

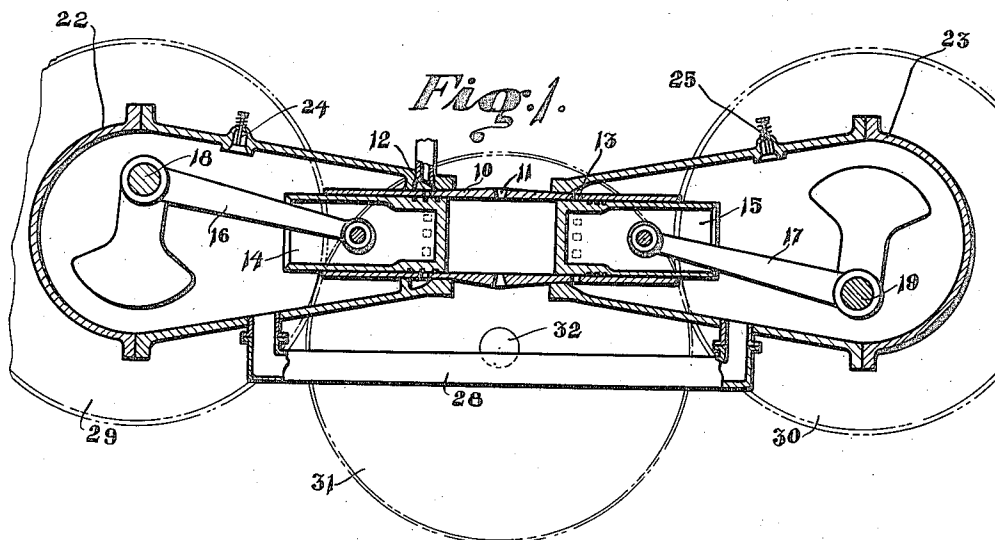
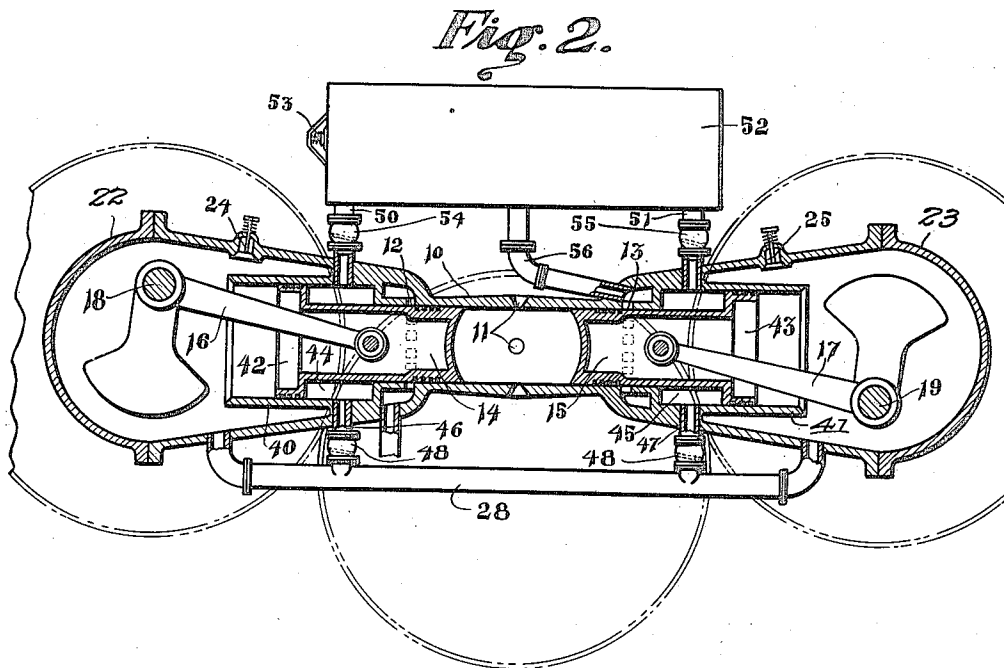
May 22, 1923.

1,455,787

H. T. HERR

DIESEL ENGINE

Filed April 12, 1921



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DIESEL ENGINE.

Application filed April 12, 1921. Serial No. 460,804.

To all whom it may concern:

Be it known that I, HERBERT T. HERR, a citizen of the United States, and a resident of Merion, in the county of Montgomery and State of Pennsylvania, have invented a new and useful Improvement in Diesel Engines, of which the following is a specification.

My invention relates to internal combustion engines and it has particular reference to internal combustion engines of the Diesel type in which oppositely-moving pistons operate in a single cylinder and serve to cover and uncover inlet ports and exhaust ports arranged at opposite ends of the cylinder.

An object of my invention is to provide a new and efficient means for supplying air at low pressure to the scavenging ports of an internal combustion engine of the character designated.

A further object of my invention is to provide, in conjunction with an internal combustion engine of the opposed-piston type, means for compressing scavenging air which shall be unitary with the power-developing elements, thus eliminating auxiliary pumps and operative connections.

A still further object of my invention is to provide a simpler and more compact construction of an internal combustion engine of the type referred to above in which the oppositely-moving pistons, compression pumps and power-transmitting mechanisms shall be arranged symmetrically with respect to a plane passing normally through the central portion of the piston, thus producing a substantially perfect balance of the moving engine parts.

In engines of the character designated, it has been the practice heretofore to compress air for scavenging purposes by means of pump structures auxiliary to the engine proper. In some instances, the pump pistons have been directly connected to an engine piston, a structure which produces an unbalanced condition of the moving parts. In the structure of my present invention, I provide duplicate compression means at each end of the engine cylinder, as well as duplicate power transmitting means for each piston, so that the masses of the moving parts are at all times in substantially perfect balance. This construction permits of the use of fluid-tight crank casings in which scavenging air is com-

pressed and from which it is conveniently delivered to the scavenging ports of the engine.

In the drawing, Fig. 1 is a diagrammatical sectional view of one embodiment of my invention, and Fig. 2 is a diagrammatical sectional view of a modification thereof.

Referring to the drawing, and particularly to Fig. 1, 10 designates an engine cylinder open at both ends and provided with fuel inlet ports 11, exhaust ports 12, and scavenging ports 13. Oppositely-moving pistons 14 and 15 are arranged to reciprocate within the cylinder 10 and to cover and uncover the inlet ports 12 and the scavenging ports 13 near the outer extent of their travel. The pistons 14 and 15 are connected, in any suitable manner, by rods 16 and 17 to crank shafts 18 and 19, which are located at opposite ends of the piston 10, and intersect the axial line of the engine cylinder. The shafts 18 and 19 with their associated mechanisms are enclosed in suitable crank casings 22, 23, so constructed as to provide fluid tight chambers. The crank casings 22, 23 are each provided with inwardly opening valves 24, 25 which are normally held in their seats. A conduit 28 of ample size connects the crank casings 22 and 23. The shafts 18 and 19 are preferably connected to power-transmitting gears 29 and 30, the gears 29 and 30 operatively engaging a gear 31 which is secured to a driving shaft 32. This gear system not only transmits the power developed by the engine in a highly efficient manner but insures perfect synchronism in the movements of the opposite-moving pistons 14 and 15.

Having thus described the arrangement of a device embodying my invention, the operation thereof is as follows: As the pistons 14 and 15 move inwardly from the position shown in Fig. 1, air is drawn into the crank cases 22, 23 through the valves 24, 25. As the pistons move outwardly, air is compressed within the crank casings 22 and 23 and when the pistons 14 and 15 have uncovered the exhaust and inlet ports, the burned gases escape through the exhaust ports 12 and the air under pressure enters from the crank casing 23 through the ports 13 into the engine cylinder 10, removing the remaining burned gases and filling the cylinder with pure air for the succeeding charge. The conduit 28 is made sufficient

in size so that the compressed air in the crank case 22 may be readily transferred to the crank case 23 upon the opening of the scavenging ports 13. It will be noted that the forces acting upon the piston, both within the working chamber and within the compression casing, are at all times equal and opposite in direction. The masses of all moving parts being distributed symmetrically with respect to a central plane are also equal. The synchronous movement of the parts so disposed produces a substantially perfect engine balance.

Referring to the structure illustrated in Fig. 2, 10 designates an engine cylinder provided with a fuel inlet 11, exhaust ports 12 and scavenging ports 13. Pistons 14 and 15 are arranged to reciprocate within the cylinder and are connected through rods 16 and 17 with crank shafts 18 and 19. Crank cases 22 and 23 of any suitable construction enclose the crank shafts 18 and 19 and the respective end portions of the cylinder 10. Each crank case is provided with an inlet valve 24, 25 which is held normally seated. The above construction is similar to that described in relation to Fig. 1. The cylinder 10 is provided at both ends with extensions 40, 41 which are larger in diameter than the central or working portion of the cylinder. The pistons 14 and 15 are each provided at their outer portions with extensions 42 and 43 of greater diameter than the main pistons and which cooperate with the cylinder extensions 40, 41 to form annular pump chambers 44 and 45.

A conduit 28 establishes communication between the crank cases 22 and 23. Branch conduits 46 and 47 lead from the pipe 28 and into the pump chambers 44 and 45. The branch conduits 46 and 47 are each provided with check valves 48, 49, so disposed that fluid may pass from the conduit 28 into the pump chambers. Conduits 50 and 51 lead from the pump chambers 44 and 45 into a tank 52 which is preferably provided with a pressure relief valve 53. Check valves 54, 55 are disposed within the conduits 50, 51 and are arranged to open so that air may pass from the pump chambers to the tank. The tank 52 is placed in communication with the scavenging ports 13 by means of a conduit 56.

The operation of the construction of my improved scavenging means, as shown in Fig. 2, is as follows: Assuming the pistons to be in their outer position (shown in Fig. 2), upon the inward stroke of the pistons, air is drawn through the valves 24, 25 and into the crank casings 22, 23. At the same time, the air within the pump chambers 44, 45 is being compressed and forced through the conduits 50, 51 and past the check valves 54, 55 into the tank 52. On the outward stroke of the pistons, air is compressed with-

in the crank casings 22, 23 and delivered through the conduits 28, 46, and 47 to the pump chambers 44, 45 which are at this time expanding. Air is thus delivered to the chambers 44 and 45 at a pressure somewhat higher than atmospheric pressure. It is evident that, upon the succeeding inward stroke of the pistons, air will be delivered from the pump chambers 44, 45 to the tank 52 under a still higher pressure. The free communication between the tank 52 and the scavenging ports 13 permits the delivery of air under pressure to the cylinder 10 when these ports 13 are uncovered by the outward movement of the piston 15, the inward movement of the piston automatically cutting off the supply of air to the cylinder. To secure the most satisfactory results, the pump chambers should be so proportioned with respect to the power-developing elements that a pressure of five to ten pounds is normally maintained within the tank 52.

My improved scavenging mechanism has the distinct advantage of providing ample quantities of scavenging air at suitably low pressure by means of auxiliaries disposed in compact relation to the power-developing elements of the engine and so arranged and operated as to avoid the necessity of shafting, gearing or other exterior connections from the air compressors to moving parts of the engine. A further advantage is derived from the symmetrical distribution of the masses of both the stationary and moving parts of the engine and from the employment of two crank shafts situated near the opposite ends of the cylinder and connected by gearing which insures synchronism in the rotation of the shafts and moving parts of the engine. This construction results in a perfect balancing of the engine parts and insures a smooth and highly efficient operation of the engine.

While I have shown my invention in but two forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a two-cycle internal combustion engine of the opposed-piston type, a differential cylinder having a central portion and two end portions, the end portions being of slightly greater diameter than the central portion, the central portion constituting a working chamber and the end portions second stage compression chambers, a differential piston arranged to reciprocate in each end of the cylinder, piston controlled exhaust and scavenging ports at the outer

ends of the central cylinder portion, a crank shaft adjacent each end of the cylinder, each shaft being operatively connected to the adjacent piston, a fluid-tight crank case for each shaft to form first stage compression chambers, an inwardly opening valve in each crank case, connections between the crank cases and the second stage compression chambers, and connections between the second stage compression chambers and the scavenging ports.

2. In a two-cycle internal combustion engine of the opposed-piston type, a differential cylinder having a central portion and two end portions, the end portions being of slightly greater diameter than the central portion, a differential piston arranged to reciprocate in each end of the cylinder, the central cylinder portion and co-operating portions of the differential pistons constituting a power element, the end cylinder portions and co-operating portions of the differential pistons constituting second stage compressors, piston controlled exhaust and scavenging ports at the outer ends of the central cylinder portion, a crank shaft adjacent each end of the cylinder, each shaft being operatively connected to the adjacent piston, a fluid tight crank case for each shaft to form first stage compression chambers, an inwardly-opening valve in each crank case, connections between the crank cases and the second stage compression chambers and connections between the second stage compression chambers and the scavenging ports.

3. In a two-cycle internal combustion engine of the opposed-piston type, a differential cylinder having a central portion and two end portions, the end portions being of slightly greater diameter than the central portion, a differential piston arranged to reciprocate in each end of the cylinders, the central cylinder portion and co-operating portions of the differential pistons constituting a power element, the end cylinder portions and co-operating portions of the differential piston constituting pump elements, piston controlled exhaust and scavenging ports at the outer ends of the central cylinder portion, a crank shaft adjacent each end of the cylinder, each shaft being operatively connected to the adjacent piston, a fluid tight crank case for each shaft, an inwardly-opening valve in each crank case, connections between the crank cases and the pump chambers, a storage tank, connections leading from the pump chambers to the storage tank, and a connection from the storage tank to the scavenging ports.

4. In a two-cycle internal combustion engine of the opposed-piston type, a differential cylinder having a central portion and two end portions, the end portions being of slightly greater diameter than the central

portion, a differential piston arranged to reciprocate in each end of the cylinder, the central cylinder portion and cooperating portions of the differential pistons constituting a power element, the end cylinder portions and cooperating portions of the differential piston constituting pump elements, piston controlled exhaust and scavenging ports at the outer ends of the central cylinder portion, a crank shaft adjacent each end of the cylinder, each shaft being operatively connected to the adjacent piston, a fluid tight crank case for each shaft, an inwardly opening valve in each crank case, connections between the crank cases and the pump chambers, a storage tank, connections leading from the pump chambers to the storage tank, a pressure relief valve in said tank, and a connection from the storage tank to the scavenging ports.

5. In a two-cycle internal combustion engine of the opposed-piston type, a differential cylinder having a central portion and two end portions, the end portions being of slightly greater diameter than the central portion, the central portion constituting a working chamber and the end portions second stage compression chambers, a differential piston arranged to reciprocate in each end of the cylinder, piston controlled exhaust and scavenging ports at the outer ends of the central cylinder portion, a crank shaft adjacent each end of the cylinder, each shaft being operatively connected to the adjacent piston, a fluid-tight crank case for each shaft to form first stage compression chambers, an inwardly opening valve in each crank case, connections between the crank cases and the second stage compression chambers, and connections between the second stage compression chambers and the scavenging ports, gearing for synchronizing the movements of the pistons symmetrically disposed with respect to a plane normal to the axis of the cylinder at its central point, whereby the compression forces within the crank cases and within the second stage compression chambers are substantially equal and opposite in direction, and the inertia forces of the moving masses are also substantially balanced.

6. In a two-cycle internal combustion engine of the opposed-piston type, a differential cylinder having a central portion and two end portions, the end portions being of slightly greater diameter than the central portion, a differential piston arranged to reciprocate in each end of the cylinder, the central cylinder portion and co-operating portions of the differential pistons constituting a power element, the end cylinder portions and co-operating portions of the differential pistons constituting second-stage compressors, piston controlled exhaust and scavenging ports at the outer

ends of the central cylinder portion, a crank shaft adjacent each end of the cylinder, each shaft being operatively connected to the adjacent piston, a fluid tight crank case for each shaft to form first stage compression chambers, an inwardly-opening valve in each crank case, connections between the crank cases and the second stage compression chambers and connections between the second stage compression chambers and the scavenging ports, gearing for synchronizing the movements of the pistons symmetrically disposed with respect to a plane normal to the axis of the cylinder at its central point, whereby the compression forces within the crank cases and within the second stage compression chambers are substantially equal and opposite in direction, and the inertia forces of the moving masses are also substantially balanced.

In testimony whereof, I have hereunto subscribed my name this 29th day of March, 1921.

HERBERT T. HERR.