Form 27 (Small)

ROYAL AIR FORCE

CHL

SKETCH BOOK

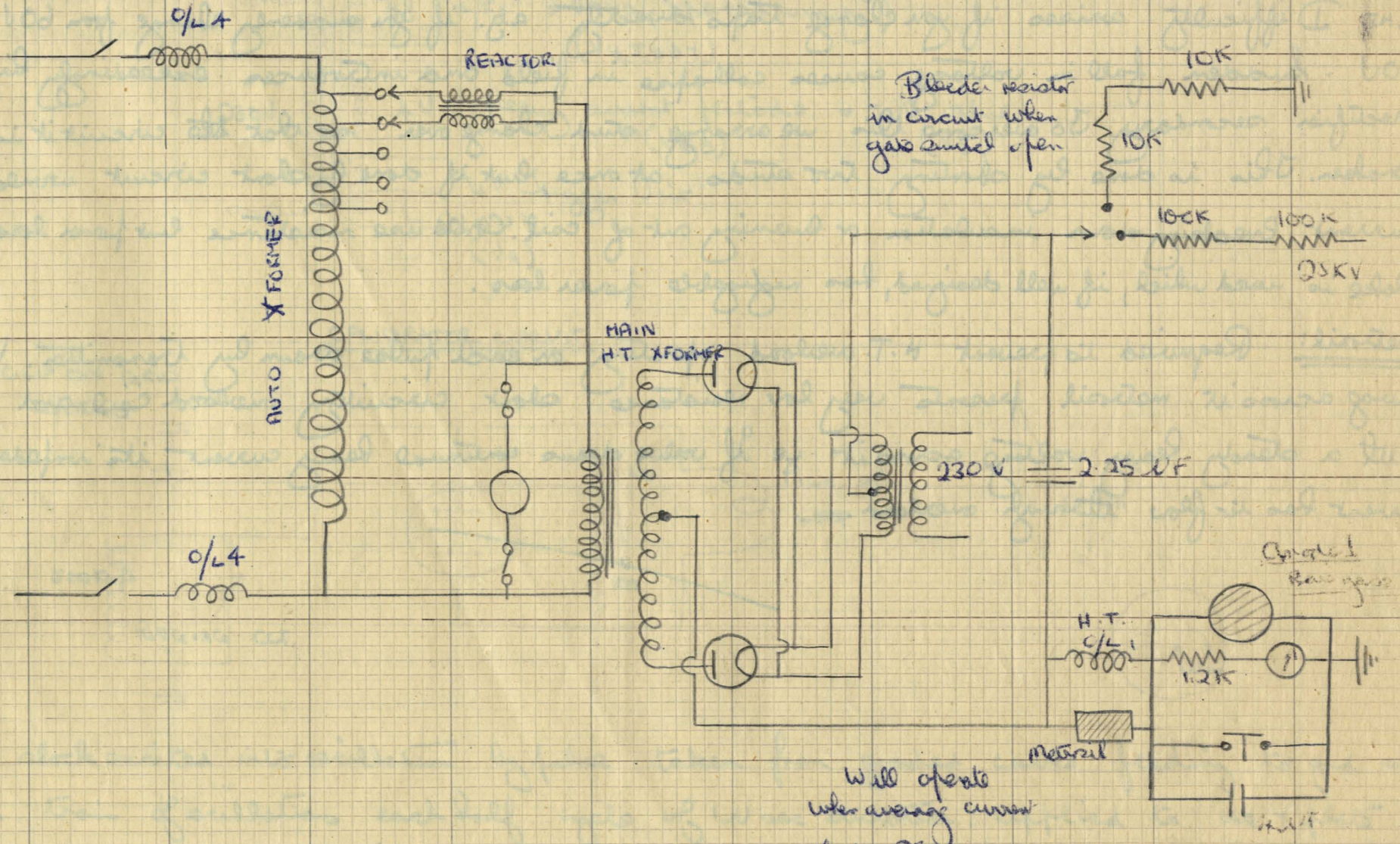
(FOR USE OF THE AIRCRAFT APPRENTICES' TRAINING ESTABLISHMENTS, THE ROYAL AIR FORCE COLLEGE, AND THE OFFICERS' ENGINEERING COURSE, HENLOW.)

T.9049 Wt. 5500. 25,000 Bks. 11/45 CWS

T. 3079.

C.H.L. EXTRA NOTES

25KV POWER SUPPLY.

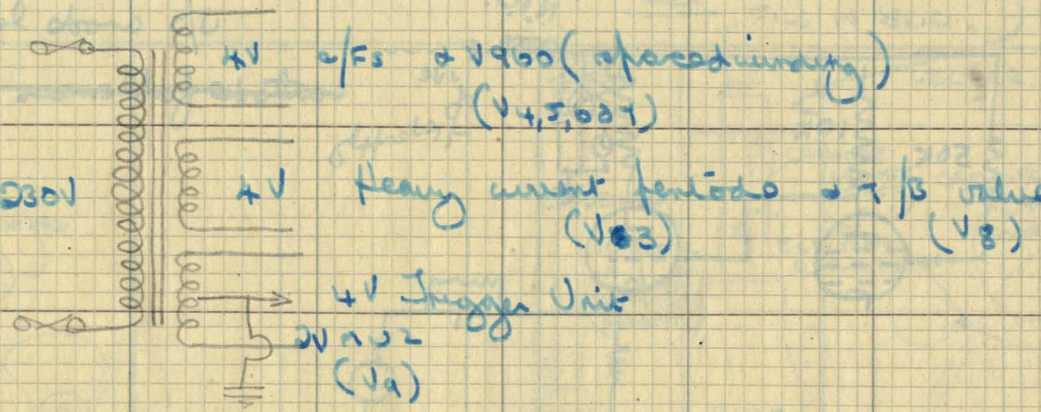


25K1 Power Supply

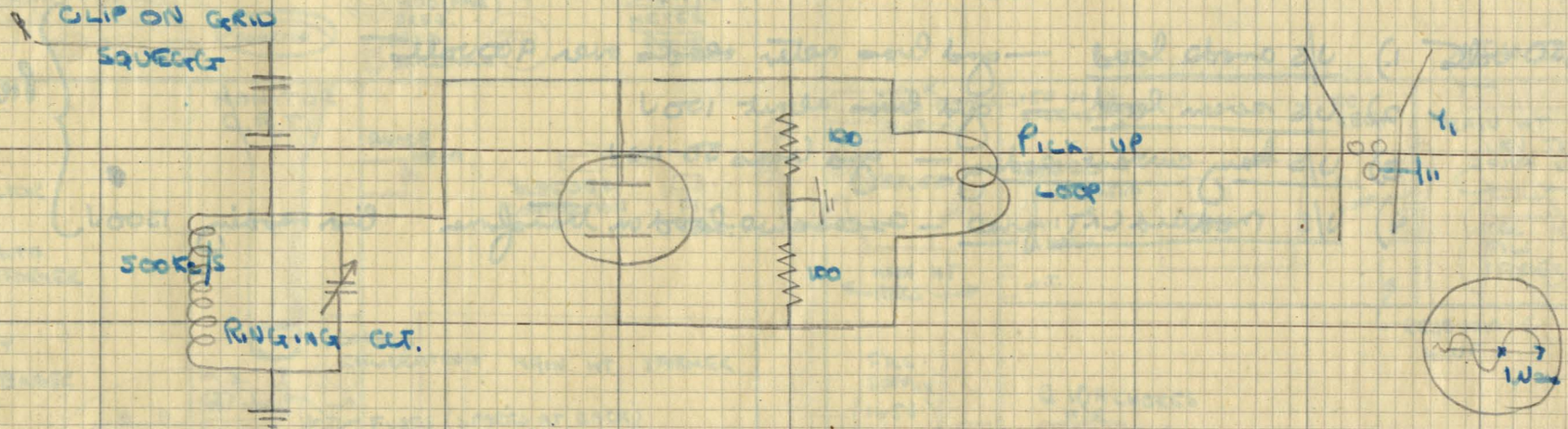
Resctor: Auto transformer taps from 60 - 230 volts followed by second step up transformer 230-601-300V E.H.T. Difficulty arises if you change taps directly e.g. if you suddenly change from 601-0 and then to 10V. Sudden fall in voltage causes collapse in field and introduces exceedingly high voltage in rectifier secondary. To overcome this we arrange stud change over so that the circuit it is never completely broken. This is done by shorting two studs at once, but if done by short circuit would create very high current breaking down insulation or burning out of coil. Could use resistance but power losses high so a choke is used which, if well designed, has negligable power loss.

Metrosil: Required to prevent H.T. overload operating on each pulse drawn by transmitter. With a sudden surge across it metrosil presents very low resistance short circuiting overload coil and preventing operation. With a steady heavy voltage across it ie If value draws continual heavy current, its impedence is high and current has to flow through overload.

MODULATOR TRANSFORMER

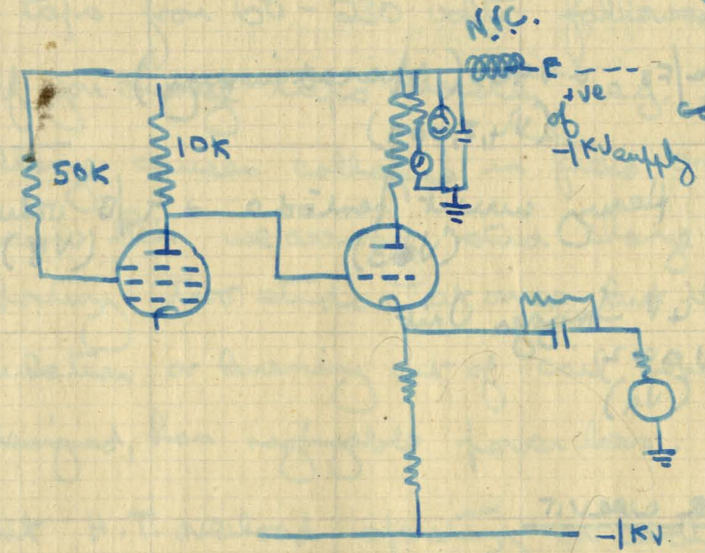


CALIBRATOR CIRCUIT



500 c/s cct. clock excited into oscillation by pulse taken from grader cable feeding to grid squegg gives damped train of oscillations each half cycle of 1V see duration. Applied to one Y plate by connecting wander lead to CRT in place of normal lead connection. A piece of paper can now be calibrated

Faults — Heavy current pentode



Normal bias 650-850 volts

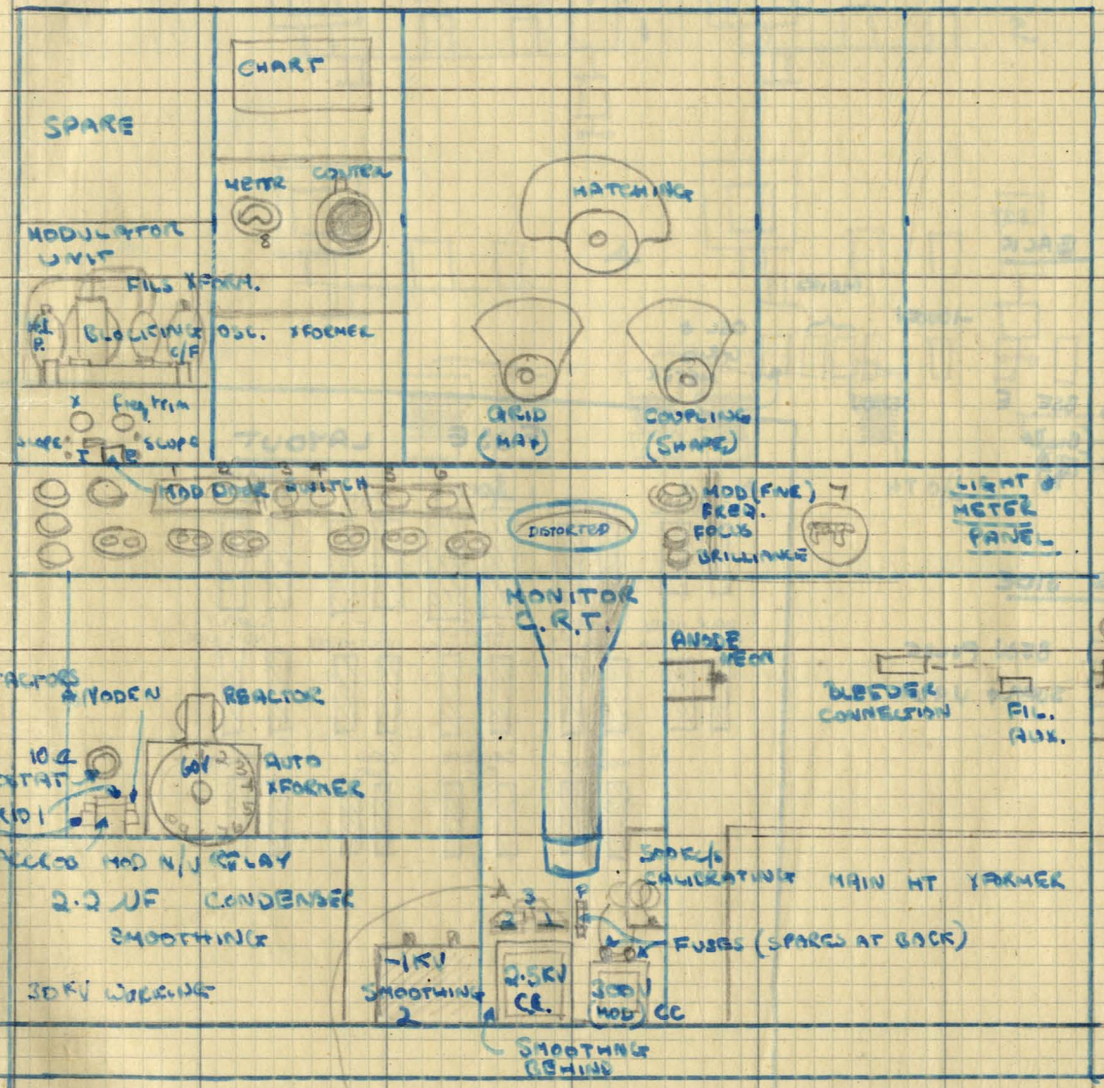
1) V/S anode load — grid bias meter reads over 900 volts
2) V/S screen load — grid bias about 150V
3) V/S heavy current reading — grid bias 50-100V
4) V/S mod and CRT fuse — excessive load on transformer bias reading 1300V

} Prevent mod H/V coil operating

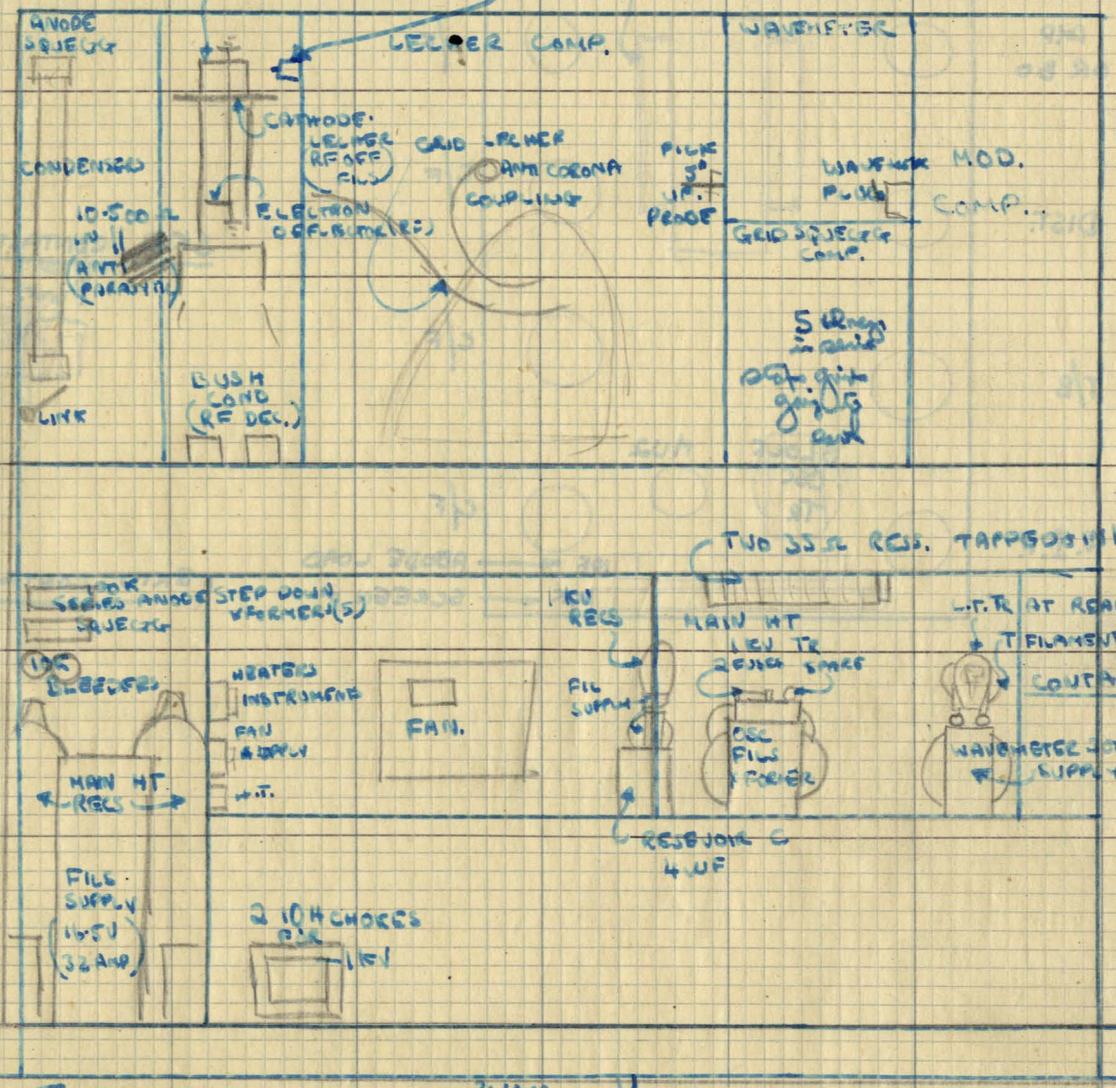
V/S anode load — ~~overheating~~
~~cathode follower, remains conductive~~

LAYOUT DIAGRAMS

T3079 — Front



Rear



Mods CRT fuse also fuses fils to mod. unit

PLUGS

1. BRILL & FOCUS
2. MAINS IN & 300V OUT TO MOD. UNIT.
3. 2·5KV SUPPLY TO MON. & 4V TO FIL. HEATERS

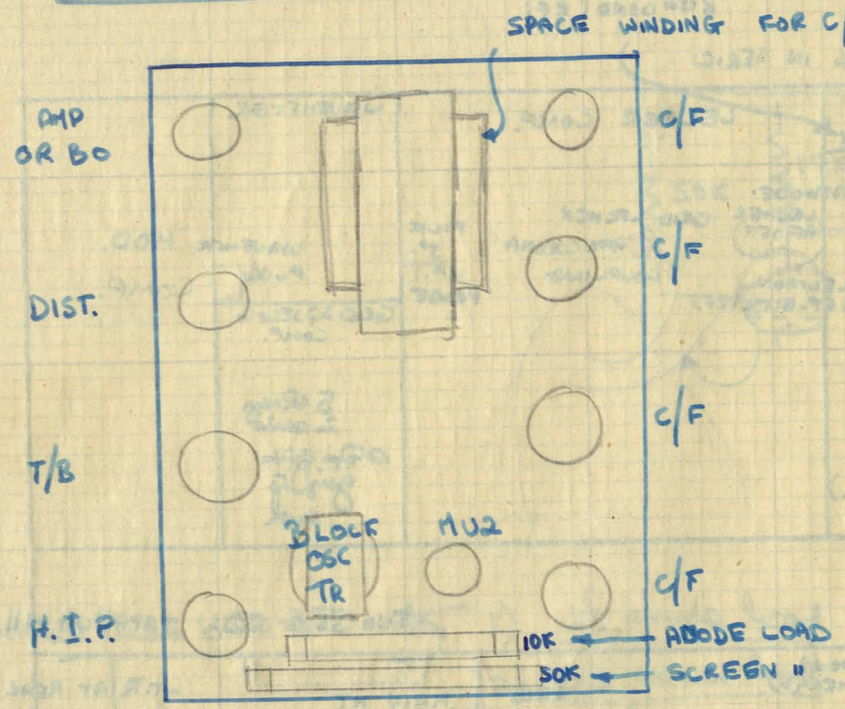
meters

1) Mains — across supply
2) EHT — 2nd'y auto & former
3) fils — 2nd'y fils & former
4) Grid bias — anode VLTS
5) angle I — earth — -1KV (anode c/c)

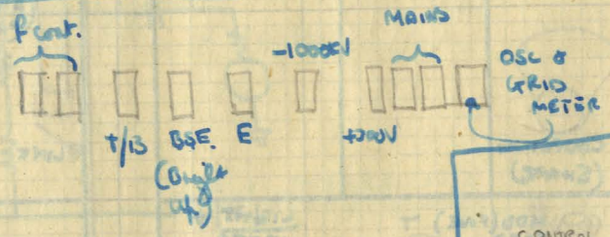
Canada Flux / Eat Lock

7) Rear meter
8) Wavemeter — after TD2 + GSW V.

MODULATOR LAYOUT

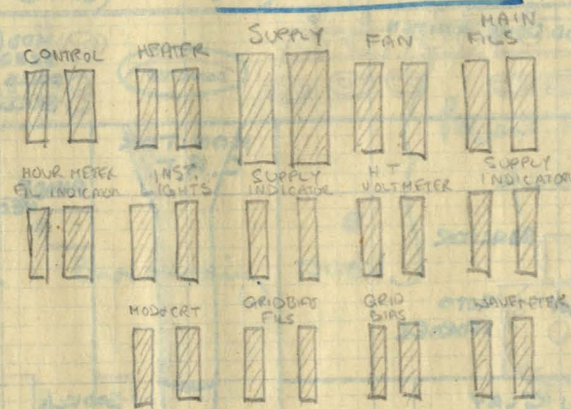


SKID CONTACTS BACK

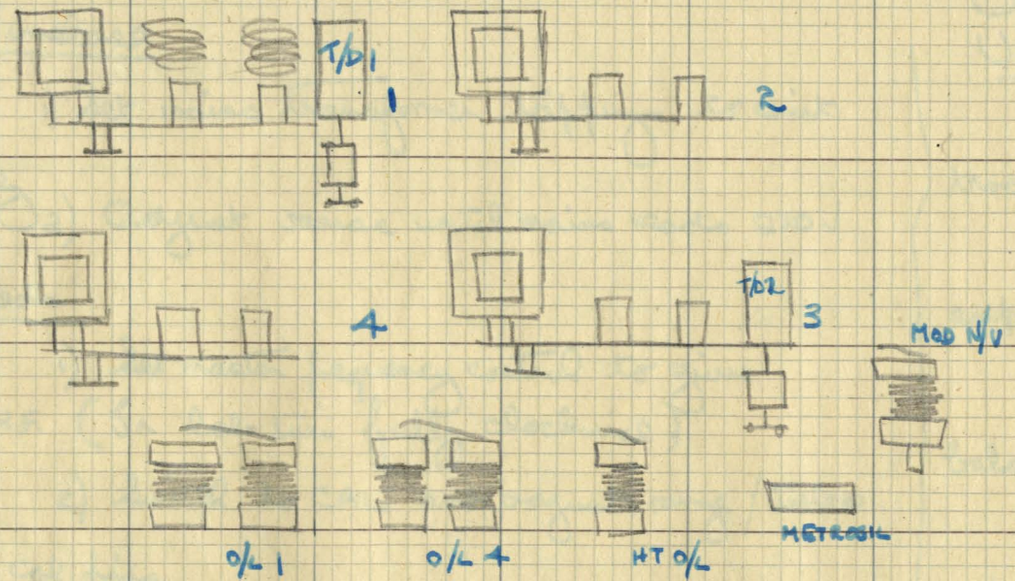


SKID CONTACTS SIDE

FUSE LAYOUT



CONTACTOR LAYOUT



R 3202 Setting up Procedure.

H/R Timebase

General 1) Set mains transformer tapping to suit local supply.

2) Adjust variac until mains reads 230 V

Hairy deflection

1) Set master frequency control to give required P.R.F. (fully anti-clockwise)

2) Switch to CAL and adjust range/timebase control for 4 cal pips

3) Switch off and remove top cap of second P.R.A.

4) Switch on set and adjust velocity for trace length of 3"

5) Switch off and replace top cap

6) " on and adjust hairy balance control for trace length of 6"

7) Linearity trace with linearity and velocity controls.

Vertical deflection

1) Adjust vertical shift control until trace reaches DCK level.

2) Remove hairy lead and adjust cal amp control for 1v cal pips.

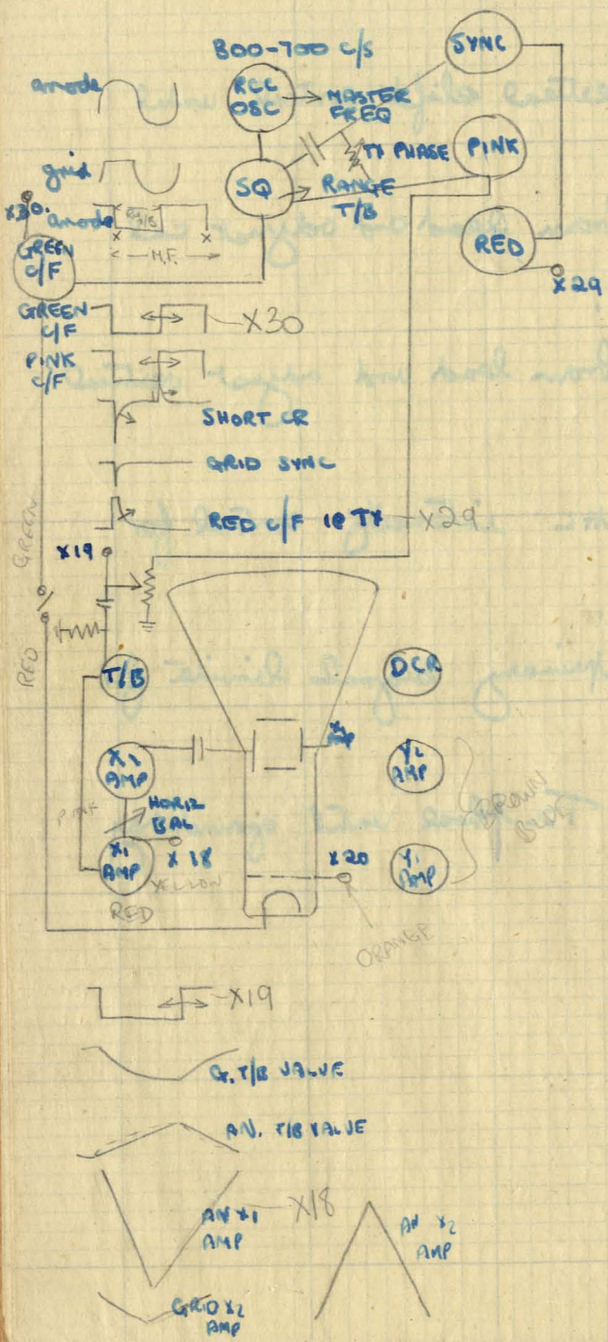
3) Replace hairy lead and adjust vertical balance for 2v cal pips.

4) Adjust CRT intensity control for = of ers conveniences

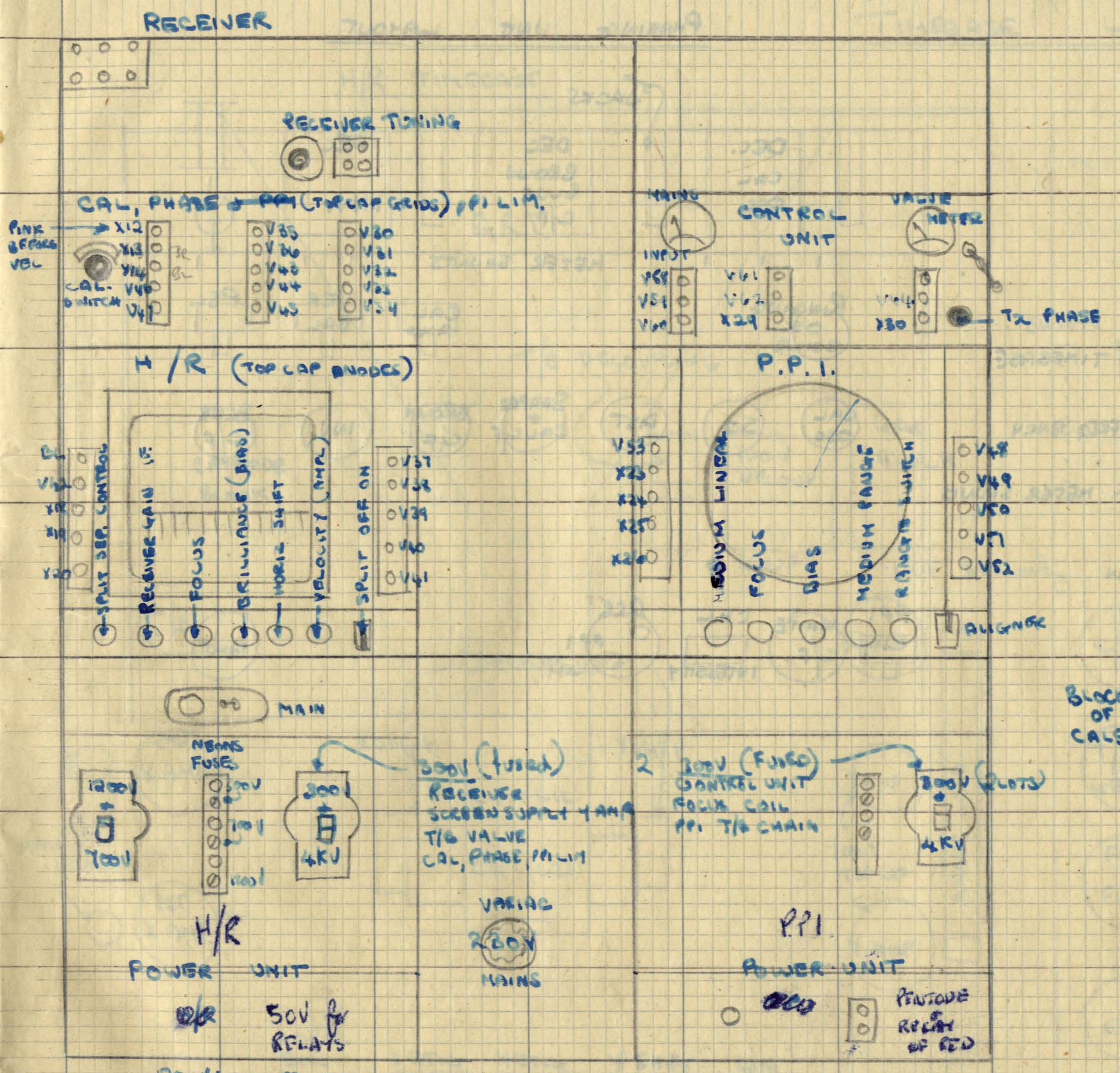
5) Adjust primary signals limiter for 7cms of ground ray.

6) Adjust Tx. phase until ground ray on 3rd cal pip.

BLOCK DIAGRAM RB202



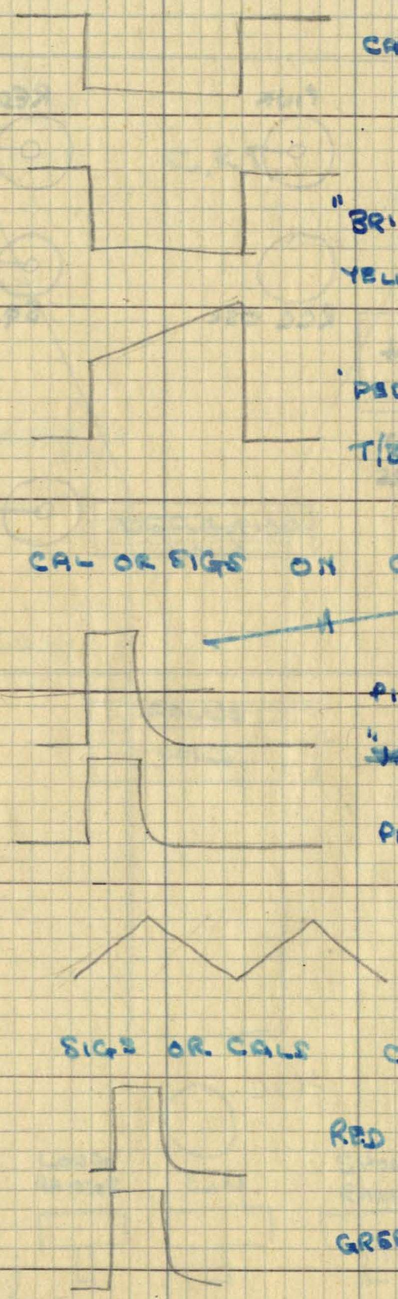
LAYOUT



1200V: X AMPS

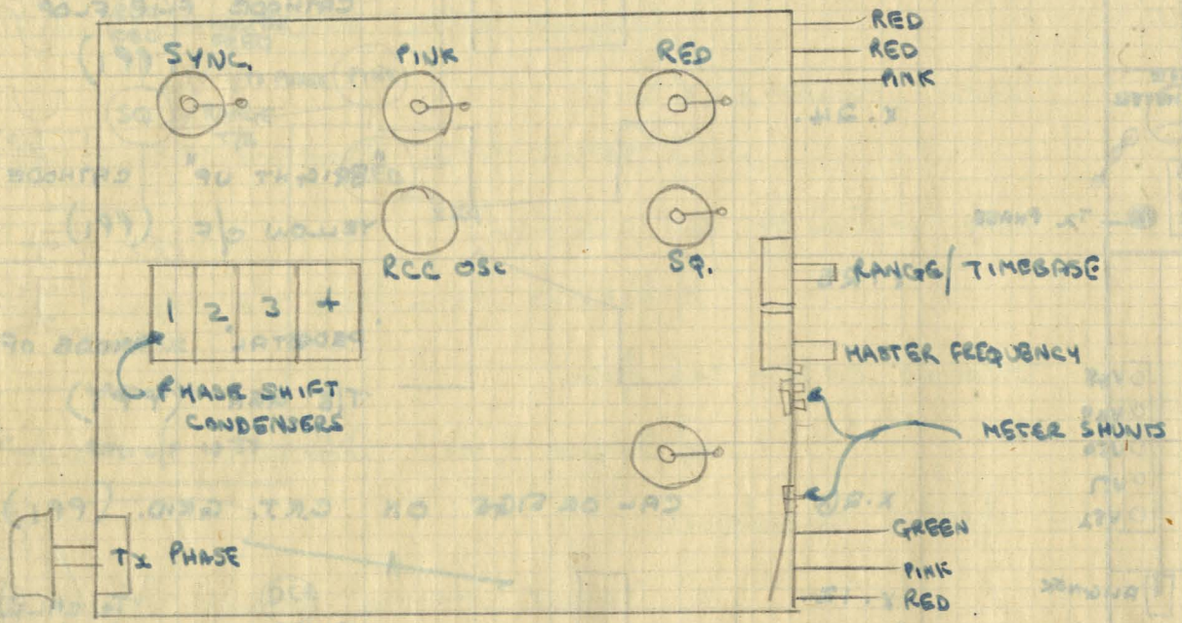
700V:

Scope points.

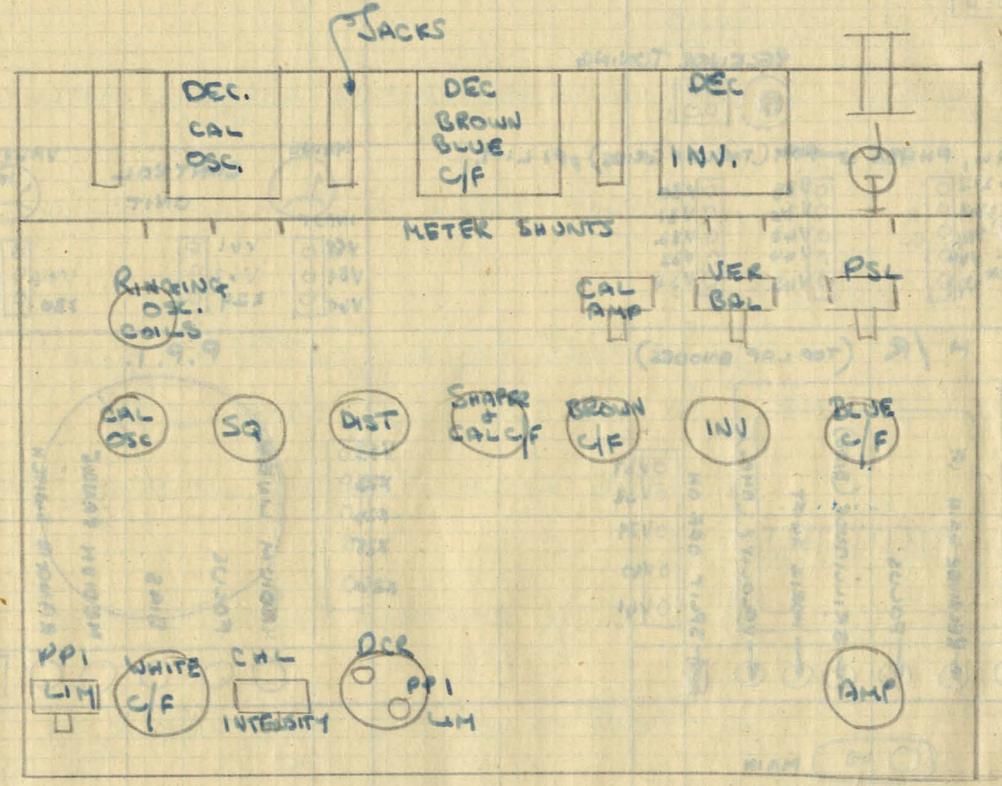


X.23.	CATHODE FLIP FLOP (PP1)
X.24.	"BRIGHT UP" CATHODE YELLOW c/F (PP1)
X.25	'PEDESTAL' ANODE OF T/B GEN (PP1)
X.26	CAL OR SIGS ON C.R.T. GRID. (PP1)
X.12.	PINK INPUT ~~BEFORE~~ TO CAL.
BLOCKS OF CALS { X.13 BROWN, X.14 BLUE }	~~"VELOCITY"~~ (H/R)
X.19.	PINK INPUT AFTER "VEL" (H/R)
X.18	T/B ANODE OF 1ST PARA AMP.
X 20	SIGS OR CALS CRT GRID (H/R)
X 29	RED PULSE CATHODE c/F (H/R)
X 30	GREEN PULSE GREEN c/F (H/R)

CONTROL UNIT LAYOUT

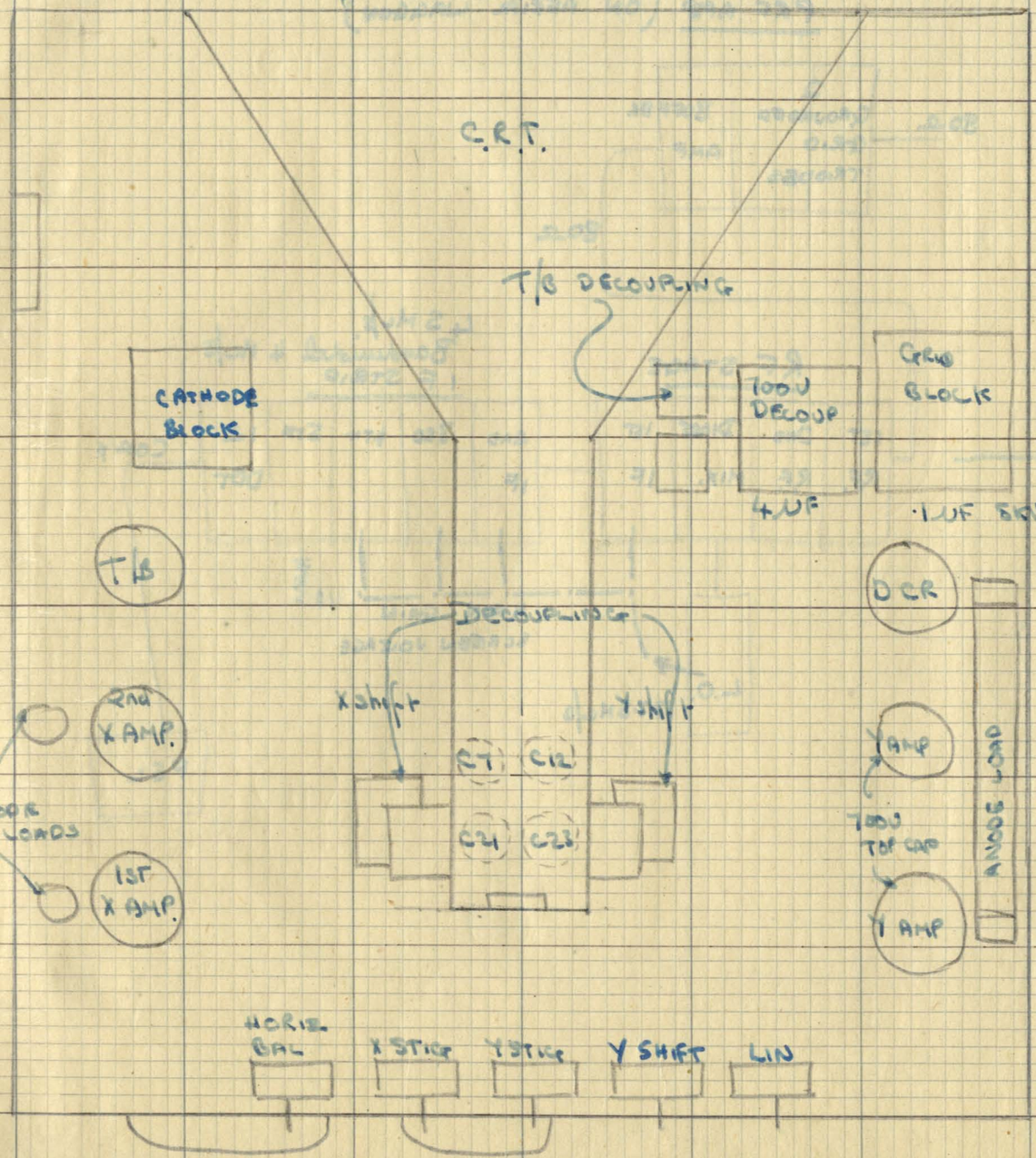


PHASING UNIT LAYOUT

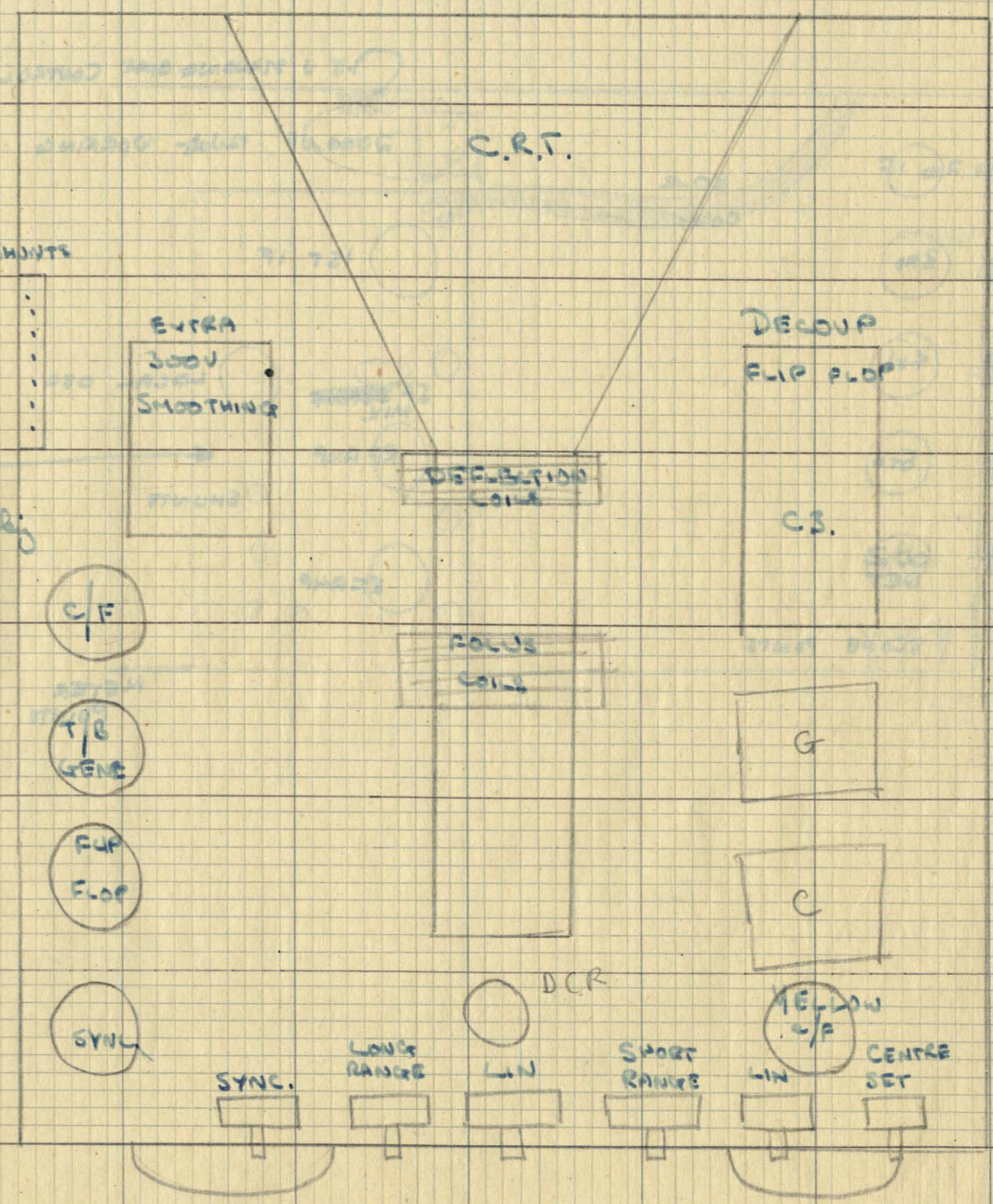


TIMEBASE LAYOUTS

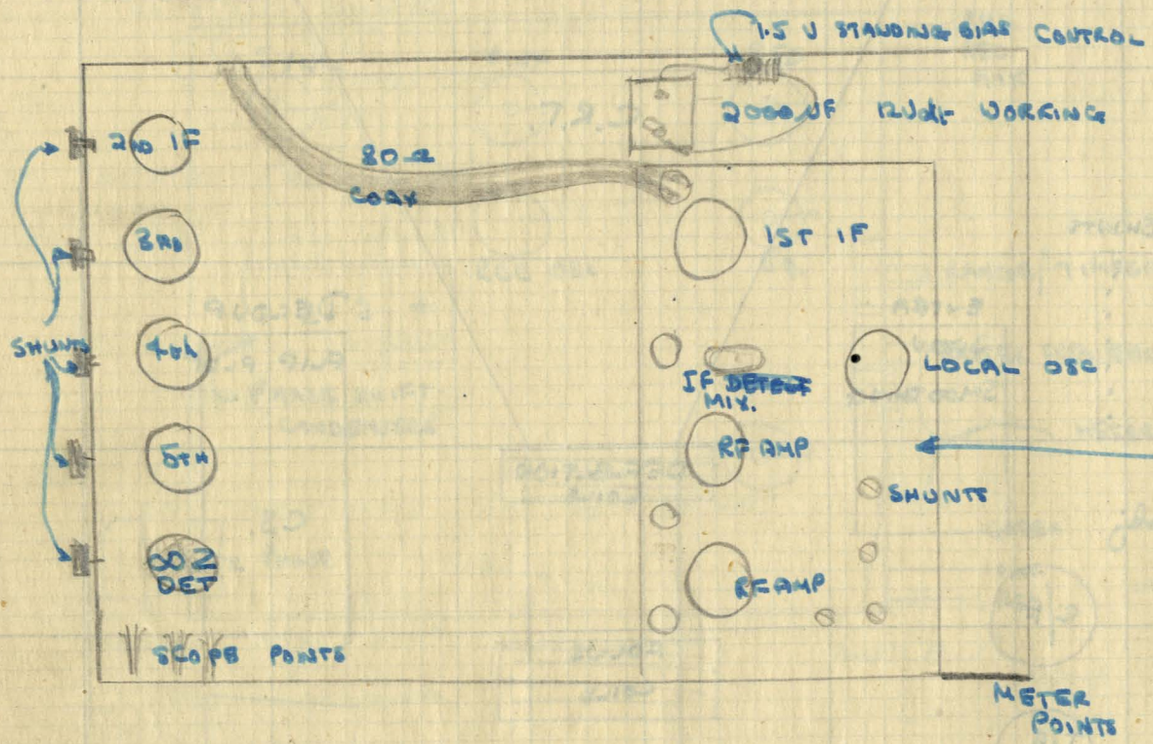
H/R TIMEBASE



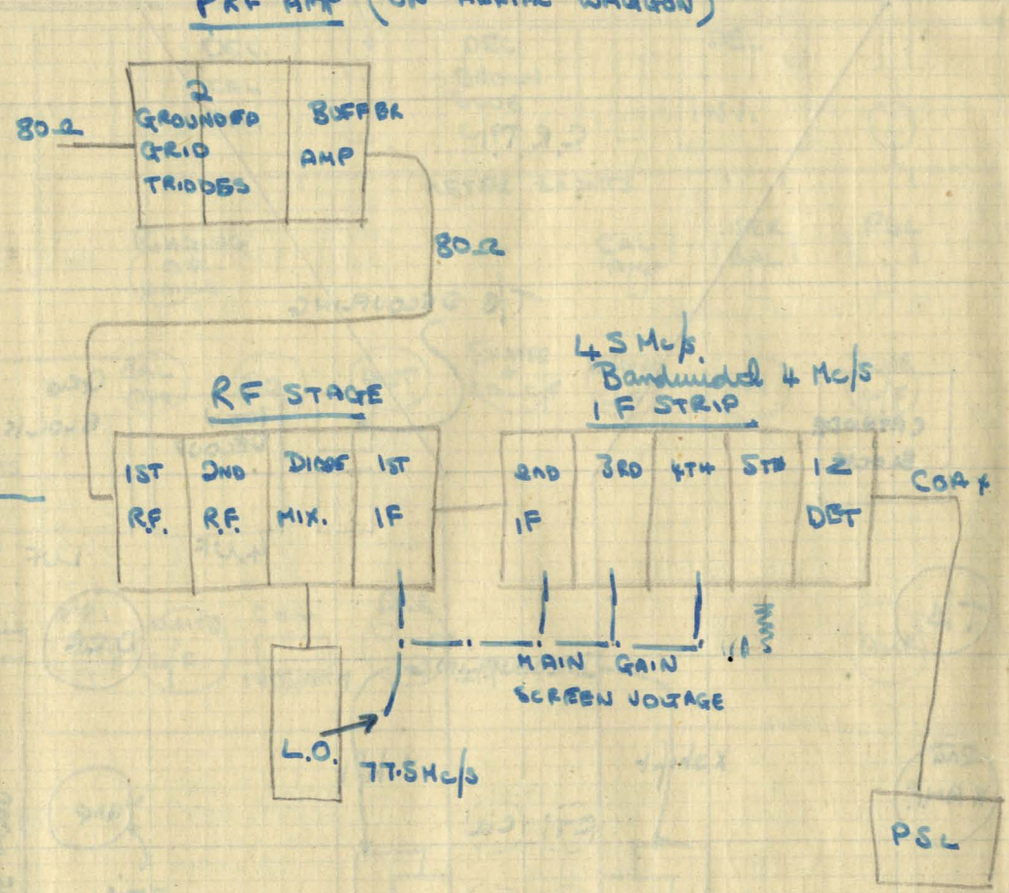
P.P.I. LAYOUT



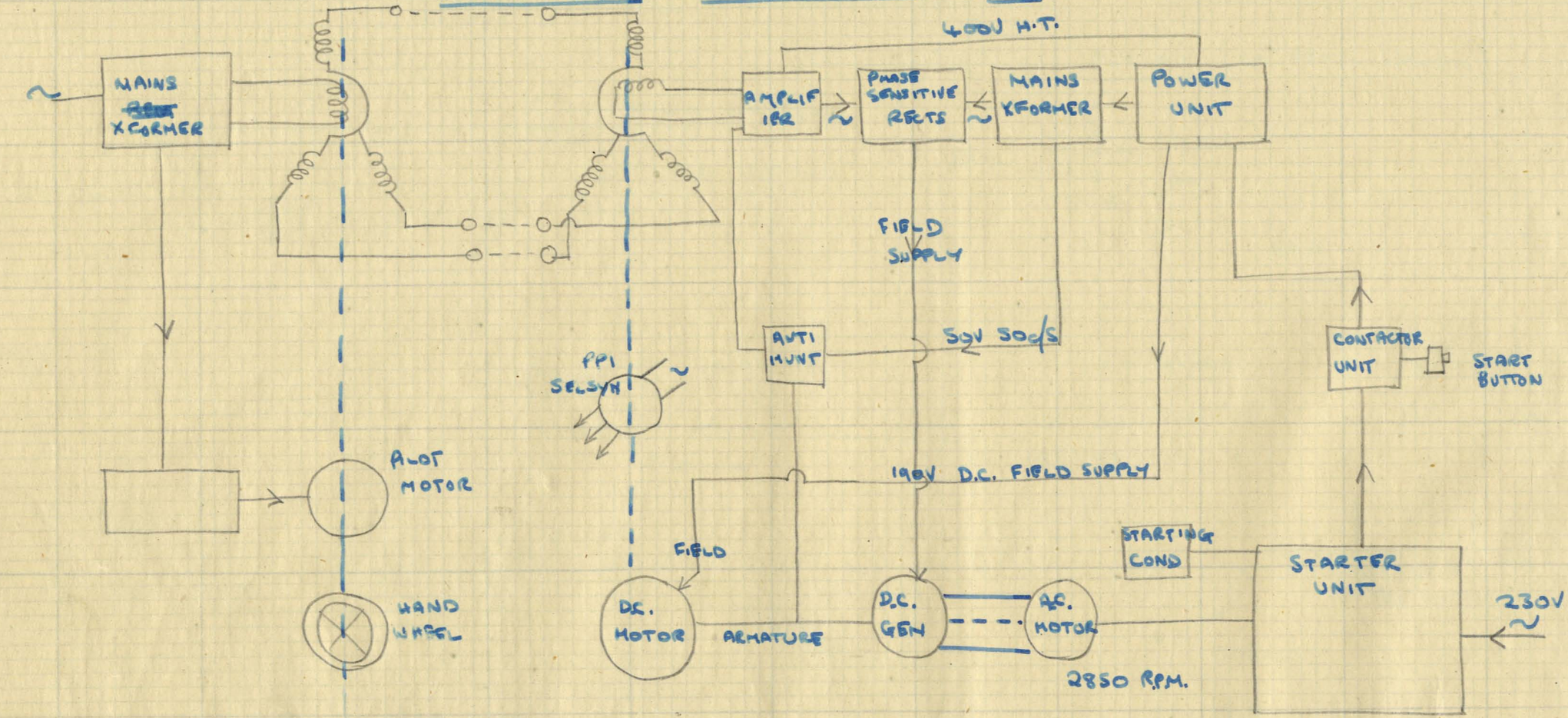
RECEIVER LAYOUT



BLOCK DIAGRAM



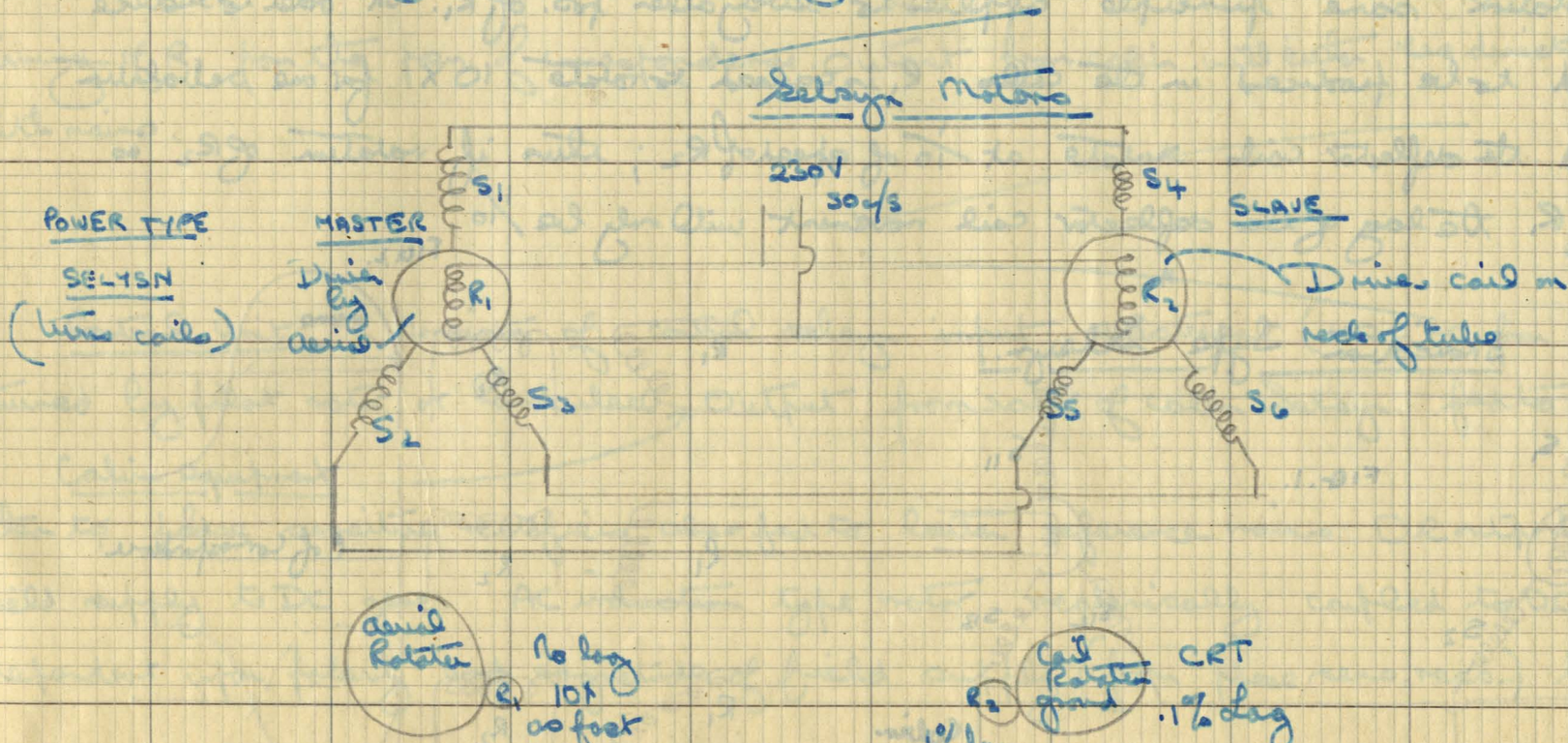
BLOCK DIAGRAM 5TH TURNING GEAR T.3.



C.H.L. B.T.H. Tuning Gear. Type 8

Requirements

1) Continuous rotation either direction of $\frac{1}{2}$ to 6 R.P.M. — done by Dead Reckoning system.
2) Provision for Remote Control i.e. from control unit to aerial — Done by servo relays.
3) Visible indication of sector on P.P.I. — Done by special commutator.
4) Facilities for PPI indication of aerial position — done by power relays.
5) Control of two aerial units from one point.
6) Automatic locking in any fixed bearing.



Power Type Selsyns output mechanical

When a PPI is used for determination of bearing the scan (trace) must be aligned with the rotation of the aerial. When a magnetic tube is used this can be achieved by moving the deflector coils round the neck of the tube. Mechanical means of obtaining this motion from the aerial rotation are impracticable. Therefore an electrical method known as the selsyn motor is used. Assume 230V applied to R_1 & R_2 and R_1 being rotated by the aerial system is in a vertical position. Maximum EMF induced into S_1 and max. EMF in the slave system across S_{14}. Since R_2 is an electro magnet it will be pulled into line with S_{14}, thus slave is always aligned with master and so coils on neck of CRT are driven in synchronism with aerial rotation same principle applies to everyother pos. of R_1. In order to reduce the slight lag which is bound to be produced in the coils R_1 is caused to rotate 10 x for one rotation of the aerial, at the other end the deflector coils rotate at $\frac{1}{10}$ of speed of R_2; thus if rotation of R_2 is lagging by 1° on rotation of R_1 the lag of the deflector coil movement will only be $\frac{1}{10}$

Indication Type Selsyn.

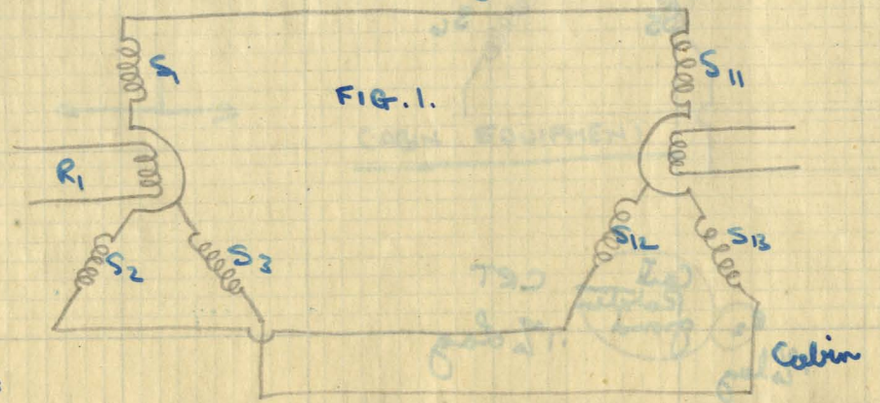


FIG. 1.

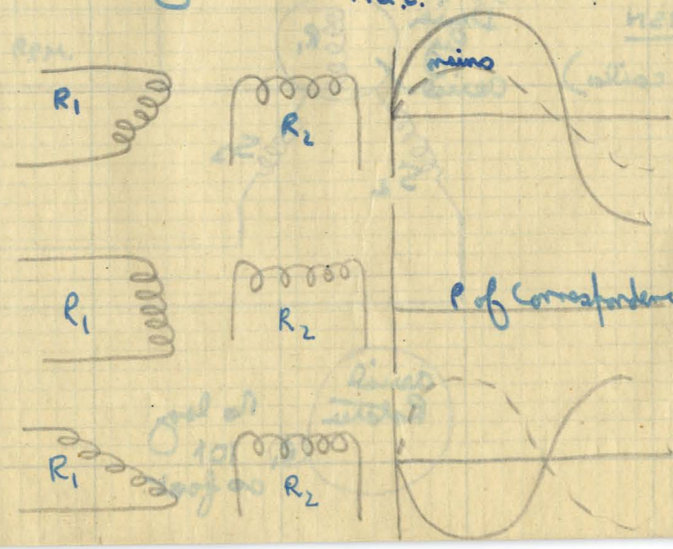


FIG 2.

Central Cable

Servo Indication Type Relay output Electrical

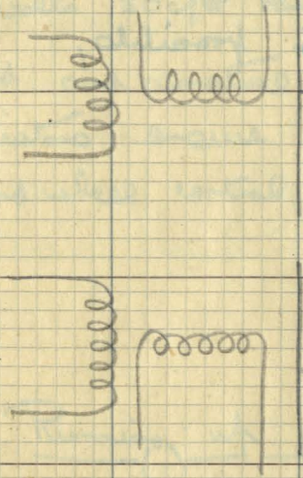


Fig 1 If we pass an AC current through R_1 EMF will be induced into S_1 S_2 & S_3 and current will be established in S_{11}, S_{12} and S_{13}. Thus the field set up by R_1 will be reproduced in the cabin relays. R_2 is a search coil and according to its pos. with respect to pos. of R_1 will pick up voltage which after amplification and rectification are used mostly to control the turning motor.

Fig 2 shows how the output of R_2 will vary with direction of the turning of R_1 from the pos. of correspondence. Output from cabin will either be directly in phase or 180° out of phase with mains.

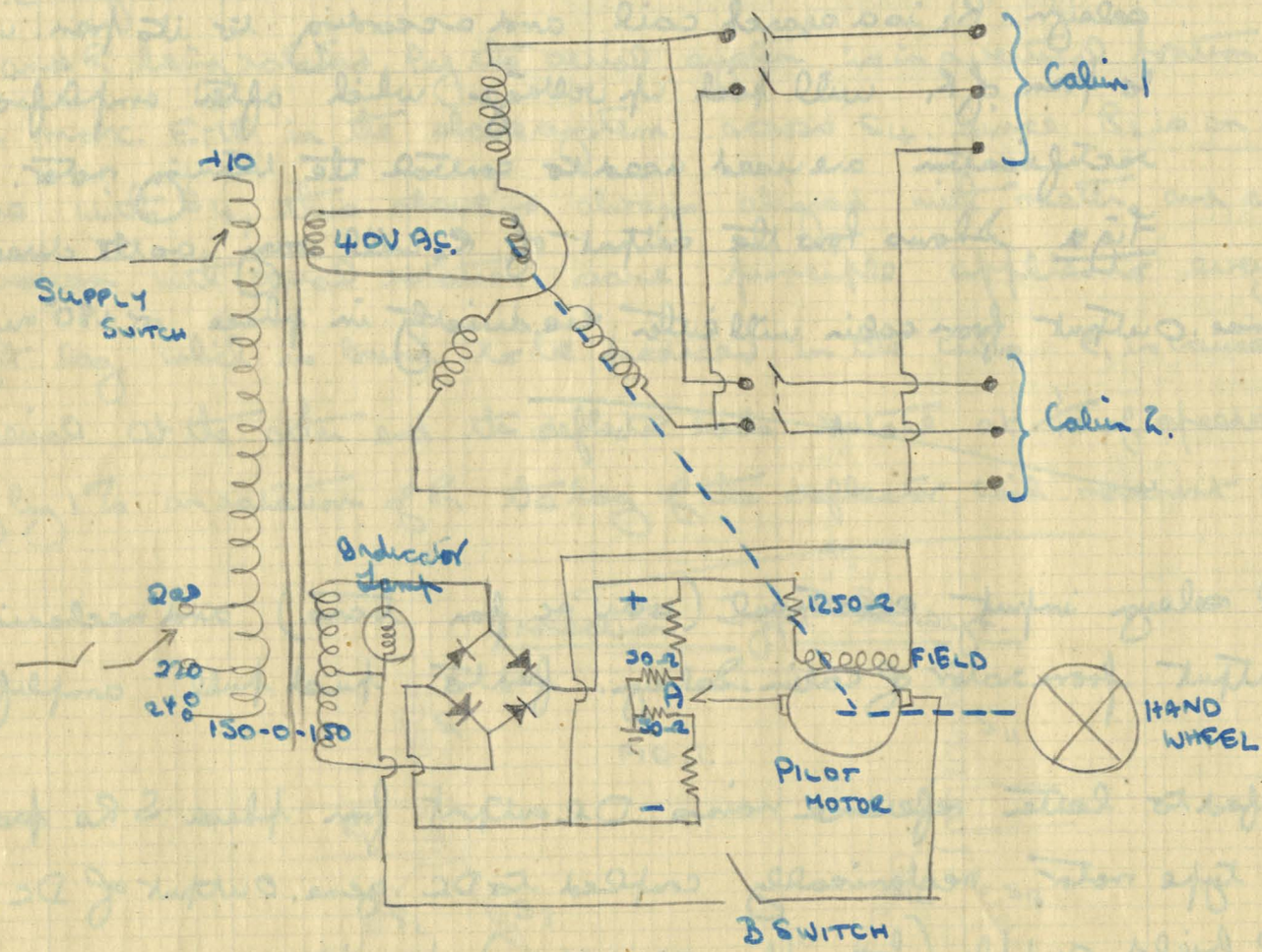
Control Unit consists of control relays input electrical (400 V AC from trans.) and mechanical (rotor turned by pilot rotor or handwheel → Output from rotor of cabin relays. fed to push pull amplifier and

Cabin equipment

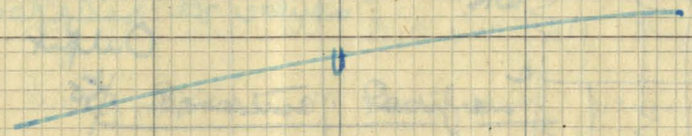
thence to phase sensitive rectifier also fed to latter reference mains DC output from these SRs provides field supply to DC gene. AC induction type motor mechanically coupled to DC gene. Output of DC gene dependent upon polarity and magnitude of field supply (from phase sens. recs.) provides armature current for

"Worth" motor. Worth motor has permanent field supply hence speed and direction of rotation governed by armature supply. "Worth" motor turns aerial P.P.I relays and cabin rotor into syn. of correspondence Contactor unit safety device enabling mechanic to leave aerial cabin before rotation possible,

Control Unit



Control Unit. Contains a relays which is used to control position of cabin. The Rotor supplied ~~the~~ with 40 volts 50c/s rotated either manually by hand or automatically by pilot-motor. Power motor small DC machine, obtains field and armature supply from rectifier, armature current variable in direction and magnitude by 'A' control. 50Ω resistors ensure aerial commences turning at a ½ R.P.M. Automatic turning and hand wheel control interlocked when hand wheel control engaged Bonnet open circuits.



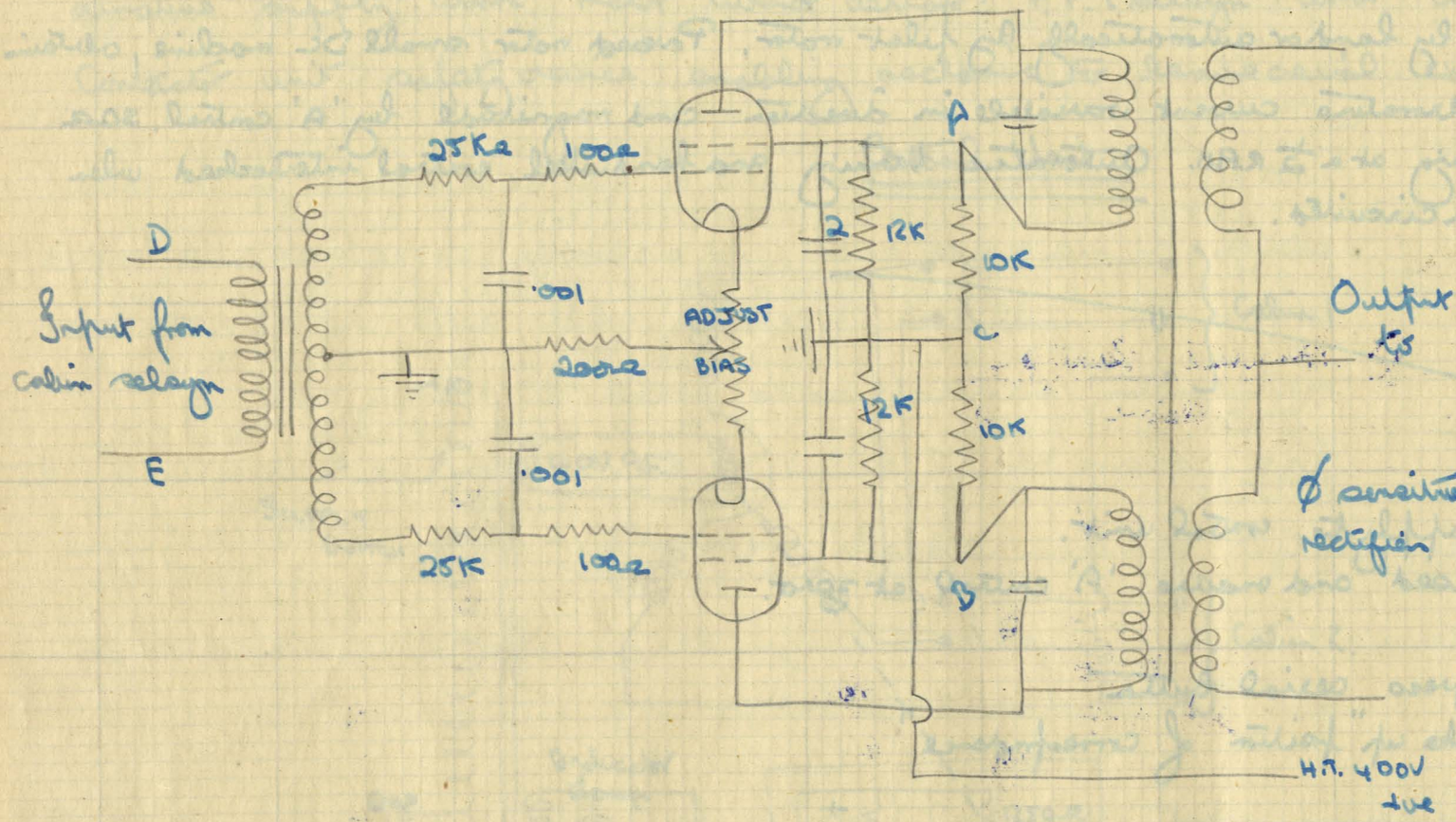
Running up Procedure

1) Switch on mains supply to control unit.
2) Select cabin to be used and ensure 'A' control at zero.
3) Start up A.C. motor.
4) Close cabin door and press aerial button
5) Wait for cabin to take up "position of correspondence"
6) ~~Turn~~

Running down Procedure

1) Turn A control to zero
2) Trip AC. motor
3) Switch off control unit

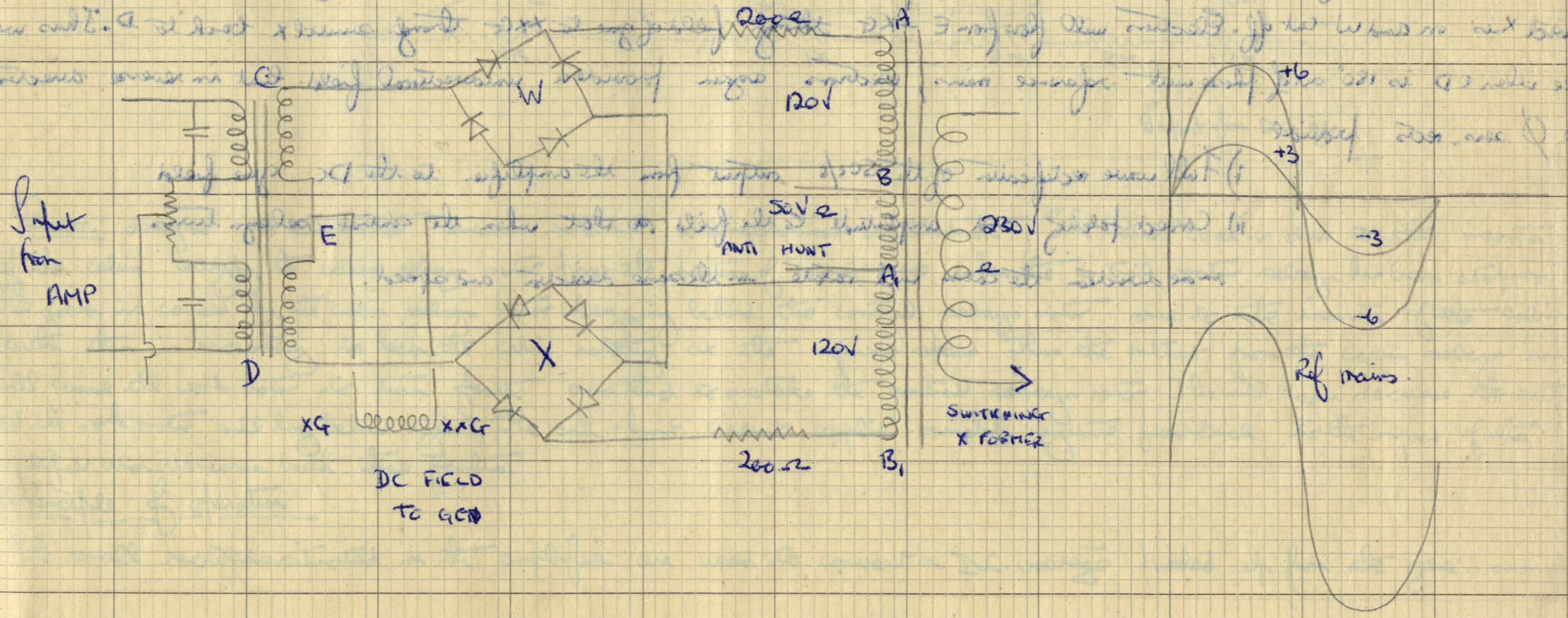
PUSH PULL AMPLIFIER



Amplifier

Purpose: Normal push-pull amp. (class 'A') required to supply necessary power to field of gen. after rectification. Since the input for this circuit is alternating at 50 c/s the amp. has been specially designed to give maximum response at this frequency, other higher frequencies may be picked up in the control lines but are attenuated by filter input circuit. Bias adjustable, so that valves may be balanced indicated when zero potential difference between A & B. (3 volts across each resistor) 200 Ω resistor ensures safe bias applied to valves

Φ Sensitive Rectifier



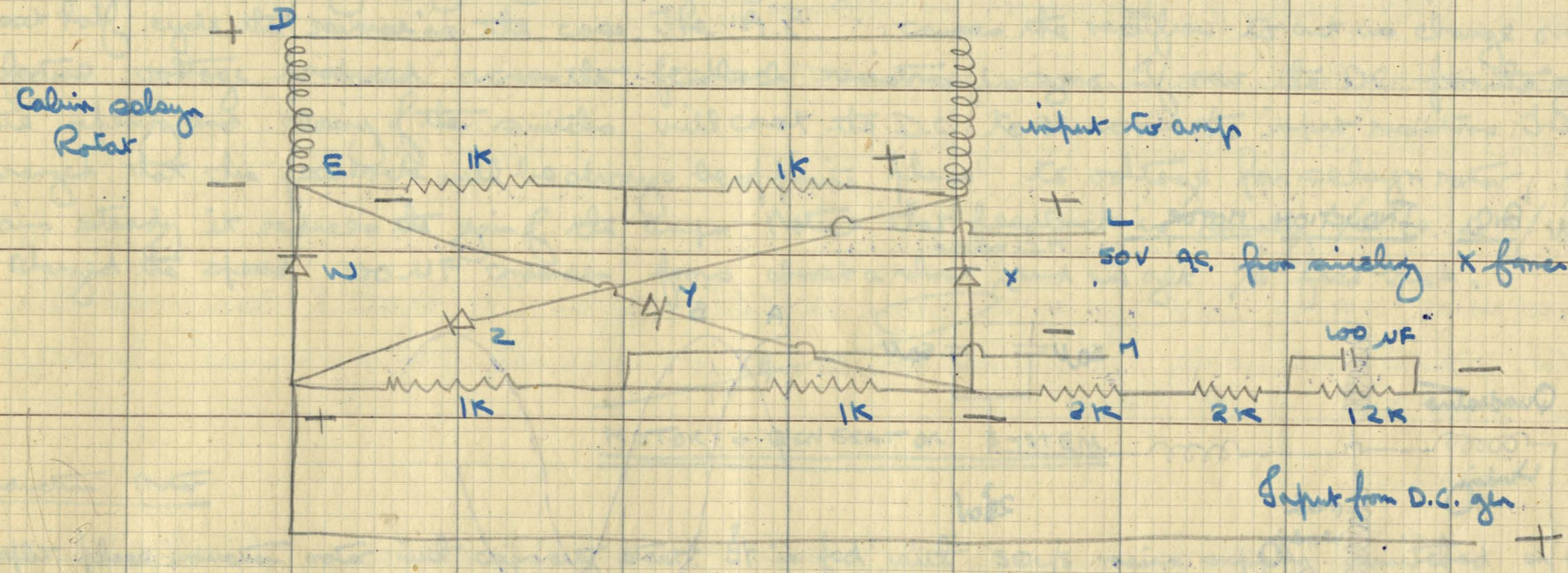
Points C & D can be considered as a pair of switching contacts and the circuit through them made and broken by application of a suitable potential across A & B, providing that the latter is always in excess of the voltage to be avoided across C & D. Voltage across CD in phase with the voltage across AB, A_1B_1. When A is positive with respect to B_1 switch X cut on and W cut off. C positive with respect to D ∴ electrons flow from D through switch X to XXG, through field of gen to X ~~generator~~ and back to E. On the next half cycle A will be -ve and B_1 positive, and C will be negative D positive. Switch W cut on and switch X cut off ∴ electrons will flow from C through switch W to XXG through field of gen to XG and back to E. Thus as long as CD is in phase with AB and A_1B_1 electrons will flow from XXG to XG providing DC. gen. with a uni directional field. However, when CD is out of phase ~~just~~ with AB and A_1B_1, with A +ve and B_1 negative, C -ve and D +ve switch X is on and W cut off. Electrons will flow from E - XG ~~through~~ field of gen to XXG ~~through~~ switch X back to D. Thus we see when CD is 180° out of phase with reference mains, electrons again provide a unidirectional field but in reverse direction.

The Ø sensing rects provide

i) Full wave rectification of the 50c/s output from the amplifier to the DC gen field

ii) Correct polarity and amplitude to the field so that when the control selsyn turns in one direction the cabin will rotate in the same direction and speed.

ANTI HUNT CIRCUIT

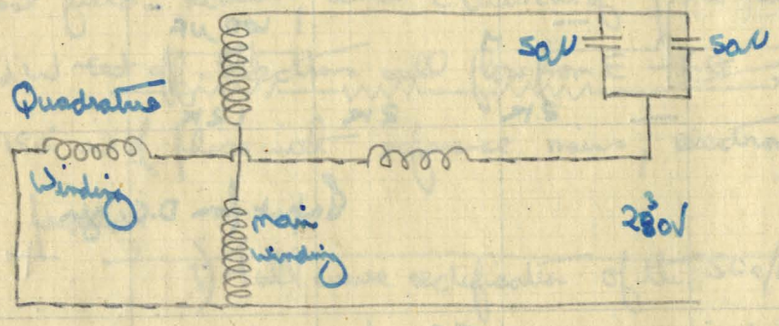


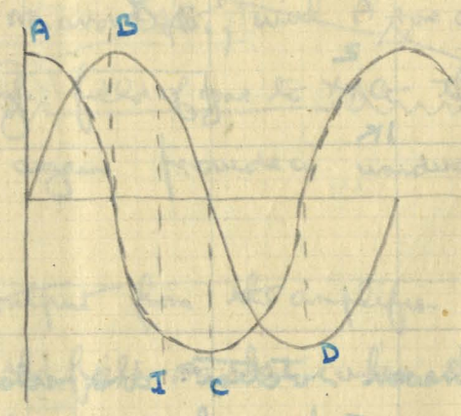
Reason: designed to eliminate uneven rotation and mechanical oscillation. The latter case is due to the inertia of the cabin carrying the cabin relays motor past the position of correspondence when the control rotor relays has been stopped. The former is caused by the cabin relays rotor lagging behind the control relays motor due to the inertia of the cabin further than is necessary to keep the cabin rotating at the required speed. Thus the output from the cabin relays rotor will cause the work motor to turn faster and tend to overtake the control relays rotor. This will again decrease the output and the work motor will lag behind again. The anti-hunt circuit applies variable negative feedback to the input of the amplifier and overcomes both these faults.

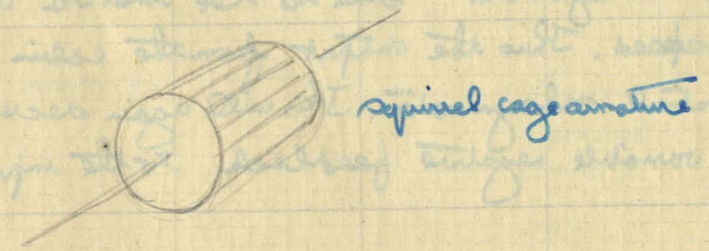
Principle of operation

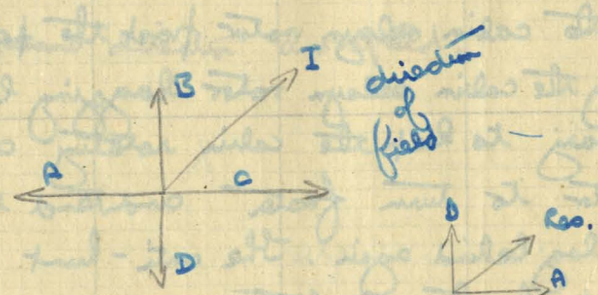
The small rectifiers situated in the amplifier are used to convert a D.C. voltage tricked up from the gen. armature

A.C. INDUCTION MOTOR









into A.C. which is used to damp out natural oscillations of the circuit and to make recovery from a change of speed approximately aperiodic. During ½ cycle of A.C. 1 pr. of rectifiers is conducting and the other pair is open circuit On the next half cycle the reverse is the case. The A.C. ∴ causes the rectifiers to act as change over switches, but the effective voltage produced across the feedback resistor is zero. If now the D.C. from the amp is applied the alternate opening and closing of the switches will cause the D.C. to A.C. across the input resistor. If the circuits are so arranged that the feedback will be always be of such phase as voltage from relay rotor, provided the DC remains steady it reduces the gain of the amp. Note that feedback is normally 1/4 i.e. 2K/18K, If however we suddenly changed the speed 100 uF condenser from almost a short (note 2K) and we get ½ feed back.

4

MOTOR & GENERATOR SYSTEM.

A.C. Induction Motor

This is a split phase induction motor with capacity start. It is fed with 50c/s mains supply switched on by starter unit. It remains at constant running speed whenever the cabin is switched on and drives the armature of the D.C. generator.

Action:- condenser in series with quadrature winding causes current through it to lead in main winding by 90°. At point A current through main winding zero, current in quadrature winding maximum. Field I in direction of arrow. Similarly for points B, C D and I. Thus the field rotates 1 complete revolution for each cycle of the A.C. Field rotates at 3,000 r.p.m. (since mains 50/c/s) If a slotted coil is placed in the field it has an EMF induced into it and will rotate and try to catch up with the main field (squirrel cage type conductors) Note the speed of conductors cannot be the same as speed of the field, otherwise no E.M.F. induced in conductors and speed will fall off. Good efficiency to get within 50-150 rpm. Two condensers shown are in ‖ i.e. 100 uF for starting to overcome the inertia of the rotor, switched in series 25 uF for running by the start run switch which disconnects the A.C. supply to motor.

Slipping Clutch

Adjustment

1) Run gear up until position of correspondence is obtained
2) Connect meter capable of reading 30 amps across fuse connections
3) Force aerial handle out of correspondence and adjust clutch nuts until it slips at 26.7 amps.

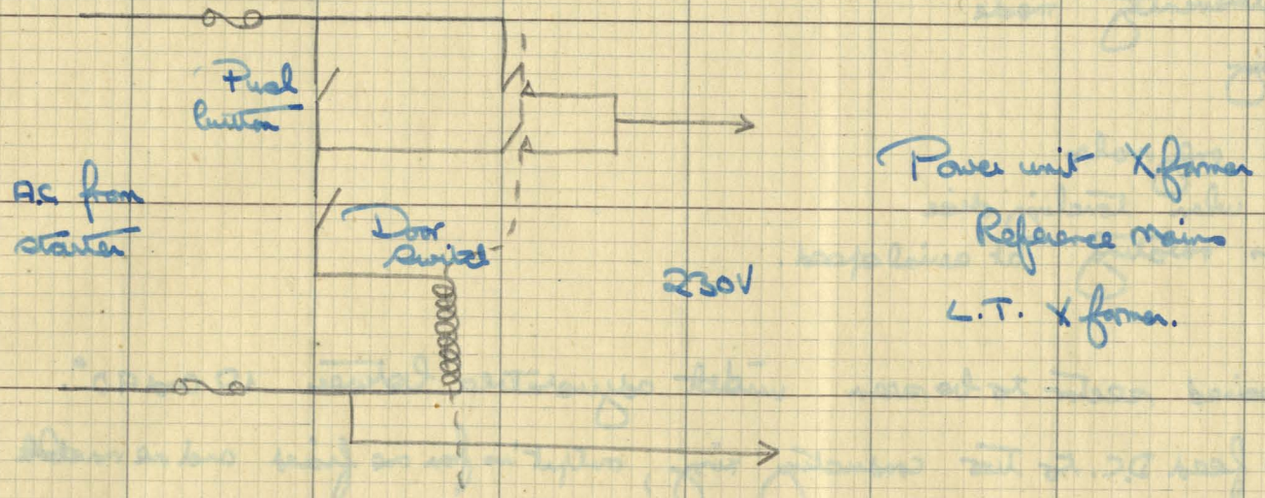
D.C. Generator

This has a separately excited field fed by the phase sensitive rectifier. The armature being mechanically coupled to the A.C. motor rotates continuously it provides no D.C. output until the field is energised. The output of this gene depends on the output of the field current.

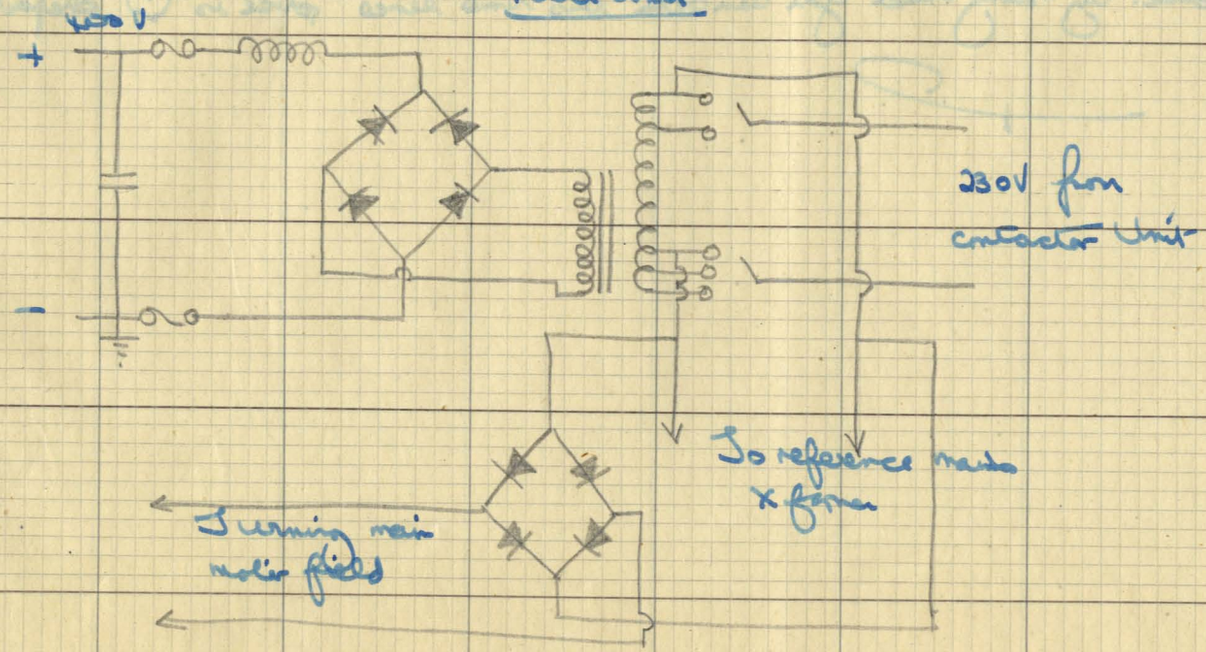
Main turning motor:

This is a D.C. motor fed from the D.C. gene output. It turns the cabin and cabin assyn. Its field is separately excited which is continuously supplied so that the direction of rotation depends upon the polarity of the armature input.

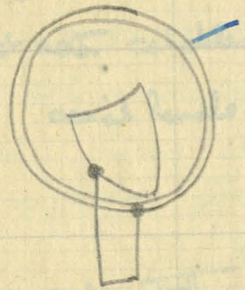
Contactor Ckt.



Power Unit



Strobe Commutator



one brush permanently made

~~moving~~

other brush only makes contact when touching disc which is rotating at aerial speed.

This enables an indication of any desired sector to be seen width adjustable between 10 and 90°. Disc rotates at aerial speed two brushes feed D.C. to two conducting ring, output is from one fixed and one metallic brush. N.B. Output only when brush touches disc. By moving brush you can alter this time since disc is ♡ shaped