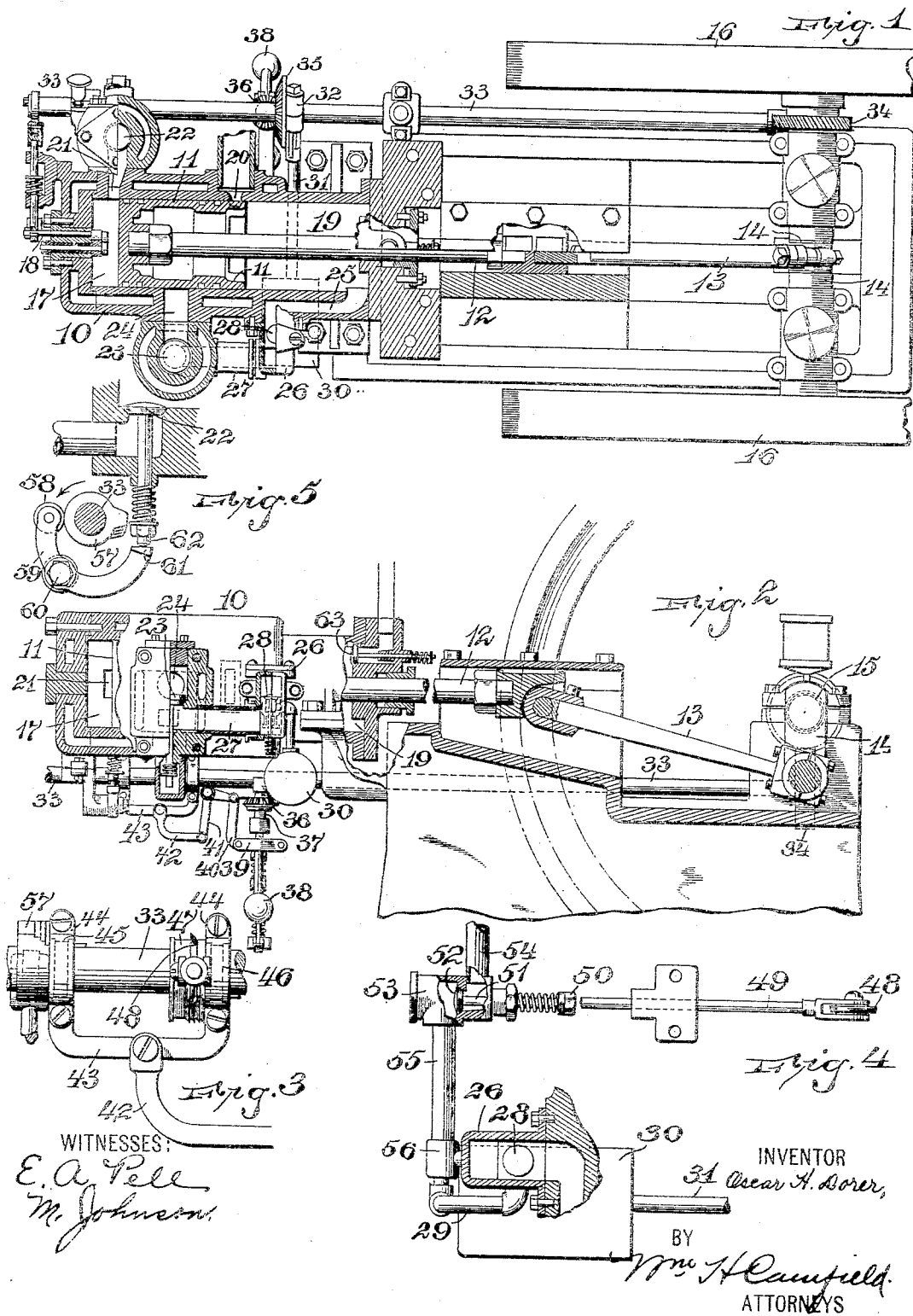


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TWO-CYCLE GAS ENGINE.
APPLICATION FILED OCT. 26, 1908.

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UNITED STATES PATENT OFFICE.

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To all whom it may concern:

Be it known that I, OSCAR H. DORER, a citizen of the United States, residing at Irvington, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Two-Cycle Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

This invention is designed to provide a gas engine or an internal combustion engine which uses a fuel gas, the engine being a two-cycle engine and having a fuel efficiency and power of production to equal a four-cycle engine. These results are brought about by making a good mixture in the fuel and by means of different mechanisms to be hereinafter more fully described.

The gas engine is designed to provide a cylinder, one end of which is used as a compression chamber, the piston reciprocating to compress the air in the compression chamber, and at the same time being actuated by an explosive mixture on the other side of the piston. When the power stroke is complete, two exhausts are opened, one being opened by the action of the piston passing it, and the other being opened mechanically, these exhausts being at opposite ends of the chamber which is formed by the piston and the cylinder when the piston is at the end of its power stroke. Mechanism is also installed whereby the inlet for the air from the compression chamber is opened so that free air is admitted to the chamber formed by the cylinder and the piston, when at the end of its power stroke, so that a "body of pure air" is injected into this chamber in the cylinder and has a tendency to divide and force the exploded gases from this chamber at its two ends, thus thoroughly scavenging the chamber. This operation of cleaning out the cylinder takes place at the end of the stroke, while the crank is going over, and sufficient time is given to force this air from the compression chamber to clean out the explosion chamber, and the air from the compression chamber picks up fuel gas, when the scavenging is complete, so that an explosive mixture is admitted to the explosion cham-

ber after the free air has cleaned it out, and this mixture is then compressed to form an explosive mixture that is then ignited by a spark in the usual manner, and the operation is repeated.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a top view partly in section showing the improved engine. Fig. 2 is a side view of the same broken away in portions to better illustrate the device, and Fig. 3 is a detail of the shifting mechanism for the cams for operating the gas inlet and the exhaust of the explosion chamber. Fig. 4 is a view showing the connection of the fuel pump with the inlet for the fuel vapor. Fig. 5 is a detail showing the means for operating the mechanically operated exhaust.

The engine comprises a cylinder 10 which is water-jacketed, as usual in this class of engine, so as to prevent the heating of the parts. The cylinder has, operated therein, a piston 11 which reciprocates in the cylinder and is provided with a piston rod 12 which is connected in any well known manner, but preferably by the link 13 with the crank 14 of the shaft 15 of the engine, and it is also provided with the usual balance wheels 16 to steady the motion and carry the engine over. The piston, when in the position shown in Figs. 1 and 2, has completed its compression stroke and is about to start on its power stroke, the explosive mixture in the chamber 17 being ignited by any usual form of sparker mechanism 18, and the piston is started on its power stroke, at the same time compressing the air in the chamber 19. When the piston finishes its power stroke, the head of the piston has completely uncovered the exhaust 20 which is then at one end of the chamber 17, the chamber 17 being enlarged by the movement of the piston, and the exhaust 21 is opened by a mechanical means to be hereinafter described, the opening being by means of the valve 22 and simultaneous with the uncovering of the exhaust 20. These two exhausts 20 and 21 are opened fully at the completion of the stroke and give two outlets for the passage of the exploded gases from the explosion chamber, which divides these gases, and they pass out either end of the explosion chamber. This is taking place while the crank is going over about thirty degrees at the end of its stroke, and in the meantime this outlet,

through two exhausts, has permitted about sixty per cent. of the exploded gases to pass, and this naturally greatly reduces the pressure which would necessitate, under normal conditions, a longer time for the remaining gases to pass out. To sweep them from this explosion chamber, the reduction in pressure permits the valve 23, leading into the inlet port 24, to be forced open by the air compressed in the chamber 19, which air passes through the channel 25 and through the casing 26 into the pipe 27, and up past the valve 23 through the port 24 into the center of the explosion chamber, that is, about central between the two exhausts and preferably on the opposite side of the cylinder. This fresh air rushing into the explosion chamber forms a "body of pure air" which forces both ways toward the exhausts and cleans out the exploded gases thoroughly. It will be understood, however, that it is necessary, as soon as enough pure air has passed into the explosion chamber to form the body of pure air for scavenging, that fuel vapor be taken, along with the remaining air, and fed into the explosion chamber behind the body of pure air, the whole operation being completed an instant after the exhausts are closed. Thus, at this instant, an explosive mixture fills the explosion chamber. To accomplish this it is necessary to open a valve 28 which is connected, by suitable piping 29, to a fuel pump 30, shown more particularly in Figs. 2 and 4 the valve 28 being normally held shut by a suitable spring. This pump is operated by a rod 31 and is a pump of any usual construction, the rod 31 being operated by the eccentric 32, shown in Fig. 1, which is operated by the shaft 33 which is rotated by means of the spiral gears 34, one of which is attached to the shaft 33, and the other, to the shaft 15 of the engine. This pump is continually operating, but the admission of fuel vapor thereto is regulated by means of a mechanism to be described hereinafter. The pump 30 and the chamber 19 work in harmony, that is, when gas is being compressed in the pump, air is being compressed in the chamber, the maximum pressure the gas attains being greater than that of the air, in approximately the ratio of 50 to 33. When about one-sixth of the compressed air in the chamber 19 and the inlet 24 has been allowed to expand into the cylinder, the gas admission valve 28 opens, that is, when the pressure of the air in the passage between the compression chamber 19 and the explosion chamber 17 is reduced, the valve 28 opens because the pressure of the gas underneath it is greater than the pressure of the air above it. The fuel gases rush with the air into the casing 26 and through the pipe 27 through the valve 23 and the inlet port 24, and the gas and the air are well mixed and form an explosive mixture

that is efficient, said explosive mixture expanding behind the scavenging air as before stated. Thus the whole operation of exhausting the exploded gases from, and admitting fresh gases to, the cylinder takes place while the crank is revolving through sixty degrees at the end of the power stroke. The fresh gases replace the exploded gases as the latter are driven from the explosion chamber, and are prevented from mixing with the exploded gases by the "bodies of pure air."

It is necessary that the valve 28 should close before the valve 23 closes, so that all of the explosive mixture will enter the cylinder. If this were not done, some gas would remain in 27 and act with the "body of pure air" to scavenge out the exploded gases in the explosion chamber, after the next explosion took place. This would be a waste and detract from the efficiency of the engine. This particular closing action is insured by the strength of the springs actuating these valves, and by the compression which takes place in the inlet port 24, when the piston passes up and closes this port previous to the explosion of the gases. The eccentric 32 rotates with the beveled gear 35, which meshes with a second beveled gear 36, and rotates a shaft 37 which rotates in bearings secured to the machine frame, and on which is a ball and upright adjustable spring, or other suitable governor 38. When the speed of the engine decreases or increases, the governor acts to raise or draw down, as the case may be, an arm 39 which operates a link 40, which in turn operates a bell crank 41 which pulls over a bar 42 which is pivotally connected with a yoke 43, shown more particularly in Fig. 3. This yoke is connected, by means of the straps 44, to collars 45 and 46 which rotate with the shaft 33 and are slid along a feather.

To one collar 46 is attached a circumferential "step down" cam 47 similar to 57 in Fig. 5, against which operates a wheel 48, and a movement of this cam along the shaft 33 regulates the outward movement of the wheel 48, this wheel being shown more particularly in Fig. 4, and it is attached to a rod 49. The end of this rod is adapted to engage a regulating screw 50 which can be moved toward or from the end of the rod 49 by screwing it on the stem 51 of a valve 52 in the casing 53. This valve regulates the admission of fuel gas through the pipe 54, from a source of supply, and said gas then passes through the pipe 55 to the casing 56, and from there into the pump 30 and through the pipe 29 underneath the valve 28 and is admitted, at the proper time, through the means above quoted. The cam 47 is so constructed that the valve 52 is kept open during the whole of the suction stroke of the rod 31, when the engine is running

normally, and each "step" on the cam corresponds to an arc about six degrees less than its preceding "step".

As the engine speeds up, a smaller of the stepped cams engages wheel 48, and keeps valve 52 open less time. Therefore less gas is drawn into pump 30 and there will be less compression to the gas when the piston of pump 30 returns. Therefore valve 28 will not be opened so soon, because there is less pressure underneath it, which permits more air to pass into the "bodies of scavenging air." To accommodate the increase in speed in the engine and to allow for the exhaustion of the larger "bodies of scavenging air", the mechanically operated exhaust is kept open longer. This is accomplished by a circumferential "step down" cam 57 which is attached to the collar 45 and which when moved along the shaft 33 regulates the length of time of the throw of a roller 58 in the end of the arm 59, which arm is pivoted at 60, the other end 61 of which operates the end of the stem 62 which is attached to the valve 22, which is the mechanically operated exhaust valve. The "steps" on 57 are in the opposite direction to those on 47, and are on the side of the cam corresponding to the closing of the valve 22. As the engine speeds up, the exhaust valve 22 is kept open longer as per 57, while at the same time the gas valve 52 is kept open less time as beforestated. The rotation of 57 takes place in the direction indicated by the arrow. These adjustments through the governor are arranged to bring about the best results by timing the opening and closing of these valves so that there is a perfect cooperation, and so as to permit of throttling the mixture and keeping it always of the same strength. Air is admitted to the chamber 19 through the inlet valve 63, shown in Fig. 2, at the return of the piston 11.

Having thus described my invention, what I claim is:—

1. An internal combustion engine comprising a cylinder having a piston therein, the cylinder having a pair of exhausts arranged so as to be at the ends of the explosion chamber when the piston is at the limit of its power stroke, the piston uncovering one exhaust at the limit of its power stroke, means for opening the second exhaust while the first exhaust is uncovered, an air inlet to the cylinder substantially equidistant between the exhausts whereby the admission of air through the inlet cleans the explosion chamber from its two ends, and means for supplying fuel to the air inlet after a portion of the air has passed the fuel supplying means.

2. An internal combustion engine comprising a cylinder having a piston therein, the cylinder having a pair of exhausts, the exhausts being arranged at opposite ends of

the explosion chamber when the piston is at the limit of its power stroke, a compression chamber formed in the end of the cylinder on the opposite side of the piston from the explosion chamber, means for conducting compressed air from the compression chamber to a point in the explosion chamber substantially equidistant between the exhausts whereby compressed air is admitted to the explosion chamber to force the exhaust from both ends, and means for supplying fuel to the air inlet after a portion of the air has passed the fuel supplying means.

3. An internal combustion engine comprising a cylinder having a piston therein, the cylinder having a pair of exhausts, one exhaust being opened by the piston, means for opening the second exhaust when the piston is at the limit of its power stroke, a compression chamber formed by the piston and the cylinder at the back of the piston, means for conducting compressed air from the compression chamber to the explosion chamber, means for admitting fuel gas to the conducting means, and means for governing the quantity of gas admitted to the air conducting means.

4. An internal combustion engine comprising a cylinder having a piston therein, the cylinder having a pair of exhausts arranged to be at the opposite ends of the explosion chamber when the piston is at the limit of its power stroke, one of the exhausts being opened by the piston, means for opening the second exhaust when the piston is at the limit of its power stroke, a compression chamber in the cylinder behind the piston, means for conducting air from the compression chamber to the explosion chamber after the exhausts have been opened, a fuel pump, means for conducting fuel gas from the pump to the air conducting means, and means for governing the quantity of gas admitted to the air conducting means.

5. An internal combustion engine comprising a cylinder, a piston in the cylinder, the cylinder having a pair of exhausts, one exhaust being arranged at one end of the cylinder, and the other exhaust being intermediate of the ends of the cylinder, the second exhaust being uncovered by the piston at the limit of its power stroke, mechanically operated means for opening the exhaust at the end of the cylinder when the piston is at the end of its power stroke, the cylinder at the back of the piston forming a compression chamber, means for conducting air from the compression chamber to a point in the explosion chamber substantially equidistant between the exhausts, a fuel pump, and means for admitting fuel gas to the air conducting means after a portion of the pure air from the compression chamber has passed from the compression chamber to the explosion chamber.

6. An internal combustion engine comprising a cylinder, a piston in the cylinder, the cylinder having a pair of exhausts, means for opening one exhaust when the
5 piston is at the limit of its power stroke, the other exhaust being opened by the piston, the cylinder at the back of the piston forming a compression chamber, means for conducting compressed air from the compression chamber to the explosion chamber, a
10 fuel pump, and means for admitting fuel gas to the air conducting means after a portion of the air has passed from the compression chamber toward the explosion chamber.
15 7. An internal combustion engine comprising a cylinder, a piston therein, a pair of exhausts, one exhaust being adapted to be uncovered by the piston when the piston is at the limit of its power stroke, a valve in
20 the second exhaust, a cam adapted to open

said valve when the first exhaust is uncovered, the cylinder having an inlet equidistant between the exhausts, means for compressing air, means for conducting air from the air compressing means to the air inlet, 25 whereby air is admitted to the explosion chamber to force the exhaust from both ends of the explosion chamber, a fuel pump, and means for admitting fuel gas from the fuel pump to the air conducting means after 30 some pure air has passed toward the explosion chamber.

In testimony, that I claim the foregoing, I have hereunto set my hand this 21st day of October 1908.

OSCAR H. DORER.

Witnesses:

E. A. PELL,
M. JOHNSON.