(No Model.)

2 Sheets—Sheet 1.

L. H. NASH.

GAS ENGINE.

No. 271,902. Patented Feb. 6, 1883.

Fig. 1.

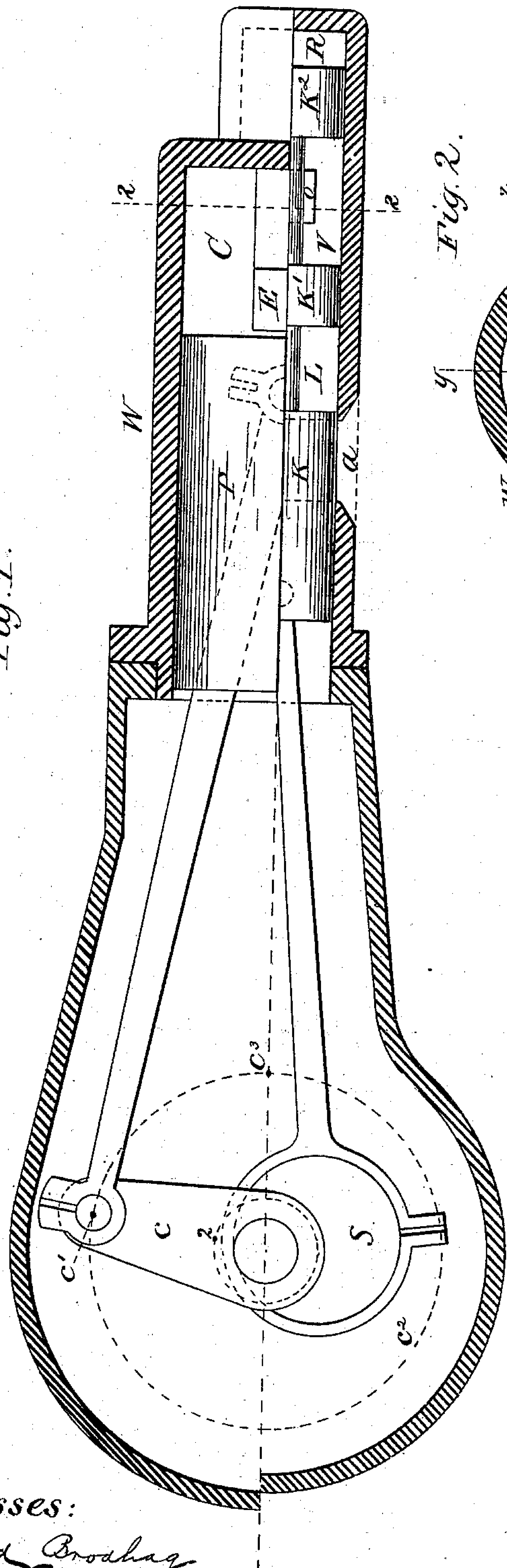


Fig. 2.

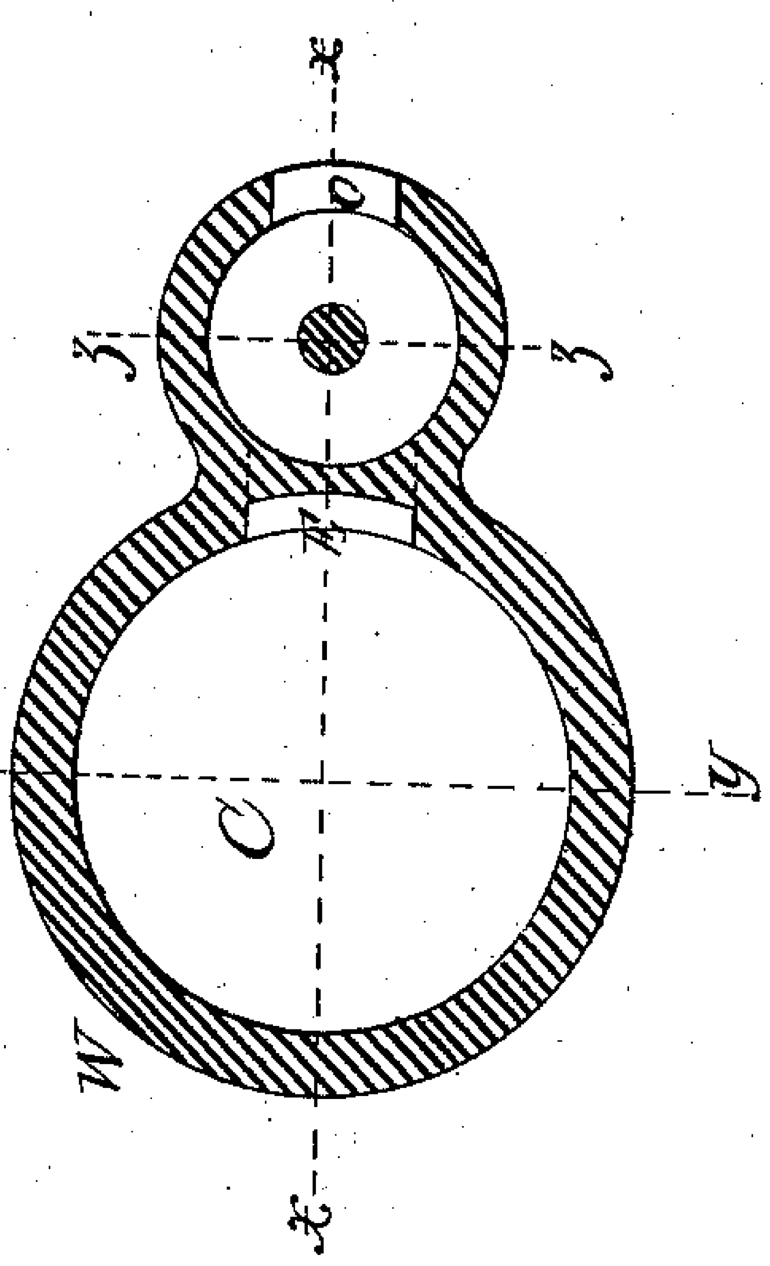
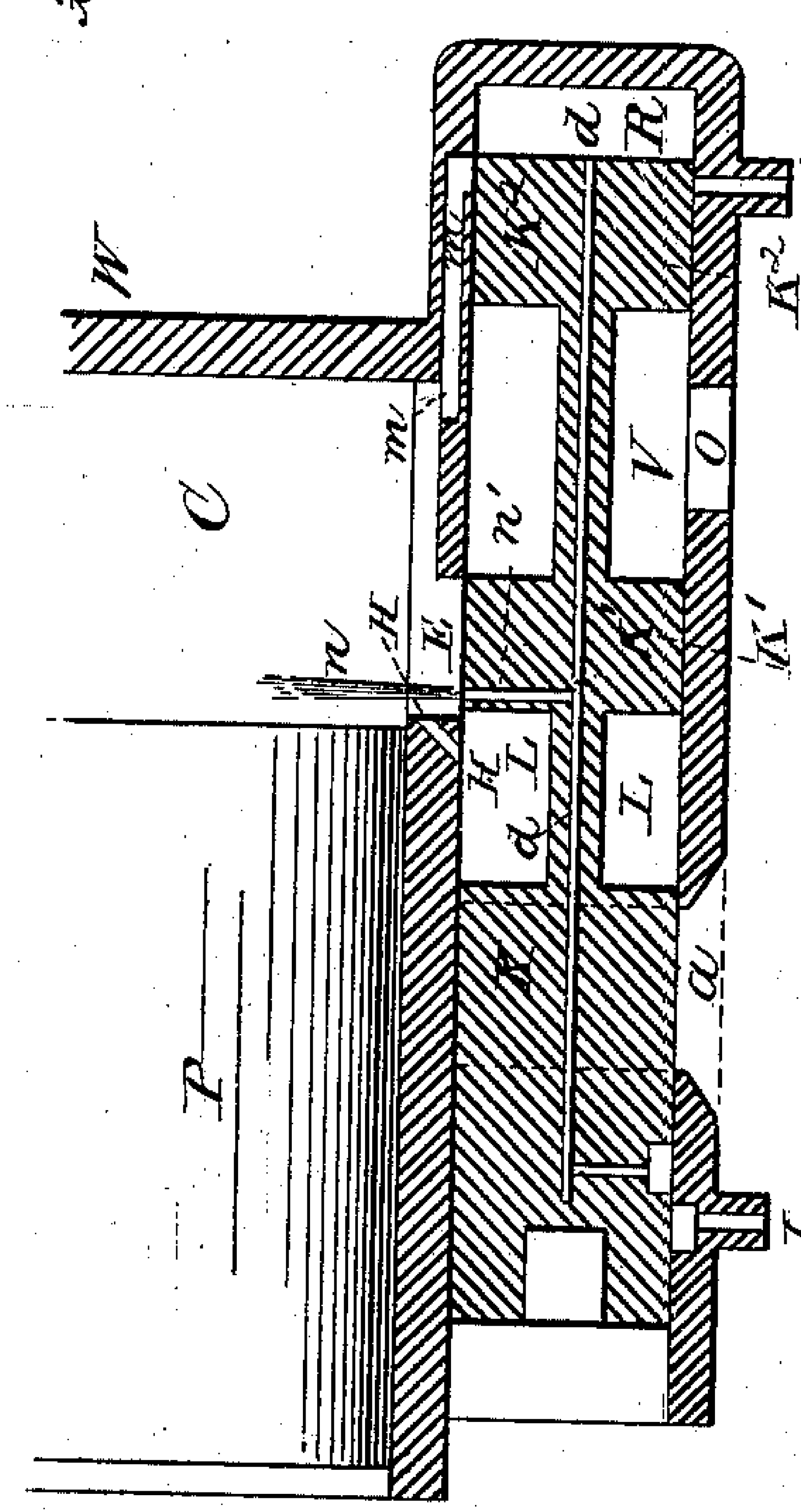


Fig. 3.



Witnesses:
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(No Model.)

2 Sheets—Sheet 2.

L. H. NASH.

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Fig. 4.

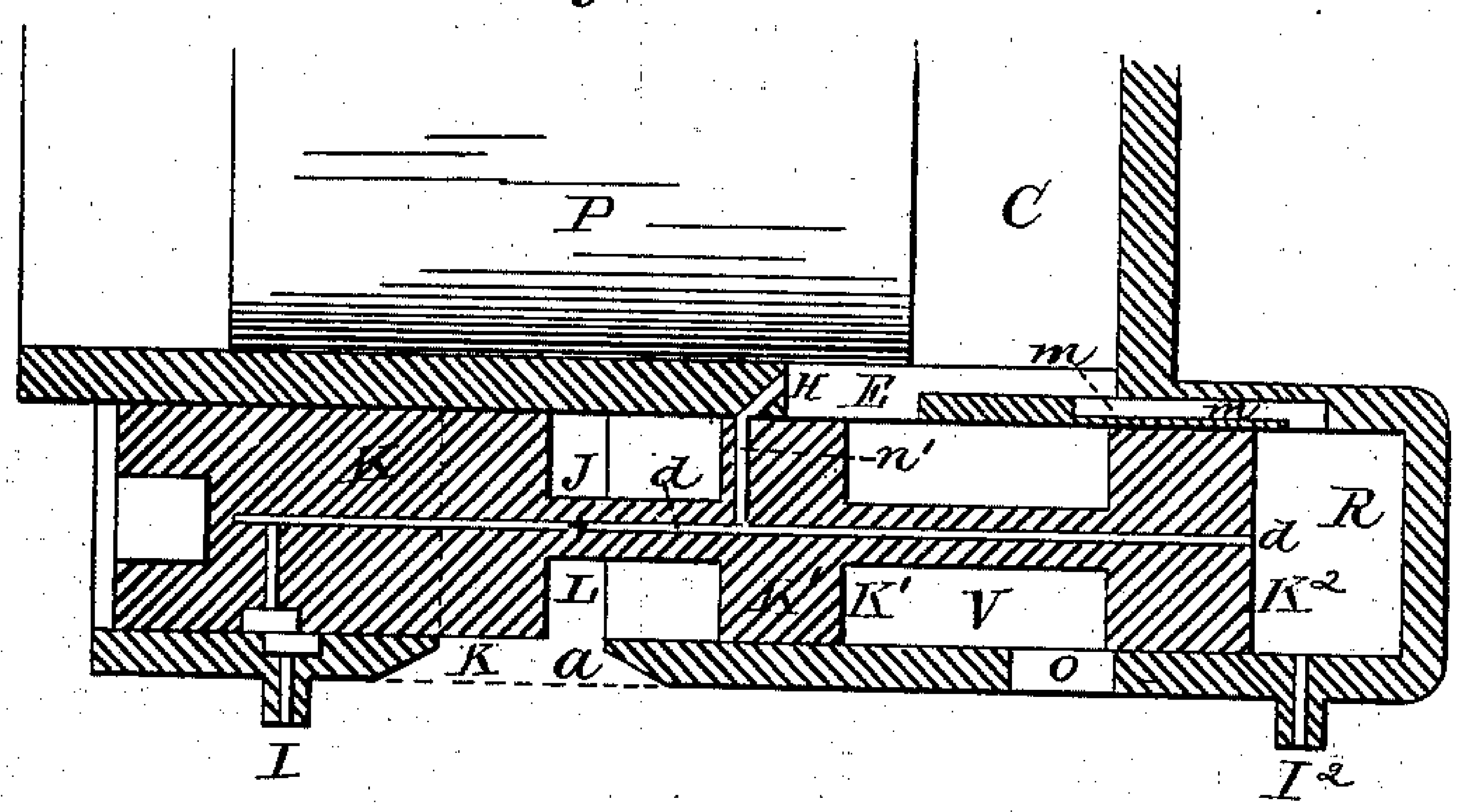


Fig. 5.

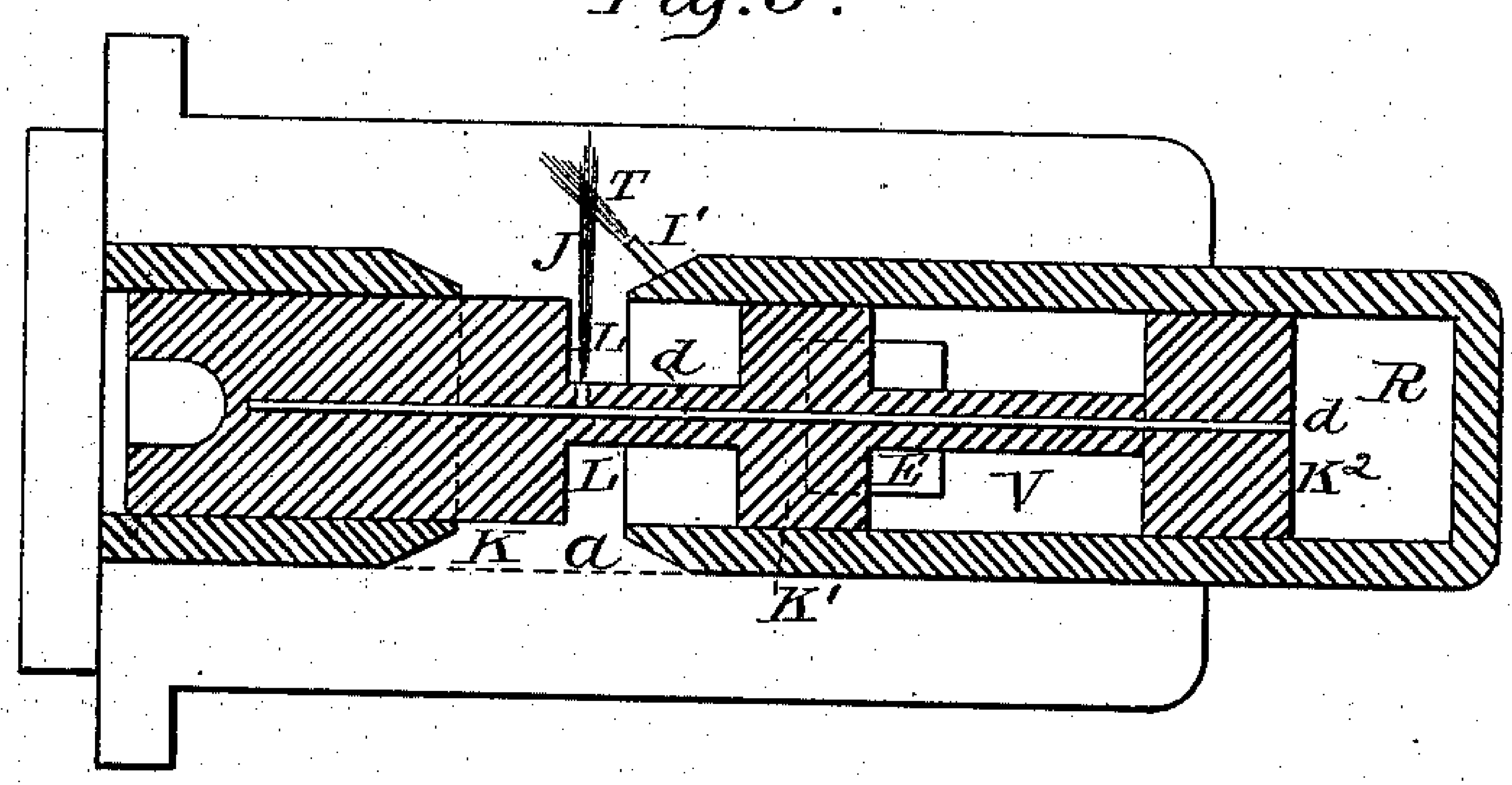
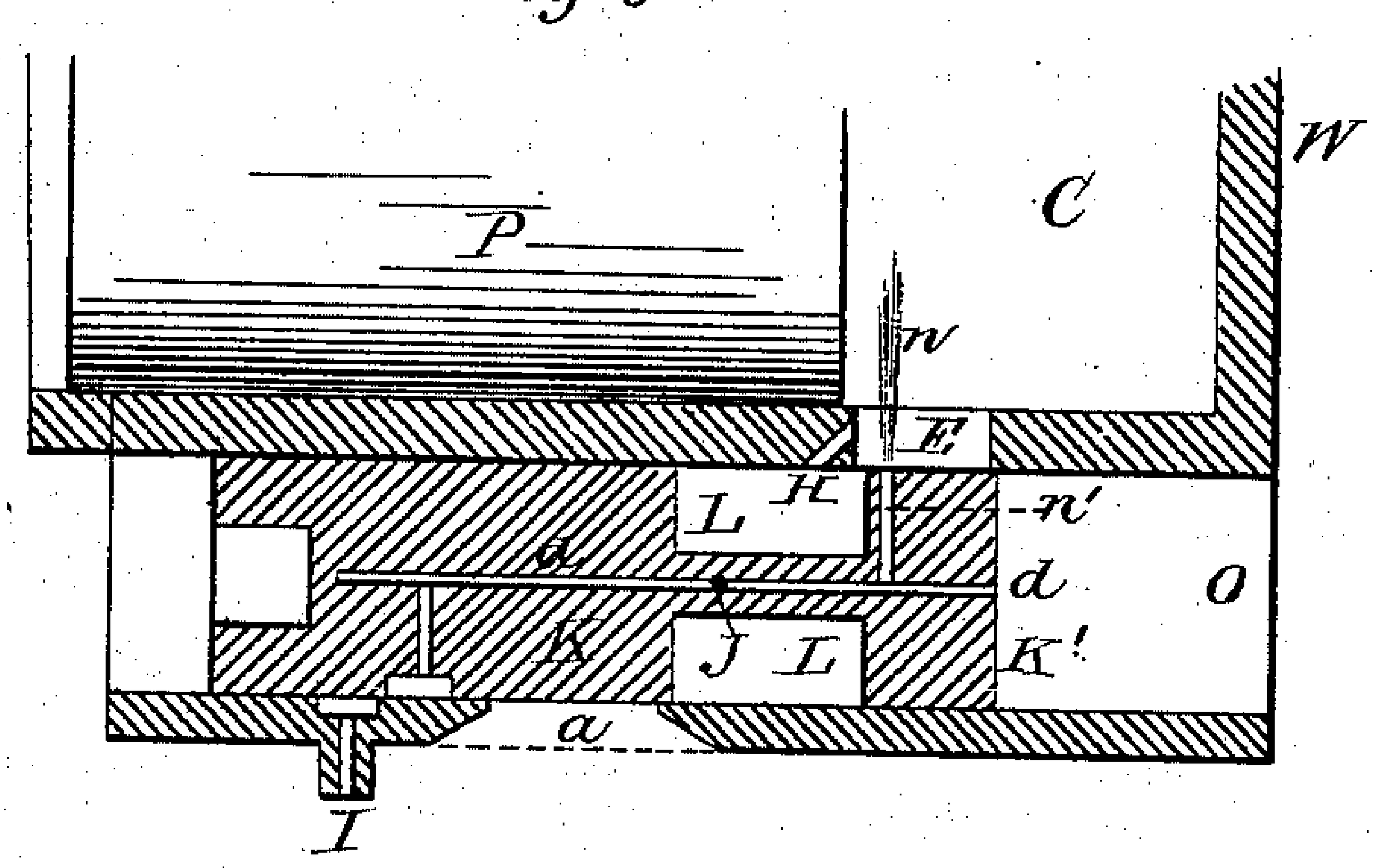


Fig 6



Witnesses:
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Inventor.
Lewis H. Nash
By Johnson and Johnson
Atty's

UNITED STATES PATENT OFFICE.

LEWIS H. NASH, OF BROOKLYN, ASSIGNOR TO THE NATIONAL METER COMPANY, OF NEW YORK, N. Y.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 271,902, dated February 6, 1883.

Application filed May 19, 1882. (No model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented new and useful Improvements in Gas-Engines, of which the following is a specification.

I have improved that class of motors in which a mixture of combustible gas or vapor and air is used as the source of power by being ignited within a cylinder containing a piston, so as to impart motion to the same by the expansive forces thereof; and the improvements relate mainly to the means employed for introducing the gases, cutting off the supply, igniting the gases within the cylinder, and excluding the waste gases therefrom.

The invention consists, first, in providing a valve and lighter combined in one piece, operated by an eccentric or crank, which shall perform all the functions of admitting the gases, cutting off the supply, lighting the charge, allowing the gases to expand, driving the piston forward until the expansive force is exhausted, allowing the spent gases to contract or condense, thereby producing partial vacuum, whereby the piston is returned through a portion of its stroke by atmospheric pressure acting against its external end, and then discharging the waste gases through the inlet-port; and, second, in the method of lighting the gases in the cylinder, which consists of a series of jets lighted one after another, and in a reservoir or chamber, by means of which a continuous flow of gas is secured, as will be hereinafter more fully described.

Reference being had to the accompanying drawings, making part of this specification, Figure 1 is a longitudinal section on the line *x x* of Fig. 2, showing in elevation the relative operative movements of the piston and valve, one side only of the piston and cylinder being shown. Fig. 2 is a transverse section of the cylinder and valve-casing, with the piston and valve removed, on the line 2 2 of Fig. 1. Fig. 3 is a longitudinal section on the line *x x*, Fig. 2, showing the position of the piston and valve at the instant the valve closes and ignition takes place. Fig. 4 is a like section, showing the inlet-ports uncovered in position for free admission of gas and air to the cylinder. Fig. 5 is a longitudinal section through the valve on the line *z z* of Fig. 2, showing the lighter-jets T and J; and Fig. 6 represents a modification in which the reservoir is dispensed with.

Like letters of reference indicate like parts in all the figures.

Referring to Fig. 4, P is the piston.

K K′ K^2 are sections of the valve formed by cutting it away to form the chambers L and V.

C is the space in the cylinder W, into which the mixture of gas and air is being admitted through the ports and openings O, *m*, H, and E.

R is a reservoir, into which gas is admitted through the pipe I^2, and from which the jet J is supplied in a continuous stream through the passage *d*, and from which it passes to the cylinder through the opening *m*.

The chamber V registers with the ports O and E, and serves as an inlet for the air, and an outlet for waste gases.

K′ is that portion of the valve forming in this case what is technically known as the "shield," and its function is to prevent the ignition of the gas in the cylinder until the parts assume the position shown in Figs. 1 and 3. There is an opening, *d*, through the valve, which connects the reservoir with the lighter space L, and by which the gas is supplied to the jet J. The purpose of this jet is to light jet *n* at every stroke when the valve is in the position shown in Fig. 3, while the purpose of jet *n* is to light the gases in the cylinder C.

n′ represents a passage which connects with the passage *d*, and through which a jet of gas enters the cylinder, its function being to ignite the gas in the cylinder when it reaches the port E.

H is a passage through which the gas escaping from the reservoir R and not consumed by the jet J can pass to the cylinder through E. This is a matter of much importance, for without this provision all the gas passing through *d* from R when the jet is not burning would remain in chamber L or pass into the open air.

T, Fig. 5, is an external jet, supplied with gas from the pipe I′ and kept constantly burning, its office being to light the jet J at every revolution of the engine.

The external lighter, T, burns continuously, and its purpose is to light the jet J at each stroke of the piston when the valve is in the position shown in Fig. 5, the jet *n* serving to light the gases in the cylinder C, and both jets are extinguished at every stroke.

In the operation of the engine, the valve being in the position shown in Figs. 4 and 5, the jets J and *n* having been extinguished by the previous stroke of the piston, the permanent jet T lights jet J. Gas, entering through pipe I, supplies J and fills the reservoir R through the passage *d*, and enters the cylinder through the passage *m*, the valve, moving back into the position shown in Fig. 3, is closing the reservoir R and displacing the gas therein. Now, when the valve is moving into the position shown in Fig. 3, there is a time when chamber L is opening communication with port E, and when this opening is wide enough the jet J will light jet *n*; but the exact amount of opening required for the flame from J to light *n* cannot be absolutely determined, so there is a time while this opening is being made any instant of which the ignition may take place. This movement of the valve may amount to one-sixteenth of an inch. It is important that inlet I be closed before this explosion does take place, and therefore to make sure that the inlet I shall always be closed such closing is made just before the port E is opened, thus shutting off the supply of gas from jet J; but the valve has yet a small movement to make before port E is opened enough to light *n*, and as the supply of gas to jet J is cut off this jet would be extinguished before this, if it were not for reservoir R. Since reservoir R is full of gas and valve K is moving into it, the gas in R can only escape through passage *d* and out through jet J and *n*. Therefore, although inlet I and the jets J and *n* are still maintained by gas from reservoir R while the valve is opening port E until the ignition of the charge, still all the gas in R will be forced out through J and *n* as the valve moves backward, said gas being burned until the valve has completed its backward stroke, at which time jets J and *n* will be extinguished. Thus it will be seen that by means of reservoir R the stream of gas is prolonged through J and *n* until after the ignition of the charge, thus making the lighter act quickly and certainly. The valve now begins its forward stroke, and reservoir R is receiving the waste gases from the cylinder until I is opened again, when the gas through *d* fills the reservoir again, forcing out some of the gases from the reservoir; but before the fuel begins to waste through the passage *m* and be lost with the discharged gases from C the piston begins its next forward stroke, and the gas from the reservoir is required for the next charge.

When the engine is not running at full power the charge of gas in the cylinder C is not large enough to produce a mixture that will explode instantly, and a little jet of flame from J through the port E might not light the charge; but by having a jet, *n*, of gas issuing into the cylinder C when jet J lights jet *n* it presents a broad surface of flame to the cylinder-gases in C, and they take fire immediately.

It will be seen from the foregoing description that a series of jets, T, J, and *n*, are provided, the two latter of which are successively lighted, one after another, until the final ignition in the cylinder takes place.

It will also be observed that by these means a continuous flow of gas to the cylinder is kept up until the instant of explosion without the use of an independent cut-off or a check-valve in the gas-passage to prevent the gas being blown back into the supply-pipe when the explosion occurs.

It is not essential that gas only should be admitted to the receiver R, for a mixture of air and gas in proper proportion will produce the same results, and in some cases it will be advantageous to so proportion and mix the air and gas before its admission to the reservoir, for a continuous jet of mixed air and gas forced into the lighting-chamber would continue to burn after all the air it contained had been consumed.

When gas alone is used the jet J should be so directed that it will carry all the waste gases out of the chamber through the port *a*, so that it may be filled with pure air; otherwise, instead of igniting the jet *n* when the shield K′ uncovers the port E, it would be extinguished by excess of gas in the chamber. This is particularly true of small motors. In large machines the direction given the jet would not be material, for in such cases the chamber would contain so large a quantity of air as not to be materially affected by the comparatively small accumulation of waste gases.

The construction might be so modified as to dispense with the receiver R when such a system of jets are employed by providing an additional inlet, as at I, placing a check-valve in the passage leading to the supply-pipe, and providing a suitable cut-off to prevent the inflow of gas to the cylinder during the outflow of the waste gases, and again admit it when such gases have escaped and fresh air is entering the cylinder.

In Figs. 1 and 3 the positions of the valve and piston are shown at the instant the mixed air and gases in the cylinder are ignited, the sections of the valve K′ K² having closed all the ports and passages except H, which opens into the now closed lighter-chamber L. The gases, having been ignited, now expand, driving the piston rapidly forward, in the meantime losing their heat by expansion and radiation, so that when the piston has reached the outer end of its stroke the pressure of the gases in the cylinder will have fallen to that of the atmosphere. While the crank is moving over the center and beginning its backward stroke the gases will be giving out more of their heat to the cylinder, so that when the piston is just beginning its backward stroke the pressure of the gases within the cylinder will be made less than that of the external air. Hence the external air will force in the piston until the gases in the cylinder have been raised to the pressure of the atmosphere, when the valve opens, allowing them to escape into the air at the time the eccentric S has reached the position indicated at 2. The section K′ of the valve now opens the port E, and the waste gases pass out through V and O into the open air until the crank c arrives at the point c^3. The piston, now advancing, draws in air through the passages O, V, and E, and gas through m and H until the crank arrives at the point indicated by c', when the valve again closes the ports E and m, and at the same time opening communication between the lighter space L and the port E, so that the gases are lighted for another stroke.

It will be observed that air is admitted and the waste gases discharged through the same port, which admits of the use of a very simple valve mechanism.

It will also be observed that the engine may be made double-acting by providing a valve and system of lighters for each end of the cylinder.

Referring to the lighting system, it will be observed that, in addition to the jets T and J heretofore employed, I have provided a jet, n, so located as to enter the port E at the moment when it is desired that ignition shall take place, when it will quickly catch the flame from the chamber and communicate it to the gases in the cylinder.

The operation is as follows: The valve being in the position shown in Fig. 5, the jet J passes out from the chamber L, and is lighted by the constantly-burning jet T, and at the same time all the waste gases remaining in the chamber L escape, allowing it to be filled with pure air. As the valve advances to the position shown in Figs. 3 and 6 there is enough air in the chamber L to keep the jet J burning, and all the gases as fast as formed are drawn away through the hole H until the chamber L communicates with the port E, when the flame lights the jet n, which again lights the charge in the cylinder. Both jets J and n are extinguished at each stroke of the piston. The function of the reservoir R is performed as follows: Gas is admitted to it at any point in the casing, as at I or I^2, the valve K being so arranged as to shut off the supply to the cylinder before the ignition takes place. While the piston is pressing out the waste gases the reservoir R is enlarging, so that it becomes filled with gas, and when the piston begins its forward stroke gas is admitted to the cylinder through the passage m, and when the influx of gas is shut off at I^2 the valve entering the reservoir forces out a stream of gas through the passage d, thereby keeping up a continuous flow of gas through the jets J and n, so that there will be no interruption of the jet until the gases in the cylinder are lighted. It will therefore be observed that the function of the reservoir is to hold the gases from passing into the cylinder while the waste gases are escaping therefrom, and at the proper time supplying it with such gases, and constituting in conjunction with the valve a force-pump, by means of which the jets J and n are supplied with gas to ignite the charge in the cylinder.

In the modification shown in Fig. 6 the reservoir is dispensed with, the operation of the jets being the same as above described, the gas being supplied to the engine through a valve in any convenient manner. The position of the inlet and discharge passage is the same as before, making the same combination with the eccentric and piston as in the other cases.

I claim—

1. The method of operating an explosive gas-engine, which consists in admitting to the working-cylinder a charge of gas from a reservoir or other source of supply, and a charge of air from a separate chamber, igniting the same by successive jets, and finally discharging the waste gases through the same port and chamber by which the charge of air is admitted, substantially as herein set forth.

2. A gas-engine in which a charge of gas is admitted to the working-cylinder from a reservoir controlled by a suitable valve, and a charge of air from a chamber formed between the pistons of the controlling-valve, and ignited by means of a jet supplied with gas from the reservoir, conducted through the main valve and introduced into the working-cylinder at the point where the explosion is desired to take place, substantially as herein set forth.

3. The combination, with the reservoir R and the chamber L, of the jets J and n and the cylinder W, arranged and operating substantially as described, and for the purpose set forth.

4. The combination of the reservoir R, chamber V, lighter-space L, port E, jet n, and the cylinder W, substantially as shown and described.

5. The valve composed of the sections K K′ K^2, forming chambers L and V, and provided with the passages d and n', substanstantially as described.

6. The combination of the cylinder W, port m, reservoir R, chamber V, and jets J and n, substantially as set forth.

7. The combination of the cylinder W, reservoir R, port m, chamber V, ports o and E, and means, substantially as described, for igniting the explosive mixture in the cylinder.

8. The combination of the cylinder W, reservoir R, chambers V and L, ports m O E H, and jets T, J, and n, substantially as described, for the purpose specified.

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

LEWIS HALLOCK NASH.

Witnesses:

WM. M. BROWN,

CHRISTOPHER C. WHITTEMORE.