Jan. 11, 1944. F. J. WIEGAND 2,338,888

NOZZLE FOR LIQUID DISCHARGE

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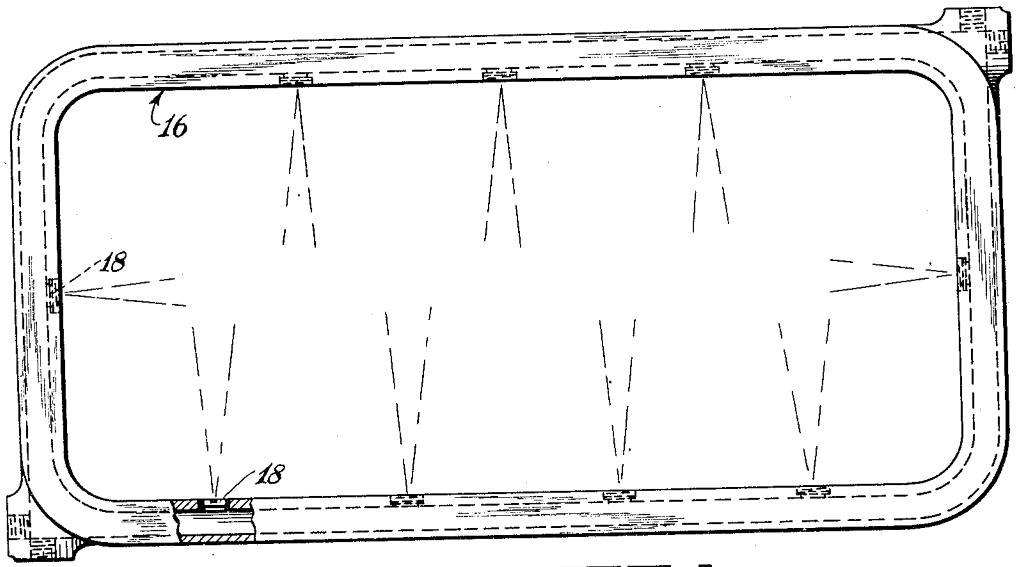

Fig. 1

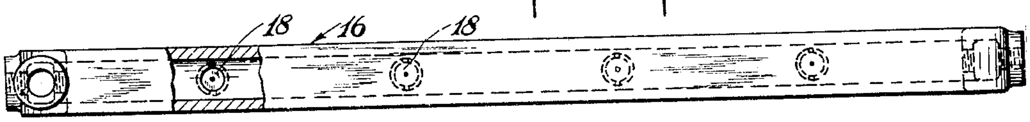

Fig. 2

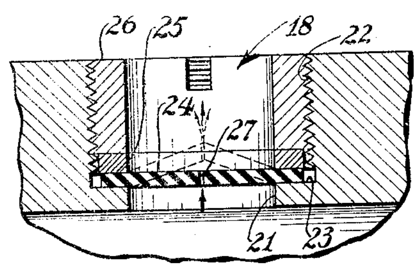

Fig. 3

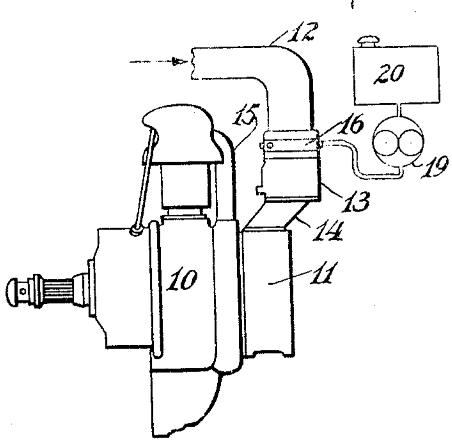

Fig. 4

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NOZZLE FOR LIQUID DISCHARGE

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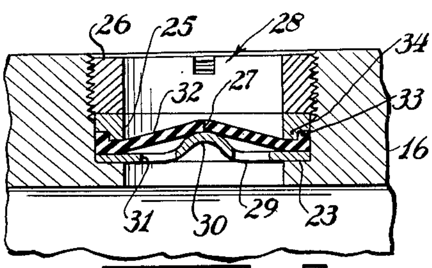

Fig. 5

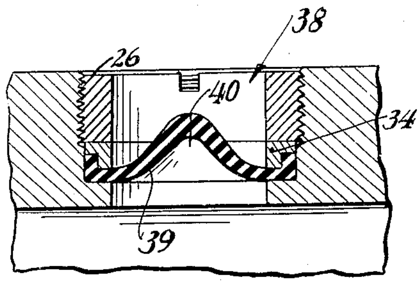

Fig. 6

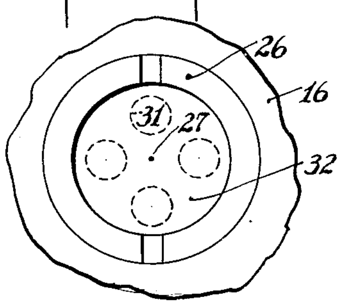

Fig. 7

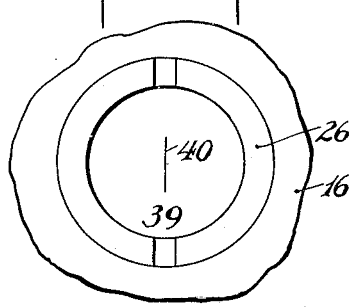

Fig. 8

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NOZZLE FOR LIQUID DISCHARGE

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7 Claims. (Cl. 261—18)

This invention relates to elastic nozzles for dispersing liquid and is particularly concerned with a nozzle system arranged to introduce de-icing liquid into the air induction system of an internal combustion engine.

In recent years it has become well established that aircraft engines are susceptible to ice formation in the induction system under certain atmospheric conditions. Reduction of ice accretion, or prevention of ice formation, may be effected by the introduction of alcohol or other suitable solvents into the airstream. It is one of the objects of this invention to provide a nozzle system by which a minimum quantity of de-icing liquid may be distributed into an induction system to secure maximum effectiveness in reducing or in preventing ice formation. It is a further object of the invention to provide an elastic nozzle which, if it becomes iced, will quickly free itself of ice as the de-icing liquid is delivered to it. A further object is to provide an improved form of elastic fluid discharge nozzle which will be liquid-tight when the liquid pressure is nil or low and will discharge liquid as the pressure of liquid is raised to a suitable value. By this arrangement, a distributing system may be maintained full of liquid at all times without possible drainage when flow of liquid is not desired. A further object of the invention is to provide a multiple nozzle system for delivery of small quantities of liquid, wherein the liquid delivery from all of the several nozzles will be substantially the same.

Further objects of the invention will become apparent in reading the detailed description below in connection with the drawings, in which:

Fig. 1 is a plan view, partly in section, showing a de-icing liquid distributor;

Fig. 2 is a side elevation of a distributor;

Fig. 3 is an enlarged section through a portion of the distributor showing one of the nozzle units in detail;

Fig. 4 is a schematic elevation of an aircraft engine showing the disposition of the distributor therein and showing a de-icing liquid supply system;

Figs. 5 and 6 are enlarged sections through alternate arrangements of fluid discharge nozzles;

Fig. 7 is a plan of the arrangement of Fig. 5; and

Fig. 8 is a plan of the arrangement of Figs. 3 or 6.

Referring first to Fig. 4, a radial cylinder aircraft engine is shown, the crankcase section being designated 10, and the rear section being designated 11. The induction system comprises an air scoop or conduit 12 feeding a carburetor 13, the fuel-air mixture from the carburetor passing through an adapter 14 to the rear section 11 and thence through induction pipes 15 to the engine cylinders. Between the conduit 12 and the carburetor 13, I dispose a distributor ring 16 for de-icing fluid, this ring being shown enlarged in Figs. 1 and 2. The ring comprises a pipe having a plurality of fluid discharge nozzles 18 spaced therearound to discharge liquid in a uniform pattern across the carburetor air intake. The ring 16 is fed with de-icing fluid from a selectively operable pump 19 fed in turn from a liquid reservoir 20. Alternatively fluid pressure may be obtained by other means, and a valve may be used to control liquid delivery to the distributor.

The nozzle 18 is shown enlarged in Fig. 3. The inner wall of the ring 16 is drilled as at 21 and is counterbored as at 22 to form a shoulder 23. A disc of rubber or the like, designated 24, is seated on the shoulder 23 and a washer 25 is placed thereover. Then, a lock screw 26 is screwed into the counterbore 22 to secure the washer and disc in position. The center of the disc is pierced to form a hole 27 which serves as a discharge nozzle. This hole, when the disc 24 is flat, will either be closed or of such small size as to prohibit the passage of liquid when the liquid pressure is either nil or low. When the pump 19 (Fig. 4) is started, liquid pressure is built up in the ring 16 which will press the disc 24 outwardly as shown in dotted lines in Fig. 3, thereby distending the hole 24 to allow for fluid discharge. When the several discs 24 of all of the several nozzle units 18 are uniform in character, the amount of liquid discharge will be uniform and the spray from all of the nozzles will traverse the air passage within the ring so that a substantially homogeneous mixture of air and de-icing liquid is formed thereby preventing ice formation or dissolving ice accretions which may have formed prior to starting of the pump 19.

Should ice have formed over the nozzle units 18 prior to pump starting, the distortion of the discs 24 as fluid pressure builds up in the ring 16 will crack off the ice with minimum delay to allow of the de-icing function above mentioned.

In Fig. 5 an alternate nozzle assembly 28 is shown wherein a valve disc 29 is first pressed against the shoulder 23, this valve disc having a central raised rounded valve portion 30 and a plurality of holes 31 disposed therearound forming free fluid passages. A rubber disc 32 is placed over the valve disc 29 and is clamped at its periphery by the screw 26. At its edge, the disc is provided with a shoulder 33 engaged by a complementary shoulder 34 formed on the washer 25 to prevent the edges of the disc from drawing inwardly. Under static conditions, the hole 27 in the disc 32 comprises a valve seat engaging the valve 30 of the disc 29, closing the nozzle against fluid discharge. As pressure rises on the upstream side of the nozzle, the disc 32 is pushed away from the valve 30 and fluid may discharge through the hole 27. In this environment, the hole 27 may have positive area under static conditions and need not seal closed since the valve 30 prevents fluid exit.

Fig. 6 shows an alternate nozzle 38 which is different from those previously described only in the form of the rubber discharge member. In this instance, the rubber designated as 39 has a preformed hump to comprise a nipple not unlike that of a nursing bottle. The central part of this element may be provided either with a hole as in the previous embodiment or with a slit 40. Preferably, the upstream side of the rubber should be in compression to seal the opening 40 under static conditions. As soon as liquid pressure is applied, the element 39 is distended outwardly to open the hole or slit 40 to allow of liquid discharge.

The embodiments of Figs. 3 and 5 may likewise be provided with slits instead of holes centrally thereof. When the term "rubber" is used herein, it refers not only to natural rubber but to any known or contemplated synthetic rubber or rubber substitute having the general physical properties associated with natural rubber.

A plurality of rubber nozzles of the character disclosed constitute a considerable improvement over multiple nozzles of the prior art particularly where the total rate of fluid flow through the assembly is small. The nozzle openings of these rubber elements will adjust themselves to the fluid discharge established by the pump 19 or its equivalent so that a fine spray of liquid is delivered regardless of the rate of liquid delivery. If solid metallic nozzles were used, they would have a fixed nozzle area and their effectiveness would depend upon liquid pressure in the system. If the pressure were too low, the liquid would merely dribble from the nozzles without forming an effective spray into the carburetor airstream. Furthermore, where the total quantity of liquid to be delivered is small, and where it must be divided up among a plurality of nozzles, the size of the holes in individual nozzles would be extremely small and therefore the nozzles would be difficult to manufacture and would have poor characteristics for uniformity of flow. Such nozzles also would be easily damaged and would not have the characteristic mentioned heretofore of automatically freeing themselves of foreign matter on the upstream side of the system or ice accretion on the downstream side of the system.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

I claim as my invention:

1. A liquid discharge nozzle comprising an annular receptacle having a shoulder, a member seated thereon having a projecting valve button formed centrally of the member, the member having openings for free passage of liquid therethrough, a diaphragm of rubber or the like stretched over the button on said member and having a perforation alined with and closed by said button, and means to secure said diaphragm in said receptacle; said diaphragm when subjected to liquid pressure, stretching away from said button to open said perforation for liquid passage therethrough.

2. In an engine induction system comprising a conduit, a hollow ring member embracing said conduit and having a plurality of outlet openings disposed around said conduit, a resilient diaphragm of rubber or like material secured across each outlet opening, each diaphragm having a small hole therein, and means to supply a de-icing fluid under pressure to said hollow member to expand said diaphragms and enlarge the holes therein in accordance with the pressure at each diaphragm to allow proper ejection of the fluid through the holes into the conduit, the holes in said resilient diaphragms being of such size as to be substantially closed when the fluid pressure supply means is not operating.

3. In an engine induction system comprising a conduit, a hollow member embracing at least a portion of said conduit, a plurality of nozzles spaced along the inner wall of said member, said nozzles comprising perforated resilient diaphragms of rubber or like material, and means to supply a de-icing fluid under pressure to said hollow member to distend said diaphragms and enlarge said perforations in accordance with the pressure at each diaphragm, whereby the de-icing fluid is ejected through said perforations into said conduit, the perforations in said diaphragms being of such size as to be substantially closed when said pressure fluid is not being supplied to said hollow member.

4. In an aircraft engine induction system comprising a conduit, a hollow member embracing at least a substantial portion of said conduit, means to supply de-icing fluid under pressure to said hollow member, a plurality of nozzles disposed along said member for discharging de-icing fluid into said conduit, each of said nozzles comprising a perforated diaphragm of rubber or like material, said diaphragms yielding and enlarging their perforations upon the application of de-icing fluid pressure thereto, each of said nozzles being arranged to substantially close when said de-icing fluid pressure is not applied to maintain de-icing fluid within said hollow member by preventing leakage of de-icing fluid out through the perforations in said nozzle diaphragms.

5. In an aircraft engine induction system comprising a conduit, a hollow member embracing at least a substantial portion of said conduit, means to supply fluid under pressure to said hollow member, a plurality of nozzles disposed along said member for discharging fluid into said conduit, each of said nozzles comprising a perforated diaphragm of rubber or like material, means to supply fluid under pressure to said hollow member to expand said diaphragms and enlarge the perforations therein in accordance with the pressure at each diaphragm to provide for proper ejection of the fluid through the diaphragm perforations into the conduit, each of said nozzles being arranged to substantially close when said fluid pressure is not applied to maintain fluid within said hollow member by preventing leakage of fluid out through the perforations in said nozzle diaphragms.

6. In an aircraft engine induction system comprising a conduit, a hollow member embracing at least a substantial portion of said conduit, means to supply de-icing fluid under pressure to said hollow member, a plurality of nozzles disposed along said member for discharging de-icing fluid into said conduit, each of said nozzles comprising a valve seat and a diaphragm of rubber or like material stretched over said valve seat and having a perforation alined with said seat, whereby said diaphragms are adapted to stretch away from said seat and enlarge their perforations upon the application of de-icing fluid pressure thereto and when said de-icing fluid pressure is not applied the engagement of said diaphragms with their associated valve seats maintains de-icing fluid within said hollow member by preventing leakage of de-icing fluid out through the perforations in said diaphragms.

7. A liquid discharge nozzle comprising an annular receptacle, a member secured therein having a centrally disposed projecting valve button formed thereon, a diaphragm of rubber or the like stretched over said valve button and having a perforation alined with and closed by said button, means to secure said diaphragm in said receptacle, and means to deliver liquid under pressure to the supply side of said diaphragm, said diaphragm when subjected to liquid pressure, stretching away from said button to open said perforation for the lassage of liquid therethrough.

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