

The 120HP Beardmore (1)

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General description:

6 cyl w.c. engine, can be used in either pusher or tractor type planes, owing to double thrust bearings being fitted. The only alternation is the fitting of a new prop.

Cylinders:

Are cast separately and are désaxé or off set 18mm in the direction of rotation. The reason for this is to lessen the bending strain on the connecting rod on the power stroke & to give a better turning effort to the crank. Friction is also reduced between cyl

Carburettor:

Two Beardmore carburettors are fitted on the left of engine each feeding three cyls. By this method cyl receives an equal supply of mixture thus equalising the explosive pressure on the piston & giving an even torque to the crank.

Magneto:

Two mags type D.V.C. & a self starting C.A.V. Mag are fitted. Double ignition is . . .

is por the two mags. The ignition is The C.A. V is used for starting ble. pupposes my. Trop: to durect on the crauk ti - clock wine Can - Shaft Is peared down to 1/2 engine speed , + is driven from the nankshaft through the I am intermediate wheel (termed the DAER wheel) Thus the Cam Shaft revolves in the same duection as the hand that. The Beardmore works on the Otto Cycle a four shorts OTTO CYCLE principle. The form chickes are known as INDUCTION - COMPRESSION - POWER - EXHAUST, They fore there is only spower stroke in every a slikes of the piston or a war of the want shaft. INPUCTION . The whilet value is mechanically opened near the top of the shoke + the sector then travels down the cylinder melling in the petiod vapour. hear the bottom of the stroke the whet value dores. Compression . The piston now havelo up the cylinder comprising the vapour with a small space at

... obtained from the two mags. The ignition is variable. The C.A.V. is used for starting purposes only.

Prop:

Is mounted direct on the crankshaft & revolves anticlockwise.

Cam-Shaft:

Is geared down to ½ engine speed & is driven from the crankshaft through the medium of an intermediate wheel (termed the IDLER wheel). Thus the Cam Shaft revolves in the same direction as the crank shaft.

OTTO cycle:

The Beardmore works on the Otto Cycle, a four stroke principle. The four strokes are known as: INDUCTION – COMPRESSION – POWER – EXHAUST. Therefore there is only 1 power stroke in every four strokes of the piston on 2 revs of the crankshaft.

<u>INDUCTION</u> The inlet valve is mechanically opened near the top of the stroke & the piston then travels down the cylinder sucking in the petrol vapour. Near the bottom of the stroke the inlet valves closes.

<u>COMPRESSION</u> The piston now travels up the cylinder compressing the vapour into a small space at . . .

(Beardmore 2)

(Beardmore 2) the lop of cylinder Russon as the emphaster chanter . Power. The compressed vapour is now iquited + the explorin which takes place devis the pester down the cylinder . EXHAUST The Exhaust value is opened wear the bottom of the shoke this allowing the burnt gaves to escape to the air . The poten now travels up the cyluder ejecting the remaining gases. The exhrust value dires at the top of the aticks . This Orro CYCLE also applies to the CLERGET Engine GENERAL DATA. Weight of Engine & radiater = 630 ch. · 52 16 Weight her HP. · 46 43 \$15 . 6%. Oil ansunstan · 86 10 galls the Peter . Bine = 130 mms Shoke . · 75 MMs . TANT D = 96 che to sq in Compression formal news: = 1200 pmin, max: - 1400 . .. - 153/24 Order of loving The extenders are numbered from Pup , and of enque.

... the top of cylinder known as the combustion chamber.

<u>POWER</u> The compressed vapour is now ignited & the explosion which takes place drives the piston down the cylinder.

<u>EXHAUST</u> The exhaust valve is opened near the bottom of the stroke thus allowing the burnt gases to escape to the air. The piston now travels up the cylinder ejecting the remaining gases. The exhaust valve closes at the top of the stroke.

This OTTO CYCLE also applies to the CLERGET Engine. **GENERAL DATA** Weight of engine & radiator = 630 lbs Weight per HP = 5 ¼ lbs Oil consumption = 4 to 4 ½ pts ph = 8 to 10 gallons ph Petrol " Bore = 130 MMS = 175 MMS Stroke Compression = 95 lbs to sq in Normal revs = 1200 p min Max u = 1400 p min = 153624 Order of firing The cylinders are numbered from Prop end of engine.

had of cast un ni we puce with exhaust value CVLINDERS . centing . Julet value is detachable and is ground into a tapered reating locked by a locking ung. a still base is secured and sweated for string the. Explunders are secured to crank case by 4 bo 3 studo which we interchangeable with the of 1+6 owing to water currections a sharking per tole is bored in each side of cylinder head racuall lole is dulled near the bottom for bulication , The water packets are Smis thick and made of copper which is elestic deposited around ea cyluder + exhaust valve seatings. This process ensures a water gacket of wen thickness, light in when the + clean in finish . Space between the Jackets & cylunder walls so In Trade of mild still machined from the edia STOAS May are slightly the tapered towards the conce heads to allow for expansion. They are fitted I cast non rings , the gaps of these rings are stepped + should be set at 120 " when are anothing , demance of the gaps is '007ms. 3 groves are at in the pinton wall for tubrection, the centre

CYLINDERS

Made of cast iron in one piece with exhaust valve seating. Inlet valve is detachable and is ground into a tapered seating locked by a locking ring. A steel base is screwed and sweated for strength. Cylinders are secured to crank case by 4 bolts & 3 studs which are interchangeable with the exception of 1 & 6 owing to water connectors. A sparking plug hole is bored in each side of cylinder head & a small hole is drilled near the bottom for lubrication. The water jackets are 3 MMS thick and made of copper which is electro deposited around each cylinder & exhaust valve seatings. This process ensures a water jacket of even thickness, light in weight & clean in

finish. Space between the jackets & cylinder 3/8 ins.

PISTONS

Made of mild steel machined from the solid. They are slightly tapered towards the concave heads to allow for expansion. They are fitted with 3 cast iron rings, the gaps of these rings are stepped & should be set at 120° when assembling. Clearance of the gaps is 007 ins. Three grooves are cut in the piston wall for lubrication. The centre . . .

(Beardmore 3)

(Beardmore 3) (PISTONS CONT and interests the Godgen Pin and conveys oil stungh this hollow his to the small and leave Googson Pros. Trade of C.N. steel, case hardened and hollowed out for butnesting It is secured to the postin lag. by the ends hering takened + by burg a driving fit. It is looked in portion by a Rey fitted to the larger takend and by a grat server, concurring partly into the gudger prin & partly into the person hig at the small tapered and ... Convectore Roos made of H" Section C.N. steel. a plaster house bush is filled on the small and & a white we tal bearing in the other end . The find and bearing is in helver, on the bottom half is a scoop which such up oil from the sump balacating the und hearings. auk staff: Made of C.N. steel machine for the solid Abelow for sheight rlightness. It is built up in 3 sections. (1) Prop. sleeve (2) Main shaft. (1) biwing shaft. p. sleeve: Is fitted the post and of the main shaft by a taper, key, locking week a greet The sleeve is servated on the

(PISTONS cont'd)

... groove intercepts the GUDGEON pin and conveys oil through this hollow pin to the small end bearing.

GUDGEON PINS

Made of C.N. steel, case hardened and hollowed out for lubrication. It is secured to the piston lugs by the end being tapered & by being a driving fit. It is locked in position by a key fitted to the larger tapered end and by a grub screw, screwing partly into the gudgeon pin & partly into the piston lug at the small tapered end.

CONNECTING RODS

Made of "H" Section C.N. steel. A phosphor bronze

brush is fitted on the small end & a white metal bearing on the other end. The Big end bearing is in halves, on the bottom half is a scoop which picks up or oil from the sump, lubricating big end bearings. <u>Crank shaft</u>:

Made of C.N. steel machined from the solid & hollow for strength & lightness. It is a built up in 3 sections. (1) Prop sleeve (2) Main shaft (3) Driving shaft

Prop. Sleeve:

is fitted to the front end of the main shaft by a taper, key, locking nut & grub screw. The sleeve is serrated on the . . .

surface to four a g · six the The pairs are 1,6 8 hear radial ball ad 45. a spen ale penap made of case, church , crau e tu we beau 7 Repear und of the cam so on whee seged/a spec drives the car rous

... outside surface to form a fixing for the prop. boss & prop.

Main shaft:

has six throws set in 3 pairs at 120° apart. The pairs are 1, 6: 2, 5: 3, 4. The shaft is supported by 8 bearings; 7 white metal bearings & 1 radial ball bearing which is situated in the thrust box. <u>Driving Shaft:</u>

is fitted on the rear end of the main shaft by being a driving fit over two keys. It carries a spur wheel & a bevel gear which driver cam shaft & oil & water pump respectively.

Cam shaft:

is made of case hardened C. N. steel. It has 12 cams which are machined from the solid. It is supported in the crank case by 4 phosphor bronze bearings, the two centre bearings being split. Fitted to the rear end of the cam shaft is a piston wheel twice the size of a spur wheel on the crankshaft which drives the cam shaft at ½ engine speed through the medium of . . .

(Beardmore 4)

(Beardmore A) an idler sheel at the part and is wheel which drives the at J: 2 engu bee 02 3.1 shall speed Gank Care:-Lelves, top +bottom + is ? alluni all half: Carries all internal rexternal thing parts with the exception of the water pump. It has It engine bearers each side for attaching & durpla ue, bu pout inflation for 2 magn. On left side are bolted 3 heathers which releive compression - 14also used for bouring orl Carries Lalveso 700 hal bearing botton Laber of & being in positio by alluminum caps, o shap bolts which pass through the rite scare. These web also adown cyls. thou half :- acts as the sump the It is divides into 6 compar

... an idler wheel. At the front end is fitted a spur wheel which drives the 2 mags. at 3:2 engine speed or 3:1 cam shaft speed.

Crank case:

Made in halves, top & bottom & is of Aluminium alloy.

<u>Top half</u>: Carries all internal & external working parts with the exception of the water pump. It has 4 engine bearers cast on each side for attaching to Aeroplane. On front is platform for 2 mags. On left compression in crank case. Also used for pouring oil into sump. Carries half of 7 white metal bearings bottom halves of 5 being held in position by alluminium [sic] caps, steel straps & bolts which pass through the ribs of crank case. These bolts also helps to hold down cyls.

Bottom half: Acts as the sump & holds 4 ½ pts. oil. It is divided into 6 compartments . . .

to prevent oil flowing to either end. When machine clubs or decends. In bottom of each compartment a plug for draining acle Suns should be an sump. 12 hrs running. The bottom lalfala caries the bottom halves of 197 man bearings. On outside there are Trits for stength, they also anist in cooling the oil. be He near and there is an ox kention for carring pump Holves of erank case are holded together by munarus small bolk which make an oil fourt + distribute the shain equally on both sides Values the made of trungelow a the eye head. 1.V. has head is Loc outo que a é in the sepansion. area to le case hardened & prevens the steins an yave statled recare cotter se Value Jear :the loss of eye is in which is pivoled the pocker a

... to prevent oil flowing to either end when machine climbs or descends. The bottom of each compartment is a screwed plug for draining & cleaning sump. Sump should be emptied after 12 hrs running. The bottom half also carries the bottom halves of 1 & 7 main bearings. On outside there are 7 ribs for strength, they also assist in cooling the oil. On the rear end there is an extension for carrying water pump. Halves of crank case are bolted together by numerous small bolts

which make an oil-tight joint & distribute the strain equally on both sides.

Valves:

are made of tungsten steel & are situated in the cyl head. I.V. has flat head, E.V. head is hollowed out to give a larger cooling area & to lessen the expansion. The tips of the stems are case hardened to prevent wear & are slotted to receive cotter pin.

Valve gear:

Bolted on the top of cyl is a standard in which is pivoted the rocker arm.

(Illustration of cut through engine & cyls].



[Calculation of cyls firing and degrees thereof]



BEARDMORE (5)

BEARDMORE (5) attacked to this rocker arm is a and spring whe tursins in V. Stens herfung Uso Pivoko the wocker sede sugle bull speech The botton end Ro ich is anyle lever rank case. 2 caus on Ca opperate of He lamangle it have can puples E.V. La Lan Jeus The cullt value open applications :-T. O.C. IV. closes 10-12 min, part B.D.C. sach us lefore T. D.C. on cony - Species 18-20 non before B.D.C. EV closes at T.D.C

Attached to this rocker arm is a laminated spring which lifts against the cotter pins in V stems keeping Vs on their seatings. Pivoted to the rocker arm on I.V. side is a single pull & push rod. Attached to bottom end of rod is a cam angle lever which is pivoted in the crank case. 2 cams on cam shaft operate of the cam angle lever. The rt head cam pushes up the rod & opens E.V. [illegible] cam pulls rod down & opens I.V.

Cycle of operations:

The inlet valve opens 8 -10 mm past and T.D.C. I.V. closes 10 -12 mm past B.D.C. Ignition occurs 15 mm before T.D.C. on compression stroke. E.V. opens 18 - 20 mm before B.D.C. E.V. closes at T.D.C.

Value Luning: adjust chasence between weken ans redeve stems to .025" adjust ligh of pull spirch no until charance tween weke ann voalse stem can just be felt when the came are in a henhal position . (ii) Rotate crank shaft anti-clocking until Not E.V. Las Spence + first the alosed (in) annest idets wheel (ir) Rotah crank shaft auto clochionso ? until the i pistor is T. D.C. (V) Remish idles wheel the values should now be timed concerty as a check su that IV opens 8-10 un bast T.D.C

(Illustration of cycle of operations)

<u>Valve tuning</u>: Adjust clearance between rocker arms & valve stems to .025". Adjust length of pull & push rod until clearance between rocker arm & valve stem can just be felt when the cams are in a neutral position.

- (ii) Rotate crankshaft anti-clockwise until no 1E.V. has opened & just closed
- (iii) Unmesh idler wheel

- (iv) Rotate crankshaft anti-clockwise until No1 piston is T.D.C.
- (v) Remesh idler wheel

The valves should now be timed correctly. As a check see that I.V. opens 8-10mm past T.D.C.

BEARDMORE (6)

BEARDMORE (Equation timing :-is Place the pictor of hos age at 15 mm before T. D.C. on compression the sthaw may (fully advances) with the aturn pts just heating routh the ributor bushow to 1 sequeus (ii) Much may with cam shaft spur whal me up in the order of for (iv) Repeat (ii) (iii) with left has sparks are syncropped

Ignition timing:

(i)	Place the piston of no1 cyl at 15mm
	before T.D.C. on compression stroke.
(ii)	Set the rt hand mag (fully advanced)
	with the platinum pts just breaking &
	with the distributor brush on no1
	segment.
(iii)	Mesh mag with cam shaft spurr [sic]
	wheel & wire up in the order of firing
(iv)	Repeat (ii) & (iii) with left hand mag &
	see that sparks are synchronised.

nelo alauce The maps in used (206 liper) five 2 spor res. The may are setuated on a fo Shey are drive ut ever of enquee. at 3:1 the 3 sparks amaterie clocker Water to fetter to a 1 crank on e the crank shaft the beed from a bevelpear this of the centry buck repin 2 falues. The upper wheel of e Cear been the lower to vou tel escure She bater circulation water flow ser in ru i to the cyls. cy & rechard value chambe

Magneto gearing:

The mags used (D.V.C. types) give 2 sparks per rev. The mags are situated on a platform at front end of engine. They are driven from cam shaft at 3:1 thus giving 3 sparks per rev. of crankshaft. The armature of crankshaft rotates clockwise.

Water pump:

Is fitted to an extension on bottom half of crank case or sump, underneath crankshaft & is driven at engine speed from a bevel gear on driving shaft. It is of the centrifugal type & is built up in two halves. The upper half containing the gear wheel spindle & blades of the pump, the lower half contains the inlet & outlet connections.

The water circulation:

The water flows by gravity from radiator to lower connection at base of cyls. It circulates round the cyls & exhaust valve chambers . . .

BEARDMORE (7)

DEARD MORE Tpasses out a I then passes suce Lavo are xue wate oly Va Y Wa exceed 15

... & passes out at the top above E.V. ports into a copper return pipe to top of radiator. It then passes through radiator where it is cooled before going back to pump completing the circulation. Two small pipes are taken from the copper return pipe to the water jackets surrounding mixing chamber of carburettors. It then flows back to water pump. The object being to assist vapourisation [sic]. The water capacity of radiator & water jackets is 6 gals. The temperature of water should never exceed 85° cent.

[Illustration of Beardmore water circulation]

EARD MORE CITCUTOTION Shrust - She object of the thrus leaving is to mininge the picture beto whating a stationary parts ; parts the las to would dishibute the bull apresh of revolving throughout engine tion lystem Is carried out by 3 methods. vij :-() Force (ii) splach. (iii) greasers. Force opperate by Boach but which is fixed to rear and of ceant case + driven from crank shall. bit is force from hebrication brough extende steel pipes

<u>Thrust</u>:

The object of the thrust bearing is to minimise the friction between rotating & stationary parts of the engine & also to evenly distribute the pull or push of revolving prop. throughout engine. <u>Lubrication system</u>: is carried out by 3 methods via: (i)Force (ii) splash(iii) greasers Force opperated [sic] by Bosch lub. which is fixed to rear end of crank case & driven from crank shaft. Oil is forced from lubrication through external steel pipes . . .

BEARDMORE (8)

BEARDMORE (P) to cyl walls, man bearings & thisset box. The oil entres cylo e through a non return fall : is creater by the bigenes big art the sump. There mall scoop on bottom half ds which but begand beari hel by g cam sha bearings s voucelle arega lever black also he cyl. walls of external working parts. casero 6 sauce fand, rease funsace fitted. R rocker a spudle. 2 large auto preace puns are fetted, 1 h water percep, neo drewing sta Value eleen s are lu lo y praphe Bosch bel Tump: Courses of an aluman containing a vertical shaft bearing 2 distates disco. arranged round Tare 6 plum ps.

... to cyl walls, main bearings & thrust box. The oil enters cyl at base through a non return ball valve.

<u>Splash</u>: is created by the big ends dipping into the sump. There is a small scoop on bottom half of big ends which lub. big end bearings. The parts lub. by splash include cam shaft bearings, cams, cam angle levers & small end bearings. The splash also helps to lub. the cyl walls & pistons.

<u>Greasers</u>: lub. external working parts. 6 small hand grease guns are fitted, 1 to each rocker arm spindle. 2 large auto grease guns are fitted, 1 to water pump, the other to driving shaft. Valve stems are lub. by graphite.

Bosch Oil pump:

Consists of an aluminium casing containing a vertical shaft bearing 2 cams or distorted discs. Arranged round this shaft are 6 pumps . . .

each having a value pistor plunger. These gersau slotter to receive the edge of · in reduced & the speed. que speed 4 - acore ya the in span Al. lower a cun luce Here - rabe pluger. ps there are & separate deliv are 6 kin ord the action of kunps There are 4 shokes (i) Value plunger is passed bunging hole drulled through it in line Lape (11) Value plunger is stationary while perlos pluger barret through whet be Piston plunger is stationary where value (10) blunger descends closing whet yat sauce have by mean Tallat. is a pa ye from pe fand to delivery pe

... each having a valve & piston plunger. These plungers are slotted to receive the edge of cams. The speed of cams is reduced to 1/25th engine speed by a worm & worm gear fitted inside pump casing. The upper or layer cam operates piston plunger, while lower or smaller cam operates valve plunger. Since there are six pumps there are 6 separate deliveries of oil. The action of pump is as follows.

There are four strokes:

- (i) Valve plunger is raised bringing hole drilled through it in line with inlet pipe
- (ii) Valve plunger is stationary while piston plunger rises drawing oil into piston plunger barrel through inlet pipe
- (iii) Piston plunger is stationary while valve plunger descends closing inlet & at same time by means of a flat cut on it forms a passage from piston to plunger barrel to delivery pipe.

(iv) Value plunger is stationary while peoloin plu the wh delivery p the b enge parts:-1 p box Zp 3 4 bearing 5 man 5 6 475 adjustment of pumps: -To adjust to 14,506 servers adjusting screw right down in clock direction then unecres 2/2 terms 2 r 3. seren right 21 hun glock. to excisted & unfefel 0/2 pts of out per bou the driving spundle is extended through logs a flai bot fitte with 4: 1 reduction

 (iv) Valve plunger is stationary while piston plunder [sic] descends forcing oil through delivery pipe to engine.

The pumps supply following parts:

1 pump supplies No1 main bearing & thrust box

		0			
2 pump	" 1, 2 & 3 cyls				
3 pump	u	4, 5, 6 "			
4 pump	" 6 & 7 main bearings				
5 pump	u	2&3""			
6 pump	u	4&5""			

Adjustment of pumps:

To adjust No 1, 4, 5 & 6 screw adjusting screw right down in clockwise direction then unscrew 2 ½ turns & lock. To adjust 2 & 3 screw right down & unscrew 1 turn & lock. The pumps are now adjusted to supply engine with 3 ½ pts of oil per hour.

The driving spindle is extended through top cover of casing & drives rev. indicator through a gear box fitted with 4:1 reduction gear.

Carbinettor :- Ino continettors of Beaddurse type are fitter, each suppling 3 cyl. Each have a single fet 1.75 min. reachalled by a whany sleeve throttle the interior of which forms the mixing chamber. This is surrounded by H. W. Jacker which arsists in vapaijing not. Three ports are cut in please which regulate size of main textra and meet in order to keep the proportion of an a period constant at all engine speeds. Hoat chamber in annular in shape slining hollow forms the main an intake. It is fixed underneath the

(Illustration of Bosch oil pump)

Carburettor:

Two carburettors of Beardmore type are fitted, each supplying 3 cyl. Each have a single jet 1.75mm & controlled by a rotary sleeve throttle the interior of which forms the mixing chamber. This is surrounded by j & w jacket which assists in vaporising petrol. Three ports are cut in sleeve which regulate size of main & extra air inlet in order to keep the proportion of air & petrol constant at all engine speeds. Float chamber is annular in shape & being hollow forms the main air intake. It is fixed underneath the . . .

mixing chamber. bu one side of float chamber is a headle value seating . - will float helps perolat 1 Both throatles are ted & operated by I leve cou 1°etrol is how bank to Exha k through af + needle dalve secting to loat chamber. The petrol thee passes through a lole drelled in float chamber to get wheet ter in centre of a concede shaped tube called cloke late. When enqu ucted through main air p air is now let in form of a spray petrol 1 an spend pass through the tube mixing chamber where they are mixed, assisted the saponyed ver plosing by H.w. facket. misture is then drawn through the inde be +1. Vis to cyl. where it is compressed, fired finally exhausted wets the Jures p the fixed in a wear the fills

... mixing chamber. On one side of float chamber is a needle valve & seating which in conjunction with float keeps petrol at constant level. Both throttles are connected & operated by 1 lever. Path of petrol from tank to exhaust:

Petrol is pressure fed from tank through a filter & needle valve seating to float chamber. The petrol then passes through a hole drilled in float chamber to jet which is situated in centre of a conical shaped tube called choke tube. When engine is running air is sucked through main air intake & also petrol from

jet in form of a spray & both air & petrol pass through choke tube into mixing chamber where they are mixed, assisted by H.W. jacket. The vaporised & explosive mixture is then drawn through the induction pipe & I.V.s to cyl where it is compressed, fired & finally exhausted into the air. <u>C.A.V. mag</u> (wiring):

Is used for starting purposes only & is fixed in or near the pilot's seat.

The H. I lead pour C.A. I is connected b the central terminal of left hand The low tension termilal is course to a switch so hat when enque ha started CAV can be latter The current durated by C.A.V. passes through H.J. lea ferminal Through an attac bush throw ring as diskbutor 1 a pars - buch carrier to an just belin a the dishibu carbon huch. us in live with a just after pistor has Fordis hibutor The current funfer converged to plugs in usual man

The H.T. lead from C.A.V. is connected to the central terminal of left hand mag. The low tension terminal is connected to a switch so that when engine has started C.A.V. can be earthed. The current generated by C.A.V. passes through H.J. lead to centre terminal of left hand mag distributor. Through an attached brush, through a brass ring on distributor carbon brush carries to an electrode fitted just behind the distributor carbon brush. This comes in line with a segment on distributor just after piston has passed T.D.C. The current jumps to segment & is conveyed to plugs in usual manner.

General Running Faults

	lac	neral Ru	unnig	
	e de	reral Rue	C.	
houble of	Fault:		Result	Remedy.
Black sucke	too rich a untere.	(1) fet los large (1) Petrol level torhigh (1) Primetine float	iquition, overlating,	1) Fit suracle fet (1) adjust collar on needle Value fort.
Popping back in Carbinettor.	loo week a wintere	if et to purale, petive cevel too low, I Cu leaks in industron pipes.	power, occusional dissificing. Vileation	
Blue suroke issues from exhaust	over Lutrication	Oil pump out of oid furtiment of toomined oil in fump	Carlon deposit on peter cope heads causing projection bosting relay play causing minifaling.	adjust Bosch bit pung. to supply sh pr pur boun concet amount foil in sump.
Engine pluggish on controls.	under labrication	Cil pering and Bor adjust ment or unafficient oil in sump.	Overheating, hand any gengine to seize.	adjust oil pump + Cumps
Vibration	chipped propellor, Wow Harneys. mis fing, stiguie love in muchue.		Ineffectioncy in gentral.	Replace propellor, bearings + tepther locking down bolts

Indication of trouble	<u>Fault</u>	<u>Cause</u>	<u>Result</u>	<u>Remedy</u>
Black smoke issues	Too rich a mixture	(i) Jet too large	Carbon deposit, pre-ignition,	(i) Fit smaller jet
from exhaust		(ii) Petrol level too	overheating, loss of power	(ii) Adjust collar on needle valve
		high		(iii) Renew float
		(iii) Punctured float		
Popping back in	Too weak a mixture	1 Jet too small	Overheating, loss of power,	(i) Fit larger jet
carburettor		2 Petrol level too low	occasional misfiring. Vibration	(ii) Adjust collar on needle valve
		3 Oil leaks in induction pipes		(iii) Repair induction pipe
Blue smoke issues	Over lubrication	Oil pump out of adjustment or	Carbon deposit on piston or cyl	Adjust Bosch oil pump to supply 3 ½ pts per hour.
from exhaust too		too much oil in sump	heads causing pre-ignition	Correct amount of oil in sump.
			sooting & [illegible] of plugs	
			causing misfiring	
Engine sluggish on	Under lubrication	Oil pump out of adjustment or	Overheating, tendency of engine	Adjust oil pump & sump supply
controls		insufficient oil in sump	to seize	
Vibration	Chipped propeller, worn	-	Inefficiency in general	Replace propeller, bearings & system holding door bolts.
	bearings. Misfiring, engine			
	loose in machine			

Comparisons between Robary Ataliouary higues. Stationary: - (i) Can be W.C. (ii) Can be sclenced. (11) Runsfor longer periodes without overhave. (11) has oil consumption (1) Has longer range of conhol. Robary - (1) Light in weight per up (ii) More compact. (iii) Even torque. (iv) Runs on ball bearings (les preteri) (V). lasin to overhand. Justuneals :-Res. Indicator (Beardenese) :- Fixed on a backet on oil pump voliven at engine speedpour oil pump spindle. Internal spin wheels par down flixible shaft to 1/4 ungine speed. This reduces friction owear of plexible Comparisons between rotary & stationary engines Stationary:

(i) Can be W.C. (ii) Can be silenced (iii) Runs for longer periods without overhaul (iv) Less oil consumption (v) Has longer range of control Rotary: (i) Light in weight per H.P. (ii) More compact (iii) Even torque (iv) Runs on ball bearings (less friction) (v) Easier to overhaul

Instruments:

Rev indicator (Beardmore): Fixed on a bracket on oil pump & driven at engine speed from oil pump spindle. Internal spur wheels gear down flexible shaft to ¼ engine speed. This reduces friction & wear of flexible shaft.

Rev. Indicator (cluged: - Some an Beardneve, xared down 17 stead of H. dle which re pump spice It enque speed air Pump: - Consists of a small peston worke una eylunder. Hisdriven tis fixed underneath fuselage. Un is adm through value to explender thed atten forced through a non-return value petrol bank maintaining a pressure of 354 looper D. There is an well pistor head to now return exhaust delve in cylinder head. Air release value !- a spring loaded safety value an pipe, it 's adjusted to about H lbs release an 17. Hand an pun Coursests of proton with cupped leather waster barrel. Mis operated forces air through a non-return schol tank.

Rev indicator (Clerget):

Same as Beardmore, but is geared 1/7" instead of ¼. It is driven from oil pump spindle which revolves at 7:4 engine therefore flexible shaft revolves at ¼ engine speed.

<u>Air pump:</u>

Consists of a small pump working in a cylinder. It is driven by a small prop & is fixed underneath fuselage. Air is admitted through valve to cylinder & then forced through a non-return valve to petrol tank maintaining a pressure of 3 to 4 lbs per sq. ". There is an inlet valve in the piston head & a nonreturn exhaust valve in cylinder head.

Hand air pump:

Consists of a piston fitted with cupped leather washer working in a barrel. It is operated by hand & forces air through a non-return valve to petrol tank.

Dourdon pussere guage :- This sed to register the an I tank the heat of the w pressure of oil tube fitted in a encula this being secured to the inshument board. The pressure led in the tube tends to sharphen it, tension moves a pointer over a nated scale goo indecates the Un pressure un pehol uk register by the Boundon gua ld be about 3 at the per o" mage: - Not fitted on Beardure. Oupresence of a bounder grage filled oil pressure system Transmitting themometer - Consists of a full fitted in radiator, This bull is filled with other tis connected with unshament on dash by a mail copper tube. The heart of the water expands effer which registers the heat in

Bourdon pressure gauge:

This instrument is used to register the air pressure in petrol tank & the heat of the water in radiator & the pressure of oil in various other engines. It consists of a bent, flat section tube fitted in a circular brass box, this being secured to the instrument board. The pressure exerted in the tube tends to strayhten [sic] it, this tension moves a pointer over a graduated scale & so indicates the pressure. Air pressure in petrol tank registered by the Bourdon gauge should be about 3 or 4 lbs per sq".

Oil pressure guage [sic]: Not fitted on Beardmore (

Not fitted on Beardmore. Consists of a Bourdon guage [sic] fitted to oil pressure system. <u>Transmitting thermometer</u>: Consists of a bulb fitted in radiator, this bulb is filled with ether & is connected with instrument on dash by s small copper tube. The heat of the water expands ether which registers the heat in . . .

degrees centr. The heat of water should on no account rise above po cee Vaccoun Control :- The object of the vaccoun control is to keep the ratio of period van constant at high altitudes owing air becoming rarefreed. I small pipe is taken por unduction pipe to the float charles, the penning outrect , the pilots plat. When fully open part of suction pourpeston is constantated on perol in float chamber whe tends to told back the clow of from the fet so preventice a rech sur line ferred drawn from carbenellors. Periodo of Courtane: - The engine requise top overhand after 150 fours recuring. To do this elean of carbon deposed remove cyluders, pistous ocylinders, pund in values ver Value cage seating. Gamme piston re the complete overhand is reces worn parts. necessary after wery 300 his recurring.

... degrees centi. The heat of water should on no account rise above 85° cent.

Vacuum control:

The object of the vacuum control is to keep the ratio of petrol & air constant at high altitudes owing to the air becoming rarefied. A small pipe is taken from the induction pipe to the float chamber, the opening of which is operated from the pilot's seat. When fully open part of suction from piston is concentrated on petrol in float chamber which tends to hold back the flow of petrol from the jet so preventing a rich mixture being drawn from carburettor.

Periods of overhaul:

The engine requires a top overhaul after 150 hours running. To do this remove cylinders, clean off carbon deposit from pistons & cylinders, ground in valves & inlet valve cage seating. Examine piston rings, renew worn parts. The complete overhaul is necessary after every 300 hours running . . .

complete we have the sugue bed completty chaned, arenewed Dismanthing. To takeout Cam shall (i) Lake of mays, stand viney driving wheel. (ii) Sate out pull speech pods leters (iii) Remove 2 set screws from centre bearings turing wheel cover + wheel (iv) 3 unto from stude securing rear (V)bearing. Frise out can shaft from front. To fake out E.V.: - (i) Disconnect - tarderelivinpipe leading to particular cyl. (i) Disconnect feel speech rod from rocker and (iii) Depress laminated spring whate out cotterpin from I. & steen. (rv) Lake out I.V. + cage couplete (V) Depress laminated spring on E. stake out cotterpin.

... on a complete overhaul the engine is stripped completely & all parts examined, cleaned, & renewed if necessary. **Dismantling:** To take out camshaft: To take out E.V.: (i) Take off mags, stand & mag driving wheel (ii) Take out pull & push rods & cam angle levers cyl. (iii) Remove 2 set screws from centre bearings " turning wheel cover & wheel (iv) (v) 3 nuts from studs securing rear bearing from I.V. stem Drive out cam shaft from front.

- (i) Disconnect induction pipe leading to particular
- (ii) Disconnect push & pull rod from rocker arm
- (iii) Depress laminated spring & take out cotter pin
- (iv) Take out I.V. & cage complete
- (v) Depress laminated spring on E. & take out cotter pin

(VI) lit E.Y. fall on piston Tead remove through in let value port. .

(vi) Let E.V. fall on piston head & remove trough inlet valve port.