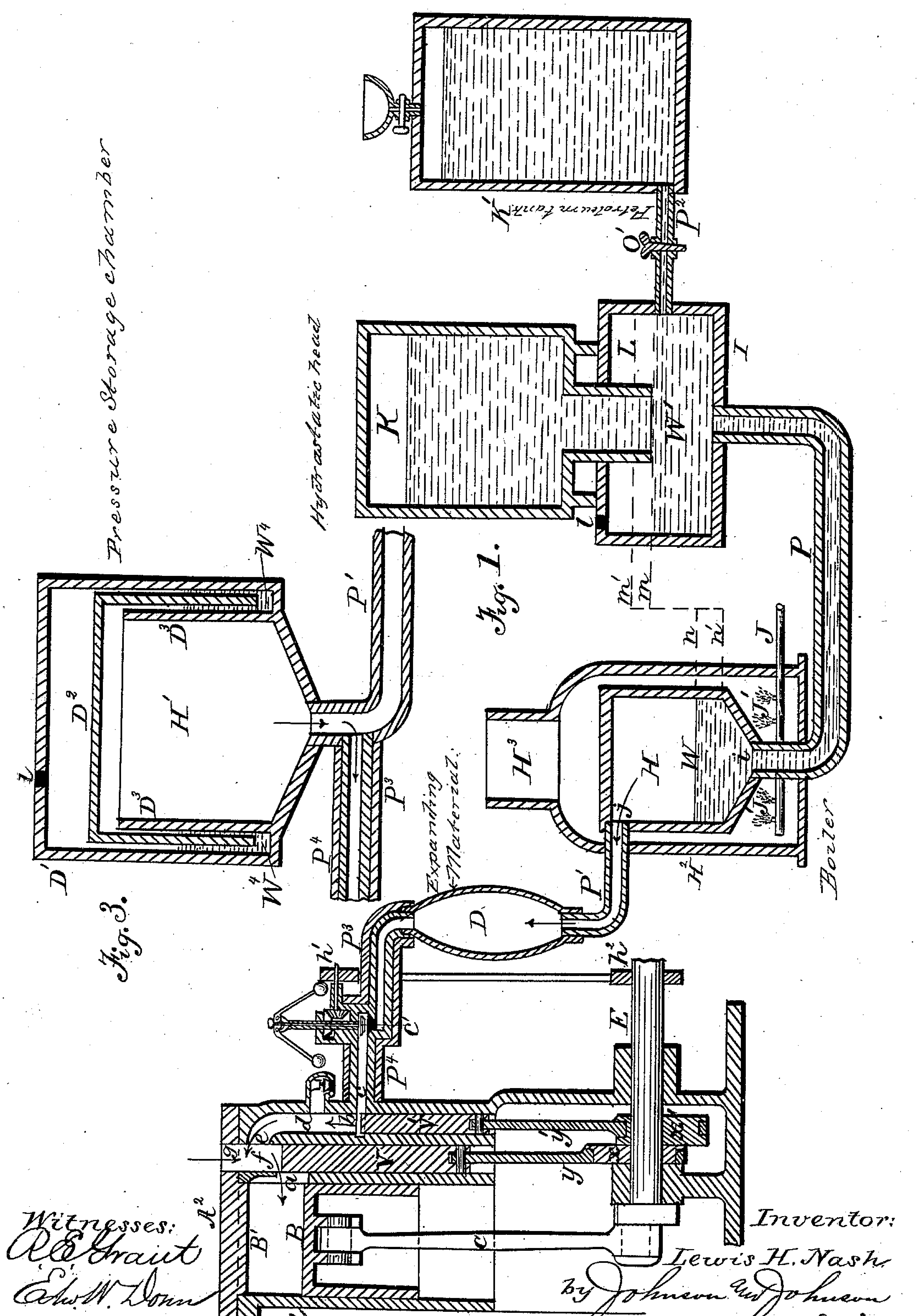
(No Model.)

2 Sheets—Sheet 1.

L. H. NASH.

METHOD OF OPERATING GAS ENGINES.

No. 331,080. Patented Nov. 24, 1885.



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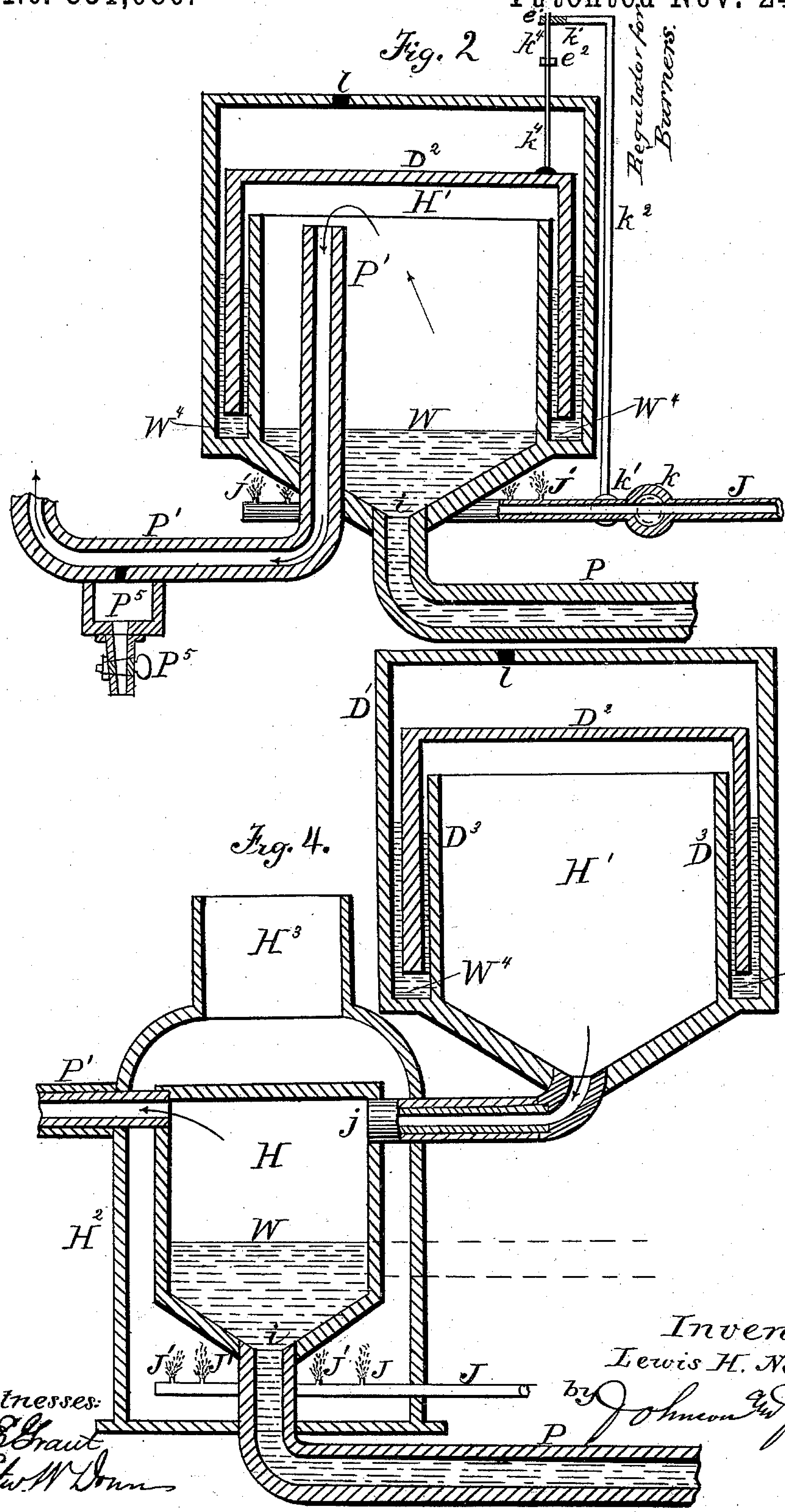

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UNITED STATES PATENT OFFICE.

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

METHOD OF OPERATING GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 331,080, dated November 24, 1885.

Application filed February 24, 1885. Serial No. 156,740. (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 Methods of Operating Gas-Engines, of which the following is a specification.

In an application for a patent for improvement in explosive-vapor engines, filed by me October 23, 1884, under Serial No. 146,263, I have described and claimed certain combinations embracing an engine, a boiler independent of the engine, for containing the oil for producing the working-vapor, arranged to drain the vapor-supplying pipe; a pressure-chamber for receiving and storing the vapor, also arranged to drain into the boiler, and means for supplying or injecting the liquid fuel into the boiler, all co-operating to deliver a dry vapor produced from a volatile oil into the engine and to control and regulate the production of the vapor and the amount of fuel evaporated in proportion to the pressure of the vapor generated, all making one operative mechanism, one concrete organization, tending to the accomplishment of a single result—viz., to operate the engine with dry vapor delivered therein direct from a boiler with a pressure practically constant, with a production regulated by the degree of such pressure, and with provision for draining the engine connecting-pipes into said boiler, to the end that the disarrangement of the regular action of the engine will be prevented, which would otherwise result from the employment of the vapor of oil introduced into the engine direct from the boiler.

My present improvement consists in operating an explosive-vapor engine by a vapor produced from volatile oil in a dry and superheated condition, and thereby exclude liquid particles from the combustion-chamber of the engine in the method of automatically supplying vapor to an explosive engine and controlling the supply of oil for producing the vapor by the pressure of the latter as it is produced; in the method of automatically supplying vapor to an explosive engine and regulating the degree of heat of the vapor produced by the pressure of the vapor, and thereby determine the quantity of the vapor generated and the degree of its pressure, and in the method of operating an explosive engine with a volatile liquid, which consists in supplying a boiler with a volatile oil, evaporating it therein, controlling the quantity of oil evaporated by the pressure of the vapor generated within said boiler, passing the vapor so produced to the engine, and completing the charge for the engine by mixing it with a sufficient quantity of air.

In the accompanying drawings I have shown one means by which my improvement in operating an explosive-vapor engine may be practiced; but I do not claim herein such operative mechanism in its combination or concrete organization, as such matter is embraced in my said application and illustrates the embodiment of my present improvements, whereby the gas-engine may be used in places where there is no provision for supplying gas from street-mains, or for use in ships' launches or otherwise where it may not be desirable to use illuminating-gas for the working.

In these drawings, Figure 1 represents in vertical sectional elevation a gas-engine connected for operation with a boiler for producing vapor from volatile oil, a pressure-storage chamber for the vapor, and an oil-supplying reservoir, the vapor-supplying pipes, and the said pressure-storage chamber being arranged to drain into the boiler; Fig. 2, a vertical section of a boiler having a pressure-storage chamber inclosed therein; Fig. 3, a vertical section of a modified form of pressure-storage chamber, and Fig. 4 a vertical section showing a modification in the arrangement of the pressure-storage chamber in relation to the boiler.

I have shown in connection with the evaporator or boiler a simple form of gas-engine provided with a simple form of governor for controlling the supply of vapor to the engine-valves, using a charge of air at atmospheric pressure; but my invention may be applied to any gas-engine—as, for instance, to the engine shown and described in an application for a patent filed by me May 8, 1884, under Serial No. 130,786, which is a single-acting gas-engine.

In the drawings which illustrate such engine, A represents the cylinder, B the piston, and C the rod connecting the piston with the crank-shaft.

The main valve V is operated by the eccentric *x* and rod *y*, so as to control the inlet of the air and vapor into the cylinder and the discharge of the waste products therefrom. A supply-valve, V′, for the vapor, is similarly connected and operated by the rod *y*′ and eccentric *x*′, the two valves being placed side by side and operating in chambers which communicate with the air, with the vapor-supply pipe, and with the combustion-chamber of the cylinder. The chamber of the valve V opens at the top of the cylinder-head A^2 at *g*, and into the combustion-chamber B′ by the side port, *a*, which is opened and closed by said valve. The vapor-supplying valve V′ is of less length than the valve V, and its chamber extends up and opens at *e* into the chamber *f* of the valve V, and forms the vapor-supply passage *d*, isolated from the direct communication with the cylinder-chamber. The valve V operates a port, *b*, at the bottom of the vapor-supply passage *d*, which port communicates with an outside vapor-supply pipe, *c*, upon which the governor is arranged for operating the valve *c*′, which controls the vapor-supply. The governor is operated by the pulleys *h*′ h^2 from the crank-shaft E and connecting-gear. In this construction the air required to complete the combustible charge is sucked into the cylinder by the action of the engine through the passage *f*, which opens at the top of the cylinder-head.

The fuel-boiler or evaporating-chamber H may be of any suitable construction and heated by any suitable means, having an inlet-opening, *i*, for the liquid fuel at the bottom, and the outlet-opening *j*, for the vapor at the top, which communicates with the bottom of the pressure-storage chamber D, having a variable volume. The boiler or evaporating-chamber is supplied with the oil through the pipe P, which connects the bottom of said boiler with the bottom of a reservoir, I, having an air-inlet, *l*, and which may be placed at any desired distance from the engine and at a height sufficient to cause the liquid to freely flow therefrom by gravity into the boiler, but not to fill the latter.

The volume of the oil in the boiler is regulated by the pressure of the vapor generated therein, and in proportion to the degree of such pressure the oil W therein will be forced back into the supply-reservoir, so that the level of the oil W′ in the latter will at all times be higher than the level of the oil in the boiler. If the level of the oil in the reservoir be represented by the line *m*, and that in the boiler by the line *n*, the height *m n* will indicate the degree of the pressure of the vapor in the boiler. To keep the reservoir I constantly supplied with the oil fuel, it is supplemented by an air-tight reservoir, K, having a pipe extending into the reservoir I, so as to act upon the principle of the well-known student's lamp to maintain the supply in the reservoir having direct communication with the boiler. I may, however, place this supplemental reservoir K any desired distance from the reservoir I, and construct it of any desired capacity, as shown at K′, and connect it with the reservoir I by a pipe, P^2, provided with a cock, O′, so that the level of the oil in the reservoir I would be governed by said pipe.

The storage-chamber D is constructed so as to be capable of expanding and contracting, according to the pressure of the vapor therein, to give out a sudden and free volume of the vapor into the cylinder the instant the engine-valves open. The chamber for this purpose may be of any suitable construction that will adapt itself to a variable volume and pressure, such as the rubber bag used with the gas-engine and the street-main gas-supply pipe for the same purpose. This chamber is connected at the bottom to the boiler by the pipe P′, and at the top of the engine by the pipe P^3, so that the condensation of the vapor will drain back into the boiler. This chamber may be placed any desired distance from the engine; but the vapor-conducting pipes should be convered by a non-conductor, P^4, to prevent as far as possible the condensation of the vapor in the pipes. This pipe *c*, which carries the governor-valve *c*′, should be arranged so as to drain into the pipe P^3, which connects the storage-chamber, and the latter is connected so as to drain into the boiler. The boiler may, however, receive the drainage from the condensation direct from the vapor-supplying pipe P^3, and also from the storage-chamber separately, because to effect the desired result it is not necessary that the storage-chamber should be placed in the vapor-supply pipe, or that the vapor should flow through it to the engine; but it must have free communication with the boiler or with a pipe leading therefrom.

In Fig. 3 I have shown a modification of the pressure-storage chamber, consisting of a metal box, D′, having a hopper bottom and an inner circular partition, D^3, of less height than the box D′, whereby to form a mercury-chamber, W^4, into which an inverted hollow float or cup, D^2, dips, and forms a cover for the vapor-chamber. The space above the inverted cup D^2 communicates with the outer air by the opening *l*, to allow the float to rise freely, and the space under said cup forms the storage-chamber H′, and connects with the boiler by the pipe P, so that the condensation of the vapor will drain back into the boiler, while the pipe P^3 drains from the engine-valves directly into the boiler vapor-supply pipe P at its connection with the storage-chamber.

In Fig. 4 I have shown the storage-chamber of the boiler independent of the pipe P′, which connects the boiler-chamber with the engine-valves, so that in this arrangement the pressing function of the storage is made active by pressing the vapor through the boiler into the engine.

For economy of heat the boiler is inclosed in a case or jacket, H^2, provided with a chimney, H^3, and the necessary heat for the boiler is obtained by the burner-jets J′, which are supplied by the pipe J, which enters the jacket, so as to support the burners beneath the bottom of the boiler; or the boiler may be heated in any other desired way.

In Fig. 2 I have shown a convenient way in which the boiler may contain the pressure-storage chamber. In this modification the boiler is formed, like the storage-chamber shown in Fig. 4, with a circular partition, so as to form a mercury-cup, within which an inverted cup-float is placed, so as to form a movable sealed cover or pressure-chamber for the boiler. In this modification the vapor-outlet pipe P′ passes up through the bottom of the boiler and extends above the surface of the fuel therein, so as to open into the vapor-space, and the float is caused to rise and fall within the boiler, according to the pressure of the vapor, and to fall to press out the vapor into the engine at every opening movement of the valves. In this modification I have made provision for automatically controlling the heat of the boiler. The jet-supplying pipe J has a cock, k, which is operated to control the supply to the burners by a lever, k', which connects with a vertical rod, k^2, having a horizontal arm, k^3, at its upper end, which extends over the top of the boiler-case and connects with the upper end of a rod, k^4, which, passing through the top of the boiler-case, is attached to the top of the pressure-regulating storage-chamber. This rod is provided with collars e' e^2 above and below the end k^3 of the rod k^2, so that when the float rises high enough by the pressure of the vapor the collar e^2 will lift the rod k^2, which, by its connection with the lever k' of the cock k, will turn the latter and shut off the full supply to the burners, and thus reduce the quantity of oil evaporated. When the float falls, the collar e' will engage the arm k^3 and open the cock, to give a full supply to the burners and again increase the quantity of fuel evaporated. In this way the expansion and contraction of the storage-chamber is utilized to control the heat of the boiler and the quantity of the oil evaporated in the boiler. In this construction the drain from the vapor-supply pipe P′ will be by a draw-off cock in the lowest part of said pipe. In proportion to the pressure of the vapor generated the quantity of the oil in the boiler will be increased or diminished, and thus regulate the amount of surface of the oil which is in contact with the hot walls of the boiler, and thus regulate the quantity of the oil evaporated. This regulating action is effected in the constructions shown in Figs. 1, 3, and 4 without the heat-controlling cock, as I will now describe.

In Fig. 1 the lines m n illustrate the level of the oil in the boiler and in the pressure-storage chamber when the engine is working, so that the pressure of the vapor in the boiler will be measured by the difference of the level m n. An increase of the vapor-pressure may cause the levels of the oil to change to m' n', which will then represent the pressure of the vapor in the boiler. Should the pressure increase sufficient to force all the oil from the boiler into the supply-reservoir, then the evaporation of the oil will practically cease until the pressure decreases sufficiently to allow the oil to again feed by gravity into the boiler. By this means the pressure in the boiler can never be greater than that of the hydraulic head, and the quantity of oil evaporated will be controlled by the quantity of oil in the boiler. By making the supply-reservoir of large surface in comparison with the volume of the boiler, the variations in the level of the liquid in the supply-reservoir will not be very great, and hence the pressure of the vapor in the boiler will be constant enough to render the pressure or discharging function of the storage-chamber always active.

I have stated that the vapor-supplying pipes are arranged to communicate with the engine-valves at a hot portion of the engine, and I mean by this such connection must be in such proximity to the combustion-chamber of the engine as to be so highly heated by the waste heat thereof as to superheat the vapor before its entrance into the cylinder. This provision, in connection with draining the vapor-supplying pipes, is of essential importance in operating an engine by the vapor of a volatile oil.

I have shown no means for igniting the charge, as I may use any of the known methods by which such ignition may be effected.

I have shown an engine operating with a charge at atmospheric pressure; but my invention may be applied to any engine operating to compress its charge.

I claim—

1. The method, substantially hereinbefore described, of supplying vapor for operating an explosive engine, which consists in supplying a boiler or evaporator with a volatile oil solely by gravity from an uninterrupted communicating reservoir, evaporating it within the boiler, and controlling the supply of oil to the boiler by the pressure of the vapor generated therein, acting to drive the oil therefrom back into the supply-reservoir under an excess of pressure, and thereby diminish the supply of oil and the production of vapor.

2. The method, substantially herein described, of supplying vapor to an explosive engine, which consists in supplying a boiler uninterruptedly with volatile oil evaporating therein under a heat controlled by the press-

ure of the vapor, and regulating the production of the vapor by automatically displacing the oil from the boiler to reduce its evaporating capacity or surface in the way set forth.

3. The method herein described of operating an explosive engine with a volatile liquid, which consists in supplying a boiler with a volatile oil, evaporating it therein, controlling the quantity of oil evaporated by the pressure of the vapor generated within said boiler, passing the vapor so produced to the engine, and completing the charge for the engine by mixing it with a sufficient quantity of air.

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

LEWIS HALLOCK NASH.

Witnesses:

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WILLIAM C. WESTERVELT.