No. 842,392. PATENTED JAN. 29, 1907.

J. ECKHARD.

EXPLOSIVE ENGINE.

APPLICATION FILED JUNE 29, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

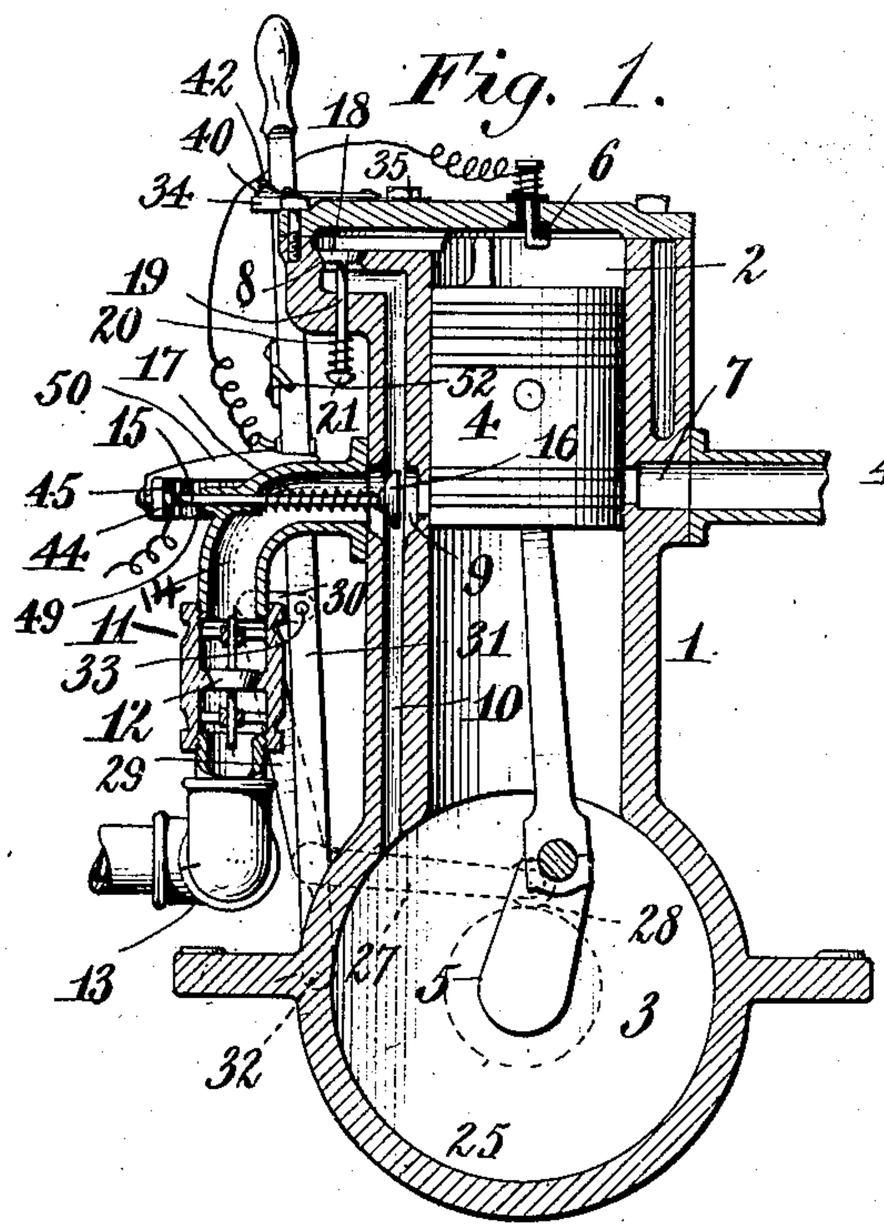

Fig. 2.

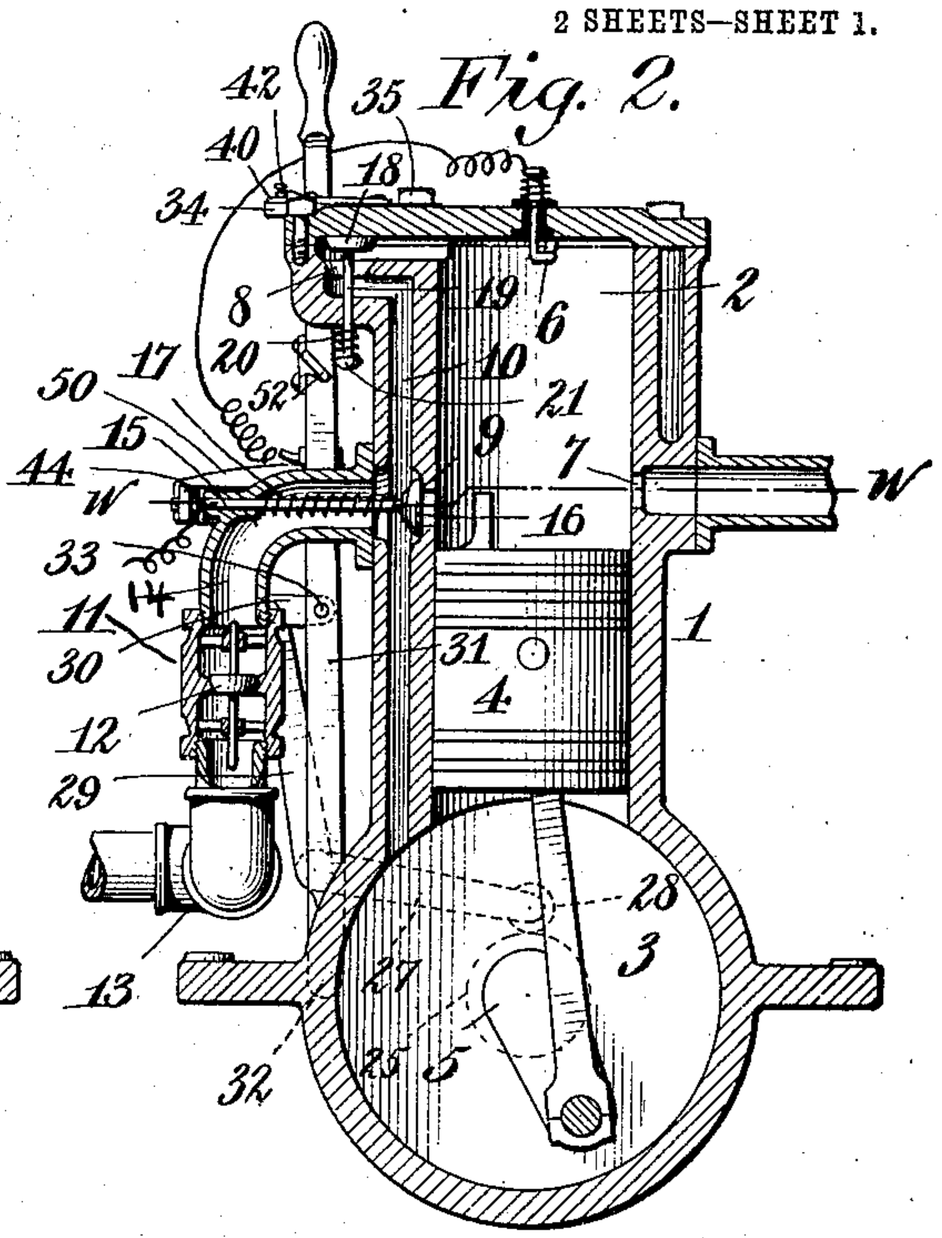

Fig. 3.

Witnesses:
Julius Lawson
Harry Harris

John Eckhard, Inventor:
By Emil Neuhark, Attorney.

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2 SHEETS—SHEET 2.

Fig. 4.

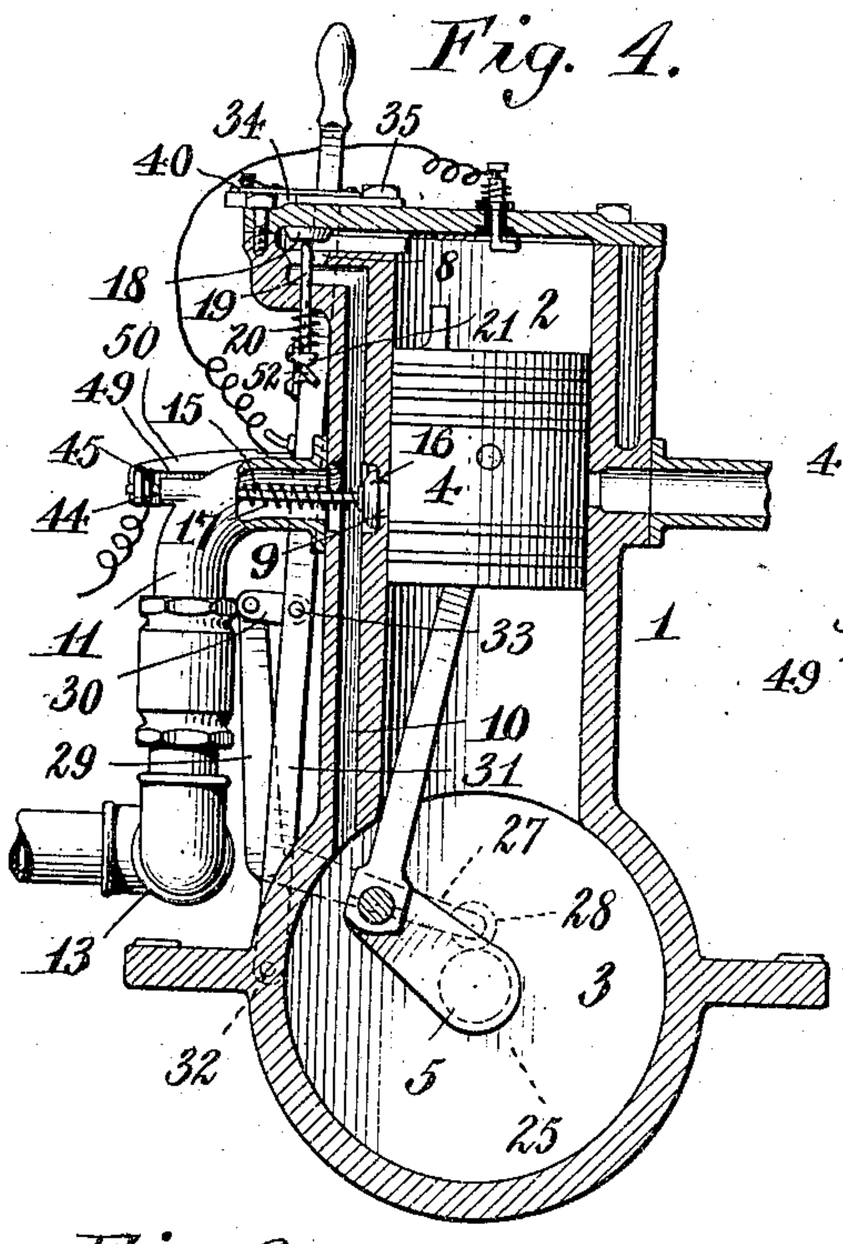


Fig. 6.

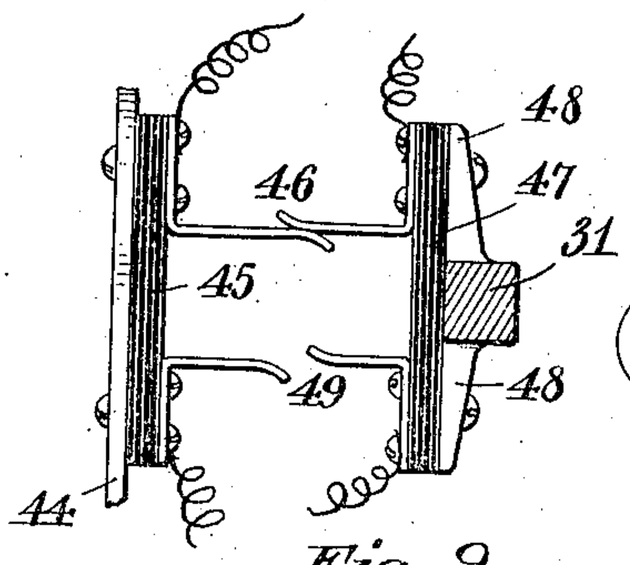


Fig. 9.

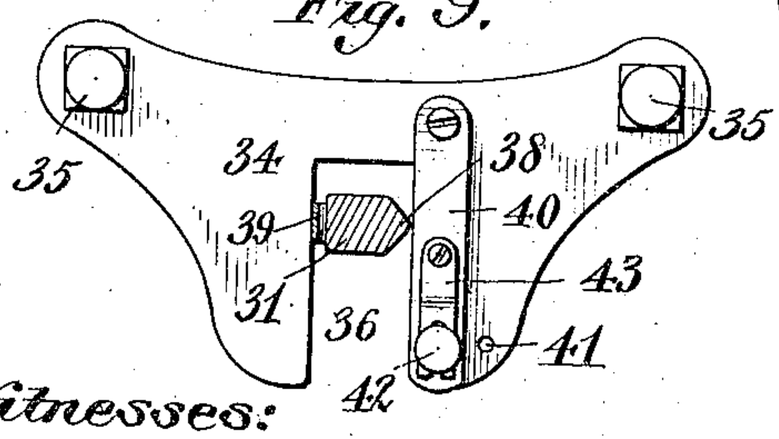


Fig. 5.

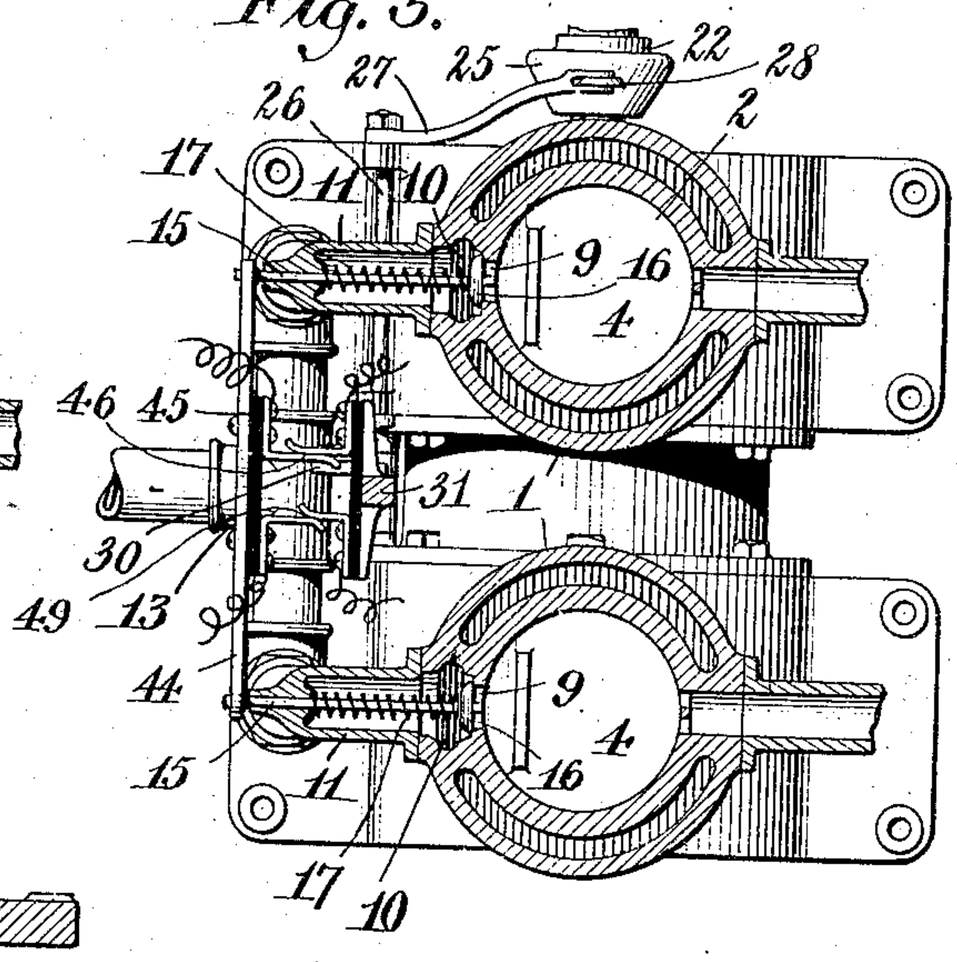


Fig. 7.

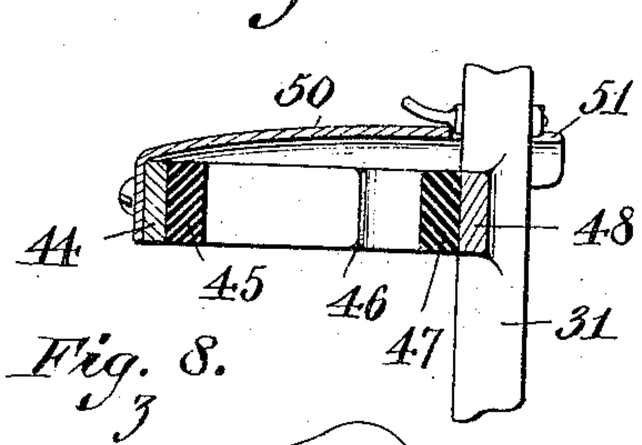


Fig. 8.

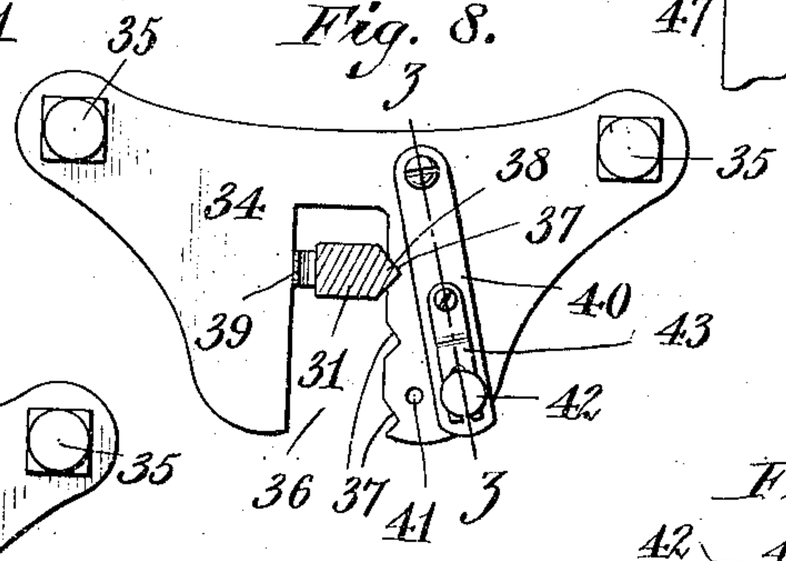
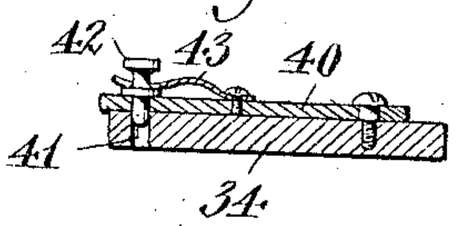


Fig. 10.



Witnesses:

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Attorney.

UNITED STATES PATENT OFFICE.

JOHN ECKHARD, OF BUFFALO, NEW YORK, ASSIGNOR OF ONE-HALF TO JOSEPH P. FELL, OF BUFFALO, NEW YORK.

EXPLOSIVE-ENGINE.

No. 842,392. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed June 29, 1905. Serial No. 267,633.

To all whom it may concern:

Be it known that I, JOHN ECKHARD, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

My invention relates to improvements in explosive-engines; and its objects are to produce an engine of the two-cycle type in which base explosion is entirely avoided, to provide a multiple-cylinder engine in which explosion may take place in any number of cylinders less than the whole number provided, to provide valve-controlled side and head inlet-ports and means to close the valve of the side inlet-port and open the valve of the head-inlet port, to provide means for automatically closing the side ports when the engine is running at a slow speed without load, and to provide means whereby the side port-valve is opened farther when greater power is used or when the speed is increased to a certain limit under load.

Further objects are to provide an engine in which either or both inlet-valves may be actuated manually or automatically and to provide an engine of the two-cycle type which shall be especially adapted for marine and automobile use.

My invention consists in the construction, arrangement, and combination of parts to be hereinafter described, and particularly pointed out in the subjoined claims.

In the drawings, Figure 1 is a central vertical section taken through the right-hand cylinder of a duplex engine embodying my invention in representative form, the side port-valve being open to permit the explosive charge to enter the cylinder and the end port-valve being closed. Fig. 2 is a similar view showing the side port-valve closed and the end port-valve opened by the suction of the piston. Fig. 3 is a front elevation of the engine. Fig. 4 is a view similar to Fig. 1, showing the right-hand cylinder arranged for action without explosion, under which arrangement the side port-valve is held closed, the end port-valve held open, and the igniter disconnected electrically. Fig. 5 is a horizontal section taken on line *w w*, Fig. 2. Fig. 6 is an enlarged sectional top plan view of the switch for electrically disconnecting the igniters of one of the cylinders. Fig. 7 is an enlarged vertical section taken on line *x x*, Fig. 3. Fig. 8 is an enlarged horizontal section taken on line *y y*, Fig. 3. Fig. 9 is a similar view showing the switch and valve-lever disconnected from the locking-teeth on the lock-yoke. Fig. 10 is a section taken on line *z z*, Fig. 8.

Two-cycle engines have heretofore been in use in which a side inlet-port has been provided and also in which an end inlet-port has been used. Under the former construction improper mixture is drawn into the cylinder and high speed produced, resulting in the explosion being carried through the inlet-passage to the crank or compression chamber and producing what is generally termed "base explosion," which acts against the piston to stop or retard the engine, consequently producing irregular action or entire stoppage. Under the construction in which the engine is provided with an end inlet the engine cannot develop the necessary speed nor sufficient power. I therefore utilize both ports in conjunction with valves, so that when the engine is running at too high a speed under load which would lead to improper explosion the side port-valve will close and the charge be led through the end port-valve, whereby the speed of the engine is reduced and the explosion of the explosive mixture properly controlled, so as to ignite it within the explosion-chamber, and base explosion is therefore rendered impossible.

Referring now to the drawings in detail, like numerals of reference refer to like parts in the several figures.

The reference-numeral 1 designates the cylinders provided with the usual explosion-chambers 2 and having formed integrally therewith or connected thereto, as may be desired, the crank or compression chambers 3, commonly termed the "base" of the engine. Each cylinder is provided with the usual working piston 4, connected by a piston-rod with crank-shaft 5, journaled in the end walls of the crank or compression chambers. Suitable igniters 6 are provided for the cylinders, which may be of the "make and break" or "jump-spark" type, but preferably the latter, and exhaust-ports 7 serve to discharge the burned or exploded gases. The above-mentioned parts are common, but essential to the operation of a two-cycle engine, and their construction and arrangement may be

varied, as they in themselves form no part of my invention.

In carrying out my invention I provide each of the cylinders with an end inlet-port 8 and a side inlet-port 9, located between the compression-chamber and the end inlet-port. A passage 10 connects the head end of the cylinder with the compression-chamber, and entering the same in line with the side inlet-port is the gas-induction pipe 11. The induction-pipes are each provided with a check-valve 12 and unite at 13 for connection with a suitable carbureter. (Not shown.) The induction-pipes are provided with elbows 14 at the points of connection to the cylinders, and extending through the same for guidance are the valve-stems 15 of valves 16, that are adapted to open and close the side inlet-ports. Surrounding the valve-stems and bearing with their ends against the valves and the walls of the elbows are springs 17, which tend to hold said valves against their seats.

Closing the end inlet-port is a valve 18, having its stem 19 extending out through the wall of the cylinder. Surrounding said stem without the cylinder is a spiral spring 20, bearing with its upper end against the cylinder and with its lower end against a semispherical collar 21 at the lower end of said stem, the curved surface of which faces downward for a purpose to be presently described.

Secured to or connected with the engine-shaft, if desired, is a governor 22 of any suitable construction. That herein shown is provided with weighted bell-crank levers 23, having their weighted ends connected by a spring 24 and their opposite ends connected to a cone 25, slidably mounted on the shaft. Journaled horizontally on one of the cylinders is a rock-shaft 26, which has secured to one end thereof an arm 27, equipped at its free end with a roller 28, riding the slidable cone on the engine-shaft. Secured to the opposite end of the rock-shaft and arranged centrally between the cylinders is an arm 29, having its free end connected by a link 30 to a hand-lever 31, pivoted to the engine-casing at 32. The connection of the link 30 to the hand-lever is made by a pin 33, which may be removable, so that when the engine is to be governed by the hand-lever the governor is free to act without affecting other working parts.

A lock-yoke 34 is secured to the heads of the cylinder by means of bolts 35, it being provided with a slot 36, having one of its side walls provided with a series of notches 37, preferably V-shaped. The hand-lever passes through said slot and is provided with a corresponding V-shaped portion 38, adapted for engagement with the notches on the yoke-piece, so that the lever may be held in any desired position. In order that this be accomplished, the said lever is equipped with a spring 39, which bears against the opposite wall of the slot to force the lever into engagement with the notches 37. By reason of the governor having connection with the hand-lever provision must be made to permit the free action of said lever when the engine is to be governed automatically. This is done by a lever 40, pivoted on the lock-yoke and adapted to be swung over the notches 37 on the latter, so that the hand-lever is forced out of engagement with said notches and may bear against the edge of said pivoted lever, as shown in Fig. 9. The lock-yoke is provided with two perforations 41, in either of which a pin 42, carried on the lever 40, is to be pressed by a spring 43, bifurcated to straddle the head of the pin and cause said pin to be held in the perforation. In this manner the lever 40 may be swung to the position shown in Fig. 8 when the engine is to be governed by hand.

Connecting the valve-stems of the side port-valves is a cross-bar 44, having a strip of insulation material 45 secured thereto, to which is affixed one of the spring-tongues of a switch 46, the other coacting spring-tongue of said switch being secured to a strip of insulating material 47, secured to lateral arms 48 on the hand-lever. The cross-bar 44 also has connected to the insulating material thereon one of the spring-tongues of a switch 49, which has its other spring-tongue secured to the insulating-strip 47 on the hand-lever. The tongues of the switch 46 are longer than those of the switch 49, and therefore can be brought into contact to establish an electric circuit, while the tongues of the switch 49 are held out of contact, as shown in Fig. 6.

The switches are covered by a suitable hood 50, secured to the cross-bar 44 and formed with a slot 51, through which the hand-lever extends. Said hand-lever is free to move in the slot 51 after the side port-valves are closed; but in swinging said lever outward it comes in contact with the inner end of said slot and causes the cross-bar 44 to be moved outward, which action unseats the side port-valves against the action of the springs surrounding the stems thereof. One of the switches is placed in the circuit of the igniter in one cylinder, while the other switch is placed in the circuit of the igniter in the other cylinder, and it is therefore apparent that both circuits may be broken or an electric circuit established for both igniters or for only one, as may be desired.

Extending laterally from the hand-lever is an arm 52, having a downwardly and inwardly directed face adapted when the hand-lever is swung to its extreme inner position to engage the semispherical head of the end inlet-valve stem of one of the cylinders and cause the valve thereon to be held unseated. When the lever is in this position, the switch

49 in the circuit of the corresponding igniter is separated, and consequently no explosion in the corresponding cylinder can take place. As shown in Fig. 4, when this condition exists the side port-valve is closed, and therefore the charge of the explosive mixture taken into the cylinder is forced back and forth through the passage 10 and into the explosion-chamber and compression-chamber, thereby permitting one of the cylinders and the piston therein to be used idly without developing power. This is of great advantage when the power developed in a single cylinder is sufficient to perform the work, and as the charge is simply moved back and forth in the other cylinder without compression and no new charge taken in a great saving in fuel results therefrom. Furthermore, by providing free communication between the compression-chamber and the explosion-chamber a great saving in power is obtained, the counteraction resulting from the compression of gases in the idle cylinder of engines otherwise constructed being obviated entirely, such compression being merely a brake or resistance to the power developed in the other cylinder. The circuit-wiring is applied in the usual manner with the switches simply interposed in the wires leading to the igniters, and therefore it was thought unnecessary to enter into detail with reference thereto or to show the same herein.

When both cylinders are to be put into use and the engine governed by hand, the hand-lever is moved out to the position shown in Fig. 1. In this condition both switches are connected so that the igniters of both cylinders ignite the explosive mixture at the proper time, which time is of course governed by the periodic circuit-closer always used on multiple-cylinder engines. When it is found that the engine is running at too high a speed under load, the hand-lever is moved to an intermediate position, as shown in Fig. 2, in which case the side port-valves are closed and the explosive mixture must pass through the end inlet-ports, the valves thereof opening against their spring-pressure on the downward stroke of the pistons and closing during the compression-stroke. When the side inlet-valves are open, the charge of the explosive mixture is of course drawn into the cylinder through the side inlets and the end inlet-valves remain closed

My invention is susceptible to many changes in form, construction, and in the arrangements of the parts as shown herein without departing from the principle involved or sacrificing any of the advantages thereof.

Having thus described my invention, what I claim is—

1. An explosive-engine comprising a cylinder having a compression-chamber and an explosion-chamber, a passage leading from the explosion-chamber to the compression-chamber, an exhaust-port, an inlet-port at the connection of the upper end of said passage with the explosion-chamber, an inlet-port in the cylinder between the ends of said passage, a spring-controlled valve for the first-mentioned inlet-port, a suitably-governed valve for the other inlet-port, and a piston working in said cylinder.

2. In an explosive-engine, the combination with the cylinder having a compression-chamber at one end and an explosion-chamber at the other end, a passage connecting both chambers, an inlet-port between the ends of the cylinder, an inlet-port at the explosion end of the cylinder, and a working piston in the cylinder, of a spring-controlled valve for the last-mentioned inlet-port, a valve for the first-mentioned inlet-port, and combined manually-operative and automatically-operative mechanism for controlling the last-mentioned valve.

3. In an explosive-engine, the combination with the cylinder having closed ends and a passage connecting said ends, two inlet-ports arranged at different points and connecting said passage with the bore of the cylinder, a working piston in the cylinder, a spring-controlled valve for one of said ports, and a valve for the other port, of a hand-lever operatively connected with the last-mentioned valve, and a governor operatively connected with said hand-lever.

4. An explosive-engine comprising a cylinder having closed ends and a passage connecting said ends, an inlet-port connecting the passage with the bore of the cylinder between its ends, a valve for said port, and a valve normally closing the passage at the upper end of the cylinder, a working piston in the cylinder, and a hand-lever connected to the first-mentioned valve to open or close the same.

5. An explosive-engine comprising a cylinder having closed ends and a passage connecting said ends, an inlet-port connecting the passage with the bore of the cylinder between its ends, a valve for said port, and a valve normally closing the passage at the upper end of the cylinder, a working piston in the cylinder, a hand-lever connected to the first-mentioned valve to open or close the same, and a notched lock-piece secured to the cylinder to be engaged by said lever to hold the same in any desired position.

6. An explosive-engine comprising a cylinder having closed ends and a passage connecting said ends, an inlet-port connecting the passage with the bore of the cylinder between its ends, a valve for said port, and a valve normally closing the passage at the upper end of the cylinder, a working piston in the cylinder, a hand-lever connected to the first-mentioned valve to open or close the same, a governor having detachable connec-

tion with said lever, and means for holding the hand-lever in any desired position when disconnected from the governor.

7. An explosive-engine comprising a cylinder having closed ends and a passage connecting said ends, an inlet-port connecting the passage with the bore of the cylinder between its ends, a valve for said port, and a valve normally closing the passage at the upper end of the cylinder, a working piston in the cylinder, and a hand-lever connected to the first-mentioned valve to open and close the same and adapted when moved to a certain position to open the last-mentioned valve.

8. An explosive-engine comprising a cylinder having closed ends and a passage connecting said ends, an inlet-port connecting the passage with the bore of the cylinder between its ends, a valve for said port, and a valve normally closing the passage at the upper end of the cylinder, a working piston in the cylinder, a hand-lever connected to the first-mentioned valve to open or close the same, a governor having detachable connection with said lever, a notched lock-piece for coaction with said lever, and means for disengaging said lever from the notches of said lock-piece when connected with the governor.

9. An explosive-engine comprising a cylinder having closed ends and a passage connecting said ends, an inlet-port connecting the passage with the bore of the cylinder between its ends, a valve for said port, and a valve normally closing the passage at the upper end of the cylinder, a working piston in the cylinder, a hand-lever connected to the first-mentioned valve to open and close the same, a governor detachably connected with said lever, a slotted lock-piece on the cylinder having one wall of its slot provided with a series of notches, a spring serving to force the said lever in engagement with said notches, and a lever pivoted on the lock-piece and adapted to be swung over the notches thereof to cause the hand-lever to engage the edge of said pivoted lever.

10. In an explosive-engine, the combination with two cylinders having their ends closed and a passage connecting the closed ends of each cylinder, a spring-controlled valve at the upper end of each of said passages, a spring-pressed valve between each passage and the bore of the corresponding cylinder between its ends, a suitable igniter in each cylinder, and working pistons for the cylinders, of a cross-bar connecting said spring-pressed valves, a lever adapted to actuate said valves during a portion of its movement, circuit-wires for the igniters, and switches in the circuits, one part of each switch being carried on said cross-bar and the other part on said lever, said switches being arranged that in a certain position of said lever one switch only is closed, while in a second position of said lever both switches are closed, and in a third position of said lever both switches are open.

11. In an explosive-engine, the combination of two cylinders having their ends closed and a passage connecting the closed ends of each cylinder, a spring-controlled valve at the upper end of each of said passages, a spring-pressed valve between each passage and the bore of the corresponding cylinder between its ends, a suitable igniter in each cylinder, and working pistons for the cylinders, of a cross-bar connecting said spring-pressed valves, a lever adapted to actuate said valves during a portion of its movement, circuit-wires for the igniters, and switches in the circuits controlled by the movement of said lever.

In testimony whereof I have affixed my signature in the presence of two subscribing witnesses.

JOHN ECKHARD.

Witnesses:
EMIL NEUHART,
MAY F. SEWERT.