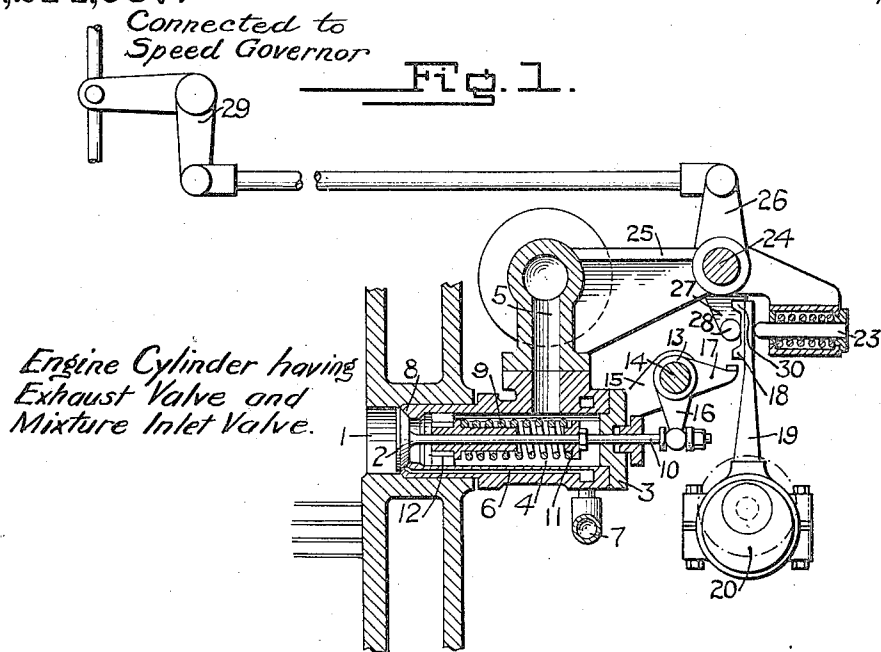
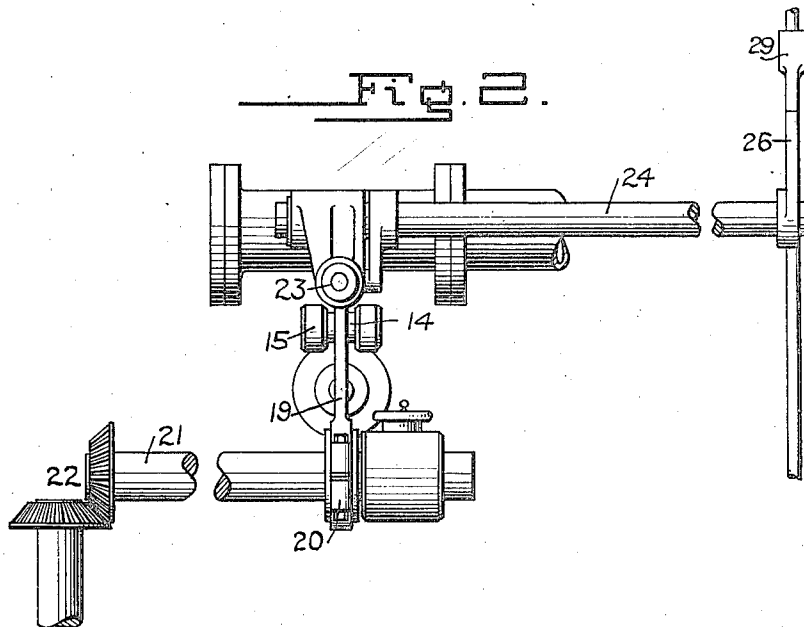


H. MENSFORTH.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED DEC. 20, 1910.

1,214,937.

Patented Feb. 6, 1917.



WITNESSES:

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INTERNAL-COMBUSTION ENGINE.

1,214,937.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HOLBERRY MENSFORTH, a subject of the King of Great Britain, and a resident of Manchester, England, have made a new and useful Invention in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines and has for its object to construct an improved engine of this kind.

Internal combustion engines may be broadly divided into two classes, in one of which the cylinder is filled with a charge of gas and air, and this explosive mixture compressed to a pressure which may be in the neighborhood of 180 pounds per square inch or more as a maximum but which in many cases is much less. This compressed charge is then ignited and the combustion is approximately instantaneous. This is the system under which, what are commonly known as gas engines, operate. In the other class of internal combustion engine, a charge consisting substantially or wholly of air, is compressed to a much higher pressure than is employed in the former class, pressures in the neighborhood of 600 pounds per square inch being common. Oil is then forced into the combustion chamber and ignites owing to the heat of the compressed air. The combustion continues as long as the oil valve is open and has not as a general rule the characteristics of an explosion.

According to the present invention, the improved engine possesses some of the characteristics of both classes of engine above mentioned, that is to say, provision is made for compressing an explosive charge in the cylinder to the ordinary pressure employed in a gas engine, this charge is then ignited and after ignition, oil together with some or all of the air requisite for its complete combustion, is injected at a suitable pressure into the cylinder and becomes ignited by the high temperature due to the ignition of the gas charge, thereby furnishing additional energy during the power stroke. The length of time during which oil is supplied to the cylinder is preferably determined by a governor of any suitable type, which is, however, either so connected with the, oil and air valve that the opening of said valve, when the valve opens at all, occurs about the same point in the cycle, the time of clos-

ing being determined by the governor, or the governor is connected to the fuel pump controlling the amount of oil injected.

In order that the nature of the invention may be clearly understood, I will proceed to describe the same with reference to the accompanying drawings, in which Figure 1 is a view in front elevation partly sectional of a form of valve actuating and controlling mechanism arranged in accordance with this invention, and Fig. 2 is a view in side elevation of the mechanism illustrated in Fig. 1.

Referring now to the drawings, the air and liquid fuel is admitted to the combustion chamber through a passage 1 formed in the wall of the combustion chamber and is controlled by means of a valve 2 here shown as of the conical or puppet type located within a casing 3 attached to the wall of the combustion chamber and comprising a chamber 4 to which air is supplied under pressure through a pipe and passage 5 in open communication therewith. The air admitted to the chamber 4 is compressed prior to its entrance into this chamber by means of a pump (not shown) driven by the engine or by other means. Formed within the casing 3 is a duct or passage 6 for the liquid fuel connected by means of a pipe 7 to the source of liquid fuel supply and leading to the seat 8 of the valve 2. The valve 2 is normally retained upon its seat by means of a spring 9 surrounding the stem 10 of the said valve and interposed between a collar 11 formed on the stem and a web 12 attached to the wall of the chamber 4. The pressure of the air in the chamber 4 may be about 50 pounds per square inch higher than the pressure in the combustion chamber at the time of ignition so that the air admitted from the chamber 4 will atomize the liquid fuel and carry the same into the combustion chamber. The liquid fuel may be normally maintained under pressure by means of the same pump as affects the compression of the air or it may be supplied to the combustion chamber by means of a fuel injection pump of any suitable and well known construction, which is arranged to cause the injection of the fuel when the valve 2 is moved from its seat.

The opening of the valve 2 is effected by means of a bell crank lever 13 pivotally

mounted at 14 upon a bracket 15 attached to the casing 3. One arm 16 of the bell crank lever is connected to the stem 10 of the valve 2, which projects through the wall of the chamber 4, the other arm 17 being so disposed as to be engaged by a projection 18 formed on a reciprocating rod 19 driven by the engine. The reciprocating rod 19 is preferably operated by means of an eccentric 20 mounted upon a shaft 21 driven from the cam shaft of the engine by means of bevel gearing 22. The reciprocating rod 19 is maintained in position to operatively engage with the arm of the bell crank lever 13 by means of a spring actuated stop 23 which is yieldingly held in engagement therewith. Pivotally mounted at 24 upon a bracket 25 attached to the valve casing is a two-armed lever 26, one arm 27 of which is provided with a projection 28 for engaging with one end of the reciprocating rod 19. The other arm of the lever 26 is connected by means of suitable link-work and a bell crank lever 29 to the operative member of the governor.

The upper extremity of the reciprocating rod 19 is provided with a cam surface 30 cooperating with a wheel or roller attached to the projection 28; the interval of time during which the projection 18 will be maintained in engagement with the arm 17 of the bell crank lever is dependent upon the position of the projection 28 relatively to the cam surface 30, as will be hereinafter explained.

The operation of the apparatus is as follows:—

When the explosion of the gas and air mixture has occurred in the combustion chamber and the piston has commenced its outward stroke, the projection 18 on the reciprocating rod 19 will be brought into engagement with the arm 17 of the bell crank lever 13, the latter of which will be rotated upon its pivot and acting upon the stem 10 of the valve 2 will open the valve and admit a charge of liquid fuel and air from the chamber 4 into the combustion chamber. It will be understood that the timing mechanism will be so arranged as to accurately determine the point in the cycle at which the projection 18 on the reciprocating rod will be brought into engagement with the arm of the bell crank lever and effect the opening of the valve 2. When the reciprocating rod 19 has moved sufficiently to bring the cam surface 30 into engagement with the roller on the projection 28, the projection 18 will be moved out of engagement with the arm 17 of the bell crank lever, thereby permitting the valve 2 to remain closed due to the action of the spring 8 and the supply of air and liquid fuel will remain cut off.

It will readily be seen from an inspection

of Fig. 1 that the position of the projection 28 relatively to the cam surface will determine the point at which the effective portion of the cam will move the reciprocating rod 19 against the action of the spring actuated stop 23 and consequently the point at which the projection 18 is moved free from the arm 17 of the bell crank lever. It should be noted that the point of opening of the valve 2 whenever it is opened is an invariable one since the projection 18 will then be brought into engagement with the arm 17 of the bell crank lever at each downward movement of the reciprocating rod 19. The interval of time during which liquid fuel and air under pressure are supplied to the combustion chamber is dependent upon the time at which the arm of the bell crank lever is released from the projection on the reciprocating rod 19. Under these circumstances the opening of the air and liquid fuel valve will always occur at the same point in the cycle, the amount of fuel injected into the combustion chamber being dependent upon the interval of time during which the valve 2 is lifted from its seat.

Under some circumstances it may be preferable to vary the amount of liquid fuel supplied to the engine by employing a liquid fuel injection pump, the stroke of the pump and consequently the amount of liquid fuel which is injected into the combustion chamber being arranged to be varied automatically in accordance with the load upon the engine.

It will be observed that in the improved engine according to this invention, the advantage of a prolonged combustion period is obtained without the necessity for the high pressures which are required in oil engines of the class hereinbefore mentioned. It results from this therefore that the average pressure through the power stroke will be higher than is the case with an ordinary gas engine working with the same maximum pressure where the time of combustion is very short.

Although the invention is particularly applicable to engines operating on the four-stroke or Otto cycle, it will be understood that it is not limited in this respect and may be applied to engines operating on the two-stroke cycle, for instance. Furthermore, the invention is not limited to the construction of valve mechanism herein described and illustrated for controlling the supply of liquid fuel admitted to the combustion chamber and various modifications may be made without exceeding the scope of the invention, for instance in place of the single valve for controlling the supply of liquid fuel and air to the cylinder, two separate valves may be employed for this purpose, the fuel valve being arranged to be

closed prior to the air inlet valve, the latter of which may be arranged to independently vary the amount of air admitted to the combustion chamber in accordance with the load or to operate in conjunction with the valve controlling the supply of liquid fuel, both valves being under the control of the governor.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. In combination with the cylinder of an internal combustion engine provided with an exhaust valve and a gas and air mixture inlet valve, a liquid fuel supplemental supply, a supply of air under pressure, a valve common to said supply of air under pressure and said liquid fuel supply and adapted to control the admission of the same to said engine cylinder, a speed governor for said engine and a tripping mechanism operating synchronously with said engine under the control of said governor for opening said valve.

2. In combination with the cylinder of an internal combustion engine having a fuel admission port, an exhaust port, and an auxiliary mixture supply port, an auxiliary fuel supply, and an auxiliary air supply communicating with said auxiliary port, an auxiliary valve for controlling the delivery of fuel and air from said auxiliary supplies, and governor controlled means for opening said auxiliary valve at a determined point of the engine cycle and for timing the duration of the open period of the valve in response to variations in the load demand.

3. In combination in an internal combustion engine having a cylinder provided with a main admission port, an exhaust port and an auxiliary fuel supply port, an auxiliary

fuel supply and an auxiliary air supply communicating with said auxiliary fuel supply port, an auxiliary valve for controlling the delivery of fuel and air through said auxiliary port, and means controlled by the engine governor for opening said valve at an invariable point in the engine cycle, and for timing the period of opening in response to variations in the load demand on the engine.

4. In combination in an internal combustion engine having a cylinder provided with a mixture supply port, an exhaust port and an auxiliary fuel admission port, a valve for controlling the delivery of liquid fuel through said auxiliary port and governor controlled variable cut-off trip mechanisms for opening said valve and for timing the open period of said valve in response to variations in the load demand on the engine.

5. In combination with an internal combustion engine having a cylinder provided with a mixture admission port, an exhaust port and an auxiliary fuel supply port, an auxiliary liquid fuel supply and an auxiliary air supply communicating with said auxiliary port, an auxiliary valve for controlling the delivery of air and liquid fuel through said auxiliary port and a governor controlled trip mechanism for opening said valve at an invariable point in the engine cycle and for timing the duration of the open period of said valve in response to variations in the load demand.

In testimony whereof, I have hereunto subscribed my name this 28th day of November 1910.

HOLBERRY MENSFORTH

Witnesses:

PERCY WM. HOLT,
H. R. KITSON.