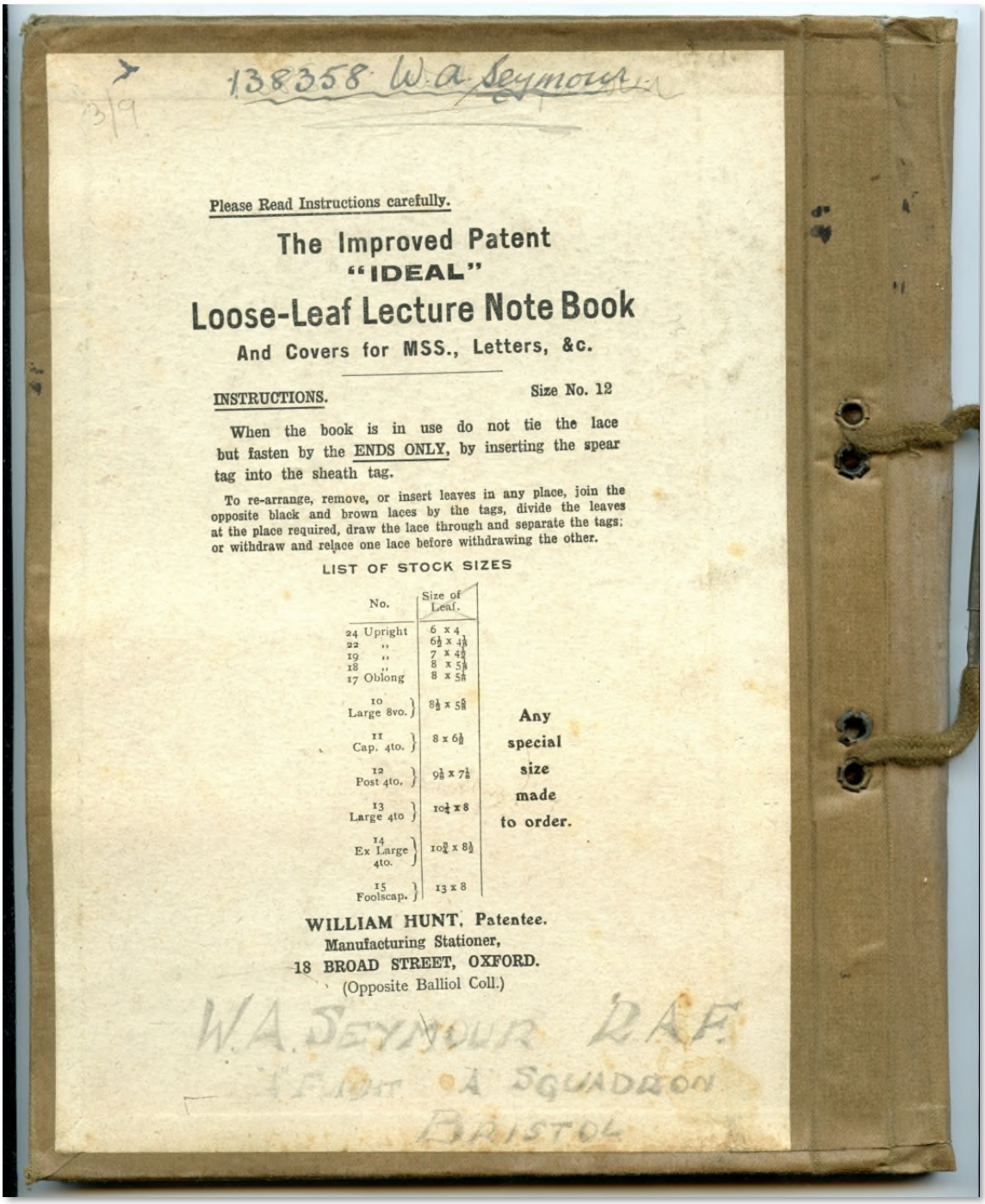
PER ARDUA AD ASTRA

The "Ideal" Royal Air Force Loose Leaf Note Book.

WILLIAM HUNT,
18, Broad St., Oxford.
(opposite Balliol College).



138358 W.A Seymour

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The Improved Patent "IDEAL" Loose-Leaf Lecture Note Book

And Covers for MSS., Letters, &c.

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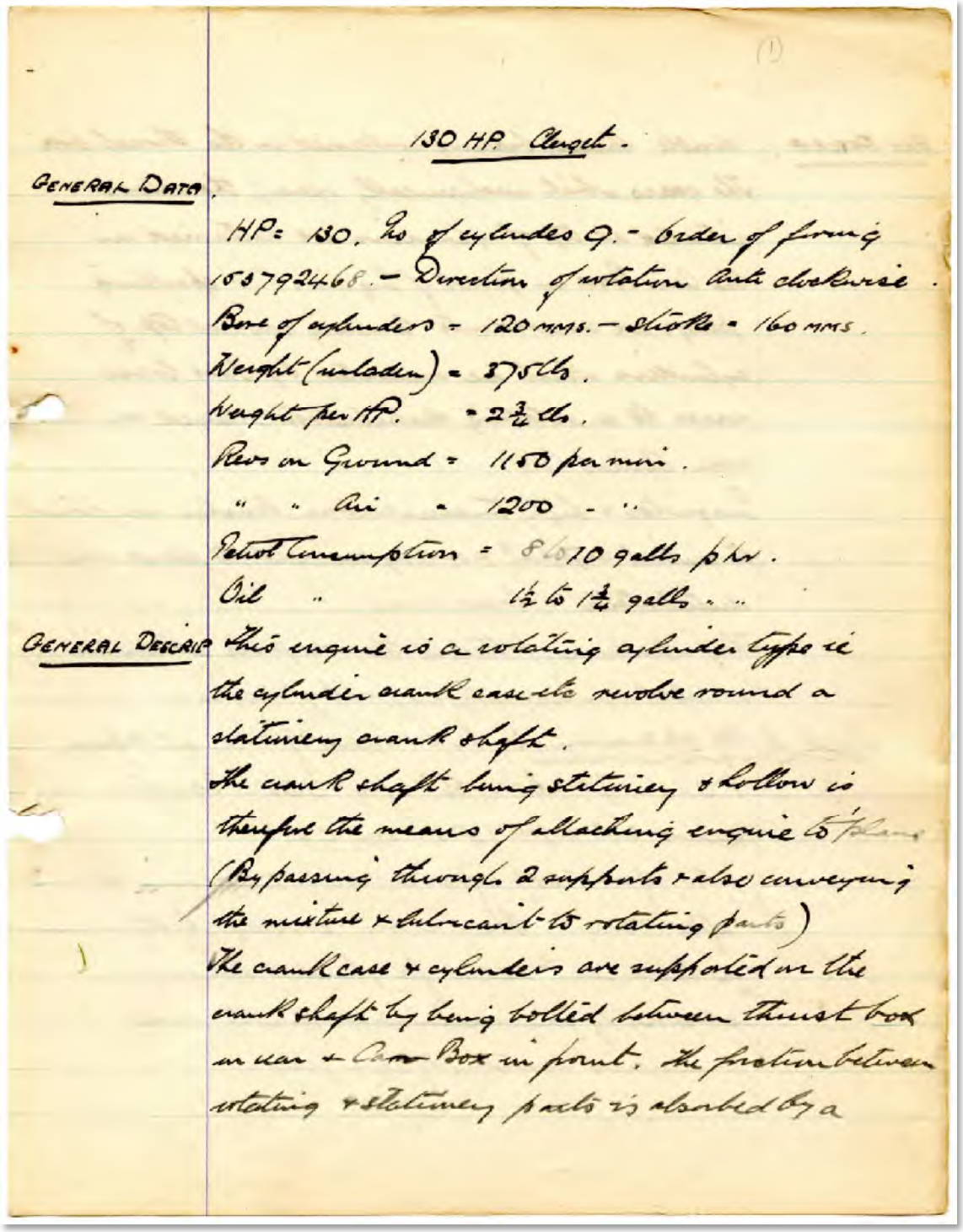
WILLIAM HUNT, Patentee.
Manufacturing Stationer,
18 BROAD STREET, OXFORD.
(Opposite Balliol Coll.)

W.A. SEYMOUR R.A.F.
1 FLIGHT A SQUADRON
BRISTOL

138358 W A Seymour

W A Seymour RAF,
'1' Flight A Squadron
Bristol



130 HP. Clerget.

GENERAL DATA.

HP: 130. No of cylinders 9. - Order of firing 1 5 3 7 9 2 4 6 8. - Direction of rotation anti clockwise.
Bore of cylinders = 120 mms. - Stroke = 160 mms.
Weight (unladen) = 375 lbs.
Weight per HP. = 2¾ lbs.
Revs on Ground = 1150 per min.
" " Air = 1200 - "
Petrol Consumption = 8 to 10 galls p hr.
Oil " ½ to 1¼ galls. "

GENERAL DESCRIP This engine is a rotating cylinder type i.e. the cylinder crank case etc revolve round a stationary crank shaft.
The crank shaft being stationary & hollow is therefore the means of attaching engine to 'plane (By passing through 2 supports & also conveying the mixture & lubricant to rotating parts)
The crank case & cylinders are supported on the crank shaft by being bolted between thrust box on rear & Cam Box in front. The friction between rotating & stationary parts is absorbed by a

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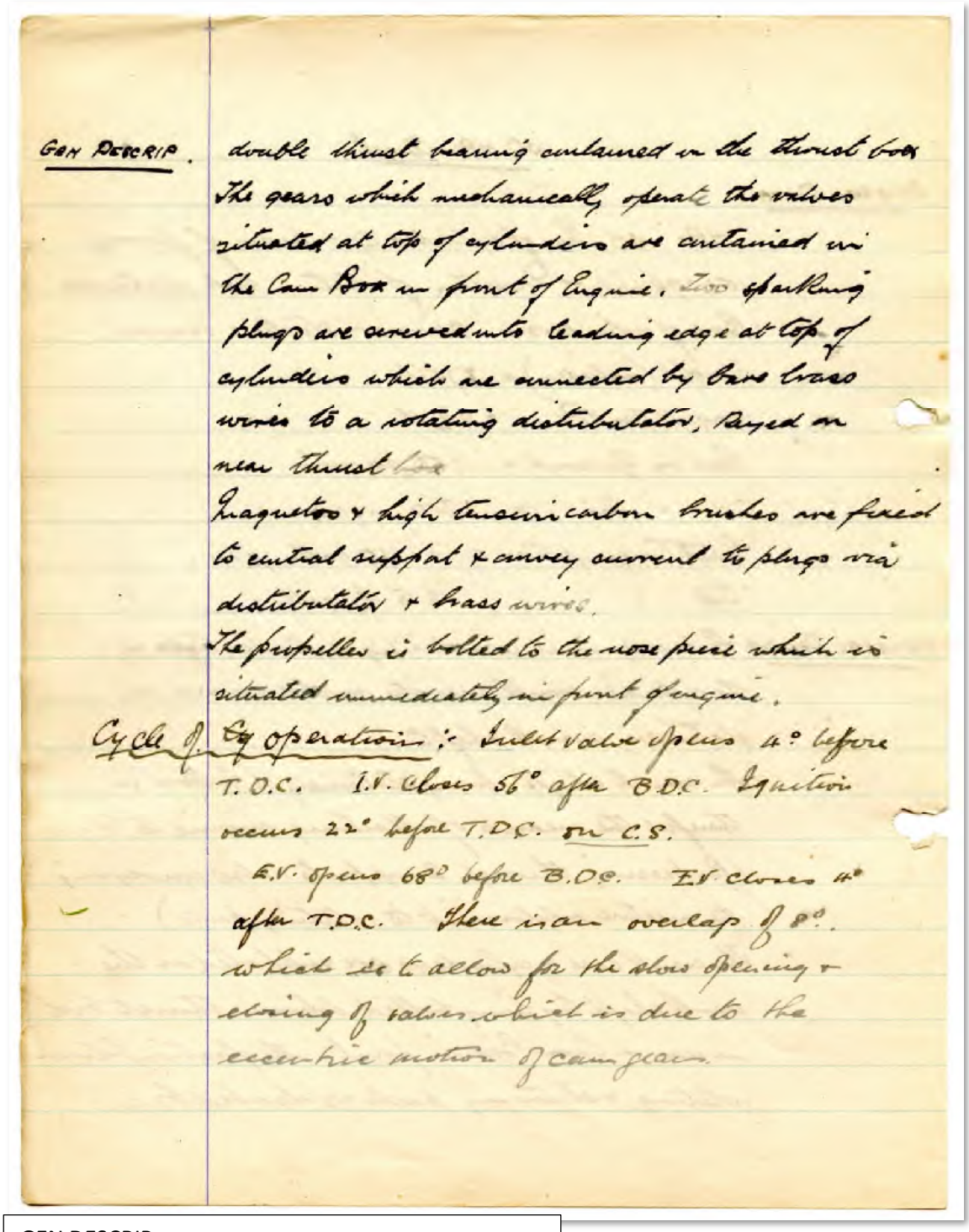

Gen Descrip. double thrust bearing contained in the thrust box
The gears which mechanically operate the valves situated at top of cylinders are contained in the Cam Box in front of Engine. Two sparking plugs are screwed into leading edge at top of cylinders which are connected by bare brass wires to a rotating distributator, keyed on rear thrust box
Magnetos & high tension carbon brushes are fixed to central support & convey current to plugs via distributator & brass wires.
The propeller is bolted to the nose piece which is situated immediately in front of engine.
Cycle of Op operation :- Inlet valve opens 4° before T.D.C. I.V. closes 56° after B.D.C. Ignition occurs 22° before T.D.C. on C.S.
E.V. opens 68° before B.D.C. E.V. closes 4° after T.D.C. There is an overlap of 8°. which is to allow for the slow opening & closing of valves which is due to the eccentric motion of cam gear.

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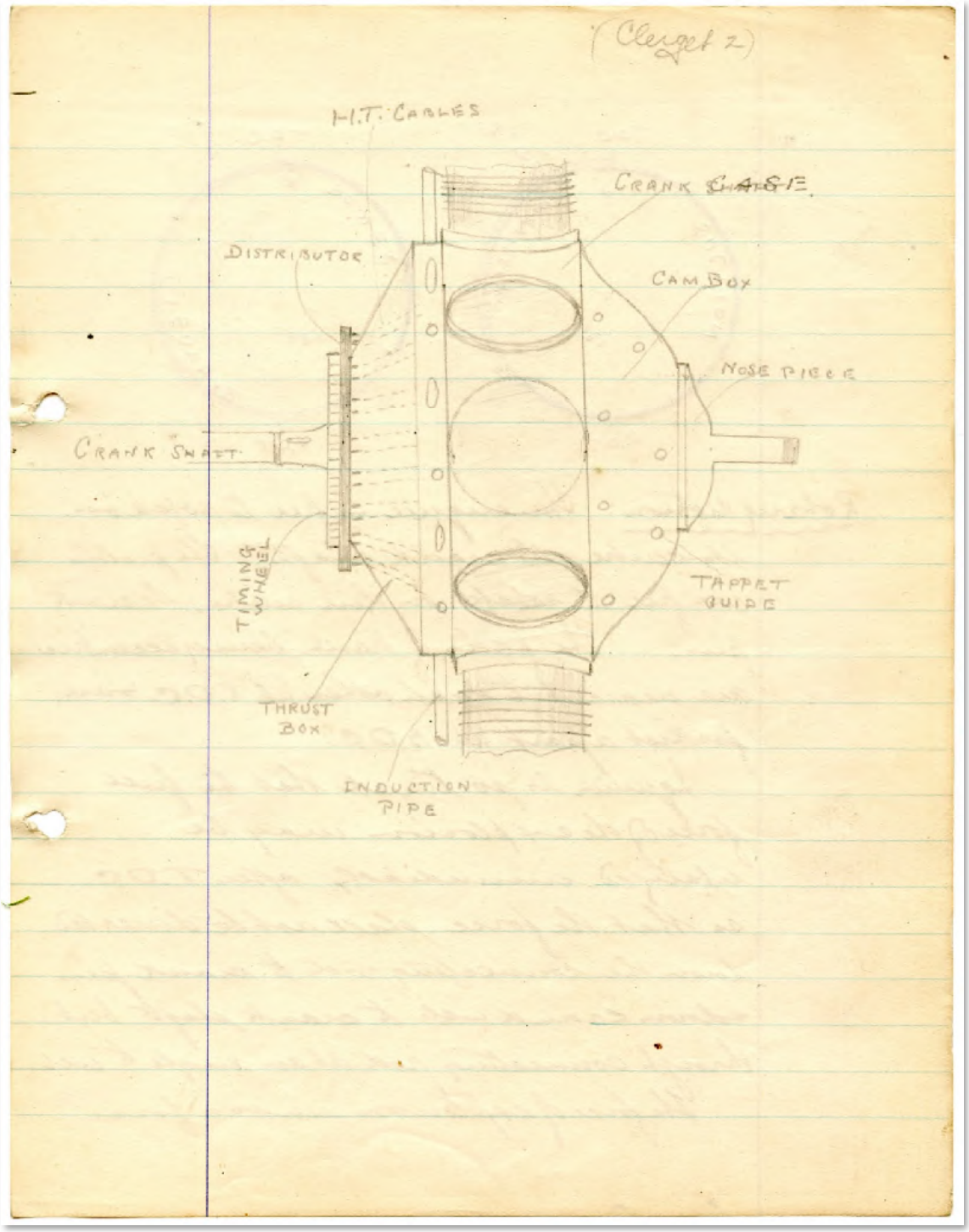
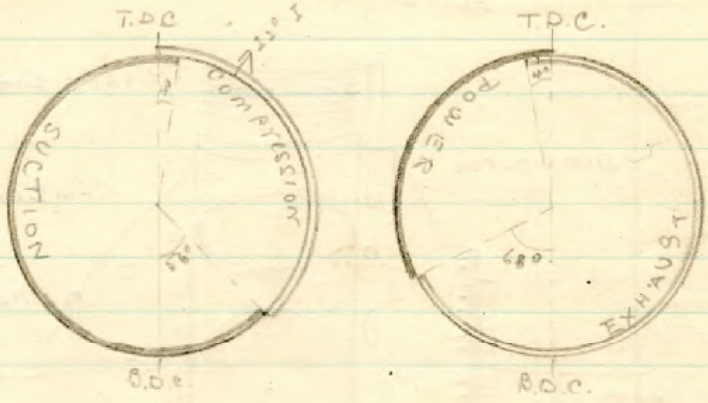

(Clerget 2)
H.T. CABLES
CRANK CASE
DISTRIBUTOR
CAM BOX
NOSE PIECE
CRANK SHAFT
TIMING WHEEL
TAPPET GUIDE
THRUST BOX
INDUCTION PIPE



Rotary motion: The engine is free to rotate on its centre, the crank shaft. The pistons are free to rotate on their centre, the crank pin. The paths of travel being eccentric are nearest to each other at T.D.C. & are farthest apart at B.D.C.

Ignition is so timed that the full force of the explosion may be utilised immediately after T.D.C. so that the force shall not be directed down the connecting rod to crank pin & down crank web to crank shaft but through connecting rod at an angle to web. The force of explosion sends a force

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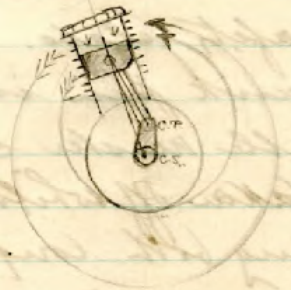
CLERGET (3)

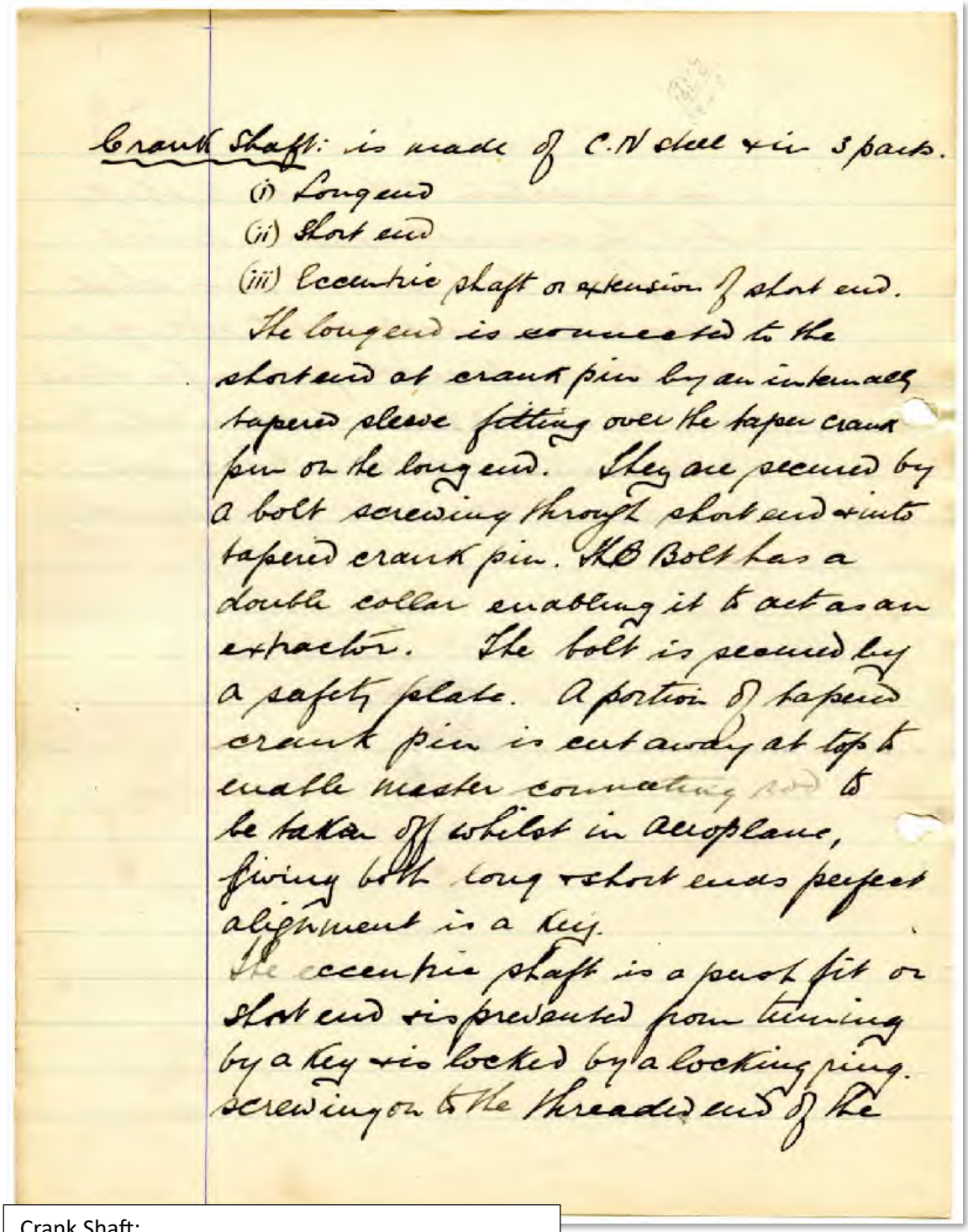
in a direction to the crank shaft, but the connecting rods direct this force to the crank pin which being an immovable object sets up a reactionary force to the gudgeon pin which creates a third force which is at L to connecting rod & takes line of least resistance & gives rotary motion to the engine.

T.D.C



B.D.C

. . . in a direction to the crank shaft, but the connecting rods direct this force to the crank pin which being an immovable object sets up a reactionary force to the gudgeon pin which creates a third force which is at [character for “right angles”] to connecting rod & takes line of least resistance & gives motion to the engine.



Crank Shaft: is made of C.N steel & in 3 parts.
(i) Long end
(ii) Short end
(iii) Eccentric shaft or extension of short end.
The long end is connected to the short end at crank pin by an internally tapered sleeve fitting over the taper crank pin on the long end. They are secured by a bolt screwing through short end & into tapered crank pin. The Bolt has a double collar enabling it to act as an extractor. The bolt is secured by a safety plate. A portion of tapered crank pin is cut away at top to enable master connecting rod to be taken off whilst in aeroplane, giving both long & short ends perfect alignment is a key.
The eccentric shaft is a push fit on short end & is prevented from turning by a key & is locked by a locking ring screwing on to the threaded end of the

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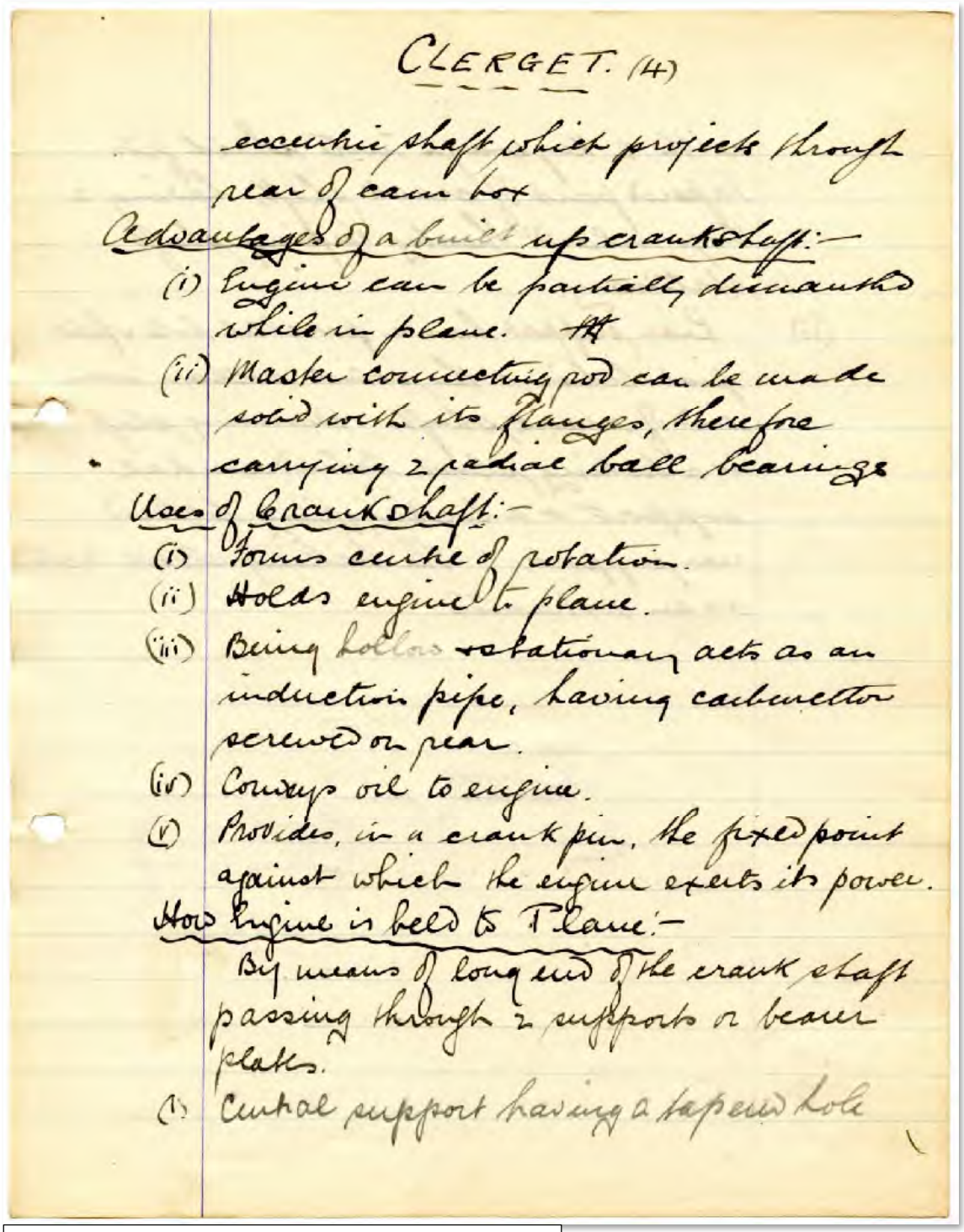

CLERGET. (4)

eccentric shaft which projects through rear of cam box

Advantages of a built up crankshaft:-

(i) Engine can be partially dismantled while in plane.

(ii) Master connecting rod can be made solid with its flanges, therefore carrying 2 radial ball bearings

Uses of Crankshaft:-

(i) Forms centre of rotation.

(ii) Holds engine to plane.

(iii) Being hollow & rotationary acts as an induction pipe, having carburettor screwed on rear.

(iv) Conveys oil to engine.

(v) Provides, in a crank pin, the fixed point against which the engine exerts its power.

How Engine is held to Plane:-

By means of long end of the crank shaft passing through 2 supports or bearer plates.

(1) Central support having a tapered hole

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Uses of crankshaft:

Forms centre of rotation

Holds engine to plane

(i) Being hollow & stationary acts as an induction pipe, having carburettor screwed on rear

(ii) Conveys oil to engine

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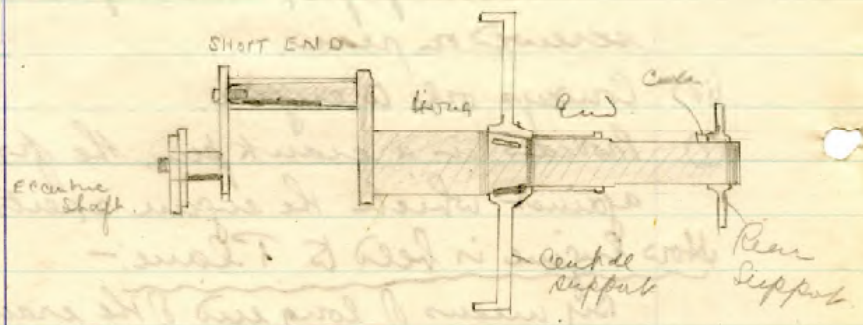
How engine is held to Plane:

By means of long end of the crank shaft through 2 supports or bearer plates.

(i) Central support having a tapered hole

with 2 keyways into which fits tapered part of crank shaft, having 2 keys inlaid thereby keeping shaft stationary.

(ii) Rear support has a parallel hole & fits just behind the solid collar near end of crank shaft. Securing shaft is a locking sleeve behind central support & a locking ring behind rear support. The locking sleeve acts as an extractor.



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CLERGET (5).

Crank case:- Is a steel stamping made in halves which when bolted together by 9 bolts forms 9 appertures to hold cyls. In each half of apertures is a groove into which fits a collar on cyls, 9 dowel pins are fixed in rear half of crank case engage ½ in solid collar & ½ in crank case thereby preventing cyls from turning. To crank case is bolted thrust box in rear & cam box in front.

Cylinders:- Are made of C.N. steel with radiating pins for cooling & strengthening purposes. In each cyl head & I & E.V. cage the exhaust being on the leading edge for cooling purposes. 2 fulcrum posts are screwed into cyl head directly opposite screwed apertures for valve cages. On the leading edge towards the top are 2 holes. threaded to accomodate plugs. Near base of cyl is a solid collar which fits into recess or groove in crank case.

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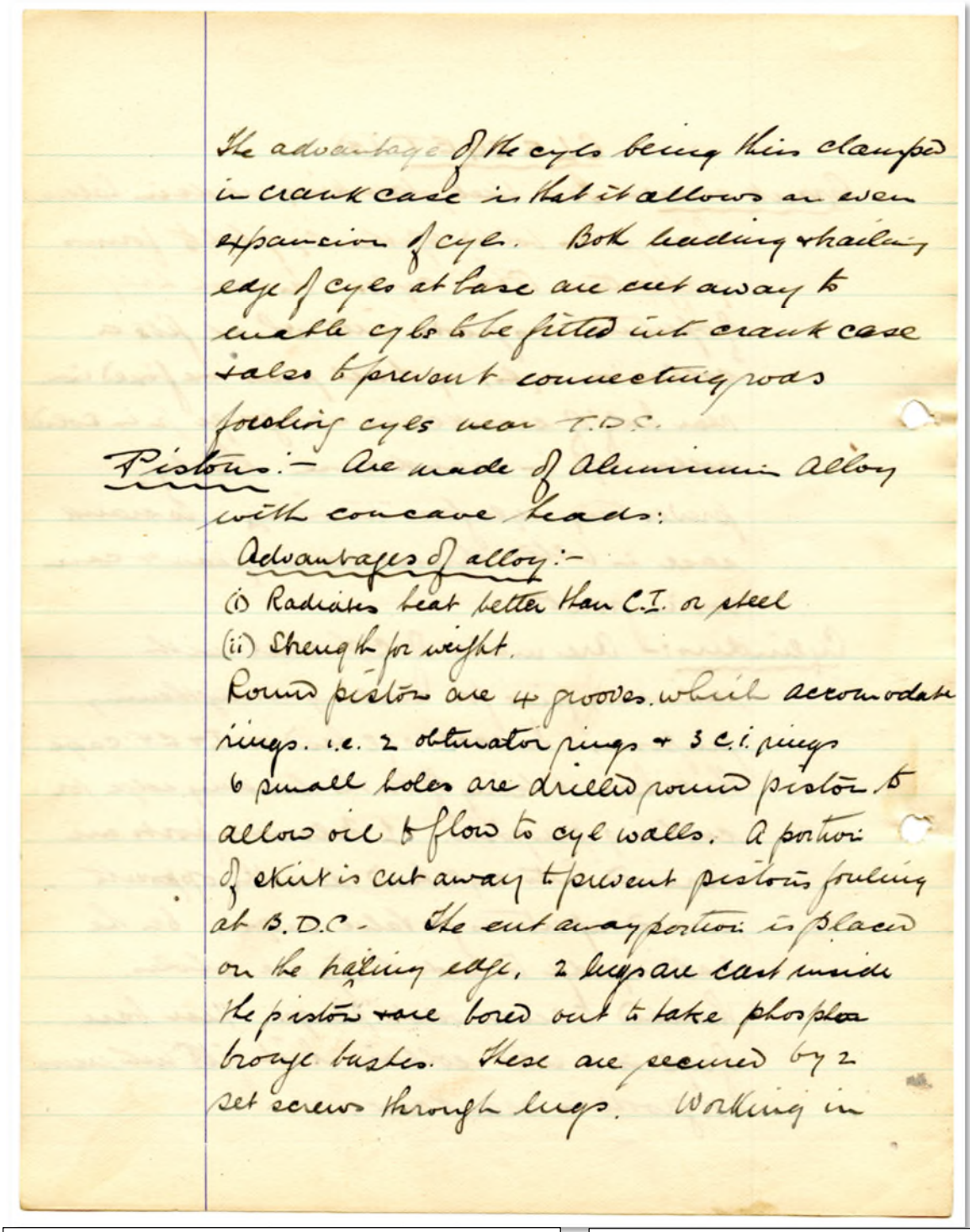


The advantage of the cyls being thus clamped in crank case is that it allows an even expansion of cyls. Both leading & trailing edge of cyls at base are cut away to enable cyls to be fitted into crank case & also to prevent connecting rods fouling cyls near T.D.C.

Pistons:
Are made of Aluminium Alloy with concave heads:

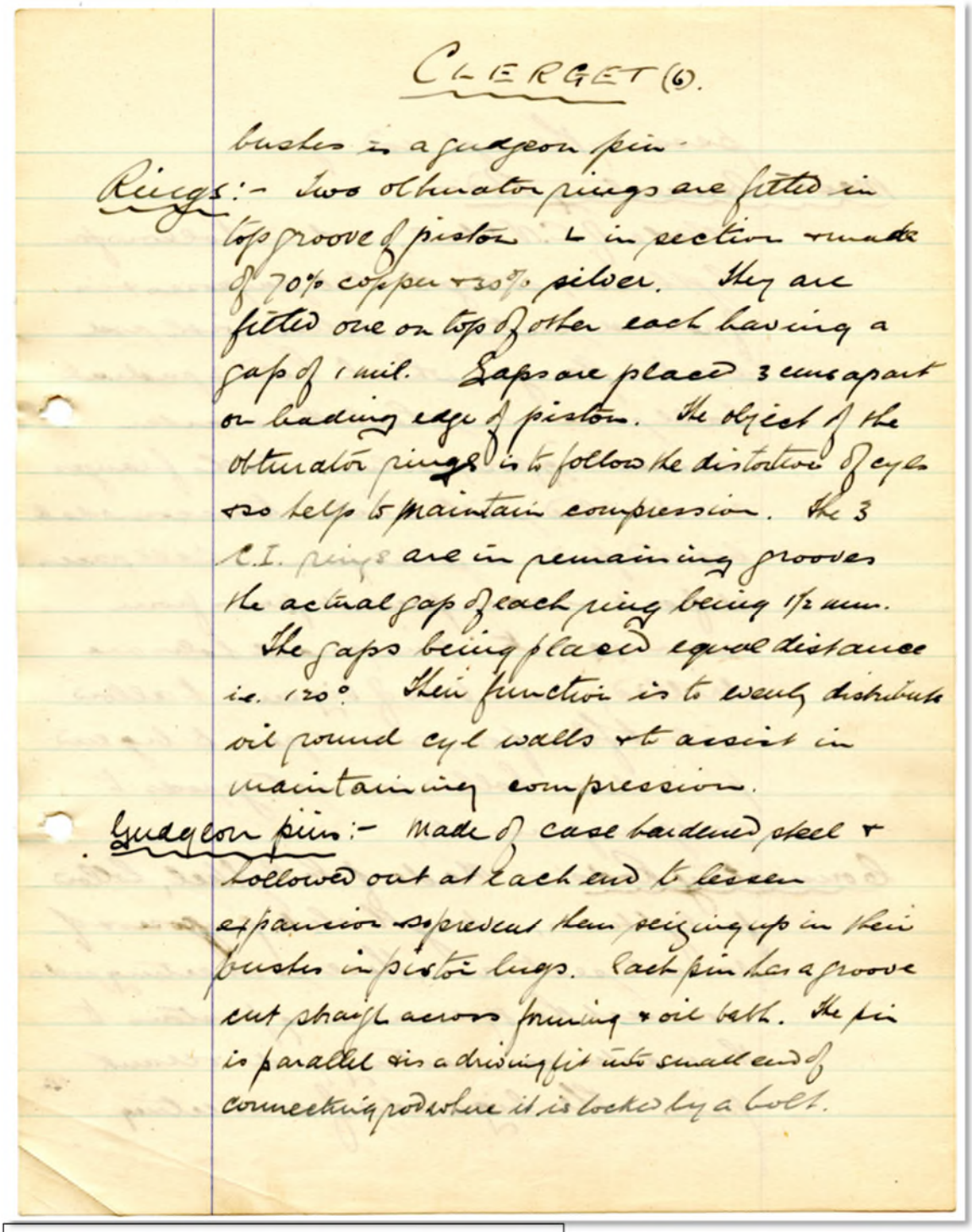
(i) Radiates heat better than C.I. or steel
(ii) Strength for weight

Advantages of alloy:

(i) Radiates heat better than C.I. or steel
(ii) Strength for weight

Round pistons are 4 grooves which accommodate rings, i.e. 2 obturator rings & 3 c.i. rings

6 small holes are drilled round piston to allow oil to flow to cyl walls. A portion of skirt is cut away to prevent pistons from fouling at B.D.C. The cut away portion is placed on the trailing edge, 2 layers are cast inside the pistons & are bored out to take phosphor bronze bushes. These are secured by 2 set screws through keys. Working in . . .



CLERGET (6).

bushes is a gudgeon pin.

Rings:- Two obturator rings are fitted in top groove of piston L in section made of 70% copper & 30% silver. They are fitted one on top of other each having a gap of 1 mil. Gaps are placed 3 cms apart on leading edge of piston. The object of the obturator rings is to follow the distortion of cyls & so help to maintain compression. The 3 C.I. rings are in remaining grooves the actual gap of each ring being 1½ mm. The gaps being placed equal distance i.e. 120°. Their function is to evenly distribute oil round cyl walls & to assist in maintaining compression.

Gudgeon pins:- Made of case hardened steel & hollowed out at each end to lessen expansion so prevent them seizing up in their bushes in piston lugs. Each pin has a groove cut straight across forming an oil bath. The pin is parallel & is a driving fit into small end of connecting rod where it is locked by a bolt.

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passing through rod & pin.

Master Connecting Rod:—

Made of C.N. Steel, rod is hollow for lightness, strength & lub. purposes & is of round section. Solid with rod are two flanges which hold 2 radial ball races on which the master connecting rod revolves. Both flanges are drilled with 8 holes to accomodate big end pins or wrist pins. Ball races at front & rear prevent pins from coming out. Nine small holes are drilled round boss of big end to allow oil to flow from crank pin to big end pins down hollow connecting rods to gudgeon pins etc.

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CLERGET (7)

rods are bored out to hold phosphor bronze bushes. These bushes are grooved & drilled forming a bath for oil for big ends pins & to allow oil to flow down hollow connecting rods to gudgeon pins. Big ends of rods are slotted to receive oil from the master connecting rod.

Big End pins or Wrist pins:-

There are 8 made of case hardened steel grooved for lubrication purposes & are hollow & threaded for the purpose of extraction. Each pin has a peg which fits into the slot in the front flange of master connecting rod & so prevents them from turning.

Cam box:- Consists of a C.N. steel casing & is bolted to front of crank case.

It carries a radial ball bearing which forms one of the front supports of the engine on the eccentric shaft

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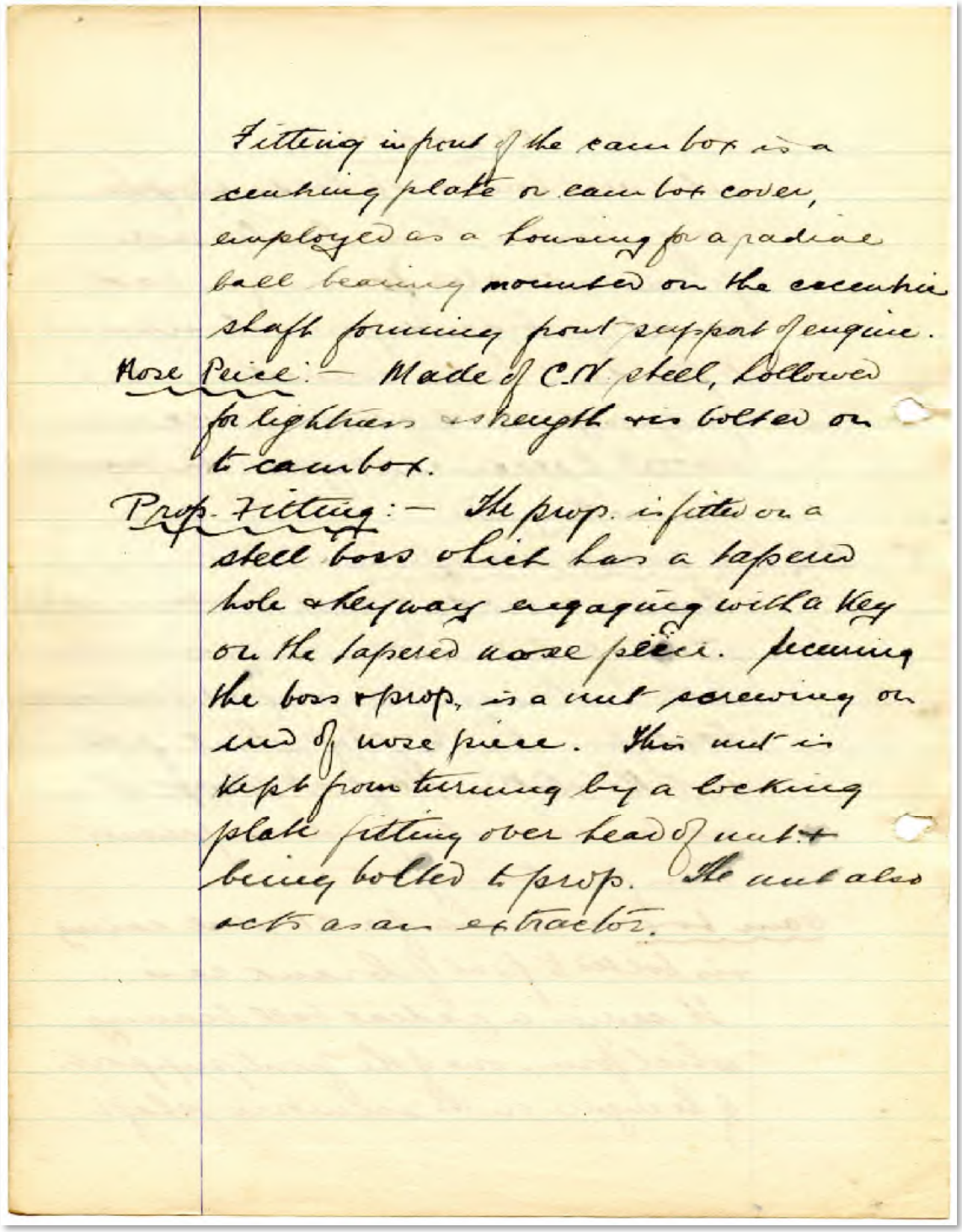

Fitting in front of the cam box is a centring plate or cam box cover, employed as a housing for a radial ball bearing mounted on the eccentric shaft forming front support of engine.

Nose Piece:— Made of C.N. steel, hollowed for lightness & strength & is bolted on to cam box.

Prop. Fitting:— The prop. is fitted on a steel boss which has a tapered hole & keyway engaging with a key on the tapered nose piece. Securing the boss & prop, is a nut screwing on end of nose piece. This nut is kept from turning by a locking plate fitting over head of nut & being bolted to prop. The nut also acts as an extractor.

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CLERGET (8).

Cam gear & action:— The cam gear consists of 2 steel cam gear rings & 2 cam gear wheels. Cam gear rings have 18 teeth internally cut & are keyed inside the cam box & therefore revolve at engine speed. Meshing & being driven by each ring respectively are the 2 cam gear wheels, each having 16 teeth externally cut. Both cam gear wheels are mounted on eccentric centres on the eccentric shaft. Every 4th tooth of cam gear wheels are extended to the rear & act as cams. The inlet cam gear consists of 1 cam gear ring & 1 wheel which are placed in cam box front & mesh with each other on the left side of cam box only. The exhaust cam gear consists of cam gear ring & wheel, which mesh only on right of cam box.

Action:- The cam gear ring with 18 teeth revolving at engine speed drives the cam gear wheel with 16 teeth at a speed of 8:9 respectively (this means that cam gear wheel revolves faster than engine.) The gear wheel must therefore gain 2 teeth every rev of engine.

Cam gear & action: The cam gear consists of 4 steel cam gear rings & 2 cam gear wheels. Cam gear rings have 18 teeth internally cut & are keyed inside the cam box & therefore revolve at engine speed. Meshing & being driven by each ring respectively are the 2 cam gear wheels, each having 16 teeth externally cut. Both cam gear wheels are mounted on eccentric centres on the eccentric shaft. Every 4th tooth of cam gear wheels are extended to the rear & act as cams. The inlet cam gear consists of 1 cam gear ring & 1 wheel which are placed in cam box front & mesh with each other on the left side of cam box only. The exhaust cam gear consists of cam gear ring & wheel, which mesh only on right of cam box.

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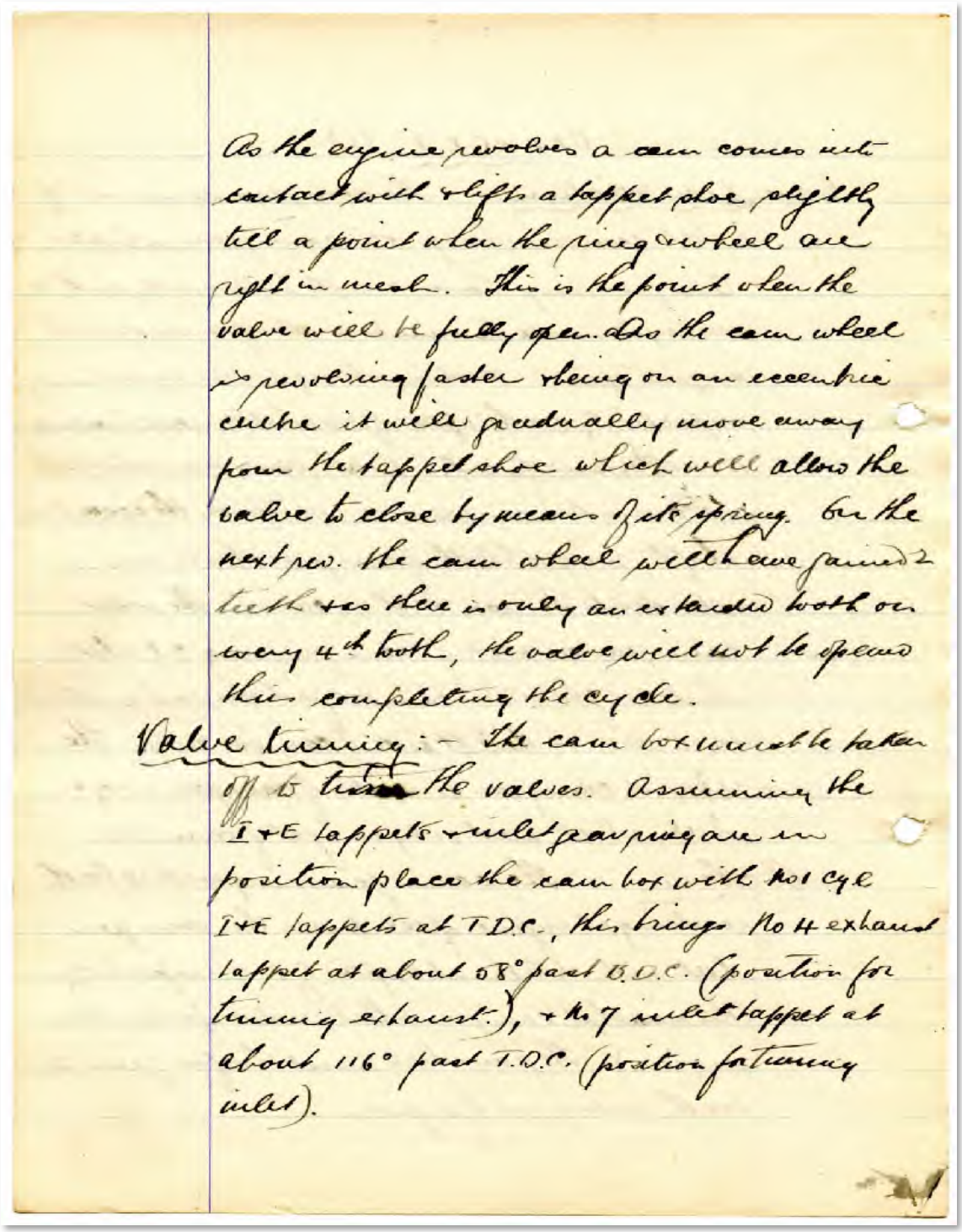
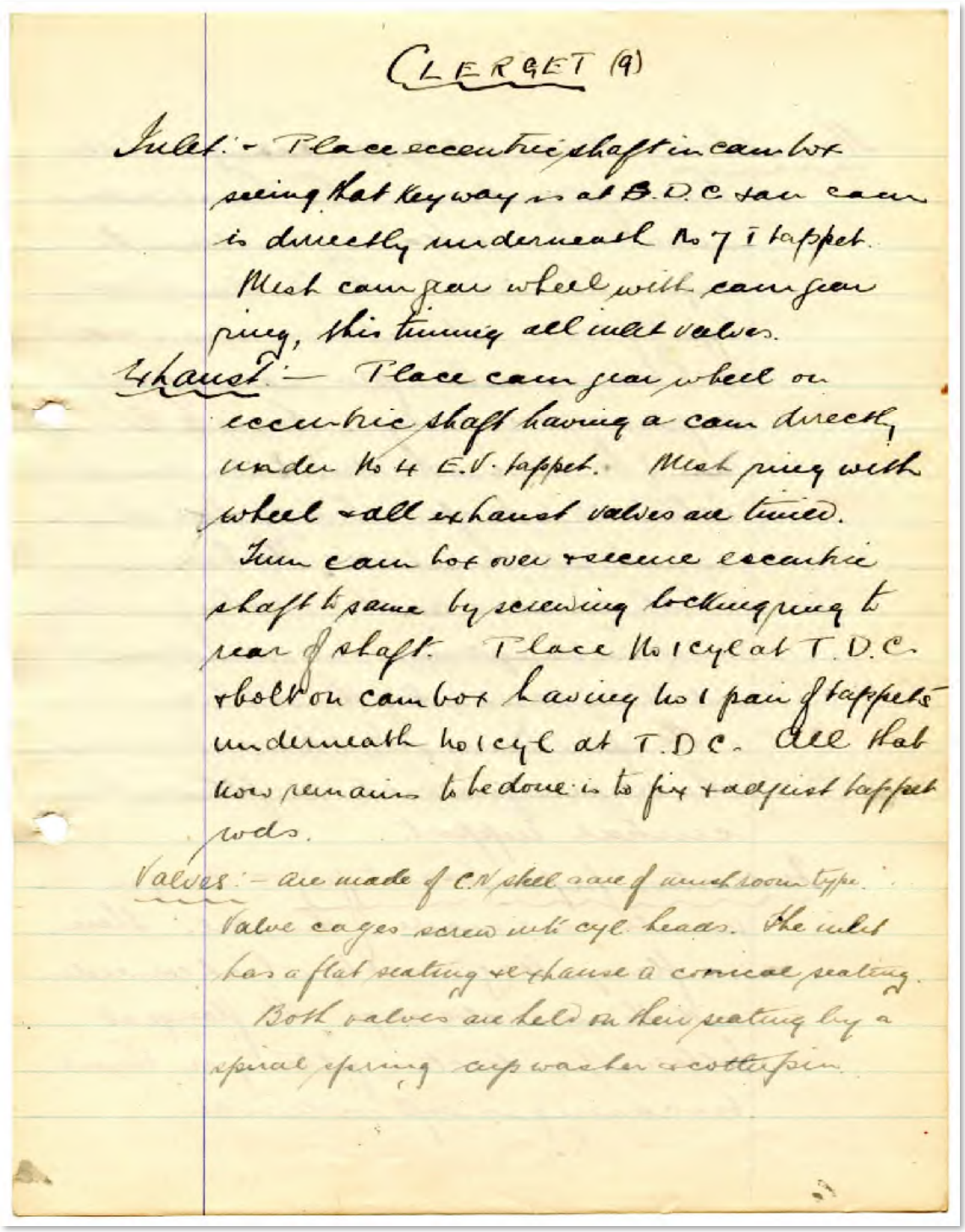


As the engine revolves a cam comes into contact with & lifts a tappet shoe slightly till a point when the ring & wheel are right in mesh. This is the point when the valve will be fully open. As the cam wheel is revolving faster & being on an eccentric centre it will gradually move away from the tappet shoe which will allow the valve to close by means of its spring. On the next rev the cam wheel will have gained 2 teeth & as there is only an extended tooth on every 4th tooth, the valve will not be opened thus completing the cycle.

Valve timing: The cam box must be taken off to time the valves. Assuming the I&E tappets & inlet gear ring are in position place the cam box with No1 cyl I&E tappets at T.D.C., this brings No4 exhaust tappet at about 58° past B.D.C. (position for timing exhaust), & No7 inlet tappet at about 116° past T.D.C. (position for timing inlet)



CLERGET (9)

Inlet:- Place eccentric shaft in cam box seeing that key way is at B.D.C & av cam is directly underneath No 7 I tappet. Mesh cam gear wheel with cam gear ring, this timing all inlet valves.

Exhaust:- Place cam gear wheel on eccentric shaft having a cam directly under No 4 E.V. tappet. Mesh ring with wheel & all exhaust valves are timed. Turn cam box over & secure eccentric shaft to same by screwing locking ring to rear of shaft. Place No 1 cyl at T.D.C. & bolt on cam box having no 1 pair of tappets underneath no 1 cyl at T.D.C. All that now remains to be done is to fix & adjust tappet rods.

Valves:- are made of C.N. steel & are of mushroom type. Valve cages screw into cyl heads. The inlet has a flat seating & exhaust a conical seating. Both valves are held on their seating by a spiral spring, cup washer & cotter pin.

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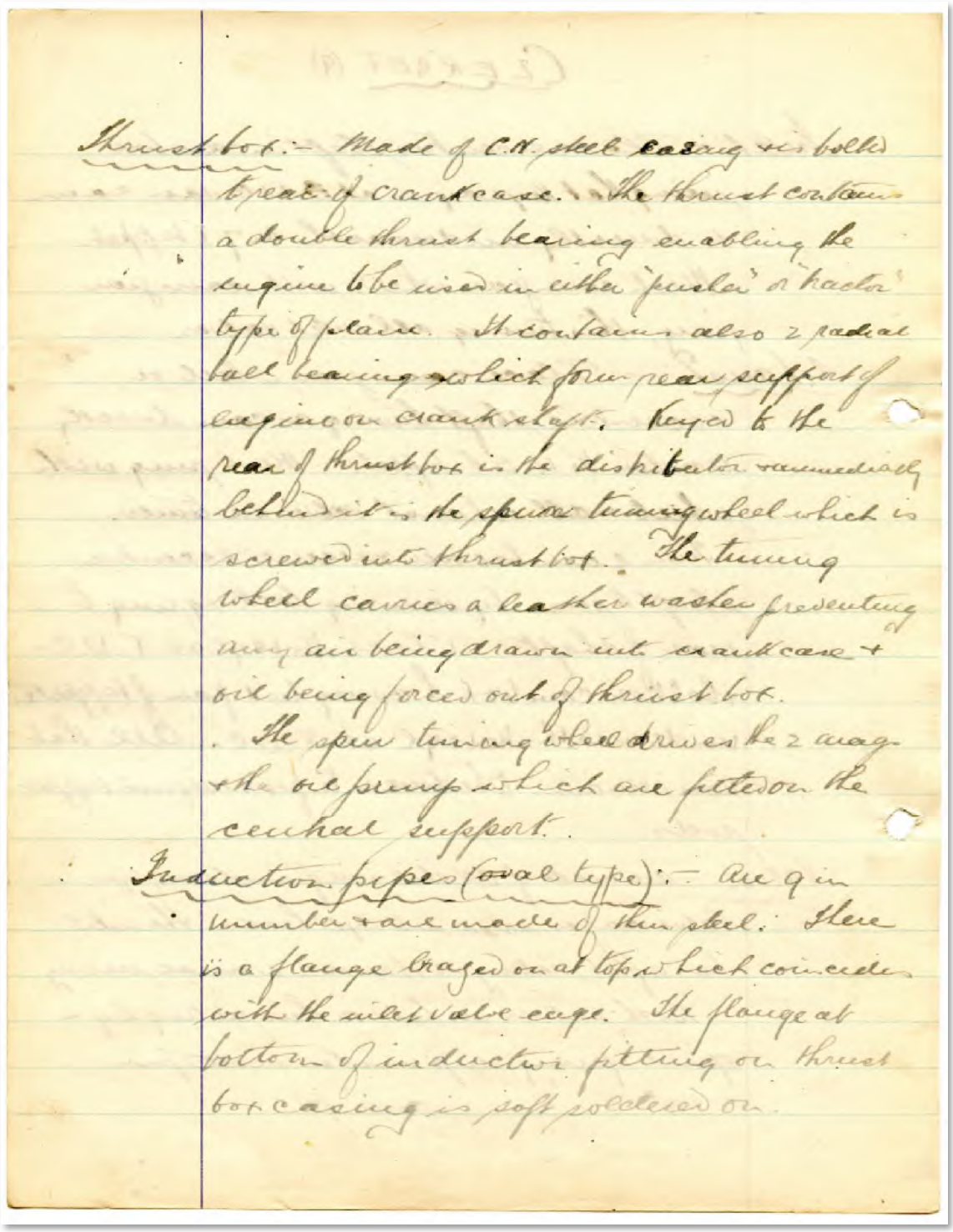

Thrust box:- Made of C.N. steel casing & is bolted to rear of crank case. The thrust contains a double thrust bearing enabling the engine to be used in either "pusher" or "tractor" type of plane. It contains also 2 radial ball bearing which form rear support of engine on crank shaft. Keyed to the rear of thrust box is the distributor immediately behind it is the spur timing wheel which is screwed into thrust box. The timing wheel carries a leather washer preventing any air being drawn into crank case & oil being forced out of thrust box. The spur timing wheel drives the 2 mags & the oil pump which are fitted on the central support.

Induction pipes (oval type):- Are 9 in number & are made of thin steel. There is a flange brazed on at top which coincides with the inlet valve cage. The flange at bottom of inductor fitting on thrust box casing is soft soldered on.

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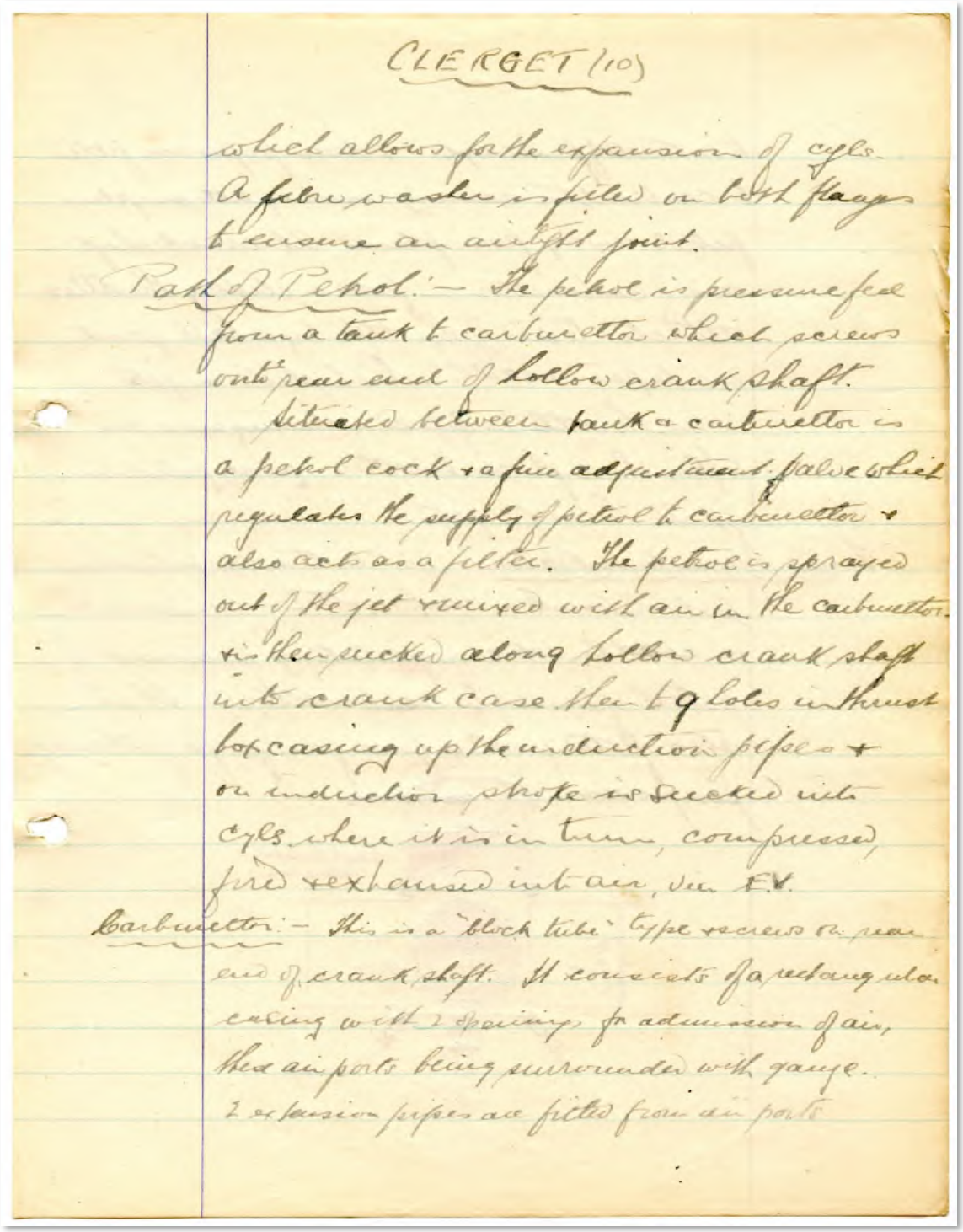

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which allows for the expansion of cyls. A fibre washer is fitted on both flanges to ensure an airtight joint.

Path of Petrol:- The petrol is pressure fed from a tank to carburettor which screws onto rear end of hollow crank shaft.

Situated between tank & carburettor is a petrol cock & a fine adjustment valve which regulates the supply of petrol to carburettor & also acts as a filter. The petrol is sprayed out of the jet & mixed with air in the carburettor & is then sucked along hollow crank shaft into crank case. Then to 9 holes in thrust box casing up the induction pipes & on induction stroke is sucked into cyls where it is in turn, compressed, fired & exhausted into air, via E.V.

Carburettor:- This is a "block tube" type & screws on rear end of crank shaft. It consists of a rectangular casing with 2 openings, for admission of air, these airports being surrounded with gauge. 2 exhaustion pipes are fitted from air ports

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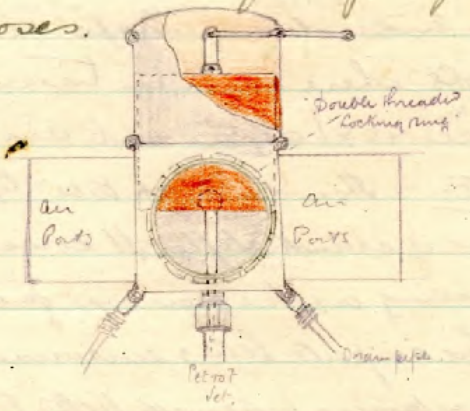
Fuse adjustment valve: is situated between petrol tank & carburettor & contains a needle valve regulating amount of petrol flowing to carburettor, It is also fitted with a fuse gauge for filtering purposes.



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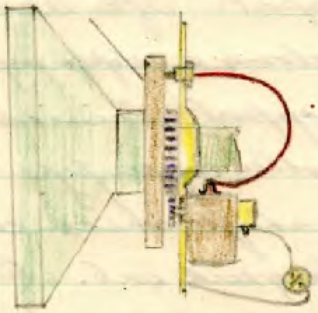
Wiring to plugs:- Mags revolve 9:4 engine speed clockwise. From H.T. terminal on mag a H.T. insulated wire is led to a carbon brush bolted to central support. This carbon brush is always in contact with distributor, which being keyed at rear of thrust box casing revolves at engine speed. From terminals on distributor bare brass wires are led to sparking plugs.



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Ignition timing :- Place any cyl. on compression stroke at 22° before T.D.C. Turn ignition wheel mag in direction of rotation i.e. clockwise, & 2 platinum pts are just about to break. Then mesh mag. wheel pinion wheel with engine spur wheel (on thrust box) & bolt up mag. Connect up H.T. & switch current. Care must be taken to synchronise both mags.

Lubrication :- The oil is gravity fed to oil pump bolted to central support. After leaving pump it is forced along a copper pipe to a union on central support. Coinciding with union is another copper pipe inside the hollow crank shaft which conveys oil as far as the long end web. The remainder of the shaft is drilled to four oil channels.

There are three outlets for oil. (i) At back of long end web lub. thrust box & contents. (ii) At crank pin lub boss of master connecting rod, big end pins & then passing down hollow connecting rods lub gudgeon pins,

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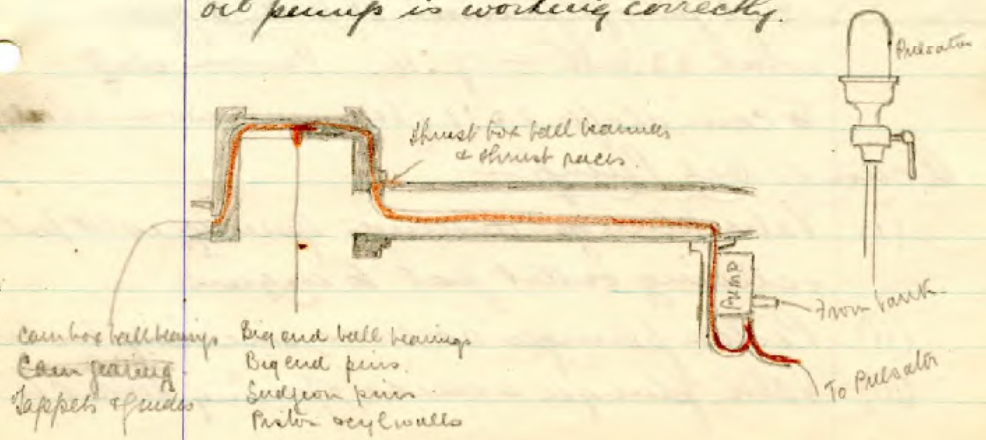
In cold weather 10% meths spirit is mixed with castor oil to prevent it from congealing.

Pulsator Glass:- is a dome shaped glass fitted to instrument board. Connected to main oil pipe by a lead taken from pipe between oil pumps & union on central support. The glass is ½ filled with oil & the pressure caused by the pump forcing oil to engine, also causes oil in glass to rise & pulsate. A tap is fitted on pulsator glass to turn of oil should glass get broken. The use of glass is to see that oil pump is working correctly.



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Oil Pump:- Consists of an aluminium casing bolted to central support containing a shaft on which are mounted 2 cases kept in contact with cams by spiral springs are a valve & piston plungers working in phospha bronze barrels.

Screwed to bottom of pump casing is an oil inlet chamber. This chamber is filled with oil by gravity from tank. The amount of oil being pumped to engine can be regulated by a screw which operates on piston plunger either lengthening or shortening the stroke.

The gearing of oil pumps is as follows.

Oil pump pinion 36 teeth to spur wheel 63 teeth = 7:4. Pinion shaft to cam shaft 25:1 (by worm & worm wheel).

Action of Oil Pump:—

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(ii) Piston plunger ascends succing in oil.

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Oil Pump:
Consists of an aluminium casing bolted to central support containing a shaft on which are mounted 2 cases kept in contact with cams by spiral springs are a valve & piston plungers working in phosphor bronze barrels. Secured to bottom of pump casing is an oil inlet chamber. This chamber is filled with oil by gravity from tank. The amount of oil being pumped to engine can be regulated by a screw which operates on piston plunger either lengthening or shortening the stroke. The gearing of oil pump is as follows: Oil pump pinion 36 teeth to spur wheel 63 teeth = 7:4. Pinion shaft to cam shaft 25:1 (by worm & worm wheel)

Action of oil pump:
(i) Valve plunger descends opening inlet port & closing outlet port to engine
(ii) Piston plunger ascends succing [sic] in oil
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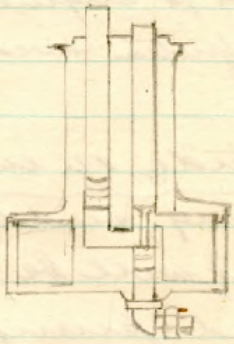
engine & closing inlet.

(iv) Piston plunger descends forcing oil to engine.



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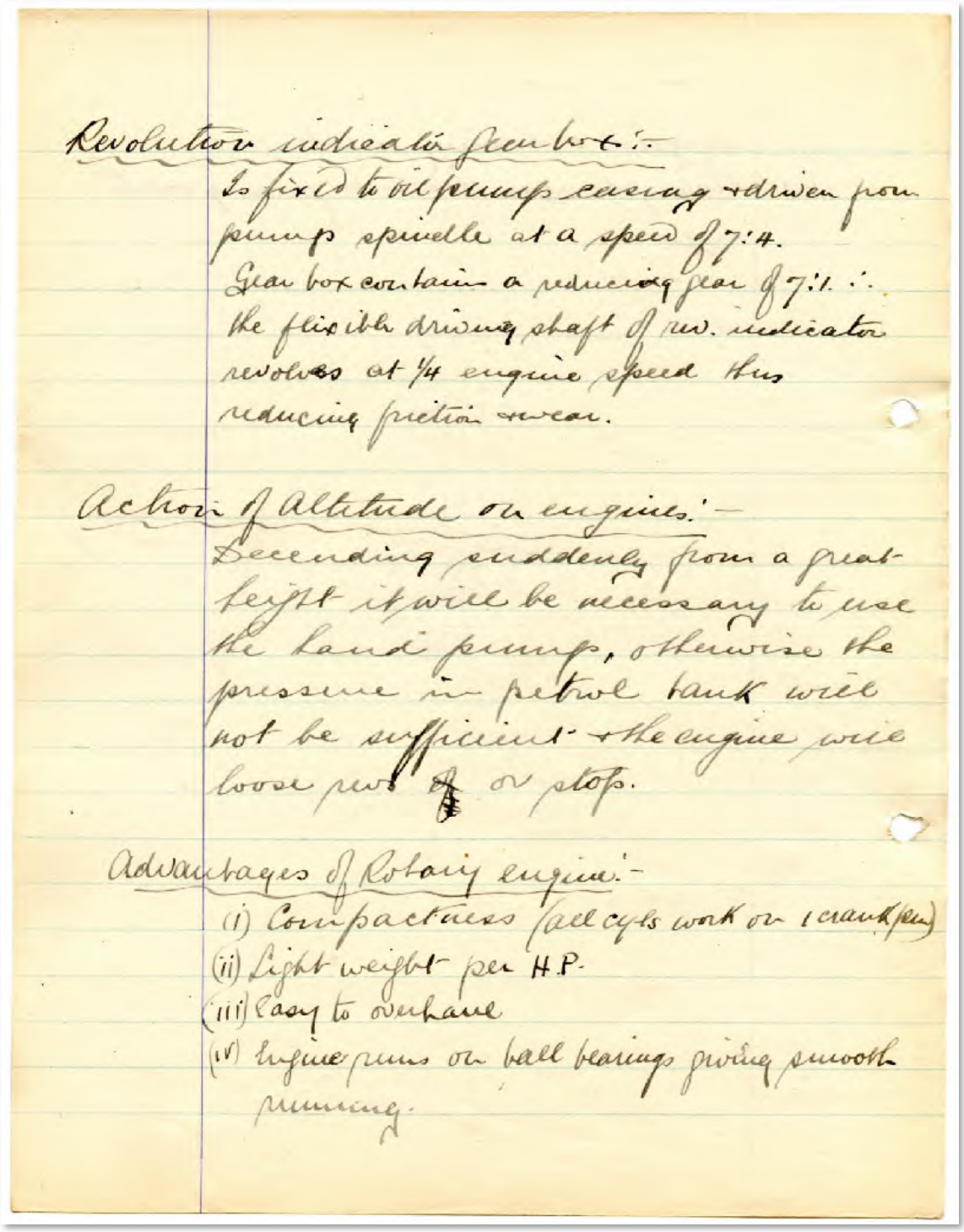

Revolution indicator gear box:-
Is fixed to oil pumps casing & driven from pumps spindle at a speed of 7:4.
Gear box contains a reducing gear of 7:1. ∴ the flexible driving shaft of rev. indicator revolves at ¼ engine speed thus reducing friction & wear.

Action of Altitude on engines:-
Descending suddenly from a great height it will be necessary to use the hand pumps, otherwise the pressure in petrol tank will not be sufficient & the engine will loose revs or stops.

Advantages of Rotary engine:-
(i) Compactness (all cyls work on 1 crank pin)
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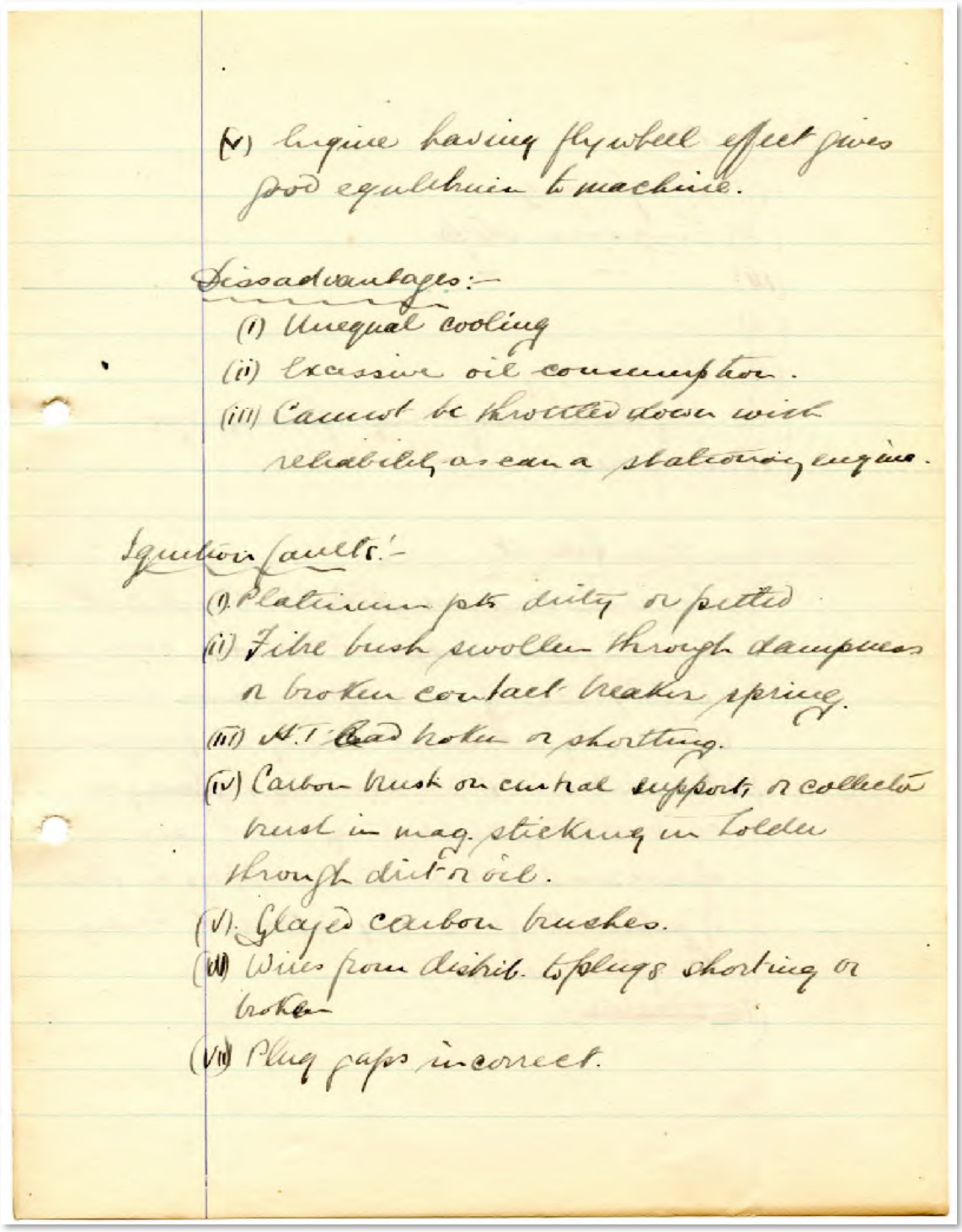


(iv) Engine having fly wheel effect gives good equilibrium to machine

Dissadvantages: [sic]

(i) Unequal cooling

(ii) Excessive oil consumption

(iii) Cannot be throttled down with reliability as a stationary engine

Ignition faults:

(v) Platinum pts dirty or pitted

(vi) Fibre bush swollen through dampness or broken contact breaks spring

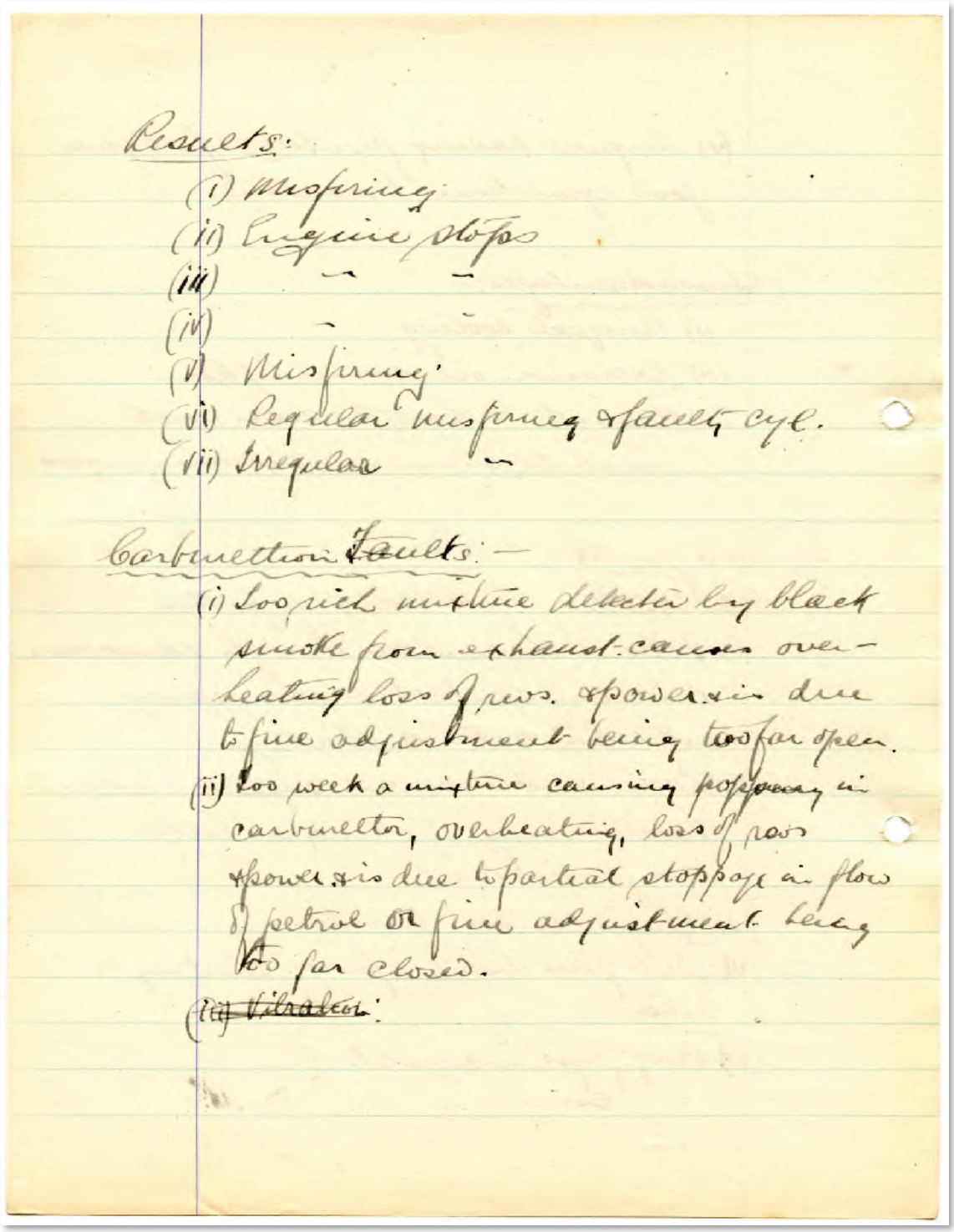
(viii) H.T. lead broken or shortting [sic]

(ix) Carbon brush on central support, or collector brush in mag sticking in holder through dirt or oil

(x) Glazed carbon brushes

(xi) Wires from distrib. to plugs shorting or broken

(xii) Plug gaps incorrect



Results:

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(i) Misfiring
(ii) Engine stops
(iii) " "
(iv) " "
(v) Misfiring
(vi) Regular misfiring & faulty cyl
(vii) Irregular "

Carburettor Faults:

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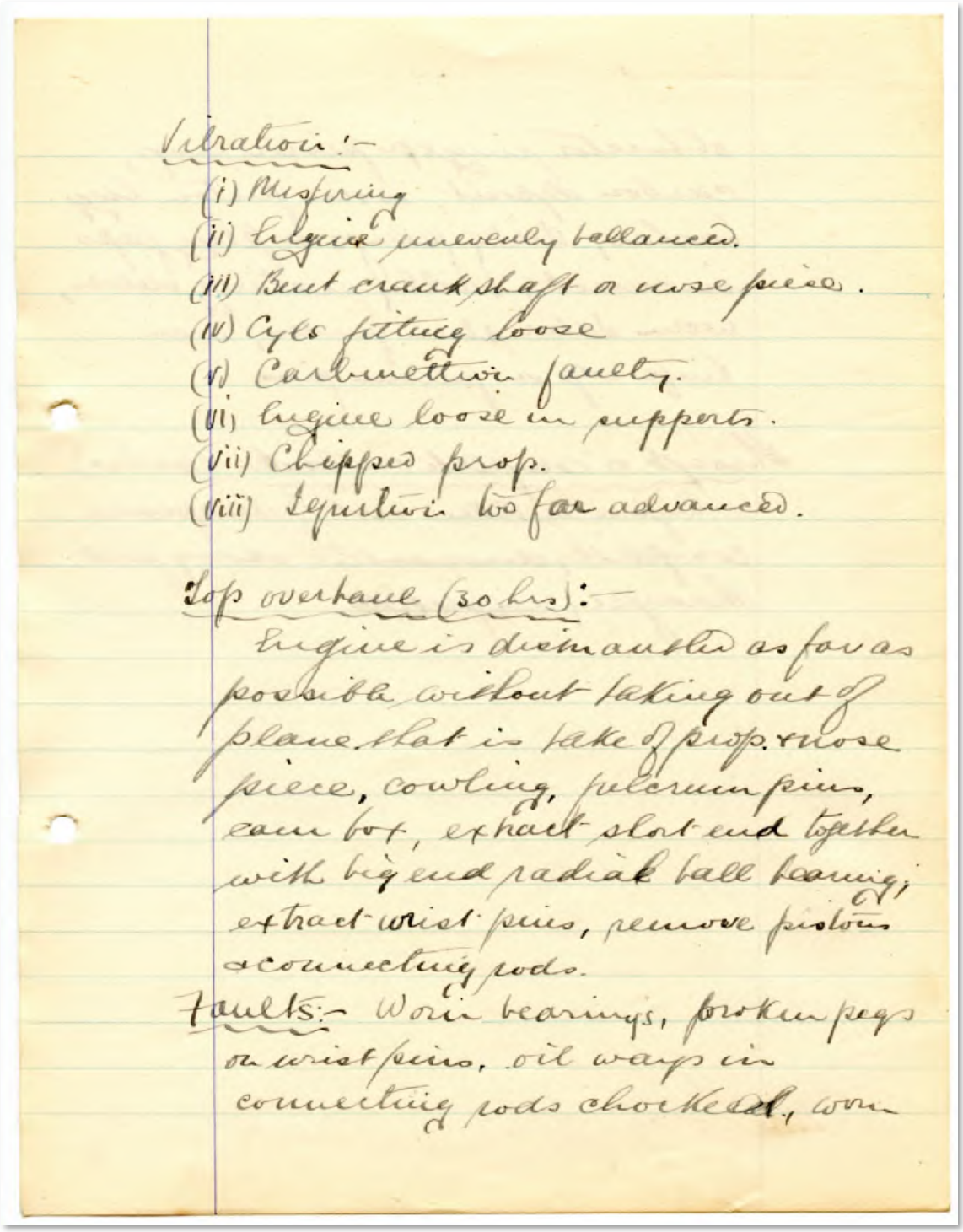
(i) Too rich mixture detected by black smoke from exhaust causes overheating loss of revs. & power & is due to fire adjustment being too far open
(ii) Too weak a mixture causing popping in carburettor, overheating, loss of revs & power & is due to partial stoppage in flow of petrol or fire adjustment being too far closed.
(iii) ~~Vibration~~

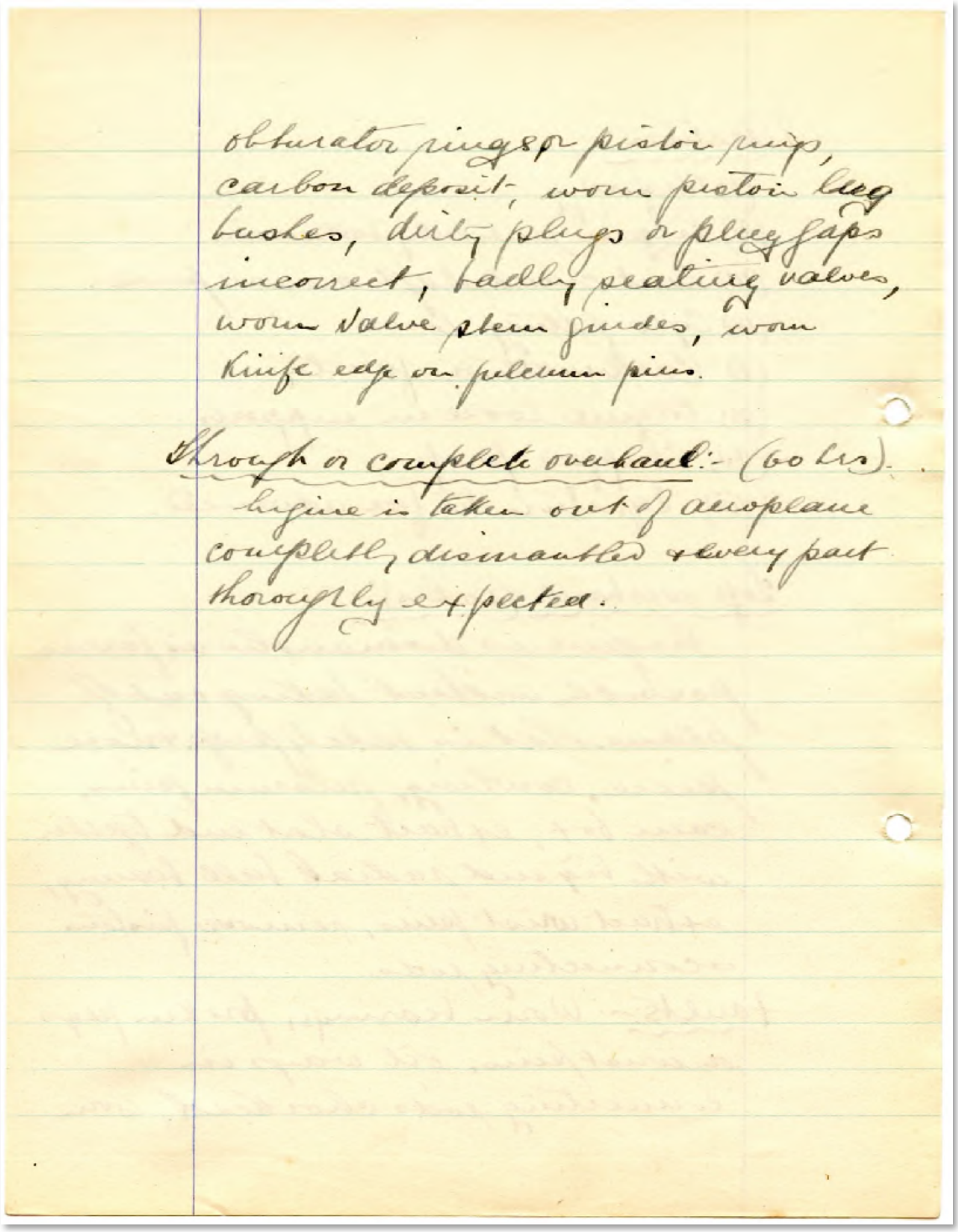


Vibration:

- (i) Misfiring
- (ii) Engine unevenly ballanced [sic]
- (iii) Bent crankshaft or nose piece
- (iv) Cyls fitting loose
- (v) Carburettor faulty
- (vi) Engine loose in supports
- (vii) Chipped prop
- (viii) Ignition too far advanced

Top overhaul (30 hrs):
Engine is dismantled a far as possible without taking out of plane, that is take of [sic] prop & nose piece, cowling, fulcrum pins, cam box, extract short end together with big end radial ball bearing, extract wrist pins, remove pistons & connecting rods.

Faults:
Worn bearings, broken pegs on wrist pins, oil ways in connecting rods chocked {sic], worn . . .



obturator rings or piston rings, carbon deposit, worn piston lug bushes, dirty plugs or plug gaps incorrect, badly sealing valves, worn valve stem guides, worn knife edge on fulcrum pins.

Through or complete overhaul:- (60 hrs).
Engine is taken out of aeroplane completely dismantled & every part thoroughly expected.

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