H. L. REESE & H. H. PLATT.

INTERNAL COMBUSTION ENGINE.

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1,091,389.

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Fig. 2.

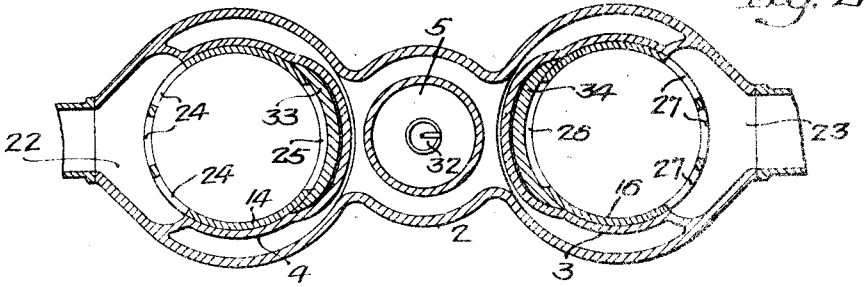
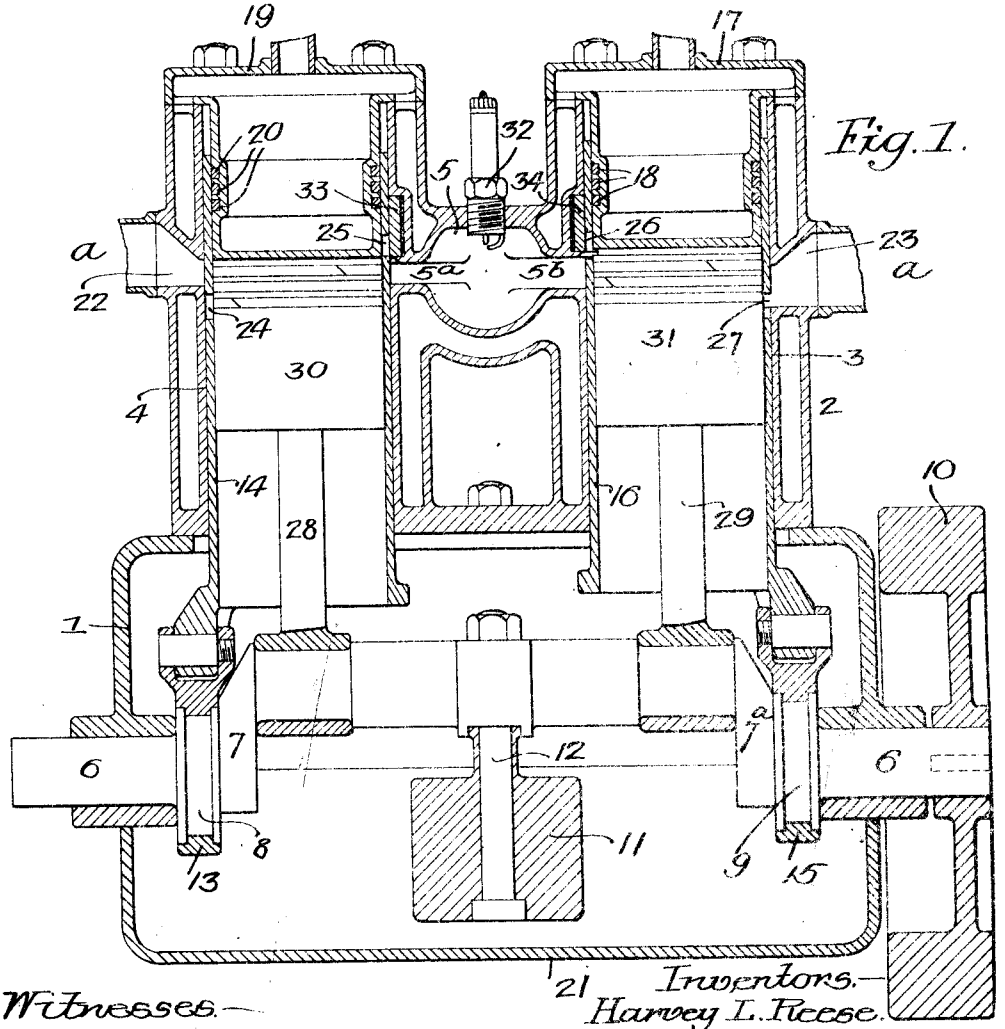


Fig. 1.



Witnesses.—

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,091,389. Specification of Letters Patent. Patented Mar. 24, 1914.

Application filed December 20, 1912. Serial No. 737,842.

To all whom it may concern:

Be it known that we, HARVEY L. REESE and HAVILAND H. PLATT, both citizens of the United States, and residing, respectively, at 1422 Arch street, Philadelphia, Pennsylvania, and Wallingford, Delaware county, Pennsylvania, have invented certain Improvements in Internal-Combustion Engines, of which the following is a specification.

One object of this invention is to provide an engine whose construction and method of operation shall be relatively simple, and whose part shall be so designated and arranged that said engine for a given capacity shall be comparatively inexpensive to manufacture and maintain.

We further desire to provide an internal combustion engine and method of operating the same, according to which the flow of fuel and of the products of combustion shall be controlled by valves driven directly from the crank shaft; the engine including a compression and a working cylinder with which said valves coöperate, in combination with a combustion chamber whose communication with said cylinders is governed by said valves.

Other objects of our invention are to construct an internal combustion engine operative on the four cycle principle, but without half speed mechanism; the arrangement of parts being such as to reduce the cost, friction and wear, and increase the efficiency, power and reliability of the engine.

Another object is to construct an engine of the above type so that it shall possess a positive intake at all speeds, which intake shall be unhampered by the expansion of burned gases in the clearance space.

These objects and other advantageous ends we secure as hereinafter set forth, reference being had to the accompanying drawings, in which:

Figure 1, is a vertical section, to some extent diagrammatic, illustrating an engine constructed in accordance with our invention; and Fig. 2, is an inverted section on the line *a*—*a*, Fig. 1.

As shown in the above drawings, we provide a crank case 1 having bearings for the crank shaft 6, and provided with a removable bottom closure 21. On said crank case is mounted a cylinder casting 2, which includes the working cylinder 3, a compression cylinder 4, and a combustion chamber 5, having ports 5^a and 5^d leading respectively from the compression cylinder and to the working cylinder. The casting is also provided with an inlet port 22, leading to the compression cylinder 4, and an exhaust port 23 leading from the working cylinder 3.

The crank shaft is provided with two eccentrics 8 and 9, the first of which, through a strap 13, is directly connected with a reciprocating sleeve 14 operative within the compression cylinder 4. The second eccentric is likewise provided with a strap 15 directly connected to a second sleeve valve 16, reciprocable within the working cylinder 3. The first of these sleeves 14 is provided with two ports 24 and 25 placed to respectively connect with the inlet port 22 of the cylinder casting and with the port 5^a of the combustion chamber, while the second sleeve 16 is likewise provided with two ports 26 and 27 placed to respectively communicate with the port 5^d of the combustion chamber and with the exhaust port 23 of the cylinder casting.

It will be noted that the engine has but a single crank, with two crank pins, as indicated at 7 and 7^a, and to these are connected two rods 28 and 29, respectively attached to two pistons 30 and 31, which are operative respectively within the valve sleeves 14 and 16 of the compression and working cylinders. The crank is in a great measure counter-balanced by a weight 11, connected thereto midway between the two crank pins by a bolt 12, in such a manner that it projects oppositely to said pins.

The compression cylinder 4 is provided with a head 19, having an inwardly extending portion designed to fit within the upper end of the valve sleeve 14, and provided with a series of packing rings 20 to prevent leakage between it and said valve. Similarly, the working cylinder 3 has a head 17 extended within the valve sleeve 16, and likewise provided with packing rings 18; it being noted that there is a minimum of clearance between the piston 30 and its head 19, and a slightly greater clearance between the piston 31 and its head 17, when said pistons are at the upper ends of their strokes.

The above noted construction is employed because it is obviously desirable to drive out of the compression cylinder the greatest possible quantity of each of the fuel charges

delivered therefrom to the combustion chamber, and for this reason the clearance in this cylinder is made as small as is allowable. In the case of the working cylinder, the clearance is only slightly greater than that in the compression cylinder because the necessary closure of the exhaust port before the working piston reaches the top of its stroke, unavoidably traps some of the products of combustion, and it has been found advisable to provide some small clearance for the accommodation of such gases.

A suitable charge-igniting device, such as the spark plug 32, is provided within the combustion chamber 5, and the various parts of the cylinder casting and heads are preferably water-jacketed, as shown.

In order, under operating conditions, to prevent leakage from the combustion chamber through the port 25 into the compression cylinder, we mount in a suitable recess of the cylinder casting a curved plate 33 pressed toward the sleeve 14 by a suitable spring. We likewise provide a second plate 34 for preventing leakage through the valve port 26 of the sleeve 16; this being also provided with a spring of suitable design, for pressing it into engagement with said sleeve.

Under operating conditions, and assuming that the shaft 6 is to rotate in a counter clock-wise direction when considered from a position immediately adjacent the fly wheel 10, it will be seen that with the cranks at their highest positions, the piston 30 in the compression cylinder is just beginning its downward movement, while the valve sleeve 14 is moving upwardly, so that the port 24 therein shortly permits communication between the inlet or fuel supply port 22, and the interior of said sleeve. Obviously, communication through the port 25 with the combustion chamber 5 is cut off. Fuel is therefore drawn into the compression cylinder during the full downward stroke of the piston 30, and since the combustion chamber 5 is cut off from said cylinder by the sleeve 14 before the port 24 opens, it follows that said cylinder is completely filled with fresh fuel unmixed with any spent products of combustion from a previous explosion. The eccentric 8 is so set that by the time the piston 30 has reached and just passed the lowest point of its stroke, the valve 14 cuts off communication with the inlet port 22, so that the fuel charge in the cylinder 4 is delivered into the combustion chamber 5 through the port 25, which shortly comes into register with the port 5a. The eccentric 9 is so set that during this transfer of fuel to the combustion chamber, the sleeve 16 completely cuts off communication with the cylinder 3, and by the time the piston 30 has reached the top of its stroke, practically all of the fuel within the cylinder 4 has been transferred to the combustion chamber 5 and compressed therein, the sleeve 14 finally cutting off communication with the port 5a at substantially the time that said piston is nearest the cylinder head 19. In the meantime, the working piston 31 has likewise moved upwardly in its cylinder, and has compressed a portion of the gases from a previous explosion between its upper end and the head 17 until, slightly before it reaches the top of its stroke and when the gases in the working cylinder 3 have been highly compressed to a pressure substantially equal to that in the combustion chamber, the valve sleeve 16 permits communication between the combustion chamber and the interior of the cylinder 3, whereupon the charge in said chamber is fired by the igniting device 32. The products of combustion then act on the working piston 31 and force it downwardly in the cylinder 3, until when it reaches substantially the bottom of its stroke, the sleeve 16 opens communication between said cylinder and the exhaust port 23 of the cylinder casting, thus permitting the escape of the expanded products of combustion. At this time, the compressor piston 30 has likewise reached the bottom of its stroke after having drawn in another charge of fresh fuel, and moves upwardly to transfer and compress this fuel in the combustion chamber. Before communication with the combustion chamber is cut off by the sleeve and after the port 27 has opened, practically complete scavenging of the combustion chamber takes place through the working cylinder, and thereafter the piston 31 expels the products of combustion from the cylinder 3 until it has made practically seven-eighths of its upward stroke, whereupon the port 27 is closed by said piston. Thereafter, the continued upward movement of the latter compresses the spent gas still remaining in the working cylinder until it is at substantially the pressure of the unfired fresh charge in the combustion chamber. This fresh charge is then exploded, and the cycle of operations heretofore described is repeated.

It will be noted that the sleeve 16 opens communication between the working cylinder 3 and the combustion chamber 5, slightly before the piston 31 reaches the top of its stroke, thus permitting an escape for the highly compressed spent gases in said cylinder and allowing of the sparking or ignition being advanced beyond the engine center. The combustion chamber 5 is preferably given a substantially spherical form in order to permit of the most efficient combustion of the fuel charge therein, and it is noted that the whole engine is constructed and arranged with a view to simplifying its structure and reducing the number of the parts required. Obviously, an engine having but a single crank, is considerably less

expensive than one having two cranks set at different angles, and the driving of the valve sleeves from said crank shaft instead of from one or more auxiliary shafts, likewise materially reduces the expense both of construction and maintenance, as well as assists in securing the maximum simplicity of construction. It is further noted that there is an explosion for every revolution of the shaft, although the engine operates on the four cycle principle, and in view of the small clearance in the compression cylinder, it is enabled to secure the most efficient action since the fresh charge is not mixed with spent gases prior to its admission to the combustion chamber.

While we preferably employ sleeve valves for controlling the flow of fuel and of the products of combustion through our engine, it will be understood that without departing from our invention we may use any of a number of other forms or types of valves for the same purpose.

We claim:—

1. The combination in an internal combustion engine, of a compression cylinder; a working cylinder; pistons for said cylinders; a combustion chamber; mechanism including a single sleeve valve for controlling the flow of fuel into the compression cylinder and from the same into the combustion chamber; other mechanism including a second sleeve valve for controlling the flow of products of combustion from the combustion chamber to the working cylinder and from the latter; with means for firing fuel charges in the combustion chamber.

2. The combination in an internal combustion engine of a compression cylinder; a sleeve valve therein; a working cylinder; a second sleeve valve therein; pistons for said cylinders; a combustion chamber capable of communicating through said valves with said cylinders; and means for igniting a fuel charge in the combustion chamber.

3. The combination in an internal combustion engine of a combustion chamber; a cylinder and piston for compressing the fuel charges in said chamber; means for exploding the charges in the combustion chamber; and a working cylinder and piston for utilizing the energy of the products of combustion from the exploded charges; with a valve adjusted to permit communication between the combustion chamber and the compression cylinder during the latter part of the compression stroke and a second valve adjusted to permit communication between the combustion chamber and the working cylinder during the expansion stroke and for a portion of the exhaust.

4. The combination in an internal combustion engine, of a compression cylinder having an inlet port; a working cylinder having an exhaust port; pistons for said cylinders; a substantially spherical combustion chamber mounted directly between the sides of said cylinders and opening into the same through ports in the curved surfaces thereof; a valve for the compression cylinder formed to control the flow of fuel through both of its ports; a second valve controlling the flow of products of combustion through both of the ports of the working cylinder; and means for actuating said valves.

5. The combination in an internal combustion engine of a compression cylinder; a working cylinder; pistons for said cylinders; a combustion chamber; a sleeve valve for each cylinder; means for actuating said valves to connect and cut off said chamber and the cylinders at predetermined points of the strokes of the pistons; said means including the engine crank shaft and eccentrics thereon directly and independently connected to the valves.

6. The combination in an internal combustion engine of a compression cylinder; a working cylinder having an exhaust port; a combustion chamber; pistons for said cylinders; a crank shaft having two crank pins extending in substantially the same straight line; means for connecting said crank pins with the pistons; valves; with means for actuating said valves to connect and cut off said chamber and the cylinders at predetermined points of the stroke of the pistons, one of the valves being adjusted to establish communication between the combustion chamber and the exhaust port through the working cylinder during the first portion of the exhaust stroke.

7. The combination in an internal combustion engine of a compression cylinder; a working cylinder; pistons for said cylinders; a combustion chamber opening into both of said cylinders; a sleeve valve operative in each of the cylinders for controlling the flow of working fluid therethrough; a crank shaft; means for directly connecting said shaft to both of said sleeve valves; and means for connecting the shaft to both of said pistons.

8. The combination in an internal combustion engine of a combustion chamber; a compression cylinder; a working cylinder; pistons in said cylinders; a valve for connecting the compression cylinder and said chamber during the compression stroke of the piston in said cylinder; and a second valve adjusted to connect the combustion chamber and the working cylinder during the working stroke of the piston in the latter and for a part only of the exhaust stroke; with means for igniting charges in the combustion chamber.

9. The combination in an internal combustion engine of compression and working cylinders; pistons for said cylinders; there

being an intake port for the compression cylinder and an exhaust port for the working cylinder; a combustion chamber; two cylindrical valves for the cylinders having ports for controlling the flow of fluid into and from them; with means for actuating the valves to open the compression cylinder to the intake port and close it to the combustion chamber, and to open the working cylinder to said chamber and close it to the exhaust port during the outward movement of the pistons in the cylinders, and during the inward movement of said pistons to close the compression cylinder to the intake port and open it to the combustion chamber, and to open the working cylinder to the exhaust port and thereafter close it to said combustion chamber to permit of the scavenging of said chamber through the working cylinder.

10. The combination in an internal combustion engine of a compression cylinder having a fuel inlet; a working cylinder having an exhaust opening; a combustion chamber opening into both of said cylinders; a sleeve valve in the compression cylinder having ports coöperating with the fuel inlet and with the opening to the combustion chamber; a second sleeve valve in the working cylinder having ports coöperating with the opening from the combustion chamber and with the exhaust opening; a shaft having two crank pins whose axes are substantially coincident; pistons in said cylinders; a rod connecting each piston with one of the crank pins; and eccentrics on the crank shaft having straps directly connected to the sleeve valves respectively.

In testimony whereof, we have signed our names to this specification, in the presence of two subscribing witnesses.

HARVEY L. REESE.
HAVILAND H. PLATT.

Witnesses:
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JOS. H. KLEIN.