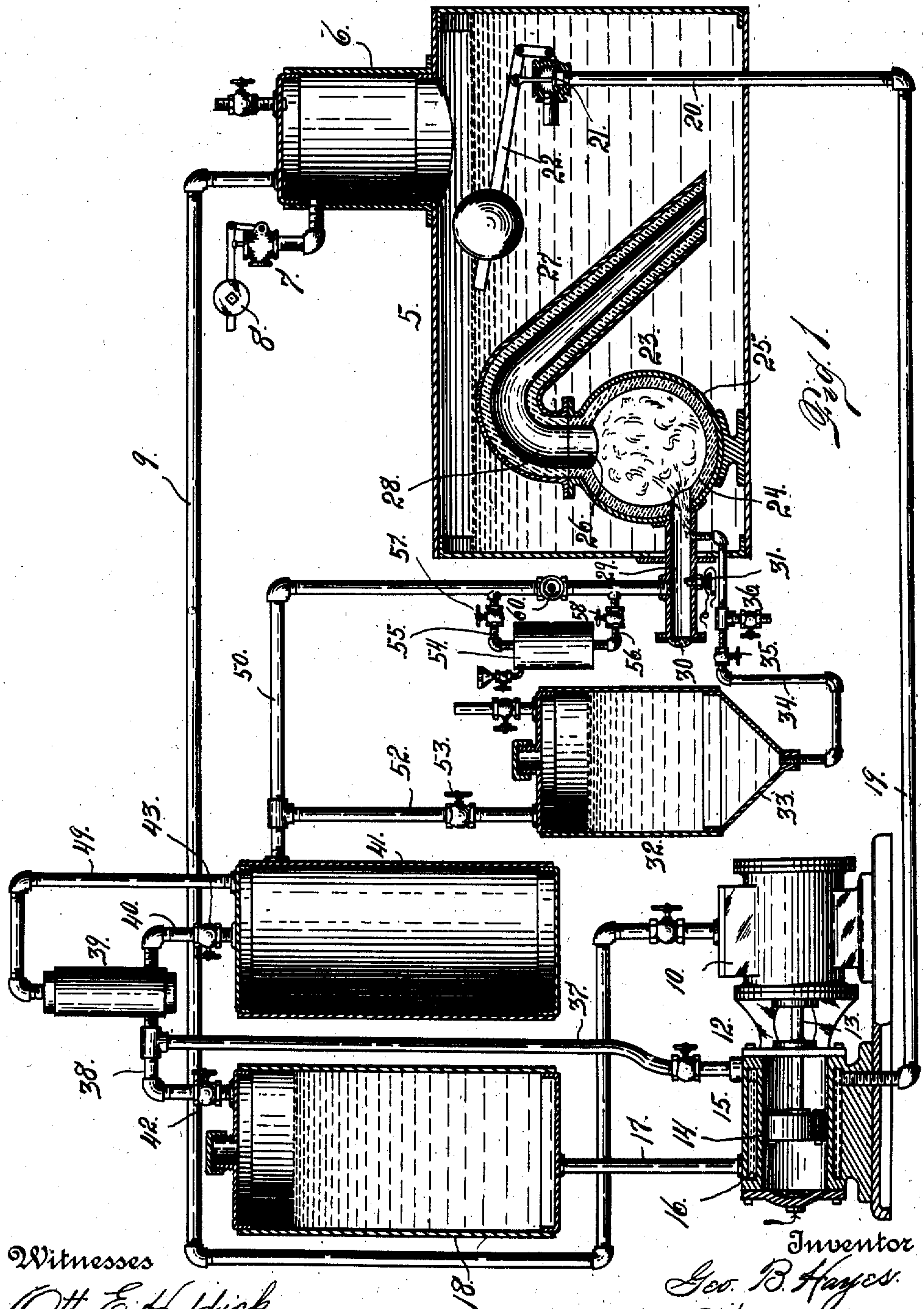


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G. B. HAYES.
 APPARATUS FOR GENERATING MOTIVE FLUID.
 APPLICATION FILED NOV. 1, 1909.

Patented Nov. 15, 1910.
 2 SHEETS—SHEET 1.



Witnesses
Otto E. Hoddick.
J. D. Thornburgh.

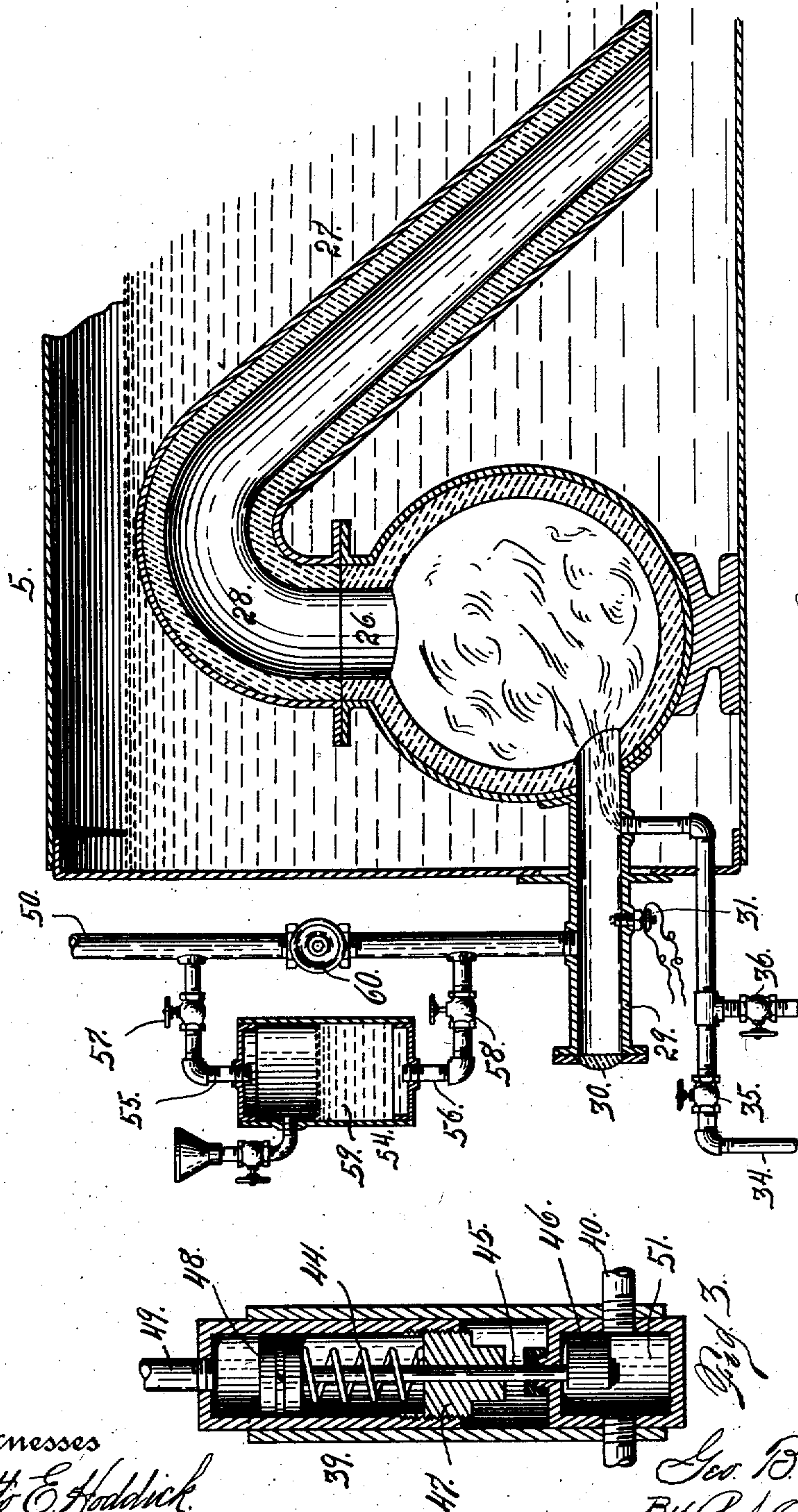
Inventor
Geo. B. Hayes.
 By *A. J. O'Brien.*
 Attorney

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UNITED STATES PATENT OFFICE.

GEORGE B. HAYES, OF DENVER, COLORADO.

APPARATUS FOR GENERATING MOTIVE FLUID.

976,077.

Specification of Letters Patent.

Patented Nov. 15, 1910.

Application filed November 1, 1909. Serial No. 525,689.

To all whom it may concern:

Be it known that I, GEORGE B. HAYES, a citizen of the United States, residing at the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Apparatus for Generating Motive Fluid; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in apparatus for generating motive fluid, my object being to provide a fluid of this character in which all of the heat units due to combustion are combined in a working medium that can be utilized in a motor without detriment to the cylinders. In doing this, both the products of the combustion and steam generated by the excessive heat of the products of combustion, are utilized, both being suitable for motive fluid, preferably in a combined condition.

My further object is to obtain complete combustion of the fuel even of a low grade, with as little excess air as possible. This is accomplished by the exceedingly high degree of heat retained in the combustion chamber and utilized for regenerating the gases. The manner in which the products of combustion are separated from the combustion chamber also contributes to this end.

The invention relates to that class of internal combustion generators in which the fuel and air are burning continuously and under constant pressure, while the highly heated products of combustion are delivered to a liquid contained in the generator, and thus diluted with steam and automatically reduced to a suitable working temperature, so that it can be used in the working cylinder of a motor without detriment thereto. Both products of combustion and the vapor of the liquid are utilized, preferably in combined form, as heretofore stated.

In my improved apparatus, the combustion chamber is entirely submerged in the liquid which protects the parts exposed from the fierce heat of combustion, thus making it practicable to utilize the maximum heat due to combustion. By locating the combustion chamber inside the gener-

ator, the internal pressure in the combustion chamber is counteracted on the outside by the generator pressure, thus rendering it unnecessary to construct a combustion chamber of sufficient strength for withstanding unaided, the great internal pressure incident to an apparatus of this character.

When gaseous fuel is used, a gas or air compressor and a governor valve for the gas are required in addition to the elements required for liquid fuel.

The fuel feed device is designed for automatically regulating or controlling the delivery of combustibles to the combustion chamber, as required by the generator, and also for delivering them in suitable proportions for perfect combustion, for various qualities of fuel.

Assuming that a given number of pounds of excess pressure in the fuel and air receptacles, will deliver the necessary combustibles for supplying the generator when working at ordinary capacity, the valves may be adjusted so that the combustibles will be delivered in correct proportion for this given pressure and it is assumed that the ratio of air to fuel delivery will for other pressures remain nearly enough constant for practical purposes.

The safety valve connected with the generator should be set to go off at a somewhat lower pressure than the predetermined pressure of the fuel and air supply, whereby a flow of combustibles is always insured.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing, in which is illustrated an embodiment thereof.

In this drawing: Figure 1 is a vertical longitudinal section taken through my improved apparatus, illustrating the necessary connections for burning liquid fuel. Fig. 2 is a fragmentary section taken through the generator and the combustion chamber therein, together with some of the adjacent elements of the apparatus, the parts being shown on a larger scale. Fig. 3 is a vertical, longitudinal section taken through the governor valve, the parts being shown on a larger scale.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate the generator provided with a dome 6 and a safety valve 7, the weight 8 of which should be so adjusted

as to allow the valve to open at a pressure somewhat less than the pressure which is to be maintained in the air and fuel receptacles.

A pipe 9, leads from the dome of the generator 5 to the chest 10, of an engine 12, whose piston rod 13, is connected with the plunger 14, of an air compressor 15. The cylinder of the air compressor is surrounded by a water jacket 16, which is supplied with water through a pipe 17, connected with a water tank 18.

The water, after flowing through the jacket 16, passes by way of a pipe 19, into the generator 5, through a standpipe 20, whose upper end is controlled by a float valve 21, acted on by a weighted lever 22.

Within the generator 5, is located a combustion chamber 23, which as shown in the drawing, is spherical in shape and composed of an inner layer 24, of fire clay and an outer layer 25, of metal, or other suitable material. This chamber has an opening 26, in its top with which is connected a gooseneck-shaped pipe, or conduit 27, which curves upwardly from the combustion chamber, as shown at 28, and then abruptly downwardly, its lower extremity being open and terminating near the bottom of the generator.

Connected with the combustion chamber is a twyer 29, through which the air or other combustion-supporting medium and fuel are delivered to the combustion chamber. The outer extremity of the twyer is closed by a transparent lens 30, to permit the inspection of the interior of the twyer, and of the combustion chamber.

A spark plug 31, is connected with the twyer for the purpose of the initial ignition of the gaseous fuel for the purpose of supporting the fire. The fuel tank 32, has a cone-shaped bottom 33, connected with the twyer by a pipe 34, containing a controlling valve 35. This pipe is also equipped with a valve-controlled nipple 36, whereby means are provided for introducing additional fluid to the twyer through the pipe 34.

Leading from the air-compressor cylinder 15, is a pipe 37, which communicates with a pipe 38, one extremity of which leads to the top of the water tank 18, while the other extremity is connected with the bottom of a governor valve 39. Also leading from the bottom of this valve is a pipe 40, which communicates with the top of an air receiver 41. The pipes 38 and 40 are provided with valves 42 and 43 respectively. The function of the governor valve 39, is to maintain the air within the receiver 41, at a predetermined pressure, and this is determined by the tension of a spring 44, surrounding a stem 45, whose lower extremity is equipped with a valve 46. The opposite extremities of this spring act upon a plug 47, and a piston 48, movable in the valve casing. The spring 44 is set at such tension

that it will resist a predetermined pressure in the receiver, which pressure acts upon the piston 48, through a pipe 49, leading from the top of the receiver to the top of the valve casing above the piston 48. Until the pressure within the receiver attains a degree above the predetermined degree, the air will pass from the pipe 37, through the lower compartment 51, of the valve casing and out through the pipe 40, into the air receiver. However, should the pressure within the receiver become too great, this pressure acting upon the piston 48, will serve to depress the said piston and cause the valve 46, to cut off, or partly cut off the passage of compressed air through the compartment 51 of the receiver.

The receiver is connected by means of a pipe 50, with the twyer 29. The pipe 50, is also connected with the top of the fuel receptacle 32, by a pipe 52, provided with a valve 53.

A small receptacle 54, is mounted upon the pipe 50, by means of upper and lower branches 55 and 56, controlled by valves 57 and 58. This receptacle contains a quantity of fuel 59, for supporting the fire, and when it is desired to accomplish this purpose, the two valves, 57 and 58 are opened, and a valve 60, in the pipe 50 between the branches 55 and 56 is closed. The fuel within the receptacle 54, is thus placed under the pressure of the air in the receiver 41, whereby it is forced out into the pipe 50, below the valve 60, and thus into the twyer 29.

Provision may be made for producing a spark, or a succession of sparks through the instrumentality of the spark plug 31, with which the twyer is equipped, as heretofore explained. After the fire is well started, the valve 35, in the pipe 34, leading from the bottom of the fuel receptacle, is opened and the fuel from the tank 32 automatically delivered to the twyer and thence to the combustion chamber, as will be readily understood. The products of combustion within the combustion chamber, must escape through the gooseneck conduit 27, into the liquid of the generator, thus generating steam, which combined with the products of combustion, form the motive fluid which it is the object of my apparatus to produce.

In the operation of the apparatus, the motive fluid generated supplies the engine through the pipe 9. The engine operates the air compressor, whereby the receiver 41 is supplied with air under the necessary compression. This air acts upon the water in the tank 18, and also upon the fuel in the receptacle 32, by virtue of the connections heretofore described. Air is also supplied by the receiver to the twyer for the purpose of starting the fire, this being accomplished through the medium of the small fuel receptacle 54, after which fuel is supplied to the

combustion chamber from the tank 32, through the pipe 34, the valve 35 being opened for the purpose.

The receptacle 54, as used in the drawing, 5 contains gasolene, or other highly inflammable fuel, which may be easily ignited with the spark plug 31 and the flame carried through the twyer 29 and into the combustion chamber 23, and thus used for igniting 10 the heavier and less inflammable fuel with which the combustion chamber is to be supplied later on; and furthermore for heating up the interior wall of the combustion chamber, that the gases of the heavier fuel may 15 be easily generated. A large receptacle similar to the receptacle 54 may be used for delivering to the combustion chamber any other suitable fuel, containing a large percentage of combustion-supporting elements, 20 such as liquid air, liquid oxygen or nitric acid. When liquid air or liquid oxygen are used, the receptacle should be properly insulated for excluding heat and should furthermore be equipped with a safety valve 25 for releasing any excess pressure which may be generated by the heat which the liquid would absorb from the surrounding atmosphere. When nitric acid, or other corrosive, combustion-supporting media, are used, the 30 receptacle and piping should be composed of suitable material for resisting the corrosive action of the agents employed. Of course, for some combustion-supporting media, such as nitric acid, the interior wall of this combustion chamber must be previously heated 35 to the proper temperature for disassociating the nitric acid and evolving free oxygen. Air may be used for this purpose before the acid is introduced, or may be used in conjunction with the acid. 40

Having thus described my invention, what I claim is:

1. In apparatus for generating motive fluid, the combination with a generator, of 45 a combustion chamber, submerged in the liquid of the generator and provided with an open-ended conduit connected with the top of the combustion chamber, and bent downwardly and forwardly in the combustion chamber terminating near the bottom 50 of the generator, a twyer connected with the combustion chamber and projecting beyond the generator, and means for simultaneously introducing fuel in fluid form, and a combustion-supporting medium to the twyer, 55 substantially as described.

2. In apparatus for the generation of motive fluid, the combination with a generating tank containing a liquid to be vaporized, of a combustion chamber submerged in 60 the tank and having an open-ended, goose-neck-shape outlet connected with the top of the chamber, a twyer extending in the generator tank and connected with the lower 65 part of the combustion chamber, the said

twyer being surrounded by the liquid within the generator and protruding outwardly beyond the generator, and means for simultaneously delivering to the twyer, fuel in fluid form, and a combustion-supporting 70 medium, the fuel and the said medium being delivered at uniform pressure, substantially as described.

3. The combination with a generator containing a liquid to be vaporized, of a combustion chamber submerged in the liquid 75 of the generator and having an open-ended outlet communicating with the liquid, an air receiver, a liquid containing tank, the float valve controlled pipe communicating 80 with the liquid containing tank of the generator for supplying the latter, a fuel receptacle in communication with the combustion chamber, a connection between the air receiver and the combustion chamber for 85 supplying the latter with the necessary combustion-supporting medium, means for supplying the air receiver with compressed air, a pipe connection between the liquid-containing tank and the receiver with which the air 90 compressor is connected, and a governor valve interposed in the pipe connection between the liquid-containing tank and the air receiver, and between the compressor connection and the receiver for automatically 95 regulating the receiver pressure, substantially as described.

4. The combination with a generator containing a liquid to be vaporized, of a combustion chamber submerged in the liquid 100 and having an open-ended conduit in communication with the liquid, means for supplying the combustion chamber with liquid under pressure, means for supplying the said chamber with a combustion-supporting medium 105 under pressure, means for automatically regulating the pressure of the combustion-supporting medium and the fuel, a liquid fuel receptacle through which the supporting medium passes for starting the combustion 110 and means for relieving the generator pressure at a less degree than the pressure on the combustion-supporting medium and the fuel supply, substantially as described.

5. The combination with a generator containing a liquid to be vaporized, of a combustion chamber submerged in the liquid of the generator, means for supplying fuel to the combustion chamber under pressure, a relatively small fuel receptacle for initially 120 supplying the combustion chamber with fuel under pressure, means for automatically maintaining the pressure on the fuel at a predetermined degree, and means for relieving the pressure in the generator at a 125 less degree than the pressure on the fuel supply.

6. The combination with a generator containing a liquid to be vaporized, of a combustion chamber submerged in the liquid 130

of the generator, a twyer connected with the combustion chamber and protruding from the generator, a pipe for delivering a combustion-supporting medium to the twyer,
5 a relatively small liquid fuel receptacle, mounted on the pipe through which the combustion-supporting medium passes, the said pipe being in communication with both extremities of the receptacle, a cut-off valve
10 interposed in the combustion-supporting-medium pipe between its connection with opposite extremities of the fuel receptacle,

valves for controlling the communications between the fuel receptacle and the combustion-supporting-medium pipe, and a spark 15 plug connected with the twyer for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE B. HAYES.

Witnesses:

A. J. O'BRIEN,
JESSIE F. HOBART.

Correction in Letters Patent No. 976,077.

It is hereby certified that in Letters Patent No. 976,077, 'granted November 15, 1910, upon the application of George B. Hayes, of Denver, Colorado, for an improvement in "Apparatus for Generating Motive Fluid," an error appears in the printed specification requiring correction as follows: Page 3, line 49, for the word "in" read *of*; and that the proper corrections have been made in the files and records of this office and are hereby made in said Letters Patent.

Signed and sealed this 16th day of January, A. D., 1912.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.

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