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ATOMIZING NOZZLE

Original Filed May 2, 1944

Fig. 1.

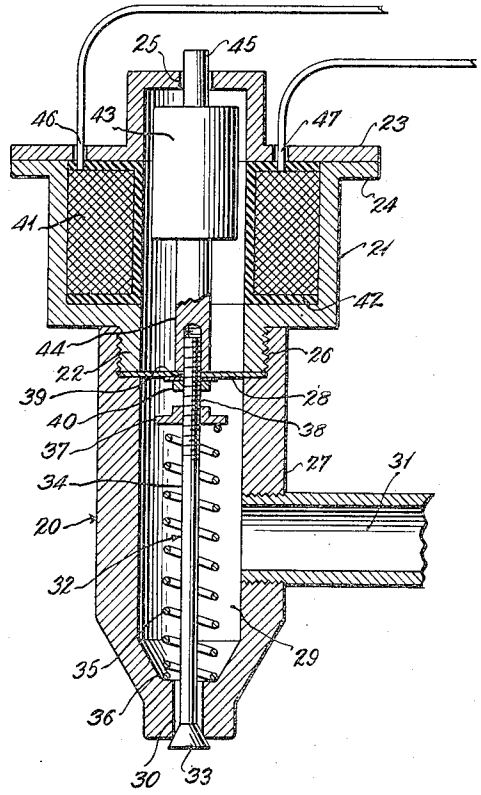
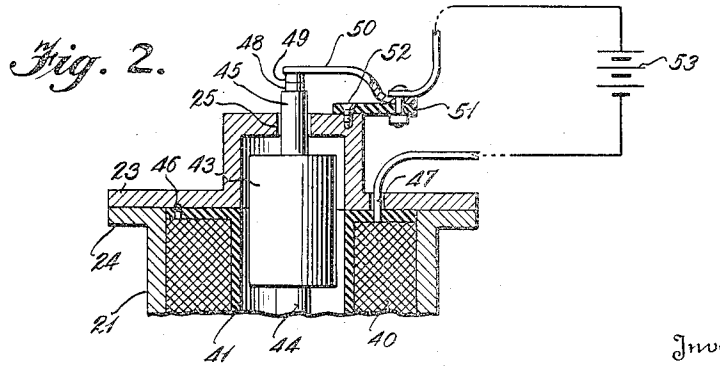


Fig. 2.



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ATOMIZING NOZZLE

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5 Claims. (Cl. 299—121)

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The present invention relates to nozzles for atomizing liquids and particularly to such a nozzle in which a vibrating member is employed to bring about the desired degree of atomization. This application is a division of my copending application Serial No. 533,720, filed May 2, 1944, now abandoned, in which automatic vibration of a valve member causes atomization of the liquid issuing from the nozzle.

In the commercial atomizing nozzles on the market today in which pressure alone is employed as the atomizing force as contrasted with those in which a gas under pressure is used as the propelling and disruptive agency, the atomization of the liquid is produced by subjecting it to a whirling action before ejecting it from an orifice of the desired shape and size. The whirling motion is imparted to the liquid by passing it under pressure through a chamber of special construction. All of the nozzles of this type are inherently inefficient because of the pressure drop caused by the absorption of energy as fluid friction when the liquid traverses the nozzle chamber.

It is an object of the present invention to produce an atomizing nozzle of a design radically different from that discussed above in which energy losses due to fluid friction are in a large part eliminated.

It is a further object of this invention to produce an atomizing nozzle in which a much lower fluid pressure is required to obtain a certain degree of atomization than is the case with the presently-known types of atomizing nozzles.

It is still another object of the invention to provide an atomizing nozzle of a construction which brings about a more efficient atomization of liquids than those presently in use.

It is a still further object of the present invention to produce an atomizing nozzle in which the degree of atomization of the liquid can be readily varied within wide limits.

Other and further objects of the invention will be apparent from the detailed description thereof, taken in conjunction with the following drawings, in which:

Figure 1 is a cross-sectional view of the invention in which rapid vibration of a valve member of a nozzle is produced by a positively acting external force; and

Figure 2 is a fragmentary cross-sectional view of a modification of the device illustrated in Figure 1.

According to Figure 1 of the drawing, numeral 20 generally denotes the body structure of the device on this invention including both the structure enclosing a vibration producing means and the structure enclosing the nozzle proper. The portion containing the electric vibration producing means, whose specific structure will be fully described hereinafter, consists of a circular casing 21 having threaded boss portion 22 at one end and a flange 24 at the other. A cover member 23 is secured to flange 24 by any suitable means and said cover member 23 has an aperture 25 located at its center.

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The threaded boss portion 22 of the casing member 21 is received in a threaded counterbore 26 at the upper end of the structure 27 forming the body portion of the nozzle proper. A flexible diaphragm 28 is positioned on the shoulder of the counterbore 26 of the body portion 27 and is held firmly in place by the boss portion 22. Diaphragm 28 serves to separate the nozzle section from the vibration producing means. The body portion 27 of the nozzle contains a chamber 29 which is preferably of circular cross-section and which narrows to a discharge orifice 30 of a smaller dimension. Liquid under pressure is supplied to the chamber 29 by means of a conduit 31 entering the side thereof and connected thereto by suitable means, for example by threading as shown in the drawing, and communicating with any suitable pressure source. The liquid under pressure is prevented from reaching the vibration producing portion of the structure by diaphragm 28.

Located centrally of the chamber 29 and discharge orifice 30 and extending laterally thereof is a valve member 32 having an enlarged conically shaped head portion 33 and a stem portion 34 of such dimension that there is sufficient clearance between said stem 34 and the walls of the discharge orifice 30 that liquid will be readily discharged. The enlarged head portion 33 of the valve member 32 is normally seated upon the outer edge of the discharge orifice 30.

The force with which the valve member 32 is seated may be controlled by a coil spring 35 one end of which bears against a recess 36 in the body portion 27 of the nozzle and the other end of which bears against the underside of an adjustable nut 37 upon a threaded end 38 of the valve stem 34.

Valve stem 34 projects through an aperture 39 in the flexible diaphragm 28. The nozzle side of the flexible diaphragm 28 rests upon a washer adjacent a nut 40 positioned on the threaded end 38 of the valve stem 34.

Now referring with particularity to the electromagnetic vibration producing means, numeral 41

denotes a coil of the usual construction wound about a spool of dielectric material 42. Coil 41 surrounds a core member 43 which is maintained in position by having an internally threaded extension 44 screwed down upon the threaded portion 38 of valve stem 34 until it engages the upper side of the flexible diaphragm 28 which is thus held tightly against the washer of nut 40. An upper axial extension 45 of core 43 of relatively small circular cross-section projects through the aperture 25 in the cover member 23. The coil 43 is provided with terminals 46 and 47.

In the operation of the device of the invention, terminals 46 and 47 of coil 41 will be connected to a source of alternating current or a pulsating direct current, the frequency of which will determine the frequency of the vibration of the valve member 32.

If alternating current is used, the frequency of vibration of valve member 32 will be twice that frequency of the alternating current used as a downward force will be exerted on the core member 43 during each half cycle of current flow. When the current passes through zero, core 43 is forced upwardly by the force of spring 35, by the tendency of the flexible diaphragm 28 to return to a normal position and, if the surface of the underside of the diaphragm 28 presented to the pressure of the liquid in chamber 29 is greater than the surface presented by head 33 of valve member 32, by the fluid pressure, itself. This action closes and opens the valve for each half cycle of current.

When direct current is employed, the frequency of vibration will, of course, be equal to the frequency of the current. Upon each pulsation the valve head 33 will be lifted from its seat on the edge of orifice 30, and upon each cessation of current flow valve head 33 will be reseated by the forces described above.

Figure 2 of the drawing illustrates a modification of the device illustrated in Figure 1, which is designed to operate only with a source of direct current. The general structure of the modification may be the same as that of the device described in connection with Figure 1 of the drawing and, therefore, a detailed description will not be necessary.

In the modification of Figure 2 a contact point 48 is attached to upper extension 45 of core member 43. A contact point 49 is positioned by a spring contact arm 50 directly above contact point 48 so that points 49 and 50 will meet when the valve member 32 is seated. Contact arm 50 is maintained in position by being bolted to a member 51 of insulating material which is in turn rigidly fastened to cover member 23 by screw 52. A source of direct current 53 is connected to the spring contact 50 and one terminal 47 of the coil. The other terminal 46 of the coil is connected with the cover member 23.

In operation whenever the contact points 48 and 49 meet, the coil 41 is energised and the core 43 is pulled down unseating the head of valve member 32 and opening the circuit. The valve is then reseated by the forces described in connection with the embodiment of the invention illustrated by Figure 1 of the drawing and the operation repeated. In this modification, the frequency will be controlled by the strength of the current source 53, the mass of the moving parts, and the magnitude of the forces tending to reseat the valve head 33 of valve member 32.

In both of the above described embodiments of Figures 1 and 2 of the invention, it is inevitable that a certain degree of erosion will occur in the valve and the seat because of vibration. Therefore, if the parts are constructed of relatively soft material it is necessary that inserts of harder material be employed in connection with these parts. However, it is to be understood that the various materials used form no part of this invention, and in every case any suitable material may be selected.

It is to be understood that the essence of the present invention is the employment of a vibrating member for atomization of a liquid, and it is realized that there are many available ways other than those specifically disclosed herein for bringing about this desired result.

Having described my invention, I claim:

1. An atomizing nozzle comprising a body portion having a chamber within said body portion and an outlet orifice of smaller cross-section having an edged seat on the outer side with relation to said chamber, the edged seat of said outlet orifice being substantially flush with said body portion, a flexible diaphragm positioned in said chamber and fixed to said body portion and separating said chamber into a nozzle portion including said orifice and a housing portion for a vibration producing means, a valve member positioned within said nozzle portion projecting through said diaphragm and having a conically shaped head concentrically seated on the outer edge of said orifice, said valve member being adapted to freely vibrate substantially free from friction, a spring positioned within said nozzle porttion of said chamber urging the head of said valve member against the edged seat of said orifice, a solenoid core positioned within said housing portion and connected to said valve member, and an electrical coil surrounding one end of said core and connected to a source of pulsating current, said pulsating current causing movement of said core so as to rapidly vibrate said valve member.

2. The nozzle of claim 1 in which said source of pulsating current is a source of alternating current.

3. The nozzle of claim 1 in which said source of pulsating current is a source of direct current.

4. An atomizing nozzle comprising a body portion having a chamber within said body portion and an outlet orifice having an edged seat on the outer side with relation to said chamber, the edged seat of said outlet orifice being substantially flush with said body portion, a flexible diaphragm positioned within said chamber and separating said chamber into a nozzle portion including said orifice and a housing portion for a vibration producing means, a valve member positioned within said nozzle portion projecting through said diaphragm and having a conically shaped head concentrically seated on the outer edge of said orifice, said valve member being adapted to freely vibrate substantially free from friction, a spring positioned within said nozzle portion of said chamber urging the head of said valve member against the edged seat of said orifice, an electrical coil having two terminals positioned within said housing portion, a solenoid core attached to said valve member and having one end positioned within said coil, a fixed contact arm positioned directly above the unattached end of said solenoid core contacting said core when the head of said valve member is seated in said orifice, one of said terminals of said electrical coil connected to said body portion, and a

source of direct current connected to the other terminal of said electrical coil and to said contact arm whereby said valve member is maintained in rapid vibration to cause atomization of a liquid fed to said nozzle.

5. An atomizing nozzle comprising a body portion having a chamber for holding liquid to be atomized and an outlet orifice of smaller cross-section for the passage of liquid from said chamber, said outlet orifice having an edged seat on the downstream side substantially flush with said body portion, means for connecting said chamber with a conduit transmitting liquid, a flexible diaphragm positioned within said chamber and separating said chamber into a nozzle portion including said orifice and a housing portion for a vibration producing means, a valve member concentrically seated in said edged seat of said outlet orifice, said valve member being adapted to freely move in a direction substantially perpendicular to said orifice, a spring positioned in said nozzle portion for urging said valve member against said edged seat of said outlet

orifice, and electromagnetic means positioned in said housing portion adapted to rapidly vibrate said valve member so as to atomize liquid passing from said chamber through said orifice.

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