C. E. MAUD.

TWO-CYCLE INTERNAL COMBUSTION ENGINE.

APPLICATION FILED SEPT. 24, 1909.

980,110. Patented Dec. 27, 1910.

Fig. 1.

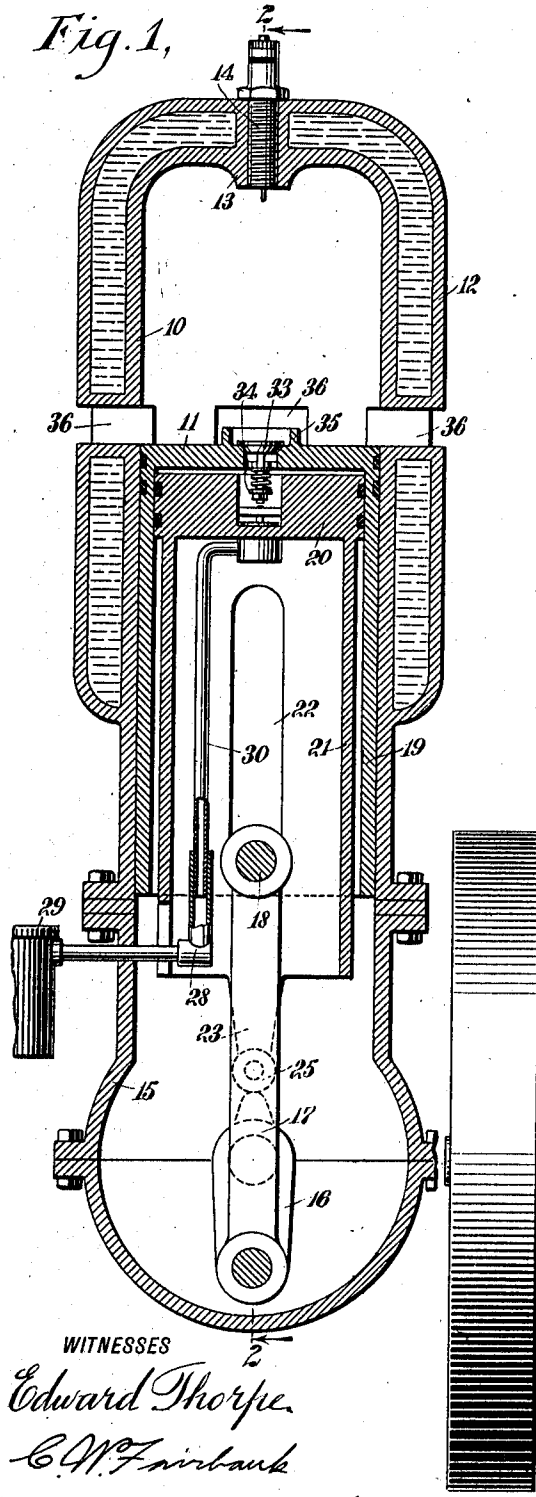
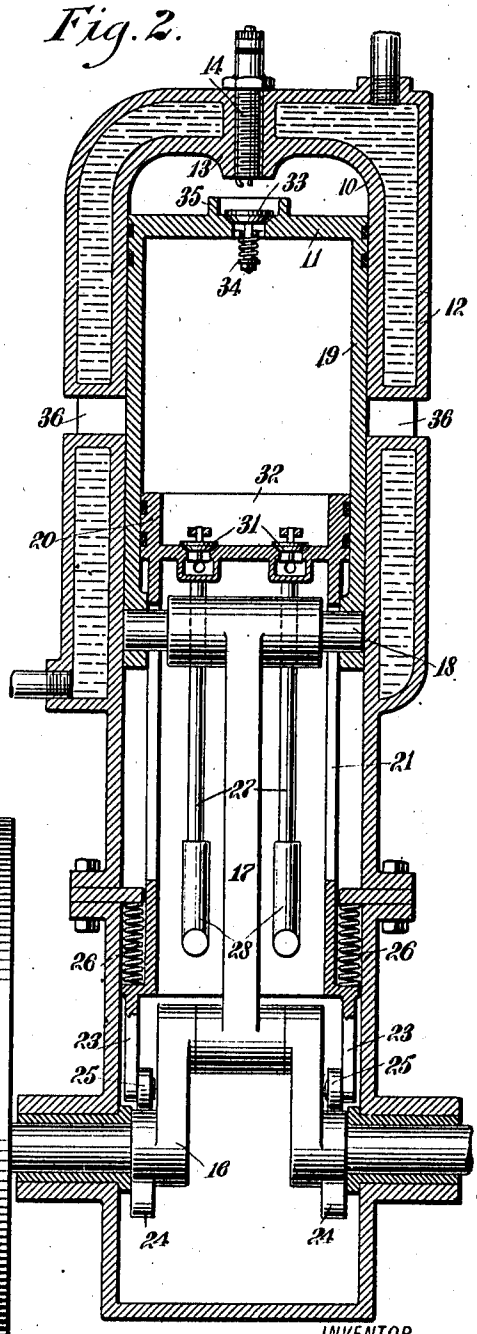


Fig. 2.



WITNESSES

Edward Thorpe.

C. W. Fairbank

INVENTOR

Charles E. Maud

BY

Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

CHARLES E. MAUD, OF MONTEREY, CALIFORNIA.

TWO-CYCLE INTERNAL-COMBUSTION ENGINE.

980,110. Specification of Letters Patent. Patented Dec. 27, 1910.

Application filed September 24, 1909. Serial No. 519,313.

To all whom it may concern:

Be it known that I, CHARLES E. MAUD, a citizen of the United States, and a resident of Monterey, in the county of Monterey and State of California, have invented a new and Improved Two-Cycle Internal-Combustion Engine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in two-cycle internal combustion engines of that type in which the piston serves to separate the explosion chamber from the compression chamber and operates to compress a charge on one side of the piston during the explosion and expansion of the gases upon the opposite side of the piston. In engines of this type in which the charge is compressed in the crank case, all of the gas cannot be transferred from the crank case to the cylinder upon the opening of the inlet port in the latter, and there is therefore a considerable quantity of gas needlessly compressed at one compression stroke. Furthermore, with the large crank case chamber, the gas cannot be compressed to high enough pressure to insure its proper transfer to the cylinder and the proper scavenging of the cylinder.

One object of my invention is to avoid the necessity for compressing any larger quantity of gas during each compression stroke, than it is desired to transfer to the explosion chamber at the end of said stroke.

A further object of the invention is to insure the complete transfer to the cylinder of the compressed charge after the exhaust port is opened and while the piston is approaching or at dead center.

My invention involves the provision of a separate movable or operating member, which serves to completely eject the compressed gas from the compression chamber at the desired instant, said member having movement relative to the piston when the latter is adjacent the end of its power stroke. The cylinder head preferably presents a frusto-conical deflector, and the gas is transferred from the compression chamber through the center of the piston and directed toward this deflector. In this way the exhaust gas at the upper end and at the sides of the cylinder, is forced outwardly and downwardly to the exhaust ports, and the cylinder is completely and thoroughly scavenged.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in both the figures, and in which—

Figure 1 is a longitudinal section through an engine constructed in accordance with my invention, the power piston being at the end of the power stroke; and Fig. 2 is a section taken substantially on the line 2—2 of Fig. 1, the power piston being at the end of its compression stroke.

My invention relates only to the means for taking in, compressing and delivering the explosive charge to the cylinder and the scavenging of the exhaust gas from the latter.

The engine illustrated constitutes only one form which my invention may assume, as various changes may be made within the scope of the appended claims, without departing from the spirit of my invention.

In my improved engine there is employed an engine cylinder 10, having a working or power piston 11 mounted to reciprocate therein. The cylinder may be of any form or size desired, and may be cooled in any suitable manner. I have illustrated the cylinder as provided with a water jacket 12, although any other cooling means might be employed instead. The cylinder head preferably presents an inwardly-directed frusto-conical portion 13, concentric with the cylinder and constituting a deflector for the incoming gases, as will be pointed out more particularly hereinafter. This deflector may, if desired, support an igniter 14 in the form of a spark plug, but the form and position of this igniter are not essential.

The engine cylinder is supported upon any suitable form of base 15, which may or may not be in the form of a crank case. As no gas is compressed in the crank case, a mere skeleton work may serve to form a bearing for the crank shaft 16 and to support the engine cylinder. Any suitable form of piston rod 17 connects the crank shaft with the piston pin 18. The power piston 11 preferably has a skirt or sleeve 19, of a length slightly greater than its length of travel, and the interior of this sleeve or skirt is ground true to constitute a second or compression cylinder. The lower end of this skirt or sleeve is connected to the piston pin, so that there is a considerable space

between said piston pin and the head of the piston.

Within the power piston there is provided a second piston 20, serving as the rear or lower end of the compression chamber. In other words, the gas is compressed between the two pistons and within the peripheral skirt of the power piston. The piston 20 has a much shorter travel than the power piston, and in fact, it may normally remain stationary, moving toward the power piston to transfer the compressed charge during the final movement of the power stroke of the latter. The piston 20 may be operated from the crank shaft in any suitable manner. One means for securing this movement includes a skirt or sleeve 21 on the piston 20 and concentric with the sleeve 19 of the power piston. This sleeve 21 has a slot 22 therein to receive the piston pin, and at its lower end it has extensions 23, terminating adjacent the crank shaft. The crank shaft is provided with two cams or projections 24, of such shape and so disposed that during the rotation of the crank shaft these cams or projections will engage with the extensions 23 and cause the piston 20 to intermittently reciprocate a limited distance. For reducing friction, the extensions 23 may be provided with antifriction rollers 25 for engagement with the hub of the crank shaft and with the cams, and for causing the rollers to remain at all times in engagement with their operating members, suitable springs 26 may be provided. These springs undergo compression during the lifting of the piston 20, and serve to return this piston after it has been raised by the cams. It is, of course, evident that other mechanism might be employed for giving to the piston 20, the desired movement.

The fuel charge is taken into the space between the two pistons and thence delivered through the center of the power piston to the explosion chamber. The mechanism for feeding the charge to the space between the pistons preferably includes one or more conduits 27, each formed of two telescoping sections. The lower section 28 of each conduit extends out through the base or the crank case to a carbureter 29 or to any other suitable device for supplying the explosive mixture. The other section 30 of each conduit is attached to the piston 20 and is slidably connected to the stationary section 28. Each conduit section 30 at its upper end delivers to an upwardly-opening check valve 31 in the piston 20. Two of these conduits and two valves are preferably provided and arranged upon opposite sides of the piston rod, but it is evident that a greater or lesser number might be employed, if desired. The piston 20 is provided with a recess in its upper surface in which the valves 31 are placed, so that said valves do not come into engagement with the under surface of the power piston. The power piston has a port extending through the center thereof and controlled by a valve 33, which opens upwardly and which may, if desired, normally be held closed by a coil spring 34. Surrounding the valve is an annular flange or baffle 35, which constitutes a deflector or guard, and which also serves the purpose of a nozzle in directing the gases from the compression chamber longitudinally and axially of the cylinder and toward the center of the dome. For permitting the escape of the exhaust gas after the power piston has completed the major portion of its stroke, the cylinder is provided with one or more exhaust ports 36. Preferably, there are a plurality of these ports arranged around the cylinder, so that the exhaust gas may very freely escape. All of these exhaust ports man connect to a manifold or the exhaust gas may be taken care of in any other suitable manner. After the completion of a power stroke and after the piston reaches dead center, the parts will be in the position indicated in Fig. 1, that is, the power piston is in its lowermost position and the piston 20 is in its uppermost or highest position. As the crank shaft continues to rotate, the power piston rises to cover the exhaust ports and the cams 24 pass from beneath the extensions 23, so that the piston 20 moves downwardly to its lowermost position. This separation of the two pistons causes a partial vacuum in the space between the two, and the explosive charge is drawn in through the conduits 27 and past the valves 31. The piston 20 now remains substantially stationary and the working or power piston continues to move lengthwise of the cylinder, to draw in more charge to the compression space and to compress the charge in the explosion chamber. Upon the completion of the compression stroke of the working piston, the parts reach the position indicated in Fig. 2, and the working piston immediately returns under the influence of the exploded charge. The valve 33 remains closed during both of these strokes, as the pressure in the explosion chamber exceeds the pressure in the space between the pistons. When the power piston nearly reaches the lower end of its stroke, it uncovers the exhaust ports 36 to permit the escape of the remaining exhaust gas, and immediately thereafter the cams 24 strike the rollers 25 and raise the piston 20 toward the power piston during the completion of the downward movement of the latter. At the time the exhaust port opens, the pressure in the cylinder is slightly in excess of that of the compressed charge, but as soon as the exhaust ports have opened, the pressure of the exploded charge immediately drops and the pressure of the gas between the pistons overcomes the ten-

sion of the spring 34, opens the valve 33, and is directed lengthwise and axially of the cylinder toward the center of the dome or cylinder head. The gas is transferred to the cylinder not only by reason of its pressure, but also by the bringing of the two pistons together during the final part of the downward movement of the power piston. The fresh charge in traveling axially of the cylinder, forces the exhaust gas back down along the sides of the cylinder toward the exhaust ports, so that by the time the compressed charge is transferred to the engine cylinder, all of the exhaust gas will have been forced out through the exhaust ports. This is insured by the fact that the chamber between the two pistons exceeds in volume the space displaced by the power piston. This difference in volume is approximately equal to the space occupied by the compressed gases in the cylinder when the power piston is at the end of its compression stroke and just prior to the ignition. Thus, the charge transferred to the cylinder is sufficient to completely fill the latter, which is not the case in an ordinary two-cycle engine having crank case compression.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An internal combustion engine having a cylinder, a reciprocatory piston within said cylinder, a second piston forming with the first piston a compression chamber, a passage in said first-mentioned piston for the delivery of gas from said compression chamber to said cylinder, and means for moving said second-mentioned piston substantially into engagement with said first-mentioned piston to transfer substantially all of the charge through said passage when said first-mentioned piston is adjacent the end of its power stroke.

2. An internal combustion engine having a cylinder, a piston subdividing the cylinder into an explosion chamber and a compression chamber and operating to compress a gas in the compression chamber during the application of power to the opposite side of the piston, a passage in said piston for the delivery of the gas from the compression chamber to the explosion chamber, and a member in the rear of the piston movable toward said piston and substantially into engagement therewith to transfer substantially all of the gas within the compression chamber to the explosion chamber when said piston is adjacent the end of its power stroke.

3. An internal combustion engine having a compression chamber and a cylinder inclosing an explosion chamber, the maximum capacity of one of said chambers being substantially equal to the maximum capacity of the other, a piston separating said chambers and operating to vary their relative capacities during its reciprocation, a second piston forming an end wall for said compression chamber, a passage connecting said chambers and means for moving said second piston toward and substantially into engagement with said first-mentioned piston when said first-mentioned piston is adjacent the end of its power stroke, to reduce the capacity of the compression chamber approximately to zero and transfer approximately the entire compressed charge to the explosion chamber.

4. An internal combustion engine having a cylinder, a reciprocatory hollow piston therein provided with a valved passage leading to the explosion chamber of the engine, a reciprocatory piston within the first-mentioned piston, a fuel conduit leading from the exterior of the engine to the interior of the first-mentioned piston, and means for moving said second-mentioned piston toward the head of the first-mentioned piston when the latter is approximately at the end of its power stroke.

5. An internal combustion engine having a cylinder, a reciprocatory hollow power piston therein provided with a passage leading from the interior of the piston to the interior of the cylinder, and terminating in a deflector within said cylinder and serving for the delivery of gas to the cylinder, a reciprocatory piston within the first-mentioned piston and provided with a valved passage therethrough, and a fuel conduit leading from the exterior of the engine to the last-mentioned passage for the delivery of fuel to the interior of the hollow piston.

6. An internal combustion engine having a cylinder, a power piston therein, a piston within said power piston, a main shaft for the engine having a cam thereon, an extension from the second-named piston, terminating in operative relationship to the cam on the shaft, independent connections between said shaft and the power piston, a passage for delivering a gas to the interior of the power piston, and a passage for delivering the gas from the interior of the power piston to the interior of the cylinder.

7. An internal combustion engine having a cylinder, a hollow power piston therein, a piston within the power piston, a shaft having cams in operative relation to the second-mentioned piston, springs constraining the second-named piston toward said cams, a passage for delivering a gas to the interior of the power piston, and a passage for delivering the gas from the interior of the power piston to the explosion chamber of the engine.

8. An internal combustion engine having a power cylinder provided with a cylinder head having an inwardly-directed central portion, an igniter carried by said inwardly-

directed portion, a hollow power piston within said cylinder having a valved passage terminating in an annular deflector on the explosion chamber side of the piston, a reciprocatory piston within the first-named piston and provided with a valved passage therethrough, and a fuel conduit leading from the exterior of the engine to said valved passage in the second-named piston.

9. An internal combustion engine having a cylinder, a reciprocatory power piston therein, a piston within the first-named piston, a crank shaft for the engine, a connecting rod pivoted to said first-mentioned piston and to said crank shaft, cams on said crank shaft for intermittently reciprocating said inner piston, said inner piston remaining stationary during the intervening time between said reciprocations, a passage for delivering a gas to the space between said pistons, and a passage for delivering said gas from said space to the interior of the cylinder.

10. An internal combustion engine having the combination with the cylinder, crank case, piston, crank shaft and piston rod, of a second piston within the first-mentioned piston and forming with the first-mentioned piston, a compression chamber, means establishing communication between said compression chamber and the cylinder, and a conduit extending through the wall of said crank case and communicating with said compression chamber, said conduit being formed of two telescoping sections.

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

CHARLES E. MAUD.

Witnesses:

CLAIR W. FAIRBANK,

PHILIP D. ROLLHAUS.