J. L. CAMPBELL.

TWO-CYCLE EXPLOSIVE ENGINE.

APPLICATION FILED JULY 10, 1912.

**1,082,402.**

Patented Dec. 23, 1913.

Fig. 1.

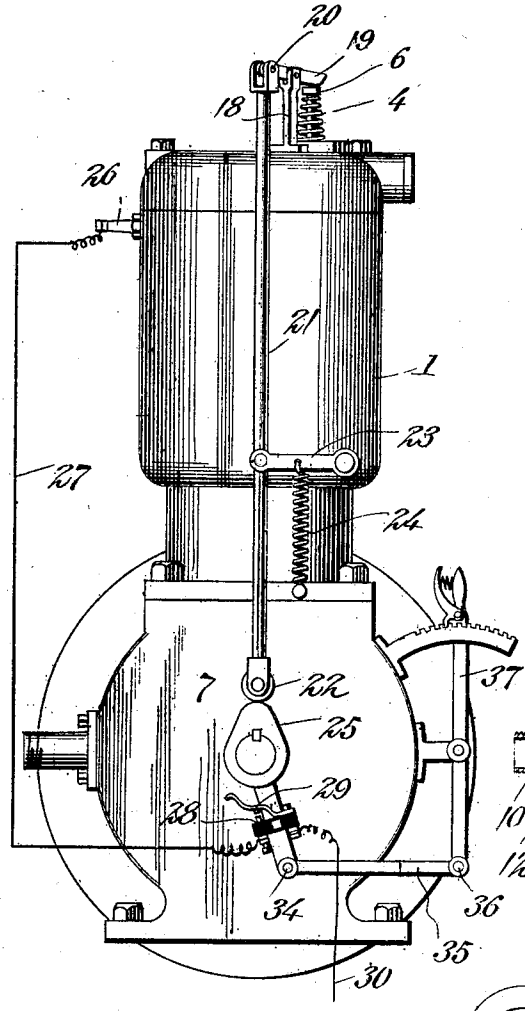



Fig. 2.

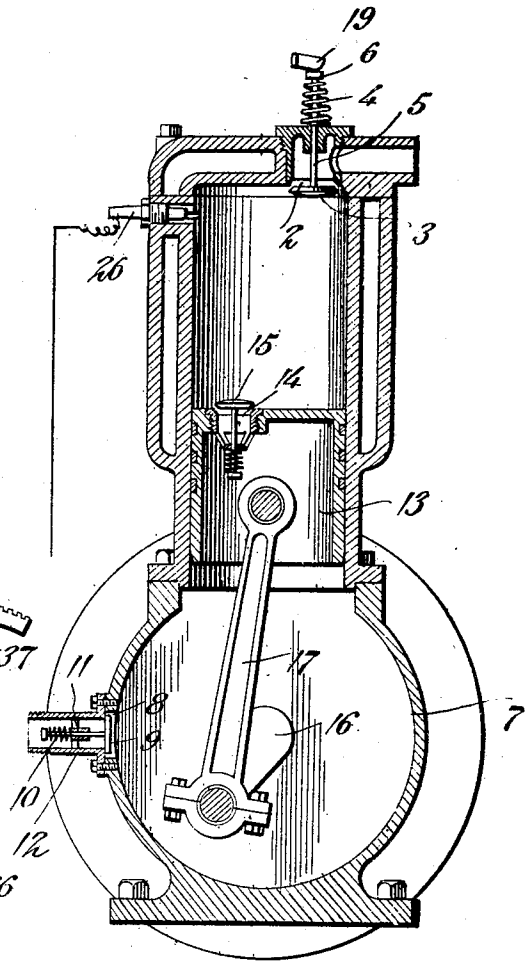
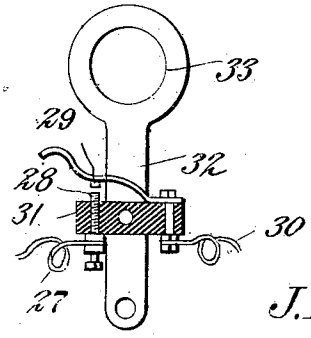



Fig. 3.

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# UNITED STATES PATENT OFFICE.

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## TWO-CYCLE EXPLOSIVE-ENGINE.

1,082,402. Specification of Letters Patent. Patented Dec. 23, 1913.

Application filed July 10, 1912. Serial No. 708,683.

*To all whom it may concern:*

Be it known that I, JAMES LEONARD CAMPBELL, a citizen of the United States of America, residing at Barryton, in the county of Mecosta and State of Michigan, have invented new and useful Improvements in Two-Cycle Explosive-Engines, of which the following is a specification.

This invention relates to improvements in internal combustion engines and has particular application to two cycle engines.

The primary object of my invention is the provision of an explosive engine wherein the ignition of the charge within the cylinder will be under the control of the valve actuating mechanism and in which the time of ignition may be regulated at will with respect to the position of the piston within the cylinder, thereby enabling the ignition of the charge to be brought about at any desired time in the stroke of the piston, that is to say, retarded or advanced.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of parts hereinafter set forth in and falling within the scope of the claim.

In the accompanying drawing; Figure 1 is a side elevation of an explosive engine constructed in accordance with my invention. Fig. 2 is a central vertical sectional view of the same, and Fig. 3 is a view of a detail of the invention.

Two cycle internal combustion engines, heretofore constructed, waste more or less of the explosive mixture utilized for motive power, such wastefulness being due, to a great extent, to the way in which the mixture is introduced into the explosive chamber or cylinder. By means of my invention, I eliminate this objectionable feature and other objectionable characteristics inherent in two cycle combustion engines and at the same time do not impair the working or power giving qualities of the engine, but, in fact have greatly increased the efficiency of two cycle engines and produced an engine wherein the output of power is commensurate with the consumption of motive fluid. In two cycle engines, the piston and other working parts soon become overheated, incident to the engine having a power stroke in each revolution of the crank shaft, and the piston rings under the excessive heat become a menace as they easily lose their temper and therefore effectiveness. With my engine, however, the fresh gases enter the explosion chamber or cylinder through the piston and such mixture tends to cool the piston and its associated parts, thereby avoiding the above-mentioned difficulties and disadvantages usually encountered in this type of motor.

The intake valve is preferably opened under the pressure of the compressed gases in the crank case, while the exhaust valve is mechanically opened at each revolution of the engine crank shaft and as the exhaust valve is not opened until the piston is practically at the limit or end of the power stroke, the exhaust valve being located preferably in the head of the cylinder, the incoming gases effectively remove the spent or burnt gases from the cylinder previous to a succeeding explosion.

Referring now to the accompanying drawing in detail, the numeral 1 indicates the engine cylinder having formed in the head thereof an exhaust port 2 controlled by an inwardly opening exhaust valve 3 normally held against its seat by an expansion spring or the like 4 surrounding the stem 5 of the valve, said stem extending outwardly of the cylinder head and terminating in a head 6 between which and the adjacent portion of the cylinder head, the spring is interposed.

The numeral 7 designates the crank case of the engine which, in the present instance, is arranged beneath the cylinder and is designed to have communication therewith. This crank case is adapted to receive the explosive mixture from a carbureter or other suitable form of mixing device and is formed with an intake port 8 controlled by means of an inwardly opening inlet valve 9, such valve being held normally closed by means of a spring 10 or the like surrounding the stem thereof and having one end abutting a spider 11 formed in a connecting pipe 12, while the other end of such spring engages a head on the valve stem, the connecting pipe 12 being adapted for communication with the carbureter. Mounted within the cylinder 1 and adapted for reciprocation therein is a piston 13 formed with an inlet port 14 controlled by means of a pressure operated valve 15 carried by the piston and adapted to open in the downward movement thereof to establish communication between the cylinder and the crank case, whereby the gases in the crank case, under compression, due to the downward move-

ment of the piston within the cylinder, may be forced into the explosion chamber of the cylinder. Journaled in the end walls of the crank case 7 is a crank shaft 16 having connections with the piston 13 through the medium of a pitman 17. The exhaust valve 3 is mechanically operated to open position and against the action of the spring 4 and is preferably controlled by the crank shaft of the engine so that the burnt or spent gases may be discharged from the cylinder at the proper time in the stroke of the piston.

Mounted upon the cylinder head adjacent the head 6 on the valve stem 5 is a standard or bracket 18 upon which is pivotally mounted a rocker arm 19 having one end in engagement with the head 6 of the exhaust valve stem 5, while the opposite extremity has pivotally connected thereto as at 20 an actuating shaft 21 equipped at its free extremity with a roller 22 and held in proper position upon the engine by means of a link 23 pivoted at one end to the actuating lever and at its opposite end to the adjacent portion of the cylinder, a tension device as a spring 24 being connected to the link and the cylinder and acting to hold the valve actuating lever inoperative and the free end of the rocker arm away from the head on the exhaust valve stem. The roller 22 on the free end of the valve actuating lever is disposed within the influence of a cam 25 keyed upon one end of the crank shaft beyond the crank case and adapted to rotate with the crank shaft and impart a sliding movement to the valve actuating shaft 21 to rock the arm 19 about its pivot and so open the exhaust valve and release such valve.

The operation of my engine thus far described may be briefly stated as follows: On the upward stroke of the piston, a charge of the explosive mixture is drawn into the crank case through the intake valve 9 which latter, when not in operation, is held closed by the spring 10. The piston on its upward stroke also compresses the charge of the explosive mixture previously admitted to the cylinder and at the proper time this charge is exploded and the piston forced to the lower end of the cylinder, compressing the charge of the explosive agent previously drawn into the crank case. When the piston is at approximately the limit of its power stroke, the cam 25 engages the roller 22 and slides the valve actuating lever 21 with the effect to rock the rocker arm 19 and so opening the exhaust valve 3. Simultaneously with the opening of the exhaust valve, the pressure in the cylinder being released, the charge of the mixture in the crank case escapes or is driven into the cylinder through the intake port 14 in the piston, the incoming gases forcing the burnt or spent products of combustion outwardly of the cylinder by way of the exhaust port therein and completely and effectively scavenging or cleaning such cylinder of the inert gases, the fresh charge replacing the burnt gas. In the initial upward movement of the piston to compress the fresh gases, the valve actuating lever is relieved of the influence of the cam and the exhaust valve closed under the action of the spring 4, the exhaust valve being so timed relatively to the stroke of the piston, that the burnt gases are completely discharged from the cylinder without removing any of the live gas.

In order to ignite the charge in the cylinder at the proper time, the ignition apparatus is preferably controlled by the exhaust valve mechanism and in the present instance is under the influence of the cam 25 and includes a spark plug 26 connected by way of a wire 27 with one contact 28 of a make and break device adapted to be actuated by the cam 25, the other contact 29 of such device being spaced apart from the contact 28 and connected by way of a wire 30 with a suitable source of electrical energy. The contacts 28 and 29 are preferably mounted upon a block of insulating material 31 rigidly secured to a support 32 pivoted as at 33 in proximity to the cam 25 and also pivotally connected as at 34 to a link 35, the latter in turn being pivoted as at 36 to a controlling lever 37. Thus, the contacts 28 and 29 may be moved or swung about the pivot 33 so as to be engaged or actuated by the cam 25 sooner or later, as desired whereby the time of the explosion in the cylinder may be advanced or retarded, as will be readily understood by those skilled in the art to which the invention appertains, the contact 29, of course, being engaged by the cam 25 and movable into contact with the contact 28 so as to complete the circuit to the spark plug.

From the foregoing description taken in connection with the accompanying drawing, the construction and mode of operation of my invention will be readily apparent.

While I have herein shown and described one preferred form of my invention by way of illustration, I desire to have it understood that I do not limit myself to the precise details of construction herein described and delineated, as modification and variation may be made within the scope of the claim and without departing from the spirit of the invention.

I claim:

In an explosive engine, the combination with a cylinder, a piston within the cylinder, a crank shaft, a connection between the crank shaft and the piston, an exhaust valve in the cylinder, of a cam connected to said crank shaft for operating said exhaust valve, a spark plug arranged within the cylinder, a support fulcrumed at one end upon said crank shaft and depending therefrom, a

block carried by said support, contacts carried by said block and normally spaced apart and connected in circuit with said spark plug, said contacts being disposed in the path of movement of said cam, and means connected to the opposite end of said support for swinging the latter about the crank shaft whereby the closing of the circuit at the contacts under the action of the cam may be varied.

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

JAMES LEONARD CAMPBELL.

Witnesses:

JAMES L. CAMPBELL.

O. SIMS.