No. 863,594. PATENTED AUG. 20, 1907.

C. DE MATTIA.

ENGINE.

APPLICATION FILED DEC. 28, 1906.

2 SHEETS—SHEET 1.

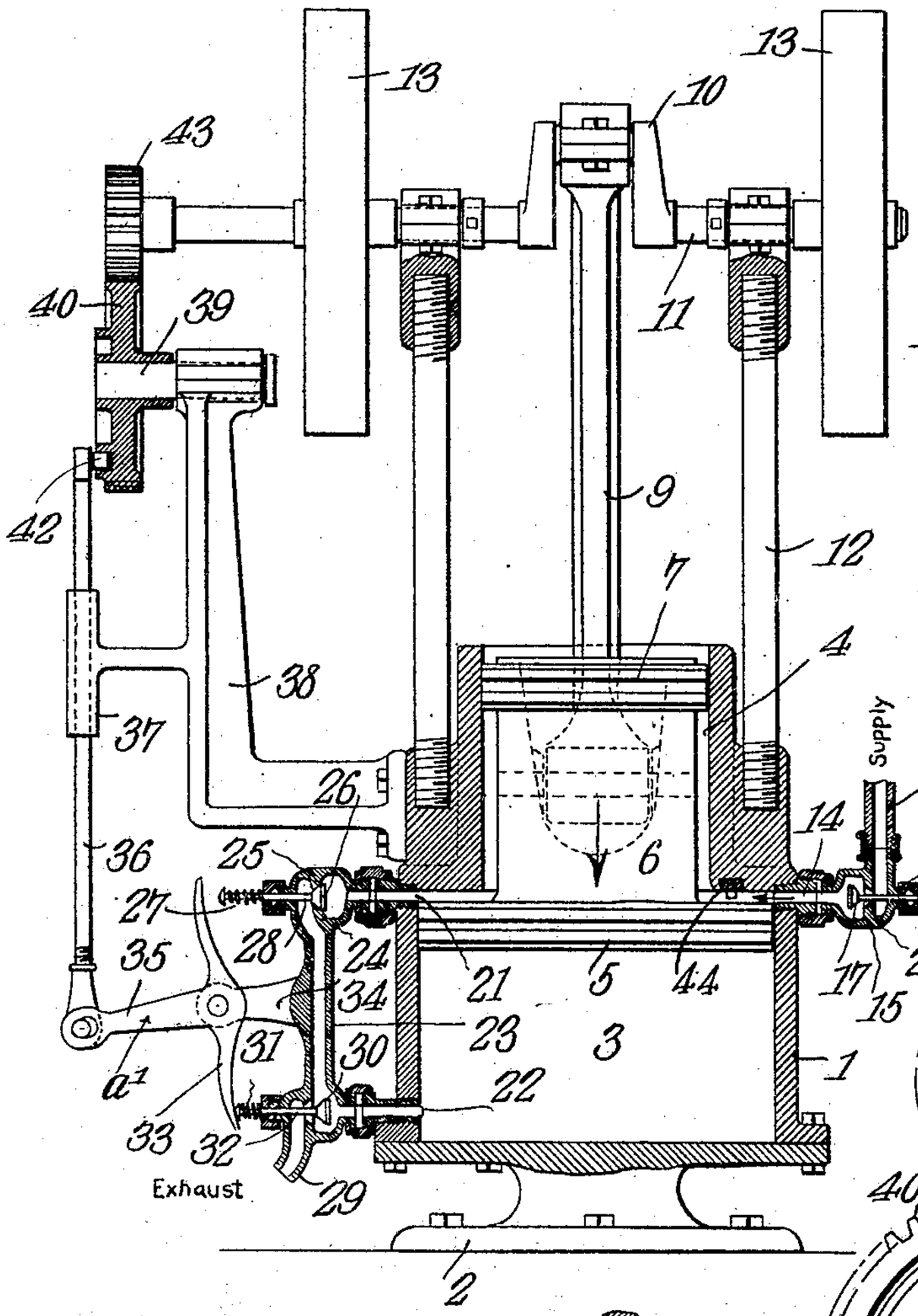

Fig. 1.

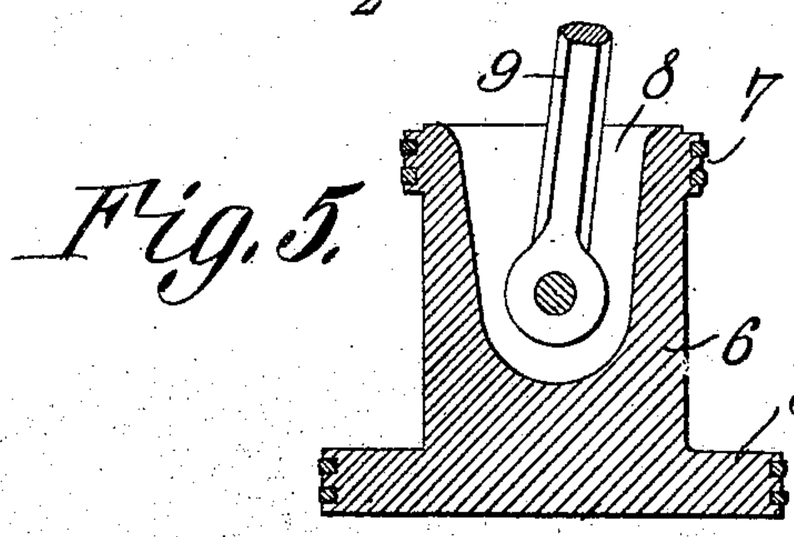

Fig. 5.

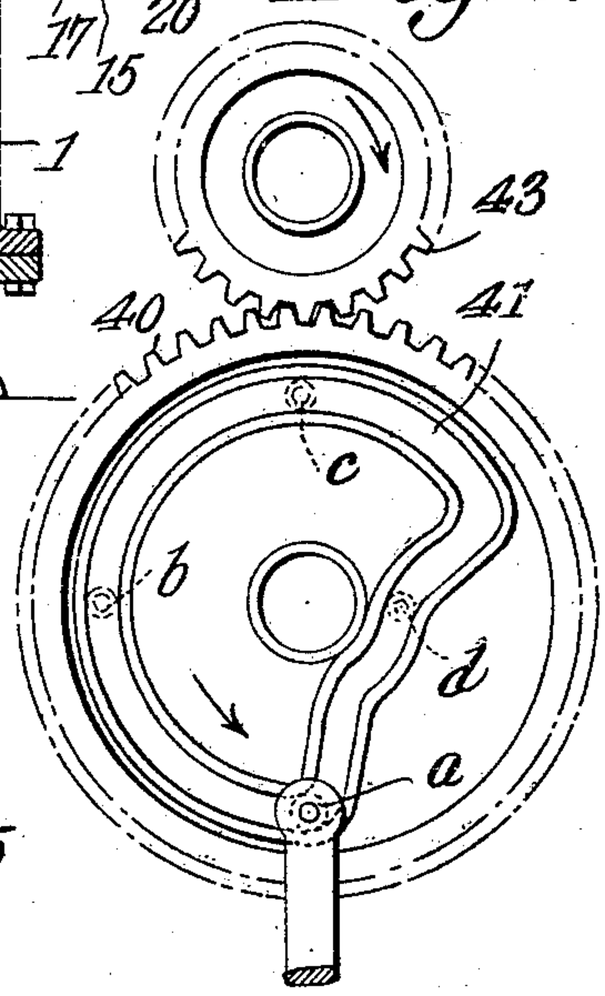

Fig. 6.

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2 SHEETS—SHEET 2.

Fig. 2.

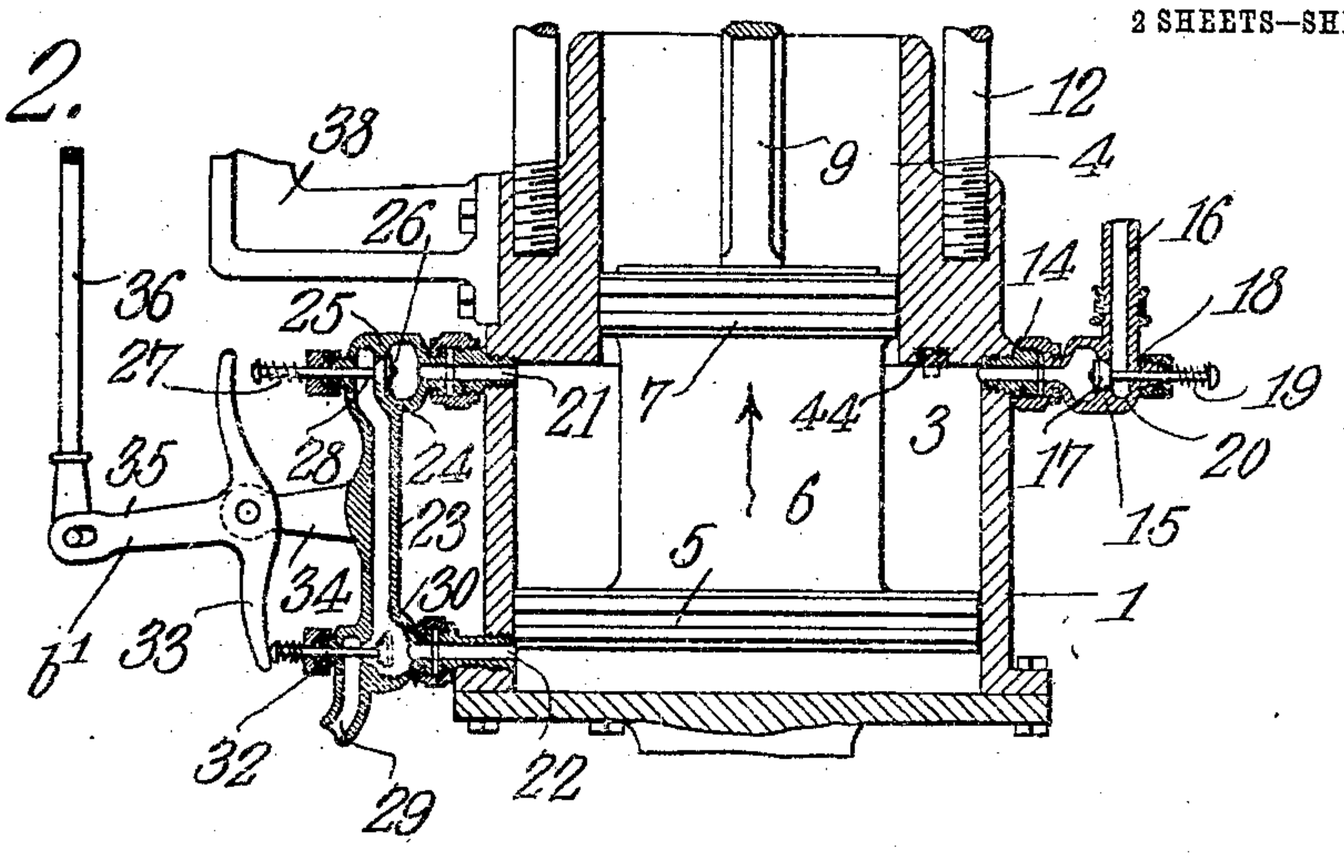


Fig. 3.

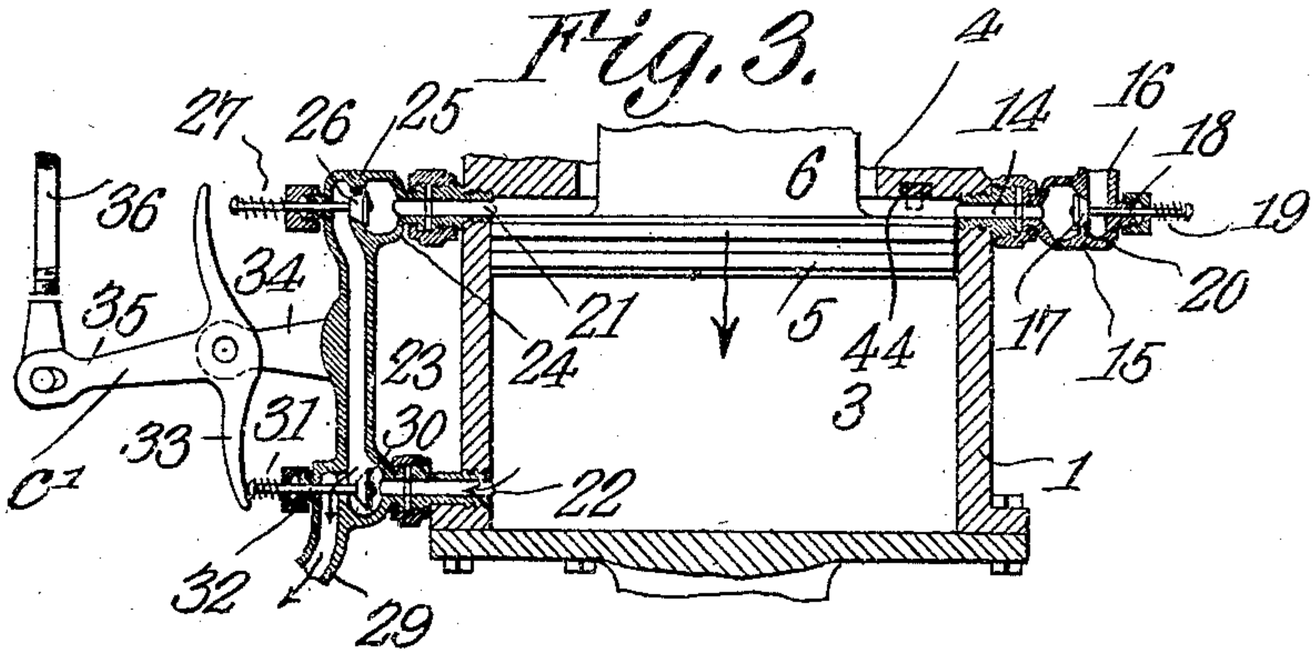
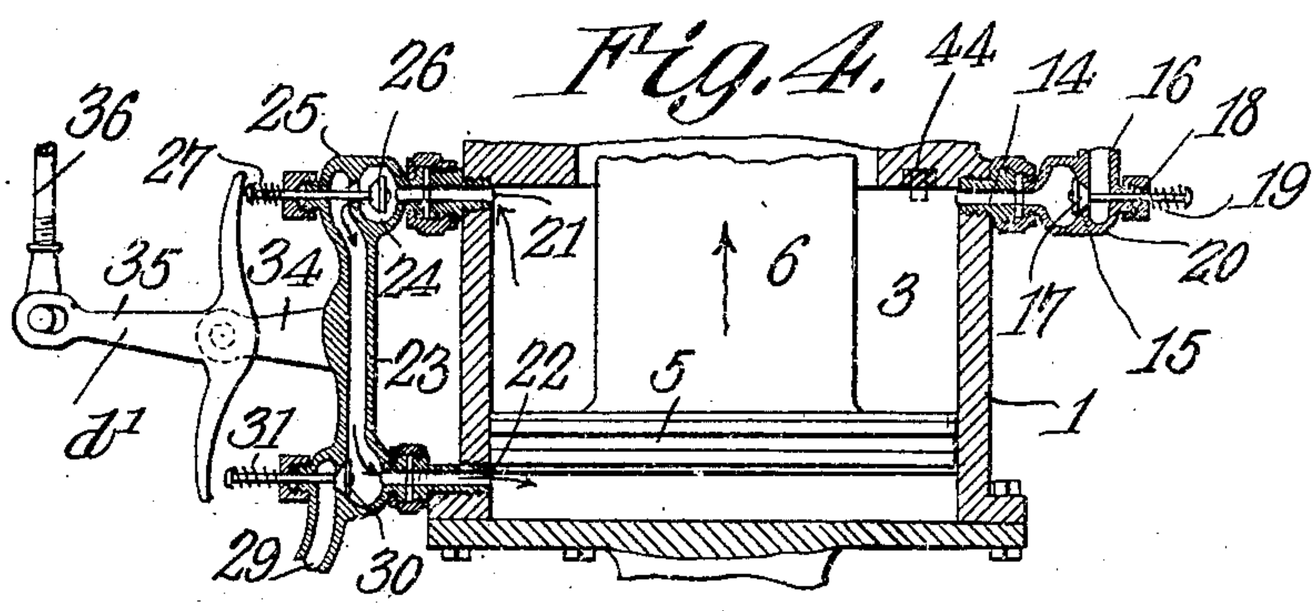


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ENGINE.

No. 863,594. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed December 28, 1906. Serial No. 349,867.

To all whom it may concern:

Be it known that I, CONSTANT DE MATTIA, a citizen of the United States, residing at Fort Madison, in the county of Lee and State of Iowa, have invented a new and useful Engine, of which the following is a specification.

This invention relates to four-cycle compound engines of that type utilizing hydrocarbon gases as a propelling medium and the object of the invention is to provide a simple and compact device of this character which is very light and durable in construction, which is of high power, and which is therefore particularly designed for use in propelling motor vehicles.

A still further object is to provide novel valve mechanism whereby the gas may be directed at proper periods into the high pressure compartment and thence into the low pressure compartment and finally exhausted from the engine.

With these and other objects in view the invention consists of certain novel features of construction and combinations of parts which will be hereinafter more fully described and pointed out in the claims.

In the accompanying drawings is shown the preferred form of the invention.

In said drawings: Figure 1 is a vertical section through the engine and showing the positions of the parts at the beginning of the first down stroke of the piston; Fig. 2 is a section through the lower portion of the engine and showing the positions of the parts at the beginning of the second stroke of the piston; Fig. 3 is a similar view showing the adjustments of the parts at the beginning of the third stroke; Fig. 4 is a similar view showing the positions of the parts at the beginning of the fourth stroke; Fig. 5 is an enlarged section through the piston; and Fig. 6 is an enlarged elevation of the valve-actuating eccentric and its drive gear.

Referring to the figures by characters of reference, 1 is a casing mounted on a suitable support or base 2 and the upper half of the casing is of considerably smaller diameter than the other half so that a large or low-pressure cylinder 3 is formed at one end of the casing and a small or high-pressure cylinder 4 is formed at the other end of the casing. The two cylinders communicate and that end of the casing forming the high pressure cylinder 4 is open. A piston 5 is mounted to reciprocate within the low pressure compartment and is connected by a cylindrical body 6 with a smaller piston 7 adapted to reciprocate within the high pressure cylinder 4. The body 6 is provided with a recess 8 in which is pivotally mounted one end of a pitman 9 which engages the crank 10 on a shaft 11. This shaft is journaled upon standards 12 which are supported by the casing 1 and fly wheels 13 are secured to and rotate with the shaft.

An inlet port 14 is formed within the cylinder 1 at a point disposed at all times between the pistons 5 and 7 and extending from this port and secured to the casing in any preferred manner is a valve casing 15 communicating with a supply pipe 16 through which the motive fluid is adapted to be fed to the interior of the engine. A valve 17 is arranged within the casing 15 and has a stem 18 on which is mounted a spring 19 which serves to hold the valve normally in position upon its seat 20. An outlet port 21 is also formed in the casing 1 at a point constantly between the two pistons 5 and 7 and this port is preferably disposed diametrically opposite port 14.

A combined inlet and exhaust port 22 is formed within casing 1 adjacent the closed end of the casing and is located beyond the path of the piston so that said port is at all times disposed between the piston and the closed end of the casing. A casing 23 having a passage extending therethrough is secured upon the casing 1 so as to constitute a connection between the two ports 21 and 22 and a partition 24 having a valve seat 25 therein is located within the casing 23 close to the port 21. A valve 26 is normally held upon the seat 25 by means of a spring 27 which bears upon the stem 28 of the valve. It is therefore apparent that communication from the port 21 to the passage within the casing 23 is normally cut off. Port 22 is constantly in communication with the interior of casing 23. An exhaust port 29 extends from the casing 23 adjacent inlet 22, however, and is normally closed by a valve 30 having a spring 31 upon the stem 32 thereof whereby said valve is held normally upon its seat so as to close the exhaust. The stems 28 and 32, are adapted to be alternately contacted and actuated by a rock arm 33 fulcrumed upon a bracket 34 and having an arm 35 which is pivotally connected to a rod 36. This rod is slidably mounted in a guide 37 extending from a bracket 38 which is secured to the casing 1. Bracket 38 constitutes a bearing for a shaft 39 carrying a gear 40. This gear has an eccentric 41 of peculiar contour upon one face thereof said eccentric being in the form of a groove in which is adapted to travel a roller 42 extending laterally from one end of the rod 36. A gear 43 is secured to shaft 11 and meshes with gear 40 and the two gears are so proportioned that one revolution of the gear 40 will be produced by every two revolutions of the gear 43.

As has been heretofore stated the normal positions

of the valves of the engine are closed. When, however, the pistons 5 and 7 begin their first down stroke the eccentric 41 is located so that the roller 42 is disposed in the position shown at *a'* in Fig. 1 and thereby permitting the valve 26 to remain upon its seat but forcing the valve 30 open. The downward movement of the piston 5 creates a suction sufficient to overcome the tension of the spring 19 and thereby cause the valve 17 to open and permit the motive fluid to pass into the casing between the two pistons. In this connection it might be stated that the spring 19 is of less strength than the spring 27 so that only the valve 17 will be opened by the suction thus established. The downward movement of the piston, as indicated by the arrow thereon in Fig. 1 will drive the gases in the path thereof outward through the port 22 and the exhaust 29. This downward stroke of the piston produces one-half a revolution of gear 43 which will be sufficient to bring the roller 42 into the position indicated by *b* on eccentric 41. This will cause the rock arm 33 to retain the position shown by *b'* in Fig. 2. The valve 30 will therefore remain unseated. The second or return stroke of the piston as indicated by the arrow thereon in Fig. 2 will force the valve 17 to its seat and result in the compression of the gases between the two pistons. The formation of the vacuum back of the pistons is prevented by air admitted through the open valve 30. The second or return stroke of the piston will cause the gear 43 to complete its first rotation and will bring the roller 42 into position shown at *c* in Fig. 6 thereby still maintaining the valve 30 open as shown at *c'* in Fig. 3. As soon as the piston reaches the limit of its second or return stroke the compressed fluid is exploded by any desired sparking mechanism such as indicated at 44 and the expansion of the exploded or ignited gases will drive the piston upon its third stroke as indicated by the arrow thereon in Fig. 3. The expanding gases will hold the valve 17 and 26 upon their seats and the air which has been sucked back of the piston during the second stroke is discharged through the port 22 and thence through the exhaust 29. This third stroke of the piston will impart another half revolution to gear 43 and will bring the roller 42 into position indicated by *d* in Fig. 6 which will cause the rock arm 33 to assume the position shown at *d'* in Fig. 4. This will throw the valve 26 open and cause the valve 30 to close and as soon as the piston begins its fourth stroke as indicated by the arrow thereon in Fig. 4 the partly expanded gases between the pistons will be expelled through the port 21 and casing 23 and thence through the port 22 into the low pressure cylinder between piston 5 and the closed end of the cylinder. Here the gases will further expand so as to drive the piston upward and cause the completion of the cycle. The roller 42 will of course be brought into position indicated by *a* in Fig. 6 and the operation hereinbefore described will then be repeated in every detail. It is to be understood that any suitable cooling means such as a water jacket will be placed around the casing 1 and the valves and their casings so as to prevent injury as a result of the heat generated by the explosion of the gases. It will be seen that the third and fourth strokes of the piston are produced by the pressure of the expanding gases upon the pistons and the momentum imparted to the fly wheels 13 by the strokes will be sufficient to carry the pistons through the first and second strokes.

By providing the novel arrangement of ports and pistons and the valve mechanism which has been described it is apparent that a piston within the low pressure cylinder receives two impulses during every four strokes, the first impulse being imparted by the explosion of the charge, and the second impulse being imparted by the rush of gases from the high pressure to the low pressure cylinder immediately upon the completion of the explosion.

What is claimed is:

1. In an engine the combination with concentric longitudinally displaced high pressure and low pressure cylinders having a passage for establishing communication therebetween, and a valved fuel intake opening into the high pressure cylinder; of rigidly connected pistons mounted to reciprocate within the respective cylinders, a valve normally closing communication between said passage and the high pressure cylinder, a combined exhaust and air intake, a valve normally closing communication between the passage and the exhaust, and means operated by the movement of the piston for seating and unseating the valves at predetermined points during the strokes of the pistons.

2. In an engine the combination with concentric longitudinally displaced high pressure and low pressure cylinders having a passage for establishing communication therebetween, and a valved fuel intake opening into the high pressure cylinder; of rigidly connected pistons mounted to reciprocate within the respective cylinders, a valve normally closing communication between said passage and the high pressure cylinder, a combined exhaust and air intake, a valve normally closing communication between the passage and the exhaust, a rock arm for alternately unseating the valves within the passage, an eccentric for actuating said rock arm, and means operated by the piston for actuating the eccentric.

3. In an engine the combination with concentric longitudinally displaced high pressure and low pressure cylinders, said high pressure cylinder having a fluid inlet port and an outlet port, and said high pressure cylinder having a combined outlet and air intake port, and a spring seated valve within the fluid inlet port; of a casing connecting the outlet ports and having a passage therein communicating with said ports, a spring seated valve in the casing for closing communication between said passage and the port of the high pressure cylinder, an exhaust, a spring seated valve in the casing for closing communication between the passage and the exhaust, rigidly connected pistons mounted to reciprocate within the high pressure and the low pressure cylinders, and mechanism operated by the pistons for opening the valves within the casing at predetermined points during the strokes of the pistons.

4. In an engine the combination with concentric longitudinally displaced high pressure and low pressure cylinders, and a valved fuel inlet in the high pressure cylinder; of rigidly connected pistons mounted to reciprocate within the respective cylinders, outlet ports within said cylinders, a casing having a passage therein communicating with the ports and provided with an exhaust, a spring pressed valve normally closing communication between the passage and the outlet port of the high pressure cylinder, a spring pressed valve normally closing communication between said passage and its exhaust, a rock arm, an eccentric, means actuated by the eccentric for rocking the arm to unseat either of the valves, and mechanism operated by the pistons for actuating the eccentric.

5. A four cycle engine comprising concentric longitudinally displaced high pressure and low pressure cylinders, said high pressure cylinder opening directly into the low

pressure cylinder, connected pistons mounted to reciprocate within the respective cylinders, a valved intake in the high pressure cylinder, and valved means exterior of the cylinders for directing exploded gases from the high pressure to the low pressure cylinder to impart a second impulse to the piston within the low pressure cylinder.

6. A four-cycle engine comprising longitudinally displaced high pressure and low pressure cylinders, rigidly connected pistons movable within said cylinders, a valved intake within the high pressure cylinder, a valved intake within the low pressure cylinder, and valved means for directing an exploded charge from the high pressure cylinder through the intake of the low pressure cylinder to impart a second impulse to the piston therein, said intake of the low pressure compartment constituting an exhaust.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

CONSTANT DE MATTIA.

Witnesses:

BORTOLO DE MATTIA,

WM. F. WILKEN.