs, etc., since their removal exposes the EHT circuit of the CRT with no safety precautions.

Indicating unit cradle

3. The construction of the indicating unit cradle is shown in fig. 3, which shows the framework with the timebase unit and power unit drawn fully forward, and the indicating unit removed. Reference may also be made to fig. 4, which shows the cradle fully extended with the indicating unit mounted on it.

4. Each side of the cradle consists of a three-draw telescopic bar. The outer member is approximately of C section, and is secured rigidly to the rear vertical member and the front sloping member of the console framework. The second member, also approximately of C section, slides inside the first, ball bearing being employed to ensure smooth operation. The third, or inner member, is solid, and has a rectangular cross-section; it carries at each end a bracket, into which the trunnions on the indicating unit are fitted. The rear member on each side is fitted with a catch which engages with a projection on the front sloping member of the console framework.

5. Running from front to rear of the console framework are two steel rods, upon which is

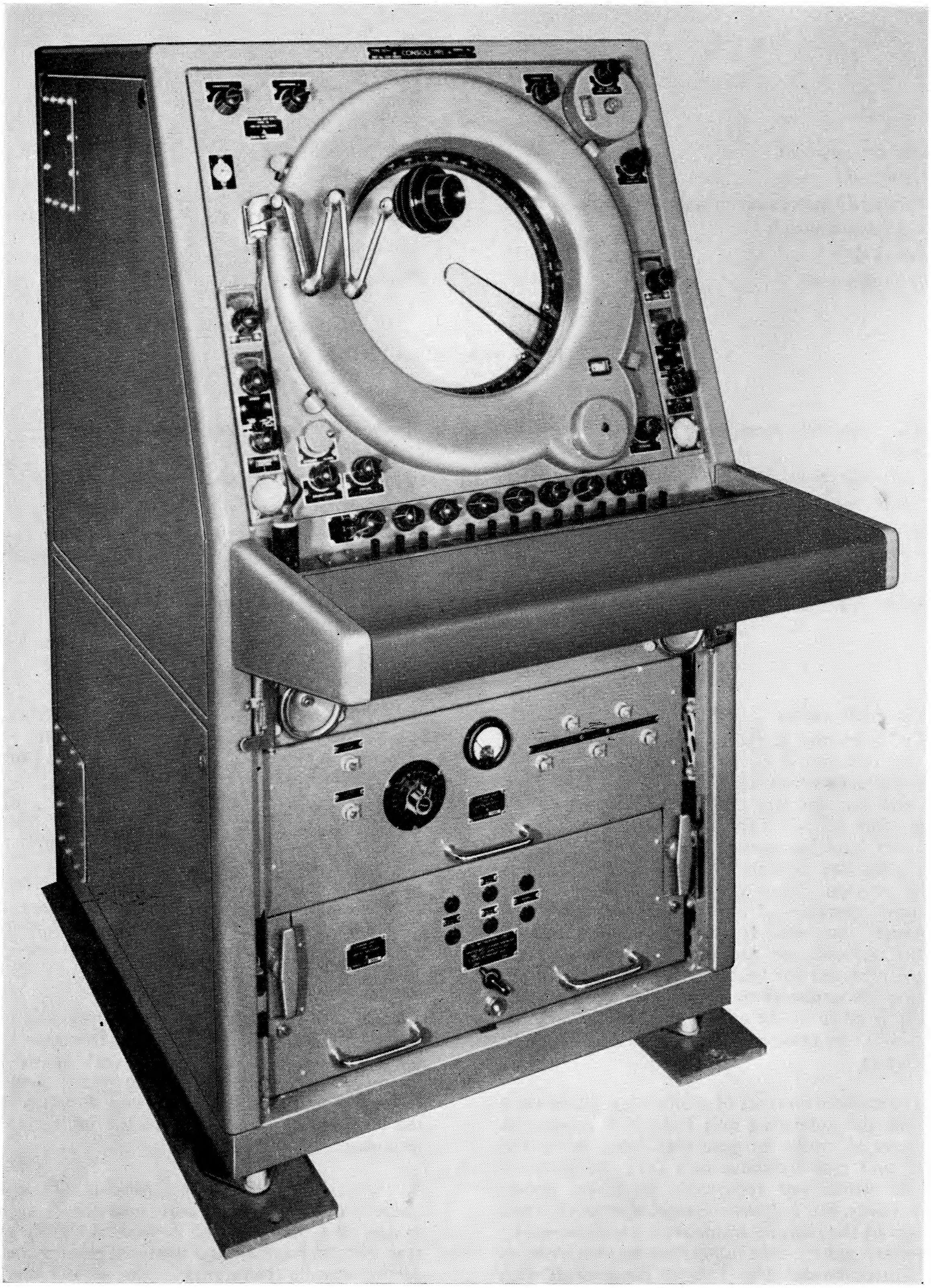
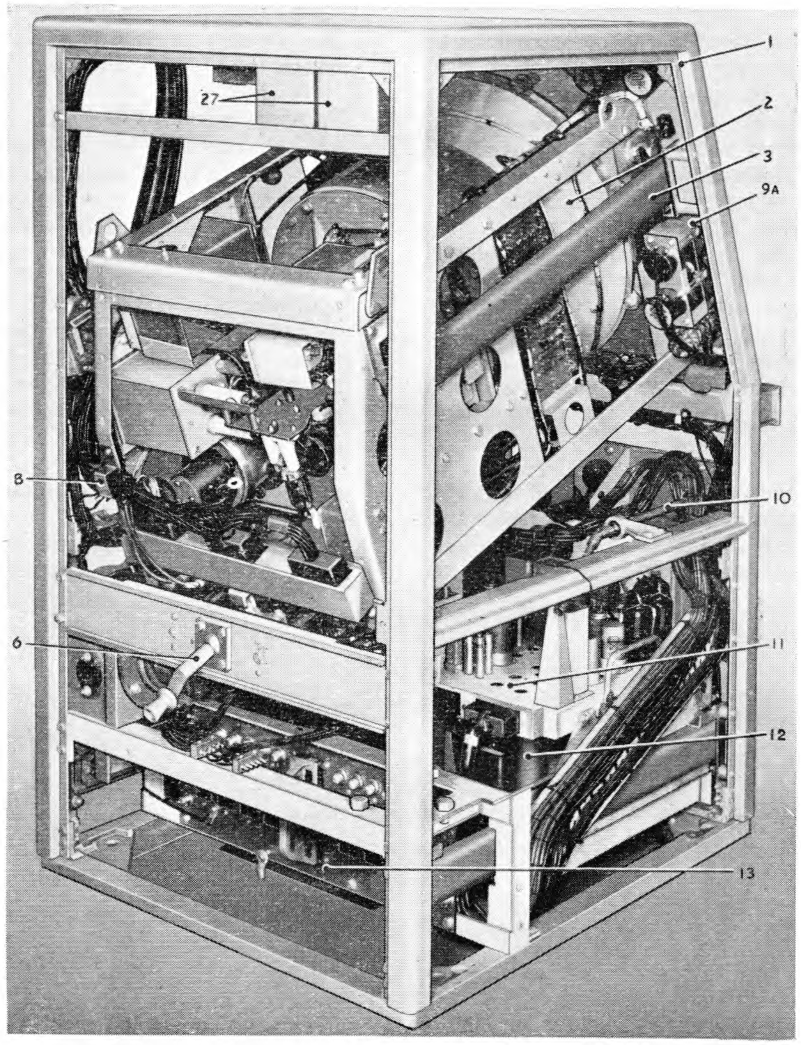


Fig. 1. Console Type 60, front view (bottom cover removed)



1 CONSOLE FRAMEWORK
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8 CLEAT ON INDICATING UNIT CABLEFORM
9A LEFT-HAND TURNING GEAR CONTROL PANEL
10 LEFT-HAND SELSYN DRIVE SHAFT
11 TIMEBASE UNIT
12 POWER UNIT
13 INPUT PANEL

Fig. 2. Rear left side view with cover panels removed

mounted a sliding carriage fitted with a tongue (fig. 3 and 4). The sliding carriage can be moved along the rods by turning a lead screw, the lead screw being fitted with a detachable handle for this purpose. With the cradle in the extended position and the carriage fully forward, as in fig. 3, the indicating unit is placed in position on the cradle with the tongue on the carriage engaging a forked projection carried upon the lower transverse member of the indicating unit chassis.

Removal and replacement of indicating unit

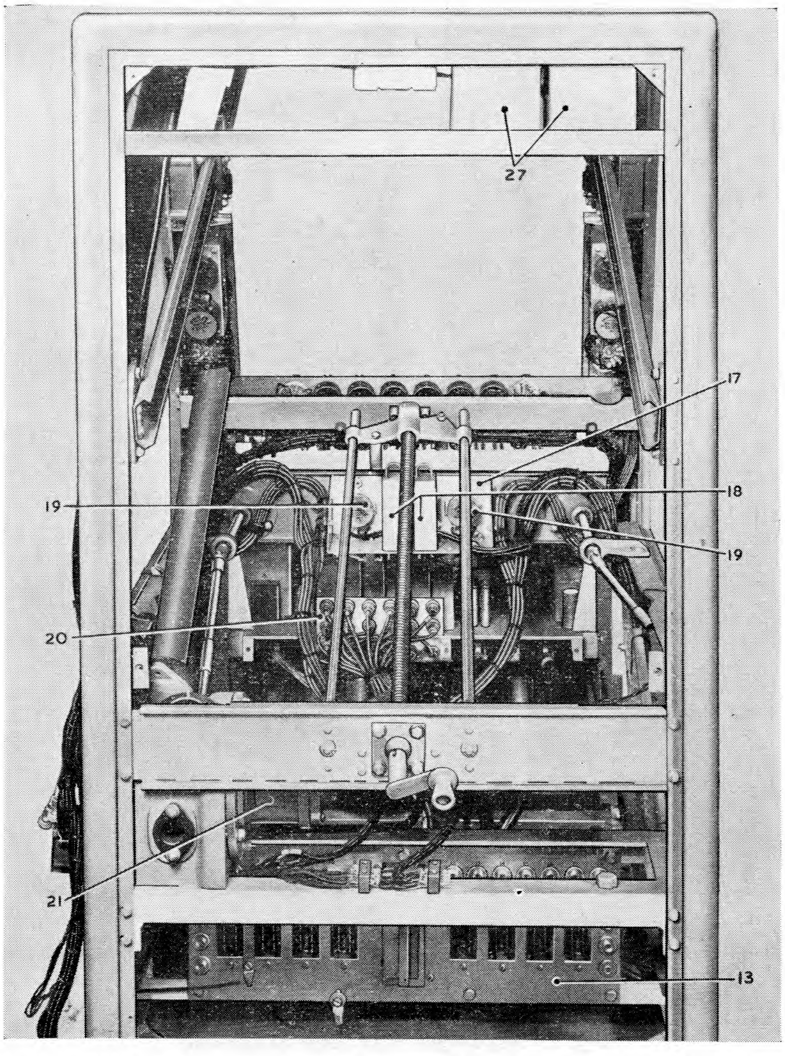
6. Owing to the considerable size and weight of the indicating unit, special arrangements are made for its removal and replacement in the console. These arrangements include the provision of:—

(1) A conveyor beam by which the unit may be transported from a position immediately adjacent to the console, to the exit door of the compartment (or vice versa).

(2) A special hoisting tackle, which is of the self-sustaining type and has a safe working load of 5 cwt.

(3) A special lifting frame, to which the unit is attached at four points before hoisting.

7. The lifting frame consists of a mild steel plate with drilled lugs for attachment to the indicating unit; it is stiffened longitudinally on its upper surface by a steel plate perpendicular to the main plate. A hole is provided in the stiffening plate by which the hook of the lifting tackle may be



13 INPUT PANEL
17 SUB-DESK PANEL
18 RELAYS REL.10 AND REL.11
19 PHASING CONTROL POTENTIOMETERS
20 INPUT PANEL OF TIMEBASE UNIT
21 TURNING CONTROL SELSYN

Fig. 6. Rear view of console

WARNING

Care must be taken never to leave the console with the top cover panel removed, unless the safety switch has been placed in the OFF position and the latch drawn backward. When possible, the top panel should be replaced and latched whenever the console is left unattended.

21. Fig. 6 is a view looking directly into the rear of the console framework. This shows the rear of the sub-desk panel, with the two relays mounted thereon. On each side of the relays is mounted a phasing potentiometer for the turning gear; these are pre-set, the spindle being accessible through the front of the sub-desk panel. The rear of the time-base unit, with its coaxial input panel, is also seen. Near ground level is the input panel of the console, with its eight Jones plugs, recessed into wells, and with numbered coaxial sockets mounted round the top and side edges.

22. Fig. 7 is a view of the console from the rear, showing also the right-hand side. The indicating unit is partly withdrawn, and the illustration shows the engagement of the tongue and fork by which the indicating unit is moved. The cover is here removed from the side of the selsyn scale projector. The manner in which the shafts for the selsyn motor drives are supported is shown both in fig. 6 and 7. The shaft is fitted with two universal joints, one, near the end of the upper horizontal run, being supported by a ball race close to the universal joint. A collar surrounds the shaft at this point, in order to damp out the over-run due to any slight unbalanced torque which may exist. The second universal joint is introduced between the drive shaft and the shaft of the selsyn itself.

attached; the location of the hole ensures that the point of attachment is vertically above the centre of gravity of the unit.

8. This arrangement permits the indicating unit to be lifted sufficiently high to clear the top of the console, even where there is comparatively little head-room, e.g. in the RVT.510. It also eliminates any tendency to distort the framework of the unit, which would occur if slings were directly attached to the four lifting plates on the indicating unit framework. For this reason, the lifting frame should invariably be used when a tackle is employed to lift the unit. The frame is also fitted with handles, which are sufficiently strong to support the weight of the unit, and is found advantageous, in some circumstances, to fit the frame and manhandle by means of these handles, instead of handling by members of the indicating unit itself.

9. The frame is attached to the indicating unit by pins fitted with captive chains, and also with captive retaining pins of the type usually called 'pip pins'. The same means may also be used to secure the frame in its stowage position, e.g. in the RVT.510, it is secured to lugs welded to the roof of the container.

10. Details of the procedure for removing the indicating unit are given in Chapter 3 of this Part.

Turning control panels

11. On console Type 60, each of the front sloping members of the framework carries a small panel, upon each of which is mounted a set of turning gear controls. That on the left-hand side is called control, training, Type 910, and the right-hand one is called control, training, Type 911. Each set of controls is associated with its own selsyn mounted on a platform at the rear of the console, near ground level. Both selsyns are fitted with a bearing scale and cursor, and each is associated with an optical projection system. By this means, an image of a portion of the bearing scale is thrown on to a small circular ground glass screen fitted below the control knobs on each of the turning gear control panels.

12. The metal tube through which the projection beam passes is seen on the far side of the console in

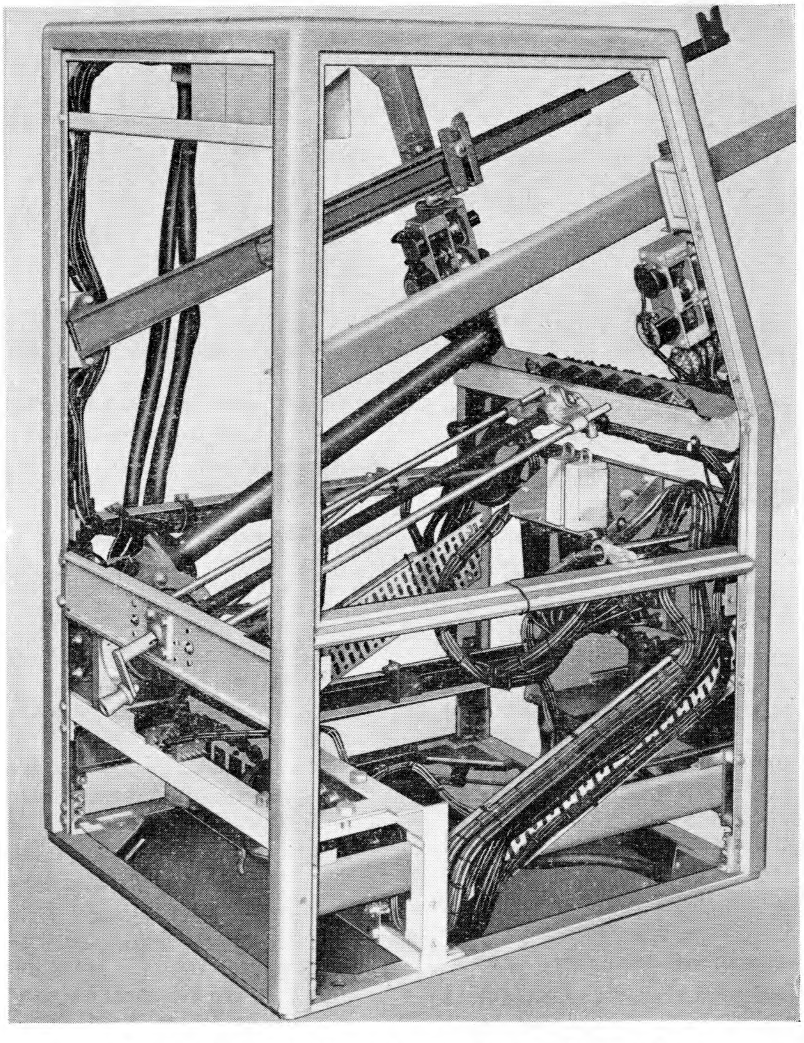
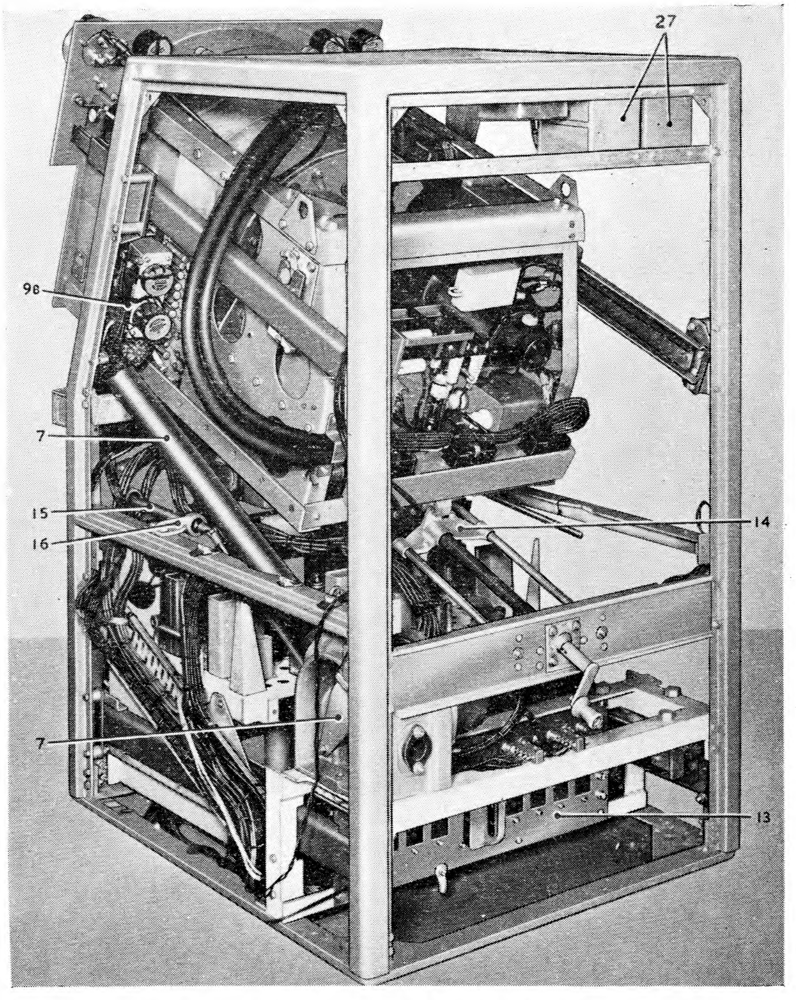


Fig. 3. Rear side view with indicating unit removed



7 OPTICAL SYSTEM FOR SELSYN
9B RIGHT-HAND TURNING GEAR CONTROL PANEL
13 INPUT PANEL
14 CARRIAGE ON LEAD SCREW
15 RIGHT-HAND SELSYN DRIVE SHAFT
16 SUPPORT AND BEARING FOR SELSYN DRIVE SHAFT
27 OFF-CENTRING CHOKES

Fig. 7. Half-right rear view of console

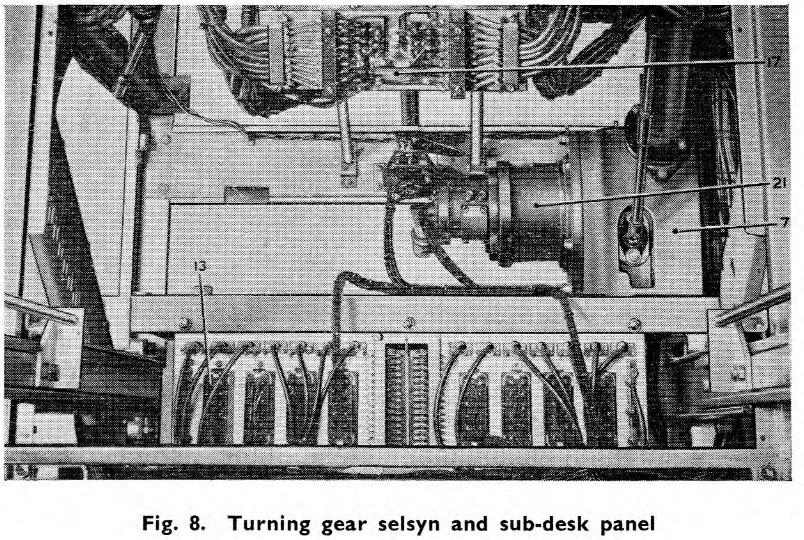
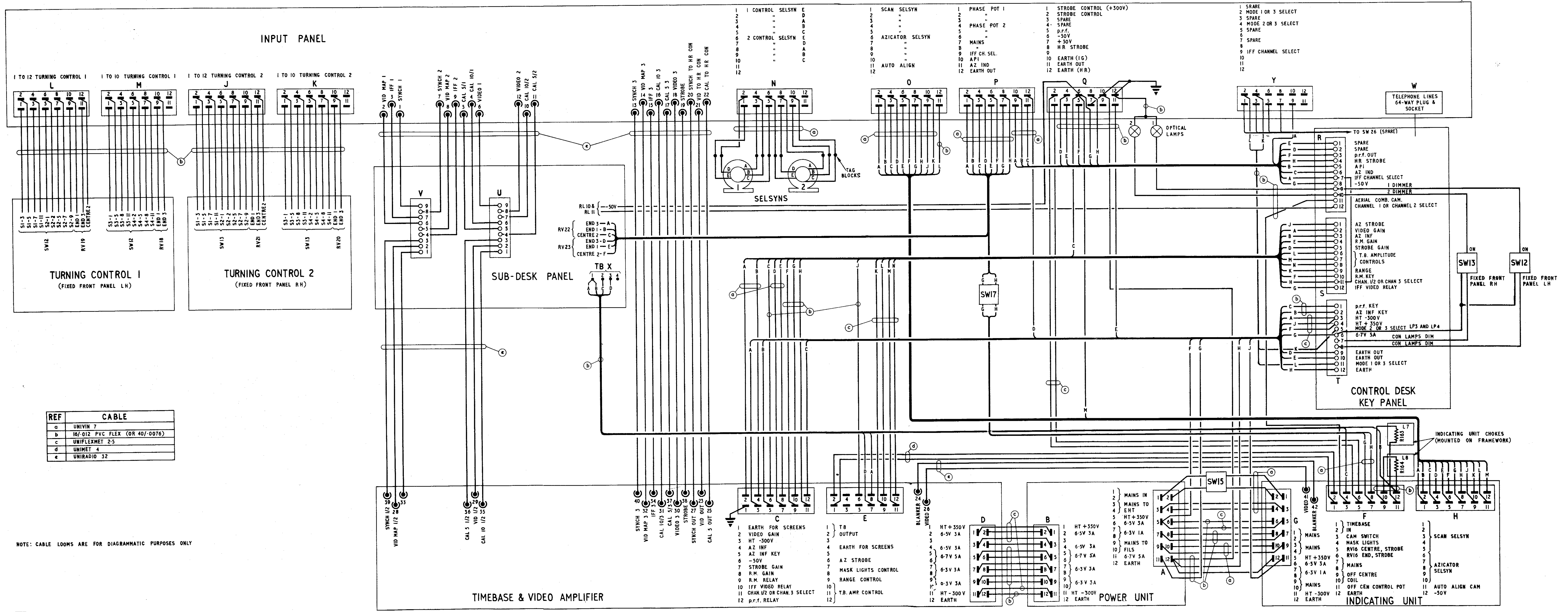


Fig. 8. Turning gear selsyn and sub-desk panel



REF	CABLE
a	UNIVIN 7
b	16/·012 PVC FLEX (OR 40/·0076)
c	UNIFLEXMET 2·5
d	UNIMET 4
e	UNIRADIO 32

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Console Type 60 — cabling

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Fig. 9

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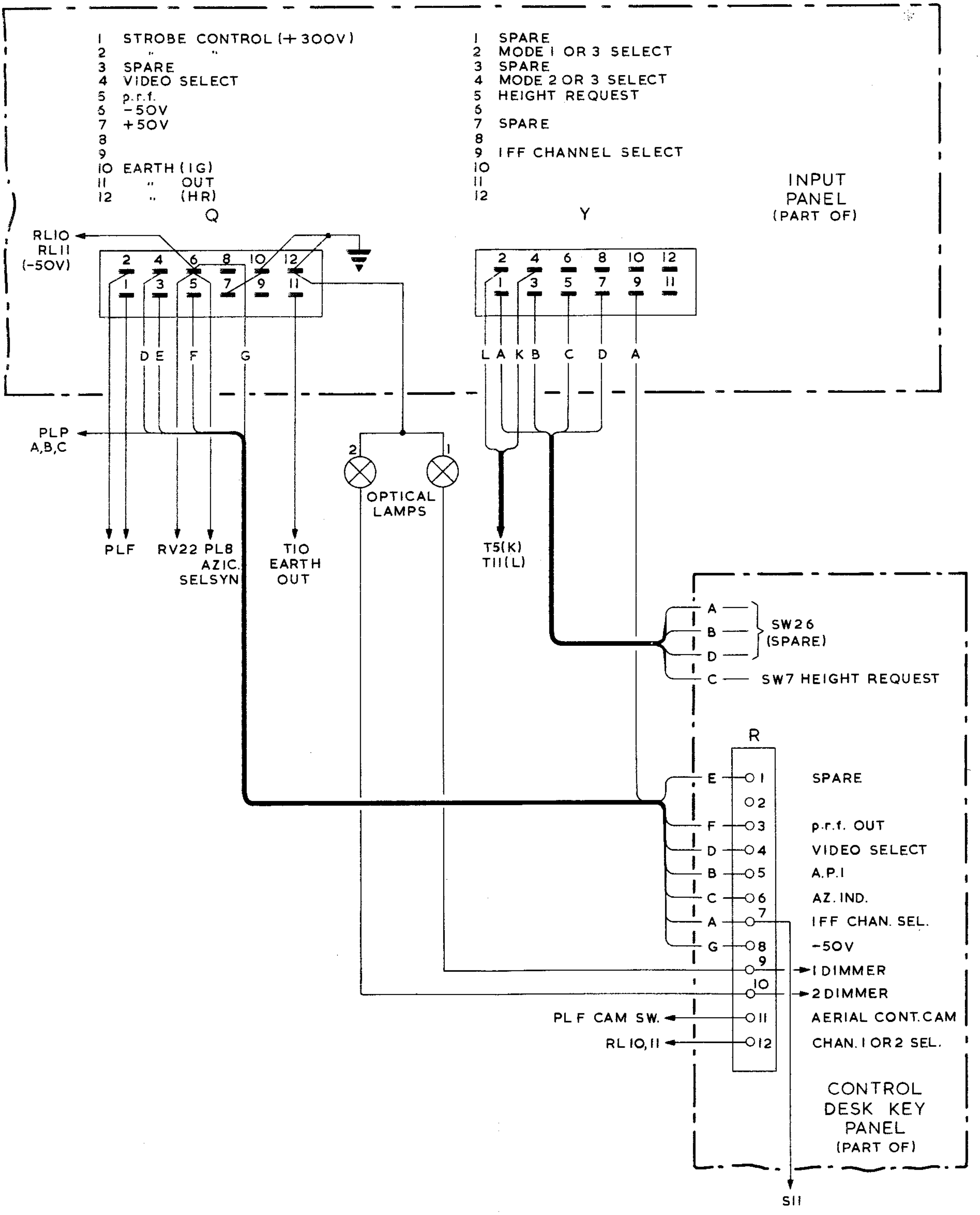
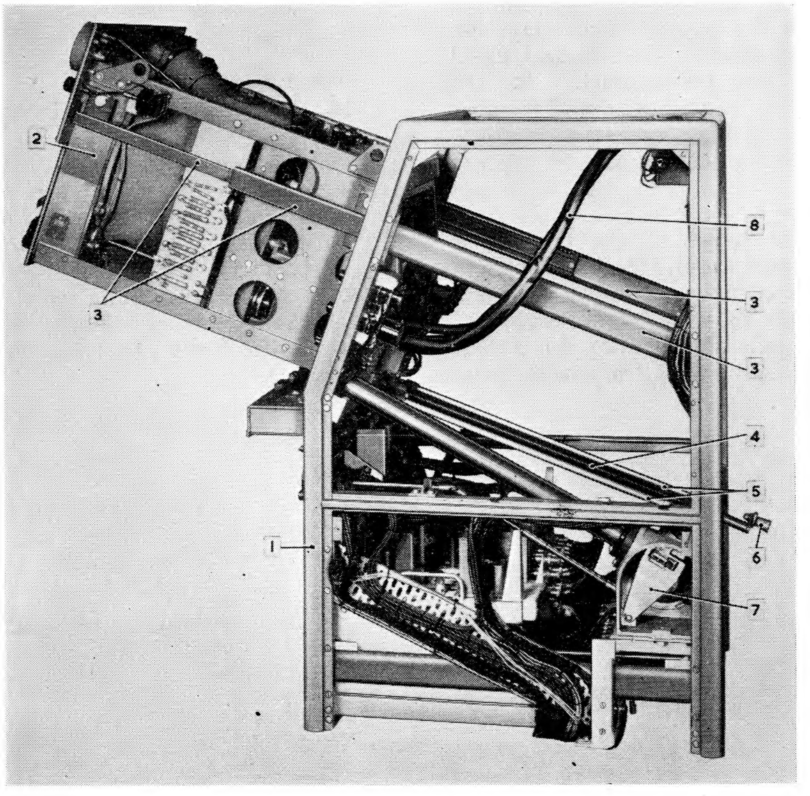


Fig. 9a Console type 60 (special) — modified cabling Fig. 9a



1 CONSOLE FRAMEWORK
2 INDICATING UNIT (CRT) TYPE 30
3 TELESCOPIC MOUNTING FOR INDICATING UNIT
4 LEAD SCREW
5 GUIDE RODS
6 HANDLE FOR TURNING LEAD SCREW
7 SELSYN OPTICAL SYSTEM
8 INDICATING UNIT CABLE-FORM

Fig. 4. Console with cradle fully extended

fig. 3; the selsyn and optical system on the near side was removed prior to the photograph being taken, to avoid obscuring certain features.

13. ▶◀

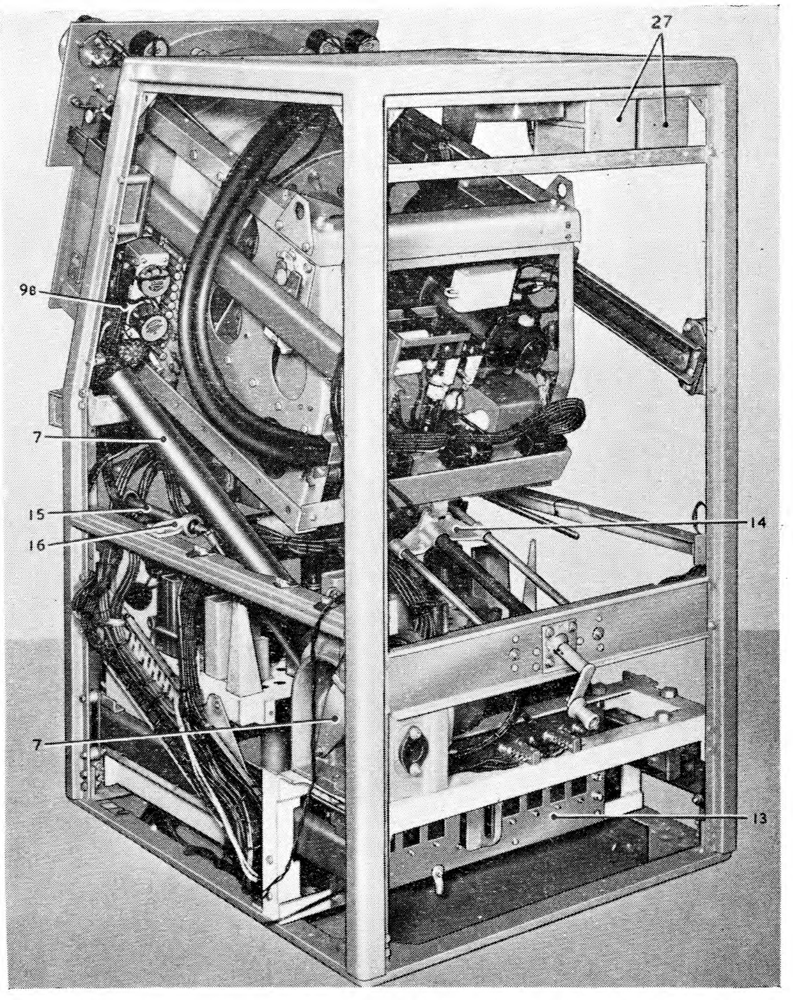
14. Each of the turning gear controls units is easily detachable from the console, complete with its associated cable-form. To remove the complete unit, the appropriate Jones plug is first detached from the input panel by removing the screws. The cable-form is then threaded back so that it can pass clear when the control panel itself is unscrewed from its support.

Control desk

15. The control desk proper is a detachable unit which is attached to a fixed portion of the console framework called the desk unit. The only wiring on the control desk is that connecting the front desk lights to a coaxial plug PL.43. A floating socket SK.43 connects this plug to a 6·7V source on power unit Type 742. It is important to disconnect this plug and socket before removing the control desk.

16. The desk unit carries several potentiometers, wafer switches, and key switches. Further reference is found in Chapter 5 of this Part.

17. The underside of the desk unit carries three 12-way GPO tag blocks, annotated R, S and T, by which connections between the radar display key switches and the other portions of the console are made. Connections to the key switches concerned with the GPO telephone system are made via a 64-way GPO tag block on the lower transverse member of the console frame-work, at the rear. Another tag block is fitted to act as a junction point for the power supply for the mast lighting on the indicating unit.



7 OPTICAL SYSTEM FOR SELSYN
9B RIGHT-HAND TURNING GEAR CONTROL PANEL
13 INPUT PANEL
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15 RIGHT-HAND SELSYN DRIVE SHAFT
16 SUPPORT AND BEARING FOR SELSYN DRIVE SHAFT
27 OFF-CENTRING CHOKES

Fig. 7. Half-right rear view of console

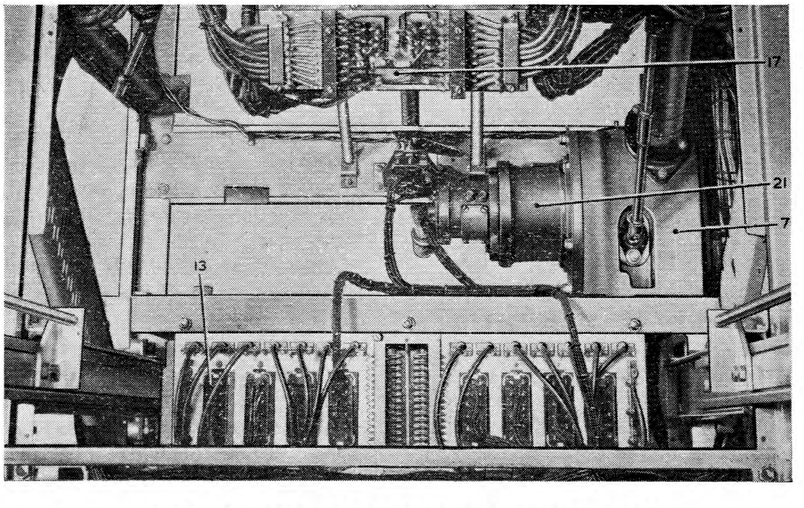
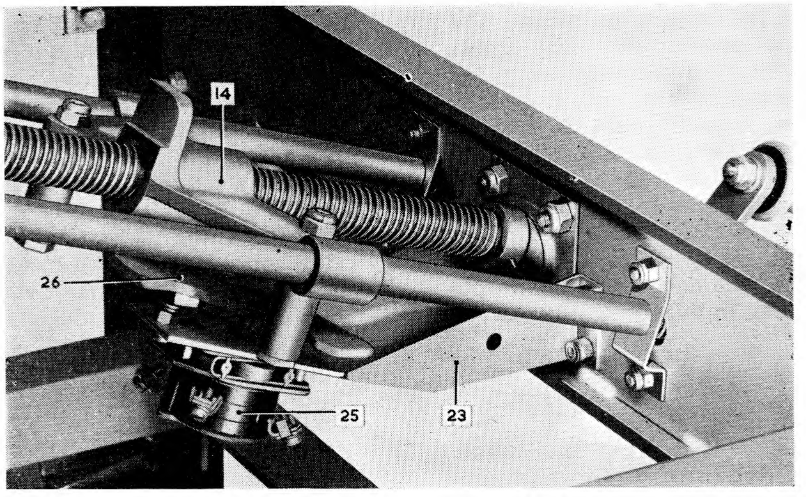


Fig. 8. Turning gear selsyn and sub-desk panel



14 CARRIAGE ON LEAD SCREW
23 BRACKET CARRYING SAFETY SWITCH
25 SAFETY SWITCH
26 TOGGLE OPERATED BY MOVEMENT OF CARRIAGE

Fig. 10. Safety switch at rear of indicating unit

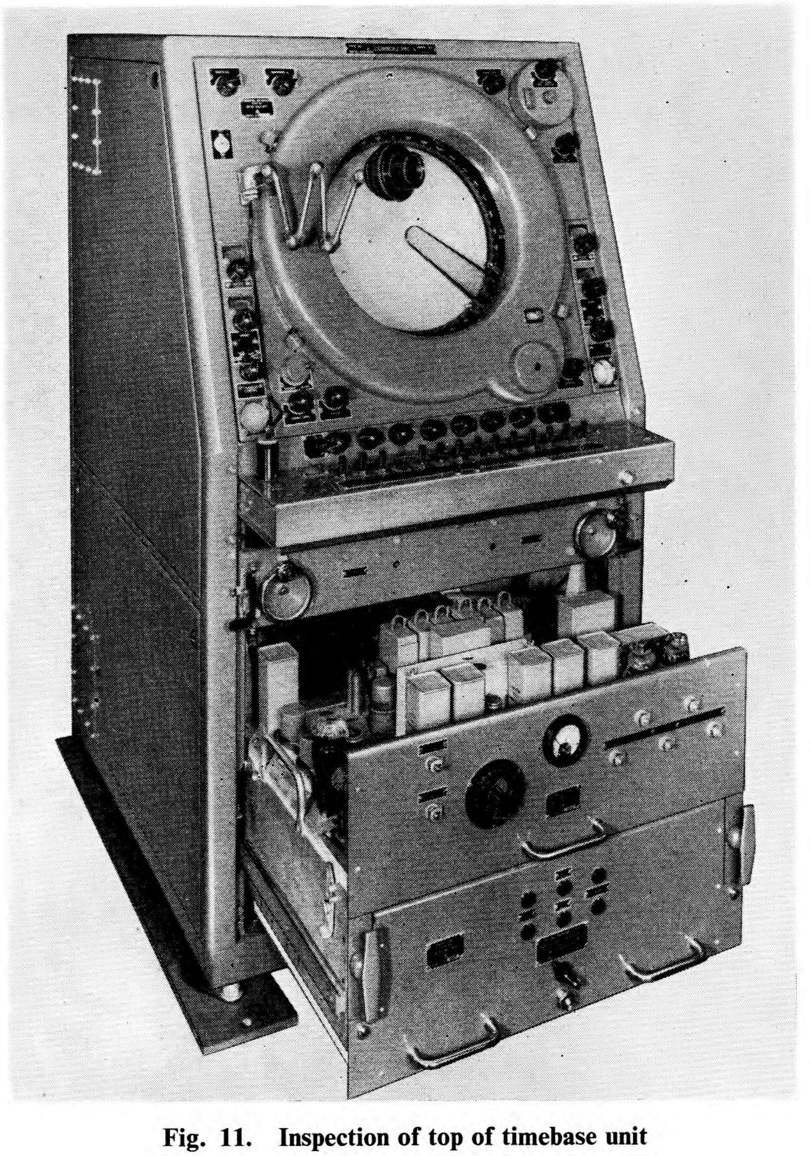


Fig. 11. Inspection of top of timebase unit

23. Fig. 8 is a view looking into the console framework, just below the control desk, showing the right-hand turning gear control selsyn, and also the sub-desk panel in the inspection position. To lower the panel to this position two small screws must be removed from the transverse member which carries the two turning gear control handles (these screws are visible, just above the two phasing controls, in fig. 13). In the illustration, however, these retaining screws are removed, and the panel has been allowed to swing backward and downward, giving easy access to the underside of the panel. The 9-way tag-strip on the left is tagboard U, and that on the right is tagboard V. The rear of the main input panel is seen in this illustration, below the selsyn mounting.

Rear safety switch

24. The safety switch at the rear of the indicating unit is shown in fig. 10. The switch is carried on a bracket 23, attached to the rear transverse member of the console, and is operated by a toggle 26. The latter is mounted in such a manner that it is tripped by the movement of the sliding carriage 14. When the indicating unit reaches its normal operating position, the toggle is tripped and the safety switch is moved to the ON position.

25. When the indicating unit is being removed, the toggle is tripped by the first few turns of the lead screw, and the switch moves to OFF. If, however, it is desired to operate the console with the indicating unit drawn somewhat forward (e.g. for fault tracing), the toggle can be tripped by hand, and the switch restored to the ON position.

26. When the indicating unit is again drawn rearward into the working position, the toggle will automatically trip the switch into the OFF position before the working position is reached, and then restore the switch to ON when the indicating unit is fully home.

Cabling

27. ◀The inter-unit cabling is shown in fig. 9. Fig. 9a shows the modifications to the cabling for the special console used in RVT. 510 Mk. 3. The cables terminated by coaxial plugs are of Uniradio 32, and other single-core shielded leads are of Uniflexmet 2·5 or Unimet 4 cable.▶The turning

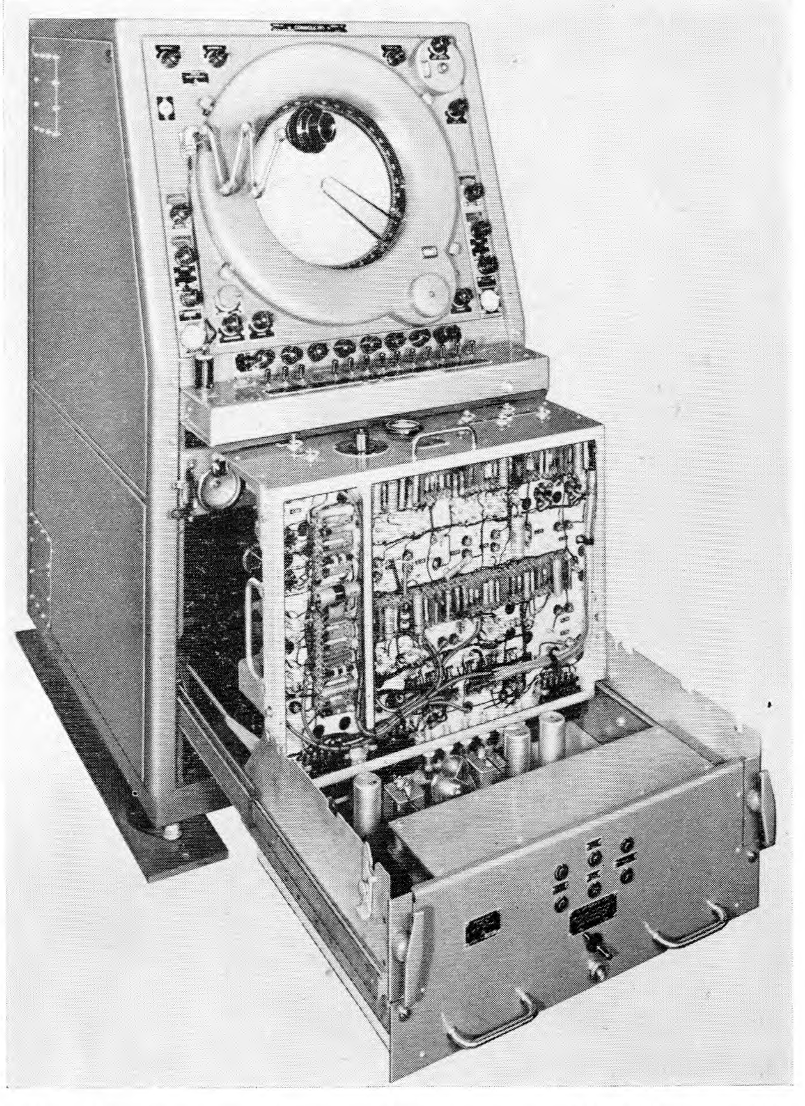


Fig. 12. Inspection of underside of timebase and top of power unit

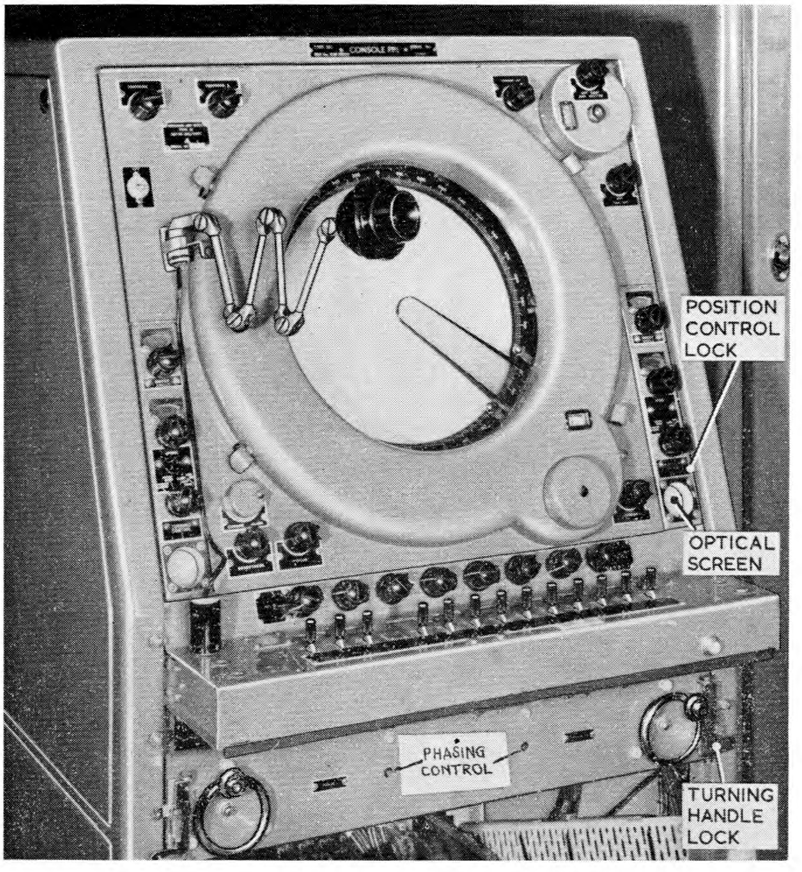


Fig. 13. Position of aerial safety locks

gear selsyn leads and the mains supply are of Univin 7, and the low-voltage wiring is made with PVC-covered flex.

28. The off-centre chokes and associated resistors, which are really part of the indicating unit circuit, are mounted on a supporting bar at the top rear of the console framework, as shown in fig. 4 and 5. These chokes are connected into the indicating unit wiring via Jones plug F, as shown in fig. 9.

Timebase and power unit

29. Fig. 11 is a view of the console with the indicating unit removed, and the two bottom units drawn forward for examination. The power unit is carried on telescopic members of the type used for the indicating unit cradle, and the timebase unit is mounted on top of the power unit. The power unit is fitted with a latch interlocked with a safety switch, of the same type as that described in para. 21. When the two units are withdrawn together, immediate access is given to the upper side of the timebase unit chassis. Access to the underside of the timebase unit, and the upper side of the power unit chassis, is obtained by releasing a spring catch on the left-hand side of the power unit, and lifting the timebase so that the chassis is vertical, as shown in fig. 12. A perforated metal screen normally protects the underside of the timebase unit from accidental contact, but in the illustration this has been removed. The timebase unit can be completely removed by detaching all connectors at the rear, and then removing the two pivot screws at the rear.

30. Circuit diagrams of the timebase unit, indicating unit, and power unit are given in Chapters 2, 3 and 4 respectively, of this section. The circuits of the control desk, turning gear controls, and sub-desk panel are given in Chapter 5 of this section.

Aerial safety devices

31. Whenever it is necessary to enter the aerial vehicle container, or to perform servicing operations on the aerial system, the aerial rotation should be stopped and locked until all personnel are clear of the aerial vehicle. To lock the aerial at 'stopped', the turning control switch is put to POSITION CONTROL and locked by a catch underneath the label (*fig.* 13). The position control hand wheel must also be locked by means of a hinged flap at the side of the wheel. This is also shown in fig. 13.

Phasing controls

32. The two phasing controls for the turning gear are accessible through apertures in the transverse web carrying the turning control handles (*fig.* 13).

Chapter 2

TIMEBASE UNIT TYPE 129

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CIRCUIT DESCRIPTION

Introductory

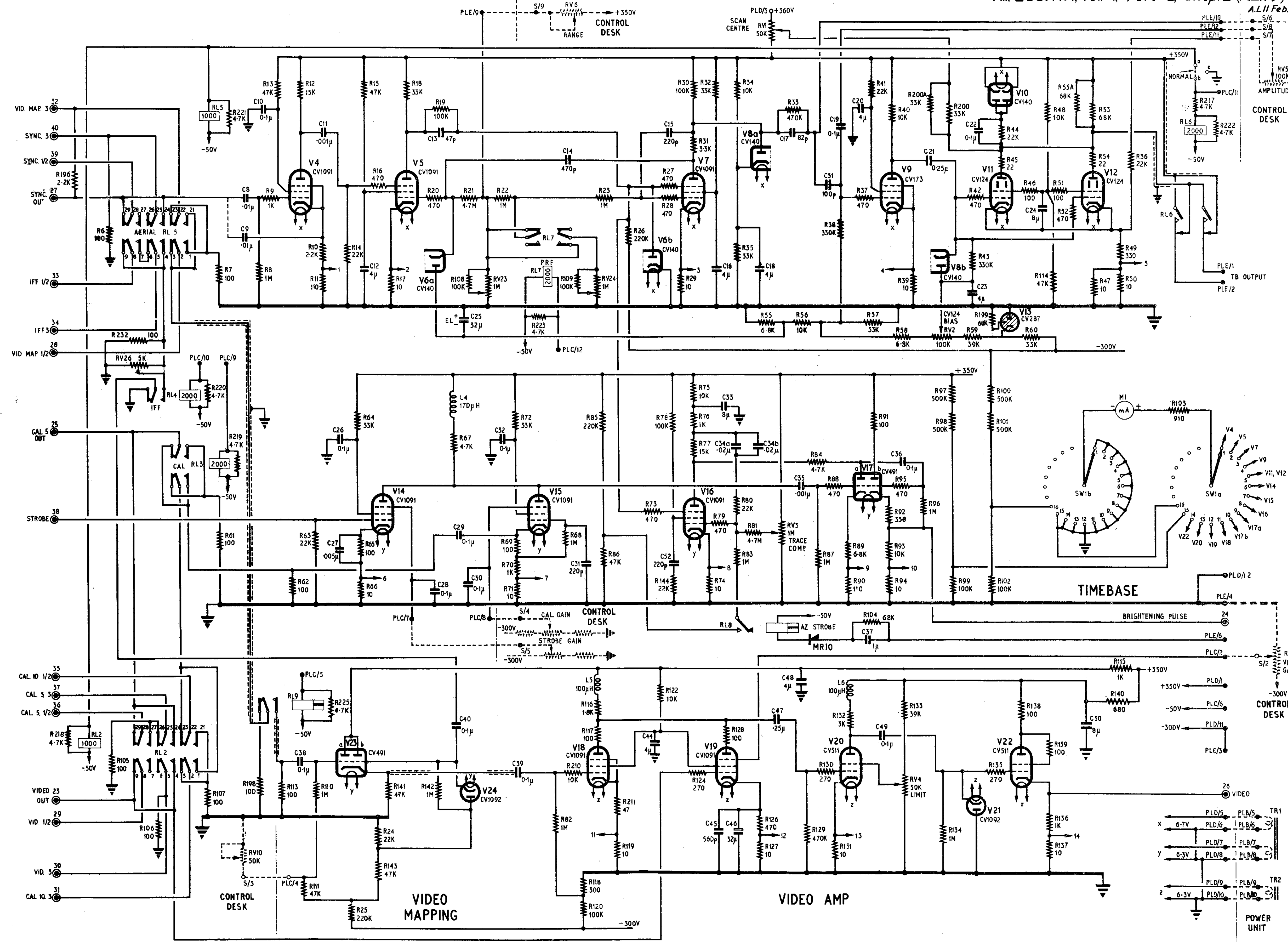
1. The timebase unit circuits may be considered to consist of four sections, *viz.*, the sanatron timebase generator, the feedback amplifier and output stage, the CRT cathode modulation circuits, and the CRT grid modulation circuits. These will be discussed with reference to fig. 1, which for convenience of reference has been placed at the end of the chapter.

2. In the circuit description which follows, it is assumed that the channel selection relays, REL.2 and REL.5, are in the normal, i.e., unenergized, condition. This implies that the channel selection system is set to 'Channel 1.' The principles of the channel selection system are dealt with in Part 1, Chap. 1. The action of each of the other relays in the timebase unit is dealt with in the following paragraphs as it arises.

3. The sanatron embraces the group of valves V4, V5, V6, V7, V8a, while the feedback amplifier and output stage consists of V9, V8b, V10, V11 and V12, with associated circuits. The voltage stabilizer V13 acts as a bias stabilizer for both the foregoing groups.

4. The cathode modulation group consists of the brightening pulse generator V16, the strobe amplifier V14, the range marks amplifier V15, the valve V17a, which mixes the brightening pulse range marks and strobe, and the cathode follower V17b which feeds the mixed output to the CRT cathode, via the coaxial socket No. 24.

5. The grid modulation group consists of the azimuth information amplifier V23a, the IFF video amplifier V23b, V24, and the valve V18 which combines the outputs of V23a and V23b with the output of the radar video amplifier V19. The whole of the video signals, i.e., azimuth information,



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CA 651
CA 832

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Console Type 60

Timebase unit Type 129, circuit

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Fig. 1

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radar, and IFF, are fed through the limiting stage V20, DC restored by V21 at the control-grid of the cathode follower V22, and fed to the control-grid of the CRT via the coaxial socket No. 26.

Sync. buffer-amplifier

6. The valve V4 amplifies the trigger pulse, and also serves to isolate the timebase circuit from the sync. source. The input arrangements permit the use of either a positive or a negative trigger pulse; for a positive pulse, the connections are permanently made as shown in fig. 1, the pulse being applied to the control grid of V4 via C8 If however the unit is to be used with a negative source, the condenser C8 is disconnected from the relay and the free side of the condenser C9 is wired into circuit in its place. The components associated with the valve are so proportioned that the gain is substantially the same for a pulse of either polarity.

7. The sync. pulse should have an amplitude of from 15 to 20 volts and the output of V4 should be of the order of 30-40 volts. This output (*fig.* 2) is a negative-going pulse developed across R12, and is applied to the suppressor-grid of V5 via C11 and the grid stopper R16.

Fig. 2. Sync. pulse at anode of V4

Sanatron timebase generator

8. The saw-tooth waveform is produced by the valves V5 and V7, V5 acting as an electronic relay triggered on its suppressor-grid, while V7, under the control of V5, produces the anode voltage run-down characteristic of Miller type timebases.

9. When the circuit is in a quiescent condition, both V5 and V7 are passing control-grid current, since their control-grids are connected to a point of positive potential derived from a potentiometer chain across the 350-volt HT supply. When running at the normal p.r.f. of 500 c/s, this chain consists of RV6 (the RANGE control, mounted on the control desk) R108, and its adjustable shunt RV23. The valve V5 is normally in the 'bottomed' condition, i.e., anode current is flowing and the anode voltage rests at a low value, at which a positive increase of control-grid voltage makes no appreciable change in either anode current or anode voltage.

10. The valve V7 however is cut off by a negative voltage from the—310 volt power pack, applied through R26 and R27. The magnitude of this negative bias is determined by a potential divider network R19, R26, connected between the anode of V5 and the negative bias rail. In this condition the anode of V7 would normally tend to rise to the full HT rail potential, but it is clamped at approximately 250 volts positive by the diode V8a (half of a CV140). This potential is determined by a divider network R34, R35 (slightly modified by the coupling network to V9, *para.* 21).

11. Since the control-grid of V7 is (under quiescent conditions only) clamped by control-grid current, and there is no anode current, the condensers C14 and C15 are charged to the 'caught' potential of 250 volts. When the circuit is triggered on the suppressor-grid of V5, the anode current of the latter is cut off and the anode voltage rises. This increase is passed to the suppressor-grid of V7 via R19 (shunted by C13 to widen the pass-band and so preserve the pulse shape). The negative bias on the suppressor-grid of V7 is thus annulled and its potential can rise to that of earth, but not beyond, owing to the presence of the clamping diode V6b (half a CV140).

12. The valve V7 then starts to conduct, and current flows through both R30 and R31; owing to the voltage across R31, the anode of V7 falls below the potential of the junction of R30 and R31. Since the anode is connected through C15 to its control-grid, while the junction of R30 and R31 is connected through C14 to the control grid of V5, the potential of the latter falls below the control-grid potential of V7; the fall is in fact sufficient to cut off the anode current of V5.

13. The condenser C15 now takes current through R22, R23, and the range control VR6, and the potential of the anode of V7 starts to fall linearly from its original value of 250 volts. The time taken for the complete-run-down depends upon the DC potential of the junction R21, R22 and is controlled by the setting of RV6, hence its designation RANGE control. The variation of waveform, with variation of RANGE setting is indicated in fig. 3.

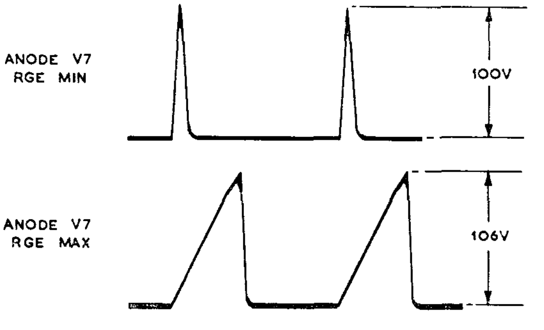


Fig. 3. Waveform at anode of V7

14. As the anode potential approaches that of the cathode, the rate of change of anode potential falls to zero and the Miller feed-back action from anode to control-grid ceases. The control-grid potential then tends to rise to the potential at the junction R21, R22, until it reaches cathode potential, when it is again clamped by the control-grid current.

15. A somewhat similar action occurs at the control-grid of V5, which during the run-down remains caught at approximately—6 volts by the action of the diode V6a (one-half of a CV140). At the end of the run-down, the control-grid of this valve returns to near earth potential, owing to the charge on C14, and the valve quickly reverts to the normal bottomed condition. The rise of current through R18 brings the anode down to nearly earth potential, and this change, fed through R19 to the suppressor-grid of V7, cuts off the anode current of the latter. The anode voltage then rises exponentially towards HT rail voltage, but is caught at 250 volts by the diode V8a. The circuit is now in its original condition and remains quiescent until it is again triggered.

P.r.f. relay

16. When the relay REL.7 is not energized, as in fig. 1, the 1-megohm resistor R22 is short-circuited, and the junction of R21 and R22 is connected to earth through the variable resistor RV23, partly shunted by R108. It will easily be seen that the total range of variation is from 100 K (approximately) to 1 megohm. The variable resistor is pre-set and is so adjusted that the timebase operates correctly at maximum range when locked to a transmitter p.r.f. of 500 c/s.

17. When the relay REL.7 is operated the short-circuit on R22 is removed, and the combination RV24, R109, is placed in parallel with RV23, R108. This arrangement is suitable for triggering when the transmitter p.r.f. is 250 c/s. The relay is operated by a key switch, marked P.R.F., on the control desk. This switch also operates two other relays, one in the transmitter head by which the transmitter p.r.f. is controlled simultaneously, and the other in the external range marks generator, which changes the range of the calibrator. Both pre-set resistors RV23, RV24, are set up during the initial setting-up procedure, and should not require subsequent alteration.

18. Two indicating lamps, one marked 250, and the other marked 250 EXT. are associated with this switch. The 250 lamp lights when the key switch is thrown to 250. The 250 EXT. lamp lights when the p.r.f. is changed by the operator at any other console fed from the same aerial.

Feedback amplifier and output stage

19. The linear run-down voltage at the anode of V7 is fed into the control-grid of V9 through part of what is, in effect, a potentiometer network across the HT supply. This network consists of R30, R33, RV5 (the AMPLITUDE control, mounted on the control desk) R36, R49, R47, and R50. The control-grid of V9 is connected to the variable tapping on RV5 through C19 and the stopper resistor R37; a small amount of coupling between the anode of V7 and the control-grid of V9 is also provided by C51.

20. Since R30 is in the anode circuit of V7, a voltage waveform is developed across it; this is a replica of the anode waveform, and the control-grid of V9 follows the run-down portion of the anode wave-form without appreciable delay.

21. To prevent the clamped anode potential of V7 from being appreciably lower than the potential across R35 (i.e. the cathode potential of the diode V8a) the resistance of the potentiometer chain must be large compared with R30; actually in this unit it is about eight times the magnitude of R30. The major portion of this resistance is lumped in R33; the latter is shunted by a small capacitance C17, in order to maintain the frequency response of the network and so minimize waveform distortion.

22. The working control-grid bias of V9 is fixed at an optimum value for a normal CV173 valve (about 12 volts). Under normal conditions (i.e. with no control-grid input) the valve passes a steady current of about 25 mA and the p.d. across the anode resistor R40 is about 250 volts, i.e. the anode is about 100 volts above earth potential. On the arrival of the run-down voltage at the control-grid, the latter is driven negative, the anode current falls and the anode voltage rises towards HT rail potential.

23. The exact amount of this voltage rise, and the resulting waveform at the anode, depends upon the settings of the RANGE and AMPLITUDE controls. Fig. 4 shows the four extreme cases which arise. With the RANGE control at minimum, the voltage sweep is of the order of 15–20 volts, whereas at maximum, it is of the order of 90 to 110 volts, irrespective of the setting of the AMPLITUDE control. The time taken for the actual sweep is however the same in each case. Again, the amplitude of the voltage change, with the AMPLITUDE control at maximum, is about six times that obtained with the control at minimum, irrespective of the setting of the RANGE control. For practical purposes, therefore, the reaction of one control upon the other is negligible.

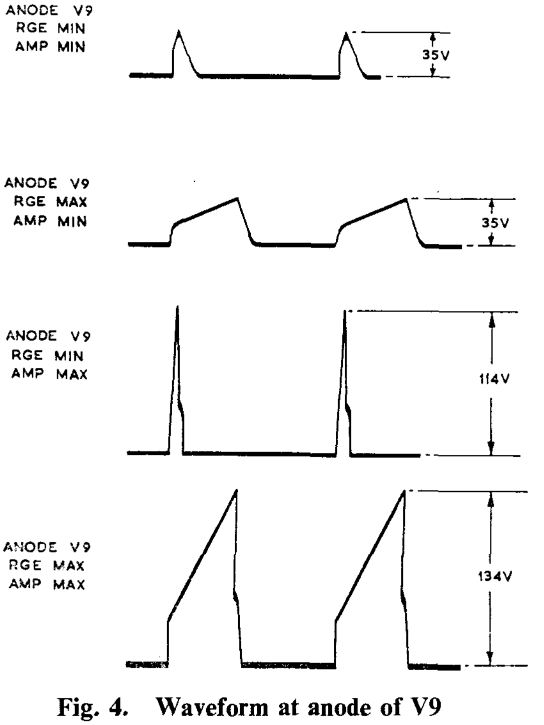


Fig. 4. Waveform at anode of V9

24. The rise of voltage at the anode of V9 is communicated, through the coupling condenser C21 and the two stopper resistors R42, R52, to the control-grids of a pair of valves V11, V12, which are connected in parallel to provide adequate power-handling capacity. This is necessary because of the large amplitude of the required trace, when full off-centring is in use.

25. The deflection coils of the CRT form an anode load common to V11 and V12. For the present, these coils may be considered to be directly connected in series with the anodes; details of the actual connections are dealt with in para. 31–33. The output of V11, V12, is a sawtooth current waveform, causing the CRT spot to be deflected in the normal manner.

26. A voltage proportional to the current through the deflector coils is generated across the resistor R49 in the cathode circuit of the output valves V11, V12. This voltage, which constitutes the feedback, is returned to the control-grid of V9, via R36, the AMPLITUDE control RV5, and the condenser C19.

27. The output valves are biased just beyond the nominal cut-off by the voltage from the potentiometer RV2 (the CV124 BIAS control). In the absence of an input to the control-grids, and provided the SCAN CENTRE control is correctly set, the valves pass no current, and the CRT beam is not deflected. There is then no feedback across R49. When setting up, reduction of the CV124 bias causes the origin of the trace to move away from the centre of the CRT screen; as the bias is increased, the origin moves towards the centre, but eventually a point is reached where the origin moves no further. The CV124 BIAS control is then at its optimum setting. The origin can then be brought to a true centre by adjusting the SCAN CENTRE control (*para.* 34).

28. To recapitulate, the anode of V7 commences its run-down immediately the sync. pulse is received, and the control-grid potential of V9 follows without appreciable delay. Its anode voltage rises and drives the control-grids of the output valves into their grid base. As the valves take current, the latter flows in the deflection coils of the CRT. Owing to the inductance of these coils, the current build-up tends to bear a non-linear relationship to the sawtooth voltage developed across the anode load of V7. This tendency to non-linearity is further aggravated by the bottom bend of the Ia-Vg characteristic, because the working point moves through this bend immediately after the beginning of the timebase stroke.

29. This non-linearity would normally cause the current through the deflection coils to start slowly and to be non-linear, and the non-linearity would increase progressively throughout the sweep, so that the current rise would tend to be exponential. The negative feedback corrects this tendency, with the result that the initial rise in the anode current of V9 is increased, and additional drive is provided for the output valves.

30. As a consequence of the increased drive, the output current through the deflection coils is increased; the final result of this cumulative process is to force a linear sawtooth current through the deflection coils, producing a timebase having the same degree of linearity as the initial run-down at the anode of V7. The waveforms at the cathode and anode of the output stage, for extreme settings of the RANGE and AMPLITUDE controls, are shown in fig. 5.

Trace-reversing relay

31. As will be seen from fig. 1, the anode circuit of the output valves is rather more complex than has hitherto been assumed. Each valve has an anode stopper in series, viz., R45 and R54, the remainder of the anode circuit being common to the two valves. This portion will now be considered.

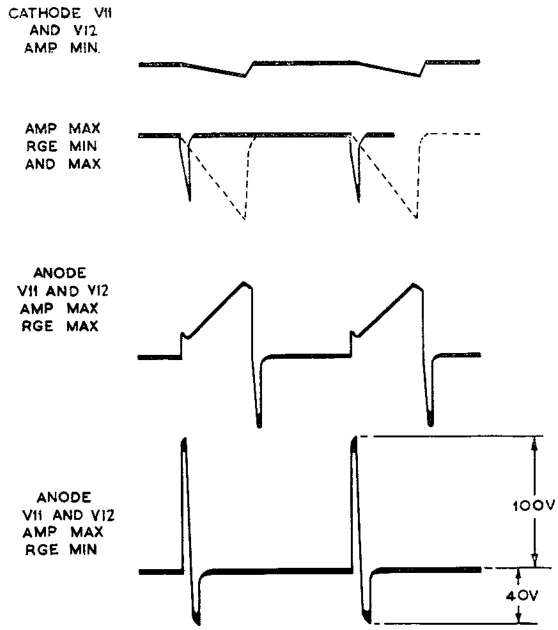


Fig. 5. Waveform at anode and cathode of V11, V12

32. In the first place, it is necessary for operational reasons (*Part I, Chap.* 1 refers) to provide for a reversal of direction of the timebase stroke; this entails a periodic reversal of the sawtooth current waveform through the deflection coils, with respect to the HT rail and the common anode point (the junction of R45 and R54). The contacts of the trace-reversing relay REL.6 are therefore used in the deflection coil circuit in the manner of a reversing switch, so that the direction of travel of the trace is reversed when the relay is energized. The relay is fed from a 50-volt DC supply through the AERIAL COMBINATION switch SW19 and the AERIAL SELECT key switch SW3, which are associated with the trace-reversing cam as explained in Part I, Chap. 1 of this volume (*para.* 63–65 also refer).

33. The relay contacts are of the make-before-break (MbB) type, so that the load on the output valves is not removed during the change-over interval. The deflection coils (with associated stray capacitance) form a tuned circuit which tends to 'ring' when the current through the coils is interrupted, and, to a less extent, when applied. The tendency to ring at the commencement of the stroke is eliminated by the damping resistor R53 and R53A which in effect are shunted across the winding. The 'ring' which occurs at the flyback requires greater damping, owing to the greater rate of change of current. The double-diode V10 is therefore shunted across R53, R53A, with a resistor-condenser combination R44, C22, in series; the latter impose a small voltage delay before the diode starts to conduct. The overswing on the flyback is thus reduced to about one-third of the amplitude of the forward stroke.

34. The common anode point (junction of R45 and R53) is also connected via R200, R200A (15K) to a tapping on the potentiometer RV1 connected between the HT rail and a point some 10 volts above the potential of the latter. The control RV1 is pre-set, and is mounted on the front panel; it is called the SCAN CENTRE control. Its function is to neutralize the slight 'tail' current which flows through the output valves, even if biased beyond their so-called cut-off point. Without this backing-off current, the timebase origin would tend to rotate in a small circle during the normal PPI sweep in azimuth, owing to the effect of the residual current.

35. The grid leak resistor R43 of the output valves is shunted by a diode V8b (one-half of a CV140) to provide DC restoration of the signal level at this point. Each valve has its own screening-grid stopper, the common point being connected to a fixed potentiometer chain R48, R114; the screening-grid potential is thus maintained at approximately 60 volts positive to earth.

Cathode modulation circuits

Brightening pulse generator

36. The brightening pulse generator consists of the valve V16 arranged in a simple type of Miller timebase generator. It is designed in such a manner that the output waveform has a large initial step followed by a Miller run-down with a variable slope. The CRT is normally biased off (by the BRILL control) so that the trace is blacked out, and the initial step lifts this bias sufficiently to allow normal level video responses to be presented. Owing to the Miller run-down, the bias is reduced progressively through the sweep, and the slope of the run-down may be varied to suit local conditions by a control labelled TRACE COMP. (trace compensation).

37. With this control in the minimum position, the run-down is so slow that the brightening pulse is of practically the same amplitude along the whole length of the trace, whereas with the control in the maximum position, the amplitude at the end of the trace is approximately double the amplitude of the initial step.

38. The TRACE COMP. control should be adjusted in such a manner that when the brilliance control is set to give a faint trace, and the latter is in rotation at normal speed, the overall brightness of the tube face is approximately the same along any radius (obviously the most recent traces will be brighter than the older ones). With the control at minimum the inner portion of the tube face will be appreciably brighter than the portion near the periphery, owing to the close proximity of successive traces near the middle of the screen.

39. As already stated, the trace is blacked out, except during the forward stroke of the timebase. Hitherto, it has been assumed that the brightening pulse reaches its full amplitude instantaneously, i.e., by a vertical step in the waveform. Actually, however, the step is an approximately exponential curve having a time-constant of about 24 microseconds, corresponding to a range of about four data miles. This time-constant is introduced in order to suppress the so-called ground wave response at the middle of the PPI screen. The components chiefly concerned with ground wave suppression are C52 and R144, connected in series between the screening-grid of V16 and earth. To simplify the explanation, the presence of these components will at first be ignored; they will however be dealt with later (*para.* 44). With this simplification, the action of the brightening pulse generator is as follows.

40. Immediately prior to the initiation of the timebase, the circuit is in a stable state. The suppressor-grid of V16 is connected to the suppressor-grid of V7 and is therefore at the same potential, i.e., well beyond its cut-off voltage. The anode is therefore a little below HT rail potential. The control-grid is connected to RV3, the trace compensation potentiometer, and the latter is connected directly between HT rail and earth. The control-grid thus takes sufficient grid current to ensure that its potential is very little above earth. It follows therefore that the Miller timebase condenser C34 is also charged to nearly HT rail potential.

41. When the timebase is initiated, the suppressor-grid bias is lifted simultaneously with that of V7, and V16 takes anode current. The anode voltage then falls below that of the HT rail owing to the voltage drop across the resistors R76 and R77 (R75 is merely a decoupling resistor, the p.d. across which remains approximately constant owing to the large capacitance of the decoupling condenser C33).

42. The voltage drop across R76 is fed to the control-grid through the Miller condenser C34. Since the control-grid is in effect self-clamped at earth potential, the voltage drop across R76 cannot exceed the grid base of the valve. The values of R76 (1K) and R77 (15K) are so chosen that equilibrium is reached when the anode current through R76 produces a voltage across it equal to that through which the control grid can fall, that is, the grid base.

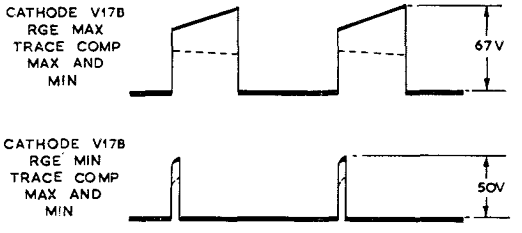


Fig. 6 Waveform at cathode of V17b

43. The condenser C34 then commences to discharge through the associated resistance network, giving the usual Miller run-down in the anode circuit of V16. The time-constant of the discharge circuit is such that the time taken for a complete run-down would be very much longer than the timebase period, the actual discharge period (and therefore the slope of the run-down portion of the waveform) being determined by the setting of the trace compensation control. As already stated, in the extreme case the run-down takes place so slowly that the output waveform is to all intents and purposes a square wave. The variation in the brightening pulse waveform for extreme variations in the settings of the RANGE and TRACE COMP. controls, is shown in fig. 6.

Ground wave suppression

44. When the anode circuit of V16 is opened by the positive-going pulse on its suppressor-grid, the immediate effect is to increase the electron flow from the cathode, but the majority of this current is intercepted by the screening-grid, charging the condenser C52 negatively on its upper plate, through the resistor R144. As the condenser charges, the proportion of space current going to the anode increases in an approximately exponential manner, so that the leading edge of the brightening pulse is approximately exponential in shape, reaching two-thirds of its maximum amplitude in approximately 24 microseconds. As stated in para. 39, the effect is to suppress the so-called ground-wave response at the centre of the screen.

Azimuth indication strobe

45. The conditions described above obtain when the relay REL.8 is not energized. This relay is connected in a 50-volt DC circuit in series with a key switch (AZ. IND.) on the control desk, and a trip switch on the aerial turntable (or pivot mount). Assuming that the key switch is closed, therefore, the relay is energized once per revolution of the aerial, but only during the short interval in which the condenser C37 is charging (*para.* 47).

46. When the relay is energized, the contacts are closed, and the control-grid of V16 is then connected, via R83, to a point on the potentiometer network R85, R86, at which the potential is about 70 volts positive to earth. The trace is therefore suddenly brightened ('flashed') during the short period in which the relay remains energized. This flashing should occur regularly on the same PPI bearing, giving an indication that the aerial is in rotation at the correct speed. The principal use of this facility, however, is during the initial siting and lining up of the aerial and PPI selsyns.

Note . . .

In certain installations, this relay can be energized, independently of the turntable switch, by closing a key switch (marked PPI STROBE) on the control desk of an associated console Type 61. *The manner in which this facility is used is a matter for operational organization.*

47. When the 50-volt circuit to the relay is completed through the switch or switches mentioned in para. 45, the condenser C37 charges rapidly on the short time-constant of the condenser and the relay coil resistance, R104 having little effect. The relay is a fast-operating one, and the contacts close immediately. As soon as the current reaches its peak, it commences to die away, and the relay falls off when the current falls to the 'release' value. The condenser remains charged until the circuit is opened, and then discharges through the bleeder resistor R104.

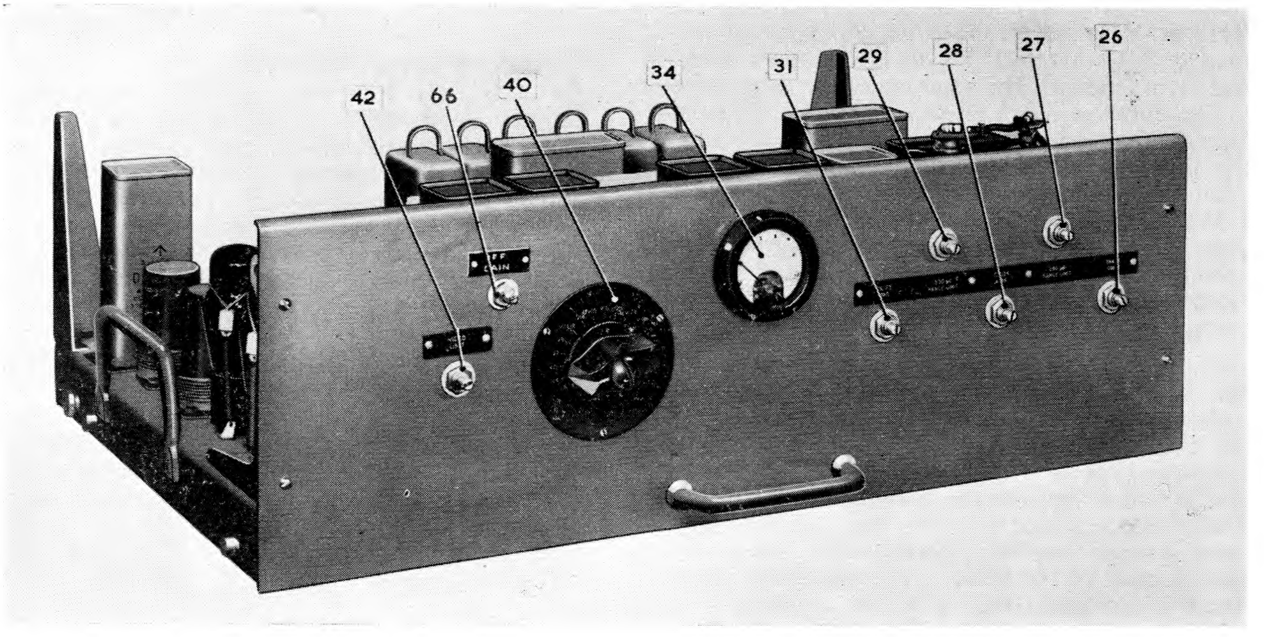
48. The brightening pulse and azimuth strobe are fed to the cathode of the CRT through the cathode follower V17b together with other information as detailed in para. 51.

Range marks

49. Range marks are normally generated in a separate rack assembly known as the information generator. ▶◀Provision is made for the range marks to be taken from any one of three calibration units on the information generator, either 5 data mile or 10 data mile spacing being available. Selection is made by the RANGE MARKS switch on the control desk. An OFF position is provided on the RANGE MARKS switch for testing purposes and for operational use, e.g., where a video map is used. In the 5M and 10M positions the brightness of the range marks can be controlled by a potentiometer marked CAL. AMP (RV8), mounted on the control desk. When the switch is in the OFF position, however, a 1K series resistor at the earthed end of the resistor chain is disconnected from earth. Under these conditions a high negative bias voltage (70 to 150 volts) is applied to the suppressor-grid of V15, and the valve is accordingly cut off.

IFF strobe pulse

50. ◀The IFF strobe pulse is derived from the IFF Mk. 3 display in an associated H/R console and must not be confused with the azication indication strobe referred to previously. The IFF strobe pulse facility is no longer used, but the circuit remains and is here described.▶ The strobe pulse is applied to the control grid of V14, and the



26 RV3 (TRACE COMP CONTROL)
27 RV24 (250 P.R.F. RANGE LIMIT CONTROL)
28 RV2 (CV124 BIAS CONTROL)
29 RV23 (500 P.R.F. RANGE LIMIT CONTROL)
31 RV1 (SCAN CENTRE CONTROL)
34 SPACE CURRENT METER
40 METER SWITCH
42 LIMIT CONTROL
66 IFF GAIN CONTROL

Fig. 7. Timebase unit, Type 129, Front view

selected range marks are applied via C29 to the control grid of V15. These valves share a common anode load R67, L4. The inductance L4 is included in order to increase the bandwidth, and so preserve the waveform of the steep-fronted strobe and calibration pulses.

51. The combined output of V14 and V15 is applied to the control-grid of V17a, in which it is amplified and is then mixed with the output of the brightening valve V16. This combined waveform is then applied to the control-grid of the cathode follower V17b; the resulting output appears across the resistor R93, from whence it is fed to the cathode of the CRT via the outlet 24 on the timebase unit, and the inlet 42 on the indicating unit.

Grid modulation circuits

52. In the present connotation, the term 'azimuth information' means either true radial marks from the azimuth marks generator in the I.G. rack, or the video map derived from the marker unit (video map) Type 30, where the latter is installed. Whichever of these is used, it is mixed with the IFF video and the radar video in the grid modulation chain.

52. The radar video signals are positive-going and are derived from the radar receiver in the aerial head. They are fed into the information generator at intermediate frequency, and after conversion to video frequency are distributed to the individual consoles along a low impedance (75-ohm) line. This line is terminated, in the console, by a 100-ohm resistor R106; the voltage developed across the resistor is applied to the control grid of the valve V19, sharing an anode load with V18. The input signal is limited, in the information generator, in such a manner that the valve V19 is not driven into grid current.

54. The azimuth information input is also positive-going. These marks are distributed from the information generator to the individual consoles through a 75-ohm line. When azimuth information is to be displayed, the key switch AZIMUTH INF. (SW6) on the control desk is closed. The input line is then terminated by the 100-ohm resistor R113, and the signal is applied to the control-grid of V23a. When the information is switched off, the input line is terminated by the 100-ohm resistor R198.

55.◀The IFF information is also distributed via the information generator, but in this case the line is terminated by a 5 kilohm potentiometer RV26 in parallel with a 100-ohms resistor R232. When the IFF information is to be displayed the key switch DISPLAY SELECT (SW25) on the control desk is moved to the IFF ONLY or IFF + RADAR position; this energizes the relay REL. 4. The mode of interrogation is selected by the operation of the key switch MODE SELECT (SW10); this sets up circuits in the IFF10 equipment. The IFF video appro-

◀priate to the channel selected by the key switches AE. SEL (sw3) and AE COMB (sw19) is then fed from the tapping on RV26 (which acts as the IFF gain control) and is applied to the control grid of V23b.▶ V23a and V23b share a common cathode load R141, so that the IFF video and azimuth information are mixed. The resulting output is applied to the control-grid of V18, which acts as a low-gain amplifier, the video bandwidth being broadened by the inclusion of the inductor L5 in the anode circuit. This provides a fairly even response up to 1 Mc/s. The anode load is shared by V19, consequently the output of the latter consists of mixed azimuth information, IFF responses, and radar video signals. This mixture is applied to the control-grid of the limiting valve V20.

56. The screening-grid potential of V20 is controlled by the potentiometer RV4, the LIMIT control, the total range of variation being from about 170 volts to zero. Now a reduction of screening-grid potential shortens the grid-base of the valve. The valve is operated with zero bias, and the input swing is negative-going. Consequently, the maximum output of the valve is dependent upon the length of the grid base, i.e. by the screening-grid potential. The output of V20 is therefore limited at a value set by the LIMIT control. The anode circuit is frequency-compensated in the same manner as the preceding stage.

57. The output of V20 is DC restored by V21 and applied to the control-grid of the cathode-follower valve V22. The output of this valve is DC connected to the control electrode of the CRT, so that the signals are applied to the latter as positive modulation.

58. It should be noted that the valves, V23, V18, and V19 share a common HT rail, decoupled by R115 and C48. A separate HT rail is provided for V20 and V22, decoupled by R140 and C50.

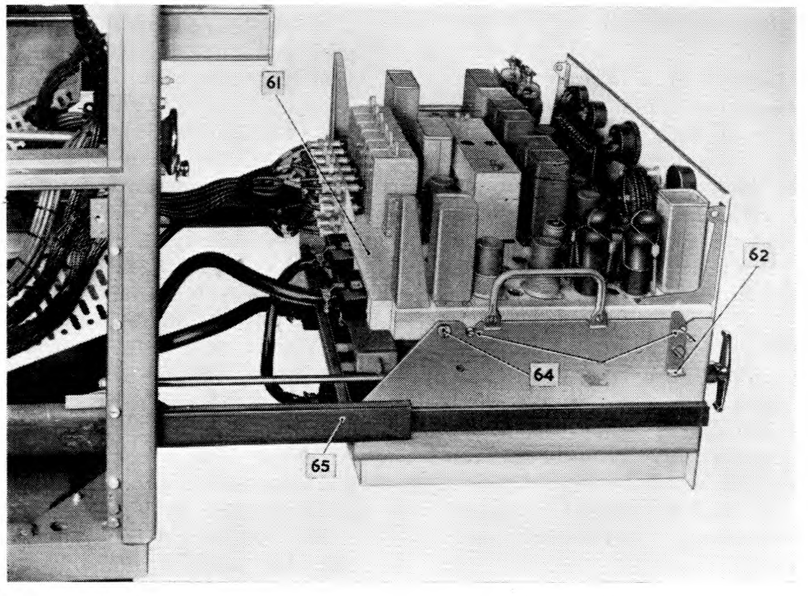
Current and voltage monitoring

59. With the exception of V23, each triode, tetrode, and pentode, on the console has a meter shunt wired in the cathode circuit. These shunts (14 in all) are connected to points on a 2-wafer 16-way rotary selector switch. The wipers of this switch are connected to a milliammeter having a full scale deflection of 0·5 mA, the scale of which is graduated in units 0 to 5. All the meter shunts are 10 ohms, except those of V4 and V17a, which are 110 ohms, and V11, V12, which share a common cathode load with a meter shunt of two 10-ohm resistors in parallel, i.e. 5 ohms.

60. The cathode current readings are given by the first 14 positions of the switch, each position being marked with the circuit reference of the valve being monitored. The readings are, to within a small error, in 10 mA units when shunted by 10 ohms, and 1 mA units when shunted by 110 ohms.

61. The other two positions of the switch are marked HT.1 and HT.2; the former is used to monitor the HT rail voltage, and the latter the negative bias rail voltage. The multiplying factor in each case is 100, i.e. a scale reading of 3·5 signifies a voltage of 350.

62. The meter readings on the various settings of the monitoring switch should be within 20 per cent of those given in Table 1. It will be seen that the readings obtained may vary with the setting of an



61 TIMEBASE UNIT CHASSIS
62 SPRING CLIP
63 STUD, SUPPORTING
64 PIVOT SCREW
65 TELESCOPIC SUPPORT FOR POWER UNIT

Fig. 8. Timebase unit and power unit withdrawn for inspection

associated control, e.g. the reading in position 6 (V14) varies with the setting of the strobe gain control. In such cases, both maximum and minimum readings are given. It should also be noted that the readings given in the Table are those obtained when the timebase unit is quiescent, i.e. when no sync. pulse is applied. Since there is then no brightening pulse, the CRT beam should be blacked out with no sync., nevertheless, as a precaution, the brilliance should be turned down to zero before removing the sync. plug.

Tagboard for REL.2 and REL.5

63. Referring to fig. 1, the earthy ends of the coils of relays REL.2 and REL.5 are connected in parallel, and the common lead taken to one point on a 3-way tagboard, marked 'a' in fig. 1. The point marked 'b' is connected to the earthy end of the coil of relay REL.6, and also to the AERIAL SELECT and AERIAL COMB. switches in the control desk. The point 'e' is earthed. For use with three (or fewer) signal chains (e.g. on console Type 60 in mobile applications) the tags 'a' and 'b' are connected, so that relays REL.2 and REL.5 operate in parallel with REL.6, under the control of the above-mentioned switches (*Part* I, *Chap.* 1 of this volume refers).

64, 65 ▶◀

CONSTRUCTIONAL DETAILS

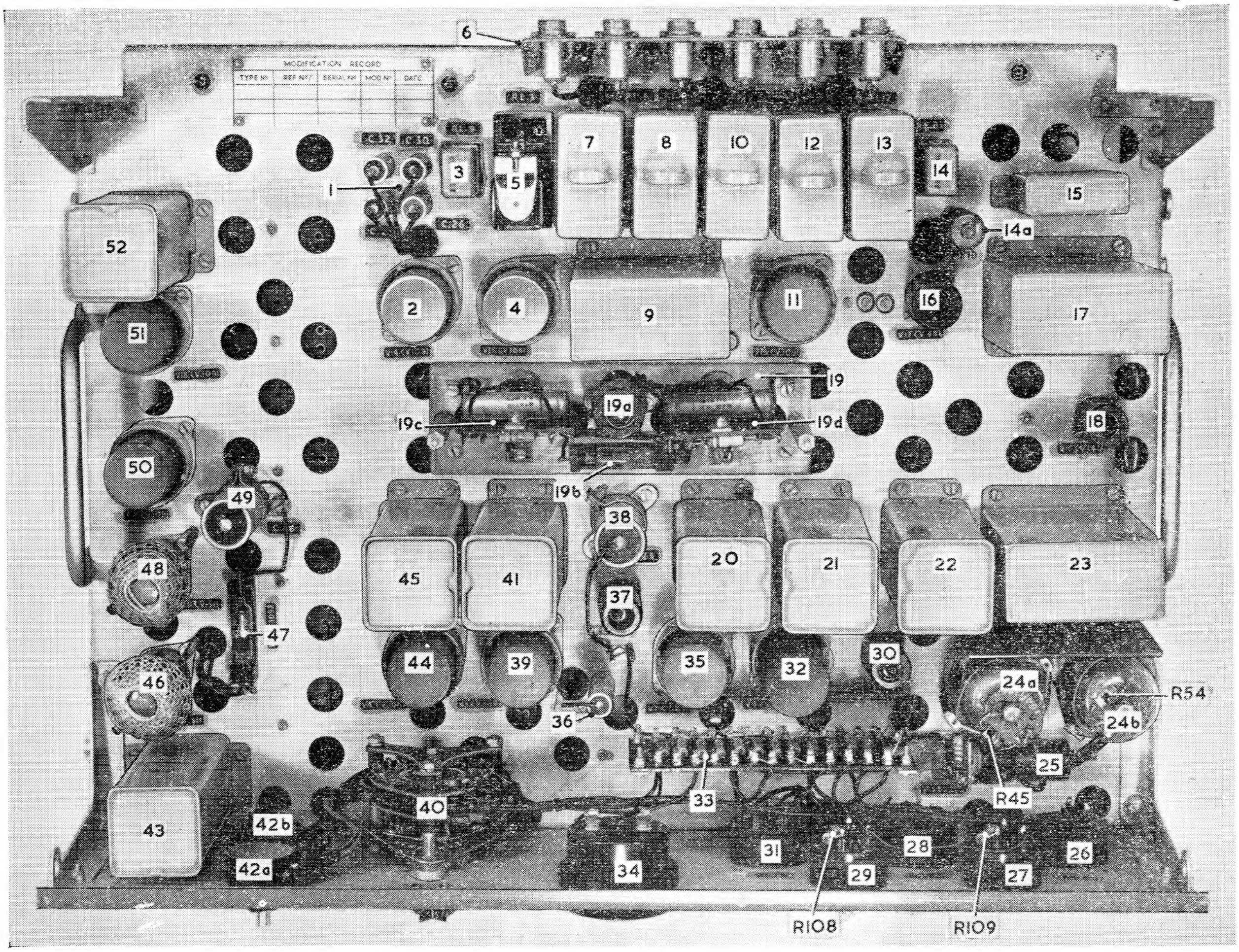
66. Fig. 7 is a front view of the timebase unit, showing the positions of the pre-set controls, the current monitoring meter, and the meter selector switch. The timebase unit is mounted above the power unit Type 742 in the manner shown in fig. 8. On each side of the chassis there are two short studs which rest in U-shaped notches in the upper edge of each side of the power unit chassis. The stud at the front, on the left-hand side, is locked in its notch by a spring-loaded catch. In addition, on each side of the chassis, at the rear, is a screw by which the latter is secured to the chassis of the power unit.

67. When secured together in this manner, the timebase unit and power unit together can be drawn forward for inspection, as shown in fig. 8, by switching off the power supply at the power unit safety switch, slacking off and lifting the knurled knob directly underneath the latter, and re-tightening the knob. The combined units can then be drawn forward, supported by telescopic sliders which are constructed in the same manner as those

TABLE 1

Monitoring current readings

Switch position	Valve selected	Steady meter reading	Meter reading with control variation MIN.	MAX.	Associated control
1	V4	2·22	—	—	None
2	V5	1·35	—	—	None
3	V7	—	0·95	0·85	RANGE
4	V9	1·2	—	—	None
5	V11, V12	—	0	1·4	CV124 BIAS
6	V14	—	0·7	1·4	STROBE AMP
7	V15	—	0·7	1·5	CAL. AMP (Cal. key at 5 M)
8	V16	0·33	—	—	None
9	V17a	2·45	—	—	None
10	V17b	1·56	—	—	None
11	V18	1·4	—	—	None
12	V19	—	0·6	0·7	VIDEO GAIN
13	V20	—	0·1	3·7	LIMIT
14	V22	2·0	—	—	None
15	HT rail	3·4	—	—	None
16	Bias rail	3·2	—	—	None



1 CONDENSERS C26, C28, C30, C32
2 V14
3 REL.9
4 V15
5 REL.3
6 CO-AXIAL SOCKET BOARD
7 REL.5
8 REL.4
9 CONDENSER C33
10 REL.6
11 V16
12 REL.7
13 REL.2
14 REL.8
14a METAL RECTIFIER MR10
15 CONDENSER C37
16 V17
17 CONDENSER C50
18 V10
19 AZIMUTH INFORMATION SUB-ASSEMBLY
19a V23
19b V24
19c } TAG BOARDS (para. 71)
19d }
20 CONDENSER C20
21 CONDENSER C18
22 CONDENSER C23
23 CONDENSER C24
24a V11
24b V12
25 V13
26 RV3 (TRACE COMP. CONTROL)
27 RV24
28 RV2
29 RV23
30 V8
31 RV1
32 V9
33 GROUP BOARD No. 1 (13-way)
34 SPACE CURRENT METER
35 V7
36 CONDENSER C10
37 V6
38 CONDENSER C25
39 V5
40 METER SWITCH
41 CONDENSER C16
42a RV26
42b RV4
43 CONDENSER C22
44 V4
45 CONDENSER C12
46 V22
47 V21
48 V20
49 CONDENSER C46
50 V19
51 V18
52 CONDENSER C44

Fig. 10. Timebase unit, top view

the video amplifying chain, V18, V19, V20, V21, V22 is arranged down the left-hand side, between the condensers C44 at the rear and C22 at the front. At the rear of the chassis is a panel carrying the eighteen co-axial inlets, and immediately in front of this are the six standard relays REL.3, REL.5, REL.4, REL.6, REL.7 and REL.2. In the photograph, the cover of REL.3 is removed to show the relay itself. Flanking these are two miniature relays, with fast-operating characteristics, REL.9 on the left and REL.8 on the right. The cathode modulation chain V14, V15, V16, V17 is arranged transversely across the chassis immediately in front of this chain.

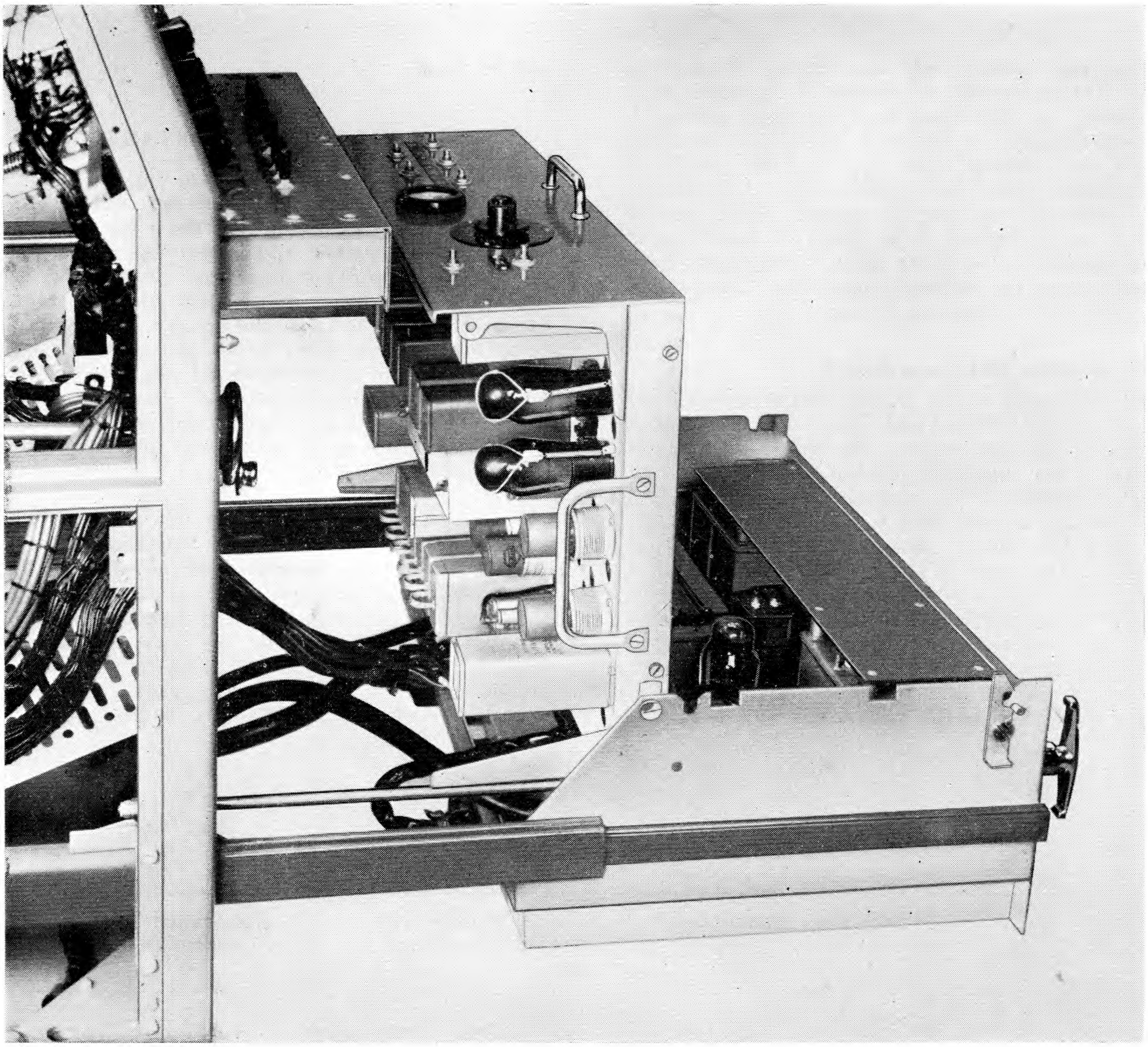


Fig. 6 Timebase unit lifted for access to power unit

supporting the indicating unit (Chapter 3 of this Section refers). This gives complete access to the various sub-assemblies on the top of the timebase chassis, and to the Jones and coaxial connections at the rear.

68. Further access to the components of these sub-assemblies in some cases requires the removal of small covers, e.g., the relays, and the azimuth information sub-chassis. Access to the underside is obtained by releasing the spring clip holding the stud on the left-hand side, and lifting the unit by the handle at the front. The unit then pivots about the two screws at the rear (*para.* 66) and can be lifted into a vertical position as shown in fig. 9. An expanded metal cover protects the components beneath the base; care must be taken to replace this after examination or servicing, before lowering the timebase unit into the working position.

69. If it is desired to remove the unit completely from the console, the two pivot screws at the rear should first be removed, and all coaxial and Jones plugs disconnected. After releasing the left-hand front stud from its spring-loaded catch, the unit can be lifted clear of the power unit. Two side handles are provided for transport. The unit is replaced by reversing this procedure, especial care being taken to return the pivot screws to their proper positions.

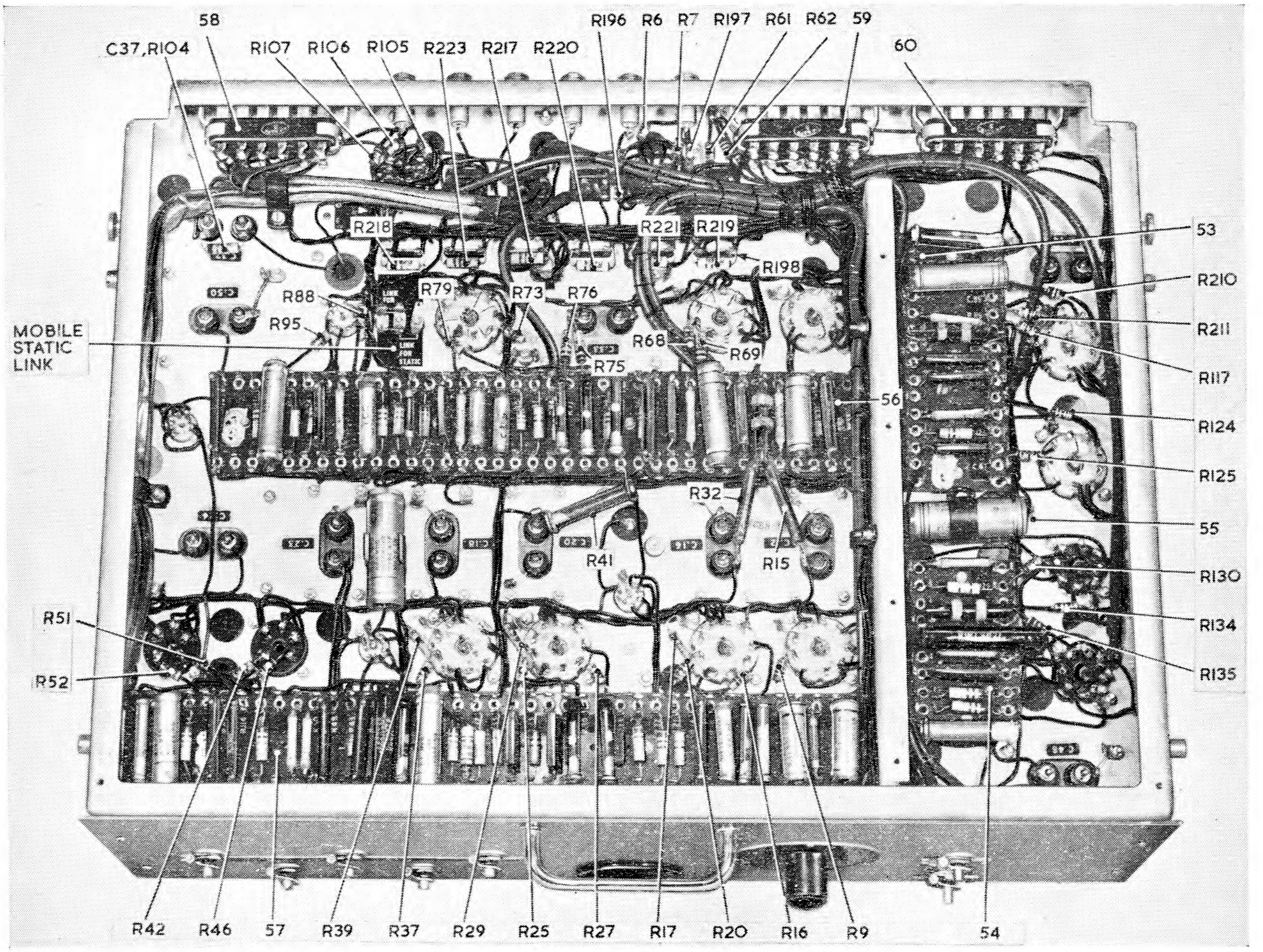
70. Fig. 10 is a view of the top deck of the chassis, showing the arrangement of the principal components on this side. As viewed from the front,

71. The valves V23 and V24, with a number of components associated with the video mapping and IFF mixer are mounted on a small sub-chassis, approximately in the middle of the chassis. The tag board annotated 19c in fig. 10 carries R111, R110, R113, R141 (in that order from top to bottom) with C38 on the rear. The tag board annotated 19d in this illustration carries R25, R143, R24, R142 on the front, and C40 on the rear.

72. On the extreme right is the double diode V10, associated with the anode circuit of the valves V11, V12. Still further to the front, spread across and slightly to the right of the chassis, is the timebase chain V4 to V12 (except for V10). Some of the associated components are mounted on the adjacent group board, and the bias voltage stabilizer V13 is mounted near the right-hand end of this group board.

73. The underside of the unit also carries a large number of components, most of which are mounted on four group boards. All these components are sign-written with their circuit references, and little difficulty should be met in identification. The three Jones plugs, C, D and E, are mounted here. The underside is enclosed by an expanded metal screen to avoid the possibility of accidental earthing. A view of the underside, with this screen removed, is shown in fig. 11. The arrangement of the components on the group boards is given in fig. 12.

74. Most of the components associated with the cathode modulation chain are mounted upon a group board fitted transversely across the chassis adjacent to the valve holders. Similarly, most of the components belonging to the video (control-grid modulation) chain are mounted on two group boards fitted on the right-hand side as viewed from the front. The components associated with the timebase chain, other than those on the top deck are mounted upon a 13-way group board fitted across the front of the chassis (fig. 12).



53 GROUP BOARD No. 2 (15-way)
54 GROUP BOARD No. 3 (10-way)
55 CONDENSER C49
56 GROUP BOARD No. 4 (37-way)
57 GROUP BOARD No. 5 (41-way)
58 JONES PLUG E
59 JONES PLUG D
60 JONES PLUG C

Fig. 11. Timebase unit, underside view

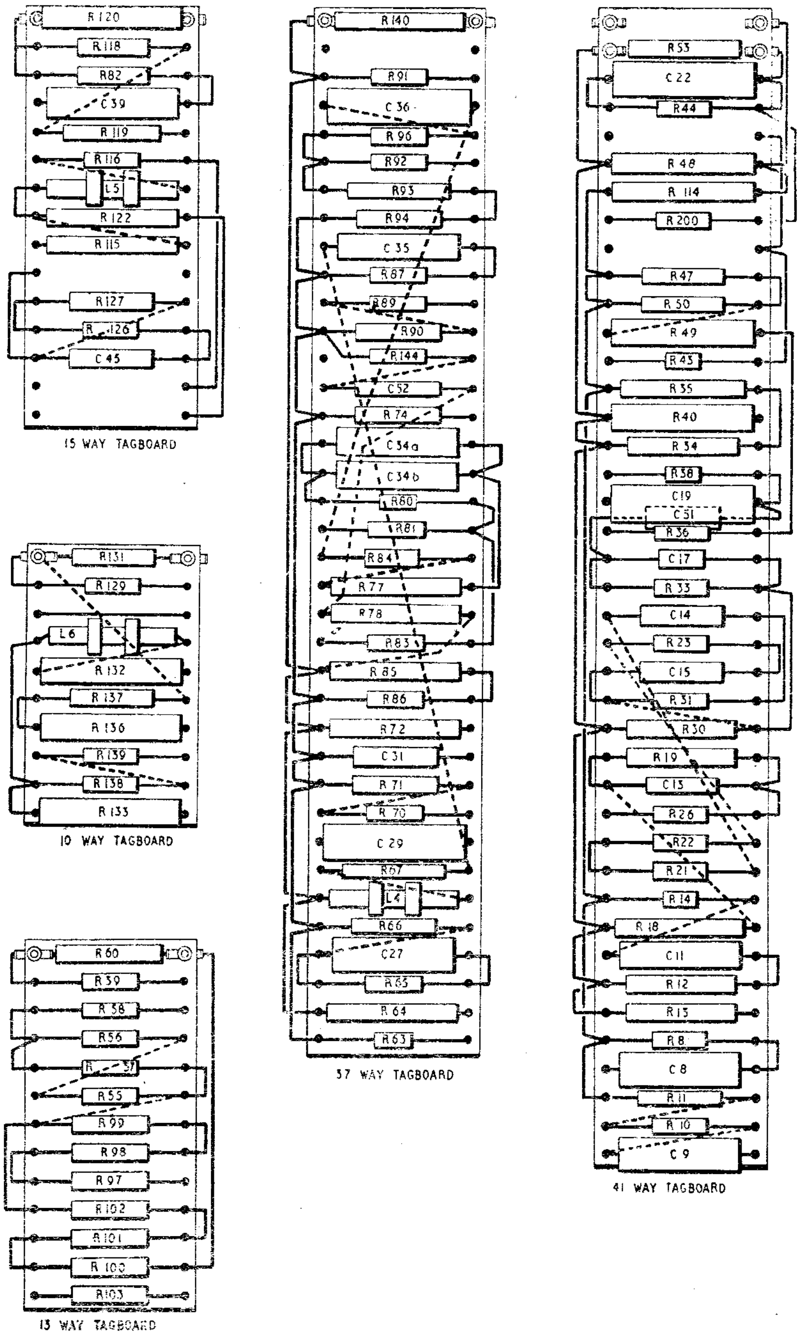


Fig. 12. Components on group boards

TABLE 2

List of annotations

The number or numbers in brackets refer to the fig. No. in which the component is annotated

1 Condensers C26, C28, C30, C32 (suppressors and screens of V14, V15) (10).
2 V14 (10).
3 Relay REL.9 (10).
4 V15 (10).
5 Relay REL.3 (10).
6 Co-axial socket board (10).
7 Relay REL.5 (10)
8 Relay REL.4 (10).
9 Condenser C33 (10).
10 Relay REL.6 (10).
11 V16 (10).
12 Relay REL.7 (10).
13 Relay REL.2 (10).
14 Relay REL.8 (10).
14a Metal rectifier MR10 (10).
15 Condenser C37 (10).
16 V17 (10) (11).
17 Condenser C50 (10) (11).
18 V10 (10) (11).
19 Azimuth information sub-assembly (10).
20 Condenser C20 (10) (11).
21 Condenser C18 (10) (11).
22 Condenser C23 (10) (11).
23 Condenser C24 (10) (11).
24 Output stage (10), 24a—V11, 24b—V12 (10).
25 V13 (10).
26 RV3 (TRACE COMP CONTROL) (10) (7).
27 RV24 (250 p.r.f. RANGE LIMIT) (10) (7).
28 RV2 (CV124 BIAS) (10) (7).
29 RV23 (500 p.r.f. RANGE LIMIT) (10) (7).
30 V8 (10).
31 RV1 (SCAN CENTRE) (10) (7).
32 V9 (10).
33 Group board No. 1 (10).
34 Space current meter (10) (7).
35 V7 (10).
36 Condenser C10 (10).
37 V6 (10).
38 Condenser C25 (10).
39 V5 (10).
40 Meter switch (10) (7).
41 Condenser C16 (10).
42 LIMIT CONTROL (7).
42a RV26 (IFF gain pot.) (10).
42b RV4 (limit control pot.) (10).
43 Condenser C22 (10).
44 V4 (10).
45 Condenser C12 (10).
46 V22 (10).
47 Diode V21 (10).
48 V20 (10).
49 Condenser C46
50 V19 (10).
51 V18 (10).
52 Condenser C44 (10).
53 Group board No. 2 (11).
54 Group board No. 3 (11).
55 Condenser C49 (11).
56 Group board No. 4 (11).
57 Group board No. 5 (11).
58 Jones Plug E (11).
59 Jones plug D (11).
60 Jones plug C (11).
61 Timebase unit chassis (8).
62 Spring clip (8).
63 Stud, supporting (8).
64 Pivot screw (8).
65 Telescopic support for power unit (8).
66 IFF GAIN CONTROL (7).

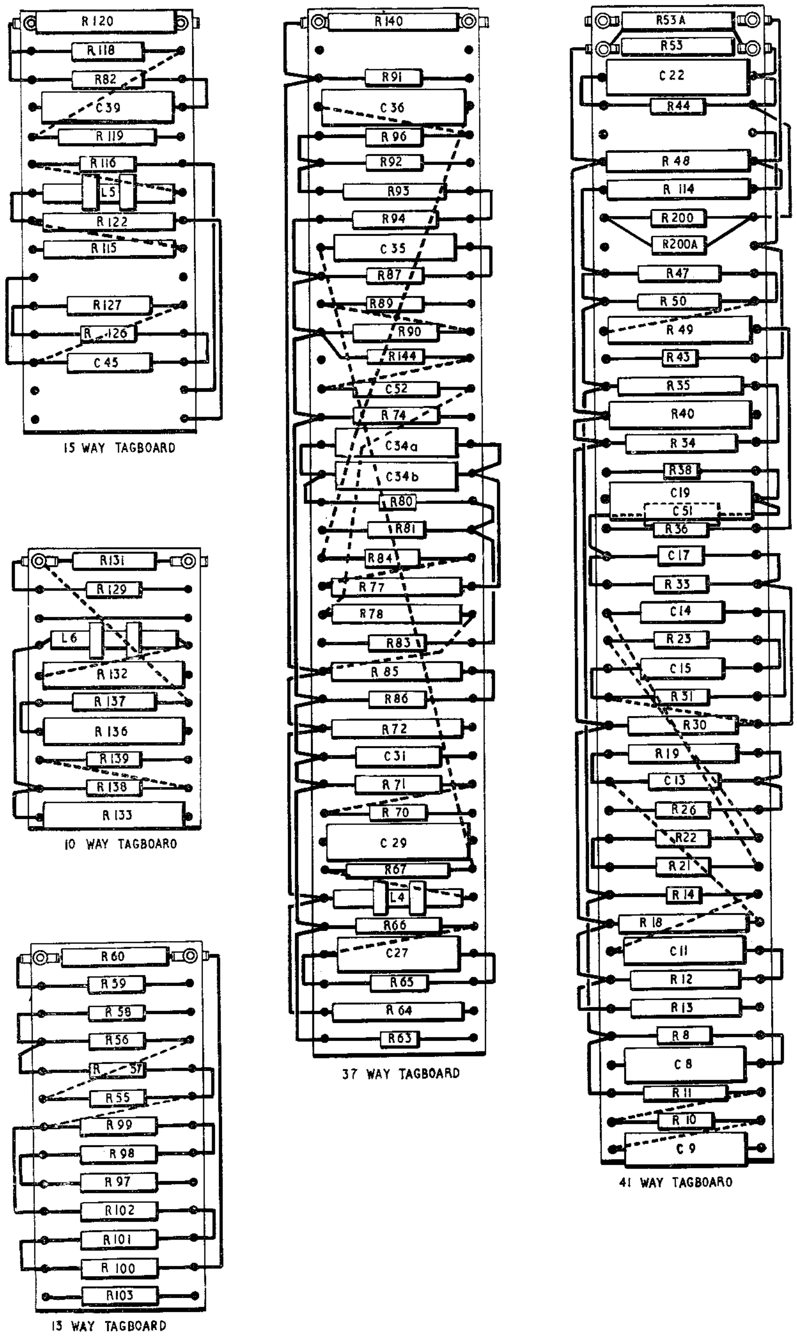


Fig. 12. Components on group boards

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47 Diode V21 (10).
48 V20 (10).
49 Condenser C46
50 V19 (10).
51 V18 (10).
52 Condenser C44 (10).
53 Group board No. 2 (11).
54 Group board No. 3 (11).
55 Condenser C49 (11).
56 Group board No. 4 (11).
57 Group board No. 5 (11).
58 Jones Plug E (11).
59 Jones plug D (11).
60 Jones plug C (11).
61 Timebase unit chassis (8).
62 Spring clip (8).
63 Stud, supporting (8).
64 Pivot screw (8).
65 Telescopic support for power unit (8).
66 IFF GAIN CONTROL (7).

Chapter 3

INDICATING UNIT (CRT) TYPE 30

LIST OF CONTENTS

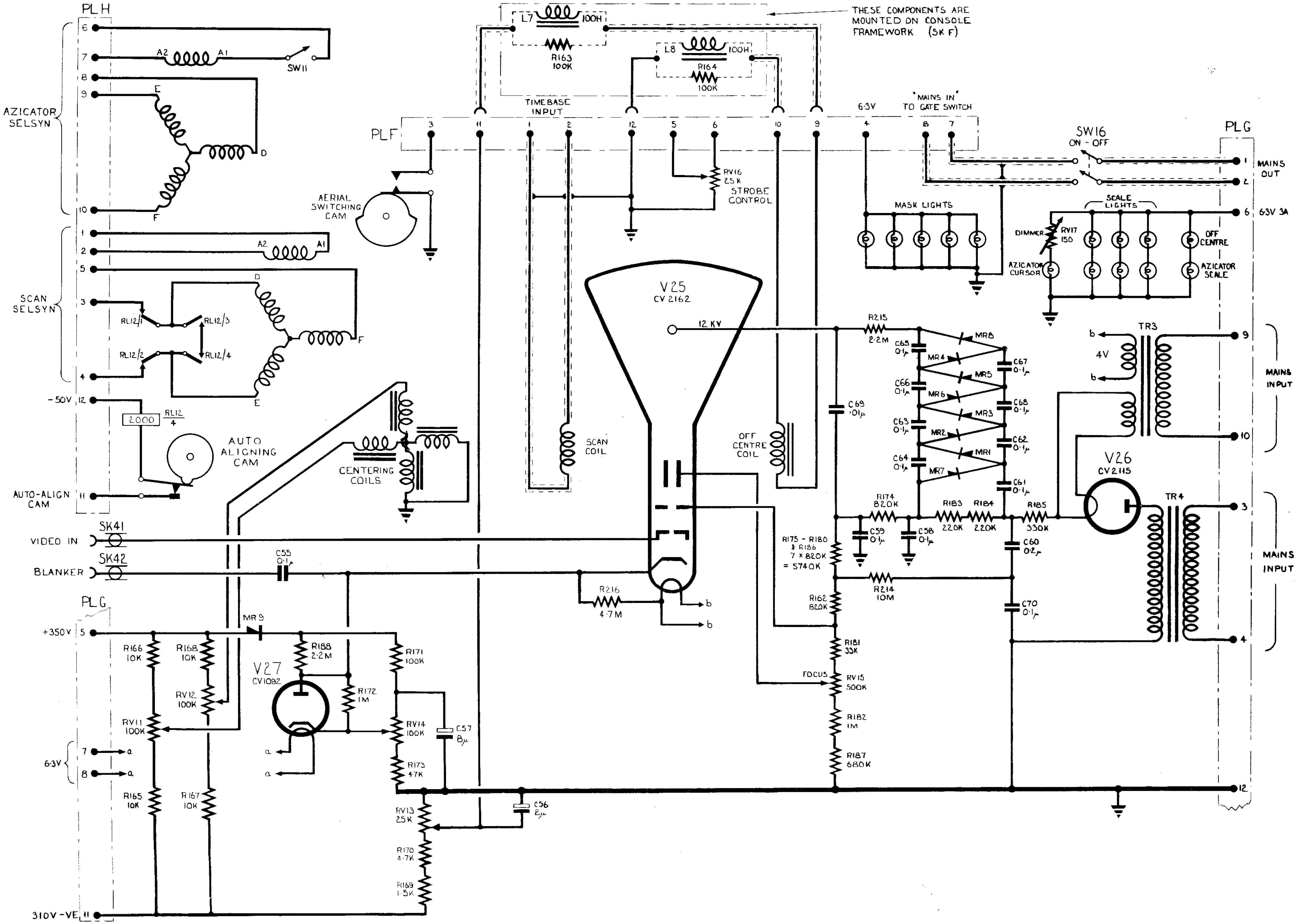
LIST OF ILLUSTRATIONS

GENERAL DESCRIPTION

Introductory

1. This chapter describes the indicating unit (CRT) Type 30, upon which the radar and IFF responses are presented, together with associated operational information, e.g. video map and azimuth strobe. The mechanical details are very fully shown in the illustrations, since some of these details cannot be seen once the unit has been fully assembled. The indicating unit must be regarded as a highly accurate mechanism, and care must be taken never to interfere with any portion of the assembly, except to perform routine setting-up adjustments, or to execute any authorized modifications which may be introduced in the future. Casual tightening or slackening of nuts, bolts, or other details, may lead to considerable deterioration of performance.

2. The circuit diagram, fig. 1, which is placed at the end of the chapter for ease of reference, should be consulted as necessary for correlation with the illustrations of mechanical details. A



AIR DIAGRAM 6111 E/MIN.

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[CONSOLE TYPE 60] Indicating unit (CRT) Type 30, circuit

Fig. 1

REPRINTED NOVEMBER 1958
8008 347809 12/58 1,500 C.B.&S.LTD. GP924.

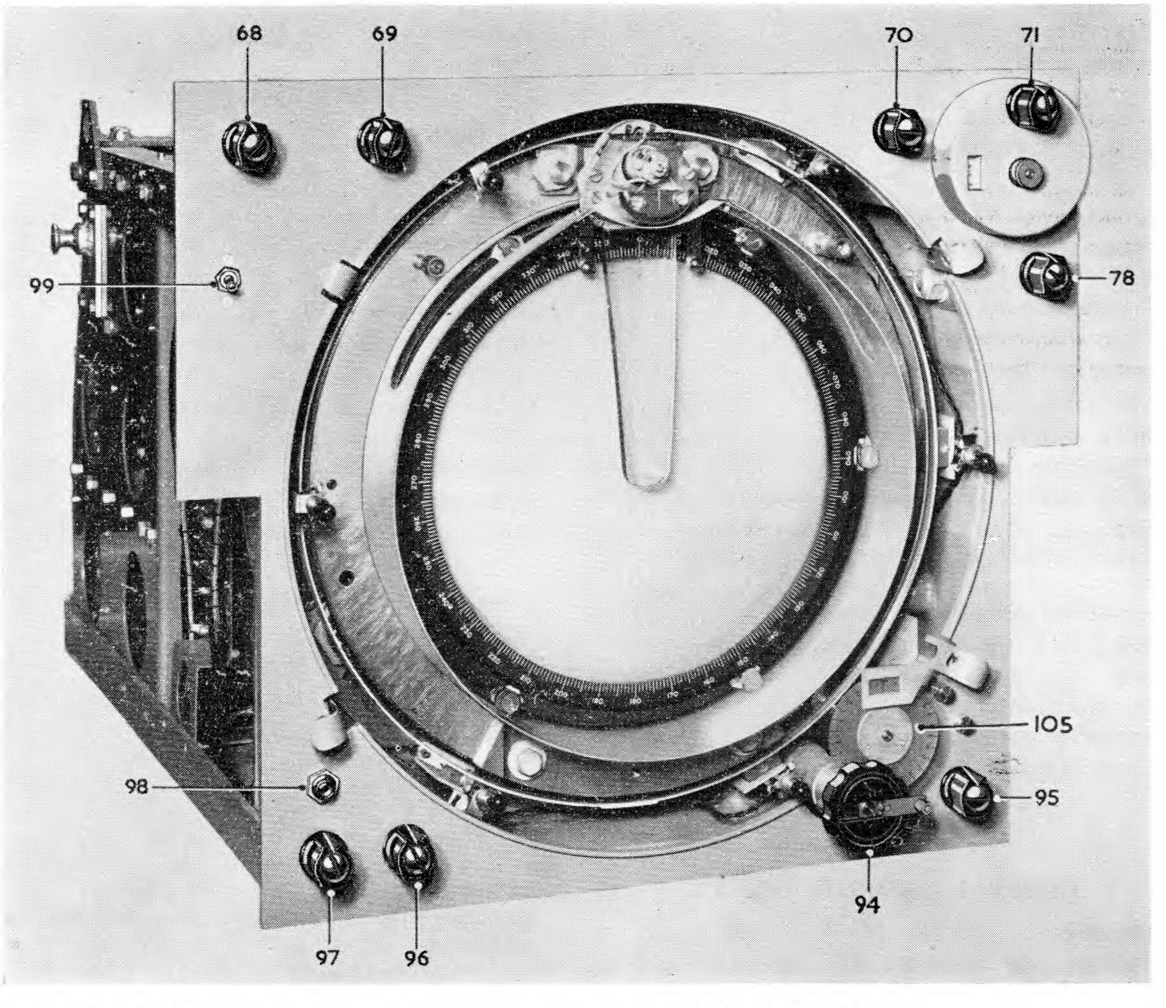
complete list of all the numerical annotations on the photographic illustrations is given in Table 1, which is also placed at the end of the text.

Cathode ray tube

3. The indicating unit is fitted with a 12 in. diameter cathode ray tube Type 2162, the commercial prototype being known as 12-LO-1A. This tube has a long after-glow screen of the order of one minute, the screen material being a fluoride, aluminium backed (Type 009). Certain impurities (e.g. beryllium) which would be detrimental to the operation of the tube are carefully excluded from the screen material during manufacture.

4. The tube is much less liable to random scintillation (flashing) than PPI tubes of earlier design. On the other hand, the screen material is very easily burnt, and a stationary or slow-moving spot should never be displayed. Under normal conditions, this possibility should not arise, because the power supply to the EHT power pack in the indicating unit is not completed until after the HT rail voltage has been applied to the timebase unit. This ensures that the scanning voltage is applied to the deflection coils of the PPI before the EHT is switched on, hence the spot is never stationary. When it is necessary to suppress the timebase by removing the sync. supply (e.g. for taking current monitoring readings in the timebase unit vide Chap. 2) the brilliance should always be turned down to zero.

5. A window of amber-tinted perspex is fitted in front of the tube face, and the scale illumination is provided by blue light. In addition, five lights are arranged round the edge of the mask itself. This combination gives good contrast between the video picture and the background, and should greatly reduce eye-strain. The window is actually mounted in, and held in position against, the face of the CRT by the circular azimuth scale, the whole forming the azicator scale assembly.



68	CENTRING CONTROL No. 1	95	IFF STROBE CONTROL
69	CENTRING CONTROL No. 2	96	BRILLIANCE CONTROL
70	CURSOR LAMP DIMMER	97	FOCUS CONTROL
71	OFF-CENTRE AZIMUTH CONTROL	98	CURSOR ALIGN BUTTON WITH COVER REMOVED
78	OFF-CENTRE AMPLITUDE CONTROL	99	ON/OFF SWITCH
94	AZICATOR MANUAL CONTROL HANDLE	105	AZICATOR SUB-SCALE

Fig. 2. Indicating unit, front view with spinning removed

Controls

6. The face of the tube is surrounded by a metal spinning, held in position by four spring clips. Fig. 2 is a front view of the indicating unit with this spinning removed. The controls, etc., mounted on the front panel are as follows. At the top, on the left-hand side, are the two centring controls (CENTRING 1, CENTRING 2), with the ON/OFF switch immediately below. On the top right-hand side are the cursor lighting dimmer (CURSOR DIM) and the off-centre azimuth control (OFF CENTRE AND SECTOR) and the off-centre distance (OFF CENTRE AMP.) control (the AMP. refers to the fact that the control actually varies the amplitude of the timebase sawtooth voltage). At the bottom on the left-hand side, is the cursor alignment switch (fitted under a circular metal cover and labelled CURSOR ALIGN) and below this the brilliance (BRIGHTNESS) and FOCUS controls. ◀At the bottom right-hand side is the IFF strobe control (STROBE), which is not used now that IFF10 has been installed, and, underneath a circular protrusion on the metal spinning, the manual drive for the cursor setting.▶ The latter is geared to the front end of a shaft by which the mechanical drive is transmitted from the azicator selsyn to the final drive pinion, and thence to the azicator ring. Further details of this drive are given later under the heading 'constructional details.'

7. Under normal operating conditions, the manual drive for the cursor setting is concealed by the removable cover of the protrusion on the metal spinning already mentioned, with a drive handle for the shaft folded across the knob. By removing the metal cover, the handle can be unfolded and used to drive the azicator shaft if a large change in the cursor setting is required. The rear side of the handle is slotted, and a circular aperture in the cover permits small changes of cursor setting to be made without removing the cover. A transparent scale, illuminated from the rear, is driven by rotation of the azicator drive shaft; this is called the cursor sub-scale. One complete revolution of the sub-scale corresponds with a cursor movement of 30 deg. on the main azimuth scale. The sub-scale is graduated in degrees, and interpolation permits the cursor setting to be read to an accuracy of $\frac{1}{4}$ deg.

Initial cursor alignment

8. The cursor must be accurately aligned so that it shows the precise bearing upon which the radar Type 13 aerial is trained. This alignment is performed when the equipment is first installed on a static site, or on each occasion of removal to a new site, in a mobile installation. In brief, the procedure consists of aligning the aerial very accurately upon a known bearing, and then setting the cursor to the same bearing, reading the latter from the main scale to the nearest 10 deg., and from the sub-scale to the nearest $\frac{1}{4}$ deg.

9. The switch SW11 (operated by the CURSOR ALIGN button) opens the rotor circuit of the azicator selsyn. This is necessary owing to the strong magnetic lock between the rotor and stator of the selsyn when power is on. This lock prevents the azicator ring being turned by the manual cursor drive, without the application of considerable force which might strain the manual drive. When the button is pressed, however, the cursor ring may be turned either by the handle, or by a screwdriver inserted through the aperture in the circular cover.

10. Since there is always a possibility that either the aerial array, or the azicator ring, or both, may be moved for servicing purposes during a non-operational period, the cursor alignment should be checked at the beginning of each operational period, as laid down in the operating instructions, Part I, Chap. 4.

Circuit details

11. Referring to fig. 1, the circuits of the indicating unit fall naturally into seven groups, viz.:—

(1) the CRT and CRT power supplies.

(2) the centring coil supply.

(3) the off-centre coil supply.

(4) the timebase scan circuit.

(5) the signal circuits.

(6) the selsyn circuits.

(7) the lighting circuits.

These will be taken in order.

CRT and CRT power supplies

12. The final anode of the CRT requires an operating potential of 12 kV, and especial care is taken to prevent corona discharge inside the indicating unit, the EHT power supply pack being mounted as near to the tube as possible. A transformer TR3 provides heater supply for the CRT and also for the EHT rectifier valve V26 (CV2115). An EHT transformer TR4 feeds the half-wave rectifier valve, developing 10 kV mean steady voltage across the reservoir capacitance, which consists of C60 and C70 in series.

13. A resistor chain R184, R183, R174, with capacitors C38 and C39, forms a smoothing filter across the 10 kV output, and a further resistor chain R175–180, R186, R162, R181, RV15, R182, R187, provides for the first and second anode potentials of the tube, the first anode being fed from a fixed tap between R162 and R181 at a potential of approximately 2 kV, and the second anode from the focus potentiometer RV15 at a potential of approximately 1·9 kV with respect to cathode.

14. The additional 2 kV required for the final anode potential is obtained from the AC ripple which inevitably exists across the resistor chain R183, R184 of the smoothing filter; in the present instance this ripple is of the order of 125 volts AC. This voltage is rectified and doubled four times in an auxiliary EHT unit consisting of a Cockcroft-Walton ladder-type voltage multiplier, so giving a 2 kV output which is effectively added to the 10 kV developed across the reservoir capacitance. An additional network R215, C69 is fitted to smooth the EHT output.

15. The full 12 kV is applied to the graphitic inner coating of the CRT which thus functions as a post-deflection accelerator electrode as well as a screen. It will be noted that the CRT is operated with the cathode near earth potential and the anodes at high positive potential to earth. This eliminates the necessity for high voltage insulation of the heater and cathode circuits and the heater transformer windings.

Centring coil supply

16. The centring coils are fed from two potentiometer chains, viz., R166, RV11, R165, and R168, RV12, R167 respectively; these chains are connected in parallel, with one end connected to the positive 350-volt and the other end to the negative 310-volt supplies. It follows therefore from considerations of symmetry that a point near the middle of each of the variable resistors is at earth potential, and the amount of current flowing in each centring coil depends upon the displacement of the slider on the associated resistor, from the earthy point. By correct adjustment, therefore, the scan centre can be brought exactly on the centre of the screen, i.e. beneath the cross on the cursor. This adjustment should invariably be made on reverting to centralized scan after off-centre operation.

Off-centre coil supply

17. The off-centring coil is supplied from a tapping on RV13, which is connected in series with R170 and R169, between the negative 310-volt supply and earth. To suppress any AC ripple in the centring coil current, an 8 μF capacitor C56 is fitted between the potentiometer tap and earth, and two iron-core chokes of high inductance are fitted in series with the coil (one on each side). Each choke is damped by a 100K resistor shunted across it. Since the space in the indicating unit is limited, these chokes and resistors are mounted on the framework of the console itself, connections being made via PL.F and SK.F.

Timebase scan circuit

18. The deflection (or scan) coil is also connected to the timebase unit via PL.F and SK.F, screened cables being used throughout. Connection to the coil itself is made through slip rings mounted on the rear end of the tube carrying the scan coil winding.

Signal circuits

19. Signals from the video amplifier in the timebase unit leave the latter on SK.26 and enter the indicating unit on SK.41; these signals are applied to the CRT control-grid as positive modulation. They comprise the radar video signal proper, together with IFF video and azimuth information (either video map or azimuth marks). The brightening pulse from the timebase unit leaves the latter on SK.24 and enters the indicating unit on SK.42 (marked BLANKER in fig. 1). Mixed with the brightening pulse are the range marks and azimuth indicator pulses, the whole signal being applied to the cathode of the CRT as negative modulation. The mean brightness level is set by the potentiometer RV14 which is connected in a potentiometer chain with R171 and R173 between

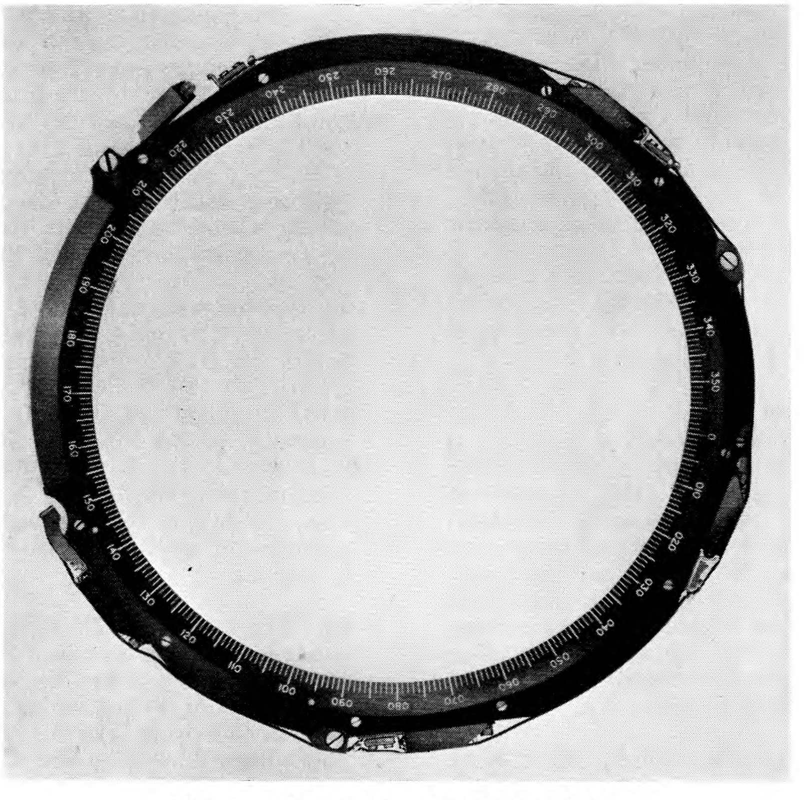
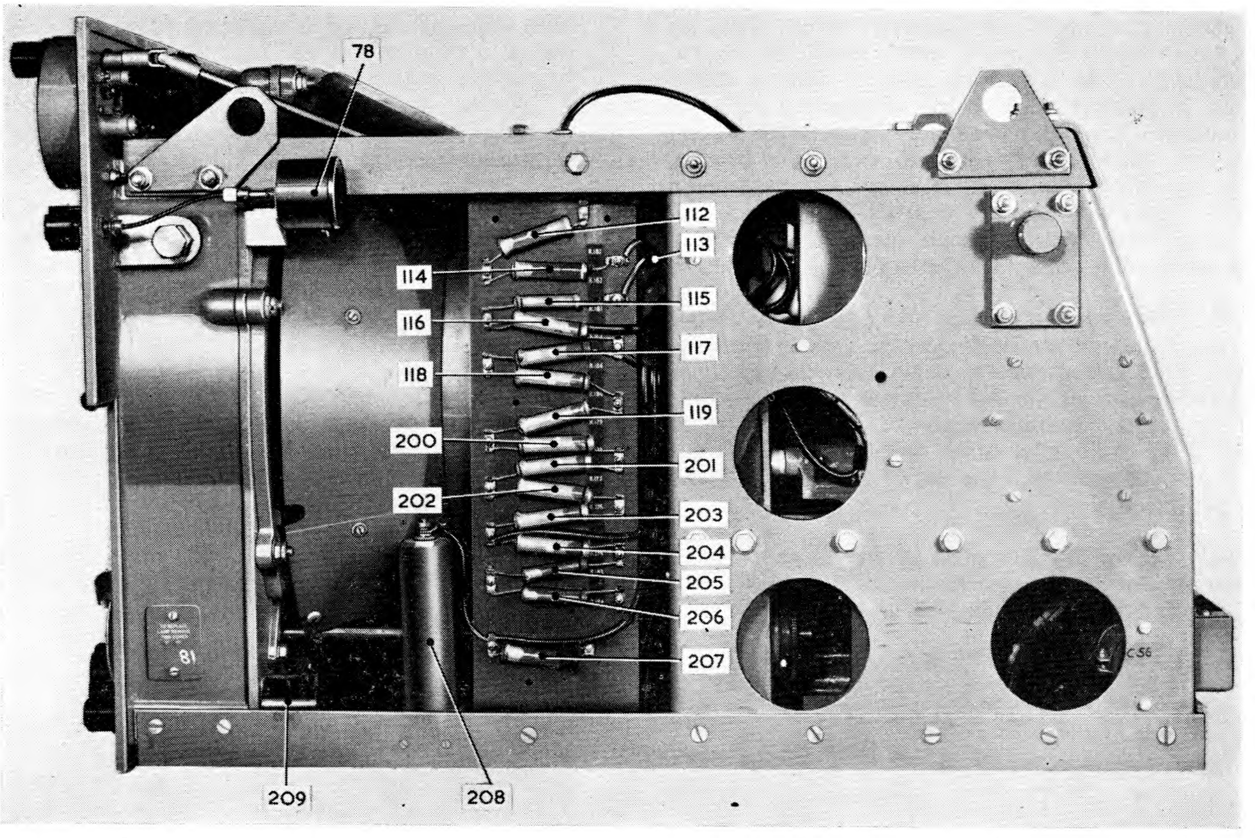


Fig. 3. CRT mask, showing edge lights



112 RESISTOR R187
113 LEADS FOR RV15
114 RESISTOR R182
115 RESISTOR R181
116 RESISTOR R162
117 RESISTOR R186
118 RESISTOR R180
119 RESISTOR R179
200 RESISTOR R178
201 RESISTOR R117
202 RESISTOR R176
203 RESISTOR R175
204 RESISTOR R174
205 RESISTOR R183
206 RESISTOR R184
207 RESISTOR R214
208 CAPACITOR C70
209 RESISTOR RV16
78 RESISTOR RV13
81 COVER PLATE FOR ACCESS TO CURSOR SUB-SCALE LAMP

Fig. 4. Indicating unit, right-hand side

the positive 350-volt supply and earth. A DC restorer valve V27 (CV1082) is connected across part of this chain to maintain the mean level constant at the value set by RV14; the metal rectifier MR9 in series with this valve anode is to prevent interaction between the 'blanker' input and the centring and off-centring chains, since the latter are connected across the 350-volt DC supply also.

Selsyn circuits

20. The selsyn circuits are quite conventional except for (a) the switch SW11 (CURSOR ALIGN) and (b) the contacts of the auto-align relay RL.12 in the stator circuit of the scan selsyn. The auto-align system is dealt with in Part 1, Chap. 1.

Lighting circuits

21. Six scale lamps are mounted upon small brackets round the outside of a translucent screen, for the illumination of the azimuth scale. One lamp is also fitted behind the azimuth sub-scale, and one behind the off-centre and sector scale. These eight lamps are connected in series-parallel as shown in fig. 1. On the same circuit is the azimuth cursor illuminating lamp, with the CURSOR DIM rheostat in series.

22. Five G.P.O. switchboard-type lamps are mounted round the edge of the CRT mask and are wired on a separate circuit, the line connection being made through a spring contact at about 150 deg., and an earth return through a locating dowel. The lamp holders are pivoted in such a manner that they can be turned towards the front for withdrawal of the lamp, as shown by the lamp at 220 deg. in fig. 3.

CONSTRUCTIONAL DETAILS

23. The general arrangement of the azimuth scale and mask assembly is shown in fig. 3. The mask is fitted with the 0 deg. mark at the top, a locating pin being fitted at this point. The slotted head of this pin can be seen in fig. 3 immediately over 0 deg. The assembly is fitted in place before the CRT face by three captive screws. The spring contact at 150 deg., referred to in the previous paragraph, is also visible in the illustration; the lamp at 220 deg. is turned toward the reader with the lamp partially withdrawn.

24. Fig. 4 is a view of the right-hand side of the indicating unit showing the rear of the off-centre amplitude and off-centre azimuth (or centre of sector) controls. The former is driven from its control knob through a short length of flexible shafting. The off-centre azimuth control drives the pinion upon which the off-centring coils are mounted, through a shaft fitted with two universal joints. This control is used to set the mid-bearing of a sector (in the event of sector sweeping being used) and also sets the bearing upon which the radar video input changes over, when using a back-to-back presentation (twin aerial sweep).

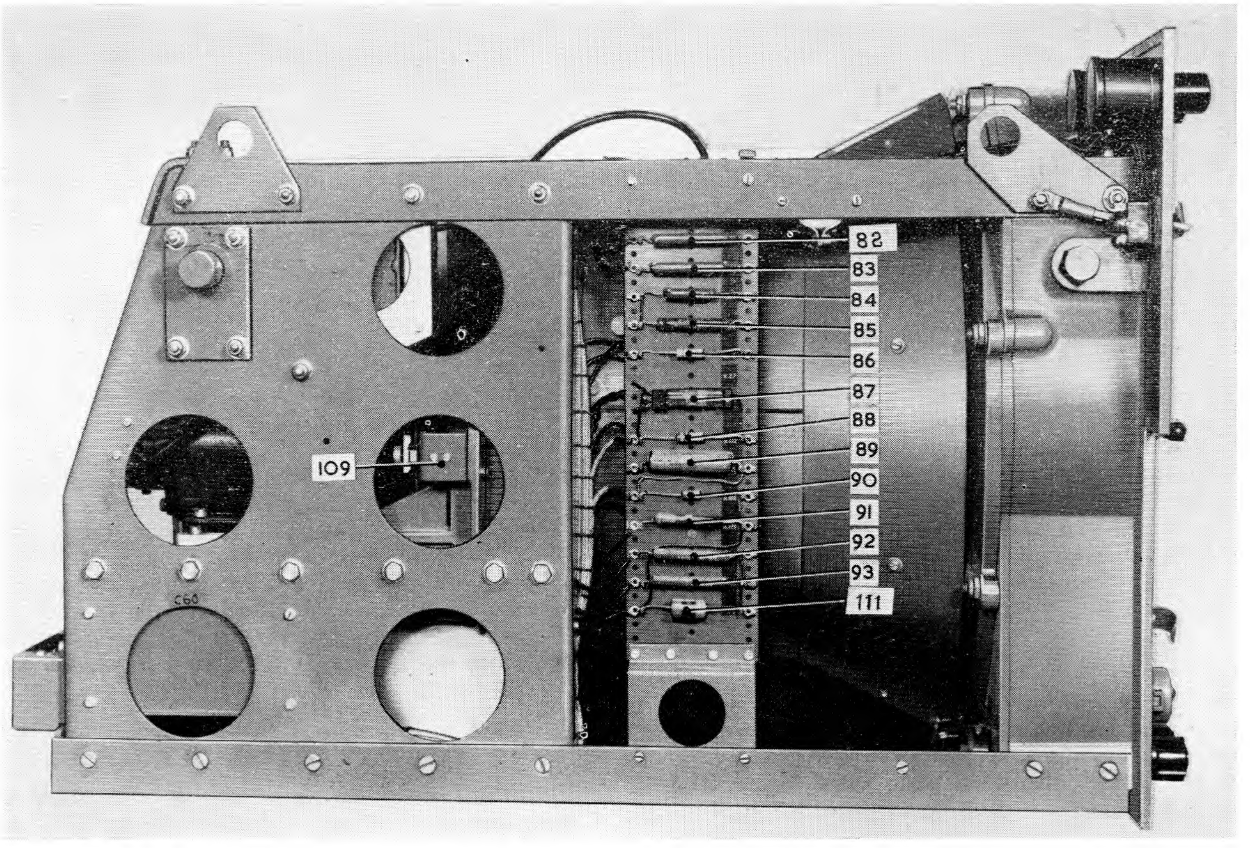
25. The component group board on the right-hand side of the unit carries the fixed resistors comprising the EHT potentiometer chain (other than those forming part of the EHT voltage multiplier unit). The FOCUS potentiometer, which is also part of the EHT chain, is mounted on the rear of the front panel; the leads to it are shown as item 113 in the illustration.

26. The small cover plate on the lower left-hand corner can be removed to give access to the scale lamp for the cursor sub-scale.

27. Fig. 5 is a view of the left-hand side of the indicating unit. The component group board on this side carries the components associated with the centring and off-centring resistor chains, and also those of the DC restorer network in the brightness control circuit. The bracket 109 carries a knurled screw by which the deflection coil rotating gear can be clamped during certain setting-up operations (para. 48 refers).

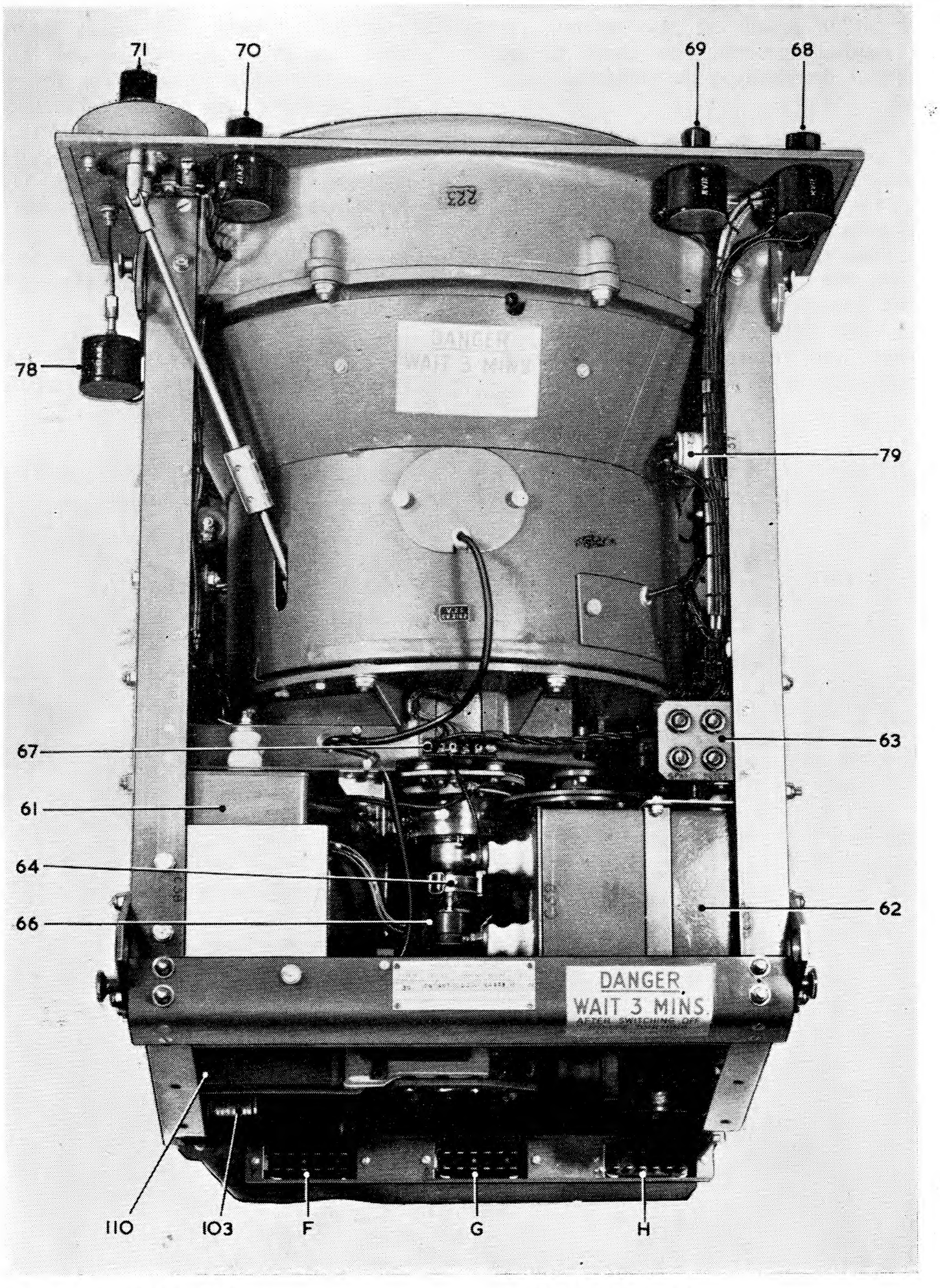
28. Fig. 4 and 5 also show the eye plates fitted to the upper side members. A special lifting frame is supplied, which can be bolted on to these eye plates to permit the indicating unit to be removed from the console. Further information regarding the method of lifting is given in para. 73.

29. Fig. 6 is a top view of the indicating unit showing the two centring control potentiometers on the right, and the off-centre bearing and off-centre amplitude controls on the left. The cursor dimming rheostat is also shown. The 12 kV EHT lead is seen to enter the mu-metal screen surrounding the CRT through an insulating grommet in an elliptical plate near the flare of the screen, the lead being supported by a perspex



82	RESISTOR R165	89	CAPACITOR C55
83	RESISTOR R167	90	RESISTOR R188
84	RESISTOR R169	91	RESISTOR R171
85	RESISTOR R170	92	RESISTOR R168
86	RESISTOR R175	93	RESISTOR R166
87	VALVE V27	111	METAL RECTIFIER MR9
88	RESISTOR R172	109	BRAKE ON DEFLECTION COIL SELSYN

Fig. 5. Indicating unit, left-hand side



68	CENTRING POTENTIOMETER No. 1	79	CAPACITOR C57
69	CENTRING POTENTIOMETER No. 2	61	CAPACITOR C58
70	CURSOR LAMP DIMMER RV17	62	CAPACITOR C59
71	OFF-CENTRE AZIMUTH CONTROL	63	FUSES FOR POWER UNIT 742
78	OFF-CENTRE AMPLITUDE CONTROL POTENTIOMETER RV13	64	STRAP SECURING CRT STEM
		66	CRT BASE CAP
110	EHT MULTIPLIER UNIT ON TR3	103	CAPACITOR C56

Fig. 6. Indicating unit, top view

strip. The two large capacitors with heavily insulated terminals are C58 and C59, in the EHT smoothing system. The position of the voltage multiplying unit (110) is also shown.

30. This illustration also shows the positions of the two capacitors C56 and C57, the former being in the off-centring circuit and the latter in the DC restoring circuit. A removable rectangular plate on the right-hand side of the mu-metal screen gives access to the brushes for the slip-ring connections to the trace-reversing contacts and the off-centre coil, the leads to these being taken through an insulating grommet in the plate.

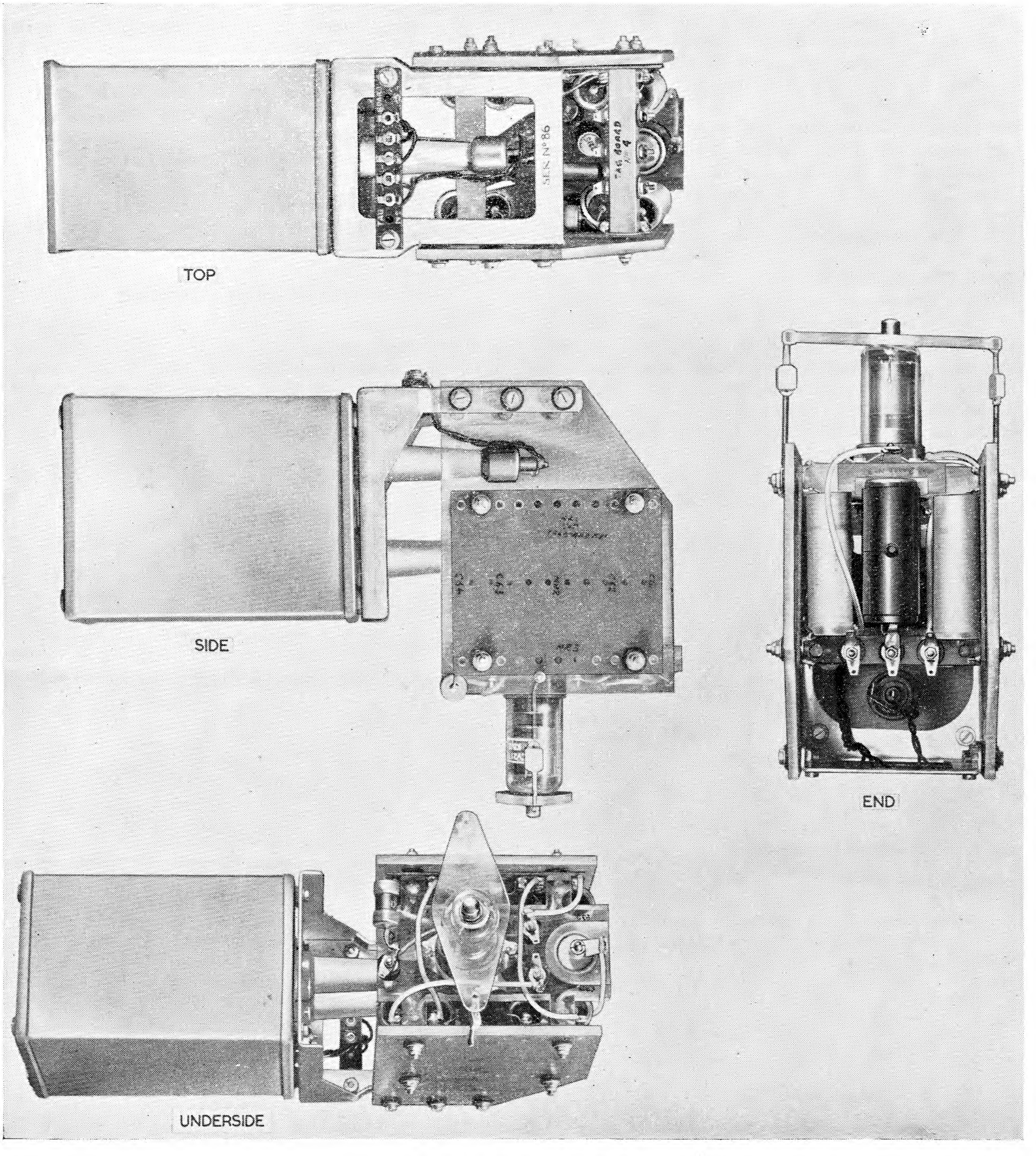


Fig. 8. EHT multiplier unit

securing the stem of the CRT, and the octal valve holder by which all connections are made to the tube base. The four fuses mounted on a small panel on the right are spares for those in the power unit Type 742.

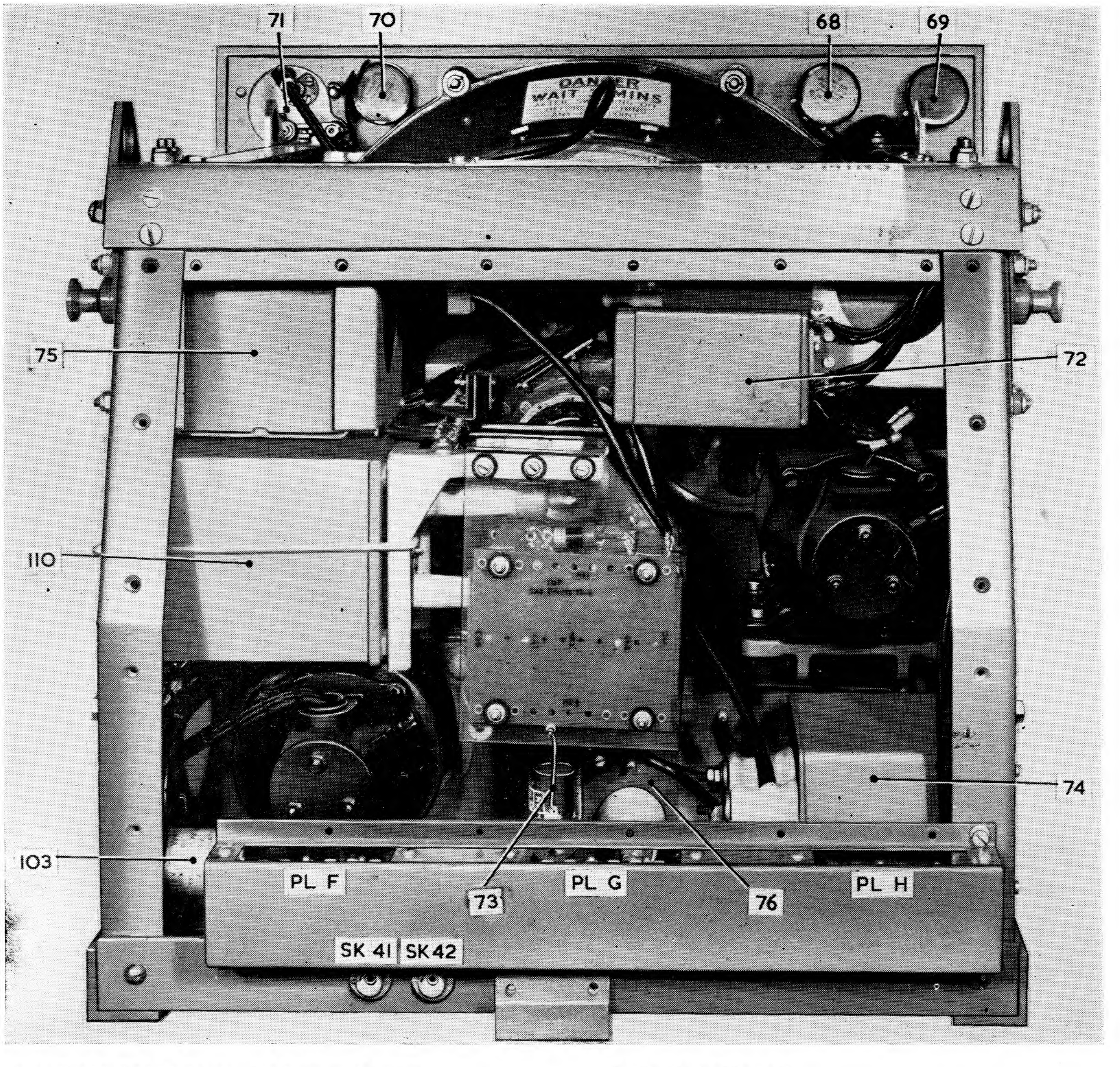
35. A rear view of the indicating unit, completely assembled except for the cover plates (top and side) is shown in fig. 7. This shows the location of the voltage multiplier (110) and the manner in which the EHT rectifier valve is mounted upon it. It also shows the location of the EHT transformer TR4, the first reservoir capacitor C60, and the second reservoir capacitor C58. Other items shown in this illustration are the four controls at the top of the front panel, the power supply

31. The metal rod on the left-hand side, connected to the off-centre bearing control through a universal joint is that which drives the off-centring coil pinion (para. 52 also refers). A mechanical coupling permits the shaft to be separated without dismantling the universal joint at the top end.

32. The main power supplies to the unit are taken through the Jones plugs F, G and H, which are sunk into wells at the rear of the unit. ◀Plug F carries the leads to the trace-reversing cam, the timebase input, the off-centring circuits to the chokes on the console framework, the 6·3 volt circuit for the mask lights, the mains input to the ON/OFF switch, and the strobe control which is not used since the advent of IFF10▶.

33. Plug G carries the mains out from the ON/OFF switch, the negative 310-volt and positive 350-volt supplies to the centring, off-centring, and DC restorer networks, the mains input to the two transformers, and the 6·3-volt supply to the lighting circuits (other than the mask lights). Plug H carries the leads to the deflection selsyn and the azicator selsyn (five leads each). One of the leads to the rotor of the azicator selsyn has the cursor alignment switch SW11 in series, for reasons already explained. The leads to two stator phases of the deflection coil selsyn are taken via contacts on the auto-align relay RL.12. Two other leads from plug H are taken to the auto-align cam contacts.

34. Fig. 6 also shows the terminal block by which connection is made to the centring coils, the strap



68 CENTRING CONTROL No. 1 POTENTIOMETER
69 CENTRING CONTROL No. 2 POTENTIOMETER
70 CURSOR LAMP DIMMER RV17
71 OFF-CENTRE AZIMUTH CONTROL
72 AUTO-ALIGN RELAY
73 EHT RECTIFYING VALVE V26
74 CAPACITOR C60
75 CAPACITOR C58
76 EHT TRANSFORMER TR4
103 CAPACITOR C56
110 TRANSFORMER TR3 CARRYING EHT MULTIPLIER UNIT

Fig. 7. Indicating unit, rear view

sockets, and the two coaxial sockets to which the cathode and grid modulation signals are fed. The relay (72) in its protective cover is that associated with the auto-align system.

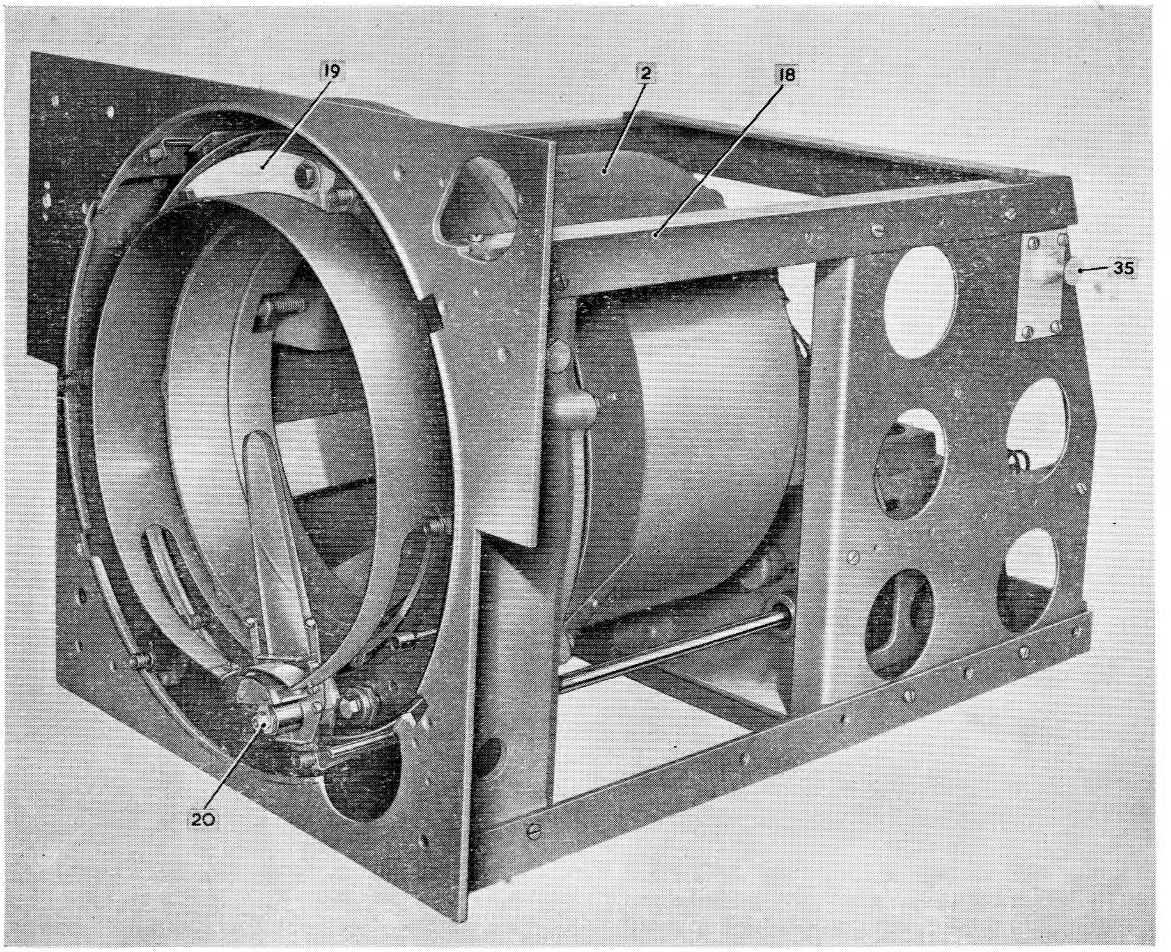
36. Fig. 8 shows four views of the EHT voltage multiplier. This consists of the filament transformer TR3, upon which is mounted a metal platform in the form of a bracket. The latter carries a box-like structure made of perspex, carrying five tag boards. Tag board No. 1 carries the metal rectifiers MR1, MR2, MR3, and capacitors C61, C62, C63, C64, on the inside of the box. Tag board No. 2 carries MR4, MR5, MR6, and C65, C66, C67, C68. The resistor R185 (330K) is connected between the valve filament terminal on the valve base and terminal 4 on tag board No. 3, and thence to C61. The resistor R215 is connected between the upper terminal of C65 (also connected to MR8) and terminal 4 on tag board No. 4, thence to the side cap of the CRT. The end rectifiers MR7 and MR8 of the chain are mounted inside the box. C69 is connected between terminals 4 and 6 on tag board No. 4. A lead runs from terminal 4 on tag board No. 3 to R184 (left-hand side group board), and another lead from R184 to C58 and terminal 2 on tag board 4; these leads connect the EHT multiplier across the ripple filter resistors as explained in para. 14.

37. The 230-volt AC supply to the EHT multiplier is taken into the transformer TR3 via terminals 4 and 5 on tag board No. 5, and the 4-volt supply from TR3 to the CRT heater is taken from the same tag board, terminals 1 and 2. The earth screen of the transformer is connected to terminal No. 3 which is earthed.

38. The rectifier valve is mounted with its anode cap downwards, a retainer (valve) Type 539 being employed.

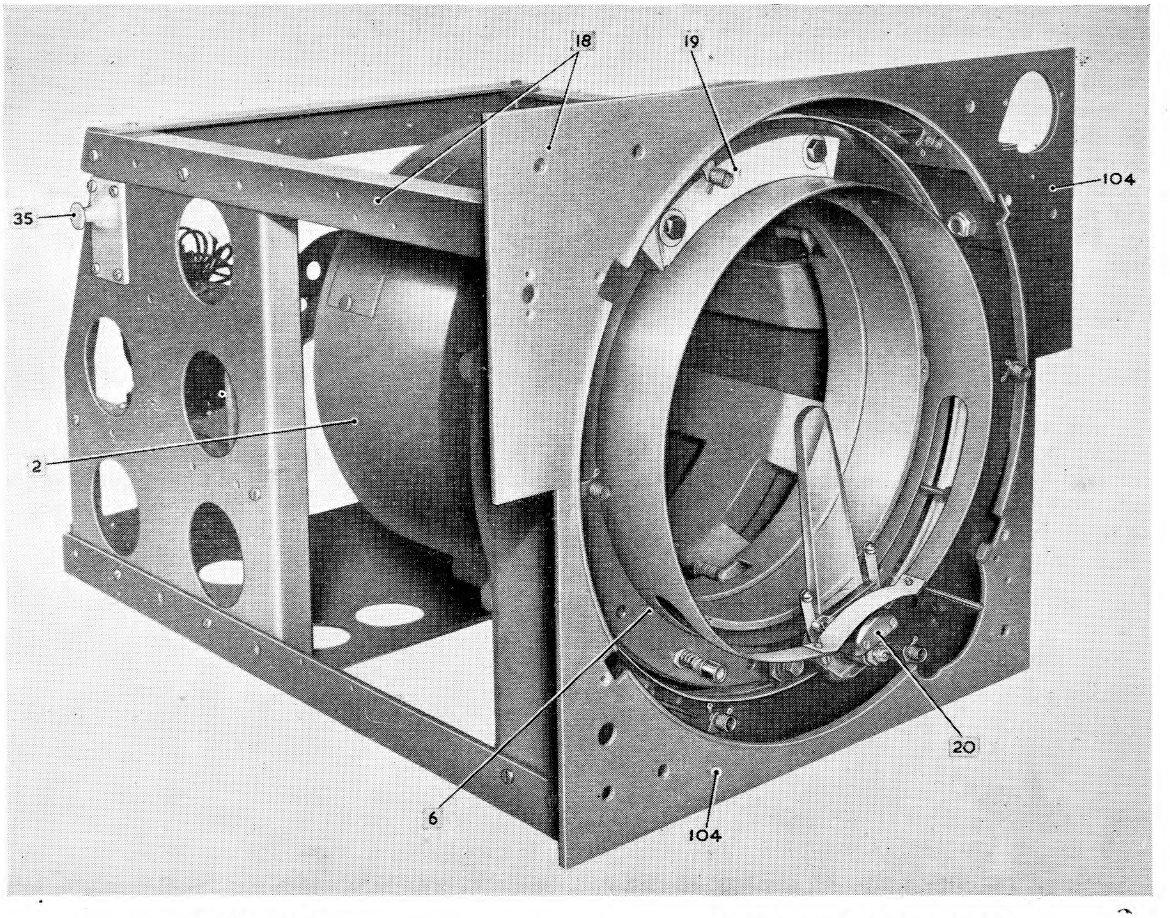
MECHANICAL ASSEMBLY

39. Two views of a partially assembled indicating unit are given in fig. 9 and 11. These show more clearly than in earlier photographs the azicator ring assembly, with the cursor assembly and its balance weight. The trunnions by which the chassis is supported in its telescopic cradle are also shown.



2 MU-METAL SCREEN
18 INDICATING UNIT FRAMEWORK
19 AZICATOR BALANCE WEIGHT
20 CURSOR MOUNTING ASSEMBLY
35 TRUNNION MOUNTINGS

Fig. 9. Indicating unit partially assembled, view 1



2 MU-METAL SCREEN
6 AZICATOR RING ASSEMBLY
18 INDICATING UNIT FRAMEWORK (INCLUDING FRONT PLATE 104)
19 AZICATOR BALANCE WEIGHT
20 CURSOR MOUNTING ASSEMBLY
35 TRUNNION MOUNTINGS

Fig. 11. Indicating unit partially assembled, view 2

Coil rotating mechanism

40. The coil rotating mechanism is partially housed inside the mu-metal screen. Fig. 12 is an exploded view of the principal parts of this mechanism, and should be examined in conjunction with fig. 10, which is a simplified general arrangement drawing showing how the mechanism is assembled. The mechanism is built up inside the spider casting, which is secured to the rear side of the front casting by seven studs and one locating dowel. Between the front casting and the spider casting is the CRT mounting ring, which carries an inner lining ring; when the indicating unit is completely assembled, the lining ring fits snugly round the CRT flare, a certain amount of compliance being introduced by the spring mounting between the mounting ring and the lining ring.

41. The mu-metal screen surrounds the spider casting and is a snug fit upon the latter. The back plate casting is bolted to the rear end of the spider casting as shown in fig. 13 and 14, in which the mu-metal screen has been omitted for clarity. The screen is pierced as necessary for the cover plates giving access to the various terminals, etc., as previously mentioned.

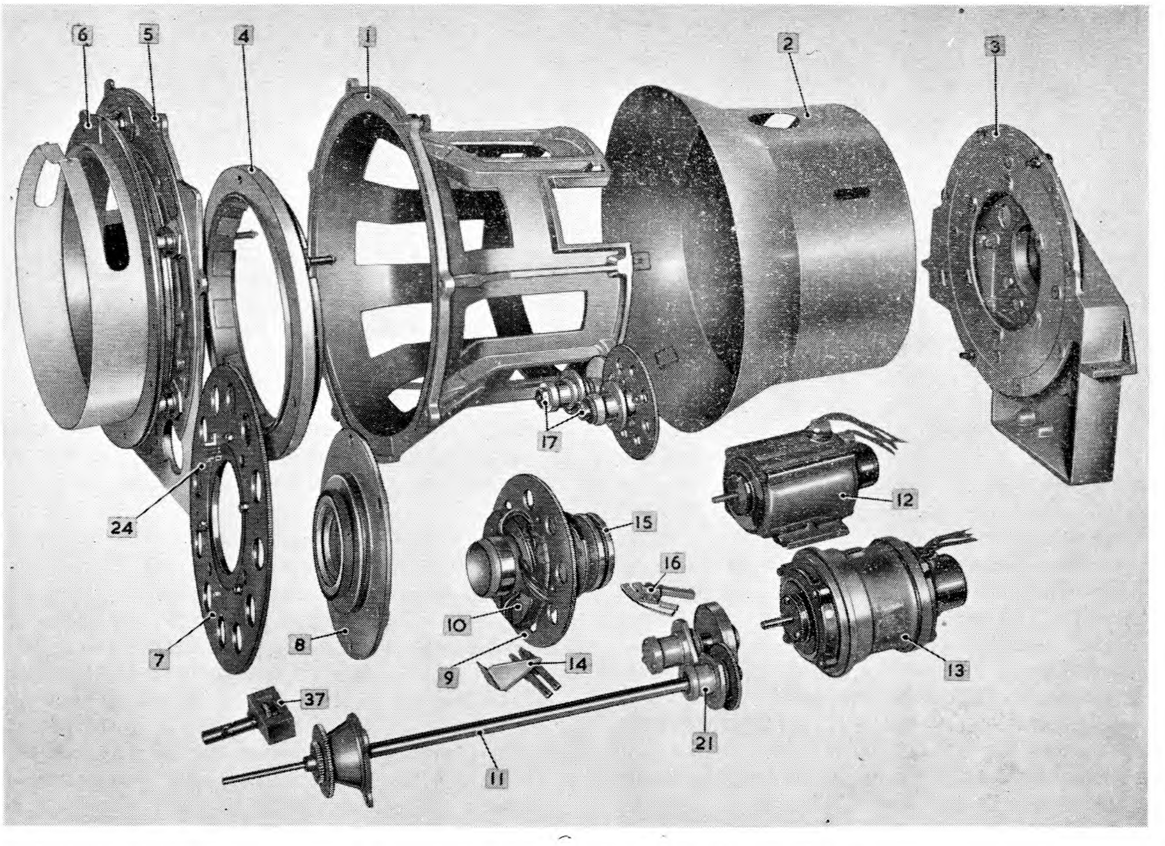
42. Fig. 15 is a rear view of the front casting, showing the CRT mounting ring secured to the front plate by three bolts having large slotted heads. These bolts pass through holes in the mounting ring, sufficient clearance being provided to allow the mounting ring to slide over the front casting for a distance of about $\frac{1}{8}$ inch in any direction. The mounting ring is, however, retained in the desired position by screws which pass through three pillars, one pillar being fitted in the front casting opposite to each alternate slotted bolt. This provides means for adjusting the CRT so that its neck is centralized in the deflection coil tube assembly. The mounting ring is adjusted by the manufacturer, and it should not be necessary to readjust it, except after a repair involving the stripping of the assembly. (Para. 67 also refers).

43. Fig. 16 is a front view of this casting, showing the azicator ring assembly, with the cursor assembly and its balance weight. The cursor is in the normal operational (radar Type 13) position, and is lightly but positively locked in a truly radial direction with respect to the azicator ring and azicator scale by means of a click plate and spring. When not required for use with Type 13, it can be rocked laterally either to the right, so that the cursor rests against the stop 22b (fitted with a rubber buffer) or over to the left, so that it rests against the similar stop 22a. The translucent screen 23, which surrounds the azimuth scale to eliminate glare from the six azimuth scale lamps, is slotted to allow the cursor to be moved in this manner.

44. The stops 22a and 22b differ in one respect, in that 22a is spring-loaded, and can be depressed to allow the cursor to pass completely over it, returning to its normal attitude when the cursor is clear of the stop. This facility is provided principally to ensure that the cursor is safely out of the way when removing or inserting a cathode ray tube. To stow in this manner the cursor must first be set to approximately 185 deg., at which point there is room for the cursor to stow behind the front mounting plate 104. Para. 54 also refers.

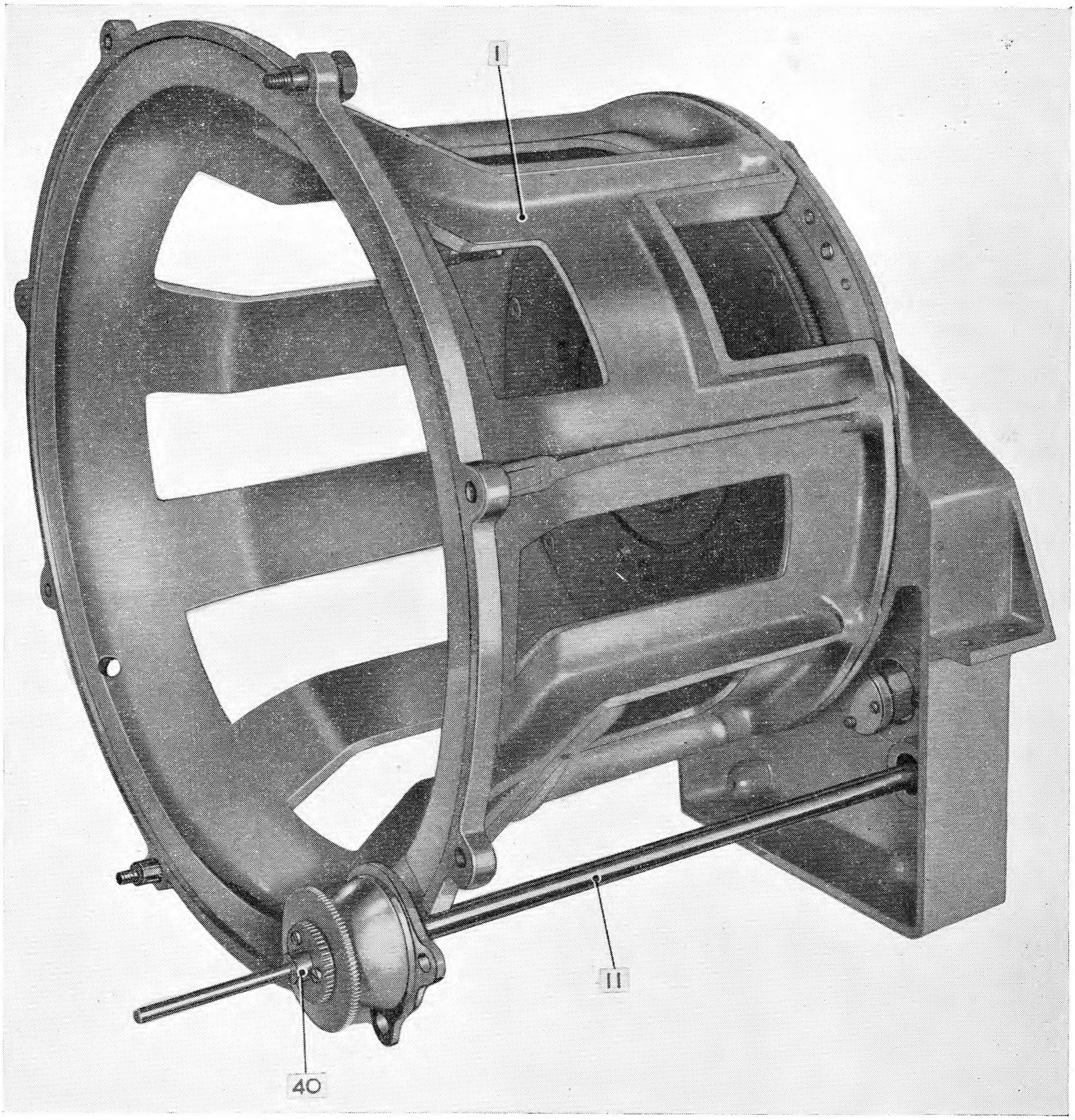
45. Fig. 17 is a rear view of the partially assembled unit, and shows the two selsyns, the azicator selsyn on the left and deflection coil selsyn on the right. The deflection coil is mounted upon a tube which is rotated through suitable gearing by the selsyn. This tube carries at the rear end a pair of insulated slip rings by which connection is made to the coil windings through a pair of flat spring brushes as shown in the illustration. The photograph was taken before the deflection coil was actually fitted. After the latter operation has been performed, the ends of the windings are soldered to metal pins connected to the slip rings. The coil winding is distributed round the inner circumference of the tube in order to obtain the most uniform field possible.

46. When the indicating unit is completely assembled and the CRT is fitted, the stem of the tube is supported by a bracket carrying a metal strap which is secured to the rear plate by studs with wing nuts. The threaded holes for these



1 SPIDER CASTING
2 MU-METAL SCREEN
3 BACK PLATE CASTING
4 CRT MOUNTING RING CARRYING SPRUNG LINING RING
5 FRONT CASTING
6 AZICATOR RING ASSEMBLY
7 OFF-CENTRING COIL MOUNTING PINION
8 CENTRING COIL MOUNTING PLATE
9 DEFLECTION COIL ASSEMBLY
10 CENTRING COIL ASSEMBLY
11 AZICATOR DRIVE SHAFT
12 DEFLECTION COIL SELSYN
13 AZICATOR SELSYN
14 DEFLECTION COIL BRUSHES AND BRUSH MOUNTING
15 DEFLECTION COIL SLIP-RINGS
16 AUTO-ALIGN CONTACT ASSEMBLY
17 DEFLECTION COIL DRIVE GEARING
21 AZICATOR DRIVE GEARING
24 TRACE-REVERSING CONTACTS
37 OFF-CENTRING PINION DRIVE AND MOUNTING

Fig. 12. Exploded view showing coil rotating mechanism



1 SPIDER CASTING
11 AZICATOR DRIVE SHAFT
40 AZICATOR FINAL DRIVE PINIONS

Fig. 13. Spider casting, front view

studs are shown at 60 in fig. 17. The studs pass through holes in the bracket with about $\frac{1}{8}$ inch clearance all round, so that the bracket may be moved to centralize the stem of the tube in the deflection coil assembly tube. This adjustment is complementary to that described in para. 42, and is performed at the manufacturers' works. subsequent adjustment should not be necessary unless the indicating unit is stripped for repair.

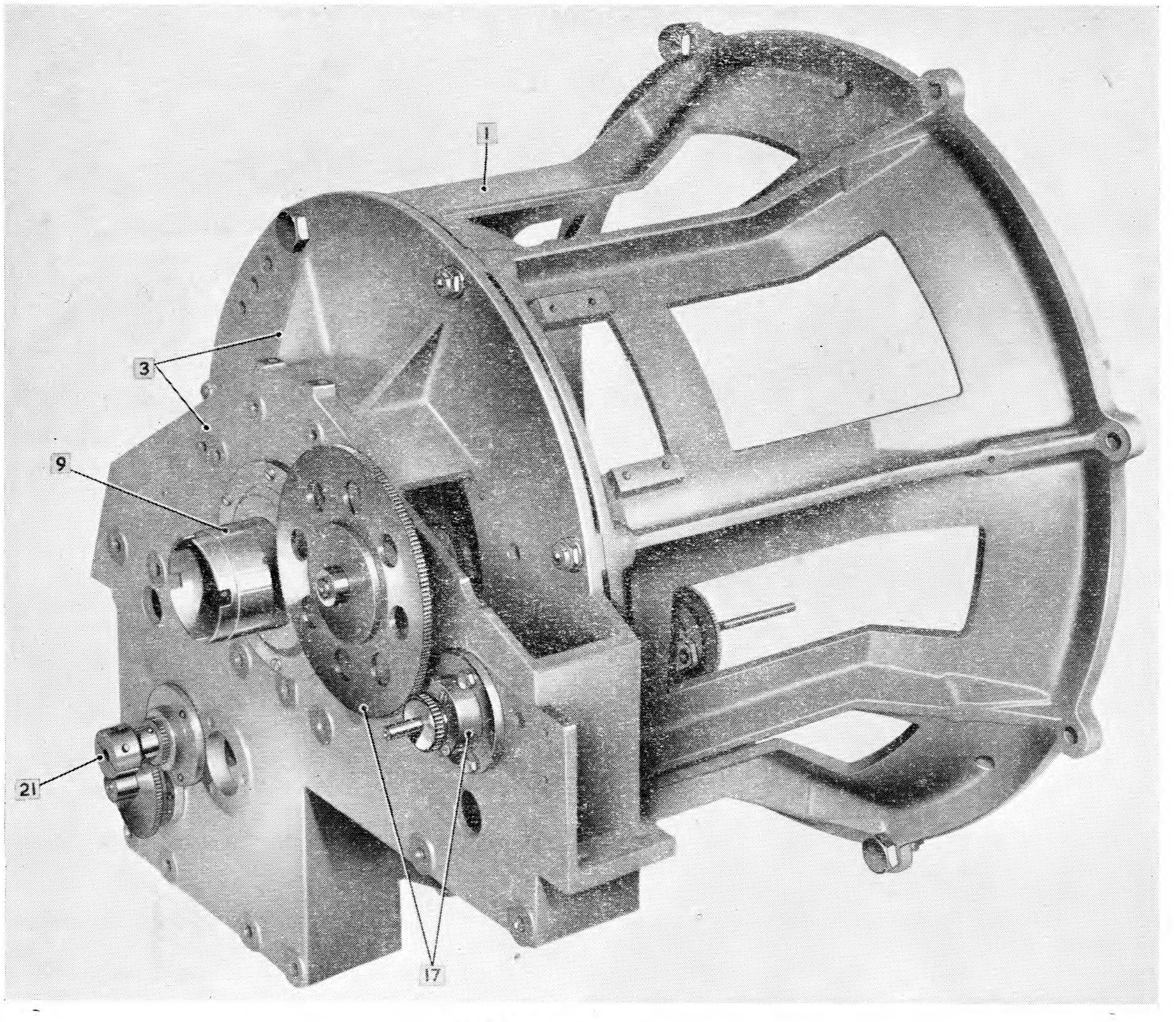
47. The leads 25 are connected, inside the rear casting, to the centring coils, and externally are normally connected to the tag block referred to in para. 34.

48. The complete driving system for the deflection selsyn can be studied with the aid of fig. 18, 19, and 20, the two latter being exploded views of the drive assembly, while fig. 18 shows the assembled driving mechanism. The selsyn 12 drives a small pinion 30 through a three-plate type of universal coupling 34; the outer plates of this coupling are secured to the selsyn shaft, and the small pinion shaft, respectively by split collars. A mechanical brake is fitted to this coupling in order that the selsyn may be mechanically locked during certain setting-up operations. The brake is not shown in fig. 18; it is operated by a knurled knob (109, *fig.* 5) which is accessible through an aperture in the left-hand side of the unit when the side cover plate is removed. This brake must always be eased off during operational conditions.

49. The small pinion 30 drives a large pinion 31, which is supported by a bearing mounted in the rear webb of the back plate casting. The inner end of this shaft carries another small pinion 32, which drives the final pinion 33, the latter being part of the deflection coil tube assembly. The total reduction between the selsyn shaft and the coil itself is 30-to-1.

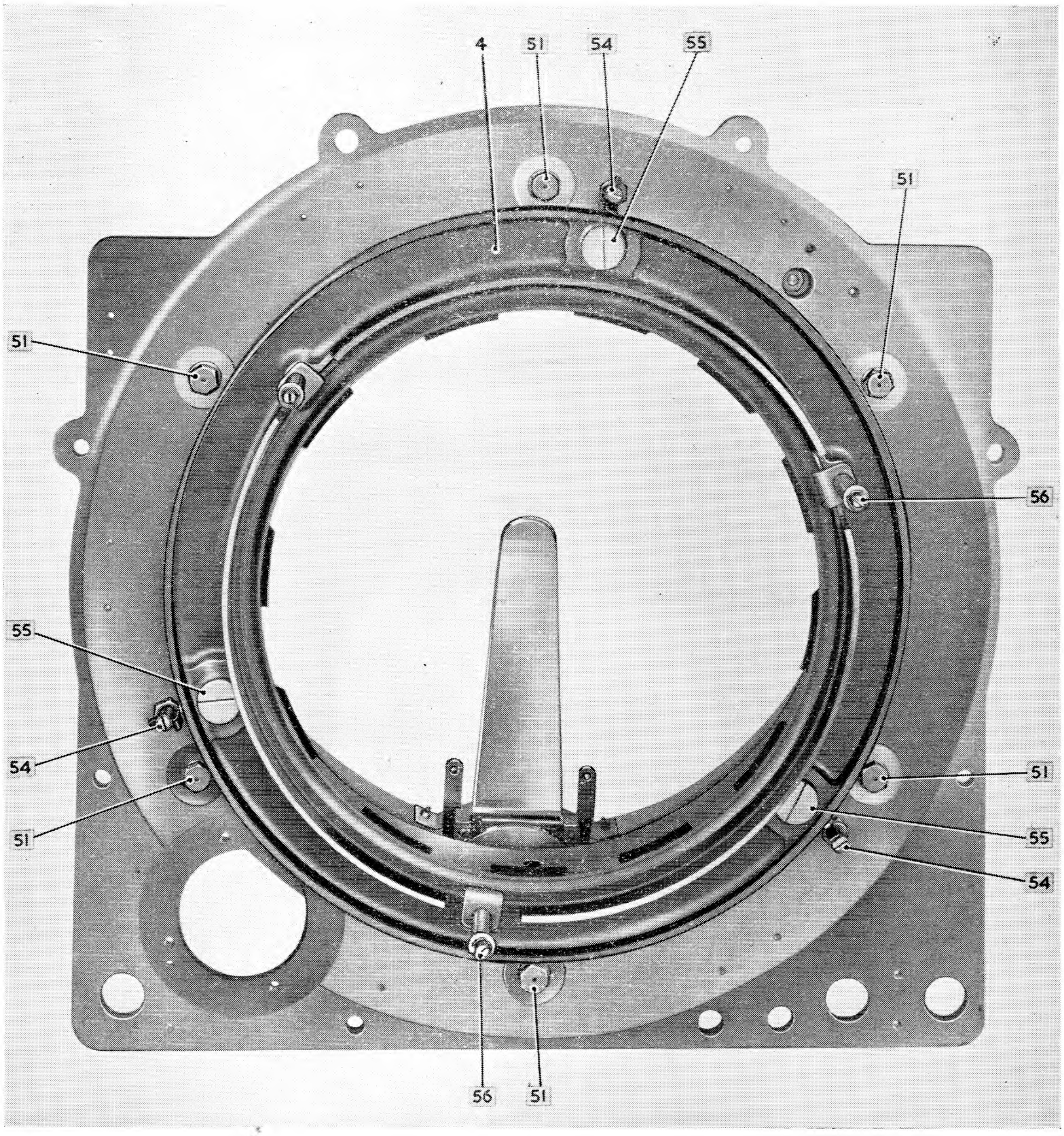
50. Fig. 21 is a close view of the rear end of the deflection coil tube, showing the slip-rings and the pins by which connections are made between the slip-rings and the coil, after the latter has been fitted. The arrangement of the auto-align cam and contacts is also shown here. The cam consists of a segment of insulating material, secured by two screws so that it may be removed when necessary to allow the complete deflection coil slip-ring assembly (including the cam ring) to be withdrawn without dismantling the drive up to and including the large pinion 31. The contact assembly is mounted upon a metal plate and is also removable. The plate can be slewed through an angle of about eight degrees, to allow for certain adjustments in the initial alignment of the auto-align system.

51. Fig. 19 also shows the centring coil assembly, slipped over the deflection coil tube assembly in the approximate position which it occupies when the unit is fully assembled (compare with fig. 10). The coil assembly consists of an iron yoke upon which are wound four coils; the connections to these coils are shown in the circuit diagram, fig. 1. The manner in which the coil is mounted will be explained with reference to



1 SPIDER CASTING
3 BACK PLATE CASTING
9 DEFLECTION COIL TUBE ASSEMBLY
17 DEFLECTION COIL DRIVE GEARING
21 AZICATOR DRIVE GEARING

Fig. 14. Spider casting and rear plate, rear view



4 CRT MOUNTING RING CARRYING SPRUNG LINING RING
51 BOLT SECURING SUPPORT ROLLER ASSEMBLY
54 PILLAR CARRYING ADJUSTING SCREW
55 SCREW ATTACHING CRT MOUNTING RING TO FRONT CASTING
56 SPRING SUPPORT FOR LINING RING

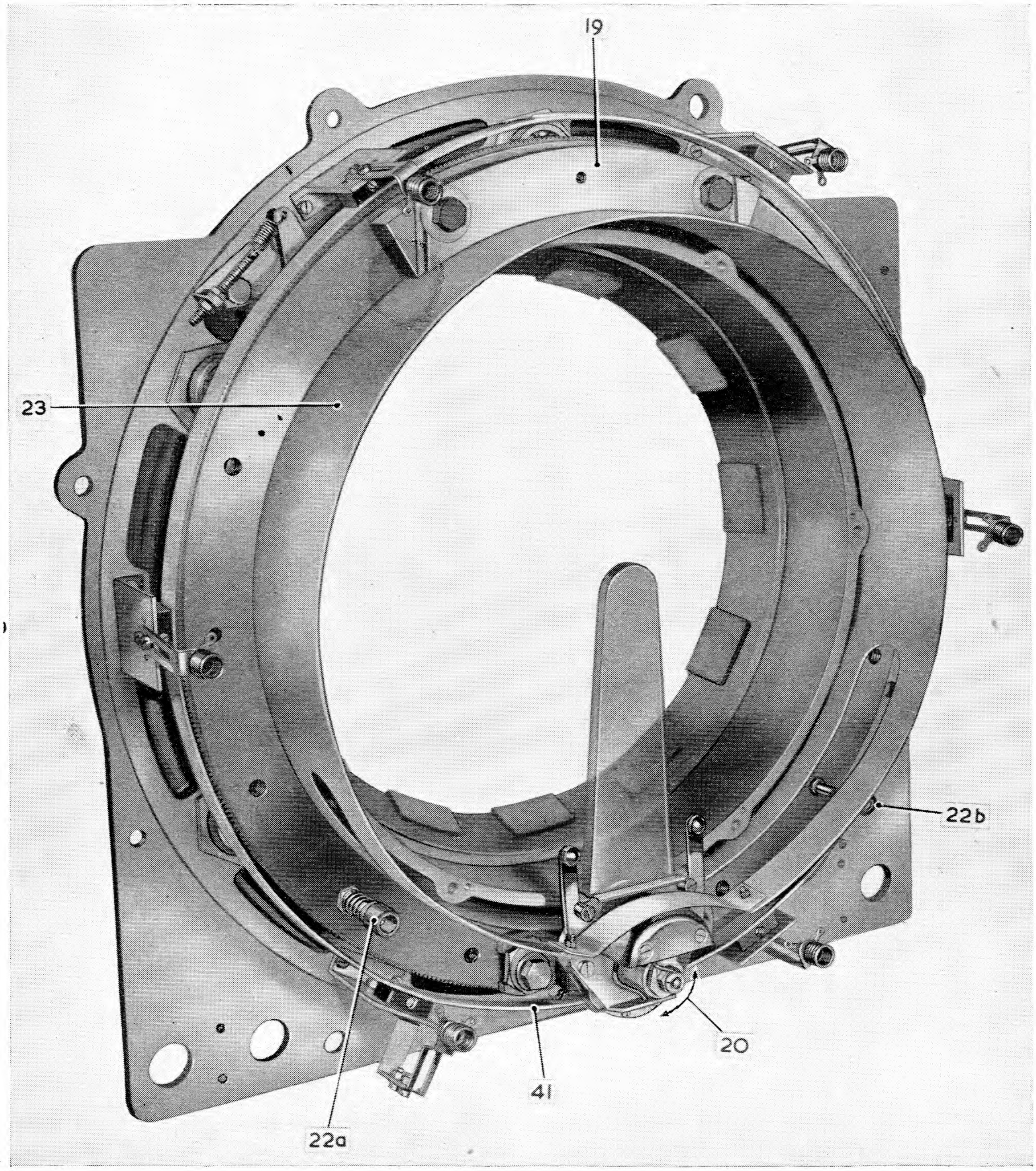
Fig. 15. Rear view of front casting

fig. 10 and 12. The plate 8 (*fig.* 12) is bolted to the front of the rear plate 3, and carries bearings in which the trace-reversing cam rotates. The latter is keyed to and rotates with the deflection coil assembly. The centring coil assembly is bolted to the rear side of the plate 8, the connections being brought out through an orifice in the rear of the casting 3 and taken to the tag board as shown in fig. 6.

52. The front end of the deflection coil assembly, carrying the trace-reversing cam as described above, is shown in fig. 22. The off-centring pinion 7 rotates round the neck of the CRT, carrying the off-centring coil assembly which is mounted on the pinion (compare fig. 10, 22, and 23). In fig. 22 the coil assembly has been removed to show the trace-reversing cam and contacts more clearly. Referring back to fig. 6, the control 71 turns the shaft through two universal joints, and thus turns the pinion 37 (*fig.* 22). The pinion 37 engages with the pinion 7 as shown and so turns the off-centring coils that the off-centre is in the direction required.

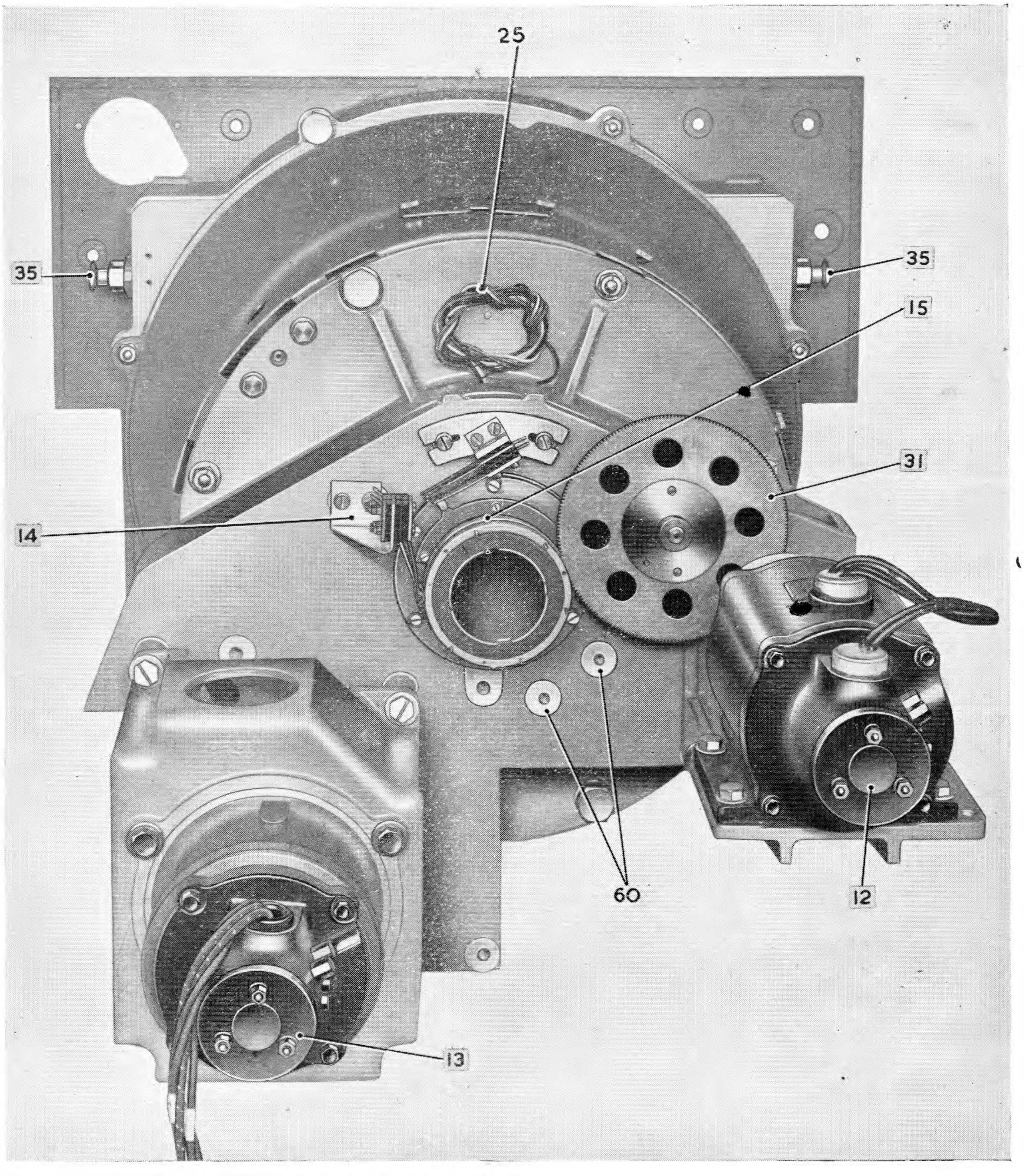
53. Again, referring to fig. 10 and 23, in addition to the off-centring coil assembly 100, the pinion 7 also carries a drum 106 of insulating material upon which are mounted four slip rings, two of which carry the current for the off-centring coils, and the other two the current to the trace-reversing contacts. The currents to and from the slip-rings are carried by brushes which are mounted on a bracket, supported on the rear end of the spider casting.

54. Fig. 23 is an oblique view showing the deflection coil winding 107 (note the distributed winding) and the off-centring coil assembly



19 AZICATOR BALANCE WEIGHT
20 CURSOR MOUNTING ASSEMBLY
22a LEFT-HAND CURSOR STOP
22b RIGHT-HAND CURSOR STOP
23 TRANSLUCENT SCREEN FOR SCREEN LIGHTING
41 SLIP-RING FOR CURSOR LAMP

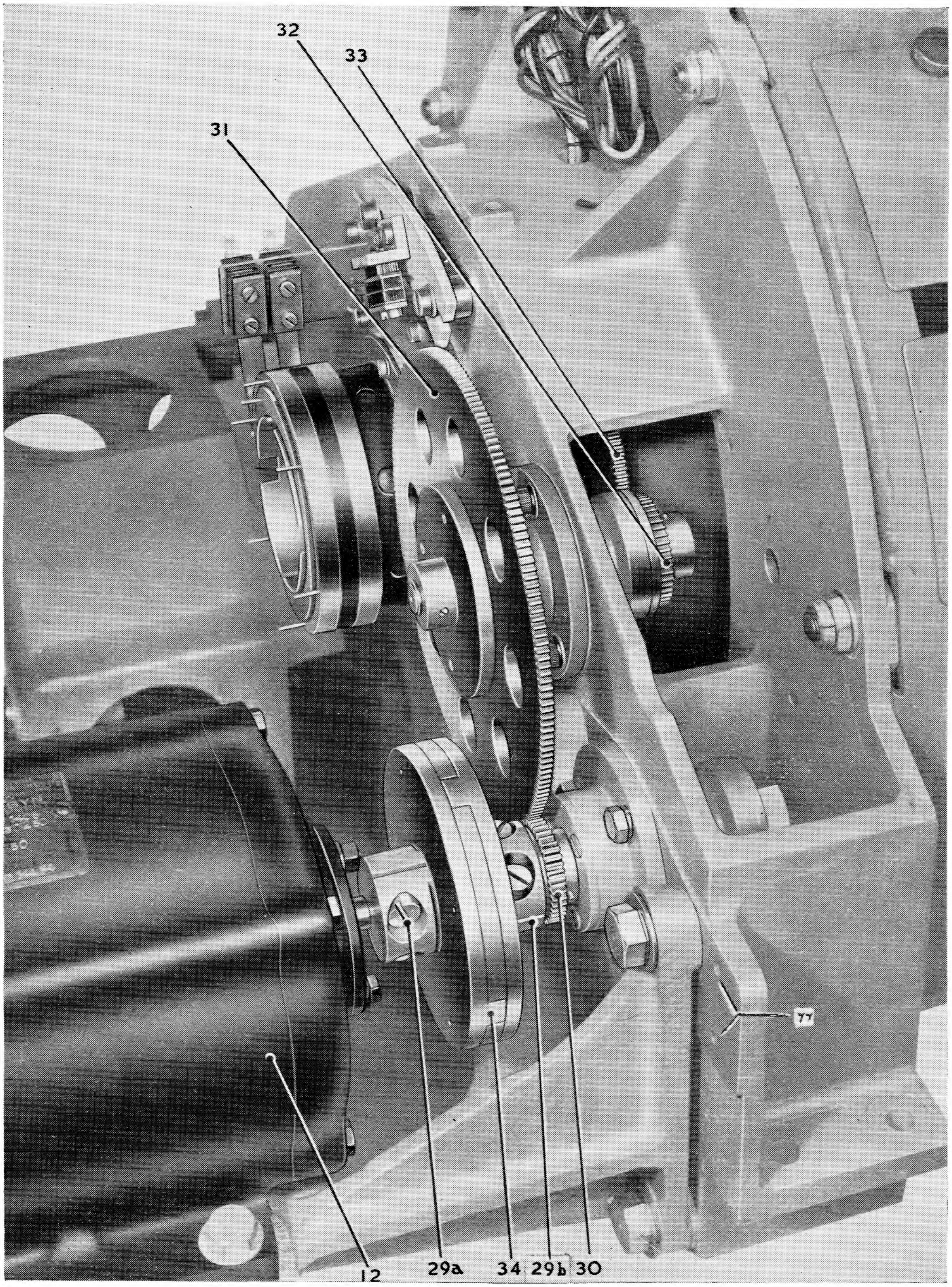
Fig. 16. Front view of front casting showing azicator ring assembly



12 DEFLECTION COIL SELSYN
13 AZICATOR SELSYN
14 DEFLECTION COIL BRUSHES AND BRUSH MOUNTING
15 DEFLECTION COIL SLIP-RINGS
25 LEADS TO CENTRING COIL
31 DEFLECTION COIL DRIVE, SECOND PINION
35 TRUNNION MOUNTINGS
60 HOLES FOR CRT SUPPORT BRACKET

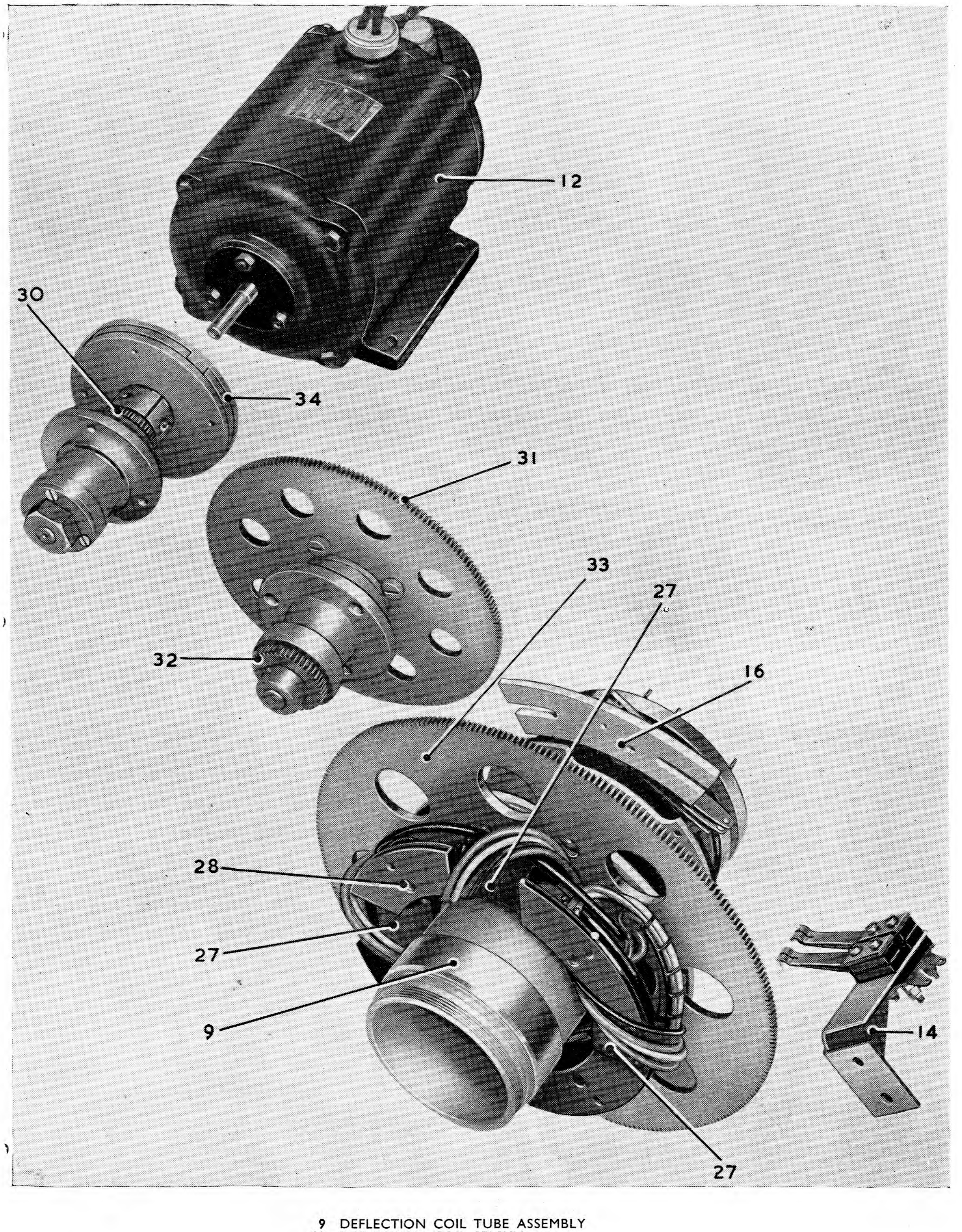
Fig. 17. Rear view of indicating unit, partially assembled

mounted in position on the pinion 7. The location of the brushes 108 bearing upon the slip rings on the drum 106 is also shown. Incidentally, in order to obtain this photograph, the cursor was necessarily turned into the stowage position, to the left of the spring-loaded stop, as described in para. 44.



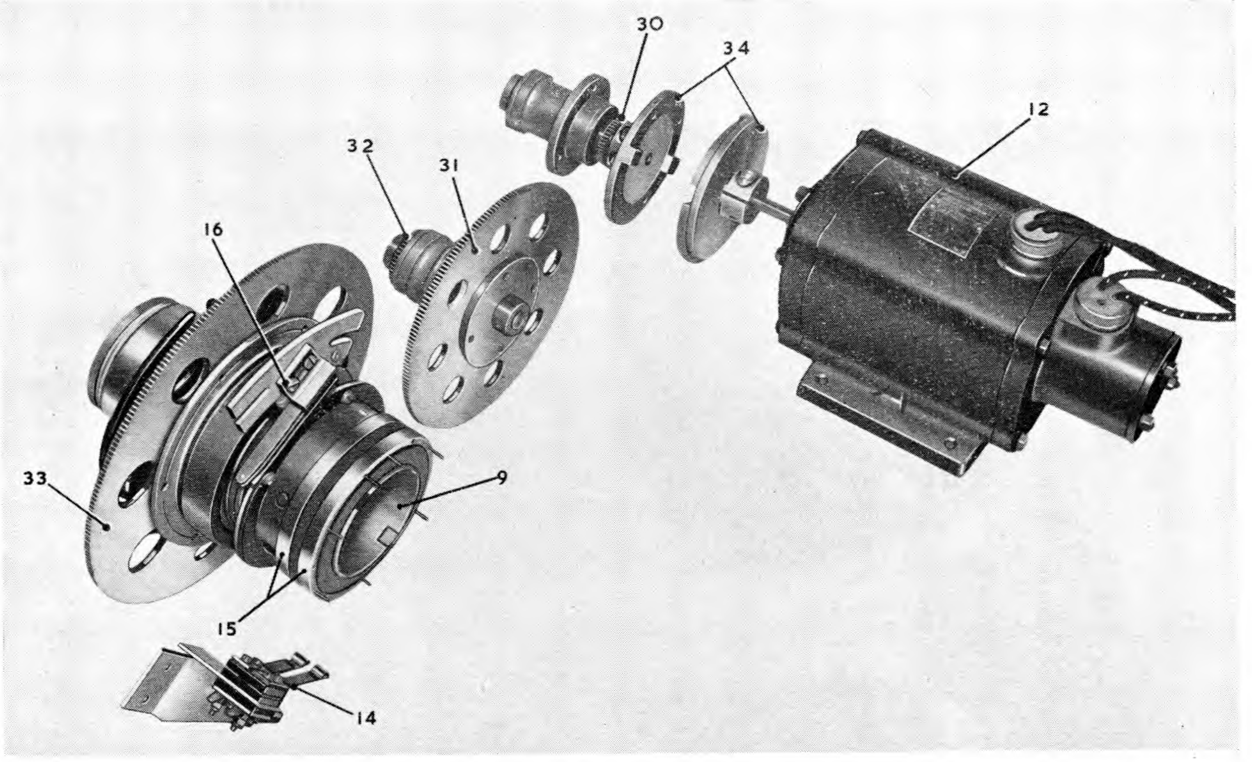
12 DEFLECTION COIL SELSYN
29 (A AND B) SPLIT COLLARS SECURING PLATE COUPLING
30 DEFLECTION COIL DRIVE, FIRST PINION
34 PLATE COUPLING
31 DEFLECTION COIL DRIVE, SECOND PINION
32 DEFLECTION COIL DRIVE, THIRD PINION
33 DEFLECTION COIL DRIVE, FOURTH PINION
77 MOUNTING POSITION FOR SELSYN LOCK BRACKET

Fig. 18. Driving mechanism for deflection coil tube



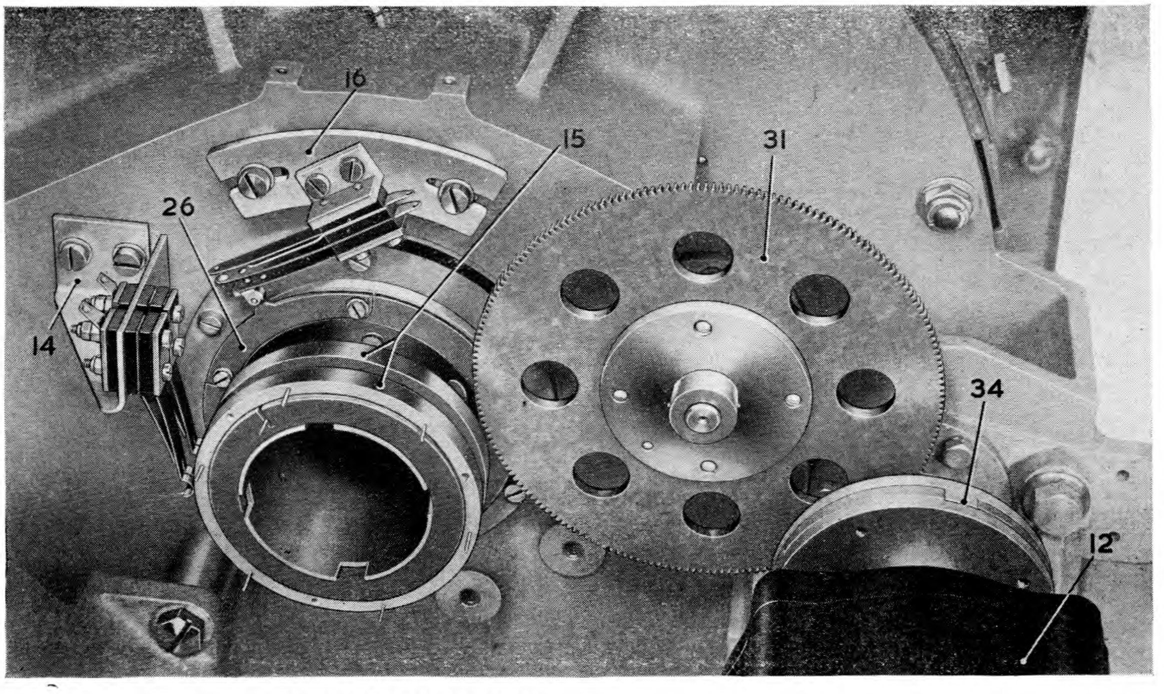
9 DEFLECTION COIL TUBE ASSEMBLY
12 DEFLECTION COIL SELSYN
14 DEFLECTION COIL BRUSHES
16 AUTO-ALIGN CONTACT ASSEMBLY
27 CENTRING COIL WINDINGS
28 CENTRING COIL YOKE
30 DEFLECTION COIL DRIVE, FIRST PINION
31 DEFLECTION COIL DRIVE, SECOND PINION
32 DEFLECTION COIL DRIVE, THIRD PINION
33 DEFLECTION COIL DRIVE, FOURTH PINION
34 PLATE COUPLING

Fig. 19. Exploded view of deflection coil selsyn drive from front



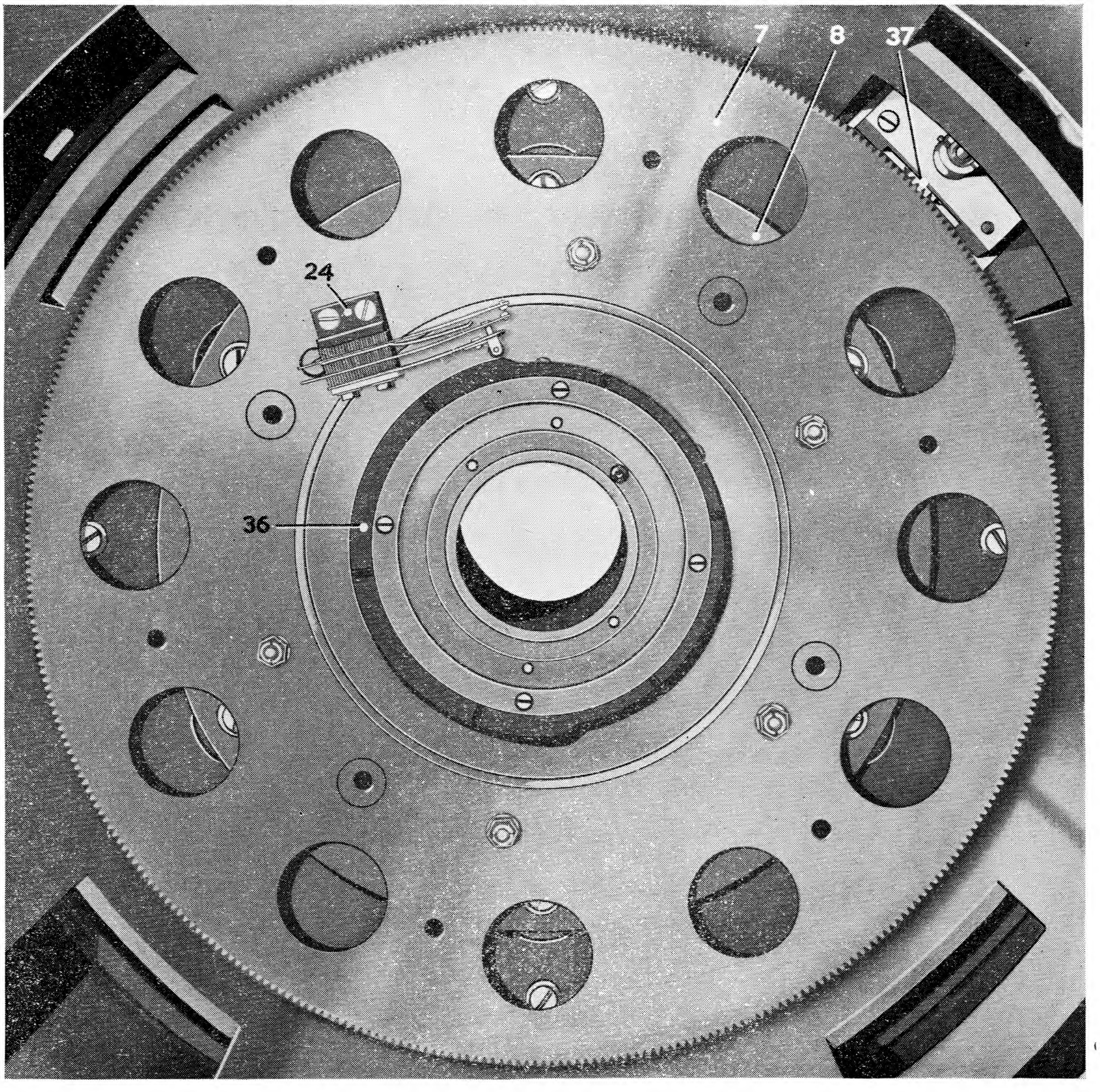
9 DEFLECTION COIL TUBE ASSEMBLY
12 DEFLECTION COIL SELSYN
14 DEFLECTION COIL BRUSHES AND BRUSH MOUNTING
15 DEFLECTION COIL SLIP-RINGS
16 AUTO-ALIGN CONTACTS
30 DEFLECTION COIL DRIVE, FIRST PINION
31 DEFLECTION COIL DRIVE, SECOND PINION
32 DEFLECTION COIL DRIVE, THIRD PINION
33 DEFLECTION COIL DRIVE, FOURTH PINION
34 PLATE COUPLING

Fig. 20. Exploded view of deflection coil selsyn drive, from rear



12 DEFLECTION COIL SELSYN
14 DEFLECTION COIL BRUSHES AND BRUSH MOUNTING
15 DEFLECTION COIL SLIP-RINGS
16 AUTO-ALIGN CONTACT ASSEMBLY
26 AUTO-ALIGN CAM
31 DEFLECTION COIL DRIVE, SECOND PINION

Fig. 21. Rear end of deflection coil tube and slip-rings



7 OFF-CENTRING COIL MOUNTING PINION
8 CENTRING COIL MOUNTING PLATE
24 TRACE-REVERSING CONTACTS
36 TRACE-REVERSING CAM
37 OFF-CENTRING COIL PINION DRIVE AND MOUNTING

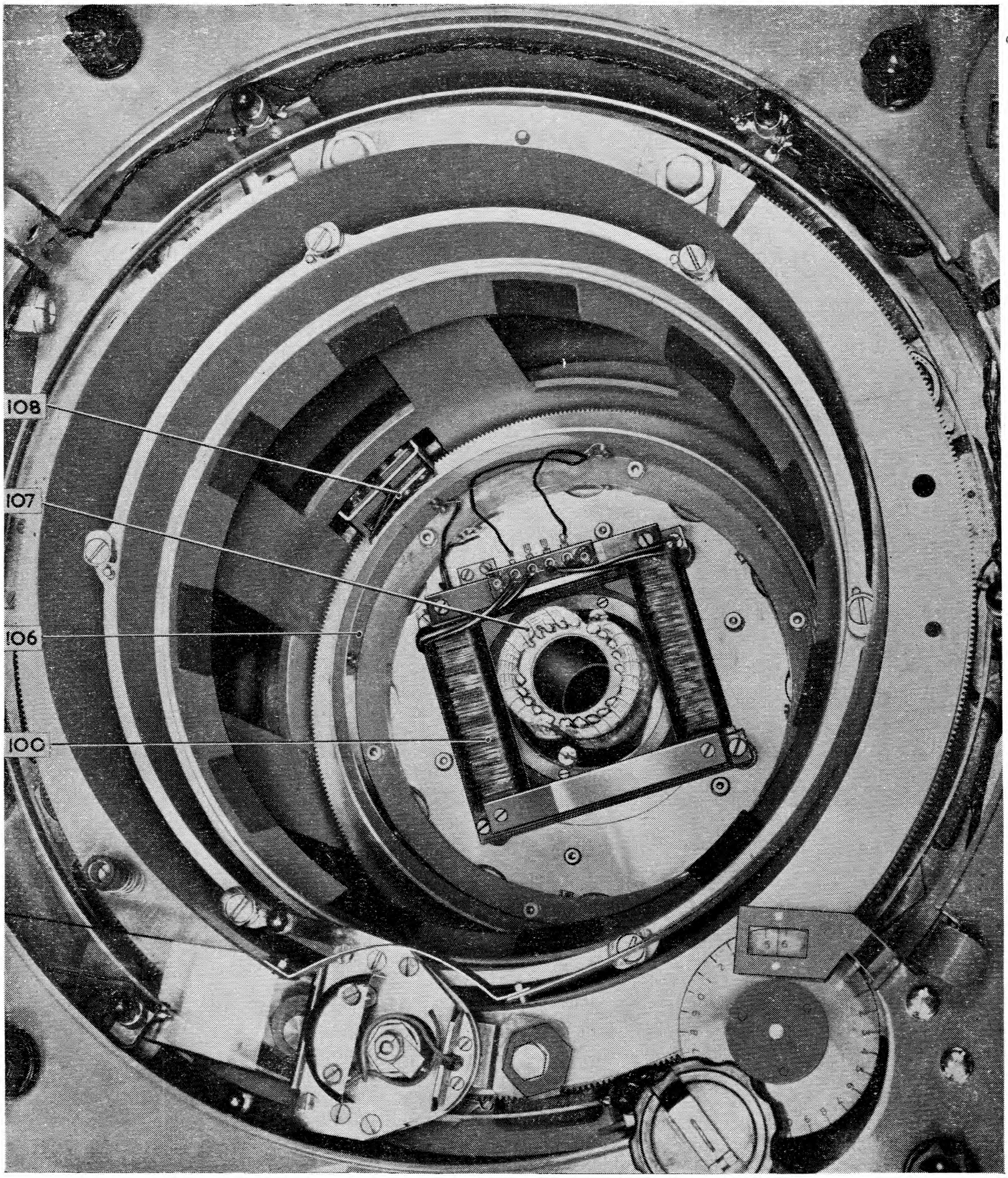
Fig. 22. Trace-reversing cam and off-centre pinion

55. Fig. 24 is another view of the partially assembled indicating unit, showing the relative positions of the spider casting, azicator ring assembly, cursor assembly, cursor stops, and cursor. The small brackets 38 carrying the azimuth scale lamps are somewhat fragile and care must be taken not to distort them. The slip ring 41 carries current to the cursor lamp, the latter being housed in a lamp house on the cursor mounting. Contact to the slip ring is made by a pair of strip metal contacts, mounted in such a manner that the cursor moves freely in either direction without bending or otherwise distorting the brushes.

56. The position of the azimuth ring take-up roller is also indicated in this illustration, another view is given in fig. 26. The manner in which the final drive to the azicator ring is arranged is also shown. The shaft from the azicator selsyn carries a small pinion which engages with the circular rack on the ring, the velocity reduction in this gearing being 12-to-1.

Azicator drive

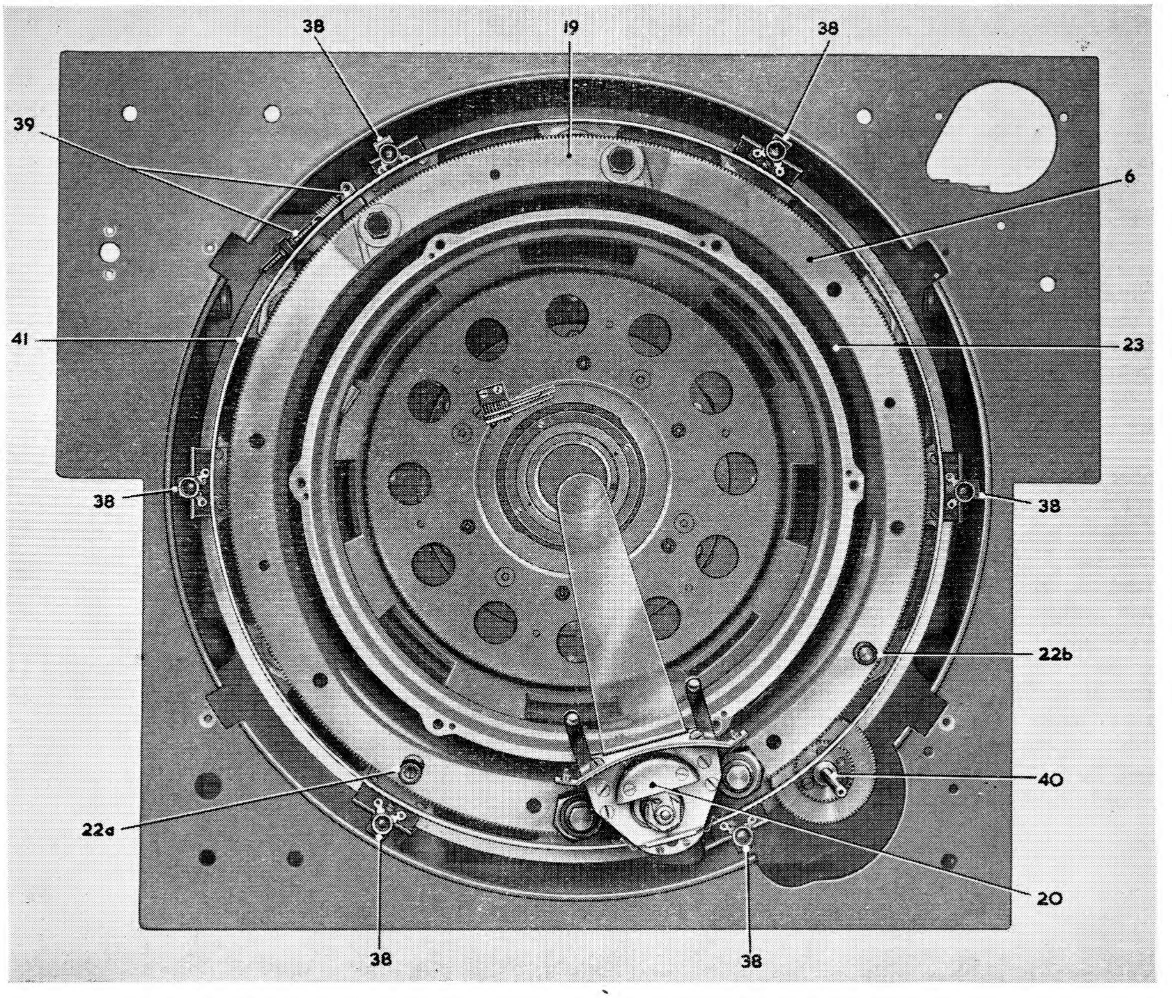
57. The initial stages of the azicator drive are shown in fig. 14 and 17. A close-up view of the gearing is given in fig. 25. These figures should be correlated with the aid of fig. 12, which shows an exploded view of the whole drive. The azicator selsyn **13** drives a small pinion **43** (*fig.* 25) through a plate coupling **42**, similar to that used in the deflector coil drive system; this is secured to the selsyn shaft by a split collar. This pinion is mounted in ball bearings mounted in a collar on the rear plate, and drives a second pinion **44** which is mounted on the end of the shaft **11**. The latter carries at its front end the pinion **40** (*fig.* 24) by which the final drive to the azicator ring is obtained. This shaft is supported at both front and rear ends by ball bearings fitted in collars. The velocity reduction between the pinions **43** and **44** is $2\frac{1}{2}$-to-1, while between the pinion **40** and the azicator ring it is 12-to-1 as previously stated. Hence, the total reduction between the selsyn and the azicator ring is 30-to-1.



100 OFF-CENTRING COIL ASSEMBLY
106 DRUM CARRYING SLIP-RINGS
107 DEFLECTION COIL WINDING
108 BRUSHES FOR OFF-CENTRING COIL AND TRACE-REVERSING CONTENTS

Fig. 23. View showing off-centring coils, slip-ring drum, and deflection coil

RESTRICTED



6 AZICATOR RING ASSEMBLY
19 AZICATOR BALANCE WEIGHT
20 CURSOR MOUNTING ASSEMBLY
22a CURSOR STOP, LEFT-HAND
22b CURSOR STOP, RIGHT-HAND
23 TRANSLUCENT SCREEN FOR SCALE LIGHTS
38 SCALE LAMP HOLDER
39 AZICATOR RING TAKE-UP ROLLER AND SPRING
40 AZICATOR RING FINAL DRIVE
41 SLIP-RING FOR CURSOR LAMP

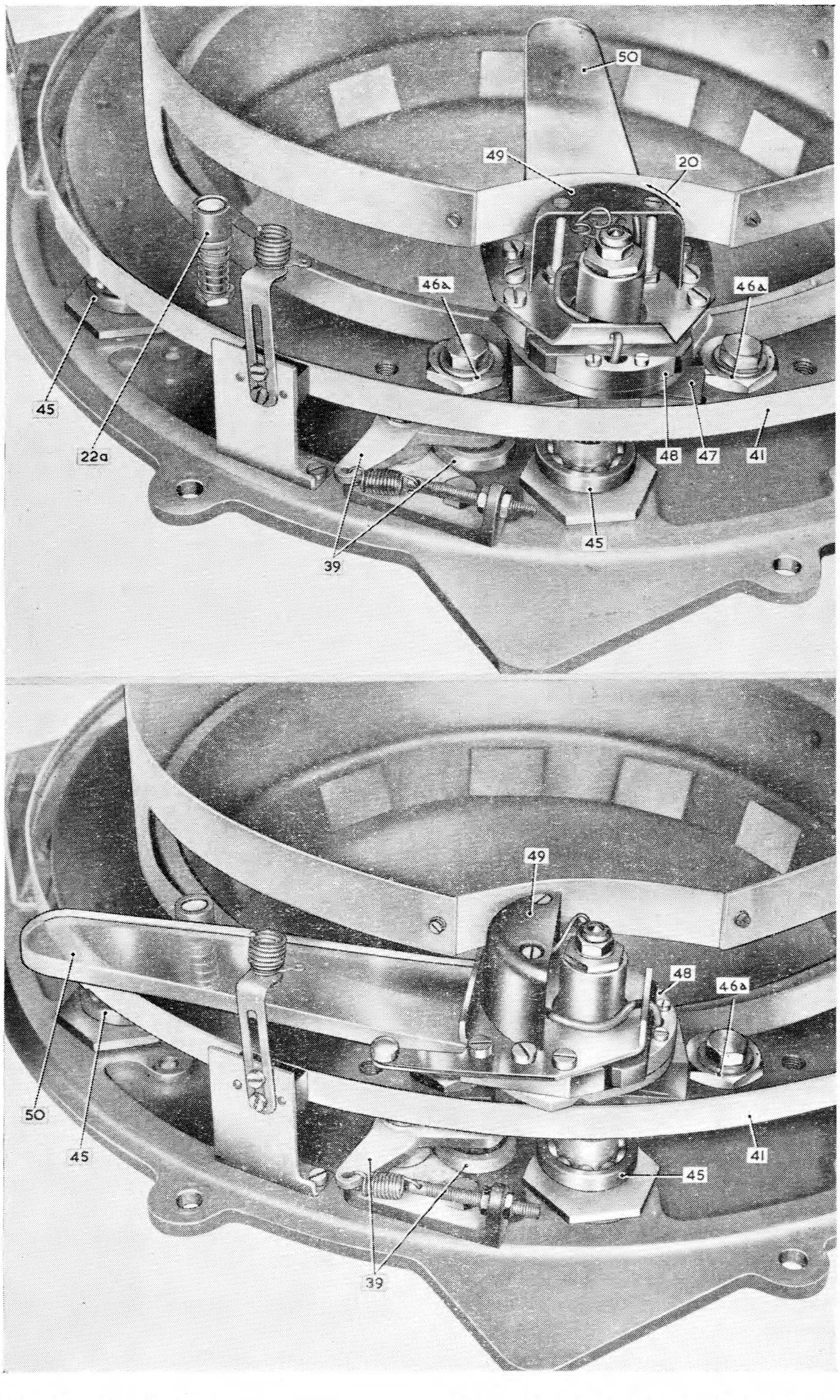
Fig. 24. Front view of indicating unit, partially assembled

Cursor assembly

58. The cursor itself is of glass, ground from the solid to fit the contour of the tube face. It is engraved upon the underside with a radial cursor line having a short perpendicular line crossing it. The intersection of these lines (subsequently referred to simply as "the cross") must lie accurately over the mechanical centre of the PPI. If it does not, the cross will describe a small circle as the cursor rotates, instead of remaining directly over the centre. To avoid parallax errors when setting up or when taking bearings, two lines are engraved upon the upper side of the cursor about 2 millimetres apart. When reading from the cursor, the eye should be in such a position that the single line on the underside appears to be midway between the two lines on the upper side.

59. When the console is used as a "putter-on" for radar Type 13, it is essential from the operational aspect that the electrical centre of the display shall be made to correspond with the mechanical centre, as defined by the cross on the cursor; this accurate alignment must, of course, be maintained during the operational use of the equipment. The adjustment is easily made by the use of the two centring controls. On the other hand, when returning to a normally-centred display after the use of an off-centre display, it is generally necessary—and always advisable—to reset the timebase origin to the cross. This is because the residual magnetic field of the off-centre coil yoke may cause a slight deflection of the spot.

60. Two views of the cursor assembly and fittings



20 CURSOR MOUNTING ASSEMBLY
22a CURSOR STOP, LEFT-HAND
39 AZICATOR RING TAKE-UP ROLLER AND SPRING
41 SLIP-RING FOR CURSOR LAMP CIRCUIT
45 AZICATOR RING SUPPORT ROLLER
46a HEXAGON-HEADED ECCENTRIC COLLARS ON ITEM 46
47 CURSOR ASSEMBLY MOUNTING PLATE
48 BASE OF CURSOR ASSEMBLY
49 CURSOR LAMP-HOUSE ASSEMBLY
50 CURSOR

Fig. 26. Cursor mounting assembly

adjacent thereto are given in fig. 26. The cursor is assembled upon a bronze base 47 having forked ends, and this base is mounted upon the azicator ring by two large bolts 46, one through each fork. These bolts carry hexagonal-headed collars 46a which are eccentric with respect to the axis of the bolt, and so permit positive, systematic movement of the cursor mounting, during the initial assembly at the makers' works (or subsequently during service, e.g. in the event of breaking the glass cursor). A special jig is used to set the cursor with the line truly radial, with the cross at the mechanical centre of the azicator ring. The collars are turned so that they hold the cursor assembly in this position, and the bolts 46 are then finally set up. It is of the utmost importance that these bolts are not interfered with, except in the execution of authorized repair or similar circumstances, where the azicator jig will be available for resetting. The procedure for re-setting is given in para. 68-70.

Azicator support rollers

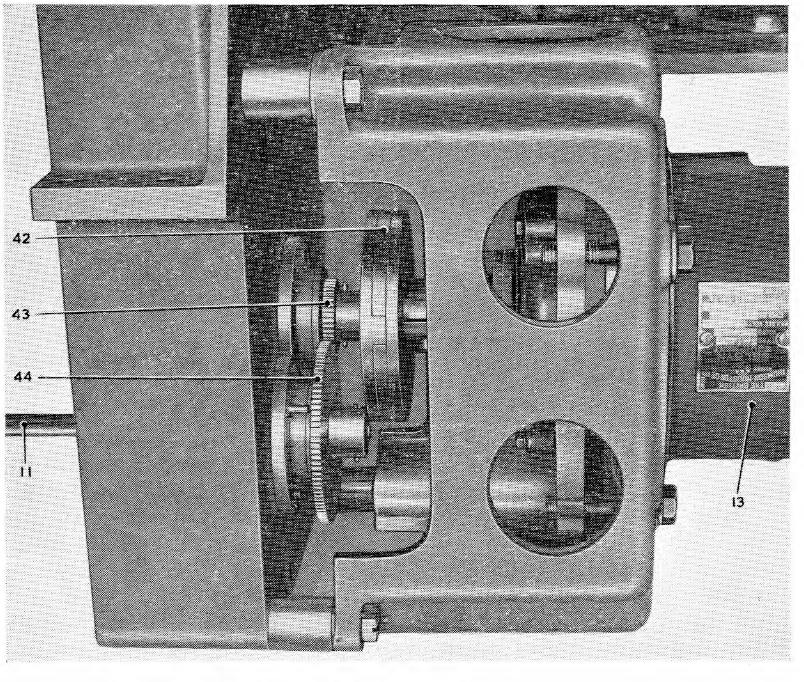
61. It is also necessary to ensure that the azicator ring shall rotate about its mechanical centre without the slightest side shake or backlash. For this reason, the azicator ring runs between six support rollers, spaced 60 deg. apart round its circumference. Two of these rollers are seen in fig. 26. The rollers are ball bearing, and each is fitted on a pillar, the latter in turn being mounted upon a large, thin hexagonal plate. During assembly, these plates are turned in a scheduled manner until the azicator ring is running truly and without shake. All six are then set up firmly at the rear of the front casting, by large hexagon-headed bolts, which can be seen in fig. 15. On no account should the setting of the hexagonal plates, or the bolts securing them, be interfered with.

62. At one point on the circumference of the azicator ring there is an additional roller, which is intended to remove the last vestige of side shake (in a perfectly new unit properly set up as described in the previous paragraph, it should perform no useful function whatever). The duty of this roller is to take up any wear which may develop in the roller bearings during use, and so to ensure continual close meshing between the teeth on the azicator ring and those on the drive pinion; hence its location on the ring is diametrically opposite to the position at which the two pinions mesh (*fig.* 24).

63. The take-up roller is mounted upon an L-shaped lever, pivoted at the angle, and is maintained in contact with its track by a spiral spring. The roller should bear lightly upon the track with the spring only just in tension.

Miscellaneous details

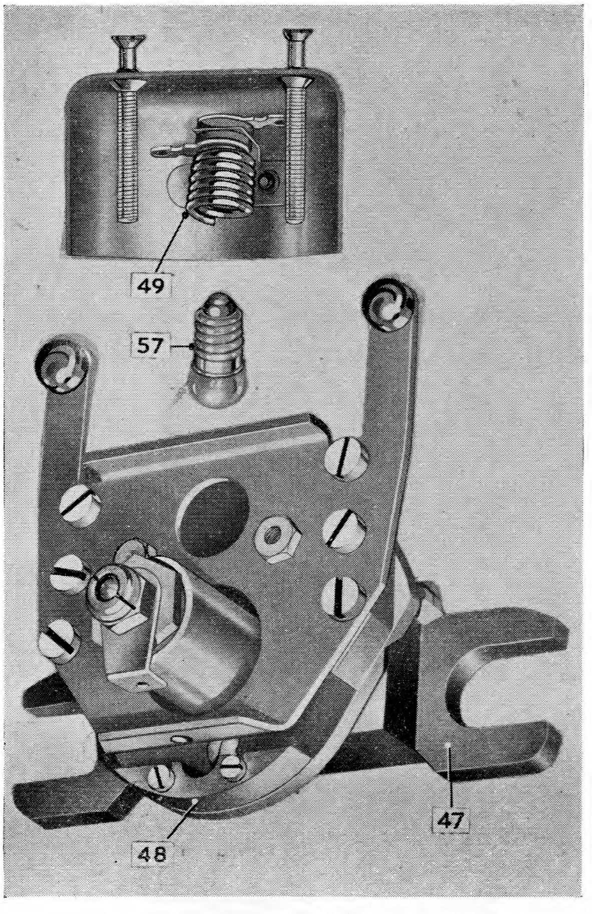
64. Fig. 27 shows details of the cursor carriage and lamp house, the latter being secured to the carriage by two captive screws, which must be eased off in order to change the lamp. The forked ends of the bronze base are here clearly shown, and also the channel in which the spring



11 AZICATOR DRIVE SHAFT
13 AZICATOR SELSYN
42 AZICATOR SELSYN COUPLING
43 AZICATOR DRIVE PINION, SMALL
44 AZICATOR DRIVING PINION, LARGE

Fig. 25. Azicator drive gearing

brush assembly for the cursor lamp circuit is fitted. The earthy body of the lamp holder has a soldering tag from which a short flexible lead is taken to the soldering tag on the centre pillar of the cursor carriage, which is integral with the bronze base electrically. The soldering tag on the centre contact of the lamp holder is connected by heavier insulated wire to the spring contacts which run on the cursor lamp slip ring.



47 CURSOR ASSEMBLY MOUNTING PLATE
48 BASE OF CURSOR ASSEMBLY
49 CURSOR LAMP-HOUSE ASSEMBLY
57 CURSOR LAMP

Fig. 27. Cursor carriage and lamp house

65. Fig. 28 shows a group of small components; at the top is a bracket 59 which carries the azicator manual drive shaft, the latter being mounted in ball bearings within the bracket. The pinion at the rear engages with a pinion on the selsyn shaft 11; another pinion on the latter engages with the toothed rim of the azicator ring as already explained.

66. Below this, on the left, is shown the assembly of an azicator ring support roller; the eccentricity of the assembly with respect to the centre bolt will be easily observed. On the extreme right are two compolastic packing pieces 58 which are used for the cursor seating.

67. Item 54 in fig. 28 shows one of the pillars carrying the positioning screws for the CRT mounting ring referred to in para. 42. When the indicating unit is completely assembled, the adjusting screw on each of the three pillars is accessible through a semi-circular aperture in the mu-metal screen, and the position of the mounting ring can be adjusted by the use of a long thin screwdriver as shown in fig. 29. As previously stated, these screws, and the complementary movement of the rear supporting bracket for the stem of the CRT, are adjusted before leaving the makers' works, and subsequent adjustment should not be necessary except after reconditioning.

SERVICING NOTES

Azicator jig

68. The azicator jig referred to in para. 60 consists of a metal bar which can be fitted horizontally across the azicator ring assembly by legs which are secured to the ring by captive 2BA screws. When the cursor is set to its normal radial position, this bar is perpendicular to the cursor lines. A second, shorter bar is rigidly secured to the first by pillars in such a manner that when in its normal position ready for checking the alignment, the cursor lies between the two bars. The upper bar is then just clear of the translucent screen. To fit the jig, the cursor must be swung sideways, as described in para. 43, before the jig is placed in position and secured; after this, the cursor is clicked back into the normal position.

69. Small circular apertures are drilled in the two bars, and when the cursor is properly aligned, the cross on the cursor will lie in the middle of the apertures, both being used for sighting to avoid parallax error. The cursor is then set up by means of the eccentric collars on the bolts holding the cursor carriage.

70. In detail, the procedure is as follows:—

(1) Check that the cursor registers accurately in the working position without sideplay.

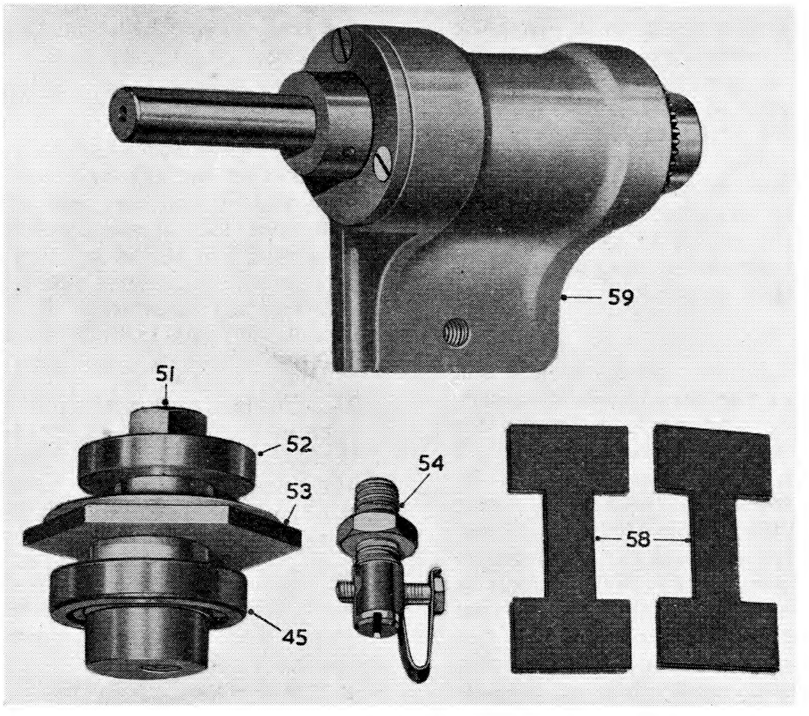
(2) Loosen the clamping bolts on each side of the cursor carriage, and adjust the eccentric collar until the square formed by the top engraved lines just frames the small hole in the lower bar of the jig.

(3) Tighten the clamping bolts finger-tight only, then check that the small hole is still framed by the square when the bottom line of the cursor appears central between the upper pair.

(4) Tighten the clamping bolts and recheck.

To remove the CRT

71. The CV2162 CRT has a fairly thick, nearly flat face. If it is necessary to remove a tube, a suitable container (preferably the packing case or carton in which the tube was supplied) should be prepared to receive it before commencing the operation. If this packing is not available, a



45 AZICATOR RING SUPPORT ROLLER
51 BOLT SECURING SUPPORT ROLLER ASSEMBLY
52 WASHER
53 HEXAGONAL MOUNTING PLATE FOR SUPPORT ROLLER
54 PILLAR CARRYING ADJUSTING SCREW
58 PACKING PIECES FOR CURSOR ASSEMBLY
59 BRACKET SUPPORTING CURSOR MANUAL DRIVE

Fig. 28. Miscellaneous small parts

box or carton packed with a soft material such as cotton wool or tow should be provided. If, however, it is necessary to place a tube upon the floor, it is preferable to stand it upright on its face on a level surface, rather than to lay it down resting upon the edge of the flare and base cap. Great care must be exercised to prevent the possibility of falling.

72. The method of removal is as follows:—

(1) Prepare a suitable container for the tube.

(2) Remove the outer spinning of the CR indicating unit by releasing four spring clamps.

(3) Turn the azicator to 185 deg. (cursor pointing upwards but slightly to the right) and rock the cursor over to the left, depressing the cursor stop to allow the cursor to swing quite clear of the tube face. Ensure that the cursor is locked by the stop. It may be necessary to move the azicator ring slightly to allow the cursor to enter the space provided for its stowage during the operation.

(4) Remove the top panel cover of the console (*see* Warning) and disconnect the EHT connector through the aperture provided in the screen. Care is necessary, as the cap is a tight fit and the glass seal carrying the EHT anode connection is somewhat fragile.

WARNING

Observe the DANGER notice stencilled on the chassis—

WAIT 3 MINUTES AFTER SWITCHING OFF BEFORE TOUCHING ANY EHT POINT.

(5) Remove the valve base cap, and release the spring clip on the strap round the stem of the CRT. The tube is then held only by the azimuth scale.

(6) Release the three captive screws holding the azimuth scale in place. The tube will come forward slightly with the scale (and mask) owing to the action of the rear seating ring. Push the tube forward from the rear until the front end can be grasped round the edge of the flare, and withdraw carefully.

(7) Place immediately in the container, if possible, otherwise stand up in a safe place as described above.

Lifting the indicating unit

73. The eye plates on the upper side members of the indicating unit must not be used to lift the indicating unit by such means as a four-tailed bridle, since the latter would tend to pinch the two side members together resulting in distortion of the chassis and consequent damage to the interior assemblies. A special lifting frame has been developed in order to provide the required stiffness; this must be fitted to the top of the indicating unit. A plate forming part of the lifting frame has a hole in which the hook of a lifting tackle can be engaged, the hole being immediately above the centre of gravity of the unit so that the latter remains in an approximately horizontal attitude when suspended.

74. In service installations, arrangements will normally be made for the attachment of a self-sustaining tackle (safe working load 5 cwt.) for lifting the indicating unit; in some installations, a conveyor beam with a small carriage will be fitted to carry the tackle so that the indicating unit can be moved clear of the console without lowering. In RVT.510, the conveyor beam and carriage are rated at 250 lb. maximum load. Where repair or servicing is performed other than on an actual installation site so fitted, it is recommended that in the absence of a conveyor beam, a mobile gantry of suitable height may be made available, the safe working loads of the equipment used being not less than those specified for use in RVT.510.

75. The lifting frame is fitted with handles, originally intended to facilitate the handling of the frame itself. In spite of the additional weight it has been found advantageous to fit the lifting frame so that these handles may be used for carrying, even where the unit is being handled manually.

76. During the operation of removing and replacing the indicating unit, it is necessary to exercise considerable care to avoid damage caused by allowing the unit to swing about and so come into violent contact with adjacent equipment. The need for especial care at certain stages is emphasized in the instructions which follow, but care and commonsense must be used during the whole of the operation. The instructions should be regarded as a guide to the order of procedure, and not as a drill to be followed automatically.

77. To facilitate the removal of the unit, the operators' desk is made in two portions, called the control desk and the desk unit respectively. The former is removable to permit the indicating unit to be lowered to floor level in front of the console without having to draw it too far forward.

78. Before commencing work on the console itself, all apparatus which may be in the way during the operation should be removed, e.g. the operators' seat. Where a conveyor beam or gantry is to be used, this equipment should be prepared for use. In any event some arrangement must be made for supporting the lifting tackle.

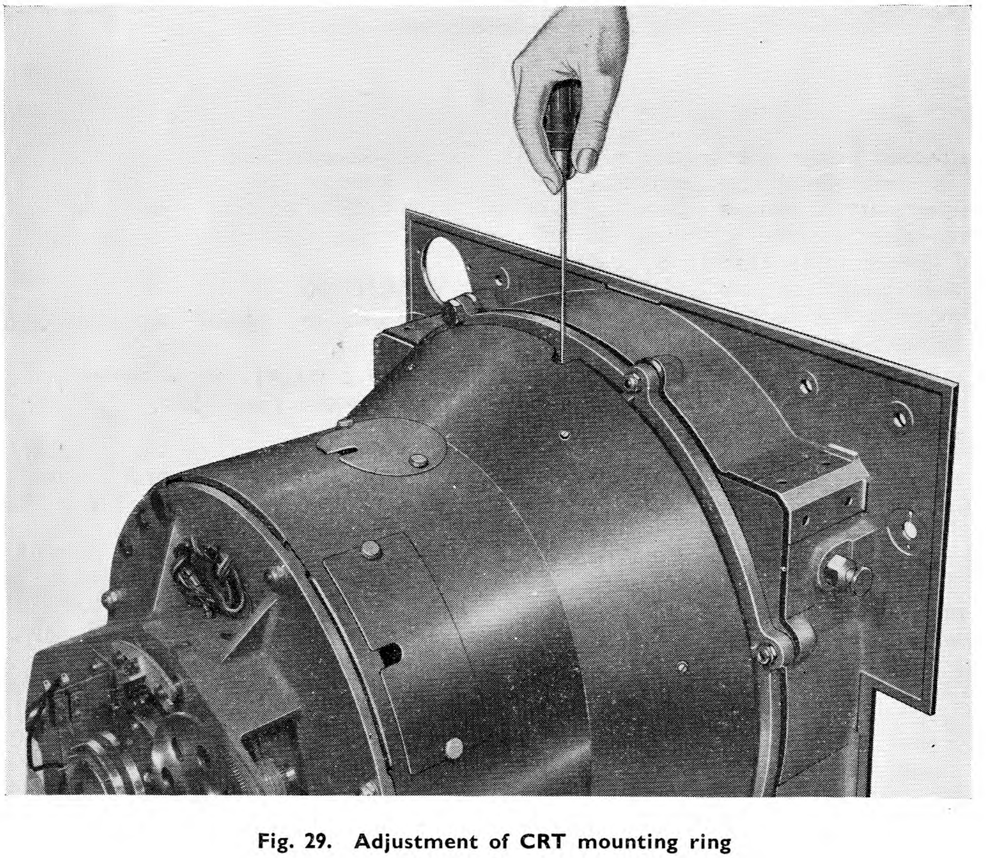


Fig. 29. Adjustment of CRT mounting ring

79. After ensuring that the power supply to the console is switched off external to the console, unplug the microphone from the desk unit and see that the lazy-tongs extension bracket holding the microphone is as close to the face of the unit as possible. During the whole of the operation, care must be taken to avoid damage to these parts. Unplug the coaxial socket carrying the indicating lamp circuit on the underside of the control desk, and all Jones and coaxial connections at the rear of the indicating unit. Then remove the control desk.

80. Using the handle provided, wind out the indicating unit to the full extent of the runners. Remove the lifting frame from its stowage position and fit it to the top of the indicating unit by means of the side pins, locking in position by means of the pip pins. This precaution must on no account be omitted. The front of the frame is easily recognised by the raised portion which is shaped to clear the flare of the mu-metal screen.

81. Attach the block of the lifting tackle to the U-bolt (or other attachment where this is not fitted) above the console, attach the hook of the tackle to the lifting frame, and pass the four parts of chain which hang free through one of the handles on the frame. This is to prevent the chains sliding down the top sloping edge of the frame when the unit is drawn forward at a later stage. If this occurs, it is possible that the chains will slide down the side of the unit and crash against the turning gear controls, or cause other damage to the console.

82. Take up the slack of the hoisting part of the chain, hold back the safety catches at the rear end of the indicating unit, and take the strain slowly upon the tackle. This must be done with caution, carefully controlling the manner in which the trunnions on the unit leave the brackets on the runners, since the rear end will tend to slew violently as soon as it is free owing to the twist in the chain. If any difficulty arises, suspend the lifting operation and investigate the cause.

83. The runners should be retracted into the console as soon as it is safe to do so, i.e. when the trunnions are clear and the weight fully taken by the tackle.

84. During the next stage it is most important to keep the indicating unit clear of the desk unit. One person should grasp the front of the indicating unit and haul it bodily forward so that it clears the desk unit, another person meanwhile attending the tackle and lowering the unit until it reaches the floor. The indicating unit may then be moved by hand, conveyor beam, or gantry, according to circumstances, great care being taken to prevent it swinging about and causing damage to itself or to other equipment.

85. The indicating unit is replaced in the console by following a similar procedure in reverse order. After it is placed in front of the console, it should be lifted as high as necessary by the lifting frame and tackle, taking care not to foul the desk unit. When the unit is fully hoisted, the console runners should be extended to receive the unit, and the latter slowly lowered and guided into position until the trunnions engage with the slots in the runners; the safety catches must be held back to permit entry. When fully supported, the lifting gear may be removed and the runners retracted. The control desk, supplies, etc., should then be replaced and the console tested functionally as soon as possible after fitting.

Replacement of scale lamps

86. When renewing the scale lamps, care must be taken not to bend or otherwise distort the brackets carrying the scale lamp holders. These brackets are of light construction and are held in position by two screws (*fig.* 24 and 26). If distorted, there is a possibility that the bracket may foul the cursor mounting.

Lubrication

87. All ball and roller bearings in the indicating unit are normally packed with a silicone grease to Specification D.T.D.825. This grease will not mix with any lubricant of mineral or vegetable origin. If any greasing is necessary the parts concerned may be treated lightly with the above-named lubricant, but on no account is any other to be used.

88. The parts principally affected are:—

(1) the ball bearings carrying the azicator ring support rollers;

(2) the roller bearing at the front end of the deflection coil assembly;

(3) the ball bearing at the rear end of the deflection coil assembly.

TABLE I

List of annotations

Note.—*The numbers in brackets refer to the illustration or illustrations in which the components are annotated*

1 Spider casting (12, 13, 14)
2 Mu-metal screen (9, 11, 12)
3 Back plate casting (12, 14)
4 CRT mounting ring, carrying spring lining ring (12, 15)
5 Front casting (12)
6 Azicator ring assembly (11, 12, 14)
7 Off-centring coil mounting pinion (10, 12, 22)
8 Centring coil mounting plate (10, 12, 22)
9 Deflection coil tube assembly (10, 12, 14, 19, 20)
10 Centring coil assembly (10, 12)
11 Azicator drive shaft (12, 13, 25)
12 Deflection coil selsyn (10, 12, 17, 18, 19, 20, 21)
13 Azicator selsyn (12, 17, 25)
14 Deflection coil brushes and brush mounting (12, 17, 19, 20, 21)
15 Deflection coil slip rings (10, 12, 17, 20, 21)
16 Auto-align contact assembly (12, 19, 20, 21)
17 Deflection coil drive gearing (12, 14)
18 Indicating unit framework (9, 11)
19 Azicator assembly balance weight (9, 11, 16, 24)
20 Cursor mounting assembly (9, 11, 16, 26)
21 Azicator drive gearing (12, 14)
22 (a) left-hand and (b) right-hand cursor stops (16, 24, 26)
23 Translucent screen for scale lights (16, 24)
24 Trace-reversing contacts (12, 22)
25 Leads to centring coil assembly (17)
26 Auto-align cam (21)
27 Centring coil windings (19)
28 Centring coil yoke (28)
29 (a) and (b), split collars securing coupling plate to shaft (18)
30 Deflection coil drive, first pinion (small) (18, 19, 20)
31 Deflection coil drive, second pinion (large) (17, 18, 19, 20, 21)
32 Deflection coil drive, third pinion (small) (18, 19, 20)
33 Deflection coil drive, fourth pinion (large) (18, 19, 20)
34 Plate coupling between selsyn shaft and first pinion (18, 19, 20, 21)
35 Trunnion mountings (9, 11, 17)
36 Trace-reversing cam (22)
37 Off-centring pinion drive and mounting (12, 22)
38 Scale lamp holders (24)
39 Azicator ring take-up roller and spring (24, 26)
40 Azicator ring final drive (13, 24)
41 Slip-ring for cursor lamp (16, 24, 26)
42 Azicator selsyn coupling (25)
43 Azicator driving pinion (small) (25)
44 Azicator driving pinion (large) (25)
45 Azicator ring support roller (26, 28)
46 Bolts holding cursor on azimuth ring (26)
46a Hexagon-headed collars on item 46 (26)
47 Cursor assembly mounting plate (26, 27)
48 Base of cursor assembly (26, 27)
49 Cursor lamp-house assembly (26, 27)
50 Cursor (26)
51 Bolt securing support roller assembly (15, 18)
52 Washer on bolt 51 (28)
53 Hexagonal mounting plate for support roller (28)
54 Pillar carrying adjusting screw for item 4 (15, 28)
55 Screw attaching CRT mounting ring to front casting (15)
56 Spring support for lining ring (15)
57 Cursor lamp (27)
58 Packing piece for cursor assembly (28)
59 Bracket supporting manual cursor drive (28)
60 Holes for CRT support bracket (17)
61 Capacitor C58 (6)
62 Capacitor C59 (6)
63 Fuse holder for power unit fuses (6)
64 Strap securing CRT stem (6)
65 CRT stem (10)
66 CRT base cap (international octal) (6)
67 Terminal block for centring coil leads (6)
68 Centring control No. 1 (2, 6, 7)
69 Centring control No. 2 (2, 6, 7)
70 Cursor dimmer (7)
71 Off-centre azimuth and sector control (2, 6, 7)
72 Auto-align relay (7)
73 EHT rectifying valve (7)
74 Capacitor C60 (2, 6, 7)
75 Capacitor C58 (7)
76 Transformer TR4 (7)
77
78 Off-centre amplitude control (2, 6)
79 Capacitor C57 (6)
80
81 Cover plate for access to azicator sub-scale lamp (4)
82 Resistor R165 (5)
83 Resistor R167 (5)
84 Resistor R169 (5)
85 Resistor R170 (5)
86 Resistor R173 (5)
87 Valve V27 (DC restorer) (5)
88 Resistor R172 (5)
89 Capacitor C55 (5)
90 Resistor R188 (5)
91 Resistor R171 (5)
92 Resistor R168 (5)
93 Resistor R166 (5)
94 Azicator manual control handle (2)
95 IFF strobe control (2)
96 Brilliance control (2)
97 Focus control (2)
98 Cursor align button (with cover removed) (2)
99 On/off switch (2)
100 Off-centring coil assembly (10, 23)
101 Off-centring coil slip-rings (10)
102 Trace-reversing cam slip-rings (10)
103 Capacitor C56 (6, 7)
104 Front mounting plate (part of framework, item 18) (11)

TABLE 1—*continued:*—

105 Azicator sub-scale (2)
106 Drum carrying slip-rings, items 101 and 102 (10, 23)
107 Deflection coil winding (23)
108 Brushes for off-centring coils and trace-reversing contacts (23)
109 Brake on deflection coil selsyn (5)
110 EHT multiplier unit (6, 7)
111 MR9 (5)
112 Resistor R187 (4)
113 Leads for RV15 (4)
114 Resistor R182 (4)
115 Resistor R181 (4)
116 Resistor R162 (4)
117 Resistor R186 (4)
118 Resistor R180 (4)
119 Resistor R179 (4)
200 Resistor R178 (4)
201 Resistor R177 (4)
202 Resistor R176 (4)
203 Resistor R175 (4)
204 Resistor R174 (4)
205 Resistor R183 (4)
206 Resistor R184 (4)
207 Resistor R214 (4)
208 Capacitor C70 (4)
209 Resistor RV16 (4)

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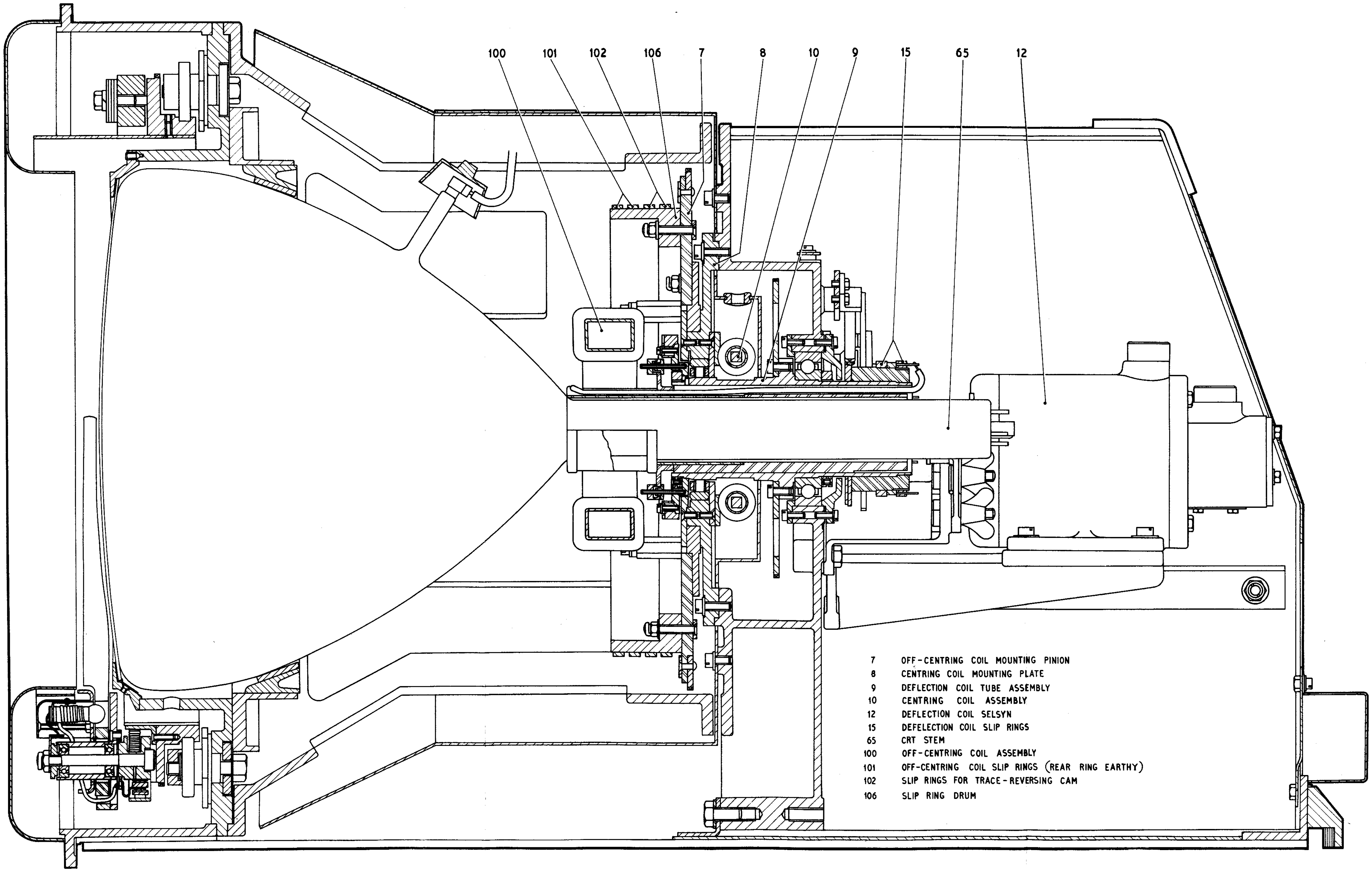

7	OFF-CENTRING COIL MOUNTING PINION
8	CENTRING COIL MOUNTING PLATE
9	DEFLECTION COIL TUBE ASSEMBLY
10	CENTRING COIL ASSEMBLY
12	DEFLECTION COIL SELSYN
15	DEFELECTION COIL SLIP RINGS
65	CRT STEM
100	OFF-CENTRING COIL ASSEMBLY
101	OFF-CENTRING COIL SLIP RINGS (REAR RING EARTHY)
102	SLIP RINGS FOR TRACE-REVERSING CAM
106	SLIP RING DRUM

Fig. 10 Indicating unit CRT Type 30. Section showing general assembly of centring and off-centring coils Fig. 10

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Chapter 4

POWER UNIT TYPE 742

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LIST OF ILLUSTRATIONS

Circuit description

1. The circuit diagram of the power unit Type 742 is given in fig. 1, which is placed at the end of the chapter for ease of reference. The unit receives an AC supply from 230-volt, 50 c/s mains. This power is connected to the input panel of the console at Jones plug P, points 7 and 8, and passes through the double-pole switch SW17 at the rear of the indicating unit, the switch SW16 on the indicating unit itself, and the switch SW15, associated with the top panel of the console, before reaching the power unit at Jones plug A, points 1 and 2.

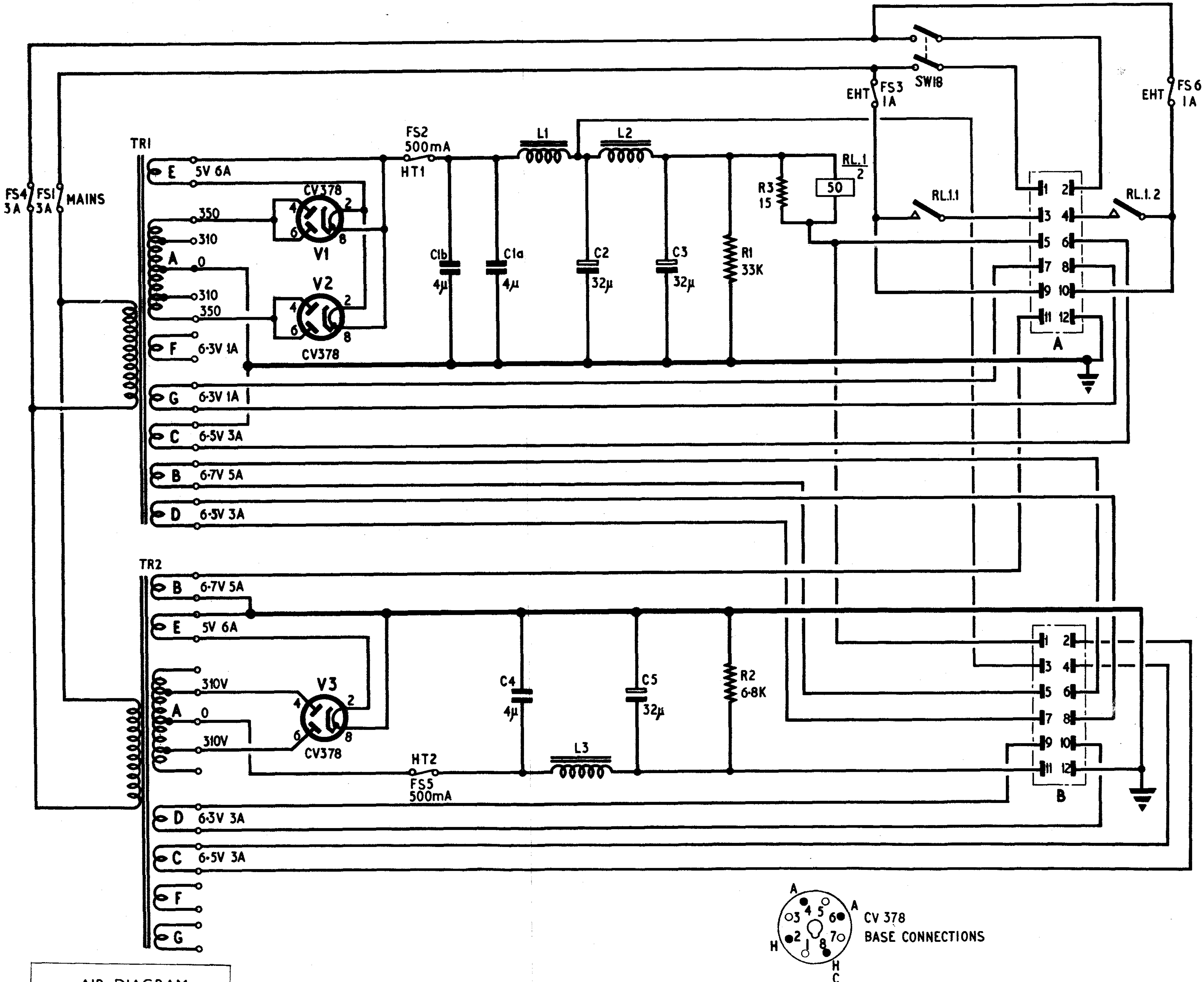
2. After entering the power unit, the circuit continues through a double-pole switch SW18 and then divides into two branches, the first being that which supplies the EHT power pack in the indicating unit. This branch passes through the double-pole fuses FS3, FS6 (marked EHT), and then again branches into two parts. One of these passes directly to points 9 and 10 on Jones plug A, and feeds the heater transformer TR3 of the EHT power pack. The other passes through the two contacts of relay REL 1, in the power unit, and then goes to points 3 and 4 on Jones plug A; from the latter, the circuit is continued into the indicating unit, where it feeds the EHT rectifier transformer TR4.

3. The second branch of the main circuit passes through the fuses FS1 and FS4 (marked MAINS) and then feeds the primaries of the two transformers TR1 and TR2, in the power unit. These transformers are identical in design; each has one centre-tapped HT winding, lettered A, one 6·7-volt winding, lettered B, one 6·5-volt winding lettered C, one 5-volt winding, lettered E, and three 6·3-volt windings, lettered D, F and G. The HT winding is tapped at 310 volts each side of the centre tap; the full voltage across each half is 350 volts.

4. A schematic diagram showing the distribution of the power supplies from the transformers TR1 and TR2 in the power unit is given in fig. 2 (also placed at the end of the chapter). This diagram also shows the distribution from the transformers TR3 and TR4 in the indicating unit Type 30. The following paragraphs 5-12 should be read in conjunction with this diagram.

TR1 outputs

5. The HT winding of transformer TR1 is set to the 350-volt taps, and the latter are connected to the CV378 rectifying valves, V1, V2, (CV378) in a full-wave rectifying circuit. The filaments of these valves are fed in parallel from secondary E. A positive output is required from this rectifier, and is therefore taken from the cathode side of the rectifier, through the fuse FS2 (marked HT1), to the main reservoir capacitance; this consists of condensers C1a, C1b, each of 4 μF.



AIR DIAGRAM
6111F/MIN.

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

Power unit Type 742, circuit
Consoles Type 60 & 60A

Fig. 1
(A.L.5 Sep.55)

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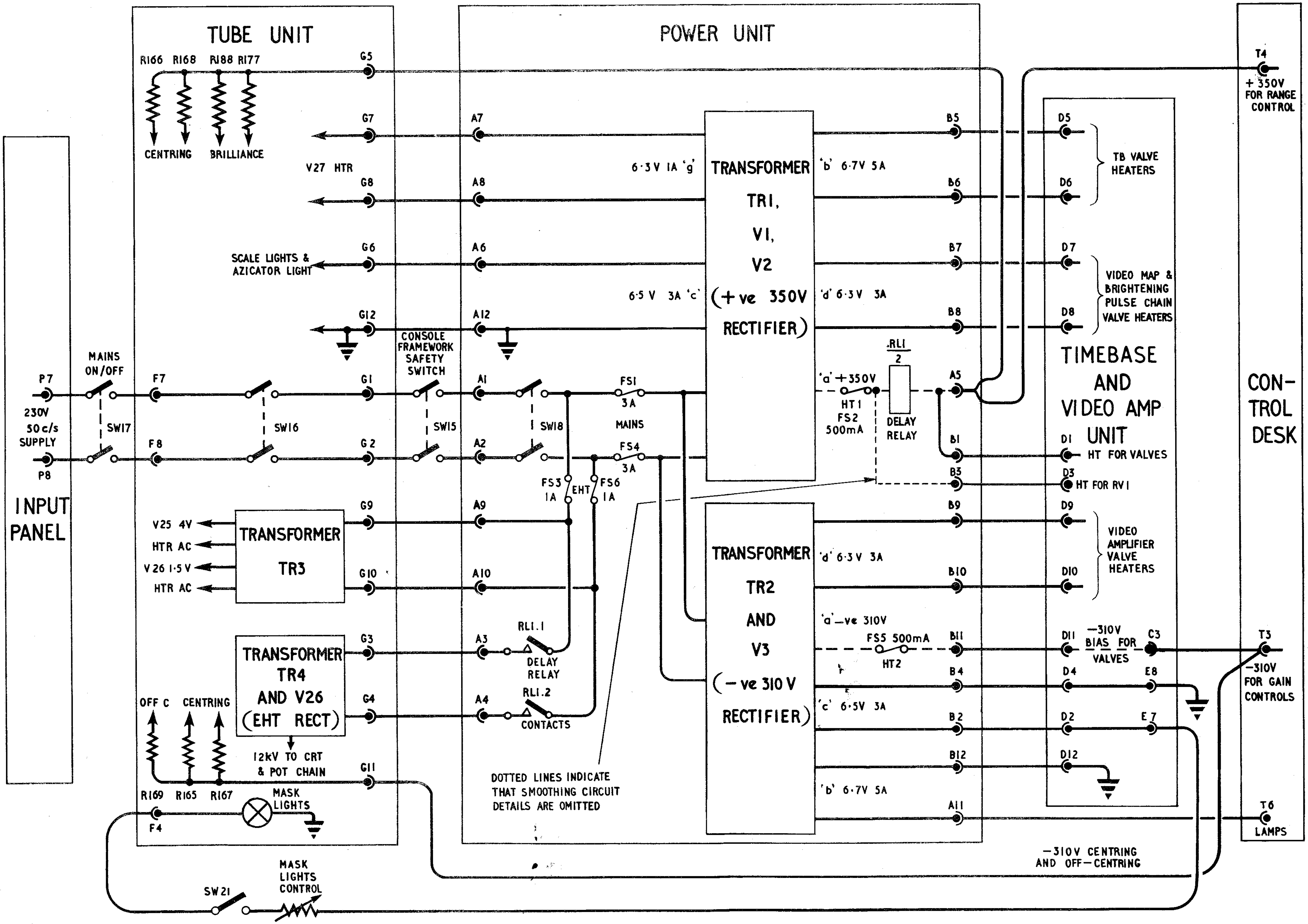


AIR DIAGRAM 6111G/MIN.

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

Console Type 60 Power supply system wiring schematic

Fig. 2

(A.L.6, Oct. 57)

6. The DC output from the reservoir capacitance is taken through a low-pass filter consisting of two iron-core chokes, L1, L2 and two 32 μF electrolytic condensers C2, C3, the latter being shunted by a bleeder resistor R1 (33 K). The junction of L1 and L2 is connected to point 3 on Jones plug B; this point is at about 360 volts DC to earth, and is used to feed the SCAN CENTRE control of the time-base unit through point 3 on Jones plug D.

7. The output end of L2 is connected through the winding of relay REL1 and its 15-ohm shunt to point 5 on Jones plug A, and point 1 on Jones plug B. The latter point is connected to point 1 on Jones plug D, in the timebase unit, and feeds the 350 volt HT rail on the latter unit. Point 5 on Jones plug A is connected to point 4 on Jones plug T, on the control desk, where it feeds the RANGE control. It is also connected to Jones plug G (point 5) on the indicating unit, where it feeds the BRILLIANCE control and the positive side of the centring coils.

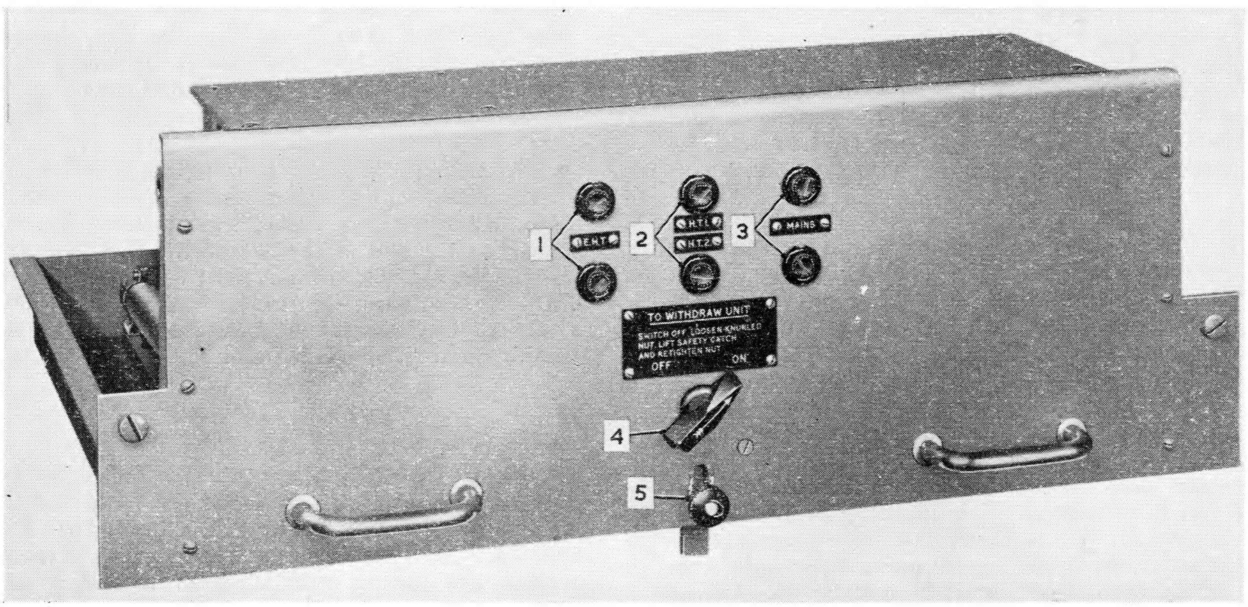
8. Winding B on transformer TR1 is taken to Jones plug B, points 5 and 6. These are connected to Jones plug, points 5 and 6, in the timebase unit, and feed the heaters of the valves in the timebase chain. Similarly, winding D feeds the video map (azimuth information) and cathode modulation (brightening pulse) chain valve heaters, via points 7 and 8 on Jones plug B (power unit) and corresponding points on Jones plug D (timebase unit). Winding C has one side connected to point 12 on Jones plug A, which is earthed, and the other connected to point 6 on Jones plug A; this lead feeds the scale lamps and azicator cursor lamp, on the indicating unit, via Jones plug G, point 6.

9. Winding E has been dealt with in para. 4, winding F is not used, and winding G feeds the heater of the DC restorer diode V27, in the indicating unit, via Jones plug A, points 7 and 8, and correspondingly numbered points on Jones plug G of the indicating unit.

TR2 outputs

10. The HT winding of the transformer TR2 is set to 310 volts, and the tappings are connected to the two anodes of the CV378 full-wave rectifying valve V3. The filament of this valve is fed from the 5-volt winding E on the same transformer, and the cathode is earthed, since a negative output is required. The centre tap on the transformer is connected through the fuse FS5 (labelled HT2) to the reservoir condenser C4, and the output is smoothed by the low-pass filter L3, C5; the latter condenser is shunted by a bleeder resistor R2. The negative 310-volt output is taken to point 11 on Jones plug B, and thence to point 11 on Jones plug D in the timebase unit. This is the feed to the negative bias rail. Point 11 on Jones plug D is also connected directly to point 3 on Jones plug C in the timebase unit, and from the latter point a negative 310-volts supply is taken into the indicating unit at point 11 on Jones plug G, via point 3 on Jones socket T; this supply feeds the negative end of the centring coil chain, and also the off-centring coils. The supply entering the control desk at Jones plug T, point 3, feeds the video, cal., and strobe gain controls.

11. The winding B is connected to point 11 on Jones plug A, from whence it is taken to Jones plug T, point 6, on the control desk, for the turning gear control and desk lights. Winding D is connected to points 9 and 10 on Jones plug B; these are connected to similarly numbered points on Jones plug D in the timebase unit, where they feed the heaters of the valves in the video amplifier chain. Winding C feeds the mask lights on the



1 EHT FUSES
2 HT1 FUSE (UPPER) AND HT2 FUSE (LOWER)
3 MAINS FUSES
4 ON/OFF SWITCH, INTERLOCKED WITH LATCH 5
5 LATCH SECURING POWER UNIT IN PLACE

Fig. 3. Power unit, front panel

indicating unit, via the mask light control, the lead being taken through the timebase unit for convenience of wiring. Windings F and G on this transformer are not used.

Constructional details

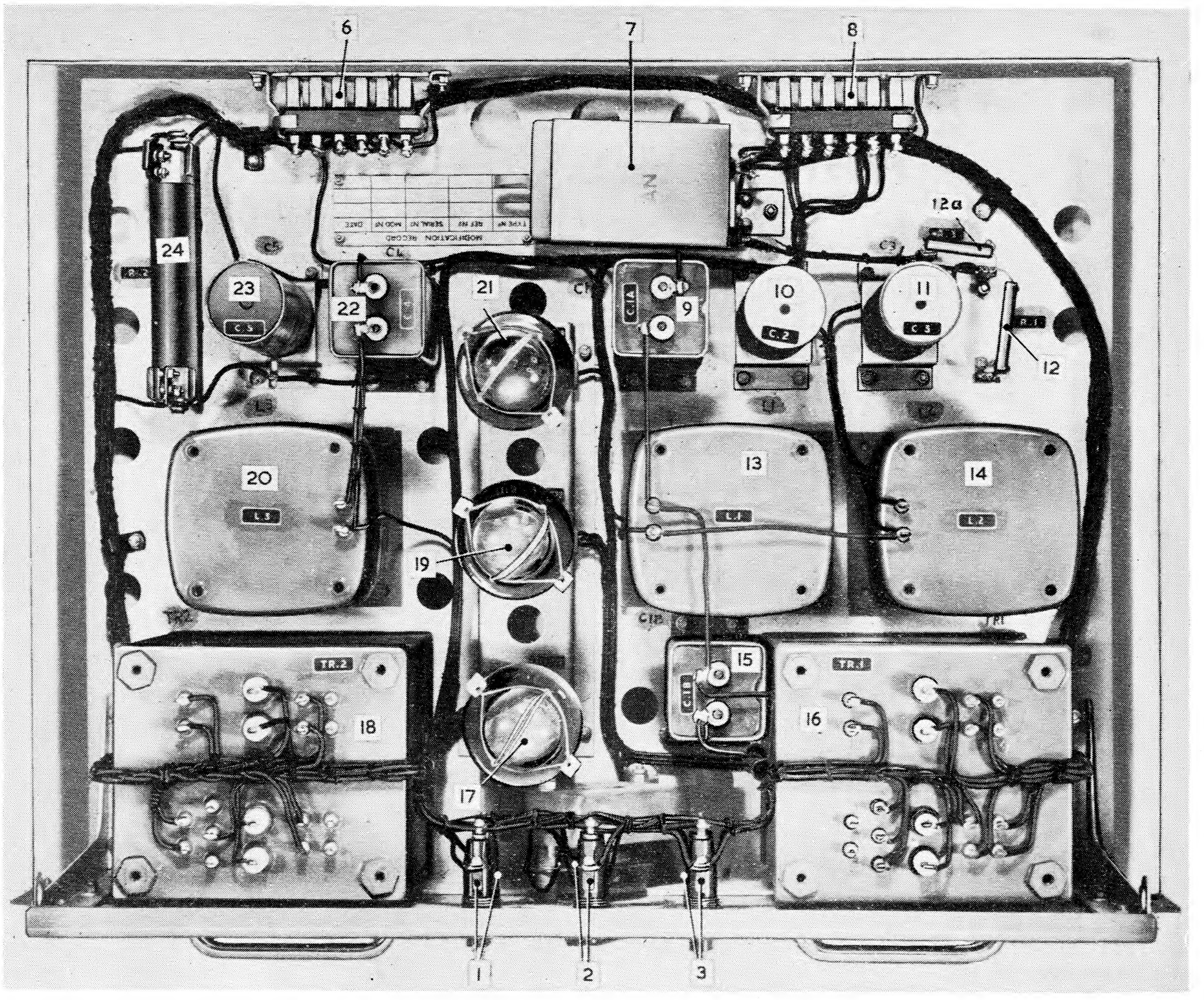
12. Fig. 3 is a front view of the power unit, showing the EHT fuses, the HT1 and HT2 fuses, and the mains fuses on the panel; spare fuses are housed in the indicating unit Type 30. The safety switch SW18 is associated with a latch at the bottom of the panel; this latch can be held in the "open" position by tightening a knurled nut shown in the photograph. The safety switch cannot be moved either way, unless the latch is down. Thus, when the power unit is in its normal position and the console is in operation, the power unit cannot be withdrawn unless the following steps are taken:

(1) Move safety switch to OFF.

(2) Loosen the knurled nut, and using it as a handle, lift the latch.

(3) Tighten the knurled nut.

The power unit and timebase unit may then be withdrawn together, as described in Chapter 2 of this Section, and the timebase unit either lifted to expose the power unit, or removed entirely.



1 EHT FUSES
2 HT FUSES
3 MAINS FUSES
6 JONES PLUG B
7 EHT POWER UNIT RELAY (REL.1)
8 JONES PLUG A
9 CONDENSER C1A
10 CONDENSER C2
11 CONDENSER C3
12 RESISTOR R1
12a RESISTOR R3
13 CHOKE L1
14 CHOKE L2
15 CONDENSER C1B
16 TRANSFORMER TR1
17 VALVE V3
18 TRANSFORMER TR2
19 VALVE V2
20 CHOKE L3
21 VALVE V1
22 CONDENSER C4
23 CONDENSER C5
24 RESISTOR R2

Fig. 4. Power unit, top view

13. If it is then desired to operate the console, e.g. for testing the power unit under working conditions, it will be found impossible to move the safety switch to ON, unless the knurled nut is loosened, and the latch dropped. Similarly, the unit cannot be forced fully home in its working position in the console, unless the safety switch is moved to OFF, and the latch lifted. When fully home, it is necessary to drop the latch, in order to move the switch back to ON.

14. All components of the unit are mounted on the upper side of the chassis, as shown in fig. 4. A guard plate is fitted over the front end of the chassis, but this was removed before taking the photograph as it obscures the view of the two transformers, the valve V3, and the fuse-holders. The plate is secured by screws which engage with the threaded holes at the corners of the two transformers. Care must be taken to replace this plate before returning the unit to the working position, if for any reason it is removed.

Regulation

15. The variation of the output voltages with varying loads is shown in fig. 5. For any given output current, the output voltage should be within ten per cent. of that shown by the graph.

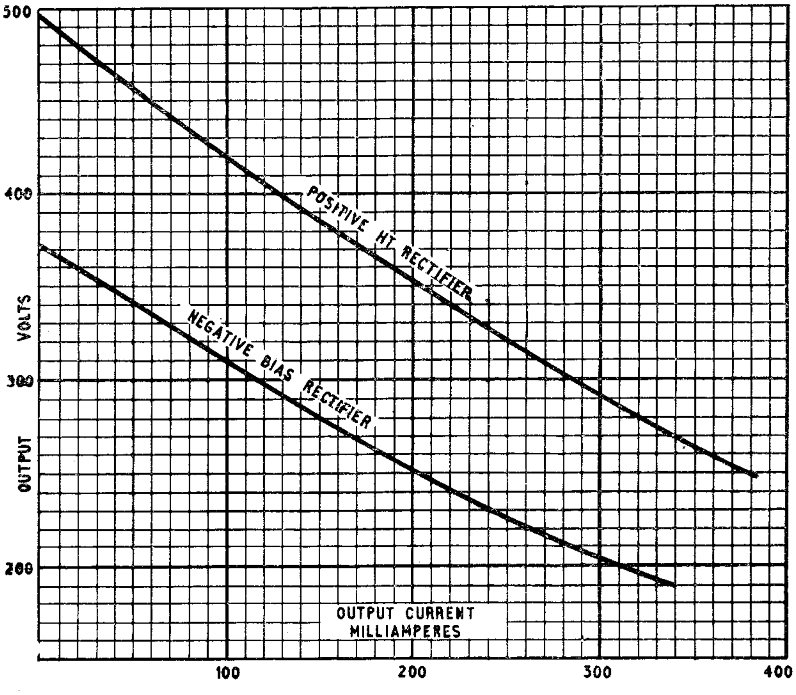


Fig. 5. Regulation curves

TABLE I

LIST OF ANNOTATIONS

Note *The figures in brackets refer to the illustration in which the component is annotated.*

1	EHT fuses (3) (4).
2	HT1 (upper) and HT2 (lower) fuses (3) (4).
3	Mains fuses (3) (4).
4	On/off switch, interlocked with latch 5 (3).
5	Latch securing power unit in place when power is switched on (3).
6	Jones plug B (4).
7	EHT power unit relay (REL1) (4).
8	Jones plug A (4).
9	Condenser C1A (4).
10	Condenser C2 (4).
11	Condenser C3 (4).
12	Resistor R1 (4).
12a	Resistor R1 (4).
13	Choke L1 (4).
14	Choke L2 (4).
15	Condenser C1B (4).
16	Transformer TR1 (4).
17	Valve V3 (4).
18	Transformer TR2 (4).
19	Valve V2 (4).
20	Choke L3 (4).
21	Valve V1 (4).
22	Condenser C4 (4).
23	Condenser C5 (4).
24	Resistor R2 (4).

Chapter 5

CONTROL CIRCUITS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Turning gear control panels

1. A front view of the turning gear control panel is shown in Fig. 1. On console Type 60, one of these panels is mounted on each side of the console framework, so that where the console is used for putting-on purposes in conjunction with a radar Type 13, one set of controls can be used for the latter, and the other for the aerial system supplying the PPI display.▶◀

2. The turning gear control panel carries two potentiometers, a four-position switch, and a translucent screen upon which an image of part of an azimuth scale is projected by means of the optical system described in para, 12-21.

3. The knob labelled TURNING CONTROL operates the four-position switch, which is of the wafer type. The positions are marked:—

(1) POSITION CONTROL.

(2) SECTOR SWEEP.

(3) CLOCK } CONT. ROT. (i.e. clockwise
(4) ANTI-CLOCK } or anti-clockwise continuous rotation).

4. When the switch is set to POSITION CONTROL the aerial can be laid on a bearing by rotating the hand-wheel fitted on the same side of the console as the turning gear control panel, just below the control desk. The bearing upon which the aerial is laid is indicated upon the translucent screen fitted in the circular aperture below the switch knob. The optical projector lamp associated with this screen is illuminated only when the switch is at POSITION CONTROL.

Note . . .

Safety devices are fitted to the position control hand-wheel and the turning control switch, to prevent the aerial being turned while personnel are working on the aerial vehicle or in its immediate vicinity. Details are given in Chap. 3, para. 10 of Part 1.

5. When the switch is at SECTOR SWEEP, the sector swept by the aerial is controlled by the knob marked SWEEP ANGLE, as described in para. 7-10. The sweep angle scale is only illuminated when the switch is in the SECTOR SWEEP position. Sectors up to 120 deg. of arc can be swept in this manner. The sweep angle scale is filled in with red material, so correlating its reading with the speed scale as explained below.

6. The speed of the sweep, both at SECTOR SWEEP and CONT. ROT., is controlled by the knob marked SPEED, subject to an interlocking action described later. The speed scale is illuminated when the switch is at SECTOR SWEEP, or at either of the CONT. ROT. positions. The scale engravings are filled in two colours, the red scale indicating the speeds on SECTOR SWEEP, and the green scale showing the speed on CONT. ROT.

Interlocking action

7. The knob of the SWEEP ANGLE potentiometer drives the wiper on the potentiometer through a short shaft upon which is mounted a translucent dial bearing a scale of degrees, numbered from 0 to 120 at 20 deg. intervals. The shaft is geared to a free-running gear on the shaft of the SPEED control potentiometer through an idler pinion.

8. The knob of the SPEED potentiometer drives the wiper of the lower potentiometer through a short shaft upon which is mounted a translucent dial bearing the speed scale, graduated in r.p.m., the green scale reading from 0 to 6, and the red scale from 0 to $2\frac{3}{4}$. The shaft also carries a metal disc, firmly secured to the shaft by a grub screw. A portion of the circumference of this disc is cut away (fig. 2), and a metal pin carried by the free-running gear (para. 7) protrudes into the cut-away arc in such a manner that the gear is driven only when the end of the cut-away bears against the pin, in either direction of travel.

9. This arrangement causes the SWEEP ANGLE and SPEED controls to be interlocked in such a manner that when sweeping a small arc, the speed of sweep cannot be excessive. For example, with the SWEEP ANGLE control set to 20 deg., the speed can be varied between zero and 1 r.p.m., If the SPEED control is further advanced, the end of the cut-away in the disc bears against the pin, and rotates the gear on the SPEED control shaft; this in turn rotates the SWEEP ANGLE control in such a direction that the sweep angle is increased.

10. Similarly, if a wide angle is being swept at maximum speed, and the angle is reduced by the SWEEP ANGLE control, the speed is maintained until the edge of the cut-away arc bears against the pin; at this point the SPEED control is rotated in such a direction that the speed is reduced.

11. The two dials are secured to their respective shafts by grub screws in the mounting flanges. Each dial may be adjusted by slackening the appropriate grub screw, turning the dial as requisite and re-tightening the screw. The idling pinion is secured on its shaft by a hexagonal nut. The angle of free sweeping (i.e. over which no interlocking occurs) can be adjusted by slackening off this nut, and re-meshing the gear train until the shafts are at the required relative setting. The nut is then re-tightened.

WARNING

> **The above adjustments are made during manufacture and should not require subsequent attention unless the whole unit is removed for repair, or in some similar contingency.**

Optical projection system

12. The principle of the optical projection system is described in Part 1, Chap. 1 of this Volume. Each of the two turning gear control selsyns is fitted with this device, by which an image of the azimuth scale fitted in the optical unit is projected upon the translucent screen at the bottom of the control panel when the TURNING CONTROL is set to POSITION CONTROL. The principal features of the left-hand optical unit are shown in fig. 3, 4 and 5. The mechanism of the unit is housed in a metal casting, one end of which is fitted with a removable cover plate (not shown in the illustration) to give access for cleaning and adjustment. The selsyn is mounted at the opposite end with its rotor shaft extending into the interior of the casting.

13. The selsyn rotor shaft carries a transparent disc, engraved with an azimuth scale. A transparent cursor, engraved with a cursor line, is mounted close up to the scale, so that the scale and cursor line are practically in the same plane. Only a short length of the scale is projected on the translucent screen. The optical arrangements are as shown in fig. 2 of Chap. 1, Part 1.

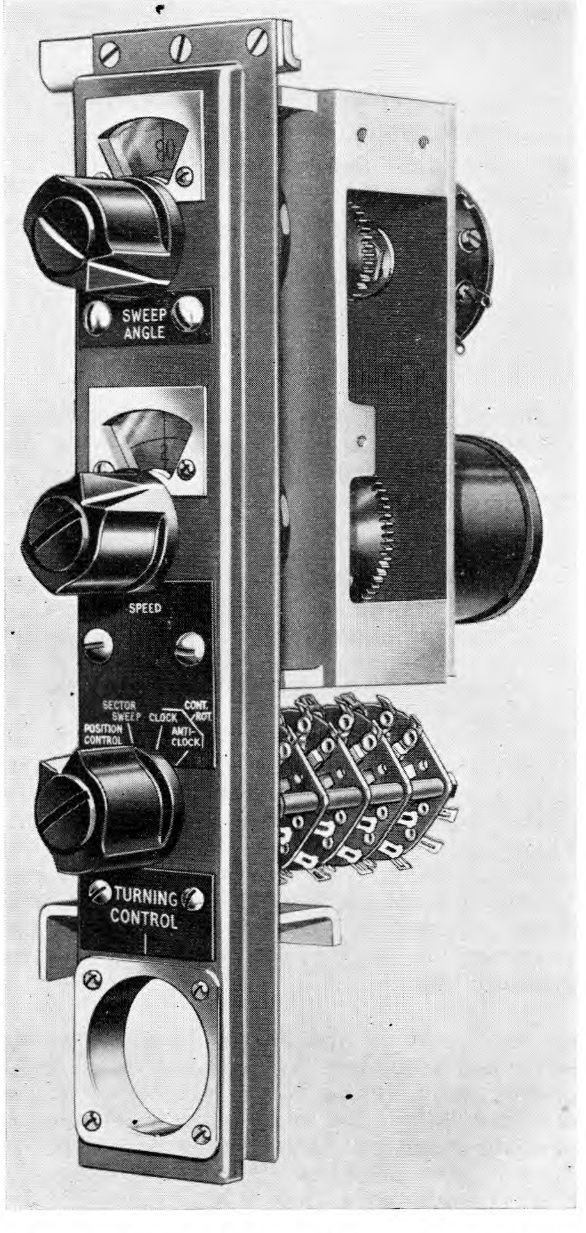


Fig. 1. Turning gear control panel, front view

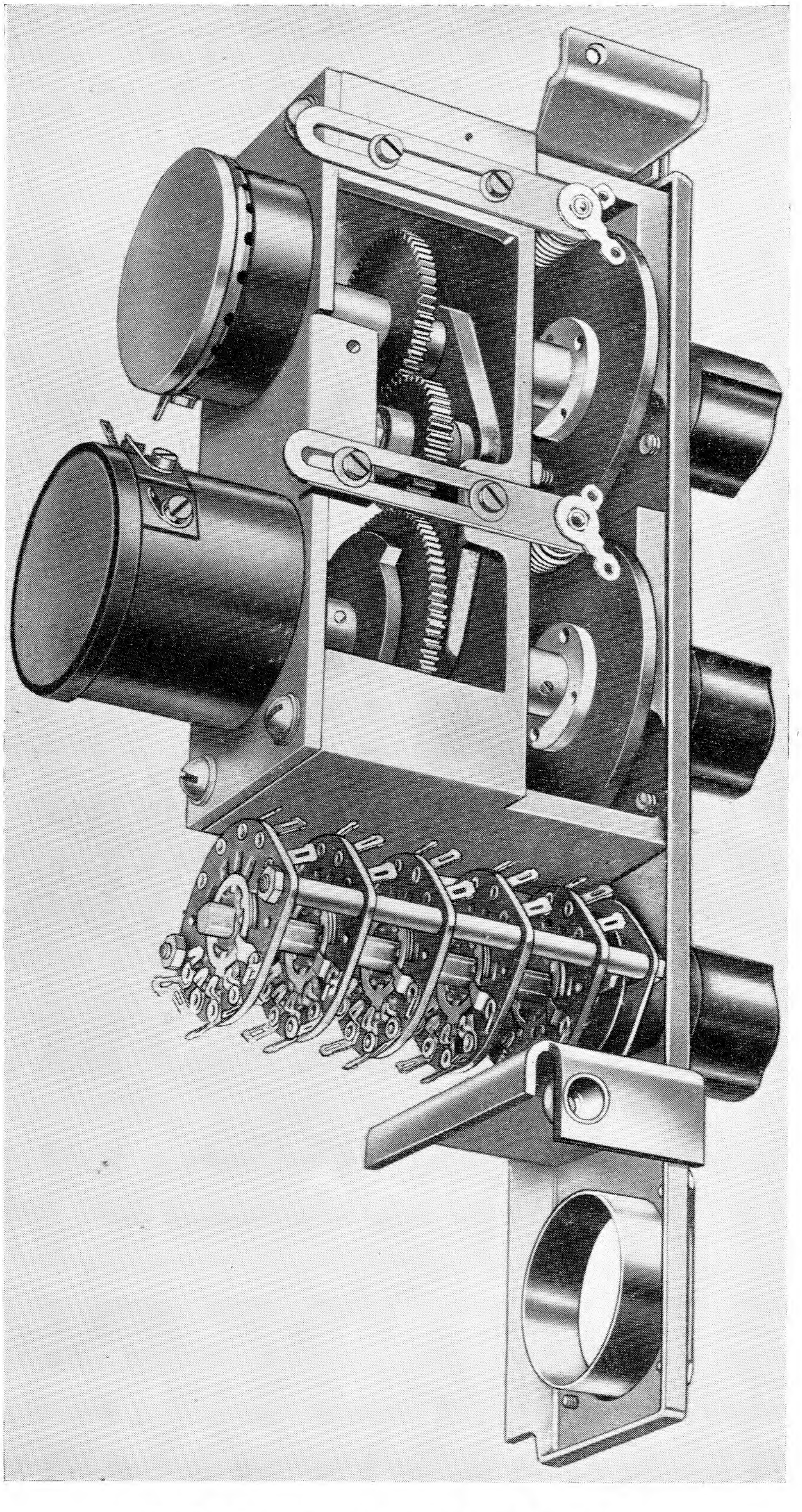
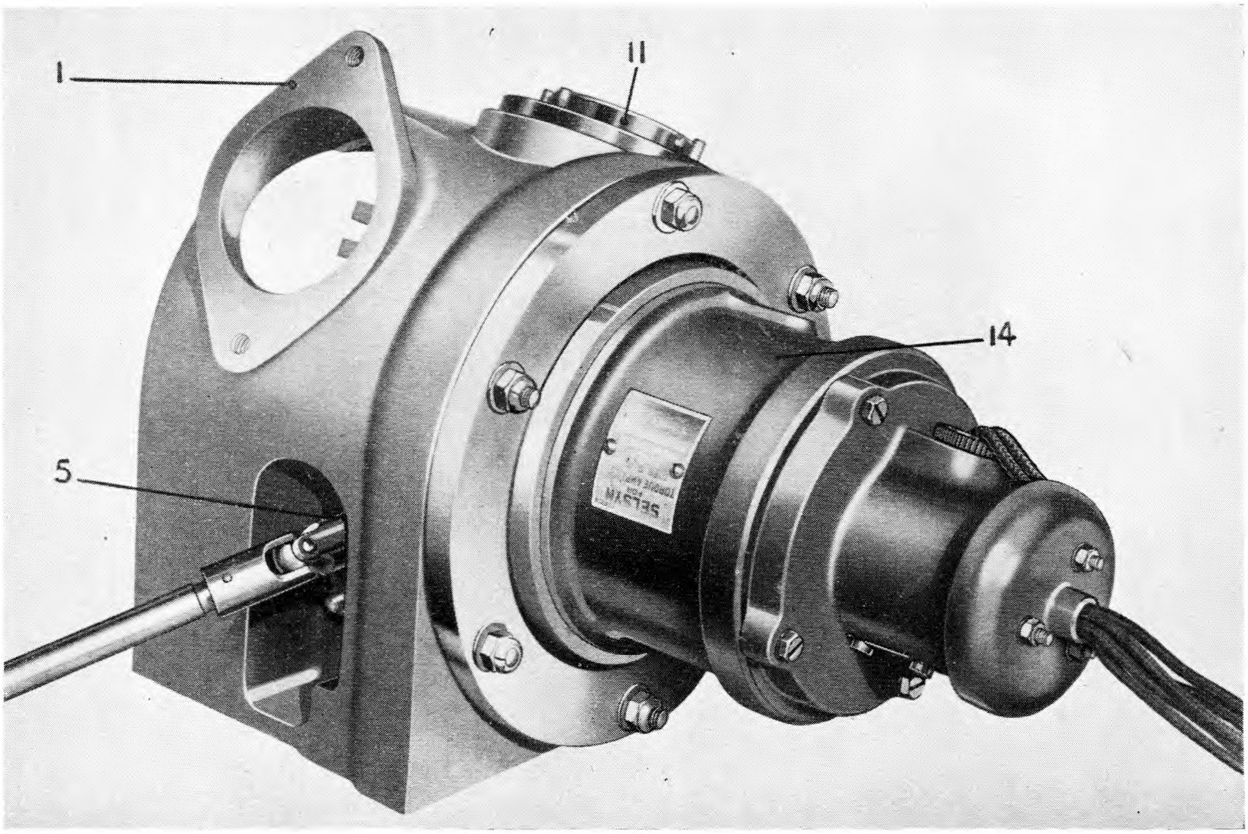


Fig. 2. Turning gear control panel, rear view

14. Referring to fig. 5, the pre-focused lamp and first prism assembly is a detachable unit which is mounted on the upper portion of the casting. It contains a special projection lamp and a condenser lens, assembled and pre-focused. After passing through the condenser lens, the beam of light from the lamp enters the first prism, mounted at the inner end of the pre-focused assembly, and is thus turned through 90 deg., emerging from the prism in a direction parallel to, and vertically above, the selsyn rotor shaft. This beam is directed outwards, away from the selsyn, and passes through the bearing scale and cursor mentioned in the previous paragraph.

15. The beam then reaches the second prism, where it is again deflected through 90 deg., into a lens which focuses the image of the scale and cursor sharply upon the screen. After passing through this lens, the beam leaves the interior of the casting, reaching the screen through a tube. It is important that the whole of the optical system is light-tight, so that the only light reaching the rear of the screen is that which originates at the projector lamp.



1 FLANGE FOR PROJECTOR TUNNEL
5 FRONT BEARING FOR CONTROL SHAFT
11 SEATING FOR PRE-FOCUSED PRISM ASSEMBLY
14 CONTROL SELSYN

Fig. 3. Turning gear control selsyn and optical unit

16. The second prism and focusing lens are mounted upon a sector-shaped arm, which is adjustable in order to raise or lower the image upon the screen. The image can also be moved to the right or left, by suitably adjusting the second prism.

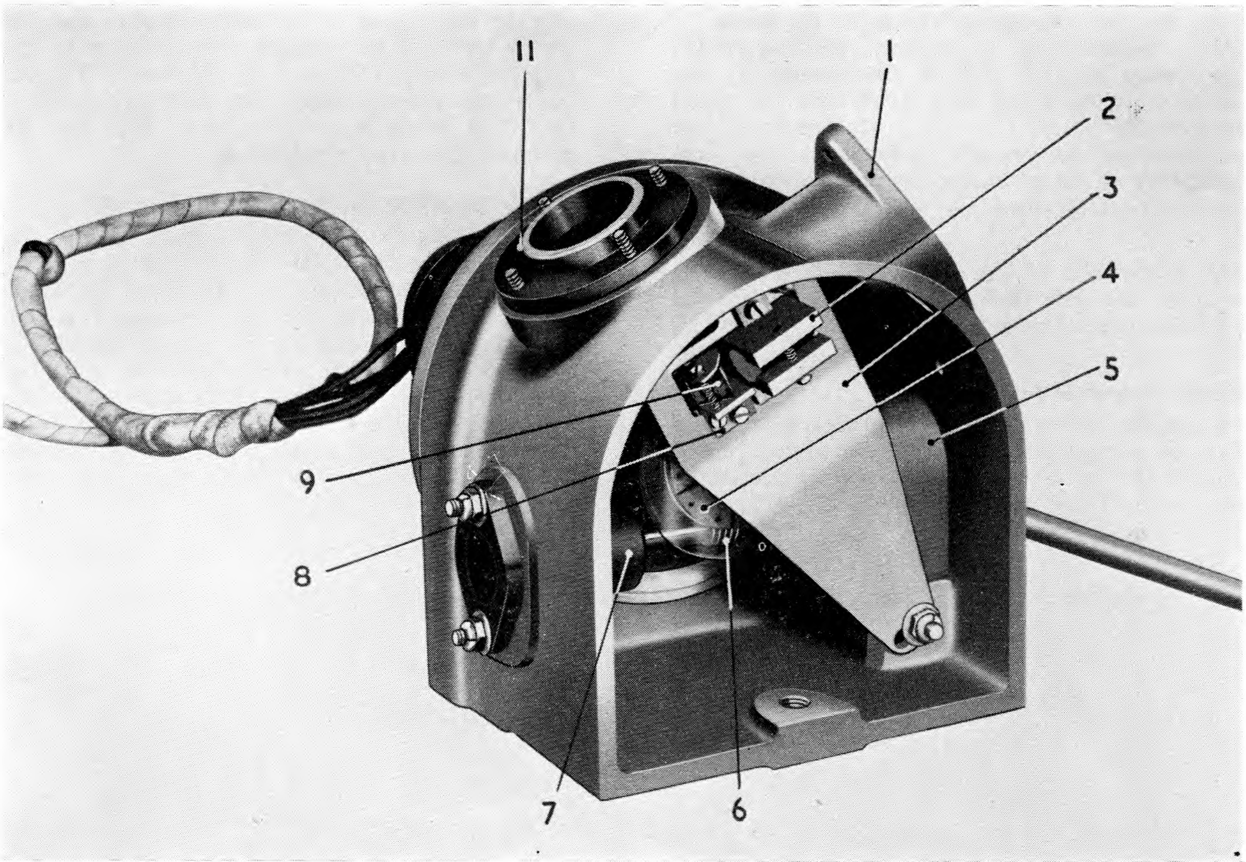
17. The prisms are held in clamps, and can be removed by easing off the screws on each side. This should not be done unless absolutely necessary, since the process of setting up must be done accurately, and may involve a considerable amount of trial and error.

18. During assembly and test at the maker's works, the optical units are lined up in such a manner that the following requirements are satisfied:—

(1) The image of the scale appears in an upright position in the middle of the screen, with the lines and figures sharply defined.

(2) The cursor line is in focus with the scale lines, sharply defined, and central on the screen.

(3) Increasing readings are obtained as the scale image moves from left to right relative to the cursor line.



1 FLANGE FOR PROJECTOR TUNNEL
2 CLAMP FOR PROJECTOR LENS
3 ROCKING ARM FOR IMAGE POSITION ADJUSTMENT
4 TRANSPARENT DISC CARRYING AZIMUTH GRATICULE
5 FRONT BEARING FOR CONTROL SHAFT
6 WORM ON CONTROL SHAFT
7 REAR BEARING OF CONTROL SHAFT
8 SECOND PRISM HOLDER
9 SECOND PRISM
11 SEATING FOR PRE-FOCUSED PRISM ASSEMBLY

Fig. 4. Optical unit with end cover removed

(4) The background of the scale image is free from shadows, and the illumination of the image is quite even. Particular attention is paid to the focusing of the lamp filament; if this is only slightly out of focus, bright spots may appear on the screen.

(5) The spare lamps are specially manufactured for projection purposes, and the substitution of a spare lamp should not cause any deterioration in the characteristics described above.

19. The seal on the removable side of the unit is dust-proof, and there should be no necessity to remove it for routine servicing. After a long period of use, however, the second prism and focusing lens may require cleaning. If there is only a little dust present, blowing with an electric dryer may suffice; failing this, the glass surface may be dusted with a small camel-hair or sable brush. The brush must be kept specially for the purpose, and must be perfectly clean and dry.

20. Any contamination which cannot be removed by this means should be removed with a piece of lens tissue, if available, or with a clean chamois leather. Do not rub hard; optical glass is very soft and is easily scratched by small pieces of grit. A very small quantity of methylated spirit or surgical spirit may be used on the chamois leather. Care must be taken to ensure that the glass is perfectly clean and dry before replacing the cover plate.

21. The first prism and condenser lens may be cleaned in the same manner, care being taken not to disturb the setting of the condenser lens and lamp-holder.

Note . . .

Para. 19 *to* 21 *must be regarded as advisory, and not as an authority to open and clean the unit. Provided the unit is functioning satisfactorily, it should not be interfered with in any way.*

Circuit of turning gear controls

22. The wiring of the turning gear controls, the relays REL. 10 and REL. 11, and the selsyn motors, is given in fig. 6. Each turning gear control panel has a selector switch having five banks; four of these are used for the turning gear control proper, and the other for dimming the turning gear control lamps. When the switch is in position 1 (POSITION CONTROL) the projector lamp is switched on. In position 2 (SECTOR SWEEP) the sweep control dial is illuminated by the appropriate lamp (LP.3 or LP.4) and the speed control dial by LP.1 or LP.2. In the other two positions of the switch (continuous 360 deg. sweeping) all lamps except the speed control dial lights are extinguished.

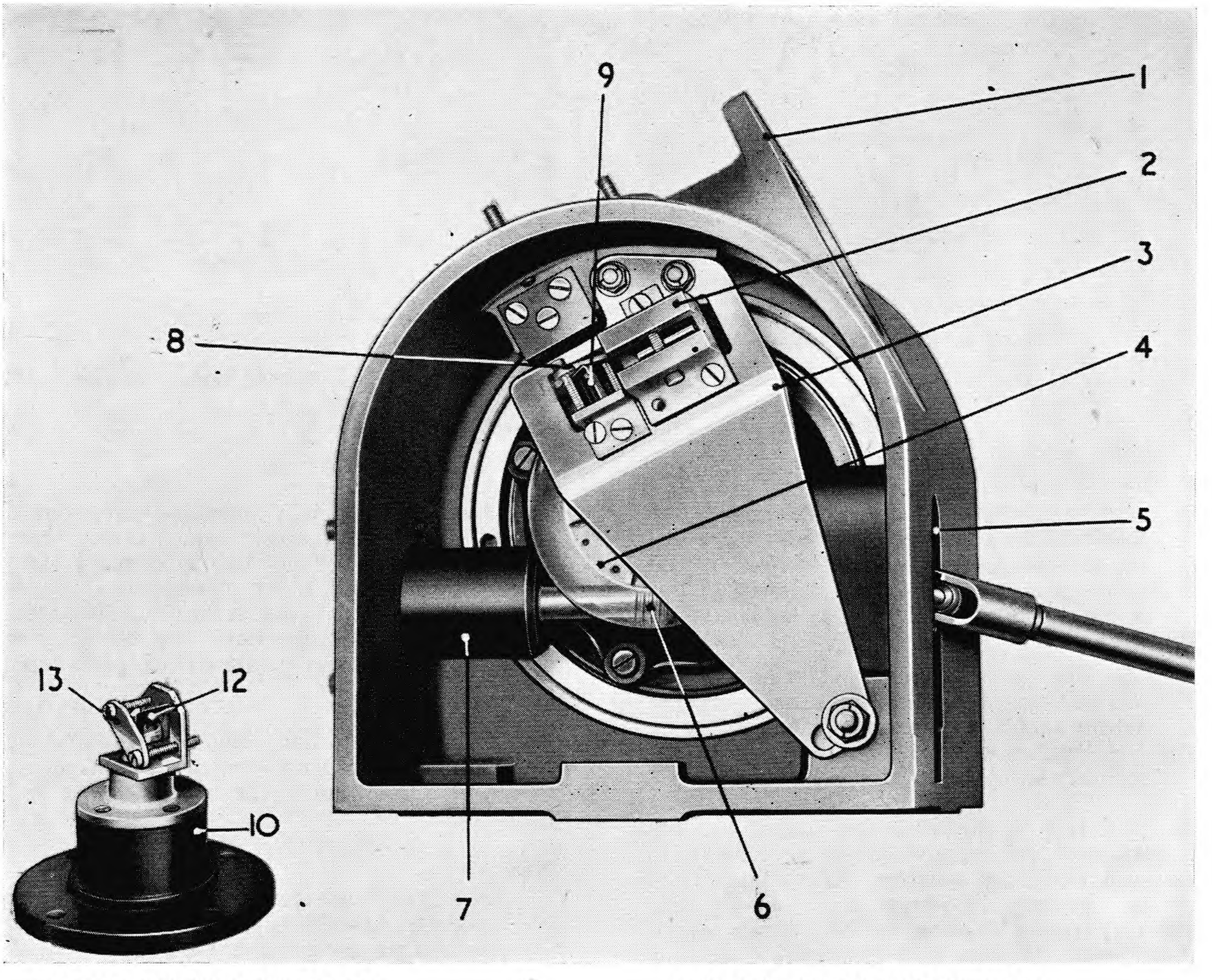
23. The action of the turning controls is dealt with in the Air Publication dealing with the particular type of radar installation.

Circuit of control desk

24. ◀The wiring of the control desk of console Type 60 is given in fig. 7, and the modifications to this for the special application when the console is used in RVT.510 Mk. 3 are given in fig. 8. The wiring is carried out in 22 S.W.G. covered with black PVC. The diagram is explained in Part 1, Chap. 3 of this Volume, para. 21 *et seq.* but mention may be made here of the control lamps dimmer switch sw14. This controls the brilliance of the projection lamps LP1 and LP2. The switch has two wafers but only one is used for switching, the tags of the other being used as soldering tags for the dimming resistors R189-R194.▶

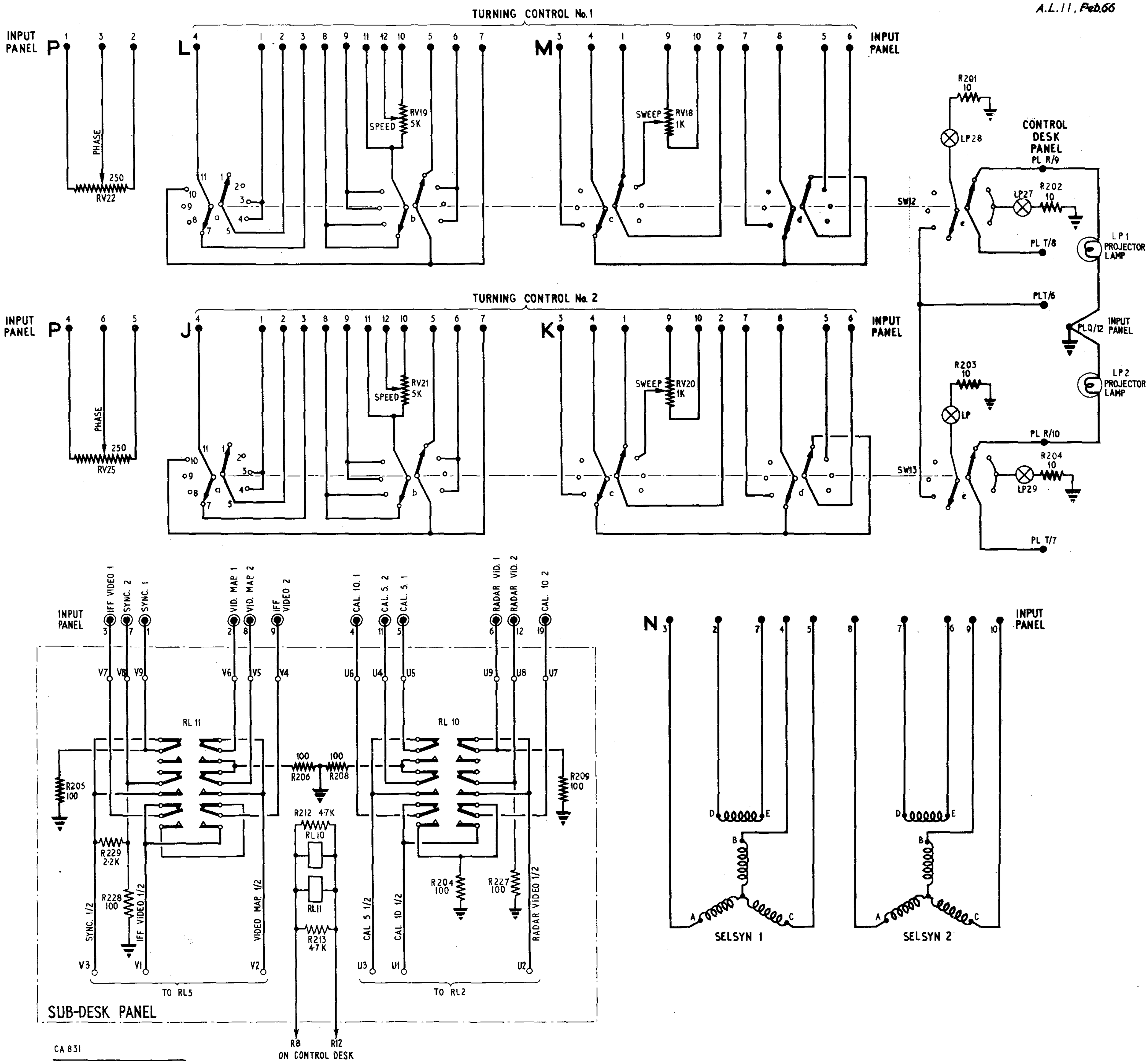
G.P.O. telephone circuits

25. The G.P.O. telephone circuits, enter the console on a 64-point 'shelf jack' which is mounted in the middle of the input panel as shown in Chap. 1, fig. 7, of this Section. This jack is annotated 'W'; the circuits associated with it are shown in fig. 9. The three key switches (R/T, MON. and I. COMM.) are mounted on the left-hand side of the control desk. The application of the telephone circuits is dealt with in the appropriate radar handbook, e.g. A.P.2897Q, Vol 1 (2nd Edn.) for circuits in RVT.510.



1 FLANGE FOR PROJECTOR TUNNEL
2 CLAMP FOR PROJECTION LENS
3 ROCKING ARM FOR IMAGE POSITION ADJUSTMENT
4 TRANSPARENT DISC CARRYING AZIMUTH GRATICULE
5 FRONT BEARING OF CONTROL SHAFT
6 WORM ON CONTROL SHAFT
7 REAR BEARING OF CONTROL SHAFT
8 SECOND PRISM HOLDER
9 SECOND PRISM
10 PRE-FOCUSED PRISM ASSEMBLY
12 FIRST PRISM
13 FIRST PRISM HOLDER

Fig. 5. Optical unit with pre-focused assembly removed



CA 831

AIR DIAGRAM 6111K/MIN.
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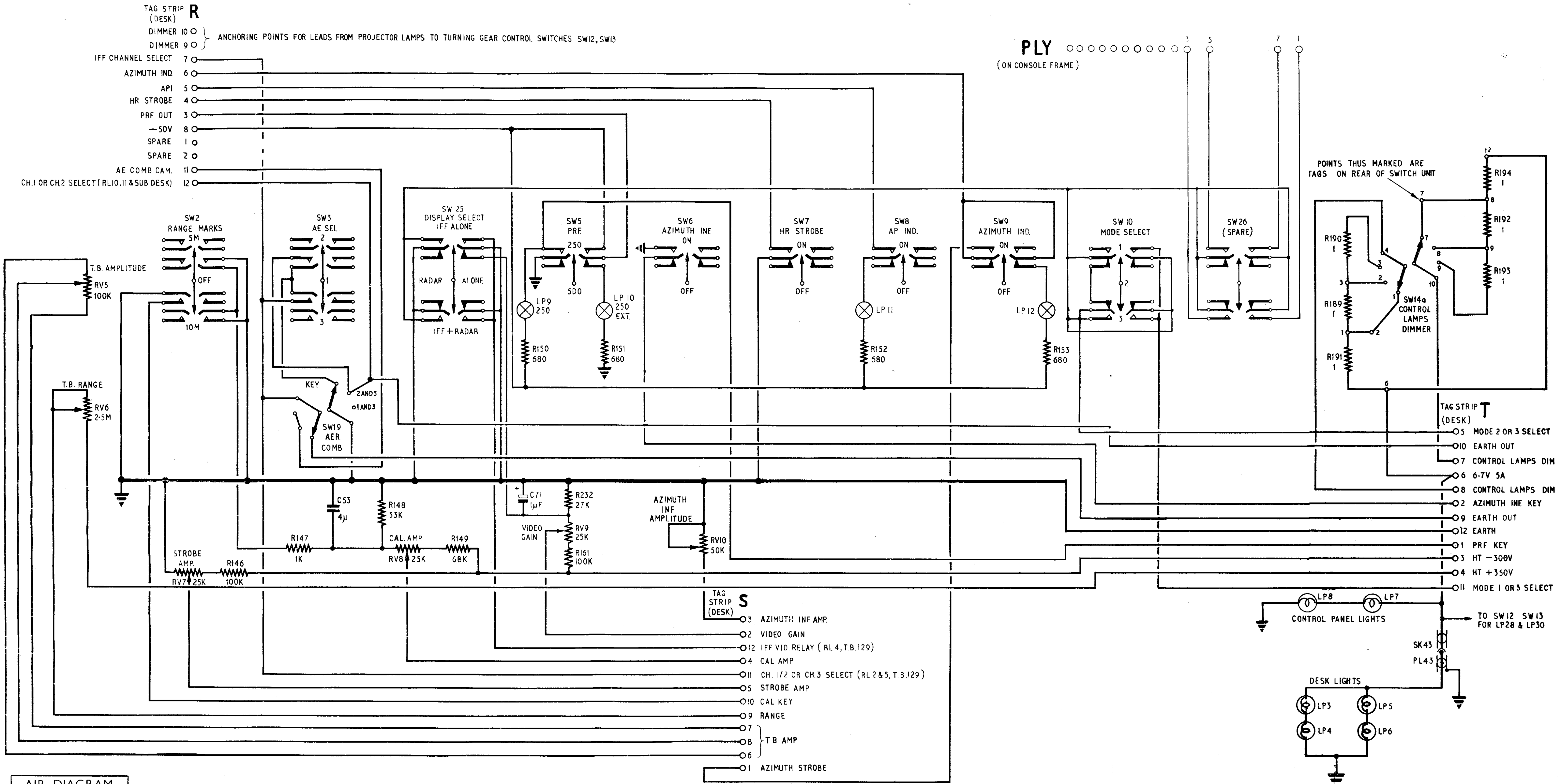
Turning gear control and sub-desk panel, circuit [Console Type 60]

Fig. 6

RESTRICTED

88065/573017/25/2/66 J. T. & S.



AIR DIAGRAM 6111J/MIN.
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FIG. 7

Control desk circuit, console Type 60

RESTRICTED

88065/573017/25/2/66 J. T. & S.

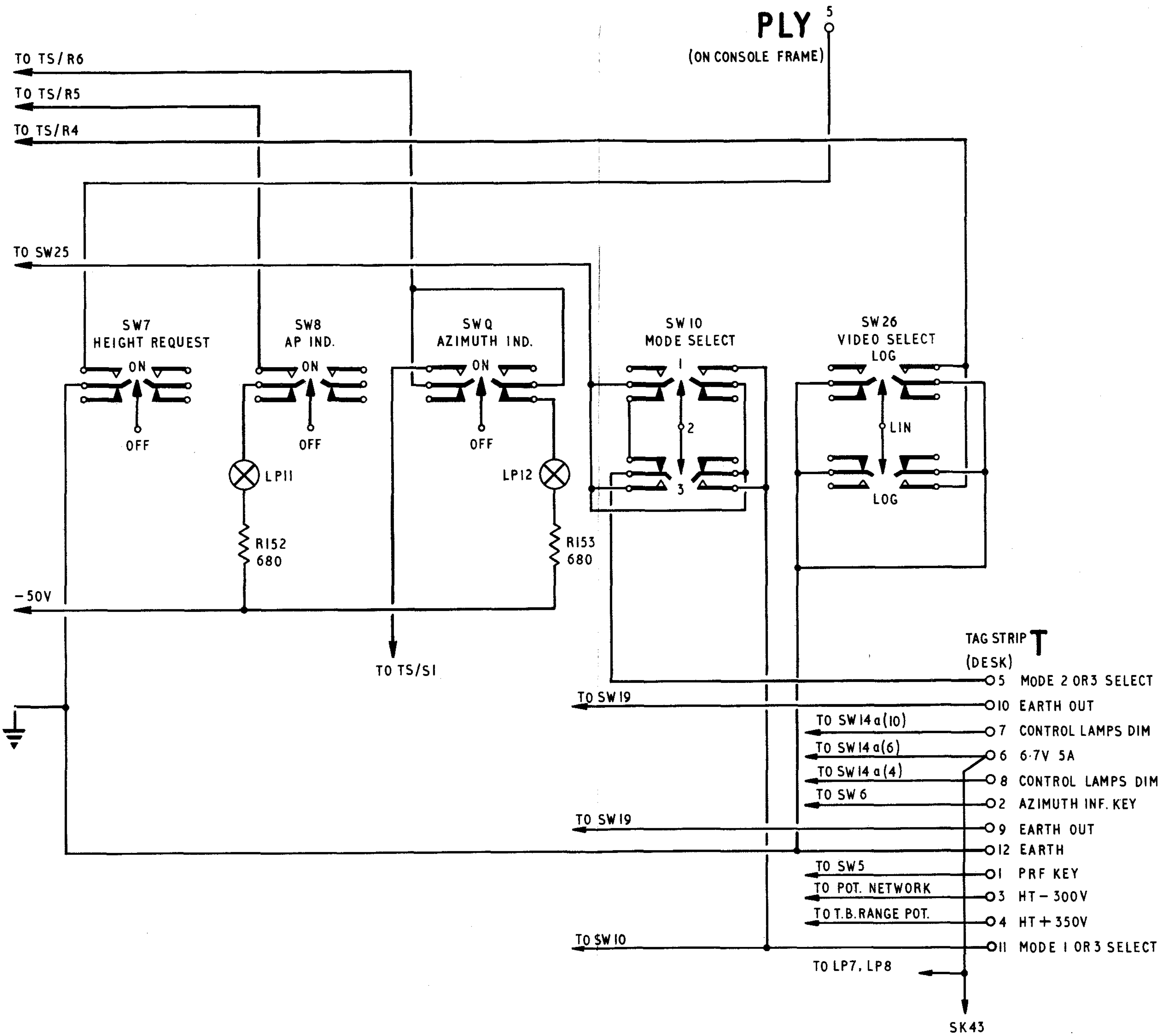

Fig. 8 Console Type 60 (special) modified circuit Fig. 8

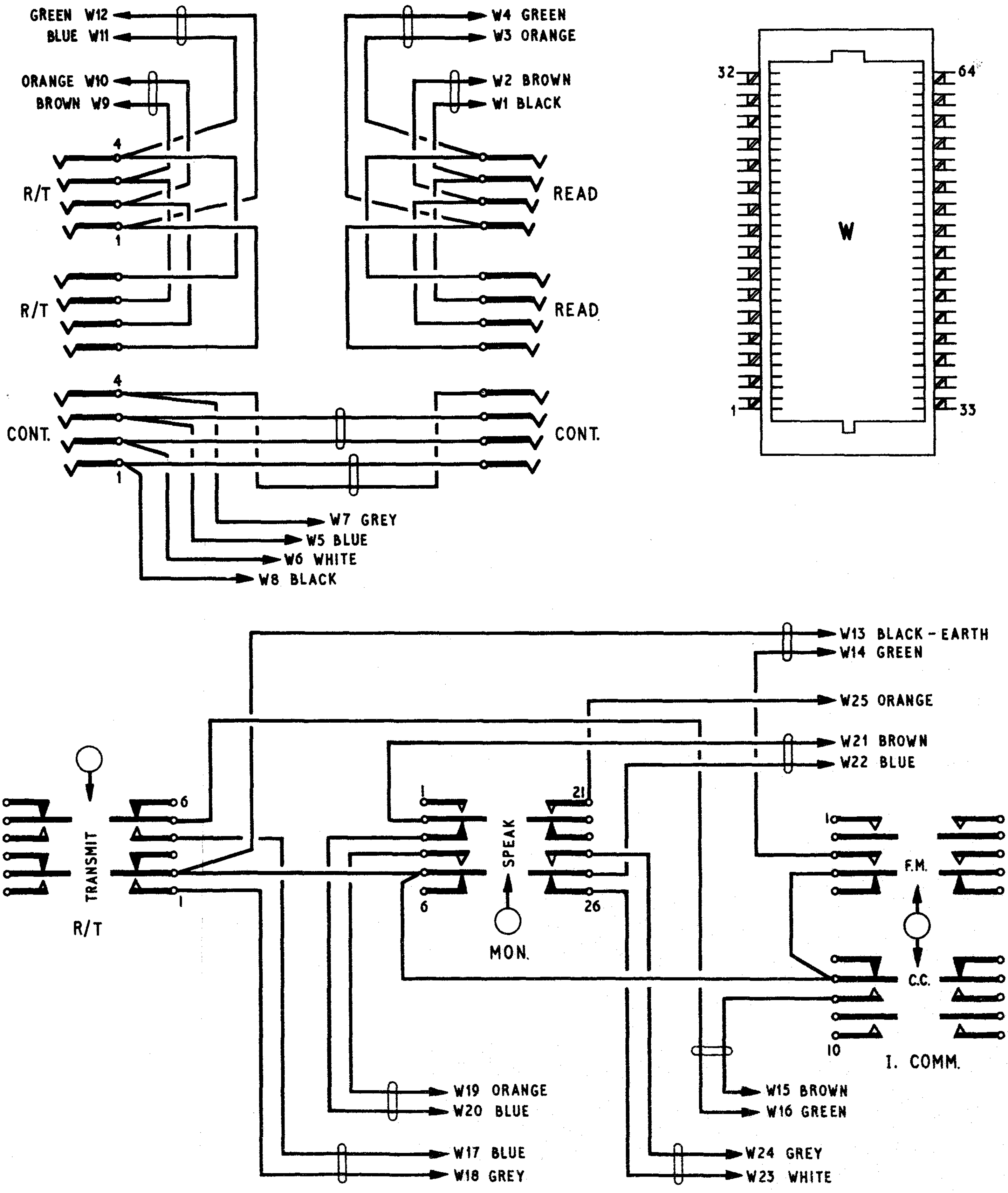

Fig. 9 G.P.O. telephone circuits on control desk Fig. 9

PART 3

FAULT DIAGNOSIS AND SERVICING

LIST OF CHAPTERS

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

Chapter 1

(*Completely revised*)

GENERAL PRINCIPLES OF FAULT DIAGNOSIS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. For rapid fault diagnosis it is essential that Station personnel should be familiar with the circuitry and operation of their equipment. In particular they should be familiar with the location and function of controls (*Part* 1, *Chap.* 3) and with the appearance of a normal display on the console 60. Any departure from normal in the display or in the effect of manipulating a control will then give a clue to the origin of the fault, which can be pursued by referring to the circuits and layout diagrams in Parts 1 and 2, and in this Chapter.

2. Inputs from external sources must be checked first, before the circuits in the console itself are suspected. It is always advisable to look for simple faults before embarking upon dismantling operations. For example:—

(1) Check that the equipment has, in fact, been switched ON, both remotely (console 60 at the RVT. 510 panel, distribution, Type 626) and locally on the console front panel, before looking for a more involved reason for non-operation.

(2) If a console will not operate immediately after servicing, it is advisable to check the servicing operations that have been carried out. It is particularly advisable to check that the plug-in connections, both internal and from external supplies, have not been disturbed or, alternatively, have been properly re-made. Cabling diagrams, showing plug and socket connections, are given in Part 2.

Fault diagnosis chart

3. In Chapter 2 of this Part the various symptoms of faults on the console 60 are listed in the form of a chart. Two major divisions of faults are possible:—

(1) Faults that are apparent when switching on a console that has been out of service.

(2) Faults that develop whilst the console is in service.

4. To resolve group (1) faults it is necessary to go through the setting-up procedure (*Part* 1, *Chap.* 3) for the console until the fault prevents further progress. Reference to the chart should then give the faulty unit. In the case of group (2) faults the console display should give a guide to the faulty unit. The symptoms are listed in Chapter 2.

Aids to fault diagnosis

5. Where the origin of the fault is obscure, much time can be wasted by trying this and that, so it is better to adopt a definite plan of action. Standard mechanical and third line servicing checks for the consoles are given in Chap. 3 of this Part. These checks may be carried out on the faulty unit to clear the fault.

Mains supply interconnections

6. It is essential to know the origin of power supplies and the location of fuses, and voltage and waveform test points. For example, on a console 60 the 230V AC mains input is on pins 7 and 8 of plug P on the input panel at the base of the console. The supply is routed via the ON/OFF switch, SW17 on the front panel, to the indicating unit Type 30, then via SW16 on this unit and safety switch SW15 on the console framework to power unit Type 742 (*fig.* 1, *Chap.* 4, *Part* 2). SW18 on the power unit feeds the internal +350V and −310V supply power packs via the 3A mains fuses FS1 and FS4. The +350V output is protected by the 500mA fuse FS2 and the −310V output by the 500mA fuse FS5. SW18 also supplies 230V AC mains back to the indicating unit via the 1A fuses FS3 and FS6. The heater transformer for the indicating unit is energized directly but the EHT transformer is supplied via the contacts RL1.1 and RL1.2 of a delay relay in the +350V and −310V output lines. Fig. 2, Chap. 4, Part 2 gives the interconnections.

50V interconnections

7. The 50V DC supply for operating relays in the console enters on pins 6 and 7 of plug Q on the input panel. The positive side of the supply is earthed and the negative line feeds relays RL10 and RL11 on the sub-desk panel, PLC/6 on the timebase unit Type 129, PLH/12 on the indicating unit and TSR/8 on the control desk. Fig. 1 and 1a give the 50V supply interconnections.

Low voltage AC interconnections

8. The power unit Type 742 produces a number of low voltage AC supplies for valve heaters and indicator lamps elsewhere in the console. Fig. 2 gives the interconnections. One 6·7V AC supply and two of 6·3V AC are made to the timebase unit 129 for valve heaters; a 6·5V AC supply is also wired via the timebase unit to the mask lights in the indicating unit Type 30. A 6·3V AC supply is made to the indicating unit Type 30 for V27 heater, and a 6·5V AC supply for the scale lights. A 6·7V 5A supply from the power unit is routed to the control desk key panel where it feeds SW13 and SW12 which control the inputs to the lamps in the turning gear control selsyn optical systems. This supply also feeds the control panel lights and the desk lights.

Video and sync. interconnections

9. The interconnections for video and sync. signals may be derived from fig. 10, Chap. 1, Part 1 and fig. 9, Chap. 1, Part 2. The circuit of the timebase unit Type 129 (*fig.* 1, *Chap.* 2, *Part* 2) shows the interconnections for various controls which operate in the timebase unit circuit but are actually located on the control desk (*fig.* 7 *and* 8, *Chap.* 5, *Part* 2).

Turning gear control selsyns

10. The interconnections for the aerial turning gear control system are given in fig. 9, Chap. 1, Part 2. Detailed circuitry is given in fig. 6, Chap. 5, Part 2.

Receiver selsyns

11. The circuits of the azicator and scan selsyns and of the aerial and auto-align cam-operated switches (located in the indicating unit Type 30) are given in fig. 1, Chap. 3, Part 2.

G.P.O. circuits

12. The telephone circuits on the control desk are given in fig. 9, Chap. 5, Part 2.

Timebase unit meter

13. If a fault is traced to the timebase unit Type 129, the meter and associated selector switch on this unit may be used to measure the valve current, HT and bias readings at various test points. These readings may be compared with the normal values taken during servicing, as a guide to fault diagnosis. A typical series of meter readings is given in Table 1 of Chap. 2, Part 2.

14. For testing other units in the console a multimeter is required (e.g., multimeter Type 1). An oscilloscope (Type 13A or 9172) is also necessary for observing waveforms.

Fault symptoms	Suggested cause	Suggested action	Relevant circuit etc.
CONSOLE WILL NOT SWITCH ON	**ABSENCE OF POWER INPUT**	Ensure that mains switch on panel 626 is ON and power available on PLP/7 and 8	(*See* block diagram of console—*fig*. 9, *Chap*. 1, *Part* 1 for general guidance)
	Faulty interconnections	Check switches SW17, SW16, SW15 and interconnections	fig. 2, Chap. 4, Part 2
	Fault in power unit 742	Check SW18 and MAINS fuses FS1 and FS2	fig. 1, Chap. 4, Part 2
6·3V lamp circuits do not light	Faulty interconnections	Ensure that outputs are available from transformers TR1 and TR2 in P.U.742 and check interconnections	fig. 2, Chap. 1, Part 3
Control desk keys ineffective. Associated indicator lamp OFF	Absence of 50V supply	Ensure that 50V input from rectifier 15 is present on PLQ/6 and 7. Check interconnections	fig. 1, Chap. 1, Part 3
Absence of current readings on timebase unit 129 meter	Fault in power unit 742 Faulty interconnections	Check HT fuses FS2 and FS5. Measure HT outputs in power unit. Replace V1 and V3 as required Test smoothing circuit components and check interconnections	fig. 1, 2, 3 and 4, Chap. 4. Part 2
CONSOLE ON BUT NO PPI DISPLAY EVEN WITH BRILLIANCE CONTROL ADVANCED	**ABSENCE OF EHT**	Measure EHT at CRT anode using electrostatic voltmeter and insulated lead **WARNING . . . 12kV may be present. If EHT absent ensure that relay RLI in P.U. 742 is operated and fuses FS3 and FS6 intact.**	fig. 1 and 6, Chap. 3, Part 2
	Faulty interconnections	Check that AC mains from P.U.742 is reaching transformers TR3 and TR4 in indicating unit 30	
	Faulty EHT components	Check that correct voltage is available at secondaries of TR3 and TR4 **WARNING . . .V26 heater and anode are normally at a high potential.** Change V26 if necessary. Check MR7 to MR8 and associated capacitors. Change faulty components	
	FAULT IN BLACK-OUT CIRCUIT	*See Bright-up Fault*	
	FAULTY CRT	If EHT and bright-up waveform are present change the CRT	para. 71-72, Chap. 3, Part 2
DEFECTIVE PICTURE	**ROTATION FAULTS** No input to scan selsyn	Check that inputs are present on PLH, from input panel PLO	
	Faulty interconnections or mechanical drive	Check scan selsyn and drive	para. 14, Chap. 3, Part 3
Absence of auto-align	Faulty interconnections Dirty contacts on auto-align cam switch or relay	Check the connections on PLO and PLH. Clean the contacts	para. 15-16, Chap. 3, Part 3

Fault symptoms	Suggested cause	Suggested action	Relevant circuit etc.
DEFECTIVE PICTURE	**BRIGHT-UP OR DEFLECTION FAULT**	Increase the brilliance to determine whether it is a bright-up or deflection fault, i.e., whether some signal component is missing or the deflection is faulty	
FAULTS IN CRT CATHODE MODULATION			
Erratic brilliance	Worn BRILLIANCE control	Connect testmeter between slider of RV14 and earth and check smoothness in variation of voltage with movement of control. Change potentiometer if faulty	fig. 1, and 2, Chap. 3, Part 2
Fluctuating brilliance	Faulty DC restorer V27	Change V27	
Brilliance too high or too low with normal setting of RV14. Brilliance graduated along trace	Incorrect bright-up waveform	Check the +ve square waveform from V7 suppressor grid to V16 suppressor grid in the timebase unit 129, using a CRO	fig. 1, Chap. 2, Part 2
	Faulty valves in T.B. Unit	Check V16 and V17 current and the waveform at coax 24 and indicating unit SK42	
◀Absence of IFF and/or AZ. STROBES (IFF strobe not normally used when IFF10 is fitted)	No input (IFF strobe)	Check coax 19 on input panel and 38 on T.B. Unit with CRO for presence of pulse, and that pulse can be controlled by STROBE RANGE RV16 on indicating unit	fig. 9, Chap. 1, Part 2 fig. 1, Chap. 3, Part 2 ▶
	Faulty valves in T.B. unit	Check valve current readings V17b, V17a, V16, V15, V14. Change valves if necessary	
	Faulty interconnections	Ensure that operation of SW9 on the control desk brings in relay RL8 and that the contacts on this relay make	
	◀Faulty STROBE AMP. control (RV7)	RV7 in the control desk is not normally used, but should be checked for smooth and effective operation. Change control if necessary	fig. 7, Chap. 5, Part 2 ▶
	Faulty connections to indicating unit	Ensure that the output from coax 24 on the T.B. unit is reaching SK42 on the CRT unit	
Absence of RANGE MARKERS	No input from marker unit 27 in IG rack	Check CAL inputs on console input panel, coax 5, 10, 11, 16 and 17	fig. 9, Chap. 1, Part 2 and fig. 6, Chap. 5, Part 2
	Faulty connections to T.B. unit	Check CAL inputs to T.B. unit on coax 35, 36, 31 and 37	
		Check the operation of the control desk switches and associated relays, i.e., SW19 (relays 10 and 11 in sub-desk panel) and SW5 (RL7 in T.B. unit)	fig. 1, Chap. 1, Part 3
	Faulty valves in T.B. unit	Check the waveform at V15 cathode and currents of V15, V16 and V17. Change valves if required	
	Faulty CAL. AMP. CONTROL (RV8)	Ensure that the CAL. AMP. CONTROL on the control desk is effective and smooth in operation. Change the control if necessary	fig. 7, Chap. 5, Part 2

Fault symptoms	Suggested cause	Suggested action	Relevant circuit etc.
FAULTS IN CRT GRID MODULATION			
Absence of video signals	No input from aerial or bad connections	Check input panel coax 6, 12 and 18, connections to T.B. unit on coax 29 and 30, and to CRT unit on SK41	
	Faulty SW3 or RL2	Operate SW3 on the control desk to select different aerials Check the operating of RL2. Ensure that a video input is reaching V19 in the T.B. unit	fig. 1, Chap. 1, Part 3
	Faulty valves in T.B. unit	Check the currents of V19, V20 and V22, and the signal output on coax 26. Change valves if necessary	
Absence of IFF response	No input from aerial or bad connections	Check inputs on coax 3, 9 and 15, and connections to T.B. unit on coax 33 and 34. Check connection from T.B. unit coax 26 to CRT unit SK41	fig. 9, Chap. 1, Part 2
	Faulty switches and relays	◀Check SW3, SW19, SW25 and SW10 on the control desk, RL5 and RL4 on the T.B. unit. and RL11 on the sub-desk panel. Ensure that an input is being made to V23b.	Para. 55, Chap. 2, Part 2▶
	Faulty potentiometer RV26	Check the operation of this potentiometer; replace if faulty	
	Faulty valves in T.B. unit	Check the currents of V18, V19, V20 and V22, and the waveform at coax 26. Replace faulty valves	
Absence of video map	No input from marker unit 30	Check inputs on coax 2, 8, 6, 12, 14 and 18	
	Faulty relay operation (RL10 and RL11)	Check the operation of RL10 and RL11	fig. 6, Chap. 5, Part 2
	Faulty connections	Check the inputs on T.B. unit coax 28 and 32	
	Faulty switch SW6 or RL9	Ensure that SW6 operates RL9 in the T.B. unit to give an input to V23A	
	Faulty valves in T.B. unit	Check the currents of V18, V19, V20 and V22 and ensure that there is an output at coax 26	
DEFECTIVE PICTURE DEFLECTION FAULT			
Jitter on trace	Dirty scan coil slip rings	Clean the slip rings	
No timebase (spot in centre of CRT)	Fault in scan timebase coil or open circuit on slip rings	Test with ohmmeter	para. 7, Chap. 3, Part 3
	Fault in timebase circuit	Ensure that sync. input is present at T.B. unit coax 39, giving 33V neg. pulse at the anode of V4	Chap. 2, Part 2
		Check valve current in V11, V12, V9, V7, V5, V4	
		Check waveform at PLE/1 and 2	

Fault symptoms	Suggested cause	Suggested action	Relevant circuit etc.
Short timebase	Faulty in timebase circuit	Check valve currents and output waveform as above	
	Faulty RANGE CONTROL (RV6) Faulty AMPLITUDE CONTROL (RV5)	Check the operation of these controls and the interconnections on PLE (timebase unit) and TBS (control desk)	
Non-linear timebase	Wrongly adjusted T.B. controls	Check the adjustment of the T.B. controls	para. 25 Chap. 3, Part 3
Fluctuations in timebase length	Fluctuating HT	Check voltage stabilization Change V10 and V13 if necessary	
Off centre trace	Poor contacts in off-centre slip ring circuits	Check off-centre and slip rings	fig. 1, Chap. 3, Part 2; para. 9, Chap. 3, Part 3
	Faulty off-centre controls	Check the operation of the controls	
		Ensure that +300V and −300V (nominal) supplies are arriving on PLG	
DEFECTIVE FOCUS	Incorrect focus potential	Check EHT	
		Check resistance of FOCUS CONTROL (RV15) and associated potential divider	
	Faulty CRT	Change CRT	
FAULTY AZICATION	Poor connections	Check input from aerial head on PLO and connections to PLH on the indicating unit	
	Wrongly adjusted selsyn	Check azicator selsyn	para. 13, Chap. 3, Part 3
FAULTY TURNING GEAR CONTROL	Poor connections	Check the connections to the aerial head on PLL, PLM, PLJ and PLK, as appropriate	
	Mechanical fault	Inspect the mechanical linkages between the control knobs and selsyns	fig. 3–8, Chap. 1, Part 2
	Faulty controls (SPEED and SWEEP ANGLE)	Test the controls	para. 6, Chap. 3, Part 3
	Faults in associated amplidyne turning gear control system	Refer to setting-up procedure	A.P.2886H
FAULTY HEAD COMBINING	Poor connections	Check the operation of the AE. COMB. switch SW19 on the control desk. Test the connections from the switch via PLF to the aerial switching cam in the indicating unit.	fig. 2, Chap. 1, Part 3
		Ensure that relays RL6, RL5 and RL2 in the timebase unit operate correctly	para. 26, Chap. 3, Part 3

Chapter 3

SERVICING

LIST OF CONTENTS

TABLE

Introduction

1. The information contained in this chapter provides a basis for normal routine servicing and also gives series of operations which may be adopted to resolve faults which are difficult to diagnose from symptoms.

Test equipment

2. The following test equipment will be required for the operations described in this chapter:—

(1) Test set Type 402 (pulse generator).

(2) Test set (selsyn) Type 406, with connector.

(3) Test set (selsyn) SG38A, with connectors.

(4) Oscilloscope Type 13A or 9172.

(5) Relay adjusting kit.

(6) Termination unit Type 34.

(7) Testmeter Type F multimeter Type 1.

◀(8) Rectifier unit Type 15.▶

Items (1) to (3) and (6) are described in A.P.2527D (Test equipment for mobile and static radar stations). The other items are covered in the series of A.P. on common test gear.

STANDARD MECHANICAL CHECKS

3. To prevent the occurrence of mechanical faults in the equipment, or to discover them when they are causing faulty operation, it is desirable to carry out the following checks. In the case of fault diagnosis the checks will, of course, be limited to the faulty unit.

(1) When carrying out mechanical checks within a unit, apply all necessary safety precautions, *i.e.*

(a) Switch off all associated switches.

(b) Disconnect all supplies.

(c) Discharge EHT capacitors.

(d) Check the action of all safety switches.

(2) Check such of the following as apply to the unit in hand, in any convenient order:—

(a) Nuts and bolts for tightness.

(b) Security of doors, side panels, fasteners, etc.

(c) Valve caps, bases and retainers.

(d) Valve cans for ease of removal, fractures, faulty springs, etc.

(e) Soldered joints for mechanical strength and dry joints.

(f) Potentiometer connections, smoothness in operation, loose knobs, etc.

(g) Overheating of components, tagboards, etc.

(h) Oil leaks in transformers, chokes and capacitors.

(i) Wear and tear of cableforms, especially flexible types.

(j) Relays for mechanical freedom, contacts for oxidization.

(k) Porcelain insulators for cleanliness and cracks.

(l) Gearing for wear, backlash and misalignment.

(m) Selsyn shafts and bearings.

(n) Universal joints.

(o) Off centre shafts and flexible drives.

(p) Jones plugs and sockets and cable clamps.

(q) Coaxial plugs and sockets for insulation, earthing of braid and correct mating.

(r) Helvin sleeves for correct identification of cables.

(s) Sliding runners for freedom of movement, distortion, etc.

(t) Fuses for correct rating.

ELECTRICAL CHECKS

4. The following series of mainly electrical checks provides a complete servicing routine for a console. In addition, it will prove helpful during fault finding to test a suspected unit in accordance with the appropriate part of the servicing routine, when difficulty is experienced in diagnosing a fault of an electrical nature.

Preliminary

5. ◀(1) Set to OFF the console MAINS switch on the panel 626, and the individual MAINS switch on the console.▶

(2) If necessary to give improved access:—

(a) Remove the panels from the console framework.

(b) Withdraw the timebase unit and power pack and 'rack out' the indicator unit.

(3) Use the vacuum cleaner to remove dust from the units and cabinet interior.

(4) Carry out the standard mechanical check on all units under test.

Turning gear control units

◀**6.** Tests are given for one unit on the console 60; they may be repeated on the appropriate connections for the second unit (fig. 6, Chap. 5, Part 2).▶

(1) Turn the function selector switch to SECTOR SWEEP. With the SWEEP ANGLE control set fully clockwise, check that pins 2 and 10 on plug K are short-circuited. With the control set fully counter-clockwise, check that the SWEEP ANGLE scale reads 20 at the commencement of the resistance reading.

(2) With the SPEED control set fully clockwise, check that pins 11 and 12 on plug J are short-circuited. With the control set fully counter-clockwise check that pins 10 and 12 are shorted. With the SWEEP ANGLE control set at 20, check that there is free movement of the SPEED control from 0-1 r.p.m. (red scale) before the cam and gearing come into play. Check that the SPEED control scale reads below ½ at the commencement of the resistance reading.

Slip rings

Scan coil slip rings

7. (1) Connect a testmeter, on a resistance range, across pins 1 and 2 of plug F on the indicating unit (*fig.* 1, *Chap.* 3, *Part* 2).

(2) Manually rotate the scan coil assembly for one complete revolution and check that the resistance remains constant.

(3) Ensure that the connections to the rear end of the slip rings clear the CRT locating flanges by at least ⅛ in.

Aerial switching cam slip rings

8. (1) Connect a testmeter, on a resistance range, between pin 3 on plug F and earth.

(2) Set the OFF CENTRE/SECTOR control counter-clockwise through 180 deg. The testmeter should read infinite resistance at this point.

(3) Manually rotate the scan coil assembly through 180 deg. The meter should now read zero resistance.

(4) Rotate the OFF CENTRE/SECTOR control counter-clockwise through a further 180 deg., at which point the testmeter should again read infinity.

(5) If at any point in the preceding checks the testmeter readings are intermittent, the brushes and slip rings should be cleaned and checked. The cam contact fingers should be checked for adjustment.

Off centre coil slip rings

9. (1) Connect a testmeter, on a resistance range, across pins 9 and 10 of plug F.

(2) Turn the OFF CENTRE/SECTOR control through 360 deg. of rotation as indicated on the dial and check that the resistance reading remains constant.

(3) Return the OFF CENTRE/SECTOR control to 360 deg. and leave it in this position during the remainder of the setting-up operations.

CRT assembly

Mechanical checks

10. (1) Check that the mu-metal tube around the CRT neck is secured to the base with PVC tape.

(2) Ensure that the CRT is mounted correctly. In particular, check that the scan coil assembly can rotate freely; that the azimuth

scale is correctly fastened; that the clamping rings hold the neck of the CRT centrally in the scan coil assembly and that the base of the CRT fits tightly into its holder.

(3) Remove the inspection cover on the top of the main mu-metal screen and check that the scan coils are mounted as near to the front of the tube as is practicable without rubbing the CRT.

Power supplies and controls

11. ◀(1) Set up the test set 402 to give a sync. pulse of p.r.f. 506 c/s and 15V peak amplitude (see A.P.2527D, Vol. 1, Sect. 1, Chap. 8) and connect the output to SKT 56 on PD3.

(2) Turn the BRIGHTNESS control fully counter-clockwise.

(3) Switch ON the console, set the AER. SEL. switch to 1 and ascertain that the rectifier Type 15 and the range marks generator are switched on.▶

(4) Check that all three safety switches (SW16, SW15 and SW18) operate correctly and that all scales are evenly illuminated.

(5) Put the meter switch on the timebase unit Type 129 to positions H.T.1 and H.T.2 in turn and check that the meter reads 3·4 and 3·2 (approx.), respectively. The EHT power supply cannot come on until the HT supply (which supplies the CRT bias network via PLG/5 and 11) operates RL1, to connect 230V mains to the EHT power pack.

(6) Check the operation of the CURSOR DIM control.

(7) Operate the TURNING CONTROL selector switch to POSITION CONTROL and check that the small circular window below the switch is illuminated. Further check that the CONTROL LAMPS DIM switch gives three levels of illumination. The figures displayed on the glass screen should be in focus and the cross wire centrally positioned.

(8) Turn the selector switch to SECTOR SWEEP and check that the SPEED and SECTOR SWEEP control dials are illuminated. With the selector switch to CLOCKWISE or ANTI-CLOCKWISE rotation, only the SPEED dial should be illuminated.

(9) Using the made-up connector for the scan selsyn (A.P.2527D, *Vol.* 1, *Sect.* 11, *Chap.* (14), connect the test set Type 406 to plug O on the console input panel. Switch on the test set and check that the scan selsyn turns the scan coil assembly smoothly at all speeds from 1 to 6 r.p.m.

(10) Using the made-up connector for the azicator selsyn, connect the test set Type 406 to plug O on the console input panel. Check that the azicator selsyn turns the cursor assembly smoothly at all speeds from 1 to 6 r.p.m. Check that the mains supply to the azicator selsyn rotor is disconnected when the CURSOR ALIGN button is pressed. An AC voltmeter across A1-A2 on the selsyn, or between these points and earth will serve as indicator.

Selsyn checks

12. These selsyn checks are carried out using test set (selsyn) SG38A.

Azicator selsyn DC check

13. DC lock is used because it is more accurate than AC, but the DC must not be connected for longer than necessary or it will magnetize the selsyn iron circuit.

(1) Connect the test set mains input plug PL9 to a suitable 5A socket using connector SG20.

◀(2) Connect PL1 on the recifier Type 15 to SKT8 (RECT.15) on the test set, using connector SG40.▶

(3) Connect the test set SELSYN CHECK socket SK4 to plug H on the console indicating unit Type 30, using connector SG1.

(4) Switch the test set SELSYN LOCK switch SWF to AZIC and the 50V/230V switch SWE to 50V.

(5) Check that the azicator CURSOR ALIGN button switch on the console is functioning correctly, because bearing errors are possible if this switch is faulty. A convenient way to test the switch is to open the selsyn rotor circuit with the switch, move the cursor a few degrees, then close the switch and check that the cursor moves back to its former position. If the switch contacts are dirty it may be necessary to operate the switch several times. When the switch is functioning correctly set the cursor to 360 deg.

(6) Close the test set mains switch SWC and switch on the rectifier Type 15 (MAINS 230V 50 c/s for UNIT 1). This applies 50V DC to the azicator selsyn rotor and stator and so locks the rotor.

(7) (a) Check that the azicator cursor locks at 360 deg. and the vernier dial reads zero.

(b) If the azicator locks at a bearing within plus or minus 6 deg. of 360 deg., loosen the bolts holding the outer casing of the azicator selsyn and, with the DC lock still on, rotate the body of the selsyn until the azicator cursor is at 360 deg.

(c) Should the vernier still not be reading zero, remove the cover at the bottom right of the CRT screen to obtain access and loosen the set screw holding it to the shaft. Re-set the vernier to zero and tighten the set screw.

(d) Tighten down the selsyn fixing bolts and switch off the rectifier 15 MAINS.

(e) Offset the cursor by plus or minus 3 deg. Check that when the rectifier 15 is switched on, the cursor returns to 360 deg. and the vernier to zero.

Scan selsyn DC check

14. (1) Connect the test set as in para. 13 (1) to (3), with the test set mains switch OFF.

(2) Switch SELSYN LOCK to SCAN. Leave the 50v/230v switch on 50v.

(3) With the console switched on and the timebase centred, manually rotate the timebase, using the large gearwheel (*fig*. 18, *Chap*. 3, *Part* 2).

WARNING...

Care must be excerised in this operation because the EHT capacitor C59 is close to this gearwheel.

Align the timebase with the hair lines of the azication cursor (set to 360 deg. in the previous operation).

(4) (a) Switch on the test set and rectifier 15 and check that the timebase remains aligned to 360 deg.

(b) If the timebase locks at a bearing within plus or minus 6 deg. of 360 deg., switch off the rectifier 15 and loosen the two set screws in the Oldham coupling adjacent to the gearing.

(c) Manually rotate the timebase to 360 deg. and tighten the brake plate screw (*fig*. 5, *Chap*. 3, *Part* 2) to hold this position.

(d) Switch on the rectifier 15 (DC lock) and tighten the set screws in the Oldham coupling, then loosen the brake plate screw the switch off the rectifier.

(e) Offset the time base manually by plus or minus 3 deg.

(f) Check that when the DC lock is switched on, the timebase returns to its position of alignment with the azication cursor hair lines at 360 deg. The correct position for the set screws in the Oldham coupling is, on the gear side, pointing upwards; on the selsyn side, facing out towards the near side of the console.

Scan selsyn auto-align check

15. *Preliminary*

First check the test set SG38A as follows:—

(1) Connect the test set to 230V AC as in para. 13(1), and the rectifier 15 as in para. 13(2).

(2) On the test set, connect SK3 (AUTO-ALIGN CHECK) to SK4 (SELSYN CHECK) using connector SG46.

(3) Switch SELSYN LOCK (SWF) to SCAN.

(4) Switch 50v/230v to 50v.

(5) Switch on the test set and rectifier 15. 50V DC is now connected to the selsyn in the test set to lock the rotor.

(6) The dial reading of 0 deg. on the test set should now coincide with the cursor line. If the selsyn on the test set has been replaced, or the 0 deg. dial reading does not relate to the cursor line, proceed as follows:—

(a) Release and lift up the lid of the test set.

(b) Disengage the gears by loosening the knurled nut on the top of the shaft casing until it is free of its location recess. Push the knurled nut into the front end of its slot.

(c) Rotate the dial to the 0 deg. cursor line and push the knurled nut back until the gears remesh. Lock the nut in its location recess.

(d) If the 0 deg. line is still not accurately related to the cursor line, loosen the nuts holding the cursor assembly. Carefully relate the cursor line to zero and tighten the nuts. Close and lock the lid of the test set.

16. *Auto-align circuit check*

Having ensured the accuracy of the test set selsyn alignment, remove connector SG46, switch OFF and disconnect the rectifier 15, and proceed with the scan selsyn auto-align check as follows:—

(1) Connect the test set to 230V AC as in para. 13 (1).

(2) Switch SELSYN LOCK to SCAN

(3) Switch 50v/230v to 230v.

(4) Connect AUTO-ALIGN (SK3) on the test set to plug H on the console indicator unit Type 30, using connector SG1.

(5) Connect a testmeter, on a resistance range, to test sockets SK10 and SK11 on the front panel of the test set, using test lead SG36.

(6) Rotation of the selsyn in the test set should now produce rotation of the scan selsyn in the console. If the scan selsyn is now set to the position at which the timebase relates to 360 deg., a resistance reading should be shown on the testmeter. This resistance is the series resistance of the relay coil (RL12 in the indicating unit Type 30) through the auto-align contacts.

(7) Rotate the test set selsyn until the fixed hair line relates to either 285 deg. or 75 deg. on the dial.

(8) Move past this point, then return to it. At the point of return, the auto-align contacts should close and the testmeter should read the resistance of the relay coil.

(9) Having obtained a check of the point at which the auto-align contacts close on one side of 360 deg. (as indicated by the timebase) rotate the test set dial through the 0 deg. position to either 75 deg. or 285 deg. depending on which side was checked first.

(10) Move past this point, then return to it. At the point of return the auto-align contacts should again close and the testmeter read the resistance of the relay coil.

(11) In this condition the auto-align contacts are set up for 5 deg. of contact, 2½ deg. on either side of 360 deg. (tolerance plus 0, minus 15 min.). The test set dial moves through 150 deg. because the scan coils and auto-align contacts are connected to the console scan selsyn rotor via a 30 : 1 gear train.

(12) Should the arc of contact be greater or less than the stated figure, loosen the two screws holding the contact fingers to the back plate (*fig*. 21, *Chap*. 3, *Part* 2). Note that the hole in the lower side is slightly larger than the screw, thus enabling up and down movement of the contacts to be effected. Move the contacts up or down as is necessary and repeat the contact checks.

(13) Should the arc of contact not be centred on 360 deg. loosen the back plate screws and move the whole assembly either side of 360 deg. until the arc is centred on 360 deg. and repeat the contact checks.

Testing the sensitivities of the video circuits

Calibration of test set Type 402

17. The test set Type 402 is also used for testing the console video circuits. Before use the test set VIDEO ECHO AMPLITUDE control must be calibrated as follows:—

(1) Switch on the test set and allow half an hour warming up period.

(2) Set the PULSE WIDTH switch to 2μs and display the VIDEO ECHO pulse on the oscilloscope Type 13A (VIDEO ECHO socket to socket A1 on the CRO).

(3) Set the CRO A1 GAIN control fully clockwise and the A2 GAIN control fully counter-clockwise. Under these conditions tube sensitivity is such that 1V input produces 1 cm. deflection.

(4) Terminate the duplicate video echo output socket SK23 (at the rear of the test set) with a termination unit Type 34.

(5) Calibrate the VIDEO ECHO AMPLITUDE control for output levels of 1V, 2V and 4V.

Preparation of console

18. (1) Switch off the head selector unit associated with the console and remove the coaxial lead 41 (video input) from the rear of the indicating unit (*fig*. 7, *Chap*. 3, *Part* 2), replacing it with a termination unit Type 34.

(2) Connect the coaxial lead 41 to socket Y1 on the CRO Type 13A.

(3) Turn the console VIDEO GAIN and VIDEO LIMIT controls fully clockwise.

(4) Connect the test set 402 VIDEO ECHO output to SK18 on the console input panel. The test set output is now passing through the console video circuits to the CRO.

Overall primary radar video sensitivity

19. (1) With an input pulse to SK18 of 1V, 2μs from the test set, the output pulse amplitude at CRO Y1 should be at least 20V.

(2) With an input pulse of 2V, 2μs, the output pulse amplitude should be at least 50V.

Overall IFF sensitivity

20. (1) Transfer the VIDEO ECHO output, from the test set 402, to console socket SK15.

(2)◀With the AERIAL switch (SW3) at position 3 and the AE. COMB. switch (SW19) at 'KEY', set the IFF GAIN control (RV26) fully clockwise, the DISPLAY SELECT key (SW25) to IFF ALONE or IFF + RAD. and the AZ. INF. AMP. control fully counter-clockwise. ▶

(3) Check that with an input pulse of 1V, 2μs the amplitude of the output pulse is at least 23V.

(4) Check that with an input of 2V, 2μs the output is at least 50V.

Overall azimuth information sensitivity

21. (1) Transfer the VIDEO ECHO output to SK14 on the console input panel.

(2) Set the AZ. INF. AMP. control fully clockwise and the AZ. INF. key to ON.

(3) Set the input pulse to 1V, 2μs; the amplitude of the output pulse should be at least 16V.

(4) Set the input pulse to 2V, 2μs; the amplitude of the output pulse should be at least 40V.

Calibration sensitivity

22. Remove the terminating unit Type 34 from SK41 (*para*. 18 (1)) and replace the coaxial lead 41, then proceed:—

(1) Remove the coaxial lead 42 from its socket at the rear of the indicating unit and connect the lead to socket Y1 on the CRO Type 13A.

(2) Connect the test set Type 402 VIDEO ECHO output to SK17 on the console input panel, thereby feeding a signal through the console to the CRO.

(3)◀With the AERIAL switch at position 3 and the AE. COMB. switch at 'KEY', set the CAL. AMP. control fully clockwise and the RANGE MARKS key to 5M.▶

(4) Set the input pulse to 2V, 2μs; the amplitude of the output pulse should be at least 10V.

(5) Set the input pulse to 4V, 2μs; the amplitude of the output pulse should be at least 20V.

Strobe sensitivity

23.◀With IFF10 the IFF strobe is not normally used, but the circuit remains and servicing may be required.▶

(1) Transfer the VIDEO ECHO output to SK19.

(2) Set the STROBE AMP. control fully clockwise.

(3) Set the input pulse to 2V, 2μs; the amplitude of the output pulse should be at least 18V.

(4) Set the input pulse to 4V, 2μs; the amplitude of the output pulse should be at least 25V.

Waveforms and meter readings

24. The waveforms to be expected at various points in the timebase unit Type 129 circuit are given in Chap. 2, Part 1. It is recommended that similar waveforms should be displayed on a CRO Type 13A when the console is working satisfactorily and drawn on squared paper for comparison with waveforms observed when the console is faulty. Similarly a chart of meter readings should be drawn up as in Table 1, Chap. 2, Part 2, for comparison with readings taken when the console is being serviced. The associated controls should always be in the same positions when readings are taken (*Table* 1 of this chapter).

TABLE 1
Meter reading chart

Switch position	*Meter reading*	*Control position*
V4		—
V5		—
V7		RANGE minimum
V7		RANGE maximum
V9		
V11 & V12		CV 124 BIAS minimum
V11 & V12		CV 124 BIAS maximum
V14		STROBE AMP. minimum
V14		STROBE AMP. maximum
V15		RM CAL. AMP minimum
V15		Key ON, CAL. AMP. maximum
V16		
V17A		
V17B		
V18		
V19		VIDEO GAIN minimum
V19		VIDEO GAIN maximum
V20		VIDEO LIMIT minimum
V20		VIDEO LIMIT maximum
V22		
HT1		
HT2		

Timebase and display circuits

25. (1)◀Set up the test set 402 and the console as in para. 11.▶

(2)◀Turn the OFF CENTRE AMP. control fully counter-clockwise, T.B. RANGE and CAL. AMP. controls fully clockwise. Switch the RANGE MARKS key to 5M, and the P.R.F. key to 500. Set the FOCUS control to its best position and turn the CV124 BIAS control from clockwise to counter-clockwise until the origin of the trace ceases to move towards the centre of the tube.▶

Note . . .

If this control is turned too far in a clockwise direction, the second range mark will move towards the first with resultant non-linearity, which is to be avoided.▶◀

(3) Connect the test set (selsyn) Type 406 to the Jones plug O on the console input panel and start the trace rotating by feeding an input from the test set to the scan selsyn.

(4) Set the centring controls so that the origin of the trace is approximately in the centre of the CRT. Set the T.B. AMP. control to give a trace length of one radius of the CRT.

(5)◀Adjust the 500 P.R.F. RANGE LIMIT control so that 25 range marks appear on the trace (i.e. to a maximum range of 120 miles).▶

(6)◀Set the test set 402 to give a p.r.f. of 253 c/s. Set the RANGE MARKS key to 10M and the P.R.F. key to 250.▶

Note . . .

The p.r.f. switch on the marker unit (range) Type 27, supplying 5-mile range marks, must be set to 500.

(7)◀Adjust the 250 P.R.F. RANGE LIMIT control to a maximum range of approximately 280 miles. With the P.R.F. key set to 500 a range of approximately 120 miles should be obtainable using either 5-mile or 10-mile markers.▶

Note . . .

The p.r.f. switch on the marker unit (range) Type 27, supplying 10-mile range markers must be set to 250.

(8) Adjust the SCAN CENTRE control so that the origin of the trace is stationary. Readjust the T.B. AMP. control if necessary.

(9) Set the TRACE COMP control to give an even illumination along the whole length of the trace (when rotating at the normal operational speed). Adjust the BRIGHTNESS control if necessary.

(10) Set the origin of the trace to the exact centre of the CRT (defined by the point of inter-section of the crossed lines on the underside of the cursor). The shift controls should give an overall movement of 4·5 cm. plus or minus 1 cm. around the centre of the CRT. Check that the SCAN CENTRE control is set to give the least possible movement of the trace origin. Any such movement should be less than 1 mm. (*i.e.*, within the boundaries of the square defined by the crossed lines on the top of the cursor). Finally rotate the azicator cursor, checking the position of the origin of the trace against the cursor at 90 deg. intervals.

Head combining

26. (1) With the timebase rotating, switch the head combining on (AE.COMB. switch).

(2) Check that when the OFF-CENTRE AND SECTOR control is set to 360 deg., the trace is reversed at 90 deg. and 270 deg. (plus or minus 2 deg.).

(3) Check that when the OFF-CENTRE AND SECTOR control is set to 90 deg., the trace is reversed at 360 deg. and 180 deg. (plus or minus 2 deg.). If the trace shows lateral displacement at the reversal points, the armature of relay RL6, in the timebase unit Type 129, should be adjusted until no displacement occurs at reversal.

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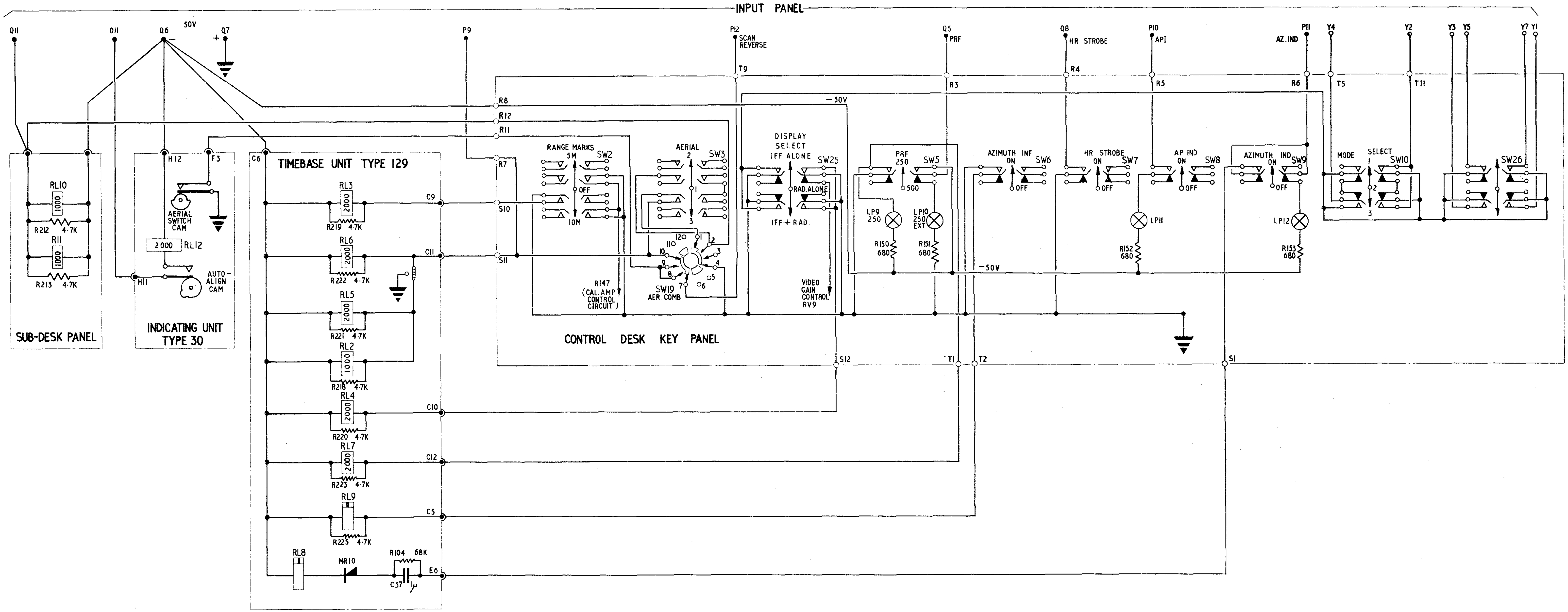

AIR DIAGRAM
6111M/MIN.
ISSUE 2 PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Console 60 -50V interconnections

Fig.1

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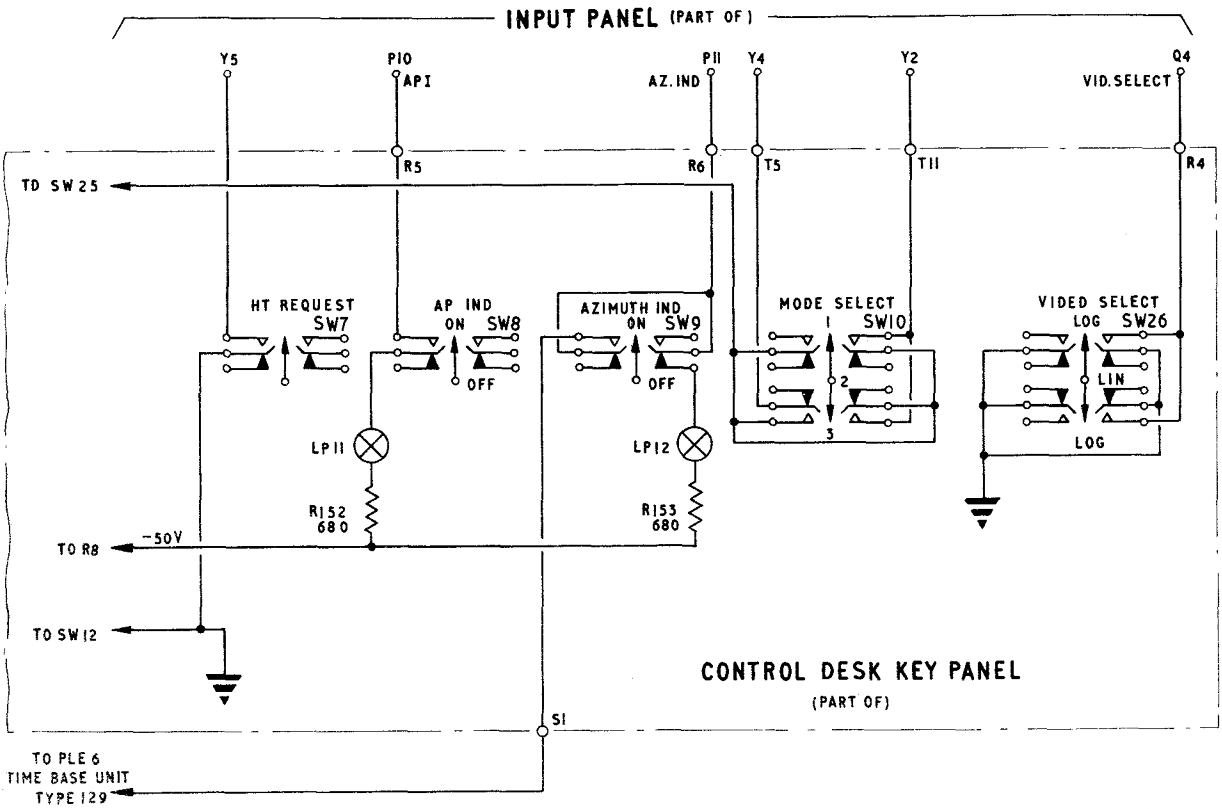
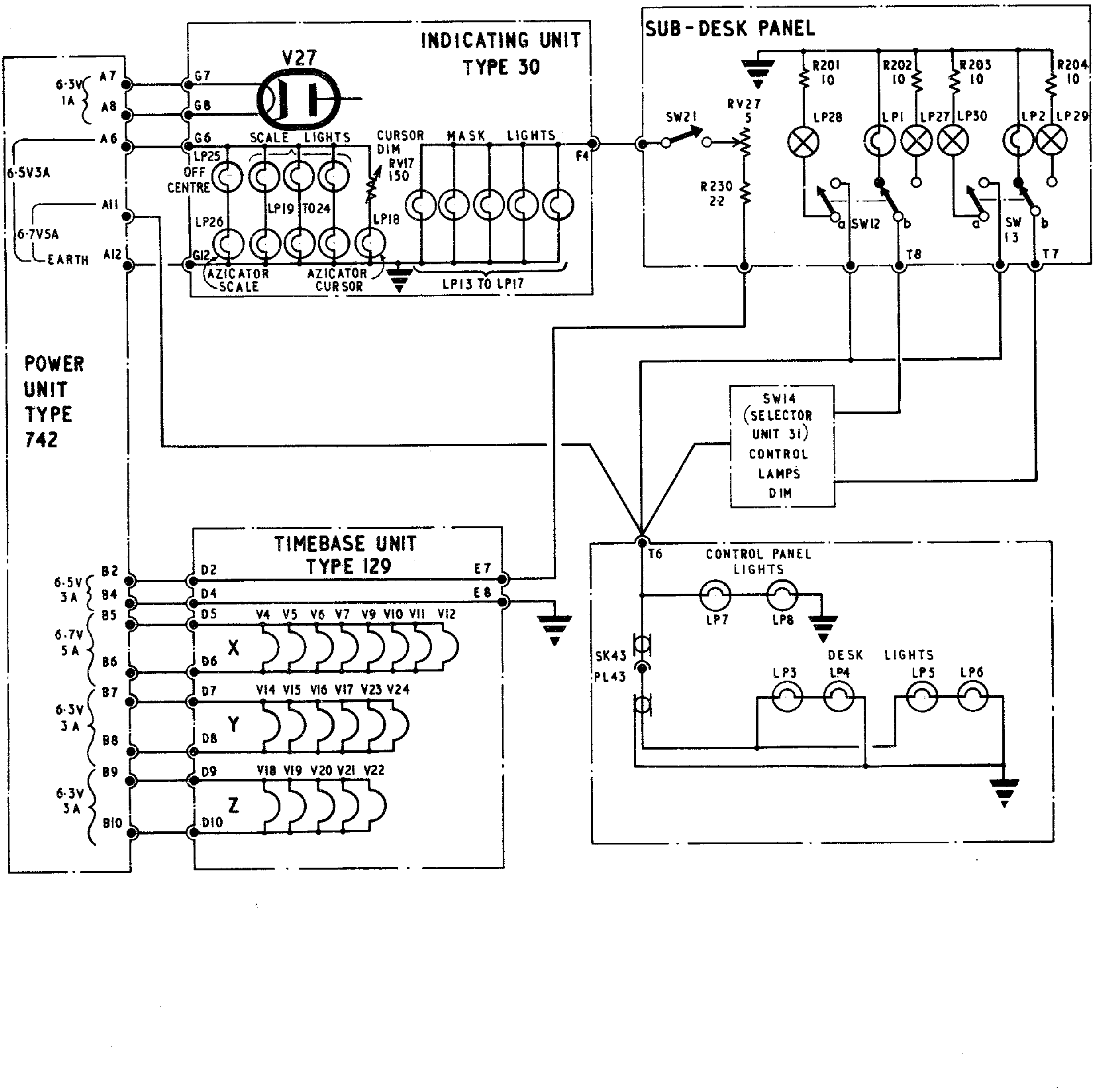


Fig. 1a — Console 60 (special) – modified 50V interconnections — Fig. 1a



Console 60 — low voltage A.C. interconnections Fig. 2

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