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INTERNAL COMBUSTION ENGINE

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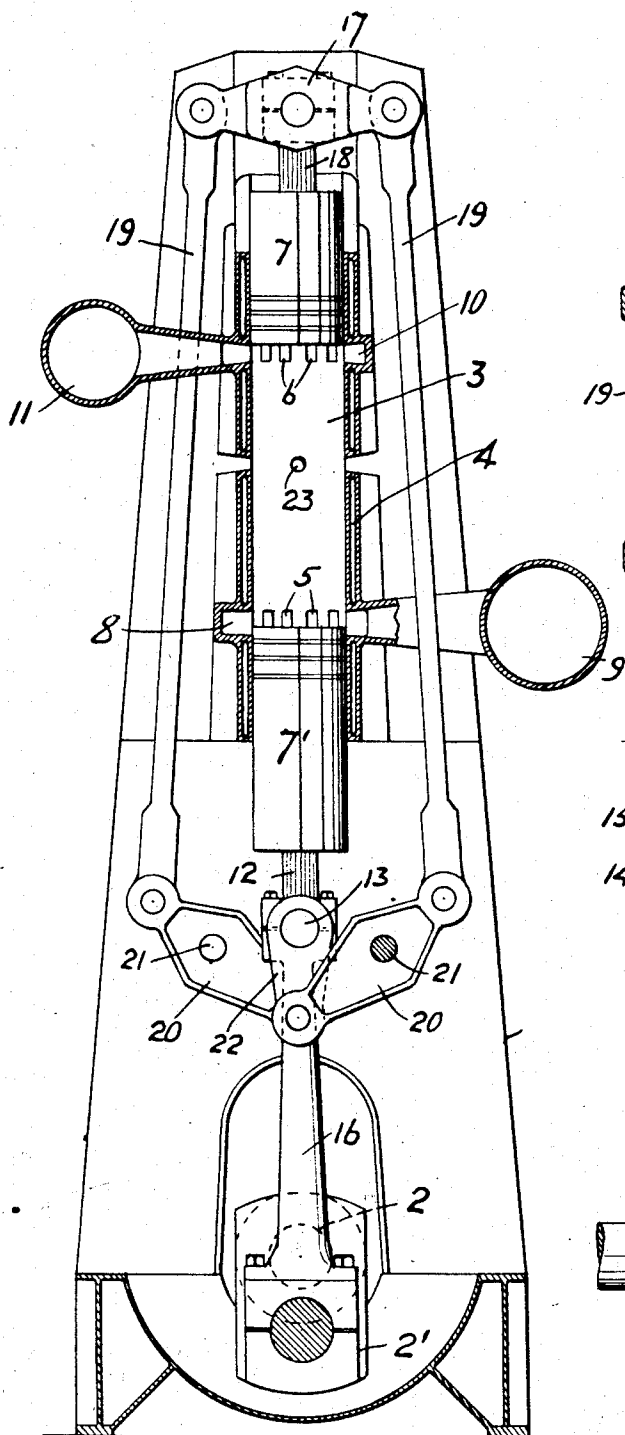


FIG. 1.

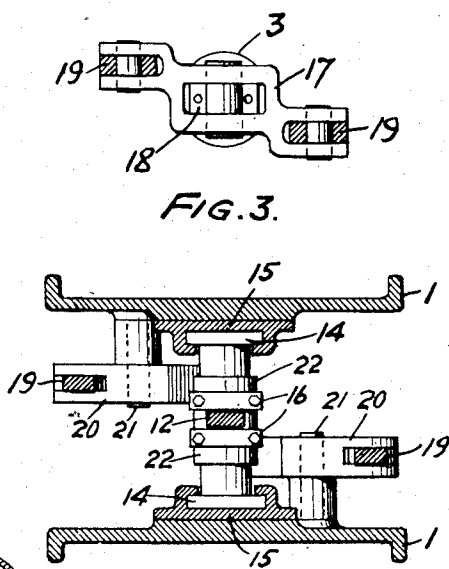


FIG. 3.

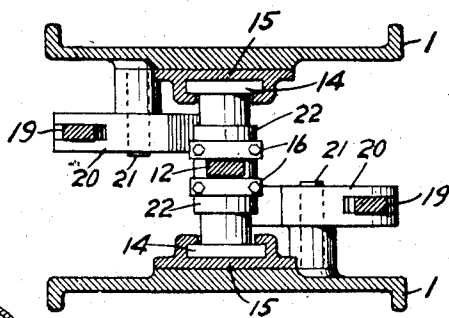


FIG. 4.

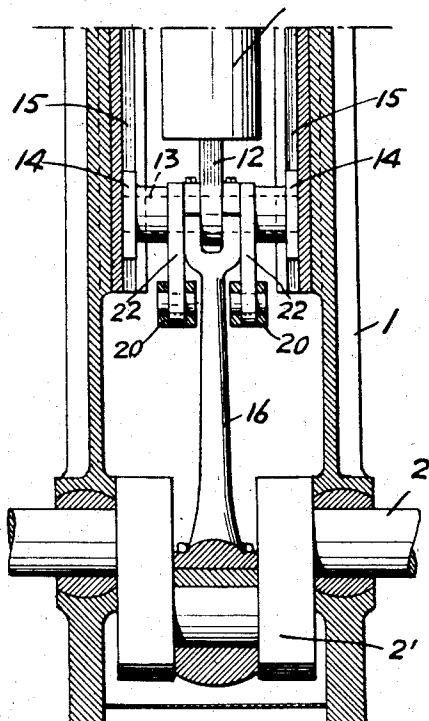


FIG. 2.

WITNESS:

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INTERNAL COMBUSTION ENGINE

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10 Claims. (Cl. 123—51)

This invention relates to an improvement in internal combustion engines.

More particularly, this invention relates to an improvement in internal combustion engines of the so-called opposed piston type and while applicable to internal combustion engines generally, it will find particular merit in adaptation to Diesel engines of the opposed piston type.

The improvement according to this invention will be found to be of merit in enabling reduction in size of opposed piston engines and in simplification of construction without sacrifice of efficiency and economy in operation.

Heretofore, as is well known, opposed piston engines comprising a pair of pistons, operating oppositely in a single cylinder, have been provided with crank shafts having three throws or cranks, one adapted for connection with one of the pistons and the other two, arranged oppositely or at 180° to the first, being adapted for connection with the other piston through the medium of side rods and a cross head.

Now in accordance with this invention, generally speaking, it is the purpose to so arrange the connections between the opposed pistons and crank shaft as to effect connection of both pistons to a single throw or crank on the crank shaft, thus eliminating complication in the construction of the crank shaft and in general simplifying the construction of the engine.

More particularly, in accordance with this invention a crank shaft provided with a single crank or throw per cylinder of the engine is connected with the opposed pistons in the cylinders, respectively, through the medium of a piston rod, a main connecting rod and through the medium of a cross head and side rods, the latter being connected to levers or rockers which in turn are connected to the main connecting rod.

Having indicated in a general way the nature and purpose of this invention, I will proceed to a more detailed description thereof in connection with a two cycle opposed piston engine of the Diesel type illustrated in the accompanying drawing, in which:

Figure 1 is a cross-sectional view of an opposed piston engine embodying this invention.

Figure 2 is a sectional view of the lower portion of the engine shown in Figure 1.

Figures 3 and 4 are sectional views showing details of construction.

In the several views variously, 1 indicates the frame of the engine, from which is suitably supported the crank shaft 2, having a crank 2', and the cylinder 3. The cylinder 3 is provided with

a jacket 4 for cooling fluid, with exhaust ports 5 and with scavenging air ports 6, the exhaust and scavenging air ports being located in the cylinder with respect to the travel therein of the opposed upper and lower pistons 7, 7'. A fuel injection nozzle 23 is also provided in the cylinder 3.

The exhaust ports 5 communicate with a receiver 8, which leads to an exhaust manifold 9, while the scavenging air ports 6 communicate with a receiver 10, which leads from a manifold 11 connected with a source of scavenging air under pressure.

The lower piston 7' is connected to the crank 2' through the medium of a piston rod 12, turnably connected to a pin 13, carrying at its ends guide shoes 14, 14, which engage vertical guides 15, 15 supported by the frame, and a connecting rod 16 connected at one end to the crank 2' and having its other end bifurcated and connected to the pin 13.

The upper piston 7 is connected to a cross head 17, through the medium of a rod 18. The ends of the cross head 17 are offset, as shown in Figure 3, and are bifurcated for connection to the upper ends of side rods 19, 19, the lower ends of which are connected to the shorter arms of the levers or rockers 20, 20 pivotally supported from the frame on pivots 21, 21, which engage the rockers off center.

The longer arms of the rockers 20, 20 are connected in turn to links 22, 22 connected to the pin 13 on opposite sides of the connecting rod 16.

It will be observed that the offset ends of the cross head 17 permit the side rods to be connected to the rockers 20 in an offset relation on opposite sides of the connecting rod 16, and that by the provision of the rockers both of the pistons 7, 7' are connected to a single crank on the crank shaft as compared with the requirement heretofore for three cranks. As will be obvious, the cross head 17 may be straight and connected to the side rods by means of offset rockers or straight bifurcated rockers.

The pivoting of the rockers off center and the connection of the side rods to their shorter arms provides for a shorter stroke of the upper piston 7, as compared with the lower piston 7' to compensate for or balance the weight of the side rods and cross head.

The operation of the engine embodying this invention will, it is believed, be readily grasped, it being understood that generally it operates on the two cycle principle, the pistons moving together on the compression stroke and apart on

the power stroke, the scavenging air ports and exhaust ports being controlled by the upper and lower pistons respectively and fuel being injected through the nozzle 23.

In operation with the main crank 2' in lower dead center position, the pistons 7, 7' will be apart the maximum distance, as shown in Figure 1. In the rotation of the crank 180° to upper dead center position, the side rods 19 will move down, connecting rod 16 will move up, the rockers 20 will turn on their pivots 21 and the pistons 7, 7' will move in opposite directions toward each other, the piston 7 moving down and the piston 7' moving up.

When the engine is in operation the power will be transmitted from the upper piston to the single crank 2' through the side rods 19, 19 to pin 13 and connecting rod 16, while the power from the lower piston will be transmitted to the single crank 2' through the piston rod 12 and connecting rod 16.

It will be understood that it is not intended that this invention shall be limited to the particular type and construction of engine described above in detail, with reference to the drawing, for illustrative purposes, since it is contemplated that various adaptation or modification in detail may be made without departing from the scope of the invention as defined in the appended claims.

What I claim and desire to protect by Letters Patent is:

1. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection between one of said pistons and said crank, a cross head connected to the other of said pistons, side rods connected to said cross head and means forming an operative connection between said side rods and said connecting rod whereby the direction of movement of the side rods is reversed relative to that of the connecting rod.

2. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection between one of said pistons and said crank, a frame for the support of said cylinder and crank shaft, a cross head connected to the other of said pistons, side rods connected to said cross head, a pair of levers fulcrumed on said frame, said levers respectively being connected at one end to said side rods respectively and said levers being connected at their other ends to said connecting rod.

3. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection between one of said pistons and said crank, a frame for the support of said cylinder and crank shaft, a cross head having its ends offset connected to the other of said pistons, side rods connected to said cross head, a pair of levers fulcrumed on said frame, said levers respectively being connected at one end to said side rods respectively and said levers being connected at their other ends to said connecting rod on opposite sides thereof.

4. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection

between one of said pistons and said crank, a frame for the support of said cylinder and crank shaft, a cross head connected to the other of said pistons, side rods connected to said cross head, a pair of levers fulcrumed on said frame each having a relatively short and a relatively long arm, the short arms of said levers respectively being connected to said side rods respectively and the long arms of said levers respectively being connected to said connecting rod.

5. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a frame for the support of said cylinder and crank shaft, a piston rod connected to one of said pistons, a connecting rod connected to said crank, a pin affording a connection between said piston and said connecting rod, a cross head having offset ends connected to the other of said pistons, side rods connected to said cross head, a pair of levers each having a relatively long and a relatively short arm fulcrumed on said frame on opposite sides of said connecting rod, the short arms of said levers respectively being connected to said side rods respectively and links connecting the long arms of said levers respectively to said pin on opposite sides of said connecting rod.

6. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a frame for the support of said cylinder and crank shaft, a piston rod connected to one of said pistons, a connecting rod connected to said crank, a pin affording a connection between said piston and said connecting rod, a cross head connected to the other of said pistons, side rods connected to said cross head, a pair of levers each having a relatively long and a relatively short arm fulcrumed on said frame on opposite sides of said connecting rod, the short arms of said levers respectively being connected to said side rods respectively and links connecting the long arms of said levers respectively to said pin on opposite sides of said connecting rod.

7. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection between one of said pistons and said crank, a frame for the support of said cylinder and crank shaft, a cross head connected to the other of said pistons, side rods connected to said cross head, a pair of offset levers fulcrumed on said frame, said levers respectively being connected at one end to said side rods respectively and said levers being connected at their other ends to said connecting rod on opposite sides thereof.

8. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection between one of said pistons and said crank, a frame for the support of said cylinder and crank shaft, a cross head connected to the other of said pistons, side rods connected to said cross head, a pair of bifurcated levers fulcrumed on said frame, said levers respectively being connected at one end to said side rods respectively and said levers being connected at their other ends to said connecting rod on opposite sides thereof.

9. In an internal combustion engine, in com-

combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod affording an operative connection between one of said pistons and said crank, a frame for the support of said cylinder and crank shaft, a cross head connected to the other of said pistons, side rods connected to said cross head, a pair of levers fulcrumed on said frame, said levers respectively being connected at one end to said side rods respectively and means adapted to compensate for relative motion affording an operative connection between the other ends of said levers and said connecting rod.

10. In an internal combustion engine, in combination, a cylinder, a pair of opposed pistons in the cylinder, a crank shaft provided with a crank, a connecting rod, means forming an operative connection between the connecting rod and said crank, a piston pin affording an operative connection between one of said pistons and said connecting rod; a cross head connected to the other of said pistons, side rods connected to said cross head, and a pair of levers, said levers respectively being connected at one end to said side rods respectively and said levers being connected at their other ends to said piston pin.

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