(No Model.) 3 Sheets—Sheet 1.

L. H. NASH.

GAS ENGINE.

No. 583,627. Patented June 1, 1897.

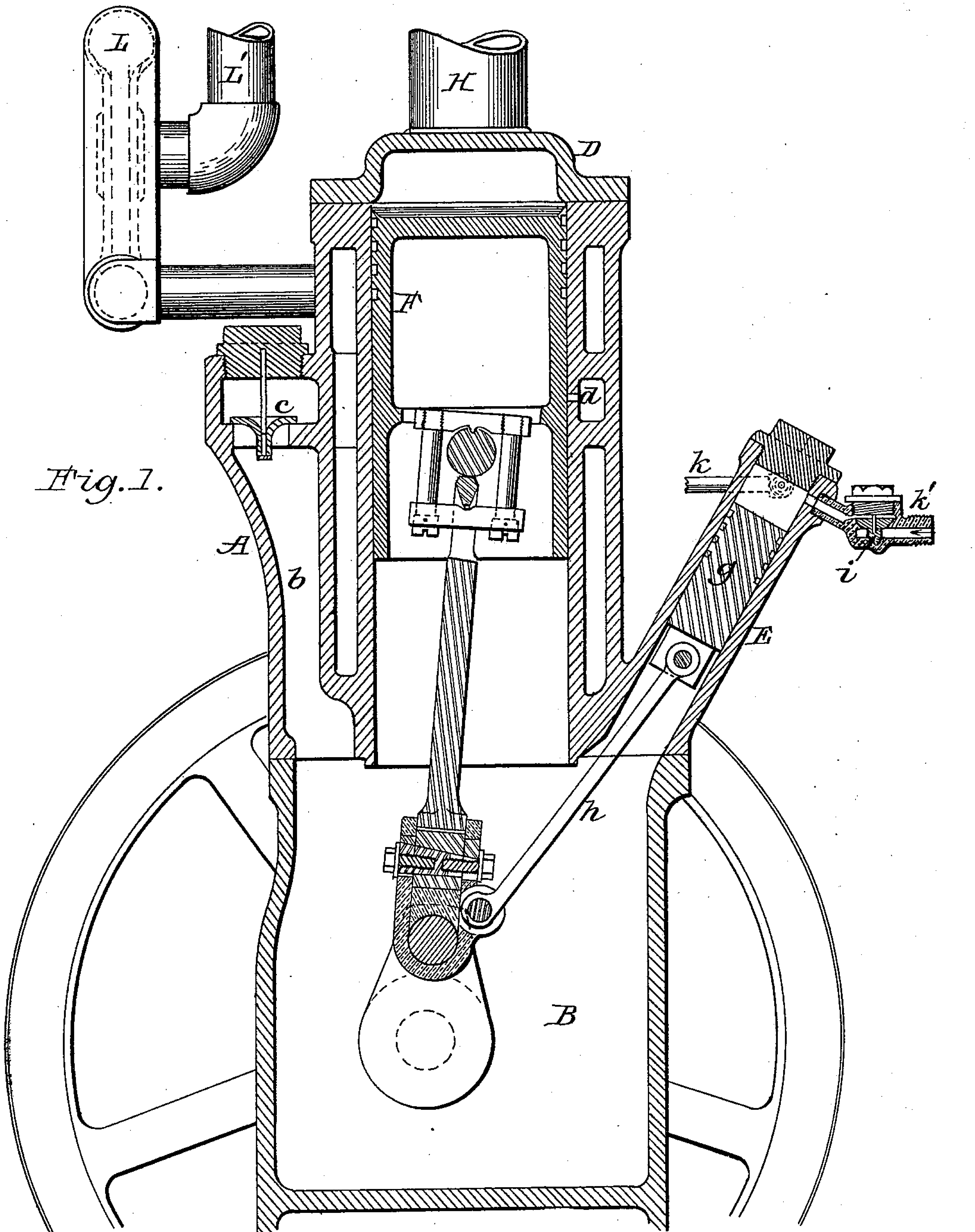

Fig. 1.

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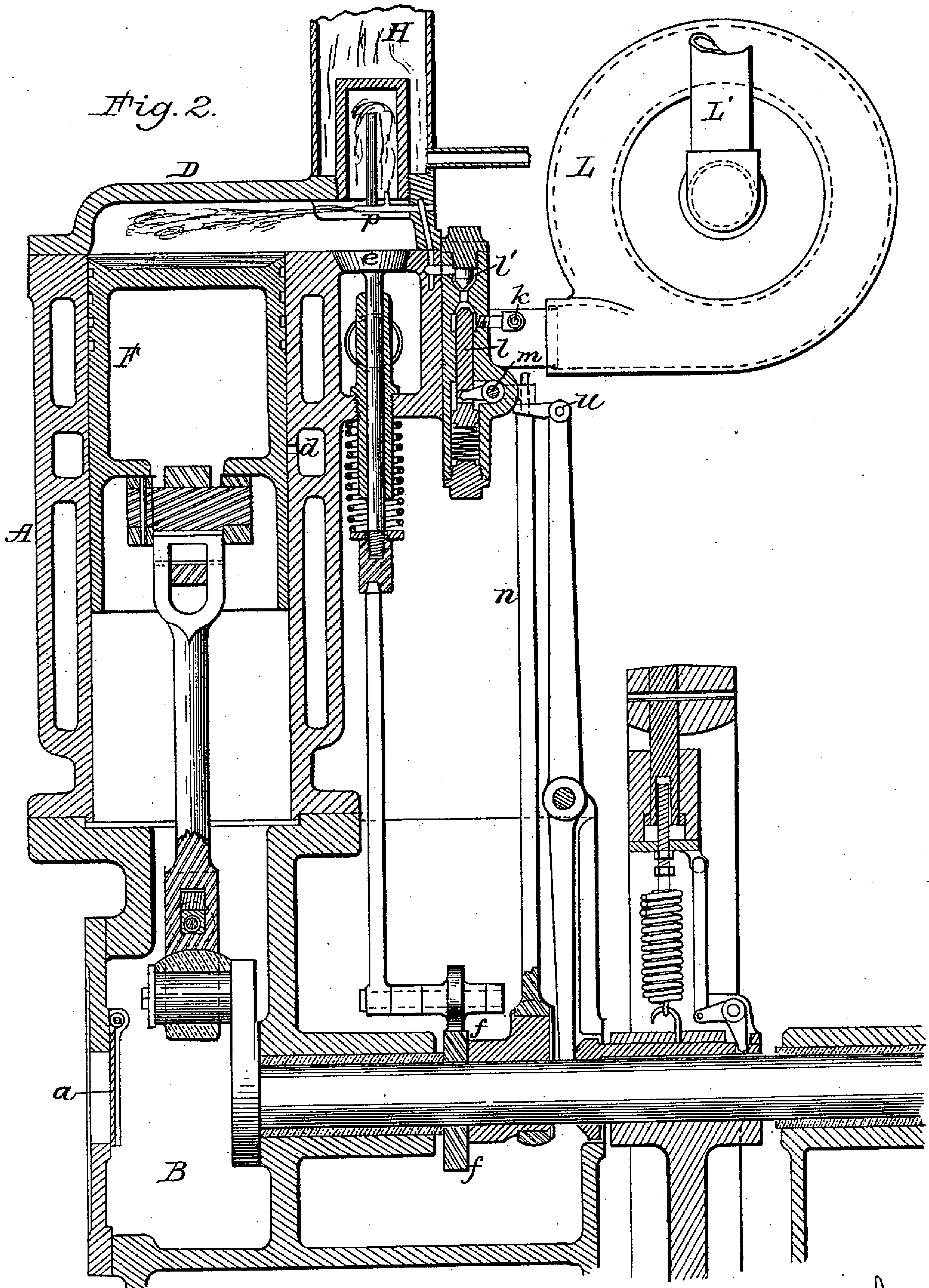
Fig. 2.



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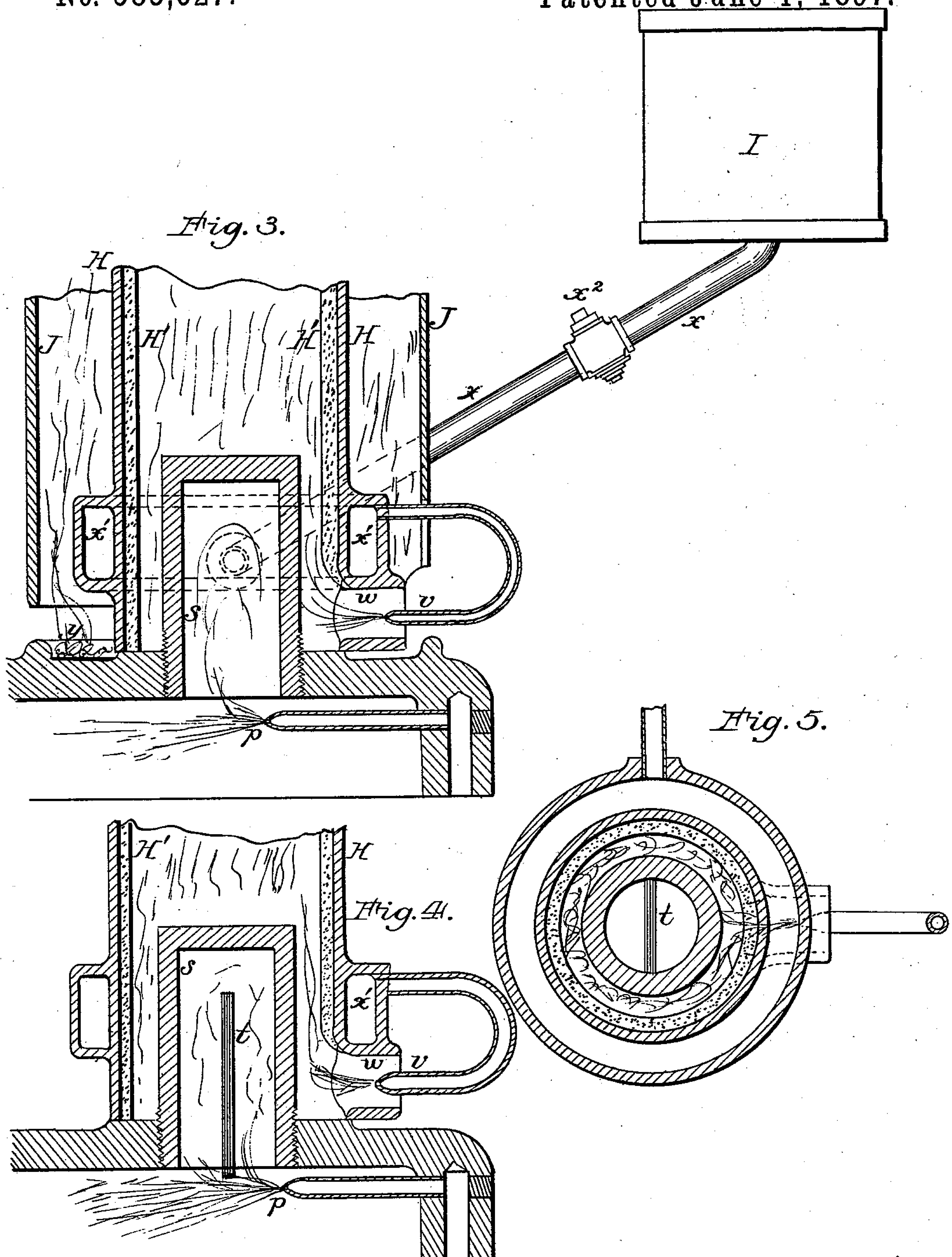

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UNITED STATES PATENT OFFICE.

LEWIS HALLOCK NASH, OF SOUTH NORWALK, CONNECTICUT, ASSIGNOR TO THE NATIONAL METER COMPANY, OF NEW YORK, N. Y.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 583,627, dated June 1, 1897.

Application filed May 22, 1890. Serial No. 352,736. (No model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, residing at South Norwalk, in the county of Fairfield and State of Connecticut, have invented new and useful Improvements in Igniters for Gas-Engines, of which the following is a specification.

My invention relates to igniters; and it consists of certain novel parts and combinations of parts, the separate features of which will be separately and specifically pointed out in the claims concluding this specification.

Referring to the accompanying drawings, Figure 1 represents a longitudinal vertical section through an engine, taken at right angles to the crank-shaft. Fig. 2 is a longitudinal vertical section taken parallel to the crank-shaft, showing one form of igniter involving my invention. Figs. 3, 4, and 5 show modified forms of my igniter.

I will now describe the structures illustrated in the annexed drawings, which show igniters involving my invention and an engine forming therewith a complete working combination. They may be applied, however, to any suitable type of engine. The engine shown and method of operating it separate from the igniter form no part of this patent, but it is made the subject-matter of Patent No. 576,604, issued February 9, 1897.

The following description, read in connection with the accompanying drawings, is sufficient to enable any person skilled in the art to which my invention relates to practice it; but it will be understood that my invention is not limited to the precise devices or the combinations of devices illustrated and described, as various modifications may be made without departing from the spirit of my invention and without exceeding the scope of the claims concluding this specification.

The drawings show an upright engine.

A is the power-cylinder, placed over the crank-shaft. F is a piston of the trunk-form suitably connected to the crank-shaft. These parts are inclosed within a chamber B, which also acts as a compression-chamber.

a, Fig. 2, is a valve arranged to open and permit air to enter said compression-chamber and to close and prevent its escape therefrom.

b is a passage leading from the compression-chamber B to the inlet-ports of the power-chamber.

c is a check-valve controlling the passage of compressed air from the compression-chamber to the power-chamber.

d are the air-inlet ports of the power-chamber, which ports are uncovered by the piston when in lower position and are covered by the piston when in the position illustrated in Figs. 1 and 2.

D is a hood forming the cylinder cap or head, and also a part of the power-chamber. It is in this hood that the charge is ignited and in which the explosion takes place, as the piston when in its uppermost position leaves this space clear. This hood also forms a passage to the exhaust-valve, as shown in Fig. 2.

e is the exhaust-valve, which is operated by suitable connections with the cam *f* on the engine-shaft.

The engine is provided with an auxiliary cylinder E, which for convenience is cast on one side of the power-chamber. *g* is a piston working in this auxiliary cylinder, which piston is connected by a rod *h* to the connecting-rod strap of the power-piston.

The power-piston F and auxiliary piston *g* are both connected, therefore, to the same source of power, and in the drawings I have shown them so arranged that the auxiliary piston is at or near the end of its inner stroke at the instant that the power-piston begins its forward stroke.

k' is a pipe leading from a suitable source of fuel-supply to the gas-compression chamber E. *i* is a check-valve controlling the passage of fuel through said pipe, which valve is raised to permit the entrance of fuel into the gas-compression chamber E when its piston reduces the pressure in said chamber below the pressure in the pipe *k'*, and is closed to prevent said fuel being forced back through the pipe *k'* when the said piston increases the pressure in said cylinder above the pressure in the pipe *k'*.

k is a duct (shown in Fig. 1 broken off) leading to the duct *k*, (shown in Fig. 2,) through which the compressed fuel passes from the auxiliary cylinder to the power-chamber.

l (see Fig. 2) is a valve controlling the entrance of fuel under pressure to the combustion-chamber, and this inlet-valve l is operated by a rock-shaft m and a rod n connected to an eccentric-strap attached to the engine-shaft. The fuel which has been admitted through the valve l rushes from the orifices p (one of which is shown in the drawings) into the power-chamber.

The igniting device, which is the special subject-matter of this patent, is shown in Figs. 2, 3, 4, and 5, and may be thus described: s is a chamber closed at one end and open at the other to the power or combustion chamber of the engine. This tube is to be heated to a sufficiently high temperature by any suitable means. This igniter-tube is preferably placed near the line of the jet of fuel issuing from one of the jet-orifices p, and is so related to the fuel-inlet that an induced or eddy current of fuel and air is caused to circulate within said tube. This I have illustrated in Figs. 3 and 4. The object of so arranging the parts is to cause a certain portion of fuel and air to pass in contact with the heated surface of the igniter-tube, and thus to render the ignition of the charge prompt and certain. If preferred, the tube p may be provided with a perforation which will send a jet directly into the igniter-tube, and in this case the tube p may advantageously be longer than that shown. In order to assist and to render more certain this action, I prefer to employ in the igniter-tube a partition t (see Figs. 4 and 5) to divide the upward-flowing currents from the return currents, and this partition may with advantage project below the bottom of the igniter-tube to direct the currents into the interior of said tube. A partition so arranged makes in effect a passage in the igniter through which a portion of the combustible mixture is caused to flow, thereby causing it to pass over a considerable extent of the heated surface and insuring a prompt ignition of the charge.

My improved igniter device may also be employed in an engine worked by combustible mixture made outside of the combustion-chamber.

The igniter-tube may be heated in any suitable way. In Fig. 3 I have shown it heated by a burner which consists of an inclosing tube or chamber H, preferably lined with a non-conducting material H'—such, for instance, as asbestos or fire-brick. The burner shown in Fig. 3 is particularly designed to be used in connection with a liquid fuel and is provided with a chambered passage x', into which the volatile liquid fuel is admitted, and a jet-tube v, which leads from said chambered passage to an opening w at one side of the chimney or tube. In this chambered passage x' the liquid fuel is converted into a vapor or gas and then passes through the jet-tube v into the chimney, the fuel being transformed from a liquid to a gaseous form by the waste heat of the flame within the chimney H. The same structure may be employed with ordinary coal-gas, such as is supplied from city gas-mains, or with other suitable gas, in which case the gas will be heated while passing through the chamber-passage x' and thence discharged through the tube v.

The operation of the device illustrated in Fig. 3 may thus be described: Fuel under pressure issues from the jet-tube v and sucks in a quantity of air with it through the opening w, which is larger than the external diameter of the tube v, or which is provided with openings or perforations in its end. The air and fuel are thus mingled and form a combustible mixture. This is, it will be seen, a blowpipe-flame and will rapidly heat the igniter-tube. Any combustible gas or vapor may be used for this purpose. When vapor or gas of a volatile oil is employed, I prefer to obtain the required pressure at the jet-orifice by means of the head of a column of fuel acting by gravity.

Referring to Fig. 3, I represents an oil-tank in communication with the passage x' by means of a pipe x, provided with a cock x^2, by means of which the flow of liquid through the pipe may be controlled. It will be seen that in this structure the pressure of the vapor in the passage x' may be as great as that due to the hydraulic head of the liquid contained in the tank I. In this figure I have also shown a tube J, which forms an outer chimney or casing for the chimney H. This casing is provided with air-passages at its base communicating with the annular space between the chimneys H and J. y indicates a depression designed to contain alcohol or some other inflammable material which when ignited will quickly heat the tube H. In this depression y asbestos or some other porous non-inflammable material may be placed to act as a wick for the alcohol flame. By this device the chambered passage x' may be primarily heated to convert the liquid fuel contained therein into a gaseous form. When this is accomplished, the blowpipe-flame issuing from the tube p is set in operation and thereafter the chamber x' is maintained at the requisite heat by the waste heat of combustion, and the external flame under the annular space between the chimneys H and J may be dispensed with.

When gas from the ordinary gas-mains is employed, it is desirable, in order that a blowpipe-flame be obtained, that the gas should be compressed by some means under a greater pressure than is employed in said mains, and this can be done by the use of a compression chamber or pump, or by any other suitable means. If instead of a blowpipe-flame an ordinary Bunsen flame be desired, such additional pressure is not necessary. Neither is it necessary for a Bunsen flame, when liquid fuel be used, to place the reservoir for such fuel at so great a height.

It has been found in practice that igniters of all forms heated to incandescence are rapidly attacked by oxidation at the temperature at which they work. One of the important features of my invention consists of protecting the igniter, whatever its form or mode of operation, or other parts of the engine subject to a high heat, with a covering or coating of an inoxidizable material—such, for instance, as glass or enamel, or any suitable flux, as borax or prussiate of potash. The use of some such material as this considerably augments the life of the parts, and these coatings may be applied as permanent coatings, or they may be added or applied to the parts in service. The highly-heated portions of the combustion-chamber are by preference also coated with a similar material.

The governor shown consists of a weight attached to the fly-wheel balanced by a spring and connected so as to impart motion to a wedge *u*, placed on the eccentric-rod *n* to vary the lift of the valve *l*, and thus to control the quantity of fuel admitted to the engine each time the valve opens. As the governor does not form any part of my present invention and as any suitable governor may be employed, a further description of this part of the structure is considered unnecessary.

The operation of the engine illustrated in the drawings and above described is as follows: The pistons F and *g* are shown in Fig. 1 in their highest position and just ready to begin their downward strokes. As the piston F moves down it compresses the air contained in the chamber B. As the piston *g* moves down it raises the check-valve *i* and draws a charge of fuel into the cylinder E. When the piston F is near its lower position, the exhaust-valve *e* is opened and the piston F uncovers the ports *d*, so that at this instant the compressed air from the chamber B rushes through the passages *b* and *d* into the power-chamber and drives out the spent gases contained therein through the exhaust-port. After the piston F has made a portion of its return stroke the valve *e* is closed and the air remaining in the power-cylinder is compressed by the back stroke of the piston F. At the same time that the piston F is making its back stroke the piston *g* is compressing the fuel contained in the cylinder E, and when the piston F is just ready to begin its next forward stroke the fuel in the cylinder E will be under high compression. At this instant the valve *l* is opened and quickly closed. While this valve is open the fuel contained in the cylinder E rushes through the passage *k* and through the orifices *p* with a high velocity, so that during a period of time probably not greater than one-hundredth part of a second a complete mixture of the gas entering the power-chamber and the air under pressure within the power-chamber is affected. A portion of the fuel so admitted enters the igniter-tube and forms therein a combustible mixture, which is ignited by its hot walls, the ignition being instantly communicated to the body of the charge. The complete mixture of air and fuel takes place in an engine so constructed, practically speaking, instantaneously while the piston is at the beginning of its downward stroke and before it has made any appreciable movement. In fact, so instantaneous is this action that the cards taken from the engine thus operated are practically the same as those taken from engines in which a combustible charge already mixed is introduced into the chamber and ignited, as in ordinary gas-engines. The piston F now moves forward by the pressure of the exploded gases and also by the pressure of the remnants of gas remaining in the cylinder E. The action of the gas-compression cylinder E and the gas-compression piston *g* effects a direct gain in economy, while the structure shown commends itself on account of its simplicity. The clearance-space of the gas-compression cylinder E, together with the passage *k*, forms a storage-reservoir which is in free communication with the gas-compression cylinder E at all times—that is to say, no check-valve separates the passage *k* from the clearance-space in the gas-compression cylinder. If no gas were used by the engine—that is, if the valve *l* did not lift—the gas contained in this reservoir would be compressed and expanded at each stroke of the piston without expenditure of fuel, because the pressure in the reservoir would never fall below the pressure in the passage *k'*, and hence no gas would enter said reservoir. If, however, a given quantity of gas is admitted to the power-cylinder by the valve *l*, the remaining portion of gas contained in said reservoir expands back until the pressure therein is below the pressure in the passage *k'*, when the valve *i* opens to admit to the reservoir a quantity of gas just equal to that used by the engine in the preceding stroke. The power therefore expended compressing the gas is by self-regulation proportional to the quantity consumed, and the pump is ready instantly to supply a full charge to the engine or no charge, just as the engine may require.

In Fig. 2 I have shown a check-valve *l'* arranged in the passage between the gas-compression chamber and the gas-cylinder. In case the ignition of the charge should take place before the valve *l* closes, this check-valve *l'* will, by means of the pressure due to the explosion, instantly close.

L (see Fig. 2) is a chamber into which the exhaust-gases from the compression-chamber are introduced by a tangential passage, and L' is a pipe leading from the center of this chamber and through which the waste gases finally escape to the air. The object of this chamber is to diminish the noise caused by the outrushing of the exhaust-gases. In a structure constructed and arranged as shown it is evident that the greater the velocity of the exhaust-gases the greater will be their tendency by centrifugal force to hug the circumference of the chamber L and the greater will be the friction between the sides of the chamber and the revolving gases. Whatever, therefore, be the velocity of these gases when they enter this chamber their velocity will be rapidly diminished and they will finally issue from the pipe L′ with a quiet flow, making little or no noise. It is not at all essential that this chamber L be circular, or that the entrance-pipe be really tangential, or that the outlet-pipe L′ be exactly in the center. The object of the device is to receive the exhaust and to diminish its velocity before it is permitted to escape to the air, and this function is best performed when the exhaust is admitted in such manner as to impinge upon the walls of the chamber and by friction therewith to reduce its velocity before it escapes. This device, obviously, is applicable to other forms of engines than that described here, and among others to engines operated by the expansion or explosion of different agents—such, for instance, as by the expansion of steam.

This patent has, as I have said, special reference to the igniter herein shown and described, which is applicable not only to a gas-engine constructed and operating as herein set forth, but is equally applicable to engines constructed and operating quite differently—for example, to engines employing any of the other well-known forms of fuel or operating as four-cycle engines. For this reason, in compliance with official requirements, the features of construction and operation independent of the igniter are covered in another pending application, filed August 16, 1890, Serial No. 362,194, which is a division of this case.

In the foregoing specification I have incidentally referred to a few of the modifications which may be adopted in practicing my invention, but I have not endeavored to specify all the modifications which might be employed, the object of this specification being to instruct persons skilled in the art to practice the several novel features of my invention in their present preferred forms and to enable them to understand their nature; and I desire it to be distinctly understood that mention by me of a few modifications is not in any way intended to exclude others not referred to, but which are within the spirit and scope of my invention.

As I have before remarked, many of the combinations and details illustrated and above described are not essential to the several features of my invention, separately and broadly considered. All this will be indicated in the concluding claims, as in any given claim the omission of an element or the omission of the particular features of the elements mentioned is intended to be a formal declaration of the fact that the omitted elements or features are not essential to the invention therein covered.

Having thus described a machine embodying in preferred forms all the several features of my present invention in combination, what I separately claim, and desire to secure by these Letters Patent, is the following:

1. An incandescent igniter for gas-engines consisting of a chamber in constant communication with the combustion-chamber having a partition dividing it into separate passages both communicating with the combustion-chamber, through which passages the combustion mixture flows in contact with the hot walls thereof.

2. In a gas-engine the combination with a fuel-supply to the power-chamber of an incandescent igniter consisting of a chamber having a partition dividing its interior into separate passages, both communicating with said power-chamber, said partition extending into said power-chamber.

3. The combination in an explosive gas-engine, of a heated chamber for igniting the charge in free communication with the combustion-chamber and a fuel-jet arranged inside the power-cylinder adjacent to said chamber so as to induce a current therein of combustible mixture.

4. The combination, in a gas-engine, of a hollow incandescent igniter, a fuel-supply jet having one of its orifices arranged across the open end of said igniter and a branch orifice standing within said igniter and a supply-valve for controlling said jet-orifices.

5. In a gas-engine, the combination, of the fuel-supply valve to the power-chamber, a hollow incandescent igniter having a partition dividing its interior into separate passages, and a supply-jet having one of its orifices arranged across the open end of said igniter.

6. In a gas-engine, the combination, with the fuel-supply valve to the power-chamber, a hollow incandescent igniter having a partition dividing its interior into separate passages, and a supply-jet having one of its orifices arranged across the open end of said igniter and a branch orifice standing in line with one of the igniter-orifice passages.

7. The combination, in a gas-engine of a hood forming a part of the combustion-chamber extended to one side of the path of the power-piston, a hollow incandescent igniter upon said hood opening into the extended end of said chamber, a fuel-supply-jet orifice arranged within said chamber across the open end of said igniter and a supply-valve for controlling said jet-orifice.

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

LEWIS HALLOCK NASH.

Witnesses:
WM. E. FITZ SIMONS,
JNO. H. NORRIS.