O. E. FREAR.

INTERNAL COMBUSTION ENGINE.

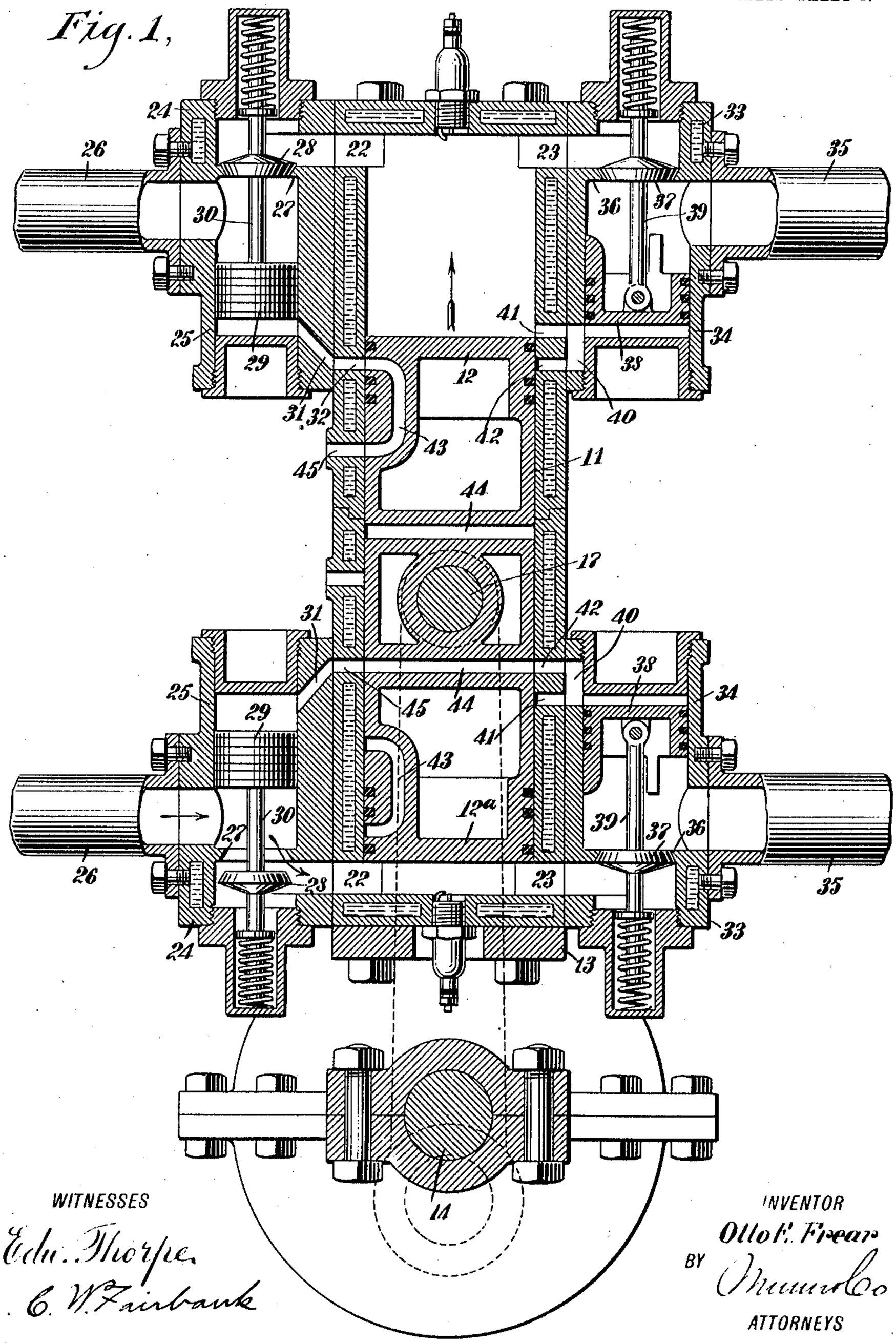
APPLICATION FILED JUNE 30, 1909.

955,786.

Patented Apr. 19, 1910.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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3 SHEETS—SHEET 2.

Fig. 2,

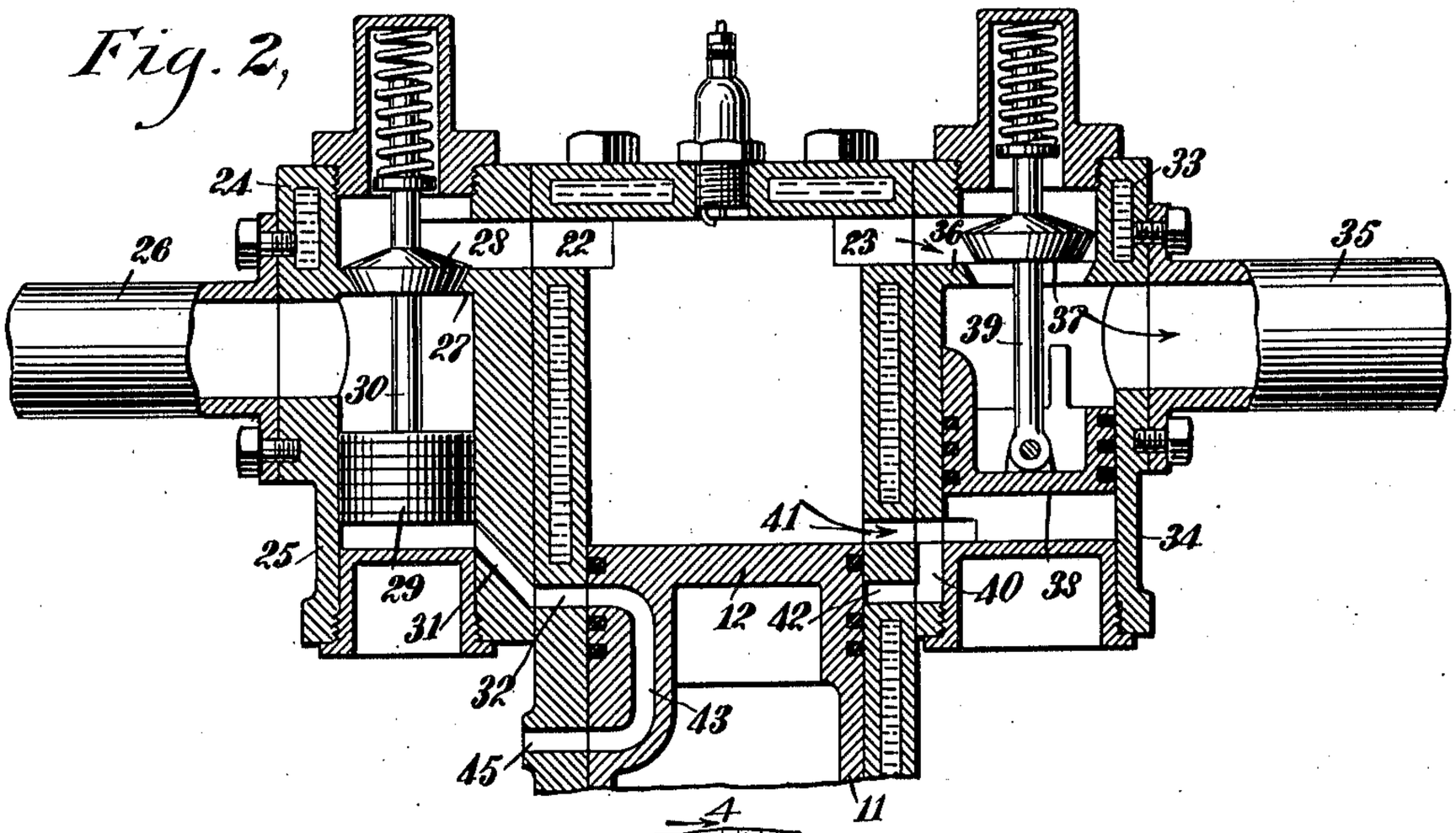
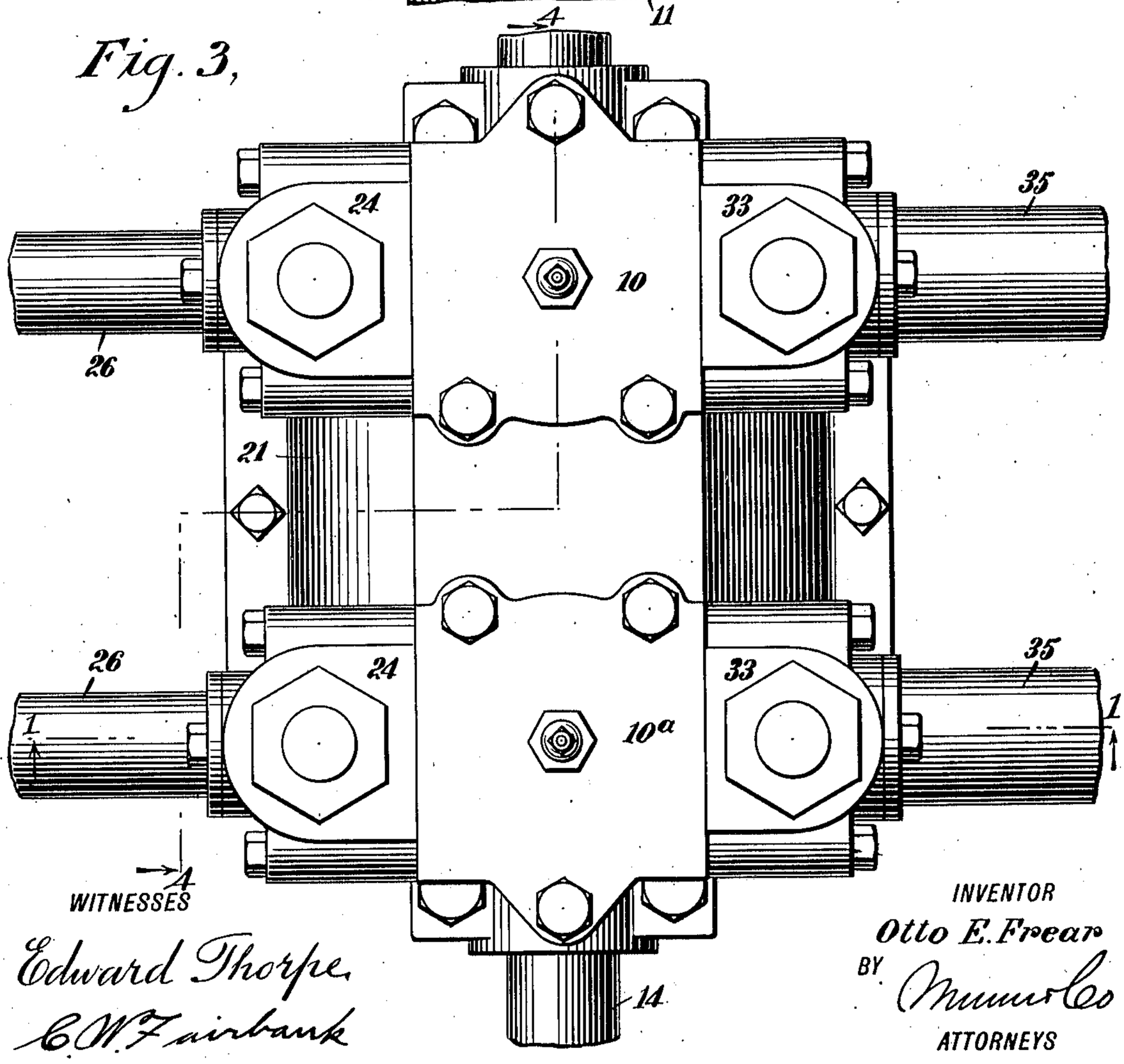


Fig. 3,



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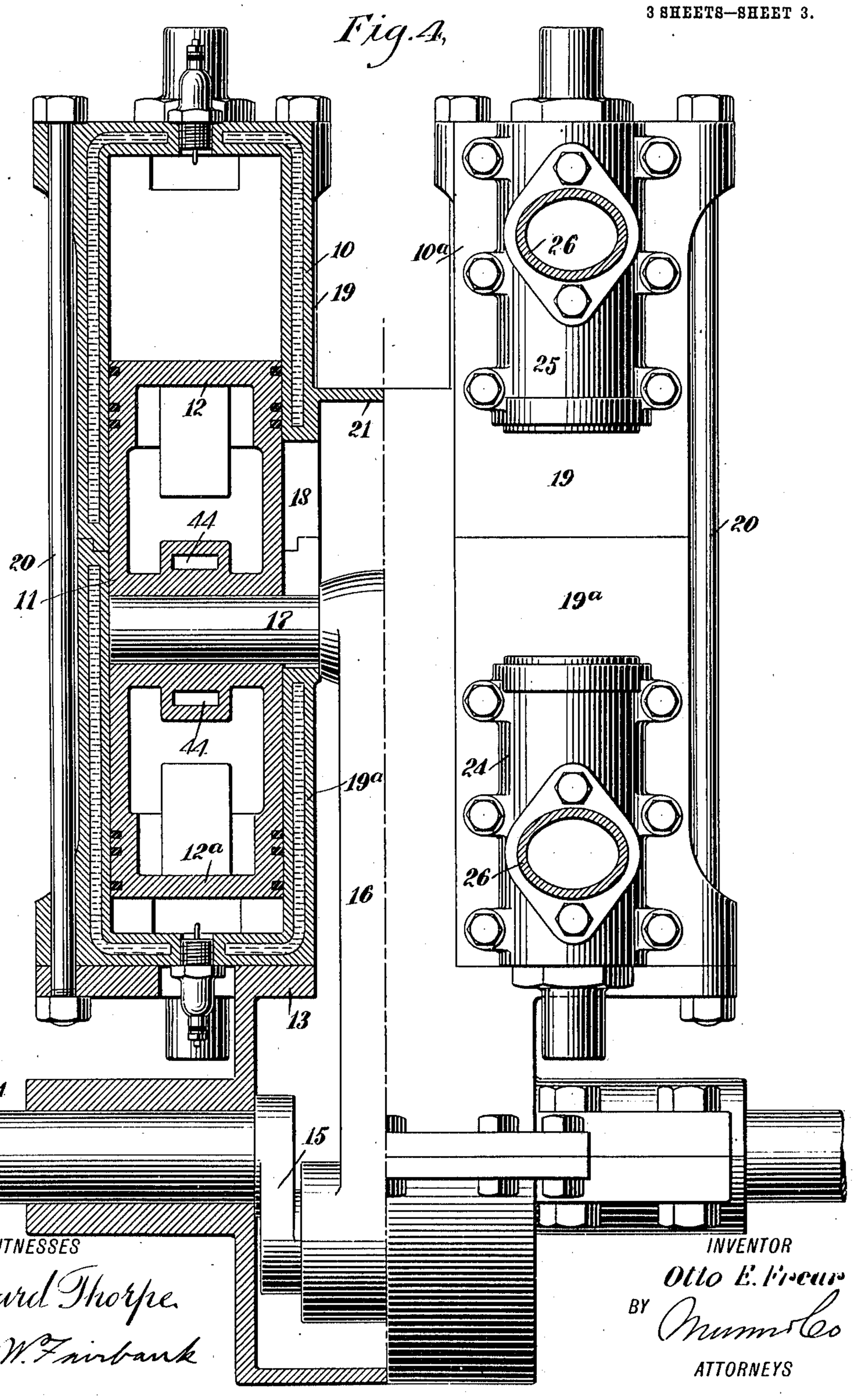
3 SHEETS—SHEET 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

OTTO E. FREAR, OF ALBANY, NEW YORK, ASSIGNOR OF ONE-THIRD TO PELATIAH J. MARSH, OF TROY, NEW YORK, AND ONE-THIRD TO FREDERICK C. FEW, OF ALBANY, NEW YORK.

INTERNAL-COMBUSTION ENGINE.

955,786. Specification of Letters Patent. Patented Apr. 19, 1910.

Application filed June 30, 1909. Serial No. 505,199.

To all whom it may concern:

Be it known that I, OTTO E. FREAR, a citizen of the United States, and a resident of Albany, in the county of Albany and State of New York, have invented a new and Improved Internal-Combustion Engine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in internal combustion engines, and more particularly to automatic means for controlling the inlet and exhaust ports of four-cycle engines by fluid pressure. In my improved engine, I connect both the inlet and the exhaust valves with auxiliary pistons mounted in auxiliary cylinders. These cylinders are connected together and to the engine cylinder by passages and ports, so arranged that as the piston reaches approximately the end of its explosion stroke, gas is admitted to one auxiliary cylinder to act on the piston therein and open the exhaust port, which port remains open until the piston reaches approximately the end of its exhaust stroke. The gas is now admitted to the other auxiliary cylinder to act on the piston therein and open the inlet valve, which valve remains open during the suction stroke. No cams, rock shafts, levers, or mechanism of any kind whatsoever need be employed for operating the valves from the crank shaft, or from any other moving part of the engine. In my improved engine, I utilize gas pressure as the sole means for operating all the valves.

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 all the figures, and in which—

Figure 1 is a longitudinal section through an engine constructed in accordance with my invention, said section being taken approximately on the line 1—1 of Fig. 3, the upper piston being at the beginning of the compression stroke; Fig. 2 is a view similar to the upper portion of Fig. 1, the piston being shown at the end of the explosion stroke; Fig. 3 is a top plan view of the engine; and Fig. 4 is a vertical section on the line 4—4 of Fig. 3.

In the specific form of engine illustrated in the accompanying drawings, I employ two cylinders 10, 10ª, arranged substantially parallel and each double acting. Within each cylinder is a piston 11 having opposite working faces 12 and 12ª movable toward and from the opposite ends of the corresponding cylinder. The two cylinders are mounted upon a base 13, which latter has journaled therein a crank shaft 14. The crank shaft has a single crank 15 intermediate the two cylinders, and a connecting rod 16 connects this crank with a piston pin 17 common to the two pistons. The connecting rod 16 is disposed between the two cylinders and the piston pin 17 extends through slots 18 in the sides of both cylinders and is connected to both pistons. The cylinders are both rigidly connected to the base 13, and preferably, each cylinder is formed of two piston sections 19 and 19ª connected together and connected to the base by tie-rods 20. A suitable casing 21 is disposed between the two cylinders and connected to the base or crank case, so as to inclose the connecting rod, crank and piston pin, and prevent the access of dust or dirt thereto, and to reduce the liability of gas escaping past the piston and through the slot 18. Each cylinder, at each end thereof, has an inlet port 22 and an exhaust port 23, both of which are preferably adjacent the piston head. A valve casing 24 is connected to the cylinder to cover the inlet port, and this valve casing includes an auxiliary cylinder 25. The casing is connected to a supply pipe 26 and has a valve seat 27 controlled by a spring-pressed valve 28. Within the auxiliary cylinder 25 is a piston 29 connected by a rod 30 to the valve 28. A passage 31 leads from the auxiliary cylinder 25 to a port 32 in the wall of the engine cylinder, which port is so positioned that it is near the face of the piston when the piston is at the end of its stroke, but said port is never uncovered to communicate with the working chamber of the engine cylinder. Connected to the opposite side of the cylinder and communicating with the exhaust port 23, is a valve casing 33, including an auxiliary cylinder 34. The casing connects to an exhaust conduit 35, and a valve seat 36 controlled by a spring-pressed valve 37. Within the auxiliary cylinder is a piston 38 of larger size than the valve 37 and connected to the latter by a rod 39. A passage 40 leads from the auxiliary cylinder to two ports 41 and 42 in the engine cylinder, the port 41 being uncovered by the engine piston at the end of the explosion stroke and the

port 42 being never in direct communication with the engine cylinder. The piston at each side of the piston pin, is provided with two passages 43 and 44, one of which is adapted to connect the port 32 with a port 45 in the side of the cylinder when the engine is at the end of its explosion stroke or intake stroke. The port 45 communicates with the outside atmosphere, so that at the end of the explosion stroke, the auxiliary cylinder 45 may communicate with the outside atmosphere through the passages 31 and 43 and the ports 32 and 45. The passage 44 extends transversely of the piston and is adapted to connect the port 32 with the port 42 when the piston is at the end of its compression stroke or its exhaust stroke. When this piston is in operation, the auxiliary cylinder 34 may communicate with the auxiliary cylinder 25 through the passages 40, 44 and 31 and the ports 42 and 32.

In the operation of my improved engine, the parts will be in the position indicated in Fig. 1 when the upper end of the piston is at the beginning of the compression stroke, and the lower end of the piston is at the beginning of the suction stroke. The auxiliary cylinder 25 of the upper end of the working cylinder is in communication with the outside atmosphere, so that the upper valve 28 will remain closed under the action of the weight of the piston 29 and the spring. As there is no pressure in the engine cylinder, there will be no pressure beneath the auxiliary piston 38 and the exhaust valve 37 will remain closed. The two valves remain closed during the compression stroke and during the explosion or working stroke. As soon as the piston uncovers the port 41, as indicated in Fig. 2, the pressure of the exhaust gas in the engine cylinder will raise the piston 38, as indicated, and this will open the exhaust valve. The piston almost immediately closes the port 41 as it travels upwardly from the exhaust stroke, and a quantity of gas is confined in the auxiliary cylinder 34 to hold the exhaust valve open during the exhaust stroke. When the piston reaches the end of the exhaust stroke, the parts will come to the position indicated in the lower portion of Fig. 1. The passage 44 will establish communication between the two auxiliary cylinders and the exhaust gas will flow from the auxiliary cylinder 34 to the auxiliary cylinder 25, to open the inlet valve 28. The auxiliary piston 38 is larger than the piston 29, and the springs and weights are so proportioned that the escape of gas through the passage 34 from one auxiliary cylinder to the other, will permit the exhaust valve to close and the inlet valve to open. The ports 32 and 42 are almost immediately closed and a quantity of gas is confined in the auxiliary cylinder 25 to hold the inlet valve open during the suction stroke. At the end of the suction stroke, the passage 43 comes into operation, as indicated in the upper portion of Fig. 1, and the gas in the auxiliary cylinder 25 is permitted to escape and the inlet port to close. This completes the cycle of operations. Both valves are operated entirely by gas pressure and the ports through which the gas passes to the auxiliary cylinders are controlled solely by the working piston, so that no mechanical connections need be employed. It is, of course, evident that the gas delivered to the auxiliary cylinders might come from a storage chamber instead of being the exhaust gas of the working cylinder. The air or gas might be compressed by any suitable means and its delivery to and escape from the auxiliary cylinders be controlled by the ports and passages in the piston.

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

1. An internal combustion engine, including a cylinder, a piston within said cylinder, an inlet valve for controlling the admission of gas to said cylinder, a chamber adapted to receive exhaust gas from said cylinder at the end of the working stroke, and means operated by said exhaust gas when the piston is at the end of the exhaust stroke for opening said inlet valve.

2. An internal combustion engine, including a cylinder, a piston therein, an inlet for controlling the admission of gas to said cylinder, an auxiliary piston therein and operatively connected to said inlet valve, means for receiving exhaust gas when said first-mentioned piston is at the end of its power stroke, and means for transferring said gas to said auxiliary cylinder to open the inlet valve when said first-mentioned piston is at the end of its exhaust stroke.

3. An internal combustion engine having a working cylinder, a working piston, an inlet valve, means for storing a portion of the gas escaping from the cylinder when the piston is at the end of its power stroke, and means for opening said inlet valve by the pressure of said stored gas when the piston is adjacent the end of its exhaust stroke.

4. An internal combustion engine, comprising a working cylinder, a working piston, an inlet valve, a movable member operatively connected to said inlet valve, means for storing a portion of the gas escaping from the working cylinder when the piston is at the end of its working or power stroke, and a passage through the piston for transferring a portion of said stored gas to said movable member to operate the latter and the inlet valve when the piston is adjacent the end of its exhaust stroke.

5. An internal combustion engine, including a cylinder having inlet and exhaust

valves, a working piston within said cylinder, auxiliary cylinders, auxiliary pistons within said cylinders and operating said valves, means for delivering fluid under pressure to one of said auxiliary cylinders to open the exhaust valve, and means for transferring said fluid from said auxiliary cylinder to the other auxiliary cylinder to open the inlet valve.

6. An internal combustion engine, including a cylinder having inlet and exhaust valves, a working piston within said cylinder, auxiliary cylinders, auxiliary pistons within said cylinders and operating said valves, means for delivering fluid under pressure to one of said auxiliary cylinders to open the exhaust valve, and means for transferring said fluid from said auxiliary cylinder to the other auxiliary cylinder to open the inlet valve, both of said means being controlled by the working piston.

7. An internal combustion engine, comprising a working cylinder having an inlet valve and an exhaust valve, a working piston, an auxiliary cylinder, an auxiliary piston within said auxiliary cylinder and operatively connected to said exhaust valve, a passage connecting said working cylinder and said auxiliary cylinder when said working piston is at the end of its explosion stroke, a second auxiliary cylinder, an auxiliary piston disposed therein and operatively connected to the inlet port, a passage through said working piston connecting said first-mentioned auxiliary cylinder with said second-mentioned auxiliary cylinder when said working piston is at the end of its exhaust stroke, and a passage through said piston and connecting said second-mentioned auxiliary cylinder with the outside atmosphere when said working piston is at the end of its suction stroke.

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

OTTO E. FREAR.

Witnesses:
E. A. PACKER,
FREDERICK C. FEW.