

D.C. Power

2 Panels R. H. side bulkheads 8 + 6.
trans. rectifiers in // 8 of them, 50 amps ea.
2 NAVS Tables. 1 Ro Table 3 F bay 2 rem bay

Alarm bell + ECM destruction circuits are live at all times

Multifaced system, to localise any shorts.

1. Ensure ~~get power~~ switch off lights OK + switch on.
2. Excite alternators. Bus tie on No 5
3. Select ea alt + adjust voltage to 208
4. " " " + adjust cycles to 400.
5. Ext. power sw. off.
6. Select all + connect it to bus.
7. Adjust until phase lights are out.
8. Close breaker switch

A. Never put alt. on line with ground power connected

B. Check phase sequence before applying external power.
- 2 lights on panel - "correct" or "incorrect".
dependent upon whether ext. power plants 123a 321.

$$\text{FREQUENCY} = \frac{\text{RPM} \times \frac{1}{2} \text{ POLES}}{60}$$

In this case - $\frac{6000 (\text{governed}) \times 4}{60} = 400 \text{ cycles}$.

A carbon pile regulator keeps the voltage constant.

Alternator is 3 phase (i.e. current led. off at 3 pts on the periphery).

There are 8 rectifiers to convert A.C. to D.C. for various pieces of equipment - D.C. operates all relays.

① Differential potential relay. Any short between Alternator & E.P.D.P. cuts off Alternator. - 3 coils round the 3 phase wires are neutral when current flows equally both ways. However, a leak causes a current in the coil, (in effect, a transformer), and this is used to close off a ^{trip} switch, isolating the alternator. This happens when a 40 amp differential builds up.

② Also, an Overload Safety Switch cuts out the alternator after it has been overloaded for 5 secs. This uses a bimetal strip switch. **DISCONNECTED**

③ Alternator constant speed drive

15 quart hydraulic reservoir.

Holds 6000 RPM from 2800 to 9500 ^{drive} ~~Brake~~ RPM. 1 turn of c/s equals 3 of the drive.

Warm up at 1000, & put to 1200 RPM to operate any service.

If it fails, at 450 cycles it is automatically locked in low speed drive - & can only be restarted by manual release when on ground.

Operating range. S.N. - 50 000'. & to -65°F.

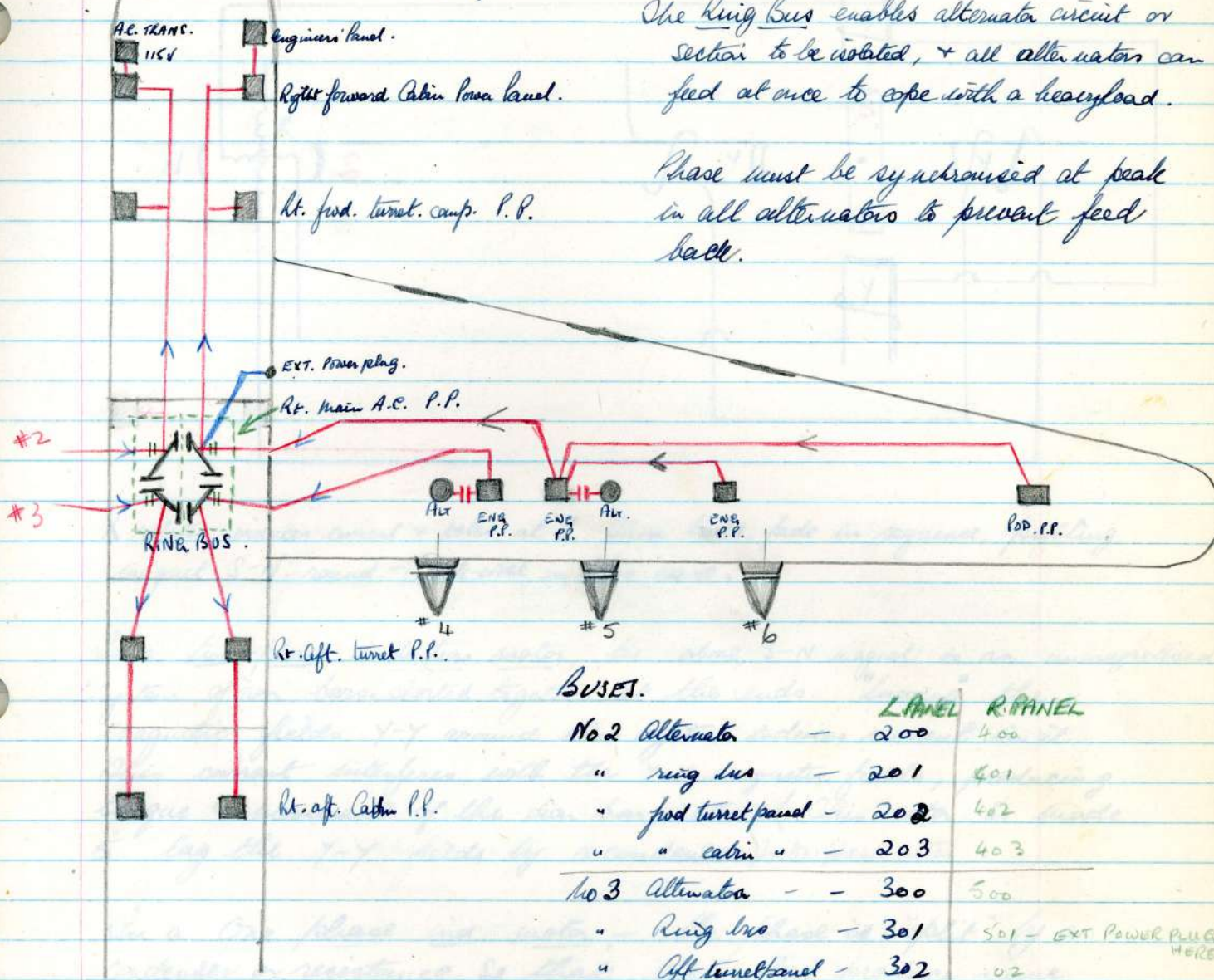
Real load - K watt load - amp power needed to turn motor
Reactor load - K VAR load - opposition built up at 90° to above

30 KW + 26 KVAR is 1 alt. under max. load.

$$\text{KVA} = \sqrt{\text{KW}^2 + \text{KVAR}^2}$$

EXERCISES ON ONIS.

A.C. Circuit - Simplified!



The Ring Bus enables alternator circuit or section to be isolated, + all alternators can feed at once to cope with a heavy load.

Phase must be synchronised at peak in all alternators to prevent feed back.

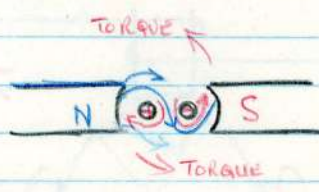
BUSES.

	L PANEL	R PANEL
No 2 Alternator	200	400
" ring bus	201	401
" fwd turret panel	202	402
" " cabin "	203	403
No 3 Alternator	300	500
" Ring bus	301	501 - EXT POWER PLUG HERE
" aft turret panel	302	02
" " cabin "	303	03

A 60 amp fuse is at each end of the E.P.P. to main P.P. lines.

A.C. + D.C. Motors

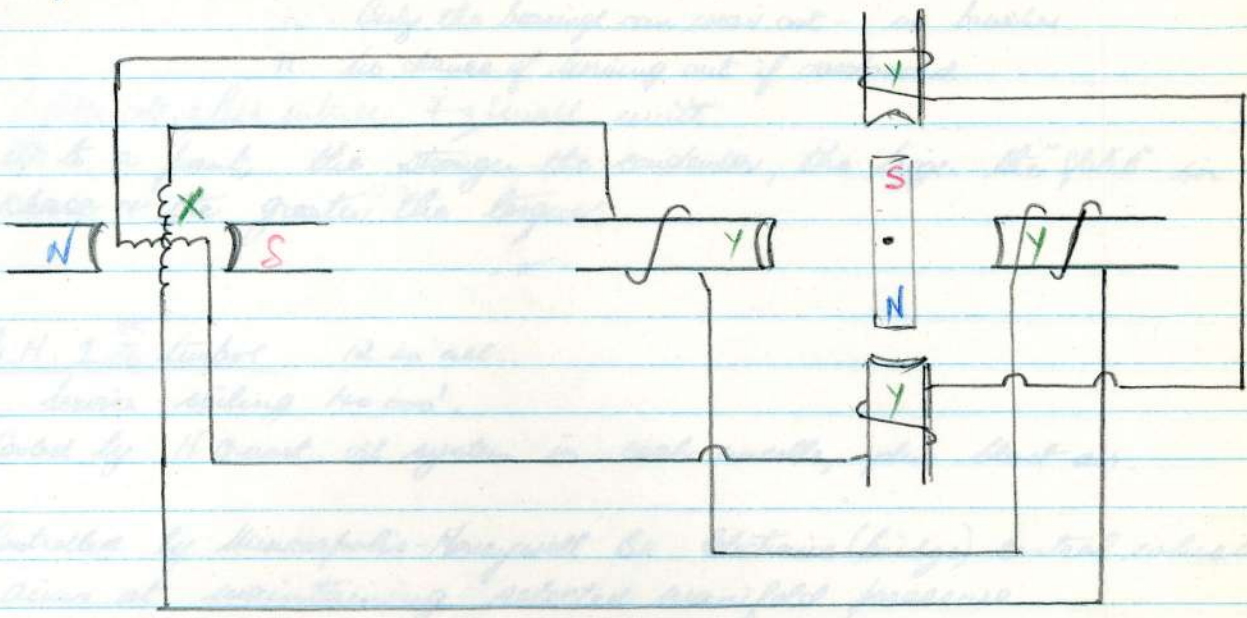
Simple D.C.



Reverse armature current - reverse motion.

motion causes counter E.M.F. round the armature - generator action.

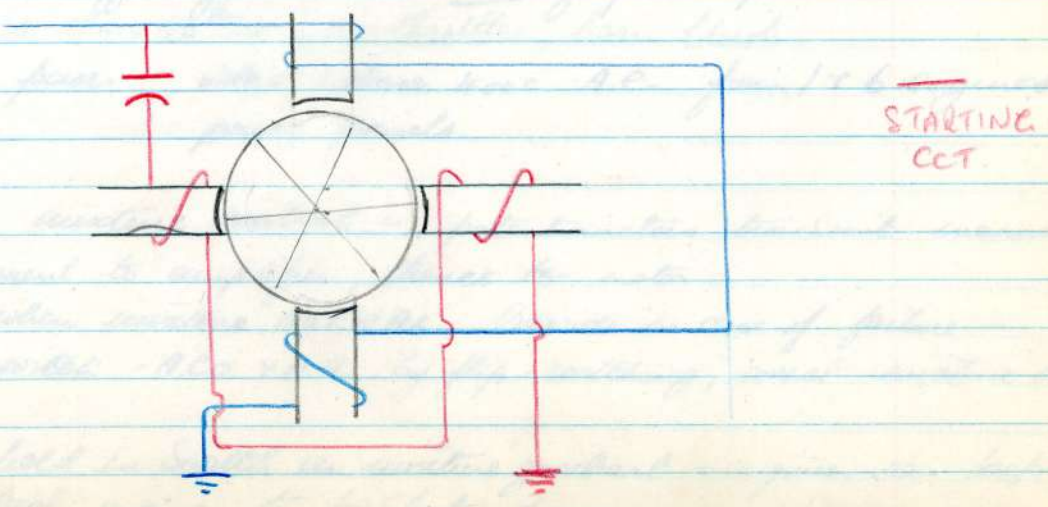
Simple A.C. Motor



X rotates, induces current & poles at Y. These build, fade in sequence, pulling magnet S-N round. - Clockwise in this case.

In a two-phase induction motor, the above S-N magnet is an unmagnetised system of iron bars, shorted together at the ends. "Lacing" the magnetic fields Y-Y around this system induces current in it. This current interferes with the Y-Y magnetic fields, producing torque & movement of the iron bar rotor. (This rotor is made to lag the Y-Y fields by a condenser) in one phase motor.

In a One phase ind. motor, - the phase is "split" by a condenser or resistance, so that two pulses produce same moving Y-Y fields as the two-phase type. A starting circuit is needed, however, -



Advantages of A.C. Motors. -

- i. Only the bearings can wear out - no brushes.
- ii. No chance of burning out if overloaded.

lighter wt., less maintenance, + 3 small units.

Up to a point, the stronger the condenser, the bigger the "spike" in phase, & the greater the torque.

-H-

18. B.H. 1 $\frac{1}{2}$ turbo 12 in all.

Service ceiling 40,000'.

Cooled by 11 Quart oil system in each nacelle, plus blast air.

Controlled by Minneapolis-Honeywell Bx Electronic (bridge) control which aims at maintaining selected manifold pressure.

The engineer has 6 potentiometers to make minor adjustments.

X 19. The ~~potentiometers~~ ^{amplifiers}, in the ~~accessory bay~~ ^{R.O.S. compartment}, amplify the engineer's manual selection signal, pass it to the waste gate motor, 115V Single phase A.C.

X 20. The Pressure valves, in the accessory bay, convey fluctuations of carb. pr. to waste gate motor (evacuated bellows).

21. The Flaps - each (6) has its own motor. 3 phase 200V Reversible two speed. - high or low.

Synchroniser. - 1 + 6, 2 + 5, 4 + 3.

If one flap leads by 8° - leader to slow speed.

" " " " " 2° - leader stops

flap catches up to 1.6° - leader to slow.

" " " " " $.4^\circ$ - leader to full speed

If flaps differ by 3° - both flaps stop.

gear down, less than 20 $\frac{1}{2}$ - 4 adv. throttles, horn blow.

Aileron tab power - 200V 3 phase 400c. A.C. from 1 + 6 engines power panels.

Electronic mixture control. - potentiometers transmit manual lever movement to amplifier, thence to motor.

6 lights ON when mixture NORMAN. Override in case of failure - two position switch - A.C.O. + A.R. - by flip-switching, correct mixture can be selected.

Alternator hold in switch on mixture quadrant - engineer can keep alt. in on last engine to be shut down.

by wing emergency flap control.

EXTRA NOTES

After using override - doors must be closed by normal selection, to reposition shuttle valves.

Hydr. snubber, cushion valve, + restrictor, all help to retard the gravity drop of the main gear.

Main gear mechanical "Free Fall" - lowering. Wear chute or safety harness. Red T handle on outboard side of door. Turn to right door drops. Remove Red linkage on gear locking arm (side brace).

Connect drum + cable assembly to lower gear, stand back, turn ratchet on drum, + gear falls. If it doesn't lock, kick lock closed.

Sequence valves - to regulate + coordinate gear and door operation. Mechanically actuated.

At T.O., at 12° extension, safety switch automatically cuts out steering system. Doors closed by mechanical catch on gear.

Steered by toothed piston on the geared strut. Travel 45° away.

Unladen, nose strut can be deflated to 12° limit for steering - plunger mounted on RH wall of forward turret bay, hoses will reduce pressure to TFSI.



{Nb. - strut must be extended or fluid will be petronised}

Landing gear + brake switch in aisle stand. Gear up, Brake switch brakes off. Lowering gear automatically opens brake switch.

A to-rotating axle on nose gear eliminates shimmy damper.

$\frac{3}{4}$ Shuttle on T.O., no flap - low

22 Landing gear

Main:-

can be lowered, -

1. Normal.
2. Overide.
3. Emergency hydraulic handpump.
4. " mechanical - "free fall".

Bolts to rear spar, retracts inwards.

Oleo clearances $3\frac{1}{2}'' \pm \frac{1}{4}''$.

Doors always closed unless gear in transit.

On retraction, rear wheels pulled up 11° higher than front set so that the gear will fit in the well. Done by small hyd. jack.

The Safety switch closes when this 11° angle is assumed,

- it
1. prevents ground retraction.
 2. Britain's flight & ground oil cooling doors (from the LEFT gear).
 3. Unlocks if locked, & prevents locking in flight of, the controls (from the RIGHT gear).

Nosewheel - 16" max oleo ext. Normal $3\frac{1}{2}'' \pm \frac{1}{4}''$ L.P. tyre. 120° retract motion.

Red handle on WOP's floor is the emergency release handle.

Pull this up 10" - slack. Then pull hard to relock the elbow. Check visually through adjacent windows. NB, the cable whips out with the gear!

If the nosewheel is up but unlocked - get hammer from rear of load locker, break the obs. window, hook into the lock & pull up.

23

Hydraulics

FLUID - AN-O-366. RED.

Tech Order 01-SEUD-2.

NEW NOMEN:- MIL-O-5606.
SAME STUFF.

Relays are on bulkhead 6.2, under canvas cover, & labelled.

Four services:-

- i. landing gear & doors. (50ccs up, 60ccs down, or jacks).
- ii. nose wheel steering.
- iii. Bomb bay doors.
- iv. Brakes.

Four Systems:-

- i. Main, operates (a) gear. (2 pumps to retract, 1 to extend).
(b) steering.
(c) bomb doors.
- ii. Brake system.
- iii. Emergency system (a) to drop up.
(b) to charge brake accumulator.
- iv. Bomb door emergency system. Normally used after landing.

Gear extension :-

- i normally
- ii Override procedure.
- iii Hydraulic emergency.
- iv Mechanical emergency.

Retraction :-

- i normally
- ii Override procedure.

lines seamless stainless steel

brake pump motor is same size
- 16 HP. Def V 3P 400 c. AC

power section (pumps, reservoir, selector + relief valves).

Locations

- i. Main system power sections - R.H. side fwd bomb bay on centre wing section. 6.2 bulkhead.
- ii. Brake System " " - 6.7 bulkhead. External pump underneath to maintain pressure on system when no electric is available.
- iii. Emergency " " Hand pump + Selector valve, R.H. side of R.O.s compartment.
Reservoir - in auxiliary crew members compartment.
- iv. Bomb door emergency " " Number 11 bulkhead, L.H. side of the fuselage aft. pressure section.

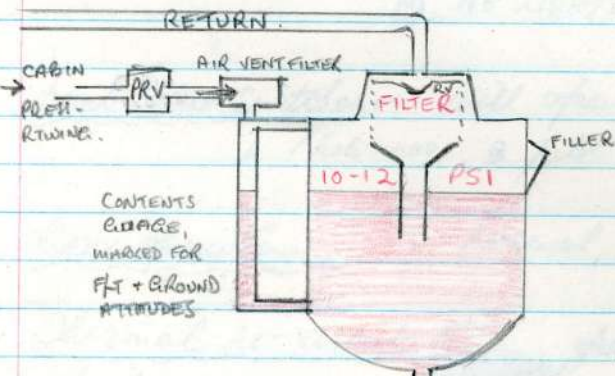
Operation

- by electrical circuits to pumps. D.C. from switch to relay - A.C. from them on to motor. Limit switches to stop motors.

There is no pressure in the lines when the system is not operating, to minimise battle damage.

Main System

reservoir contains 6.7 gallons. has oil filter.



Pressurised to keep fluid de-aerated at altitude.
to ensure delivery at the pumps.

Fluid level drops 4 gallons on T.O.
w/c takes 2 ea jacks. to retract.

Pump motor 208V 3P 1000 AC.

EA HAS 6x60 AMP FUSES

only be run for 2 minutes in every 10 at maximum pressure.

During gear retraction, both run together, & draw 150 amps.

A 1/2 second time delay is installed to cut out the huge load of both motors starting together.

Hydraulic pressure regulated by pump regulator in pump housing. At 3100 PSI, it cuts out. At 2800 PSI - full open. Also an R.V. in case reg. fails. opens at 3150 PSI. & vents to reservoir.

Pressure gauge on Engineers table. 95-100' from system power section - break anywhere in this line would cause loss of all pressure. ∴ a main gauge "fuse" - which contains a system of pistons. and pumps put out 8 gpm.



The actuating levers overtravel
slightly to ensure geometric lock.

spring. This isolates fluid line, but transmits the pressure from the fluid either side of it.

Selector valves - doors gear, + steer } D.C. energised solenoids.
Sandwich type. } (as soon as pump starts).

the selector v. directs pressure to correct line by attracting a piston. If solenoid fails, the piston can be manually pushed in - labelled.

An override switch on the engineers panel by-passes all relays + sets no 2 pump in motion - meanwhile the above manual piston operation should be carried out. Make selection first, to avoid excessive pressure on the plunger you're trying to push. Keep it depressed until operation completed.

Bomb doors fluid comes from main system reservoir.

Open in 1-2 seconds.

One actuator at each end, controlled from A) Pilot no 1, B) Pilot's panels.

3 positions - open, close, neutral. Spring loaded to neutral.

Double acting shuttle valve separates normal + emergency.

Indicator lights :-
A) Red light ON - doors fully open
B) Amber ON - doors closed + switches in closed position.
C) No LIGHTS - doors closed, or doors in transit.

Bomb Valve switches - will open, will not close doors.

i) Pilot no 1. 2) Pilot 3) R.O. table.

Door operation i) normal, ii) Override iii) Emergency.

Thermal re-circulation, operates at 0°F, closes off at 50°F. -

pushes fluid around ^{open door} system, and friction prevents congealing of the fluid. Engineer has switch and circuit breaker on his panel - doors must be closed for this system to operate, and also will only operate if no hydraulic service is being used. Door lines insulated. Operates about 5 mins every 20. @ 1900 PSI.
fibreglass.

line lengths to B/P actuators is balanced to give coordinated action.

Brake System 5 - 2 in use.

1st type disc - 3 1/2 HP.

2nd type expander tube 16 HP 208V 3P 400C.

About 100' of Shaverley tubing - from foot to system, which

1st type

hyd. pressure varies 850 - 1025 PSI. An RV. at 1050.

A "Soft pedal" is an indication of air in the slave lines.

A "Time lag" is an indication of air in the pressure lines.

2nd type

two hand pumps as the 2nd type brakes - ground servicing hand pump, & emergency HP.

Working range - 1250 - 1500 PSI.

Pressure switch brings in pump at lower limit.

PRVs at 1675 PSI.

About 3 parking brake applications flows free - takes pr. from gauge side.

to operate pk brake cont. valve. Can be reset by - @ lever on fuse - this is on bulkhead, but this is a long way down the fuselage, I use emergency handle, which applies pr. to the used up side of the "fuse".

Solid brakes - leaking bleed reservoir brake control valve.

530 lbs to EA brake assembly. Max possible - 600 lbs.

2 tubes to ea brake assembly, 8 per gear - ie 1 assembly to ea. ~~car~~ wheel. No check valves down there - so if one tube goes, all brakes gone.

Propellers Curtiss-Electric C636-SP-A.

The "A" is followed by various numbers which indicate model number.

- C - Curtiss. 3 blade, 19' diam
- 6 - Shaft size. Mechanical-electrical-hydraulic-control.
- 3 - blades.
- 6 - blade shank size. Constant speed, both normal & reverse.
- S - Steel. Reverse till light to give warning of
- P - Pusher. reverse operation. reverse range $-4\frac{1}{2}^{\circ}$ to $-11\frac{1}{2}^{\circ}$.
- A. 2 change speeds - NORMAL $2\frac{1}{2}^{\circ}/\text{SEC}$
- FAST $45^{\circ}/\text{SEC}$ feather & reverse.

Revs: controlled by-

Synchroniser keeps revs within 1 or 2 rpm of each other, constant speed, by means of single lever. Done by electrical comparison with speed of a master motor.

A 3 phase alternator passes this information to the Synchroniser.

ie checks engine RPM, passes change needed to keep constant to prop.

Oil System

ensure prop de-icing used properly to avoid boiling away the propeller oil supply & ruining the seals. Prop will go into fixed pitch in this case.

Oils -

Meropa } hub unit.
AN-03M }

AN-06. Power unit.

① 2 gallons ea. hub. - under pressure.

② $1\frac{1}{2}$ quarts in sump, 2 quarts in reservoir of power unit.

If more than 1 pt oil used in 30 hrs, rip it off & check it.

Low oil - can't feather, but will go to fixed pitch

Mechanics - H.E.H. because 40HP mech alone would be needed.

Mechanical blade angle change, hydraulic control of mechanics, and electrical control of hydraulic.

87.5 - feather 89° on - 31 model.

Square tip increases propulsive efficiency above 35,000'

Blade angles -

LOW - 15.5°

HIGH - 60.5°

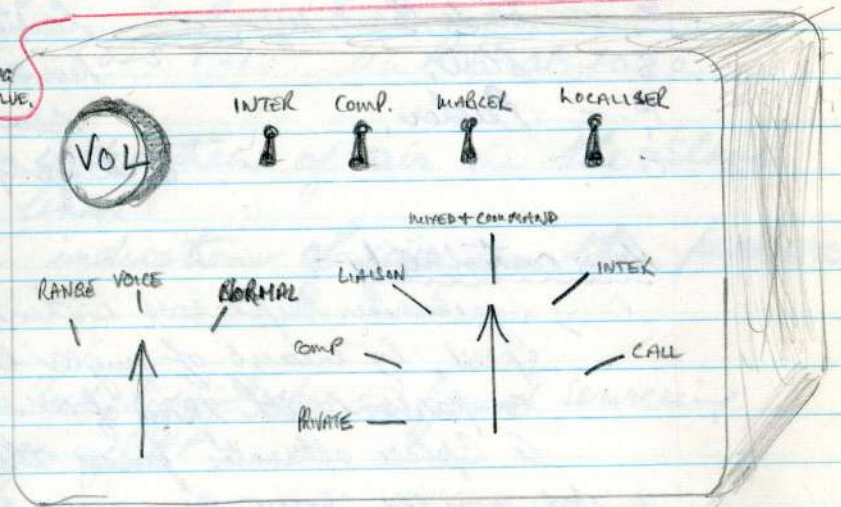
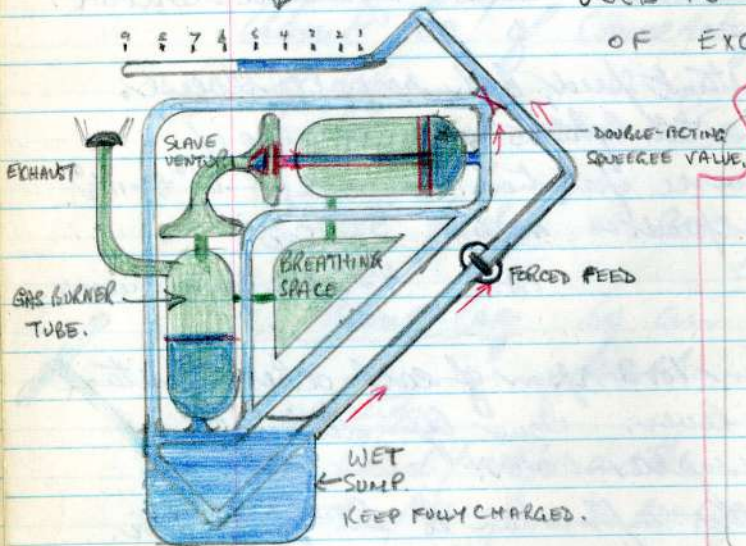
FEATHER - 89°

LOW REVERSE - 4°

HIGH REVERSE - 10.5°

OXOMETER (SCHEMATIC)

USED TO MEASURE SPECIFIC GRAVITY OF EXCRETUS OXONIS (BULLSHIT)



MANUFACTURED BY
 JOHN H. FIELD, LMTD
 LONDON, ENGLAND
 IN COOPERATION WITH R. SCHULTZ INC.
 DENVER, COLORADO
 ENG CONSULTANT + TEST ASSISTANT

Radio

Intercom:

2 Separate Systems, independent. 28v. D.C.

2 Amplifiers wired on. AM 26., A.C. (Private + Normal) Range eqs. panel.
Gain Control 1-4, wired to no 1 position.

Automatic barometric gain control, increases volume with altitude.

If baro. fails, break wire & control gain manually.

2 metal & 2 glass tubes. As long as one metal & one glass operative, will work. All tubes interchangeable.

Jack boxes C8383. P, CP, & modded type at R.O. + Vo.

Private - compass - liaison - mixed + command - enter - call.

Also 4 protectors above.

Radio operator has provision to patch in 2 recorders.

Various modifications to these control boxes to suit ca. position

Plug in Points

Hand bay, 6 engine nacelles, 1 @ bulkhead 7 for starting, near
ent. power plug, & 1 aft unpress. compt.

They have no call button & someone must monitor him.

Mixer Amplifier - if capt. decides to have all 6 signals coming
thru on command - boosts up volume.

If it burns out - no RT

2X RE 50 relays ~~near~~ are rear of eng. panel, & are
@ front end near pr. compt. ① They operate microphone to
"send" or "call" position.

② Disconnect any radio signal
when in "call" position. - i.e.

if someone switches to call - no outside broadcast.

"Private" position

Toggle switch in pilot posit. - 2 posit, ① cross combat - ② private
or ③ - all phones are on the line

Enables photo team to go onto limited line - Ind dickey
& eng etc can yak on other line.

Pilot, Cop. Radar N, Photo N, Camera panel, left oblique camera
posit, Straight N.

no call position as private, therefore

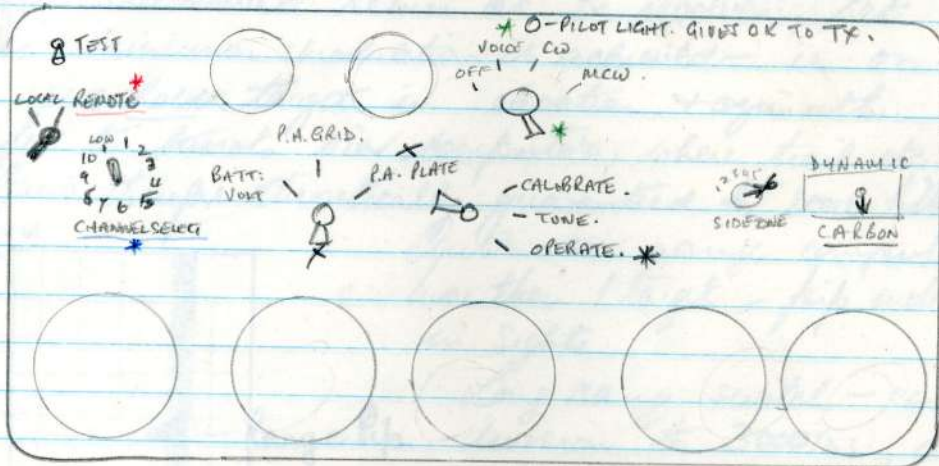
Therefore if normal fails change amplifiers.

Procedure.

1. Check in over "private" to W/O. (must be an crew combat).
2. Check with pilot - oxygen - alarm bell etc. on normal interphone.

Pilot's operation of Liaison transmitter

will transmit from 2 megs - 18.1 megs. i.e. 2000 - 18100 Kcs.



- 1* TO REMOTE.
- 2* SELECT CHANNEL. (pre-selected frequency)
- 3* SELECT TYPE READ - VOICE
- 3* TO OPERATE
- 4* P.A. PLATE.

interlocked preselected channel. never unlock + move one, or all channels failed.

Pilot has channel selector + "off voice CW MCW" ports. Do as * and * above.

2 set breakers + root fuse ~~that~~ protect the set.

RADAR

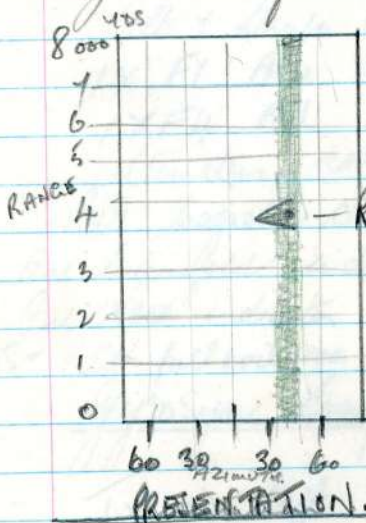
AN/APG-32 - TAIL RADAR

SEARCH TILT 12.1° TRACK TILT 1.5°
ROTATION 2100 RPM.

detect targets up to 24000 YDS
Normal 8000 YDS RANGE. TURNS ON RED LIGHT + EXCITES ALARM CIRCUIT TO BELL, OR BUZZER etc.
Search scope spins 2100 RPM - plots target, also whole unit moves to scan over about 120° rectangle.

90% MCS
2000 pulse/pls.
35 W. Average
35 KW. Peak
6ms pulse width

+ as beam rotates, dgt x gives modulated signal - increase + decreased return as tx revolves. Set hunts until minimum modulation is achieved - ie on target, and will hold target in elevation + azimuth. This info is fed to turret via computer, where trail etc are fed in. Guns therefore theoretically guaranteed to score hits.



Automatic range computation more than 1 target - pip indicates one in sights.

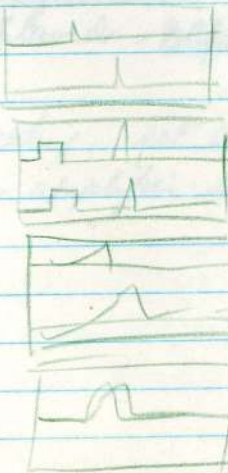
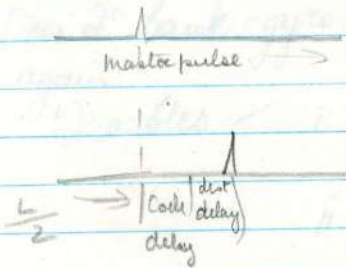
Long range switch - converts each division to 3000 YDS, and automatic IFF action taken.
Lights indicate elevation. Orange high - green low.

Computer kicks in @ 2000 YDS.
Automatic presentation.

LORAN.

AN/APN-9A

POSITION BOTTOM



- 1 Stop em.
- 2 put top line on pedestal + put bottom pedestal under bottom slave pulse.

3 further align pulses.

4 Still further align pulses.

Read result on indicator.

caution - brakes - lift - start - start - gear.
 nose closed, HF, check flaps, Rhit at 0.
 dip @ 47 full power. Gemini, Radar, DR, taxi.

	K	
3000+18	105	AIRBORNE
3000+18	115	gear up
2850+12	120	FLAP UP
2650+7	145	CLIMB.
2400+7	190	CRUISE.
2850+4	140	gear + 1/4 FLAP
2850+2	120	1/2 FLAP
2850+1	115	full FLAP, FINAL
TIMPPGCBPRH B.M.P.E.V		

Instruments.

Gyro instruments ALL ELECTRICAL. 115V 3P. 400 C.A.C.

1 Vertical Gyro - replacement for artificial horizon. 115V 3P 400 C.A.C.
Gyro has no limits. 27° rise or climb indication for horizon bar.

Above this angle, altitude is indicated by lines on the sphere behind the bar, & the words "climb" or "dive"

Ball race erection device

2 Directional Gyro - torque motor erection device - erects in relation to G. - is always true to air unless in steep slip

3 Bank & Turn (D.C.)

ASI.

True ASIs on Photo N, & in camera capt. Also one on radar sets (Kants)

Alt & temp. both compensated for.

1 X FI ASI on pilot's panel.

1 X F4 ASI " to pilots " - has Crit. Mach marked.

Altimeter, rate of climb are normal.

B21 magnetic compass.

One magnified indicator from #4.

But rev. indicator - master.

SETS - Pilot - full out pass. Copilot - Jacks & T.P. temps.

GyroSyn Compass. - a Slaved D. Gyro. Same as GHB.

1 x in left wing tip (flux valve). Master indicator and amplifier on pilot's panel. Further amplifier, isolator amplifier leads to radar & 2 repeaters. - aft capt. & Photo N.

Over 2° bank - gyro is de-slaved - D.C. power is cut off, & on when level again.

Troubles - i. One reading, set annunciator indic - one annunciator line - amplifier tube - out.

ii.

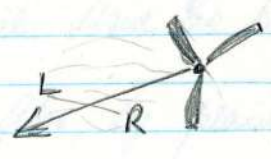
31.75
14
17.75 lb = 60"

3500HP @ 60", 2700RPM. WET. - gives 7g reading of 26p.
3250HP " " " " DRY - 4 " " " 244

Engines. P+W 4360 WARP. 10YRS OLD.

Present model R - 4360 - H1. 4x7. ABC+D, 1-7.
Radial - Cu discs - model. Cylinder offset 12 1/2°.

C 4 is lowest cylinder.



Baffling prevents hot air from one cylinder passing over the next in rear.

Intake valves at cooling fan end of engine.

7 Sections

1. nose section
2. Spacer case sect.
3. Magneto case sect.
4. Power case " (crankcase).
5. Blower " .
6. Accessory " .
7. Fan case " .

Size 60A propshaft. No blind spline - ie prop can be fitted anyway on shaft - spring of engine so even that there's no need for co-balancing.

Thrust bearing threadless, + torqueless.

Ball and Roller bearings Ball bearing, behind roller, takes up end play, roller takes up lateral movement.

Shaft carries on to mag section where a one piece steel backed bronze bearing.

Pickling hole is on nose section.

1. nose section

Prop alternator - (governor). Sends signal to prop of engine RPM. Driven 1:1 from shaft in front accessory drive gear.

115V motor for actuation of spark advance mechanism. (R.H. Gun sync. pad).

3 scavenge pumps, individual lensing, scavenging nose, spacer + mag. case

2. Spacer case section

To move prop rearwards an extra 6" to clear T.E. under all condit, and also to increase prop. efficiency.

Red: ratio .375:1.