(No Model.) 2 Sheets—Sheet 1.

L. H. NASH.

METHOD OF IGNITING THE CHARGES IN GAS ENGINES.

No. 386,214. Patented July 17, 1888.

Fig. 1.

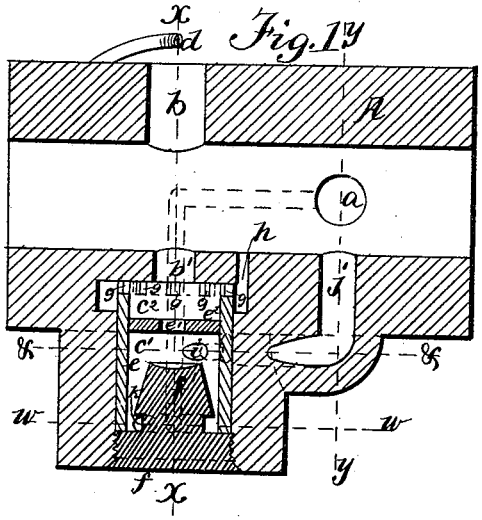


Fig. 2.

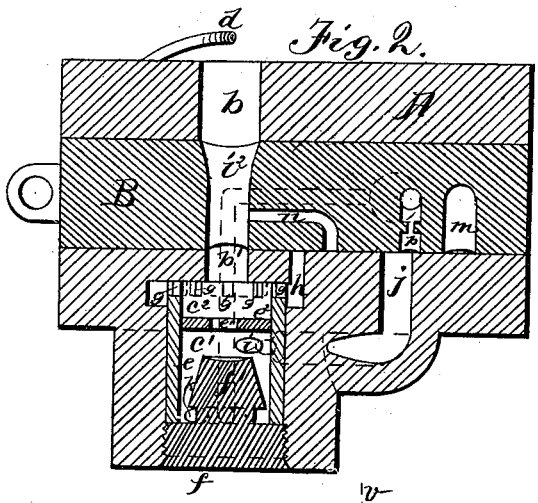


Fig. 3.

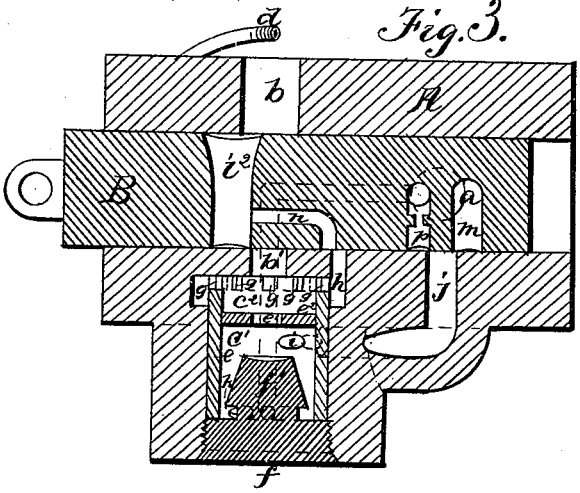


Fig. 4.

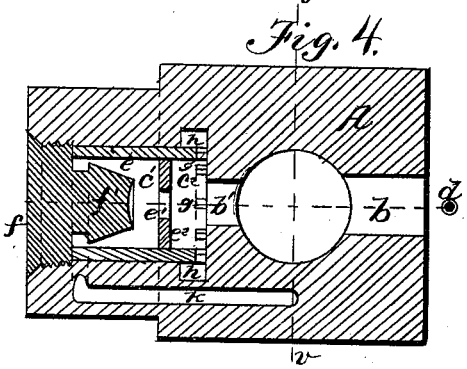


Fig. 5.

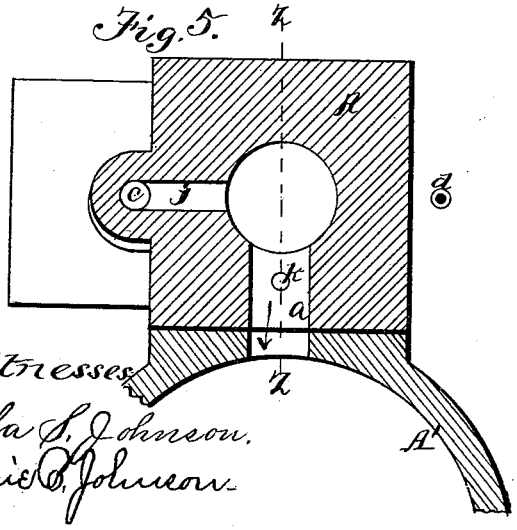
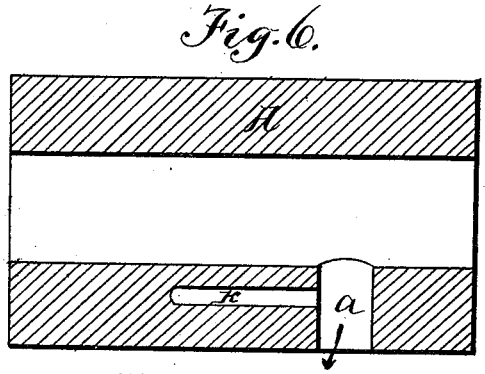


Fig. 6.



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(No Model.) 2 Sheets—Sheet 2.

L. H. NASH.

METHOD OF IGNITING THE CHARGES IN GAS ENGINES.

No. 386,214. Patented July 17, 1888.

Fig. 7.

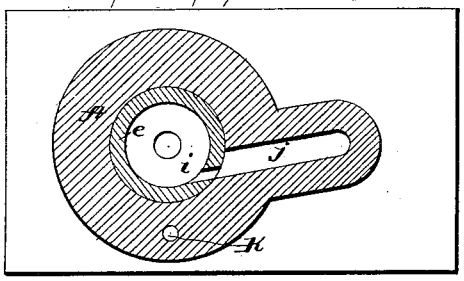


Fig. 8.

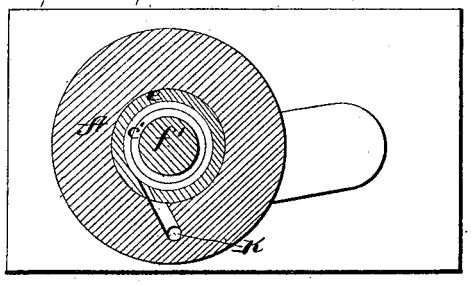


Fig. 10.

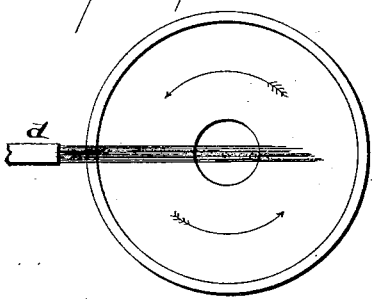
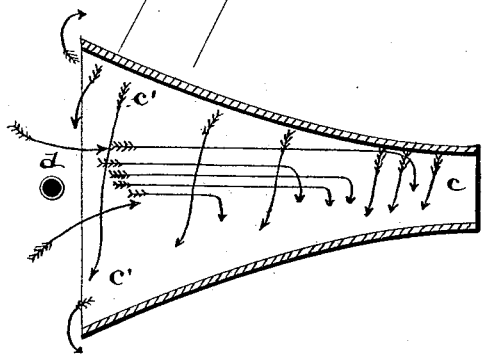


Fig. 9.



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UNITED STATES PATENT OFFICE.

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METHOD OF IGNITING THE CHARGES IN GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 386,214, dated July 17, 1888.

Application filed October 5, 1886. Renewed July 14, 1887. Serial No. 244,260. (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 the Method of Igniting the Charges in Gas-Engines, of which the following is a specification.

In a patent granted to me February 17, 1885, No. 312,499, for improvements in igniters for gas-engines I have shown, described, and claimed an igniting device in which a combustible mixture is admitted into a circular ignition-chamber in a whirling jet, which is ignited by an external lighter-jet through a port at the circumference of said chamber, the communication with the exterior lighter-jet being controlled by a valve. A port centrally located in said chamber is also operated by said valve to make communication with the charge in the power-cylinder to effect its ignition.

In my present improvement I also use an ignition-chamber which has a passage supplying it with a whirling jet, and also ports communicating alternately with an exterior ignition-jet and with the cylinder-charge controlled by a valve; and it is in connection with such whirling-jet chamber that I have so improved the operation of the passages communicating with the ignition-chamber as to cause an instantaneous flash of the flame through said ignition passages and ports when opened by the valve, and at the same time to prevent the opening and closing of the said ports from interfering with the action of the flame in the ignition-chamber.

My present improvement is directed to a method of causing gas to burn with a steady flame within a chamber, and to employ this flame to alternately ignite the cylinder-charge and to be ignited by an external permanent burner.

My present improvement is based upon and is the results of a long series of experiments by which the peculiar properties of gases of various kinds under pressure have been determined and applied.

My invention embraces a method of effecting the transmission of a flame along an ignition-passage against the flow of the current by causing the gases to flow in a manner to produce a reverse central current in said passage, along which central current the flame is transmitted.

My invention embraces a method of igniting the gases through a passage having a spiral and centrally-returning current to an ignition-chamber, and of igniting the charge in the power-cylinder from the flame in said ignition-chamber.

My invention embraces a method of effecting the ignition of the charge in the power-cylinder by causing some of the gas to flow through a retarding-passage communicating with a burner, closing communication with said burner, thereby stopping the flow from the power-cylinder and causing the flame to pass through the said supply-passage to the power-cylinder.

My invention embraces a method of igniting the charge in the power-cylinder by causing some of the gases to flow from said cylinder into an ignition-chamber with a whirl, igniting the gases therein from a burner, closing communication with said burner and opening communication with the power-cylinder to effect the lighting of the charge from said ignition-chamber through tangential passage.

My invention embraces a method in which the flowing currents are changed from a whirl to a converging cone, while at the same time maintain the whirling motion of the gases in the ignition-chamber and to produce a steady flame.

Other features of my invention will be pointed out in the claims concluding this specification.

In the accompanying drawings I have shown an ignitor device which it will be understood can be used with any gas-engine for carrying out my invention, and which I will now proceed to describe preparatory to a specific designation of the matters and things which I claim as new in the method of igniting a combustible charge in a gas-engine.

In the drawings, Figure 1 represents a central longitudinal section of the ignitor-case, taken on the line *m n* of Fig. 4, the valve being removed. Figs. 2 and 3 show similar views

with the valve in different positions. Fig. 4 is a cross-section of the valve-case, taken on the line *x x* of Fig. 1. Fig. 5 is a similar section taken on the line *y y* of Fig. 1, showing the combustion-chamber in communication with the valve-chamber. Fig. 6 is a longitudinal central section of the valve-case, taken on the line *z z* of Fig. 5. Fig. 7 shows a section of the valve-case, taken on the line & & of Fig. 1, and Fig. 8 is a section of the valve-case, taken on the line *w w* of Fig. 1. Figs. 9 and 10 represent flame and jet passages, illustrating the action of the gases when issuing from a passage with a whirling motion.

The formation, shape, and location of the ignition-chamber are not limited to any special construction, and it may be either formed in the valve or in the case, or in a depression of the joint-forming case of either, the essential feature being that it is so formed that when the gases arrive at the external orifice, *b*, they will flow in such a quiet manner as to be easily lighted by said jet.

Referring to the lighter shown in Figs. 1 to 8, the construction and form are such as I prefer to use. The lighter consists of an inclosing-case, A, having a cylindrical chamber in which a plunger-valve, B, operates. The case has an ignition-port, *a*, which communicates through the valve with the combustion-chamber of the power-cylinder A′, and it has an ignition-chamber, c' c^2, formed in its walls, which communicates through case ports *b b′* and through the valve with the external lighter-jet, *d*. The case-ports *b b′* are placed on opposite sides of the case-chamber and open into it in line with the ignition-chamber c' c^2, and the communication between them is made by means of an intermediate ignition-chamber, c^2. The ignition-chamber is formed in one side of the casing, and the external lighter is placed at the other side, and the communication between them is made direct through the valve-port i^2. The ignition-chamber is formed of two adjacent communicating spaces, c' c^2, within a bushing, *e*, inserted in the case, and closed at its outer end by a plug, *f*, which has a conical extension, *f′*, entering the chamber c^2. A plate, e^2, within the bushing divides the ignition-chambers and has a central communicating opening. The inner end of the bushing *e* has circumferential holes *g*, which connect the ignition-chamber c^2, by means of a case-wall passage, *h*, with the valve-chamber. The bushing *e* has a side orifice, *i*, which enters chamber c' tangentially and connects the latter, by means of a case-wall passage, *j*, with the valve-chamber at the same side thereof as the wall-passage *h*, so that each ignition-chamber has a separate communication with the valve-chamber. A wall-passage, *k*, also leads from the case-port *a* to the chamber c', entering it tangentially between the projection *f′* and the walls of the bushing, as shown in Figs. 4 and 8. The valve has a cross-port, i^2, which opens communication between the case-ports *b b′*, a port, *m*, which opens communication between the case-ports *j* and *a*, the port *n*, which operates the case-port *h*, and may also have the port *p* placed between the ports *m n* for making communication between the case-ports *a* and *j*. The construction which I have described and shown of my preferred plan gives an ignitor-chamber of two communicating spaces, each having two separate and distinct passage communications with the case-chamber, and each having separate and distinct communication with valve-ports. The function of the conical projection, which I have described as entering the ignition-chamber and around which the gas enters the latter, is to form a conical enlarging-passage for the jet issuing from the passage *k* into the chamber c', and in this particular is identical in its operation with the other forms of enlarging-passages, and is for the purpose of retarding the flow of the gas. It is a convenient means for forming an enlarging conical passage in a short space, whereby to effect the retardation of the flow.

The operation of the ignitor has two phases; first, the ignition of the flame in the ignition-chamber c' by the external burner, *d*, and, second the ignition of the charge at the port *a* from the flame in the said chamber. The first phase in the operation is illustrated in Fig. 2, in which the valve is in a position which allows the combustible mixture from the port *a* to pass through the case-wall passage *k* and enter the ignition chamber c' with a tangential whirl, passing through the hole e' in the division-plate e^2 into the ignition chamber c^2, then out through the ports *b′*, i^2, and *b* to the lighter-jet *d*. The flame then instantly flashes back into the chamber c', wherein it burns with a steady torch-flame. This whirling flame is very permanent and will remain burning under all variations in the velocity of the flow of the gaseous supply. This permanent flame is due to the whirling motion of the gases, whereby the centrifugal force tends to retain them in contact with the chamber-walls. They are therefore retained in the ignition-chamber sufficiently long to be completely ignited, and the products of combustion escape from the center of the flame through the hole in the division-plate e^2 and out through the connecting-passages. An important feature of this whirling movement of the gas-jet consists in the facility which it affords to the flashing of the flame from the external burner, *d*, to the chamber c' through the long connecting-passage. The flame is not readily communicated through a passage against the flow of the current of the combustible mixture; but the whirling motion of the escaping gases gives the advantage that, while there is an outwardly-flowing circumferential current in the connecting-passage, there is also an inwardly-flowing central current through the center of the same passage at the same time, and it is by means of this centrally-inflowing current that the flame from

the external lighter-jet is instantly transmitted to the ignition-chamber. This operation I will now particularly describe, referring to Figs. 9 and 10. Fig. 9 shows a channel having an outwardly-flowing spiral current, as indicated by the spiral arrows.

The whirling movement of the current causes a rarefaction of the gas in the center of the whirl, which causes a current to flow inwardly, as shown by the central arrows. The instant the flame of the lighter-jet *d* is communicated to the center of this whirling current it flashes along the center of the passage to its inner chamber. The second phase in the operation of the ignitor in igniting the cylinder-charge is shown in Fig. 3, in which the valve has closed the communication between the chamber *c' c²* and the external lighter-jet and is just opening communication between the ports *a* and *j* through the valve-port *m*, so that the combustible mixture passes through the port and passage *j* and *i* into the ignition-chamber *c'* with a whirling motion, and burns therein with a whirling flame. It will continue to burn therein as long as there is a flow of the gases through the orifice *i*. The instant the flow ceases through said orifice the flame will flash back through it and along the passage *j* to the valve-port *m*, if the latter has been opened wide enough to permit the flame to pass through said port-opening. In order to make certain that the said port shall be wide open before the flow of the gas ceases, I provide ports *g* and *h*, which lead from chamber *c²* to the valve-port *n*, which is not closed by the motion of the valve until after the port *b'* has been closed and the valve-port *m* is sufficiently opened; hence, after the valve has closed port *b'* and opened port *j*, the flow of the gaseous mixture continues through the port *i²* and escapes from chamber *c²*, through the wall-ports *g* and from the passages *h*, *n*, and *b* until the valve closes communication therewith, when the flow ceases through the orifice *i*, and the flame instantly flashes from *c'* through ports and passages *i*, *j*, and *m* to the charge in the port *a*.

Referring now to the ignition chamber *c' c²* and the wall-passages *g*, their function is as follows: It is important that the whirling motion of the flame in chamber *c'* shall not be obstructed or interfered with, and so long as the valve is in the position shown in Fig. 2 the connecting-passages are all concentric and there is nothing to disarrange the whirling motion of the gases; but as the valve closes the port *b'* and the gases are forced to escape through a small opening with great velocity the direction of the flowing currents near said orifice are entirely changed from that of the whirl to a converging cone. The dividing-plate *c²* is provided, in order to separate the conical current from the whirling, and this prevents the latter from overcoming the whirling motion in chamber *c'*. To still further decrease the injurious effect of the conical currents, I provide circumferential escape-ports *g*, from which the gases in chamber *c²* can escape. The flow of the gases through the holes *g* in the side walls does not have any injurious effect upon the whirling motion of the gases in the chamber *c'*.

Referring to the supply-passages *k* and *p*, when the ignitor is operating with a combustible mixture highly compressed, the mixture will be supplied to the ignition-chamber *c'* under a great velocity when the valve is in the position shown in Fig. 2; and in order to prevent too much of the mixture from flowing into said chamber I provide a separate source of supply at this time of much smaller capacity than that of the ignition-passage *j*. This may be done by separate passages, as at *k*, which has a separate opening into the ignition-chamber *c'*; or it may be by passage *p*, which opens into the ignition-passage *j*, formed either in the valve or case. Wherever formed its office is to supply the chamber *c'* with a limited amount of the gases when the said chamber is in free communication with the external lighter, the ignitor-port *j* being opened when the external lighter-ports *b b'* are nearly or quite closed.

The method of effecting the communication between the ignition-chamber and the highly-compressed gases of the charge in the combustion-chamber is such that the inrush of the charge is prevented from extinguishing the flame in the ignition-chamber, because the latter receives its jet-supply tangentially to its walls. When, however, the ignition-chamber receives its supply otherwise, this trouble of extinguishing the light is constantly liable to occur, because the pressure of the gases in said chamber is at first the same as that of the external air, and said chamber must open communication into the highly-compressed gases of the charge, which are liable to extinguish the flame by their sudden inrush unless they are directed around the walls of the chamber, as stated.

The escape-ports *g* and *h* may be dispensed with and still the ignitor would operate with fair results; but I prefer to use them because they render the action more certain. I may dispense with the passage *k* and cause the gases to enter the chamber *c'* by some other channel, as by a port, *p*, of the valve through the channel *j* and orifice *i*, the flow and operation of the gases being in all cases substantially as herein set forth.

The ignitor device herein specifically described and shown is not claimed herein; but as an ignitor constituting one perfected means for carrying out a specific new method it is made the subject of a separate and distinct application for a patent filed by me of even date herewith, under Serial No. 244,261, and it is only the method of igniting the charge for a gas-engine that forms the subject-matter of my claim herein.

My invention is not limited to the exact construction and operation of the devices described, but includes the use of equivalent de-

vices and combinations which perform substantially the same functions. Neither is my invention limited to the conjoint or combined use of the elements described, but involves also their use separately, as indicated in the concluding claims.

Other features of invention described or illustrated but not claimed are made the subject of other applications.

I claim—

1. The method substantially herein described of igniting a charge of combustible gases, which consists in supplying a jet of gas to an ignition-chamber having a valved communication with an external lighter through a supply-passage, closing communication with said external lighter and effecting the ignition of the charge in the engine from the ignition-chamber through the said supply-passage.

2. The method substantially herein described of effecting the ignition of the charge in a gas-engine, which consists in supplying the ignition-chamber through a passage open to an external lighter to effect the ignition in said chamber, closing such igniting communication, and causing the flame to pass back and ignite the charge in the engine through the same supply-passage, as described.

3. In an igniting device for gas-engines, the method substantially herein described of effecting the ignition of the charge along a connecting-passage, which consists in causing the gases to flow through said passage in an unbroken spiral or whirling current to the igniter, thereby creating a reverse central current in said passage along which the flame is transmitted, for the purpose specified.

4. The method substantially herein described of igniting a combustible charge for a gas-engine, which consists in causing some of the gas to flow into a circular ignition-chamber with a tangential motion, igniting the gases through a valve-port by an external burner, closing said port, and igniting the charge in the engine from said ignition chamber through a tangential supply-passage, for the purpose specified.

5. The method hereinbefore described of effecting the ignition of a combustible charge of gas in the engine, which consists in effecting the combustion of a portion thereof in an intermediate ignition chamber having valved communication with an external lighter, effecting the ignition of the charge through a passage entering said ignition-chamber tangentially and connecting it with the combustion-chamber of the power-cylinder.

6. The method of igniting the charge in a gas-engine, which consists in causing a portion of the charge to flow into an ignition-chamber with a spiral whirling jet to an external burner to effect the ignition in said chamber, closing communication with said chamber, closing communication with said external burner, and opening communication with the power-cylinder to effect the ignition of the charge.

7. The method herein described of igniting the charge in the combustion-chamber of a gas-engine from an intermediate ignition-chamber, which consists in causing a portion of the charge from the former to float into the latter with a whirling motion, igniting the gases therein by an external burner and effecting the transmission of the flame in a direction opposite to that of the flowing current by stopping the flow of the latter.

8. The method substantially herein described of effecting the ignition of the charge in the combustion-chamber of a gas-engine from an ignition-chamber, which consists in opening communication between them through a passage having a tangential relation to the ignition-chamber, whereby the entering gases are caused to circulate around said chamber in whirling currents, substantially as and for the purpose specified.

9. The method substantially herein described of igniting the charges in a gas-engine, which consists in causing gas to flow through an ignition-chamber with an unbroken spiral whirling jet to an ignitor to effect the ignition in said chamber, closing communication with said ignitor, and opening communication with the power-cylinder to effect the ignition of the charge.

10. The method substantially herein described of igniting the charge in the power-cylinder of a gas-engine, which consists of igniting a charge of combustible gases through a passage having an unbroken spiral or whirling current flowing toward a lighter, and a centrally-returning current leading to an ignitor-chamber and igniting the charge in said power-cylinder from the flame in said ignition chamber.

11. The method substantially herein described of igniting the charges of a gas-engine, which consists in causing gas to flow into an ignition-chamber with an unbroken spiral or whirling motion, igniting said whirling gas by applying a lighting device to the center of the whirling gas within said chamber and igniting the charge of the engine from said ignited gas.

12. The method substantially herein described of igniting the charges in the power-cylinder of a gas-engine, which consists in supplying the ignition-chamber with gas caused to impinge with a rotary flow upon its walls, and igniting such rotating body by a flame transmitted from an external light to the center of such whirling body.

13. The method herein substantially described of igniting the charge of a gas-engine, consisting of causing gas to enter and whirl about an ignitor-chamber, igniting said whirling gases and opening communication between said chamber and the power-cylinder, and causing the back-pressure of the gases contained in said power-cylinder to enter and whirl about said ignitor-chamber.

14. The method substantially herein described of igniting the charge of a gas-engine, consisting of supplying an ignitor with a charge

of gas, igniting said gas and opening communication between said chamber and the power-cylinder and causing the back-pressure of the gases contained therein to enter and whirl about said ignitor-chamber.

15. The method substantially herein described of igniting a charge of combustible gases, which consists in supplying a jet of gas to an ignition-chamber having a valved communication with a lighter through a supply-passage, so as to cause said gas to whirl about said chamber, closing communication with said lighter and effecting the ignition of the charge in the engine from the ignition-chamber through said supply-passage.

16. The method substantially herein described of igniting the charge of a gas-engine, consisting of supplying an ignitor with a charge of gas, igniting said gas, opening communication between said chamber and the power-cylinder, and also between said chamber and an escape-passage, and causing the back-pressure of the gases contained in said cylinder to enter and whirl about said ignitor-chamber.

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

LEWIS HALLOCK NASH.

Witnesses:
H. W. BRINCKERHOFF,
WILLIAM C. WESTERVELT.