(No Model.)

L. H. NASH.

GAS ENGINE.

No. 278,256. Patented May 22, 1883.

Fig. 1.

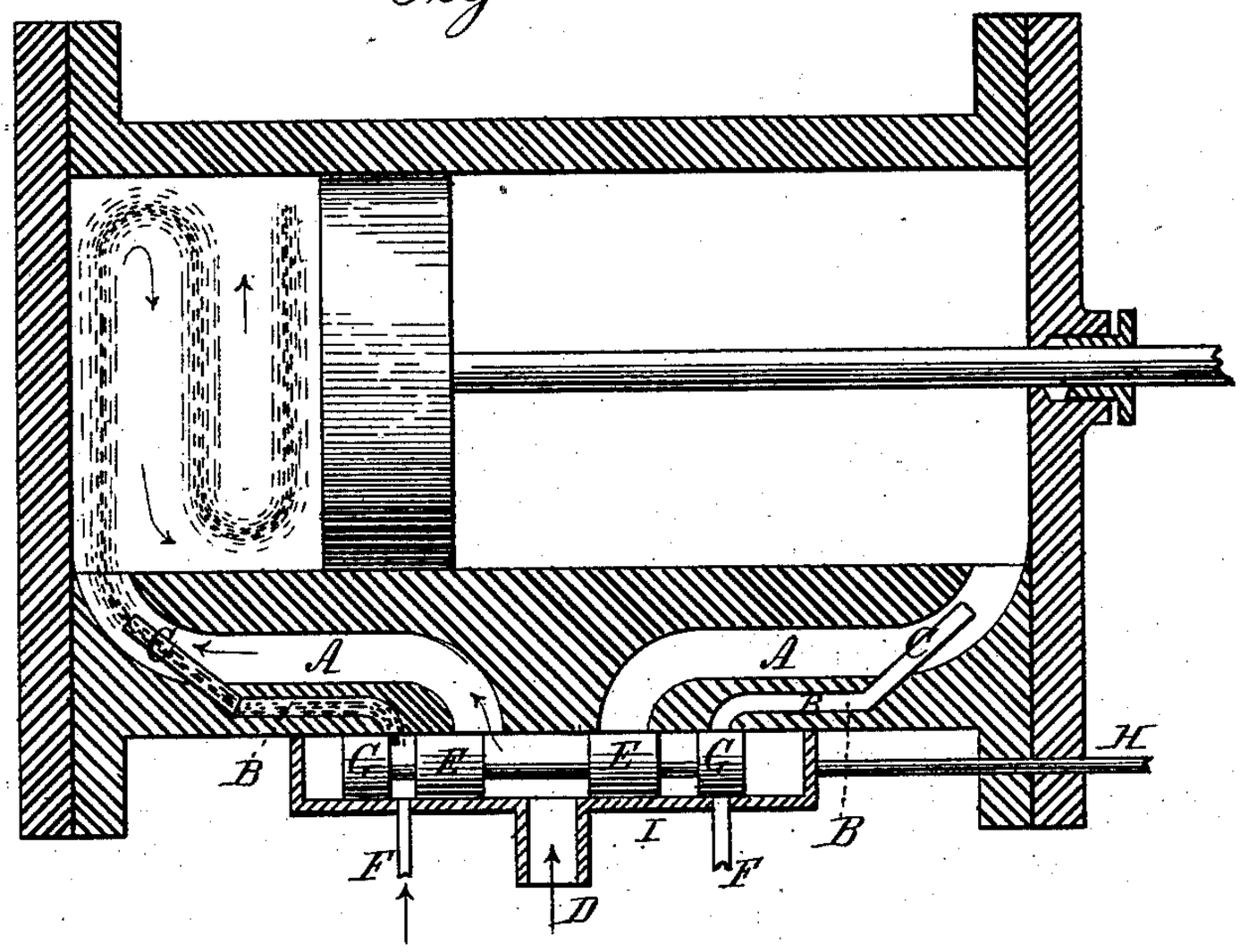


Fig. 2.

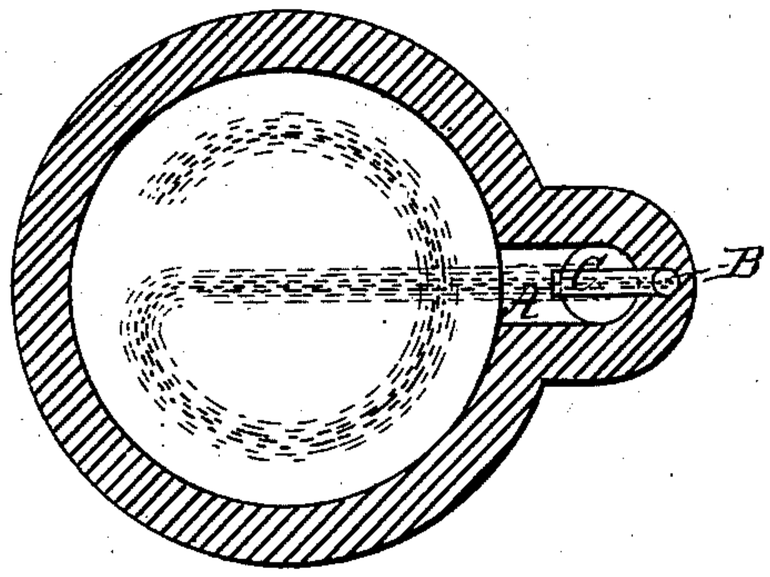
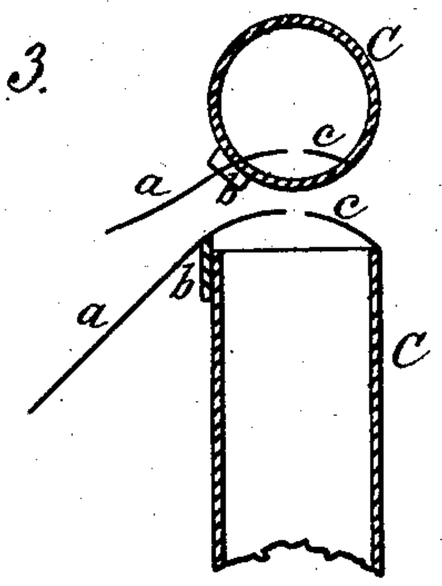


Fig. 3.



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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. 278,256, dated May 22, 1883.

Application filed September 9, 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.

My invention relates to improvements in engines operated upon the principle of receiving a mixture of air and combustible within its cylinder through a portion of its stroke, and igniting it therein, driving the piston by expansive force.

The object of my present improvement is to produce a slow combustion of the gases within the cylinder, in contradistinction to an explosion, and to introduce compressed air and gas into the cylinder in separate streams and in such volume as to cause the charge to burn without smoke to avoid the deposit of carbon in the cylinder.

In another application for a patent I have described, among other things, a gas-engine system comprehending as co-operating members an engine adapted to work with a supply of compressed air and gas, an independently-operating air-compressor, serving both as a motor for starting the engine and supplying it with compressed air when running, and means for converting the fuel into a decarbonized gas under sufficient pressure to be supplied direct to the engine, and capable of burning with a non-luminous and smokeless flame, yet readily ignited, and burning without leaving a deposit. The preparation of the fuel to produce this result is effected in a converter of suitable construction, wherein the fuel is introduced in a heated condition with steam, and the gas produced therefrom is mixed with a sufficient quantity of compressed air to absorb the oil-vapor products and to serve as a vehicle to carry the combustible mixture from the converter into the power-cylinder, and to combine with the carbon to effect complete combustion. In such preparation the gas may be produced from a solid or liquid fuel, the decarbonization being effected by a chemical union of the steam and the hydrocarbon in a highly-heated condition, the steam taking up most of the carbon of the fuel and producing a mixture containing carbonic oxide, carbonic acid, hydrogen, and some of the lower hydrocarbon gases and vapors of the oil.

In gas-engines as now used a residuum of carbonaceous matter is left in the cylinder after explosion from each charge, and retains its high temperature, rendering it liable, by a spark, to ignite the incoming charge prematurely.

In preparing the gas as described all the constituents of the fuel which will not evaporate or reduce are left in the converter, and the gas will leave it under pressure in condition to ignite readily and to burn within the cylinder in contact with the air to be expanded. I do not, as hitherto, introduce a charge of explosive mixture and air within the power-cylinder and ignite the same; but, on the contrary, I introduce a charge of pure air under compression, and at the same time a sufficient quantity of fuel, which has been previously prepared, as stated, so as to burn readily, is introduced with it, so as to be surrounded by the air. The heat from this fuel expands the surrounding air, thus developing the force of the engine. By this means the heat of the combustion of the fuel is given up to the air and not to the engine-walls. By this method a small quantity of fuel may be made to do efficient work, since it can be constantly and completely burned and its heat given directly to the air to be expanded, thus giving the advantage of avoiding the sudden explosion of a perfect admixture of air and combustible and the subsequent sudden loss of heat from the highly-heated products of combustion.

The accompanying drawings illustrate an engine constructed for effecting the admission of fuel and air in separate streams of such volume that the gas and air will not intermingle, but produce a slow combustion, in which—

Figure 1 represents a longitudinal section; Fig. 2, a cross-section in which the gaseous fuel is shown as a separate stream surrounded by air, and Fig. 3 shows a method of effecting the ignition of the charge.

The cylinder is constructed with ports A A, for the admission of air into each end of its chamber, and with separate and distinct ports B B, for the admission of the gas into the ports A A at or near their opening into the cylinder-chamber. The ports B B terminate

in tubes C C, which extend into the ports A A, so that the flow of the fuel will be in the direction of the flow of the air, and together enter the cylinder and circulate around, so that at the moment of ignition the stream of fuel will be coiled within the body of air, and when such ignition takes place the heat from these lines of fuel will be given out to the surrounding air. The ports for the admission of air under compression are of greater area than those for the admission of the fuel, the terminal tubes of which latter project within the ports for the air, so as to deliver the stream of fuel within a body of flowing air at a point just before the two streams enter the chamber of the cylinder, whereby the stream of gaseous fuel is the better caused to maintain its character as a separate strata within a volume of compressed air, to produce the best results in the production of heat directly within the body of air, the gas being distributed through the air-charge, ready to be ignited at the proper time. This method of first preparing the gases and then admitting them without admixing with the charge of air can be applied to any form of engine using gaseous fuel. Any suitable construction and arrangement of valves may be provided for separately admitting the combustible fuel and the compressed air, as stated. As shown, the valves for these ports are in four sections, carried and operated by the same stem, H, and the ports for the gaseous fuel are shown as being outside of the ports for the air, so that the tubes C C stand at an angle to direct the fuel into the cylinder with the flow of air leaving the ports A.

D represents the pipe communicating with the air-compressor. E E are the valves for the air-ports. F F are the pipes communicating with the gas producer and converter, and G G are the valves for the fuel-ports, the said valves being arranged within the same valve-chest, I.

The ignition of the charge is effected by the electric spark, and such ignition is made at the point at which the gaseous fuel issues from the tube. Any suitable means may be employed for conducting the electric current to produce the spark, or any other approved method may be adopted for lighting the charge. A convenient and effective way is shown in Fig. 3, in which C represents the tube of the gas-port in end and partial section views, and in which *a* is the conducting-wire leading to the battery, and connected to the tube by a non-conducting support, *b*, so as to extend partly over the end of said tube; and *c* is the spark-receiving point attached to the tube, so that the spark must cross the issuing stream of gas at the proper moment.

The preliminary preparation of the fuel before entering the engine is an essential feature in the plan of admitting the gas and the compressed air into the power-cylinder in separate streams to complete the charge. In completing the charge the pure air flows in a solid stream into and through the port A, and at a point outside of the cylinder-chamber surrounds a solid stream of fuel, and both then flow in together, filling the cylinder, so that at the moment of ignition there is a line of fuel extending all through the volume of air, and the combustion of this line of fuel gives its heat to the surrounding air, expanding it. Thus a small charge of fuel will give heat enough to increase the pressure of the gases as high as it is practicable to use them, and hence it will not be necessary to raise the temperature high enough to compensate for the abstraction of the heat by the walls of the engine. The advantages of effecting a slow combustion in the power-cylinder, as distinguished from explosion, are that in the latter method, at the instant of ignition, the temperature produced is very high, and it falls almost instantly through the absorption by the engine-walls, so that almost the whole of this heat at the highest temperature is lost; but by my method of preparing and burning the gases, since they do not contain sufficient air to burn instantly, no such high temperature is attained, but the heat developed by the combustion of the fuel is rapidly absorbed by the gases as they expand, driving the piston, so that when the combustion of the fuel has been completed the piston will have already made a portion of its stroke, and the heat absorbed by the work done by the piston in moving the distance between the time when the combustion begins and is completed has been expended in doing work in the engine, instead of (as would have been the case if the combustion had been instantaneous) increasing the initial temperature of the gases. The amount of time required for the combustion may be regulated to some extent by the amount of air supplied to the fuel entering the engine. A large amount of air will produce a quicker combustion, and the duration of the combustion may be determined by an indicator-card taken from the working-cylinder.

It will be understood that the slow combustion is effected by the combustible mixture containing an excess of gaseous fuel over air, and hence cannot burn until it can obtain this necessary air from the surrounding charge of air separately introduced into the cylinder—that is to say, I concentrate the fuel, first with a small admixture of air to support complete combustion, which can only take place by the fuel matter coming in contact with a sufficient quantity of the air in the cylinder, so that there can be no sudden combustion or explosion of the charge. After the air which is admixed with the fuel is burned the combustion can only proceed as fast as it can come in contact with the surrounding air, and this short interval of time is sufficient to prevent a sudden explosion of the charge.

While I prefer to admit the fuel into the air-passage through a tube or nozzle, as shown, yet in carrying out my invention it is only necessary to allow the fuel to flow quickly in a large stream into the air-stream, so that both streams may flow along together.

It is obvious that I may use ordinary illuminating-gas by admixing a sufficient quantity of air with it to cause it to burn without smoke. This admixture of air with the gas may be effected either in a passage of the engine or in the pipe supplying fuel to the engine. I prefer the latter, so that by placing a test-burner upon the pipe the quality of the mixture may be known by the flame. The mixture of air and gas passes into the power-cylinder with the separate stream of air under compression.

The simultaneous admission of air and gas in a number of small streams into the working-cylinder of a gas-engine in regular strata or layers, so as to prevent explosions when the gas is ignited, is described in English Patent No. 107 of 1861, in which a distributing-valve provided with a number of small tubes is employed to effect the admission of the gas in separate streams, while between each tube there is an opening for the simultaneous admission of air in separate streams into the cylinder, so that the air and gas enter and lie in the cylinder in regular strata of small streams. In the invention described in this English patent the gas enters the cylinder in a number of small streams, and side by side. The air must also enter the cylinder in a number of small streams, the effect of this multiplication of small streams producing an admixture of the gas and air determined by the number of such separate streams, and therefore must fail to effect the object of my invention. Moreover, such multiple of streams of air and gas effect a too intimate mixture, tending to produce instantaneous combustion, and therefore would fail to effect the object of my invention, in which the charge of gas is admitted in a separate single volume from the charge of pure air, and in the slow combustion which would result therefrom only those portions of the gas in contact with the air would burn completely; but by the addition of a small portion of air as a part of the volume of the gaseous fuel the production of smoke will be prevented. In my invention the gas and air are admitted into the cylinder in separate single volumes to complete a charge, in which the gas enters the volume of air so gently as to be enveloped by and to flow gently with it, not mixing or forming eddies in the cylinder. In an engine running two hundred revolutions per minute the mixing of the two comparatively large volumes of air and gas could not occur in the instant during which the charge is being admitted. Moreover, the larger the volume of the streams of air and gas the less liable will they be to admix, as the flow will be greater. These separate air and gas volumes can be admitted either through separate ports in the same valve or by separate valves.

I claim—

1. That improvement in the method of operating a gas-engine which consists in admitting into the cylinder a single stream of air under compression in large volume, and simultaneously therewith admitting a single stream of gas in large volume directly within the flowing volume of air, so that the latter will surround and carry the volume of gas with it into the cylinder in a single enveloped strata, substantially as described, for the purpose specified.

2. That improvement in the method of operating a gas-engine which consists in admitting into the cylinder a single stream of air under compression in large volume, and simultaneously therewith admitting in a single stream of large volume the gaseous fuel mixed with a quantity of air less than that required to effect the complete combustion of the fuel-charge, enveloped and carried by the air charged as a distinct volume, substantially as described, for the purpose specified.

3. The power-cylinder of a gas-engine, constructed with separate ports for the separate admission therein of air under compression and gaseous fuel, the issuing-orifice of each gas-port terminating within each air-port, so as to be surrounded by a flowing volume of air, in combination with suitable valves for controlling the admission of the air and gas volumes, substantially as described, for the purpose specified.

4. The combination, in a gas-engine, of the power-cylinder, constructed with the ports A A, for the admission therein of air under compression, and with ports B B, for the admission of gaseous fuel, each in single volumes, the latter ports being separate and distinct, and having terminal tubes C C, projecting within the air-ports at or near the entrance of the latter into said cylinder, with a valve or valves, substantially as described, for the purpose specified.

5. The combination, in a gas-engine, of the power-cylinder, having separate ports for the admission therein of air and gaseous fuel in separate single volumes, with extension-tubes of said gas-ports arranged to project within the air-ports at or near their entrance into the cylinder, the lighting-wires connected with the issuing-orifices of said terminal tubes, and a suitable valve or valves, substantially as described, for the purpose specified.

6. In combination, in a gas-engine, the power-cylinder having the air-ports A A, the gas-ports B B, the latter having the terminal tubes C C, the lighting-wires connected with said terminal tubes at their outlet-orifices, a valve or valves, and the piston, all constructed and adapted for operation substantially as set forth.

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

LEWIS HALLOCK NASH.

Witnesses:
A. E. H. JOHNSON,
J. W. HAMILTON JOHNSON.