AIR BOARD

TECHNICAL NOTES.

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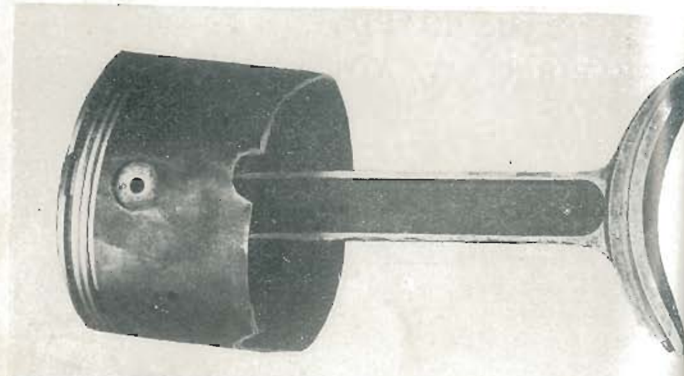
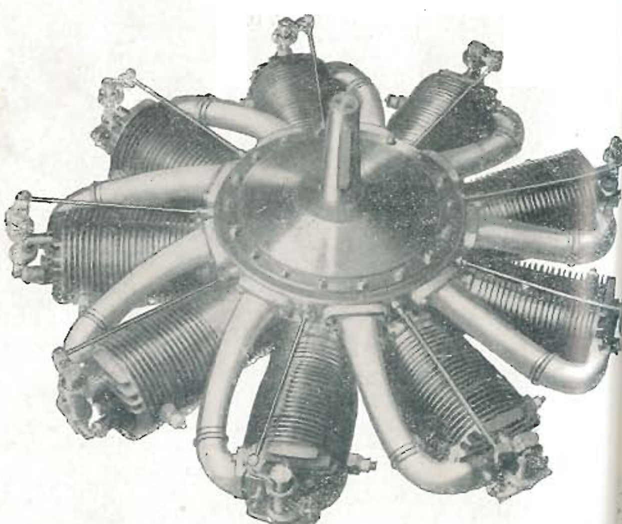
80 H.P. LE RHONE.





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

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

CYLINDERS. The cylinders are numbered 1 to 9 consecu
ly in a clockwise direction, as seen from the propeller e
the engine. The order of firing is 1, 3, 5, 7, 9, 2, 4, 6, 8.
are of steel, with cast iron liners. This construction
away with the necessity for obturator rings, and obviate
necessity for scrapping cylinders that may be badly wo
scored in the bore. The head of each cylinder carries an
and an exhaust valve pocket, and a boss into which is sc
the tubular support for the rocker arm fulcrum pin.
face of the inlet valve pocket is machined and provided
lugs to take the bolts holding the upper end of the ind
pipe in position. Owing to the valve pockets being in
with the cylinder, the valves cannot be removed withou
mantling the cylinder. The cylinders are threaded, ab
threads to the inch, at the base where they screw in
crankcase, and lock rings are provided by means of whic
are locked in position. As the tappet rods and inductio
are adjustable in length it will be seen that the compr
space in this engine may be adjusted by screwing the cyl
into or out from the crankcase. For normal use the di
from the flat on the crankcase to the outside of the top
fin on the cylinder should be 8", but for short distance
and in very cold weather it may be reduced to $7\frac{15}{16}$".

PISTONS. The pistons are of cast iron with slightly c
heads. A portion of the skirt is cut away at the trailin

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

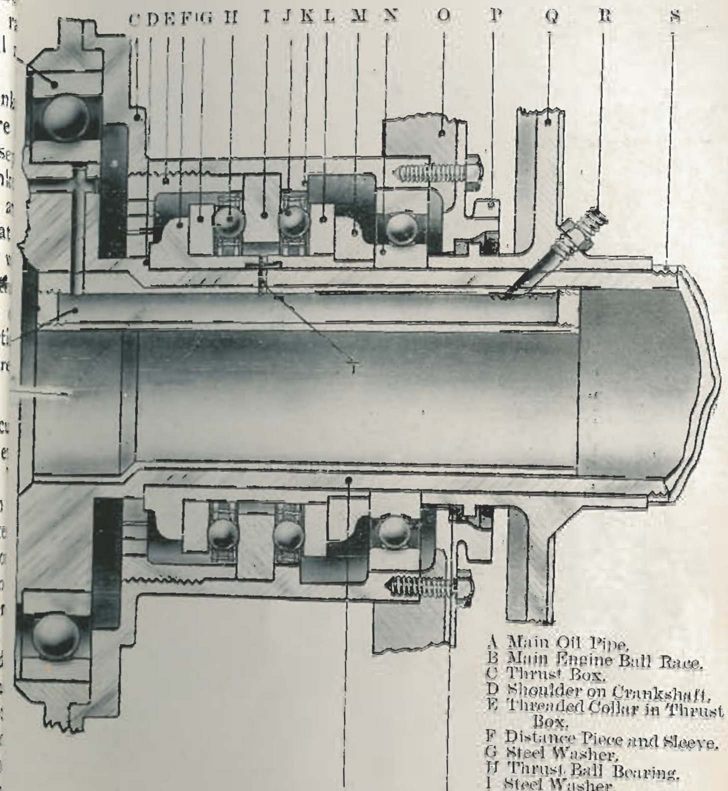


FIG. 3.

PUSHER THRUST.
FIG. 4.

TRACTOR THRUST.
FIG. 5.

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

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

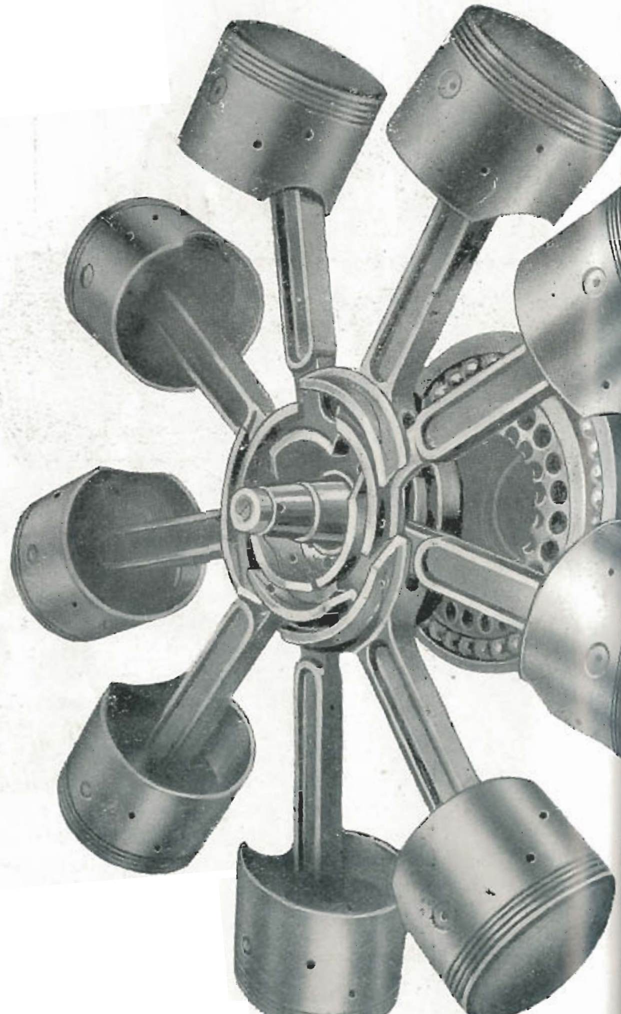


Fig. 6.

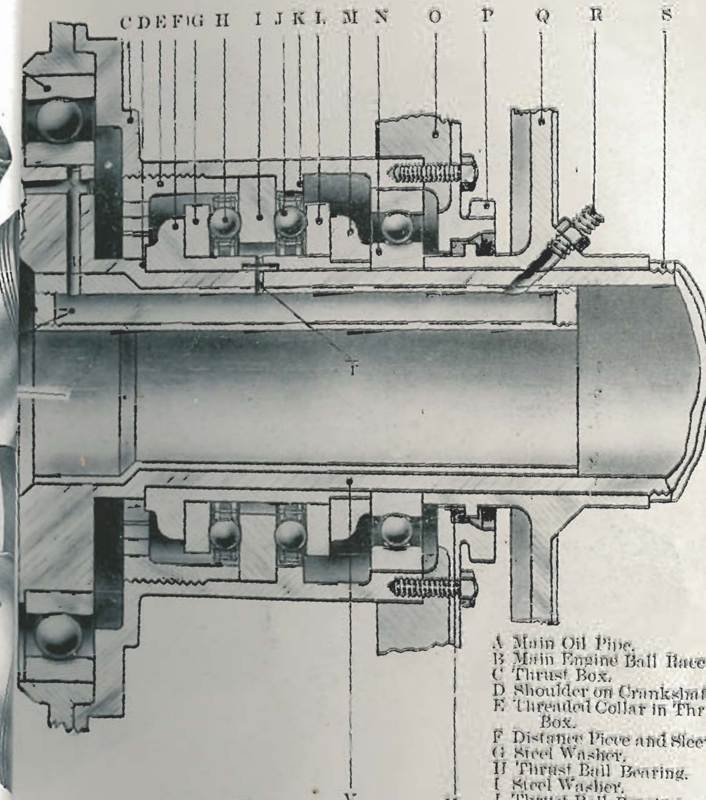
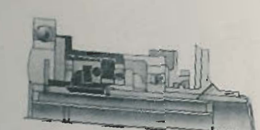


FIG. 3.

PUSHER THRUST.

FIG. 4.



TRACTOR THRUST.

FIG. 5.

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

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

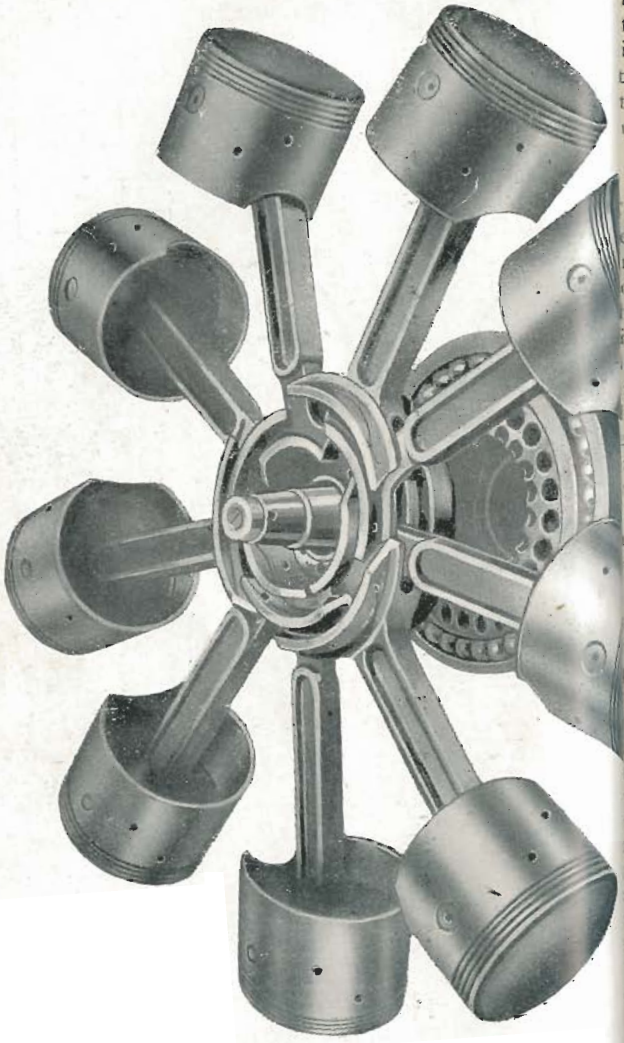


Fig. 6.

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

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

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

ALVES. The inlet and exhaust valves in each cylinder ead are mechanically operated by means of a light steel appet rod and an overhead rocker arm, which is mounted on he fulcrum post at the head of the cylinder. The valve pindles slide in cast iron bushed steel guides that are screwed nto the valve pockets. The tops of the valve spindles are hreaded to take cupped washers, which hold in position the piral valve springs. The tappet rods are jointed at their ower ends to the trailing ends of the cam roller rocker arms, which are mounted in the crankcase extension. These rocker rms have hardened steel rollers at either end, resting on the amplates. The inlet camplate is nearest the engine and arries the leading rollers, the trailing rollers running on the xhaust camplate. The edge of each camplate is cut in the orm of 5 cams, and as the cam carrier is driven at nine-enths of the engine speed, the engine overtakes the camplates

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

once in every 10 revolutions, during which period the are operated 5 times. The clearance between the rocker arm and the valve stems should be as follows:–

Engine cold, Inlet=1 to 1.2 m.m. Exhaust=0.8 to

CYCLE OF OPERATIONS. Starting with any cylin T.D.C. and the exhaust valve just about to close, the c moves forward until it is 5° past T.D.C., at which po exhaust valve closes. The cylinder then moves forwar it is 18° past T.D.C., when the inlet valve opens and s commences. At 35° past B.D.C. the inlet valve closes, cylinder moves on towards T.D.C. on the compression At 26° before T.D.C. ignition takes place and the c moves on to the working stroke, passing T.D.C. wh flame is spreading through the mixture. The exhaus opens 45° before B.D.C., and remains open throu remainder of the cycle.

Admission of explosive mixture -	18° to 215°.
Compression - - - -	215° to 360°.
Power - - - - -	0° to 135°.
Exhaust - - - -	135° to 360° + 5°.

VALVE TIMING. Set No. 1 cylinder at T.D.C. on the stroke, i.e., with both valves closed, Adjust the length tappet rod so that, when it is held outwards as if by cen force, there is a clearance of 1 to 1.2 m.m. between the arm and the inlet valve stem, and a clearance of 0.8 to between the rocker arm and the exhaust valve stem. the cylinder through 90° to the right and to the l check the clearances in such position. Repeat for c 3, 5, 7, 9, 2, 4, 6, 8. It should be noted that in tim engine the cam position is not altered. The cams are bled and the gears meshed in accordance with the m on the parts when the engine is erected, and no alter necessary.

IGNITION TIMING. Set any cylinder, for example in ignition position, i.e., 26° before T.D.C., on com stroke. To get this position set No. 7 cylinder to with its tappet rod horizontal. Turn the magneto in mal running direction until the points are just brea mesh the magneto driving gear. Wire the distribut plugs. The timing of the engine is then complete.

MAGNETO. The magneto is mounted on the back driven by a large wheel on the back of the thrust b the case of the 80 H.P. Gnome engine. The magne

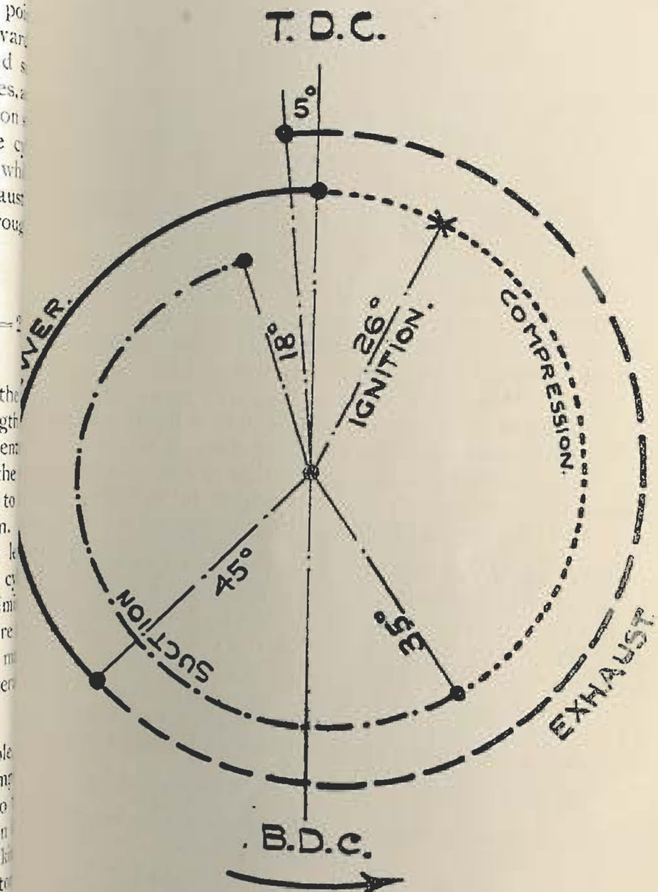


Fig. 7.

has 16 teeth, and the driving wheel 36 teeth, so that neto armature makes 9 revolutions to 4 of the engine magneto is of the rotating armature type, it gives 2 s revolution, so that there will be 9 sparks in 2 revol the engine, during which period each cylinder will h pleted 1 cycle. The high tension current from the is taken to the distributor which is mounted on the th as in the Gnome engine.

CARBURATION. The carburetter used in this en the "Block Tube" type. It is mounted on the e hollow crankshaft, through which the explosive mixtu to the crankcase and thence through the curved pipes to the cylinders. The body is cylindrical in sh practically forms an extension of the crankshaft. fed through a fine adjustment valve, controlled from t seat to a horizontal jet at the side of the body. This j throttle slide from which projects a tapered needle. Th of the needle enters the jet and as the throttle slide is needle is pushed forward, and reduces the flow of pe the jet. Drains are provided to carry away surpl At the back of the throttle slide the body is lined with able copper gauze cylinder, the function of which is the 2 horizontal air intakes, which are disposed side of the carburetter, and are joined by rubber c pieces to extensions leading to the outside of the fu

LUBRICATION. The pump delivers oil to an incli in the engine backplate, which is mounted opposite in the crankshaft. The oil passes through this pipe leading to the long end of the crankshaft. from this pipe leads to the pulsator glass. The c crankpin, and short end of the crankshaft are drille to form an oil lead from which branches are take cate the various parts of the engine, as follows :—

Part of engine.	Lubricated by
False noseplate ball race.	Restricted opening in sh crankshaft.
Cam carrier ball race.	Restricted opening in portion of crankshaft sh
Cams, cam rollers, rocker arms and tappets.	Curved pipe leading fro opening at base of crank web.

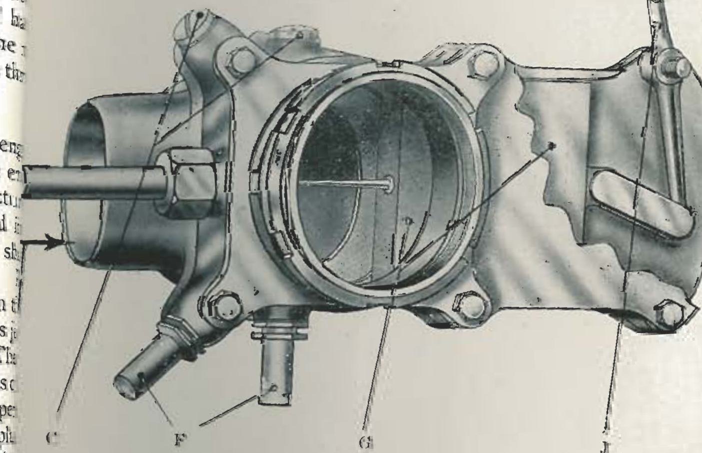


FIG. 8.

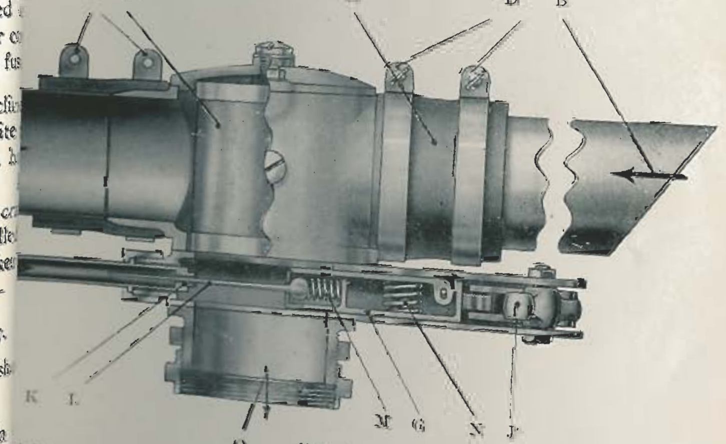
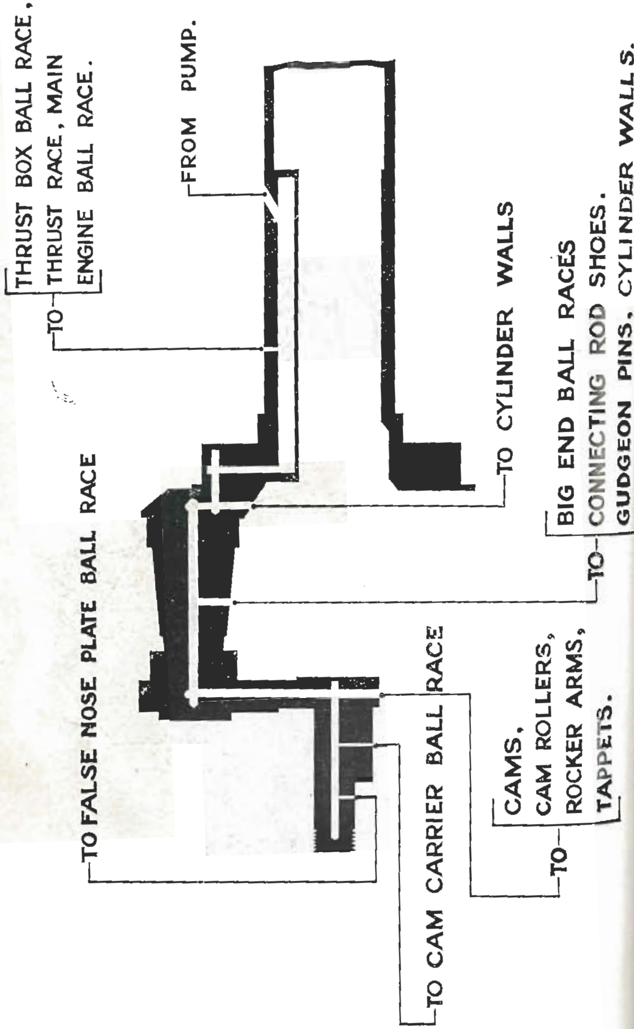


FIG. 9.

l Pipe.
ntake extending to outside of Fuselage.
native Position for Petrol Overflow
ipes.
l Clamps.
Gauze.
l Overflow Pipes.
ttle Slide.
ber Joint.

J Control Lever.
K Needle Valve Seating.
L Needle Valve.
M Spring maintaining Needle Valve on Spherical Seat.
N Spring maintaining Pressure on Faces of Throttle Slide.
O To Engine.


TO THRUST BOX BALL RACE, THRUST RACE, MAIN ENGINE BALL RACE.
FROM PUMP.
TO CYLINDER WALLS
TO BIG END BALL RACES CONNECTING ROD SHOES. GUDGEON PINS. CYLINDER WALLS.
TO FALSE NOSE PLATE BALL RACE
TO CAM CARRIER BALL RACE
TO CAMS, CAM ROLLERS, ROCKER ARMS, TAPPETS.

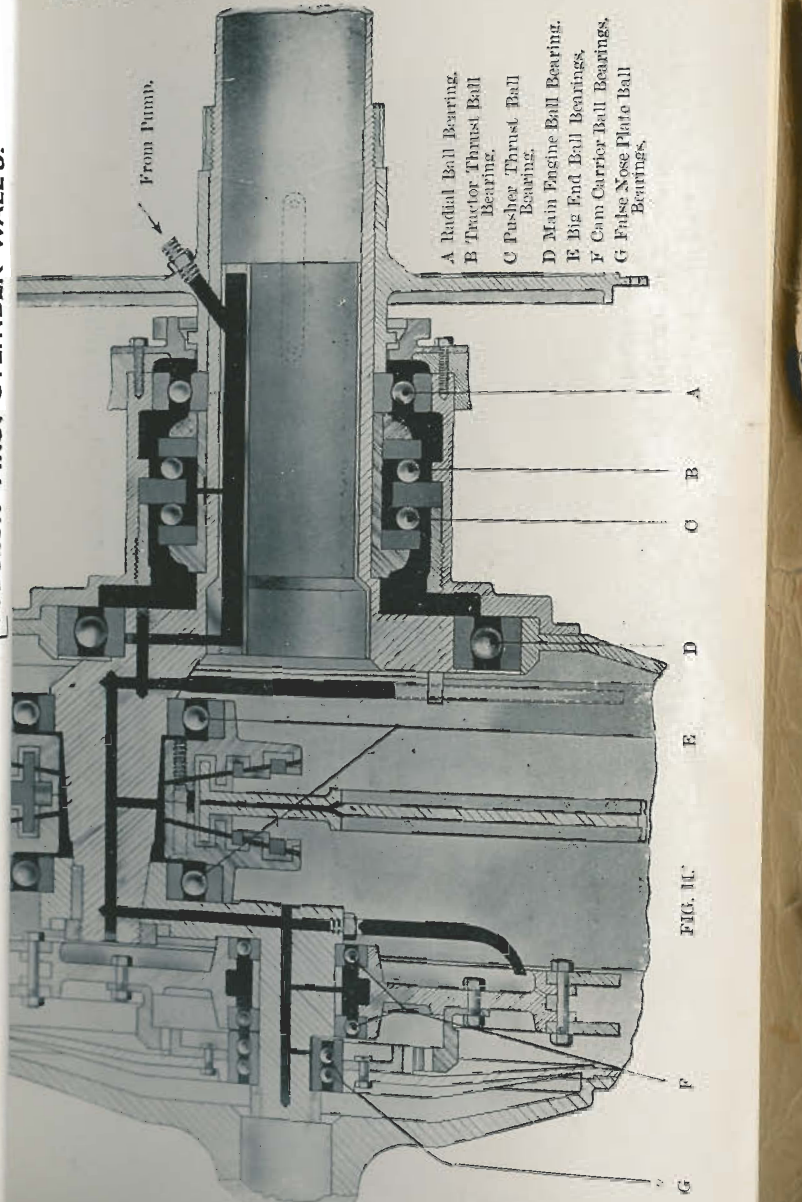

From Pump.
A Radial Ball Bearing.
B Tractor Thrust Ball Bearing.
C Pusher Thrust Ball Bearing.
D Main Engine Ball Bearing.
E Big End Ball Bearings.
F Cam Carrier Ball Bearings.
G False Nose Plate Ball Bearings.
A
B
C
D
E
F
G

FIG. 11.

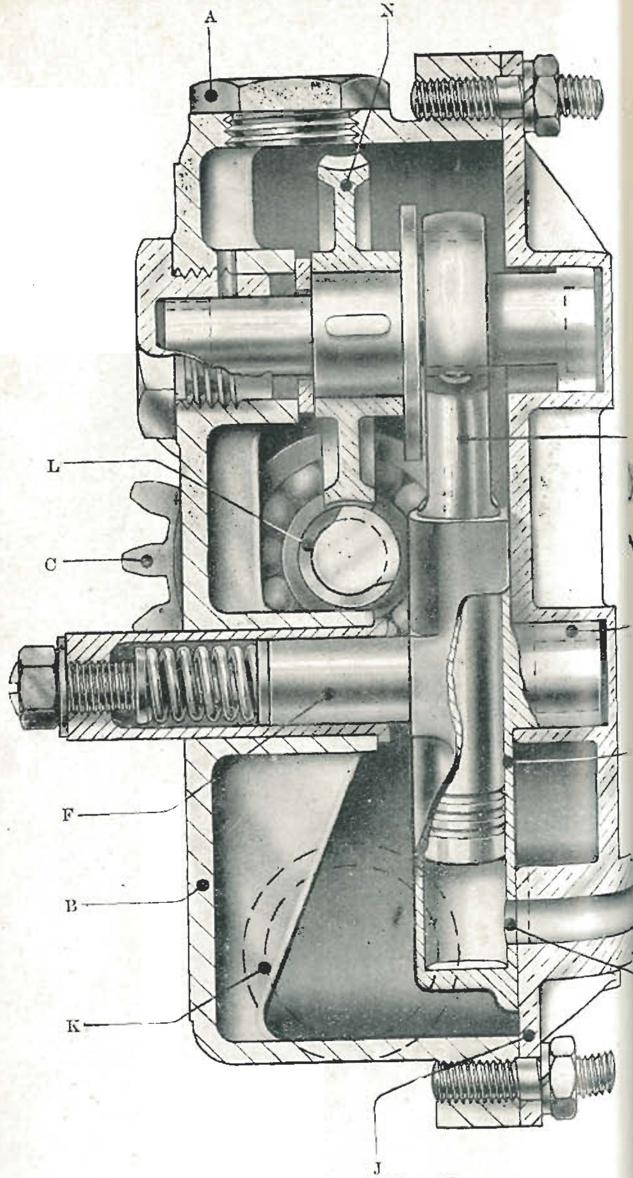


FIG. 12.
(For Descriptive Matter see Fig. 13.)

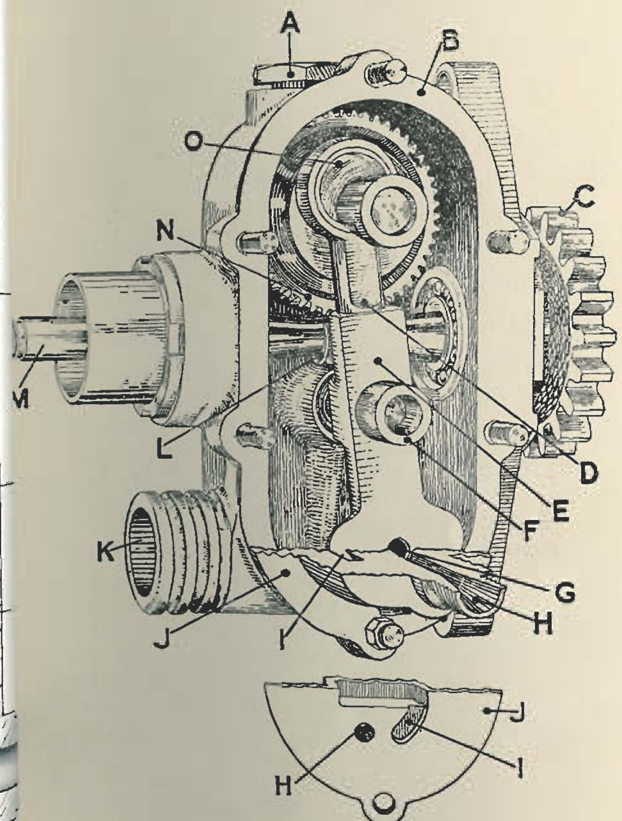


FIG. 13.

Screwed Plug.
Casing.
Wheel driven by large Wheel on Engine Thrust Box.
Piston.
Cylinder.
Pivots on which Cylinder oscillates.
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.

Big end ball races, connecting rod shoes, gudgeon pins and cylinder walls.	Opening in crankpin, holes in con. rod shoe g[illegible] through shoes to base of holes through con. rod, and bushes.
Cylinder walls.	Pipe from opening in lo[illegible] crankpin adjacent to [illegible] crankweb.
Thrust race, thrust box ball race, and main engine ball race.	*Restricted opening from pipe inside crankshaft.

PULSATOR. The pulsator glass is connected to [illegible] from the main oil pipe. The engine speed may be [illegible] from the number of pulsations per minute, as follo[illegible]

R.P.M. of engine = Pulsations per minute × [illegible]

OIL PUMP. The oil pump is mounted on the [illegible] opposite to the magneto and is driven by the same [illegible] It consists of a casing containing the oil, and a pist[illegible] in an oscillating cylinder which has a single port[illegible] position of the cylinder, during the suction stroke, [illegible] open to the oil in the casing. In the other positi[illegible] cylinder, during the exhaust stroke, the port is o[illegible] delivery from the pump. The cylinder is mounted [illegible] nions or pivots, and the piston is operated by an [illegible] which reciprocates the piston and causes it to os[illegible] cylinder. The eccentric is driven by a worm and w[illegible] inside the pump casing. A hole at the top of the c[illegible] mits air to escape when the pump is first filled with [illegible] hole is normally stopped by a screwed plug. Oil [illegible] the casing by gravity.

*In some engines the main engine ball race is also lubricated by a [illegible] in the top of the long end crankweb.

AIR BOARD.

TECHNICAL NOTES.

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110 H.P. CLERGET.

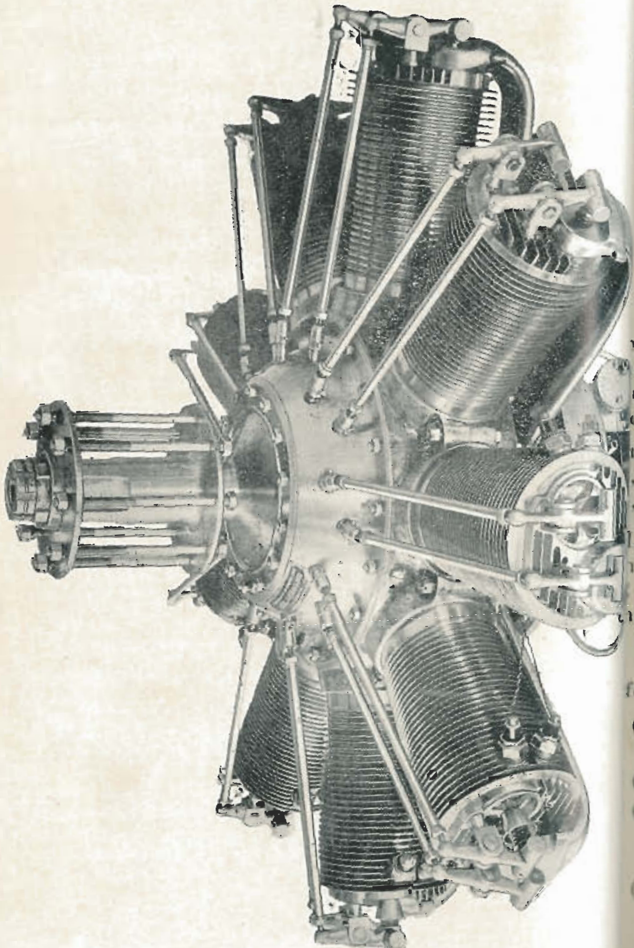


Fig. 1.

H.P. CLERGET ENGINE.

ERAL DESCRIPTION. This engine is of the rotary air
ed type, with 9 cylinders, 120 m.m. by 160 m.m., rated
10 H.P., but capable of developing 130 H.P. at 1,200
.M. *It is fitted with a double thrust ball race, which en-
s it to be used either as a pusher or as a tractor.
engine works on the Otto, or 4 stroke cycle, 2 revo-
ns of the engine giving 1 cycle (4 strokes) in each cylin-
Its chief points of difference from other rotary engines

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

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

rox. 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.

NKSHAFT. The forged steel crankshaft is hollow, and,
all single line rotary engines, has 1 throw. It consists
main parts, the long end and the short end, which are
ected by a telescopic joint at the crankpin. An exten
keyed to the short end carries the cam gear and the cam
ball races. The crankshaft is stationary and serves
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.

CRANKCASE. The crankcase is made of 2 steel stampings bolted together by steel bolts, and centred by dowel pins. It has 9 apertures disposed symmetrically around its periphery to accommodate the 9 cylinders, each of which is gripped tightly between the two parts of the crankcase and is prevented from turning by a key. It is not supported directly on the crankshaft, but carries on its faces plates, or covers, known respectively as the cam gear case, and the thrust box, or rear drum. The thrust box contains the main engine ball race,* the double thrust race, and a second radial ball race. The cam gear box contains a large radial ball race at the end next the crankweb, a smaller race at the end of the extension, and two races for the inlet and exhaust cams. These latter are mounted eccentrically on the crankshaft extension. The nose-piece, which carries the propeller boss, is bolted to the front of the cam gear box, and holds in position a centreing plate which forms a housing for the small ball race previously referred to.

CYLINDERS. The cylinders are of nickel steel, machined from the solid. The walls have a thickness of 3 m.m. They are numbered 1 to 9 consecutively, in a clockwise direction as seen from the propeller end of the engine. The order o firing is 1,3,5,7.9,2,4.6,8. The head of each cylinder is bored and screwed to take the inlet and exhaust valve seatings, and bosses are provided into which the rocker arm fulcrum posts are screwed. An external shoulder near the bottom of the cylin-der fits in a corresponding groove in the crankcase, and this together with the key previously referred to, are the means o fixing the cylinder in the crankcase. The bottoms of the cylin-ders are cut away at the opposite sides where they woul otherwise foul the connecting rods.

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

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

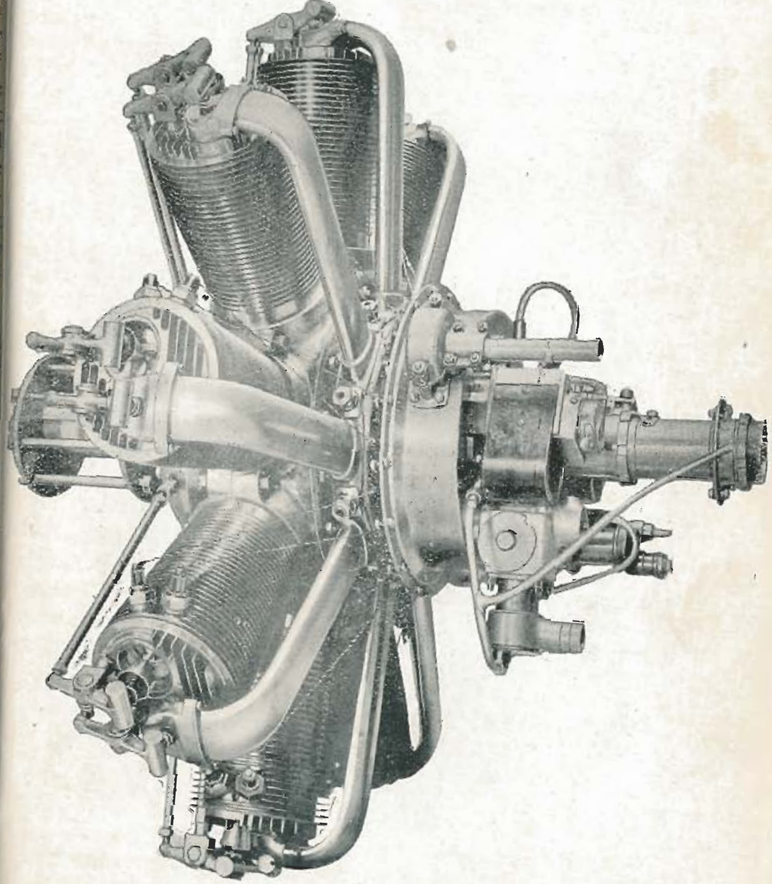


Fig. 2.

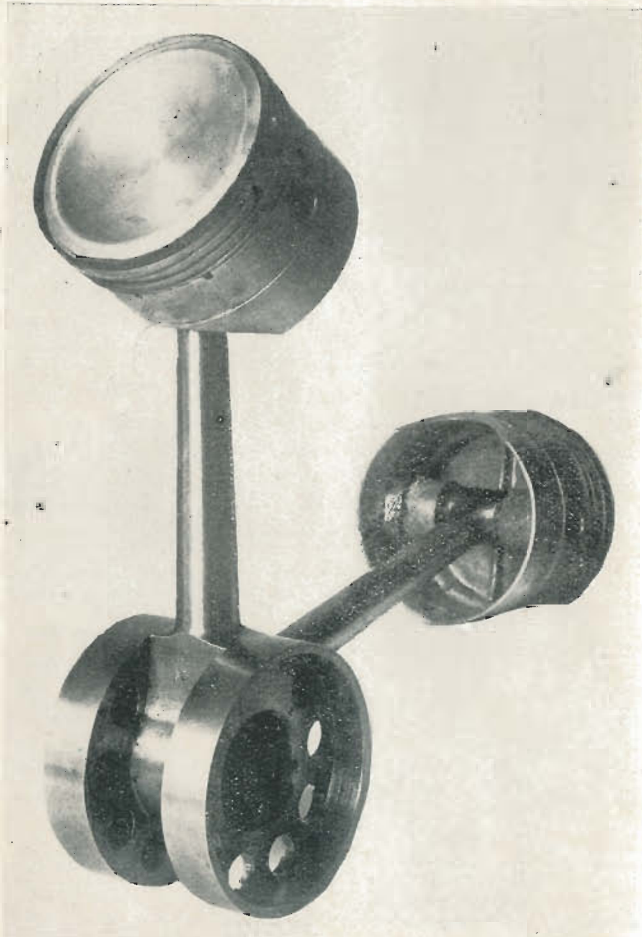


FIG. 3.

crew. The crosshead is attached to the connecting rod by a ollow steel gudgeon pin. A small square sided flange, at ne end of the gudgeon pin, lies between two shoulders on the de of the crosshead, and so prevents the pin from turning. is prevented from sliding in the crosshead by means of the nge and a copper washer at the opposite end. This washer s under the head of a bolt, screwed into the end of the gud- on pin, and engages with a recess in the crosshead lug. It turned up at either side when in position, and so locks the lt.* The pistons are fitted with 3 cast iron rings and 2 ob- rator rings. The obturator rings are carried in the same oove, one inside the other, with their gaps separated by 45° 60°, i.e., about 2 inches. The gaps in the piston rings ould be set about 120° apart, i.e., equally spaced around e piston.

†Piston clearance = 0.4 m.m. at top, 0.3 m.m. at bottom.
Piston ring gap = 0.5 m.m. to 0.75 m.m.
Obturator ring gap = 0.8 m.m.

NNECTING RODS. All the connecting rods are tubular section. There is 1 master rod and 8 auxiliary rods. e master rod big end runs on 2 ball races mounted at her end of the crankpin, and carries 8 wrist pins, by means which it is connected to the auxiliary rods. The master is bushed at its small end, and the auxiliary rods at both ls, with phosphor bronze.

LVES. The inlet and exhaust valves in the cylinder heads mechanically operated by means of light steel tappet rods overhead rocker arms, which are mounted on the fulcrum ts at the heads of the cylinders. There are 2 tappet s and rocker arms to each cylinder, 1 for the inlet valve and 1 he exhaust valve. The inlet valve is carried in a guide that is piece with a steel pocket communicating with the induc- pipe. The lower part of this pocket screws into the cylin- ead and forms the valve seating. The inlet valve seating is

---

*ther methods of supporting the gudgeon pin are used by different anufacturers of this engine. In some cases the pin fits in bosses ast in the piston, and is held by a set screw.

†Where cast iron pistons are used the clearances should be s follows:—At top of piston=0.2 m.m. At bottom=0.15 m.m.

flat, but the exhaust valve has a coned seating which opens to the atmosphere direct. The exhaust valve stem slides in a steel guide, bushed with cast iron, which is supported at the centre of the valve seating by 3 radial arms. The valve springs are of the spiral type, and that of the exhaust valve is protected from the action of the hot gases by a cone shaped deflector, which is formed in 1 piece with the guide and seating. The inlet and exhaust cam plates are driven at 9/8 times the engine speed by separate internally toothed wheels mounted inside and keyed to the cam gear case. The cam plates overtake the engine once in 8 revolutions, and each cam plate is cut in the form of 4 separate cams, so that in 8 revolutions each tappet will be lifted 4 times, i.e., once in 2 revolutions.

CYCLE OF OPERATIONS. In this engine there is 10° "overlap," i.e., the inlet valve is set to open 10° before the exhaust valve closes. Starting with any cylinder on T.D.C., with both valves open, the cylinder moves forward until it is 5° past T.D.C., at which point the exhaust valve closes. The inlet valve remains open until the cylinder has reached a point 58° past B.D.C., where it closes, and compression commences. At 25° before T.D.C. ignition takes place, and the cylinder moves on to the working stroke passing T.D.C. while the flame is spreading through the mixture. The exhaust valve opens at 68° before B.D.C. and remains open through the remainder of the cycle.

Admission of explosive mixture	—5° to 238°
Compression	238° to 360°
Power	0° to 112°
Exhaust	112° to 360° + 5°

VALVE TIMING. The exact timing of the valves is determined by adjusting the length of the tappet rods, but before this adjustment is made the cam gears must be correctly set as follows:—After inserting the fixed inlet toothed ring in the cam gear case, take the short end crankshaft extension with toothed wheel and ball race attached and set one inlet cam, toothed wheel and ball race attached and set one of the cams at the extreme throw of the eccentric. Place the whole in position in the cam gear case, meshing the teeth so that this cam is under No. 7 inlet tappet which will thus be held in its extreme outward position. Insert the fixed exhaust tooth ring and, after setting one of the exhaust cams at the

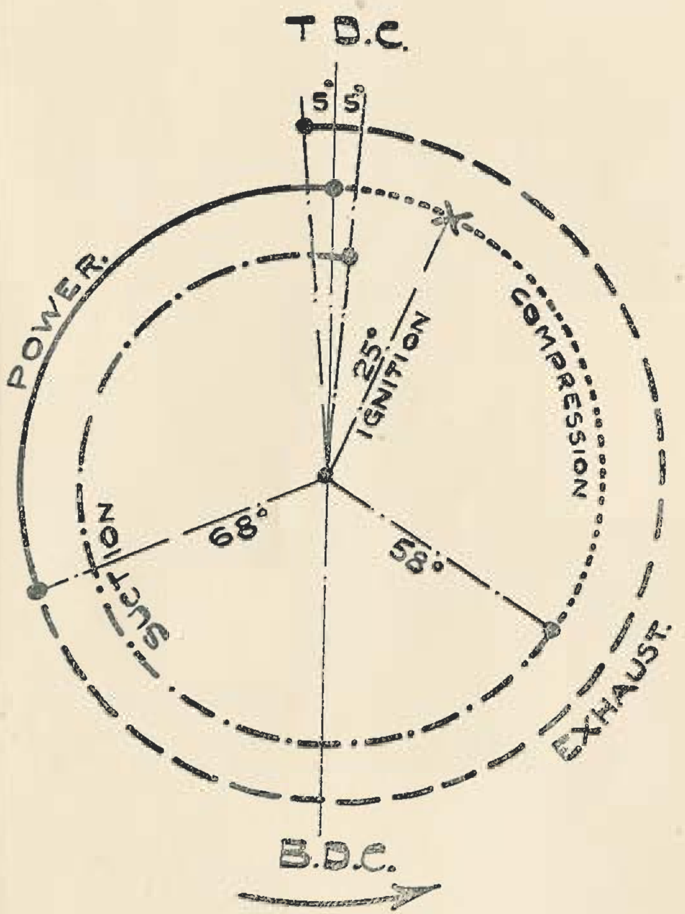


FIG. 4.

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

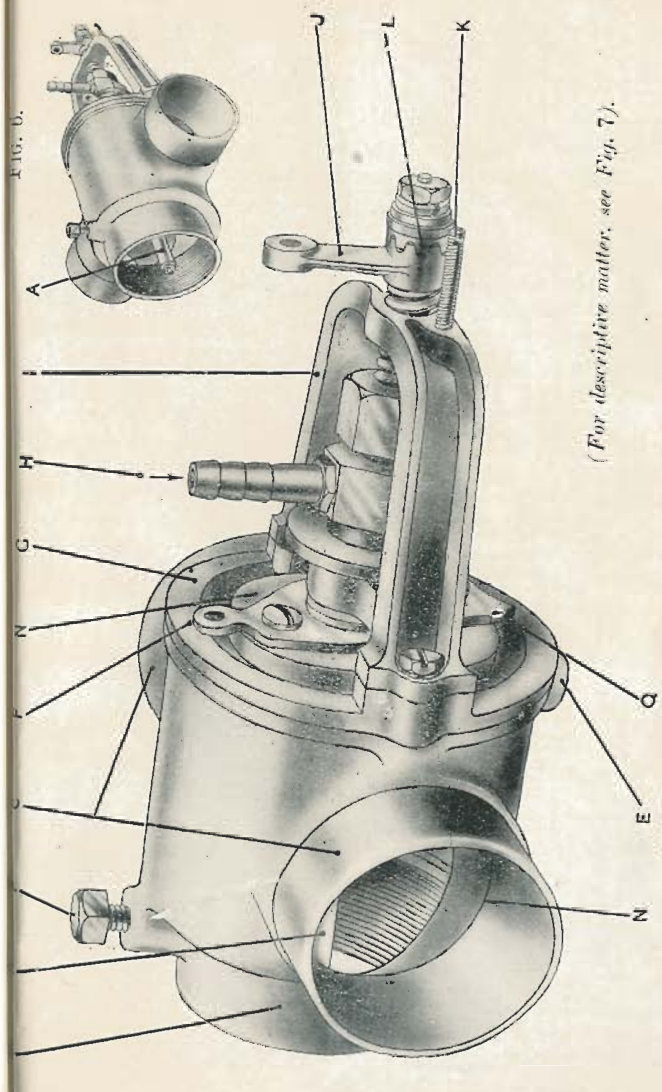
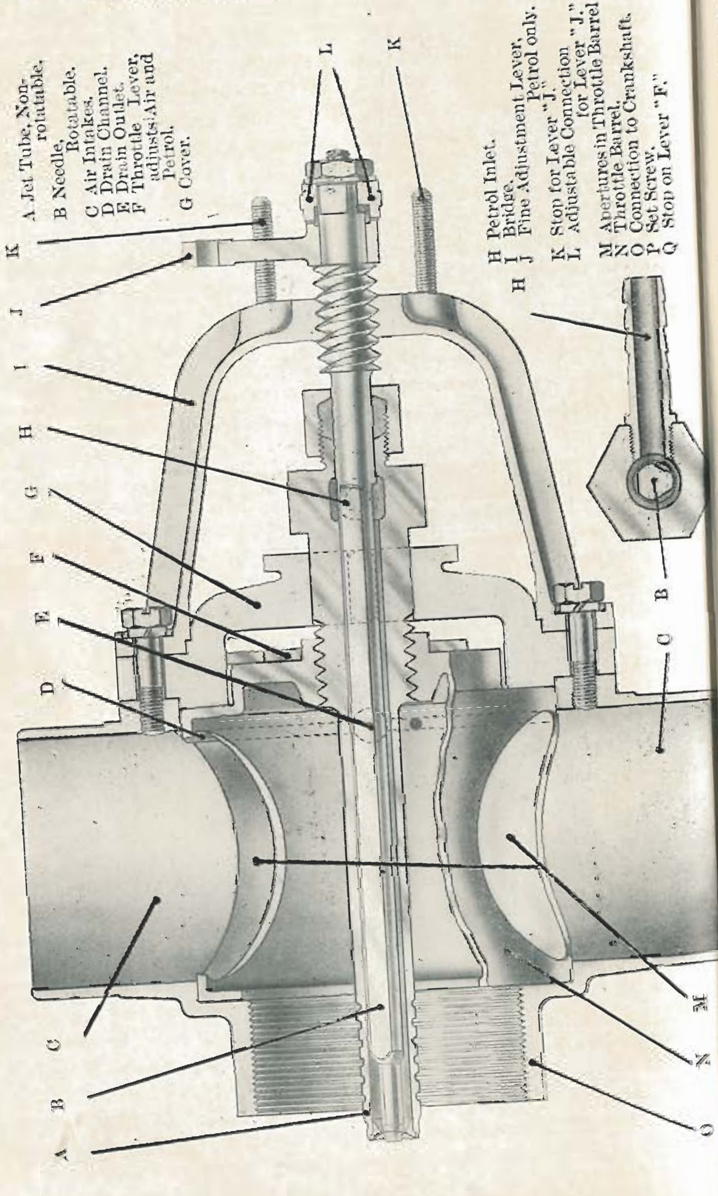


FIG. 6.

FIG. 5.

(For descriptive matter, see Fig. 7).



from the second magneto. Each corresponding pair of contacts on the two rings is connected to 1 cylinder, each contact of the pair to a separate plug in the cylinder. The arrangement is adjusted so that each cylinder has two simultaneous sparks at the time of ignition which hastens the combustion of the charge.

CARBURATION. The carburetter used on this engine is of the horizontal jet type. It is mounted on the end of the hollow crankshaft through which the explosive mixture passes to the crankcase, and thence through the induction pipes to the cylinders. The body is cylindrical in shape and practically forms an extension to the crankshaft. A drain is provided to carry away surplus petrol. There are two horizontal air intakes, at the sides of the body, which are joined by rubber connecting pieces to extensions leading to the outside of the fuselage. The amount of air entering is controlled by a cylindrical throttle, which is operated by a lever mounted on the throttle barrel. The jet, which is co-axial with and projects into the crankshaft, slides in the small bridge piece at the back of the throttle cylinder and is fed with petrol through a radial inlet near the rear end. For any given position of the throttle, the jet opening is controlled by a fine adjustment lever, at the rear of the carburetter. Movement of this lever advances or withdraws a needle inside the jet, and so closes or opens the hole through which the petrol is sprayed into the crankshaft. The base of this needle extends through a stuffing box, at the rear of the jet, and its longitudinal movement is brought about by a thread, at its base, which engages with a female thread in the large bridge piece at the rear of the carburetter. Outside the bridge piece is the fine adjustment lever, which is mounted on the needle in such a manner that it can be set at the required angle in respect to the needle. The jet is prevented from turning by two keys in the small bridge piece, through which it slides under the action of a thread on the jet, which engages with a female thread at the centre of the rear end of the throttle barrel. This thread is of the same pitch as that at the base of the needle. Equal movement of both levers therefore affects the air supply only, and movement of the fine adjustment lever affects the jet opening only, but movement of the throttle lever alone affects both and gives a jet opening bearing a relation to the throttle opening which depends upon the position of the fine adjustment lever.

LUBRICATION. The pump delivers oil to an inclined nipple which is mounted in the boss of the central support so that 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.

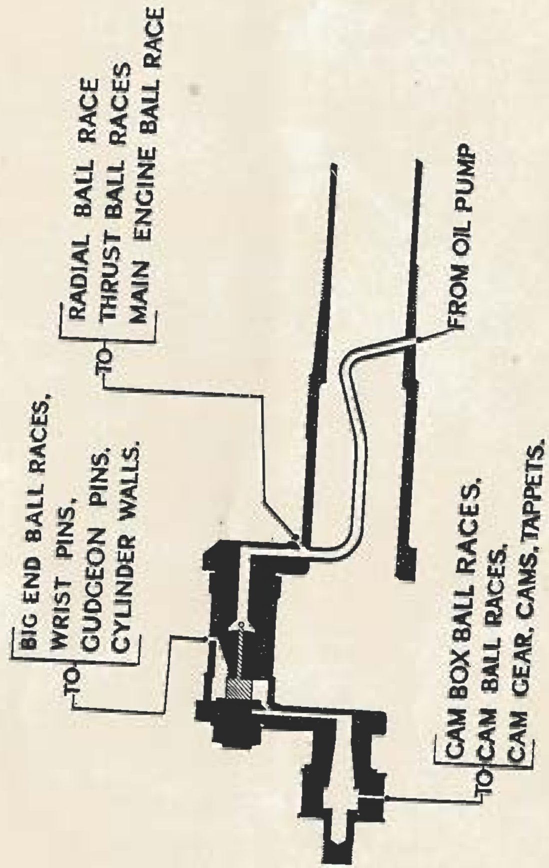


Fig. 9.

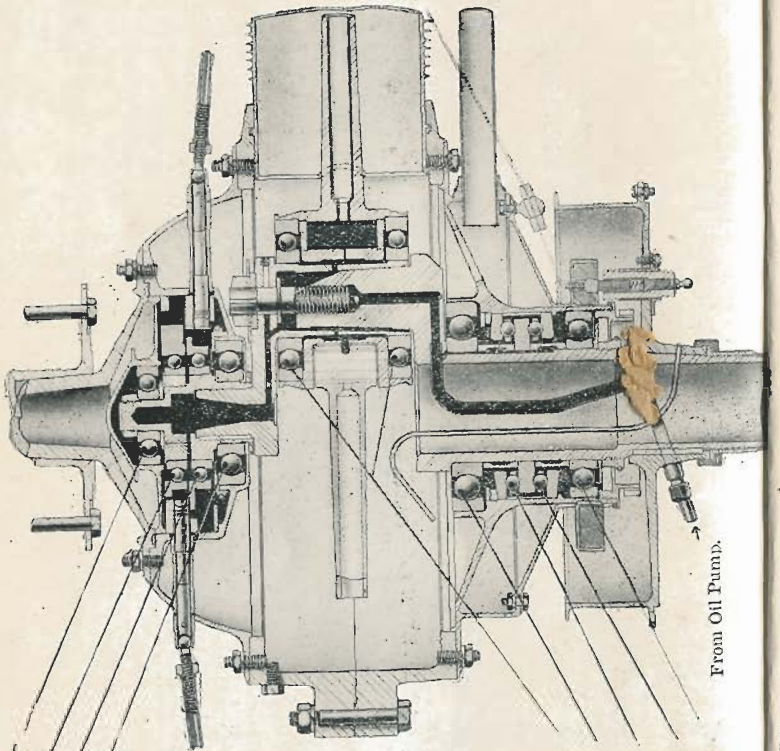


FIG. 10.

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.

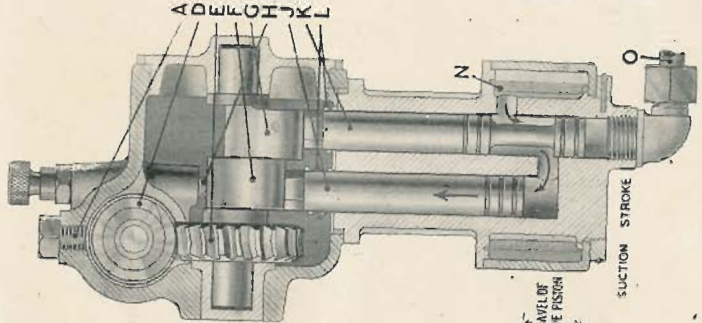


FIG. 13.

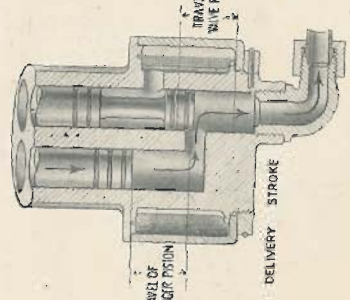


FIG. 12.

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.

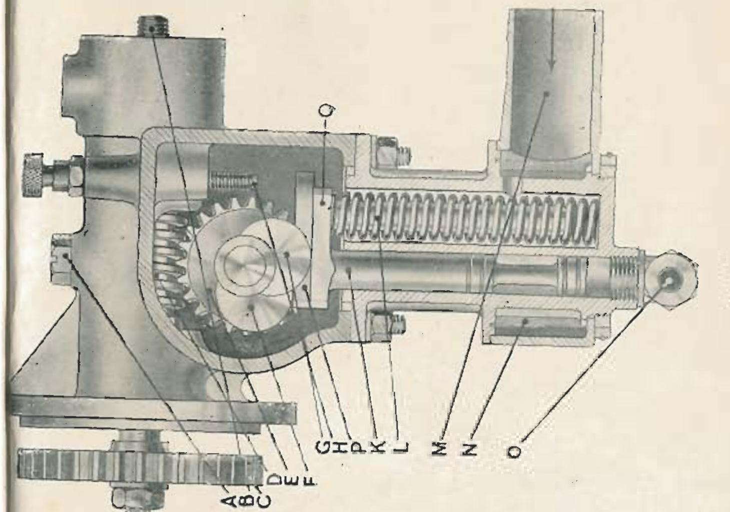


FIG. 11.

HAND-STARTING GEAR. Hand-starting gear is arranged on the left hand rear side of the central support. A hollow spindle projects through a bearing in a casing secured on the central support and carries at its inner end a skew pinion which can be engaged with teeth around the rim of the distributor by sliding the spindle in its bearing. A spiral spring in the spindle forces the pinion out of gear when the engine starts. The disengagement is assisted by the shape of the teeth. At its outer end the spindle carries a crank handle which is turned anti-clockwise to start the engine.