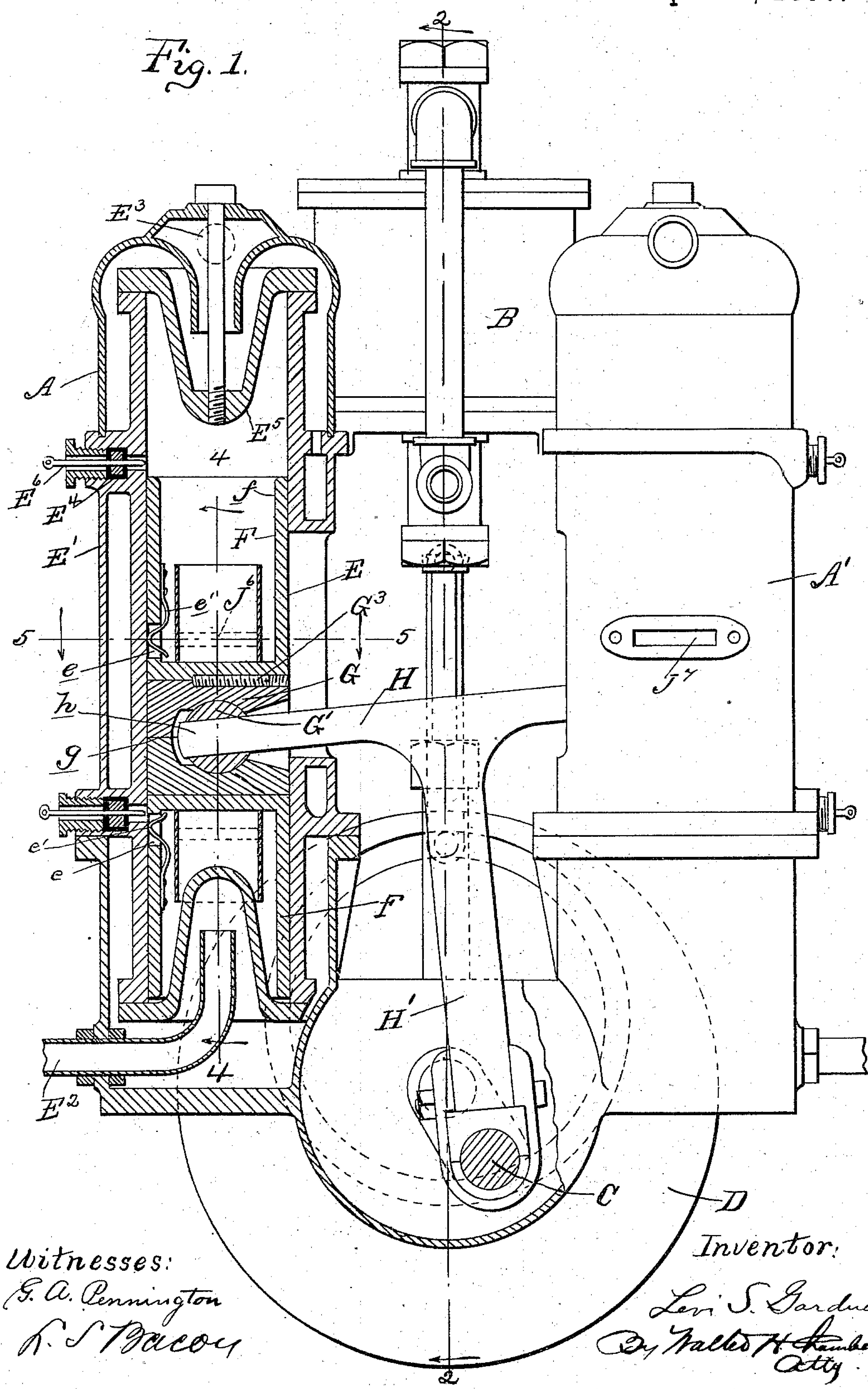
(No Model.)

3 Sheets—Sheet 1.

L. S. GARDNER.
VAPOR MOTOR.

No. 558,943. Patented Apr. 28, 1896.

Fig. 1.



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(No Model.)

3 Sheets—Sheet 2.

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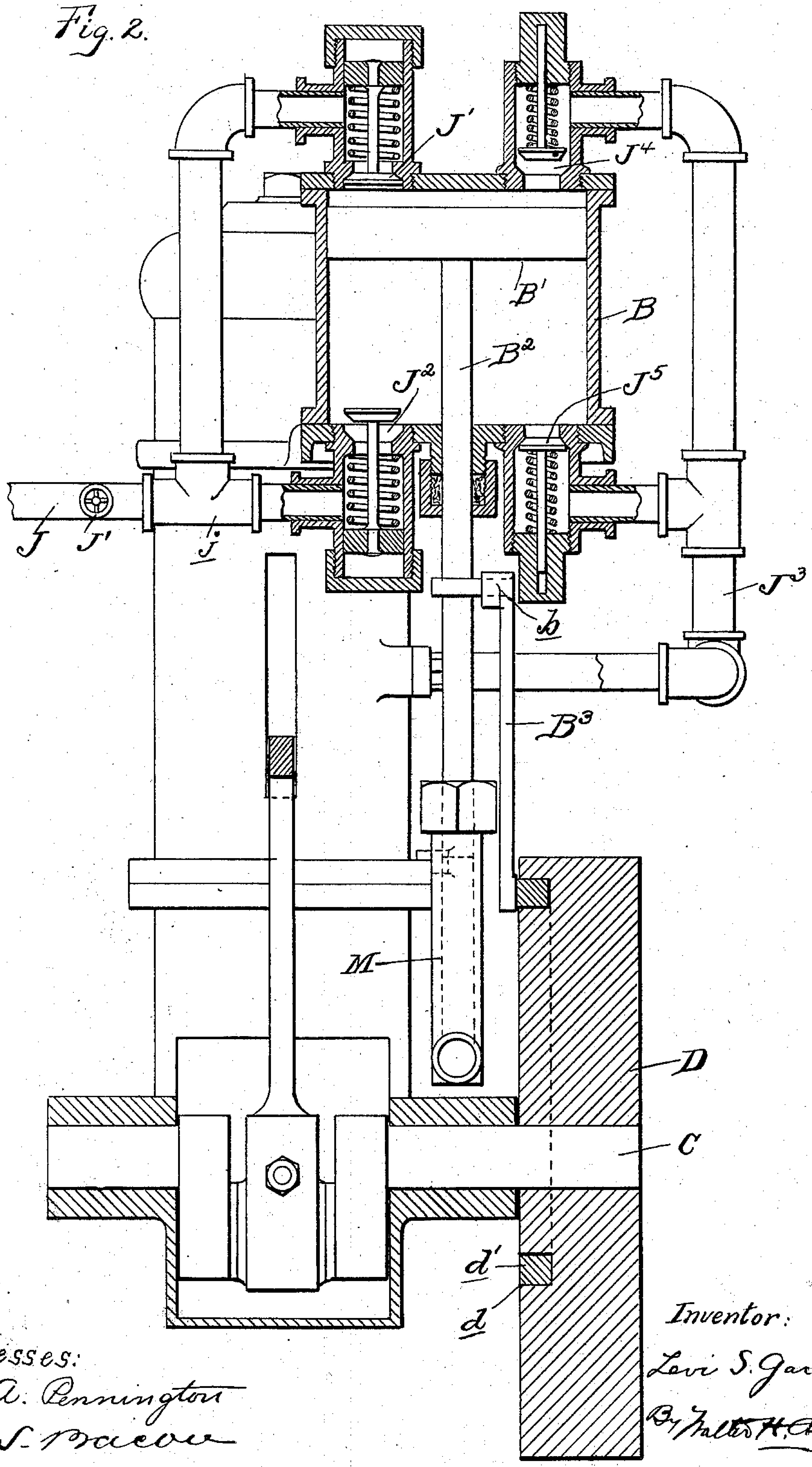
Fig. 2.



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3 Sheets—Sheet 3.

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VAPOR MOTOR.

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Fig. 3.

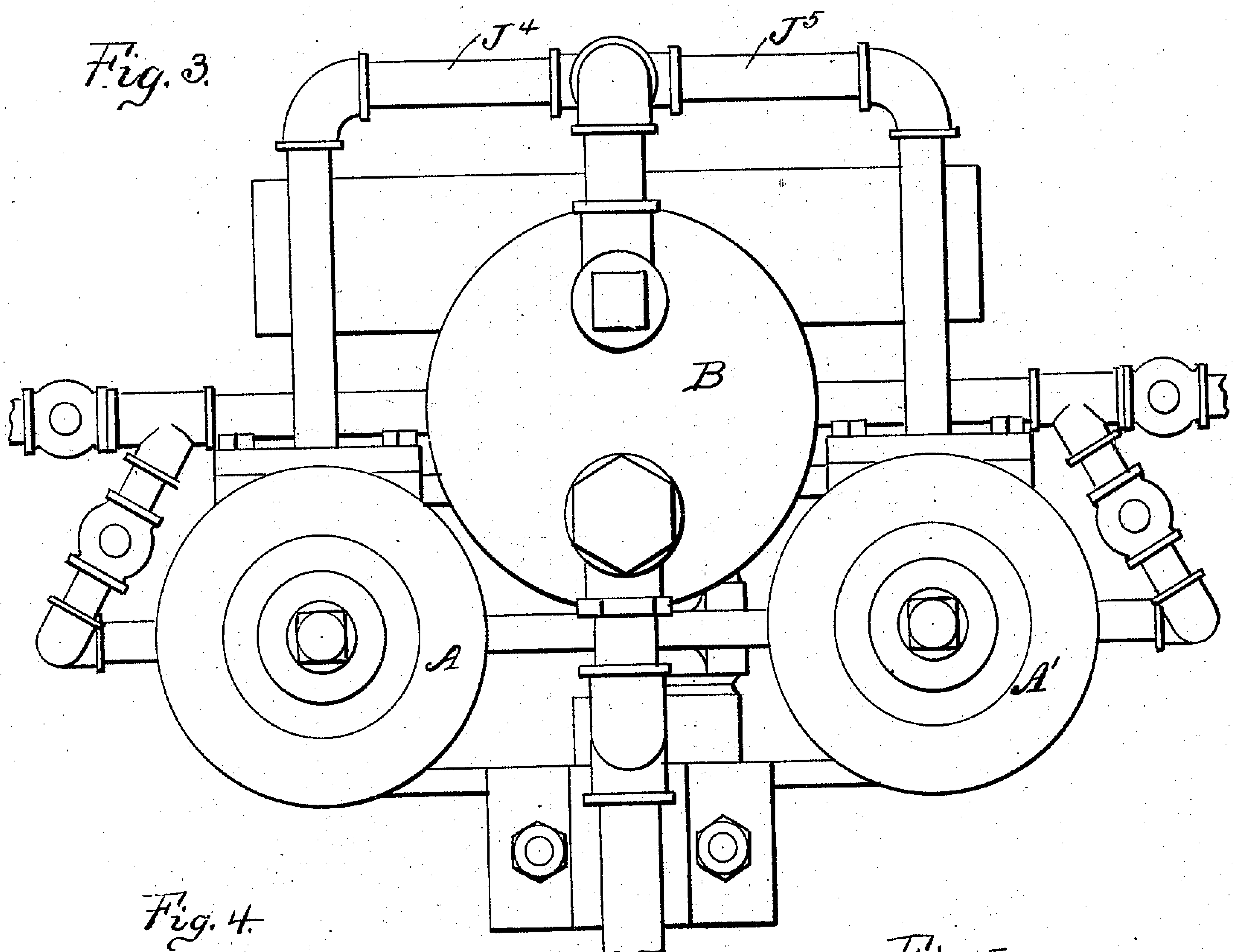


Fig. 4.

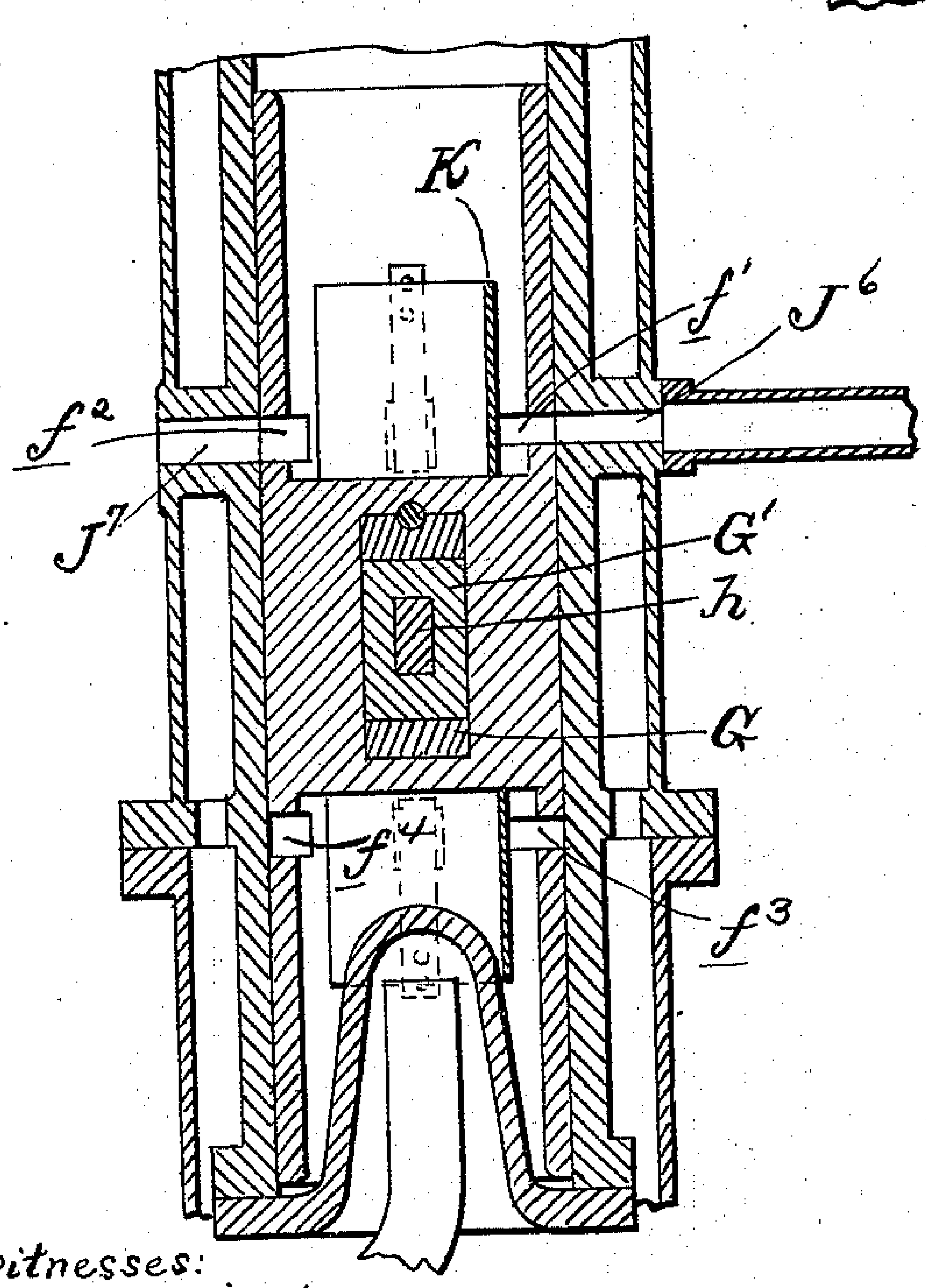
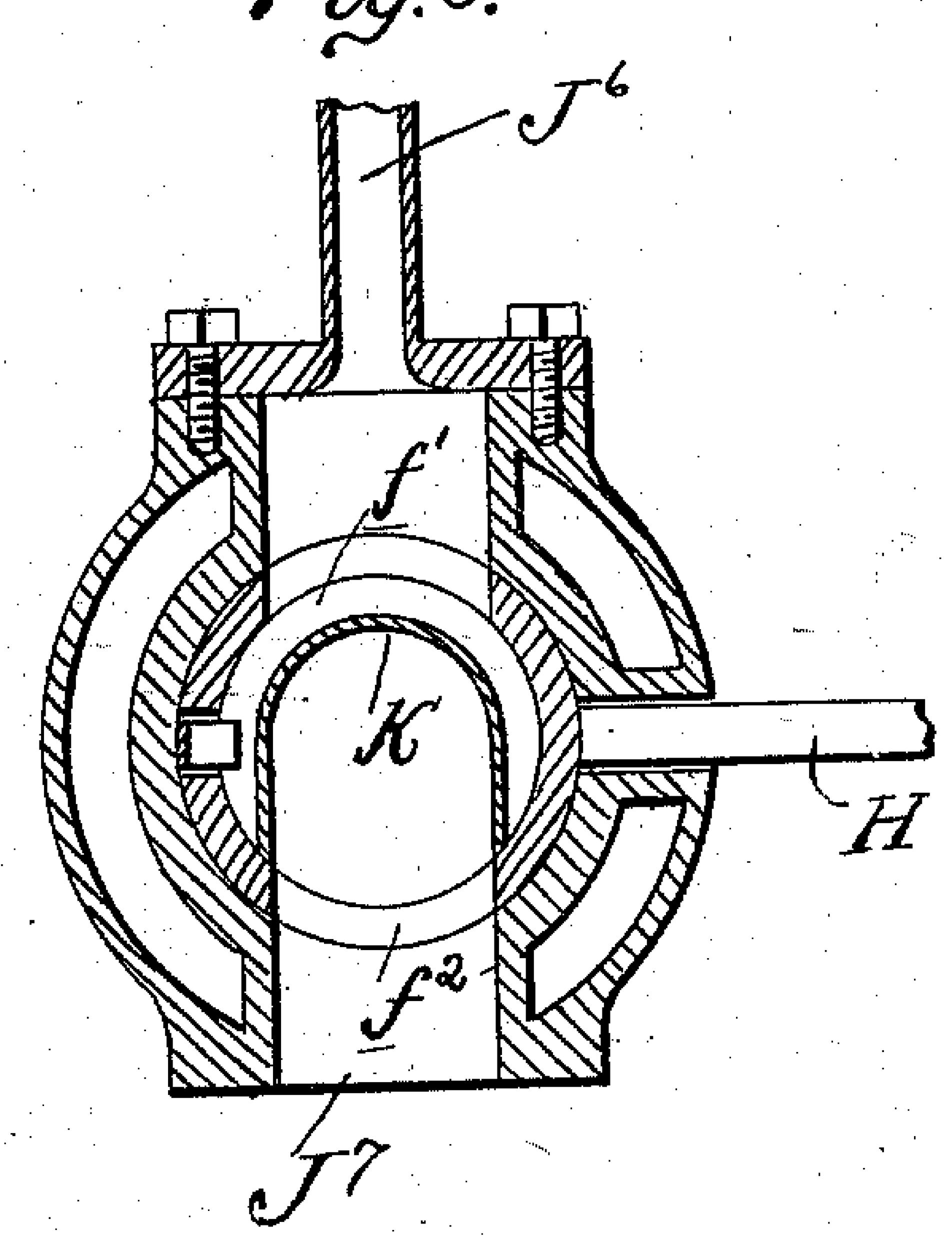


Fig. 5.



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UNITED STATES PATENT OFFICE.

LEVI S. GARDNER, OF NEW ORLEANS, LOUISIANA, ASSIGNOR OF ONE-HALF TO JEFFERSON C. WENCK, OF SAME PLACE.

VAPOR-MOTOR.

SPECIFICATION forming part of Letters Patent No. 558,943, dated April 28, 1896.

Application filed June 14, 1895. Serial No. 552,834. (No model.)

To all whom it may concern:

Be it known that I, LEVI S. GARDNER, a citizen of the United States, residing at New Orleans, parish of Orleans, State of Louisiana, have invented a certain new and useful Improvement in Vapor-Motors; and I 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 pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention contemplates the production of a motor or engine the power whereof is the explosion of a charge of gas or other explosive or inflammable agent.

The invention has for its object the production of a motor which shall be much smaller in size and lighter in weight for a given horse-power than the motors now in use; one wherein the piston-head is driven in each direction by the explosion of the vapor, thereby obviating the necessity of a large or heavy fly-wheel; one wherein two cylinders are employed to drive a single crank-shaft, the piston of one cylinder traveling slightly in advance of the other, so that there can be no dead-center; one wherein the piston of each cylinder is driven in each direction by the explosion of the charge, so that for one revolution of the crank-shaft there are four explosions, and a motor embodying other advantageous features herein described and claimed.

In the drawings, Figure 1 is an elevation, with one cylinder in section, of my machine. Fig. 2 is a sectional view taken on the line 2 2 of Fig. 1. Fig. 3 is a plan view. Fig. 4 is a sectional view on the line 4 4 of Fig. 1. Fig. 5 is a sectional view on the line 5 5 of Fig. 1.

In carrying out the invention, A A′, Fig. 3, represent, respectively, the cylinders constituting the driving-cylinders of the engine.

B represents the force-pump for forcing the vapor constituting the motive power into the cylinders. It is, of course, obvious that these cylinders may be supported by any suitable framework, and I will not herein further describe the frame.

C is a crank-shaft of the engine, and D the fly or balance wheel.

Referring now to Fig. 1, I will describe more particularly the construction of the driving-cylinder A, it being understood that the cylinder A′ is a duplicate of the cylinder A. E is the shell of the cylinder. E′ is an outer shell or jacket, the space between the two forming a water-space. By means of a pump, which I will hereinafter describe, water is forced in at the inlet E^2, circles around the cylinder, and is discharged at the outlet E^3, so that there is a constant circulation of water around the cylinder to keep it cool. F F′ represent what I will, for convenience, term the "upper" and "lower" ends of the piston. It will be observed that these ends of the piston are of a peculiar shape, being recessed or cup-shaped and having the flanges *f*.

By reference to Fig. 4 it will be seen that the middle of the piston is provided with a boxing or block G, divided, as at *g*, Fig. 1, for convenience in inserting into place. G′ is a circular bearing movable in the boxing, into which the end *h* of the cross-arm H on the pitman H′ is inserted. This pitman, as will be seen by reference to Fig. 1, is connected with the crank-shaft, and the vertical movement of the pitman will, of course, revolve the crank-shaft.

G^3 is a taper-screw entering between the boxing G and piston proper, F, and is for the purpose of tightening or loosening the parts G G′, as desired. As has just been explained, instead of the usual piston-rod I employ the cross head or arm H. This necessitates the elongated opening in the side of the cylinder, and to keep this opening covered necessitates the flanged end of the piston-head. In order that when the piston reaches the end of the stroke the new gas in that end may be compressed in as small a space as possible, I provide at each end of the cylinder the projections E^5, each adapted when the piston is at that particular end of the cylinder to enter and substantially fill the space between the flanges *f* of the piston-head. Another advantage of the projections E^5 is that the water can circulate around a much larger surface of metal and thus keep the temperature lower. In each piston-head, as at *e*, is an opening, and attached to the piston-head and projecting into the opening is a metallic spring *e′*.

E^6 is a wire or contact-piece insulated by the insulation E^4 from the frame of the machine. The end of the wire or contact E^6 terminates close to the path of the piston-head, so that the spring e' will, as it passes the wire E^6, come into contact therewith, and as the piston moves still farther the contact will be broken. Now by engaging one wire of any suitable battery-circuit to the wire E^6 and the other wire of the circuit to the frame of the engine it will be obvious that as the spring e' rides onto the wire E^6 a contact or circuit will be established, and as this contact or circuit is broken a spark will be made to ignite the gas, as hereinafter set forth.

Referring now to Fig. 2, B, as before stated, represents the pump employed to force the vapor into the cylinders. It is an ordinary force-pump with the piston B' and piston-rod B^2. Attached to this piston-rod at b is a rod B^3, the lower end of which is engaged to a ring d' in the cam-groove d in the fly-wheel D, the result being that when the fly-wheel revolves it moves the rod B^3, and consequently the piston-rod B^2, vertically. J represents the pipe leading from the source of vapor supply, which may, of course, be located at any convenient point. At j this pipe is branched, one branch leading to the top of the cylinder, where a check-valve J' is provided, and the other branch leading to the bottom of the pump-cylinder, where a check-valve J^2 is provided. J^3 represents the pipe leading from the pump to the cylinders. Connected with this pipe J^3 is the pipe controlled by the check-valve j^4 and also the pipe controlled by the check-valve j^5, the valves j^4 and j^5 being the check-valves governing the exhaust-pipe from the pump. It will thus be observed that at each stroke of the pump-piston B' a charge of gas is forced through the pipe J^3. This pipe, as shown in Fig. 3, is branched, as at J^4 and J^5, the pipe J^4 leading to the cylinder A and the pipe J^5 leading to the cylinder A', the inlet for the cylinder A being shown at J^6, Figs. 1, 4, and 5, and the cylinder A' having a corresponding inlet. The exhaust from each cylinder is shown at J^7, Figs. 4 and 5, there being, of course, one inlet and one exhaust for each cylinder.

It will be observed by reference to Fig. 1 that the inlet is an opening elongated horizontally, as shown by the dotted lines in that figure, and it will also be observed by reference to Fig. 4 that the exhaust-opening is somewhat larger than the inlet-opening. It will be further observed by reference to Fig. 4 that the upper end of the piston-head is provided with an inlet f' and an outlet f^2, and that the lower end of the piston-head is provided with an inlet f^3 and an outlet f^4, the inlets f' f^3 being substantially the same shape and size as the inlet for the cylinder, while the exhaust-openings f^2 f^4 are substantially the same shape and size as the outlet J^7 of the cylinder. It will now be seen that when the piston is in its lower position the inlet-opening f' in the piston-head will register with the inlet J^6 of the cylinder and the exhaust f^2 will register with the exhaust J^7 of the cylinder, and that when the piston travels to its upper position the inlet f^3 will register with the inlet J^6 and the exhaust f^4 register with the exhaust J^7. In order that the gas as it enters J^6 f' may be prevented from traveling directly across and passing out through the exhaust f^2 J^7, I provide in each cylinder-head the partition or deflector K, (shown in Figs. 4 and 5,) against which the vapor will impinge and be forced up or down, as the case may be, into the cylinders behind the piston-head.

By reference to Fig. 2 it will be observed that the lower end of the piston-rod B^2 of the pump B enters a cylinder M. This cylinder M constitutes a bearing for the lower end of the piston-rod, and also forms a water-pump for the purpose of forcing a circulation of water around the driving-cylinders A A'. Suitable check-valves may, of course, be located at any convenient point in the system and the pipe M' be arranged in any suitable manner to connect with the water-inlet E^2 of each cylinder, so that by the motion of the piston-rod B^2 water will be forced into each of the jackets surrounding each of the cylinders, and a constant circulation thus be maintained.

The operation of the mechanism is as follows: The machine is started by starting the revolution of the fly-wheel D. The motion of the piston-head B' of the pump B, whether it be up or down, forces a charge of gas out of the pump through the pipe J^3 to the inlet J^6 of each cylinder. The mechanism is so timed that the inlet f' or f^3, as the case may be, will not register with the inlet J^6 until the piston B' of the pump has traveled about one-third of its stroke, thereby compressing the vapor in the pump to a pressure of, say, twenty pounds to the square inch, more or less. While this operation is going on and before the inlet f' or f^3 registers with the inlet J^6 the exhaust-ports have registered with each other (because of the fact that they are larger than the inlet-ports) and the burned gases from the previous explosion have escaped, or at least substantially all of the burned gases have escaped. The inlet-ports then register with each other and the gas or vapor enters to the interior of the piston-head, strikes the partition K and flows upward and fills the space between the cylinder-head E^2 and the piston-head F. Should any of the burned gases remain they would be driven out by the higher pressure of the new gas. The continued revolution of the fly-wheel now moves the piston upward until the inlet and exhaust ports are cut off and the charge of gas is compressed between the piston and cylinder heads. The movement continues until the spring e' comes into contact with the wire F^3 and passes over and separates therefrom, when a spark will be formed that will ignite the charge of compressed gas, thus forcing the piston-head downward to its lower position; but as the piston-head reached its upper position and the gas was ignited by the spark the inlet-port f^3 and exhaust-port f^4 have registered with the inlet-port J^6 and exhaust-port J^7, the return stroke of the pump has filled the lower end of the cylinder with the new charge of gas, and as the piston moves down the charge of gas in the lower end of the cylinder is compressed and the operation is repeated. Thus the piston in each cylinder is driven in each direction by an explosion of gas. As will be seen by reference to Fig. 1, the piston in the cylinder A' is slightly in advance of the piston in the cylinder A, so that the piston in the cylinder A' will reach the end of its stroke and start back slightly in advance of the piston in the cylinder A. This has the effect of tilting the arm H at each end of each stroke of the pistons, and this tilting of the arm H tilts the lower end of the pitman H' and carries the crank on the crank-shaft over its dead-center.

It will be seen that by the above mechanism I have very largely increased the capacity in a given weight and size of machine, because I have, in the first place, so arranged the mechanism that the piston-head is given an explosion at each of its strokes, or, in other words, at each half-revolution of the crank-shaft; or, to put it in another way, the mechanism is so arranged that the explosion will take place on each side of the piston-head. This enables me to reduce the size and weight of the fly-wheel to a minimum and also to reduce the size and weight of the cylinder and the other parts to a minimum. Again, I have provided two cylinders such as above described, thereby again enabling for a given horse-power the reduction of the size and weight of the machine. Again, by means of the two cylinders and a single pitman for the two, I am enabled to obviate dead-centers and to concentrate the power of both cylinders upon the single point in the crank-shaft. Again, by the utilization of the piston-rod of the vapor-pump as a piston for the water-pump, I am enabled, without materially adding to the size or weight of or expense of the machine, to keep a constant circulation of water around the cylinders, thereby keeping them cool and increasing the explosive force of the gas. So also by this construction, after the mechanism is started, I can, by providing a suitable valve J' in the gas-inlet pipe J, admit more or less air with the gas and thereby decrease or increase, as desired, the speed of the engine without the necessity of applying braking-power to the fly-wheel.

It is obvious that many of the minor features of my invention might be altered or dispensed with without departing from the spirit thereof, and I would have it understood that I contemplate any obvious mechanical changes or substitutions for the parts shown and described.

What I claim is—

1. In a gas or vapor motor, the combination with two cylinders arranged adjacent to each other and pistons working therein, of a common pitman connected to and carried by both pistons, said pitman connected with the crank-shaft and having no connection or bearing except with the crank-shaft and pistons, substantially as described.

2. In a gas or vapor motor, the combination with two vertical cylinders arranged adjacent to each other, pistons in each, and each provided with an opening in its side, of a cross-head connecting the pistons, and a single pitman carried by the cross-head, the latter having no bearing or connection except with the pistons and pitman substantially as described.

3. In a gas or vapor motor, the combination of two vertical cylinders arranged adjacent to each other and each having an opening in its side, a piston in each cylinder, a single cross-head, one end of which is pivotally connected with one piston while the other end is pivotally connected with the other piston, and a pitman integral with or rigidly connected to the cross-head, said cross-head having no bearing or connection except with the pistons substantially as described.

4. In a gas or vapor motor the combination of two vertical cylinders, each having an elongated opening in the side, a piston-head in each cylinder, an opening in the side of each piston-head and a connection extending from each piston through the opening to a single shaft, said connection working in the vertical elongated slot in each cylinder and piston, substantially as described.

5. In a gas or vapor motor the combination of two vertical cylinders, a piston in each cylinder and connections from each piston to a common crank and crank-shaft, a gas-inlet and a gas-outlet for each cylinder and means for igniting the gas, in each cylinder, said parts so arranged that the gas in one cylinder will explode slightly in advance of the explosion in the other cylinder, substantially as described.

6. In a gas or vapor motor the combination of two vertical cylinders, each having a piston-head, a gas-inlet and a burned-gas outlet for each cylinder, connections from each piston-head to a common crank and crank-shaft and means for igniting the gas in each end of each cylinder, said parts so arranged that the gas in one end of one cylinder will explode slightly in advance of the explosion in the corresponding end of the other cylinder, substantially as described.

7. In a gas or vapor motor, the combination with two cylinders, each having a piston-head, a gas-inlet and a burned-gas outlet for each cylinder, a single pitman connected with each piston, and means for igniting the gas in each end of each cylinder, said parts arranged so that the gas in one end of one cylinder will explode slightly in advance of the explosion in the corresponding end of the other cylinder, substantially as described.

8. In a gas or vapor motor, the combination with the cylinder having inlet and outlet ports for the fresh and burned gases respectively, of the piston, having a deflector or diaphragm against which the fresh gases strike, said deflector having its side edges extended in a plane parallel with the longitudinal plane of the inlet and outlet, and said edges terminating closely adjacent to the outlet substantially as described.

9. In a gas or vapor motor, the combination with the cylinder having inlet and outlet ports, of the piston, having a flanged end, inlet and outlet ports in said flange, and a deflector opposite the inlet, said deflector having its side edges extended in a plane parallel with the longitudinal plane of the inlet and outlet, and said edges terminating closely adjacent to the outlet substantially as described.

10. In a gas or vapor motor the combination of a cylinder having inlet and outlet ports and an elongated slot in the side thereof, a piston in said cylinder having its end flanged to cover said elongated slot in the cylinder, a shaft connection extending from said piston through the cylinder-slot, inlet and outlet ports in the flange on the piston-head and a deflector opposite the inlet, substantially as described.

11. In a gas or vapor motor the combination of a cylinder having inlet and outlet ports, and an elongated slot in the side thereof, a piston in said cylinder having its end flanged to cover said elongated slot in the cylinder, a shaft connection extending from said piston through the cylinder-slot, inlet and outlet ports in the flange on the piston-head, and a deflector opposite the inlet, the end of the cylinder shaped to project inward and fill the space in said flanged end of the piston, substantially as described.

12. In a gas or vapor motor the combination of two vertical cylinders each having inlet and outlet ports, and an elongated slot in the side of each, a piston in each cylinder, each piston having at least one end flanged to cover said elongated slot in the cylinder, a shaft connection extending from each piston through the cylinder, a common crank-shaft, inlet and outlet ports in the flange on the piston-head, and a deflector in each piston-head opposite the inlet, the end of each cylinder corresponding with the flanged end of its piston-head projecting toward the interior of the cylinder to substantially fill the space within the flanged end of the cylinder, substantially as described.

13. In a gas or vapor motor the combination of two vertical cylinders each having an inlet and an outlet port, and an elongated slot in the side of each, a piston in each cylinder, each piston having each end flanged to cover said elongated slot in the cylinder, a shaft connection extending from the piston through the cylinder-slot, a common crank-shaft, inlet and outlet ports in each flange at each end of the piston-head, a deflector on each end of each piston-head opposite the inlet, each end of each cylinder projecting toward the interior of the cylinder to substantially fill the space within the flanged end of the piston-head, substantially as described.

14. In a gas or vapor motor, the combination with the cylinder having an inlet and an outlet opening, the latter being opposite to and somewhat larger than the former, of a piston having a cupped or flanged end, corresponding inlet and outlet ports in the piston-flange, and a diaphragm opposite the inlet, substantially as described.

15. In a gas or vapor motor, the combination with the cylinder, of the piston having a flanged end, and inlet and outlet ports therethrough, an electric contact, insulated from the cylinder, projecting to a point adjacent to the path of the piston, another opening in the piston-flange, and a contact-spring extending through the latter opening, substantially as described.

16. In a gas or vapor motor, the combination with the fly-wheel having an eccentric groove, of a rod, one end engaging the eccentric groove, a rod to which the eccentric-rod is engaged, said rod operating the gas-pump piston at one end and the water-pump piston at the other, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

LEVI S. GARDNER.

Witnesses:
W. H. CHAMBERLIN,
FLORENCE EMBREY.