1582185 WAKEFIELD, H.E.
55 ENTRY CLASS 6
FITTER II E & T F/E.

Form 619.

ROYAL AIR FORCE.

Notebook for use in Schools.

91/3471. Wt. 3390. 900M. Bks. 8/42. J. D. & Co. Ltd.

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SYLLABUS (AIRFRAMES) HALIFAX.

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15. Pre-flight inspection by engineer. ✓
16. Engineers panel. ✓

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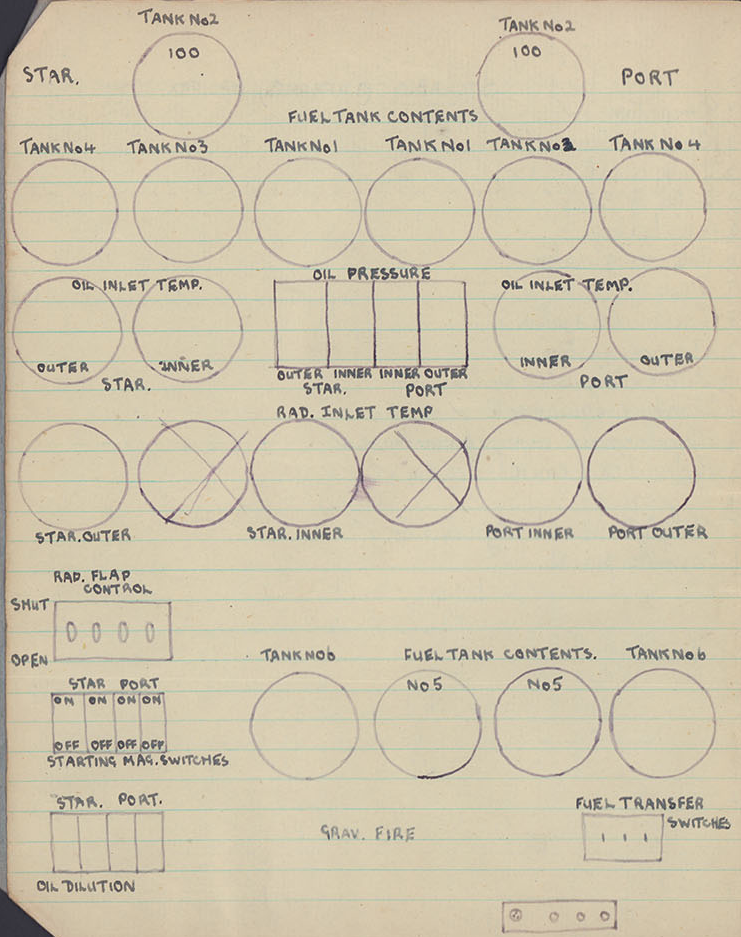

Description :- An all-metal, mid-wing heavy bomber, powered with four Merlin XX engines. The machine, which has twin fins & rudders, & hydraulically retractable alighting gear, normally carries a crew of seven. (max). Frame 7-11.

Duties of F/E

1. To act as a technical member of the crew, capable of advising, but not instructing, the captain, in the operation of engines & A/C generally.
2. To deal with any mechanical hitch that may develop.
3. To deal with the emergency operation of hydraulics.
4. To handle various controls.
5. To compute & log various data relating to the operation of the A/C.
6. To control the distribution of fuel.
7. To act as liason between aircrew & ground staff.
8. To act as a stand-by gunner & to launch pyrotechnics.

Flying Control.

Top tube rudder. Elevator bottom.

Move trimming tab control forward if elevator is locked in down position.

Movement of the primary control surfaces is transmitted through a system of push pull tubes running in tufnel bearings, & that of trim tabs through rotary movement of the same push pull tubes. A locking device for the rudder & elevator controls consists of a lever which jigs the controls at the control box on port side of fuselage just forward of rear turret. Stowage for this lever is provided at that point. A locking device for the aileron controls consists of a clamp which attaches to the control column & is now stowed above starb. rest seat.

Trimming Tabs.

Elevator - adjustable in flight.

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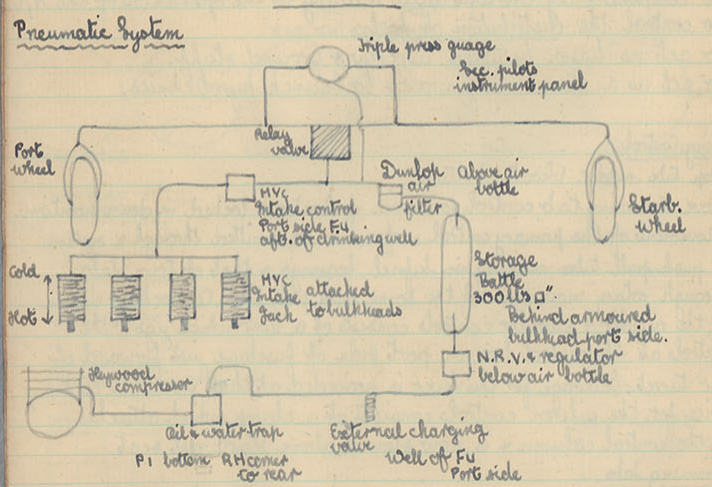
Rudder - adjustable in flight + balance tabs.
Aileron - Stbd. adjustable in flight, port ground set

after leaving target pilot cannot move control column. A/c is in a slight dive.

PILOT
Trims a/c for tail heavy.

F.E.
Examines bottom push pull tube rear tufnel bearings. Files or hammers away abrasion. If ineffective remove bearing from fuselage wall with axe.

Pneumatic System



a Heywood compressor is driven from the rear end of 'A' camshaft - port inner engine. The air bottle is situated on the port side of the fuselage just behind frame 11, (armoured bulkhead) working pressure is 300 lbs □" controlled by a Heywood regulator, fitted to the base of the bottle.

Brake System

Each main u/c wheel is fitted with two Dunlop brake units controlled by a brake lever on the control column through the medium of the Dunlop differential relay unit, the functions of which are:-

1. To reduce the pressure from 300 lbs □" to a maximum brake pressure of 90 lbs □".
2. To give progressive pressure, according to amount the brake lever is applied.
3. To give differential pressure, according to position of rudder controls.

Minimum pressure for take-off 200 lbs. □"

Hot + Cold Air Intakes

Intakes are operated by pneumatic jacks, spring loaded in the 'cold' position. The control is fitted on the rear end of the normal station stowage, forward of the front spar. In the event of pneumatic failure, intakes will automatically return to the 'cold' position.

Pneumatic System Pre-flight check

1. Apply brakes - park brake lever.
2. With rudder bar central, main system pressure should be 300 lbs □" with 90 lbs per □" in each brake.
3. Right foot forward left wheel exhaust - vice - versa.
4. Move hot + cold intake control to 'on'.
5. Leave a few minutes to check for leaks.
6. Return intake control to 'off'. (when 'off' control is pointing to centre of fuselage + is in cold position.)

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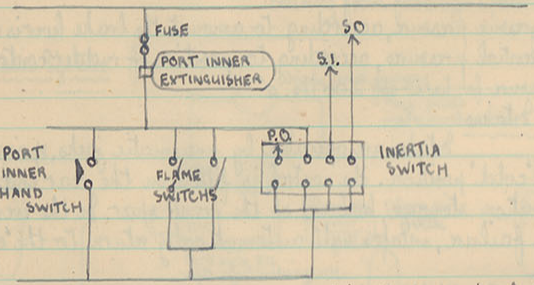
Cabin Heating

Hot air for internal heating is drawn thru' auxiliary rads. mounted on each inboard engine from air ducts on top of the nacelles. The heated air entes the fuselage, port + stark, at the front spar, through vertical trunks, with butterfly valves for control of supply. From here it is fed to various position. Cabin heating is to keep the crew + instruments warm. In case of fire in inner engines turn off warm air on that side to avoid fumes.

Graviner Fire Ext. System



Each engine has a seperate system consisting of a graviner bottle containing methyl bromide which is released electrically + sprayed on to the engine from perforated pipe-lines running around the cylinder blocks + carburetter. The releasing of the fluid is controlled by three alternative switches, the first two being automatic + the third manual.

Flame Switches:- Two fitted in each nacelle + operate when the temperature 150°C is reached in the nacelle possible only in the presence of fire. (normally wax holds points apart). ~~not connected.~~

Inertia Switch:- One only fitted under navigators table operating only under impact such as crash landing + causing all four systems to operate simultaneously.

Manual Switches:- 4 push button switches on port side of pilot cockpit each operating one engine system.

Hand Fire Extinguisher:- One fitted at each crew station + ~~one~~ in rest position. It is important that the operator should wear portable oxygen equipment + also instruct other members of crew to use their normal equipment to avoid fumes. Also in events of fire to either ~~port~~ inner engines cabin heating should be turned off for same reason.

A fourth switch is now also fitted - a gravity switch - which does not operate with u/c up, but when a/c turns to a certain angle with u/c down this switch operates releasing the contents of all four engine extinguishers at once. Also under navigators table below inertia switch. Testing bottles - empty weight stamped on handle, gross weights on side. To test circuit remove plug from extinguisher + place suitable bulb also plug points + press correct ~~p~~ button, bulb should light.

Fires + how to deal with them:-

1. Bright yellow flames + sparks from exhaust at night indicates internal coolant leak.

Procedure - Pilot	F.E.
Petrol off, open throttle.	Notify pilot.
Switches off, feather A/S.	Watch guages.

2. Small fire e.g. carb. fire

Procedure - F.E.	Pilot.
Notify pilot.	Petrol off, open throttle.
Watch guages.	

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3. Serious fire to, e.g. P.1. engine

Procedure

F.E.	Pilot.
Turn off cabin heating	Petrol off, throttle open
Notify pilot	switches off. Operate F.ext push button.
Watch guages	Feather a/s.

4. Serious fire in an outer engine.

as for no 3. but no need to shut off cabin heating.

Oxygen System :- Consists of 15 MK. V bottles under F/Es platform + another six on port side behind frame 11, these bottles are not removed for charging but charged as a system via an external charging valve situated on port side of fuselage below ↓E of M/P. A master cock is situated on floor to rear of F/Es compartment. When this is open oxygen is available up to master regulator on 2nd pilots instrument panel. This consists of 1. A stop valve + contents guage + 2. a regulator valve + flowmeter.

When the stop valve is turned on the contents of the system are registered on the contents guage, after which the regulator valve will adjust the flow, indicated on flowmeter (in 1000's of ft.), to suit the altitude. Oxygen is now available to each of the 13 points, but will not issue from them until the member of the crew unclips the flexible line from the economiser prior to connecting his type E mask Portable oxygen bottles are fitted at each crew station + two additional ones in the rest positions. These bottles need a short length of adaptor tube for use with a type 'E' mask. (Two portable bottles carried opposite F/E's position.

Oxygen System Pre-Flight Check :-

1. Open master cock.
2. Open contents guage should read full.
3. Set regulator to "+0" (+0,000 ft).
4. Check each economiser for 1 puff every 12 seconds.
5. Leave a few minutes to check for leaks.
6. Close all cocks.

Pilot has an economiser but no cut-off valve (pilot controls supply of oxygen to various positions, therefore valve is not necessary.)
Turrets — An economiser + flowmeter are fitted in each turret. The cut-off valve is fitted outside the turret, in order that the turret may be isolated in emergency.

The Use of Oxygen (as per A.M.O. A247)

Oxygen must be used by all occupants at above 15000 ft.
" " " " " " " " " 10000 ft. if lasting longer than ~~2~~ hours, or if at night, or if extremely cold.
At 10,000ft set regulator to '15'
" 15,000ft " " '25'
" 20,000ft + over regulator must always be set to 50000ft. in excess of altitude.

At night bomber crews should use oxygen until a/c has landed to improve their vision.

When to use a portable oxygen bottle :-

1. Emergency - if normal system is u/s.
2. " - if FE is fighting an internal fire.

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3. Exit by parachute at over 10,000 ft.
4. When moving about normally.

When Oxygen System is destroyed - F/E's procedure.
F/E will take two bottles opposite his position - use one himself, & give the other to the pilot. He will then inform remainder of crew, so that they may use their portable equipment. Pilot will reduce altitude as soon as practible.

Assume Rear-Gunner Unconscious Due to lack of Oxygen? Procedure.
F/E wears portable equipment & proceeds to rear turret. Fit gunners mask and connect to system. Remove bobbin & ask pilot to set to 'E'. F/E should always take the two oxygen bottles with him, in case it may be necessary to bring gunner to rest position, if e.g. wounded.

Anti-Icing.
Propellors & spinners & leading edges of mainplanes, tailplanes & fins etc are treated with 'Kilfrost' paste. Anti-icing of pilots windscreen is by 'ethylene glycol'. This is sprayed on panels by perforated tubes on the outside which are fed from a tank in the navigators position. Supply to the pilots windscreen is by a handpump on the starbd. side of seat. The pitot head is heated by an electrical element controlled by a switch located on the pilots roof panel. 3½ gals DTD 406A in tank for pilots windscreen. Pitot head switch 'on' before take-off & 'off' after landing.

Pre-Flight Inspection.
Checks outside A/C. 1. Covers off.
2. Cowlings secured.
3. Pitot head cover off.
4. Main oleo leg extension a min. of 4½" with full bomb load.
5. Main tyre creep (max ⅜")
6. Main undercarrige accumulator pressure 150 lbs □".
7. U/C door accumulator 400 lbs □".
8. Radiator shutters 'shut'.

Checks inside A/C. 1. Remove rudder & elevator locks.
2. Check tail oleo leg extension (min. 2½")
3. Check flare shute doors are 'shut'.
4. Rear turret batteries are connected.
5. Flares stowed clear of controls.
6. All fuel balance cocks 'off'.
7. Flap accumulator pressure with flaps down 400 lbs □".
8. The flap accumulator de-isolated.
9. Fuel tanks 1 & 3 port & starb. turned 'on'.
10. Mechanical up-locks for U/C disengaged.
11. Bomb door accumulator reading 400 lbs □" (doors open)
12. Bomb " " de-isolated.
13. De-clutch the Messier pump if fitted.
14. Check all wire seals on emergency cocks.
15. Check that the starting (starb.) & general (port) batteries are connected. 16. The hot & cold air intakes in 'cold' position.
17. Check for signal pistol. (Right of co-pilots seat)
18. Shut radiators if open.
19. Check fuel on contents guages.

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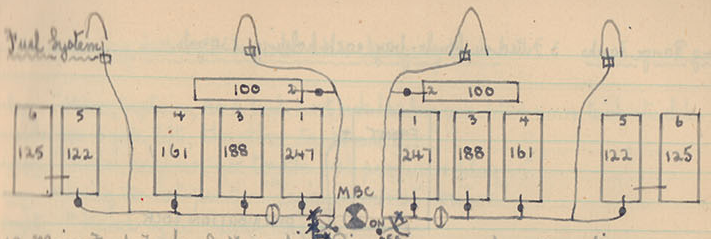
20. Turn on main engine fuelcocks.
21. Check air-pressure in main air bottle.
22. Remove aileron lock on control column.
23. Check bomb-door & flap hydraulic selectors are in neutral.
24. Check boost cut-out is in 'in', & supercharger is in 'M'.
25 Check prop. controls are in fine.
26. Check that D.R. compass & intercom are on.
27. Ensure the pilot has put the auto-clutch 'in'.
28. Inform the pilot O.K. to start up.

Maintenance away from base.

Picketing. Mooring ropes & picketing eye-bolts are stowed in the flip-up to the floor over the bomb-compartment. Points for screwing in the eye-bolts are 1. Outboard of each outer engine. 2. Under the fuselage forward of the entrance door.

Towing. Forward towing must always be used for towing the a/c over heavy or rough or when practically bogged. In the event of an a/c landing away from its base it is the responsibility of the F.E. to supervise re-fueling & to ensure an adequate inspection is carried out & form 700 signed. If repairs are necessary he should telephone his engineering officer giving detailed information of the requirements in order that a suitably equipped maintenance party may be sent. He should always carry the key to the entrance door in order that it may be locked under such circumstances.



12 Main Fuel Tanks Self-sealing. Pipe-lines are also self-sealing.
P.C.C. up when 'on'. Above pilot right shoulder.
Tank isolation cocks underneath port & starbd. rear seats. Forward to nose of A/C 'on' & numbered upwards from floor.
Wing balance cocks operated by levers rear of main spar.
Main balance cock wired in 'off' situated centre of rear spar rear face near the floor. Fuel pressure 6 lbs □" when pressure drops warning light appear & tank must be changed.
Never have two engines running off one tank unless emergency.
W.B.C & MBC must be closed on take-off. MBC must never be on whilst over the target.

• TANK ISOLATION COCK.
⧓ MAIN BALANCE COCK.
Ⓓ WING BALANCE COCK.
□ PILOT'S CONTROL COCKS.

Take off on Nos 1 & 3 tanks.

Tanks	Gallons	Take off 1 & 3	After using 80 gals close 3 open 4	Drain 4 change to 3	Drain 1 open 2	when No 2 has 5 gals left shut 3 open 5 & 6	when 2 empties close. Open wing balance.
1	247	247	167	6	X	X	X
2	100	100	100	100	100	5	X
3	188	188	108	108	102	X	X
4	161	161	161	X	X	X	X
5-6	247	247	247	247	247	247	
W.B.C	SHUT	SHUT	SHUT	SHUT	SHUT	SHUT	OPEN

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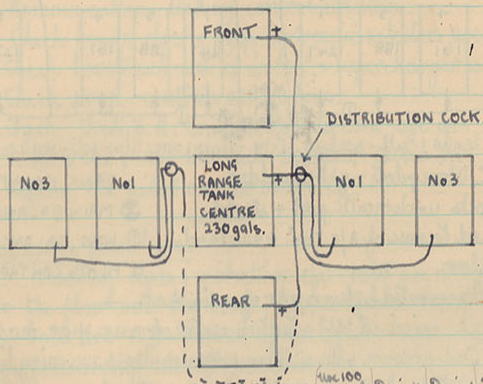
Long Range Tanks 3 Fitted in bomb-bay each holding 230 gals.



TANKS	TAKE OFF 143	AFTER USING 70 from 1+3 change to 2+4	Pump 55 into 1 Port + 1 St. 13 mins	Pump 85 into 3 port + 3 Stbd. 13 mins	Shut 2+4 open 1+3	Use 100 from each close 3 open 4	Drain 4 open 3	Drain 1 open 2	Drain 2+3 change to 5-6 when
1	247	177	232	232	232	132	7	X	X
2	100	100	82	64	64	64	64	64	X
3	188	118	118	173	173	73	73	66	X
4	161	161	143	125	125	125	X	X	X
5-6	247	247	247	247	247	247	247	247	247 / 242
W.B.	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF ON
L.R.T.	230	230	120	10 (E)	10	10	10	10	10 10

5 / 7 / 7

Allowed 15 gals. per engine to be used (from dispersal points to 1000 ft.) before starting fuel distribution calculations. If not at 1000 ft within 3 mins of being airborne, fuel calculations must be commenced just the same.

The following drill is to be used when changing tanks.

Eng. "Hello, Captain, No 4 tank port side has five gals. left + no 4 tank stbd. side has 6 gals. left, the other tanks are O.K."

Capt. "Hello, engineer, go to the rest position + plug in".

Eng. "Going to rest position". "Engineer in rest position".

Capt. "Stand by to change tanks".

Directly the fuel pressure warning light goes on the affected engine should be throttled back + following instructions given.

Capt "Hello Engineer, port outer engine failed. Turn off No 4 tank port side, turn on No 3 tank port side."

Eng "Turning off no 4 tank port side, (does so) turning on no 3 tank port side (+ does so)"

Capt "Stand by Engineer."

When fuel warning light goes out, throttle up again.

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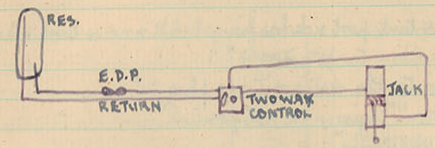
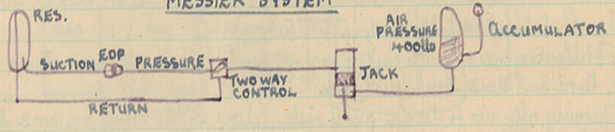
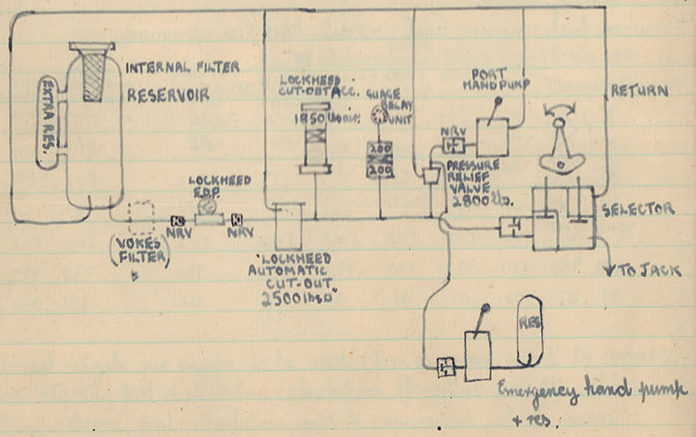
NORMAL SYSTEM



MESSIER SYSTEM



Halifax Mrk. II Messier Pump Circuit.



Position of Component.

Component	Location
Main Tank.	Behind port inner engine.
Auxiliary Tank.	Attached to 'above'.
Yokes Filter (if fitted).	Behind port inner engine.
Engine driven pump.	Behind + below p.i. engine.
Automatic cut-out.	Behind P.I. engine.
Cut-out accumulator.	Aft of bulkhead P.I. engine.
Main press. guage.	Port side of fuselage above front spar.
Port hand pump.	Port side, front face of front spar.
Emergency hand pump.	Starbd. side front face of front spar.
Emergency reservoir.	Behind starbd. inner engine.
3 Selectors.	On special bulkhead behind pilot.

Messier Hydraulic System (Pump Circuit) DTD 391.

The fluid is drawn from the reservoir through a filter into the E.D.P., from there it passes to a lockheed automatic cut-out. When the press. in the main line has reached 2500 lbs. ± the cut-out operates + by passes the fluid back to the reservoir, thus forming the idling circuit. To assist the operation of the cut-out + also for the effect of climatic changes an accumulator has been fitted to the circuit + is known as the cut-out accumulator. Fitted on the main line is the main press. guage + a guage relay unit, should the guage itself become damaged, loss of fluid is prevented by the floating piston in the relay unit moving up to the top of its travel + blanking off the outlets to the guage. The guage will react the press. in the system at all times. Fitted to the main pipe-line are two hand pumps. The port hand pump drawing its fluid from the main reservoir (port). The starbd. hand pump draws fluid from the starbd. emergency reservoir to which there is no

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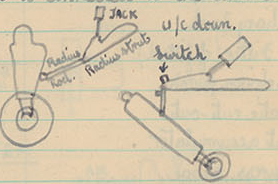
return. Therefore the starbd. hand pump should only be used in case of absolute emergency. A relief valve operating at 2800 lbs. prevents overloading of the system by the hand pumps it is connected to the common return line.



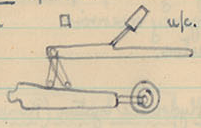
u/c System.

Down locks

1. Hydraulic. (N.R.V. in selector)
2. Geometric.
3. Internal Mechanical.
4. Electrical Mechanical. (Solenoid energized when wt. is off wheels)

u/c must be locked down before "GREEN LIGHT" operates.

"RED LIGHT" operates when down switch is broken

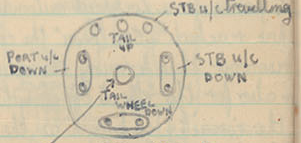


Up Locks.

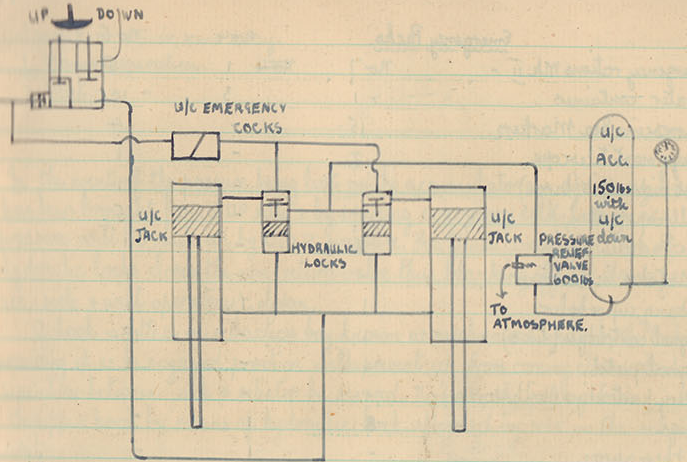
1. Hydraulic. (N.R.V. in selector)
2. Hook (let in after u/c is up)

MK II u/c locked down 'GREEN LIGHT'
intermediate position 'NO LIGHT'
u/c up mech. lock engaged 'RED LIGHT'

MK V u/c locked down 'GREEN LIGHT'
intermediate position 'RED LIGHT'
u/c locked up 'NO LIGHT'



Day & night switch, turn. Push in for top bulbs to light or pull out for bottom bulbs.



Position of Components. u/c selector lever — 1st to R.H. side of pilot.
The hydraulic locks — Attached to top of u/c jacks.
u/c accumulator — Rear of bulkhead front of retraction bay
u/c accumulator pressure guage — Front of retraction bay, to bottom right of a/c.
u/c emergency cock — Front face, front spar, port side

Description of u/c System

The u/c is lowered by acc. pressure & raised by E.D.P. pressure. When the u/c is down & the a/c is standing on the ground, the u/c will not retract because 1 Hydraulic locks which cannot be broken until an up selection is made 2 Internal mechanical which will again not operate until up selection is made. 3 Geometric lock which cannot be broken until an up selection is made. 4 The up selection cannot be made with the A/c on the ground as an electrical mechanical lock is connected to a solenoid at the selector units which in turn will only operate when the oleo leg switch is energized i.e. when wt. of A/c is off u/c.

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Emergency Packs.

	No	No 4	No 5
Emergency rations Mk II	~~No 7~~	~~No 4~~ 1	5
Water containers	1	3	10
Fluorescine Sea Markers	15	–	4
Flag + mast telescope	2	–	1
First aid outfit (large)	–	–	1
Skull caps (yellow)	–	–	5
Flare Paddles	2	–	1
35 Matches in container	–	–	1
Drinking cup + baler	1	1	1
1" Signal cartridges (tin 3)	1	–	18
1" Signal pistol.	–	–	1
1½" Very cartridges (with cover)	–	–	–
Sponge	8	1	–
Weather-apron	–	1	–
Hydrogen generator-set	–	–	–
Leak stoppers (sets of 3)	1	–	2

J Type MK III Boy 3000 lb. Crew 7 (6-8)

4 Stabilisers on bottom to prevent spinning + overturning.

Trip line from stabilisers attached to life line, to empty stabilisers.

5 Handles on bottom to assist in turning dinghy over.

In the centre stowage for topping up pumps. 1 Knife in side of dinghy.

A pocket for leak stoppers. Rescue quoits with 100 ft line attached to side. Sea anchor. Valve fitted for inflation deflation + relief

CO_2 bottle type H operating head, must cock the head before putting the bottle on. Green on operating head shows head is loaded, red means unloaded or U.S. in some way.

1. Manual operation.
2. Elect. "

In the event of the pressure being lost in the accumulator an emergency line has been brought from EDP side + by opening emergency cock loss of acc. pressure will be made up by E.D.P. pressure. This fluid comes in on tops of hydraulic locks closes the non-return valve thus blanking off the damaged acc. side + will operate u/c down.

A hook is fitted in retraction bay known as mechanical up lock, this lock providing it is in engaged position will prevent u/c from coming down should the pipe-line between jack + selector be severed. Normally the roller is held 3/16" above the upper hook by means of hydraulic lock afforded by NRV in the selector unit.

The selector unit must be operated for emergency lowering. If selector is jammed in up or (neutral) position over the centre (return) pipe line.

If accumulator is defective + u/c is desired to be lowered.

1. Dis-engage mechanical up locks
2. Open emergency cock.
3. Select u/c down.
4. When green light appears, close emergency cock.

If E.D.P. fails use port hand pump.

If port hand pump fails owing to loss of fluid in port reservoir use starbd. emergency hand pump. If this again fails manoeuvre a/c + with assistance given by bunges the u/c should lower providing the air-speed is less than 140 mph.

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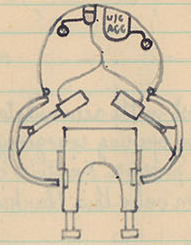
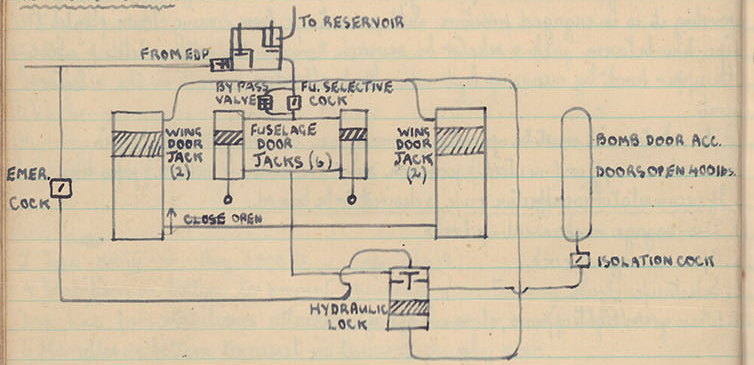
U/c Door Circuit.

4000 lbs □" doors open.



Bomb Door Circuit.



Red light when port wing doors are open.
Green " " starbd. " " are open.
White " " fuselage doors " "

Positions of Components

Bomb door emergency cock	Front face, front spar starbd. side
Fu. door selective cock.	Starb. side of engineer position near selectors.
Bomb door acc.	Just aft of front spar port side.
Acc. isolation.	Directly beneath acc.
Indicator lights (doors open)	One set red, white green on co-pilots panel, duplicated on bomb aimer's starbd. panel.

Bomb Door Circuit.

The bomb doors are opened by acc. pressure + closed in flight by E.D.P. In the event of lack of press. in acc. a line has been brought from E.D.P side through an emergency cock to the top of the hydraulic lock. This hydraulic lock blanks off the damaged acc. pipe-line + diverts the E.D.P pressure to open the bomb doors.

An isolation cock has been fitted below the accumulator + when turned off prevents the bomb doors from blowing open should the pipe-line between jack + selector be severed.

WARNING :- This isolation cock must not be closed until after bombs gone + doors are again closed.

Fuselage Selective Cock (4000 lb bomb) :- This cock is fitted to isolate fuselage bomb doors from wing bomb doors. The reason being when a 4000 lb bomb is fitted the fu. bomb doors will not close fully + so the following procedure must be carried out.

4000 lb already fitted. One person underneath fu. to shout when doors touch bomb. 1. Select bomb doors closed. 2. Using port hand pump pump until doors touch bomb 3. Cease pumping close selective cock. 4. Carry on pumping until bomb doors are closed. 5. Select neutral.

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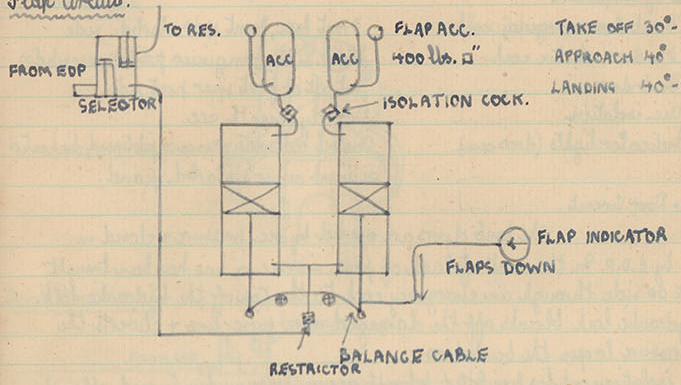
Flap Circuit.

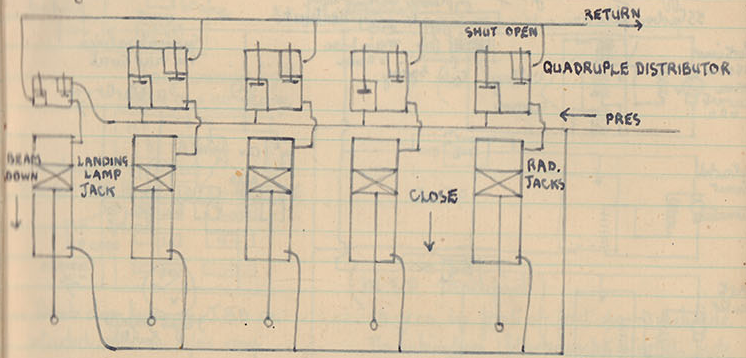


The flaps are lowered by acc. pressure & raised by E.D.P. pressure. Isolation cocks are fitted beneath each acc. to prevent flaps from blowing down should the pipe-line between jack & selector be severed. As soon as A/C is airborne & the assist to take off by 30° flaps is unnecessary isolate both accs.

WARNING:- Should a selection of flaps down be made with accs. isolated it is imperative that the selector lever must be returned to neutral position. If this is not done & isolation cocks are open the balance cable will tear itself away from pulleys & damage A/C structure.

A mech. flap indicator is provided for the pilots guidance, the indicator dial itself is situated on the left hand side of the pilots sloping dash slightly below & to right of oxygen flowmeter.

Radiator Shutters.
Landing Lamp.



Mark IV & V Reconaisance Flare.

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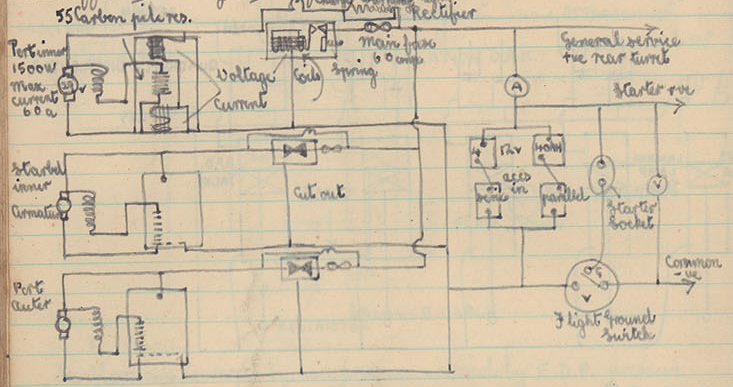
ELECTRICS.

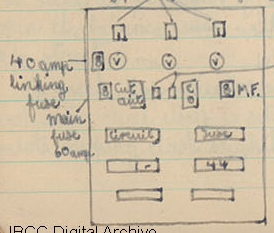
Three effects 1 Heating, 2 Magnetical, 3 Chemical.

55 Carbon piles.



4 in front of front spar two either side + on old circuit an additional two rear of rear spar starbd. side.

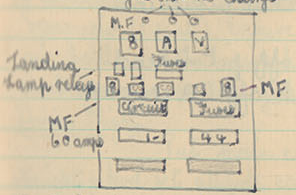
Acc cut-out electro magnetic switch wich opens when the generator voltage falls below the acc. + the acc. tends to discharge back through the gen.



Landing lamp Relays

Main Electric Panel (on right of u/c)
6 accs 4 isolation sockets starbd side.

'F' Panel
Starbd. side rear of rear spar



Bomb door fuses on J.B.D. on starbd. side in B/as comp.

(M.G.P. Modified)

4 accs in front of front spar. 2 each side No linking fuses. 1 Starter socket starbd. side trailing edge. 1 Isolating socket under tailplane starbd. side. Ground flight switch starbd. side. Rear of F.E.'s bay. Only fuses 45-48 on 'F' panel.

Blind Flying Panel.

Before take-off :- Put D.R. compass switch 'ON' + to 'SETTING' See that the altimeter is reading correct atmospheric pressure + check pointer for zero reading (permissible error +50')
See that direction indicator is caged. (Knob pushed in)
Switch on pressure head heater. (should not be on more than 5 mins with A/c stationary)

During flight :- when the A/c's course has been set on mag. compass. adjust direction indicator + uncage (pull out)

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Every 15 mins + before turning cage indicator + cross check with mag. compass.

Before landing.

When using blind flying instruments obtain barometric pressure by R/T of landing field + adjust altimeter accordingly which will then indicate correct height above that drome.

Cage direction indicator switch off pitot head.

When a/c is at a standstill switch off DR compass

Automatic Pilot.

Position of components:-

Compressor	Port bank P1 engine.
Oil cooler	Port inner engine installation
Oil Reservoir Chemical air dryer Air throttle	Port side of A/c nr. front spar
Rudder + elevator unit Aileron unit Turn regulator 3 Servo motors	Port side of A/c in F.E's position
Main Control Cock Altitude control Steering lever Clutch lever Turn regulator main switch Combined air pressure guage	Port side of pilots cockpit
Steering control	B/aimers position

Checks + operations.

Before take-off. See that clutch lever is 'in'. Move controls manually + check servo motors for freedom of movement. If clutch lever is 'out' move to in position move controls over max. range until clutches engage. Then carry out previous freedom of movement test. Ensure that correct amount of oil is in oil reservoir (1 pint). Ensure that silica gel is fresh in chemical air bottle. When engines have started up note reading of combined air pressure guage (60/70 lbs in^2).

During Flight.

Put main control cock to 'spin' position. Trim a/c straight + level set attitude control to 'zero' + steering lever control. Put main control cock to in position providing it has been at spin for at least 7 mins + A/c is above 2000 ft.

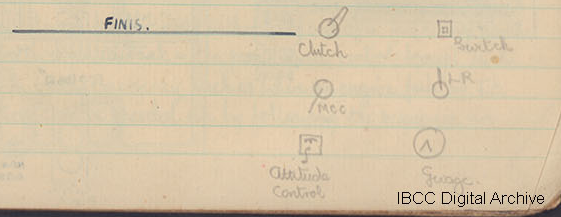
In cases of emergency, put clutch lever to 'out' position (a/c out of control or servo motors jammed)

Before steering A/c left or right turn regulator turn main switch ON + operate steering lever or steering control. When completed turn, turn switch 'off'.

Before Landing:-

Put main control cock to out position + clutch lever to out position. See that turn regulator switch is off.

FINIS.



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ENGINE (MERLIN XX)

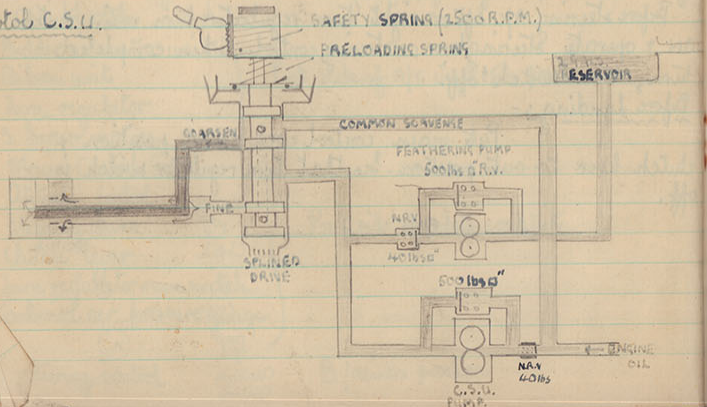
Merlin XX Leading Particulars.

Type of engine:- 12 cylinder s/c., geared, pressure cooled Vee engine, fitted with a 2 speed s/c. Bore - 5·4". Stroke 6". Swept volume 1648 cu" Compression ratio 6:1. S/C gear ratio 8·15:1, 9·49:1. Reduction Gear Spur Lay Shaft single reduction ·42:1. Prop shaft D of R. Right Hand. Crankshaft D of R Left Hand. Wt. of engine 1430 lbs. (dry). Rated altitude M gear 9 thousand, S gear 16 thousand. Fuel 100 octane. Consumption T.O. 150 g.p.h. min. cruising 40 g.p.h. approx max. cruising 64 g.p.h. Oil DTD 472B. Consumption 8-16 pints an hour at max. cruising. Magnetos two B.T.H. C5 S.E. or ROTAX N.S.E 12/4

Firing Order A 1 4 2 6 3 5
B 6 3 5 1 4 2

Cart: S.U. A.V.T. 40 Duplex. Pressure liquid cooling 30% ethylene glycol, 70% distilled water.

Rotol C.S.U.



C.S.U. Gravel.

Attached to dual drive unit, E.S. ·828:1. High speed stop, screw in to decrease R.P.M. + out to increase. One turn equals approx 180 r.p.m. cruising
Safety Spring ensures max. R.P.M. in case of failure of control.
Continual bleeds 8 to 45 pints per hour according to wear.
Engine oil enters at 75-80 lbs p".
5 things allowed to do to C.S.U.
1. Remove R.V. for cleaning (crosses same side)
2. Remove N.R.V. for cleaning (circlip in idler gear. 3/8 B.S.F. stud)
3. Older type - D of R changed (crosses same side)
4. Pipe connections either side. Both must be same side.

Difference in later type C.S.U
Only one D of R (clockwise)
Only two pipe connections.
Relief valve not reversible.
No blanking pieces.

Unfeathering.
1. Turn on fuel.
2. R.P.M. lever through gate to cruising position.
3. Allow engine to turn, switch on mags, + press starter button.

Feathering Sequence
1. Throttle back.
2. Prop. speed control lever back through gate to positive coarse or feathering position.
3. Switch off.
4. Press feathering button, until prop. stops rotating.
5. Turn fuel cock off.

NOTE:- the prop. will almost feather itself without the aid of a feathering pump provided the throttle is pulled back + the prop. speed control brought back through the gate. In great emergency such as when an engine fails at T.O. the feathering action can be speeded up by following the sequence in the order 2, 1, 4, 3, 5

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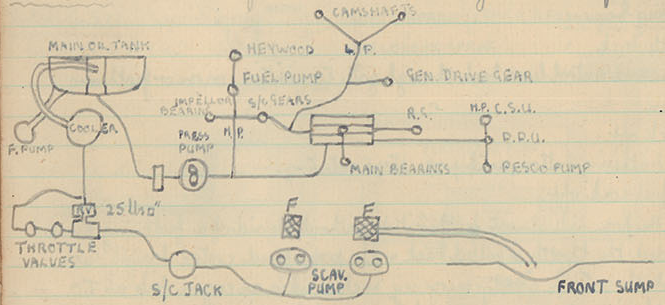
Halifax Auxiliaries

Port Outer:- 24 volt generator (E.S.1.953) provides for rear gun turret + bomb slip gear. C.S.U. (E.S.828) port side of reduction gear.
Auxiliary gen. (E.S.·25) for operation of electric R.P.M. indicator.
Port Inner:- 24 volt gen. (E.S.1.953) provides for landing lamps, instrument lamps, camera motor, pitot vane system, R.S.I. pressure head, heating, de-icing, bomb release + fusing, upper + lower mid-gun turret beam approach equipment, D.R. compass. Hydraulic pump Lockheed. B block inner drive.
Heywood compressor outer drive A block. (E.S.·5) R.A.E. Compressor (Bourge). 793 E.S. outer drive B block. Pesco pump E.S.·228. C.S.U. Aux. gen. R.P.M. indicator·25 E.S.
Starb. Inner:- C.S.U. Pesco pump. 24 volt gen. provides for engine starting, feathering, front gun turret, steering indicator, dinghy installation, call up lamps, glove heating, fuel pressure lights. Auxiliary gen·25 E.S. Engine speed indicator.
Starb. Outer Alternator for A.R.I. C.S.U. aux. gen. E.S.·25. for E.S.1.



oil from pressure pump goes to relief valve which reduces pressure to 60 lbs □" for high pressure + to 8-10 lbs □" for low pressure. The oil H.P. is taken from connection on this valve. An external H.P. line takes oil to the banjo connection on the dual drive unit. This lubricates the bearings of the dual drive unit, supplies oil to the booster pump of the C.S.U. + also to Pesco Pump bearing. A small H.P. line from pump takes oil to fuel pump drives. A drilling from the H.P. chamber of the C.R.V. takes oil to the gallery pipe which distributes it to the 7 main bearings. No 2 main feeds 1 + 2 big end. No 3 main feeds 3 big end. No 5 main feeds 4 big end No 6 main feeds 5 + 6 big end. No 1 + 7 main bearings are highly loaded taking load of R.S. + Whelcase respectively. No 4 is main thrust bearing. An external low pressure line takes oil to the two jets of reduction gear. A small sump of oil is maintained in R.S. by means of high level drain hole. A low pressure line from rear of C.R.V. takes oil to the union behind the cylinders from where it is delivered to the two camshafts + rocker gear assemblies, the bearings of intermediate gears which drive gen. the main + rear bearings of blower gears + rear bearing of impellor. Both the front + rear bearings of impellor are vented to oil tank. Back scavenge pump has a capacity 25% greater than the single press. pump. to ensure complete scavenge at all times.
The two scavenge pumps deliver to one common exit which goes straight to the servo unit of two speed blower. Here it is directed by means of a three way cock either to top or bottom of servo piston. Then on to a 25 lbs relief valve. From here it goes either by passing or entering the viscosity valve to the cooler or by pass the oil is returned to tank.

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Carburetter. AVT. 40

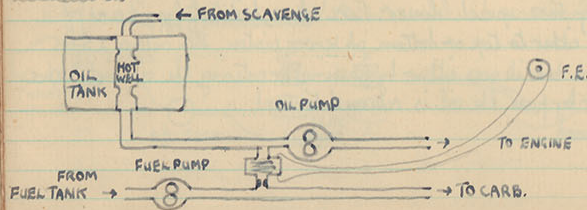
At boost pressure of +4 or below the internal spring is able to resist the boost pressure & keep the capsule stalk against the cam. The needle will remain in this position for any boost up to plus 4, the jet aperture is now large enough to supply fuel for a cruising power output only. All boost above +4 overcomes the spring, compresses the aneroid & raises the needle, so that the tapered portion is raised in the jet increasing the flow, this gives power to prevent detonation.

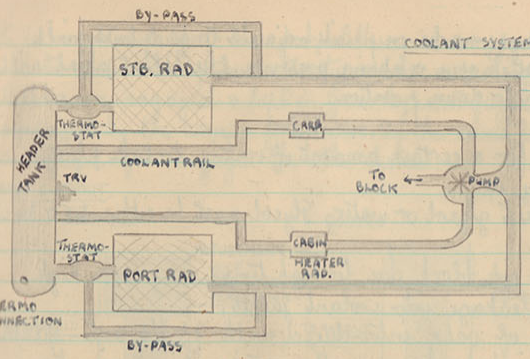
Symptoms of a punctured aneroid are detonation which will increase with rise in boost, which will in turn cause a rapid rise in coolant & oil temps. Vibration will also be called.

Altitude side Stbd. Puncture of aneroid, if this occurs the internal spring will drive the stalk upwards, thus lowering the needle until the waisted portion has entered the jet. In this position the needle will give a suitable mixture strenght for 3000 ft. beyond this altitude the mixture strenght will gradually increase as a/c ascends.

Symptoms:- usuall signs of a rich mixture, loss of power, black smoke, heavy fuel consumption.

OIL DILUTION.





COOLANT SYSTEM.

10% Distilled Water + 30% Ethylene Glycol.

Capacity - 16 gals inner, 14 outer

Thermostatic Relief Valve

Reasons for fitting:-

1. To permit pressure to build up in cooling system in order to raise boiling point of coolant & to increase its capacity to absorb engine heat
2. To act as a safety valve to prevent excess pressure building up
3. To admit air to limit the negative pressure in the system when engine stops
4. To provide an escape valve for any uncondensed gas that may exist in the coolant system.

Possible Causes of Venting

1. Leak in cooling system will allow pressure to be released causing boiling. 30 lbs pressure test to be carried out at inspection
2. Failure of thermal bellows in H.T.V. will allow pressure escape again causing boiling

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3. Dirt or damage marks on phial adjacent to guide bush will cause valve to stick open releasing pressure. Check that phial will lift $\frac{3}{32}$ & return to down position.

4. It is natural for a certain amount of venting to take place during warming up.

5. Use of incorrect glycol or water. Glycol must be either DTD 344 or DTD 344A.

6. Distortion of cyl. block due to high temps. may cause high pressure gas leakage into coolant jacket.

N.B. New type of valve introduced with 9½ lbs anti-splash spring recognised by brown & yellow stripe. Priority given to long range machines.

Two Speed Supercharger

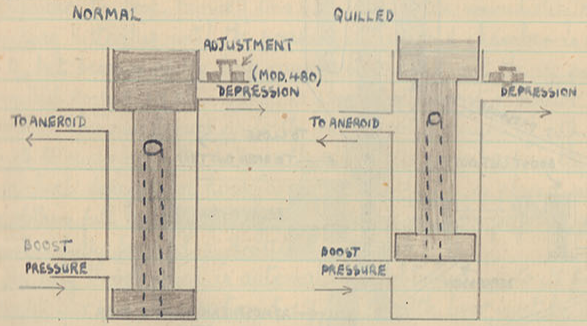
As it takes approx. 150 B.H.P. more to drive 'S' gear than 'M' gear no advantage can be gained by using 'S' below 13,000 / 14,000 ft. Always use 'M' gear for take-off & up to about 14,000 ft. & during cruising at all altitudes provided the I.A.S. can be maintained. The driving gears incorporate centrifugal clutches operated by selector forks, & levers which are on a camshaft, which is in turn operated by a servo piston operated by scavenge oil pressure. A lever in the cockpit operates the valve which admits oil to servo piston moving it up or down according to pilots selection. One clutch drives 'M' gear & two clutches drive 'S' gear.

The camshaft is so designed that it dis-engages one gear momentarily before engaging the other.

It is important that the cockpit lever is snapped in position, & to ensure this, the later types have a spring fitted.

Clutches are engaged & kept in gear by centrifugal weights, & disengaged by the cams & fork levers. As the cams engage one clutch centrifugal force engages the other clutch.

BOOST CUT-OUT.



Boost Regulator.

The Merlin XX boost control is of the progressive type. i.e. as the throttle lever is moved forward the unit is progressively reset to control at higher boost & within the limits of the unit +2 to +9 any one position of the throttle lever will always give the same boost.

The working range of the unit is +2 to +9 lbs. 9 lbs. being obtained with throttle at the gate.

The variable datum action stops at +2 so that as the boost drops below that figure the servo piston the servo piston will remain fully forward & control of the butterflies will be direct by throttle lever.

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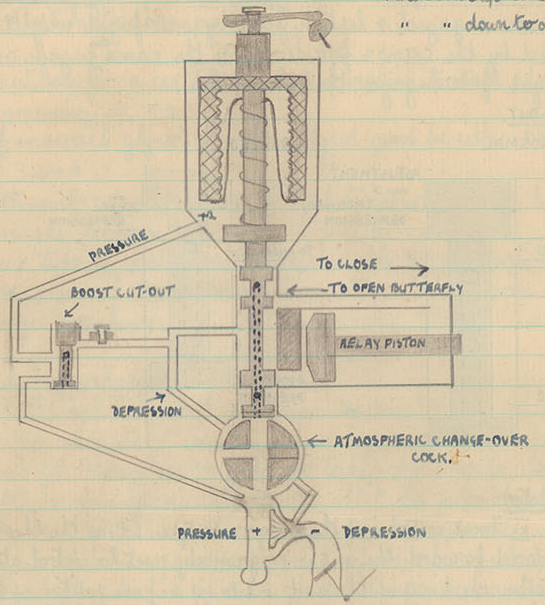
BOOST REGULATOR.

Piston valve up to close.
" " down to open.



Change-over Cock.

At very low boost the pressure difference across the S/C is so low that the servo piston would tend to move instead of the butterflies when the throttle-lever was moved. Therefore when the boost falls below zero the change-over cock substitutes atmospheric pressure instead of boost to the rear of relay piston thus holding it more positively

Boost Control Cut-Out.

In flight the max. permissible boost of +12 lbs. cannot be obtained with the throttle lever as the boost control has a max. setting of +9 lbs. + going through the gate in flight produces no result.

Therefore to obtain +12 in flight the cut-out must be used. Use of this cut-out when the throttle lever is at gate causes pressure in the aneroid chamber to drop from +9 to +6. The relay piston immediately moves forward opening butterflies until the pressure in aneroid chamber is once again +9, but because of the leak caused by the cut-out, the S/C pressure required to give +9 at aneroid is plus 12. The boost regulator will now control this new figure up to the full throttle height of +12.

Points to remember:- the distance the relay piston comes back in the cylinder at sea-level depends on how far forward the T.L. is placed in ~~gate~~ quadrant. To obtain full butterfly opening two conditions must be fulfilled, 1. Servo piston fully forward 2. Throttle lever at gate.

The only boost which is automatically obtained up to its full throttle height is +9 lbs., because to get +9 the throttle lever must be at the gate. When relay piston is fully forward the butterflies are fully open.

With 2650 R.P.M., +4 is automatically maintained up to 10/11,000 ft. Above this altitude the throttle levers must be edged forward if boost is to be further maintained.

Note Full throttle height for 2650 + 4 is 14,000 ft.

FULL THROTTLE HEIGHTS. R.A. 'M' 9500 ft. 'S' 15000 ft.

R.P.M.	Boost	'M'	'S'	R.P.M.	Boost	'M'	'S'
3000	+12	7500 ft	13000 ft.	2650	+4	14000	19000
"	+9	11000	18000	2400	+4	10000	16000
2850	+12	5500	10000	2200	+4	8000	
"	+9	9500	16000	2000	+4	5000	
2650	+7	9500	15000	1800	+4	3000	

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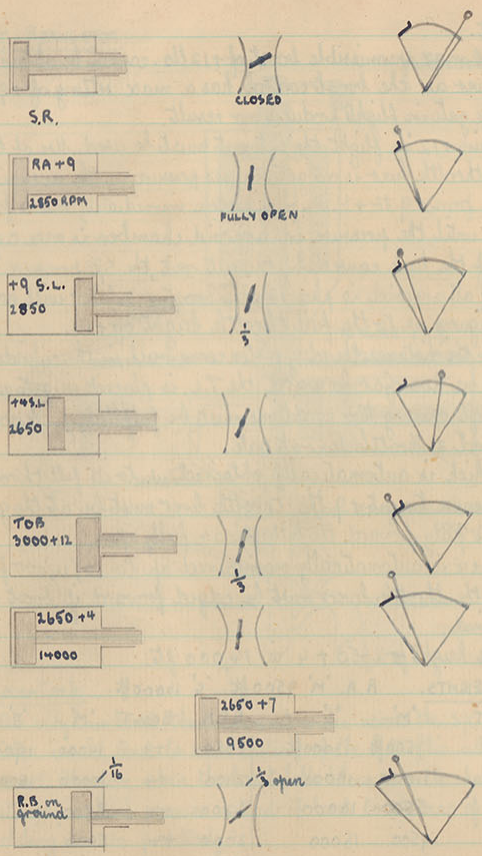

Low Boost Causes

1. Faulty boost guage or loose connection behind guage, loose connection on full trap.
2. Loose connection on swan neck of blower.
3. Slipping clutches on two speed s/c gears.

High Boost Causes.

1. Leak at the dome nut.
2. Check for fouled capsule, see that piston valve has up & down movement.
3. Loose boost regulator.

Surge Causes:-

1. Sticky piston valve.
2. Sticky relay piston or dirty cylinder.
3. Holes blocked in relay piston head.
4. Excessive wear of control pins in differential.
5. Tight differential & control pins.
6. Incorrect lubrication.

~~Rated Altitude~~

Ground Running Checks.

1. Check mags at S.R. (450-600)
2. Check C.S.U. (a) place R.P.M. lever in low cruising position (b) open throttle until there is no increase in R.P.M. (c) Note increase in boost while R.P.M remains constant.
3. Check operation of R.P.M. lever (a) open throttle to zero boost & move R.P.M. lever down to the gate (min. 1800) (b) move R.P.M. lever to max. & observe the increase in R.P.M. (c) Repeat this operation two or three times. (d) leave R.P.M. lever in max.
4. Check 'S' gear (a) Within +4 boost (R.P.M. in max.) move gear lever up to ~~the~~ which 'S'. Note drop in R.P.M. (b) re-engage M gear observing that R.P.M. are restored.

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5. Check mag. drop (a) open throttle to +7 with R.P.M. lever in max. (b) check drop in R.P.M. (max. of 150 drop).

6. Check rated boost (pilots check only) (a) open throttle to gate + R.P.M. in max. (b) observe +9 boost.

7. Check T.O.B. (pilots check only) (a) move throttle through gate + observe T.O. revs. + boost (3000 + 12).

8. Check idling ease T.L. back to 11/1200 R.P.M. + close throttle smartly (engine revs at 450-600)

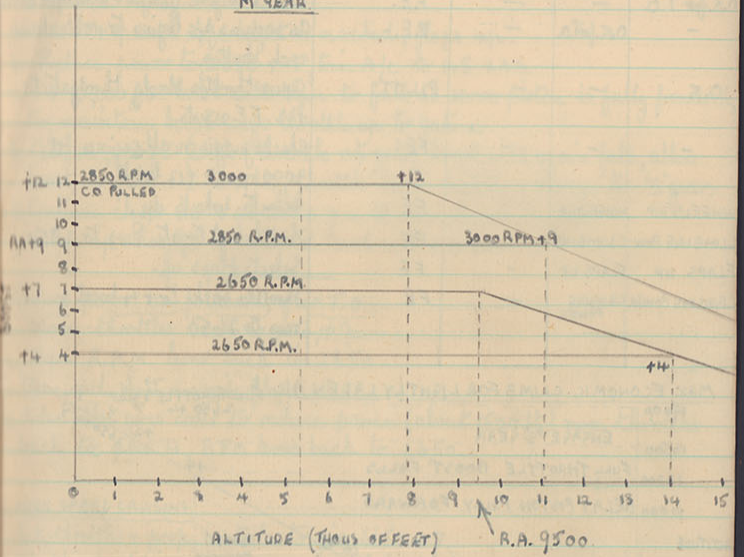
Pressures + temps. must always be checked.

STARTING PROCEDURE.

(1) Main balance cocks "OFF" (situated at rear spar)
(2) Wing balance cocks "OFF" (3) Turn on 1 + 3 port + stbd. tanks.
(4) Declutch messier hydraulic pump by operating hand pump to 2200 lbs.
(5) Intake shutters in "COLD" position

PILOTS COCKPIT (6) Switch on fuel contents guage (pilots roof panel)
(7) See that all a/c controls are free.
(8) Turn pilots fuel control cocks to 'ON' position
(9) Check fuel contents. (10) Set throttle approx ½" open. (11) Ensure prop. control is set at max. r.p.m. (12) Ensure boost cut-out lever is up. (13) Two position mixture control locked in weak. (14) S/C gear in 'M' (down)
(15) Prime 4-5 strokes when cold (16) H.S. switch on - main mags 'ON'.
(17) Press starter button (behind pilots head)
(18) When engine starts, select 1200 r.p.m. check oil + fuel pressure.
(19) When oil temp reaches 25°C + coolant reaches 60°C proceed with ground running checks (rad. shutters open)

FULL THROTTLE HEIGHTS "M" GEAR



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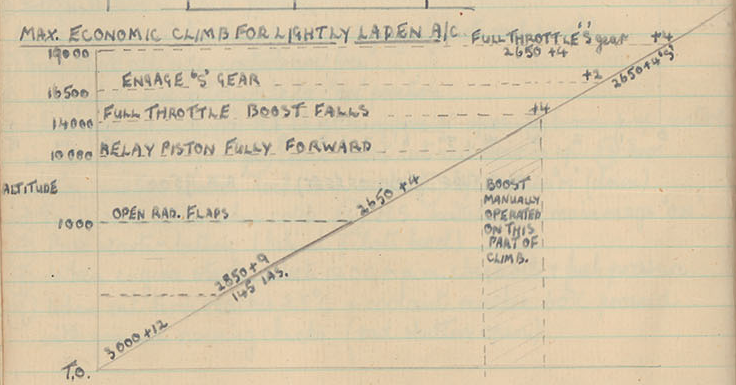
TAKE-OFF DRILL.

PILOT	F.E.	PAUSE	ACTION BY	ACTION
O.K. for T.O.	—	—	F.E.	Checks engine gauges & looks thro' astro
—	O.K. for T.O.	—	F.E.	As soon as A/c begins to roll closes rad. shutters.
O.K.	—	—	PILOT	Opens throttle slowly thro' gate to +12. F.E. assists
—	—	—	FE	Checks gauges on all engines for 3000 rpm. & +12 boost.
WHEELS UP	WHEELS UP		FE	Selects wheels up.
CLIMBING POW	CLIMBING	-	FE	Throttle back to gate. Revs. to 2850
FLAPS UP	FLAPS UP	-	FE	Select flaps up.
CRUISING POWER	CRUISING POWER	—	FE	Throttle back to +4 boost + revs to 2650

MAX. ECONOMIC CLIMB FOR LIGHTLY LADEN A/C



1. T.O. 3000 revs +12. when airborne raise u/c, + reduce power to 2850 +9, open rads.
2. 2850 +9 until safe height is reached, flaps up.
3. Reduce power to 2650 +4, trim A/c to 145 I.A.S.
4. At 10,000 ft boost will begin to fall as servo piston is fully forward, to maintain boost edge throttle up to gate.
5. At 14,000 ft. (with throttle at gate) boost will again fall, allow boost to fall 1½ to 2 lbs, throttle back slightly + change to 'S' gear.
6. Continue climb in 'S' at 2650 +4 to operational height.
7. When op. height is reached level out + cruise.

Reduce power as follows, after T.O.

1. Move throttles back to gate, +9
2. Move R.P.M. lever back to 2850
3. Open rad. shutters + raise flaps.
4. When pilot gives order to reduce power (about 1500 ft) move throttles back to plus 4, RPM levers back to 2650.

HIGH SPEED CRUISING.

Set throttles + prop. controls to give 2650 +7.

At this condition the engines are giving their max. permissible continuous cruising power, + the fuel consumption will have automatically richened.

Flight at this condition should therefore be restricted to a minimum, as range will be reduced by approx. 40% partly through being in rich mixture + partly thro' flying at uneconomical speeds.

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MAXIMUM ENDURANCE

To prolong time of flight as much as possible, i.e. waiting for fog to clear etc. use 1800 r.p.m. & reduce boost pressure until A/c is flying at 135 I.A.S. Should r.p.m. be reduced below 1800 rpm. the generators may cut out. If on the return journey therfore, it becomes obvious that max. endurance is necessary, fly at 135 I.A.S. as this gives max. range, except against head winds.

OPERATIONAL PERFORMANCE

I.A.S. Climbing loaded 150-140
.. Cruising loaded outward bound 'M' 160 (if poss)
.. .. 'S' 155
.. .. light homeward bound M or S 150

MAX. POWER CLIMB.

To achieve the max. rate of climb, the A/C should be flown at correct I.A.S. with the throttle at the gate giving +9 boost & prop. set to 2850 revs.

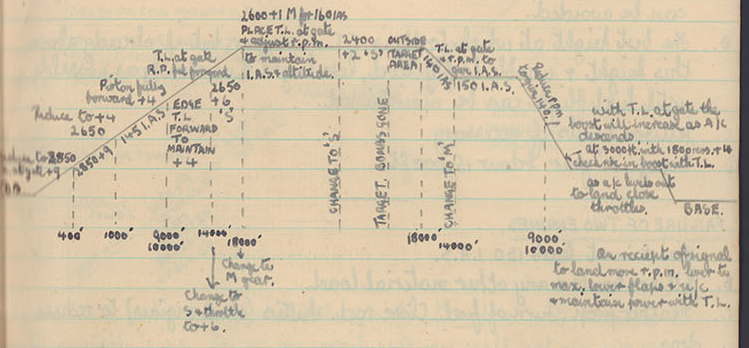
The Rad. flaps must be open
Change to 'S' when boost has fallen to +6
The max. power climb may be necessary in hot weather or icing conditions, & providing the ascent is made at about 140 I.A.S. little extra fuel is used than at economical climbing power.

Cruising Economic.

Always use R.P.M. lever for controlling the I.A.S. at the same time obtain by means of the T.L. the max. obtainable boost not exceeding +4.

Providing +4 is not exceeded the T.L. should be at the gate, & if the R.P.M. required to maintain at least the most economical I.A.S. exceeds 2650, change to 'S'.

ECONOMICAL CLIMB (LADEN)



Economical Climb

Set to 2650 R.P.M. +4 boost in M gear & climb in these conditions so long as satisfactory rate of ascent is maintained.

If the rate of climb is not satisfactory, increase boost as necessary (up to +6), above +4 the mixture strength is increased progressively & automatically. If still more power is required increase R.P.M. when +4 can no longer be maintained in M & more height is needed, continue climbing in 'S'.

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FAILURE OF ONE ENGINE

A. Feather dud engine + turn off fuel to that engine, close rad. shutters. Operate other 3 engines for normal cruising. Maintain most economical I.A.S. but do not exceed +4 boost if it can be avoided.

B. The best height at which to fly is F.T. in 'M' gear, but if already above this height + unable to fly level, lose height ℄ as slowly as possible until level flight can be maintained.

C. Jettison bombs if necessary.

D. Engage 'M' gear below 15,000 ft.

FAILURE OF TWO ENGINES.

A. Maintain at least 130 I.A.S.

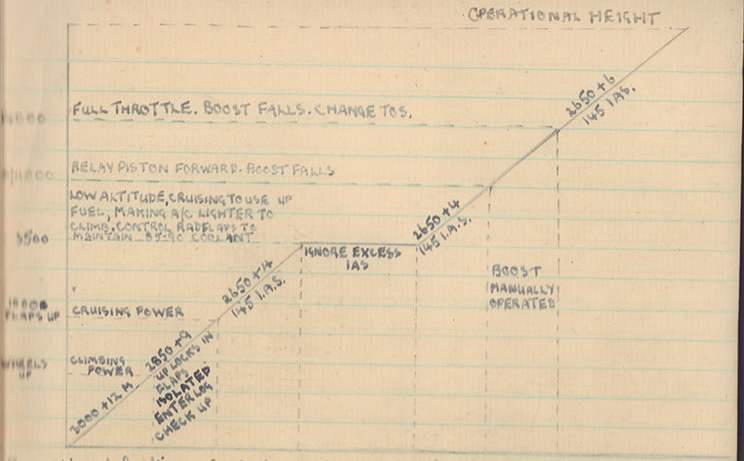
B. Jettison bombs + any other material load.

C. Feather prop. Turn off fuel. Close rad. shutters (dud engines) to reduce drag.

N.B. If feathering is impossible reduce revs. as much as possible. Engage M gear.

D. 2850 rpm. Throttle levers at gate (if above 10,000 ft. +9 will not be obtained)

E. As last emergency if height is still being lost pull cut-out + obtain +12.



Operational Sortie, principles to be aimed at:- level out, throttle to gate, control I.A.S. to 155, M.S. or if 2650 rpm. will not give 150 IAS. use gear; + 150 IAS. Rad. Rad. flaps 85°-90° to 105°C coolant. Estimate fuel left over target from navigators E.T.A.

Approaching targets. Check for hang-ups. Jill tanks if possible. Balance cocks closed. If above 12500 ft. F.S. to reserve of power to build up bomb speed, with bomb doors open for evasive tactics.

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Lift + drag depend upon 1. shape of cross section of aerofoil
2. wing area + plan shape
3. Angle of attack. 4. Speed. 5. Air density.

Angle of attack	L	D	$\frac{L}{D}$	
4°	0	5¼	–	
2	7	5½	1¼	
0	17	6	2·9	
2	24	7	3·4	
4	32	8	4	
6	40	9⅛	4·45	Optimum angle.
8	47	11¼	4·2	
10	56	13¼	4·2	
12	61	16¾	3	
14	66	20	3	stalling angle.
16	56	21½	2	
18	50	24½	2	

When the total drag on a A/c is least when flying at its optimum angle of attack + the speed at this angle of attack is known as the economical cruising speed for range flying.

To every speed of level flight there is a particular angle of attack for an A/c of given wt.

Cruising speed – optimumum L
High Speed – less than opt. L
Slow speed – greater .. .. ..

Indicated Air Speed (I.A.S.) = speed read from ASI.

Rectified Air Speed (RAS) = IAS ± Instrument error + position error correction

True .. .. (TAS) = RAS × Altitude correction factor

Position Error Correction Table

From	125	140	155	180	205	I.A.S.
To	139	154	179	204	250	M.P.H.
Add	6	5	4	3	2	

The indicated stalling speed of an A/c + cruising speed remain same for all altitudes for an A/c of given wt. The true stalling + cruising speeds increase as the altitude increases.

$$T.H.P. = \frac{D(lb) \times TAS\ (ft/sec)\ (mph)}{375.}$$

Cruising, Stalling, Landing + Take-Off speeds increase as the weight increases.

Power required for level flight

Power is a rate of doing work : $\frac{\text{work done}}{\text{time taken}}$

$\frac{\text{Force} \times \text{Distance}}{\text{Time taken}} = \frac{\text{ft. lb}}{\text{sec}}$

1 H.P. = 550 ft. lb/sec.

FINIS

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TIME	HEIGHT	IAS	ATTIT	BOOST	S/G	RPM
00·02	T.O.	T.O.	T.O.	+12	M	3000
00·05	2000	150	C	+9	M	2850
00·25	8500	150	C.	+4	M	2650
00·30	9000	150	C.	+6	M	2650
00·50	13000	150	C	+4	M	2650
01·10	14500	150	C	+6	S	2650
01·15	14500	150	C	+9	S	2850
01·35	18500	150	L	+4	S	2650
		Bombs GONE				
02·15	17500	180	L+D	+4	S	2650
02·55	9000	180	L+D	+4	M	2400
04·42	ARRIVE AT BASE					

CALCUL.

GPE

10
29
5
23
19
6
29
40
39
9

Trip to Krefeld. Estimated T.M. 760. Take given 151a Bomb load 6812
A.W.W. 57346.

TANK CAPAC	1	2	3	4	5	6	7	8	9	10	11	12	13	14
			0·05	1·10	2·05	3·05	3·49	4·05	4·42					
247	247	232	1	96	38	X	X	X						
100	100	100	100	100	100	100	86	54						
188	188	173	102	102	102	102	88	56						
161	161	161	161	96	38	X	X	X						
247	60	60	60	60	60	60	60	60						
247	247	232	1	86	38	X	X	X						
100	100	100	100	100	100	100	86	54						
188	188	173	102	102	102	102	88	56						
161	161	161	161	96	38	X	X	X						
247	60	60	60	60	60	60	60	60						
	152	147	10	90	76	52	44	28						
			304	360	282	152	208	184						
							1·2	1·0	1·0					

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Mixture Strengths

A chemically correct mixture (15-1) maintains power but is not used owing to the high temperatures involved. There is no excess fuel or air to provide internal cooling & the high temp. tends to produce detonation. A weak mixture gives economy in fuel. For economical cruising it is about 10% weak (16-17 – 1). In a richer mixture the air is all used up but not the fuel power output increases up to a mixture strength 15-20% rich. This mixture is used for full power at full throttle, & over rich or wet mixture use up to 50% enrichment & is used for take-off or emergency purposes. In both cases the excess fuel reduces the tendency to detonate & so higher boost pressure can be used to increase power output.

Requirements of an S/c carb.

1. The liquid fuel must be broken up as far as possible & thoroughly mixed with air.
2. In normal working conditions a constant mixture strength must be maintained.
3. A rich mixture must be supplied for idling.
4. Extra fuel must be supplied during acceleration.
5. Provision must be made for weakening the mixture when cruising at reduced power.
6. Provision must be made for enriching the mixture for max. power & take-off.
7. Means must be provided for preventing the mixture from becoming richer with increase in altitude.

Idling Rich mixture. Main reason: Low boost rich mixture will burn evenly. Special slow-run system. Hot spot in change over from S.R. to cruise provided by S.R. returns.

Cruising Constant mixture strength. Diffuser & bleed from pressure balance.

Climb & Take off Rich mixture for 1 Increased power.
2 Cooling effect on the charge.

Acceleration Tendency to flat spot due to inertia lag of fuel behind increased air flow.

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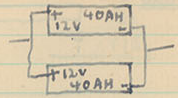
Connection

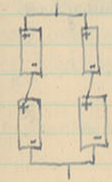
Series

24v 40 AH

Parallel



12v 80 AH.

Series Parallel Halifax

24v 80AH.

Power Watts = Volts * Amps

Power measured in watts.

$W = V \times I$

$\frac{W}{V} = I$

$\frac{W}{I} = V$

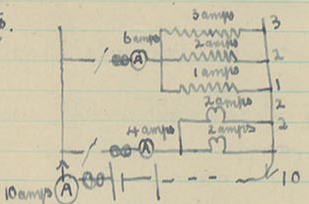
On the Halifax there are 3 1500 watt 24 volt generator, one connected to port inner & outer, starbd. inner.

E.g. Find current which one gen. can supply. $I = \frac{W}{V}$ $I = \frac{1500}{24} = 62\frac{1}{2}$ amps.

e.g. Find a current taken by a 240 watt 22 volt landing lamp

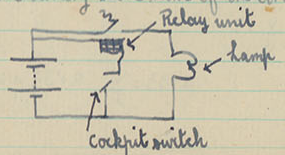
$I = \frac{240}{22} = 10\frac{10}{11}$ amps.

Parallel Circuits.



1. The voltage across each unit is constant.
2. Each unit is independant of the other.
3. Total current taken from the battery = the sum of the circuit currents.

Landing Lamp Relay Circuit.



Solenoid Circuits.

The magnetic relays are used to cut down the lenght of heavy cable thus reducing wight & volts drop of cable. It also prevents heavy wire going into the cockpit & reduces sparking to a minimum.

Fully charged cell.

Acid - Sulphuric (diluted)

S.G. 1·35 or 1350

+ plate - lead peroxide (brown colour)

- plate - lead (spongy)

Voltage 2·1 volts

Discharge cell.

Acid - weaker S.G. 1·180

+ plate

- plate lead sulphate

voltage = 1·8 volts

Capacity of a battery is the amount of electricity which can be taken from the battery & is measured in ampere hrs. The normal capacity of a battery is measured at the ten hour rate i.e. a forty A.H. battery will give 4 amps. for 10 hrs. If the current is increased the capacity decreases.

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Electricity.

Symbols:- 2 volt cell, 6 volt battery, Generator, Motor, Switch

Fuse, Lamp, Earth, Ammeter

Voltmeter, resistance, Solenoid, Solenoid Relay

Condenser

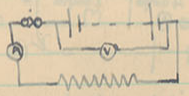
Requirements for a current flow:-

1. Electrical pressure or E.M.F.
2. Conductor.
3. A complete circuit.

Units:- E.M.F. measured in volts with a voltmeter connected in parallel with the circuit.

The current is measured in 'amps' with an ammeter connected in series with the circuit.

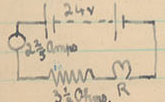
Resistance measured in Ohms.



For any circuit $\frac{\text{volts}}{\text{current (amps)}}$ = Resistance in Ohms. $\frac{V}{I} = R$

∴ Volts = Current × Resistance $V = I \times R$

$\frac{\text{Volts}}{\text{Resistance}}$ = Current $\frac{V}{R} = I$



$R + 3\frac{1}{2} = \frac{V}{I}$ $R + 3\frac{1}{2} = \frac{24}{2\frac{2}{3}}$ $3\frac{1}{2}R = 10$

$R = \frac{10}{3\frac{1}{2}}$ $R = 10 \times \frac{2}{7}$ $\frac{20}{7} = 2\frac{6}{7}$

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