

March 13, 1956

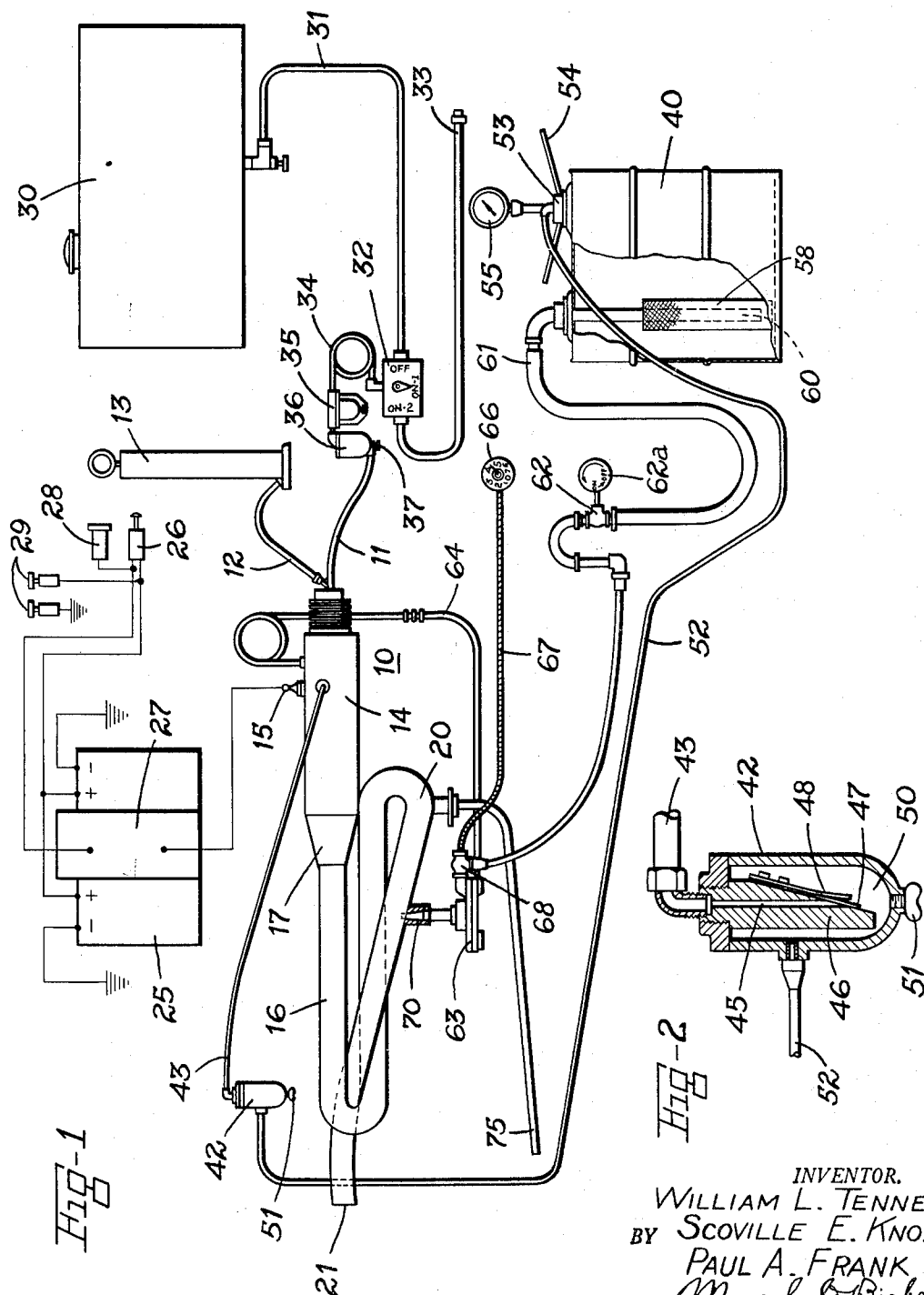
W. L. TENNEY ET AL

2,738,334

MACHINE FOR PRODUCING DISPERSIONS OF LIQUIDS IN
AIR OR OTHER GASES FOR THE PRODUCTION OF FOGS

Filed Dec. 26, 1950

3 Sheets-Sheet 1



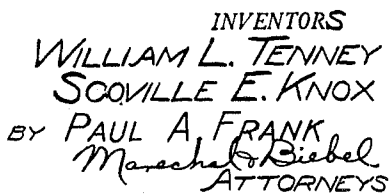
INVENTOR.
WILLIAM L. TENNEY
BY SCOVILLE E. KNOX
PAUL A. FRANK
Marshall & Diebel
ATTORNEYS

March 13, 1956 W. L. TENNEY ET AL 2,738,334
MACHINE FOR PRODUCING DISPERSIONS OF LIQUIDS IN
AIR OR OTHER GASES FOR THE PRODUCTION OF FOGS
Filed Dec. 26, 1950 3 Sheets-Sheet 2

2,738,334

3 Sheets-Sheet 2

Filed Dec. 26, 1950



March 13, 1956

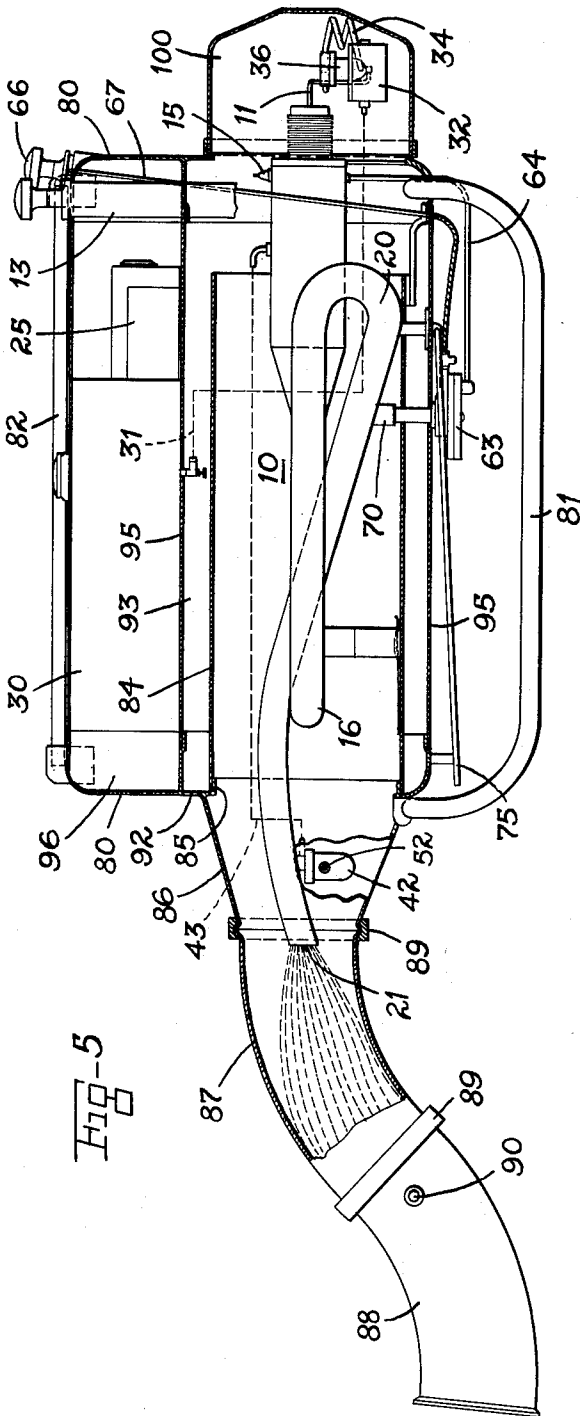
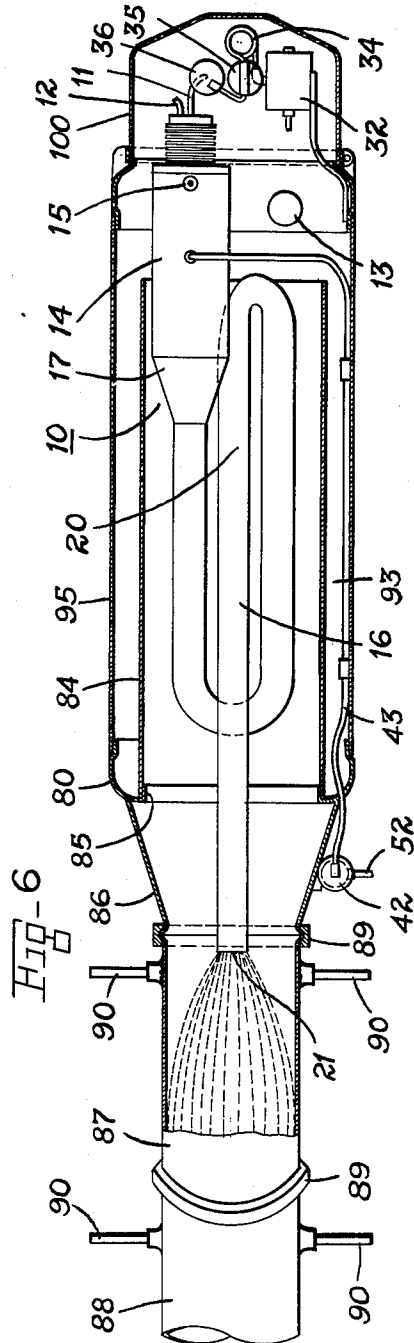
W. L. TENNEY ET AL

2,738,334

MACHINE FOR PRODUCING DISPERSIONS OF LIQUIDS IN
AIR OR OTHER GASES FOR THE PRODUCTION OF FOGS

Filed Dec. 26, 1950

3 Sheets-Sheet 3



INVENTORS
WILLIAM L. TENNEY
SCOVILLE E. KNOX
PAUL A. FRANK
BY *Marchal & Biebel*
ATTORNEYS

1

2,738,334

MACHINE FOR PRODUCING DISPERSIONS OF LIQUIDS IN AIR OR OTHER GASES FOR THE PRODUCTION OF FOGS

William L. Tenney, Dayton, Scoville E. Knox, Phoneton, and Paul A. Frank, Dayton, Ohio, assignors, by mesne assignments, to William L. Tenney, Dayton, Ohio

Application December 26, 1950, Serial No. 202,668

9 Claims. (Cl. 252—359)

This invention relates to fog generators and more particularly to fog generators of the pulse jet engine type.

A pulse jet engine has certain advantages from the standpoint of simplicity of construction and operation, small number of moving parts, and economy in size, weight and expense. Where such an engine is incorporated in a device for atomizing and distributing a formulation in the form of a fog and including special materials such as an insecticide or the like for special purposes, it is important to retain these advantages which are associated with the engine itself. A fog generator incorporating a pulse jet engine which functions as a resonant intermittent combustion device rather than as a jet propulsion device, is thus utilized which is simple in construction and mode of operation, which contains a minimum number of moving parts, which is economical in both its use of fuel for operation of the engine and in effective utilization of the formulation to accomplish the desired fog production.

It is an object of the present invention to provide such an engine which is essentially safe and in which the formulation, even though combustible itself, does not create a fire or flame hazard, regardless of whether or not it may continue to be supplied following the stoppage of the engine.

It is also an object of the invention to provide an improved arrangement for developing an expelling pressure within the reservoir which contains the fog-forming formulation which is simple, inexpensive and economical in construction and operation, having a pressurizing valve and which may be located in convenient position with a flexible connection extending to the reservoir.

Referring to the drawing which illustrates a preferred embodiment of the invention:

Fig. 1 is a somewhat schematic layout of a fog generating apparatus constructed in accordance with the present invention;

Fig. 2 is a view in section through a pressurizing valve utilized in connection with the invention;

Fig. 3 is a view in perspective of a commercial form of fog generating machine in accordance with the present invention;

Fig. 4 is an end view of the machine; and

Figs. 5 and 6 are vertical sectional and horizontal sectional views respectively through the machine.

Referring first to Fig. 1, the apparatus embodies a resonant pulse jet engine indicated generally at 10, a suitable engine for this purpose being disclosed more in detail in copending application of William L. Tenney, Paul A. Frank and Scoville E. Knox, Serial No. 111,308, filed August 19, 1949. In general, such an engine embodies a fuel supply line 11, an air connection 12 supplied from hand pump 13 for starting purposes, a combustion chamber 14 with a spark plug 15 therein for initiating combustion, and an elongated discharge tube 16 connected with the end of the combustion chamber by a conical connecting portion 17. The discharge tube is conveniently formed and bent upon itself as shown

2

in Fig. 1 and has a low point 20 upstream from its discharge outlet, indicated at 21. Such an engine embodies the combination of a combustion chamber, valved inlet ports, and a discharge tube forming a system resonant in gases which operates, after being started, with self-induced charging, ignition and scavenging, thus constituting a resonant intermittent combustion device.

The system also embodies a starting battery 25 controlled by a switch 26 which closes the circuit to the spark coil 27, providing the high tension ignition spark for spark plug 15. An indicating device 28 may be used to show when the ignition circuit is closed and outside terminal 29 may be provided for connection to an external battery source when desired. As will be understood, the hand pump and the spark coil are required only for initial starting purposes, the engine thereafter continuing to function without the use of either the auxiliary air supply or the spark coil as more fully described in said copending application.

Fuel for operating the engine is contained in fuel tank 30 and supplied through pipe line 31 to selector valve 32 which may be manually adjusted to select fuel either from the tank 30 or through line 33 from another external tank as desired. The fuel passes through line 34 to a filter 35 and float chamber 36 directly to the fuel line 11, the latter being under control of manual shut-off valve 37.

The formulation is suitably contained in a tank or reservoir 40 which is closed and capable of retaining an expelling gas pressure. Such pressure is developed from the operation of the engine itself, this being accomplished through the provision of the pressurizing valve 42 shown in detail in Fig. 2. A connection is made from the combustion chamber 14 of the engine in the form of tube 43 which is capable of withstanding the relatively high temperatures encountered adjacent the engine and which has sufficiently large flow capacity and is sufficiently close to the engine so that it will effectively transmit to the pressurizing valve 42 the rapidly occurring but discontinuous high pressure peaks in the combustion chamber. These pressure peaks are transmitted through a passage 45 in the inner valve body 46 and effect the raising of the yieldable spring or valve 47 against its back plate 48, to release such pressure peaks into the pressure chamber 50 within the valve. As soon as the pressure peak passes, the valve member 47 will close and prevent back flow, and hence only the pressure peaks of the combustion chamber are made effective within the chamber 50. Since the entire pressurizing valve is relatively close to the engine and its connecting line 43 of relatively low flow resistance, the pressure which is developed and maintained within chamber 50 can be made to closely approach the maximum pressure intermittently produced in the combustion chamber itself, thereby developing a continuous pressure within chamber 50.

A clean-out plug 51 is provided at the bottom of the pressurizing valve and a pressure supply line 52 extends from chamber 50 to the reservoir 40, being connected thereto through a fitting 53 which can be tightened by means of handles 54 and which preferably embodies a pressure indicating gage 55.

Since the connecting line 52 is more remote from the engine and is not required to transmit rapidly fluctuating pressure waves, it need not be as large in diameter as the tube 43, and in addition may be considerably longer and still provide for effective transmission of the pressure from chamber 50 to the interior of the reservoir. Further, the tube 52 does not need to be of heat resisting material because the temperature of the gas which it handles is materially lower, and satisfactory results have been obtained where a rubber tube was used for this purpose.

The pressure thus transmitted from chamber 50 to reservoir 40 causes the discharge of the formulation through a screen 53 enclosing pickup tube 60, the formulation then flowing through line 61 controlled by manual on and off valve 62 having a control knob 62a to an automatic shutoff valve 63, such as disclosed in said copending application. Such automatic valve has a pressure connection 64 extending back to the combustion chamber 14 and is normally intended to shut off the flow of the formulation immediately upon stoppage of the engine. The rate of flow for normal purposes is controlled by manual setting of the control knob 66 operating through a flexible shaft or the like 67 which functions to regulate the flow control valve 68 thereby regulating the supply of the formulation at the desired rate.

As shown in Fig. 1 the formulation is introduced into discharge tube 16 through nozzle 70 under the pressure and at the controlled rate desired. Normally upon the stoppage of the engine the supply of formulation also immediately stops. However should the automatic valve 63 for any reason fail to shut off the flow, it is quite desirable to prevent the delivery of the formulation from the discharge tube since such tube is usually highly heated, and if the formulation is allowed to pass out the end 21 thereof, it may catch fire if of a combustible nature and produce an undesirable condition.

In accordance with the present invention it will be seen that the nozzle 70 is arranged downstream from the low point 20 of the discharge tube and at a higher elevation. A drain connection 75 is provided which communicates with the low point of the tube 20 and which may be permanently open but with a relatively restricted flow passage. The operation is as follows. During the time that the engine is operating the restricted passage through outlet 75 has little effect on the operation since the passage is so restricted that at most only a small loss of pressure occurs. However should there be any continuing flow of the formulation in through nozzle 70 after the stoppage of the engine, that material will flow down to the low part of the tube, and will be drawn off through outlet 75 without flowing out of the normal outlet 21. Tube 75 thus withdraws the formulation to a point where it is relatively cool, and spaced from the outlet 21 such that upon delivery from the end of tube 75, it merely drops away without danger of spontaneous ignition or combustion.

The apparatus is conveniently embodied in the structure shown in Figs. 3 to 6 in which the entire apparatus is enclosed within a housing formed by end castings 80 mounted upon tubular runners 81 and secured at their upper ends by steel rods 82. The engine itself is enclosed within a tubular housing 84 which joins at the discharge end onto a flange 85 of end casting 80, a neck portion 86 extending in the opposite direction and having a connection for receiving two curved discharge tubes 87 and 88, connected by rings 89, and each capable of relative rotational movement by applying a twisting force to handles 90 in order to direct the discharge of the fog in the direction desired. The rings 89 are detachably secured by toggle clamps 91 providing for quick removal for ready cleaning of the discharge tube 16 from the end 21 inwardly to the injection nozzle 70.

The end housing 80 adjacent the discharge end of the engine is provided with a series of air openings 92 which open into an annular space 93 surrounding the cylindrical member 84, through which a flow of air takes place. This chamber is defined outwardly by a cylindrical member 95, the latter defining an upper space 96 in which the fuel tank 30 is received and hence protected against the high temperature of the engine itself. An outer casing 97 is removably received over the fuel tank to enclose the upper space 96 and may be secured by spring fasteners 98. The hand pump 13, the flow regulating valve control knob 66 and the quick shutoff valve 62 and knob 62a are preferably mounted in the opposite end casting 80.

A perforated cap 100 is pivotally secured on the end

casting 80 adjacent the inlet end of the engine, providing an additional path for the inflowing air required for combustion and cooling purposes. The cap 100 also encloses the manual selector valve 32, the filter 35 and float chamber 36 in the fuel supply line to the engine.

The pressurizing valve 42 is preferably located outside of the housing adjacent the connecting part 86, and its tube 43 extends through the annular space 93 and hence in the path of flow of cooling air so that it is subjected to a cooling effect through its length. The flow regulating valve 68 may be located below the outer casing 95 and the discharge line 75 may merely provide for withdrawal of the unused formulation to a place beneath or at one side of the apparatus.

The invention therefore provides a simple yet highly satisfactory fog producing generator incorporating a pulse jet engine, having a high degree of safety, embodying a minimum of moving parts, and assuring the proper and safe delivery and discharge of the formulation both during the running and upon the stopping of the engine. The term fog as used herein is intended to apply to any heterogeneous mixture of a liquid phase in a gaseous phase or any finely divided liquid droplets suspended in a gas.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, said discharge tube having a curved portion with a low point intermediate the ends thereof, a reservoir containing a formulation for discharge in the form of a fog through said discharge tube, means for supplying said formulation to said discharge tube at a point downstream thereof and at a higher level than said low point, and a drain connection to said low point having a restricted passage for venting undischarged quantities of said formulation upon the stoppage of said engine at a point remote from said discharge tube.

2. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, said discharge tube being curved and having a low point in advance of the discharge end thereof, means for introducing a fog-forming formulation into said discharge tube at a higher level than said low point, and a restricted connection from said low point providing for discharge of said formulation from said low point and withdrawal thereof from said tube upon stoppage of said engine with no substantial loss of operating pressure.

3. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, said discharge tube being curved and having a low point in advance of the discharge end thereof, means for introducing a fog-forming formulation into said discharge tube at a higher level than said low point, means controlled in response to the stopping of said engine for normally stopping the flow of said formulation, and a restricted connection from said low point providing for discharge of any remaining quantity of said formulation from said low point and withdrawal thereof from said tube upon stoppage of said engine with no substantial loss of operating pressure.

4. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, said discharge tube being curved and having a low point in advance of the discharge end thereof, means for introducing a fog-forming formulation into said discharge tube downstream from said low point and

5

at a level intermediate that of said low point and that of the discharge end of the tube providing for flow of any remaining quantity of said formulation upstream toward said low point upon stoppage of said engine, and a restricted connection from said low point providing for discharge of said formulation from said low point and withdrawal thereof from said tube upon stoppage of said engine with no substantial loss of operating pressure.

5. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, said discharge tube being curved and having a low point in advance of the discharge end thereof, means for introducing a fog-forming formulation into said discharge tube downstream from said low point and at a level intermediate that of said low point and that of the discharge end of the tube providing for flow of any remaining quantity of said formulation upstream toward said low point upon stoppage of said engine, and a continuously open but relatively restricted connection to the low point of said tube for discharge of unused formulation therefrom upon the stoppage of said engine with no substantial loss of operating pressure.

6. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through the tube, a closed reservoir for storing a formulation for introduction into said tube to produce the fog, a connection from said reservoir to said discharge tube for delivery of said formulation thereto, a pressurizing valve having a check valve member adapted to open automatically in response to said pulsating pressure and to allow passage of only the pressure peaks from said combustion chamber, a relatively short connection from said combustion chamber to said pressurizing valve having low flow resistance providing for effective delivery of said pressure peaks from said chamber to said valve to form a continuous pressure, and a relatively longer connection from said pressurizing valve to said reservoir to transmit said continuous pressure to the interior of said reservoir to establish an expelling pressure therein.

7. In a fog generator having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through the tube, a closed reservoir for storing a formulation for introduction into said tube to produce the fog, a connection from said reservoir to said discharge tube for delivery of said formulation thereto, a pressurizing valve having a check valve member adapted to open automatically in response to said pulsating pressure and to allow passage of only the pressure peaks from said combustion chamber, a relatively short connection from said combustion chamber to said pressurizing valve having low flow resistance providing for effective delivery of said pressure peaks from said chamber to said valve, means associated with said valve forming a pressure chamber for receiving said pressure peaks and accumulating a continuous pressure, and a relatively longer connection from said pressure chamber to said reservoir adapted to have greater flow resistance than said short connection to transmit said continuous pressure to the interior of said reservoir to establish an expelling pressure therein.

8. In a fog generator adapted to cause the discharge

6

of a fog-forming formulation in finely atomized form having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, a closed reservoir for receiving the formulation to be discharged, a connection from said reservoir to said discharge tube providing for flow of said formulation into said discharge tube, and means for developing an expelling pressure within said reservoir including a pressurizing valve responsive to only the pressure peaks of said combustion chamber, said pressurizing valve having a check valve member, a relatively short connection having low flow resistance from said combustion chamber to said pressurizing valve to transmit substantially the full maximum pressure peaks of said combustion chamber to said pressurizing valve to form a continuous pressure, and a connection from said pressurizing valve to said reservoir adapted to have greater flow resistance than said short connection for transmission of said continuous pressure to said reservoir to develop an expelling pressure therein.

9. In a fog generator adapted to cause the discharge of a fog-forming formulation in finely atomized form having a pulse jet engine including a combustion chamber and a discharge tube and adapted to develop a pulsating discharge pressure through said tube, a closed reservoir for receiving the formulation to be discharged, a connection from said reservoir to said discharge tube providing for flow of said formulation into said discharge tube, and means for developing an expelling pressure within said reservoir including a pressurizing valve, said pressurizing valve having a check valve member and being operable automatically in response to said pulsating discharge pressure a relatively short connection having low flow resistance from said combustion chamber to said pressurizing valve to transmit substantially the full maximum pressure of said combustion chamber in a series of pressure peaks to said pressurizing valve, a pressure chamber for receiving said pressure peaks and forming a source of continuous pressure, and a connection from said pressurizing valve chamber to said reservoir adapted to have greater flow resistance than said short connection for transmission of said continuous pressure to said reservoir to develop an expelling pressure therein.

References Cited in the file of this patent

UNITED STATES PATENTS

1,062,029	Pillsbury	May 20, 1913
1,637,898	Evans et al.	Aug. 2, 1927
1,801,565	Norton	Apr. 21, 1931
2,070,038	Batt	Feb. 9, 1937
2,408,111	Truax et al.	Sept. 24, 1946
2,476,171	Williams	July 12, 1949
2,529,942	Holthouse	Nov. 14, 1950

OTHER REFERENCES

Technical Development Division Summary of Activities No. 15, Federal Security Agency, Public Health Service, Nov. 1, 1948, pages 71-73.

Karcher, German Patent Application 138,004, Feb. 25, 1943, pub. June 11, 1948, Frames 8907-8911, Reel 83,291.