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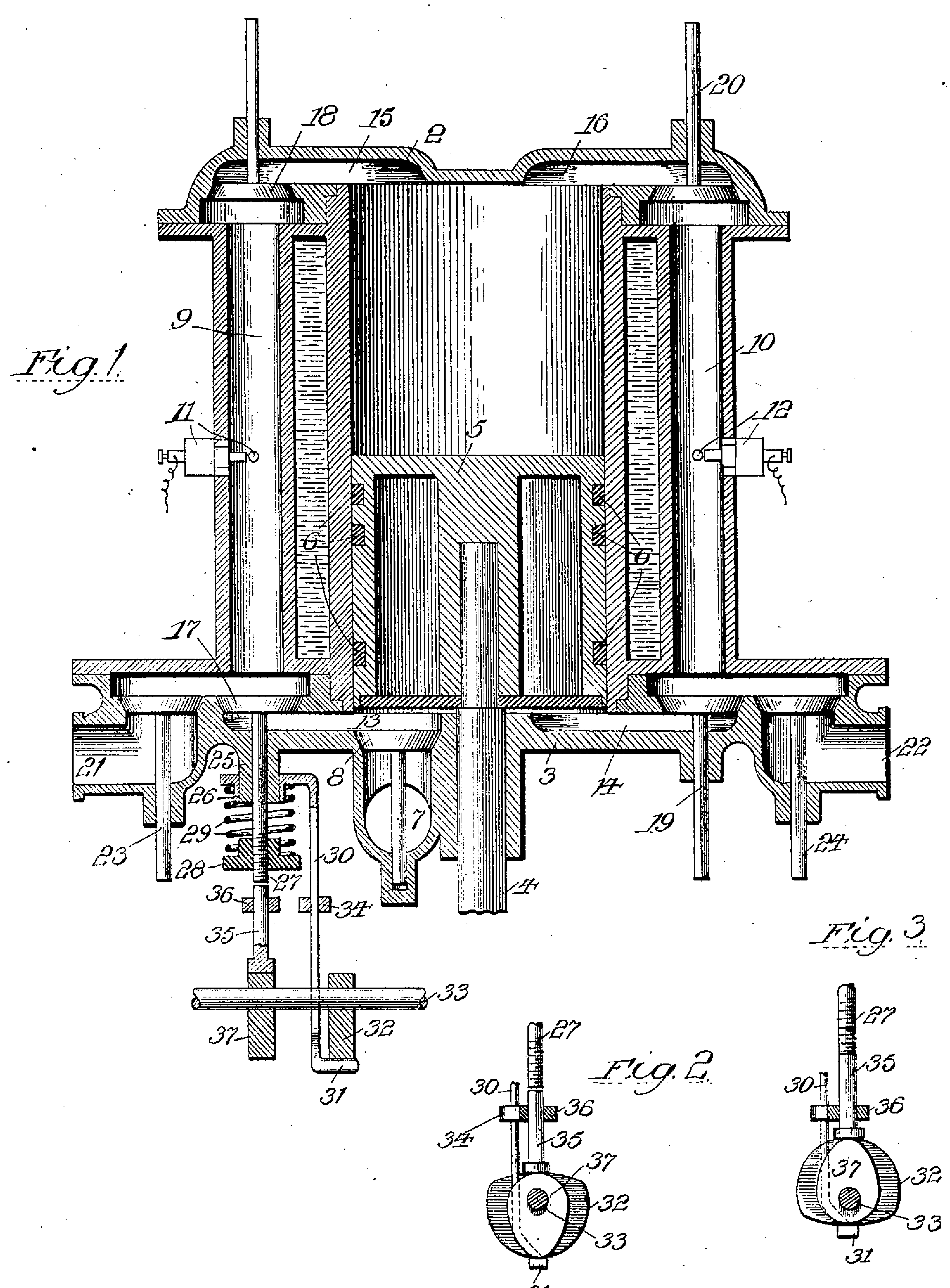
S. S. WILLIAMS.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED SEPT. 2, 1902.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

No. 809,081. Specification of Letters Patent. Patented Jan. 2, 1906.

Application filed September 2, 1902. Serial No. 121,746.

To all whom it may concern:

Be it known that I, SYDNEY S. WILLIAMS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

One object of my invention is to provide an engine capable of being efficiently run by either a light oil, as gasoline, or by kerosene or heavier oils.

Another object is to save and utilize the heat commonly lost in other kerosene and heavy oil engines in heating the oil by a separate burner or other device to the gas-producing temperature.

A further object is to do away with the excessive back pressure during the compression-stroke of the piston caused by "advancing" the ignition—that is, igniting the charge before the piston reaches the top of its stroke.

A further object is to enable the combustion to mature to or near its point of highest efficiency before admitting the combustive mixture to the cylinder.

A further object is to produce a power-stroke at every revolution in a single-cylinder engine employing a four cycle.

A further object is to compress the combustible mixture on the power-stroke, leaving the momentum of the fly-wheel and moving parts simply to revolve the motor, and to exhaust on the upstroke of the piston.

A further object is to produce a valve which shall remain tightly closed or be easily opened at will.

I attain these objects by mechanism illustrated in the accompanying drawings, which show the preferred exemplification of my invention and in which the same numerals refer to the same parts throughout the figures.

Figure 1 is a sectional view of an internal-combustion-engine cylinder embodying the features of my invention, and Figs. 2 and 3 are detail views of the valve-operating mechanism.

Referring to the drawings, the reference-numeral 1 indicates a suitable cylinder whose ends are closed by the top and bottom plates 2 and 3, respectively, the latter plate having a suitable stuffing-box, through which the piston-rod 4 passes. The piston 5 is of any suitable form, closed at both ends or cast solid, and is provided with packing-rings 6 in any suitable manner. The cylinder communicates with a suitable carbureter (not shown) by means of a port or passage 7, which is controlled by a suitable valve 8 of the puppet type.

One or more ignition-chambers are employed, and in practice I prefer to use two such chambers as shown at 9 and 10, which are formed of suitable castings secured in place by means of the top and bottom plates. The ignition-chambers are provided with suitable igniters or sparkers 11 and 12, preferably of ordinary electrical form and construction. The chambers 9 and 10 communicate with the cylinder 1 at top and bottom, as by suitable channels or passages 13 and 14, 15 and 16, formed in the bottom and top plates, respectively, as shown in Fig. 1. The communications of the ignition-chambers and cylinder are controlled by suitable valves of the puppet type, the valves 17 and 18 being, respectively, the lower and upper port-valves of the chamber 9 and the valves 19 and 20 being, respectively, the lower and upper port-valves of the chamber 10. The ignition-chambers are also provided with exhaust-passages, as at 21 and 22, respectively, which are controlled by respective puppet-valves 23 and 24. It is understood that all the valves above disclosed except the inlet-valve 8 are operated by suitable cams from the crank-shaft (not shown) of the engine and that the inlet-valve may be so operated.

The valves are controlled by the mechanism illustrated, the valve 17 alone being shown provided with this controlling mechanism in order not to encumber the drawings, it being understood that the mechanism is duplicated at the several valves, with the exception of the inlet-valve 8, which may be so provided. The stuffing-box 25 of the valve is provided with a sliding collar 26, and the stem 27 of the valve is provided with a fixed collar 28, a coil-spring 29 being interposed between the collars. The collar 26 has a projecting arm 30, provided at its free end with an angular finger 31, adapted to bear against a cam 32, fixed on a suitable shaft 33, which is suitably connected to the crank-shaft of the engine, so as to make one revolution during the two revolutions of the crank-shaft. The arm is suitably held against displacement by a convenient guide 34. A rod 35 is movably mounted in a guide 36, with one end close to the stem 27 and in alinement with it. The other end of the rod 35 bears upon a cam 37 on the shaft 33. The cam 37 has the greater portion of its periphery in the form of a segment of a circle, and the remainder of its periphery projects slightly farther from the center. The cam 32 has the greater portion of its periphery also in the form of a segment of a circle, and the remainder of its periphery recedes toward the center. The cams are secured upon the shaft so that their eccentric portions are upon the same side of the shaft.

When the valve is closed, the parts are in the positions shown in Figs. 1 and 2, the rod 35 being just out of contact with the valve-stem 27 and the finger 31 being depressed to compress the spring 29, whereby the valve is held tightly closed. When the cams revolve, the compression of the spring is reduced, as the cam 32 allows the finger 31 to rise and the collar 26 to slide along the box 25 by the expansion of the spring. At the moment that the finger 31 begins to ride over the reduced portion of the cam 32 the rod 35 is acted upon by the projecting portion of the cam 37, and the rod is thereby raised to operate the valve and open its port, the parts being then in the positions shown in Fig. 3. When the piston 5 starts from the lower end of the cylinder on its upstroke, it draws the combustible mixture into the lower end of the cylinder through the inlet-valve 8, and upon its downstroke it compresses the mixture into, say, the chamber 9 through the port-valve 17. The mixture in the chamber 9 may be ignited, the valve 17 being again closed, at any point of the next or second upstroke by the igniter 11, this point being selected so as to allow time for the explosion or combustion to mature to the degree of greatest efficiency by the time the piston approximately reaches the top of the upstroke. The exploded or exploding mixture is then admitted into the cylinder on the upper side of the piston by the opening of the port-valve 18, driving the piston downward on the succeeding or second downstroke. The products of combustion are exhausted through the exhaust-valve 23 on the succeeding or third upstroke, the first of the cycle. On the second upstroke of the piston mixture is again drawn into the lower end of the cylinder, and on the second downstroke it is compressed into the right-hand ignition-chamber 10 through the port-valve 19, the mixture then being ignited by the igniter 12 at the selected point of the third upstroke, which is the first of the cycle, and admitted to the cylinder at the top of the stroke through the port-valve 20, forcing the piston downward on the next downstroke. On the next upstroke the products of combustion are exhausted through exhaust-valve 24. In this way the lower end of the cylinder acts as a pump, drawing the combustible mixture into the cylinder at every upstroke of the piston and compressing it into the left-hand and right-hand ignition-chambers alternately at every downstroke, so that at the top of the piston's stroke there is always one ignition-chamber full of compressed mixture ignited or ready to ignite, while the other ignition-chamber has just finished exhausting its products of combustion.

The oil which mixed with air forms the combustible mixture, be it gasolene or a heavier oil, is mixed with the air in a suitable carbureter (not shown) in a finely-divided condition.

By employing one or more separate ignition-chambers provided with valves to confine the mixture for a longer or shorter period, which may be regulated by simply timing the openings of the valves, I am able to utilize a variety of oils efficiently. Different oils mixed with air require different lengths of time after ignition to attain to perfect combustion, and these periods are controlled and regulated by closing the valves of the ignition-chambers for longer or shorter times. For example, gasolene vaporizing at atmospheric temperature need not be ignited until the piston is at or near the topmost point of its stroke, it being practically a gas at the completion of the compression, and thus requiring but a comparatively short time for the ignited mixture to mature to a perfect combustion, so that gasolene may be ignited either very near to or at the finish of the upstroke, and thus used efficiently. Kerosene and heavier oils, on the other hand, will not vaporize at atmospheric temperature and at the end of the compression-stroke will be simply finely-divided liquid oil mixed with air, which mixture will ignite slowly. It is therefore ignited early on the upstroke of the piston, the mixture in the ignition-chamber becoming hotter and hotter as the combustion progresses until the oil reaches the point at which it turns to gas, which is ignited by the progressive combustion, this point being first reached in the vicinity of the igniter and afterward becoming general throughout the ignition-chamber, at which stage the combustion is perfect and the mixture may be admitted to the cylinder. The combustion, at first sectional and imperfect, thus matures through its own heat to perfection, and the time given it to thus mature may be the whole or any part of the time required for the upstroke of the piston.

By using closed ignition-chambers I am enabled to dispense with auxiliary heating devices to raise the oil to the gas-producing temperature. The oil igniting at first imperfectly and sectionally aided by the heat of compression gets hotter and hotter until it reaches the temperature of perfect combustion, the heat of its own combustion being sufficient to raise it to the gas-producing temperature, thus saving and utilizing all the oil for use as a power-producer in the cylinder and rendering it unnecessary to employ a separate burner or other heating device to raise the oil to the necessary temperature.

When the mixture is admitted to the ignition-chambers and the valves are closed, the advancing of the ignition or providing for ignition during the early stages of the upstroke of the piston will not affect the piston or moving parts until the valves are opened at the top of the stroke. By this construction there is no back pressure on the piston at whatever point of the upstroke the charge is ignited, as all pressue is taken by the ignition-chambers and the valves 17, 18, 19, 20, 23, and 24. For this reason the ignition may be "advanced" and the charge ignited in one or the other of the ignition-chambers alternately at any point of the upstroke of the piston, the engine running freely to the top of the stroke.

By means of the valved ignition-chambers the combustion which takes place may be confined within them until the condition of perfect combustion occurs, at which state the products are admitted to the cylinder through the valves 18 and 20, or the valves may be opened slightly sooner to permit the charge to reach the stage of perfect combustion just after entering the cylinder.

It is apparent that as the exploded or exploding mixture may be admitted to the cylinder from each ignition-chamber at every second revolution the employment of two ignition-chambers delivering their charges alternately to the cylinder produces a power-stroke at every revolution of the engine. Each separate individual charge of mixture is employed according to a modification of the Otto cycle, one-half revolution being required for compression into the ignition-chamber, one-half revolution for maturing the combustion, one-half revolution for power-stroke, one-half revolution for exhaust. The cycle may be described as follows: first, first upstroke, with exhaustion of chamber 9, carbureted air being drawn into lower end of the cylinder and ignition in chamber 10, enduring for the whole or any part of the stroke; second, first downstroke, with compression into chamber 9 and power-producing stroke from chamber 10 at upper end of cylinder; third, second upstroke, with ignition in chamber 9, enduring for the whole or any part of the stroke, and exhaustion from chamber 10, carbureted mixture being drawn into the lower end of the cylinder; fourth, second downstroke, with power in chamber 9, producing the stroke and compression into chamber 10. The operations include two revolutions of the engine, and it is apparent that there is a power-stroke at every revolution. Referring to the above cycle, it will be noticed that opposite compression in the lower end of the cylinder into one ignition-chamber is power-producing stroke in upper end of cylinder from other ignition-chamber, thus producing the compression on the power-stroke of the engine, leaving the succeeding upstroke only to overcome the resistance of the exhaust and of the moving parts. The compression is done in the lower end of the cylinder at every downstroke, and there being a power-stroke beginning in the upper end at every downstroke the compression is accomplished on the power-stroke, leaving the momentum of the fly-wheel and moving parts to overcome only the resistance of the exhaust, so that a light fly-wheel may be used.

It is apparent that the spring 29, being compressed by the sliding collar 26 being lowered through the bearing of the end of the rod on the most eccentric portion of cam 32, maintains the valve tightly closed until the end of the rod bears upon the less eccentric portion of the periphery of cam 32, when the compression of spring is largely reduced, and the valve may be easily opened by the cam 37 acting upon the rod 35.

Having described my invention, I claim—

1. In an internal-combustion engine, the combination of a cylinder having a piston, a plurality of ignition-chambers each communicating with both ends of the cylinder, and valves controlling the communications of the chambers with the cylinder.

2. In an internal-combustion engine, the combination of a cylinder having a piston, a plurality of ignition-chambers, ports leading from both ends of the cylinder to each chamber, valves normally closing the ports, and means to unseat the valves to open the ports.

3. In an internal-combustion engine, the combination of a cylinder having a piston, a plurality of ignition-chambers, ports leading from both ends of the cylinder to each chamber, an exhaust-passage for each chamber, a valve for each passage, valves for the ports, and means to unseat the valves.

In testimony whereof I affix my signature in presence of two witnesses.

SYDNEY S. WILLIAMS.

Witnesses:

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