Low flying aircraft

Fig 1.

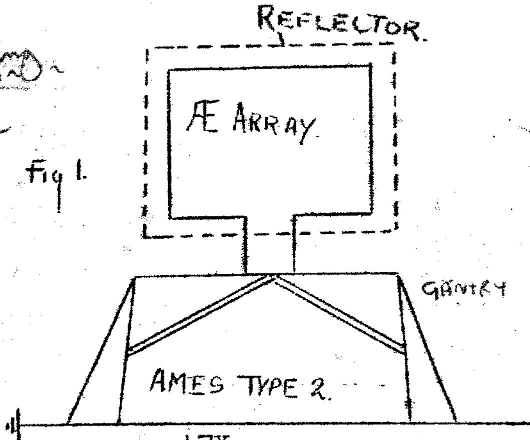
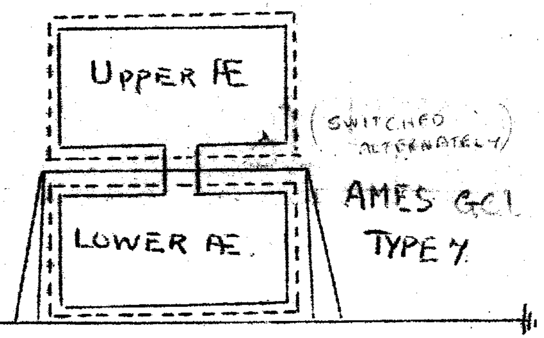


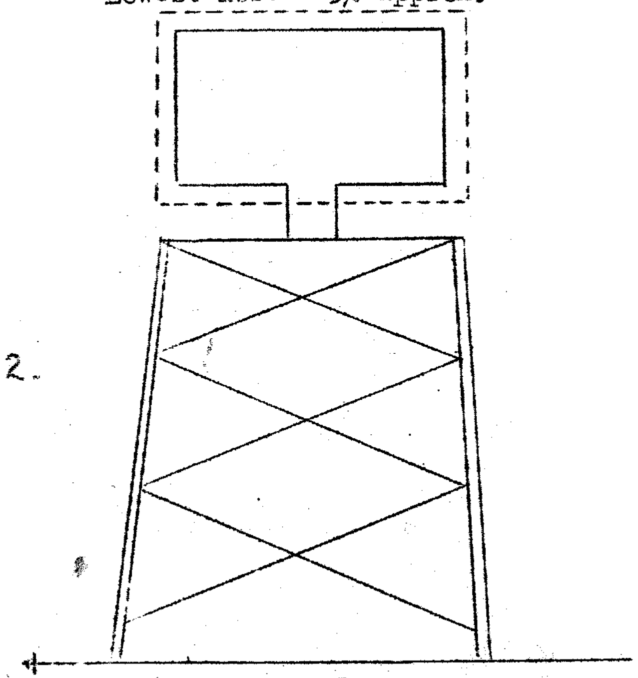
Fig 3.



Type 2. $\frac{47X}{h} = \frac{47 \times 1.5}{20}$

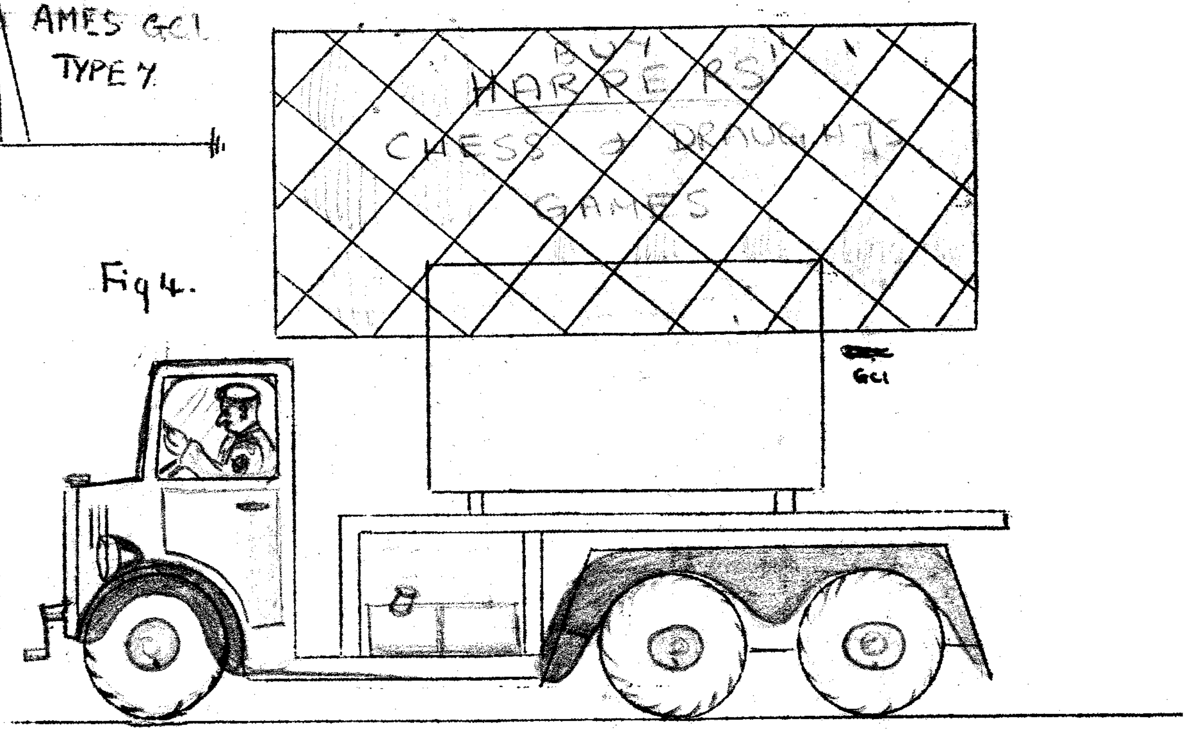
Lowest lobe = 3% approx.

Fig 2.



A.M.E.S. Type 5 Lowest lobe - Sea level
Can be used for surface searching in absence of C.H.E.L (10cms. Search Equipment)

Fig 4.



A.M.E.S. Type 15 Aerial Vehicle.

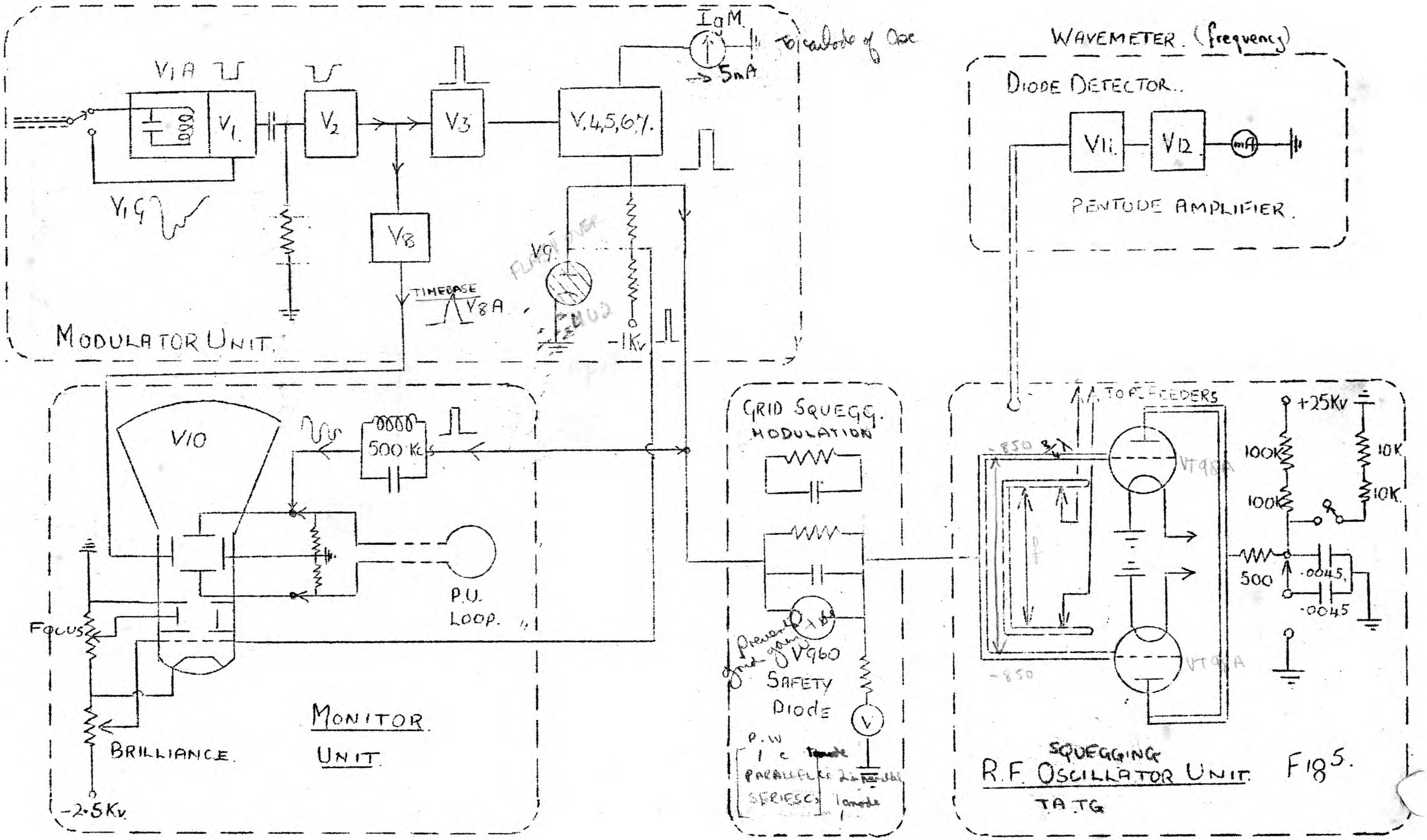


Fig 5.

ANODE SQUEGG PREVENTS DOUBLE PULSING & SHAPES PULSE

C.H.L. - G.C.I.

T3079 and R3202
General Requirements.

1. To provide an "early warning" of the approach of medium and low flying aircraft.
2. To provide an "early warning" together with a means of determining the height of approaching aircraft, to enable interception to be made.

Types of Stations.

(a) A.M.E.S. Type 2. (C.H.L.). Sited near coast, so that in conjunction with other stations, a complete defence against medium and low flying aircraft is achieved. (These stations are in association with A.M.E.S. Type 1 (or C.H.) which give cover against high flying attacks but are unsuitable to give low angle coverage.

(b) A.M.E.S. Type 5 (C.H.O.L.). Chain Overseas Low. Similar to A.M.E.S. Type 2, used overseas.

(c) A.M.E.S. Type 7 (G.C.I). Ground Controlled Interception - includes height finding.

(d) A.M.E.S. Type 15. Mobile version of (a),(b) and (c).

Aerial Systems.

All use co-linear stacked arrays of λ/2 end fed dipoles.

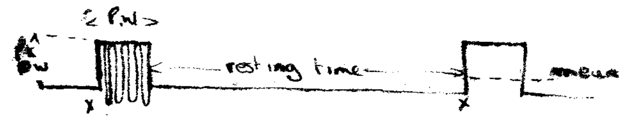
A.M.E.S. Type 2 - Aerial system mounted on 24' gantry, rotated by B.T.H. Turning Gear. (No height-finding facilities). Fig.1.

A.M.E.S. Type 5 - Aerial system mounted on 184' tower. Fig.2.

A.M.E.S. Type 7 - Mounted on a gantry with two arrays, (See Fig.3.), which are energised simultaneously when transmitting, but for reception purposes, the arrays are switched alternately.

A.M.E.S. Type 15 - Aerial array mounted on a vehicle, which can be a prime mover or a trailer. Fig.4.

TRANSMITTER T 3079. (Used with C.H.L., G.C.I. and Type 15.).



Purpose : To produce high powered pulses.

Frequency : 193 - 215 mcs. (approx).

Power Output : 100 Kw. peak with 25 Kv. H.T. - Mean power 120 watts.
{Depends of PRF & pulse width used — Overall average mean power = PRF x PW x P

P.R.F. : 400c/s. Triggered either from Rx (external triggering), or from the modulator unit of the Tx (internal triggering).
{External 250c/s - 650c/s
{Internal 350c/s - 750c/s

Pulse widths : Capable of delivering pulses of either 3,5 or 8 u/secs. (Operational pulse normally 3 u/secs.).
{Searching (wide) & identifying (narrow)

(cont.)

Oscillatory Circuit. : Two directly heated triodes (CV 1580), connected in push-pull. Lecher bar tuned circuits, equivalent to TA - TG oscillator.

A heater is installed for use when the Tx is "standby" (i.e. set up but not operating.). This eliminates chance of breakdown due to dampness.

-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-

Action of Contactor Circuit

Operation 1. (Fig. 7)

1. Mains wall switch "ON". Amber indicating lamp glows. Power up to mains GATE switch.
2. Close GATE switch. Supply meter reads, meter lamps glow, fan motor turns. (Fil. Aux. closes with GATE switch.). Fan tilt switch closes.
3. Assuming modulator in position, power now up to FIL. 'ON' button. Action of closing GATE switch, also breaks "bleeder" circuit.

Operation 2. (Fig. 8)

FILS. 'ON'

1. Press FILS. 'ON' button. Operating coil 1 (OC1) energised, closing 1L and 1R contacts. AUX.1 opens and "holding" contacts for FILS. 'ON' close. All filaments now 'ON'; E.H.T. rectifiers and oscillator filaments at half-power. All HT supplies completed with exception of main E.H.T. and -1Kv.
2. Time Delay 1 mechanically started by operation of OC1.

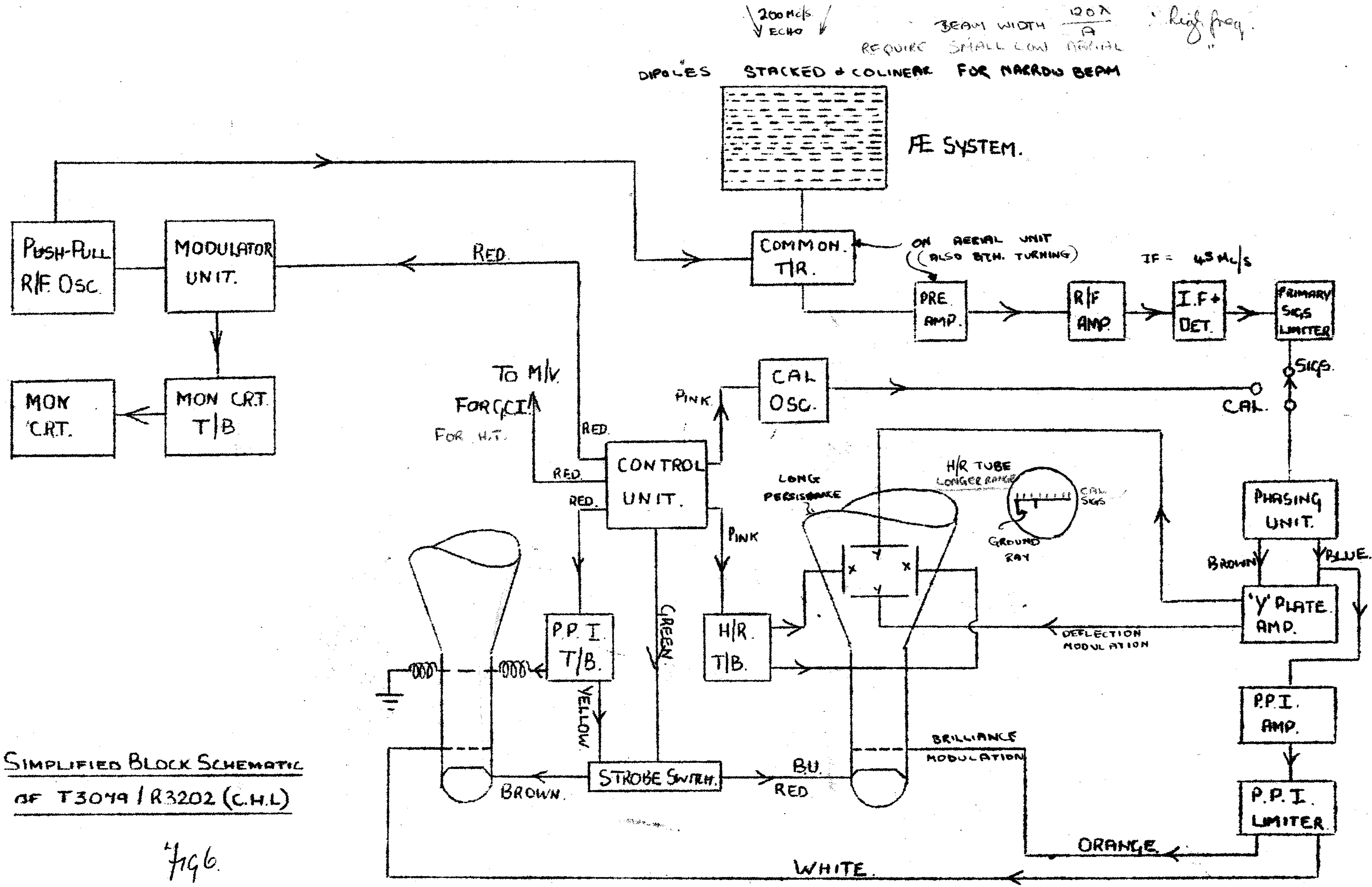
HEATER 'ON'

1. Press HEATER 'ON'. Operating coil 2 (OC2) energised, closing 2L and 2R contacts. AUX.2 opens, and "holding" contacts for HEATER 'ON' close.

Operation 3. (Fig. 9)

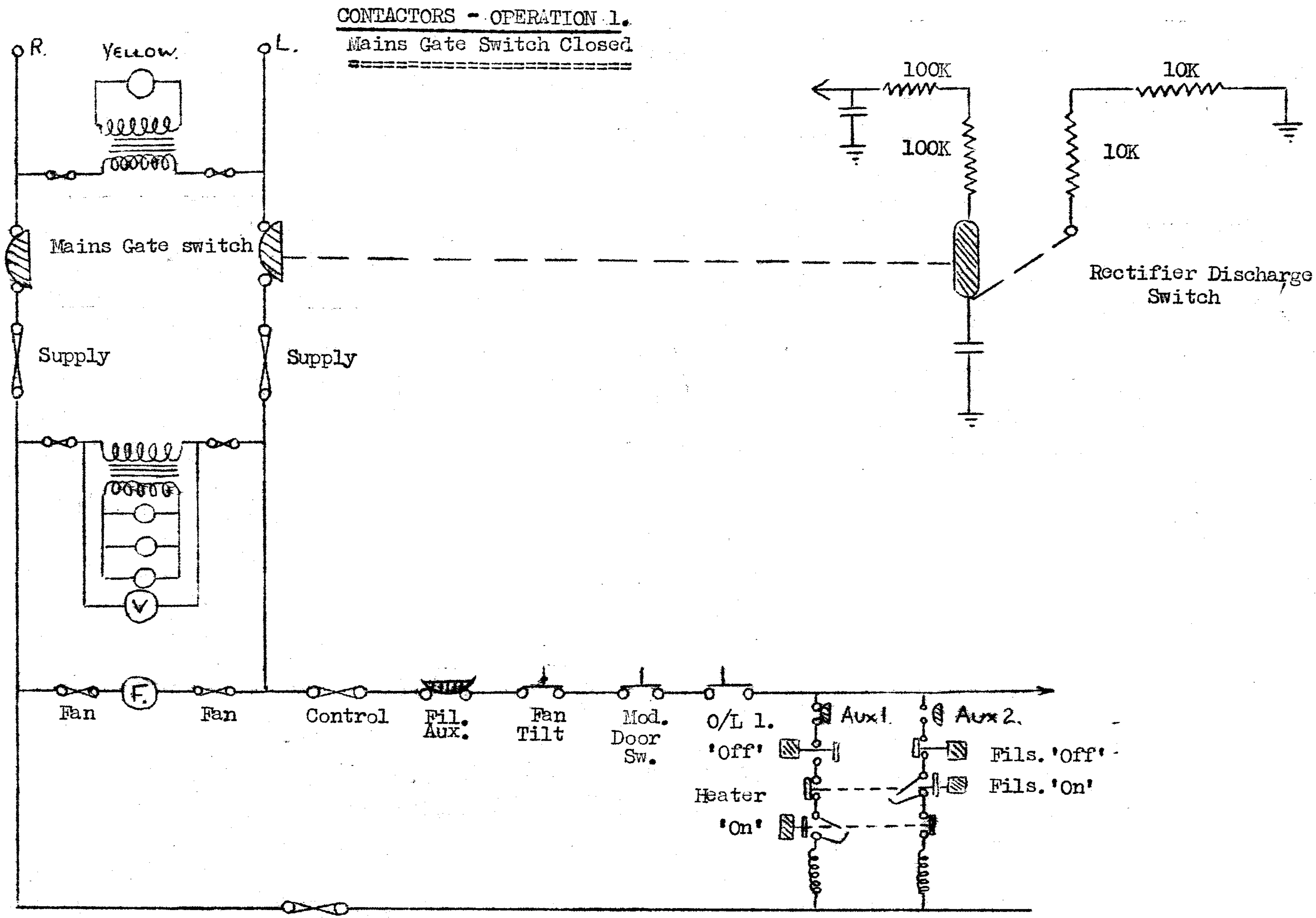
1. After 20 secs. (during which time oscillator and rectifier fils. heat up), TD1 closes, energising OC3 which closes 3L and 3R.
2. 3L contact short circuits half-power resistor, so that oscillator and rectifier filaments are now at "full" power. 3R contact completes supply to -1Kv power unit (HT Transformer)

(cont.)



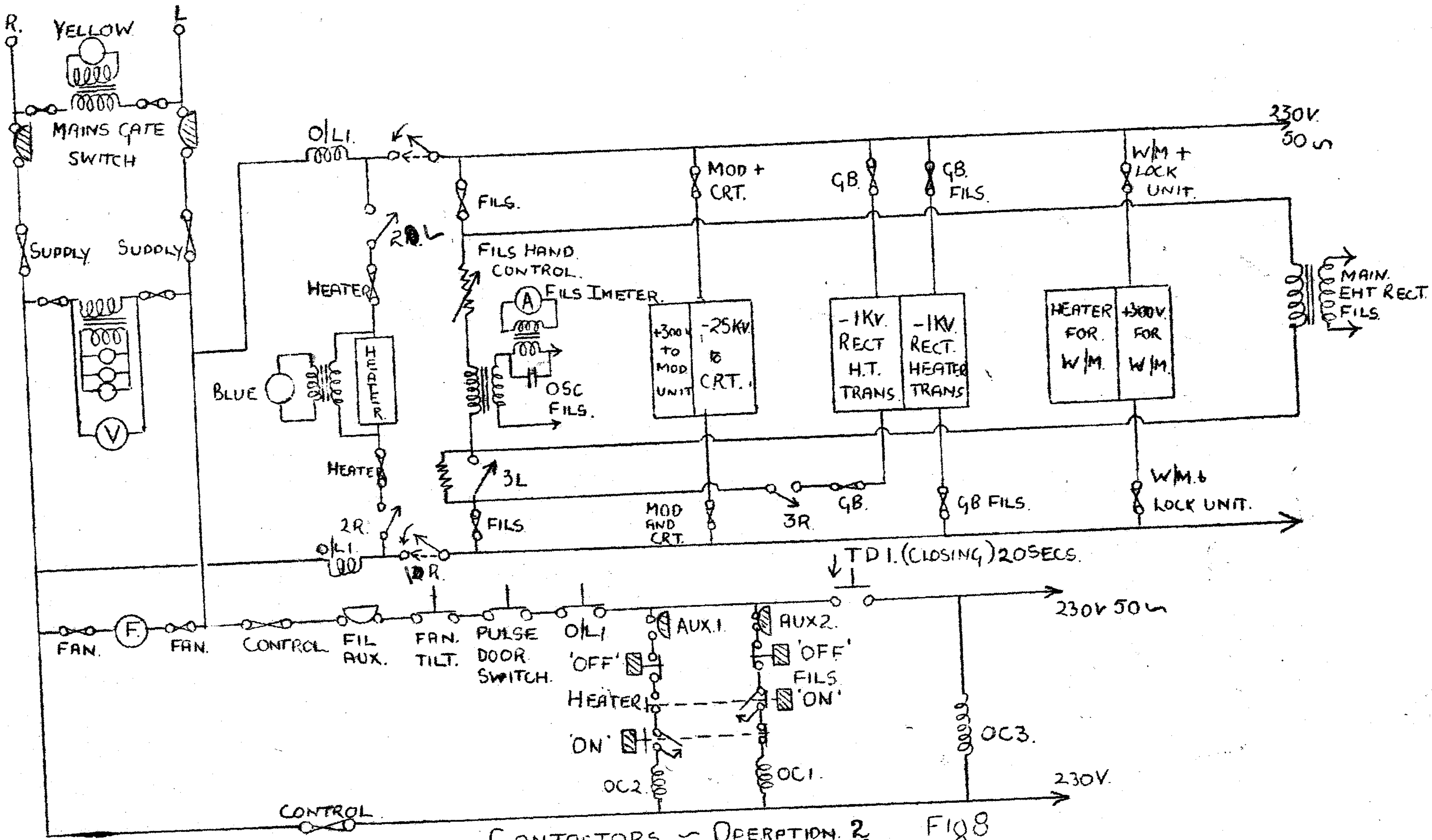
SIMPLIFIED BLOCK SCHEMATIC OF T3049 / R3202 (C.H.L)

Fig 6.



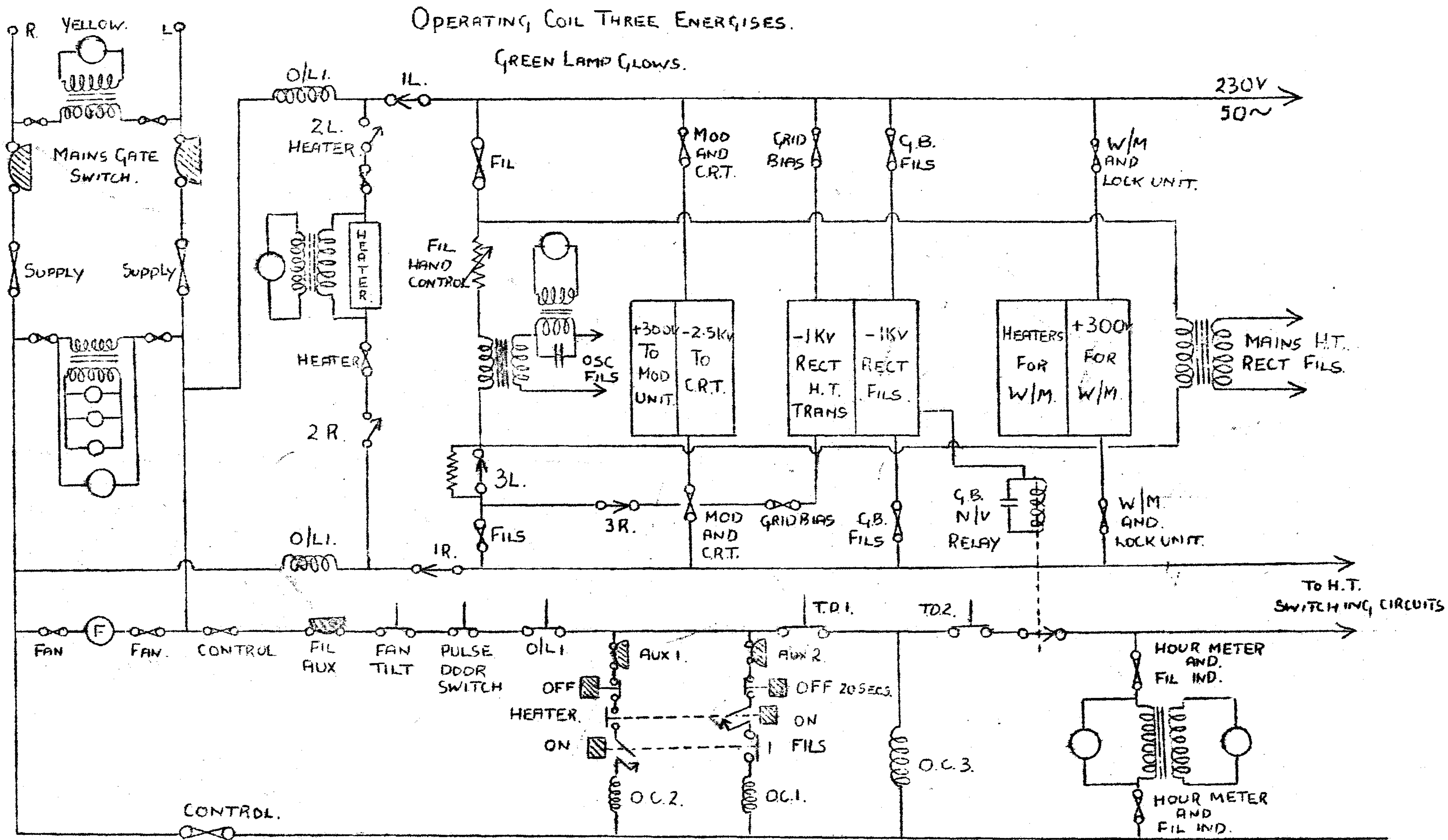
CONTACTORS - OPERATION 1.
Mains Gate Switch Closed
R.
YELLOW.
L.
100K
100K
10K
10K
Mains Gate switch
Rectifier Discharge Switch
Supply
Supply
F.
V
Fan
Fan
Control
Fil. Aux.
Fan Tilt
Mod. Door Sw.
O/L 1.
Aux 1
Aux 2.
'Off'
Fils. 'Off'
Fils. 'On'
Heater
'On'

Fig. 7



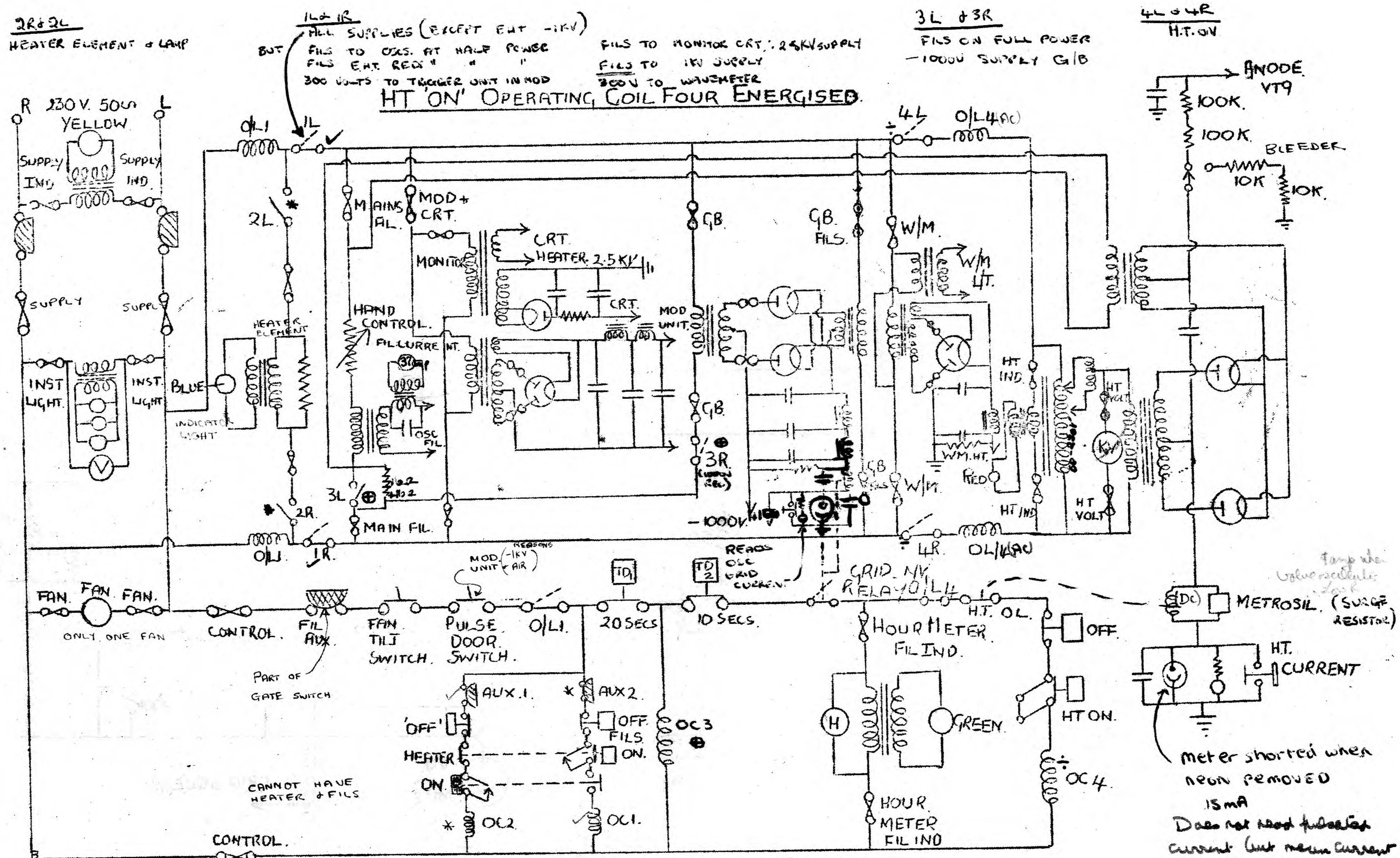
CONTACTORS ~ OPERATION. 2

Fig 8



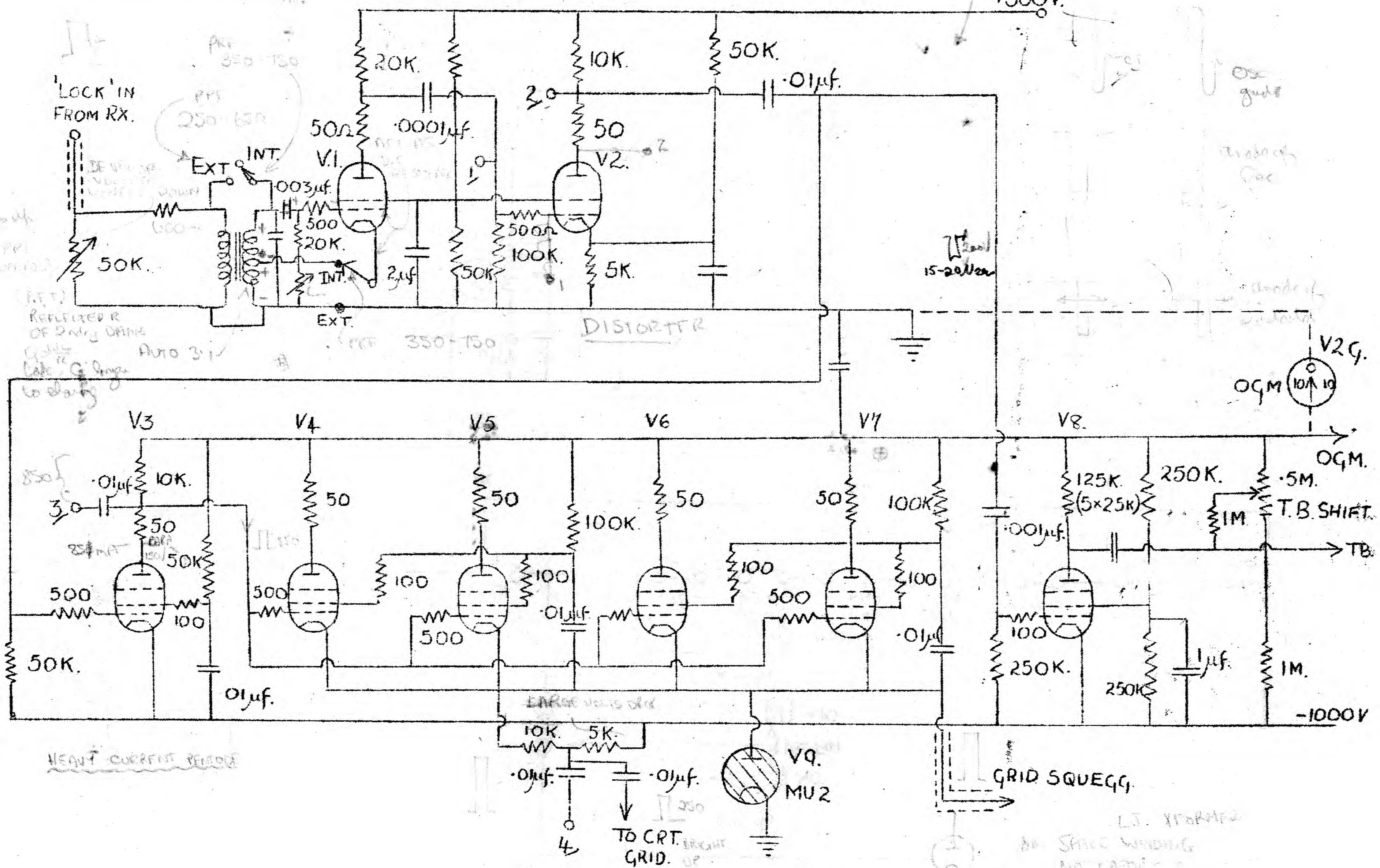
CONTACTORS ~ OPERATION 3. Fig 9

fig 9.



CONTACTORS – OPERATION 4. Fig 10.

MODULATOR UNIT T.3079. Fig 11.



3. Time Delay 2 mechanically set off by OC3.
4. G.B. "No Volt" relay energised, closing G.B. "No Volt" switch.
5. After 10 secs. TD2 closes. Mains applied across Hour Meter and Filament Indicating (Green) lamp glows.

Operation 4. (Fig. 10)

1. With O/L4 and HT O/L contacts closed, mains available up to HT 'ON' button.
2. Press 'ON' button, energising OC4 which closes 4L and 4R contactsand "holding" contacts of OC4.
   Mains now applied via auto-transformer to primary of E.H.T. transformer. HT meter reads and RED indicator lamp glows.

NOTE:

HT Voltmeter is scaled to read KV although it is actually in primary of E.H.T. transformer; the maximum voltage applied across it is 230 V.
Anode and Grid meters are protected against "surge" by neon and condenser. If a surge occurs, the condenser will charge until the voltage appearing across it is sufficient to "strike" the neon. "Striking" neon short circuits the meter.

MODULATOR UNIT (T3079)

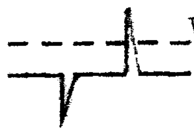
Purpose: 1. To provide a +ive going pulse to relieve "standing" grid bias on the oscillator valves.
2. To provide a time base for the monitor CRT.
3. To provide a "bright-up" pulse for brilliance modulation of the monitor CRT.

Valve Functions.

V1A

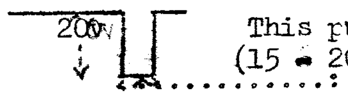
V1. On "internal" triggering acts as a "blocking" oscillator. On "external" as an amplifier. In each case, waveform produced at the anode is negative going square-wave. Coupling between V1 and V2 is Short CR. Differentiated output applied to grid of:-

C.O.
V2G



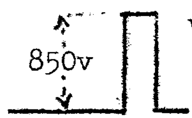
V2. Normally biassed beyond "cut- off". Positive going portion of differentiated waveform cuts valve "On" producing at V2 anode a negative going pulse 15 - 20 u.secs. in width and 20 V amplitude.

V2A



This pulse applied to grids of V3 and V8. (15 - 20 u.secs.)

V3A

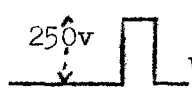


V3. Pulse from V2 anode cuts "off" V3, Va rises towards earth (from -1Kv) producing +ive going pulse of about 850v amplitude, which is applied to grids of :-

V4, V5, V6, V7. Four cathode followers in parallel. Pulse developed across common 15K@ cathode load. (C/F gain less than unity, so amplitude of pulse across cathode load is about 800v). This pulse applied to grids of oscillator valves to relieve "standing" bias.

V8A

V8 Pulse from V2 anode cuts "off" V8. Va tends to rise to HT. Rise is exponential due to capacity in anode circuit producing saw-tooth waveform to be used as time basefor monitor CRT.



V9. Safety diode. Protecting cathode followers in event of "flash over" in oscillator valves.

@ "B.U." pulse across 5K

15K Cathode load comprised of 5K + 10K. Pulse developed across 5K portion applied to CRT grid as a "bright-up" pulse.

T3079 - R.F. Oscillator and Squegging Circuits.

Grid Squeg. Purpose. To determine pulse width of Tx output.

Action.
1. Initially CV 1580s cut off by heavy negative bias on grids. Pulse from modulator relieves this bias, valves conduct and oscillations set up in grid and anode lecher circuits.
2. Positive half cycles in grid cct. cause heavygrid current to flow, charging grid capacitor. Voltage across capacitor rises until it is sufficient to cut off valves again. Time taken to charge capacitor sufficiently for cut off will depend on capacity value
   - For 3 u.sec pulse two .005 capacitors connected in series.
   - For 5 u.sec pulse single .005 capacitor.
   - For 8 u.sec pulse two .005 capacitors in parallel
3. The grid capacitors discharge through 500K parallel resistors, by which time the triggering pulse has ceased, and valves remain cut off until next triggering pulse. (Short CR when capacitor is charging - Long CR on discharge.).

Anode Squeg. Purpose.
(a) To ensure sharp cut-off of oscillator valves.
(b) To prevent double-pulsing. (Occurs if width of triggering pulse is greater than CR of grid-squeg circuit.).

Action.
1. Before arrival of triggering pulse when CV 1580s are cut-off, anode squeg. capacitor charged to 25Kv.
2. When oscillator is triggered, anode current (9A peak) flows, discharging anode squeg. capacitor.
3. Two 100K resistors in series with HT supply ensure that all HT must be drawn from anode squeg. capacitor, so when it is discharged HT is no longer available for the CV 1580s.
4. When 8 u.sec pulse is required, second anode squeg. capacitor is switched in parallel, to ensure HT available for required time period.

T 3079 - Monitor C.R.T.

Purpose. 1. To display output pulse, enabling shape and width of pulse to be checked. Used when tuning Tx, to enable correct pulse shape to be obtained.

2. To display calibrating waveform, obtained from "ringing" calibrator circuit.

Calibrator Circuit. Consists of closed oscillatory circuit, resonant at 500 kc/s. Circuit is shock excited into oscillation by applying output pulse from modulator to it. The output (500 kc/s) sine wave applied to the Y plates of monitor CRT, so that at time of application waveform shown will be 500 kc/s sine wave. Time duration for 1 cycle at 500 kc/s = 2 u.secs. By marking off appropriate number of cycles on a slip of paper, correct pulse widths of 3,5 or8 u.secs can be obtained.

T 3079 - Wavemeter.

Purpose. To enable Tx to be set up on correct frequency.

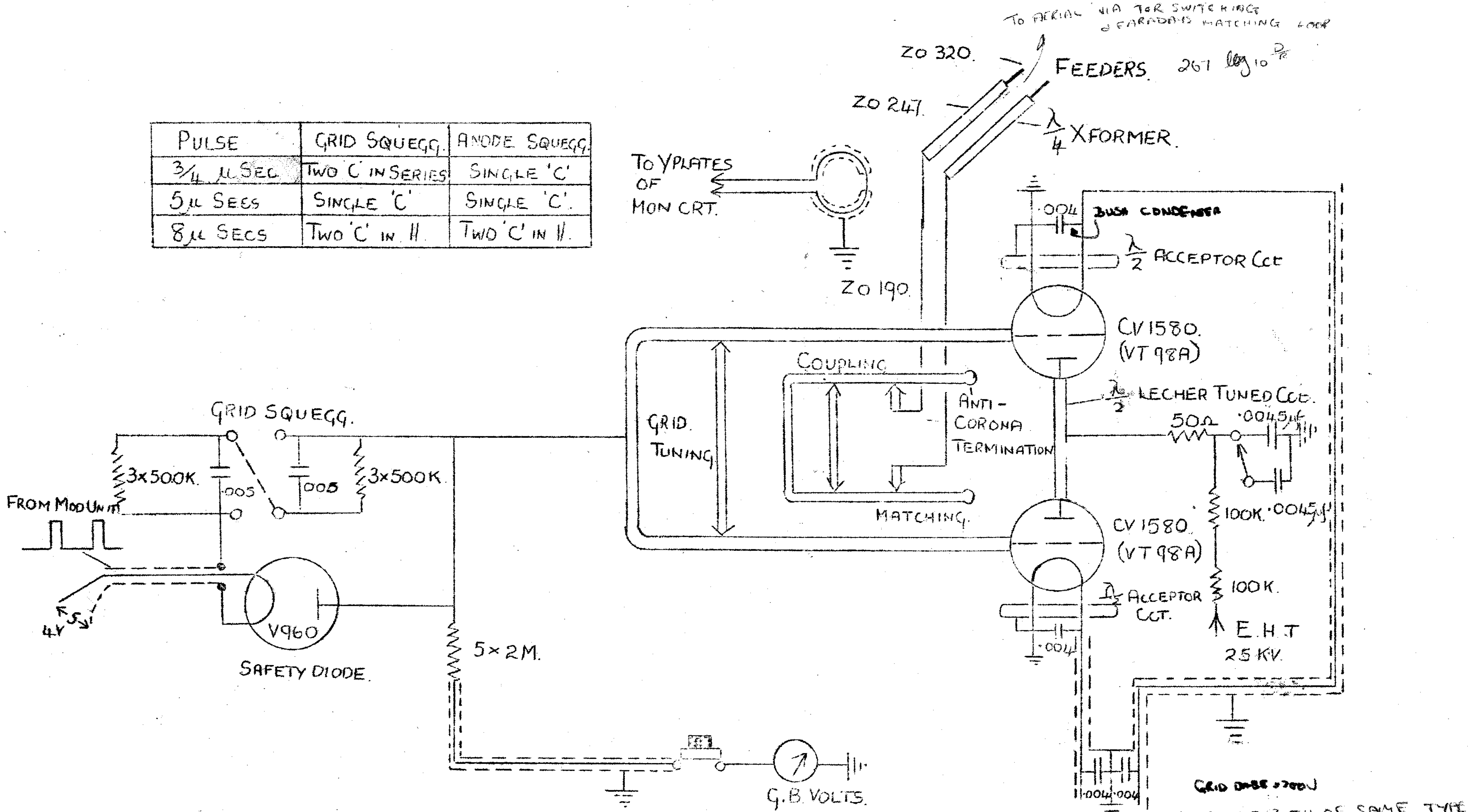
Brief description of action. R.F. energy from Tx picked up on probe and applied to tuned circuit LC (C - variable). With this circuit tuned to resonance with Tx, maximum voltage appears across it. Alternating voltage appearing across tuned circuit rectified by diode D1, output from diode applied to grid of pentode, (appears as a positive bias at grid of pentode due to CR in pentode grid circuit).

Positive bias causes valve to pass more current, the increase in current being registered in meter in pentode cathode circuit. Resonance between Tx and Wavemeter is therefore indicated by maximum reading in meter.

Setting up Tx to Wavemeter.

Set wavemeter to required frequency by using calibration chart. Tune Tx grid circuit for maximum deflection in meter. On each occasion that grid tuning is adjusted, it should be for maximum deflection in wavemeter indicator.

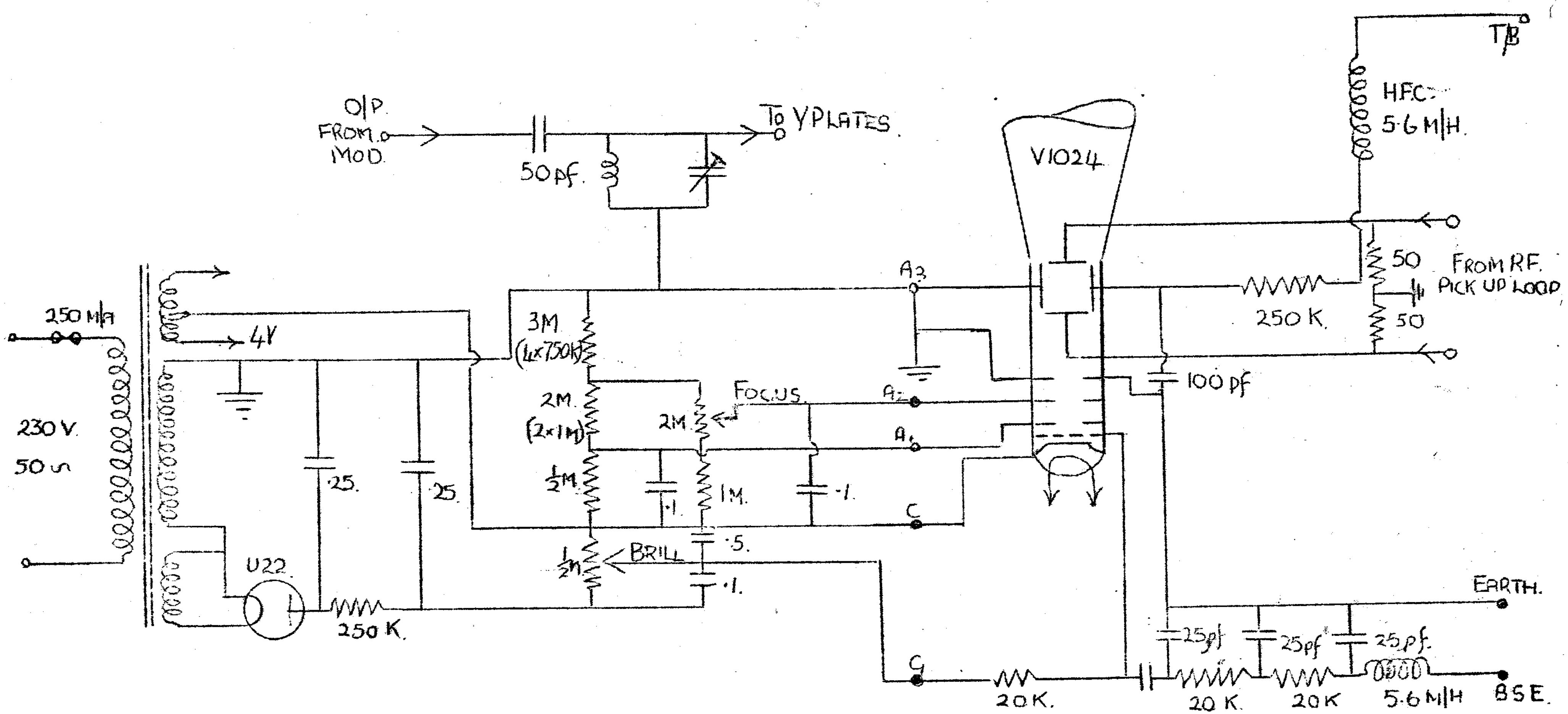
PULSE	GRID SQUEGG.	ANODE SQUEGG.
3/4 μ SEC	TWO 'C' IN SERIES	SINGLE 'C'
5 μ SECS	SINGLE 'C'	SINGLE 'C'.
8 μ SECS	TWO 'C' IN ‖.	TWO 'C' IN ‖.



T.3079. – R.F. Oscillator – Peak Power 100 KW. Fig 12.

GRID BASE = 700V

MUST BE BOTH OF SAME TYPE
WHEN BEING REPLACE VALVE
MUST BE "CONDITIONED"
ENSURE NO REVERSE GRID CURRENT



MONITOR C.R.T. AND 2·5 KV SUPPLY. FIG 13.

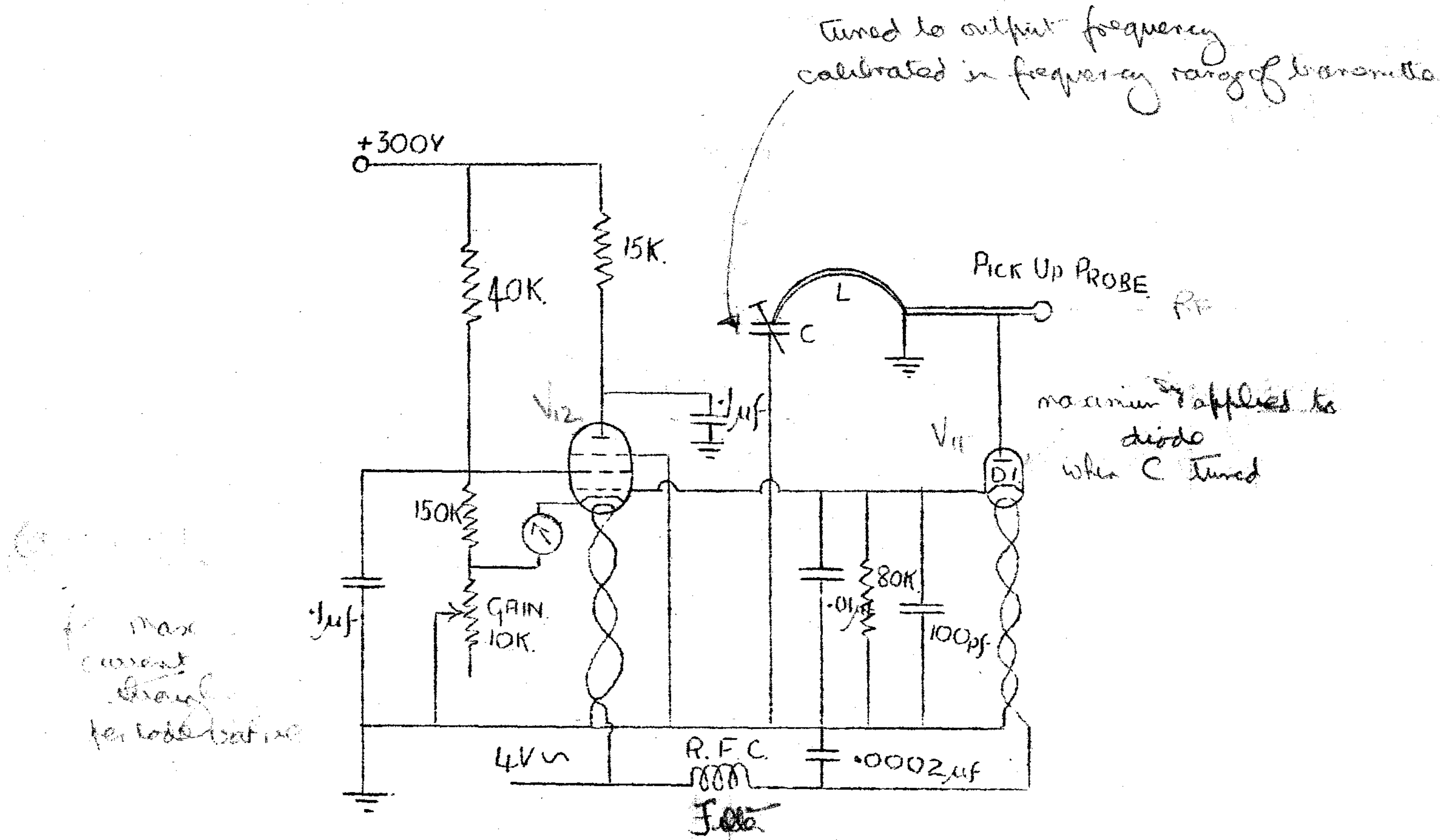
T3079 RUNNING-UP PROCEDURE.

1) Wall switch "ON" (AMBER LIGHT).
2) Close Gate switch (Supply meter reads).
3) Press "FILS ON" button. Fil. current about 25A. After 20 secs. full filament voltage applied. Set filament current to 37A. with hand control.
4) Check grid bias (-800v with no HT rising to - 1300v. as HT is increased).
5) Ensure that Monitor CRT is displaying a time-base.
6) After "GREEN" light appears, press "HT ON" button, and wind up HT to required voltage, checking grid bias volts, grid current, and anode current as HT is increased.

T3079 TUNING PROCEDURE.

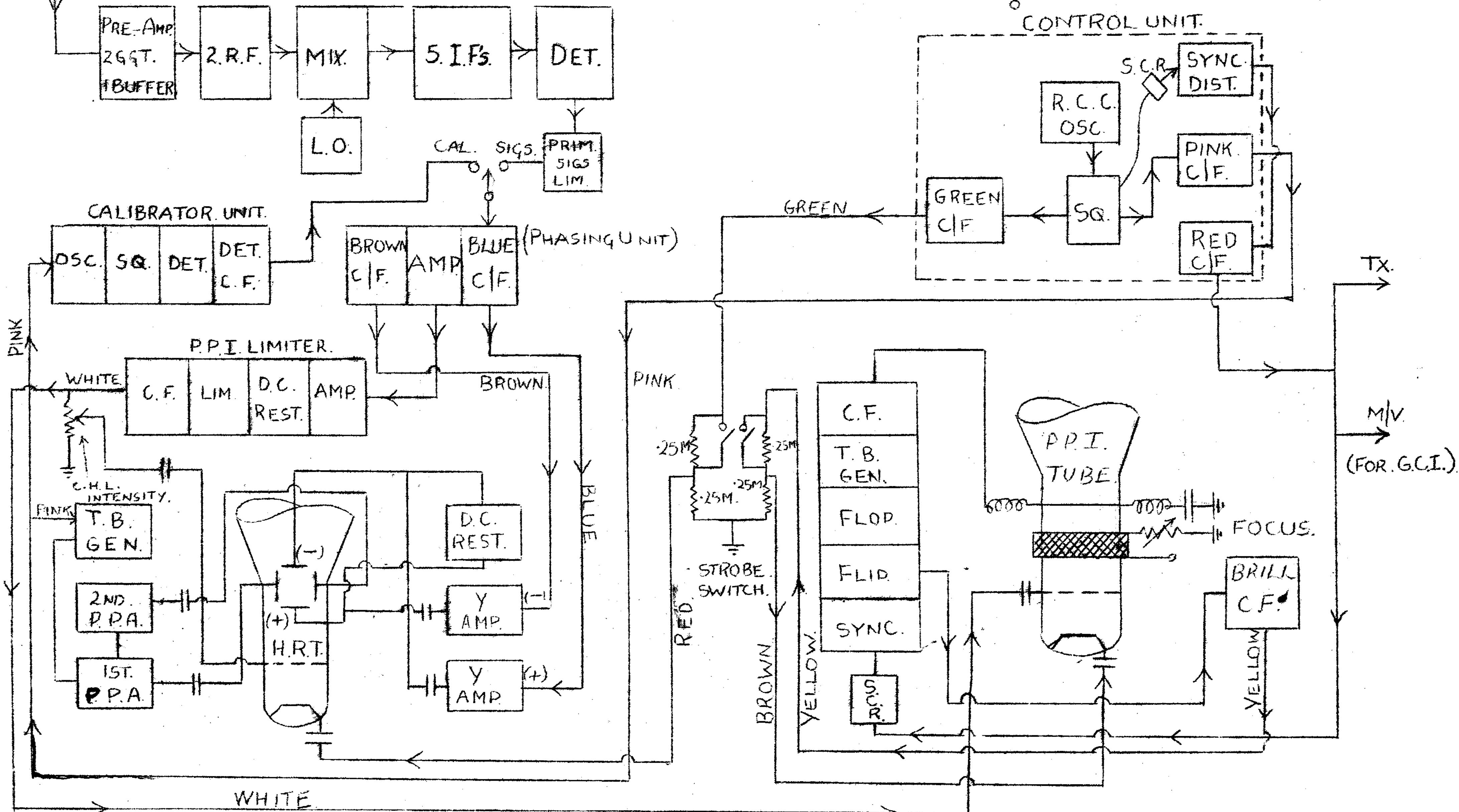
1) Set wavemeter to required frequency.
2) Tune grid lecher for maximum deflection in wavemeter.
3) Tune coupling lecher for squareness of pulse
4) Re-tune grid for max. deflection in wavemeter.
5) Adjust matching for squareness of pulse.
6) Re-tune grid for maximum deflection in wavemeter.

Repeat 2 - 6 for optimum result.



T3049 - WAVEMETER FIG 14.

R.3202. BLOCK DIAGRAM. Fig 15.



GENERAL. 1) Signals to be received consist of C.W blocks, at 200 Mc/s, each block. 3, 5 or 8 μ secs in width, which are the reflected images of the signal transmitted from T3079. These reflected signals will be very weak consequently :-

2) The Rx must be
(a) sensitive to a high degree.
(b) must be capable of amplifying signals very greatly in order that signals will finally be of sufficient amplitude to modulate indicating C.RT. Superhet Rx is required,
(c) Because of width of CW blocks, bandwidth of I.F stages must be at least 4 Mc/s.
(d) Must be capable of indicating range & bearing of target i.e. Range indicating tube. P.P.I. tube.
(e) In order that bearings given are accurate it must be possible to synchronise P.P.I. time-base with aerial movement.
(f) Must contain a "Master Tuning" circuit, which will synchronise firing of TX and all time-bases.
(g) Must be capable of producing correct T/B waveforms for production of Range & Bearing displays.
i.e. H/R Time-base requires saw tooth voltage
P.P.I. " " " pedestal wave-form.
(h) Be able to produce calibration markers.
(i) When used for G.C.I. must be capable of presenting a height finding display.

R 3202 - CONTROL UNIT TYPE 181. Diag. Ref. FIGS. 16A & 16B.

PURPOSE. To provide the triggering pulses for the whole equipment i.e. to determine the instant at which :-
(a) The transmitter fires.
(b) The time-base traces in the receiver indicators start.
(c) The calibrator circuit commences to oscillate.
(d) The "bright up" pulse is applied to the cathode of the H/R indicator.
(e) The G.C.I. multi vibrator is triggered.

REQUIREMENTS.
1) Stable frequency between 300 - 700 c/s.
2) Means of controlling frequency (P.R.F.). Frequency normally adjusted to 400 c/s.

POWER SUPPLIES. HT 300v LT 4v ~.

VALVES USED.
CV1191 (KTZ 41) - H.F. Pentode. (British 7 pin base). I.H.
CV1181 (KT 41) - Output pentode. (" " " ") "

CONTROLS. Master Frequency - Range T/B. and Tx Phase.

CIRCUITRY. V61. R.C.C. Oscillator - 3 leg R.C.C. circuit. Frequency controlled by variable centre leg resistor.

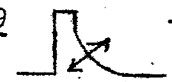
V62. Master Squarer - Sine wave input from R.C.C. oscillator squared by grid cut-off and Ig. Width of square wave made variable by grid bias control (Range T/B). Bias on grid of V62 can be made either - ve or +ve.

V58. Sync Pulse Generator. - Output from V62 passed through variable S.C.R. (Tx phase). and differentiated waveform applied to grid of V58. Output from anode of V58 used to trigger the Tx & PPI time-base (via Red C/F).

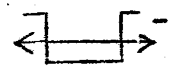
V54, V60, V64. Cathode followers - Used for matching into 80 ohms co-axial cable.

NOTE. Metering and Scope Points.

X29 Scope point showing O/P from Red C/F. Used to trigger Tx on "external" sync, P.P.I. time-base and G.C.I. multi-vibrator.

X29  - Varied by Tx phase control.

X30 Scope point showing O/P from Green C/F. (O/P from Pink C/F is same). Green C/F output used to give intensity modulation on cathode of H/R tube

X30  - Varied by Range T/B control.

Output from Pink C/F triggers :- (1) H/R time-base.
(2) Calibrator unit (Frequency of oscillation 18624c/s).

Setting up Control Unit Type 181.

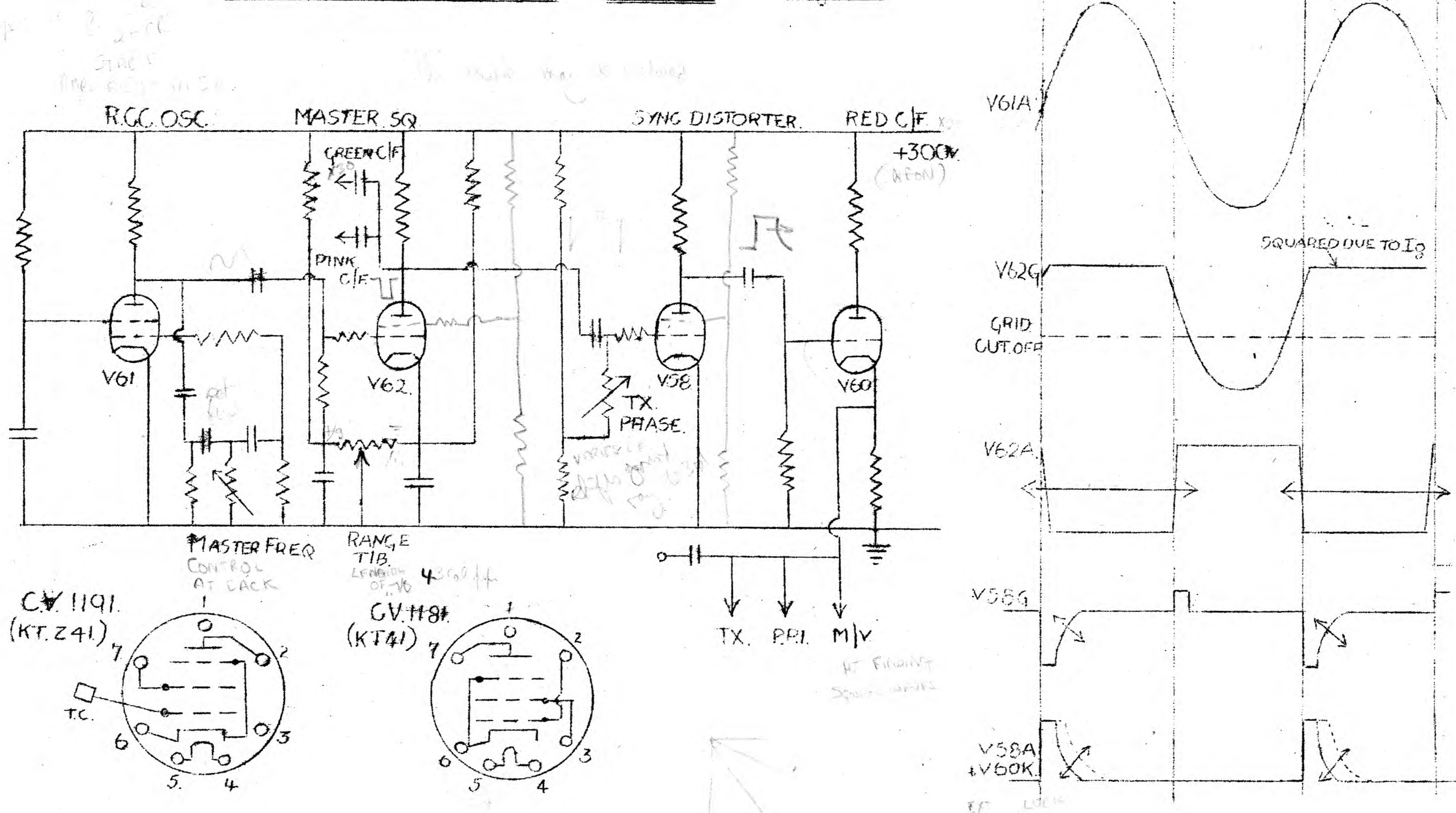
1) Adjust Master Frequency Control for correct P.R.F.
   e.g. 400 c/s - By comparison using double-beam (T.13) oscilloscope, obtain 8 sine waves from R.CC oscillator to 1 50 c/s sine wave from mains supply.
2) With Sig-Cal switch at "Cal", adjust Range T/B control to obtain 43 cal pips on H/R tube.
3) Adjust Tx Phase control so that Tx ground ray coincides with 3rd cal pip.
4) Scope X29 & X30.

R. 3202 - H/R DISPLAY TUBE. Diag. Ref. FIG. 17.

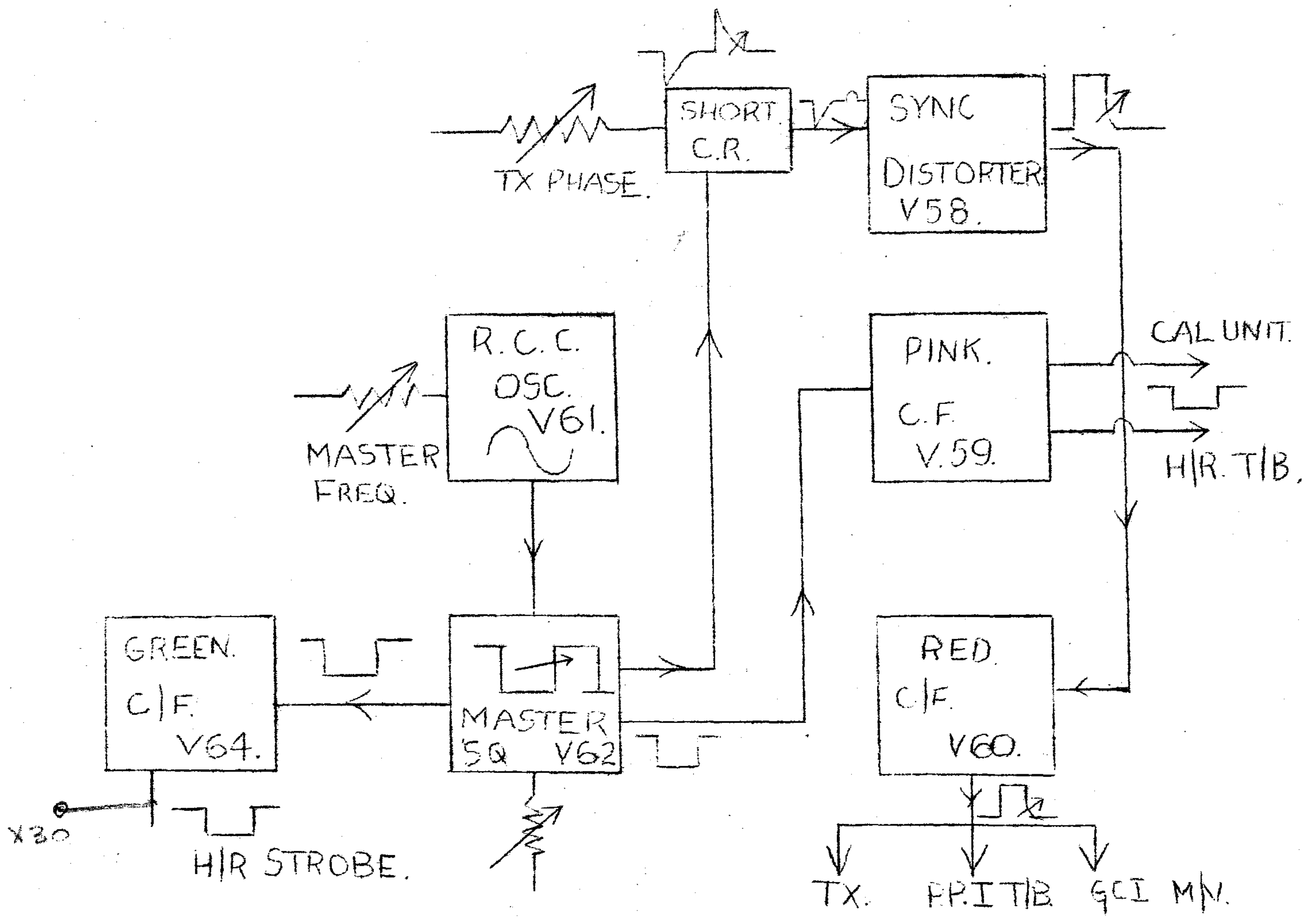
PURPOSE. 1) With AMES Types 2 & 5 to provide range display up to 200 miles.
2) With AMES Types 7 & 15 to provide range and height displays.

TYPE OF TUBE.
12" Electrostatic.

CONTROL UNIT TYPE 181. : SIMPIFIED. Fig 16 B.



CONTROL UNIT TYPE 181 BLOCK   Fig 16A.



R3202 — C.R.T. SUPPLIES — SHIFT + STIG.

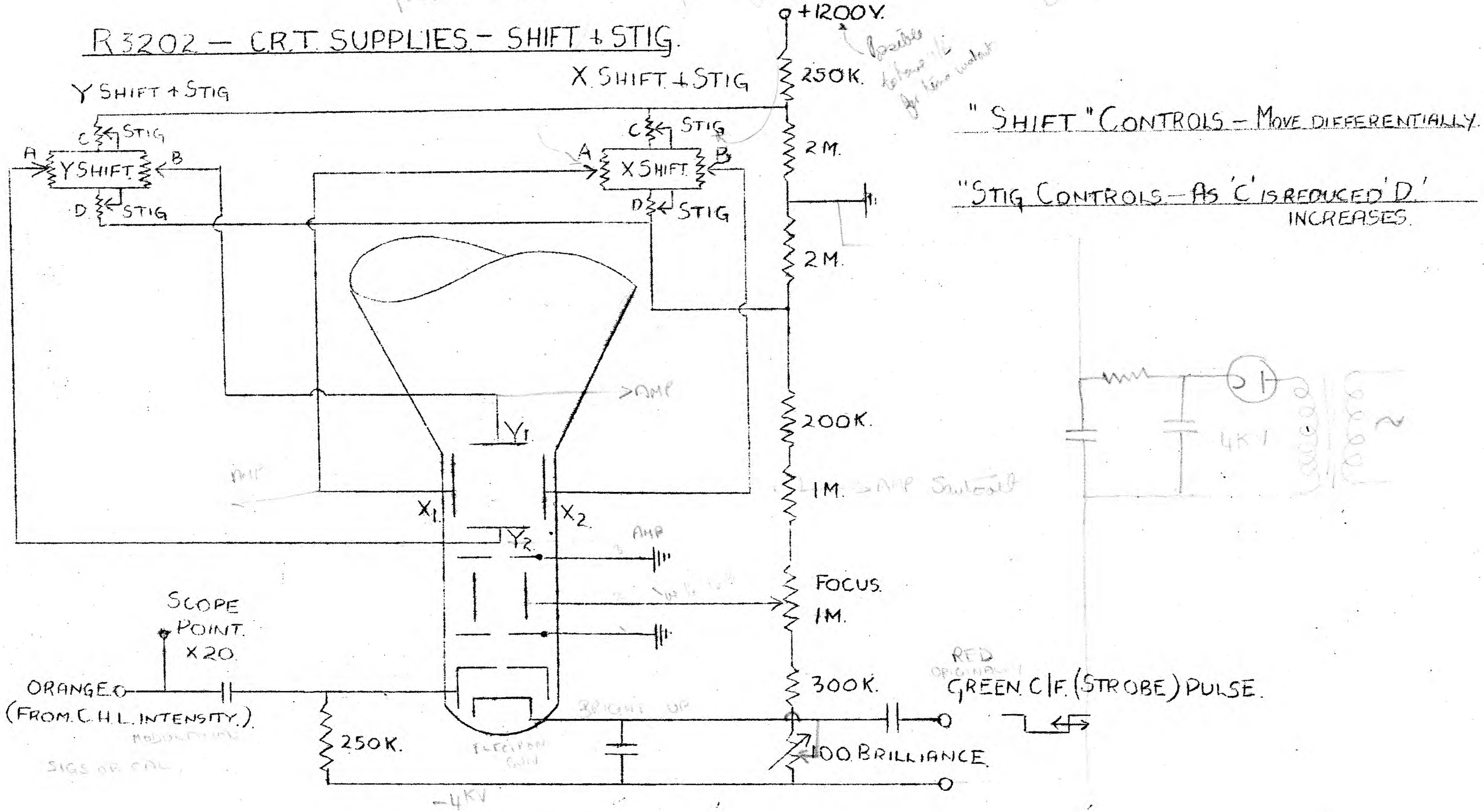
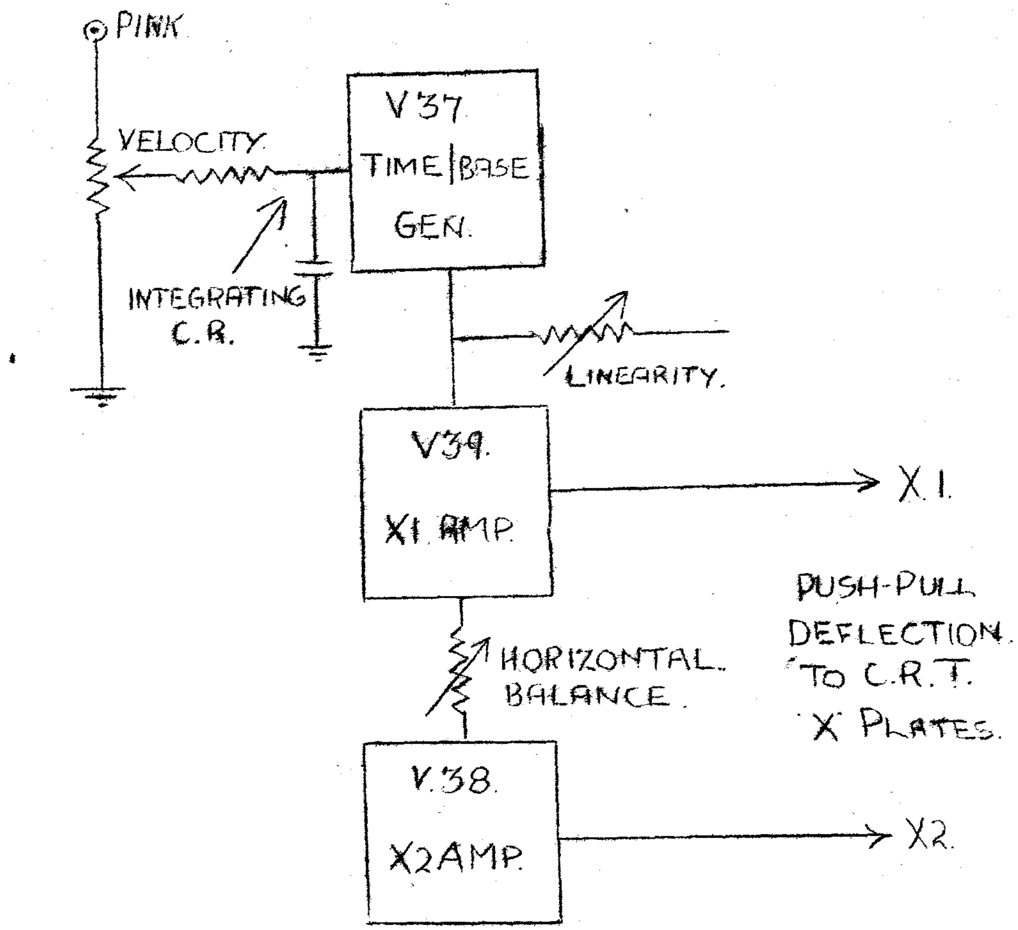
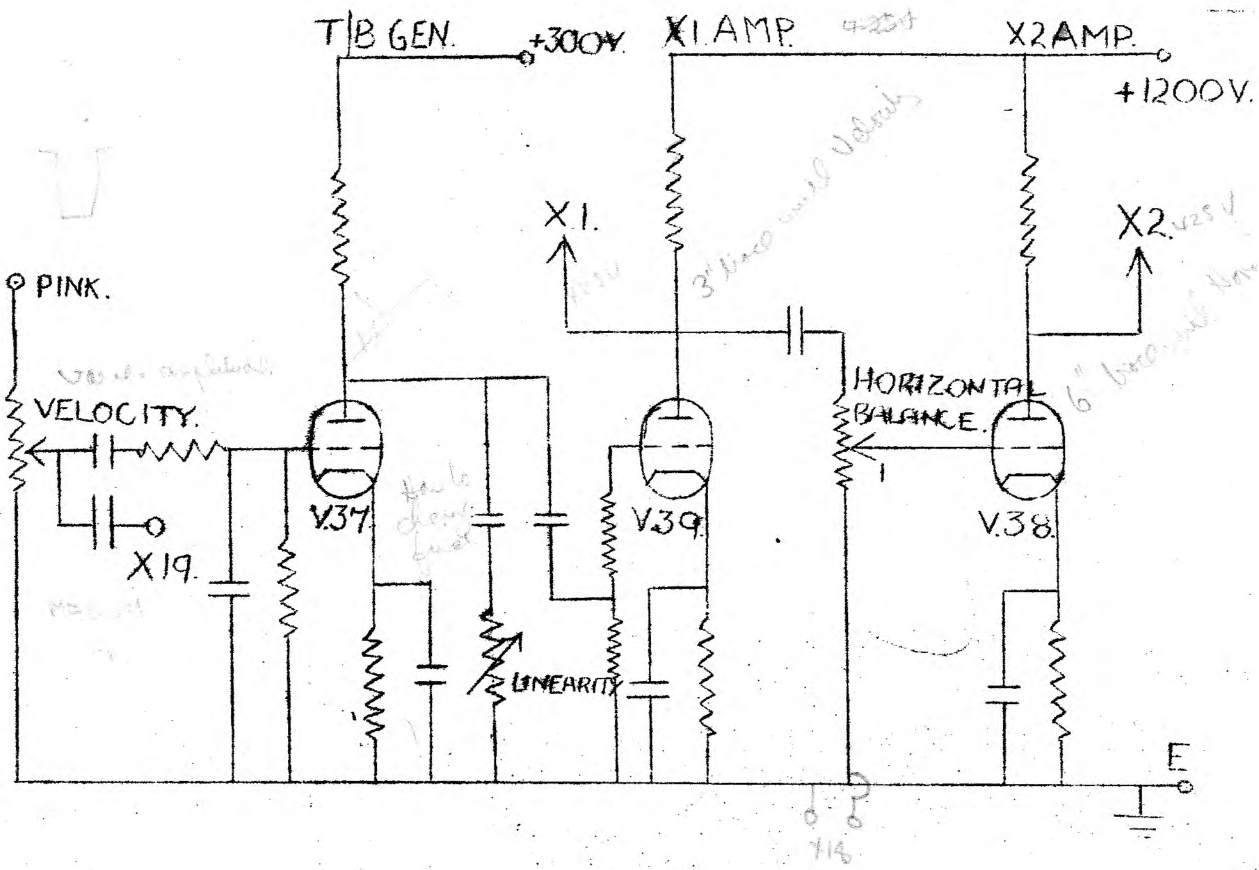


FIG 17.

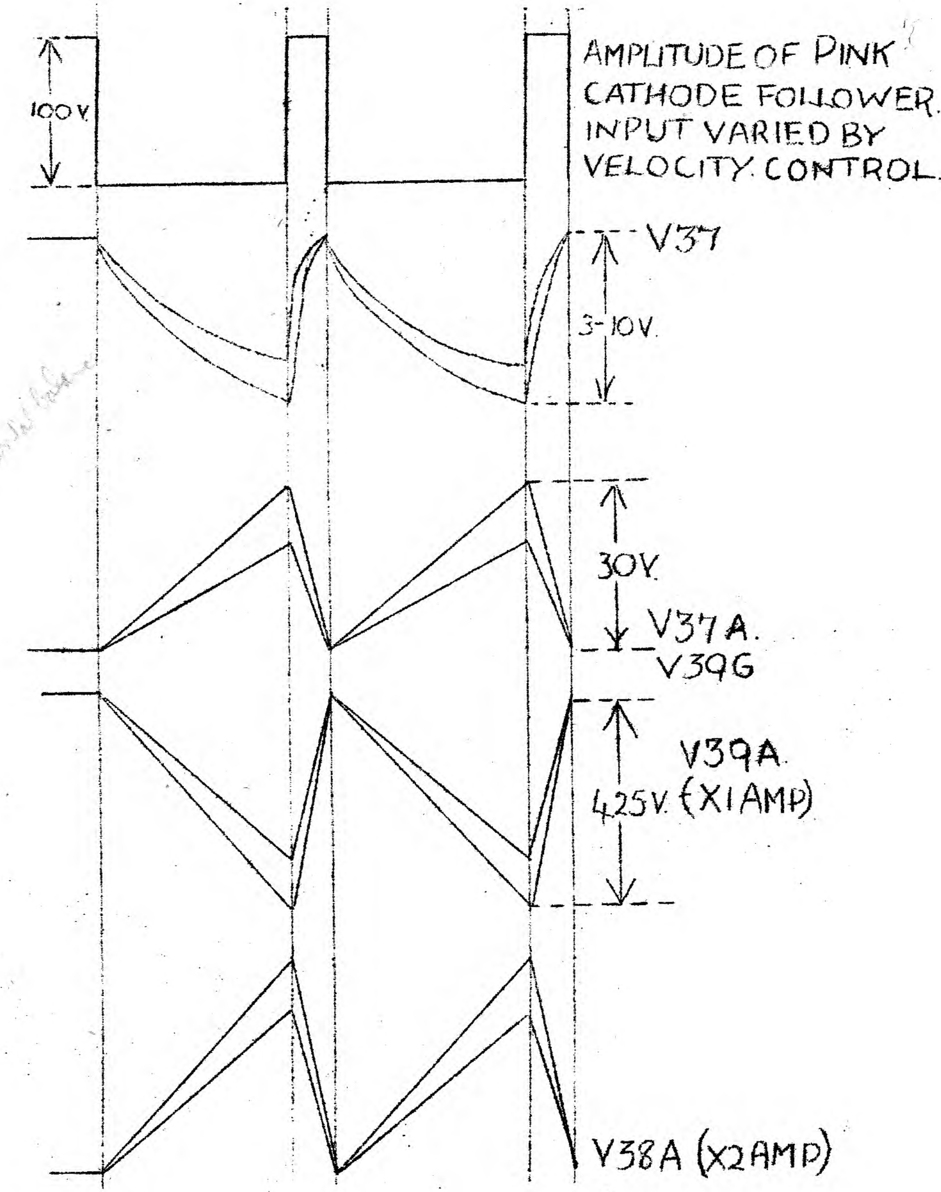
H/R INDICATOR UNIT TYPE 51. – BLOCK SCHEMATIC. FIG 18A.





SIMPLIFIED CCT. DIAGRAM
INDICATOR TYPE 51.

FIG 18B.



SUPPLIES. Heaters - 4V .
H.T. - -4KV.
Shift and Stig. voltages from resistance networks (See Diagram).
Focus - variable potential applied to 2nd anode.

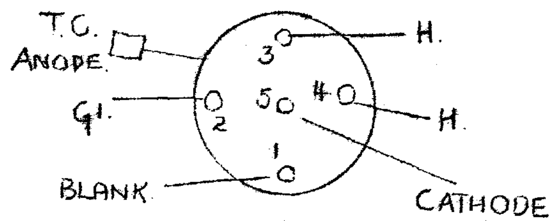
CONTROLS.
(1) Brilliance.
(2) Focus.
(3) X & Y Shifts.
(4) X & Y Stig.

FUNCTION OF CONTROLS.
(1) To vary bias between control grid/cathode, thus increasing or decreasing brilliance of display.
(2) To produce a very thin trace.
(3) To position the trace in the desired position on the tube face.
(4) To overcome any distortion (horizontal or vertical) of the display, caused by misalignment of the deflecting electrodes during tube manufacture.

H/R TIME BASE ON INDICATOR UNIT TYPE 51. DIAG. REF. FIG. 18A, 18B.

PURPOSE. To provide a linear trace of variable physical lengths.
REQUIREMENTS. A linear sawtooth (Voltage w/form) for application to X plates.
SUPPLIES. HT. 1200v and 300v LT 6•3v & 4v.
VALVES USED. CV1191 (KTZ41) Time-base generator. 2, CV1198 (ACP4) used as X plate amplifiers
CV1131 (VCR131) Electro-static C.R.T.

CONTROLS. (1) Velocity.
(2) Linearity.
(3) Horizontal Balance.



Valve Base CV1198.

CIRCUITRY. V37. Input to V37 (T/B Gen.) a negative going square wave (Fink C/F) applied to grid via integrating C.R. (•01 µF and 1M). Output from C.R. (negative going exponential voltage w/form) applied across grid/cathode of V37, a positive going amplified and linearised sawtooth w/form appearing at anode of V37.

V39. Anode w/form of V37 applied between grid/cathode of V39, amplified & inverted output from V39A applied to X1 plate of CRT.

V38. By adjustment of Horizontal Balance input to V38 can be arranged so that its output is equal in amplitude but of opposite phase to output of V39. This is applied to X2 plate of C.R.T.

P.P.I. DISPLAY C.R.T. & POWER SUPPLIES. Ref. Diag. FIG. 19.

PURPOSE. To determine range & bearing (azimuth), on 30, 60 or 90 mile ranges.
TYPE OF TUBE. Electro - magnetic.
POWER SUPPLIES. Heater 4v A.C., HT - 4KV. , Focus 300v.
CONTROLS. (a) Brilliance.
(b) Focus (Electrical & mechanical).
(c) Centre Set.

FUNCTIONS OF CONTROLS.
(a) To vary bias between control grid and cathode, thus increasing or decreasing the intensity of the electron stream.
(b) To concentrate the electron stream to a fine point.
(c) To ensure that the T/B always commences from the same point on the tube face.

P.P.I. TIME - BASE ON INDICATOR UNIT TYPE 71. Ref. Diag. FIG. 20 & FIG.

PURPOSE. :- To produce a time - base of 3 pre-set ranges. viz, 30, 60 and 90 miles.

REQUIREMENTS.

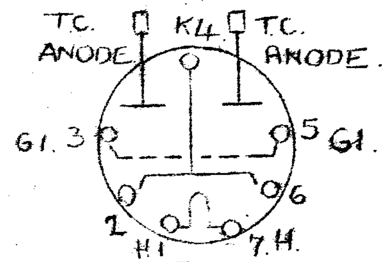
(1) A pedestal voltage waveform to establish a sawtooth of current in the T/B coils.
(2) Time-base to rotate in synchronism with the aerial array.

VALVES USED.

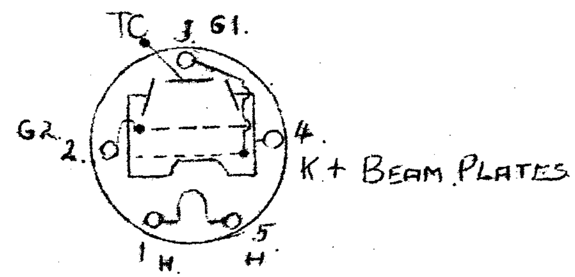
2 CV1191 (Sync valve & Yellow C/F), CV18 (Flip - Flop). 2 CV1572 (T/B Generator & T/B output).
CV1140 (Electro - magnetic C.R.T.).

CONTROLS.

1) Sync.
2) Range (3 in number) Short, Medium, Long.
3) Linearity.
4) Centre Set.

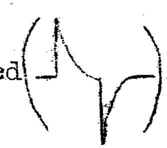


USM7 BASE
CV 18 DOUBLE TRIODE.

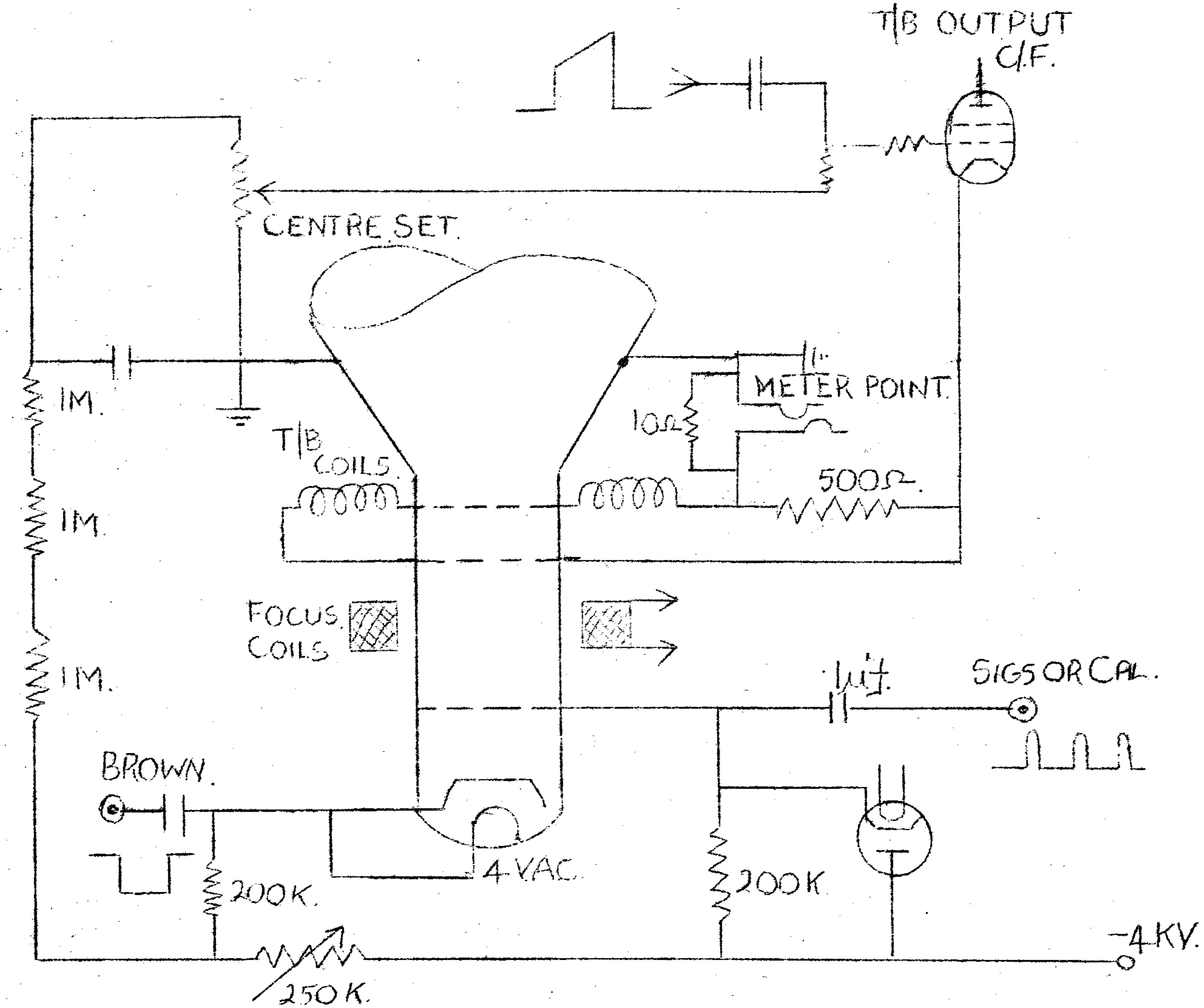


CV 1572.

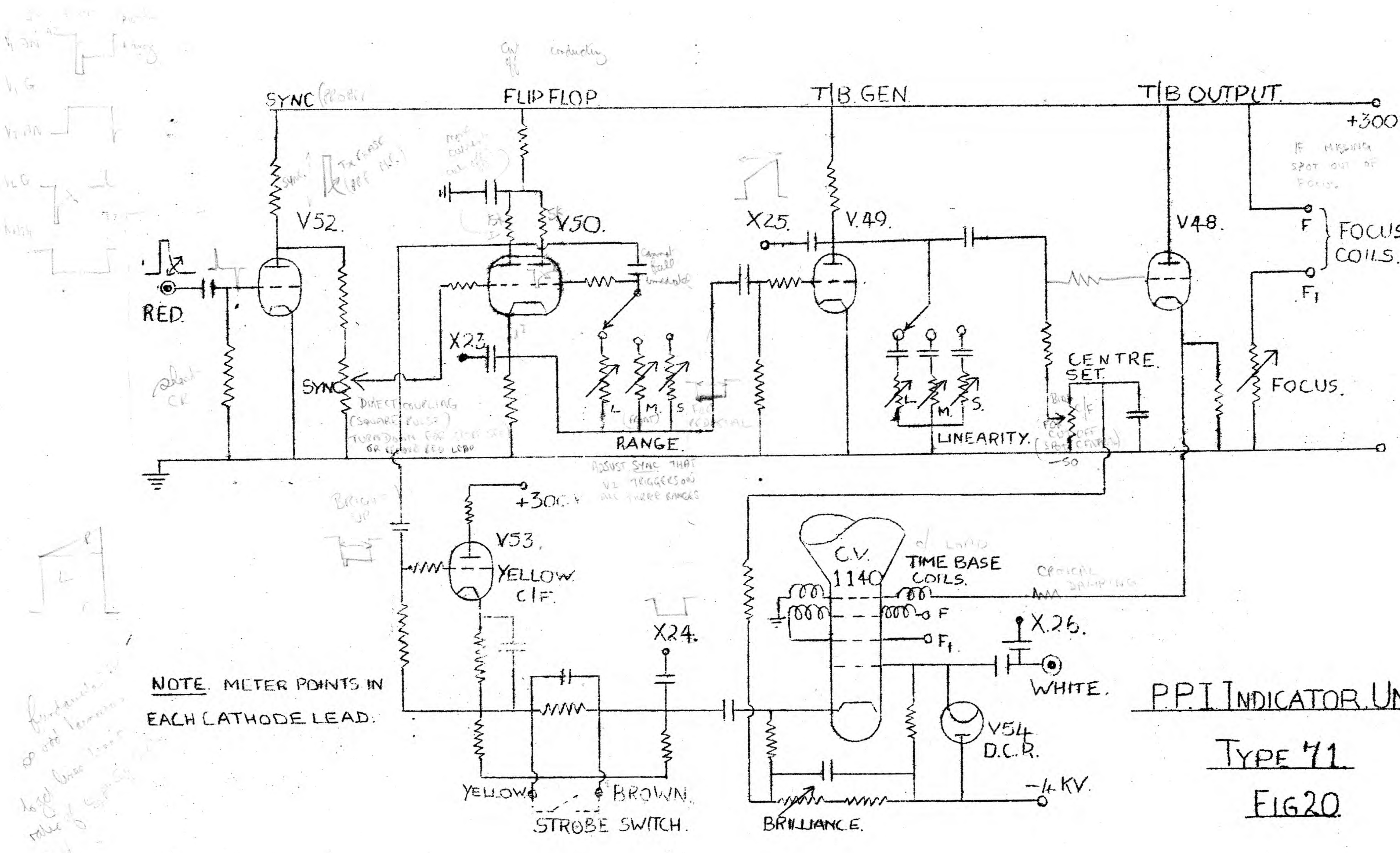
CIRCUITRY.

Input from Red C/F.  differentiated  and applied to Sync valve, (V52).

P.T.O.



P.P.I. C.R.T. SUPPLIES   Fig 19



P.P.I. INDICATOR UNIT

TYPE 71

FIG 20

Fig 21A.

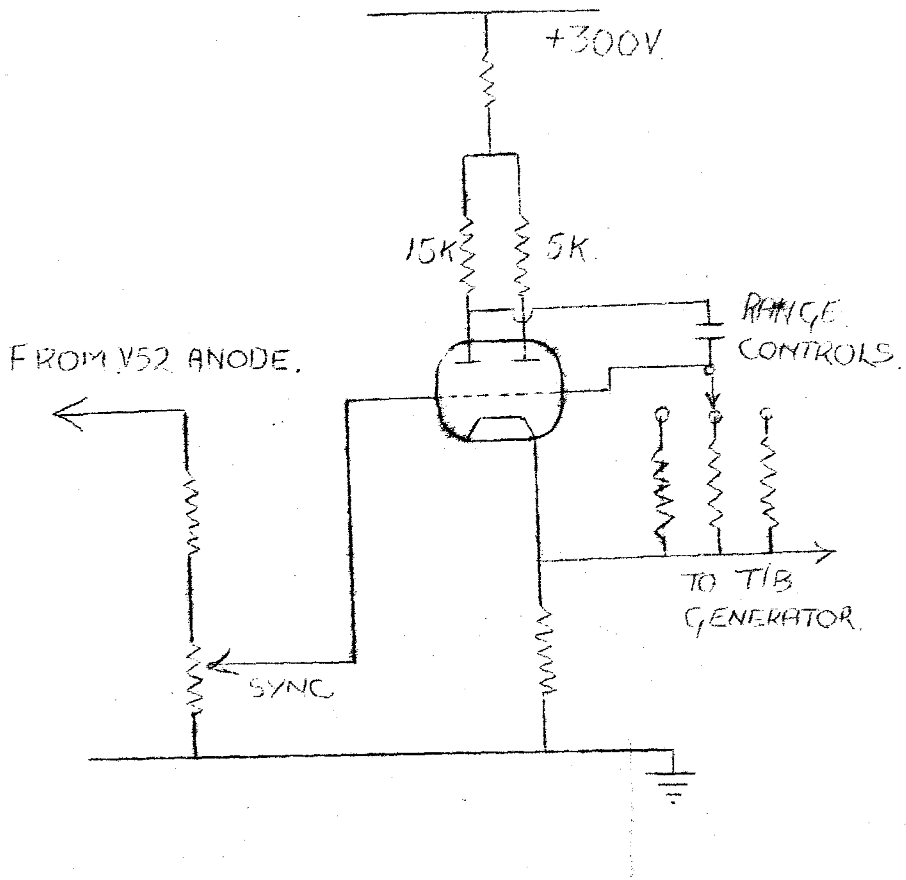
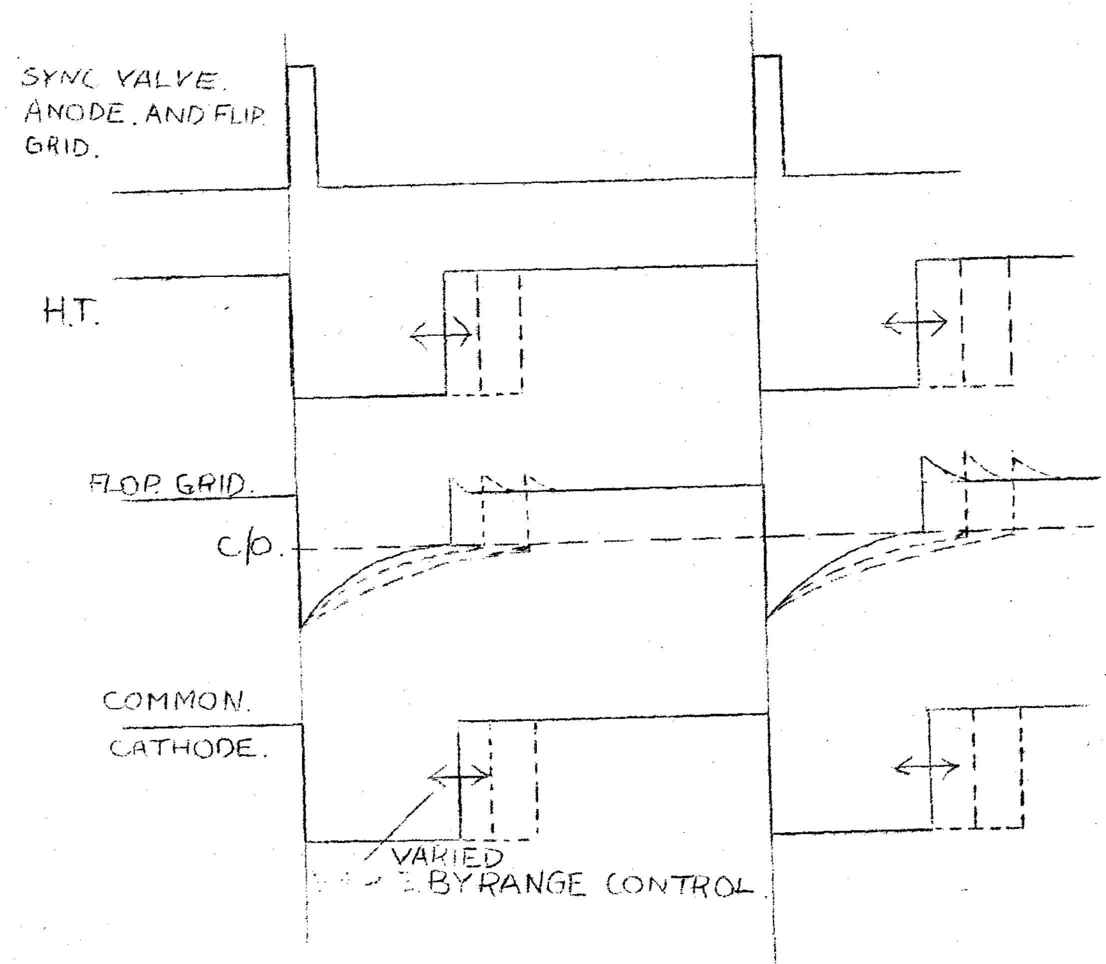
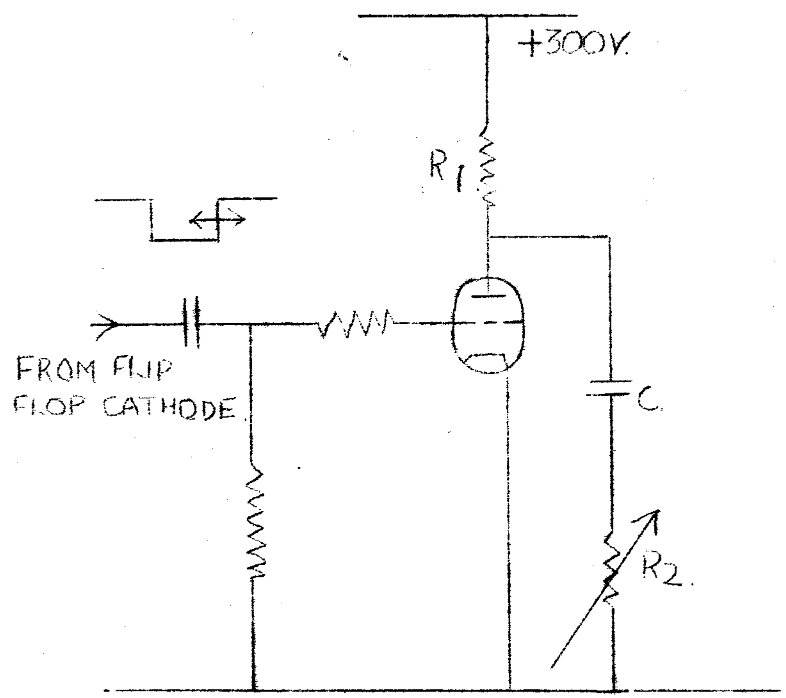


Fig 21.B.



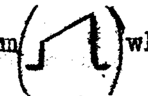
PPI TIME-BASE ~ FLIP-FLOP.

Fig 22.



TIME - BASE GENERATOR.

Positive pip removed by grid stopper & grid current action. Negative going pip on grid of V52, produces a narrow positive going pip at its anode, which triggers a cathode coupled Flip-Flop. (V50). Output square wave from cathode of flip-flop (width variable by range controls), applied to V49, T/B generator. Z = 276.07

This valve produces a pedestal W/form  which is applied to T/B output valve (V48), which has the T/B coils in its cathode cct.

The T/B output valve is normally biassed beyond cut - off, by the Centre Set control.

ACTION OF V50 (FLIP - FLOP). Ref. Diag. FIG. 21A & 21B.

INTERVAL (1).

Flip C/O, Flop conducting. A positive triggering pulse causes "flip" to conduct. Voltage at "flip" anode falls, causing corresponding fall at "flop" grid. Current through "flop" reduced resulting in reduction of current through common cathode load. Consequently voltage and cathode falls. Current through "flip" increases resulting in further fall of voltage at "flip" anode & "flop" grid. Action is cumulative until "flop" anode current is cut off.

INTERVAL (2).

C discharges, voltage at "flop" grid rises. As it passes through "flop" grid cut-off, anode current commences to flow through "flop" resulting in rise of cathode voltage. Current through "flip" is reduced. Action cumulative until original condition is reached i.e. "flip" cut-off, "flop" conducting.

INTERVAL (3).

Circuit resumes stable conditions, ready for next triggering pulse.

ACTION OF V49 (T/B Valve). Ref. Diag. FIG. 22.

Under static conditions valve conducting, anode potential therefore below HT (approx. 200v). C charged to 200v. On arrival of triggering square wave from V50, T/B generator is cut-off. The 300v HT supply is now distributed across the series cct. comprising R1, C & R2. As the cut-off of the T/B valve was instantaneous C has no time in which to change its charge, therefore C remains charged to 200v, leaving 100v to be distributed between R1, & R2. This distribution will be dependent on the ratio of R1 : R2. Assuming R1 = R2 then the distribution will be 50v across R1, 200v across C, 50v across R2. Therefore at the instant of cut-off Va will rise by 50v to + 250v and will then continue to rise exponentially towards + 300v as C charges through R2. It can be seen that by varying R2, the ratio of square wave to exponential in the pedestal wave-form output from V49, can be varied.

SETTING - UP P.P.I. TIME - BASE.

(1) Remove the "Red" triggering lead.

(2) Adjust focus coils until spot is in centre of the tube face.

(3) Switch on turning gear, and adjust centre set control until spot ceases to move.

(4) Replace "Red" lead.

(5) Adjust sync control until a trace is obtained on all three ranges. (N.B. Do not "over " sync).

(6) Switch to "CAL" and SHORT RANGE. Adjust SHORT RANGE and LINEARITY controls for 7 cal. pips.

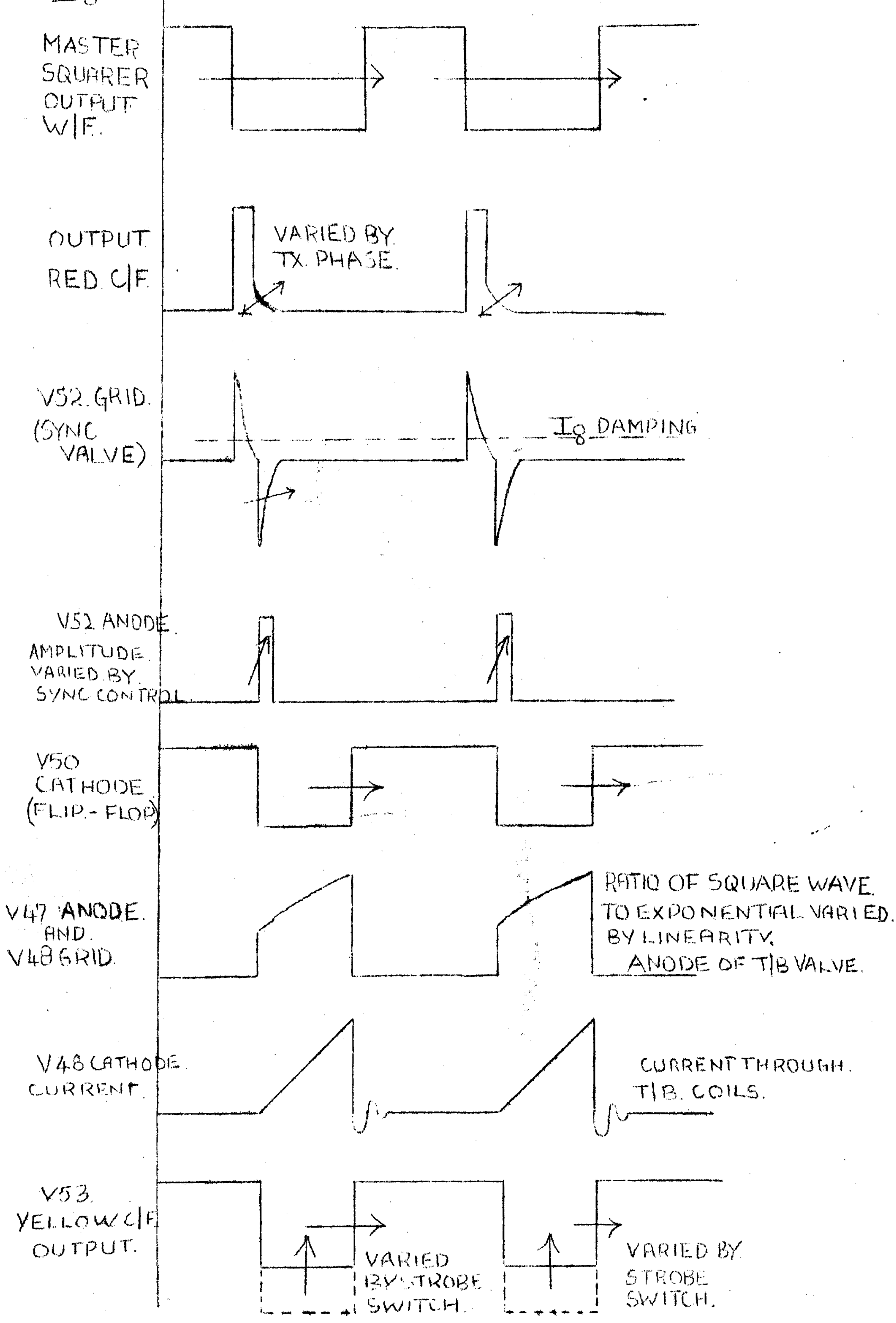
(7) Switch to MEDIUM and adjust for 13 cal pips.

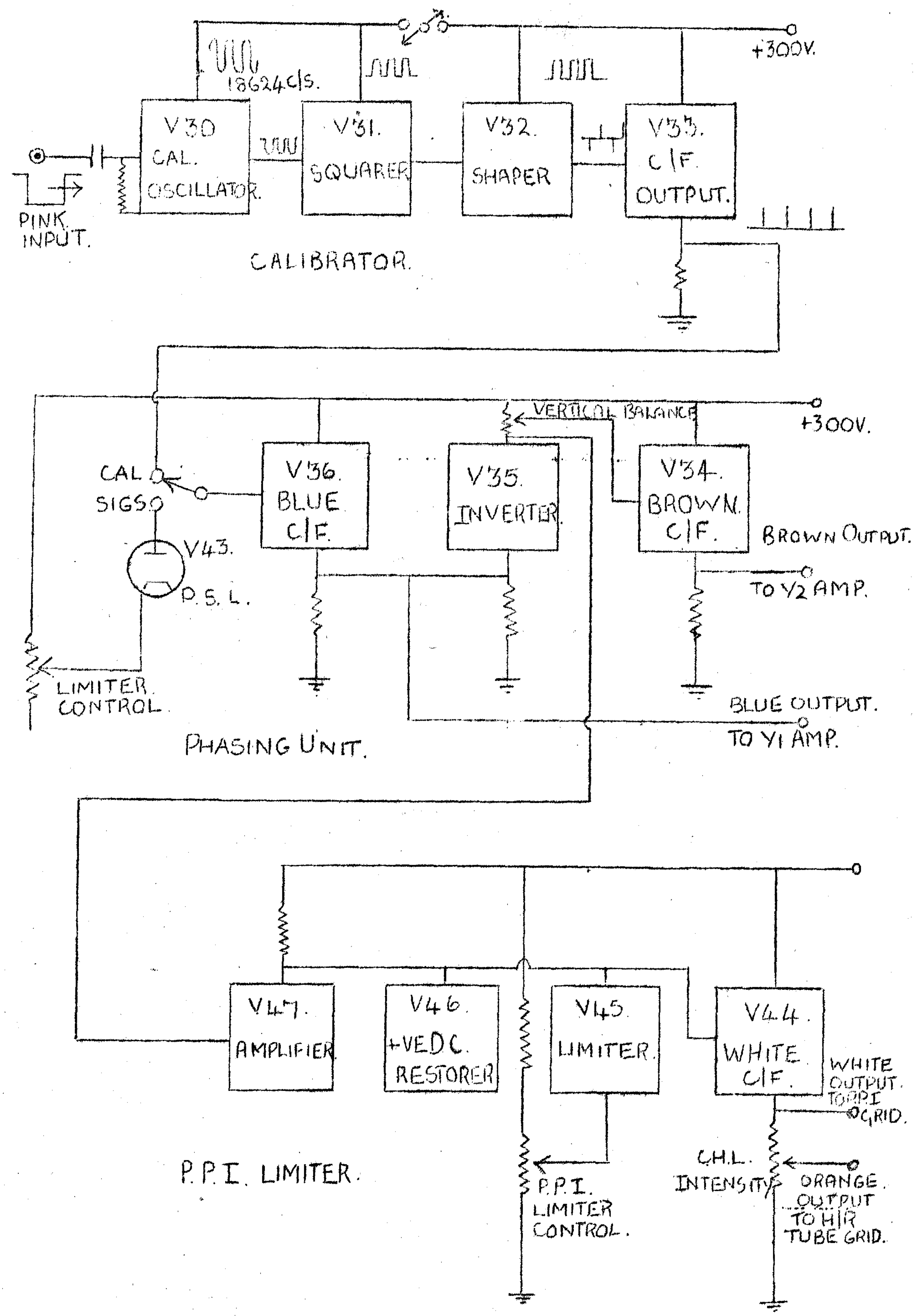
(8) Switch to LONG and adjust for 19 cal pips.

(9) Adjust "brilliance" and "focus" as required.

CONSOLIDATED P.P.I. UNIT WAVEFORMS

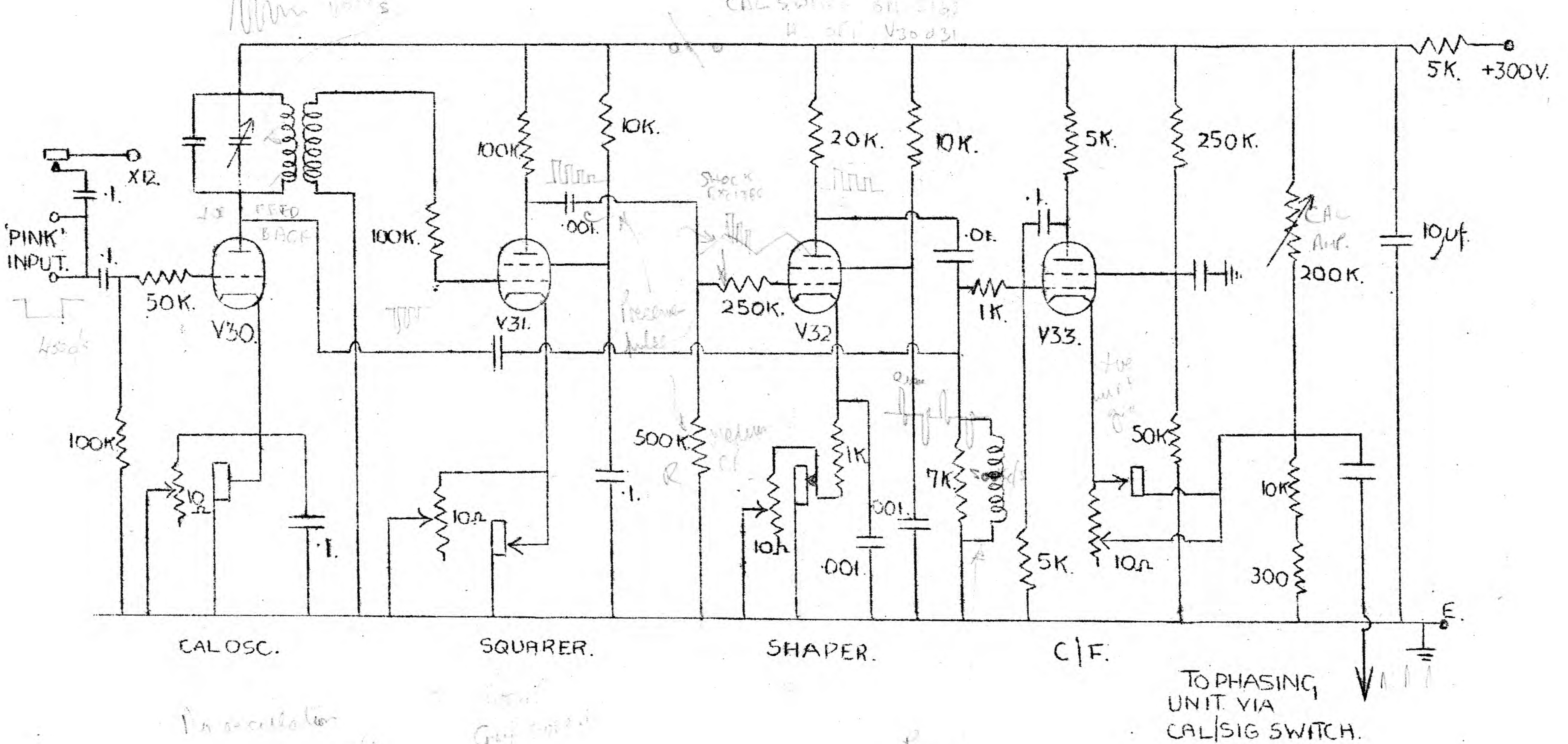
Fig 23.



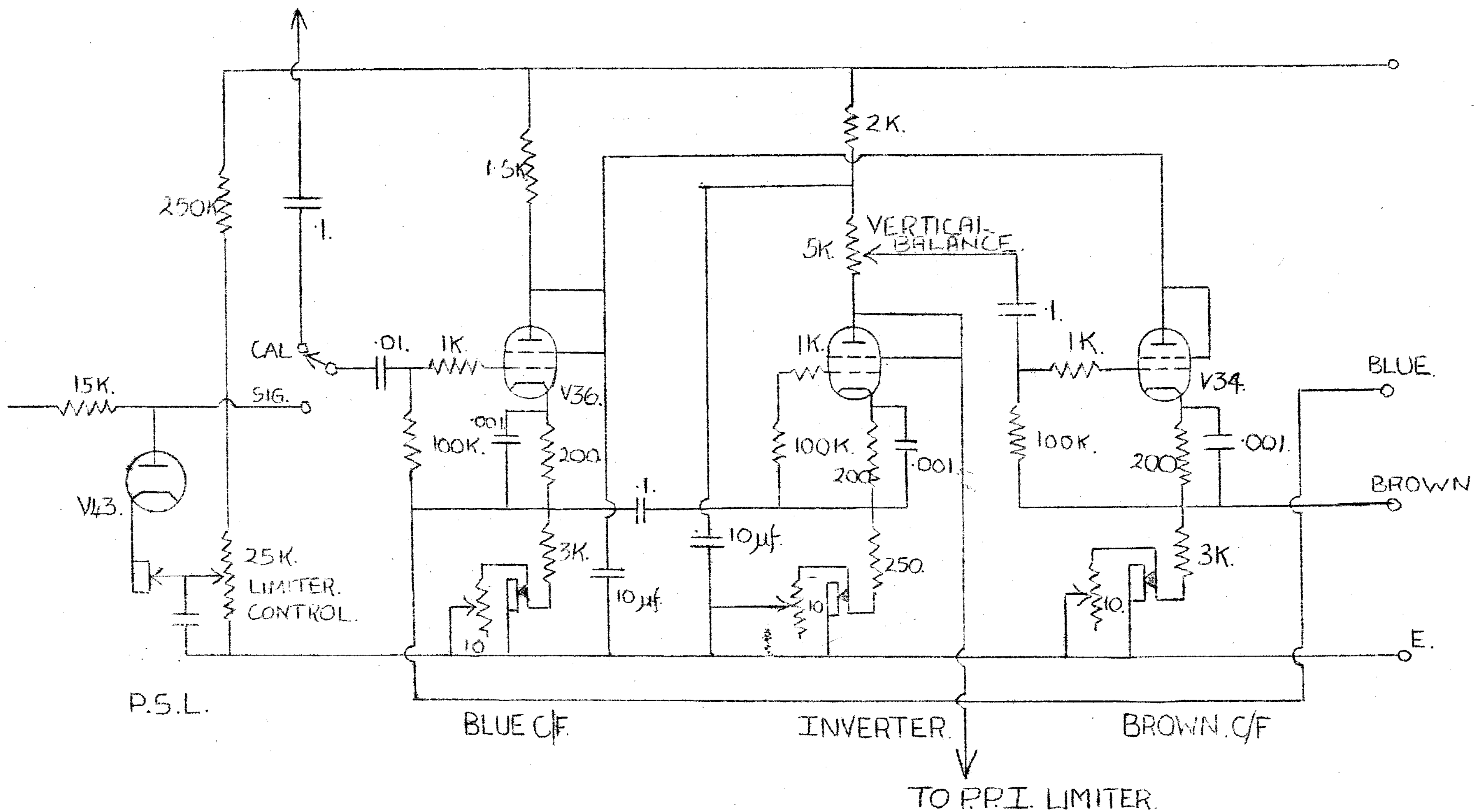


BLOCK SCHEMATIC OF CALIBRATOR TYPE 8. Fig 24.

CALIBRATOR Fig 25



PHASING UNIT. Fig 26.



CALIBRATOR UNIT TYPE 8.   Ref. Diag. FIGS. 24, 25, 26, 27, 28.

This unit houses 3 Sections.
(1) Calibrator, (2) Primary Signal Limiter, (3) P.P.I. Limiter.
(1) Consist of :- Calibration Ringing Oscillator, squarer, shaper, output C/F.
(2) " " :- Signal input Limiter, Cathode Followers and phase reversing stage for H/R Tube.
(3) " " :- + ve D.C.R., Limiter and C/F.

PURPOSE.
(1) Calibrator. To provide sharp voltage pulses of accurately controlled frequency (18624 c/s), corresponding to 5 mile interval cal pips, to indicate range.

(2) P.S.L. To limit the "ground ray" and any close range permanent echoes to a pre-determined amplitude before being applied to the H/R tube, also to provide signals or cal pips of correct phase, for application to Y plate amplifiers for H/R display.

(3) P.P.I. Limiter. To ensure that all signals are positive going before application to grid of P.P.I. tube and to limit all signals to same amplitude so that they give equal "painting" on P.P.I. tube face.

SUPPLIES. 300v HT. 6•3v LT.
VALVES USED. 8, CV1191, 1 CV2807, 3 CV1078.
CONTROLS. (1) Cal/Sig switch, (2) P.S.L., (3) Cal output, (4) Vertical Balance, (5) P.P.I. Lin. (6) C.H.L. Intensity.
OUTPUTS. (1) Blue C/F, (2) Brown C/F, (3) White C/F, (4) Orange (from CHL Intensity).
SCOPE POINTS. X 12 - Pink square wave.
X 13 - Brown C/F output (- ve going).
X 14 - Blue C/F " (+ ve going).

CIRCUITRY.
Calibrator. FIG. 25.
V30, Cal. oscillator is cut off by Pink w/form, applied between grid/cathode, causing anode cct. to "ring" at 13624 c/s; for duration of Pink w/form (Approx 43 oscillations at 18624 c/s).
V31 Squarer. Output sine waves from V30, squared due to grid current & grid cut-off.

V32 Shaper. Square wave output from V31 applied to grid of V32. 250K grid stopper used to preserve & improve shape of w/form. Symmetrical -ve goin g square wave produced at anode rings "peaking"coil (500 Kc/s, critically damped).

V33 C/F output. Operates as C/F biassed beyond cut off (so is also Infinite Z detector). Input to valve is +ve pip from "peaking" coil (which is also "fed back" to anode cct. of V30 as +ve feed back to assist in maintenance of oscillation).
Amplitude of output from C/F is decided by bias (CAL AMPLITUDE CONTROL).

P.T.O.

PHASING UNIT.
FIG. 26.

Blue C/F input is either (a) +ve going signal voltages.
(b) +ve going cal. pips.
Two outputs taken from cathode. (1) to Y1 plate amplifier.
(2) to grid of inverter stage.

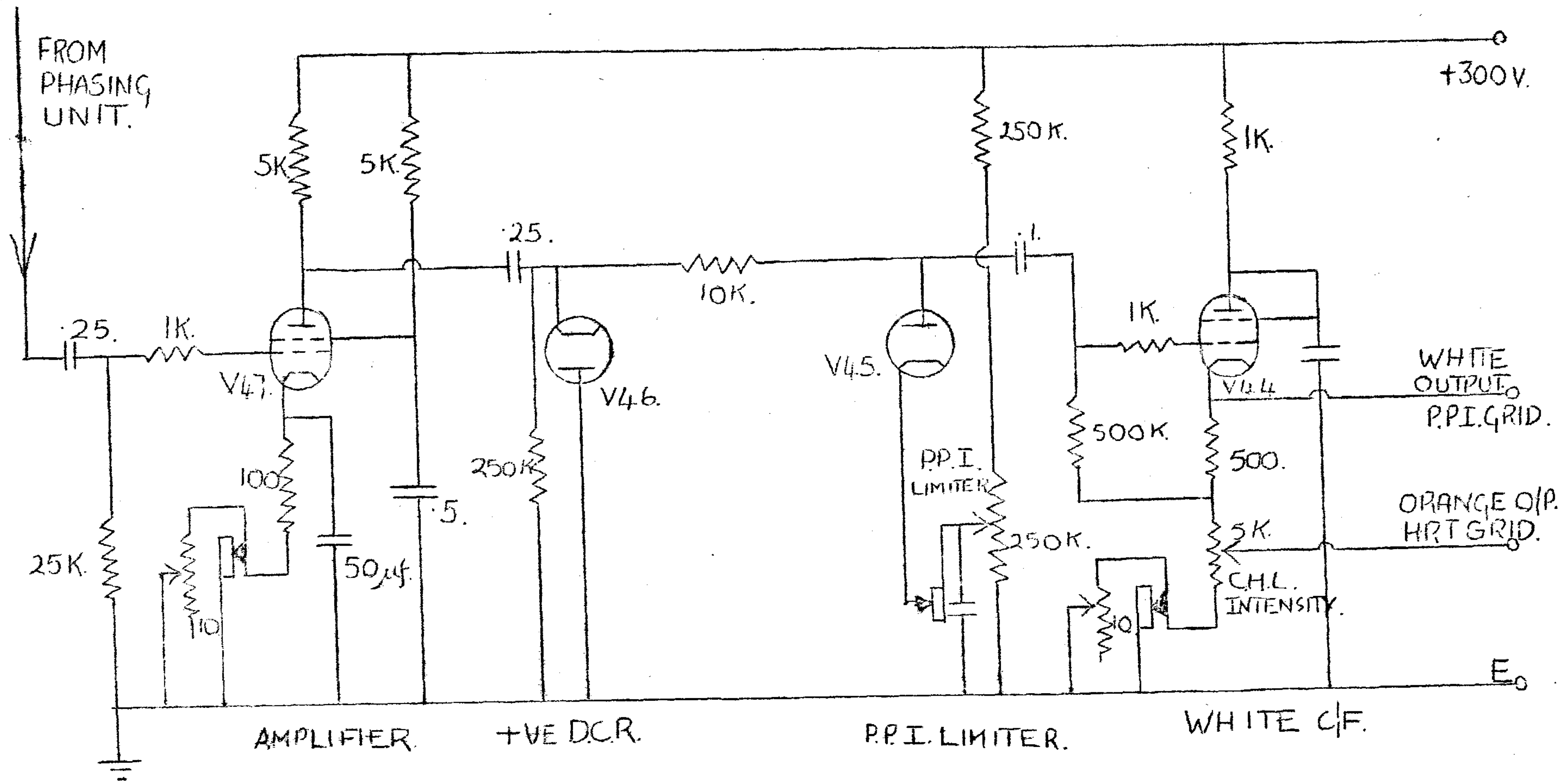
Inverter. Output from Blue C/F amplified and inverted. By adjustment of potentiometer in anode circuit, (VERTICAL BALANCE) input to, succeeding stage (Brown C/F) can be made of equal amplitude to input to Blue C/F.

Brown C/F. Output from Brown C/F is of equal amplitude but opposite phase to Blue C/F output Fed to Y2 plate amplifier.

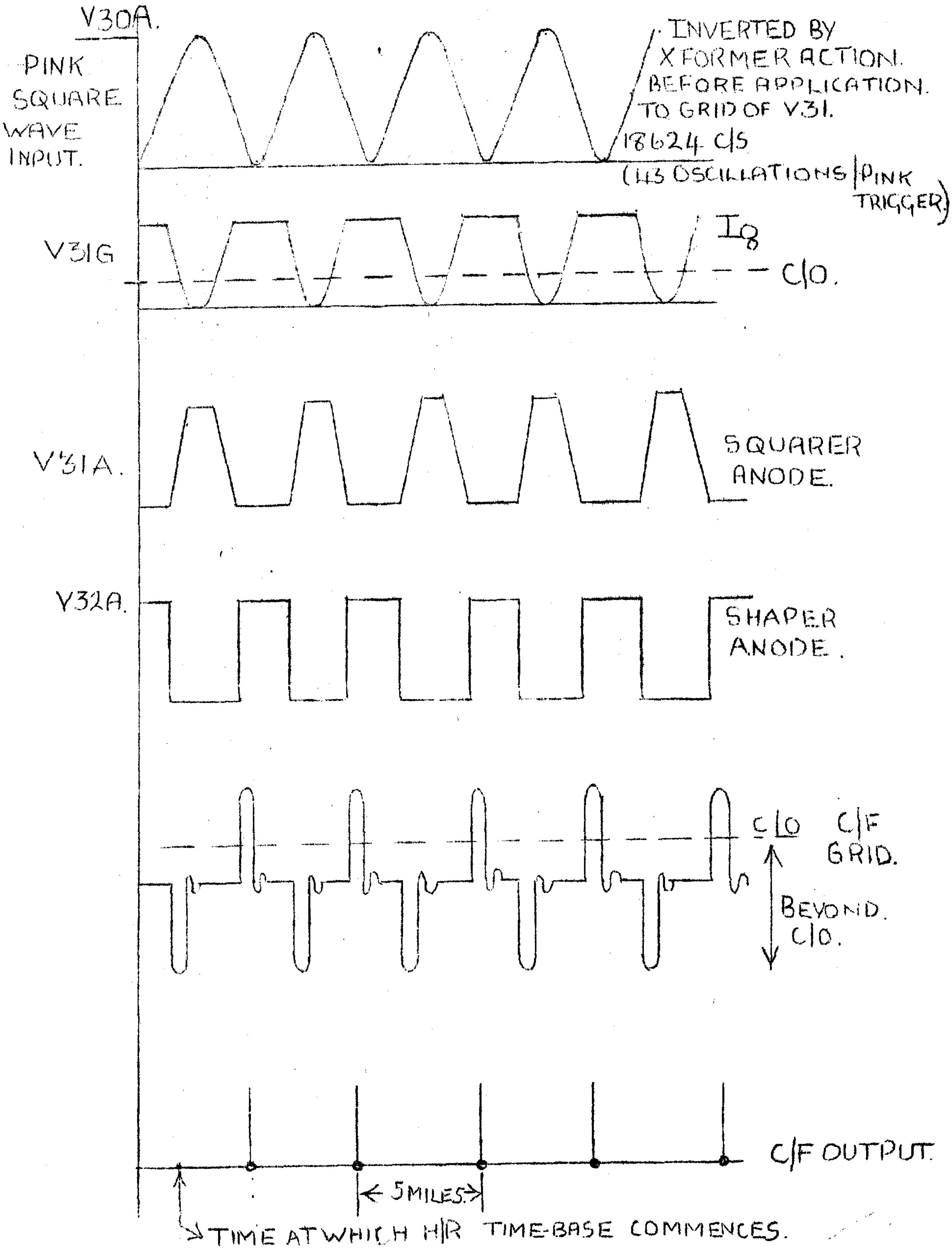
P.P.I. LIMITER.
FIG 27.

Input is either -ve going signal or cal. voltages from anode of Inverter valve V35, amplified & inverted by V47, before being D.C. restored positively from earth.
All signals limited by action of V45 (P.P.I. Limiter) to ensure even intensity modulation of P.P.I. tube, irrespective of the range of the echo.
Output from the White C/F applied to grid of P.P.I. tube.
Orange lead taps off a portion of +ve going signal for application to grid of H/R tube.
(Amplitude of "ORANGE", decided by C.H.L. Intensity control.).

P.P.I. LIMITER Fig 27.

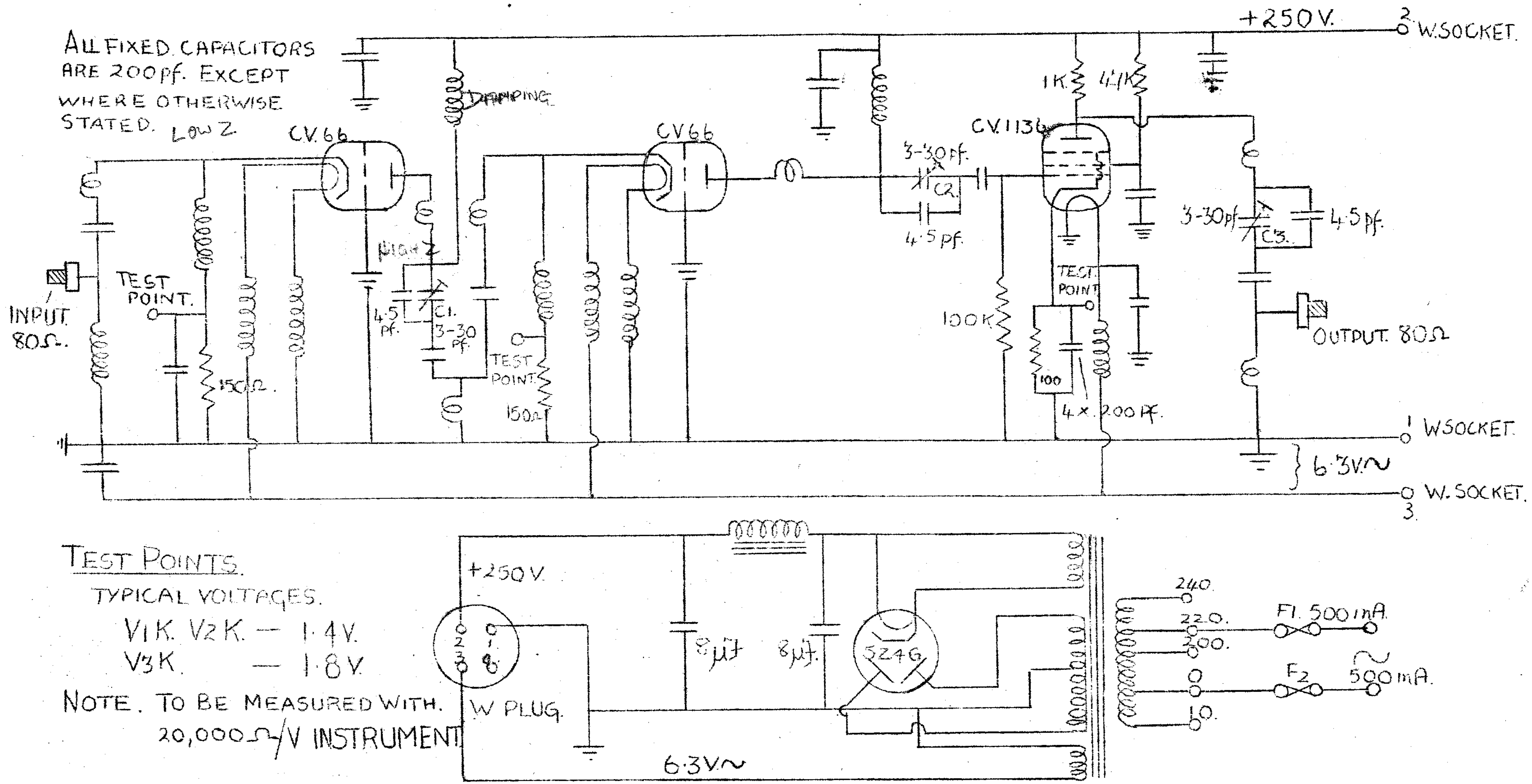


CALIBRATOR CIRCUIT WAVEFORMS FIG 28.



AMPLIFIER TYPE 3175~ CHL|GCI HEAD AMP FIG 29

ALL FIXED CAPACITORS ARE 200pf. EXCEPT WHERE OTHERWISE STATED.



TEST POINTS.

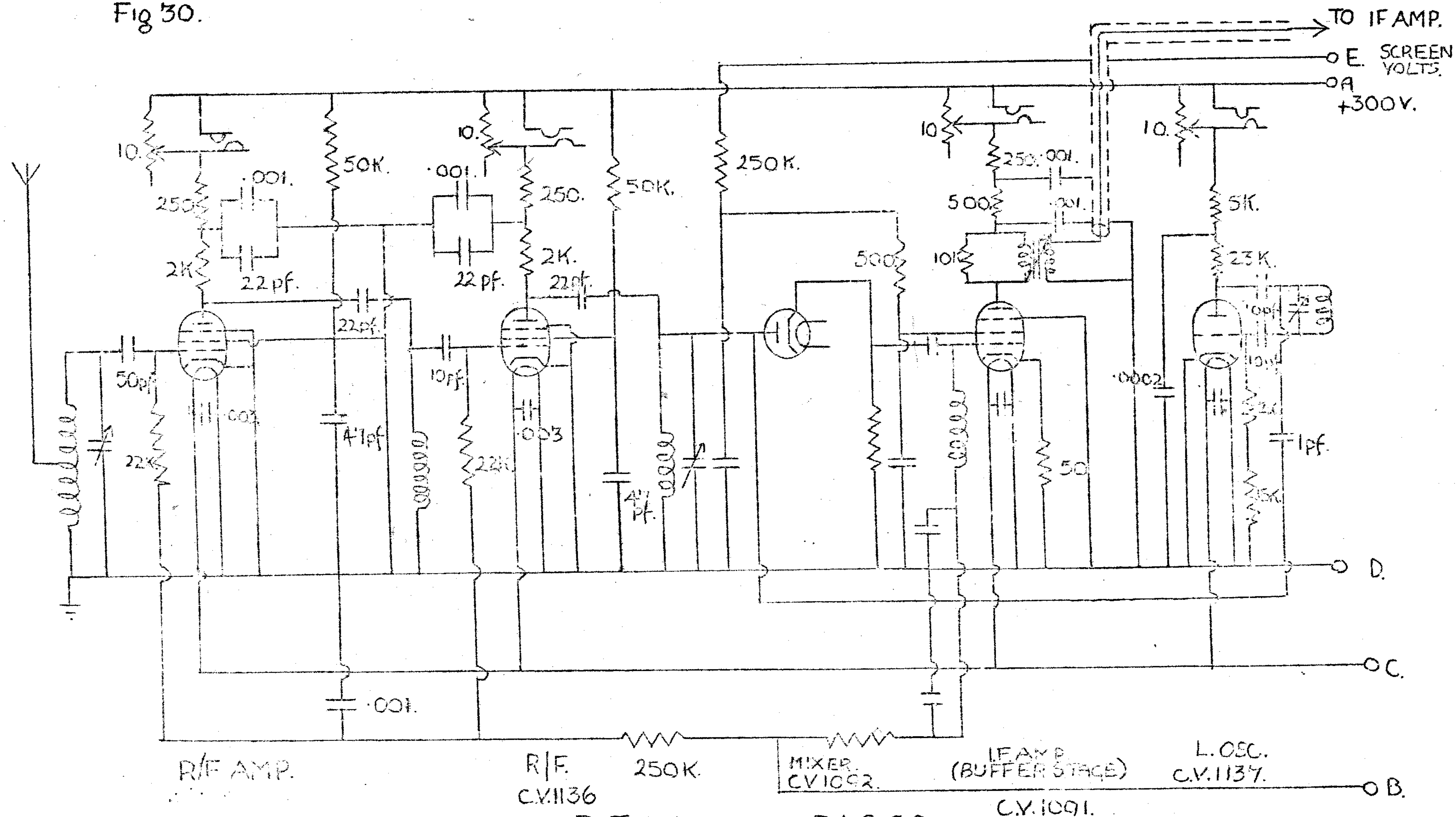
TYPICAL VOLTAGES.

V1K. V2K. — 1.4V.

V3K. — 1.8V.

NOTE. TO BE MEASURED WITH. 20,000Ω/V INSTRUMENT

Fig 30.



R.F. UNIT ~ R3202.

R3202 - PRE-AMPLIFIER UNIT TYPE A 3175. Ref. Diag. FIG. 29.

PURPOSE.

To amplify received echoes at R/F where they are strongest, and at a point where the sig/noise ratio is maximum. This amplification makes up for attenuation in the long connecting cables between the Aerial and Rx.

SUPPLIES.

H.T 300v. LT. 6·3v. - obtained from own Power Unit.

VALVES.

2 CV66 (Grounded grid triodes). 1 CV1136 (R/F pentode). CV1863 (5Z4G) F.W Rectifier (L.C Smoothing).

CIRCUITRY.

To reduce valve noise to a reasonable level, grounded grid triodes used in the first two stages of the amplifier. The third stage of amplification consists of an R/F pentode. This is effectively a "buffer" stage to enable the amplifier to feed out into an 80 ohm line. The R/F ccts. are tuned by C1, C2 & C3.

R3202 - R.F. UNIT. Ref. Diag. FIG. 29.

VALVES.

2 CV1136 (R.F Amps.) CV1092 (Diode Mixer) CV1137 (Local osc.) CV1091 (Buffer I/F).

CIRCUITRY.

Two stages of signal frequency amplification. (Fixed bias of -1·5v obtained from a 500 ohm pot meter connected across cathode and earth line and pre-set to -1·5v). The valve used is specially constructed for low inductance cathode, its cathode being brought out to four separate pins, thus effectively quartering the inductance.
The frequency changing cct. consists of a local oscillator(Colpitts) tuned to 77·5 Mc/s. The second harmonic of this frequency (i.e. 155 Mc/s) is injected together with signal freq. (200 Mc/s) into a diode mixer. Output from mixer (45 Mc/s) is applied to 1st IF stage. This stage acts as a "buffer" between diode mixer and 80 ohm co-axial cable which links R/F and I/F units, and prevents the 80 ohm cable from "damping" the diode load. The gain of the amplifier controlled by "L Gain" (Local Gain) which varies screen potential of I/F Amp.

R3202 - I.F. UNIT. Ref. Diag. FIG. 31.

VALVES USED.

CV1091.

P.T.O.

λ = 4 Mc/s
All harmonics
W100 Bandwidth
High noise

Reasons for infin Z det:
Low output — High input
Use infinite Z det. is a linear ...

small signal distortion in diode det.

Additive mixing
More signal/noise ratio

CIRCUITRY.

3 I.F, stages used, which together with buffer stage on R/F unit give an overall IF gain of 10,000,000. Bandwidth of 4 Mc/s achieved by staggering tuned ccts. (43 Mc/s anode ccts, 47 Mc/s in grid ccts.), and by damping anode circuits by inclusion of 10K resistors. "L gain" control varies screen potential of the IF Amps.

Infinite Z Detector.

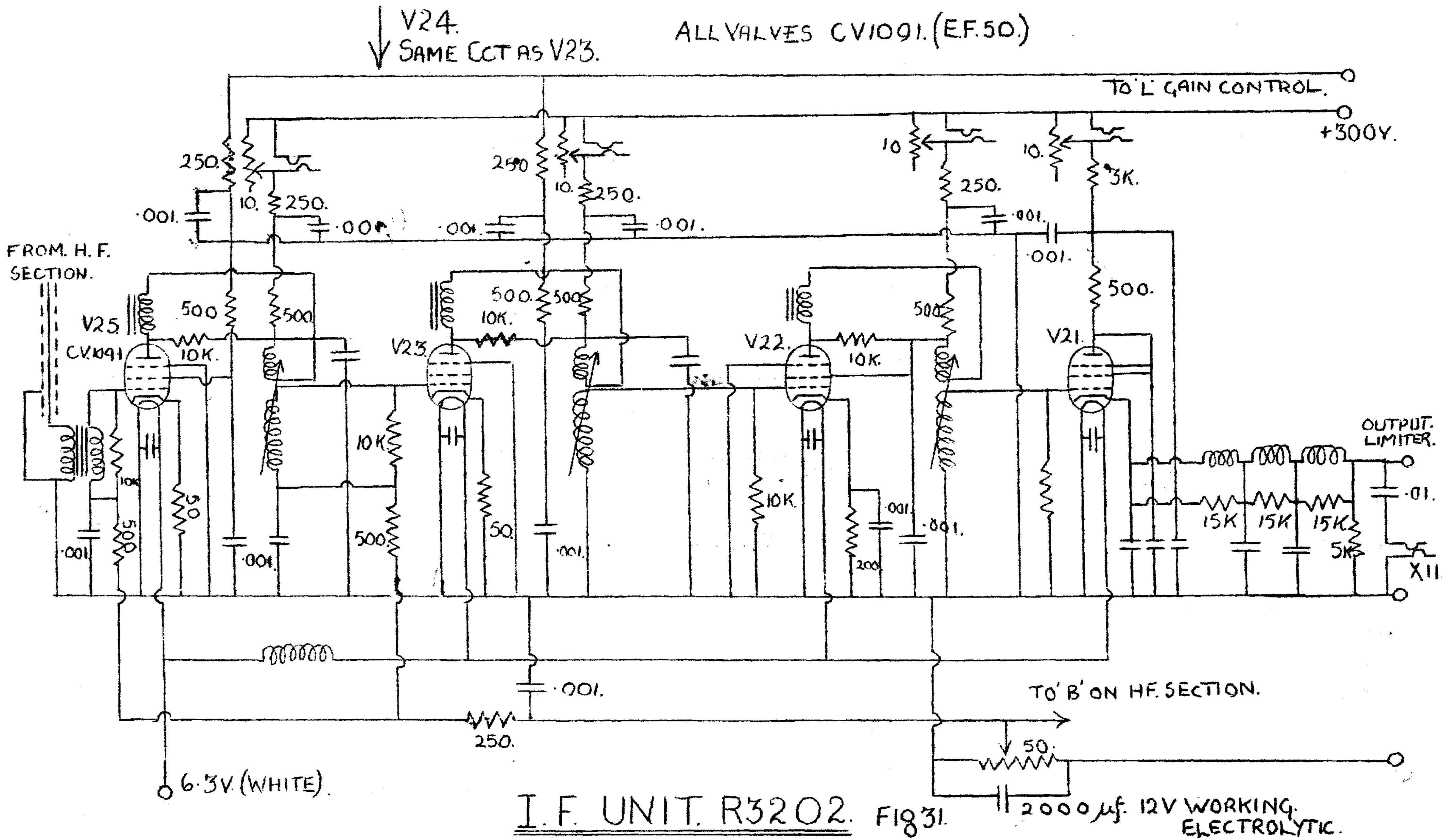
This type of detector is used as it affords linear detection, thus maintaining sharpness to leading edges of received pulse echoes, resulting in accuracy of range and height readings. It also has the following advantages :-

(a) High input impedance, therefore does not damp previous cct.
(b) Low output impedance, will therefore match easily to 80 ohm co-axial.

(a) High input Z. - Input impedance dependent on Cgf of valve. Reduction of this capacity therefore increases input Z ($Z \propto \frac{1}{wc}$). By making cathode load very high, the charge across Cgf will be reduced to a minimum, which is the same as reducing capacity of Cgf.

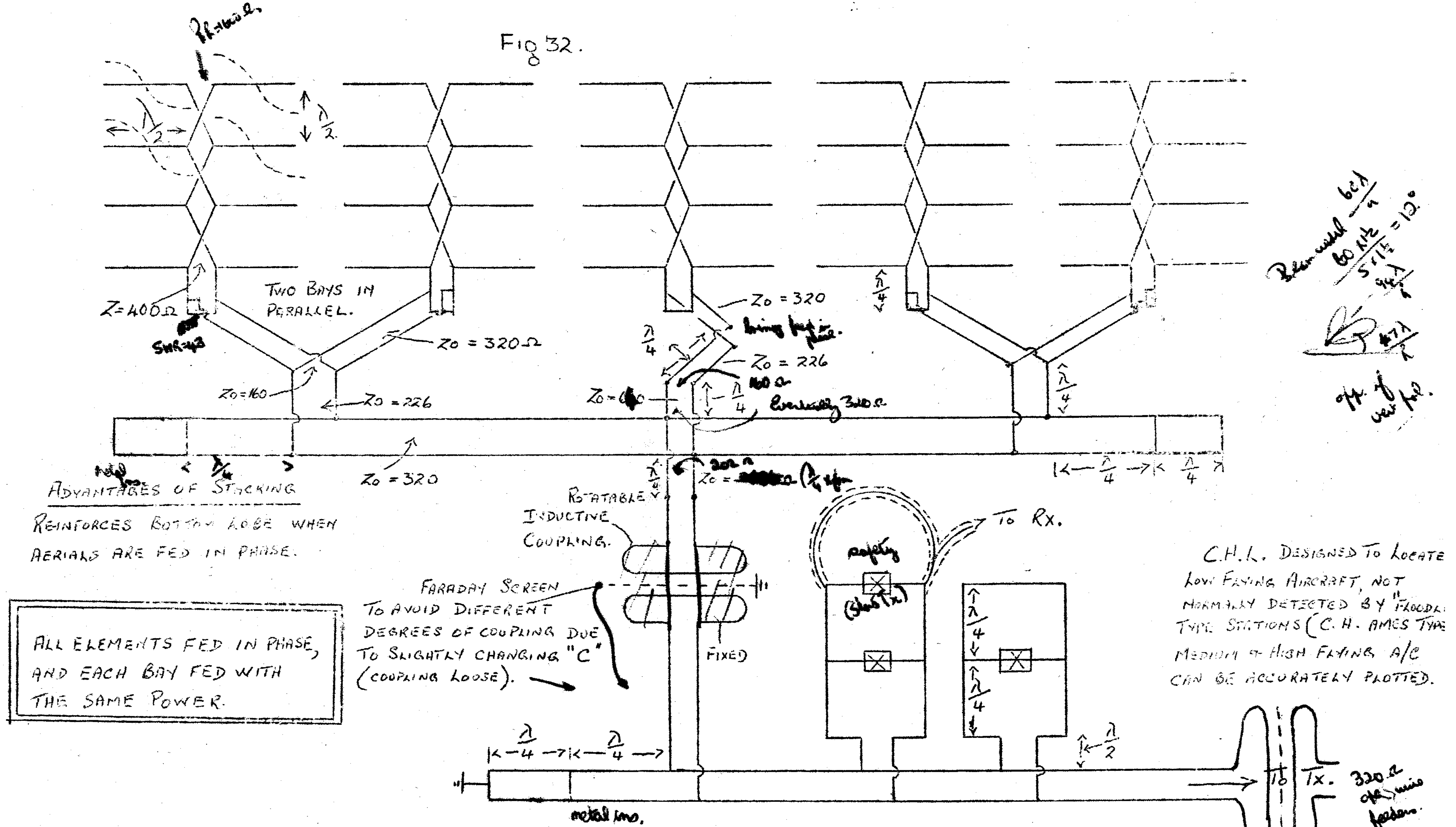
(b) If the cathode cct. is regarded as a generator whose internal resistance is very high, it can be seen that regardless of load, the output will remain reasonably constant.

Video Amplification Takes place in Cal. Unit rack for P.P.I. tube and in H/R rack for H/R tube.



I. F. UNIT. R3202. Fig 31.

Fig 32.



5 BAY, 4 STACK AERIAL ARRAY (OMIT CENTRE BAY FOR 4 BAY, 4 STACK).

FIG 32

Simplified Details of Aerial System.

Construction.

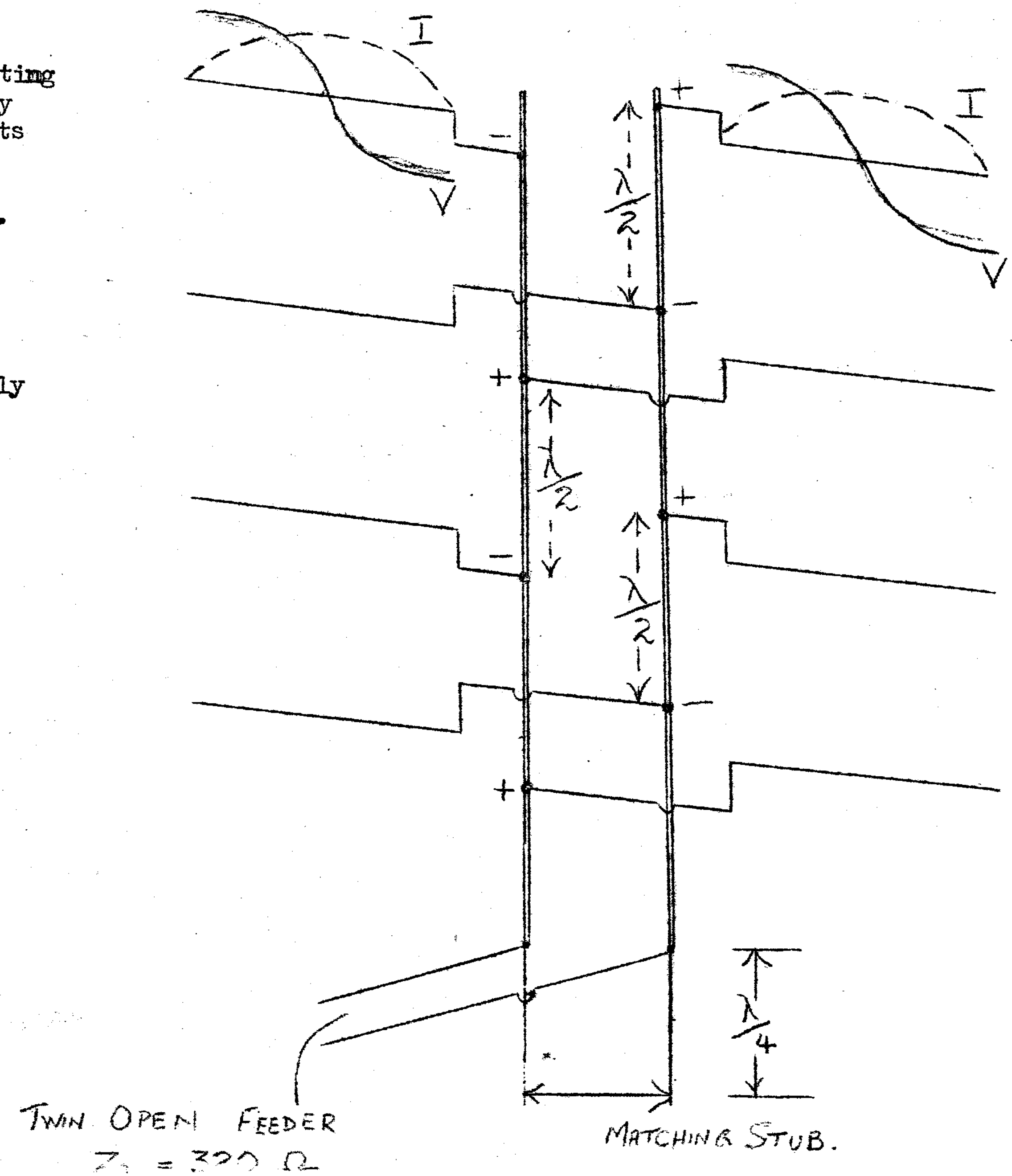
Dipoles, end fed, stacked in tiers (see fig) All radiating elements fed in phase from the Tx giving a certain polar diagram. By reciprocity theorem it may be stated that the same polar diagram exists for reception.

Rotation.

$\frac{1}{2}$ to 6 r.p.m. clockwise or anticlockwise or sector sweeping.

Advantage.

Advantage over "floodlighting" (As in C.H.). Interference reduced to a minimum (less susceptible to "jamming") due to small area covered by the aerial beam.
Highly directional properties and accuracy increased because of narrow beam width. All induced voltages phased and matched correctly for maximum input to receiver via rotatable magnetic coupling link.



CHL AERIAL ARRAY - COMMON T/R SWITCHING. Ref. Diag. FIG. 33.

PURPOSE.

To allow the use of a common aerial array for both reception and transmission.

AIM.

(a) To protect Rx. when Tx fires. (b) To prevent Tx oscillator cct from absorbing energy on reception.

ACTION.

(1) On transmit, gas gaps at A, B, & C all struck. Low impedance at A reflects high impedance at X looking towards A. Only sufficient energy to keep A struck travels in this direction. Low impedance at B reflects high impedance at Y looking towards B. No energy passes down this path towards Rx, energy travels down main feeder line to aerial array.

Safety Gas Gap. If gas gap B is unserviceable, safety gas gap at C is struck. Low impedance at C reflects a low impedance across main feeder line at Y, shorting out aerial array. Transmitter now working into no load, causing large increase in Tx anode current, resulting in tripping of HT overload on Tx.

(2) On reception, all gas gaps de-struck. Short at P-Q reflects a short across line at X. This short is reflected as a high impedance at Y looking towards X. No energy travels towards Tx, but is forced down towards Rx.

Reason for opening out lines.
(1) Gas gaps to be accommodated between lines.
(2) Reflected Zo is greater which makes for greater efficiency.
(3) Ensure a high voltage across gas gaps to give rapid ionisation.

G.C.I. WITH C.H.L. EQUIPMENT. Ref. Diag. FIG. 34.

GROUND CONTROLLED INTERCEPTION.

PURPOSE. :-

To obtain approximate height and range of an aircraft, to enable fighter a/c to be directed to a position near enough to the enemy to render airborne radar (such as AI Mk 9 or AI Mk 10) effective, when the a/c acts independently.

RANGE. :-

50 - 90 miles.

METHOD OF DETERMINING HEIGHT.

Height is found by comparing amplitude of response from two aerial systems at different heights.

REQUIREMENTS.

(1) Means of switching aerial arrays. (Upper & Lower).
(2) Display for comparison of relative amplitudes (Split separation). P.T.O.

CHL Æ ARRAY — COMMON T/R SWITCHING

FIG. 33

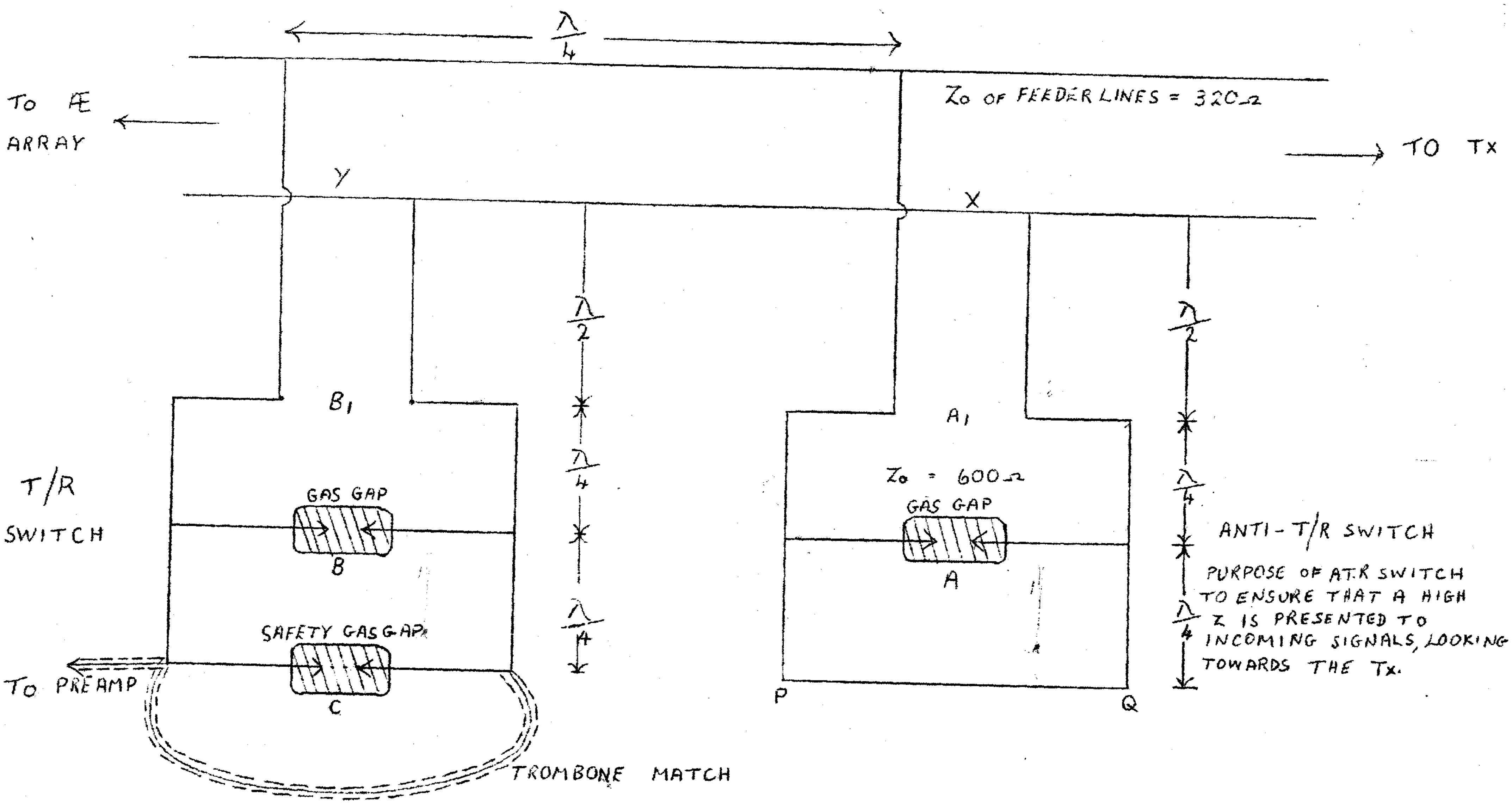


FIG 33

FIG. 34 A

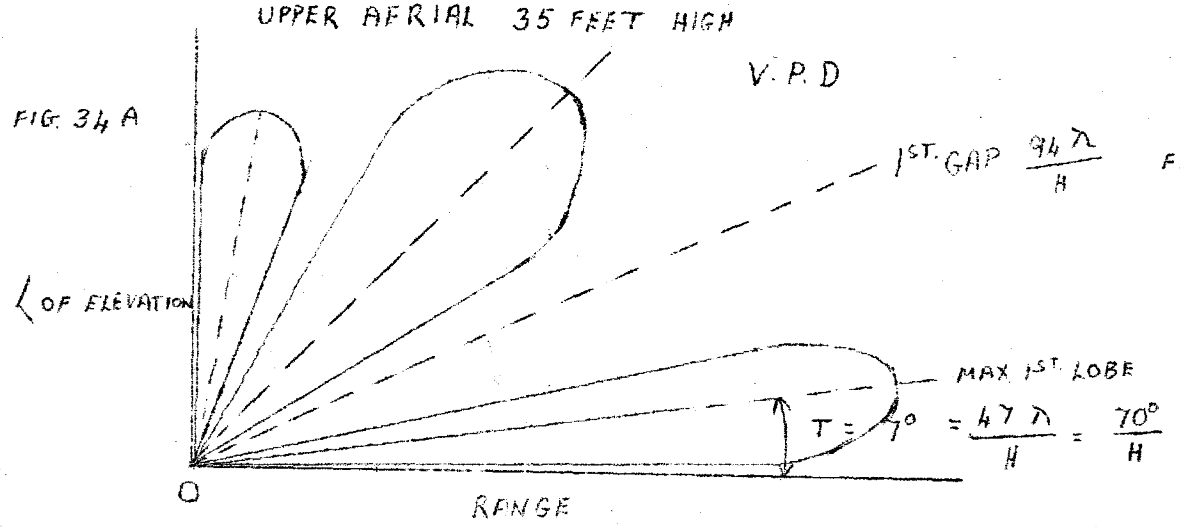


FIG 34B

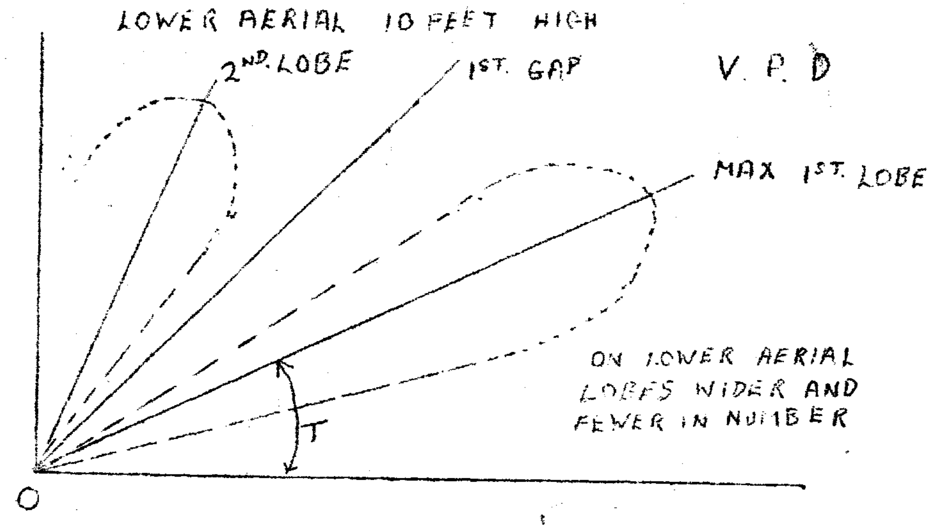
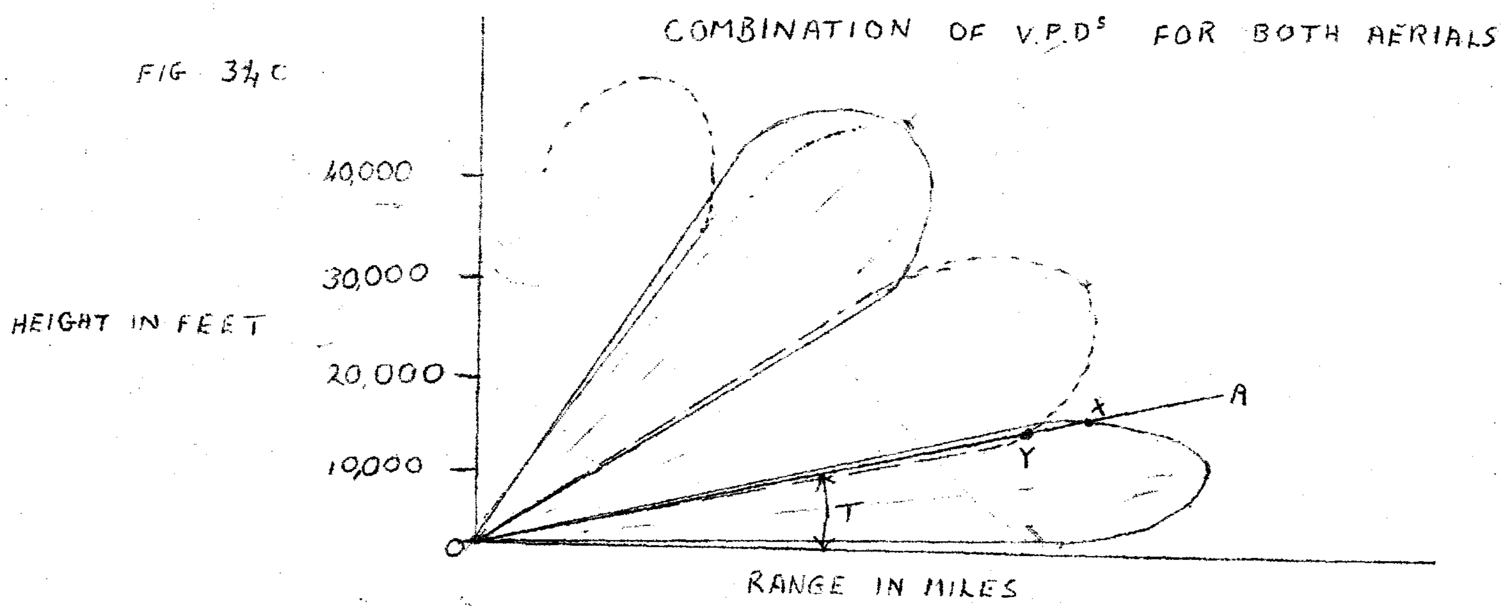


FIG 34C



$n = \frac{2d}{\lambda}$

n = No of lobes.

(3) 1 & 2 must be synchronised with each other and with the Tx. The Tx fires and energises both aerials. Reception is done on alternate aerials, one at a time (Synchronising achieved by Multi-vib. unit).

HEIGHT FINDING BY COMPARISON METHOD.

The vertical polar diagram of two aerials at differing heights consists of a number of lobes, evolved from the formula $n = \frac{2h}{\lambda}$. From this it can be seen that the higher the aerial, the greater the number of lobes. The angle subtended by the first lobe is given by $\frac{47\lambda}{h}$ degrees. The first gap appears at $\frac{94\lambda}{h}$ (λ in metres, h in feet). Referring to FIG. 34C, an aircraft in the direction OA at an angle of T, will return an echo whose amplitude is proportional to the length of OX, when echo is received on upper aerial array. The same aircraft will set up a signal in the lower aerial, whose amplitude is proportional to OY. The ratio of OX to OY will vary as the angle T varies. Thus for every angle of elevation there will be a corresponding ratio of signal strength, and by comparing the amplitudes of signal receiver from upper & lower aerial arrays it is possible to measure the angle T. Knowing the angle T and the range of the target it is now possible to calculate the height of the target. In practice the angle is computed direct as a height reading by means of a "height computer".

Ref. Diag. FIG. 34 & 35.

SOLUTION OF AMBIGUITIES.

y referring to FIG. 34D it can be seen that it is possible for wo or more differing height readings to be obtained on one arget.

ese ambiguities may be resolved by one of the following methods:-

a) Elimination of the "ridiculous" i.e. If range of aircraft is 100 miles and the angle of elevation is shown as either 5 or 45, then it obviously cannot be 45 as this would mean that it was flying at an impracticable height.

b) By comparing the phase of synal received from upper & lower aerials. i.e. Receive on both aerials at the same time. If the amplitude of synal increases the aerials are in phase, if it decreases they are anti-phase. (See FIG. 34D).

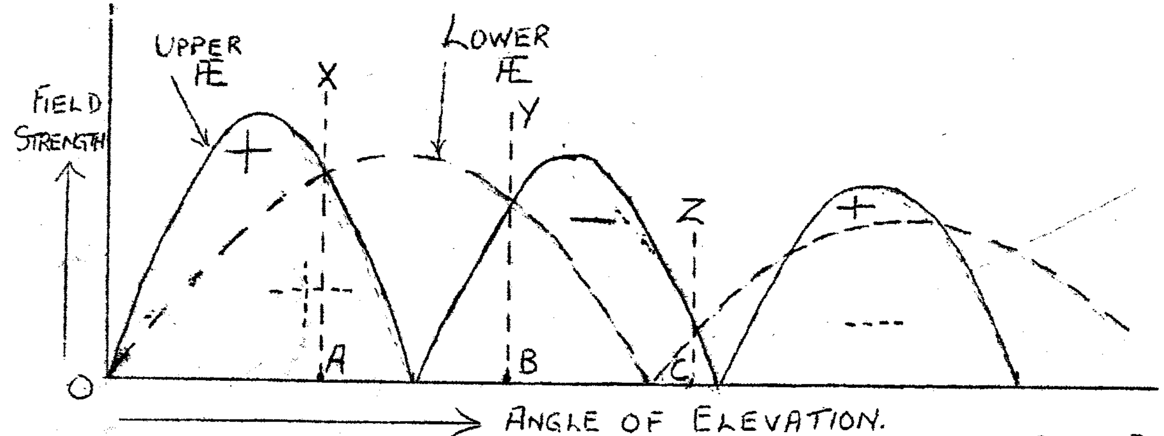


FIG 34 D

From graph shown above it can be seen that equal signal ratios will be obtained at X, Y & Z.
By switching to "Phase", it can be arranged to receive on upper and lower aerials simultaneously. If target is at an angle of elevation A, then signals from each aerial will be in phase & will produce an echo trace of increased amplitude. If target is at an angle of elevation B, signals from each aerial will be anti-phase and will cancel each other, so that the echo will disappear from tube face.

G.C.I WITH C.H.L. EQUIPMENT.

HEIGHT COMPUTOR.

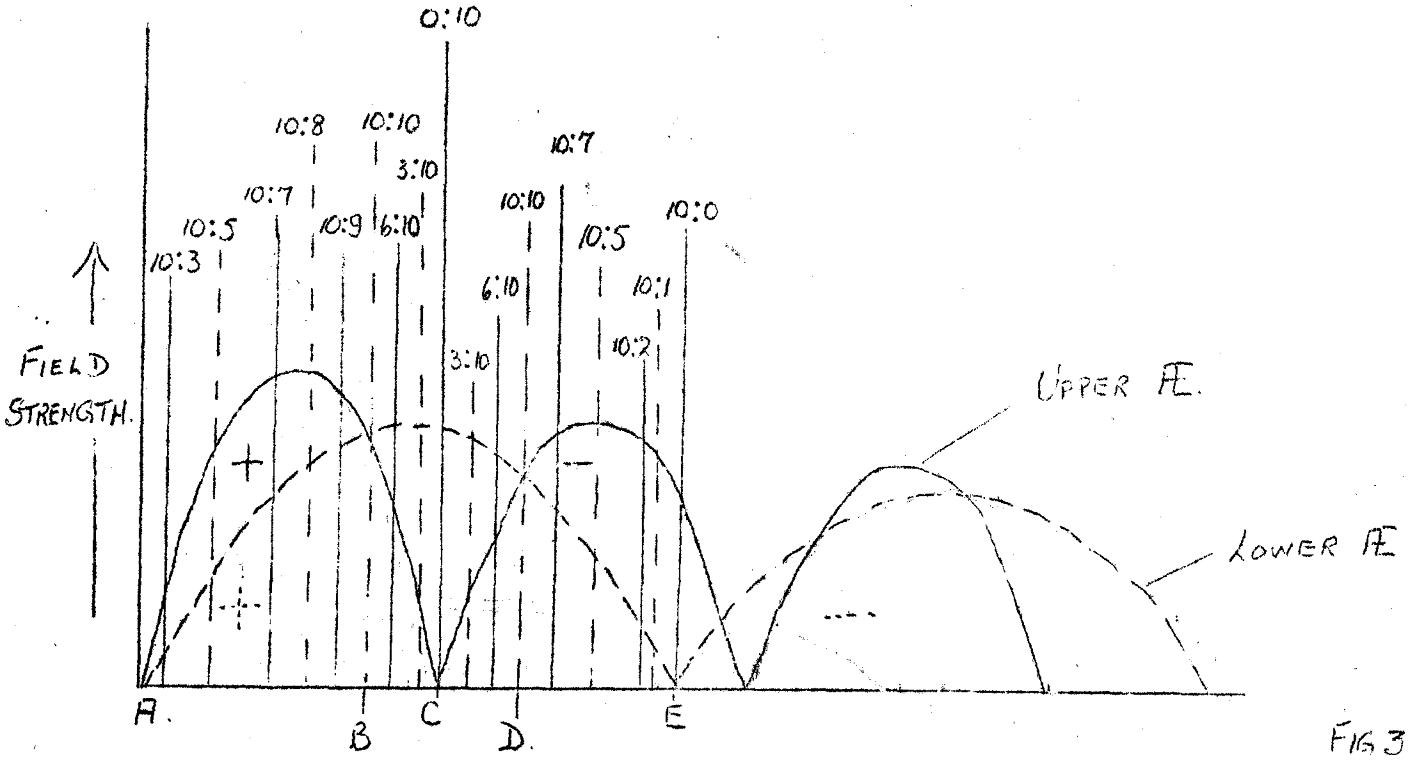


FIG 35A.

ANGLE OF ELEVATION.

SIGNAL RATIO ALWAYS EXPRESSED AS RATIO OF UPPER TO LOWER Æ.

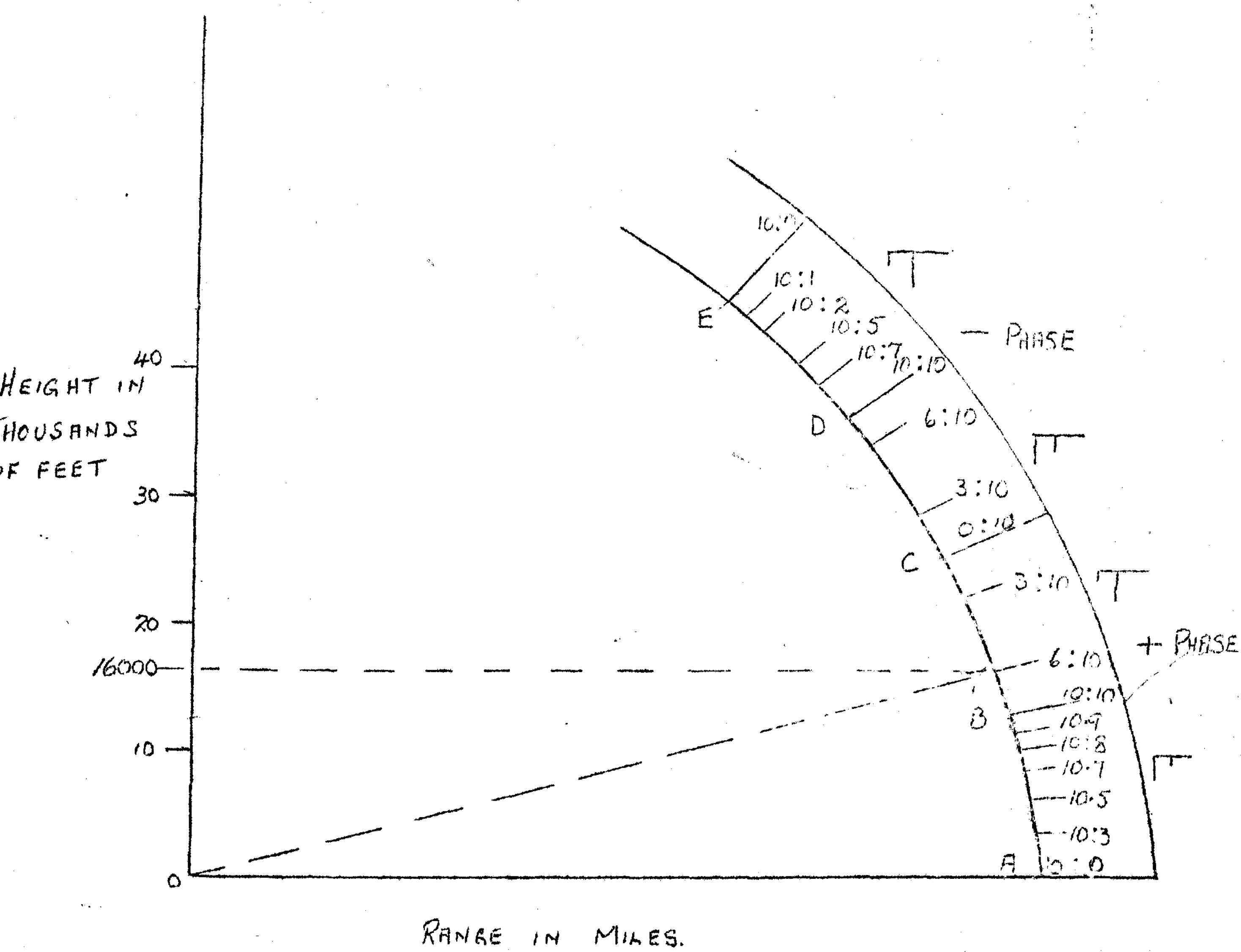
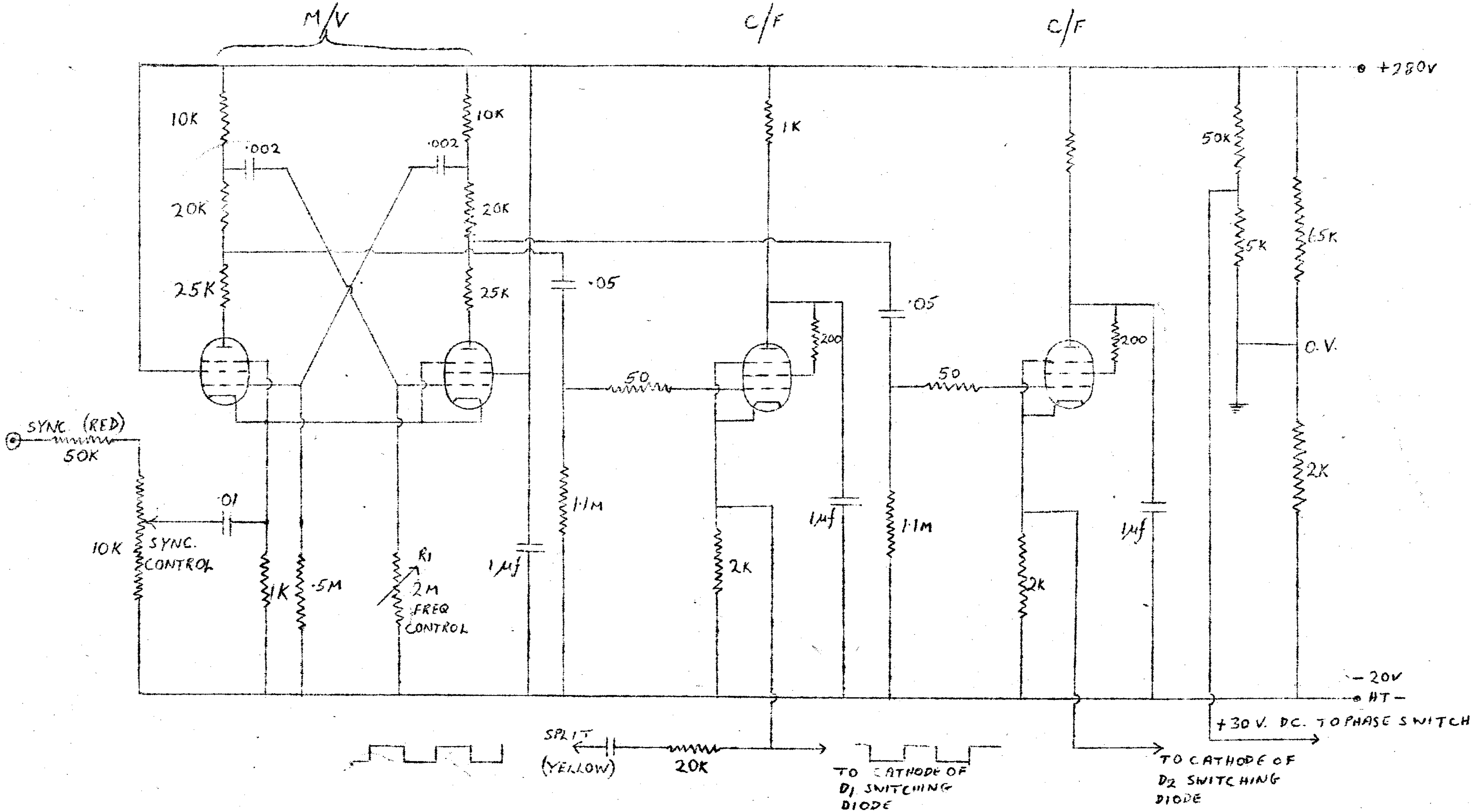


FIG 35B

GCI M/V UNIT

FIG. 36



R 3202 - MULTI-VIBRATOR UNIT FOR G.C.I. Ref. Diag. FIG. 36.

PURPOSE.

To produce triggering square waves at correct time intervals for receiver aerial switching. (By means of electronic, diode, switching).

POWER SUPPLIES.

HT 300v LT 6.3v (Provided by own power unit).

VALVES.

4. CV1091's 1. CV3759 (F.W Rect).

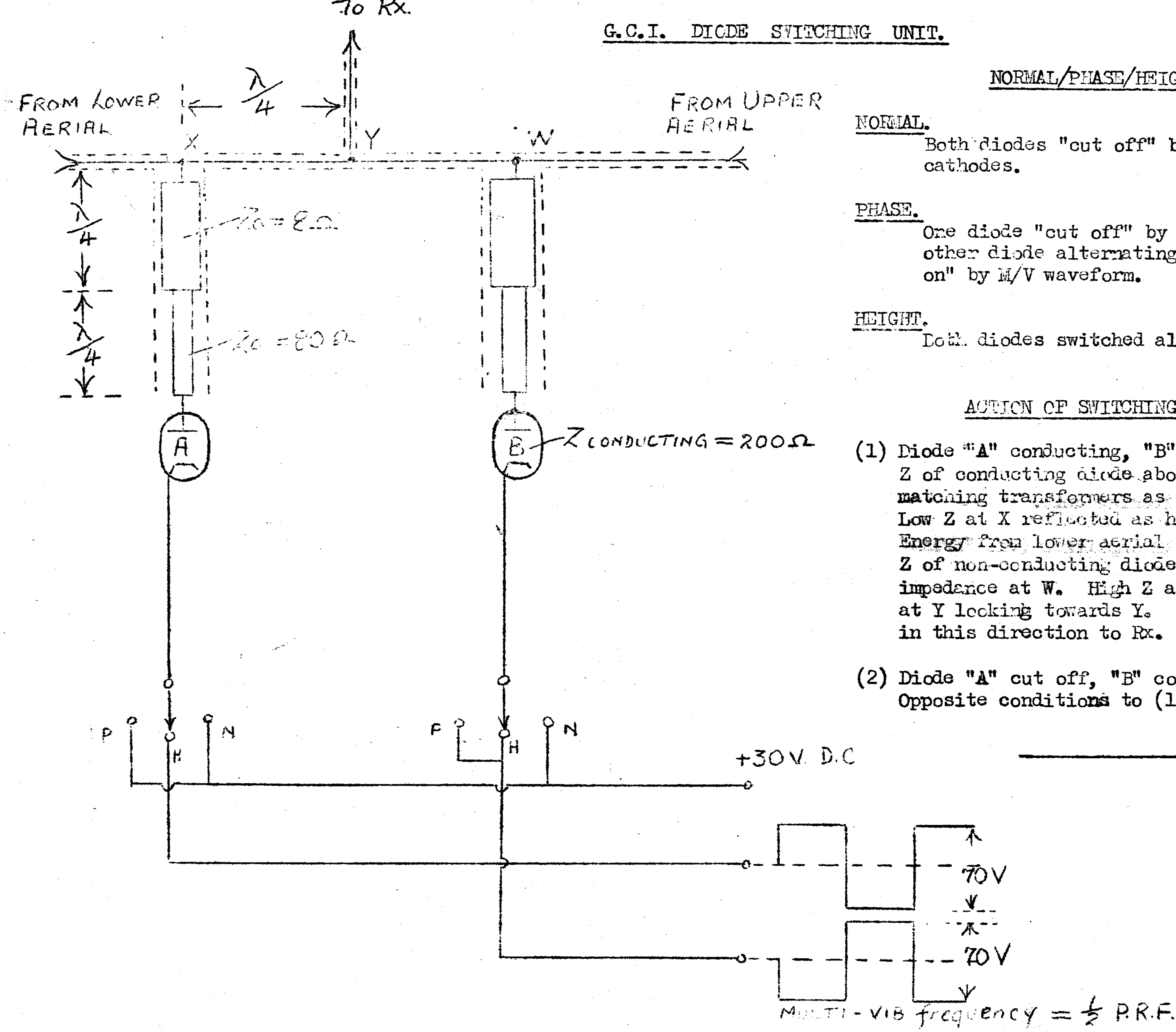
CIRCUITRY.

The M/V cct is synchronised from the Red C/F which also triggers the Tx.
Its frequency is adjusted by means of R1 so that square waves are produced at a frequency of half the Tx P.R.F. The leading edge of the M/V square wave to commence simultaneously with the start of the H/R & time-base.
Output from M/V, fed via C/F's to :-

(1) Diode switching unit.

(2) Grid of X2 amplifier (via "Split" Control). This acts as variable bias to X2 Amplifier.

G.C.I. DIODE SWITCHING UNIT.



NORMAL/PHASE/HEIGHT SWITCH.

NORMAL.
Both diodes "cut off" by DC bias (+30v) applied to cathodes.

PHASE.
One diode "cut off" by DC bias applied to cathode, other diode alternating between "cut off" and "cut on" by M/V waveform.

HEIGHT.
Both diodes switched alternately by M/V waveform.

ACTION OF SWITCHING UNIT.

(1) Diode "A" conducting, "B" cut off.
Z of conducting diode about 200 ohm, reflected via matching transformers as 2 ohm at X looking towards A. Low Z at X reflected as high Z at Y looking towards Y. Energy from lower aerial does not travel to Rx.
Z of non-conducting diode very high. Reflected as high impedance at W. High Z at W reflected as low impedance at Y looking towards Y. Energy from upper aerial travels in this direction to Rx.

(2) Diode "A" cut off, "B" conducting.
Opposite conditions to (1) prevail.

APPLICATION OF G.C.I "SPLIT" W/F TO H/R TIME-BASE.

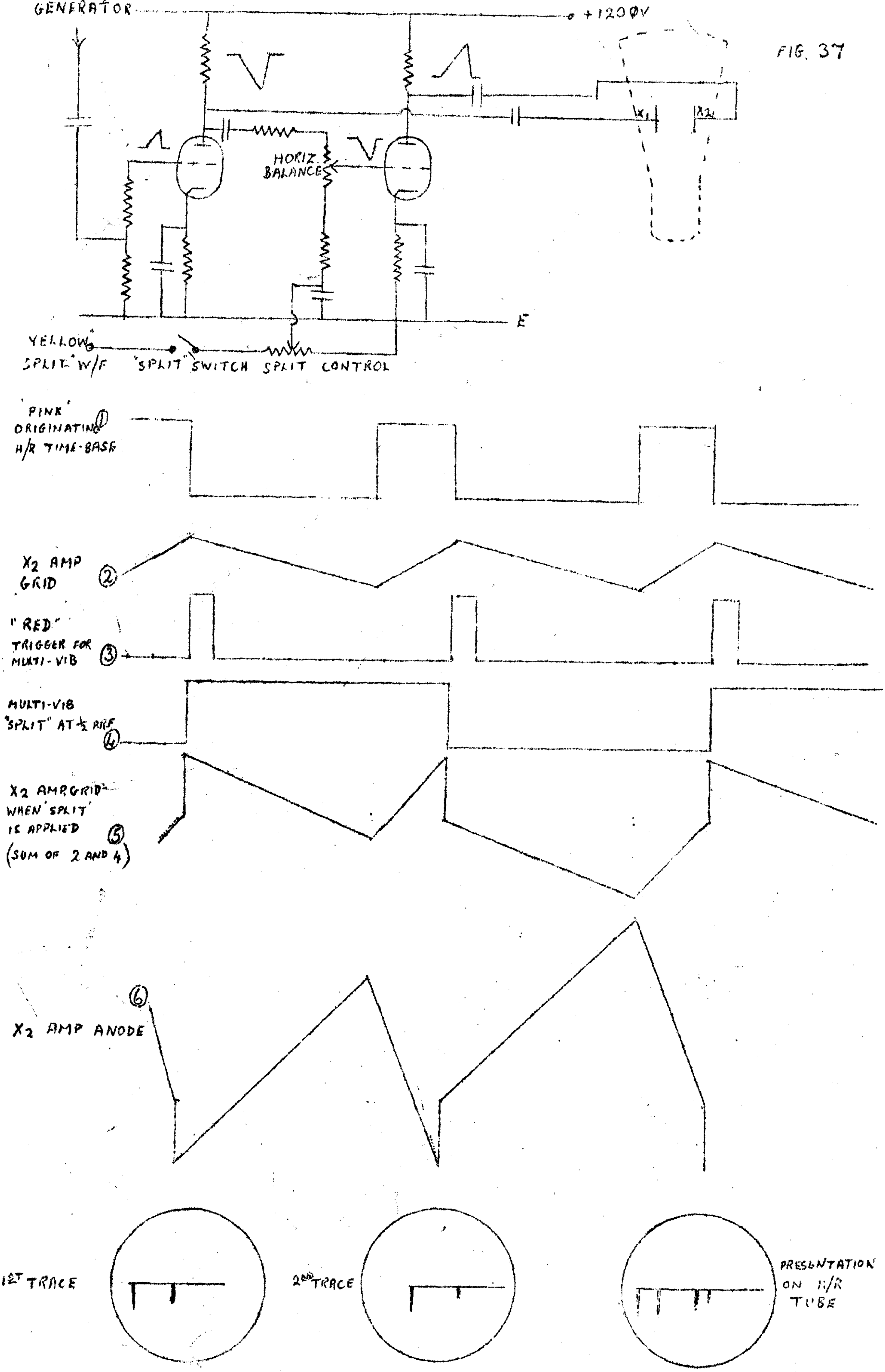
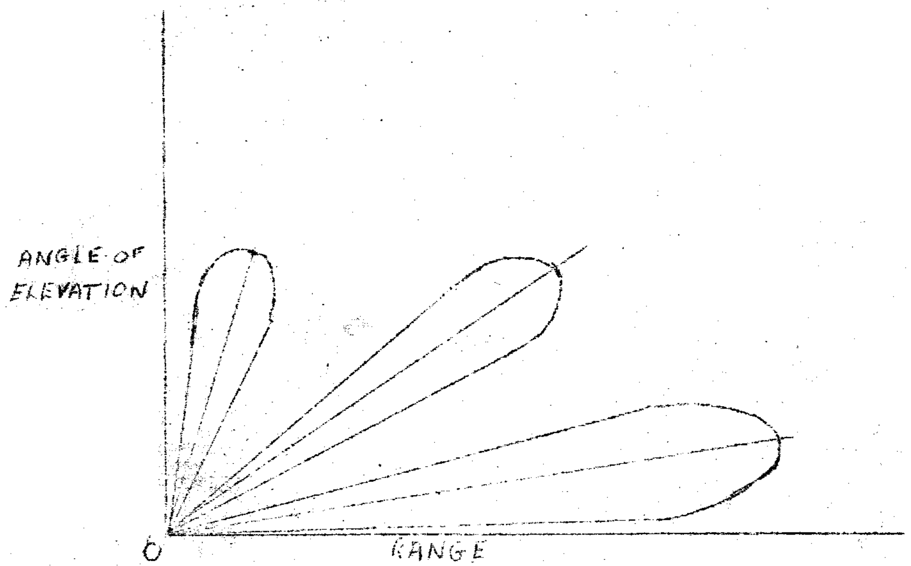


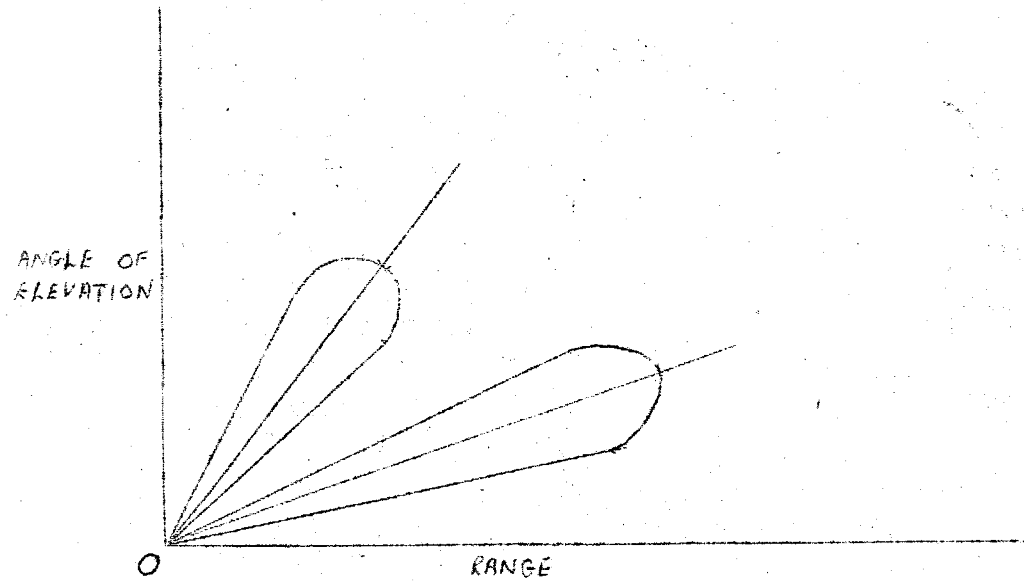
FIG. 37

C.H.L ~ GAP FILLING

FIG. 39.



① LOBE PATTERN OF AERIAL WHEN SWITCH E IS CLOSED AND A OPEN



② LOBE PATTERN WHEN SWITCH E IS OPEN AND A CLOSED (AERIAL FED IN REVERSE PHASE to CONDITION (1) CAUSING FIRST LOBE TO MOVE UP INTO THE POSITION IN WHICH FIRST GAP APPEARED

C.H.L. - GAP FILLING. Ref. Diag. FIG. 38 & 39.

PURPOSE.

To prevent aircraft avoiding detection by flying in the gaps between aerial lobes.

REQUIREMENTS.

A method of changing the position of the lobes so that they occupy the space where gaps normally appear.

METHOD.

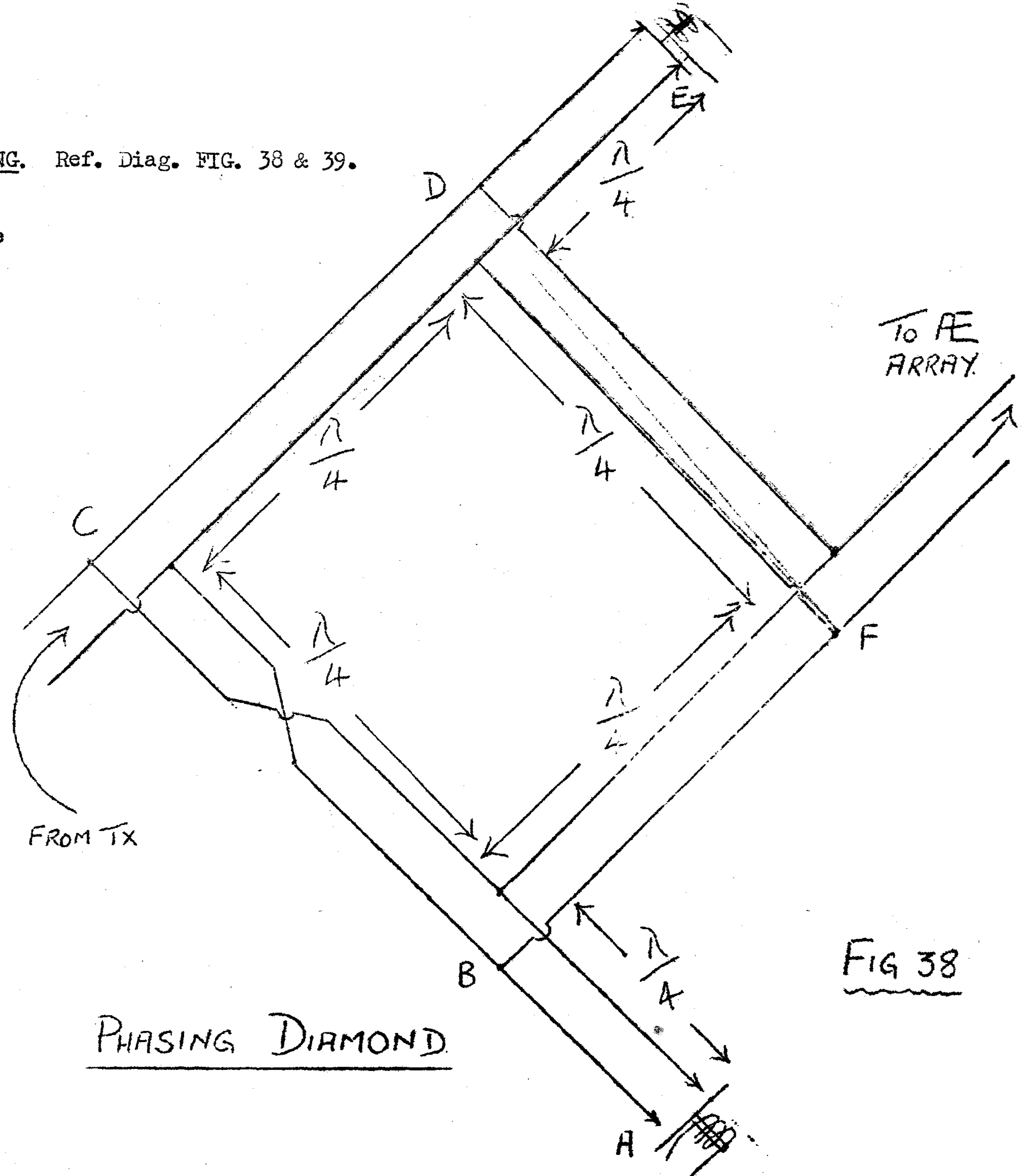
By changing the phase of the energy fed to aerial arrays, the lobes are shifted into the gaps.
This is achieved by a system of "stub" switching.

ACTION.

With stub switch at E closed, and switch at A open :-

1) Low impedance at E reflected as a high impedance at D; further reflected as a low impedance at C looking towards D.
2) High impedance at A, reflected as a low impedance at B, further reflected as a high impedance at C looking towards B.

Energy from Tx travels to aerial via C,D,F. If switches are reversed, energy travels to aerial via C,B,F. and as feeders are crossed over in CB leg of diamond, aerial will be fed in reverse phase.



PHASING DIAMOND

FIG 38