J. D. FULLERTON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 8, 1909.

1,000,085.

Patented Aug. 8, 1911.

2 SHEETS—SHEET 1.

Fig. 1.

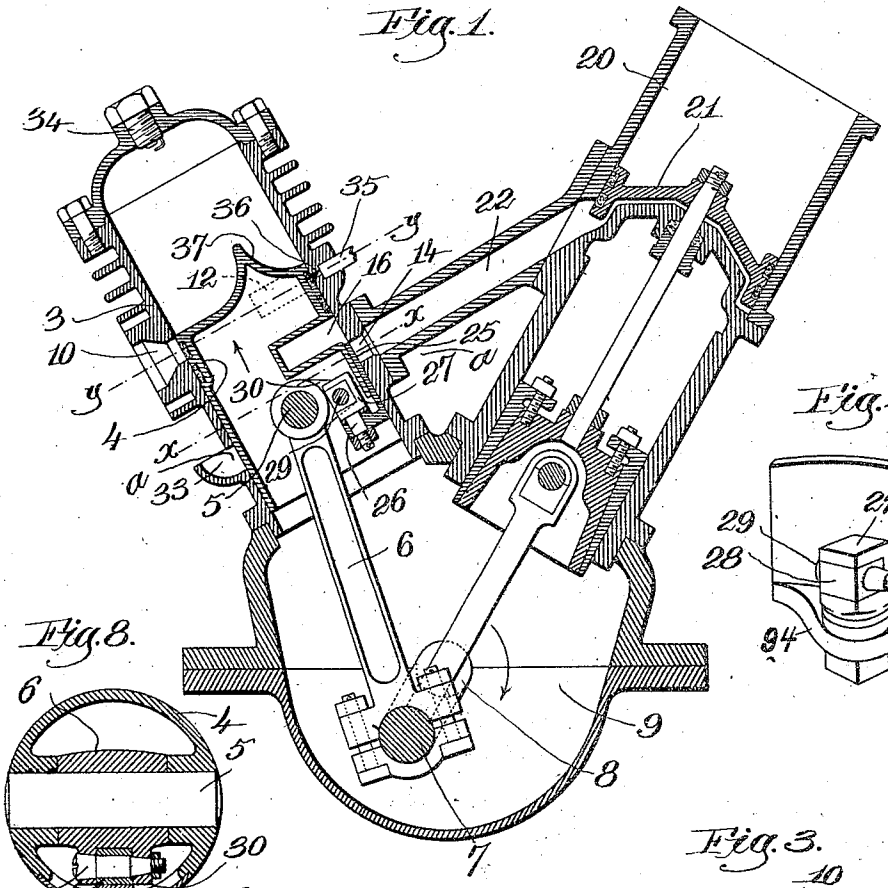


Fig. 4.

Fig. 8.

Fig. 2.

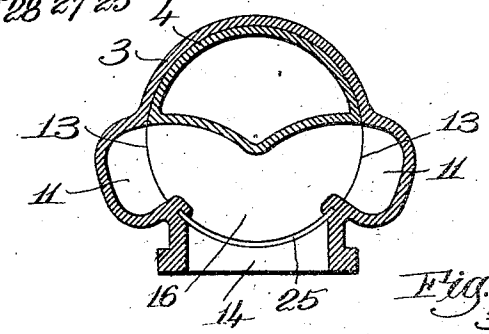


Fig. 3.

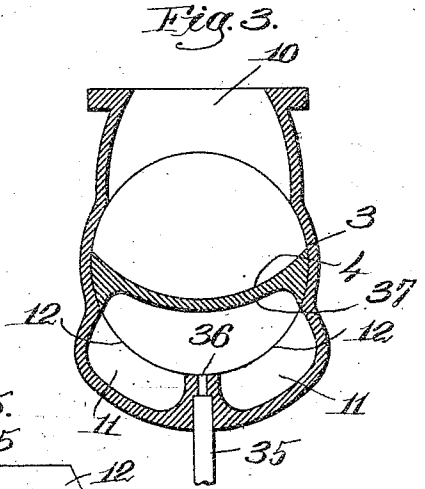
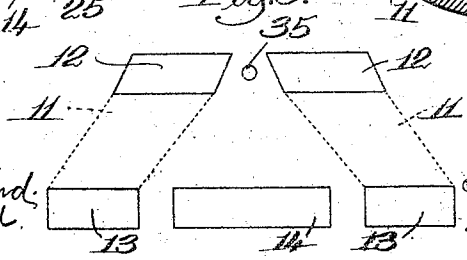


Fig. 5.



Witnesses.
Thomas J. Drummond.
Joseph M. Ward.

Inventor.
John D. Fullerton,
by Lemley & Lemley Attys.

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2 SHEETS—SHEET 2.

Fig. 6.

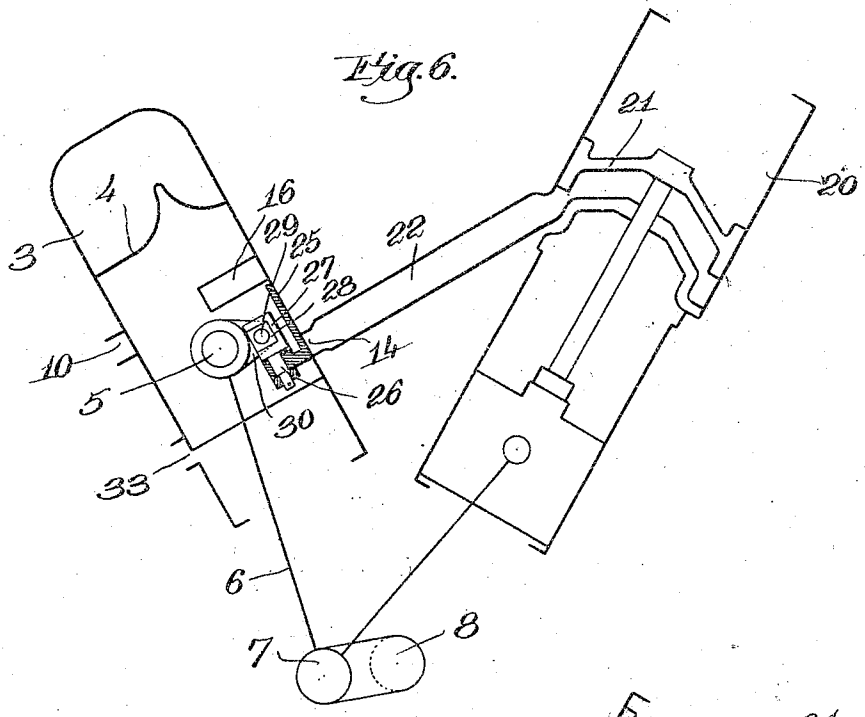
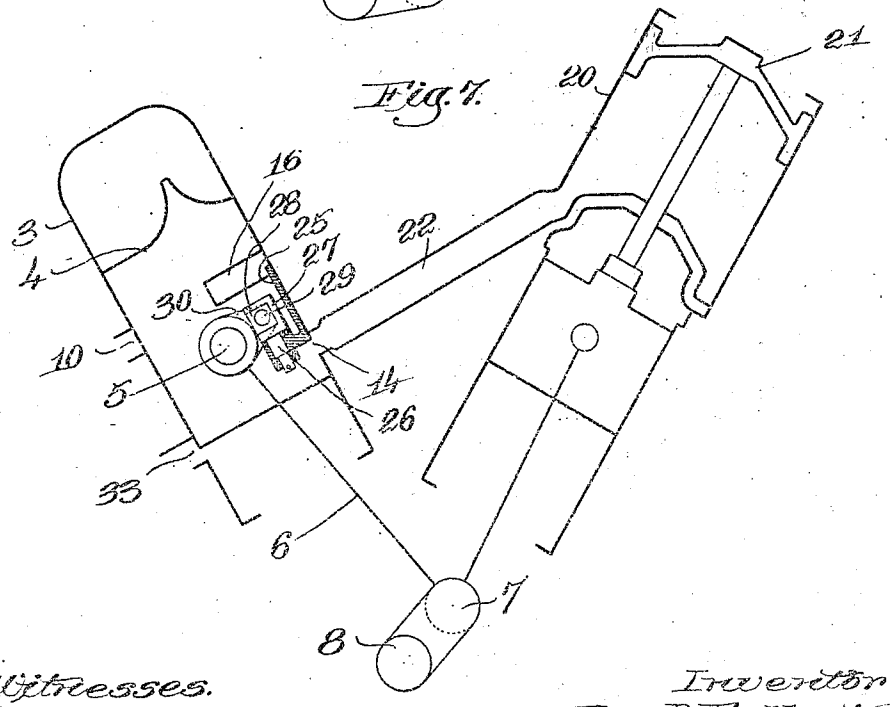


Fig. 7.



Witnesses.

Thomas J. Drummond

Joseph M. Ward

Inventor.

John D. Fullerton,

by Lemby & Gwynn Attys.

UNITED STATES PATENT OFFICE.

JOHN D. FULLERTON, OF BOSTON, MASSACHUSETTS.

INTERNAL-COMBUSTION ENGINE.

1,000,085. Specification of Letters Patent. Patented Aug. 8, 1911.

Application filed July 8, 1909. Serial No. 506,449.

To all whom it may concern:

Be it known that I, JOHN D. FULLERTON, a citizen of the United States, residing at Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Internal-Combustion Engines, of which the following description, in connection with the accompanying drawing, is a specification, like characters on the drawing representing like parts.

This invention relates to internal combustion engines, and especially to engines of the two-cycle type wherein the ports leading to and from the by-pass or transfer chamber through which air or a combustible mixture is delivered to the working end of the cylinder are opened and closed by the movement of the piston.

One of the objects of my invention is to provide a novel valve mechanism for controlling the ports of the by-pass, which valve mechanism will operate to open the port leading to the by-pass more quickly and will maintain said port open longer than would be possible if the port were controlled directly by the piston itself as is common in engines of this type; and another object of the invention is to provide a novel arrangement of pump cylinder for delivering the air or combustible mixture into the working end of the cylinder.

The features wherein my invention resides will be more fully hereinafter described and then pointed out in the appended claims.

Referring now to the drawings wherein one embodiment of the invention is shown, Figure 1 is a vertical sectional view of an engine embodying my invention; Fig. 2 is a section through the cylinder on substantially the line *x*—*x*, Fig. 1, showing the piston at the end of its down stroke; Fig. 3 is a sectional view through the cylinder on the line *y*—*y*, Fig. 1, showing the piston at the end of its down stroke; Fig. 4 is a detail perspective view of the valve; Fig. 5 is a diagram view showing the arrangement of ports leading to and from the by-pass or the transfer chamber; Figs. 6 and 7 are diagram views showing the piston and valve in different positions; Fig. 8 is a section through the piston taken on a line through the wrist pin.

3 designates the cylinder of the engine which may have any suitable or usual construction and within which operates the piston 4, said piston being hollow as is usual in engines of this type and being provided with the wrist pin 5 on which the connecting rod 6 is pivoted, said connecting rod connecting to the crank 7 of a crank-shaft 8. The crank 7 operates in a crank case 9 of any suitable or usual construction. These parts are or may be all as usual in engines of this type and form no part of my present invention.

The cylinder 3 is provided with the outlet port 10 which is opened and closed by the piston 4 in usual manner. Said cylinder is also provided with a by-pass or transfer passage through which the combustible charge is delivered into the working end of said cylinder. In the embodiment herein shown this by-pass comprises the two passages 11 that open at one end into the cylinder through two separate ports 12, and at the other end through two other ports 13. The ports 12 are shown as nearer together than the ports 13 so that the passages 11 converge toward each other, and said ports 12 are so positioned that they will be uncovered by the piston when the latter is at the lower end of its stroke. In Fig. 5 the relative position of these ports is shown diagrammatically, and the inclined passages 11 are shown in dotted lines. The cylinder is also provided with a port 14 situated between the ports 13, and the piston is formed with the chamber 16 which is of such a shape that when the piston is at the lower end of its stroke, said chamber communicates both with the port 14 and the ports 13. When the piston is thus at the lower end of its stroke, there will, therefore, be an open passage from the port 14 through the chamber 16, ports 13, passages 11 and ports 12 to the working end of the cylinder.

In the embodiment of the invention shown herein, I have provided a pump cylinder 20 within which operates a pump piston 21, said cylinder being connected to the port 14 by a conduit or pipe 22. The pump piston 20 is connected to and operated from the crank 7 and the two cylinders have such an angular relation to each other that the movements of the piston 21 are properly timed to cause it to force a charge of air or combustible mixture around through the by-pass at the time that the power piston 4 is at the lower end of its stroke.

One of the features of my invention relates to a valve for controlling the port 14,

which valve will operate to open said port quickly at the proper time and will also operate to maintain the port open longer than would be possible if said port were controlled solely by the movement of the piston. The advantage of this construction is that a better and more complete charge of combustible mixture can be admitted to the working end of the cylinder at each stroke and thus the efficiency of the engine is increased. The valve herein shown is designated by 25 and it is arranged to have a movement relative to the piston, which movement is given to it by the swinging or angular movement of the connecting rod 6. The valve is best seen in Fig. 4 and it occupies a recess formed in the side of the piston and is of a size to cover and control the port 14. Said valve is in the form of a curved flange which fits said recess, and it is provided with a laterally-extending lug 94 in which is secured a vertically-arranged stem 26 formed with a slotted head 27 in the slot of which is slidably mounted a block 28 carrying a pin 29 which extends through apertures formed in ears 30 which extend laterally from the end of and are rigid with the connecting rod 6 and are situated eithe side of said block. The result of this construction is that when the connecting rod swings past the dead center at either end of the stroke, the valve 25 will be raised or lowered relative to the piston, and this movement of the valve is so timed that the port 14 will be opened quickly at the proper time and will be maintained open for a longer period of time than would be possible if said port were controlled solely by the piston.

The operation of the engine will be readily understood from the drawings in which the direction of rotation of the crank-shaft is indicated by the arrows. In Fig. 1, for instance, the crank has just passed its lower center and the piston is rising. The port 14 is closed by the valve 25 and the pump piston 21 is at the lower end of its stroke. As the crank turns into the position shown in Fig. 6, the port 33 leading to the crank case chamber is uncovered by the piston and as the crank continues its movement, the port 14 will be opened and at the same time the pump piston 21 will move backwardly thereby causing a charge of air, or it may be combustible mixture, to be drawn into the crank case through the port 33 and thence through the pipe 22 into the pump cylinder. As the power piston 4 reaches the upper end of its stroke the swinging movement of the pitman 6 will cause the valve 25 to be moved upwardly relative to the piston, and as the crank passes the position shown in Fig. 7 the port 14 will be closed by the valve 25. During further movement of the crank, the pump piston 21 will operate to compress the charge of air or combustible mixture which has been admitted to the cylinder 20 and just before the crank passes its lower center, the upper edge of the valve 25 will come flush with the upper edge of the port 14. During the time that the crank is passing the dead center and while the piston 4 has comparatively little movement, the valve 25 will be moved downwardly comparatively quickly, thus opening the port 14, this opening movement of the port occurring during the time that the piston is comparatively stationary. When the piston is at the lower end of its stroke, the ports 12 are opened and the ports 13 register with the chamber 16 in the piston so that as soon as the port 14 is opened by the valve 25, the compressed charge of air or combustible mixture will be delivered through the by-pass to the working end of the cylinder. As the crank passes the dead center and the piston begins to rise, the valve 25 continues its downward movement relative to the piston so that the ports of the by-pass will remain open for a longer period of time than if they were controlled directly by the piston. When the parts reach the position shown in Fig. 1, the port 14 is closed and during further upward movement of the piston the charge is compressed in the working end of the cylinder and then is exploded at the proper time by any suitable sparking plug 34.

It is within my invention to admit either combustible mixture or air to the crank case and thence to the pump piston, or air alone may be thus admitted and the combustible mixture may be secured by injecting into the cylinder at the proper time a spray of gasolene. Where the latter construction is employed, the port 33 will open directly to the atmosphere and an injector pipe 35 will be employed adapted to deliver gasolene or other liquid hydrocarbon in the form of a spray directly into the cylinder through a port 36. Where the combustible mixture is formed in this way, I prefer to so time the delivery of the charge of hydrocarbon into the cylinder that the air will first be admitted through the ports 12, thus scavenging the cylinder, and when the cylinder is properly scavenged the gasolene will be admitted, which commingling with the air will form a combustible mixture.

The piston may be provided with the deflecting surface 37 against which the liquid hydrocarbon may be sprayed, such deflecting surface acting both as a means for assisting the vaporization of the hydrocarbon owing to its heated condition, and acting to deflect the current of air into the upper part of the cylinder to make the scavenging more complete.

While I have herein shown my improved valve as operating to control the inlet port

to which a pump cylinder is connected, yet it will be obvious that this same valve might be used in other locations than that shown in the drawing.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In an internal combustion engine, the combination with a cylinder having a transfer passage and a port, of a piston in the cylinder having a chamber in its side adapted to place the port in communication with the transfer passage when the piston is in one position, a connecting rod connected with the piston, a valve for said port carried by the piston but movable relative thereto, and means actuated by the swinging movement of the connecting rod to give the valve its opening and closing movement.

2. In an internal combustion engine, the combination with a cylinder having a port, of a piston in the cylinder having in its side a recess, a connecting rod for the piston, a valve for controlling said port and comprising a curved portion fitting the recess and having a laterally-extending lug, a stem secured to the lug and provided with a slotted head, a block in the slot of said head, two ears extending from the connecting rod and embracing the block, and a pin extending through said ears and said block.

3. In an internal combustion engine, the combination with a cylinder having a port, of a crank case chamber, a piston within the cylinder, means associated with the piston for putting said port in communication with the working end of the cylinder when the piston is in one position and for putting said port in communication with the crank case chamber when the piston is in another position, a pump cylinder communicating with said port, and a pump piston in said cylinder.

4. In an internal combustion engine, the combination with a cylinder having a by-pass to deliver a charge to the working end of said cylinder and also having a port, of a piston within the cylinder, means associated with the piston to connect said port alternately with the by-pass and with the atmosphere, a pump cylinder connected to said port, and a pump piston therein.

5. In an internal combustion engine, the combination with a cylinder having a by-pass to deliver a charge to the working end of said cylinder and also having a port, of a piston within the cylinder, a crank shaft to which the piston is connected, means controlled by the movement of the piston to connect said port alternately with the by-pass and with the atmosphere, a pump cylinder connected to said port, and a pump piston within said pump cylinder operated by the crank shaft.

6. In an internal combustion engine, the combination with a working cylinder having a port, a crank case chamber, a piston within the cylinder, a crank shaft, and a connecting rod connecting the piston to the crank shaft, of a valve controlling said port, means operated by the swinging movement of the connecting rod to actuate said valve to put the port in communication with the working end of the cylinder when the working piston is at the end of its working stroke and to put said port in communication with the crank case chamber when the piston is at the beginning of its working stroke, a pump cylinder separate from the working cylinder and communicating with said port, and a pump piston in the pump cylinder connected to the crank shaft.

7. In an internal combustion engine, the combination with a cylinder having a by-pass for delivering a gaseous charge to the working end thereof and a port, of a recessed piston, the recess of which constitutes communication between said port and the by-pass when the piston is at the end of its working stroke, a slide valve associated with the piston and operating to control said port, and means to give the valve a movement relative to the piston when the piston is at the end of its working stroke whereby said port will be opened quickly.

8. In an internal combustion engine, the combination with a cylinder having a by-pass for delivering a gaseous charge to the working end thereof and also having a port, of a piston provided with a chamber which constitutes communication between said port and the by-pass when the piston is at the end of its working stroke, said port being so situated that when the piston is at the beginning of its working stroke it is above the port whereby the latter will communicate directly with the crank case chamber, and means connected to said port to draw a charge therefrom when the piston is at the beginning of its working stroke and to force said charge through said port and into the working end of the cylinder when the piston is at the end of its working stroke.

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

JOHN D. FULLERTON.

Witnesses:

GEORGE L. STEBBINS,

C. C. BOGART.