1694683

Acr J SHIPMAN

FLIGHT MECHANIC (E)

COURSE TAKEN AT N°5 S.T.T. RAF LOCKING.

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INSTRUCTORS.

BASIC. - CPL MACFARLAN.

PRELIM ENGINES:- MR. MEW.

MAGNETO'S - CPL MIDDLETON.

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INLINE ENGINES - MR HODGINS

RADIAL ENGINES - SGT HOWARTH.

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" " " - CPL. NEX.

LIQUID COOLED ENGINES

Rolls Royce "Kestrel"

Leading Particulars :- Reduction geared, water-cooled engine, fully supercharged.

12 Cylinders in 2 banks of six with an included angle of 60°.

Bore 5" Stroke 5½" Compression Ratio 6 to 1

Reduction Gear :- Straight tooth spur layshaft single reduction.

D.O.R. of crankshaft :- clockwise from the front.

Weight dry :- 922 lbs Airscrew Hub 21 lbs.

Oil Consumption 3 to 8 pts per hour. Fuel Consumption 0.54 pts per B.H.P Hour.

Lubrication. Mineral oil D.T.D 109 Summer Grade.

High Pressure 60 lbs per □" Low Pressure 5 lbs per □"

Minimum inlet temperature before flight. 25° centrigrade.

Maximum 80° centigrade D.T.D 224.

Port Mags operate exhaust plugs.

Stbd " " inlet "

Timing 37° early fully advanced. Tappet clearance cold .020"

Valve timing :- Inlet opens 12° before T.D.C closes 40° after B.D.C

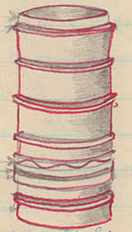
Exhaust opens 50° before B.D.C closes 2° after T.D.C

Mixing of coolant :- 30% Ethelyne Glycol 70% water

CYLINDER BLOCK

A one piece light alloy casting forms cylinder head, complete with valve ports & water jacket. Screw core plugs close holes used during manufacture only. Four valves seats are screwed & shrunk into each head, the 2 inlet are made of aluminium bronze & the exhaust from N.C.M. The plug adaptors are also made from Al Bronze. The inlet valve guides are made from cast iron to give them a better smooth bearing surface, & the exhaust from Phosphor Bronze to conduct the heat from the valve heads.

CYLINDER LINERS



Made from alloy steel, coated with nickel to prevent corrosion. Each liner as a flange at the top & bottom. In between which there is a Aluminium washer which makes a gas tight joint with the head. At the bottom is a rubber ring in between 2 S Steel Rings held in place by a wavy spring. This makes a water tight joint. The bottom spigot on the soft metal of the crankcase makes an oil tight joint. The block is positioned by Nos 3 & 6 cylinder liners.

Crankcase

Made from a light alloy casting with 14 H.T Steel studs in for engaging the cylinder block. Inside the case are 7 webs which strengthen & give support to the main bearings. The bearings a held down by the 14 studs in the webs. Through the crankcase & webs are 14 H.T Steel Transverse Bolts & nuts these also give support to the crankcase.

CRANKSHAFT

A nickel crome steel forging, with 6 main bearings & 7 journals, the former are for bearings for the conrods. The whole crankshaft is hollow for lubrecation purposes & lightness. The journals & bearings have 3 holes drilled through them for the lubrication of the bearings. One end of the crankshaft has splines to engage the aircraco hub coupling shaft & driving.

Valve gear & cover

On top of the cylinder head & 7 brackets which support the tennants on the pedestal of the cam gear. The camshaft is made from nickel crome steel hardened on the cam track lobes & bearing

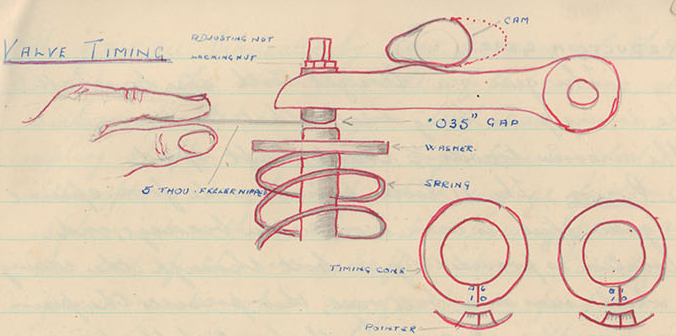
surfaces. At one end of the camshaft is the brown Bruning wheel. The camshaft is hollow for lubrication purposes. The oil comes in through no 7 pedestal & goes through drilled holes in the lovers & out on to the cam pads. The thrust is taken by a Ball Race at the brown wheel end. Also at this end is a Phospor bronze bush, which takes away most of the friction from the drive

Valves (Inlet) Tulip shaped head working in cast iron guides, which takes the case hardened stem. Two springs are on each stem, positioned by split collets & spring washer.

(Exhaust) Similar to inlet valves only the stem is hollow & filled with Sodium to conduct the heat, a cap on the top keeps the Sodium in.

Both valves are made from special material made by the makers, it has to withstand great heat, which must not affect the working of it, or warp. or bend.

VALVE TIMING



(A· BANK) Set inlet clearance to ·035 on dwell of cam.
Turn DOR until a 5 thou feeler is nipped.
Disengage camshaft drive
Turn crankshaft DOR till mark A·6·10 is opposite pointer
Reengage camshaft drive.
Check with a ·005" feeler.

(B·BANK) Set B1 clearance to ·035" on dwell of cam.
Turn DOR until a ·005" feeler is nipped.
Disengage camshaft drive
Turn till mark A·6·10 is opposite pointer.
See A·6 inlet is just opening
Turn 60° DOR to mark B·1·10
Reengage camshaft drive.
Check with a ·005 thou feeler.

REDUCTION GEAR.

The gear is a Straight tooth spur layshaft the drowing pinion being smaller that the driven wheel The airscrew travels ½ crankshaft speed.

(a) Pinion The 21 tooth pinion made from special gear steel is carried on 2 roller bearings, end location is provided by a bolt through the casing which runs on a ball race, this prevents the pinion moving along its axis. In the front of the pinion behind the ball race, is a series of splines which engage which engage further splines on the coupling shaft, the whole is connected to the crankshaft therefore drowing it crankshaft speed.

Airscrew Shaft Hollow nickel crome steel shaft is carried on 2 roller bearings, the thrust is taken by a twin ball race, just behind the front roller race. Bolted to a flange on the shaft is the 38 tooth drowen gear wheel.

Reduction gear casing made from a light alloy casting with 2 shelves top & bottom to catch oil splash which pass by a duct to both the bearings on the drowing pinion & the airscrew shaft.

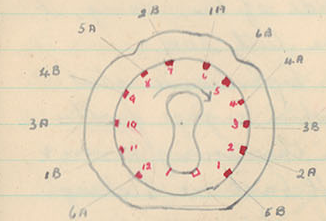
The gears are lubricated by low pressure oil through a tube on the starboard side of the casing, it is then splashed on the gear teeth DOR.

Coupling shaft made from high tensile steel with splines at either end which engage further splines at either end in the drowing pinion & the end of the crankshaft. On it are Etching pencil marks which are for timing purposes.

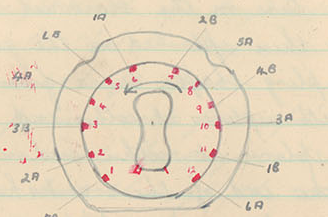
Timing cone A conical timing ring with valve & magneto timing marks on it. It is fixed to the front end of the drowing pinion. A pointer plate is sandwiched between the pinion & the cover. The marks can be seen by removing a plug on the cover.

Airscrew Hub. Rear flange & barrell all one steel forging. The nave plate in front is fastened by splines, it is made from light alloy. The two are fastened together by 8 H.T. Steel bolts which are ⅔ hollow for lightness. The hub is located by a Phosphor bronze split collet & a aluminium bronze retaining nut. The nut is locked by a vernier locking device, which is fastened to the nave plate by studs & nuts.

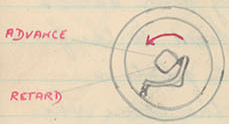
MAGNETO TIMING

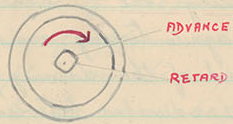


PORT MAG FIRES EXHAUST PLUGS



STARBOARD MAG FIRES INLET PLUGS

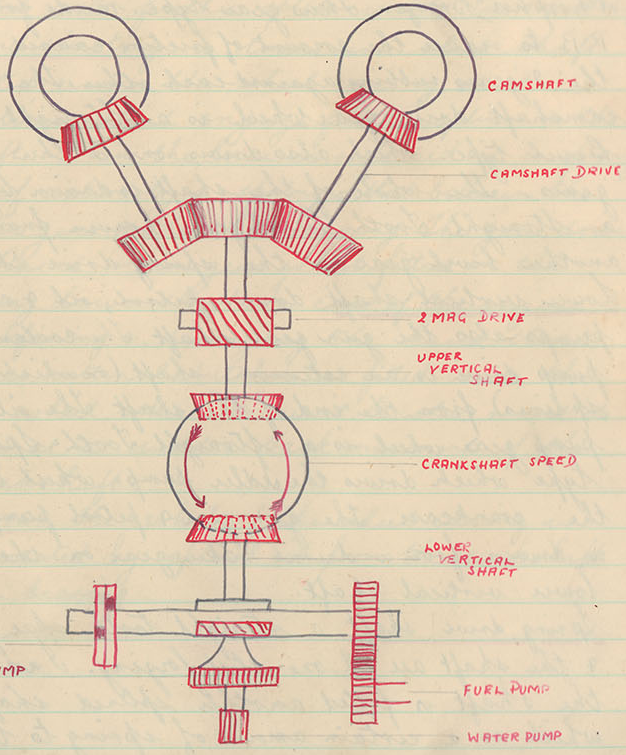




Turn engine to A6MA compression stroke
Set CB points to .012". Fully advance magnets.
Insullate primary lead.
Turn leading brush on rota arm to N°12 segment.
When CB points are just opening offer the mag up to the engine.
Adjust with the coupling rod, one splime = 2°.

WHEEL CASE

Uppu Vertical shaft. & lower vertical shaft.

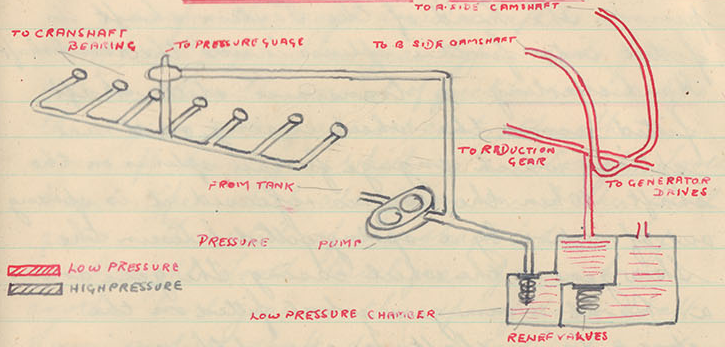


Upper Vertical Shaft drives 2 magnetos & 2 camshafts
The gear for the mags drive shaft is a Phosphor Bronze. Skew gear type. made from P.B to reduce the amount of friction caused by the 2 gears rubbing against each other. The camshaft drive gear wheel is a Straight Tooth Bevel type. which also drives on 2 other bevel gears. The whole of the shaft is driven by a Straight Tooth Bevel gear driven from another bevel gear on the spring drive shaft.
Lower vertical shaft drives petrol, oil & coolant pumps also the gun gear shaft. The coolant pump drive is an extension shaft (on which are splines) from the end of the shaft. The oil pump gear wheel is a Straight Tooth Spur type which drives the idler pump wheel inside the crankcase. The gun gear & petrol pump. is driven from a dural Skew gear on the lower vertical shaft.
Spring drive shaft. a straight tooth spur gear & the shaft are all one steel forging. Inside the shaft is fitted another splined shaft which as a certain amount of spring to take

the shock off the gears during acceleration periods. The head of the Jaution shaft is fitted into further splines inside the crankshaft.
Hand starting. a transverse steel shaft fitted across the wheel casing, on it are splines which engage further splines on the shaft. When the lever is released it is sprung out of action by a spring fitted between the Skew gear & the wheel casing. The gear drives a Dural worm gear wheel fitted on the spring drive shaft. In case of the engine backfiring & damaging the hand starter gears. internal clutches are fitted inside the gear wheel which causes it to slide round its axis at a sudden back movement of the crankshaft.

NOTE. The whole of the wheel casing is lubricated by splash oil from the crankshaft rear bearing.

LUBRICATION SYSTEM

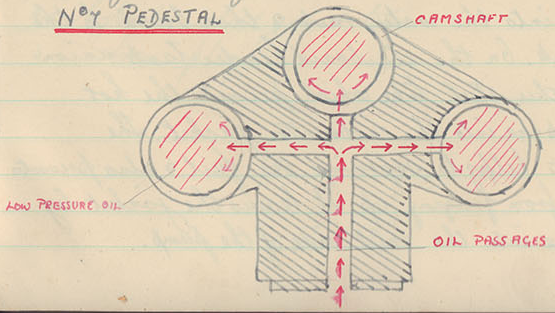


High Pressure System bought by a pipe from the tank to the pump by means of a steel pipe. From the pump it is given out at a pressure of 60 lbs per sqinch by an external steel pipe to the Port side of the crankcase through No 5 bearing to the gallery pipe. It leaves the pipe through the banjo unions on the studs on the bearings down into the hollow crankpins. It leaves the pins by a drilled hole in the front web of each throw, into the hollow journals. These lubricate the conrod bearings. From the end main bearing it passes through the Spring Drive shaft into the wheel case. All excess oil is

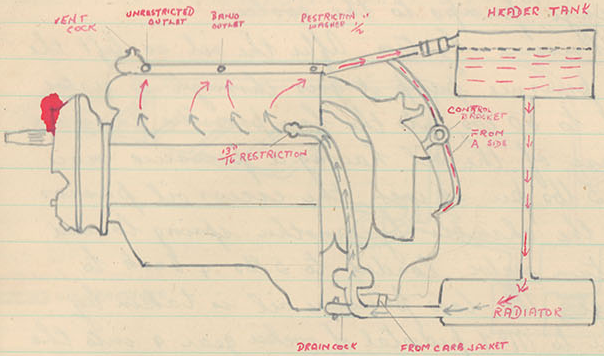
splashed back into the crankcase & by the scavenge pumps to the cooler.

Low Pressure System After the oil as left the high pressure pump it goes through a valve loaded to 60 lbs into the low pressure chamber. In case of the oil having a pressure more than 5 lbs per sq inch the excess oil passes out of the chamber by another spring loaded non return valve loaded to 5 lbs & back to scavenge. The low pressure oil is taken by a pipe to No 7 pedestal of rocker gear & into the hollow camshafts & rocker spindle. The cams & pads are oiled through holes drilled in the levers & out on the cam pads. All excess oil is returned down the gauge tubes on the exhaust side of each cylinder block & back to the crankcase.

No 7 PEDESTAL



COOLING SYSTEM



The coolant leaves the header tank by a steel tube to the radiator. From the radiator it goes into the pump & is pumped out through 2 steel tubes which leads to the exhaust side of each block. It goes through a $\frac{13}{16}$" restriction washer into the block itself by 3 outlets into the water rails & then back to the header tank. On the starboard header tank union is fitted another steel tube which permits the hot coolant to pass into the carburettor jacket. The hot coolant helps to vaporise the fuel & also prevents the throttle from freezing up. It leaves the jacket by a steel pipe into the inlet side of the pump.

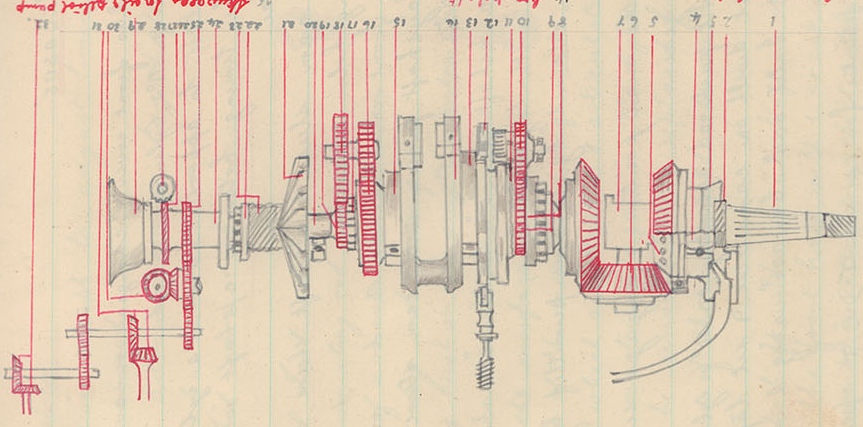
The $\frac{13}{16}$" washer prevents the coolant surging back & damaging the vanes of the pump. The $\frac{1}{2}$" washer prevent the COOLANT from going straight out of the block without cooling the front cylinders.

CYLINDER BLOCK TEST.

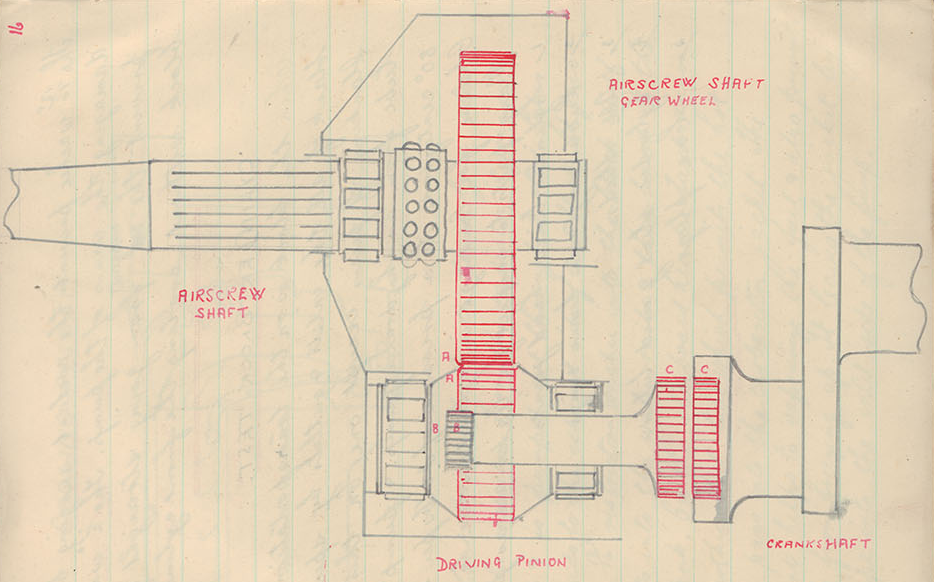
When the block is on the transportation block blank of all the inlets & outlets by special blanking off pieces except one. On this fit a tube from an hydralic pump. & pump in coolant 80° centigrade to a pressure of 20 lbs per sq. inch. Observe for leakage in cylinders due to cracks.

Main parts to inspect for leaks are as follows.

1/ Cylinder liner head joints.
2/ Rubber cylinder liner rings.
3/ All Studs
4/ Cylinder stud gaurd tubes.
5/ Core plugs.



BRISTOL "PEGASUS" CRANKSHAFT AND GEAR DRIVES



KESTREL REDUCTION GEAR

Bristol "PEGASUS"

Valve Timing

Engine has front cover & camgear removed no push rods & N°2 Cylinder removed.

Turn c/shaft to approx TDC on N°2 cylinder lining up the timing holes in c/shaft with a timing bar.

Press on cam sleeve & c/shaft sleeve lining up 1 timing hole

Fit the front cover minus the ball race engaging layshaft pinion with cam sleeve without removing later.

Slide crankshaft gear on to the camshaft engaging it with layshaft gear, observe amount of movement, obtained by rocking permitted by timing rod.

Select the mean position & engage serrations on c/shaft gear.

Checking. Fit push rod assembly on N°6 cyl. Find highest dwell on cams live & set tappets to this dwell. Inlet .004" Ex .006" using 2 sets of fulers.

Check pointer for correct T.D.C & opening of valves.

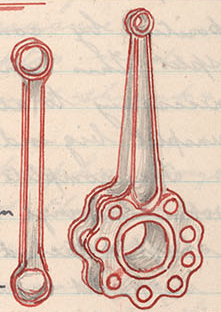
Never attempt to adjust timing with the valves closed.

To advance move layshaft gear in DOR 1 one serration = 4°.

Fit correct ball race.

Special Features.

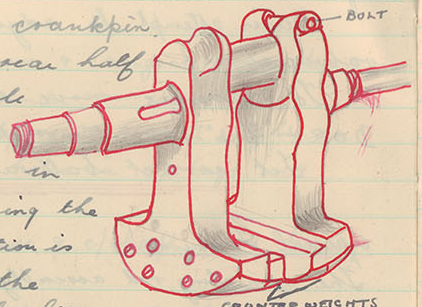
The connecting rod assembly consists of a master rod with an unsplit big end working on a floating bush on the single crankpin there are 8 "wrist pins" carried round the surface of the circumference of the master rod big end to which are attached 8 articulated rods.



The master rod goes in N°6 cylinder this must always be removed last & replaced first as the movement of the articulated rods are controlled by this.

Crankshaft. The crankshaft is in 2 main parts, the front half with 1 crankweb & the single crankpin integral with it & the rear half.

or "manston" which carries a web with a hole to receive the crankpin. The crankweb of the rear half is split down to the hole & a massive bolt clamps the crankpin in position by compressing the split. This construction is necessary to allow the unsplit big end to be fitted.



The complete crankshaft is carried on 2 roller bearings & one ball race. The tail shaft attached to the manston has its rear supported in a bush. Through which the oil supply is introduced.

Pistons. Forged aluminium alloy 2 gas rings & 1 scraper ring above the gudgeon pin. One scraper below the gudgeon pin, liberally drilled for oil return from the scraper rings.

Gudgeon Pin. Hollow fully floating made of air hardening steel retained by washers & circlip.

Cylinder Forged steel barrel heavily finned

with forged aluminium head screwed & shrunk on. A solid copper washer behind the screw thread makes the gas joint. The head & barrell is also locked in place by a steel pin screwed & shrunk into the head. the metal on which is forced into serrations as a security measure.

Two sparking plug adaptors made from phosphor bronze, screwed shrunk & pegged.

Four valve guides of phosphor bronze are press fits into the head, the valve springs acting on their lower washer which bears on the guide prevents them working out. Two brackets also on the head carry the rocker gear.

Valves (Inlet) Tulip shaped head, stem nitrided & tipped with a hardened button. Three springs retained by a washer anchored to the stem by means of a split collet. The angle of the seats is 90°.

(Exhaust) Similar to inlet but not interchangable with them. Sodium cooled i.e.

the hollow valve stem is half filled with sodium, which melts at working temperature & splashes about inside the valve carrying heat from the head to the stem where the cold air removes it. The valve is ground to an angle of 91° & the seat to 90° hence the valve cannot be ground to its seat.

Valve rocker gear. The steel rocker bracket is supported at 3 points, 2 trunnion hinges attach it to brackets bolted in the cylinder head & the tie rod at the end attaches it to the crankcase. The 2 inlet rocker shafts work on ball bearings carried in the rocker bracket, the two exhaust rocker shafts are concentric to them & work on ball bearings carried on them

Push rods. The push rods are hollow with renewable hardened end fittings they & the tie rod, are enclosed in a light alloy casing with rubber joints top & bottom. The front (inlet) push rod has a large mushroom shaped head free to rotate in the end fitting which engages the button of both rocker arms

simultaneously. The rear push rods similarly operate the exhaust rockers.

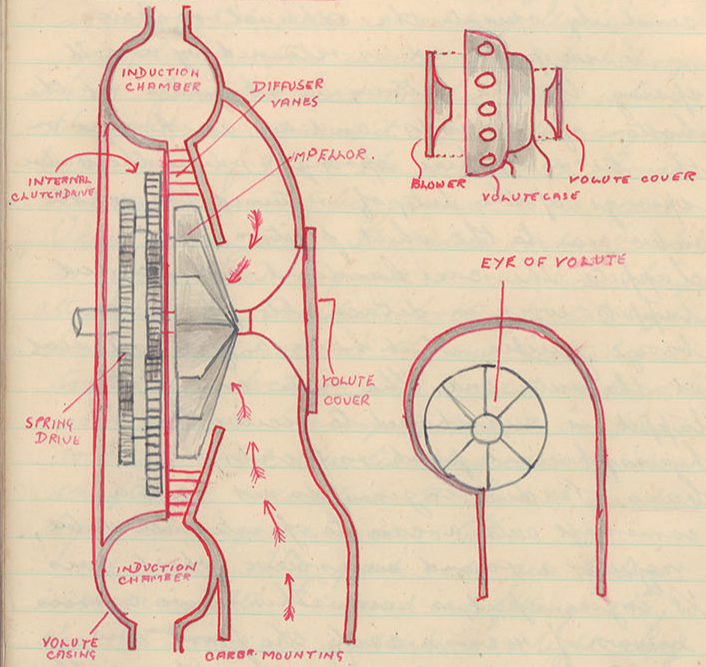
Each push rod is returned by a coil spring trapped between a shoulder at the bottom of the rods, and an anchorage on the tie rod, these springs relieve the valve springs of the duty of returned the whole valve gear to the shut position.

Tappets. The case hardened roller ended tappets work in detachable phosphor bronze guides, which have a 'gits' oil seal at the outer end. The outer end of the tappet is cup shaped to receive the hemispherical push rod ends.

Cams. Radial engines do not have a camshaft with a cam to operate each valve, instead a round camsleeve which goes 1/8th engine speed, is used. This sleeve carries 2 rows of 4 cams each, the front row operates inlet valves & the rear exhaust. The layshaft receives the drive from the crankshaft & transmits it to the internal teeth on the camsleeve In this way each valve is operated in the proper order

1.3.5.7.9.2.4.6.8

SUPERCHARGING



Type. Centrifugal vane type supercharger driven at 7 times engine speed.

Spring drive damps out tortional oscillations

of the crankshaft.

Removed as a complete unit from the engine. Is secured by the 9 crankcase bolts which are extended in the rear to receive the blower unit.

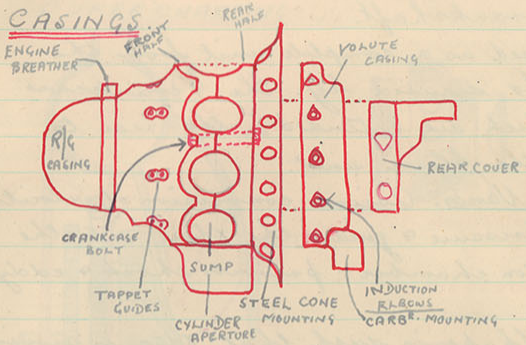
Diffuser Vanes. Assists conversion of velocity into pressure & guides the x flow into the induction chamber - prevents shock & eddy loss.

Volute Shape is such that x flow is moving in the same direction as the impellor blades when it enters the eye of the volute.

Clutch drives. Take up gradually as clutch blocks grip, due to centrifugal force - hence load on teeth is given gradually on closing of the throttle. No excess strain is caused due to increase or decrease in R.P.M.

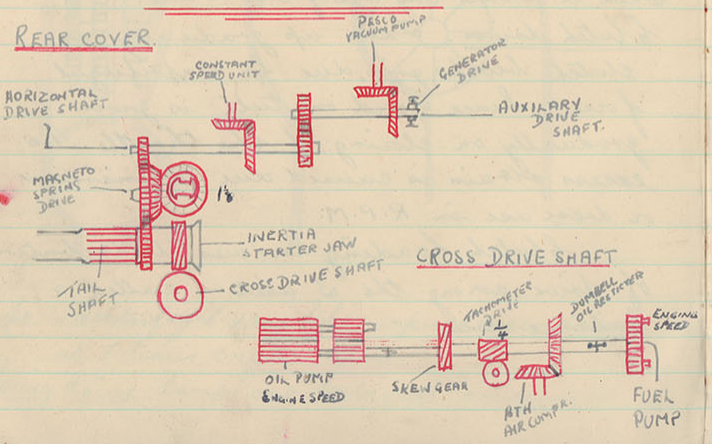
Clutch loading ensures distribution of drive among the 3 units - called a balance drive

CASINGS



All casings are made for aluminium alloy casting.

REAR COVER



The horizontal drive shaft is driven from the inertia starter jaw through a train of gears. From it is driven the Magneto spring drive from a Straight tooth bevel gear. It also drives the Auxilary & Horizontal drive shafts.

The auxilary drive shaft is driven from the Horyt. drive shaft, by means of a straight tooth spur gear. From this shaft is driven the Pesco vacuum pump & generator drive.

The horizontal drive shaft drives the constant speed unit.

The cross drive shaft is also driven from the inertia starter by a Skew gear on the shaft itself. On the port side is the oil pumps which is driven by dogs meshing in the shaft. On the Stbd side is the fuel pump. This shaft also drives the Tachometer & ATH Air Compressor if fitted.

The magnetos are driven from 2 straight tooth bevel gears driven from a combination gear on the straight tooth bevel gear.

LUBRICATION

The lubrication is on the dry sump system, the pressure pump delivers oil at 60lbs per sq-inch. & a scavenge pump of greater capacity sucks the oil used from the sumps to the radiator & returns it to the tank.

Both pumps are of the spur gear type & combined in the same casing also driven crankshaft speed by the cross drive shaft.

Pressure lubrication is supplied to all bearings in the engine (except gudgeon pins).

Splash or spray lubrication is supplied to all ball & roller race bearings, also the gear wheels.

The pistons & gudgeon pins are lubricated by splash from the big end.

The oil supplied to the supercharger is limited owing to an hole in the tail shaft being uncovered once every revolution. The cam gear is partly lubricated by splash and also by a trough which catches the splash from the reduction gear.

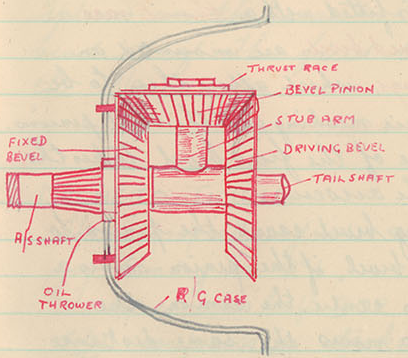
A check valve on the pump prevents the oil flooding the engine when stationary.

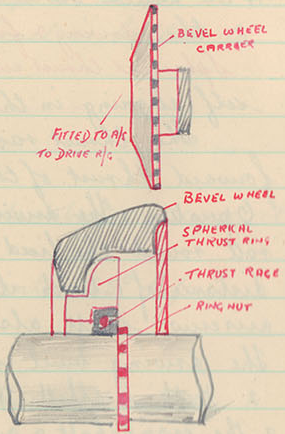
Hand lubrication of the supercharger bearings

is required if the engine as been standing for a considerable time longer than five days. There are two nipples on the crankcase & one on the rear cover for this purpose. Warm oil should be used.

Hand greasing is also provided for the valve rockers & stems.

REDUCTION GEAR





REDUCTION GEAR :- allows engine & airscrew to revolve at their most efficient speeds.
Bevel epycyclic gear enables the airscrew to.
1/ Have same DOR as crankshaft
2/ Be co-axial with crankshaft.
Parts :- 1/ A/S shaft, stub arm, tail shaft
2/ Driven bevel
3/ 3 Bevel pinions
4/ Fixed bevels.

N.B. Each bevel is fitted with a thrust race the driving & fixed bevels are mounted on Spherical thrust rings, which allows them to be self aligning in their meshing with the bevel pinions.
The thrust race of the fixed bevel takes the forward thrust of the airscrew

Operation. The driving bevel causes the pinion to roll round the fixed bevel, if the pinion moves a distance of 1 tooth its centre, the arm on the airscrew shaft also moves the same distance The driving bevel must move a distance of 2 teeth to effect this, thus the reduction is 2 to 1 & the crankshaft & airscrew rotate in the same way.
In practice three pinions equally spaced round

the airscrew shaft are used. This eliminates the side thrust & single pinion would exert & also balances the rotating parts.

Both the fixed & driving bevels are allowed a limited self centralizing action by being supported on spherically shaped thrust rings, this ensures each pinion has its proper load. The driving bevel is driven by the bevel wheel carrier fixed on splines on the crankshaft & in the driving bevel itself. The fixed bevel is bolted to the R/G casing.

MAGNETO TIMING.

The appropiatte cylinder & distributor segment for timing is N°6.
Turn crankshaft DOR until 35° before T.D.C compression stroke.
Insulate primary lead.
Flip the H.T.D in fully advance position
Turn mag till C.B points are just opening on N°6 cam.

Coffin up to the engine. Check with a lamp and battery.

For fine adjustments use the H.T.D 1 division = 1.8°

Synchronise No 2 magnito accordingly with lamp & battery.

JOINTS

2 halfs of crankcase Front cover to " R.H.G cover to front cover Tachometer drive to Rear cover.	Jointing compound.
Cylinder to crankcase Tappet guides to crankcase Tie rod brackets top & bottom Supercharger to crankcase Rear cover to Volute casing Induction pipe flanges	Rubber sealing rings.
Induction pipe joints to crankcase " elbows to cylinders	Paper compound.
Oil sump to crankcase — paper washers.	

ADVANTAGES OF SLEEVE VALVE ENGINES.

Less working parts therefore easier for mass production, also less friction.

Runs smoother & quieter.

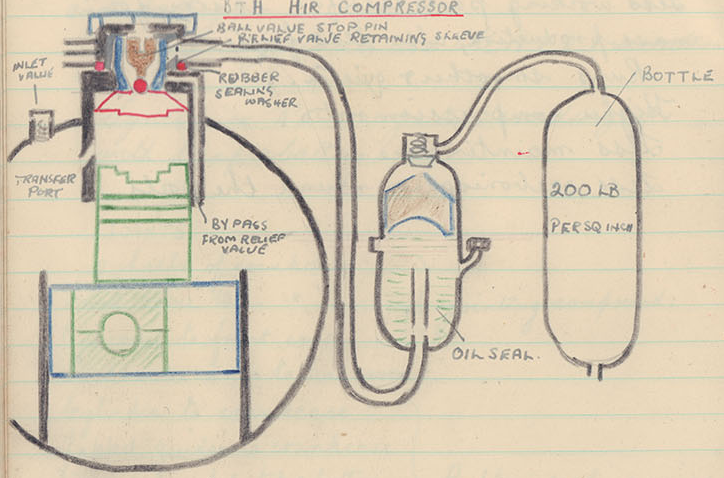
Higher compression ratio.

Less maintinance

Less carbonisation round the ports.

ENGINE COMPONENTS

BTH AIR COMPRESSOR



Compressed air is needed for starting system landing flaps & brakes particually. The pump running at half engine speed will fill the bottle with 200 lbs in 10 minutes. It has a light alloy body with spigot & mounting flanges on the front. The cylinder is heavily finned for cooling purposes.

The air inlet valve is housed in the oil inlet

valve. The spring loaded plunger on the front outercasing is an oil level indicator.

The driving spindle has a wasted portion on to prevent damage to the driving gear if the pump seizes up. It will merely twist the shaft off instead of damaging the cam & driving gear.

The cut out valve works downward in the cylinder head, it is held to the head by the spring & valve nut.

The valve assembly fits in the compression chamber & is sealed by a copper washer. The whole cylinder head is is sealed by an aluminium cap, this as also a flat copper washer to prevent an escaping.

The air is pushed out by the piston & causes a depression in the crankcase which draws more air in. When the piston descends it also leaves a depression in the cylinder therefore the air in the crankcase goes through the transfer port into the cylinder ready for the next pass by the piston.

The by-pass from the relief valve prevents to much pressure in the storage bottle & also causes an idle system.

The oil seal prevents the air escaping through the pump when the engine is stationary, instead of air it pushes oil against the ball valve & seals it. In the new type oil seal there is a gauze pad packed with horse hair which prevents the oil from getting into the bottle.

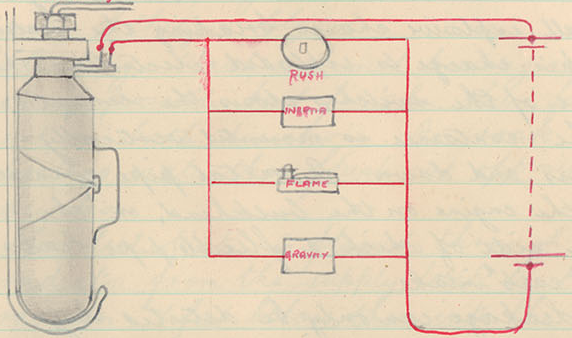
The crankcase is filled with oil by removing the filler cap which incorporates the air inlet valve. The castor oil used is DTD. 72. because it is viscos & maintaines its viscosity. secondly because it as a high flash point & does not readily form carbon. The reason for using it in the seal is because of its viscosity, makes a good seal at the ball valve & also because it absorbs petrol.

Inspection consists of removing the cap nut & valve mechanism & decarbonising the cylinder. This is every 40 flying hours.

GRAVINER FIRE FIGHTING EQUIPMENT.

TYPE A (HAND) CHARGE 6 lbs

TYPE B (AUTO) 6½ lbs.



This equipment discharges Methol Bromide on the danger areas in the engine compartment via distributor pipes & sprays

(a) Automatically if :-

i A fire occurs there, operation by an Automatic flame switch in under 3 seconds.

ii A crash occurs instantaneous opiration by either an impact switch or gravity switch if the plane turns over.

iii manually by a push switch in the pilots cockpit.

The extinguisher can also be detached & used by hand (Mark 1 only)

The methol bromide is released by a small explosive charge braking the sealing cap, this charge is exploded electrically when anyone of the switches closes the circuit.

The container is mounted vertically business end down. A metal pipe connects it to the engine on the bulkhead, on the engine side of which a flexible pipe leads to the carb^r intake.

Leakage can only be detected by weighing, the empty weight is stamped on the handle, & the full container should weigh 6½ lbs or as stated.

The switches & leads are maintained by the electrician.

RADIATORS.

Type:- Retractable from the cockpit, Shutters, Flaps behind, Coolant Thermostat.

Temporary repairs Long bolts & rubber washers through the tubes.

Leak Stopping compound not to be used with Ethelyne Glycol.

Cleaning Wash out with boiling water, or if possible boil for ½ hr. then flush out in both directions. Or soak in boiling water then flush out opposite direction.

Flow test Water is flowed through the radiator from the supply tank to the radiator 7 feet below, then into the graduated tank.

The flow should be within 18% of 15 gallons per 100 H.P. per ~~hour~~ minute.

Pressure Test

Blank off the vent take of the filler cap & replace with a special filler valve with a schrader valve in the centre. Then apply a pressure of 10 lbs per sq inch in a normal system or 30 lbs in a pressure system. Apply gradually & release gradually.

OK Test as follows:- Blank off all outlets

except one to which fit a pump connection & pressure gauge.

Apply the following pressures unless otherwise stated on rad. data plate:-
Normal System 10 lbs per □ inch P. System 30 lbs □".

Thin immerse in water.

Cold = 30 mins
85°C Hot = 10 "
Cold = 5 "

COOLANT THERMOSTATS

Consists of a thermal unit filled with Methol alcohol, connected to this are the sleeve valve controlling the radiator & by pass valves.

When the coolant is cold the by pass is open & radiator is shut off, as the coolants warms, the Methol Alcohol begins to exert a pressure. At 85°C this pressure expands the bellows & opens the radiator valves therefore closing the by-pass. At 105°C the radiator valves are fully open.

At high altitudes the external air

pressure is less, & the thermal unit would open the radiator valves at a lower temperature. The compensating unit prevents this. It is filled with $C.O^2$ & sealed, expansion of the thermal bellows, has to compress the compensator. At high altitudes the thermal unit expands more easily but the com- unit is difficult to compress, the result is the radiator valves are open at a constant temperature.

If the thermal unit fails the rad. valves would never open, ∴ the engine would over heat. to prevent this a safety device is fitted. Inside the thermal bellows if fitted a smaller one. Normally it moves with the same unit. should the thermal bellows get punctured relative movements take place between the two. This releases a trigger & a strong spring forces down a metal point & punctures the compensating device.

Inspection By pass valves should be open if its working, when cold.

Test Boil in water for 10 mins & observe valve openings & closing.

PIPE LINES

1/ RIGID Copper, Tungum, S.S, Ali, Dural.

Tungum unlike copper does not work harden & is extremely resistant to Ethelyne Glycol corrosion. It is also much stronger than copper, also resistant to sea water.

To bend the pipes they must be filled first with sand, oil, or berro-bend.

Stainless Steel Always supplied ready shaped & fit it must never be bent. Corrodes very badly but remains stainless for a considerable time. If there is sea air near, its always coated with sea plane varnish or smeared with Landaline.

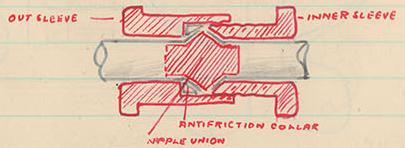
Aluminium & Dural used for petrol & vent pipes, also used extensively in all parts of aircraft.

Connections (RUBBER) White rubber for carrying water, if glycol black rubber is used. To prevent the pipe vibrating from the rubber it is bellied or beaded at the connection ends; & the joint clipped down & bonding placed across by using two metal

strips in relation to the piping. To prevent the pipe from rubber action it is coated at the joint as follows:- Copper - tinned ends. Tungum & S.S - a coating of anodizing enamel. Ali & Dural nearly always have metal connections. When the pipe is belled at the end an olive is fitted in the joints to prevent the rubber getting in & stopping it up.

Clips:- Jubilee, Double band, Jickens perforated band type.

All metal coupling, as the diagram



Standard union screwed into component, then connect the pipe line up with the nickel adaptor.

A very common union is the banjo type

3/ FLEXIBLE

(a) Petroflex used for petrol
(b) Superflexit " " " & oil
(c) Aeroflexus " " " " & water.

IDENTIFICATION :-

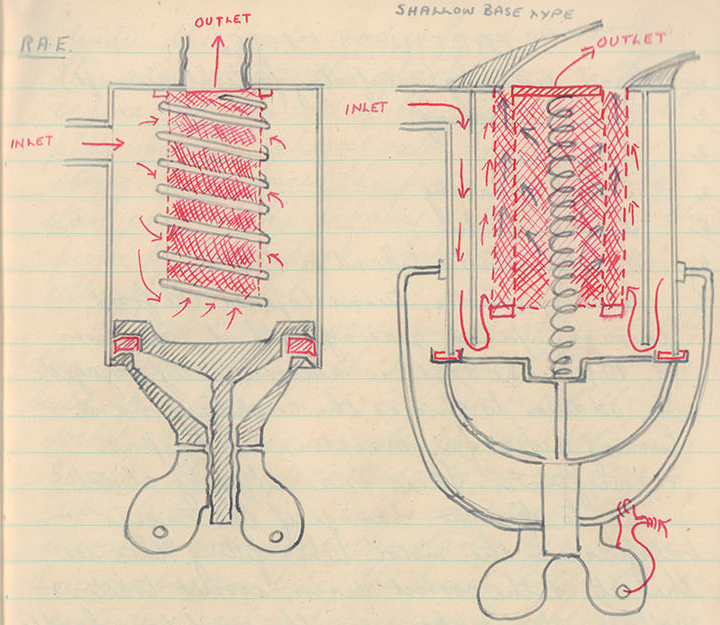
PURPOSE	MARKING BANDS	COLOUR
FUEL		RED
OIL		BLACK
COOLANT		BLUE
COMPRESSED AIR		YELLOW
HYDRAULIC		WHITE
AUTOMATIC CONTROLS		BROWN
ENGINE STARTING		GREEN

FUEL FILTERS

Filtering is generally done by passing liquid through metal gauzes or some other similar materials this clears the liquid on all impurities being therein.

ENOTS
SHALLOW BASE TYPE

R.A.E.



OIL FILTERS (RAE) Similar to fuel only longer. (Tecalemit) Inside is a felt element which passes through the oil & cleans it. In case of the filter getting choked a relief valve is fitted in the top. Scrub element to clean it, after 5 times send back to makers. Always prime with oil after cleaning

STARTING DEVICES

1/ Hand swinging (satisfactory for light aircraft.)
2/ Chain swinging
3/ Rope & bag.
4/ Hand cranking.
5/ Hucks starter
6/ Inertia starter (Hand or electric)
7/ Electric starter, turns dogs at the front through special gearing with at reduction of 90 to 1. The dogs are automatically engaged. in addition to this is the auxiliary hand turning device for maintenance purposes & emergencies. There is a slipping clutch inside to prevent damage if the engine backfires on the motor. When fitting this see that it is the correct series, correct tractor & voltage. also make sure the auxiliary handle is lined up with the hole in the cowling

HOFFMAN COMBUSTION STARTER.

A piston is forced along a cylinder by the gas pressure developed by burning cordite.

STARTER. The splined piston rod moves in helical grooves so as the piston moves along the

cylinder the piston rod is forced to rotate. This also rotates the starter jaws & the engine. At the end of the piston stroke it pulls open the exhaust valve by a rod. & a strong spring forces the piston back to the start position. The exhaust valve closes as the piston pushes it back a ball lock holds it either open or shut.

To protect the engine and starter a safety disc is provided, as the pressure of the gases build up a pressure, it is forced out of it's socket & the gases escape by exhaust.

BREECH. The cordite cartridge is carried in a seperate breech mechanism mounted on the aircraft & connected to the starter by a large bore combustion tube. The breech holds 5 cartridges, each in turn being brought into the firing position by rotation of the breech, by remote control from the cockpit. The cartridges are fired electrically, a safety device preventing ignition if the breech is incorrectly closed.

MAINTENANCE.

NB. This is carried out on a basis of cartridges fired

CONTD.

1. After 75 to 100 cartridges have been fired introduce 1 teaspoonful of lubricant through the sealing piston to lubricate breech mechanism.
2. After approx 200 cartridges, 2 teaspoonsful of lubricant through safety disc holder to lubricate the piston.
3. After 500 cartridges fit a replacement starter & return to M.U for overhaul.

Safety discs are changed. every 25 cartridges in winter every 50 cartridges in summer.

The lubricant used is COFFMAN STARTER LUBRICATING OIL No1 or. C.S.L GREASE No1.

The jaw travel to engagement should be 5/16 inches.

TANKS

No1. FUEL.

Materials :- Aluminium, Dural, Alclad, Tinned steel plate, Stainless Steel.

A sump is fitted at the lowest point. this is detachable for cleaning, to it are fitted the drain cock & main fuel pipe. Detachable

inspection covers are fitted to allow for internal examination. A readily detachable filler cap is provided for filling, next to it is the "bonding" socket, for bonding the hose to it when refuelling.

Before repair apply the following :-

Leave outside for 24 hrs with vents open.
Apply compressed air for 8 hrs.
Rinse in hot & cold water.
Swill round inside with C.B.C.

CORROSION INIBITOR. A spring forms a container in which is put a bag of Potassium Chromate Crystals

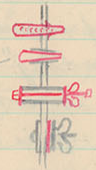
To test for leaks. paint any suspected fault with methalayted spirits & whitening, pour into the tank 1/10th of its capacity with paraffin then apply a pressure of 1.5 to 2lbs per sq-inch. Swill the paraffin about inside & any leak should show up on the whitening, a dirty brown colour.

Inspection (Intern) For corrosion, cracks, fractures or sediment.

(Exterior) Dents, crack, damage to protective finish & any signs of leakage from rivets & joints.

Methods to stop leaks (temporary)

Barbed rubber plug
Tapered wooden plug & PR Tubing
PR Tubing bolt & washer.
Pot-mender type

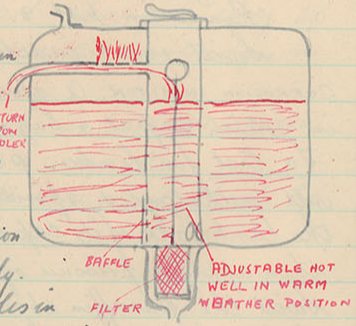


"BRENHEIM" OIL TANK.

No 2. OIL. TANKS.

For warming up. the return oil is passed to a small chamber inside the main tank and from there returns to the engine only a small amount of oil is in circulation and so warms up more rapidly.

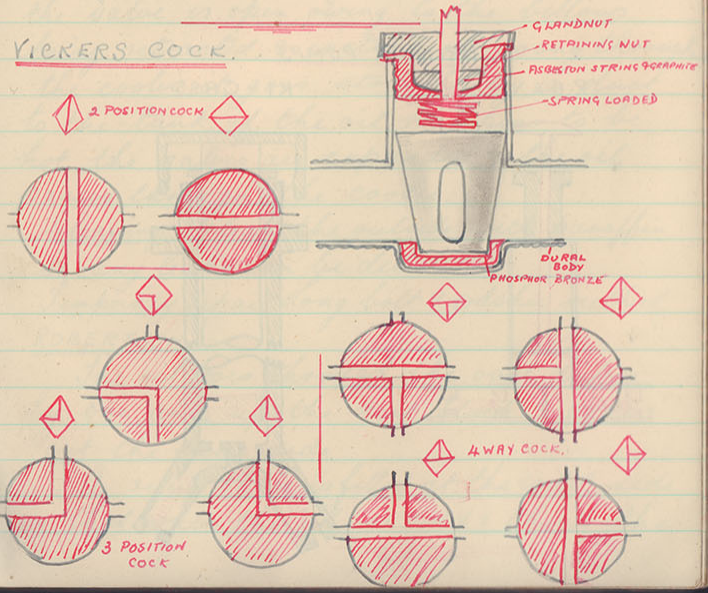
A number of small holes in the hot well & in the return pipe allow small quantities of cold oil from the main tank to pass slowly into circulation when the partial chamber is in use.



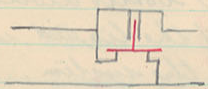
No 3 COOLANT TANKS.

Outlet by way of an Anti Vortex device which prevents the swirl of the liquid, which is liable to take air into the system. In place of an open vent pipe some tanks have a valve lightly spring loaded which opens if a partial vacuum is caused & lets air into the tank.

VICKERS COCK.



NON RETURN VALVES



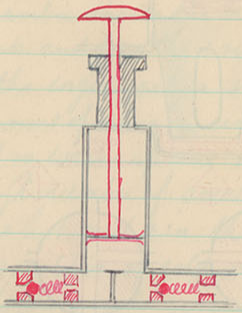
Mushroom & Knife edge

Spring loaded ball.

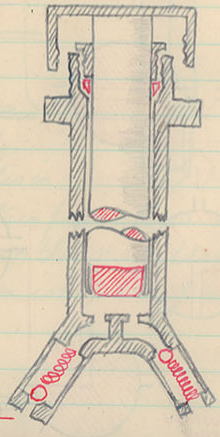
Flat type (as in Semi Rotary Pump)

PRIMING PUMPS

R.A.E



KI-GASS



OIL COOLERS

SERCK. Honeycomb type cooler

When the oil enters the ~~filter~~ it goes into the rear half first, this is so it always has cold air to cool it.

At the top of each cooler is a Thermo valve this decides whether the oil has to be cooled or not, if it is cold when it enters the valve is open owing to the bellows being retracted, & instead of going through the cooler it goes straight by a duct to the tank, if the oil happens to be hot the valves are expanded & the oil passes through the cooler.

Cleaning Clean the outside with paraffin so any leaks can be detected.

Temporary repair Long bolt & washer method.

ROBERTSON

The oil goes through the oval tubes by one and up the next block & comes out the same side.

A relief valve is fitted at the inlet side so that when the oil is cold & thick the

tubes wont take it all. After it has built up a pressure of 25lbs the oil valve lifts & it goes back to the tank.

Cleaning. Run parrafin through it both directions of flow until the parrafin runs clean.

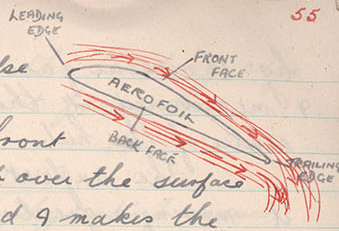
Temporary Repairs.

Break of the leaky pipe & plug the remainder up with rubber plugs. Only 30 tubes are allowed to be blocked up & the reduced flow must not be more than 10%.

PROPELLORS

The prop is designed to convey the power developed by the engine into a forward thrust. This is done by setting a blade to at an angle to the D.O.R. So that the aerofoil moves forward like a screw into a stationary nut.

The leading edge is thicker than the trailing edge on the front face. The back face is flat. It is essential to have



a shape like this or else no thrust would develop The curved shape on front causes the air to rush over the surface at a much faster speed & makes the pressure of the air drop. The air flowing over the back face is much slower than the front & causes an amount of thrust on the blade. This thrust develop on the angle of the blade, the larger the angle the greater the thrust, the angle cannot be increased more than 50° or else all the thrust is lost. These angles are chosen to agree with the weight it has to pull in the aircraft. Four things are needed to maintain thrust 1. Aerofoil shape 2. rotation 3. Angle to plane of rotation 4. Surface area.

The distance it moves forward in one revolution is called the "pitch" this pitch cannot be given in figures owing to the different resistance of the flow of air over the aerofoil.

The angle of the blades is determined

by the rear face to a vertical surface & measured at the 7/8th station from the centre of the hub.

The angle at the tip is less owing to it moving a greater speed than the root if it was the same angle it would obtain more thrust & tend to distort the blade.

Causes of vibration

Blade angles incorrect to each other, 2 Blades not in track with each other. & Balance incorrect which gives it more unequal centrifugal force as it rotates.

Method of checking the track.

The tolerance is 1/8th inch if the diameter is 15 ft.

Raise the tail of the plane to flying position if possible & make the aircraft rigid by raising it off the ground or chocking the wheels up.

Remove a sparking plug from each cylinder & reduce the compression.

Have a pointer fixed to a base & & raised to a height of 5 inches from the

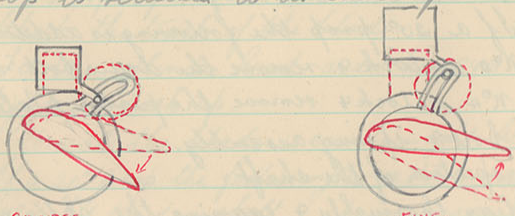
blade tip & to touch the leading edge of the tip furthermost forward.

DE HAVILLAND V.P TYPE 10°

A fine pitch is obtained by hydralic pressure.
A course " " " " centrifugal force.

To change from coarse pitch to fine oil is admitted to the cylinder under pressure, this is forced forward & the shafts working in the slots in the counterweights turn the blades to a fine pitch.

To get a coarse pitch the oil is taken from the cylinder & the weights are flung back by the centrifugal force & the prop is returned to its coarse position.



D. HAVILLAND V.P. PROPELLOR BRACKET TYPE 10° or 20° range

REMOVAL OF PROP. FROM THE SHAFT

1/ Prop must be in coarse pitch.
2/ Aircraft in flying position, tail weighted, wheels chocked up & drip tray underneath prop.
3/ Unlock & remove the cylinder head.
4/ Remove the split pins from the piston lock plate.
5/ Fit the spanner, loosen the piston, unscrew until the prop is felt to loosen.
6/ Take the weight of the prop.
7/ Continue to unscrew the piston until free then slide prop. off shaft and move clear of the aircraft (Take care not to damage the shaft.)
8/ Lower to a horizontal position on a bench or stand.
9/ Fit a sleeve on the shaft.

If a 20° prop the following is additional. After N°2 unlock & remove the draw bolt nut. After N°4 unlock & remove the piston plate draw bolt & spring assembly.

Inspection of the shaft.

Clean thoroughly & examine the splines for damage & the threads for damage & cracks.

Examine for corrosion. If O.K. then coat evenly with Whitmoors Anti Seizing Compound.

Fitting the prop to the shaft.

1/ Turn the shaft for the master spline down.
2/ Aircraft in flying position. etc.
3/ Raise the prop. to offer to shaft and slide on (be sure N°1 blade is down, the shaft threads are not damaged, the front cone leather oil seal is not fouled & the splines engaged).
4/ Start the piston & screw home by hand.
5/ Fit the spanner & tighten to the correct taut. 850 ft. lbs. or a 3 ft lever + 1 sharp tap with a 4 lbs lead hammer, of the bar near the spanner.
6/ Lock up the piston lock plate using the 3 S.S. split pins ($\frac{3}{32}$") heads inside.
7/ Check the track of the blades.
8/ Fit the cylinder head and a new C&A washer tighten & lock up.
9/ Lubricate the blades & counterweight bearings.
10/ If a 20° prop the following is additional after N°7, fit the draw bolt & spring assembly, fit the piston plate, secure & lock up. After N°8

60

fit the draw bolt nut & washer, tighten up & lock.

Ground test for operation. (2 pitch only)

Place the prop. control lever over to fine. Start the engine & warm up. Run engine at 1200 to 1500 R.P.M. then move the lever backwards & forwards several times to expel air. Run at same revs & remove the control lever from fine to coarse, there should be an immediate fall in revs. Example:- 300 then back to fine, there should be an immediate rise to the exact revs.

Also watch the cylinder travel, it should be smooth & complete. Stop the engine with the prop in coarse. If first test after installation relubricate the blades.

Maintenance (Daily)

Visually inspect the blades for bends, cracks, dents, nicks, or scratches. Check for shake. Visually inspect all external parts for damage. Examine all locking devices (5 of them) Check for oil & grease leaks (3 oil, 2 grease). Check prop controls for security & action.

Lubrication.

Is carried out every minor & subsequent

inspections. After a prop installation, the tightness of the piston is tested at the end of the first flight. After maintenance such as checking the track of the prop, removal of the prop for shaft inspection, removal of prop. for overhaul as laid down by A.M.O.° for the particular aircraft.

INSTALLATION

In the cases of inline engines, the engin is located in the airframe by N°2 bolt on either side. This bolt should be tightened right down, while the rest should be just loose enough to turn the bolt with the nut without shearing the split pin. The front two fut have a Silodo washer in between to make a tight fit & reduce friction.

Radial engines have a mounting ring. The engine is fastened to it by the cone mounting in between are pads of Silobalos to prevent the engine shearing the bolts by tending to turn at acceleration. This engine is located by all bolts which are tightened down thoroughly.

Cremodern type engines the mounting is a power unit. The engine & mounting are all connected to the bulk head. This is a quicker method of all.

Reasons for taking engine out.

1- Overhaul.
2- Mechanical Difficeincy (enemy action or other)
3- Modification
4- Excessive oil consumption.

FUEL

OCTAINE VALUE	COLOUR	
M·T Spirit	Yellow	Lead free.
73 OCTAINE	Orange	
87 "	Blue.	Leaded.
90 "	Blue-Green	
100	Green	

ENGINE LUB. OILS

All engine oils shall now be known as DTD 472 not DTD 109

472-W	with additive	2	Grade A for Winter use	3HR/33
472-X	-	-	Grade B - Summer use	3HR/32
472-Y	-	1	Grade B - - -	3HR/115
472-Z	-	2	Grade B - - -	3HR/116
472-R	-	2	Grade A - General -	3HR/15
472-S	-	2	Grade C - Coursas Only	3HR/144
472-T	-	2	Grade C Not defined (AMERICAN)	3HR/144

RDE/0/59 34/123

COOLANTS

Due to different types of aircraft operating on vastly different conditions, coolants may vary to suit their working conditions. These may be distilled water (Hydometer tested for purity) Ethylene Glycol & Inhibitor or a mixture of these

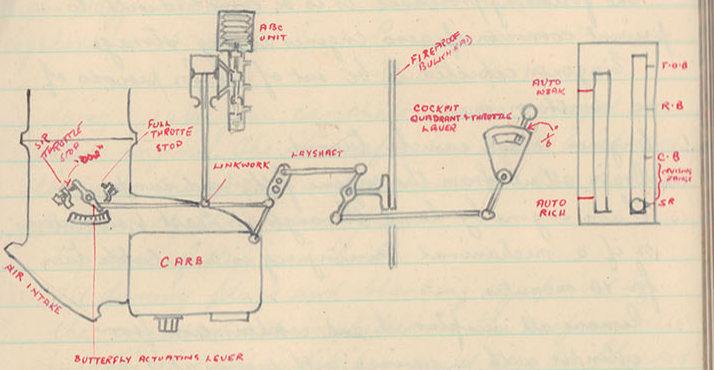
COOLANTS.

Glycol B 95% Glycol 5% Inhibitor.
Glycol Midine 30% Glycol 70% Water.
Soft water
Distilled water

ENGINE REMOVAL (KESTREL & FURY)

1. Drain oil & coolant.
2. Remove propellors.
3. " header tank and support brackets.
4. " exhaust pipes and blank off apertures.
5. Disconnect controls from crossshaft on bulkhead.
6. " priming and boost pipes.
7. " ignition switch and H.S leads from main mags.
8. Remove Hand turning shafts and gear engaging rods.
9. Disconnect oil inlet and outlet pipes from engine.
10. Disconnect oil temp. & pressure gauges.
11. " petrol pipe from filter to carbs at the filter.
12. Put aircraft in flying position, sling engine, remove beam bolts. Lift & guide clear. Rest engine on stand.

CHECKING CONTROLS.



With a ·002" fuller nipped between butterfly actuating lever & S.R or F.T stop. Cockpit lever should be approx ⅛" clear of the ends of the slot in which it works.

STORAGE OF AERO ENGINES

The following procedure is to be complied with, to prevent corrosion of aero engines during storage.

Engines expected to be out of use for periods of one month or more.

1/ Engines which can be turned.

(a) Drain all oil from the engine filter and sump.

(b) Turn engine by hand through at least 6 revolutions, or if a mechanical turning rig is available turn for 10 minutes.

(c) Remove all surplus oil and condensation from cylinder with a syringe, with pistons at T.D.C.

(d) Remove all surplus oil from valve stems and springs and in the case of inline engines from the camshaft housings

(e) Use a spraying apparatus (Stores REF 11A/1261) and spray each cylinder with anti-corrosion inhibitor Type A or Type B (Stores REF 330/563 and 33C/1465) whilst this operation is in progress the piston should be on B.D.C power stroke. The quantities of inhibitor per cylinder as follows:-

Allison	12-14 c.c's	Napier Sabre	6-8 c.c's
Arm. Siddly	12-14 "	Robjoy	5-6 "
Bristol	16-20 "	P&W Wasp	12-14 "

De Havilland	6-8 c.c's	R.R Kestrel	8-10 c.c's
Napier Dagger	5-6 "	" Merlin	12-14 "
Cyclone	15-20 "	" Peregrine	8-10 "
		" Vulture	8-10 "

(f) Spray valve gear, camshaft is also sprayed on inline engines. The stems of valves are to be sprayed through the springs and exhaust valves via the ports with the valves open.

(g) Rep lace filters and lock.

(h) Fit dummy plugs and blanking equipment if the engine is not installed in the airframe. Air intakes and exhaust pipes must also be blanked off.

(i) Repeat above procedure every 6 months.

2/ Engines which can be run.

(a) Run the engine at least once per week at about 1000 R.P.M until the oil attains normal running temperature.

3/ Engine which cannot be run.

These should be treated as at Para 1 as soon as possible and not later than 7 days from the last run.

Storage (General) A.P. 830 VOL II Leaflet C.5.

Dispatch And Packing of Aero Engines

(a) All engines despatched to return from abroad. are to be packed in standard engine cases lined with 2 thicknesses of waterproof paper.

Care must be taken when packing engine that this paper is not punctured.

(b) All parts and openings are to be effectively sealed as laid down and the engine is to be protected externally and internally against corrosion.

(c) When despatching engine logbooks must be wrapped in waterproof or suitable paper and secured inside the case.

(d) Engines are to be examined for corrosion immed- -iately on receipt and are to be inspected periodically at intervals necessitated by local conditions

Aerodrome Procedure

Unit Organisation

Flights H.Q.C etc Group II tradesmen, with N.C.O's of Group I trade: Flights carry out, Between flight, Daily & Minor inspections.

Squadron Servic- -ing Party Group I tradesmen, carry out Major inspections, simple modifications. May be called upon to assist flights, when flights have any difficult work to do.

Workshops Carry out repairs, servicing plugs, B.T.H Air compressors, Ignition harness etc. Welding, Blacksmiths, Carpentry etc are also in the workshops.

Aeroplane Maintenance Schedule.

Contains complete data, on items to be inspected on all parts of an aeroplane for all tradesmen and covers between flight, Daily, & Periodical inspections.

Issue No 1. is completed by an A.M. in form of Volume II Pt 2. of A.P. for particular type of aeroplane it is for.

ISSUE N°II Prepared by commands RAMS is divided into two sections.

SECTION I

Between Flight & Daily inspection

Sub Sectioned for trades.

A FLIGHT MECH A (AIRFRAME) B FLIGHT MECH B (ENGINES) C D E F SUBSIDIARY TRADES

SECTION II

Minor and Major inspections

Sub-sectioned for trades.

A FLIGHT MECHA (AIRFRAMES) B FLIGHT MECH B (ENGINES) C D E F SUBSIARY TRADES.

Assembly group as in Section II

Assembly groups for ease of inspection in each sub section

A.S aircrew items

i.e. P.P Power Plant

C.O Cockpit Items.

Items unstarred are done every MINOR (40 hr)

" with 1 star " " " 2nd " (80 hr)

" " 2 " " " " 3rd " (120 hr)

" underlined and described in capitals are done every Major

Inspection system consists of 5 minor inspections & a major inspection always do all minor items, as well as Major items.

One every 40 hrs is followed by a major at 240 hrs.

1st Minor Inspection at 40 hrs do all unstarred items

2nd " " " 80 " " " " + one * "

3rd " " " 120 " " " " + two * "

4th " " " 160 " " " " + one * "

5th " " " 200 " " " " "

Major inspection " 240 " " " " + * * + * * * major items.

SECTION 2 SUB SECTION B ENGINES AEROPLANE TYPE MOTH-1 AEROPLANE N° 7588

ASSEMBLY GROUP	NOTES:-	40 hr A	40 hr B	80 hr A	80 hr B	120 hr A	120 hr B	160 hr A	160 hr B	200 hr A	200 hr B	240 hr A	240 hr B
* A.S.1	AIRSCREW				✓								
A.S.2	" "				✓								
** P.P.1	POWER PLANT												
P.P.10	CAPITALS) " "												
* P.P.39				X	✓								
C.O.1	COCKPIT " "			✓									
C.O.2	CAPITALS												
* P.L.1	MAINPLANES			✓									
P.L.8				✓									
* G.E.2	GENERAL			✓									

Col "A" on inspection sheets of Sect II is condition. column if item is O.K sign in this column.

Col "B" If item requires rectifying put "X" in column "A" who ever does the repair etc will sign in Col B.

If airmen is called away or has completed his part of inspection he will draw a line across Col "A" and put his initials on this line i.e. [✓ JS]. If item requires rectifying and an X is in Col "A" his initials in Col "A" prevent anyone thinking item has been rectified i.e. [X]

Where more than one engine is fitted in an aircraft A sub section B is supplied for each engine.

PERIODICAL INSPECTION CERTIFICATE.

CERTIFIED THAT UNDERMENTIONED INSPECTION HAS BEEN COMPLETED AS PER THIS A.M.S.
AIRFRAME HAD MAJOR AT 25 hrs OWING TO CRASH.

PERIODIC INSPECTION	DUE AT HRS	MADE AT HRS	NAME OF TRADESMAN BLOCK LETTERS	INTLS	DATE STARTED	DATE FINISHED	SIGNATURE OF N.C.O i/c INSPECTION
40	65	HR · MIN 64·10	LAC · CLEAL AC · TODD	E.C. J.T	6/8/42	7/8/42	A. Staley Cpl.
80	105	102·25	A/C EWENS LAC · SCOTT	S.E A.S.	17/9/42	19/9/42	J Todd Cpl.

One periodic inspection certificate is affixed to each sub section of SEC II

SYNCHRONISATION OF ENGINES AND AIRFRAMES INSPECTIONS

For inspection purposes the hours of the A/F are used and engines are given the same inspection as the airframe in which they are fitted.

If a new engine is put into an A/F which will have a 200 hr inspection due in 10 hrs (flying) this engine is given that inspection when the A/F is due. If an engine which is to be installed in an A/F has less hours to go to a Major, then the A/F it will be given a Major before installation & then fall into line with the A/F inspection (i.e. A.F. 190 hrs to go to a Major Eng 100 hrs to go)

LATITUDE

The number of hours you may anticipate or delay an inspection. On minor inspections this is 4 hours before or after the inspection is due. On major inspections this is 8 hrs before or after. Latitude used for minors has no effect on time next inspection is due. e.i." inspection due 65 made at 61 next inspection at 101." In case of majors latitude does count. i.e" Major due 265 made at 259 next minor will be at 299." To do an inspection before due i.e. Anticipate it, verbal permission from N.C.O i/c flight is necessary only. To delay inspection written permission in form of an entry in Form 700 is needed signed by the flight commander.

SUPPLEMENTARY INSPECTION RECORD

SECTION 2 — SUB SECTION 13 ENGINES — AIRFRAME TYPE MOTH 1 — A/PLANE No 7588

ASS. GROUP SERIAL No's	INSPECTION OR AMENDMENT AND AUTHORITY	40 HOURS A	40 HOURS B	40 HOU A	40 HOU B
* P.P. 9A	Holding down nuts checked & tightened 2/5 M 831/6 F.T.C. H.Q.A.T.R.				
P.P. 27	DELETE THIS ITEM AUTH SIS A/831/6 F.T.C. H.Q. A.T.R.				

A supplementary inspection record attached to each sub section of Section 12 to record an additional deleted item & amendment or special instruction

U.M.O's PART I

Compiled by CO. They deal with general technical procedure of unit as applicable to aircraft & flying, outlining duties of various tradesmen, N.C.O's, officers and allocating responsibility to sections, for work they are to do.

U.M.O's PART II is now known as AEROPLANE MAINTENANCE SCHEDULE.

FIRE EXTINGUISHERS

	CONTAINER SCHEME	TO OPERATE	MAY BE USED ON
Soda acid.	Red	Push plunger	all except petrol & electric fires.
Foam or Froth (Carbonic)	Brown	Invert	aircraft, ground, & petrol fires
Methol Bromide	Copper	Remote, Electrically Mechanical	Filled on all aircraft, safe to use on petrol & electric fires
Tetra Chloride (Pyrene)	Brass	Pump type plunger.	M.T. Vehicles

FORM 700

A temporary history of all work done by all trades on the aeroplane including repairs, replacements, modifications. A record is kept of flying & running times & a panel indicates when next immediate inspections will be due.

A 700 is used for each aeroplane and

covers all tradesmen who have work to do on an aircraft. An "ALLOCATION OF DUTIES" panel contains a list of names of the ground crew of the machine also the pilot.

D.I CERTIFICATE:

DATE To be completed on each day on which flying takes place or an inspection is made.

AIRFRAME Hours flown by the airframe are to be brought forward from COL 29 by the responsible airmen on cessation of each flying day.

ENGINES Hours run by the engines are to be brought forward from COL 29 by the responsible airmen on cessation of each flying day.

AUTOMATIC CONTROLS The senior flight rigger of the maintenance crew is responsible for the entry of the running time of the automatic control.

AUXILARY POWER UNIT The senior flight mechanic of the maintenance crew is responsible for the entry of the running time of this.

DAILY INSPECTIONS Appropiate column to be initialled by tradesman responsible on completion.

FUEL ETC. STATE To be completed by the responsible airmen before the start of each flight. Where tanks are normally filled to capacity it is to be entered in the

appropiate column. Where tanks are normally filled to capacity, the quantities in the tanks before the start of each flight, measured in accordance with the facilities available, are to be entered.

DAILY FLYING TIMES To be completed by the responsible airmen; a seperate line is to be used for each flight.

An officer or airmen placing an aeroplane unservicable is responsible for:-

i. changing the aeroplane serviceability to "UNSERVICABLE".
ii. completing COLS 1-4 and 6 of thirlog.
iii. informing the flight commander, the NCO i/c flight or the pilot i/c aeroplane.

INSPECTIONS

For all inspections except B.F & daily an aeroplane is put unservicable

Various Inspections are:-

Between flight (not signed for)
Daily (signed for on D.1 certificate of F.700)
Periodic Inspection { Minor (every 40 hrs) signed for in A.M.S 4
Major (" 240 ") change of serviceability Reg 255 F.700.

Daily inspections hold good for 24 hours after completion unless:-

(1) Defect is discovered.
(2) A defect is reported (say by Pilot)
(3) Periodic inspection becomes due.
(4) Aeroplane is required for night flying.
(5) Aircraft makes heavy landing
(6) A Class I Modification.

In all the above cases a 2nd D.1 has to be carried out. If after D.1 A/c doesn't fly, D.1 may be waived for up to 7 days at discretion of F/Lt Commd'r, another D.1. then to be carried out to check for corrosion signs and turning engine over. If A/c is required for flight a D.1 will be carried out before flight after the expiration of the first 24 hrs.

AIR PUBLICATIONS

Are issued by A.M. for guidance and various subjects and for convenience of use, are usually divided into volumes, each of which is in sections.

Each type of engine or aeroplane in use in the RAF. has supplied, as a guidance an A.P. i.e. A.P. 1429

is for use with Pegasus engines. The addition of a letter to an A.P number, indicates that the A.P has been revised to cover a later series engine or Mark aeroplane. I.E. A.P.1 and 91C is for Pegasus II M.2. and M3 engines.

ENGINE A.P (VOLS and PARTS)

VOL I General description handbook.
VOL II PART I General orders, modification.
PART II Schedule of fits and clearances.
PART III Scheme for overhaul.
VOL III . Schedule for spare parts (except A.C.S)

AEROPLANE. A.P (VOLS + PARTS)

VOL I General description handbook.
VOL II PART I General order and modifications.
PART II Aeroplane maintinance schedule.
PART III Repair scheme for aeroplanes.
VOL III PART I Schedule of spares (except A.C.S)
PART II Schedule of equipment.
PART III Weight sheet summary.

AIR PUBLICATION 1464.

R.A.F Engineering manual.

VOL I General workshop layout and aerodrome layout.
VOL II MODIFICATIONS. Divided into sections covering Engines, Marine Craft, M.T, and various accessories and equipment in use in R.A.F.

MODIFICATIONS.

A modification is an alteration, addition, or deletion from the original design of an engine or airframe, accessory or item of equipment. By a modification we wish to increase safety of aeroplane, its operational efficiency or improve maintinance of it.

Modifications are issued by A.M. only, in signal, letter or leaflet, if either of the first two a leaflet is always sent later. The leaflet contains:- A.P number and key as to which section it belongs to. It has log book number in which is recorded at the makers, what the modification is. Class of Modification as well. A description of work to be done and parts required if any for the mod.

CLASSES OF MODIFICATION.

Class N°1 N.S. — Improve aircraft safety. (Embodiment compulsory)

Class N°2 N.S. — Improve operation efficiency. (Embodiment compulsory)

Class N°3 N.S. — Simple modifications. (Embodiment at discretion of commands)

3A New parts required

3B No parts required.

Class N°4 N.S. — Makes mods, embodied by makers at works, or in special circumstances at M.U.s. Or by parties from repair depots civilian or RAF.

Precautions when handing aircraft.

Always push aircraft tail first. Never push on the fabric or control surfaces. Push with propeller horizontal with the ground. Always chock wheels back and front with the nose of the aircraft in the wind. Always have a fire extinguisher handy when engine is going to be run.

HAND SWINGING.

AIRMAN IN COCKPIT		AIRMAN AT PROPELLOR	
1 DOES	2 SAYS	3 SAYS	4 DOES
SWITCHES OFF PETROL ON THROTTLE CLOSED	SWITCHES OFF PETROL ON THROTTLE CLOSED SUCK IN	SWITCHES OFF PETROL ON THROTTLE CLOSED SUCK IN	PRIMES CARB. FLICKS PROP OVER A NUMBER OF TIMES. SETS PROP TO SUIT HIS STATURE
6 SWITCHES ON PORT MAG ONLY IMPULSE STARTER	7 "CONTACT"	5 CONTACT	8 FLICKS PROP OVER

If engine fails to start — Repeat 1 to 8. If it still fails to start proceed as bllow.

9	10	11	12
SWITCHES OFF PETROL OFF THROTTLE OPEN	SWITCHES OFF PETROL OFF THROTTLE OPEN BLOW OUT.	SWITCHES OFF PETROL OFF. THROTTLE OPEN BLOW OUT.	TURN PROP OPP. DOR A NUMBER OF TIMES.

Repeat 1 to 8 again, the engine should start.

No head gear to be worn, no grit under prop, wheels chocked, nose of A/C towards wind, tail down if necessary, firm foot hold for airmen swinging the prop.

LOG BOOKS.

Each engine and airframe is provided with a log book in which is recorded a complete history of all flying or running times, repairs, replacements, modification etc.

A new log book is prepaud after a complete overhaul for the new life of the engine or airframe

Each log book is in five sections as follows:-

Section 1 Installation log.
Section 2. Certifies recording accuracy of entries
Section 3. Flying or running times.
Section 4. Repairs or replacements.
Section 5. Modifications.

Accesory log books are provided for magnetos etc, usually attached to the log book of engine the mags are fitted on.

FORMS CARRIED ON CROSS COUNTRY FLIGHT.

Travelling form 700, Section 1. AM.S
FORM 1711 Pilots repat of forced landing.

AIRCRAFT ON DETACHMENT.

Carries same as on cross country flight.
Sent by post courier for aircraft on detachment are Volumes 1 A.P Engine & Airframe. Also section 2. A.M.S.

HAND SIGNALS.

PILOTS SIGNALS DURING TAXYING.

Stop. Arm raised to full extent above the head, with the palm to the front.
Change Direction. Arm moves vertically above head to as far down as the cockpit allows to the side of direction he wants to run.
Stand clear. Hand waved above the head.

AIRMANS TAXYING SIGNALS

Stop. Right arm raisd above the head.
All clear (answer to pilots). A salute, when the airmen is assured there is no obstruction or other planes taking off.

SIGNALS BY AIRMAN WHEN AIRCRAFT IS APPROACHING ITS PARKING PLACE.

Arms stretched out horizontally at parking place.
Waving one arm one way or another if aircraft wants turning.
Both arms above the head indicate stop

SIGNALS AT DARK BY BLUE TORCHES.

Torches waved in circular motion for come straight on.
One torch waved in circular motion and one held.

Stationary, the pilot will turn to the steady torch.

Torches held straight down for stop aircraft, but keep engines running.

Torches down and waved criss cross over body indicates packing place

PICKETING OUT AIRCRAFT.

There is a locking device to hold control surfaces to neutral. All apertures to be closed.

Covers on all engines, wheels, turrets, props etc.

Brakes in packing position with nose to the wind.

Chocks in front and behind wheels, rope tied to U/C legs from the chocks. Permanent picketing base a 50 diameter in a circle of 6 blocks of concrete sunk into ground and a 4" in the centre of the circle. Chains may be run between blocks in order that ropes may be attached from the chains at suitable points to A/c. Main picketing points on any A/c. There are 3, the undercarriage Port and Stbd and tail of A/c.

Secondary picketing points are used on A/c such as wing tips and mid fuselage. Screw pickets usually used with secondary pickets.

Screw pickets. Used as main pickets if permanent base is not available. Two sizes 3'-6" and 5'-0" fit ground plate before using. Screw in until eye is just above the ground.

Shock absorbers. Used with secondary pickets to prevent damage during a storm. Two sizes ½ ton and 1 ton. In very strong ground anchor or spike pickets will be used in conjuction with bridge pieces. Use extractor to remove.

PICKETING IN DESERT. Take bags rope and spade leeside of hill a mound, with wheels in slight hollows made by a spade. Dig holes below points to which ropes will be tied to A/c. Fill bags with sand, tie ropes round them and bury.

SNOW OR ICE. Take shovel, ropes and blow lamp. Thaw surface with lamp and dig snow out. Fill the bags and put them on the ice at suitable points after tying one end of the ropes around them. Bags of snow will freeze to the ice.

REFUELLING.

Oil is in 4 galls cans or bowsers holding 50 gall. Care must be taken that the tank is bonded to the aircraft. It is more easy if the oil is slightly warmed before filling.

Petrol is in 4 gall drums or in 450 to 900 gall bowsers. The bowser must be bonded to the aircraft and it must be put in through a chamois leather. Care must be taken that the right type of fuel is used.

Coolants, Ethelyne Glycol 344 and 344A the latter contains 2% more inhibitor than the former. Always use the latter when mixing with water. Tap water must always be used in preference to rain water.

OILS AND GREASES

Anti freeze oil { A. clear / B. blue. } Used for boost control parts. Rocker arm pivot wick.

General purpose oil. Undercarriage axle and wheels.

Lockheed fluid. Hydralic systems

Castor oil. BTH Air compressor

Anti freeze grease — Controls

H.M.P " — Magneto spigots.

Valve gear " — Push rod assembly and rockers.

Whitemoors Compound - Prop shaft - (if Whitemoors not available V.G. Grease and tallow.

Lanoline - Anti corrosive film for Fleet Air Arm aircraft.

Graphite Grease - Sparking plug threads and alloy threads.

SUTTON HARNESS.

Is used to strap the pilot in his seat four webbing straps are used one over each leg and shoulder in the following manner.

PARACHUTE HARNESS.

Pilots straps and harness complete the pack is used as a cushion.

Left Shoulder
Right leg.
Left leg.
Right shoulder.
Insert retaining pin.

Observers harness only worn during flight, parachute pack is carried seperately on the aircraft.

Always check harness fits tight. Check chute for acid stains and security of quick release before flight.

ENGINE STARTING. RUNNING AND TESTING.

The procedure outlined below. applies to no practice type engine and covers inline and radial type. For any particular type engine refer to the relevent A.P.

PRECAUTIONS.

Aeroplane nose to wind, chocks in front of wheels, all covers removed, no grit or loose stones on the ground under the prop. Remove control locking device. Tail not pointing to a nearby building. Extinguishers at hand. If used external equipment for standing.

COCKPIT PROCEDURE.

Check or set. Switches "OFF"
Gun firing button at "SAFE"
Undercarriage selector at neutral or down.
U/c indicator lights green.
Air intake shutters set at cold.
Cowling gills open.
Rad. shutters closed, or rad. retracted.
Petrol on.
Set tail trimmer to "TAIL HEAVY"
Brakes at parking.

ENGINE STARTING PROCEDURE.

Prime the carburettor by pump or gravity.
Set the throttle for starting.
Mixture control in rich position.
Prop. control as per A.P.
All switches on if permissable.
Rotate engine by appropriate starter
Prime engine simultaneously (except Coffman and inverted.)

WARMING UP PROCEDURE.

Ensure oil pressure is normal within 30 seconds.
Switch off H.S mag (except Blenheim & Wellington)
Screw in priming pump handle and turn off priming cock.
Run engine at 800-1000 RPM until the following temperatures are indicated. Cyl temps 10° min 15°C
Coolant temp 40°C Cylinder head 100°.

BEFORE RUNNING UP CHECK:-

Radiator in and out a few times.
Check for absolutely dead mag.
Operate prop control column a few times to allow accumulation of oil.

RUNNING UP.

Open radiator shutters, or wind out rad.

Open cowling gills.
Hold control column well back.
Open throttle boost approx 2000 R.P.M.
Move prop pitch lever backwards and forwards to check prop changing pitch O.K.
Check constant speed unit.

With prop in fine pitch run engine up to max R.P.M. permitted. and check R.P.M., Boost.
Mags if permitted by. H.P.
Test Mags on engine with C.S.U. with prop in Positive fine. position.
Bring the throttle back to 1400 R.P.M, close throttle suddenly to check slow running of engine

STOPPING THE ENGINE.

Change prop. to pitch for stopping.
Allow engine to idle for 1 or 2 minutes.
Pull cut out (carb)
When engine turns over not firing switch off mags.

AMERICAN ENGINES.

Precautions Stromberg Bendix carb.
Before switching off mags on stopping engine

set mixture control to IDLE CUTOFF position. When engine fires move mixture control to Auto rich.

HURRICANE STARTING PROCEDURE. MERLIN II

1. SET. Hydralic selector - neutral. Fuel cock - Reserve tank on.
Throttle - ¼ open. Mixture control - Rich.
Radiator shutters - open. A/s Control - Max revs.
2. Operate priming pump until a slight resistance is felt.
3. Switch on main and H.S Mags.
4. Press starter button and prime as engine is turning.
5. When engine is running switch of H.S.M. and screw priming pump in.

STOPPING ENGINE

1. Ascertain A/s is in coarse pitch.
2. Idle engine for a few seconds.
3. Pull cut out till engine stops.
4. Switch off mags and turn fuel cock off.

NOTE. Before starting turn airscrew through at least 4 revs by hand.

BLENHEIM STARTING PROCEDURE.

1. SET Fuel - inner tanks on. Throttle - slightly open.
Mix control - normal. A/s Pitch - Fine (in)
Air intake - cold air. Cowling gills - fully open.
U/c Hydralic selector - neutral
4. Instruct ground crews to switch on H.S Mag.
5. Press starter button for not more than 10 secs. While engine is turning ground crew prime.

3/ When engine starts put main mags on contact.
4/ Ground cross switch of H.S Mag.
5/ Check fuel pressure 2½ - 3½ lbs.
6/ Warm engine at a fast tick over until oil temps is at least 15°C and cylinder head at 100°C. before running up

STOPPING ENGINE.

1/ Ascertain A/S is in coarse pitch.
2/ Close throttle and allow engine to idle.
3/ Pull carb. cut out.
4/ Switch off main mags.

LYSANDER STARTING PROCEDURE (MERCURY XII)

SET. Fuel cock on. Throttle - slightly open.
Mixture control - normal. A/S pitch - fine.
Air intake - cold air. Gills open.

1/ Turn priming cock to "prime carb." and operate HI-PRESS Pump.
2/ " " " " prime engine.
3/ " " " off and lock priming.
4/ Switch on H.S Mag.
5/ Press starter button for not more than 10 secs.
6/ When engine fires switch main mags on.
7/ Switch of H.S Mag.

STOPPING ENGINE.

1/ A/S coarse pitch.
2/ Close throttle and allow engine to idle a few minutes
3/ Turn off petrol.
4/ Switch off mags.
5/ Pull SR but out and hold until engine stops
6/ Release cut out.

MAGNETO'S.

Magnets.

Permanent magnets retain their magnitism usually made from H.C steel. Mild steel can be magnetized but it doesn't retain it. Temporary magnet is Electro Magnet, can be made from a piece of soft iron with wire coiled round it and an electric current passed through it, as soon as the current stops it ceases to be a magnet. Some magnets are laminated so the can be magnetized & demagnetized quickly.

All magnets give off a magnetic field also an electric current in wire. The stronger the field the more current, also more coils of wire will give a strong current. When a coil of wire is passed through an electric field it generates a current in it, the faster it is moved the more the current is. Like poles repel unlike poles attract.

B·T·H·C·I·S·E 12^{s} TYPE MAGNETO.

An electric current is generated every time the magnetic field falls over the primary winding. The magnetic flux goes round the soft metal bar from N to S when it changes direction it stops, then the magnetic field falls over the primary winding and generates a current.

ARMATURE. consists of a soft iron core laminated, each being insulated from each other. Around this core is a winding of approx 200 turns of copper wire, this is termed the primary winding. Round this winding but insulated from it is a further winding of finer wire this is termed the secondray winding.

PRIMARY WINDING. is subject to the change of direction of flow of magnetic flux, as bought about by the movement of the inductors. an E·M·F will flow in the winding providing it is part of a complete circuit. The factors which control the strenght of this current are. 1. The number of winds of wire. 2. Gauge of wire. 3. Intensity of magnetic field. 4. Quickness of the change of flow

of magnetism.

SECONDARY WINDING. When the primary current flows through the primary winding it set up a magnetic field round it. When the primary current circuit is broken by the opining of the C·B Points it collapses across both winding, thus generating a current in both. In the case of the secondary current it is of a very high voltage and is able to jump across the plug gap in the cylinder. thus completing the secondary circuit. The current is controlled by 1. The number of turns of wire. 2. The intensity of the magnetic field built up by the primary circuit, immidiatly before it is broken by the C·B points.

CONTACT BREAKER POINTS. are two points of tungsten or platinum. The first one termed the fixed point is insulated from the base of the CB assembly which is in contact with the earth of the magneto; this point is in contact with the secondry winding, thus every time a current is generated in it, it passed to the point. The points are seperated by means of a cam and

heel assembly. The function of the points is to break down the primary circuit and cause a collapse of the field round it, with the resultant generation of the secondary current.

MAINTENANCE OF C.B. POINTS

1. Inspect spring, should be a light straw colour if going blue is nitric acid corrosion setting in check spring for cracks, corrosion, and being straight.
2. Test insulated block with a Megometer. zero means the insul. is faulty, Infinity means OK.
3. Check for wear.
4. Check CB Points for wear.
5. When the points are closed there should be a good constant flow of electricity, keep them clean and free from oil. If badly pitted clean them with Contact stone or 00. Emery cloth.

Setting of points.

New type C1·SE has adjustable screw, adjust to ·012" + or − ·001".

Old type C1·SE. End of block is split like a clamp; first slacken locking nut, then clamping

screw and adjust to ·012".

CONDENSER.

Put in to cause a rapid collapse of magnetic field, and to produce a higher secondary voltage, also they prevent sparking across the C·B. points.

DISTIBUTOR CLEANING AND INSPECTION.

A CLEANING.

1. Wash in lead free petrol
2. Wash in hot water 70 to 80°C.
3. Rinse in fresh hot water.
4. Dry thoroughly.

B. INSPECTION.

1. Inspect block for warping, distortion cracks and clearance of vent holes.
2. Inspect segment & rotor brush for excessive burning and corrosion.
3. Check for good connection of H·T leads.
4. Check width of auxilary spark gap ·011" to ·019" is the correct width.

C LUBRICATION. C·I·S·E.

1. Inductor rotor and distributor rotor ball bearing

are grease packed by makers or M.U. Sufficient for 500 flying hours.

2. Rocker arm wick 1 drop of oil.

3. Cam lubricating pad is grease impregnated and is changed complete with clip every 120 hrs.

4. Contact breaker base spigot wipe clean and resmear lightly with H.M.P grease.

N.B. Always refer to instructions, and above all, avoid excess. The oil used is D.T.D 472 Wintergrade

BREEZE AND MARCONI HARNESS.

7 Millimetre lead for low voltage current.

9 " " " high " "

Continuity test.

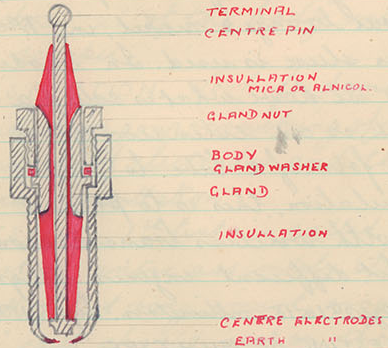
Put lead from lamp on each end of the lead and take out the Holme 1 thou resistance block. If lamp lights lead is good.

Insulation test.

1. Special high voltage test plug.
2. Earth body of H.S Mag to A/F
3. Connect lead to dist. segment and place plug on appropriate plug connector

4. Turn H.S Mag. Indication + constant sparking = good insulation
5. Test all leads the same way.

SPARKING PLUGS



BODY. Machined steel with hexagon for spanner. One end of body as earth electrodes, also it has an external thread for the centre assembly. There is a small gap between the two electrodes. The centre pin has a copper sleeve to keep it away from the body. The material used for

this insullation is Mica, or at the present day Aluminium Oxide which is white or coloured for identification. The gland of the plug assists in making a gas tight joint with the centre assembly and body. Also between the gland and body is a washer usually made from soft iron, copper, phosphour bronze & nickel, in Mica plugs a copper sleve is used. In modern types of plugs we have what is called a screen which is an extension from the gland nut in form of a tube to cover external insulation, this is to prevent interference with wireless transmission. In order to fit different engines plugs are made in 3 sizes 12-14-18 millimetres. Life 150 hrs.

CLEANING AND TESTING OF MICA TYPE.

Cleaning, inspection & testing are a very important items. A bench jig and stock & die nut must be used to dismantle and assemble Mica type plugs.

Wash all parts in lead free petrol then proceed to clean plug parts on a

Plug cleaning machine, a split collet is provided to hold the plug in the chuck of the machine. Clean the insullation with N° 0·0 glass cloth and oil, after this repolish with crocus powder and oil then for a final polish use rouge and oil and chamois leather which must be dry. To clean the carbon out of the body use a wire brush or scraper.

INSPECTION. Look for damage to threads and hexagons, cracking of metal parts and security of electrodes and the condition of mica insullation.

TESTING. 1st test is called the insullation test of centre assembly. (Insull test ring) to gap of test ring, insert ring gauge, the "not go" end should rest on the points, and the go end should just drop through, if spark jumps across the gap, the plug is clean and insullated.

2nd test is for gland leakage, replace a new washer everytime the plug is assembled. Test on gland leak tester. Insert plug then pump up tester to 100 lbs per □ inch, immerse the

plug end in a beaker of Soyol, if it bubbles, retighten the plug and try again, if it still bubbles the plug is U.S.

3rd test is sparking under pressure, test is carried out on Spark Plug tester, pump up tester to 100 lbs per □inch. The apply H.T current on plug terminal, observe sparking on earth electrodes and centre pin, failure to spark at 12'000 volts means a U.S plug.

CERAMIC TYPE PLUGS.

Insulation is light coloured for identification. K.L.G are white. A.C dpinky brown and Lodge. Pink It is very little different from Mica type when run at a very high temperature any deposit burns off. The three main items are cleaning inspecting and testing. A sand blast cleaner with 1 lbs of Silver sand is used for cleaning. Four precautions when using this are, Correct air pressure, clean it only for 10 seconds maximum time, apply compressed air intermittantly, and rotate the plug while cleaning it.

Inspection Same as Mica.

Testing carried out in three stages as later type.

1. Assemble on Constant Torque Fixture. with weights as specified.
2. Gland leakage test at 150 lbs per sq inch
3. Sparking under pressure at 100 lbs per sq inch, constant sparking at plug electrodes.

Marking- Etching pencil, centre punch. 3 sq file, red paint for U.S plug.

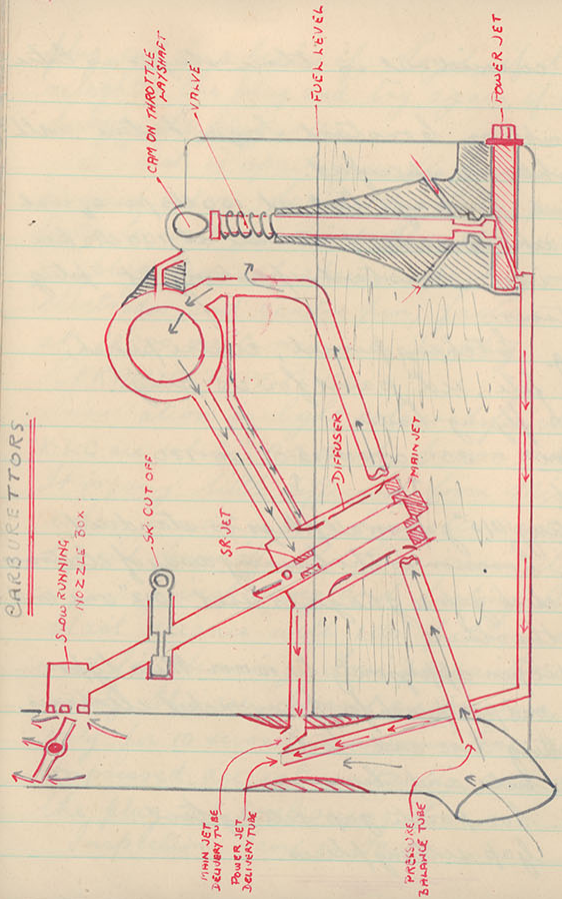
Life 180 flying hours.

Inspection 30·60·90·120, 150·180.
Cleaned. ↑ ↑

Gap setting .015" gap on all plugs is standard distance. Erosion is the burning away of electrodes in order to check gap a geuge is used .012" one end and .015" the other.

1. Coal centre pin applys only to 12 M.M. Mica type.
2. Hammer and pin punch for heavy nickel electrodes.
3. Gap setting disc and tool.
4. Lodge tube and lever.
5. K.L.G. composite gap setting tool.
6. A.C Gap setting pliers.

CARBURETTORS.



CLAUDEL HOBSON A.V.T. 80.8.

CARBURETTORS.

Petrol wont burn unless mixed with air.
The mixture of air and fuel is always taken by weight, because when engine climbs the weight of air decreases. At normal atmos. pressure 15 lbs of air is needed to burn one lbs of fuel, less air is needed to burn fuel when under compression ∴ only 13 lbs of air to 1 lbs of fuel is needed, when ready for combustion this is a correct mixture, 10 to 1 for a rich mixture, weak mixture can be 16 or 17 to 1, sometimes as high as 22 to 1.

Simple carburettor. worked entirely on pressure differences the whole time, with the U tube principle. A slight restriction is made in the air intake to cause a low depression round the fuel pipe. The reason for this is, that the air has to pick up speed through the restricted part to make up the same amount of pressure the other side. This restriction is called the CHOKE or VENTURI.

Disadvantages the more the throttle is opened the richer the mixture gets.

Pressure Balance. your 13 to 1 mixture strength is maintained by constant pressure difference between the

choke and float chamber. Pressures in the air intake vary according to flight. Increase or decrease of pressure will vary mixture strength owing to increase and decrease of pressure. Float chamber and air intake are joined together by a pressure balance passage thus ensuring constant pressure difference.

CLAUDEL HOBSON CARBR. A·V·T. 80·B.

(A·V·T. Aero vertical twin) vertical means up draft. 80 is the diameter of the throttle tube in millimetres. It is a double carbr. made in 2 halfs, the joint is made of vellumoid glass jointing compound.

BOTTOM HALF. are 2 pipes which lead to the float chamber these are the pressure balance passage. There are 2 float chambers because when the aircraft banks the centrifugal force isnt enough to keep the fuel at the bottom, the 2 chambers doesnt allow 1 feed pipe to starve. The floats are made of cork in 3 layers. The needle valve is made of stainless steel. In the base of each float chamber there is what is known as the main jet wells put there to collect all foreign matter which might get into the jets and block them up. Before removing petrol for cleaning

ascertain the fuel is turned off. secondly, have a receptacle handy for the fuel which will drain out of the float chamber. By removing the whole of the main jet well, the main and S.R jets can be got at without splitting the carbr. To clean jets rinse out in fuel if it then isnt clean apply compressed air, reverse direction of flow. NEVER use any metal to clean out the calibrated hole. The washer on the wells should be renewed each time.

SLOW RUNNING.

The slow running jet is only a small restriction in the tube itself, the whole thing is screwed into the main jet which is screwed into the diffuser itself. The body is screwed into the top half of the carbr, the top of the tube is screwed into the S.R nozzle box. In between butterfly throttle and throttle tubes is a clearance usually ·006". when engine is slow running. The only way the fuel can get into the SR tube is through the main jet. Before the fuel gets to the nozzle box there is some air already mixed with it through a hole in the

tube which is put there to vapourize the fuel before it arrives at the box. You also get a very rich vapour from the hole to the top through the air coming in from the main jet. The fuel goes evenly through the holes in the throttle and distributes it evenly.

Slow running mixture is rich for two reasons 1st we have to have a rich mixture to get a very even burning rate as the engine is only ticking over slowly. 2nd is because of condinsation when the engine is cold, the mixture at slow running is rich enough, so that by the time it reaches the cylinder it is correct. When the engine is hot do not let it stay S.R. because of rich mixture doing damage to the engine.

When the throttle is opened the depression will fall over the lower hole in the box. The second hole is put there for an overlap between jets so that there is no flat spots. The fuel will flow through both holes until the lower choke depression is great enough to draw the mixture through the main jet.

SLOW RUNNING CUT OUT. is for stopping the engine providing the throttle is in S.R. position. The waisted portion does not cut off the mixture but when pulled out a wider portion stops the flow. Pull the cut out first then stop the flow of the mixture. If engine catches fire cut off fuel and then open the throttle.

MAIN JET AND DIFFUSER. forms 3 functions.

1. It corrects the mixture for all throttle openings after slow running.
2. It vapourizes the fuel from the main jet.
3. It provides a reserve of fuel for acceleration.

A. As throttle opens depression in choke and diffuser draws air through the P.B. Duct which picks up the fuel in vapour form.

B. As throttle opens the level of fuel will drop in the diffuser because the engine is demanding more fuel than the main jet will pass ∴ more holes are uncovered in the diffuser this lets in more air to break down the depression and breaks down the fuel supply this happens only on cruising range. This diffuser prevents you getting to rich a mixture when the throttle is

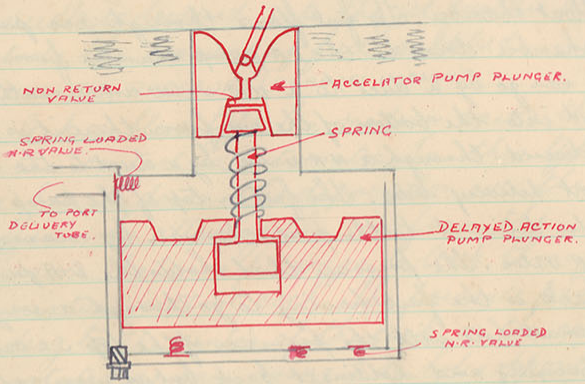
opened. In the cruising range, the main jet is calibrated to give us an economical mixture

RATING IS THE MAXIMUM POWER POSITION.

POWER JET comes into operation when the lever is moved from cruising to rating, it supplies the additional fuel wanted to mix with the change of air due to the opening of the throttle at maximum speed. The power jet is operated by means of a cam and the throttle layshaft. It is so timed that when the lever is moved to rating position in the cockpit a cam works on the valve head, as the cam is pressed down the valve opens and allows fuel to pass through a waisted bolt and by a duct to the choke. The power jet is always delivered from the starboard side

ACCELERATOR AND DELAYED ACTION PUMPS.

When the engine is running at any throttle opening we should be producing from the carbs. a 15 to 1 ratio. Acc pump is fitted to overcome a flat spot when the throttle is opened, caused by a temporary weakening of the mixture due to the fact that when the throttle is opened the air increases its weight of flow much faster than the fuel does.



The acc pump is provided to mass discharge the fuel to overcome the temporary weakening of the mixture. The delayed action pump operates after the acc pump and it corrects the mixture by supplying a measured amount of fuel during the remainder of the acc. period. We want the acc pump to come into operation everytime the throttle is moved so it is connected to the throttle layshaft from which it is operated. The acc pump is held to the del. pump by means of a distance rod and spring which measures the amount of fuel. Both pumps work in a housing which is bolted to the bottom of the

float chamber. The fuel flows through acc. pump chamber down to the D·A pump chamber from then it can go by a duct to a N·R valve underneath and into the bottom of the D·A from there it is delivered through a N·R valve by a duct to the port delivery tube. The fuel on top of the pump is also delivered to the port chamber by means of a N·R valve. The pressure that holds the D·A pump back is the fuel having to go through a very small hole with the pressure of the top S·L valve pressing and holding it back but as soon as the pressure between the 2 pumps is released it comes into operation.

MIXTURE CONTROL ALTITUDE.

As the aircraft climbs the density of the air decreases this gives us a rich mixture, so we have to cut down the amount of fuel supplied, this is not weakening the mixture, but correcting the weight of both. There are 3 types of mixture control.

1) VARIABLE JET TYPE. fitted to S.U Carbs and is entirely Automatic. It is worked off a barometer principle, fuel is controlled as aircraft climbs,

the needle is lowered into the jet further and controls the amount of fuel supplied.

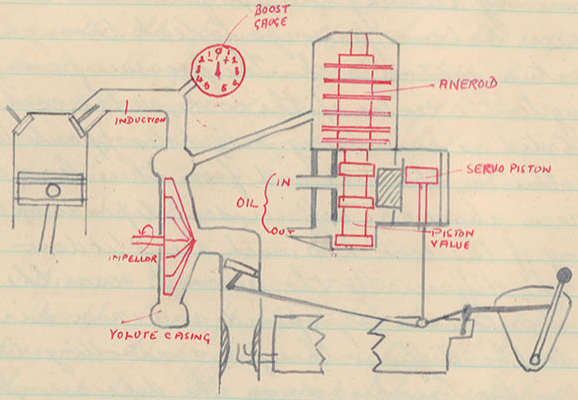
VARYING AIR PRESSURE (CLAUDEL HOBSON)

Air leak or bled type On modern carbs the mixture control is automatic. In this type we break down the depression over the diffuser by allowing the air from the pressure balance passage to leak through a mixture control cock. The pressure passage leading to the centre of the cock, as the cock is rotated we can bring 2 sq. holes opposite to each other in the cone and from these lead to the area above the diffuser, so it depends on the opening of the cock how much air is let down over the diffuser. As the aircraft rises the cock is automatically opened and more air gets to the diffuser therefore controlling the mixture. by breaking down the depression, but the amount of air must be calibrated otherwise fuel would cease to flow.

VACUUM TYPE. comes into operation at roughly 15'000 ft when the control cock is coming into the fully open position, vacuum type is automatically

bought into operation, the small hole comes opposite the small duct leading down into the float chamber. This cock is operated from the mixture control layshaft.

SUPERCHARGING.



As the aircraft climbs it is lowering the compression ratio all the time owing to the decrease of pressure of air. The only reason for this supercharging is to try to maintain a same pressure in the cylinders at high altitude the same as sea level which is 14·7 lbs/sq in

We supercharge an engine by using a revolving fan which rotates in an housing. The outlet from the supercharger is taken to the inlet valves where the pressure is built up. The impellor is driven from the crankshaft thro. a train of gears and can be run anything from 5 to 12 times engine speed. On a single speed supercharger 5 to 7 times engine speed. To save the supercharger from backfiring with the engine it is driven through 3 centrifugal clutches At low engine speed the impellor can be held stationary. The air intake comes in the centre of the impellor where it can pass between the centre of the vanes where it is thrown into the casing as soon as engine is made faster the needle on the boost gauge goes round to + and the impellor revolves instead of idling. When this happens the air is flung off the centre of the vanes into the ballon casing, where it goes to the valves then the pressure is recorded on the guage. O being atmospheric pressure. therefore the gauge will read plus. The more the throttle open the more mixture is pressed into the cylinders, making

the engine go faster which makes the impellor run faster causing more boost pressure.

AUTOMATIC BOOST CONTROL.

Controls the amount of air allowed into the induction stroke of the cylinder. The A.B.C. controls the B. throttle. The snag of supercharging is that it has to be the same at sea-level as at altitude, but it enables it to become airbourne quicker. The A.B.C is fitted on the rear cover just above the carb. main components:- aneroid fits into a chamber attached to the aneroid is the piston valve which works in a sleeve. On one side of the cylinder is the servo piston Pressure oil is fed into the cylinder by 2 holes top and bottom, the top lets in oil and the bottom lets it out to scavenge.

The time when the throttle is full open at rated altitude is the height to which the engine can maintain its sea level power.

To obtain maximum power for take off we override the boost, in other words we give the engine more boost pressure than it was origin ally disigned To do this we push the whole aneroid and

piston valve down by means of a lever which presses on the top of the aneroid ~~opening the throttle. It takes more pressure to bring~~ the piston valve down back to normal position when the aneroid is depressed.

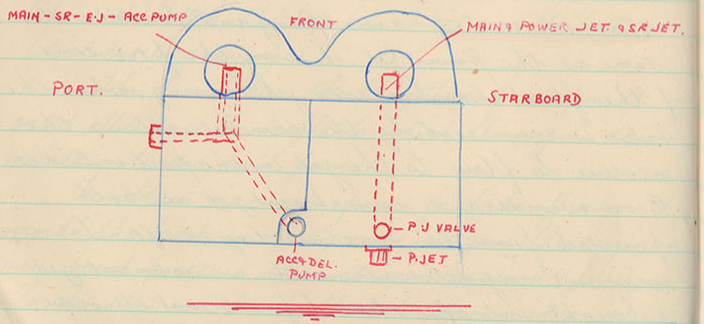
Detonation will set in with overriding the boost, it is cured by cooling the inside of the cylinders with fuel, for internal cooling of the engine. The mixture is corrected for take off with the enrichment jet. which provide additional fuel for internal cooling of the cylinders, a rich mixture has a slower flame rate than a normal mixture. this cuts the temperate down.

ENRICHMENT JET. cam spring and loaded valve same as the power jet. it is on the port side of the float chamber. into jet housing. when the valve is compressed by the cam it allows the mixture to flow to the jet in the port intake. Boost override and enrichment jet are both operated from the mixture layshaft. To overcome any detonation the enrichment jet is bought into operation before boost override.

ADJUSTMENTS. (SLOW RUNNING) Is a small screw on the end of the butterfly layshaft (PORT SIDE) this adjusts the slow running speed by varying the gap between throttle and throttle tube. By screwing it in, the gap is made wider, i. letting more fuel in and increases the speed of the engine (POWER JET) adjusted to come into operation at 42° of butterfly throttle opening, adjusted by a serrated ring. (BOOST OVERRIDE) is timed to come into operation at take off, after the enrichment jet.

1. Cam on E.J Valve.
2. E.J in operation
3. Forks on aneroid.
4. B. override in operation

SHOWING JETS.



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GROUND EQUIPMENT.

HEATERS. PARRAFIN BLUE FLAME TYPE.

ALADDIN AIRCRAFT HUMIDIFIER.

This is used to extract all moisture in A/c cabins and cockpits. Water from the products of combustion condenses in the tray at the bottom of the humidifier instead of W/T equipment and instruments. NOTE. The humidifier needs considerable treatment and must be assembled at least 25 yds from A/c or inflammable materials, also safety gauze must be in position before entering aircraft, burns parrafin only.

AIRCRAFT SHELTER TENT HEATER.

For use in A/c shelters tents and W/T trailers. To trim wick remove flame spreader and use spical trimmer provided, flame spreader must be in position before lighting and safety gauze must be in position before placing in the shelter.

CATALETIC FLAMELESS HEATER.

For use in any part of A/c when heat with safety is required such as:- pipe lines - oil tanks - portable oil bowsers, and to prevent condensation of moisture on instruments in cockpits and cabins. The heater burns petrol 73 octaine or pool, on no account must a lead spirit be used, lasts for 45 hrs on one filling ignited with liquid or solid methalayted spirit.

NOTE. Heater must always be kept vertical, nothing to be placed on catelitic grid. Extinguisher must be used to cover grid when not in use to prevent dirt collecting (Platonized asbestos fibre).

PORTABLE OIL TANK HEATER. (40 galls)

This heater type oil tank consists of a mild steel container mounted over a heater chamber in which a catelitic heater is installed. A semi rotary pump is mounted on container, connected to which is a flexible hose and delivery nozzles. A combined dipstick and thermometer is fitted, with wheels for easy transportation.

PORTABLE SERVICING TROLLEYS AND STARTERS.

These trollys are various in types and must be maintained according to instructions, care should be taken with starting operations as avoidable accidents occur during starting procedure.

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2/5 LEICS. REG. 1ST BATT. THE ESSEX. REG.
B.N.A.F. INDIA. COMMAND

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