PATENT SPECIFICATION

779,631

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International Classification:—**F02b. F06d, j, n.**

COMPLETE SPECIFICATION

Improvements relating to Internal Combustion Engines with Opposed Pistons.

I, ROLAND LARAQUE, a Citizen of the French Republic, of 42, Quai de Passy, Paris, France, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to internal combustion engines with one or more cylinders of the type in which two opposed pistons are moved in opposite directions in the same cylinder and operate through first connecting rods, rocking levers and second connecting rods, on one and the same crankshaft. Such engines are hereinafter referred to as engines of the type described.

There is described below, by way of example, a two-cylinder two-stroke engine of the above type with equicurrent scavenging, but the features of the invention can be applied in fact to engines having a different number of cylinders and not necessarily working according to the two-stroke cycle.

The example will be described with reference to the accompanying drawings in which:

Figure 1 is a longitudinal section of the engine on the line I—I, Figure 2,

Figure 2 is a cross-section on the line II—II, Figure 1,

Figure 3 is a side elevation of a rocking lever, and

Figure 4 is a section of a rocking lever on line IV—IV, Figure 3.

Referring to Figures 1 and 2, the casing of the engine has a mounting 2 for each cylinder 1 in which the cylinder is supported in suitably spaced cylindrical faces 3, 4, 5, 6, and 7. It will be seen, that the diameters of the faces decrease, from right to left (Figure 1). This greatly facilitates the installation of the cylinders.

Indeed the boring of the different cylindrical faces can be done simultaneously with a plurality of tools on one and the same mandrel, which cannot be done when the different faces have the same bore. In this event they have to be bored one after the other, the introduction or withdrawal of the tool for boring the successive faces being a delicate operation each time. Installation of the cylinder 2 is greatly facilitated since it can be introduced without difficulty into the casing almost to its final position, and a very slight movement relatively to the faces is then sufficient for its final positioning. Between the cylinders and the casing is a water jacket through which a forced circulation of water is passed. The central part 9 of the cylinder wall is provided with fins 10, to assist cooling. It will be seen that the water jackets entirely surround the cylinders. The cylinders are thus perfectly and equally cooled around their whole circumference.

Fuel is admitted beween the pistons 11, 11*a* through an injection nozzle 12 fitted into the casing and screwed on the cylinder. The admission of combustion air and exhaust air is effected in conventional manner and a supercharger 49 (see Figure 2) is employed.

Rectilinear movement of each piston is transformed into a rotary movement of the crankshaft by means of an articulated system comprising a rocking lever 16, the ends of which are articulated on the one hand with the pistons 11, 11*a* by means of first connecting rods 14, and on the other hand with big end bearings of the crankshaft by second connecting rods 20.

The arms of each rocking lever are spaced laterally relatively to one another, in the direction of the axis of rotation of the crankshaft, in such a way as to permit the two opposed pistons of one cylinder to transmit force to the crankshaft at two points offset from the pistons along this axis.

The system of connecting rods has the characteristic that, contrary to normal practice, the gudgeon pin 13 of the piston 11, and pivot

[*Price 3s. 6d.*]

pin 15 joining the connecting rod 14 and the lever 16 are secured to the connecting rod 14 and are movable relatively to and within bearings in the piston 11 and the rocking lever 16.

The formation of the connecting rods 14 is a feature of the invention. It ensures a very great resistance both to tensile and compression stresses.

Each first connecting rod 14 is formed of a body 14a terminating in two semi-cylindrical bearing surfaces which form seats for the pins 13 and 15. The body is formed with a longitudinal bore wherein is located a tube 14b screwed into the pin 13 and locked by a nut 17 on the pin 15.

The rocking levers 16 are arranged to oscillate about pivot shafts 18. On the lower end of each lever 16 there is pivoted the small end of a second connecting rod 20 the big end of which engages the crankshaft 22. The pin 19 of the small end is secured to the rod by a bolt. It will be seen that the two second connecting rods associated with one cylinder engage the crankshaft at two points staggered by 180°. The crankshaft is supported by one or more intermediate journal bearings 25, according to the number of cylinders of the engine, to ensure robustness, while two outer bearings 23, 24 support its ends.

Tie-rods 26, 27, 28, maintaining the disposition of the pivot shafts 18 of the rocking levers 16 are disposed in tubular stay members 29, 30, 31 of larger internal cross-section than the tie rods extending within the casing.

As shown in Figure 1 the tie rod 27, passes through the shaft 18 which has spherical recess 40. The tie rod is secured to the shaft by tightening a nut 41, the base of which seats into the spherical recess 40. The same arrangement is provided at the other end of the tie rod 27, and at the ends of the tie rods 26 and 28, and serves to locate the pivot shafts 18.

The lubrication of the connecting rod articulations and the cooling of the piston head are effected as follows:

A pump passes lubricating oil to the tubular stay-members 29, 30, 31 in which the tie-rods 26, 27, 28 are housed. Through channels 32, 33, 34 this oil lubricates the outer crankshaft bearings 23—24 and the intermediate bearing 25. From these bearings it passes through conduits 36—37—38—39 to the big-end bearings of the connecting rods 20.

Furthermore some of the oil introduced into the tubular stay members surrounding the tie-rods 26—27—28, passes through the interior of the pivot shafts 18 to lubricate the rocking lever bearings and then passes through ports 42, 43 in the levers 16 to lubricate the small-end bearings of the rods 20, both end bearings of the first connecting rods 14 and cools the pistons by passing through a circuit which is described hereinafter.

Through passages (not shown) formed through the pin 15 of the rod 14 and through the tube 14*b* (Figure 1) the oil lubricates one of the bearings of the gudgeon pin 13. From this bearing the oil passes through a conduit 45 formed in the piston into a labyrinth 46 from whence it arrives through another conduit in the piston (not shown) at the second bearing of the gudgeon pin 13, which in turn is lubricated. In its travel in the labyrinth the oil cools the piston at its hottest parts. From the second bearing of the gudgeon pin the oil is conducted through a passage 47 formed in the gudgeon pin 13, into the annular space situated between the tube 14*b* and the body 14*a* whence it flows through a conduit 44 in the pin 15 whence it flows into the crank case. This oil, and that which may come from leakages in the bearings, is recovered from the bottom of the crank case whence it is pumped by a draining pump 48 which delivers it to the filter 46*a* before returning it to the lubricating circuit.

Thus the lubrication is effected by the "dry sump" method.

A method of making the rocking lever shown in Figures 3 and 4 of the accompanying drawings is described and claimed in my co-pending Patent Application No. 1449/56 (Serial No. 779632).

What I claim is:—

1. An internal combustion engine of the type described, wherein each of said first connecting rods is articulated to the piston and to the rocking lever respectively by a gudgeon pin and pivot pin which are secured to the rod and oscillate respectively in bearings in the piston, and bearings in the rocking lever.

2. An engine according to Claim 1, wherein each first connecting rod comprises a hollow body at each end of which a bearing surface in the form of a part of a cylinder is provided, one to receive said pivot pin and the other to receive said gudgeon pin, which pins are secured to the body by means of a tube passing longitudinally through said body, one end of said tube being screwed into said gudgeon pin and the other end of said tube being locked against the pivot pin by a nut.

3. An engine according to Claim 1 or Claim 2, wherein the small end of each of said second connecting rods is provided with a surface in the form of a part of a cylinder to receive a pivot pin which is secured to said rod by a bolt passing through the pin and screwed into the rod and which is received in two bearings in a rocking lever.

4. An engine according to Claim 2 or Claim 3, including a system of lubrication wherein an oil pump delivers lubricating oil into channels formed by tubular stay-members in the engine and in which are housed tie-rods which pass through pivot shafts for the rocking levers and secure them in position, whence said oil is distributed in two circuits, one of which lubricates the crankshaft bearings and then passes the oil through conduits in the crank-

shaft to the big-end bearings and the other of which lubricates the rocking lever bearings on said shaft and then passes the oil through ports in the levers to one end of each of said first connecting rods along said first connecting rods to the other end bearing thereof and then passes to passages in the pistons to cool the pistons.

5. An engine according to Claim 4 wherein the oil circulating in the other of said circuits passes from each rocking lever bearing, through a conduit in one arm of said lever to the bearings for one end of one of said first connecting rods, whence the oil passes through the pivot pin of said connecting rod into the tube thereof, through a port pierced in the latter, lubricates one of the gudgeon pin bearings in a piston, passes through the piston into cooling grooves, passes therefrom through the piston and lubricates the other bearing of said gudgeon pin and passes through a conduit in the gudgeon pin and through a space between the tube and the body of said first connecting rod through a conduit in said pivot pin, whence it passes to the crank case.

6. An engine according to Claim 4 or Claim 5, wherein the oil pump comprises two pumps, one of which pumps oil from a reservoir and delivers it into the tubular stay-members, while the other collects the oil returned to the crank case and delivers it into said reservoir through a filter.

7. An internal combustion engine substantially as hereinbefore described with reference to the accompanying drawings.

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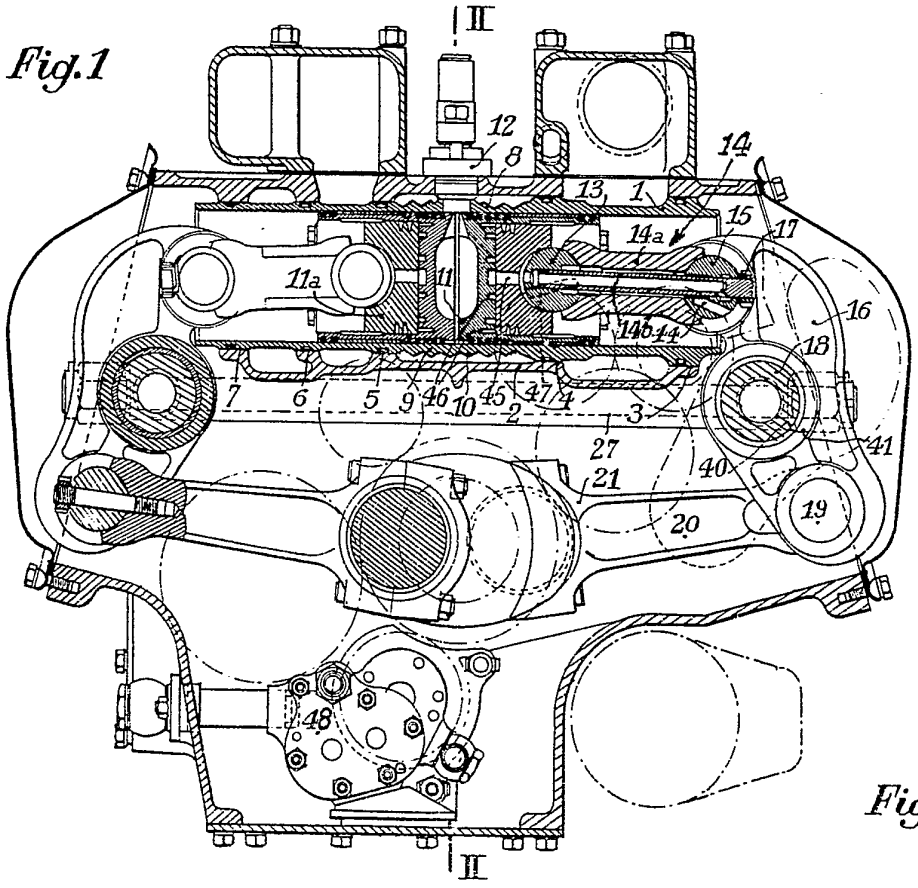
Fig. 1


II
12
8
14
13
1
15
17
14a
11a
11
16
14b
14
18
7
6
5
9
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4
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27
21
40
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19
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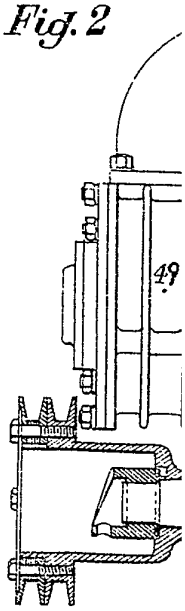
48
II

Fig. 2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779,631 COMPLETE SPECIFICATION
2 SHEETS

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SHEET 1

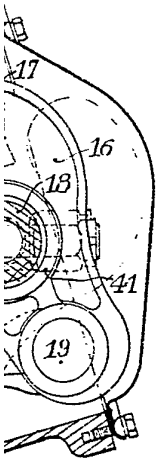
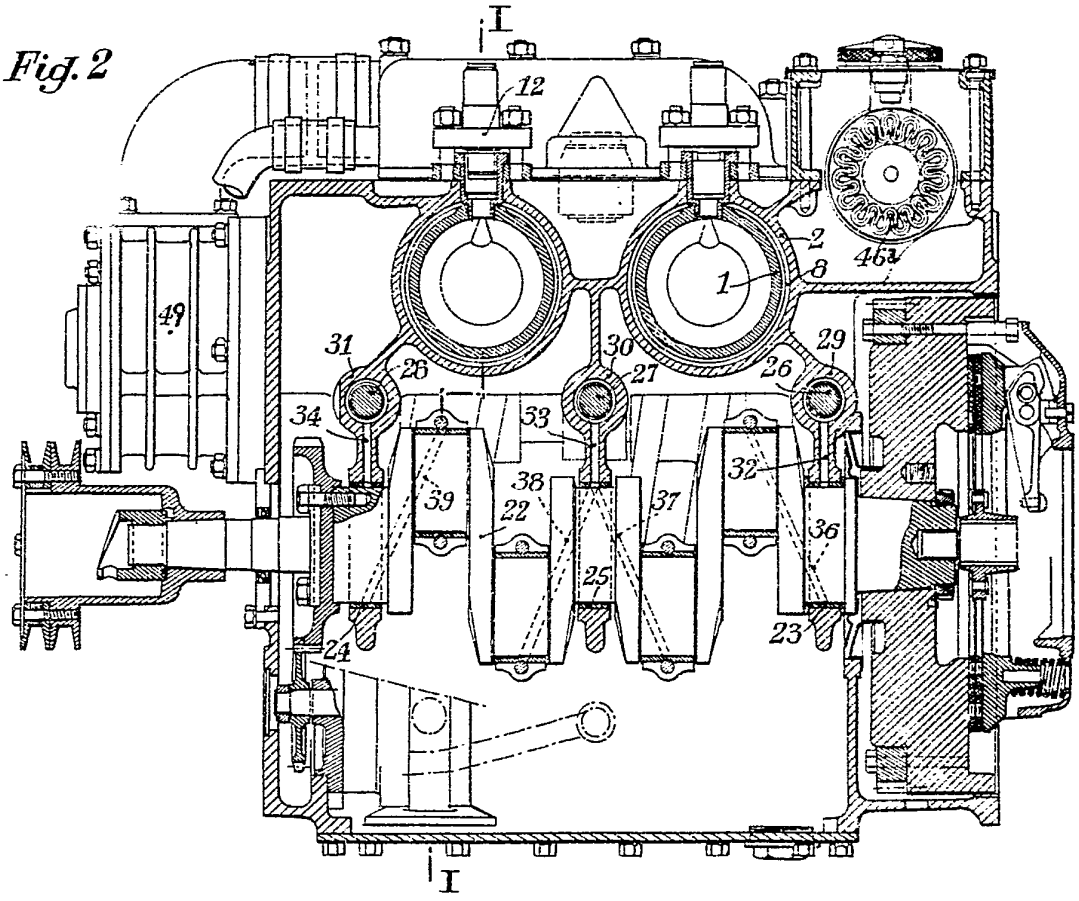


Fig. 2



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SHEET 1

Fig. 1

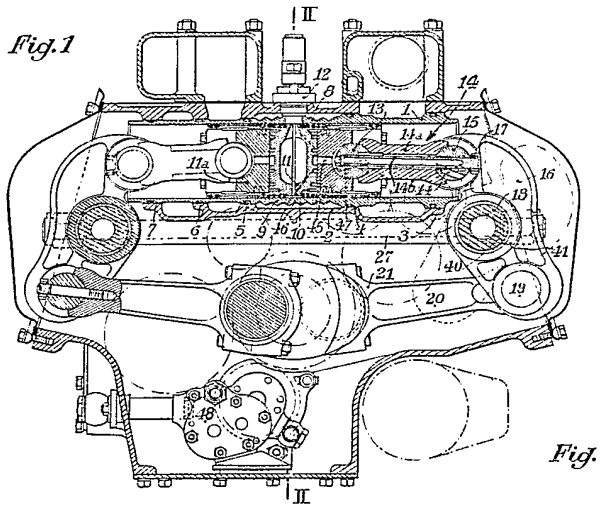
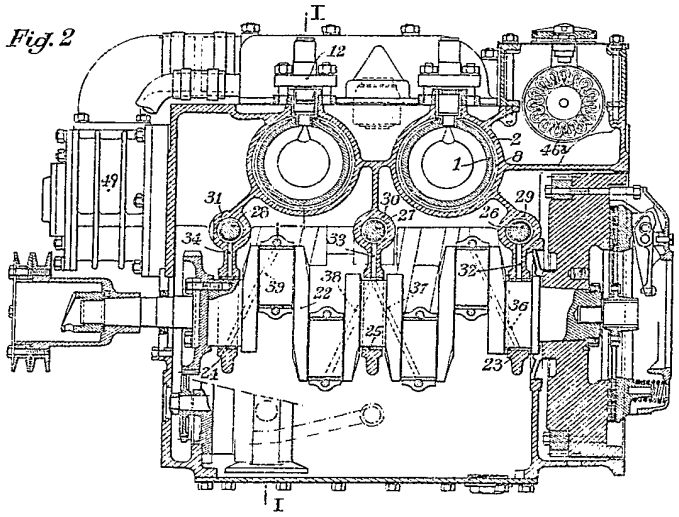


Fig. 2



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2 SHEETS

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SHEET 2

Fig. 3

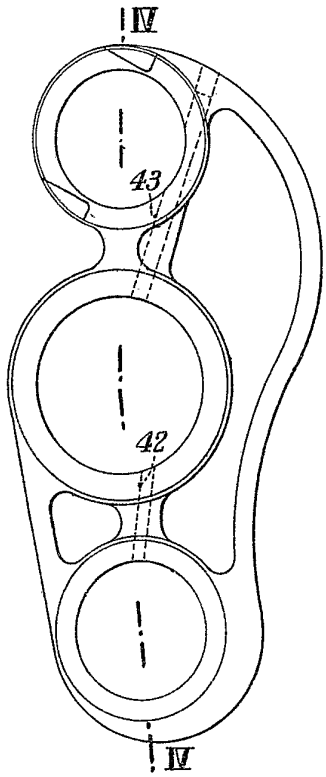

Fig. 4