No. 696,856. Patented Apr. 1, 1902.

F. D. CLARK.

COMBINED STEAM AND INTERNAL COMBUSTION MOTOR.

(Application filed May 20, 1901.)

(No Model.) 4 Sheets—Sheet 1.

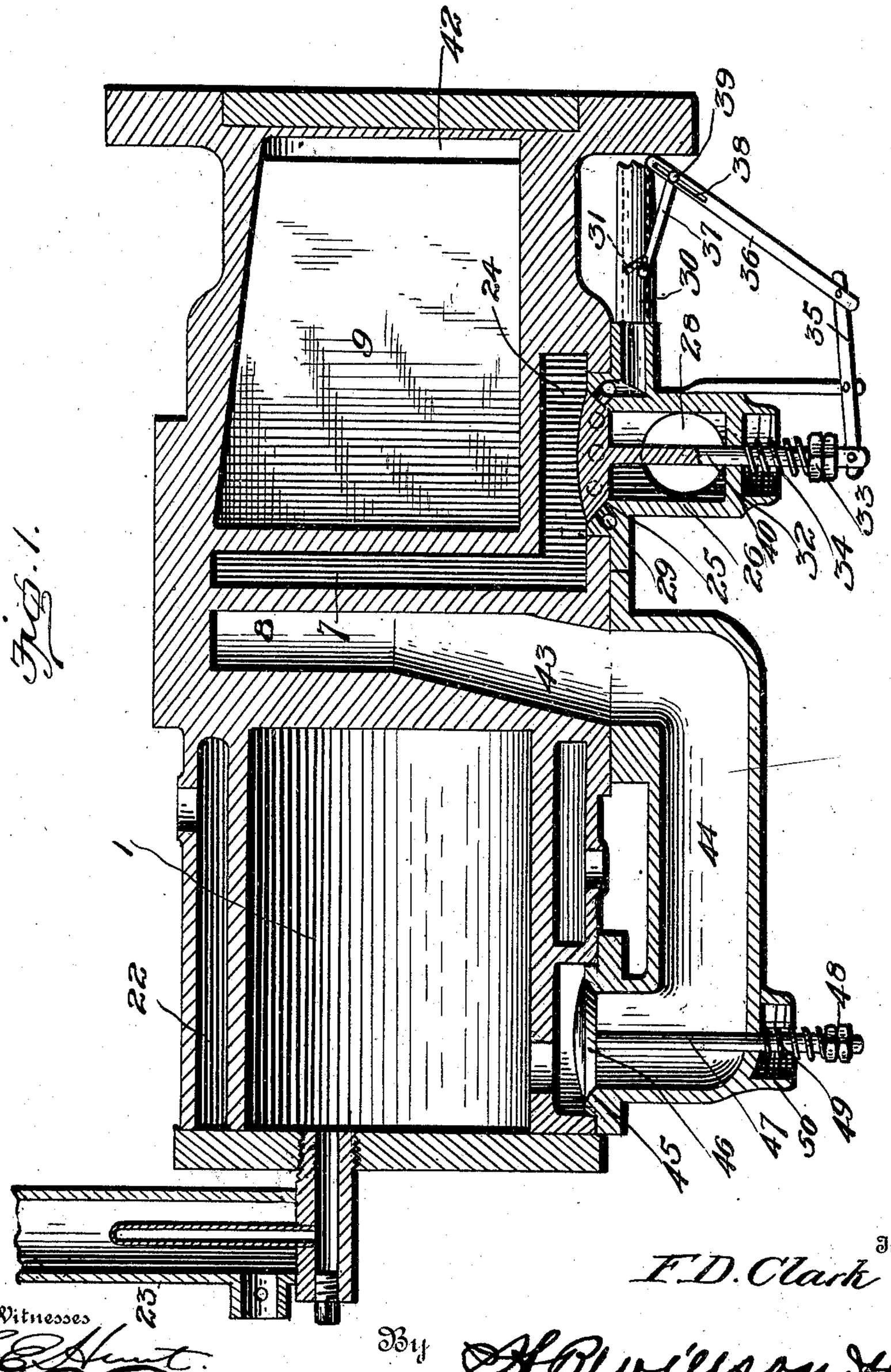

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

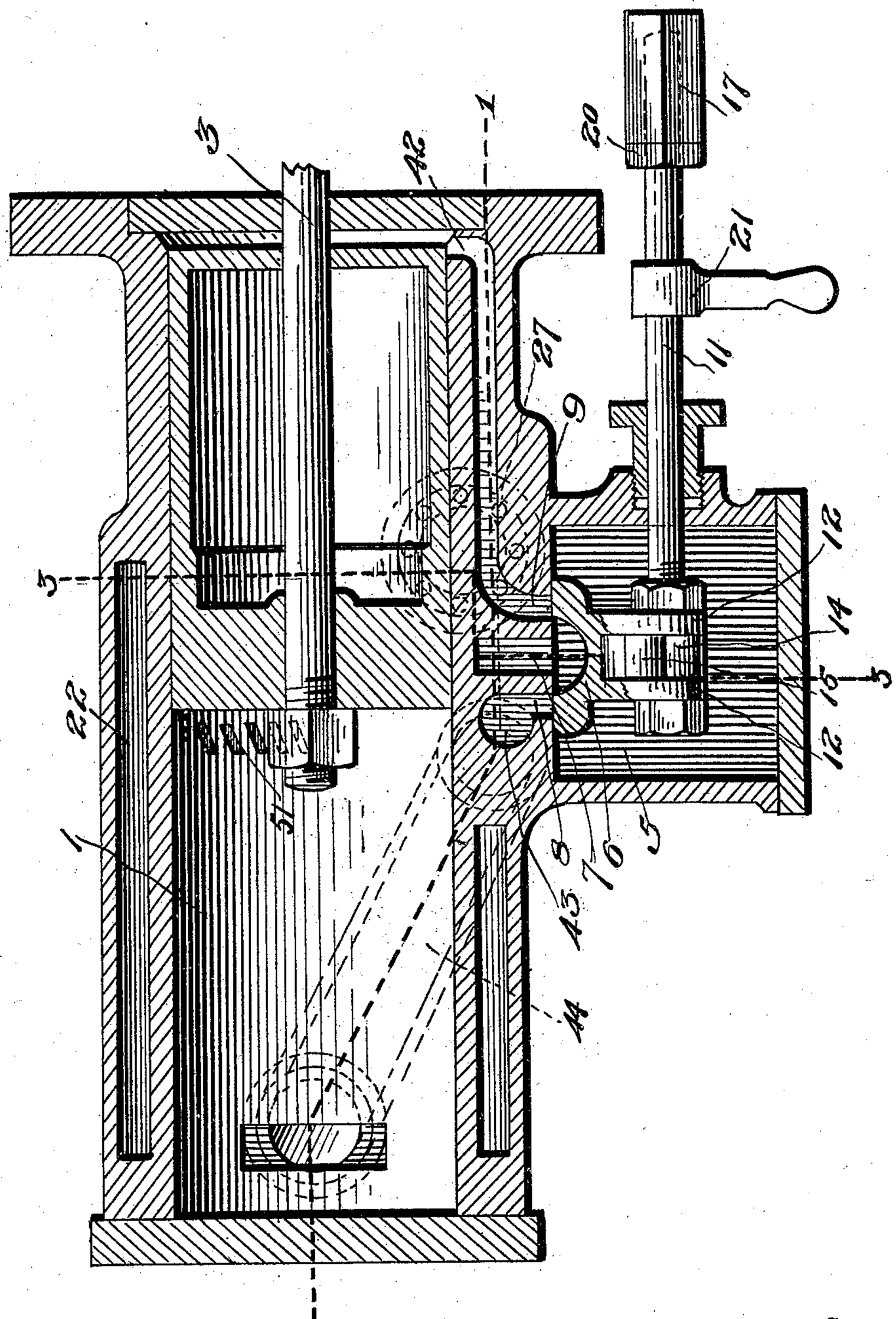

Fig. 2.

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(Application filed May 20, 1901.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 3.

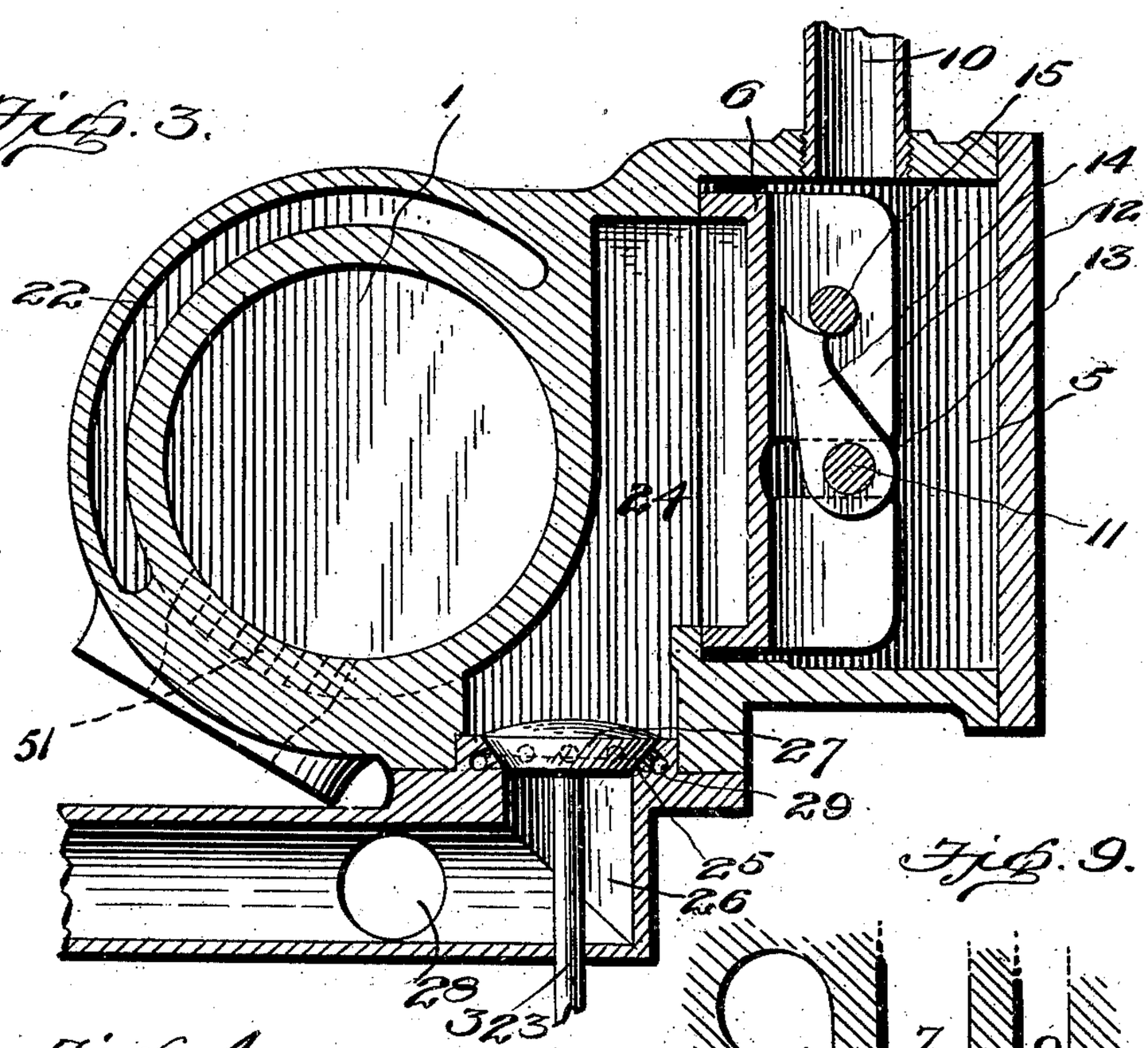

Fig. 4.

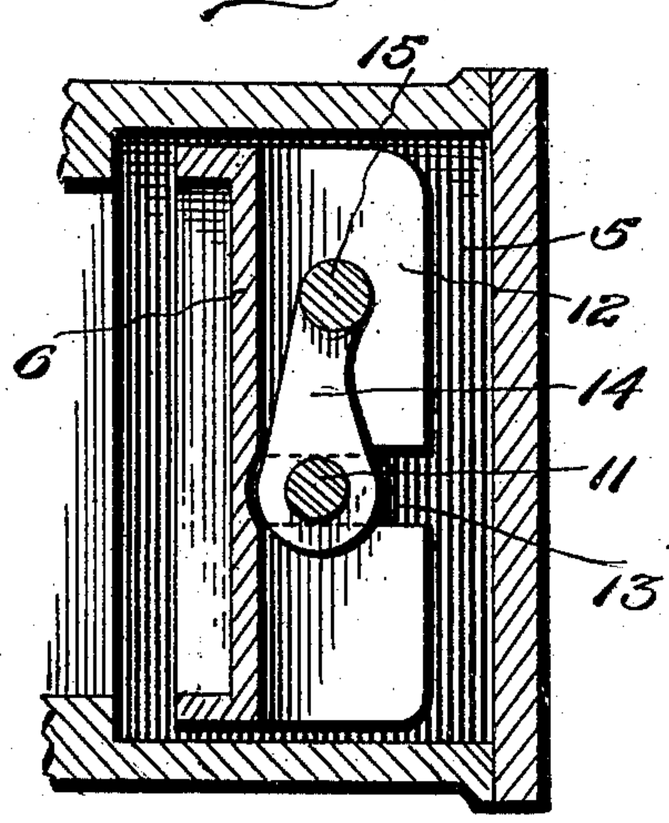

Fig. 9.

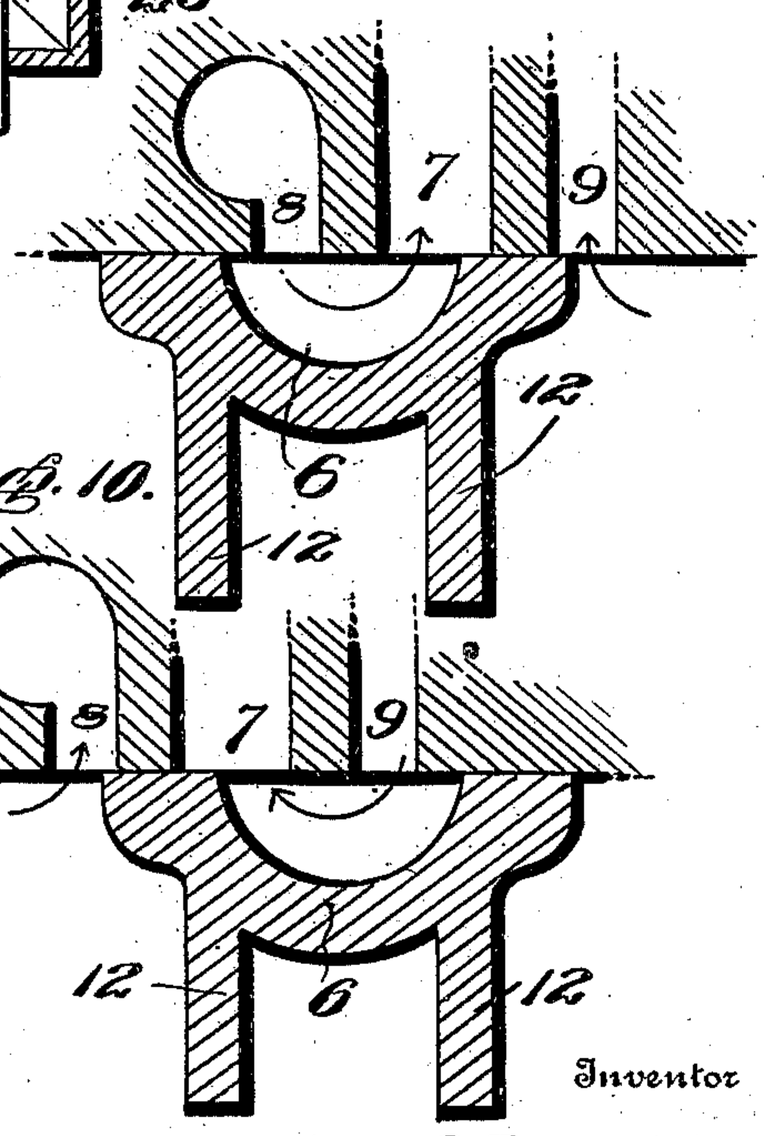

Fig. 10.

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(Application filed May 20, 1901.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 5.

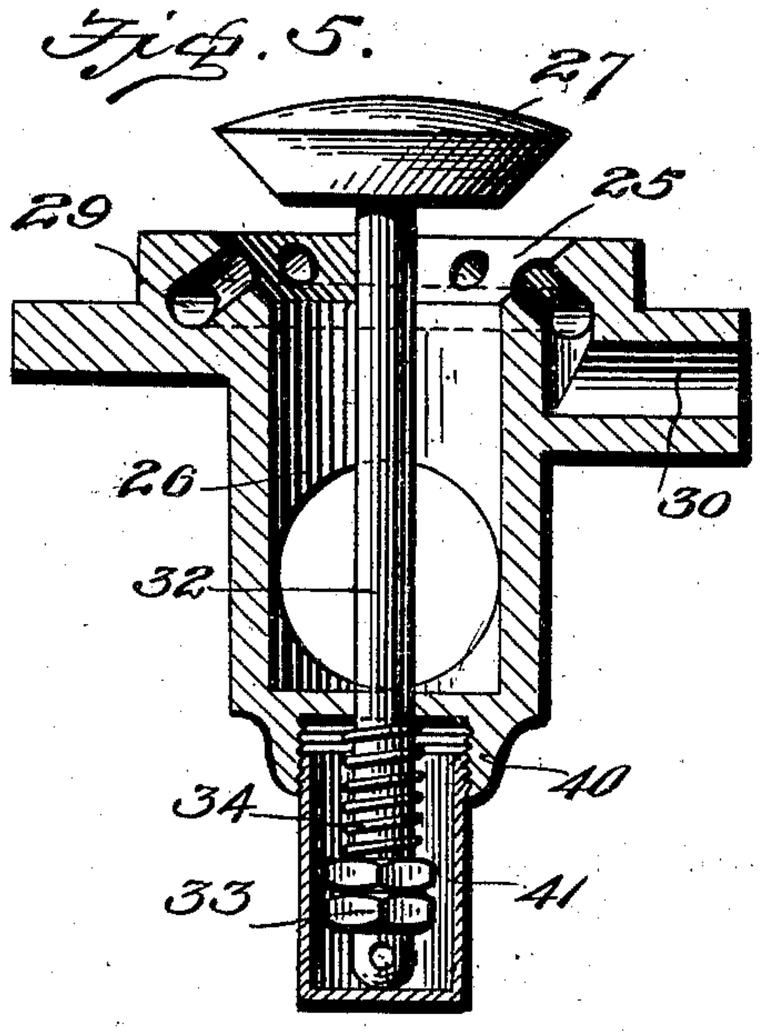


Fig. 6

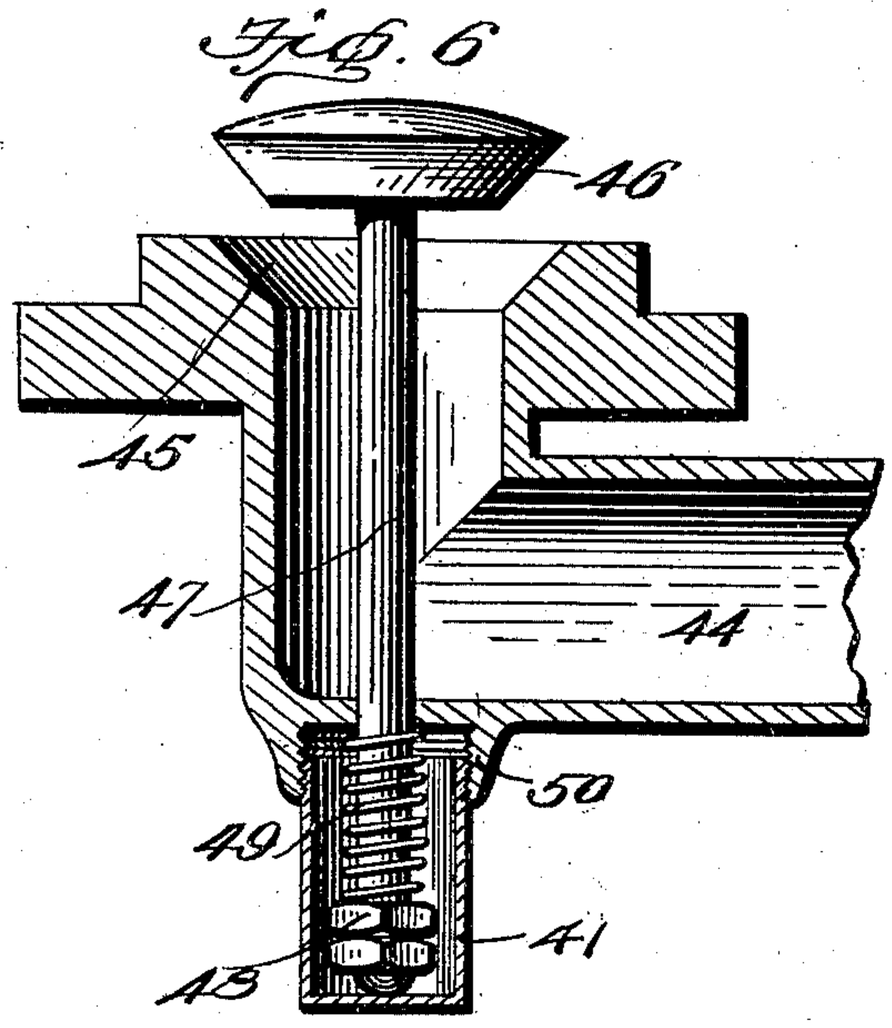


Fig. 7.

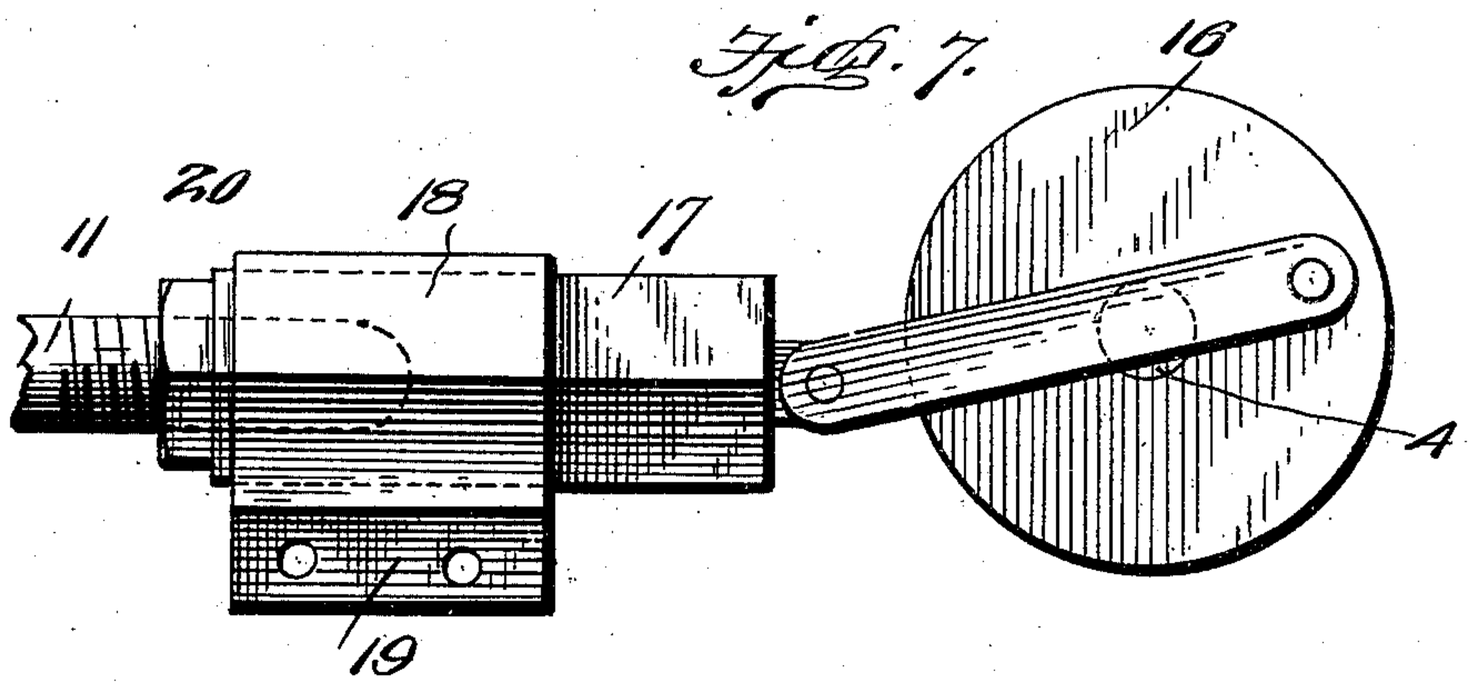
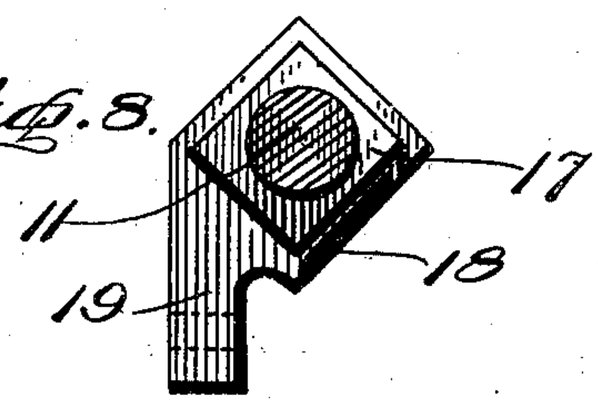


Fig. 8.



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UNITED STATES PATENT OFFICE.

FRED D. CLARK, OF McDONALD, PENNSYLVANIA.

COMBINED STEAM AND INTERNAL-COMBUSTION MOTOR.

SPECIFICATION forming part of Letters Patent No. 696,856, dated April 1, 1902.

Application filed May 20, 1901. Serial No. 61,090. (No model.)

To all whom it may concern:

Be it known that I, FRED D. CLARK, a citizen of the United States, residing at McDonald, in the county of Washington and State of Pennsylvania, have invented certain new and useful Improvements in a Combined Steam and Internal-Combustion Motor; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of this invention is provide an engine or motor which may be driven either by steam or an explosive mixture and may be with very little trouble converted to act as a steam-motor or internal-combustion motor at will.

The invention consists in an engine or motor embodying certain novel features of construction, combination, and arrangement of parts, as will be hereinafter more fully described, and particularly set forth in the appended claims.

In the accompanying drawings, Figure 1 is an irregular vertical longitudinal section of the motor on the line 1 1 of Fig. 2. Fig. 2 is a horizontal section of the same. Fig. 3 is a cross-section on line 3 of Fig. 2, omitting the piston. Fig. 4 is a cross-section through the steam-chest, showing the slide-valve thrown out of operative position. Figs. 5 and 6 are detail sectional views showing the manner in which the induction-valve and check-valve are held open when the device is used as a steam-motor, and Figs. 7 and 8 are detail views of the means for securing the slide-valve stem to its sliding block. Figs. 9 and 10 are detail sectional views showing the two operative positions of the slide-valve for controlling the admission and exhaust of steam.

The numeral 1 in the drawings represents the engine-cylinder, which may be mounted in any preferred manner. 2 is the piston which operates therein. 3 is the piston-rod which communicates motion to the crank-shaft 4. 5 is the steam-chest; 6, the U-shaped slide-valve therein governing the three ports 7, 8, and 9, and 10 is the steam-supply pipe opening into the steam-chest.

The slide-valve stem 11 is so connected to the valve 6 as to be operated to throw said valve into and out of operative position at will. To this end the valve is formed with parallel flanges 12, having slots 13 to loosely receive the stem 11, which latter carries a dog or lever 14, adapted to abut against the body of the valve and against a pin or contact-piece 15, fitted in said flanges, to slide the valve toward or from its seat at will, so that the valve may be moved into position to cooperate with the ports 7, 8, and 9, or away from its seat to expose or leave all of said ports open, as desired. The valve-stem 11 is operated by the crank-disk 16 or an eccentric on the shaft 4 and is screwed at its outer end into a block or box 17, slidably mounted in a bearing 18, having a flange 19 for attachment in any suitable manner to one part of the engine-frame. A nut 20 screws onto the threaded end of the stem and binds against the block 17 to hold the stem secured thereto against axial movement. When it is desired to throw the slide-valve into or out of operative position, the nut 20 is loosened up and the stem turned or oscillated in one direction or the other to force the dog against the body of the valve 6 or the pin 15 to force the valve toward or from its seat, as will be readily understood. A lever 21 may be connected to the valve-stem to enable it to be easily turned.

A water-jacket 22 may surround the cylinder, through which water may be circulated to cool the cylinder when the device is used as an explosive-motor. A hot exploding-tube 23 or its equivalent—a sparking device of any preferred kind—is also provided for use when the device is used as an explosive-motor.

The port 7 communicates with a chamber or passage 24 on one side of the cylinder 1, and this chamber or passage 24 is in communication through a port 25 with a valve-box 26, controlled by a gas-induction puppet-valve 27, and opening into the box 26 is an air-inlet pipe 28.

In the valve-seat of the port 25 is a series of gas-induction ports 29, which communicate with a gas-supply pipe 30, having a controlling-valve 31, governing the passage of the gas therethrough and to the said ports 29. The valve 27 has a stem 32, which projects downward through the bottom of the box 26 and has connected thereto a nut or head 33, between which and the said bottom of the box

is a coiled spring 34, encircling said stem and adapted to hold the valve 27 normally seated. To the lower end of the stem 32 is connected one of a series of jointed levers 35, 36, and 37, which are also connected to the valve 31 to operate the same to open and close said valve synchronously with the opening and closing of the valve 27.

The intermediate lever 36 is formed with a slot 38 to receive an adjusting bolt and nut 39 on the lever 37, whereby the stroke of said system of levers may be lengthened or shortened to regulate the operation of the valve 31 to admit more or less gas, as desired, and to properly time the inlet of the same from the pipe 30 to the ports 29. Upon the lower end of the valve-box 26 is mounted an internally-threaded annular boss or socket 40, which is adapted to receive the open threaded end of a cap or retracting-tube 41 for holding the valve 27 off its seat in the manner shown in Fig. 5 and as hereinafter more fully described.

The passage 9 is in communication with a passage 42, leading through the wall of the cylinder, to the right-hand end of said cylinder, for the admission and exhaust of steam and gas, as hereinafter described.

The passage 8 communicates with an inclined passage 43, extending downward and rearwardly therefrom, and communicating at its opposite end with one end of the valve-box or passage 44 on the bottom of the cylinder and extending toward the left-hand end thereof. The outer end of the said box or passage 44 forms a port in communication with the left-hand end of the cylinder, which port is provided with a valve-seat 45 for the reception of a check-valve 46. This valve has a downwardly-projecting stem 47, extending to the exterior through the bottom of the box or passage 44 and carrying one or more heads or nuts 48, between which and the box 44 is a spiral spring 49, encircling said stem and acting on the head 48 to draw the stem 47 downward, and thereby to normally hold the valve 46 seated. An annular internally-threaded boss or socket 50, similar to the boss or socket 40, is formed on the box 44 and is adapted to receive a retracting tube or cap 41, of the construction heretofore described, for holding the valve 46 off its seat when it is desired to employ the device as a steam-motor, as hereinafter more fully explained.

Exhaust-ports 51 are formed in the wall of the cylinder for the exhaust of the spent gases and products of combustion therefrom when the device is used as an explosive-motor or gas-engine.

The operation is as follows: When the device is used as a steam-engine, the lever 35 is disconnected from the stem 32 of the valve 27 and the retracting caps or tubes 41 applied to the sockets 40 and 51 to hold the valves 27 and 45 off their seats. The slide-valve 6 in the steam-chest 5 is arranged in its normal position, as shown in Fig. 2, and is operated as the piston communicates motion to the crank-shaft 4, through the instrumentality of the eccentric 16. Figs. 9 and 10 show the two positions of the slide-valve 6 for controlling the supply and exhaust of steam to the opposite ends of the cylinder. When the valve is in the position shown in Fig. 9 to admit steam to the right-hand end of the cylinder, the live steam passes through the ports 9 and 42 to the right-hand end of the cylinder and drives the piston to the left, the exhaust from the left-hand end of the cylinder passing through the port 45, passage 44, passage 43, ports 8 and 7, to chamber 24, through the open port or passage 25, and thence to the atmosphere through the air admission and escape pipe 28. Steam passes to the left-hand end of the cylinder, as shown in Fig. 10, through the port 8, passage 43, passage 44, and port 45 and exhausts from the right-hand end of the cylinder through the passage 42, port 9, through the recess in the slide-valve to the port 7, thence into chamber 24, through the port 25 in the valve-box 26, and to the atmosphere through the pipe 28. In this operation of the device as a steam-engine it will be seen that the valves 27 and 46 are not used, but are held open to form free passsges for the supply and exhaust of steam to both ends of the cylinder.

When the device is used as an explosive-motor, the retracting-caps 41 are detached from the bosses or sockets 40 and 50 and the lever 25 connected up with the valve-stem 32. Both valves 27 and 46 will then be held normally closed by their springs 34 and 49 in readiness for operation. The slide-valve 6 is then thrown out of operative position by loosening up the nut 20 and turning the stem 11, by means of the lever 21, to throw the crank arm or dog 14 to the right in Figs. 3 and 4 to contact with the pin 15, and thereby force the valve 6 away from its seat, so as to leave the ports 7, 8, and 9 normally open or exposed. The nut 20 is then tightened, and the valve 6 may then reciprocate with its stem, but at a point beyond or outwardly from said ports 7, 8, and 9, so as not to affect the same. As the piston 2 moves to the left in the cylinder gas is drawn in through pipe 30 and ports 29 simultaneously with air through the pipe 28, and the air and gas combine and pass into the chamber 24, and thence through the port 7 to the chest 5, and from there through the port 9 and passage 42 to the right-hand end of the cylinder. Then as the piston moves to the right the valve 27 closes, the mixture of gas and air is forced back through the passage 42, port 9, chest 5, port 8, passage 43, passage 44, and through the port 45 into the left-hand end of the cylinder. On the piston again being moved to the left the valve 46 closes and the mixture is compressed and exploded by means of the hot tube or sparking device 23, and at the same time a fresh charge of air and gas is drawn into the right-hand end of the cylinder. As the piston is

moved to the right by the force of the explosion it uncovers the ports 51, through which the spent air and gas escape. The admission of gas is governed by the valve 31 and the gas-supply pipe 30. As the piston moves to the left slowly the valve 27 is raised by suction a short distance from its seat, and as the motion increases said valve will be lifted further from its seat and will thereby operate, through the medium of levers 35, 36, and 37, the valve 31 to gradually cut off the inlet of gas. By means of slot 38 and adjustable connection 39 the lever 36 may be lengthened or shortened to adapt the valve 31 to be closed at a longer or shorter period, as desired, to admit more or less gas into chamber 24, as will be readily understood.

From the foregoing description, taken in connection with the accompanying drawings, the construction, mode of operation, and advantages of my invention will be apparent, and it will be seen that the invention provides a simple and convenient type of motor, which is reversible at will and with slight expenditure of time and labor to be operated through the medium of either an expansive fluid or explosive charges. The device will be found of great convenience for use in many kinds of establishments and for different purposes where a convertible engine of this type can be utilized and supplied with power through either or both of the aforesaid sources.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A combined steam and internal-combustion motor comprising a cylinder, a steam-chest, a spring-closed air and gas induction valve, a spring-closed check-valve for admitting the explosive mixture to one end of the cylinder and closing to prevent the escape of the same under compression, a valve in the steam-chest for controlling the supply of steam to the cylinder, steam, air and gas connections controlled by said valves, means for throwing the induction-valve and check-valve out of operation against the tension of their springs when the device is used as a steam-motor, means for throwing the valve in the steam-chest out of operation when the device is used as an explosive-motor, a gas-supply valve, and an adjustable system of levers connecting the said gas-supply valve with the air and gas induction valve, substantially as described.

2. In a combined steam and internal-combustion motor, the combination of a cylinder, a piston operating therein, a crank-shaft driven by the piston, a steam-chest, an air and gas supply pipes, ports and passages communicating between the steam-chest, air and gas supply pipes and the opposite ends of the cylinder, a slide-valve in the steam-chest, an air and gas induction valve controlling the passage of air and gas into the steam-chest for admittance to the cylinder, the check-valve for controlling the admission of explosive mixture to one end of the cylinder, means for holding the induction and check valves open for the free passage of the steam through the ports and passages controlled thereby, when the device is used as a steam-motor, means for throwing the slide-valve out of operation when the device is used as an internal-combustion motor, a valve in the gas-supply pipe, and variable connections between the air and gas induction valve and gas-supply valve for operating the latter, substantially as described.

3. In a combined steam and internal-combustion motor, the combination of a cylinder, a piston operating therein, a crank-shaft driven by the piston, a steam-chest, an air and gas supply pipes, ports and passages communicating between the steam-chest, air and gas supply pipes and the opposite ends of the cylinder, a slide-valve in the steam-chest, an air and gas induction valve controlling the passage of air and gas into the steam-chest for admittance to the cylinder, the check-valve for controlling the admission of explosive mixture to one end of the cylinder, means for holding the induction and check valves open for the free passage of the means through the ports and passages controlled thereby, when the device is used as a steam-motor, and means for oscillating the stem of the slide-valve for throwing said valve out of operation when the device is used as an internal-combustion motor, substantially as described.

4. In a combined steam and internal-combustion motor, and in combination with a cylinder, a steam-chest, air and gas supply pipes, and ports and passages communicating between the steam-chest, air and gas supply pipes and the opposite ends of the cylinder, an air and gas induction valve, a box or chamber therefor, having a threaded socket, a stem attached to the valve and sliding through said socket, a spring acting on the stem to hold the valve closed, and a threaded retracting-tube adapted to be inserted into said socket, to hold the valve open against the tension of said spring, substantially as described.

5. In a combined steam and internal-combustion motor, and in combination with a cylinder, a steam-chest, air and gas supply pipes, and ports and passages communicating between the steam-chest, air and gas supply pipes and the opposite ends of the cylinder, an air and gas induction valve, a gas-supply valve in the gas-supply pipe, a spring for closing the air and gas induction valve, means for holding said valve open against the tension of said spring, and a variable system of levers connecting the said induction-valve with the gas-supply valve, substantially as described.

6. In a combined steam and internal-combustion motor, and in combination with a cylinder, a steam-chest, air and gas supply pipes, and ports and passages communicating

between the steam-chest, air and gas supply pipes and the opposite ends of the cylinder, an air and gas induction valve, a box or chamber therefor, a stem attached to the valve and sliding in the box, a spring acting on the stem to close the valve, and means for holding the valve open against the tension of said spring, a gas-supply valve in the gas-supply pipe, and a system of pivoted operating-levers connecting the induction and gas supply valves, one of said levers being detachably connected with the stem of the induction-valve and another adjustably connected with the stem of the gas-supply valve, substantially as described.

7. In a combined expansion propelled and internal-combustion motor, a cylinder, a piston therein, a steam-chest, a slide-valve therein provided with slotted parallel flanges and a contact-piece, a valve-stem loosely mounted in the slots of the flanges and carrying a dog adapted to abut against the body of the valve and the contact-piece to move the valve toward and from its seat, and means for oscillating said stem, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FRED D. CLARK.

Witnesses:
WM. MADGWICK,
S. C. PETERSON.