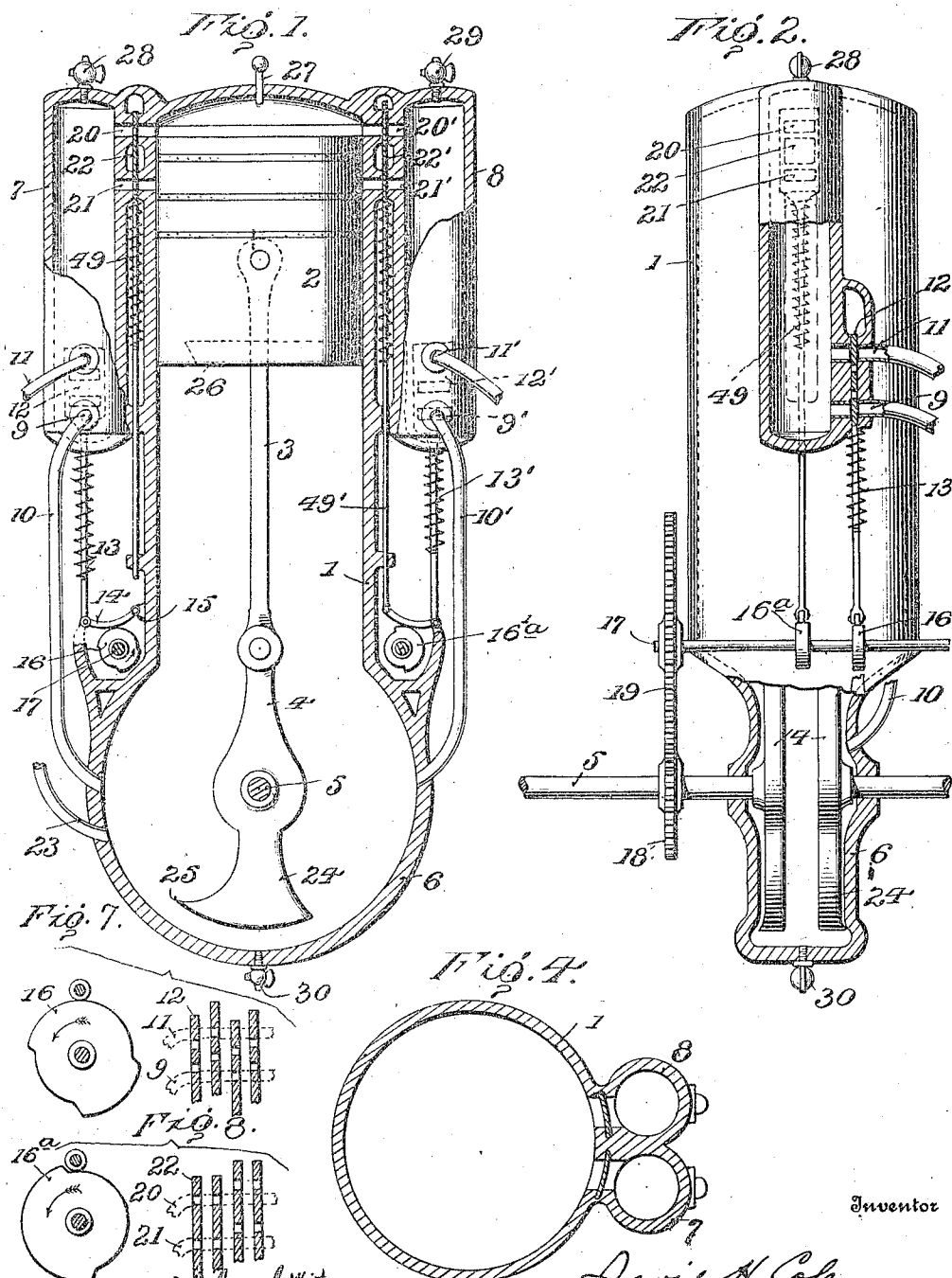


D. H. COLES.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED OCT. 16, 1908.

933,960.

Patented Sept. 14, 1909.

2 SHEETS—SHEET 1.



Inventor

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2 SHEETS—SHEET 2.

Fig. 5.

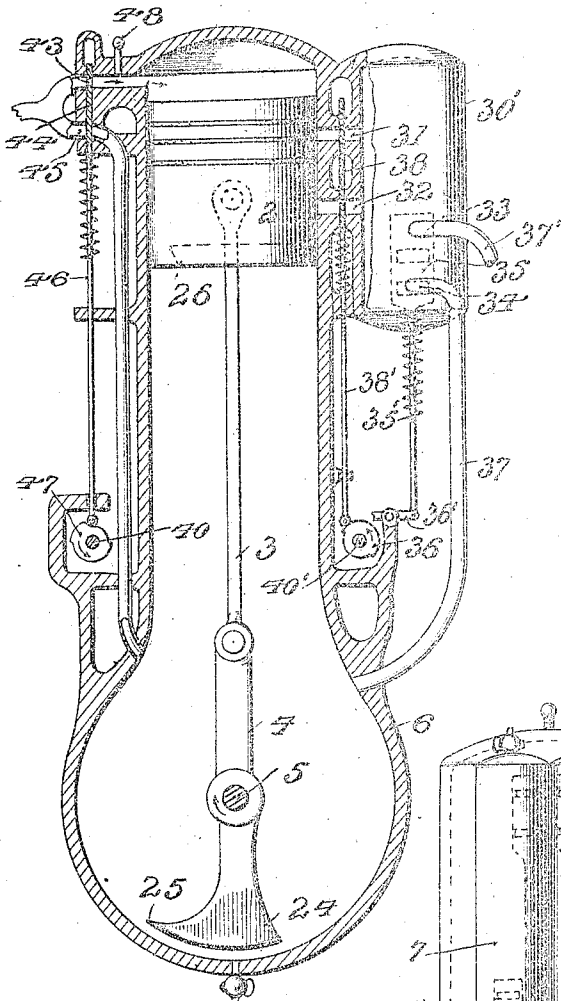


Fig. 6.

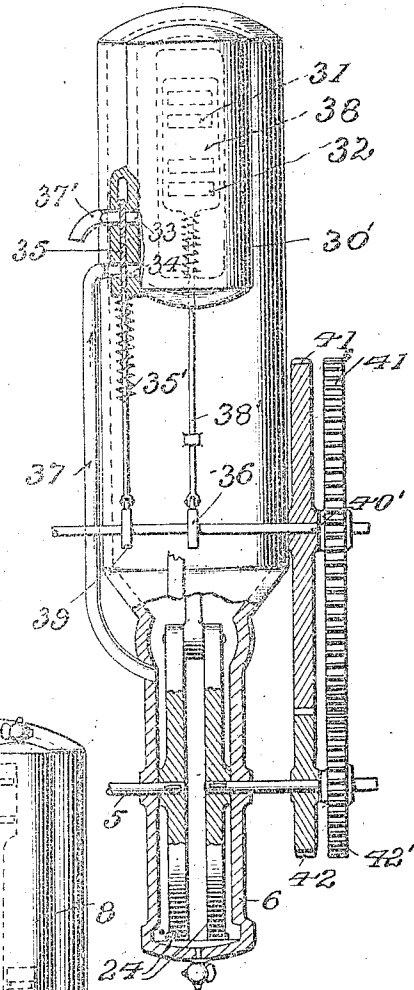
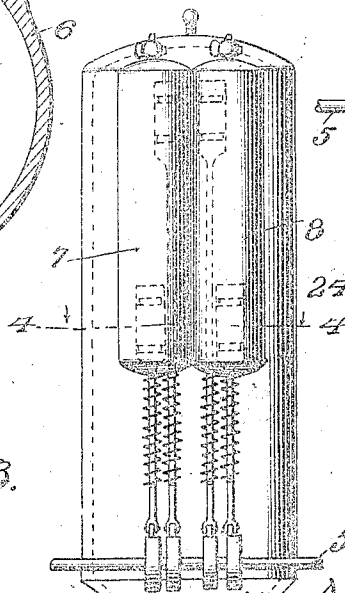


Fig. 3.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

933,980.

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To all whom it may concern:

Be it known that I, DAVID H. COLES, of Brooklyn, New York, have invented a new and useful Improvement in Internal-Combustion Engines, which invention is fully set forth in the following specification.

This invention relates to improvements in internal combustion engines of the two-cycle type, and has for its chief object to provide means whereby the products of combustion may be practically eliminated from the engine cylinder during the exhaust stroke, enabling the subsequent introduction and burning of a pure gas and air mixture at each power stroke, and thereby reducing tendencies of fouling, and securing better sparking and greater power.

Further objects of my invention are to increase the pressure in the engine cylinder by introducing high pressure gas after the first explosion, thereby holding the pressure up to near the end of the stroke; and to generally improve the construction of engines of this class.

These and other objects will be more fully set forth and explained in the detailed description following.

For the purpose of securing the objects of this invention, I provide an internal combustion engine, having a gas-tight crank casing, with compression chambers preferably mounted on the engine cylinder, each of said chambers being provided with ports and valves, preferably of the slide-valve type, controlling the same, one port opening into the crank casing, another into the atmosphere and one or more opening into the engine cylinder. Means for timing the operation of the valves are also provided, such means preferably consisting of a series of cams mounted on shafts driven from the main power shaft of the engine. When my improvement is applied to a two-cycle engine, I provide two compression chambers which I may locate one on each side of the cylinder, but preferably I place both chambers on one side, with a view of simplifying the valve-operating means. By means of this construction, I am enabled, in the case of a two-cycle engine, for example, to practically drive all products of combustion from the engine cylinder and to draw a charge of gas from a carbureter into the crank casing below the piston at each exhaust stroke. I compress each charge separately on the power stroke into each compression chamber alter-

nately, and supply the engine cylinder therefrom with an explosive gas mixture which is nearly free from products of combustion.

In order that the combustible gas or vapor may be intimately mixed in the crank casing, and also enable the lubricating oil to be distributed to the working parts therein, I further provide the crank arms which are within the casing with projections preferably in the form of backwardly extending members or dashers having scoop-form ends which escape the walls of the casing and in their revolution dash the oil against the bearings and thoroughly mix the air and gases before entering the compression chambers.

In order that the invention may be clearly understood and readily carried into effect, I will describe the same with reference to the various constructional forms embodying the invention represented by way of example in the accompanying drawings, in which—

Figure 1 is a central vertical sectional view of a two-cycle combustion engine provided with my improvements; Fig. 2 is an end elevational view of Fig. 1 with certain parts broken away to show the interior construction; Fig. 3 is an elevational view of a two-cycle engine showing the location of the compression cylinders on one side of the cylinder; Fig. 4 is a cross-section of Fig. 3 on the line 4—4; Figs. 5 and 6 are views in central section and part elevation and broken section respectively of a four-cycle engine provided with my improvements; Figs. 7 and 8 are views partly in detail and partly diagrammatic showing two of the cams and the valve positions.

Referring to the drawings, Figs. 1 and 2 illustrate a two-cycle internal combustion engine, in which 1 is the engine cylinder within which plays a piston 2, having a piston rod 3 connected to a crank arm 4 fast to a power shaft 5. The walls of the engine cylinder are extended to form a flattened casing 6 for receiving the working parts connected with the piston and to constitute a gas and liquid-tight receptacle. On opposite sides of the engine cylinder and toward the end thereof are located two chambers 7 and 8, which are preferably made integral with the walls of the cylinder, but it is obvious that they may be made separable therefrom. The left-hand compression chamber 7 is provided with a gas or vapor inlet port 9

which, near its lower end, communicates through a conduit 10 with the crank casing 6, and an exhaust-port 11 in proximity to inlet port 9, both of which ports are controlled by a single slide valve 12 operated through a spring-pressed rod 13 engaging the end of a rock arm 14 hinged to a lug 15 on the cylinder casing, which rock arm is operated by a three-stepped cam 16 fast on a shaft 17 driven from power shaft 5 through gears 18 and 19, the latter making one revolution to two of the former. Chamber 7 communicates at or near its upper end with engine cylinder 1 through ports 20 and 21 which are controlled by a slide valve 22 having a spring-pressed valve stem 49 operated by a two-stepped cam 16^a through shaft 17, in a manner similar to that of slide valve 12 above described. The valve stem spring for valve 22 may be, and preferably is, however, within the wall separating the engine cylinder and chamber.

Compression chamber 8 is in all respects like chamber 7, and is provided with ports 9', 11', 20', 21', valves 12' and 22' having spring pressed valve stems 13' and 49' respectively. A conduit 10' connects the chamber 8 with casing 6. The slide valves 12' and 22' are operated by means of cams similar to those previously described. One of these cams 16'^a appears in Fig. 1.

The crank casing is provided with a gas or vapor inlet pipe 23 which is in communication with a carbureter and controlled by a check-valve, not shown, which delivers a mixture of air and gas or vapor to the crank casing in a well-known manner.

The piston rod 3 is engaged by two crank arms 4 between which the rod passes in rotating the power shaft 5. Each crank arm 4 is extended into a member 24 having a scoop-shaped extremity 25 adapted to lift lubricating oil in the bottom of this compartment and dash it over the working parts connected with the piston, and is also adapted to churn and mix the explosive mixture of gases or vapors within the crank chamber on their way to the compression cylinders 7 and 8.

The piston 2 is preferably provided with a transverse recess 26 on its under side to permit it to descend as low as possible in the cylinder while clearing the dasher 24. A sparking device 27 of any approved form is provided, and also pet cocks 28, 29 and 30 in the cylinders 7 and 8 and crank casing 6.

My two-cycle engine as thus far described operates as follows:—It is assumed that the piston is in position to receive an impulse from explosion of the gases contained in the left-hand cylinder 7 compressed therein at a previous cycle in the operation. The valves will be positioned by their respective cams to close ports 9, 11, 11', 20' and 21' and open ports 20, 21 and 9'. Gas inlet 23 will be

closed. Any suitable means for securing the proper movements of the valves may be employed, such as cams, two of which are shown enlarged in Figs. 7 and 8. Referring to Fig. 7, cam 16 has three steps, one low step and one high step, each one quadrant in length and one long intermediate step two quadrants in length. Cam 16^a has only two steps, as shown in Fig. 8. The three positions of valve 12 corresponding to one revolution of cam 16 are shown at the right in Fig. 7. The two positions of valve 20 during the same period of operation of the piston is shown at the right in Fig. 8. During the power stroke, ports 9 and 11 are closed by valve 12 which is held in closed position by the second half of the intermediate long step of cam 16. Ports 20 and 21 have been uncovered by valve 22, which will be held in open position by the low step of cam 16^a during its next half revolution or during the power stroke and the return exhaust stroke, as indicated in the valve scheme shown in Fig. 8. Ports 20' and 21' have been closed by valve 22' operated by cam 16'^a and will remain closed by its high step during the period that valves 20 and 21 are open. Port 9' is opened and port 11' is closed by valve 12' during the above power stroke by a cam in all respects like cam 16 above described. Gas inlet 23 is controlled by a check-valve or equivalent means, not shown. The openings in valve 12 are adapted to register one at a time with their corresponding ports, but not both at a time. The same is true of valve 12'.

With the valves arranged as above described for the power stroke, gases previously confined under pressure in chamber 7 escape through port 20 into the piston cylinder and are exploded by sparking of the spark plug 27. The increased pressure of the exploded gases imparts to the piston its working stroke which is materially accelerated as the piston passes port 21 through which the gases enter the cylinder to give additional power to the stroke. During the working stroke a fresh charge of gas previously drawn into chamber 6 through pipe 23 is driven through open port 9' and compressed into chamber 8 therein to be held under pressure during the next or exhaust stroke of the piston. When the piston reaches the end of its first power stroke, port 11 opens by lifting of valve 12 by the high step on cam 16, while port 9 remains closed and port 9' is closed by its valve 12', which is lifted by the intermediate steps of its cam, which, as previously explained, is like cam 16 but differently timed. Port 11' remains closed as do ports 20' and 21' during the exhaust stroke, and ports 20 and 21 remain open, as explained. During the exhaust stroke piston 2 expels the products of combustion from the engine cylinder through ports 20, 21, and

exhaust port 11, and draws in a fresh charge of gas through supply inlet 23 from the carbureter. During this stroke a charge of gas has been held under compression in chamber 8 ready to be exploded. The piston has now received an impulse and expelled substantially all combustion products from the engine cylinder in one revolution of the power shaft and is ready to receive an impulse from the explosion of the charge held in cylinder 8. The same cycle of operations is now repeated with the charge of gas in cylinder 8 while gas is compressed and held under pressure in cylinder 7.

By reason of the construction described, a charge of pure gas or vapor and air has been thoroughly mixed in the crank casing by the dasher 24 and passed into one compression chamber and held therein while gases of combustion are expelled from the engine cylinder, thereby preventing in a large measure the dilution of the fresh charge with the products of combustion, as in the case where the incoming charge is used to wash out the burned gases. The piston is given one impulse in each revolution of the shaft and greater power is given to the stroke, enabling the engine to run on a lower speed, thereby reducing wear and vibration of the engine. The desired speed in the machine to be driven is secured by gearing up on the driving shaft, a procedure particularly to be desired in running motor cars.

Above is described a two-cycle engine having the compression chambers on opposite sides of the engine cylinder. The two chambers may, and preferably are, placed on one side of the cylinder, as illustrated diagrammatically in Figs. 3 and 4, thereby avoiding one extra set of drive gears.

In Figs. 5 and 6 my improvement is shown as applied to a four-cycle internal combustion engine, which is provided with a crank casing as previously described. 30' is a compression chamber associated with the engine cylinder. 31 and 32 are ports between the engine cylinder and chamber adapted to be both opened or both closed by slide-valve 38 operated through a spring pressed valve stem 38' engaging at its lower end a two stepped cam 36 similar to cam 16, Fig. 1. An exhaust port 33 opening into pipe 37' and an inlet port 34 opening into pipe 37 are controlled by slide-valve 35 having two openings either of which is adapted to register with its port while the other is out of register with the other port. This valve is operated through a spring-pressed stem 35' pivoted to a lever 36', the opposite extremity of which rides on a three-stepped cam 39, Fig. 6, and of the form above described and shown in Fig. 7, but reversed. The inlet port 34 communicates with the crank casing through a conduit 37.

On one side and near the end of the engine cylinder are gas supply/inlet ports 43 and 45 leading to the engine cylinder and crank casing 6 respectively. Ports 43 and 45 are controlled by a slide valve 44 having two openings either of which may register with its port or both may be out of register. Valve 44 is operated by a spring pressed stem 46, the lower end of which rides on a three-stepped cam 47 of the form shown in Fig. 7. Cams 36 and 39 are mounted on shaft 40' and cam 47 is mounted on shaft 40. Said shafts are driven by gears 41' and 41 meshing with gears 42', 42, having half the diameter of the former and fast on the drive shaft 5.

Starting with the parts in position shown in Figs. 5 and 6 on the suction stroke, ports 43 and 34 are open, and ports 45, 31, 32 and 33 are closed. Gas or vapor is drawn from a carbureter, not shown, through port 43 into the engine cylinder. At the same time, as gas enters the cylinder, a previous charge in the crank casing 6 is forced by the back of the piston 2 into chamber 30' through open port 34 and therein compressed. On the compression stroke, ports 43 and 34 close while ports 31, 32, 33 and 45 remain closed. At the termination of the compression stroke, the charge is ignited by spark 48 and the piston starts on its power stroke. Valve 38 registers its openings with ports 31 and 32 as its stem 38' drops off the high step onto the lower step of cam 36. As the piston advances ports 31 and 32 are uncovered in succession to deliver the highly compressed gas in chamber 30' to the engine cylinder to be ignited and increase the cylinder pressure throughout the whole stroke of the piston. On the last or fourth stroke valve 44 is lifted its full height by the high step on cam 47, opening port 45 to the carbureter and holding port 43 closed. Ports 31 and 32 remain open and valve 35 is lifted to register its upper opening with port 33 while keeping port 34 closed. The piston then expels the products of combustion from the engine cylinder while drawing in a fresh charge of gas into the casing to be delivered to chamber 30' on the next stroke of the piston.

Instead of employing one compression chamber more than one may be used to give a succession of impulses to the piston, preferably, however, on this type of engine one chamber is used.

It will be observed that the piston on its exhaust stroke travels to near the end of the engine cylinder, thereby reducing the clearance space to the minimum, and enabling the expulsion of substantially all the products of combustion from the cylinder before drawing in a pure charge directly from the carbureter or other fuel supply while storing under high pressure a charge to be delivered

during the working stroke of the piston to hold up the pressure on the same to the end of its stroke.

What I claim is:—

- 5 1. In an internal combustion engine, the combination of an engine cylinder having a piston therein, a crank casing forming a rear compression chamber and having a gas receiving port, two gas compression chambers
- 10 each communicating with said engine cylinder and casing on opposite sides of said piston, and valve means for permitting gas to pass under pressure from said casing into said chambers alternately, to hold said gas
- 15 under pressure therein during an exhaust stroke and to deliver said gas to the engine cylinder and an igniter located in the engine cylinder to explode the gas therein upon the face of the piston on a working stroke.
- 20 2. In an internal combustion engine, the combination of an engine cylinder having a piston therein, two gas compression chambers, each of said chambers communicating with said cylinder by a plurality of ports successively uncovered by said piston, valve
- 25 means controlling each set of said ports to admit compressed gas to said cylinder from said chambers alternately, a gas admission port between each of said chambers and the rear of said cylinder, and valve means controlling said ports to deliver gas compressed
- 30 by said piston to said chambers alternately to be held under pressure in said chambers alternately through the exhaust stroke of said piston.
- 35 3. In an internal combustion engine, the combination of an engine cylinder having a piston therein, a crank casing forming a rear

compression chamber and having a gas-receiving port, a two compartment compression chamber fast to one side of said cylinder, each of said compartments being in communication with said cylinder and casing on opposite sides of said piston, valve means for permitting gas to pass under pressure from said casing into said compartments alternately, to hold gas under pressure in each compartment through an exhaust stroke of said piston and to deliver said gas to the engine cylinder, and an igniter located in the engine cylinder to explode the gas therein upon the face of the piston on a working stroke.

4. In an internal combustion engine, the combination of an engine cylinder having a piston therein, two compression chambers each of which communicates with said cylinder on opposite sides of said piston, valve means for delivering compressed gas from said chambers to said cylinder alternately, valve means for delivering gas compressed in the rear of said cylinder to said chambers alternately to be held under pressure in said chambers alternately through the exhaust stroke of said piston, an igniter in the engine cylinder to explode the gas therein upon the face of the piston in a working stroke, and a valve controlled exhaust port in each of said chambers.

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

DAVID H. COLES.

Witnesses:

RALPH L. SCOTT,

WILLARD H. HARTING.