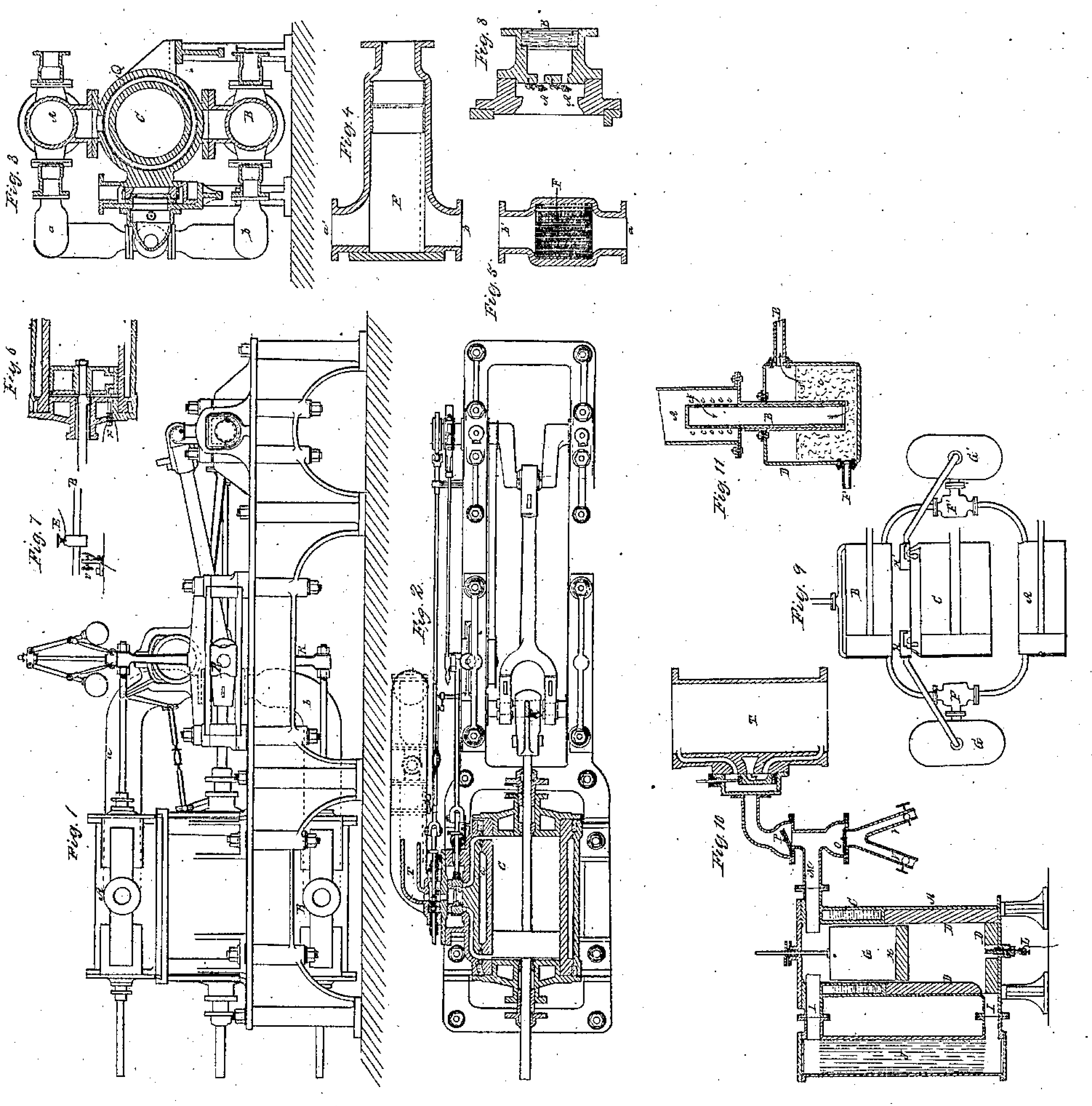
F. Million,

Gas Engine.

No. 63,416. Patented Apr. 2, 1867.



Witnesses;

Inventor;
Francisque Million
By Fowler & Wells
Attys

United States Patent Office.

FRANCISQUE MILLION, OF PARIS, FRANCE.

Letters Patent No. 63,416, dated April 2, 1867.

IMPROVEMENT IN GAS ENGINE.

The Schedule referred to in these Letters Patent and making part of the same.

Specification of Improvements in Hot-Air and Gas Engines invented by FRANCISQUE MILLION, of Paris, in the Empire of France.

Introduction.

All engines of this general character, as usually constructed, involve very grave defects by reason of the means commonly employed for heating or igniting the air and gases to produce the necessary expansive force. Among these defects are the following: In cases where the fire is applied outside of the engine, like the manner practised with steam engines, heaters of enormous size are required, owing to the large extent of heating surface required. In cases where the fire is applied inside of the engine, as usually practised in some gas engines, its proper management has been found a matter of no little difficulty, and the working of the parts has been impeded by the impurities of the gas and the products of combustion which find their way into or form in the cylinder. The object of this invention is to overcome these difficulties by means of an engine capable of efficiently burning internally gases prepared for combustion by the admixture of a proper proportion of atmospheric air, and said invention consists in the improvements hereinafter more fully described and set forth.

Description of the Drawings.

In the accompanying drawings—

Figure 1 is a side elevation of my machine.

Figure 2 is a plan or horizontal view of the same, showing the driving-cylinder, cylinder-heads, valve-chest, valves, and some other parts in section.

Figure 3 is a vertical transverse section of the driving-cylinder, pumps, and some other parts.

Figure 4 is a vertical longitudinal section of the pipe and apparatus, in which the different gases are mixed on their way to the valve-chest.

Figure 5 is a vertical section taken through the centre of the pipes a' and b', (fig. 4,) and showing more clearly the construction of the apparatus for dividing both the gas and air into veins or thin sheets, and interpolating the veins of gas with the corresponding veins of air as they pass into the open or unobstructed portion of the pipe.

Figure 6 is a central section of the driving-piston and a part of the main cylinder, showing the device for passing the electric current through the cylinder-head and igniting the gases inside of the cylinder.

Figure 7 is a detail view, showing the construction of parts for connecting the wire which conveys electricity into the driving-cylinder to ignite the gases, with a wire connected with an electrical battery.

Figure 8 is a central section of an auxiliary valve-box or pipe, to be placed on the main valve-chest, and provided with clack-valves to prevent the return of the combustible gases through the pipes leading to the valve-chest when the spark in the cylinder ignites the gases.

Figure 9 represents an arrangement in which there are two separate receivers in which the gas and air used are received from the pumps, one of which receivers is connected to one end of the driving-cylinder, and the other with the other end, each of the pumps being double acting.

Figure 10 represents an arrangement of parts by which the gases are fired in an auxiliary cylinder, and conducted in an expanded state to the driving-cylinder, where the effect of such expansion is utilized. It also shows the mode of lining the combustion-cylinder.

General Description.

In the drawings, figs. 2, 3, 6, and 9, C is the main or driving-cylinder of the engine, which cylinder is supplied with a mixture of atmospheric air and inflammable gas by means of two pumps, A and B, the former supplying air, and the latter supplying gas. In the arrangement represented in figs. 1, 2, and 3, the piston rods of these pumps are connected directly by means of the cross-head R to the piston-rod of the driving-cylinder, and are moved by it. This cylinder, C, is surrounded by a casing, Q, which is accurately fitted to the cylinder at the ends and around the gas passages, and the joints carefully packed, as represented, leaving a space or opening around the cylinder, and between it and the casing, for a current of water to pass through for the purpose of cooling the cylinder. The heads of the driving-cylinder are also chambered, as shown, to allow a similar circulation of water through them for the same purpose; and the chambers in these cylinder heads are so connected with the space between the cylinder and its casing, and so provided with external openings, that the water to cool the cylinder may be forced into or supplied to the chamber in the cylinder-head at one end of the cylinder, and passing between the cylinder and the casing enter and be discharged through the chamber in the opposite head of the cylinder. The cylinder may also be cooled by placing a large casing around it, with an opening at the bottom of the casing and another at the top, to the latter of which it would be well to attach a chimney to cause the air to circulate rapidly through the casing to cool the cylinder. The cylinder might also be cooled by injecting into it a jet of cold water, in which case the casing Q would be dispensed with. The cylinder C is provided with a slide-valve, *c*, opening passages into the cylinder, and a cut-off, *d*, placed in a cut-off box outside the main valve-chest, as shown. These valves may be operated by any of the appliances used to operate similar valves in steam and other gas engines, and the power of this engine is applied by means of a crank in the ordinary manner. In constructing and arranging the main slide-valve, I make it hollow throughout its entire thickness, and in two parts, with a gasket or other packing between them, as shown, the two parts together having sufficient depth to extend from the valve-seat to the cover of the valve-chest; and I also make an exhaust opening through the said cover, so as to allow the engine to exhaust directly through the valve, and obviate the necessity of an exhaust port in the cylinder, and at the same time in such a manner as not to require more than the usual single pair of passages from the slide-valve into the cylinder for the induction and eduction of the gases. The pump A supplies atmospheric air, as above stated, and the pump B furnishes combustible gas from a gasometer, or other source of supply, said pumps discharging through the pipes *a* and *b* respectively into the respective branches *a′* and *b′* of the mixer, represented in figs. 4 and 5. It will be observed that the construction and arrangement of the two pumps and the cylinder, in combination with each other, is such that one of these pumps forces forward a supply of air at the same instant that the other forces forward a supply of gas, so that both air and gas, in their proportionate quantities, are forced into and through the mixer simultaneously, thus insuring a uniform mixture of the two elements. F, in figs. 4 and 5, is a diaphragm, the purpose of which is to divide the air and the gas into thin parallel and interpolated veins, and may be made of a single sheet of metal folded several times on itself in such a manner as to form parallel passages opening alternately, one from the side at which the gas is admitted, and the other from the side from which the air is received; or it may be constructed of separate sheets united by ribs placed on the air side and gas side alternately, as shown in fig. 5. In consequence of this arrangement, the air and the gas, on entering the mixer, are divided into parallel and interpolated veins, which very much facilitates their being evenly mingled when they come together after passing this diaphragm. The gas and air thus interpolated come together in the pipe *c*, across which, if thought desirable, wire cloths may be placed to perfect the mixing. The gases thus mixed pass through the pipe *c* to a pressure reservoir or gasometer made of metal, of any desired capacity, and provided with a safety-valve to allow the gas to escape when it reaches an unsafe limit. The gas from said reservoir subsequently passes to the valve-chest through the pipe T, and the supply to the engine is regulated by a butterfly-valve and governor in the same way that the supply of steam to a steam engine is controlled. The mixer may be placed in either of two different positions with relation to other parts. First, it may be located between the pumps and the reservoir, as already described; second, it may be placed in the pipe which conveys the gases to the driving cylinder and near the valve-chest, in which case there should be two reservoirs, one to receive air from the air-pump, and the other to receive gas from the gas-pump. The gas, mixed with air, being thus introduced into the cylinder of the engine, is ignited at the proper point in each stroke by means of a Rubinkorff apparatus, or electrical battery, which is controlled by the rod which works the cut-off valve. The advantages of working the igniting apparatus by the cut-off will be apparent when we consider that by such arrangement the ignition is accomplished at the precise moment that the closing of the passage is effected by the cut-off, which insures security on the one hand and the earliest practicable ignition on the other. To accomplish this purpose two insulated wires pass through the cylinder head, as represented at *x* in fig. 6, and their ends, inside of the cylinder, are placed near to each other, so that the electric spark may pass from one to the other to ignite the gas contained in the cylinder. These wires may, however, be connected by a piece of platinum, and the gases ignited by the heat produced in it by the passing current. These wires are properly connected to a Rubinkorff apparatus, or other electrical machine or battery, the connection being controlled by means of the apparatus represented in detail in fig. 7, and less distinctly shown in fig. 2. In fig. 7, B is a sliding iron rod connected to the cut-off rod, which operates the parts that open and close the electric circuit. This rod carries an adjustable insulated metallic button or stop, E, to which one of the wires of the circuit is attached, and one of the wires to connect with it and complete the circuit is attached to a spring secured to the fixed portion of the engine, and made adjustable by means of the screw *v* in fig. 7. It will readily be perceived that by this arrangement as the cut-off rod B reaches the end of its stroke the button E, coming in contact with the spring, will close the circuit and cause the discharge of an electric spark in the cylinder, and the consequent ignition of the gas in that end of the cylinder in which the spark is discharged. It will also be obvious that by a similar connection at the other end of the stroke of the rod B to the other end of the cylinder a corresponding ignition of the gas, at the other end of the cylinder, can be produced at the proper time for the return stroke. It will be well to have several lighting points in the cylinder, so as to secure a more simultaneous ignition of the gas, or a small chamber may be made upon the cylinder head with holes opening into the main portion of the cylinder at different points, so that the gas, being first ignited in this chamber, will be forced simultaneously, or nearly so, through these different holes and ignite the main body of the gas in the cylinder at several different points at once. To prevent the increased pressure, caused by the ignition of the gas, from recoiling upon the pumps and reservoirs, and for the further and equally important purpose of preventing the combustion from extending back too far, I place in the pipe leading to the valve-chest of the engine, between said valve-chest and the reservoirs and pumps, a series of clack-valves, A A, as shown in fig. 8, so arranged as to be opened by the flow of gas to the driving-cylinder, and to be instantly closed by the first effect of the back pressure produced by the ignition of the gas in the cylinder. As these valves, owing to the sudden manner in which they are shut, are liable to derangement, it is advisable for better security to place several sets, one behind the other at proper intervals, in the pipe, so that if one fails the next can be relied on. As a further security against the passage of the flame to the reservoir and pumps, I also place a series of wire cloths, B, in the pipe just back of one of the sets of valves, as shown in fig. 8. These wire-cloths are not indispensable, but they afford additional security, and it is a matter of prudence to use them. It will be obvious that by modifying the arrangement of the slide-valve, cut-off valve, and igniting apparatus with relation to each other, or by changing their movements relatively to each other and the driving-piston, the action of the parts and the effect of the expansion caused by ignition may be greatly modified; and if the arrangement should be such that the cut-off valve would be closed during the whole time of the ignition, the valves shown in fig. 8 would be materially relieved, if not, indeed, entirely dispensed with. For the purpose of lubricating the piston and sliding-valves, and of freeing the engine from any tar or other impurities which may be carried over into the engine by the gas used, it may be desirable to introduce a small amount of water into the gas as it is brought to the engine, or directly into the engine itself. This can be done by means of various appliances. For the sake of extending the same benefits to the pumps, it will probably be the best arrangement to introduce this water by means of stop-cocks into the air and gas pipes between the pumps and the sources of supply from which the gas and air are received, care being taken to turn them off when the engine is stopped; or the same thing may be done by very small pumps worked by the engine, and these last would need no such attention. A hand-pump may be used for charging the reservoirs in the first instance, so as to supply the engine for the first stroke before the main pumps are put in operation, if found necessary. The proportions of air and combustible gas may be modified to any desirable extent by means of butterfly-valves placed in the air and gas pipes between the pumps and the sources of supply, and by this means the proper proportions to secure prompt and perfect combustion in the cylinder may always be regulated.

Fig. 9 shows a modification, in which there is a separate reservoir and a separate slide valve for each end of the cylinder, the reservoir being made of the proper size to hold the proper amount of gas and air to be burned at a single stroke, and the clack or check-valves being placed between the reservoir and the pumps, so as to allow the gas to be ignited in the reservoirs. In this drawing, A is the air-pump; B is the gas-pump; C is the driving-cylinder; F F mixers; G G the reservoirs; and H H the slide valves. Each reservoir is connected to one of the valve chests and to one end of both of the pumps. The construction and operation will be sufficiently obvious without further description.

Fig. 10 shows another modification, in which a mode of lining the combustion-cylinder, or a portion thereof, with refractory materials, as represented, and in which is also shown a modified mode of working the gas. In this figure, T is the driving-cylinder; S is the slide-valve; and M is a pipe which leads from an auxiliary cylinder, A, where the gases are burned, to the driving-cylinder. This combustion-cylinder, A, is provided at the top with a water-chamber, C, and the lower part, where the combustion takes place, is lined with a refractory non-conducting material, P, and the piston G has a similar facing, H. In this arrangement the gas is burned in the lower part of the cylinder A, and the expansive force is used and applied in the cylinder T, the piston G being used as a simple displacer, and to separate the body of gas below it from that above, so as to compel whatever gas passes from above the piston to the chamber below it to pass through a porous body, which, by having been itself heated by the outgoing gas which has already been burned and is hot when it escapes, is made to impart its heat thus received to the incoming gas and prepare it for combustion. The porous body J may be composed of wire cloths, or plates of sheet iron, or any other suitable material which will make the interstices sufficiently fine to prevent the passage of flame, and will yet be sufficiently open to allow the gas to pass with sufficient freedom. It is placed in the pipe I, which forms a communication between the upper and lower portions of the cylinder A, or it may be placed in the piston G itself. The gas is fired in the lower part of the cylinder A by means of electricity introduced through the wire L.

The operation of the arrangement represented in fig. 10 is as follows: The gas and air to supply the engine are introduced through the pipes V V, which receive them from the gas generator and from the outside atmosphere, or from pumps, in the manner already described with relation to figs. I, 3, and passing through the valve O and the pipe M enter the upper part of the cylinder A, from which a portion of it passes through the pipe I and the porous heater J to the lower part of the same cylinder. Having arrived there, it is ignited at the proper moment by the electric spark, and the amount contained in the lower part of the cylinder below the piston G will be burned and cause an expansion, which will raise the valve P and force the gas under pressure into the slide-valve chest and into the cylinder T, where its power will be utilized in the same manner that the power of steam is utilized in the common steam engine, and the spent gas will be discharged in the same manner that spent steam is ordinarily discharged. As the pressure on one side of the piston G is substantially the same that it is upon the other, it is obvious that to make it useful for any purpose as a piston it must be moved automatically by some connection with the driving-piston. This connection should be such as to give it two strokes for each one made by the driving-piston. It will be observed that those gases only which are below the piston A and the heater J will be burned, consequently the greatest amount of combustion and consequent expansion will take place when the piston A is in its highest position, and the descent of this piston, by forcing the burnt gases through the porous body J, and thereby cooling them, will have a tendency to create a partial vacuum in this cylinder and the pipes I and M, which will close the valve P and open the valve O to let in fresh gas and air, which, passing through the porous heater J as the piston A rises, will become heated by the caloric left by the burnt gases which have just passed through it, and thus prepared for more ready and complete combustion. After the closing of the valve P, the stroke of the piston T will, of course, be completed by the expanding force of the gases already in the cylinder and the passages leading to it from the valve P. Such being the case, the piston A may properly commence its upward stroke at about the time of the commencement of a stroke in either direction by the piston T, and the ignition of the gases in the cylinder A should take place at about the same time. It is obvious that the different arrangements above described involve considerable changes in the construction of the engine, but they all have certain features in common, though they do not all of them have all the features embodied in my improvements.

The combustible material used in all these styles of engines consists of a gas made by the distillation of coal or other gas-producing substance, the process being similar to that of the distillation of ordinary illuminating gas with the exception that a small quantity of air, and perhaps a small quantity of water also, is introduced into the gas-producing substance in the process of distillation so as to produce a gas which is a mixture or combination of common illuminating gas and the products of combustion, and by this means make the gas more efficient and yet readily combustible, said gas being mixed after distillation, and before it reaches the cylinder of the engine, with a proper quantity of air to make its combustion and propulsive effect complete and efficient.

Figure 11 represents a device for utilizing the heat of the spent gas after it passes from the engine. In this figure, A is the pipe which brings the spent gas from the engine. B is a metal or earthen pipe pierced around the upper part with holes, *e e e*, through which the gas passes into said pipe B, by which it is conducted into a reservoir, D, containing water to be heated by the gas. The pipe B is open at the bottom and discharges the gas into the water, which it passes through, and is discharged through the pipe E. F is a supply pipe which brings the necessary water to the reservoir D. This arrangement may be modified by using a porous body instead of the reservoir, and keeping it constantly wet.

Claims.

I claim as my invention—

1. The combination of the cylinder C, the pumps A and B, the branch receiving pipes *a* and *b*, and the mixer F, in such a manner that the air and gas to supply the engine shall be forced simultaneously through the mixer to supply the cylinder by the simultaneous action of the two pumps, A and B, as set forth.

2. The combination of the mixer F, represented in figs. 4 and 5, composed of a folded plate of metal, as described, with the branch pipes *a'* and *b'*, so constructed and arranged in combination with each other and the main pipe as to deliver the gas in the latter in thin, alternate layers, as set forth.

3. The combination of the parts represented in fig. 7, or their equivalents, with the cut-off rod in such a manner that the closing of the current shall be effected simultaneously with the closing of the cut-off valve, substantially as and for the purpose set forth.

4. The combination, with a gas-burning engine, of a porous substance, B, placed in the receiving pipe, as represented in fig. 8, substantially as and to the effect set forth.

FRANCISQUE MILLION.

Witnesses:

E. MILLION,

I. MILLION.