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

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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 which may be located in convenient position with a flexible connection extending to the reservoir.

Referring to the drawings 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;

Figs. 4 and 6 are 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 16, a suitable engine for this purpose being disclosed more in detail in a pending 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.
The pressure thus transmitted from chamber 50 to reservoir 40 causes the discharge of the formulation through a screen 55 enclosing pickup tube 60, the formulation thereby flowing down the discharge line 61 of the engine, 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 a manual setting of the control knob 66 operating through a flexible shaft or the like 87 which functions to regulate the flow control valve 55 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 fail to operate as 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 to pass out the end 21 thereof, it may catch fire if of combustible nature and produce intolerable fumes.

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 upon 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 disclosed in Figs. 3 to 6 in which the entire apparatus is enclosed within a housing formed by end castings 89 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 83 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. This discharge end is usually 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 temperatures 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 manually operated 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 48 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 stoppage 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
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 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 receiving said pressure peaks and forming a source of 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.

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