Chapter 13

INDICATING UNIT TYPE 277

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LIST OF ILLUSTRATIONS

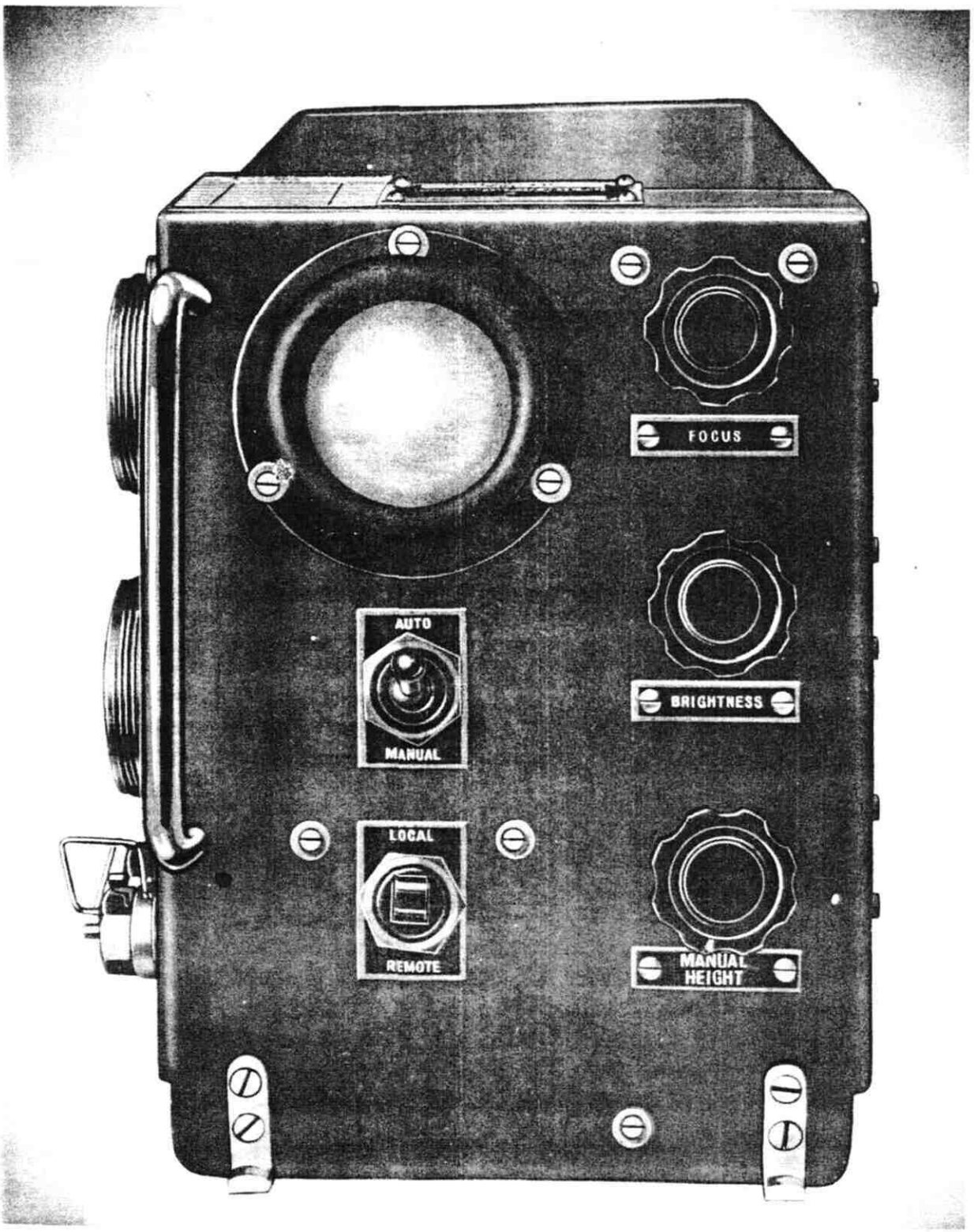

Fig. 1. INDICATING UNIT, TYPE 277: FRONT PANEL

GENERAL

Introduction

1. Indicating unit, Type 277 is designed for use as a monitor when setting-up the receiver in an aircraft. The unit is mounted near the receiver and is connected between it and junction box, Type 341. A small CRT (diameter 1½ in.) is used for the display which consists of an 8 nautical mile horizontal timebase with signals and markers displayed as vertical deflections.

2. The unit also contains an AUTO/MANUAL switch and a MANUAL HEIGHT control which are duplicates of those mounted on indicating unit, Type 300. A LOCAL/REMOTE switch on indicating unit, Type 277 enables either set of controls to be brought into circuit.

3. Without the use of this indicator the setting-up of a receiver in an aircraft would be difficult because of the distance between indicating unit, Type 300 (in the navigator's compartment) and the receiver (stowed amidships).

General description

4. A block schematic of the unit is given in *fig.* 2 and a circuit diagram in fig. 10. The 20 μs priming pulse is fed to the *violet* Pye plug and the leading edge of this pulse is used to trigger the scan generator. The first stage of the scan generator is a Miller valve which produces a linear voltage run-down at its anode. The outputs from the anode of this valve and a paraphase valve are fed to the X plates of the CRT to generate the straight line timebase. The rate of anode run-down and consequently the duration of the timebase can be varied

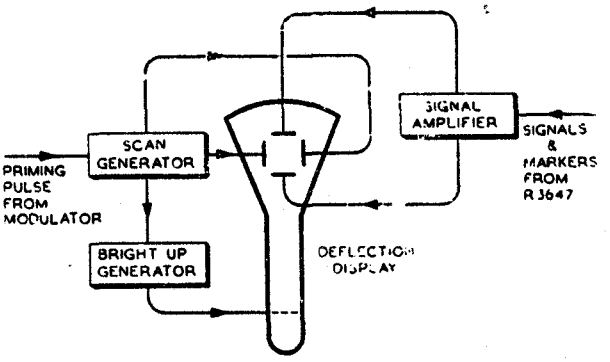

Fig. 2. Block schematic

by altering the value of the Miller feedback condenser.

5. A positive square wave of the same duration as the run-down is fed from the screen grid of the Miller valve to the grid of the CRT. This waveform is used to brighten up the timebase for the period of the working stroke.

6. Signals and markers are fed from the *orange* Pye plug on receiver, Type R.3647 (Chap. 7) via the *white* Pye plug to a cathode-coupled amplifier in indicating unit, Type 277. The paraphase outputs from the anodes of the amplifier valves are fed to the Y plates of the CRT, the signals and markers consequently appearing as vertical deflections of the timebase.

7. All supplies to the receiver pass through indicating unit, Type 277; this enables the duplicate AUTO/MANUAL switch and MANUAL HEIGHT control, together with the LOCAL/REMOTE changeover switch, to be introduced without adding to the complexity of the cabling.

CIRCUIT DESCRIPTION

Scan generator

8. The scan generator consists of a Miller valve (V1, VR91) and a paraphase valve (V2, VR91). The generator (*fig.* 3) is triggered by the 20 μs priming pulse which is fed from junction box, Type 326 to the *violet* Pye plug on the unit and thence through C1 (0·1 μF) to the suppressor grid of V1.

9. Immediately before the priming pulse the grid of V1 is trying to rise in potential as it is tied through R5 (1M) to the +330V line. The diode V5 (VR92, however, limits its rise to a potential (approximately +50V) set by the potentiometer chain R6 (100K) and R7 (18K) between +330V and earth. The cathode also rises with the grid due to current flow through R2 (4·7K) and sits a few volts above it. The suppressor will be approximately 50 volts lower than the cathode as it is returned to earth through R1 (820K). The valve is consequently cut off on its suppressor with the whole of the valve current going to the screen. The anode is at a steady potential of 470 volts.

10. The 50V positive priming pulse (*fig.* 4*a*)

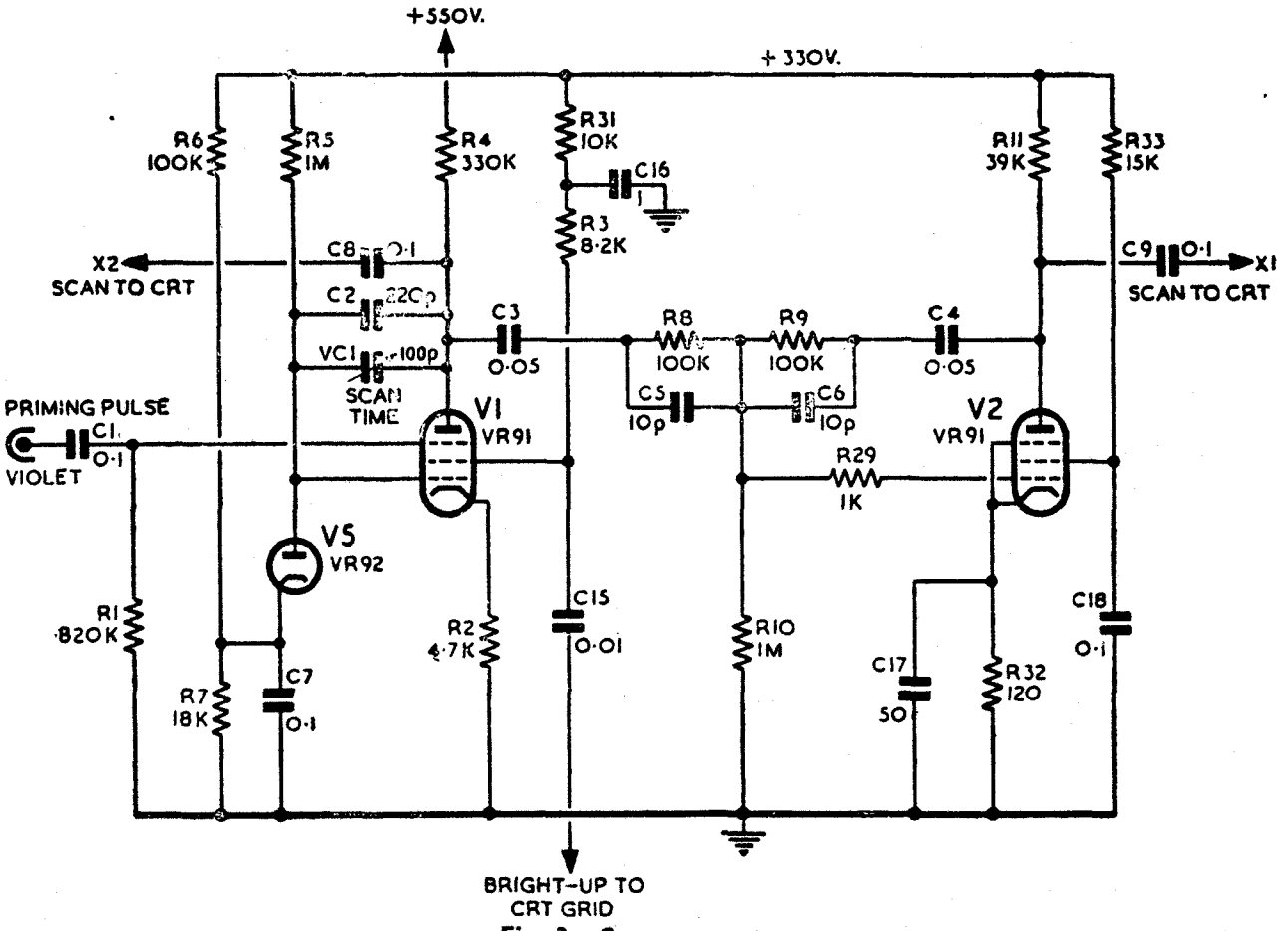

Fig. 3. Scan generator

increases the suppressor potential sufficiently to let anode current flow. The anode potential consequently falls and this fall is fed back to the grid through VC1 (100 pF) and C2 (220 pF) in parallel. The anode and grid fall together, almost instantaneously, until an equilibrium position is reached with the grid just above cut-off. The grid now tries to rise towards +330V through R5 but the consequent fall at the anode is fed back to slow down this rise. The normal Miller run-down ensues, with a time-constant dependent upon the values of C2, VC1, and R5, until the anode " bottoms," when any further increase in the valve current is taken by the screen.

11. At the beginning of the anode run-down the suppressor is held at +50V by the priming pulse. When this pulse ends the suppressor falls to zero V., but this does not cut off the anode current as the cathode potential has fallen because of the fall in grid potential and the consequent decrease in the current through the valve. When the anode " bottoms " the feedback to the grid ceases and the latter is free to rise. The cathode potential rises sharply with that of the grid and soon reaches a value sufficient to cut off the valve on its suppressor. Anode current is cut off and the anode rises exponentially with a time constant determined by C2, VC1, and R4 to its original steady value. The grid rises almost instantaneously (*fig.* 4*c*) to +50V at which potential it is caught and held by the diode V5.

12. Before the arrival of the priming pulse at the suppressor the screen of V1 is taking most of the valve current as the anode is cut off. The fall in anode voltage, which is fed back to the grid, causes the screen current to fall and its potential to rise sharply. When the anode " bottoms " the screen takes more current, and as the suppressor quickly cuts anode current off the screen potential falls rapidly to its original level. The resulting square wave (*fig.* 4*d*), which is of the same duration as the run-down, is fed to the grid of the CRT to brighten up the working stroke of the timebase.

13. In order to generate balanced waveforms for application to the X plates of the CRT, V1 and V2 are connected in a form

of floating paraphase circuit. The output from the anode of V1 (*fig.* 4*b*) is stepped down in amplitude and applied to the grid of V2 by condenser C3 (0·05 μF), and resistor R8 (100K) in parallel with condenser C5 (10 pF). The anode of V2 is coupled back to the grid through R9 (100K) in parallel with C6 (10 pF).

14. Before the start of the run-down V2 is conducting as its grid is held positive by the anode of V1. The run-down is fed from the anode of V1 to the grid of V2 (*fig.* 4*e*) and consequently causes the anode potential of V2 to run up (*fig.* 4*f*). As R8 and C5 are equal in value to R9 and C6 the ratio of the anode potentials of V1 and V2 is very nearly unity, and this ratio is practically independent of small variations in the amplification of V2. The feedback from the anode to the grid of V2 makes the amplification more linear. The anode of V1 is connected through condenser C8 (0·1 μF) to the X2 plate of the CRT, and the anode of V2 through condenser C9 (0·1 μF) to the X1 plate.

15. The duration of the run-down at the anode of V1 is controlled by the setting-up of the variable condenser VC1 (SCAN TIME). This control enables the length of the scan ("*l*" in *fig.* 4*b*) to be varied between 100 and 150 microseconds.

Signal amplifier

16. Signals and markers from the signal and marker output stage in the receiver are fed to the signal amplifier in indicating unit, Type 277 via the *orange* Pye plug on the receiver and the *white* Pye plug on the indicator.

17. Valves V3 and V4 (VR 91) form a cathode-coupled paraphase amplifier (*fig.* 5) the cathodes being connected together by the variable resistor VR1 (1K) and returned to earth through individual but equal loads (R13 and R14, each 1·5K). The anodes of V3 and V4 are connected through equal resistances (R15 and R16, each 15K) to a decoupled HT supply derived from the +550V line by R18 (15K) and C10 (0·1 μF). The screen grids are also connected to this supply through the common load R17 (12K). The signal input (negative) is applied to the grid of V3 which is returned to earth through R12 (1M); the grid of V4 is directly connected to earth.

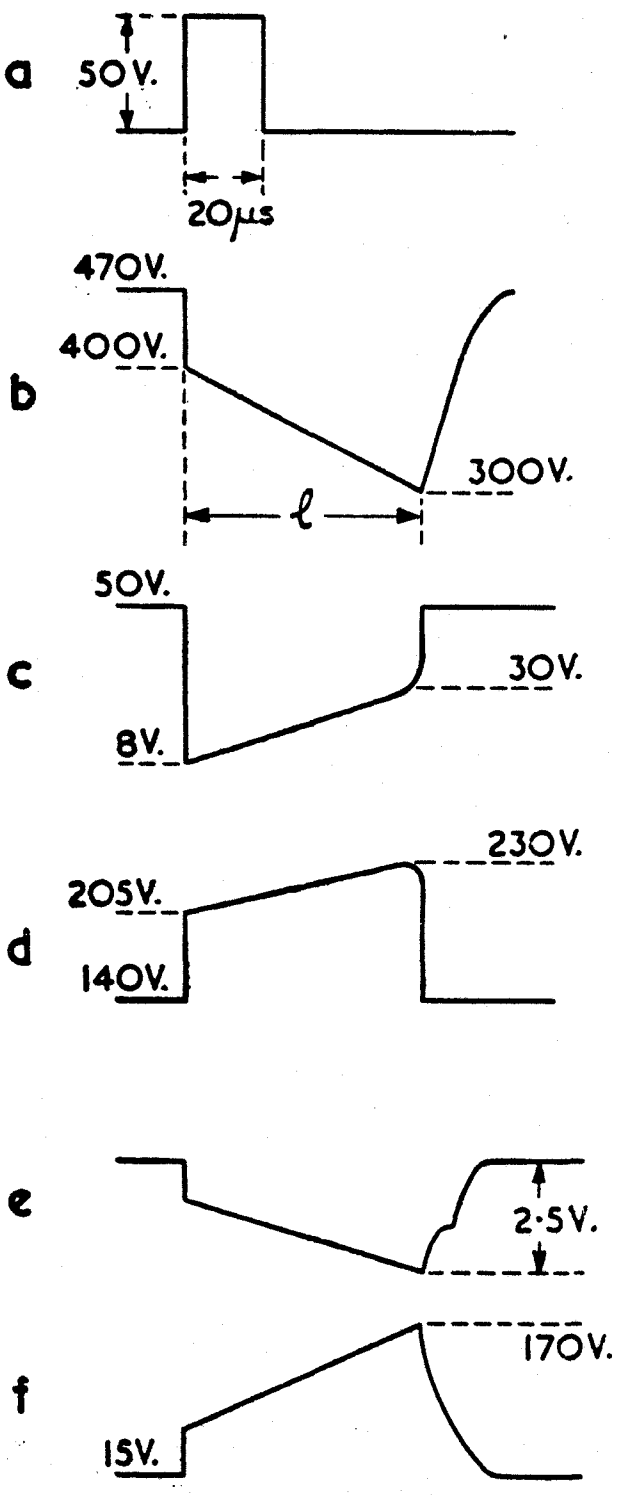

Fig. 4. Scan generator waveforms

18. When VR1 (GAIN) is reduced to zero (fully clockwise) the cathodes of V3 and V4 are at the same potential and the gain of the amplifier is at maximum. A negative signal at the grid of V3 appears as a positive amplified signal at the anode. The decrease in current through the valve lowers the

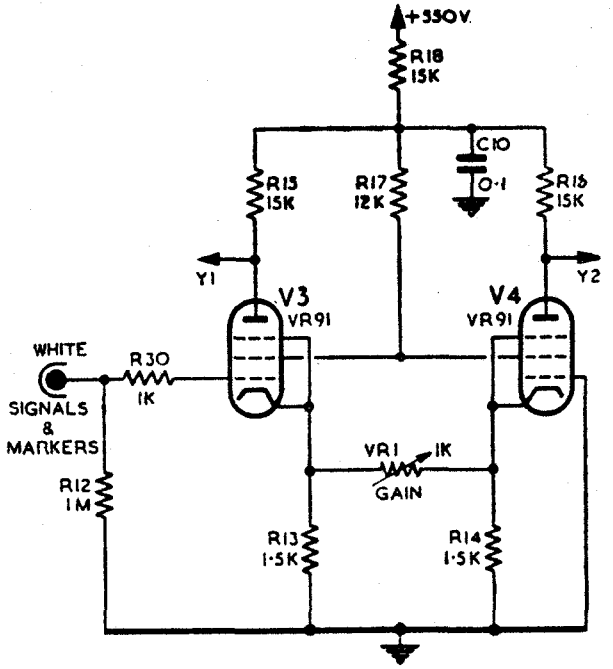

Fig. 5. Signal amplifier

cathode potential of both V3 and V4 consequently increasing the grid-cathode potential of V4 as the grid is held at earth. This gives rise to a negative output from the anode of V4 and the circuit is so designed that this output is approximately equal in amplitude to that from the anode of V3. As VR1 is turned anti-clockwise, negative feedback is introduced and the gain of both valves is reduced.

19. The paraphase outputs from the anodes of V3 and V4 are fed to the Y1 and Y2 plates respectively of the CRT.

CRT circuit

20. The cathode ray tube used in indicating unit, Type 277 is a CV1597 with a tube face $1\frac{1}{2}$ in. in diameter and a British Standard 9-pin base.

21. Voltage supplies for the electrodes of the CRT are obtained from a potentiometer chain (*fig.* 6) between +550V and —300V, the value of the supply to the focusing anode being controlled by VR2 (FOCUS), and of that to the cathode, by VR3 (BRIGHTNESS).

22. The average potential of the X1 plate is determined by the resistors R19 (560K) and R21 (1·8M) between +550V and the cathode; the X2 plate is returned to +550V through R20 (1M). The bright-up waveform from the screen of V1 (*para.* 12) is DC-restored to the potential of the slider of VR3 by the diode V6 (VR78) and applied to the grid of the CRT.

Power supplies

23. All the HT supplies for the indicator are fed to it from the power units *via* junction box, Type 341. Filament supplies are obtained from transformer T1 which has two secondaries delivering 4V. at 1A. for the CRT and V6, and 6·3V. at 1·5A. for the rest of the valves in the unit; the latter supply has one side earthed.

24. The current drawn from the supplies by an average indicator is as follows:—

Supply	*Drain*
80 V. AC	200 mA.
+550 V.	11 mA.
+330 V.	11 mA.
— 300 V.	1 mA.

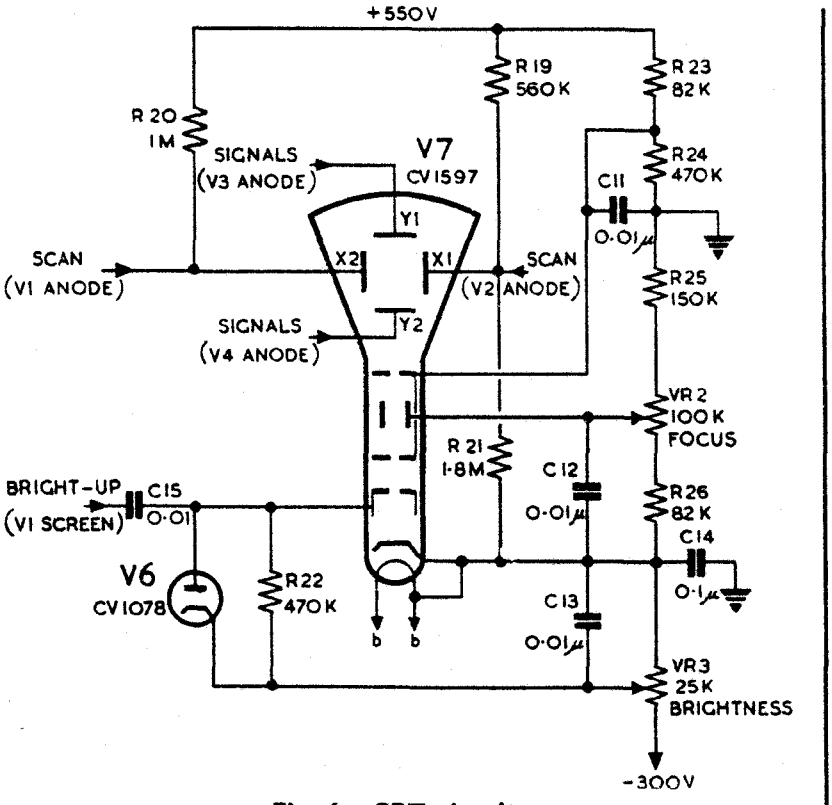

Fig. 6. CRT circuit

Operator's controls

Duplicate receiver controls

25. As stated in *para.* 2, indicating unit, Type 277 contains an AUTO/MANUAL switch and a MANUAL HEIGHT control which are duplicates of those mounted on indicating unit, Type 300 and used for controlling the action of the strobe searching generator in the receiver (*Chap.* 7). A LOCAL/REMOTE switch, also mounted on indicating unit, Type 277, enables either set of controls to be brought into circuit. The circuit of the duplicate controls and of the LOCAL/REMOTE switch is shown in *fig.* 7.

26. When the LOCAL/REMOTE switch is in the *remote* position the action of the strobe searching generator is controlled from indicating unit, Type 300 and the controls on indicating unit, Type 277 are out of circuit. If the AUTO/MANUAL switch on the former unit is in the *auto* position, relay RY1 in the receiver is unoperated, and the voltage at the anode of the strobe searching generator, and consequently the position of the height marker, is determined by the strobed rectifier (*Chap.* 7, *para.* 42). If the switch is in the *manual* position relay RY1 is operated and the voltage at the anode of the strobe searching generator is determined by the setting of VR8 (MANUAL HEIGHT) in indicating unit, Type 300; the receiver circuit now operates as described in *Chap.* 7, *para.* 44.

27. When the LOCAL/REMOTE switch is in the *local* position the controls on indicating unit, Type 300 are out of circuit and the strobe searching generator is controlled from indicating unit, Type 277. The action of the AUTO/MANUAL switch and MANUAL HEIGHT control on the latter unit is, however, the same as described in *para.* 26. The MANUAL HEIGHT control (VR4) is connected in a resistance chain (R28, 180K; VR4, 500K; R27, 390K) between the "3h" potential and —150V which is identical with the chain in indicating unit, Type 300.

28. For normal operation in flight the LOCAL/REMOTE switch is kept in the *remote*

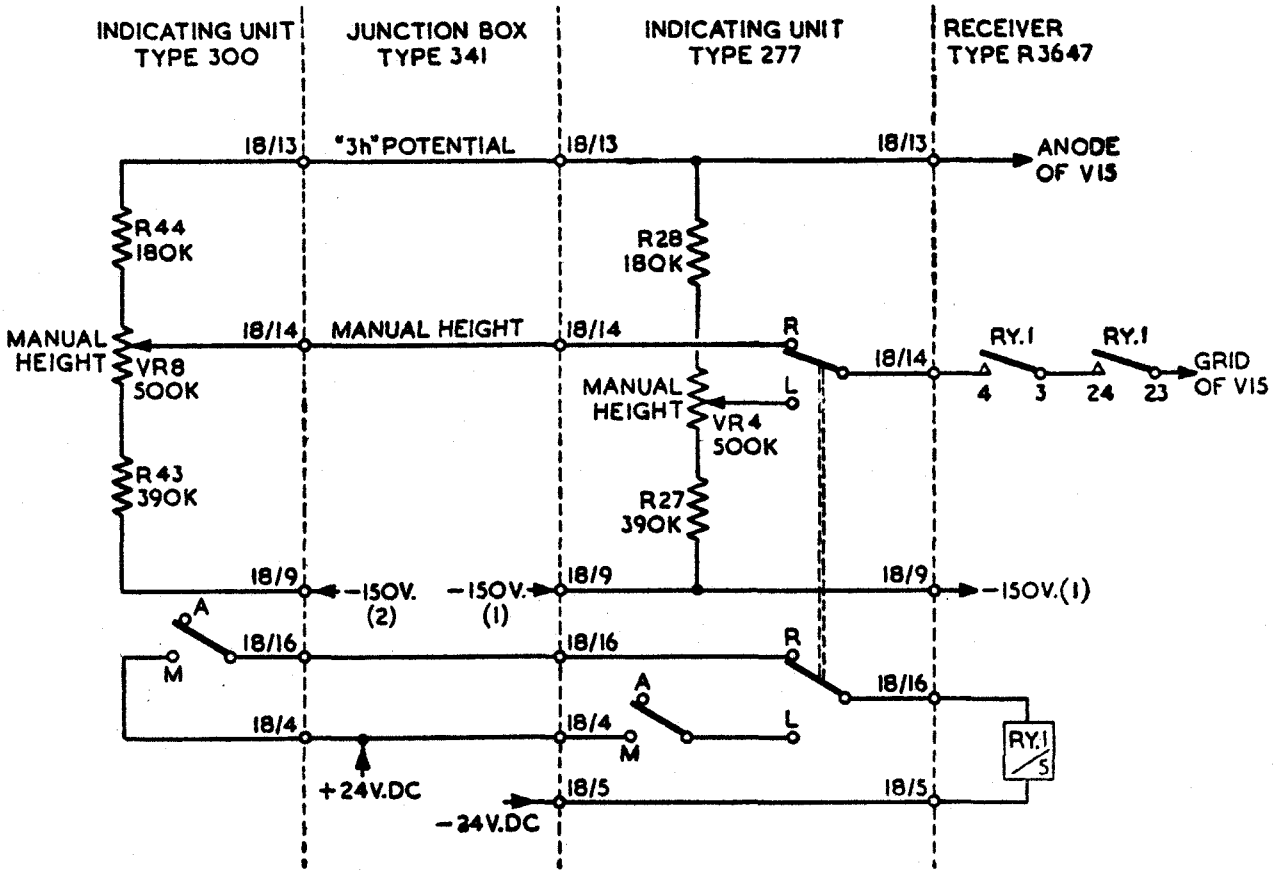

Fig. 7. Circuit of the local/remote switch

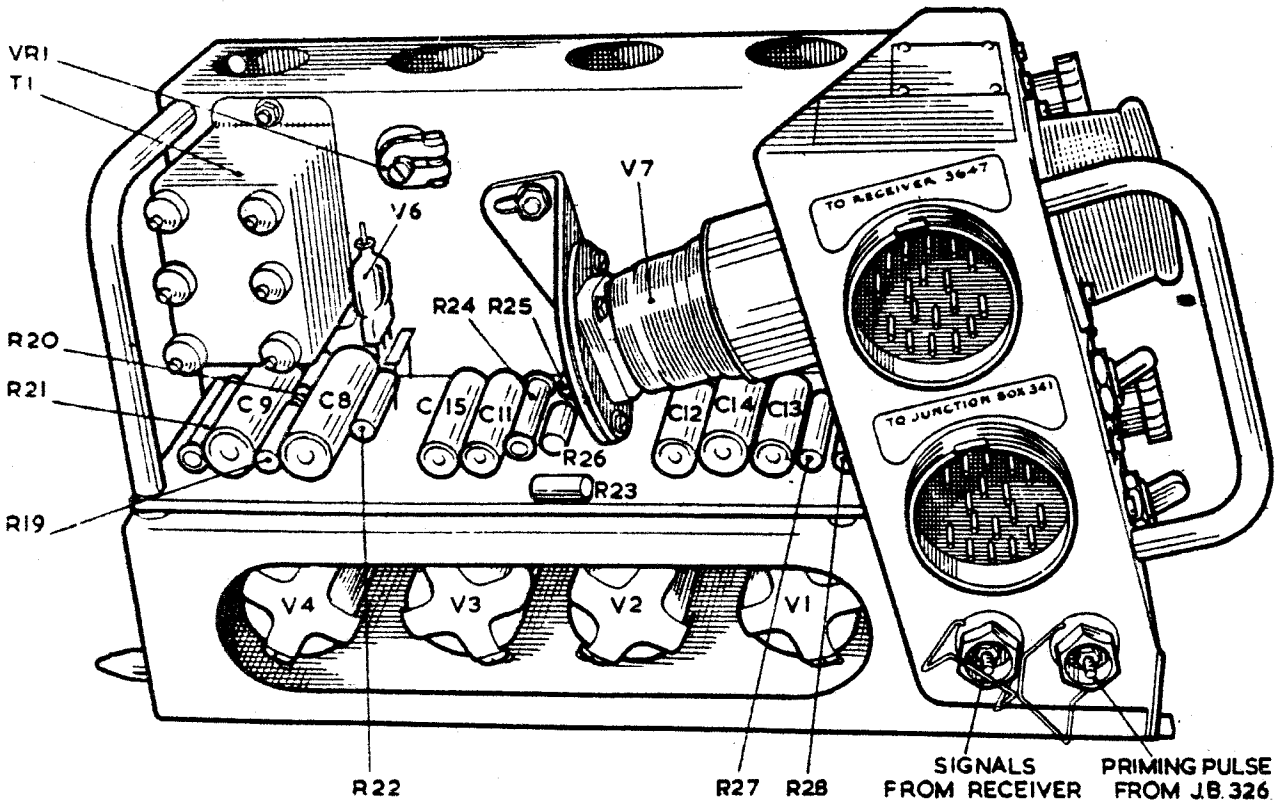

Fig. 8. Indicating unit, Type 277 : left-hand side of chassis

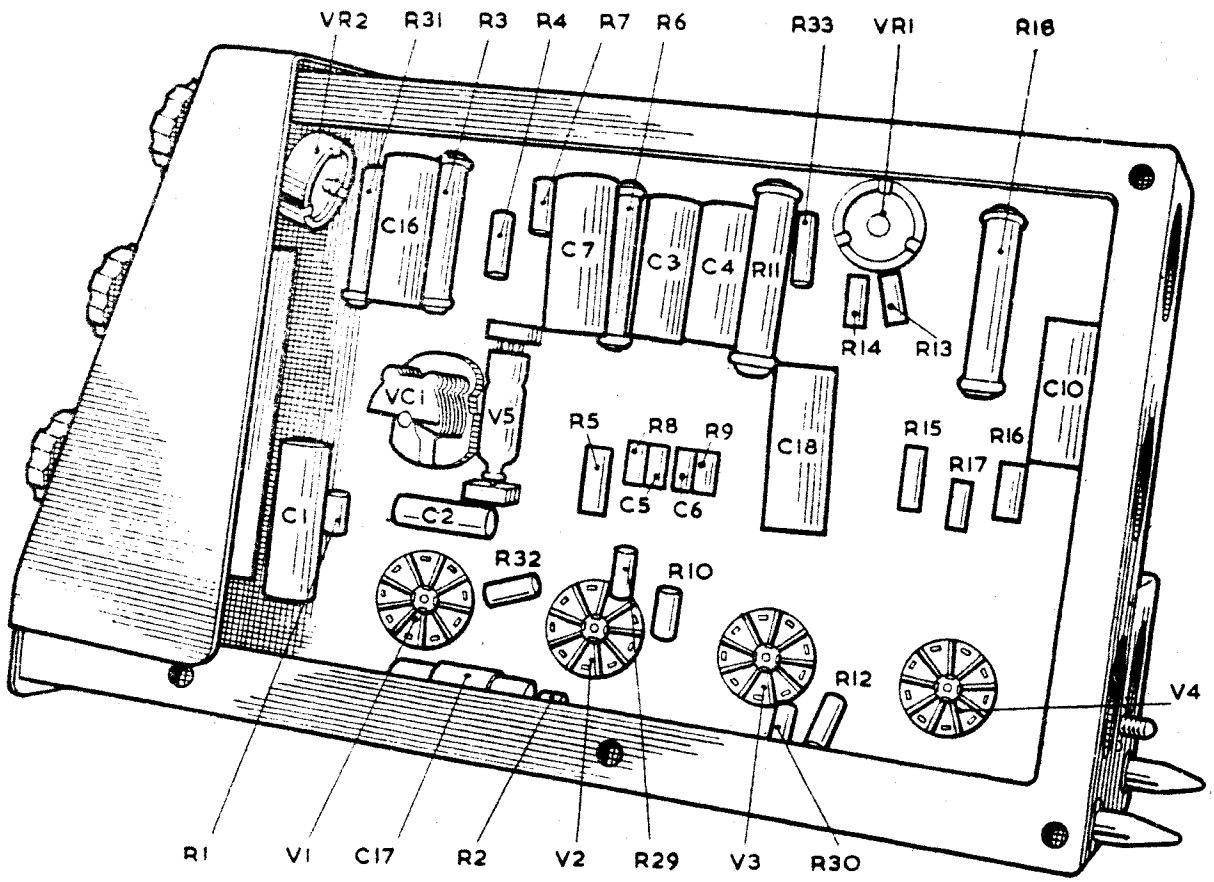

Fig. 9. Indicating unit, Type 277 : right-hand side of chassis

position and the controls on indicating unit, Type 300 are used. When setting-up the receiver in an aircraft, however, the switch is put in the *local* position and the controls on indicating unit, Type 277 are used.

Focus and brightness controls

29. The operator can vary the presentation on the CRT by means of the FOCUS (VR2) and BRIGHTNESS (VR3) controls which are mounted on the front panel of the indicator.

Pre-set controls

Gain control

30. The variable resistor VR1 (GAIN) should be so set that, with an input amplitude of 4V. at the *white* Pye plug, calibration pips are 5 mm. high as seen on the face of the CRT.

Scan time control

31. The variable condenser VC1 (SCAN TIME) should be set so that when the ½-mile calibration pips are fed in from test set, Type 296 (connected to the receiver) the timebase is just long enough to allow 16 pips to be visible on the CRT face.

Connections

32. Indicating unit, Type 277 is connected between junction box, Type 341 and receiver, Type R.3647. The two 18-way W plugs are both coloured *white* but are labelled with their destinations on the unit; most of the pins are directly cross-connected. The unit also has two Pye plugs. Details of the connections are as follows:—

(1) Plug, Type W203; 18 way *white*, connected to junction box, Type 341.

Pins 1 and 2	80 V., 2,000 c/s
Pin 3	Earth
Pin 4	+24 V. DC
Pin 5	−24 V. DC
Pin 6 (AL24)	+550 V(2)
Pin 7 (AL24)	+330 V(2)
Pin 8	+200 V. (1) Stab.
Pin 9	−150 V. (1) Stab.
Pin 10 (AL24)	−300 V. (2)
Pin 11	" h " potential
Pin 12	" h sec β " potential
Pin 13	" 3h " potential
Pin 14	Manual height voltage from indicating unit Type 300 if the AUTO/MANUAL switch on that unit is in the *manual* position.
Pin 15	Gain control voltage from indicating unit, Type 300 to the receiver.
Pin 16	+24 V. DC if the AUTO/MANUAL switch on indicating unit, Type 300 is in the *manual* position.
Pin 17	Screen voltage for the head amplifier in TR.3523E from the receiver.
Pin 18	Blank

(2) Plug, Type W203; 18-way *white*, connected to receiver, Type R.3647.

Pins 1 and 2	80 V., 2,000 c/s
Pin 3	Earth
Pin 4	+24 V. DC
Pin 5	−24 V. DC
Pin 6	+550 V.(2) (AL24)
Pin 7	+330 V.(2) (AL24)
Pin 8	+200 V. (1) Stab.
Pin 9	−150 V. (1) Stab.
Pin 10	−300 V. (2) (AL24)
Pin 11	" h " potential
Pin 12	" h sec β " potential
Pin 13	" 3h " potential
Pin 14	Manual height voltage. If the LOCAL/REMOTE switch is in the *remote* position and the AUTO/MANUAL switch on indicating unit, Type 300 is in the *manual* position this voltage comes from the slider of VR8 (MANUAL HEIGHT) in the latter unit. If the LOCAL/REMOTE switch is in the *local* position and the AUTO/MANUAL switch on indicating unit, Type 277 is in the *manual* position the voltage comes from the slider of VR4 (MANUAL HEIGHT) on indicating unit, Type 277.

Pin 15 — Gain control voltage from indicating unit, Type 300 to the receiver.

Pin 16 — +24 V. DC if the LOCAL/REMOTE switch is at *remote* and the AUTO/MANUAL switch on indicating unit, Type 300 at *manual*. Alternatively, also, if the LOCAL/REMOTE switch is at *local* and the AUTO/MANUAL switch on indicating unit, Type 277 is at *manual*.

Pin 17 — Sereen voltage for the head amplifier in TR.3523E from the receiver.

Pin 18 — Blank.

(3) Plug, Type 229; Pye *violet*; priming pulse from junction box, Type 326.

(4) Plug, Type 229; Pye *white*; signals and markers from the *orange* Pye plug on receiver, Type R.3647.

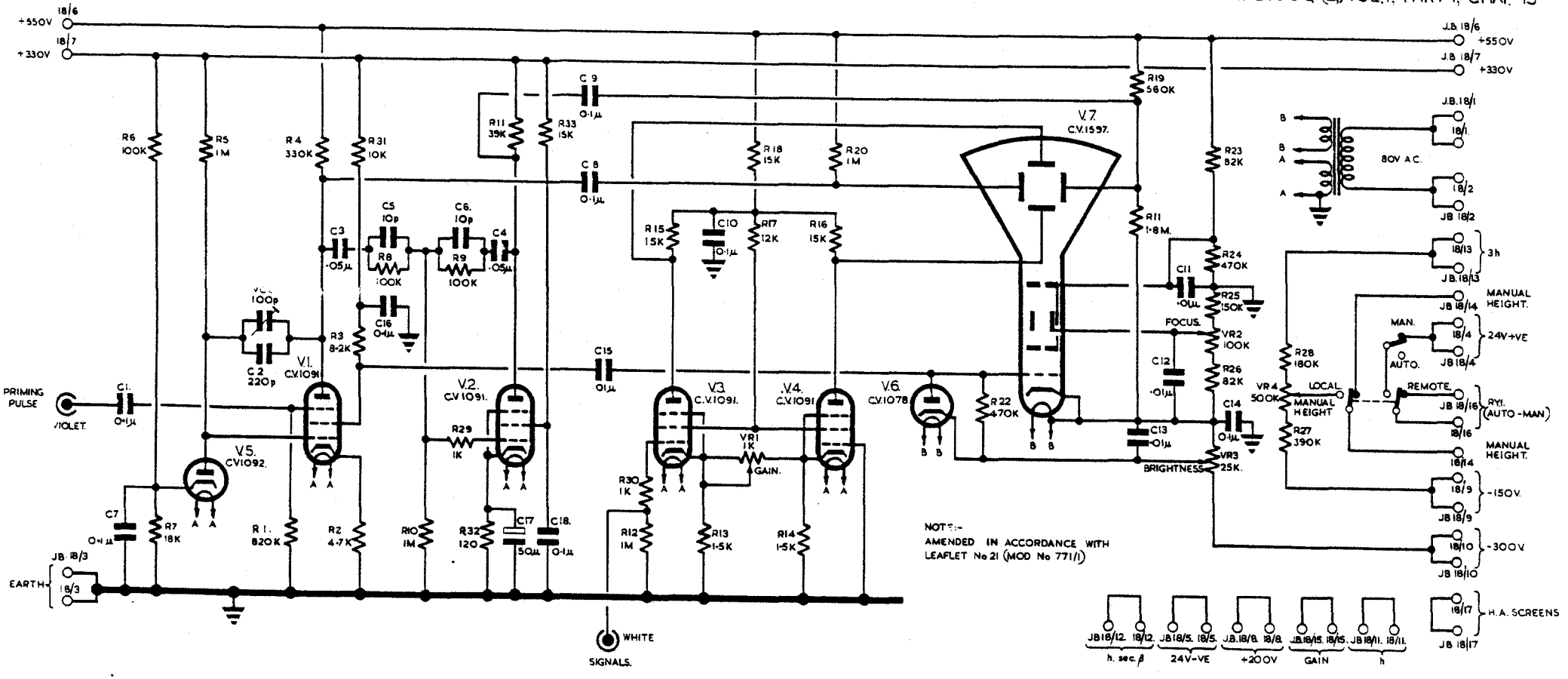

FIG. 10

INDICATING UNIT TYPE 277: CIRCUIT

FIG. 10

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