(No Model.) 3 Sheets—Sheet 1.

C. SINTZ.

GAS ENGINE.

No. 339,225. Patented Apr. 6, 1886.

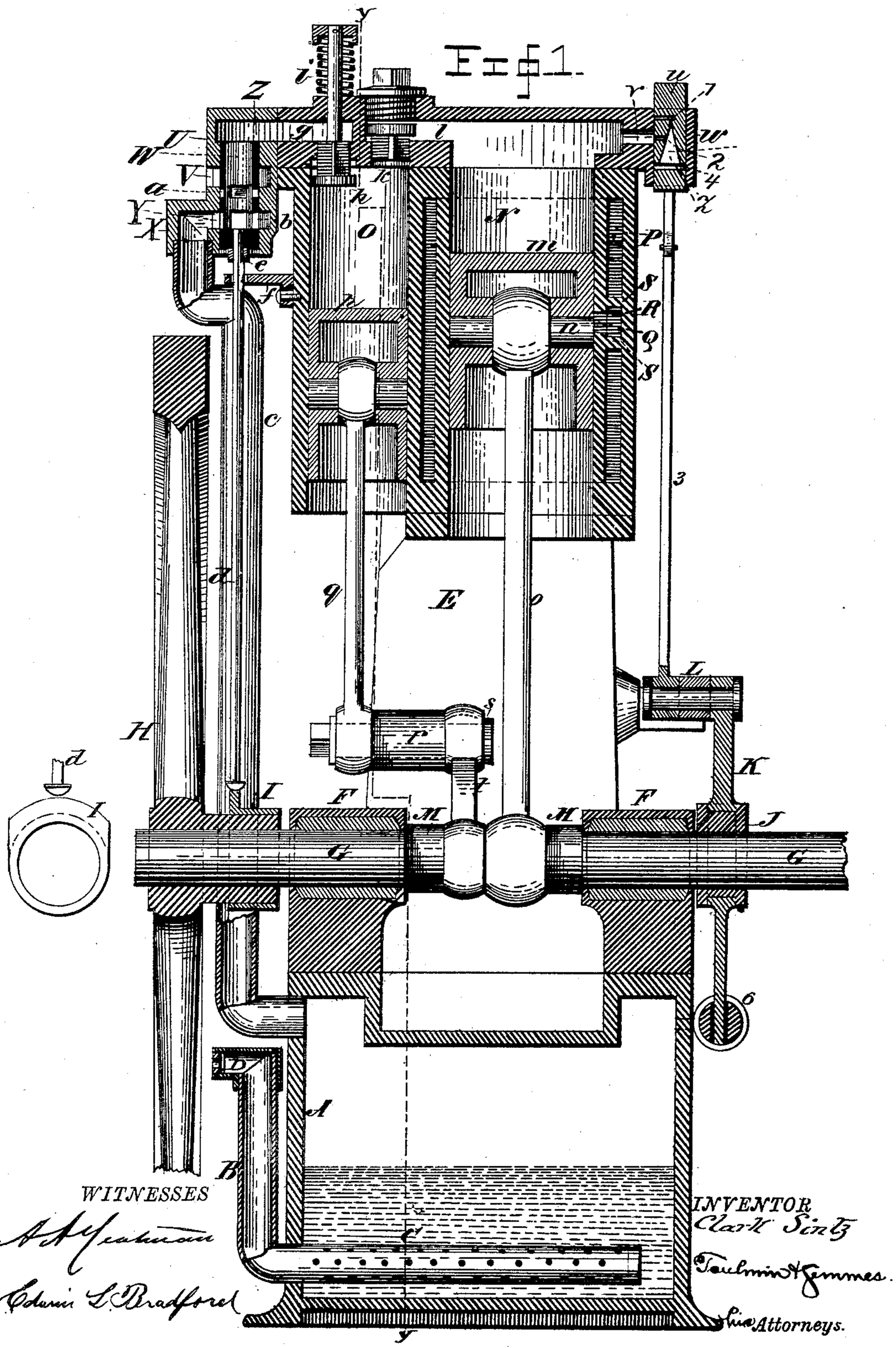

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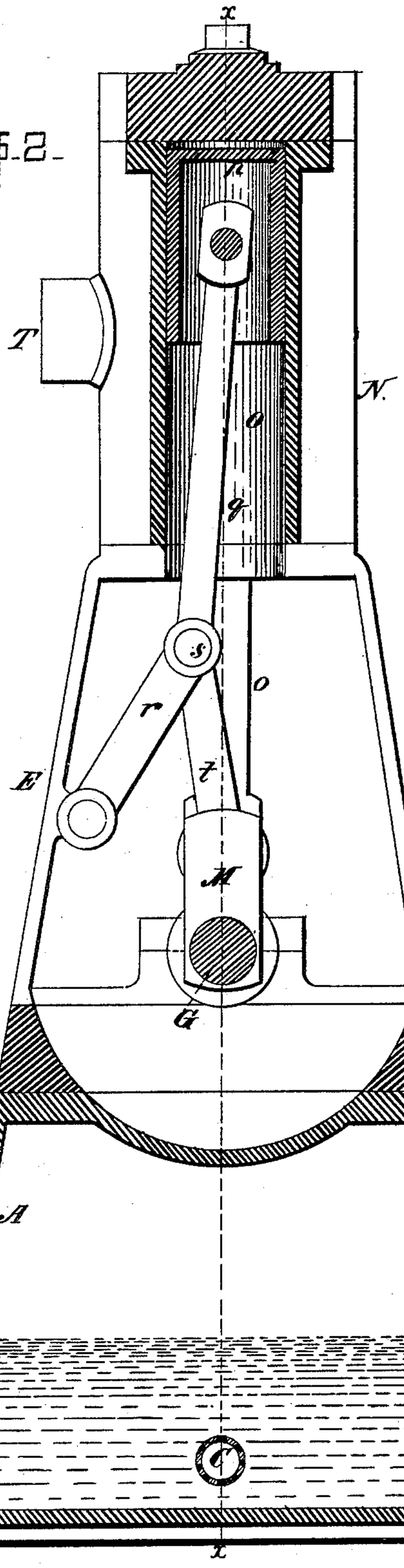
Fig. 2.



WITNESSES

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(No Model.) 3 Sheets—Sheet 3.

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Fig. 4.

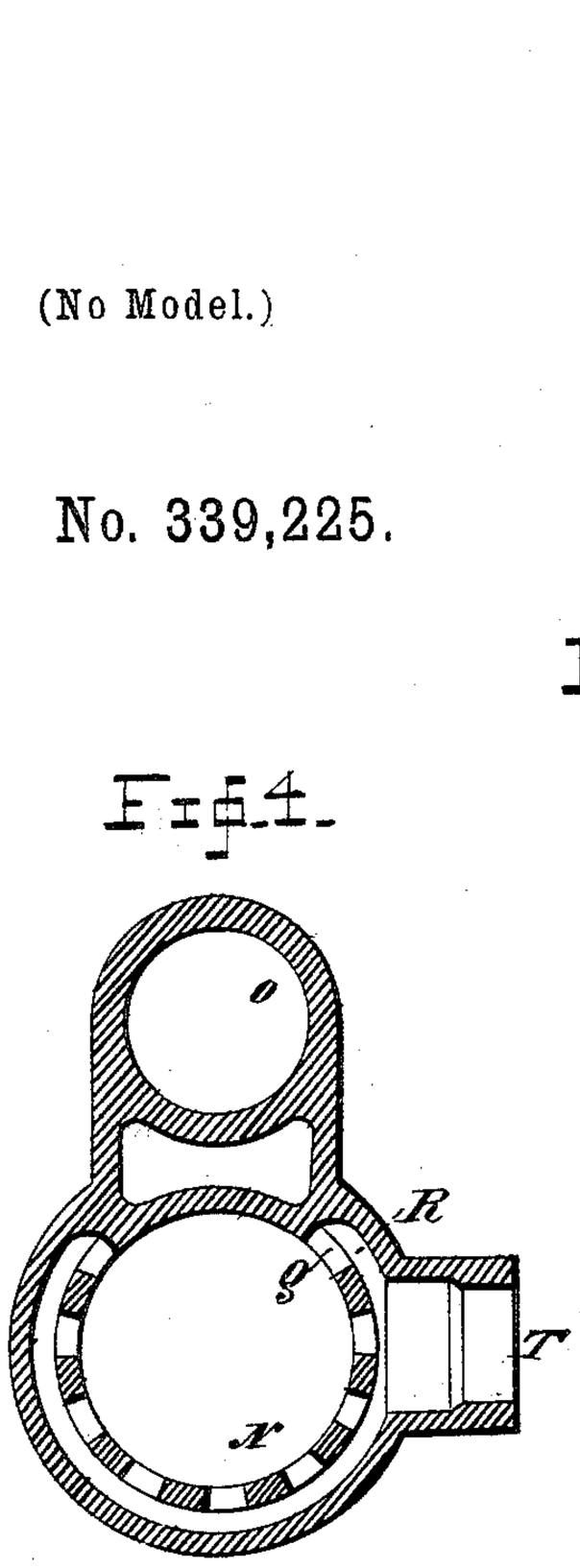

Fig. B.

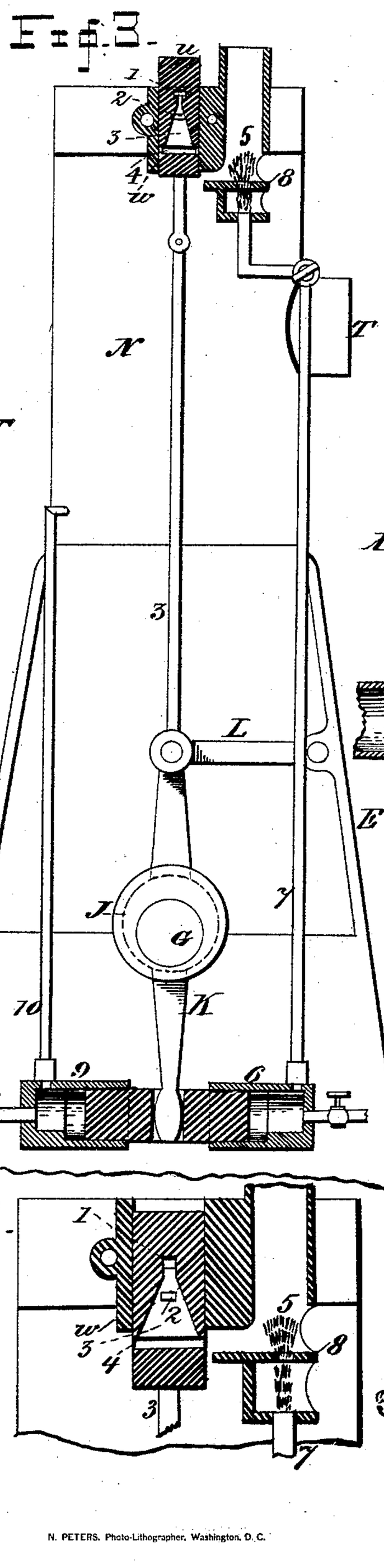

Fig. 5.

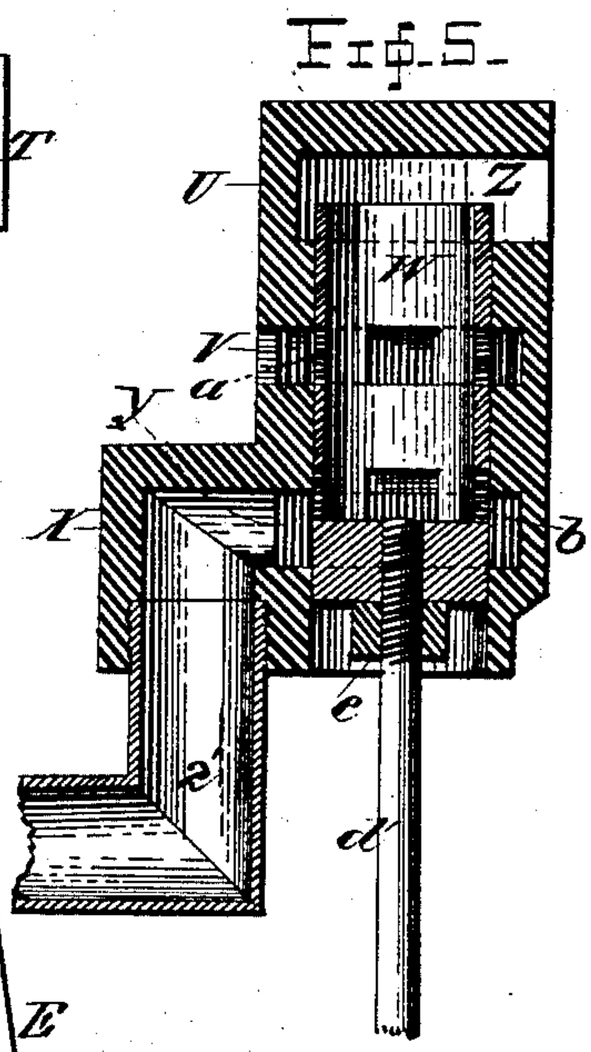

Fig. 6.

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GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 339,225, dated April 6, 1886.

Application filed January 13, 1886. Serial No. 188,396. (No model.)

To all whom it may concern:

Be it known that I, CLARK SINTZ, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to improvements in that class of engines in which the motive power is derived from some explosive agent, as air carbureted with gasoline or illuminating-gas mixed with the proper proportion of atmospheric air; and it has for its objects, first, to so organize the engine that the necessity of the usual "mixing-chamber" shall be entirely avoided, and a charging and power cylinder so constructed and arranged that the explosive can be directly conducted by the charging-cylinder into the power-cylinder; second, to provide a mixing-valve—that is to say, a valve for the admission of the explosive into the charging-cylinder—of such construction that the relative proportions of the constituents of the explosive agent can be varied from the smallest quantity of either above zero (0) to one hundred per centum—that is, that one hundred per centum of one constituent may be admitted through the valve, and none of the other constituent, or any per centum less than one hundred of one constituent and such per centum of the other as will correspond with the increase or reduction of the first; third, to provide an explosive-valve of such construction that the explosive may be ignited outside of the cylinder, and an ignited quantity thereof be conducted into communication with the explosive contained in the power-cylinder by the valve; fourth, to provide such an arrangement between the crank and connecting-rods that the piston in the charging-cylinder will make its upward stroke and begin its return by the time the piston in the power-cylinder reaches its upward limit, though both are connected with the same crank, for a purpose which will hereinafter appear; fifth, to provide means for generating an explosive agent by the operation of the engine itself and during the time of operation only, the explosive being conducted to the inlet-valves of the charging-cylinder as it is generated, the result of which is that the expense of production is stopped when the engine is stopped, and the liability of leakage of the explosive during the time the engine is standing avoided.

In the accompanying drawings, forming a part of this specification, and on which like reference-letters indicate corresponding parts, Figure 1 represents a vertical sectional view of my improved engine, taken on the line *x x* of Fig. 2, and showing some of the parts in elevation; Fig. 2, a vertical sectional view taken on the line *y y* of Fig. 1, showing the power-cylinder and some of the other features in side elevation; Fig. 3, a side view of the engine, having the lower portion removed, and showing the exploding-valve and the water and igniting pumps in vertical section; Fig. 4, a horizontal sectional view of the power and charging cylinder; Fig. 5, a detached vertical sectional view of the mixing-valve, showing the cut-off in position for the admission of gas and atmospheric air; and Fig. 6 a like section of the exploding-valve, showing the position of the slide when the explosive is being ignited.

The letter A designates a metallic tank, constituting a receptacle for a quantity of gasoline, from which to generate one form of explosive agent, and the letter B a perforated pipe extending into the tank at one end, C, and provided at the outer end with a suitable valve, D, adapted to open for the admission of atmospheric air into the pipe B, and to prevent the escape of the same by automatically closing itself.

The object in perforating the pipe is to admit of the atmospheric air being drawn through it and into and through the gasoline contained within the tank A in the manner which will hereinafter appear, whereby the air is carbureted and made to partake of the combustible qualities inherent in the gasoline, so as to be capable of supporting combustion.

Upon the tank is mounted a suitable frame-like structure, E, of cast-iron, provided with suitable journal-boxes, F, in which the engine-shaft G is journaled. This shaft is provided at one end with a balance-wheel, H, whose hub carries a cam, I, the eccentric periphery of which actuates the mixing-valve, as will ap-

pear farther on. The said shaft G is also provided with an eccentric, J, at its other end, upon which is mounted an actuating-arm, K, an eye being formed therein for the purpose of receiving and riding upon the eccentric. The upper end of this arm K is pivotally connected with the frame E by a link, L, and when the shaft G is in rotation the arm is given a reciprocating motion, as well in a vertical plane as in a horizontal plane, the former movement serving to actuate the exploding-valve and the latter to actuate two pumps, the function of which will also appear presently. The shaft G is further provided with a crank, M, to which are connected the connecting-rods of the power and charging cylinder pistons.

The letters N and O designate, respectively, the power and the charging cylinders, the same being by preference constructed of a single casting, as seen more clearly in Fig. 4. The comparative size of these two cylinders is preferably about one to two—that is to say, the power-cylinder has about twice the superficial area in cross-section that the charging-cylinder has in respect to the same measurement, the object of which is to reduce the terminal pressure in the power-cylinder, and to also reduce the clearance-space, and to obtain the results of increased expansion. This reduction in the terminal pressure brings about a corresponding reduction of the noise occasioned by the exhaust. Around the power-cylinder is an annular space, P, forming a water-jacket for keeping that cylinder from becoming too hot. It is also provided with a series of openings, Q, which form exhaust-ports, and which discharge into an annular space, R, divided off from the water-jacket P by the walls S, and opening externally at T, as shown in Figs. 2 and 4. These two cylinders are mounted upon and firmly secured to the upper portion of the frame E. To the charging-cylinder O is attached the shell or casing U of the mixing-valve, (or it may be cast with the cylinder-head,) and this shell is provided with a port, V, leading into an annular internal recess, for the purpose of allowing a free influx of atmospheric air into the interior of the shell, and thence to the charging-cylinder, when the cut-off W is adjusted for that purpose. The shell is also provided with an elbow, X, which communicates with its interior through a second port, Y, and its annular space.

The letter Z designates the tubular cut-off of the mixing-valve, the same being snugly fitted into the shell U, and having the ports *a*, which act in conjunction with the port V and its annular space, for the introduction of air, and the ports *b*, which act in conjunction with the port Y and its annular space, for the introduction of carbureted air, or the introduction of gas. A pipe, *c*, establishes communication between the tank and the elbow X, whereby when the piston of the charging-cylinder is making its downward stroke a pump-like action is induced, and the air is drawn through the pipe B and the gasoline in the tank A and carried up to the mixing-valve.

The cut-off W is automatically actuated to and fro by means of the stem *d*, secured to it and riding at its lower end upon the cam I. When the concentric portion of the cam I is opposite the stem *d*, the stem drops, bringing the valve cut-off with it, a jam-nut, *e*, being fitted to the stem to prevent the stem from unscrewing from the cut-off. A bracket, *f*, suitably supported—as by the charging-cylinder—acts to stop the valve at the same point of descent every time. A passage, *g*, formed in the upper portion of the cylinder O, communicates with the mixing-valve and with the interior of the cylinder O when the valve *h* is down, as seen in Fig. 1. The stem has a cap, beneath which is placed a delicate spring, *i*, which serves to keep the valve normally elevated and in its seat, but is just sufficient for this purpose, being easily overcome by the incoming explosive agent. When the charging-cylinder piston is making an upward stroke, the valve *h* instantly closes and leaves the only escape of the explosive agent through the orifice *j*, in which is fitted a valve, *k*, and through which and the short passage *l* the explosive finds its way to the power cylinder N. The remainder of the operation being dependent upon the arrangement of the connecting-rods, the movements of the pistons and the construction of the exploding-valve will be deferred until these parts are described.

The letter *m* designates the power-piston, the same being in the present instance (though any convenient form may be used) of cylindrical form, closed at one end, and provided with apertures into which is fitted a pin, *n*, on which is mounted one end of the connecting-rod *o*, the other end being connected with the crank M. This piston has a regular up-and-down movement in accordance with the movement of the crank.

The letter *p* designates the charging-piston, the same being constructed like the power-piston, and its connecting-rod *q*, pivotally connected at its lower end with a link, *r*, by a bolt, *s*, (seen more clearly in Fig. 2,) which in turn is pivoted to the frame E. To the connecting-bolt *s* is also fitted the pitman *t* at one end and at the other to the crank M. By means of this construction the connecting-rod *q* is thrown out of a right line between the crank M, and the relative movements of the two pistons are as follows: We shall presume that the crank M is at its upper dead-point, as seen in Fig. 2. When this is the case, a right line drawn from the center of the crank to the center of the power-piston will pass through the axis of the shaft G and that piston will be at its upper dead-point. The charging-piston, however, will be slightly below its upper dead-point, for its extreme upper limit depends upon the center of the shaft of the crank and of the bolt *s* being in line, and this coincidence of centers will have been passed when the crank has reached the posi-

tion shown in Fig. 2. Therefore when the said crank was in that previous position necessary to effect this coincidence of centers the charging-piston was at its higher dead-point. Later on in the revolution of the crank it reached the position shown and placed the power-piston highest, so that the fact is that the charging-piston reaches its upper dead-point before the power-piston reaches its upper dead-point again during the time between the moment the charging-piston reached said point and the moment the power-piston reached said point the former was descending, so that it is also true that the charging-piston begins its downstroke before the power-piston begins that stroke. It is also true that the power-piston begins its ascent before the charging-piston begins its ascent, and this is true to such an extent that the power-piston has just crossed the exhaust-port in its upward movement when the charging-piston begins its upward movement. This enables me to discharge the explosive from the charging-cylinder into the power-cylinder without the intervention of the usual mixing-chamber.

The letter *u* designates the shell of the exploding-valve, the same being preferably cast with the main cylinder-head, and is provided with a passage, *v*, which establishes communication between the interior of the power-cylinder and the ports of the slide *w*. This slide works smoothly within the shell *u*, and has an interior conical recess, *z*, from which extend the ports 1 and 2, the former from the apex and the latter some distance below it. This slide is actuated to and fro by means of the stem 3 and the arm K, the link L, and the eccentric and shaft J and G, in the manner already described, so as to bring the ports 1 and 2, respectively and alternately, opposite the passage *v* when the eccentric J is in its lowest and highest positions, respectively. When the eccentric is in its lowest position, the explosive, which has previously entered conical opening *z*, will pass laterally out of the transverse lower port, 4, as shown in Fig. 6, and issue to the flame 5 and become ignited, the ignition following up into the conical opening, and as the eccentric, being in motion all the while, elevates the slide into the shell *u* the contained flame will ignite the explosive in the cylinder N through the port 1, and thus actuate the engine by the resulting explosion acting upon the piston *m*. As this occurs the slide will continue on up and the port 2 be presently presented opposite the passage *v*, when the conical opening *z* will again become filled with the explosive, this latter, however, being delayed until the cam I shall have operated the mixing or inlet valve and admitted a charge of the explosive in the manner already stated.

From these remarks it will appear that the operation of the several parts of the engine is synchronous, and also that the position of the throw of the cam I and the eccentric J with respect to each other is such that the charge will be admitted at such intervals as to cause a supply to be in the power-cylinder in waiting for or at the time of the arrival of the ports 1 and 2, alternately, of the exploding-valve opposite the passage *v*, so as to maintain a regular and constant action of the engine. Now, to go back to the flame 5, it is to be observed that the carbureted air is taken from the tank A by the pump 6, actuated by the arm K, and conducted thence through the pipe 7 to the burner 8, the space between the upper and lower portions of which containing the lower part of the flame and preventing it from being entirely blown out should the violent issue of the explosive from the port 4 put out the upper part thereof. The pump 9, which is also actuated by the arm K, forces a supply of water to the water-space about the power-cylinder through the delivery and supply pipes 10 and 11, the water escaping from the space by a suitable opening.

In Fig. 5 I have represented a view of the mixing-valve, showing the relative position of the ports *a* with respect to the port V and its annular space, and the ports *b* with respect to the port Y and its annular space, atmospheric air being admitted through the former and the illuminating-gas through the latter, a pipe, 12, being employed to conduct the gas from the source of supply. This position of the valves admits of the proper proportions of air and gas to constitute, when united and ignited, an explosive. From this it will be understood that the mixing-valve acts in that capacity when atmospheric air and illuminating-gas are used as the explosive, and that it also acts in that capacity when the air, after having been drawn through the gasoline, is found to be too pregnant of the attributes of the gasoline; upon the happening whereof the cut-off W is adjusted to admit of the influx of atmospheric air through the ports *a* and the port V, to counteract this condition of the carbureted air. When, however, the latter is found to be properly enriched for the purpose in view, which will seldom happen otherwise, then the said valve acts in the capacity of an inlet-valve merely.

I contemplate hereafter applying for Letters Patent on the method of generating and conducting the explosive agent as described in this present application.

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

1. In a gas-engine, the combination, with a charging-cylinder provided with a piston, an inlet-valve, and a check-valve, of a power-cylinder in direct communication with the charging-cylinder, save by a valve between the two, and having a piston and an exploding or igniting valve, means to operate the said inlet and exploding valve, and a crank-shaft with which the pistons connect, and suitable machinery to cause one of the pistons to reach

its upper dead-point and begin its return by the time the other piston reaches its upper dead-point.

2. In a gas-engine, the combination, with the charging-cylinder provided with a piston, and a mixing-valve constructed of a shell and a cut-off having, respectively, a plurality of ports and varying the proportions of the explosive admitted through it, of the power-cylinder provided with a piston, and an exploding-valve consisting of a shell and a slide having an internal chamber and ports extending therefrom, and an explosive generating-tank in communication with the mixing-valve, whereby the explosive is generated by the operation of the engine.

3. In a gas-engine, the combination, with the power-cylinder, of a valve-shell in direct communication therewith, and a valve fitted within said shell and having an internal conical chamber whose base is below the said communication, and from which extend a lower igniting-port and two upper ports which discharge an ignited portion of the motive agent into the power-cylinder.

4. In a gas-engine, the combination, with the shell of the inlet mixing-valve having a plurality of ports, of the cut-off having a plurality of ports, one of which is adapted to register with one of the ports of the shell while the other port of the shell is not registering with the other port of the cut-off, yet adapted to admit of communication of the respective shell-ports with the respective cut-off ports, and an adjustable stop to limit the downward movement of the cut-off.

5. In a gas-engine, the combination, with a charging-cylinder provided with a piston, an inlet-valve, and a check-valve, and a power-cylinder in direct communication with the charging-cylinder, save by a valve between the two, and having a piston and an exploding-valve, of the generating-tank in communication with the inlet-valve, whereby the explosive is generated by the operation of the engine and directly introduced from the charging-cylinder into the power-cylinder, and thence caught up by the exploding-valve, ignited without, and the flame carried back into contact with the charge in the power-cylinder.

6. In a gas-engine, the combination, with the power-cylinder and the exploding-valve, whose shell communicates with the same and whose slide has a stem, of the arm pivotally connected at one end and mounted upon an eccentric, the pump having its piston connected with the other end of the arm, and the supply-pipe leading from the pump to near the valve.

7. In a gas-engine, the combination, with the power-cylinder, of a shell having an opening communicating with it, and a slide having an internal opening communicating with a transverse port and with other ports which communicate alternately with the power-cylinder through the shell-port, the said transverse port being adapted to communicate with the flame when the slide is down.

8. In a gas-engine, the combination, with an explosive-generating tank, a pump in communication therewith, and means to actuate the pump, of a pipe-burner and an exploding-valve located in proximity to each other, and a pipe leading from the pump to the burner, and a flame established near the said valve.

9. In a gas-engine, the combination, with the generating-tank, the pump communicating therewith, the arm, the shaft and eccentric which actuate the arm, and the pivotal connection at the upper end of the arm, of the pipe leading from the pump to near the exploding-valve.

10. In a gas-engine, the combination, with the shaft having an eccentric, and a pivoted arm mounted upon the eccentric, of the pump communicating with the water-space about the cylinder and actuated by the said arm.

11. In a gas-engine, the combination, with the crank, of the piston and connecting-rods, one of said rods having a joint between its piston end and the crank, and a link or device to throw said joint out of a straight line drawn between the crank-shaft center and the piston-center, whereby one of the pistons reaches its upper dead-point and begins to return by the time the other piston reaches its upper dead-point.

12. In a gas-engine, the combination, with a charging and power cylinder, of a piston in each and their connecting-rods, one of said rods having a joint between its piston end and the crank and a link or device to throw said joint out of a straight line drawn from the crank-shaft center to the piston-center, whereby one of the pistons is caused to commence its upward stroke and allowed to pass the exhaust-port by the time the other of said pistons begins its upward stroke.

In testimony whereof I affix my signature in presence of two witnesses.

CLARK SINTZ.

Witnesses:
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A. A. YEATMAN.