M. E. KNIGHT.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 8, 1911.

1,068,781.

Patented July 29, 1913.

2 SHEETS—SHEET 1.

Fig. 1,

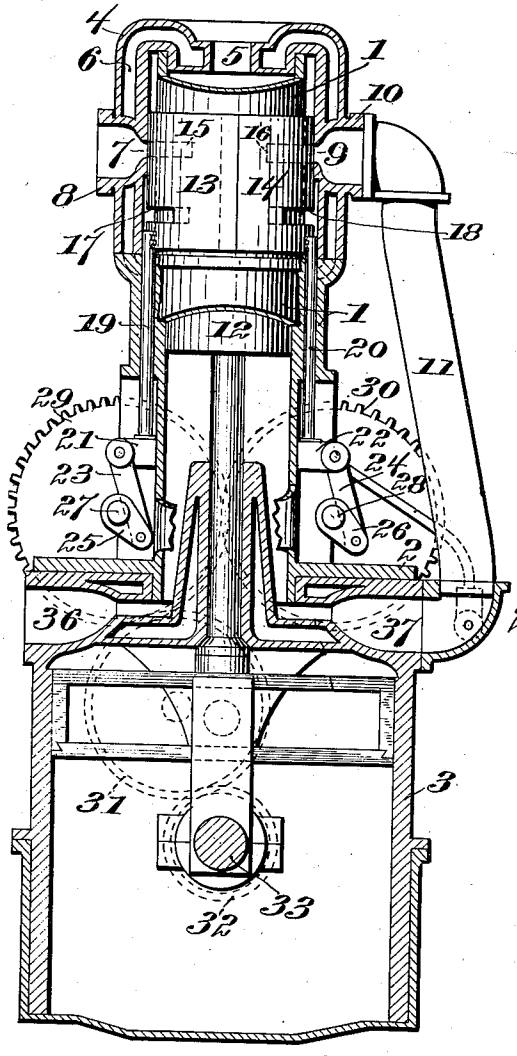
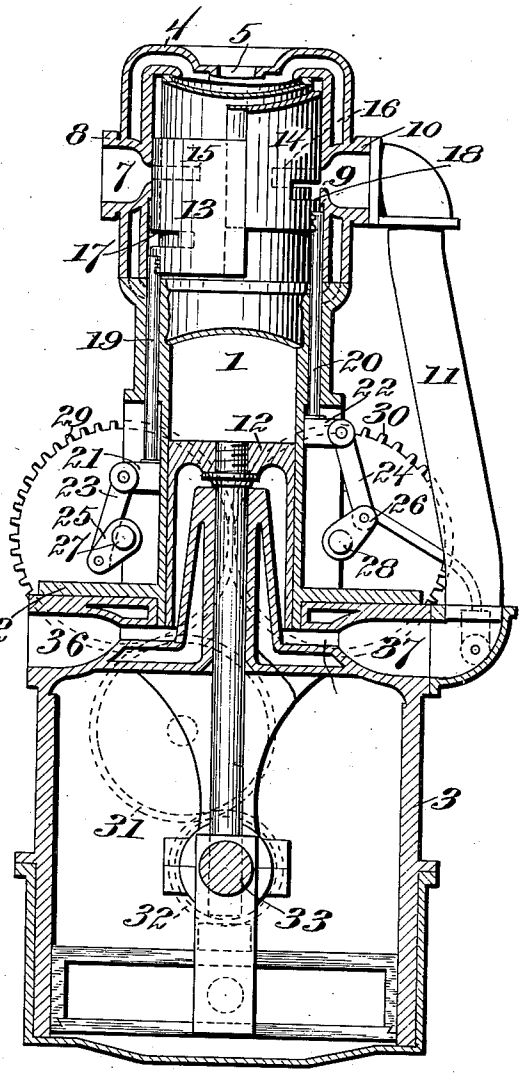


Fig. 2,



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2 SHEETS—SHEET 2.

Fig. 3.

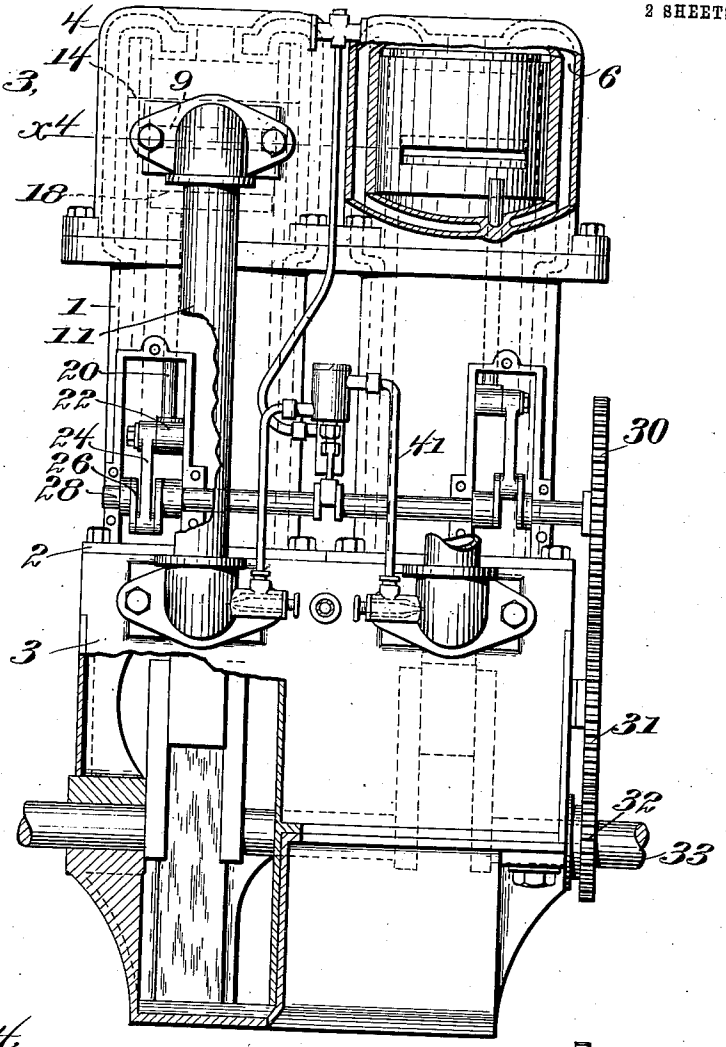
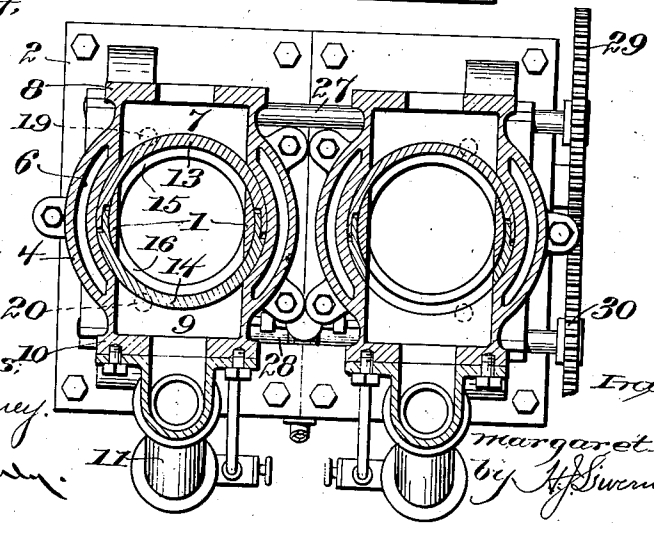


Fig. 4.



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UNITED STATES PATENT OFFICE.

MARGARET E. KNIGHT, OF SOUTH FRAMINGHAM, MASSACHUSETTS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO K-D MOTOR COMPANY, A CORPORATION OF NEW YORK.

INTERNAL-COMBUSTION ENGINE.

1,068,781. Specification of Letters Patent. Patented July 29, 1913.

Application filed July 8, 1911. Serial No. 637,508.

To all whom it may concern:

Be it known that I, MARGARET E. KNIGHT, a citizen of the United States, residing in South Framingham, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Internal-Combustion Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to an internal combustion engine, and is embodied in a novel construction and arrangement of the valves and valve actuating mechanism, and in certain novel details relating to the general construction of the engine.

In accordance with the invention, the cylinder is provided with lateral inlet and exhaust ports at opposite sides, the said ports being controlled, respectively, by separate slide members which are movable with relation to the cylinder and provided with port openings adapted, in the movement of the slide members, to coöperate with the cylinder ports in opening and closing communication with the interior of the cylinder. The said slide members are operated independently of each other, and are properly timed to control the ports.

In accordance with the invention, the movement of the slides is produced through the agency of connecting mechanism between the slides and the engine crank shaft, and the purpose of the invention is to arrange the valve mechanism so as to cause a prompt and complete opening of each port approximately at the time when the crank and crank shaft are at one dead center position, and a prompt and complete closure of the port when the crank and crank shaft are at the other dead center position. Each slide constitutes the sole means for opening and closing the port controlled by it, and, since the connecting mechanism between the crank shaft and one valve is independent of the connecting mechanism between the crank shaft and the other valve, each valve can be timed independently of the other to suit the conditions required in designing an engine.

Figure 1 is a vertical section, through one cylinder of an engine embodying the invention; Fig. 2 is a similar view showing the parts in a different position; Fig. 3 is an elevation, partly in section, and on a plane at right angles to that of Figs. 1 and 2; and Fig. 4 is a horizontal section on the line x^4 of Fig. 3.

The engine which I have shown as a practical illustration and embodiment of the invention is provided with a cylinder 1 shown as a tubular member having a flange 2 at the bottom which is supported on a base 3, the top of the cylinder being closed by a cap 4 provided with a spark plug opening 5 and a water jacket space 6 with which the cap is provided if the engine is to be water cooled. The inner bore of the cap 4 is larger in diameter than the outside diameter of the cylinder 1, so that an annular space is afforded between the cap and the cylinder which constitutes a guide-way for slide valves which control, respectively, the inlet and exhaust passages through the wall of the cylinder.

The inlet passage 7 is formed at one side of the cap 4, the said cap being provided with a coupling 8 to receive the manifold leading from the carbureter, or other source of gaseous fuel.

The exhaust port 9 is formed in the opposite side of the cap and is provided with a coupling 10 which receives the exhaust pipe 11. The said exhaust pipe is herein shown as leading to the space in the cylinder below the piston 12 which is provided with inlet and outlet passages 37 and 36. The means for disposing of the exhaust through the pipe 11, and the space below the piston in the cylinder forms the subject of a divisional application filed by me, and need not be further herein described.

The ports 7 and 9 are comparatively narrow longitudinally, but may be extended a comparatively long distance laterally around the cylinder, as best shown in Figs. 3 and 4, so that they have a large capacity, when fully open. In the construction shown, each port extends approximately one-third of the distance around the cylinder. The valves 13 and 14 which, respectively, control the inlet and exhaust ports, are herein shown as semi-cylindrical slides fitting between the cylinder 1 and the cap 4, and being guided thereby, and the said slides may be extended sufficiently far circumferentially to overlap, at adjacent edges, as best shown in Figs. 2 and 4, although such a construction is not essential.

In alinement with the ports 7 and 9, the ports 15 and 16 are formed in the walls of the cylinder 1, and the slide valves 13 and 14 are provided, respectively, with openings 17 and 18 which, in the reciprocating movement of said valves aline with the ports 7 and 9 at the proper time to admit new fuel, and to provide for the exhaust of the spent gases.

It is necessary for efficient operation in internal combustion engines that the inlet and exhaust ports should have the greatest possible area, and that they should be opened to their fullest capacity in the briefest possible time; that they should remain wide open as nearly as possible throughout substantially the entire stroke during which they operate, and that they should be closed as promptly as possible approximately at the finish of said stroke. Slight variations in the timing of these valves should also be possible in order to meet different conditions in the design of the engine, and the construction should be such that the valves can be timed independently of each other.

In accordance with the invention, in which independent slides constitute the moving elements of the valves. it is obviously easy to time, each valve, as indicated, and any suitable mechanism operated by the engine crank shaft can be employed to produce the necessary movement of the valves at the right periods in the operation. As an efficient expedient involving the least amount of noise, and being extremely simple in construction, a crank and pitman connection with each valve can be employed, these connections being so related to the movement of the engine crank shaft as to open the valves while the valve cranks approach their dead center position, and to close the valves while said valve cranks travel away from their dead center position, the entire opening and closing movements taking place while the engine crank is traveling from one of its dead center positions to the other.

In the construction chosen to illustrate the invention, the slide valves are connected by means of rods 19 and 20 with sliding heads 21 and 22 which, in turn, are connected through the links 23 and 24 with cranks 25 and 26 which are mounted on shafts 27 and 28 provided with gears 29 and 30 in mesh with each other, one of said gears being driven through an intermediate gear 31 from a gear 32 on the crank shaft 33. The gear ratio is such that the operation of the shafts 27 and 28 corresponds to that of the usual half time cam shaft of the ordinary four-cycle engine.

In Fig. 1, the parts are shown as substantially at the end of the compression stroke, both of the slides being near their lower position, and both of the ports 7 and 9 being closed, so that the active charge is confined in the cylinder. As the piston 12 travels outward in its working stroke, the inlet slide valve is traveling downward, and the inlet port remains closed. The exhaust port is also closed, but the exhaust valve 14 during this part of the operation is approaching the exhaust port with a comparatively rapid movement, since the crank 26 is traveling through the last quarter of its stroke; and the latter part of said movement, as indicated in Fig. 2, will bring the exhaust slide valve 14 to such a position as to open fully the exhaust port 9. The said port, furthermore, will be rapidly closed during the first part of the next quarter turn of the shaft 28 which occurs after the dead center has been passed; but the said valve member will have remained nearly stationary with substantially its full area available for the outflow of the gases, while the crank 26 has crossed its dead center position, and this movement lasts during substantially the entire instroke of the engine piston. The same movement will carry the crank 25 to a position practically corresponding to that of the crank 26, shown in Fig. 2, so that the intake port will open rapidly as the piston starts to descend, remaining nearly fully open until the piston has almost reached the end of its outstroke, and then closing promptly. After this, during the compression and firing strokes, the two valves remain closed, as shown in Fig. 1.

What I claim is:

1. In an internal combustion engine, the combination with a stationary cylinder provided with lateral inlet and exhaust ports; of concavo-convex port-controlling members conforming to the walls of the cylinder and located at opposite sides thereof; a concentric cylindrical guide for the said port controlling members outside of the cylinder; operating shafts for said members; and crank and pitman connections between said shafts and said members.

2. The combination with a stationary cylinder having lateral inlet and exhaust ports at opposite sides; of semi-cylindrical slide-valves conforming to the outside of the cylinder wall, and being located at opposite sides of said cylinder; a concentric cylindrical guide surrounding said cylinder, the slide valves fitting the space between the outer wall of the cylinder and the inner wall of the said guide, said guide having port openings in line with the cylinder ports; and means for reciprocating said slide valves.

3. The combination with a stationary cylinder provided with lateral ports at opposite sides; of semi-cylindrical slide-valves conforming to the outside of the cylinder and coöperating with said ports; a cylinder head provided with a cylindrical extension concentric with the cylinder and forming,

with the cylinder, a guide for the valves, said extension having port openings in line with the cylinder ports; and means for producing a properly timed reciprocating motion of said slide-valves.

4. The combination with a stationary cylinder having narrow inlet and exhaust ports at opposite sides, the length of each port being approximately equal to one-third of the circumference of the cylinder; of a water-jacketed cap forming the cylinder head and surrounding the cylinder below the head, said cap being provided with ports in alinement with the cylinder ports; semi-cylindrical port-controlling members located at opposite sides of the cylinder between the outer wall of the cylinder and the inner wall of the water-jacketed cap; and means for reciprocating said sliding members.

5. The combination with a stationary cylinder having lateral inlet and exhaust ports at opposite sides; of two convex slide members having port openings to be moved into and out of alinement with the cylinder ports, said slide-members fitting the outside of the cylinder and each extending slightly more than half around said cylinder and overlapping the other; external supporting means for holding said slide members in close contact with the cylinder; and means for reciprocating each of said slide-members.

6. The combination with a stationary cylinder having inlet and exhaust ports at opposite sides; of a water jacketed guide member concentric with said cylinder and surrounding the same, said guide member being provided with ports in alinement with the cylinder ports; separate sliding port controlling members one for each port, said members being located, respectively, at opposite sides of the cylinder between the outer wall thereof and the inner wall of the guide member; and means for reciprocating said port controlling members.

7. The combination with a cylinder having a lateral port; of a reciprocating valve provided with a port controlling said cylinder port, said valve being located outside of the cylinder; a guide outside of said valve to hold it in position; a piston; a crank shaft; a half time shaft operated by said crank shaft; a crank connected with said half time shaft; and a pitman connecting said crank to said valve to reciprocate the same, the port in said valve being so located that it is in substantially full register with the port in the cylinder when the connection between the pitman and the crank is between the valve and the axis of the crank, and the crank and pitman are in alinement with each other.

8. The combination with a stationary cylinder having lateral inlet and exhaust ports at opposite sides; of a water jacketed guide sleeve surrounding the cylinder, and being concentric therewith, the said guide sleeve having ports in alinement with the ports in the cylinder; semi-cylindrical sliding valves located at opposite sides of the cylinder between said cylinder and said guide sleeve and having ports to control the cylinder ports; and a crank and pitman connection between each half time shaft and one of the sliding valves, whereby said valves are operated independently of each other.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

MARGARET E. KNIGHT.

Witnesses:
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DAVID C. AHEAM.