(No Model.)

J. H. NOLAN.

FLUID PRESSURE GENERATOR.

No. 495,140. Patented Apr. 11, 1893.

Fig. 5.

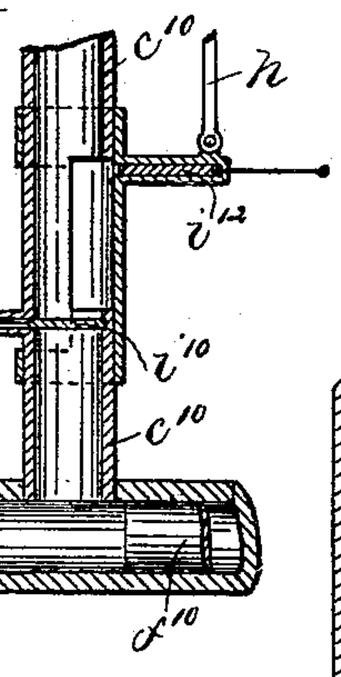


Fig. 1.

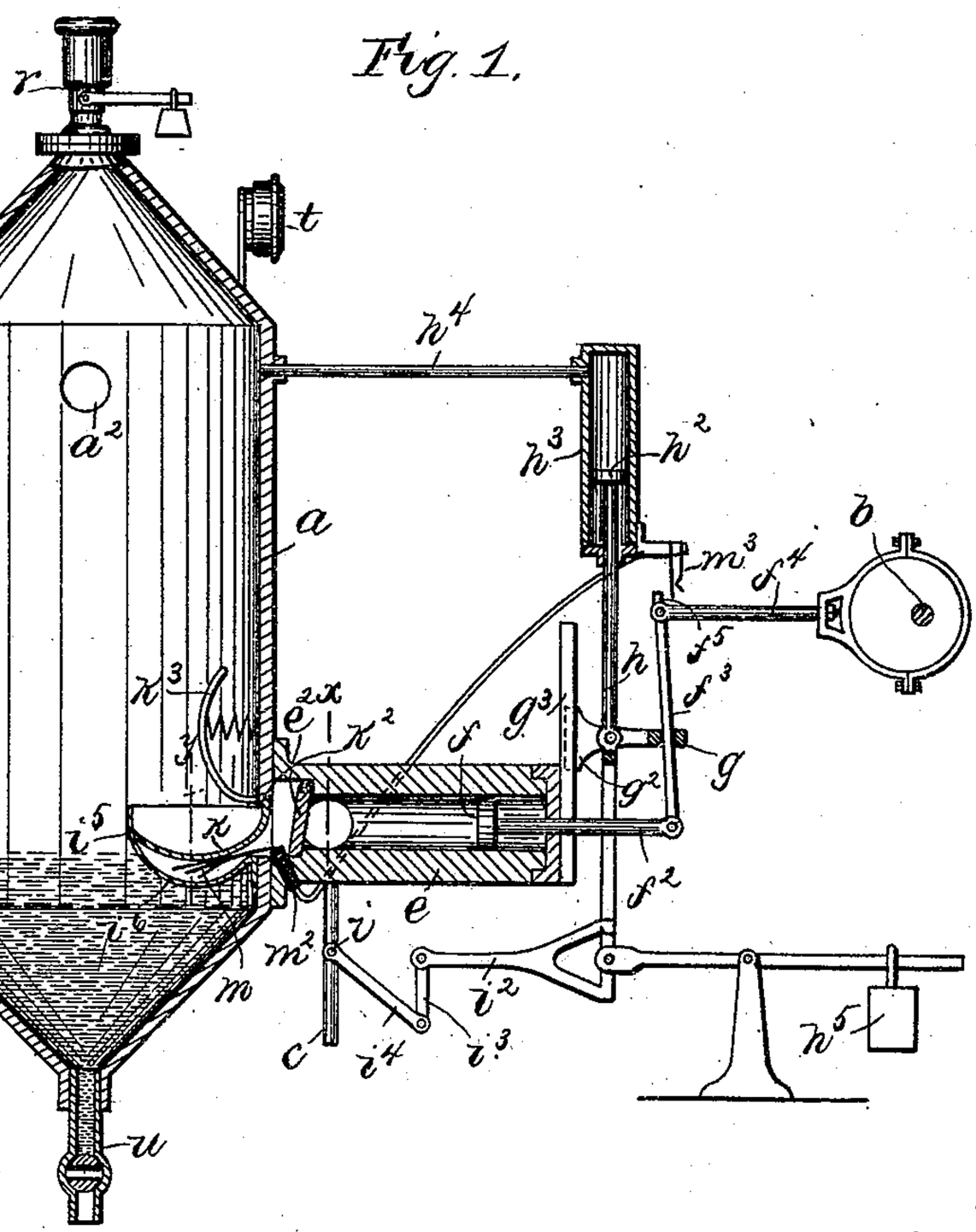


Fig. 2.

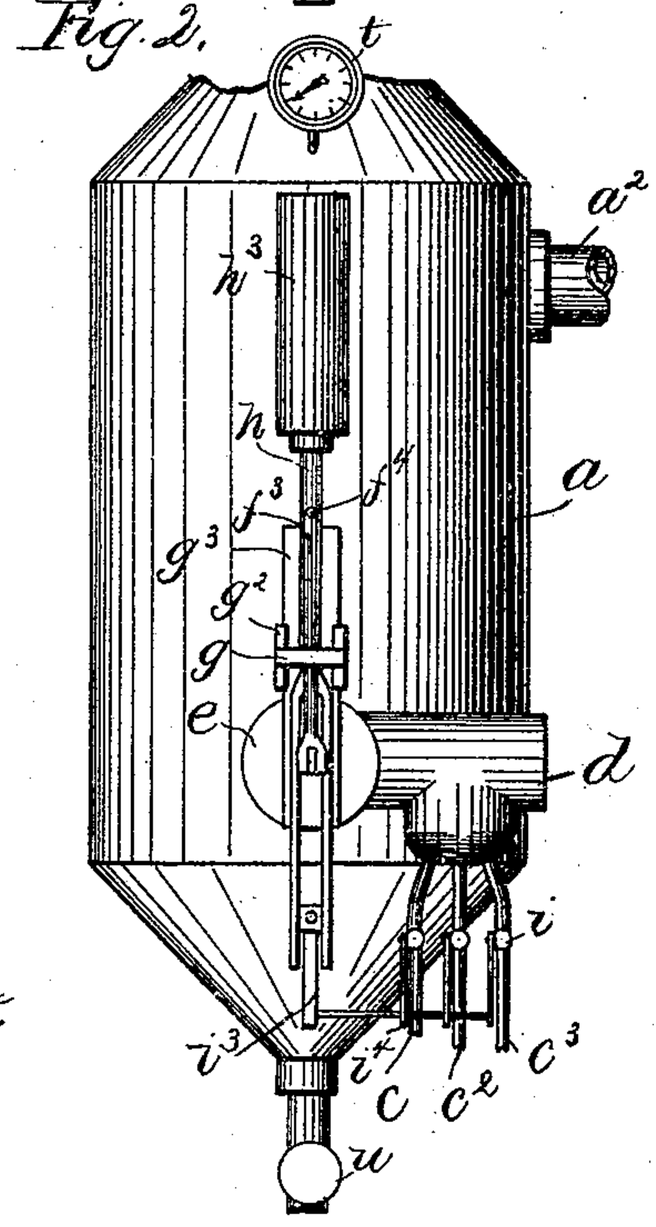


Fig. 3.

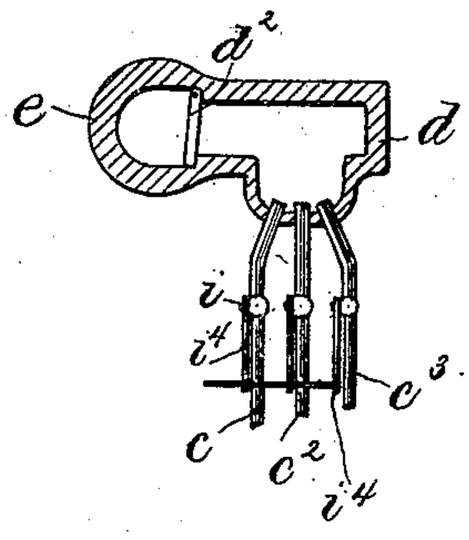
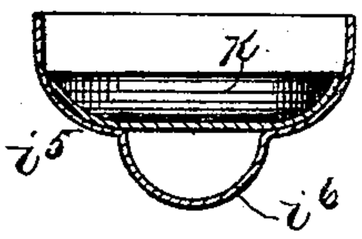


Fig. 4.



Witnesses
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UNITED STATES PATENT OFFICE.

JOHN H. NOLAN, OF BOSTON, MASSACHUSETTS.

FLUID-PRESSURE GENERATOR.

SPECIFICATION forming part of Letters Patent No. 495,140, dated April 11, 1893.

Application filed August 21, 1891. Serial No. 403,352. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. NOLAN, of Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Fluid-Pressure Generators, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to fluid pressure generators to be used for producing an elastic fluid under pressure to be used as motive power for driving engines or for analogous purposes, the said pressure being produced by chemical action of materials which commonly act as explosives, and which in accordance with the present invention produce gases under high pressure which are confined in a suitable holder or reservoir from which they are drawn to be used as motive power.

The invention consists mainly in appliances for automatically controlling the introduction of the explosive materials in accordance with the pressure produced and maintained in the reservoir, so that when said pressure falls below the desired amount, as is the case when the consumption is rapid, the charges of explosive material will be increased; and on the other hand when the pressure rises said charges will be diminished, and when the pressure reaches the desired maximum will be wholly cut off until pressure again falls below the predetermined maximum or normal amount.

The appliances for actuating and controlling the introduction and ignition or detonation of the materials are connected with the engine or motor so as to work in unison therewith; but the engine itself is not herein shown, as its specific construction forms no part of the invention, for my invention may be employed in connection with an engine or motor of any suitable construction adapted to be driven by an elastic fluid.

Figure 1 shows in vertical section a fluid pressure generator embodying this invention, the parts being shown rather in diagram to illustrate their functions and relation to one another, than in actual working proportions. Fig. 2 is a side elevation thereof; Fig. 3 a sectional detail on line x, Fig. 1; Fig. 4 a sectional detail on line y, Fig. 1, enlarged, and Fig. 5 a sectional detail showing a modification of the introducing apparatus.

The apparatus comprises a reservoir or receptacle a to contain the gases generated, which reservoir should be of proper material and construction to give the strength required to sustain the high pressures that are to be produced, which pressures will vary according to circumstances but will generally be much greater than steam pressures commonly used. The said reservoir a may be provided at any desired point with a discharge pipe a^2 through which the gas is conducted to the engine or motor, not shown, which said gas is intended to actuate. The parts governing the action of the pressure generator are driven from a shaft b connected by gearing or otherwise with the main shaft or other moving part of the engine, so that said shaft b moves in unison with the engine, the period of operation of the devices hereinafter described driven by said shaft b being the same as the stroke of the engine piston when a reciprocating engine is employed.

The apparatus may be supplied with any suitable chemicals, which before the chemical reaction or explosion occupy a comparatively small volume and which when properly mixed and ignited suddenly evolve a large volume of gas.

The present invention does not relate to the specific chemical compound used and is not limited to any specific explosive compound, but is shown as adapted to operate with a mixture of three materials introduced through pipes c, c^2, c^3, as best shown in Figs. 2 and 3, into a mixing and receiving chamber d, communicating with the barrel or cylinder e of a pump or forcing apparatus shown in this instance as containing a piston f, see Fig. 1, actuated from the shaft b, the rod f^2 of said piston being shown in this instance as connected with one end of a lever f^3 the other one of which is connected with an eccentric rod f^4 driven from the main shaft b the said piston f thus making one to and fro movement to each rotation of the shaft b which may be so connected with the engine as to make a complete rotation at each single stroke of the engine piston, or in any other desired proportion.

The barrel of the injecting pump or forcing apparatus communicates with the interior of the reservoir a and suitable valves d^2, e^2, are provided to cause the material to flow only from the mixing or receiving chamber d into

the barrel *e*, and from the latter into the reservoir *a* said valves being shown as inwardly opening check valves. If the piston *f* had a uniform stroke, equal amounts of the explosive materials would be introduced at each stroke, but as the draft of the elastic fluid from the reservoir *a* will depend upon the amount of work done by the engine and may consequently vary widely, means are provided for varying the amount of material introduced in accordance with the requirements at any time. As shown in this instance the means for varying the amount introduced comprises a shifting fulcrum *g* for the lever f^3 by which the piston *f* and shaft *b* are connected, said fulcrum being formed upon a carriage or slide g^2 movable upon a guide g^3 and connected with a rod *h* connected with a piston or equivalent device h^2 working in a cylinder h^3 or otherwise subjected to the pressure of the fluid in the reservoir *a* said cylinder being shown as communicating with said reservoir through a pipe h^4. The said piston h^2 or its rod *h* is acted upon by a counterbalancing force shown in this instance as a weight h^5 so set as to about balance the force on the piston h^2 derived from the gas in the reservoir *a* when at the normal pressure it is intended to carry, so that a slight increase in pressure above the normal moves the piston h^2 downward and shifts the fulcrum *g* of the lever f^3 in such manner as to lengthen the arm of the said lever connected with the actuator f^4 and shorten the arm connected with the piston rod f^2 thus making the strokes of the piston shorter, and also more powerful as is desirable owing to the fact that the material has to be forced into the receiver against a greater back pressure. When on the other hand the pressure in the reservoir diminishes, the pressure piston h^2 moves upward under the force of the weight h^5 which is not quite counterbalanced by such reduced pressure, such upward movement shifting the fulcrum *g* so as to lengthen the arm of the lever connected with the piston f^2 and sborten the arm connected with the actuator f^4 thus increasing the length of stroke of the piston so that it forces a larger volume of material into the reservoir at each stroke.

The supply pipes or ducts *c*, c^2, c^3, which convey the several materials of the compound to the mixing chambers *d* may be made of such size relative to one another as to deliver the materials in the requisite proportions, and as a further safeguard toward controlling the admission of the materials in accordance with the pressure in the said reservoir said ducts are provided with stop cocks or controlling valves *i* the operating arms of which are connected with the rod *h* that is responsive to changes in pressure in the reservoir *a* said rod being shown in this instance as having an arm i^2 connected by links i^3 with the operating arms i^4 of the several stop cocks so that the said stop cocks are opened or closed in proportion as the piston *h* moves down or up in response to a rise or fall in the pressure in the reservoir *a* being wholly closed when the said pressure arrives at or exceeds the maximum amount which it is intended to carry so that no more of the explosive material can be introduced until the said pressure is reduced so as to permit the piston *h* to move in the direction to open the valves *i* and at the same time produce an effective stroke of the piston *f*.

In order to provide for the proper ignition or explosion of the materials after they are introduced into the reservoir *a* the said reservoir is provided with a receiver i^5 shown as a pan or cup having a depressed portion i^6, see Fig. 4, in its bottom into which the material flows as it enters from the pump barrel *e* and in which it may be confined if necessary in order to produce the proper explosive action by a movable cover *k* pivoted or hinged at k^2 so that it may be thrown open by the gases evolved when the explosion takes place.

A suitable bunter or yielding stop k^3 is provided to receive the impact of the cover, which falls back by gravity immediately after the explosion has taken place and the pressure around it becomes equalized.

The ignition or detonation may be effected by the action of electricity in any usual manner, suitable wires *m* being shown as introduced at m^2 said wires including a suitable circuit closer or connector m^3, actuated by a projection f^5 carried by the eccentric rod f^4 or otherwise actuated from the shaft *b* at the proper time to apply the current after the charges have been introduced by the stroke of the piston *f*. Preferably a number of igniting or detonating wires are employed so as to afford certainty of operation in case any of said wires should become damaged or inoperative.

In order to protect the receiver or igniting vessel i^5 i^6 from being too strongly heated by the explosives, the reservoir *a* is kept supplied with water as shown at *n* up to a level sufficient to partially immerse and cover the outer surface of said exploding receptacle. The body of water being below the point at which the heat is applied will not be heated to a very high temperature although small portions of the water will be heated and evaporated at the upper surface forming steam which will mix with the other elastic fluid and pass out through the delivery pipe a^2. Another function of the water is to absorb such products of combustion as are not gaseous, and thereby permitting of the withdrawal of such absorbed matter through the discharge pipe *u*.

The supply of water may be maintained by a pump or other forcing apparatus as indicated at *p* which may be actuated from the engine shaft or otherwise, and driven continuously or intermittingly as may be required in order to keep the water at proper level.

My open pan as an explosive receiver dif-

fers from those receivers heretofore used and which are closed excepting for an outlet valve in several important particulars, some of which I will proceed now to mention. In the first place, the gas or gases generated by the explosion expand directly into the reservoir, and hence the open receiver, not having to resist the pressure of a confined volume of expanding gas, may be made much lighter and more cheaply than those valved receivers which are closed save for the valve. In the latter class of receivers, the explosion occurring in a chamber closed save for its valve, the gases expand in said chamber and the latter must be made of sufficient strength to resist the consequent pressure. In my receiver the cover does not act to confine the exploded material, it has no effect in resisting escape of the gases generated by such explosion, but, on the contrary, serves simply to confine or locate the unexploded material for exploding purposes, and the first effect of the explosion is to lift the cover and let free the gases directly into the reservoir.

The reservoir a may be provided with all appliances that are necessary or convenient for apparatus of this kind, such for example as a safety valve indicated at r, the pressure gage indicated at t and a blow off or discharge pipe indicated at u.

The invention is not limited to the details of mechanism thus far described, which may be widely varied without departing from the invention, the essential features of which consist mainly in appliances for introducing the explosive compound into the reservoir, and co-operating appliances responsive to changes in pressure in said reservoir for governing the said introducing apparatus as described and thereby controlling the amount of explosive materials introduced.

The introducing appliances shown in Figs. 1, 2, and 3 are especially adapted for introducing materials that are liquid or semi-fluid in their nature. In case dry powder or granulated materials are to be introduced, the construction shown in Fig. 5, may be employed, the inlet or supply duct c^{10}, being controlled by shut off slides i^{10}, i^{12}, so actuated that the former remains closed while the latter is being opened and closed, after which the lower slide i^{10}, is opened and permits the charge of material that has been contained between the slides to fall into the introducing cylinder e^{10}, from which it is carried forward by the introducing plunger f^{10}, to the point where the explosion takes place. The said plunger in its forward movement closes the lower end of the supply duct and thus cuts off communication between it and the reservoir while the explosion is taking place. In this construction the introducing plunger f^{10}, may have a uniform stroke and the amount of charge is varied in accordance with the pressure in the reservoir by making one of the slides as i^{12}, movable toward and from the other slide, as the pressure rises and falls, the slide i^{12} being mounted in a carriage having a telescopic movement along the supply pipe and having its position controlled by the pressure responsive devices h, h^2, h^3, which may be the same as represented in Fig. 1.

As already stated, the apparatus is capable of use with any suitable gas-producing agent, but I prefer a mixture of two parts of carbon-bisulphide and three parts of nitrogen-tetroxide or nitrogen-protoxide, or I may use in place of the carbon-bisulphide, benzole, petroleum, ether, mineral volatile oils or other liquid or solid carbonaceous materials, or I may use Sprengel's explosive.

I claim—

1. The combination with the reservoir and means for introducing gas-generating material therein, of a receiver arranged within the reservoir and composed of the pan or cup i^5 open at the top and having the depressed portion i^6 and the movable self-closing cover k, substantially as described.

2. The combination with the reservoir and means for introducing gas-generating material therein, of a receiver arranged within the reservoir and composed of the pan or cup i^5 open at the top and having the depressed portion i^6, the movable self-closing cover k, and the spring bunter k^3, substantially as described.

3. The combination with the reservoir and means for introducing gas-generating material therein, of a receiver arranged within the reservoir and composed of the pan or cup i^5 open at the top and having the depressed portion i^6 and the movable self-closing cover k, the said depressed portion of the pan and the parts immediately adjacent thereto being submerged in a cooling agent, substantially as described.

4. The combination of the reservoir, an exploding chamber therein, an injecting pump having a piston, supply pipes for said pump, valves in said supply pipes, a lever having one arm connected to said piston and the other with any suitable actuator, a movable fulcrum for said lever, the position of which is varied in accordance with variations in pressure in said reservoir, and connections between said movable fulcrum and the valves in the supply pipes, substantially as described.

5. The combination of the reservoir with an injecting pump and actuating mechanism for the piston thereof, comprising a lever having one arm connected with said piston and the other with the actuator, a movable fulcrum for said lever the position of which is varied in accordance with variations in pressure in said reservoir, substantially as and for the purpose described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN H. NOLAN.

Witnesses:

JOS. P. LIVERMORE,

M. E. HILL.