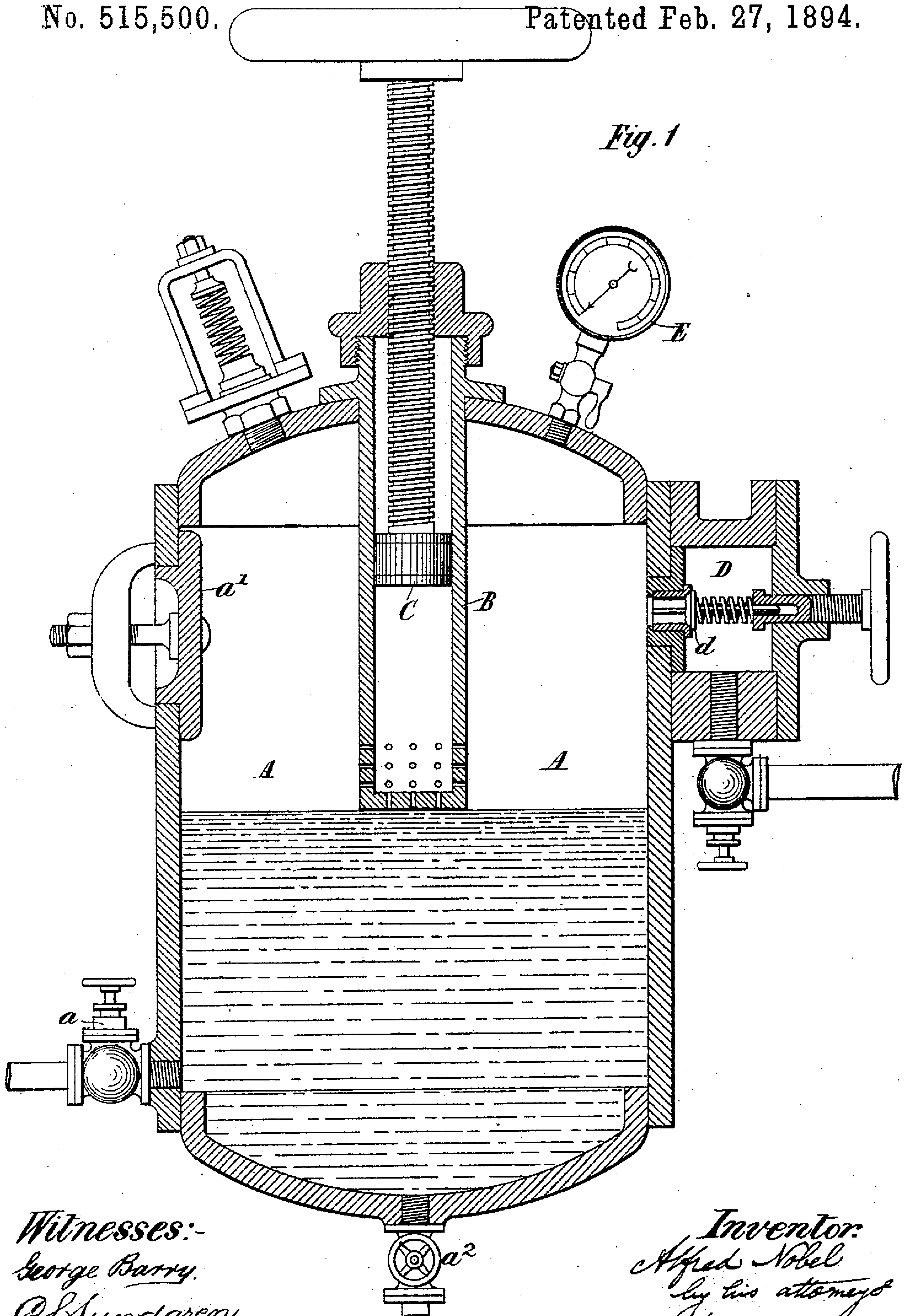
(No Model.) 2 Sheets—Sheet 1.

A. NOBEL.

MEANS FOR GENERATING GASES UNDER PRESSURE FOR OBTAINING MOTIVE POWER.

No. 515,500. Patented Feb. 27, 1894.

Fig. 1



Witnesses:-
George Barry.
C. L. Sundgren

Inventor:
Alfred Nobel
by his attorneys
Brown & Seward

THE NATIONAL LITHOGRAPHING COMPANY, WASHINGTON, D. C.

(No Model.)

2 Sheets—Sheet 2.

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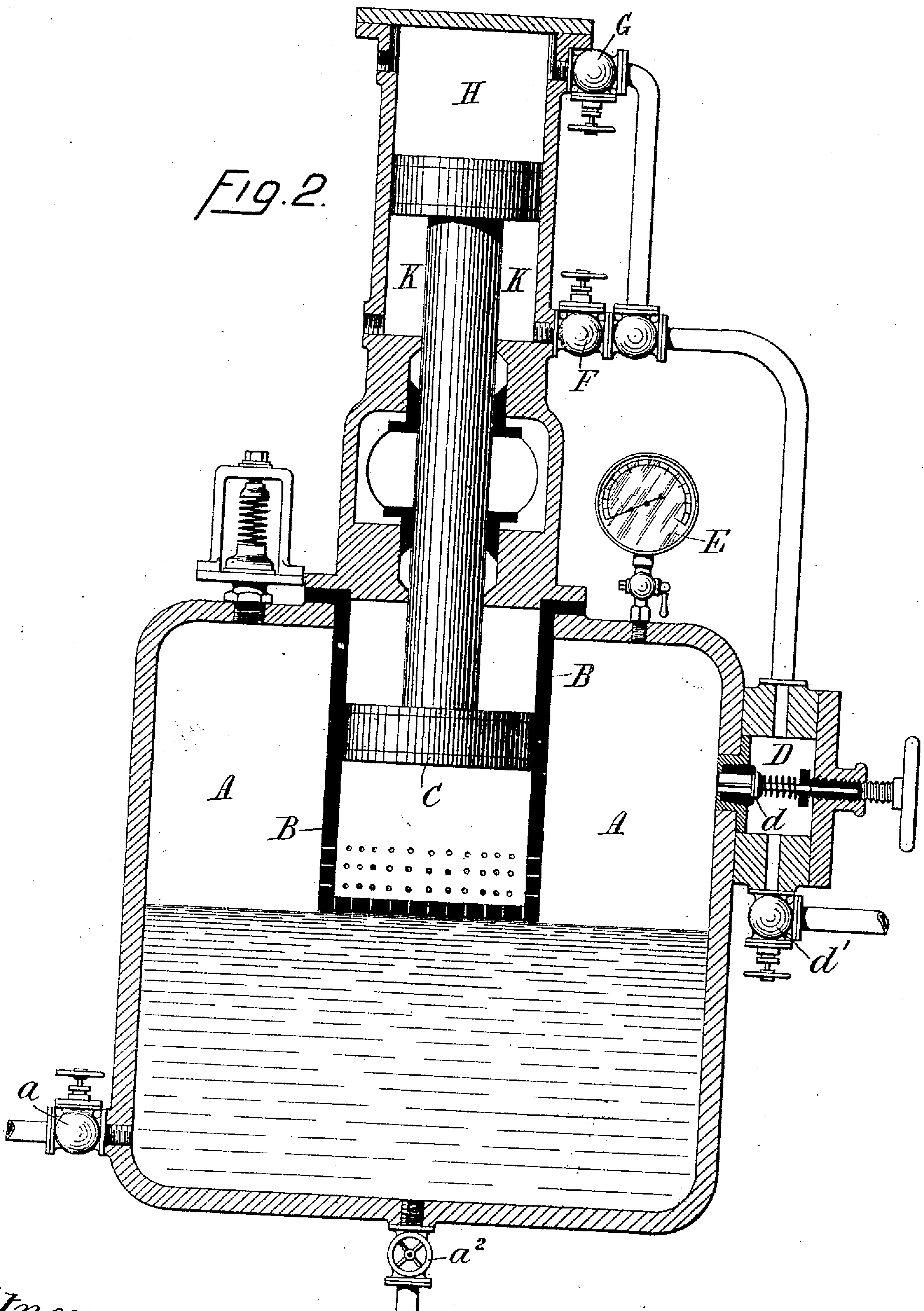
Fig. 2.



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UNITED STATES PATENT OFFICE.

ALFRED NOBEL, OF PARIS, FRANCE.

MEANS FOR GENERATING GASES UNDER PRESSURE FOR OBTAINING MOTIVE POWER.

SPECIFICATION forming part of Letters Patent No. 515,500, dated February 27, 1894.

Application filed July 29, 1892. Serial No. 441,611. (No model.)

To all whom it may concern:

Be it known that I, ALFRED NOBEL, engineer, of 59 Avenue Malakoff, Paris, in the Republic of France, have invented certain new, useful, and Improved Means for Generating Gases under Pressure for Obtaining Motive Power, of which the following is a specification.

For propelling torpedoes and other explosive missiles, for controlling the course of balloons, and for various modern industrial purposes, a motive power is required, of which the cost of production is of comparatively slight importance, provided the material which develops it, and the machinery requisite therefor, be extremely light in regard to the developed energy which can be practically utilized. Hitherto, compressed air, liquid carbonic acid, and electric primary and secondary batteries, have been applied for such purposes, and they have proved comparatively inadequate. I substitute for such motive power the energy developed by the chemical reaction of metallic sodium or potassium or alloys of those two metals which possess the property of decomposing water at the ordinary or a slightly raised temperature, thus setting free or developing a permanent gas or vapor the explosion of which is capable of producing motive power.

To explain.—Sodium, in contact with water, combines with its oxygen, and liberates hydrogen gas. The reaction of the aforesaid metals, or metallic alloys, on water, produces great development of heat, which also is a source of motive power. Thus, twenty-three grams of sodium, when brought in contact with eighteen grams of water, sets free 43.1 units of heat, which are theoretically capable of developing an energy equal to eighteen thousand two hundred and thirty kilogram-meters, or one horse power sustained for four minutes. Hence, three hundred and forty-five grams of sodium would theoretically produce and maintain one horse power for an hour, or ten horse power for six minutes. The practical utilization will of course fall considerably short of these theoretical figures, but I consider that the waste will be small, owing to the small dimensions of the engine required, and the high pressure under which it can be made to work.

The reaction of sodium or potassium or their alloys on water is very intense and somewhat partakes of the character of explosive mixtures but I moderate it by adding ammonia. Water at a low temperature, or under pressure, will absorb large quantities of ammonia gas, which the heat generated by the reaction of sodium, or potassium on the water, will liberate.

If, for instance, twenty-three grams of sodium are acting on a liquid composed of twenty-seven grams of water and eighty-five grams of ammonia (NH^3), then the result will be as follows:—Out of the 43.1 units of heat set free, as above shown, twenty-three will be needed to vaporize eighty-five grams of ammonia, and the remaining 18.1 will raise the temperature of the said eighty-five grams of ammonia gas, as well as the solution of caustic soda formed (fifty grams), and of the one gram of hydrogen gas set free to about 200° centigrade. The volume of ammonia and hydrogen thus vaporized and expanded, would, under the atmospheric pressure, represent a volume of of about two hundred and ten cubic decimeters. Each cubic meter of gas to be produced, would therefore, under the above conditions, require about 109.5 grams of sodium, 128.5 grams of water, and four hundred and four grams of ammonia, or, in all, six hundred and forty-two grams. The proportion of water should be so regulated as to dissolve the caustic soda produced by the reaction; otherwise that reaction would be rendered irregular, owing to the formation of crusts of said caustic soda. Whatever water may be added over and above the said proportion, chiefly serves to quicken the chemical reaction.

It will be seen from the above figures, that when the proportion of ammonia is as high as eighty-five parts to twenty-three parts of sodium, the temperature of the evolved gas will be as high as 200° centigrade. But if the reaction is taking place under high pressure, that temperature may be considerably increased by lowering the proportion of ammonia and increasing the proportion of water. In practice, those proportions must be regulated in such manner as to be suited to the pressure under which it is intended to let the ammonia gas be utilized, which pressure is regulated by the inlet of sodium, or its equivalent metal or alloy, as well as by a safety valve. It should be borne in mind, that the higher the pressure under which said gas is emitted, the more useful effect can be obtained from its expansion, but also the more heat will also be absorbed by that expansion. Hence it is desirable that the aforesaid gas should be emitted at a temperature sufficiently high to make up for the heat absorbed by the expansion, thus securing the full useful effect attainable. Seeing that the recipient wherein said reaction takes place, can be of very small dimensions, there is no practical reason why the pressure should not be kept up as high as fifty or one hundred atmospheres, or even much higher, the inlet of said metal into the water and ammonia mixture, being regulated at a proportionate speed.

In carrying out my invention, I make use of a vessel capable of resisting high pressures, and in which the aforesaid reacting materials are brought into contact. This can be done in several different ways; for instance, these two reacting materials can both be injected separately and gradually into the vessel, each of them at such rate, and in such proportion, as to develop the quantity of gas required in a certain time. Or the vessel can be made of such capacity as to contain the entire supply of ammonia and water needed for the development of the required energy in which case the sodium or potassium or its alloy is gradually discharged into the liquid on which it has to react. In this case, the full mechanical effect is at first developed somewhat more slowly, since it takes some time before the reaction produced can heat up the entire quantity of water and ammonia contained in the vessel. If sodium is used as the oxidizer, this metal must be injected into the vessel either at such high temperature as to liquefy it, when it can be injected and dispersed as any other liquid, or if it is used in the solid state at the ordinary temperature, this metal being very soft, it can be pressed into the liquid through holes conveniently situated in the containing vessel. This feeding operation can be done by hand, but most generally will be effected by means of some mechanical contrivance so arranged as to render the feeding proportionate to the energy required and the time during which it has to be applied.

When very quick feeding is required, I prefer, as a rule, an alloy of sodium and potassium which is liquid at the ordinary temperature. By injecting it in the shape of finely divided spray, a very vivid action is easily obtained, evolving in a short time a large quantity of gas; this action will not present any feature of an explosive character, owing to the aforesaid mode of gradual feeding. The higher the pressure is kept up in the vessel, the less the liquid will be liable to spurt; hence the gas emitted will occupy a proportionately smaller bulk.

If sodium or potassium or their alloy is to react on water or other liquids developing chiefly permanent gases, such as hydrogen, there is no absolute need for an engine or other mechanical contrivance to utilize the developed energy, since said gases, directed under very high pressure against water, or even against air, will realize a considerable amount of propulsive or repulsive force. But, as a rule, it will be more economical, and more practical, to use the compressed gas thus generated, in the same way as compressed air is now used, to feed an engine or other mechanical contrivance capable of developing motive power.

In the accompanying drawings, Figure 1 shows in sectional elevation, suitable means for generating gas at a high pressure for this and kindred purposes, and Fig. 2 is a modification of the same.

A is a steel cylinder formed with rounded or dome shaped ends, and made sufficiently strong to resist the extreme pressure of the gas which has to be generated therein. Fitted to this cylinder or gas generator, is a small pendent cylindrical chamber B, for receiving the sodium or potassium, or alloy thereof, needed for decomposing the liquid in the cylinder A, and supplied thereto by a pipe *a*.

The cylinder A can either be made of such dimensions as to contain the total quantity of liquid wanted for generating the whole amount of energy required, or it can be made of such dimensions that the supply of the liquid through the pipe *a* should be gradual in proportion to the supply of the metal or alloy. In both cases, it will be useful to have a sufficient quantity of water or other suitable liquid to dissolve, as it is formed, the metallic oxide (due to the chemical action set up), in order to prevent said oxide coating the surface of the metal, and thus hindering the chemical reaction.

The cylindrical chamber B is closed at top by a cover which is fitted with a gland to receive the rod of a piston C, which is intended to act as a propeller, causing the plastic metal (when such metal is used) to ooze out at openings made in the bottom of the cylindrical chamber B. If the metal should not be in the plastic state, suitable arrangements will have to be made in order to bring it into contact with the liquid; as mere pressure would not be applicable for the purpose, the delivery may be effected by means of a stirrer or equivalent apparatus. Also, in the case of a metal in the liquid state (such as an alloy of sodium and potassium), the injection may be made in the shape of a finely divided spray. The valve chamber D communicates with the vessel A by means of a valve *d*, regulated by a hand screw or other suitable arrangement, for the purpose of determining the pressure of gas that shall be maintained in the chamber A. *d'* is a pipe serving to lead off the compressed gas to be used, either with or without the intermediary help of an engine for motive power purposes.

The vessel A is provided with a manhole a' for the inspection of the interior, and with a discharge pipe a^2 at bottom. It is also fitted with a pressure gage E, for indicating at each instant the pressure of the gas in the interior of the vessel, and may also be fitted with a safety valve, as used in ordinary boilers.

When the feeding of the metal is to be done by hand, the piston rod C is fitted with a handle by which the attendant is enabled to depress the piston with facility and discharge, as and when required, a fresh supply of the metal into the liquid.

In Fig. 2 I have shown an arrangement by which the feeding of the metal can be made automatically. From the valve chamber D, I lead part of the gas into another piston chamber fitted at the outer end of the piston rod which works the discharge of the metal, and, by regulating, with suitable differential valves F and G, the pressure on both sides H and K of the piston, I can make it to work in such a way that the rate of discharge increases as the pressure diminishes in the chamber when the reaction takes place.

It will be readily understood that means for bringing the metal into contact with the liquid may vary according to circumstances, a continuous discharge being sometimes required, whereas at other times an intermittent delivery may be preferable.

Having now described my said invention, what I claim is—

The mode of generating gas under pressure for obtaining motive power consisting in submitting sodium or potassium or an alloy composed of those metals to the action of a solution of ammonia in water in a closed vessel, substantially as herein described.

ALFRED NOBEL.

Witnesses:
ROBT. M. HOOPER,
J. CHATEL.