No. 652,724. Patented June 26, 1900.

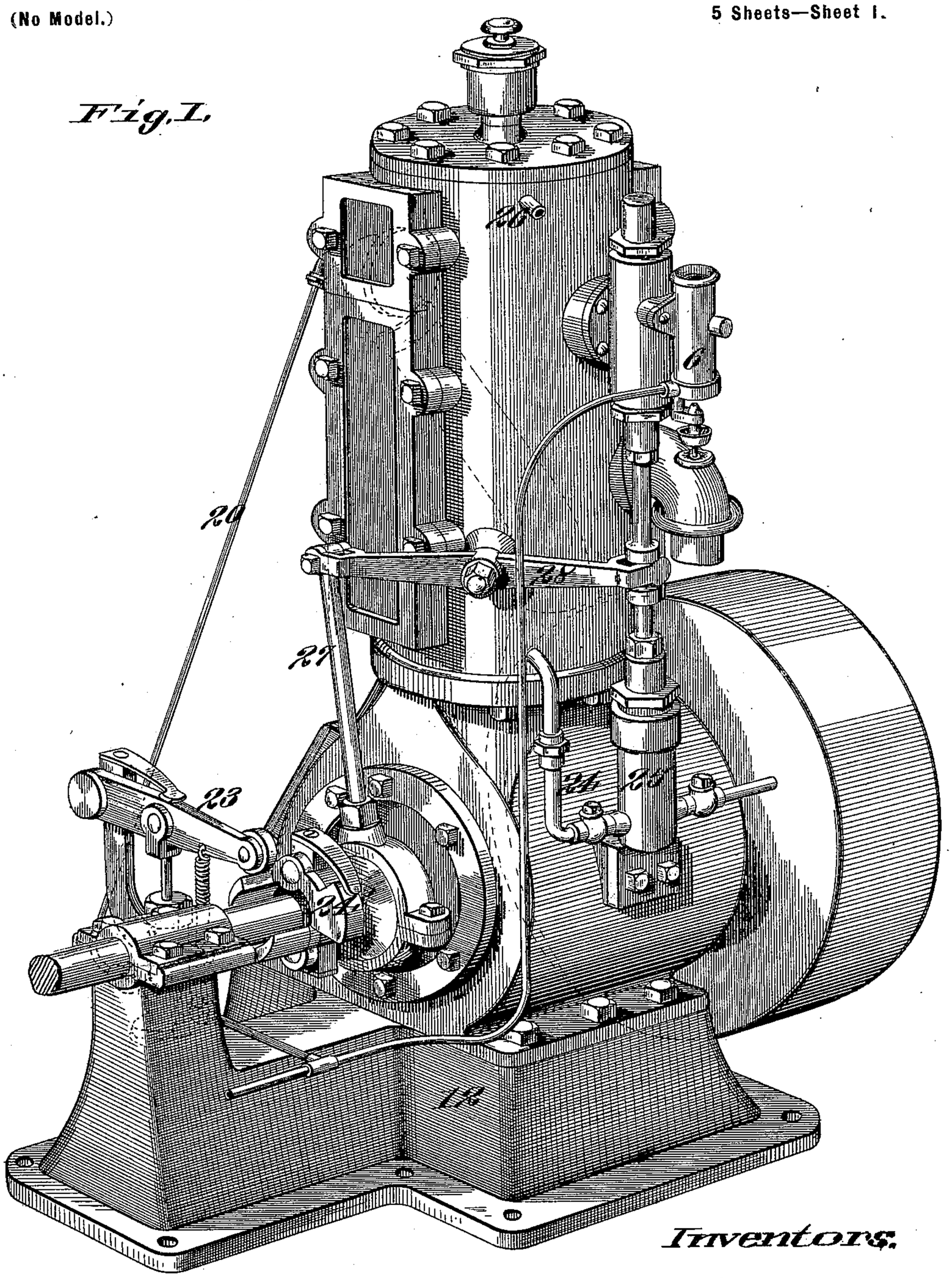
C. K. PICKLES & N. W. PERKINS, Jr.

GAS ENGINE.

(Application filed May 3, 1897. Renewed Nov. 20, 1899.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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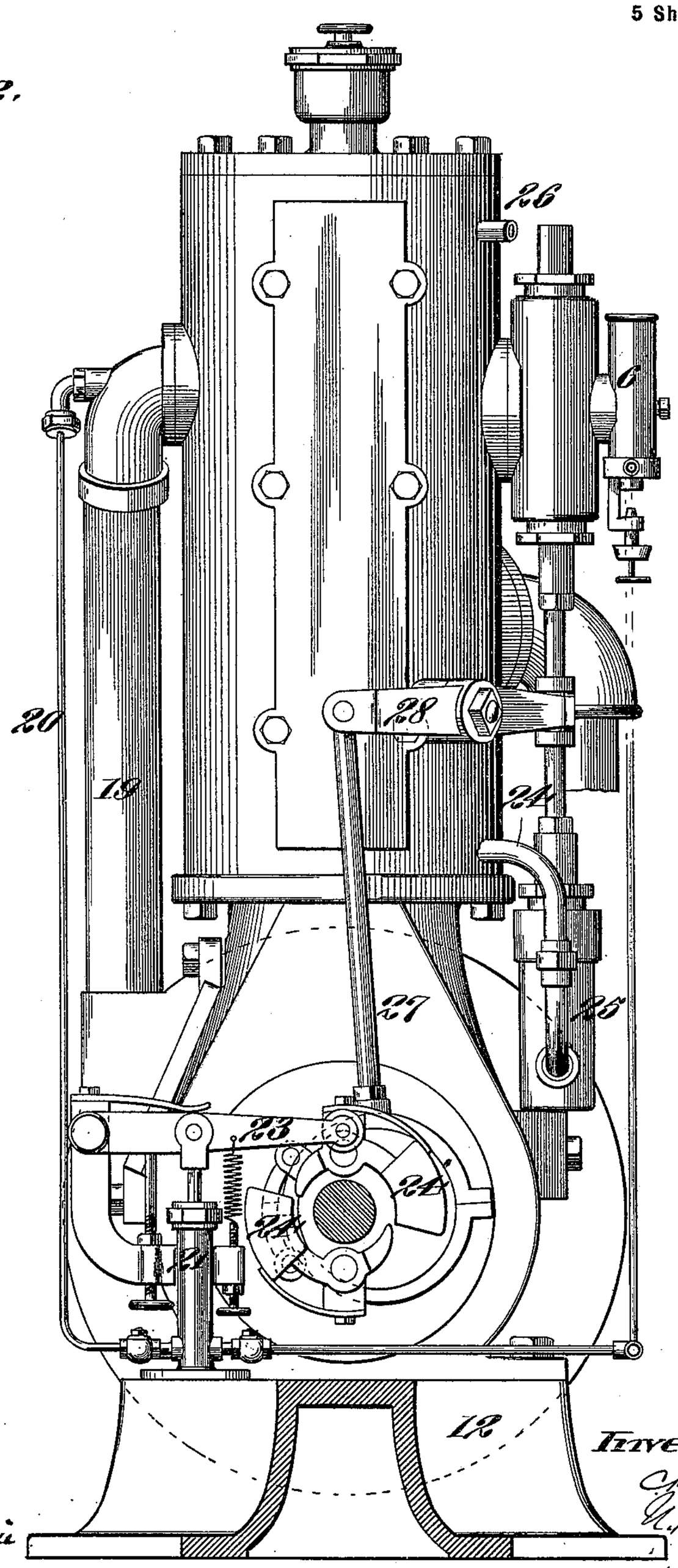
(No Model.) 5 Sheets—Sheet 2.

Fig. 2.



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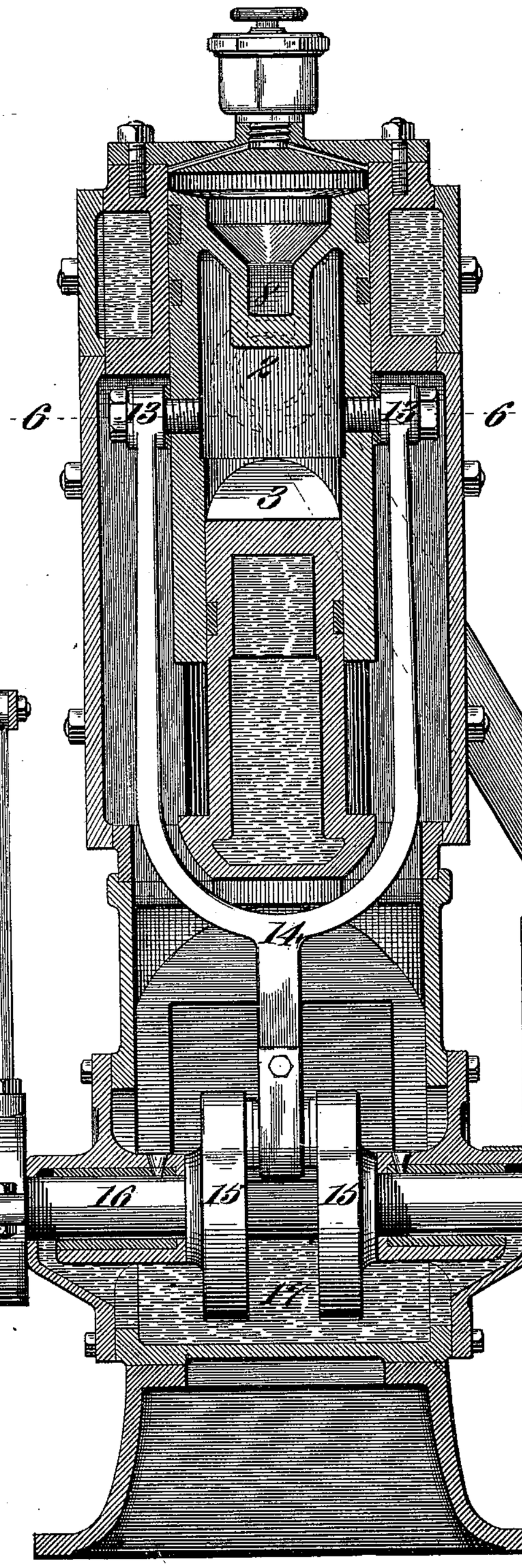
(No Model.) 5 Sheets—Sheet 3.

Fig. 3.



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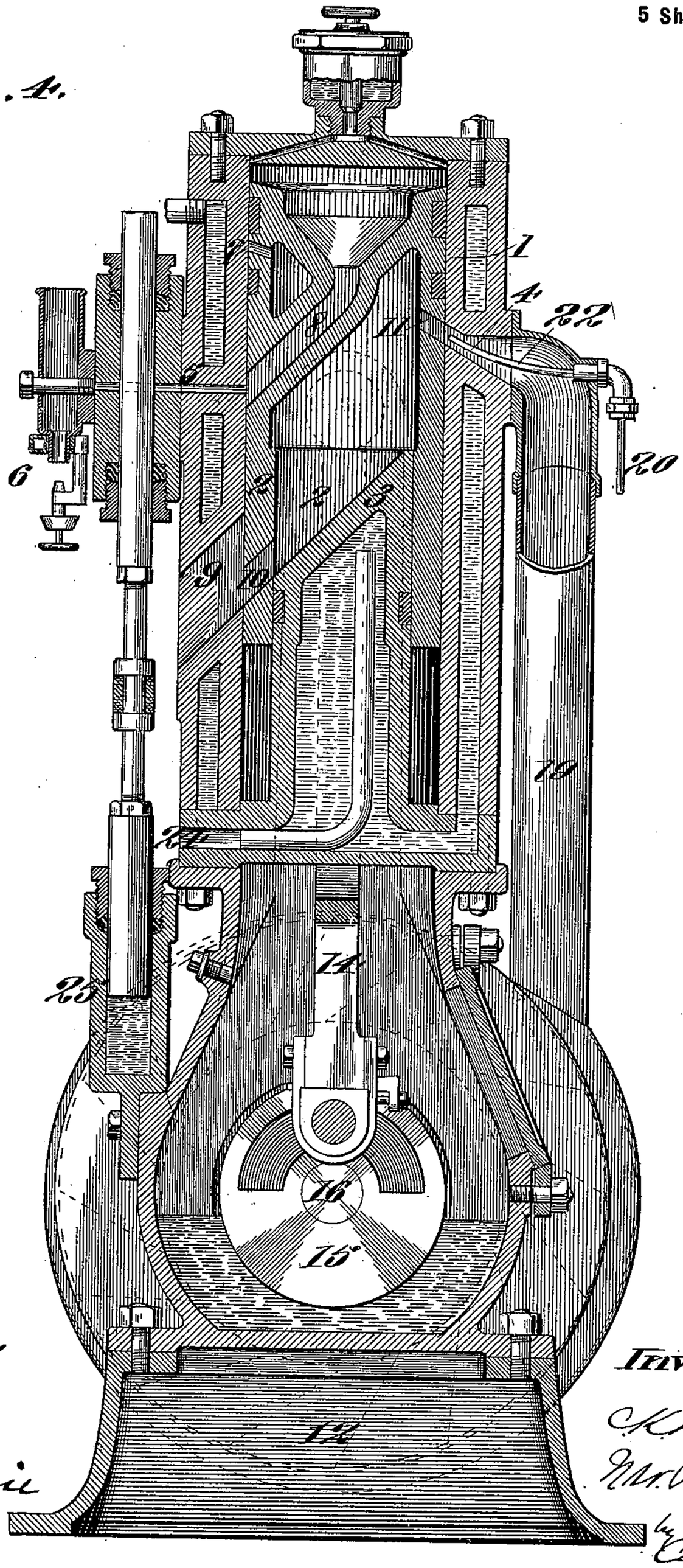
GAS ENGINE.

(Application filed May 3, 1897. Renewed Nov. 20, 1899.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4.



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GAS ENGINE.

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(No Model.) 5 Sheets—Sheet 5.

Fig. 5.

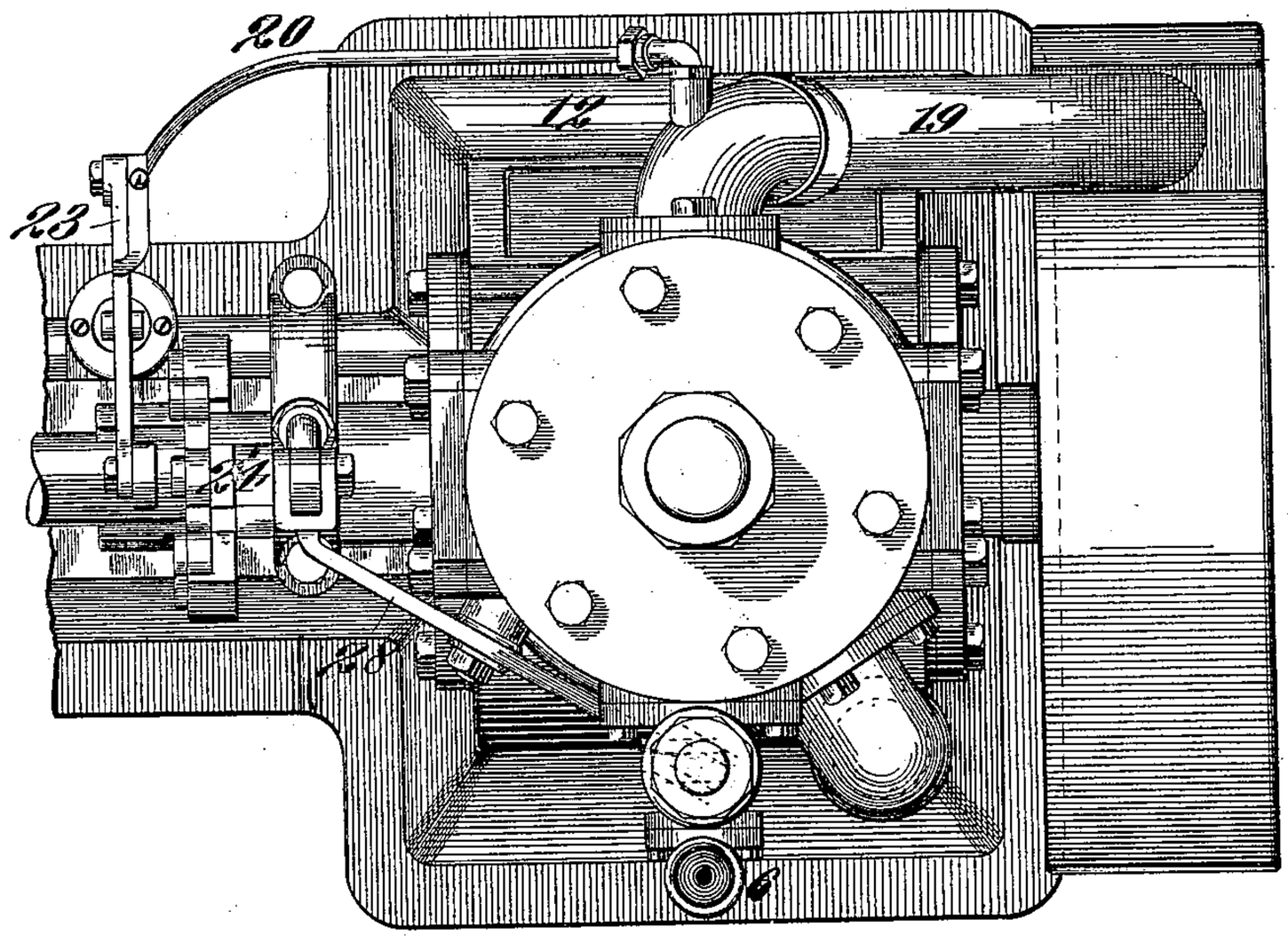


Fig. 6.

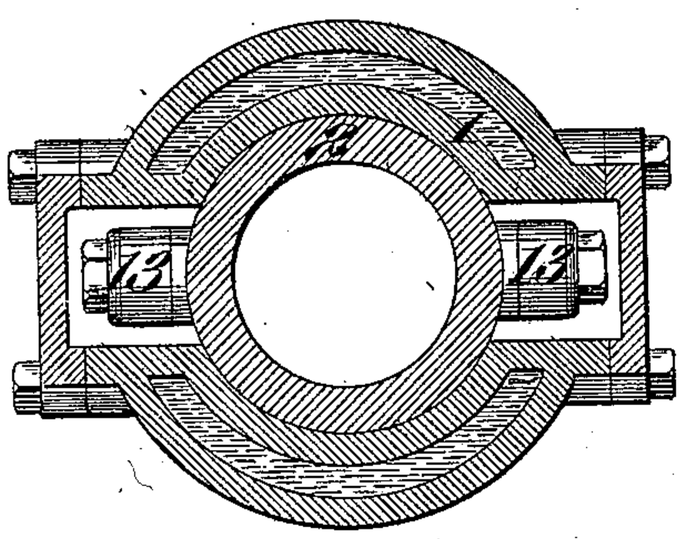


Fig. 7.

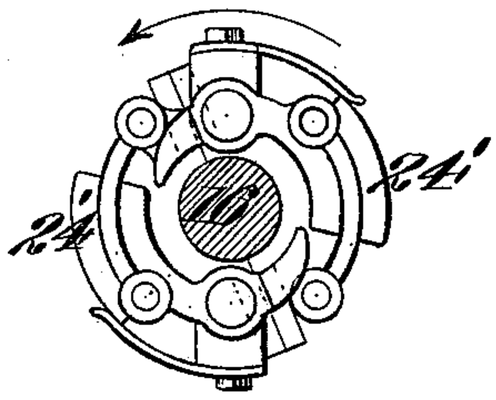


Fig. 8.

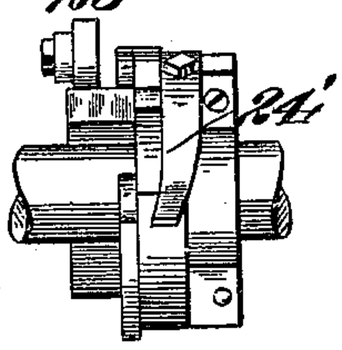
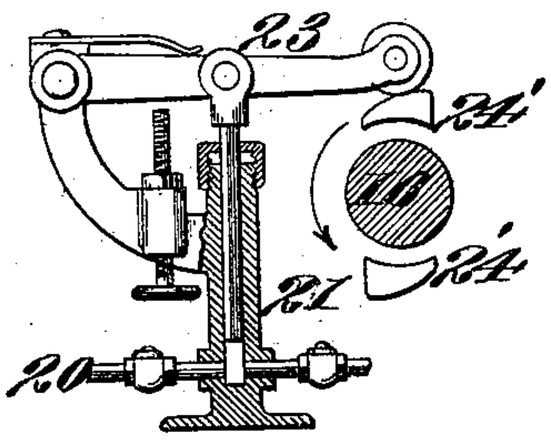


Fig. 9



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UNITED STATES PATENT OFFICE.

CHARLES K. PICKLES AND NATHAN W. PERKINS, JR., OF ST. LOUIS, MISSOURI, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO ROBERT BURNS AND BURT E. TILDEN, OF CHICAGO, ILLINOIS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 652,724, dated June 26, 1900.

Application filed May 3, 1897. Renewed November 20, 1899. Serial No. 737,703. (No model.)

To all whom it may concern:

Be it known that we, CHARLES K. PICKLES and NATHAN W. PERKINS, Jr., citizens of the United States, residing in the city of St. Louis, in the State of Missouri, have invented a new and useful Improvement in Gas-Engines, of which the following is a specification.

Our invention relates to gas-engines. Its principal objects are to effect explosions at the two ends of the cylinder alternately, to provide automatically-regulated means for forcing air into the cylinder, and to improve the construction of gas-engines.

To these ends our invention consists in the parts and arrangement of parts hereinafter described and claimed.

In the accompanying drawings, which form part of this specification, Figure 1 is a perspective view of our gas-engine. Fig. 2 is a side elevation thereof. Fig. 3 is a central vertical section lengthwise of the shaft. Fig. 4 is a central vertical section transverse of the shaft. Fig. 5 is a plan view. Fig. 6 is a horizontal section on the line 6 6 of Fig. 3. Fig. 7 is a detail side elevation of the governor which operates the oil-supply pump. Fig. 8 is a detail side elevation of said governor. Fig. 9 is a sectional detail view of the oil-pump.

Like symbols refer to like parts in the several views.

A cylinder 1, closed at one end and having a piston 2 working through the other end, constitutes the main explosion-chamber of our engine. The piston 2 is itself an elongated hollow cylinder closed at the end which enters the main cylinder 1. Its open end fits over a ram 3, fixed, like the cylinder 1, to the frame 4 of the engine. The hollow piston, in connection with the fixed ram, constitutes a secondary explosion-chamber.

In the side of the cylinder 1 is a supply port or opening 4, closed by the piston, but so located as to be uncovered when the piston is at the limit of its forward stroke. A second port or opening 5 extends through said cylinder 1 and connects with a duct leading to an igniting device 6. This second port or opening is in position to register with a hole 7, extending through the piston-shell into the secondary explosion-chamber, when the piston is at the limit of its forward stroke. A duct 8 is formed through said piston, opening at one end into the main explosion-chamber and having its other end in the side of the shell in position to register with the ignition-duct 5 when the piston is at the limit of its backward stroke. Also in the side of the cylinder 1 is an exhaust port or opening 9, so located that the port of the piston-duct 8 will register therewith when the piston is at the limit of its forward stroke. A vent-hole 10 for the secondary explosion-chamber extends through the piston-shell in position to register with the exhaust-port 9 in the cylinder when the piston is at the limit of its return stroke, and another port 11 is so located in said shell that in the same position of the piston it will register with the supply-port 4 in the cylinder.

Any suitable means may be used for charging the explosion-chambers, for igniting the charge, and for transmitting the energy of the piston, and such means are shown in the drawings and described hereinafter.

It follows from the foregoing arrangement that when the piston has reached the limit of its stroke in either direction the chamber toward which it has moved is entirely closed, except that it is open to the ignition-duct. At the same time the other chamber, which has attained its maximum volume, is open both to the supply-port 4 and to the exhaust-port 9 and closed to the ignition-duct. In order to displace the spent charge with the least waste of fresh fuel, the upper closed end of the piston is formed in a funnel shape, with the duct 8 inclined downwardly therefrom. For the same reason the fixed ram has its end inclined down to the exhaust-opening in the cylinder.

The operation is as follows: The initial movement may be communicated to the piston by any suitable means. When the piston reaches the limit of its forward stroke, the explosive mixture or the ingredients thereof enter the main explosion-chamber through the supply-port, displacing the gaseous contents

of said chamber through the duct 8 and the exhaust-port. On the back stroke of the piston the supply-port is first cut off and almost simultaneously therewith the exhaust-port is cut off, leaving the explosive mixture in a closed chamber of decreasing volume. The explosive mixture continues to be compressed until the limit of the back stroke, at which position it has access through the ignition-duct to the igniting device, with the result that the entire compressed mixture is exploded. At the time when the explosion in the main chamber occurs the secondary chamber is receiving a charge through the supply-port. The explosive energy of the explosion in the main chamber forces the piston forward, compressing the explosive mixture in the secondary chamber until its port 7 registers with the ignition-duct, at which point the explosion in the secondary chamber occurs. The escape-duct of the main chamber begins to register with the exhaust-port very shortly before the supply-port is uncovered, so that the larger portion of the products of combustion has been exhausted and the main pressure has been relieved from the main chamber when the fresh charge is supplied thereto, and it is while the main chamber is being supplied with a fresh charge that the explosion occurs in the secondary chamber. The explosion in the secondary chamber forces back the piston, which thereupon repeats the cycle of operation hereinbefore described, the supply, ignition, and exhaust of the respective chambers being the same and occuring at opposite places of the piston-stroke. The reciprocating motion of the piston thus effected may be used in divers forms of engines. The drawings illustrate an upright engine, which type we contemplate as the best embodiment of our invention. In this type the cylinder is mounted vertically on the engine-frame 12, and the piston has trunnions 13 on its opposite sides, on which the forks of the piston-rod or pitman 14 are journaled. The lower end of the piston-rod is pivotally connected to an ordinary crank 15, mounted on the main shaft 16 of the engine. Preferably an oil-chamber 17 is built around the crank-arm for the lubrication of the shaft and connections.

Mounted on the main shaft 16 or a shaft connected thereto is a fan or blower 18, whose force thus depends automatically on the speed of the engine. An air pipe or flue 19 leads from the casing of the fan to the supply-port 4 of the cylinder, either directly, as shown in the drawings, or through an intermediate carbureting apparatus.

The fuel or combustible material is preferably a hydrocarbon oil which vaporizes at a low temperature, at least below the ordinary working temperature of the chambers. For the purpose of feeding the oil into the cylinder an oil-pipe 20 leads through a pump 21 to the supply-port 4, where it terminates in a nozzle or injector 22, located inside of the air-pipe 19.

As shown in Fig. 9, the oil-pump 21 consists of a vertical cylinder inserted in the pipe 20 between two check-valves and having a plunger projecting from its top and connected to a spring-pressed lever 23. One end of this lever is pivoted on a fixed piece and the other end bears on the offset shorter and lighter ends of levers or fliers 24′ on the main shaft and constituting a governor therefor. A set-screw limits the downward movement of the lever, and thereby limits the downward stroke of the plunger.

The operation of the oil-pump is as follows: The several fliers lift the plunger-lever, which is immediately retracted by its spring after each flier, thus communicating a reciprocating motion to the plunger. The space in the cylinder vacated by the plunger is filled with oil from the tank, the check-valve between the tank and the pump opening automatically to the forward pressure, while the other check-valve is held closed by the back pressure. The height to which the plunger rises, and therefore the volume of oil introduced into the pump at each stroke, varies with the position of the centrifugal fliers. When the speed of the engine increases, the longer and heavier ends of the fliers fly out, thereby turning the other ends toward the shaft. As the lever 23 rests on the inner ends, its rise varies inversely as the speed—that is, when the speed becomes too fast the supply of fuel is checked automatically.

A convenient igniting device consists of a simple vapor-burner connected to the oil-pipe and located slightly below the end of the ignition-duct 5. A thin pipe closed at its outer end opens into the ignition-duct and is mounted in a flue or chimney directly above the vapor-burner. This pipe constitutes a retort which during the operation of the engine is kept heated to a bright-red heat, sufficient to cause explosion immediately upon the contact therewith of the explosive mixture.

For the purpose of preventing overheating the main cylinder-wall and the interior ram are made hollow or with communicating water-spaces. A water-pipe 24 extends from a pump 25 through the inside of said ram to the top thereof, so as to prevent formation of steam therein. At or near the top of the cylinder is an outlet-pipe 26, through which the water issues after passing through the ram and the cylinder-jacket. The water-pump may be actuated by a pitman 27 on the main shaft, connected to a lever 28, arranged to reciprocate the pump-piston.

As shown in Fig. 4, a valve may be arranged in the ignition-duct to more accurately control the time of explosion.

What we claim is—

1. A gas-engine comprising a cylinder open at one end and having a supply-port, an exhaust-port and an ignition-duct, and a hollow

cylindrical piston inside of said cylinder and working over a fixed ram, said piston having ports arranged to register with said supply-port, exhaust-port and ignition-duct, respectively, substantially as described.

2. A gas-engine comprising a cylinder open at one end and having a supply-port, an exhaust-port and an ignition-duct, and a hollow cylindrical piston inside of said cylinder and working over a fixed ram, said piston having ports arranged to register with said supply-port, exhaust-port and ignition-duct, respectively, and having also a duct leading from its end through its side in position to register alternately with said exhaust-port and ignition-duct, substantially as described.

3. A gas-engine comprising a cylinder open at one end and having a supply-port, an exhaust-port and an ignition-duct, and a hollow cylindrical piston inside of said cylinder and working over a fixed ram, said piston having ports arranged to register with said supply and exhaust ports respectively at one limit of its stroke and a port arranged to register with the ignition-duct at the other limit, substantially as described.

4. A gas-engine comprising a cylinder open at one end and having a supply-port an exhaust-port and an ignition-duct, and a hollow cylindrical piston inside of said cylinder and working over a fixed ram, said piston having three ports in its side and a duct leading from its end through its side, two of said piston-ports being arranged to register with the cylinder supply and exhaust ports respectively while the piston-duct registers with the ignition-duct, and the third port being arranged to register with the ignition-duct while the piston-duct registers with the exhaust-port, substantially as and for the purpose set forth.

5. A gas-engine comprising a water-jacketed cylinder having ports therethrough and being open at one end, a hollow cylindrical piston in said cylinder working on a fixed hollow ram, a water-supply pipe opening into the hollow interior of said ram near the top thereof, and a water-escape pipe near the highest portion of the cylinder-jacket, substantially as and for the purpose set forth.

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