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AIR BOARD

TECHNICAL NOTES

ISSUED BY

· CONTROLLER ·

TECHNICAL DEPARTMENT

NOTE.

THE information contained herein is not to be communicated either directly or indirectly to any person not holding an official position in His Majesty's Service.

A.B.T.D. T.5. 8/17. 80 H.P. LE RHONE.

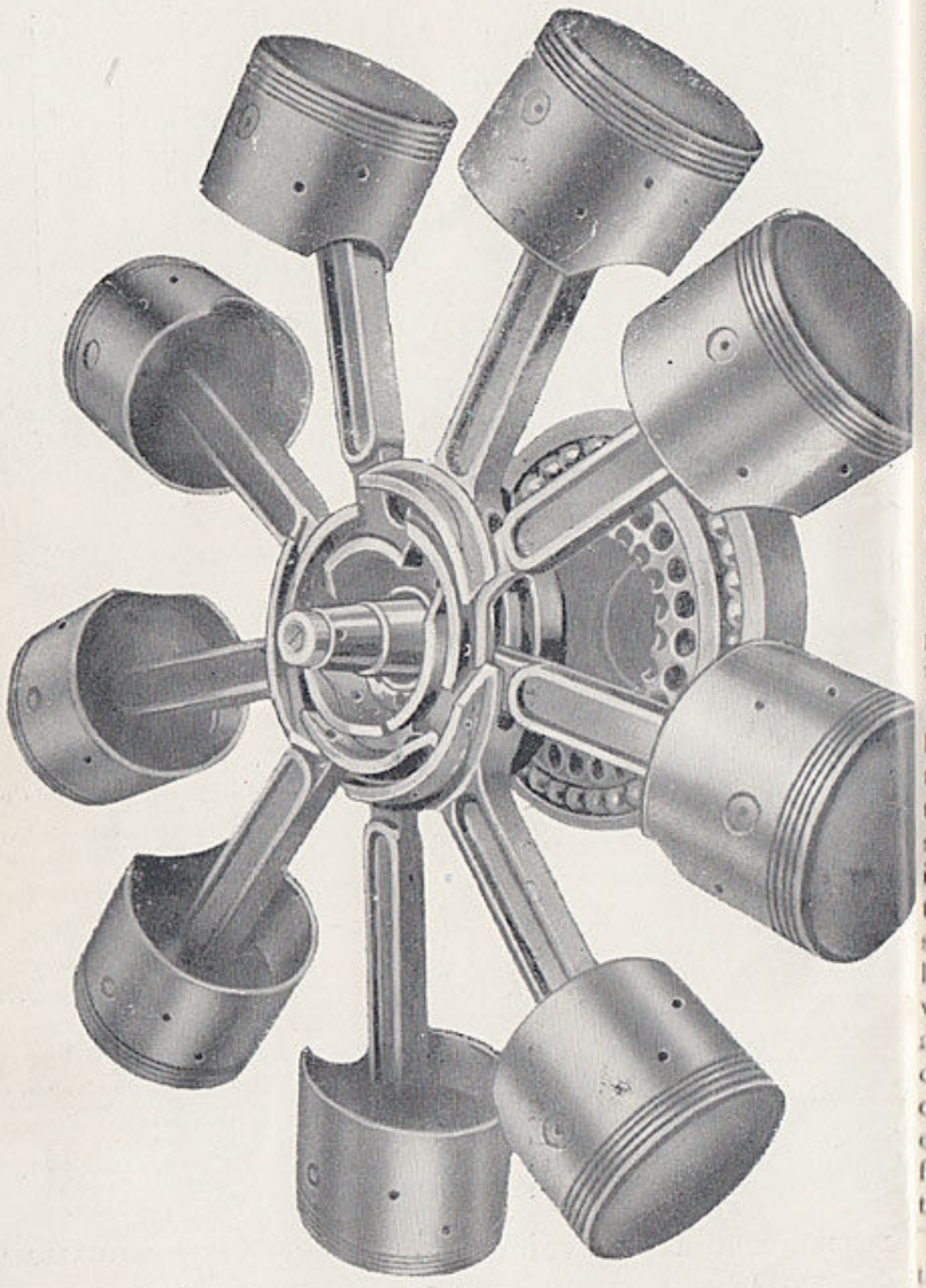


FIG. 6.

to allow the piston in the adjoining cylinder to clear at the bottom of the stroke. Each piston is fitted with 4 rings of special steel. The gaps in adjacent rings should be set at 90° apart, so that no 2 gaps are in the same line. The piston is attached to the connecting rod by means of a hollow steel gudgeon pin, which is locked in position by means of 2 steel set screws that pass through its ends and screw into the gudgeon pin bosses.

Piston clearance = 0.2 m.m.
Piston ring gap = 0.75 m.m.

CONNECTING RODS. The steel connecting rods are of H section, and are provided with shoes in place of the usual big end.* The big end proper, which is common to all the connecting rods, runs on 2 radial ball races, mounted on the long and short ends of the crankpin respectively. It consists of 2 steel discs with flanges at the back, in each of which the outer ring of a ball race is housed, and with a series of 3 bronze lined annular grooves in their faces, between which the connecting rod shoes lie. The rods are of 3 different lengths, 3 rods terminating in each of the 3 grooves, and the ends of the rods and the shoes are shaped in such a way that there is no fouling when the shoes oscillate in the grooves during rotation of the engine. The connecting rod small ends are of normal design, bushed with phosphor bronze.

VALVES. The inlet and exhaust valves in each cylinder head are mechanically operated by means of a light steel tappet rod and an overhead rocker arm, which is mounted on the fulcrum post at the head of the cylinder. The valve spindles slide in cast iron bushed steel guides that are screwed into the valve pockets. The tops of the valve spindles are threaded to take cupped washers, which hold in position the spiral valve springs. The tappet rods are jointed at their lower ends to the trailing ends of the cam roller rocker arms, which are mounted in the crankcase extension. These rocker arms have hardened steel rollers at either end, resting on the camplates. The inlet camplate is nearest the engine and carries the leading rollers, the trailing rollers running on the exhaust camplate. The edge of each camplate is cut in the form of 5 cams, and as the cam carrier is driven at nine-tenths of the engine speed, the engine overtakes the camplates

* The "shoe" system has the advantage of equalising the wear on the cylinders. Where a master rod is used the cylinder in which it works wears more rapidly than the others.

apertures for the tappet guides and induction pipes. At the rear of the engine is the thrust box, which contains a double thrust bearing of the normal type.* and a separate radial bearing. A third radial bearing, the main engine ball race, is situated between the thrust box and the crankcase. The outer race of this bearing lies in a recess in the crankcase and is gripped by the flange of the thrust box, where it is bolted to the crankcase. The noseplate and false noseplate are bolted to the extension on the front of the crankcase. The false noseplate runs on a double radial ball race at the extremity of the crankshaft, and drives the camplates at nine tenths of the engine speed, by means of a spur wheel, which engages with the inside of an annular toothed ring that is bolted to the cam carrier. The cam carrier runs on 2 separate radial ball races, which are mounted on a portion of the crankshaft small end, which is eccentric to the centre line of the engine.

CYLINDERS. The cylinders are numbered 1 to 9 consecutively in a clockwise direction, as seen from the propeller end of the engine. The order of firing is 1, 3, 5, 7, 9, 2, 4, 6, 8. They are of steel, with cast iron liners. This construction does away with the necessity for obturator rings, and obviates the necessity for scrapping cylinders that may be badly worn or scored in the bore. The head of each cylinder carries an inlet and an exhaust valve pocket, and a boss into which is screwed the tubular support for the rocker arm fulcrum pin. The face of the inlet valve pocket is machined and provided with lugs to take the bolts holding the upper end of the induction pipe in position. Owing to the valve pockets being integral with the cylinder, the valves cannot be removed without dismantling the cylinder. The cylinders are threaded, about 16 threads to the inch, at the base where they screw into the crankcase, and lock rings are provided by means of which they are locked in position. As the tappet rods and induction pipes are adjustable in length it will be seen that the compression space in this engine may be adjusted by screwing the cylinders into or out from the crankcase. For normal use the distance from the flat on the crankcase to the outside of the top radial fin on the cylinder should be 8", but for short distance flights and in very cold weather it may be reduced to $7\frac{15}{16}$".

PISTONS. The pistons are of cast iron with slightly convex heads. A portion of the skirt is cut away at the trailing edge

*This is a pure thrust bearing as distinct from the combined thrust and radial bearing used on the Gnome and Monosoupape engines.

A.B.T.D. T.5. 8/17. 80 H.P. LE RHONE.

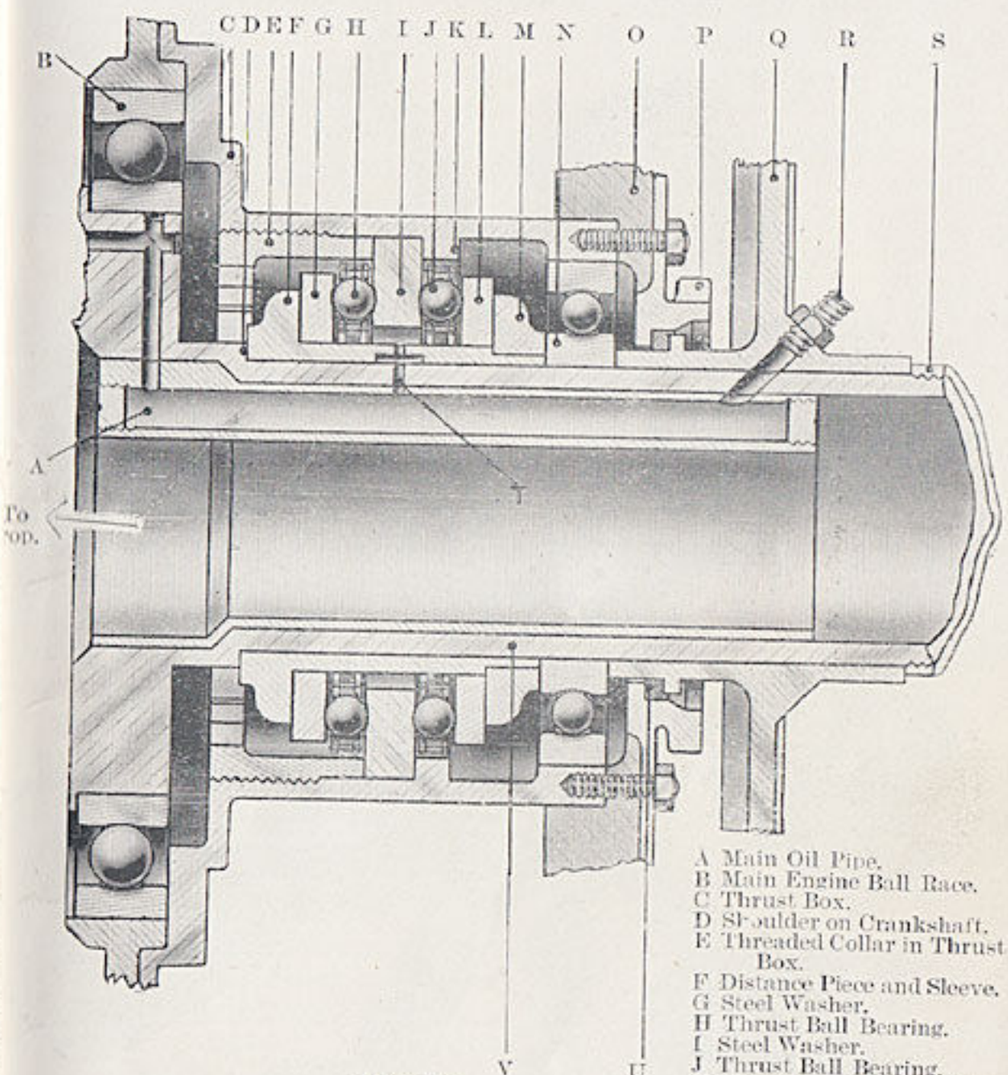
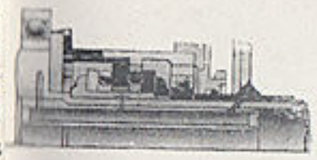


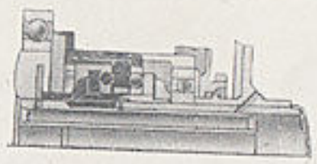
FIG. 3.

A Main Oil Pipe.
B Main Engine Ball Race.
C Thrust Box.
D Shoulder on Crankshaft.
E Threaded Collar in Thrust Box.
F Distance Piece and Sleeve.
G Steel Washer.
H Thrust Ball Bearing.
I Steel Washer.
J Thrust Ball Bearing.
K Shoulder on Thrust Box.
L Steel Washer.
M Distance Piece.
N Radial Ball Race.
O Distributor.
P Wheel driving Magneto and Oil Pump.
Q Backplate.
R Main Oil Inlet.
S Collar on Crankshaft.
T Restricted Opening.
U Felt Oil Retainer.
V Crankshaft.



PUSHER THRUST.

FIG. 4.



TRACTOR THRUST.

FIG. 5.

Pusher Thrust. C.E.I.J.L.M.N. Q.S.V.

Tractor Thrust. C.K.I.H.G.F. D.V.

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80 H.P. LE RHONE.

CRANKCASE. The crankcase is made of 2 steel stampi
bolted together by steel bolts, and centred by dowel pi
It has 9 apertures disposed symmetrically around its periph
to accommodate the 9 cylinders, each of which is gripp
tightly between the two parts of the crankcase and is prevent
from turning by a key. It is not supported directly on
crankshaft, but carries on its faces plates, or covers, kno
respectively as the cam gear case, and the thrust box, or r
drum. The thrust box contains the main engine ball rac
the double thrust race, and a second radial ball race.
cam gear box contains a large radial ball race at the end n
the crankweb, a smaller race at the end of the extension,
two races for the inlet and exhaust cams. These latter
mounted eccentrically on the crankshaft extension. The no
piece, which carries the propeller boss, is bolted to the fr
of the cam gear box, and holds in position a centreing pl
which forms a housing for the small ball race previously re
red to.

CYLINDERS. The cylinders are of nickel steel, machi
from the solid. The walls have a thickness of 3 m.m. T
are numbered 1 to 9 consecutively, in a clockwise direct
as seen from the propeller end of the engine. The order
firing is 1,3,5,7,9,2,4,6,8. The head of each cylinder is bo
and screwed to take the inlet and exhaust valve seatings;
bosses are provided into which the rocker arm fulcrum p
are screwed. An external shoulder near the bottom of the cy
der fits in a corresponding groove in the crankcase, and t
together with the key previously referred to, are the mean
fixing the cylinder in the crankcase. The bottoms of the cy
ders are cut away at the opposite sides where they wo
otherwise foul the connecting rods.

PISTONS. The pistons are of aluminium alloy with flat-c
cave heads. A portion of the skirt is cut away at the trail
edge to allow the piston in the neighbouring cylinder to cl
at the bottom of the stroke. Each piston carries a crossh
as in the case of the Gnome engine. The piston head is bo
to take the crosshead, which is flanged at the top so that
piston is gripped between this flange and a castellated
which is screwed up from underneath and locked by a sm

*Some manufacturers of this engine fit a self-aligning race, b
plain radial race is more usual.

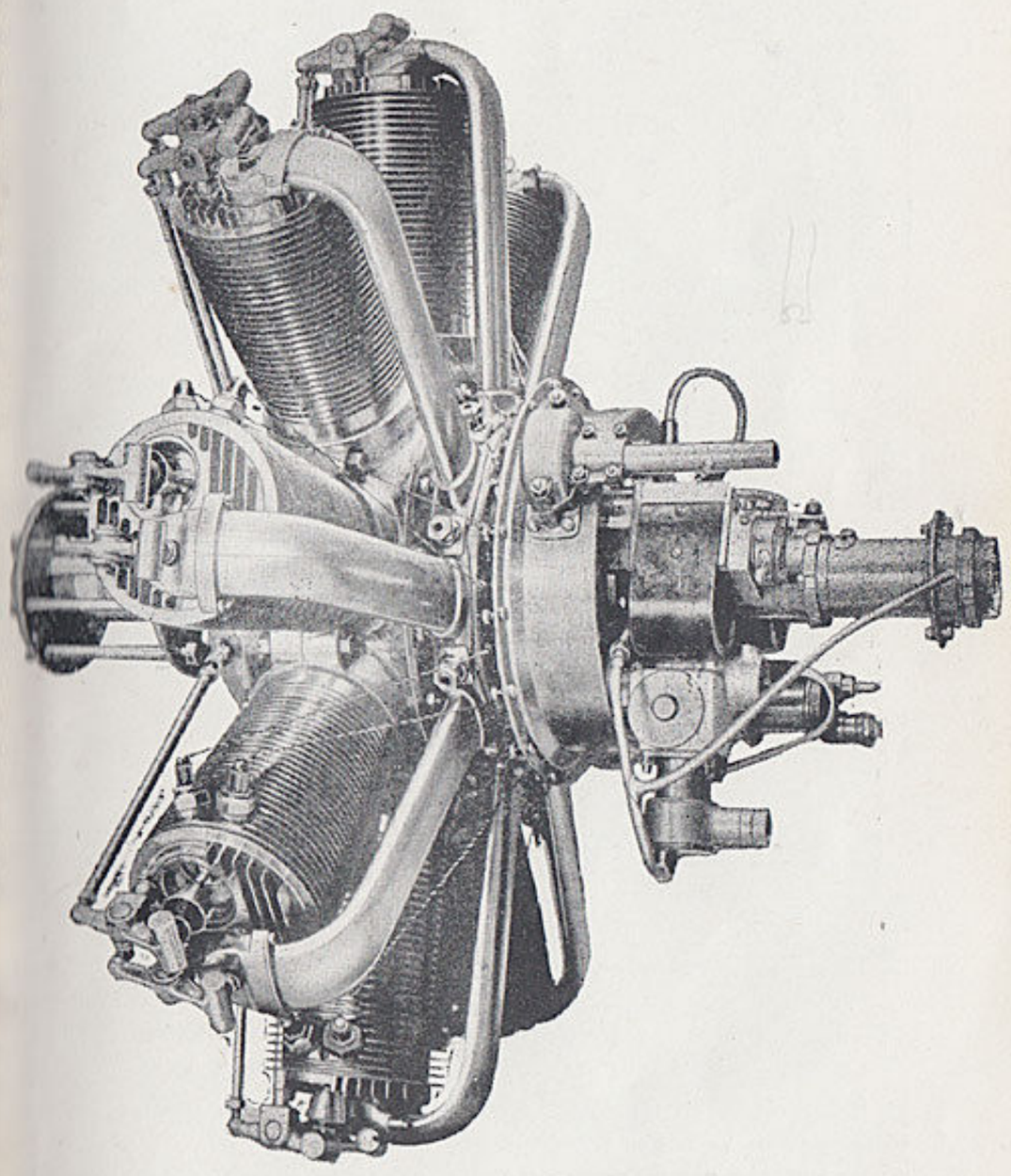


FIG. 2.

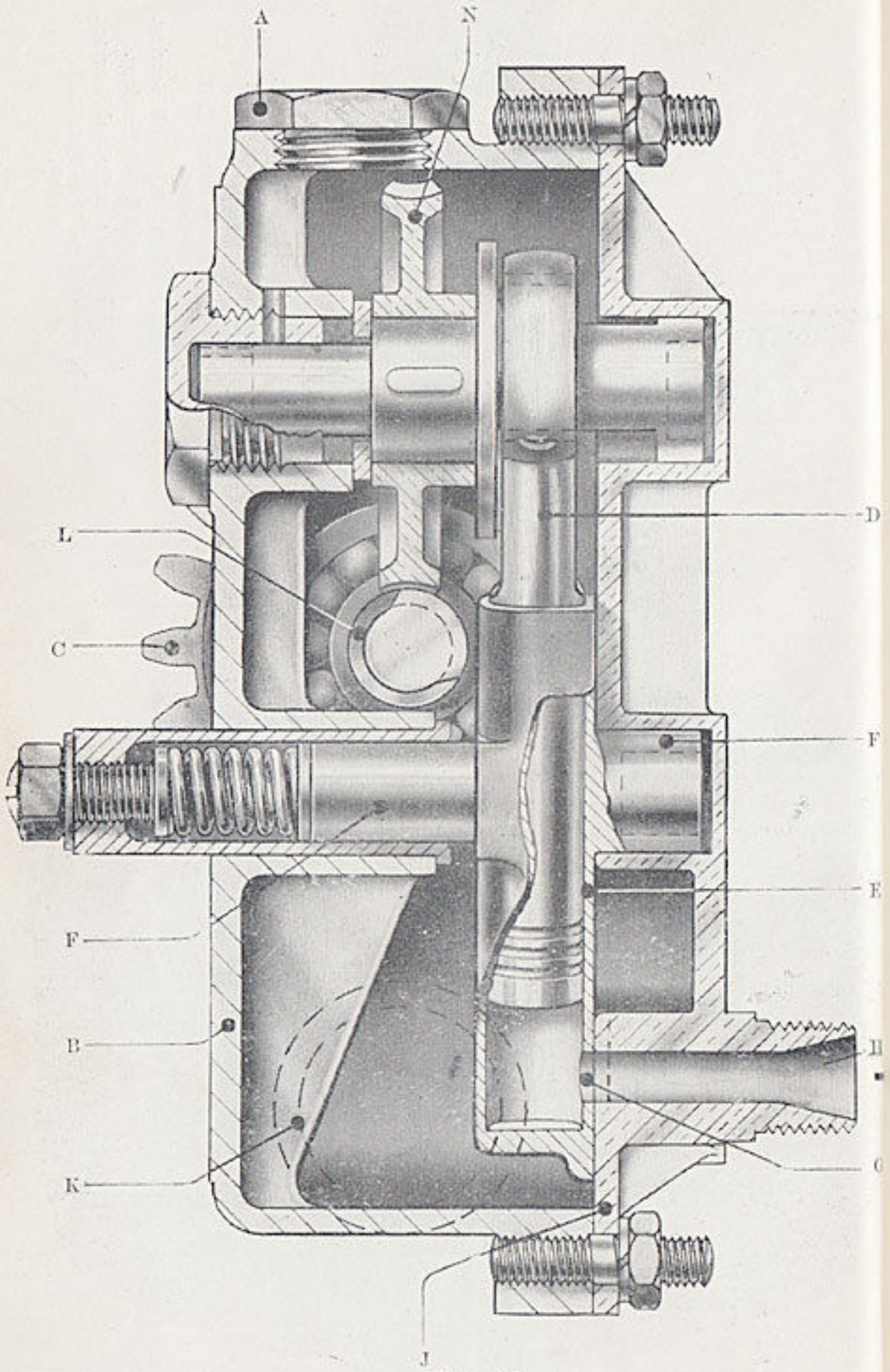


FIG. 12.
(For Descriptive Matter see Fig. 13.)

A.B.T.D. T.5. 8/17. 80 H.P. LE RHONE.

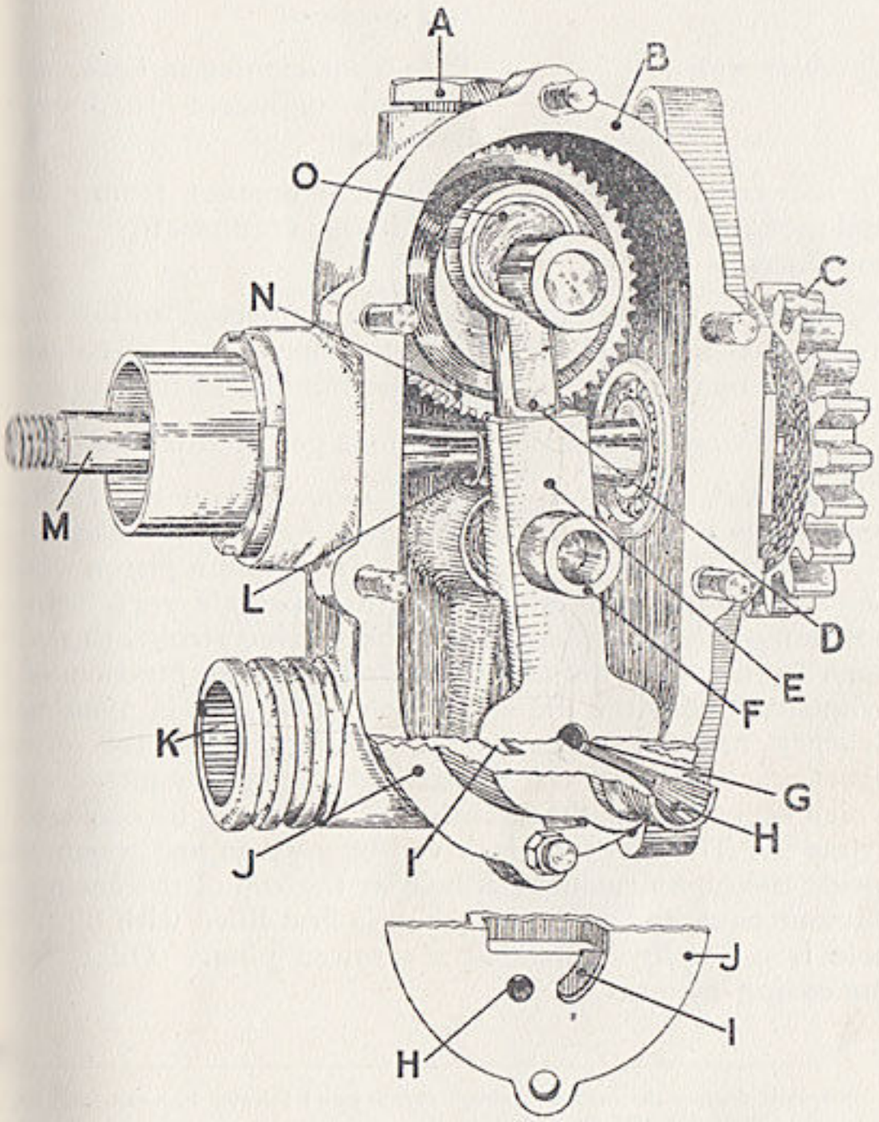


FIG. 13.

A Screwed Plug.
B Casing.
C Wheel driven by large Wheel on Engine Thrust Box.
D Piston.
E Cylinder.
F Pivots on which Cylinder oscillates.
G Cylinder Port.
H Delivery Port.
I Inlet Port.
J Casing Cover.
K Oil Supply.
L Worm.
M Revolution Indicator Drive.
N Worm Wheel.
O Eccentric.

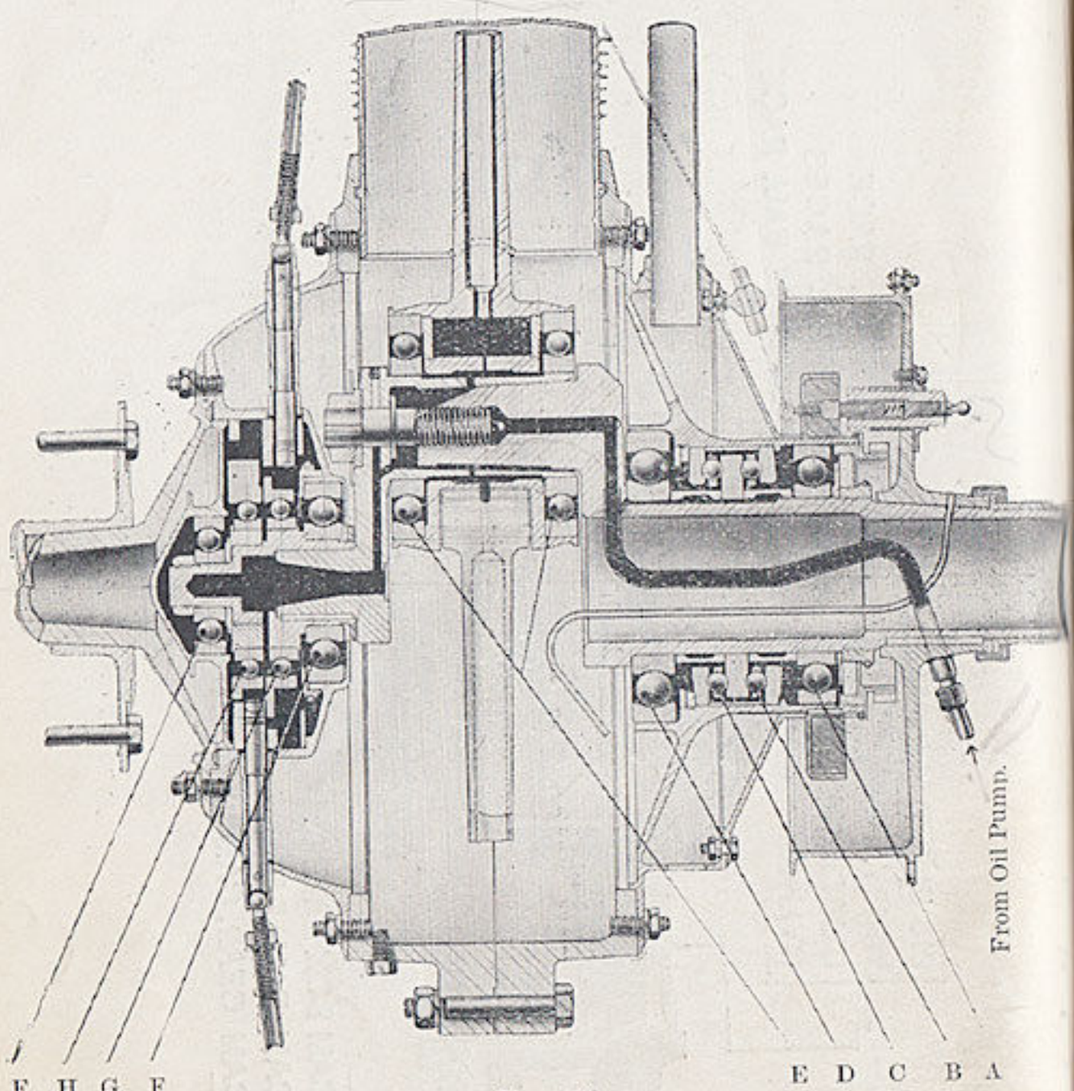


FIG. 10.

A Radial Ball Bearing.
B Tractor Thrust Ball Bearing.
C Pusher Thrust Ball Bearing.
D Main Engine Ball Bearing.
E Big End Ball Bearings.
F Cam Box Ball Bearings.
G Inlet Valve Cam Ball Bearing.
H Exhaust Valve Cam Ball Bearing.

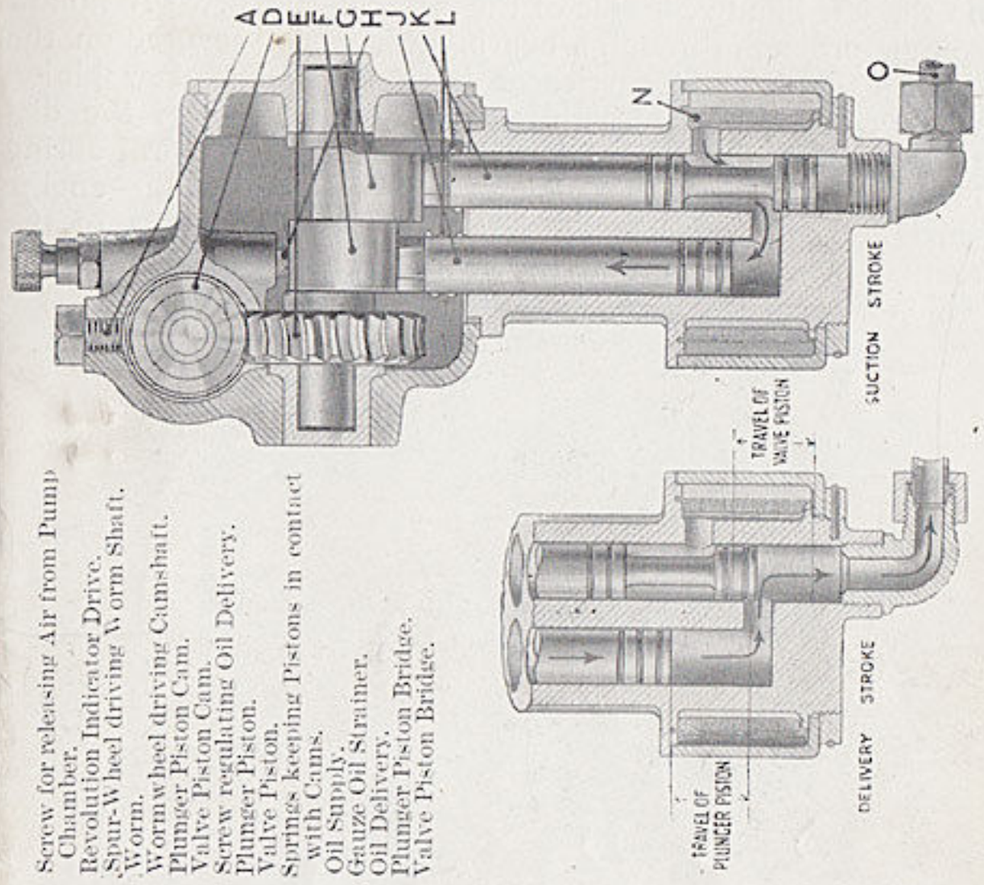


FIG. 12.

A Screw for releasing Air from Pump Chamber.
B Revolution Indicator Drive.
C Spur-Wheel driving Worm Shaft.
D Worm.
E Wormwheel driving Camshaft.
F Plunger Piston Cam.
G Valve Piston Cam.
H Screw regulating Oil Delivery.
J Plunger Piston.
K Valve Piston.
L Springs keeping Pistons in contact with Cams.
M Oil Supply.
N Gauze Oil Strainer.
O Oil Delivery.
P Plunger Piston Bridge.
Q Valve Piston Bridge.

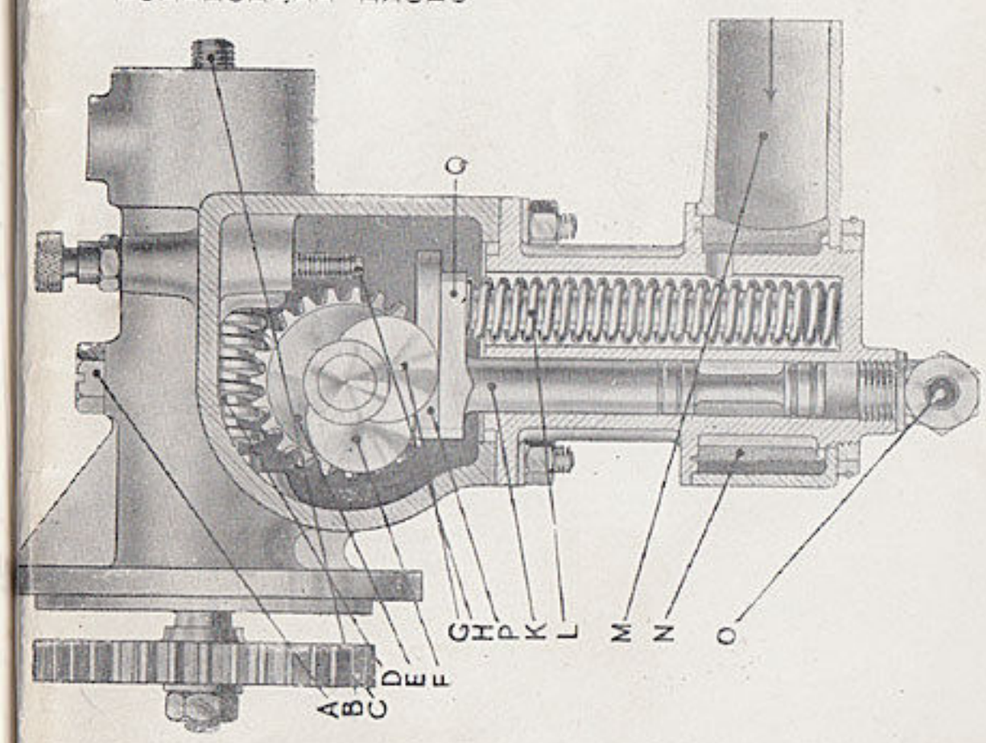


FIG. 11.

it is opposite a hole in the crankshaft. A branch also leads to the pulsator glass. The hole in the crankshaft terminates in a copper pipe through which the oil flows, inside the crankshaft, to the long end crankweb. This crankweb, the crankpin, and the short end crankweb, are drilled to form an oil lead which terminates in the hollow short end of the shaft and from which oil lead branches are taken to lubricate the various parts of the engine as follows :—

Part of engine.	Lubricated by.
Ball races, gears, cams and tappets in cam gear case.	Restricted opening in short end crankshaft extension.
Master connecting rod ball races, wrist pins, gudgeon pins, and cylinder walls.	Restricted opening in crank-pin to wrist pins (as in Gnome engine) and inside hollow connecting rods to gudgeon pins.
Main engine ball race and thrust box ball races.	Restricted opening at base of long end crankweb.

PULSATOR. The pulsator glass is mounted where it can be easily seen by the pilot. It shows whether the oil pump is working properly and the number of pulsations per minute is a measure of the engine speed which may be calculated as follows :—

R.P.M. of engine = Pulsations per minute × 14·3.

OIL PUMP. The oil pump is similar to that used in the Gnome and Monosoupape engines but it has 1 pump plunger and 1 valve piston only. It is driven by the large wheel on the back end of the thrust box and is fitted with an oil strainer and an adjustment for varying the lift of the pump plunger and so regulating the delivery of oil.

AIR PUMP. The air pump, which maintains the pressure in the petrol tank, is driven from the same wheel as the oil pump and magnetos through a triple thread worm and wheel. There are no suction valves as the inlet is through the sides of the pump barrel and a delivery valve is on the outer cover. The pump is single-acting with 1 crank. Ratio 9 revolutions of the pump crank to 16 of the engine. Discharge, 770 cubic inches of free air per minute, which is sufficient to displace 10 times the petrol consumed, by air at 4lbs. pressure per square inch above atmosphere.

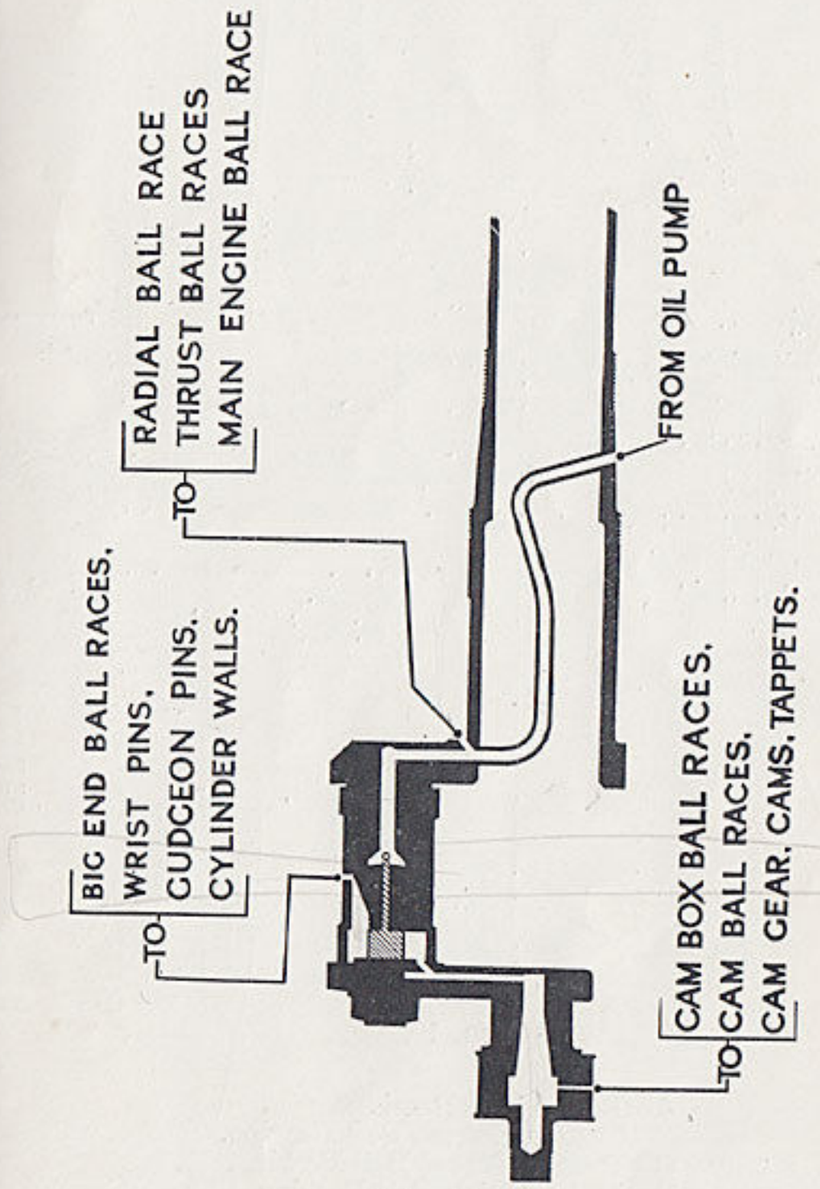


FIG. 9.

extreme throw of the eccentric, place the eccentric in position on the crankshaft extension, meshing the teeth so that this cam is under No. 4 exhaust tappet which will thus be held in its extreme outward position. After erection has been completed the adjustment of the tappet rods is made as follows:—

EXHAUST VALVE SETTING. Set any cylinder, for example No. 1, in exhaust opening position, i.e., 68° before B.D.C. on the power stroke and adjust the length of the tappet rod until the exhaust valve is just opening. Repeat for cylinders 3,5,7,9,2,4,6, 8. NOTE.—No. 1 cylinder is 68° before B.D.C. when the centre line of No. 6 is 2° above horizontal.

INLET VALVE SETTING. Set any cylinder, for example No. 1, in inlet valve closing position, i.e., 58° past B.D.C. on compression stroke, and adjust the length of the tappet rod so that the inlet valve is just closing. Repeat for cylinders 3, 5, 7, 9, 2, 4, 6, 8. NOTE.—No. 1 cylinder is 56° after B.D.C. when the centre line of No. 7 is 2° to the right of vertical.

IGNITION TIMING. Set any cylinder, for example No. 1, in ignition position, i.e., 25° before T.D.C. Turn the magneto in normal running direction until the contact points are just breaking, and mesh the magneto driving gear. Repeat with the second magneto. It is essential that the two magnetos be absolutely sychronised, i.e., that the two breaks occur at exactly the same instant. A fine vernier adjustment is provided for this purpose. NOTE.—No. 1 cylinder is 25° before T.D.C. when No. 5 is downwards with its centre line 5° to the left of vertical.

MAGNETOS. The magnetos are mounted on the central support and driven by a large wheel on the back end of the thrust box. Each magneto pinion has 28 teeth and the driving wheel 63 teeth, so that the magneto armature makes 9 revolutions to 4 of the engine. As the magnetos are of the rotating armature type, they give 2 sparks per revolution, so that there will be 9 sparks in 2 revolutions of the engine during which each cylinder will have completed 1 cycle. The high tension current from both magnetos is taken to the distributor which is mounted on the thrust box. The distributor has 2 rings with 9 contacts on each. One ring of contacts receives high tension current from the first magneto, and the other ring of contacts receives high tension current

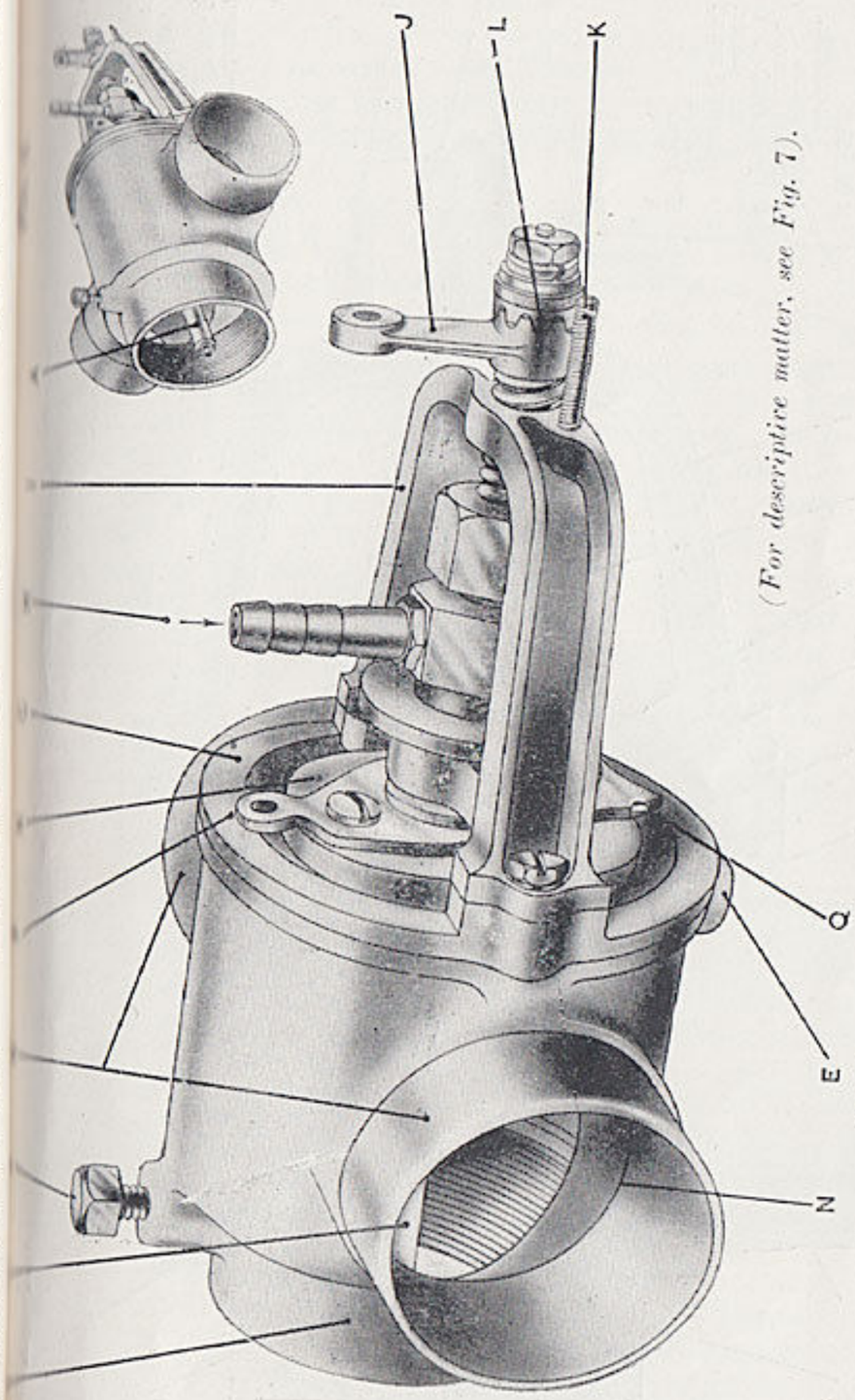


FIG. 5.

(For descriptive matter, see Fig. 7).

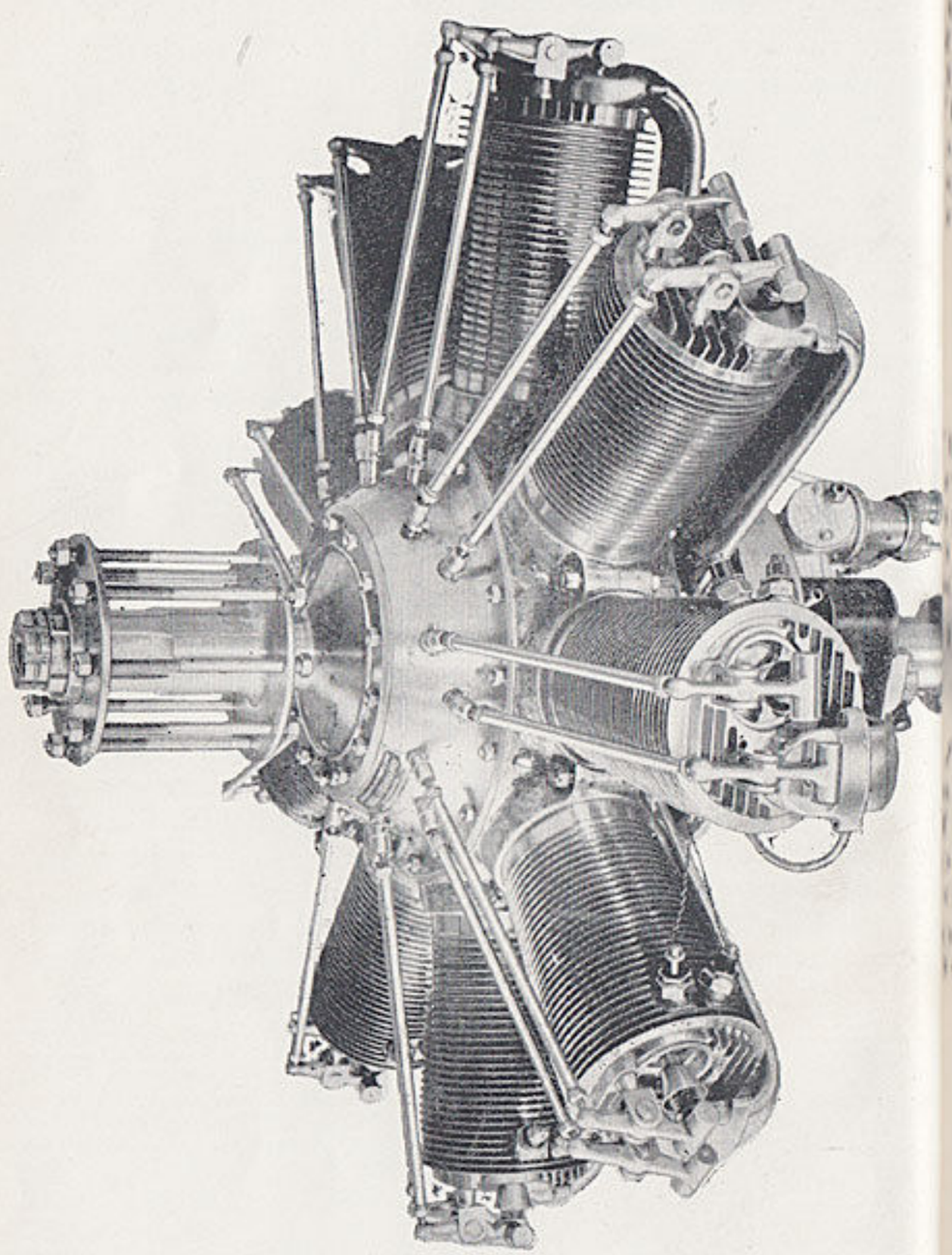


FIG. 1.

110 H.P. CLERGET ENGINE.

GENERAL DESCRIPTION. This engine is of the rotary air cooled type, with 9 cylinders, 120 m.m. by 160 m.m., rated at 110 H.P., but capable of developing 130 H.P. at 1,200 R.P.M. *It is fitted with a double thrust ball race, which enables it to be used either as a pusher or as a tractor.

The engine works on the Otto, or 4 stroke cycle, 2 revolutions of the engine giving 1 cycle (4 strokes) in each cylinder. Its chief points of difference from other rotary engines are :—

(1). The pistons are of aluminium alloy.
(2). The connecting rods are of tubular section.
(3). The inlet and exhaust cams are mechanically operated by means of separate cams, tappets and rocker arms.

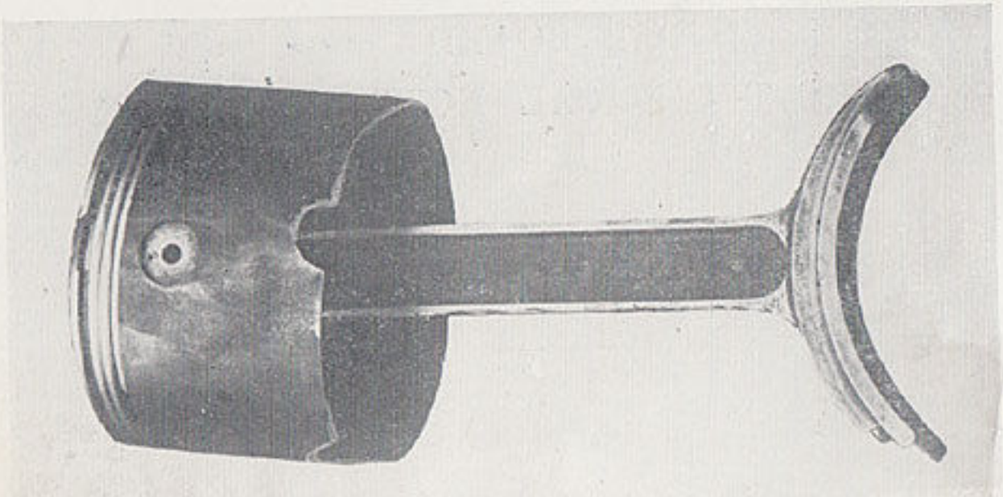
The direction of rotation is anti-clockwise as seen from the propeller end of the engine. Like all other rotary engines it is made chiefly of steel, for strength and lightness. The angle through which the engine turns between any 2 consecutive explosions is 80°.

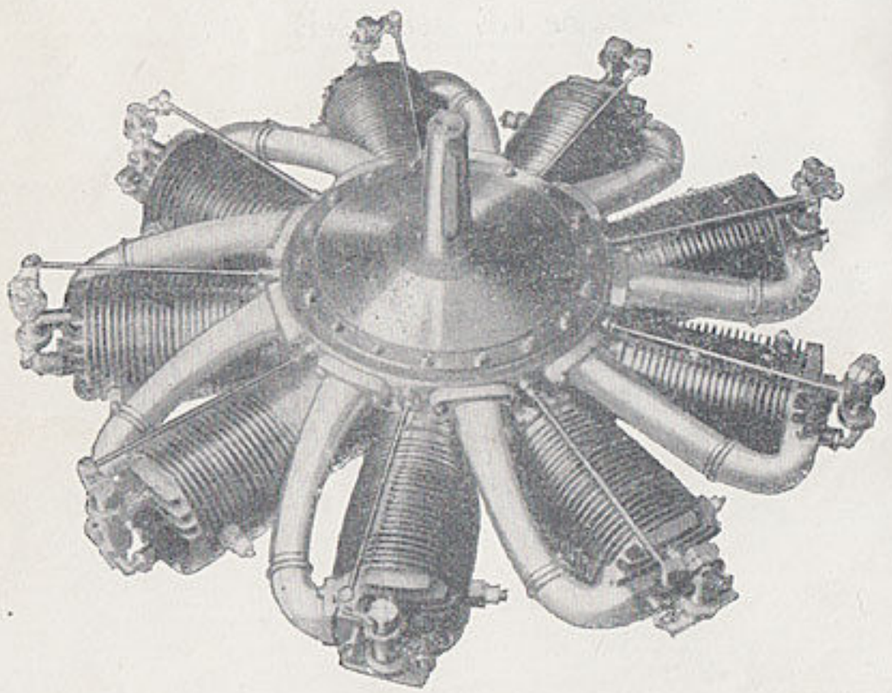
Approx. oil consumption =2 galls. per hour.
" petrol consumption=10 galls. per hour.
" weight of engine =365 lbs, i.e., 3.3 lbs per rated H.P.

CRANKSHAFT. The forged steel crankshaft is hollow, and, as in all single line rotary engines, has 1 throw. It consists of 2 main parts, the long end and the short end, which are connected by a telescopic joint at the crankpin. An extension keyed to the short end carries the cam gear and the cam on ball races. The crankshaft is stationary and serves the following purposes :—

(1). It provides a means of attaching the engine to the aeroplane.
(2). It conveys the oil to the working parts.
(3). The carburetter is mounted on the rear end of the hollow crankshaft, which acts as an induction pipe.
(4). It provides, in the crankpin, the fixed point against which the force of the explosion exerts itself in turning the engine.

*This is a pure thrust bearing and distinct from the combined thrust and radial bearing used in the Gnome and Monosoupape engines.





80 H.P. LE RHONE ENGINE.

GENERAL DESCRIPTION. This engine is of the rotary air cooled type, with 9 cylinders, 105 m.m. by 140 m.m., rated at 80 H.P., but capable of developing 93 H.P. at 1,200 R.P.M. It is fitted with a double thrust ball race, which enables it to be used either as a pusher or tractor. The engine works on the "Otto," or 4 stroke cycle, 2 revolutions of the engine giving 1 cycle (4 strokes) in each cylinder. Its chief points of difference from other rotary engines are :—

(1). The cylinders are fitted with cast iron liners.
(2). No obturator rings are fitted.
(3). There are 9 curved copper induction pipes which convey the explosive mixture from the crankcase to the inlet valves.
(4). There is no master connecting rod.
(5). The inlet and exhaust valves in each cylinder are operated by 1 tappet rod.

The direction of rotation is anti-clockwise as seen from the propeller end of the engine. Like all other rotary engines, it is made chiefly of steel, for strength and lightness. The angle through which the engine turns between any 2 consecutive explosions is 80°.

Approx. oil consumption = 1 gallon per hour.
„ petrol consumption = 6 to 7 gallons per hour.
„ weight of engine = 240 lbs., i.e., 3 lbs per rated H.P.

CRANKSHAFT. The crankshaft is of chrome nickel steel. It is hollow and in 2 parts, a long end and a short end, which are united by a coned joint and centred by means of a round key. As in all single line rotary engines, it has 1 throw. It is stationary, and serves the following purposes:—

(1). It provides a means of attaching the engine to the aeroplane.
(2). It conveys oil to the working parts.
(3). The carburetter is mounted on the rear end of the hollow crankshaft, which acts as induction pipe.
(4). It provides, in the crankpin, the fixed point against which the force of the explosion exerts itself in turning the engine.

CRANKCASE. The steel crankcase is made in 1 piece, with 9 circular apertures disposed symmetrically around the periphery, and threaded to take the 9 cylinders. It has an extension at the front, i.e., propeller end of the engine, with