March 26, 1963 J. O. HRUBY, JR 3,082,961

LIQUID DISCHARGE

Filed Jan. 16, 1962

FIG. 1.

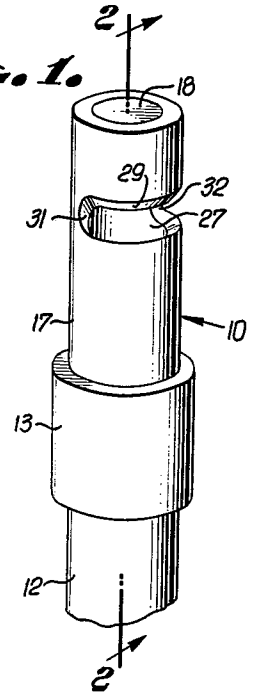


FIG. 2.

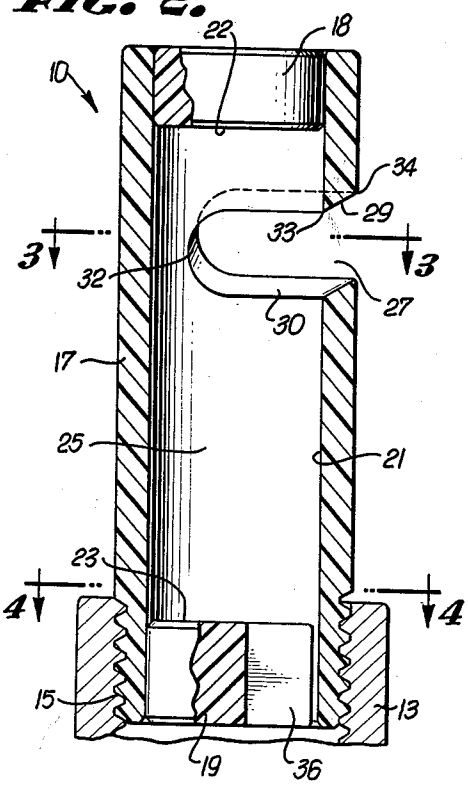


FIG. 3.

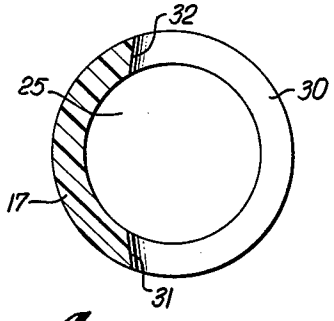


FIG. 4.

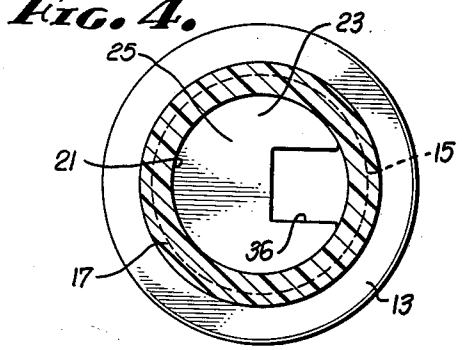
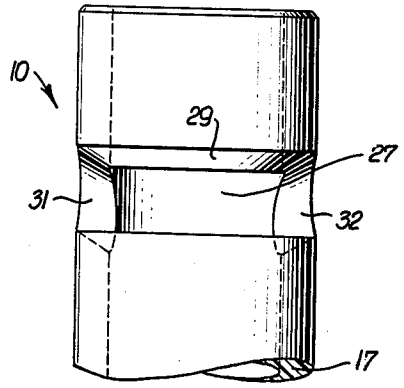


FIG. 5.



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LIQUID DISCHARGE

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This invention relates generally to the art of discharging liquids in a spray of discrete droplets.

Devices of this invention are usable for various purposes. They may be made to a relatively large size for quickly flushing an area, and they may be made relatively small as for lawn sprinkling purposes. Whatever the size, a device of this invention provides a diffused spray of discrete liquid drops. It is contemplated further that devices embodying this invention may be employed as nozzles in air cooling systems, for example.

Devices of this invention have no moving parts. They are simple in construction. It is in the action of the liquid being discharged that the devices of this invention are unusual. In an embodiment having an outlet opening extending in a horizontal plane, for example, it will be observed that the liquid being discharged flutters up and down with the result that both the periphery of the area being sprayed and the regions immediately adjacent the device are covered evenly by the spray, and the spray is constituted of large or small drops depending upon the relative dimensions of the parts of the device.

Briefly, a device of this invention comprises a body having a chamber with an inlet opening in one end and an outlet opening in a side wall between the ends of the body, the inlet opening being eccentric of the chamber, and, preferably, the inlet and outlet openings being so disposed that their centers are in a common axial plane of the chamber. I surmise that the flutter of the liquid being discharged is the result of what may be a condition of reverberation of liquid in the chamber from the end opposite the inlet opening, and I suggest that the motion of liquid in the chamber may correspond to that of air in an organ pipe and in a whistle.

In the following part of this specification, the details of construction and mode of operation of a device embodying this invention and designed to provide a voluminous spray are described with reference to the accompanying drawing, in which:

FIG. 1 is a perspective view of the device mounted atop a liquid supply pipe;

FIG. 2 is a longitudinal vertical section on a larger scale through the device taken upon a plane indicated by line 2—2 on FIG. 1;

FIGS. 3 and 4 are cross-sections taken along lines 3—3 and 4—4 respectively, on FIG. 2; and

FIG. 5 is a side elevation of the upper half of the device as viewed from the right in FIG. 2.

The illustrated device is designated generally by reference numeral 10. It is shown as mounted atop a vertically extending water supply pipe 12 as with an internally threaded nipple 13 which receives the lower end of the device, the external screw threads on the device for coupling to the pipe being designated by numeral 15.

The device is a hollow body, which in the illustrated embodiment is formed of a cylindrical tube 17, here of circular cross section, an upper end wall 18 and a lower end wall 19. The tube 17 is the side wall of the device, its inside surface 21 and the inside surfaces 22 and 23 of the upper and lower end walls 18 and 19 respectively defining a chamber 25 which in the illustrated embodiment is a right cylinder of circular cross section with its longitudinal axis extending vertically. Such vertical arrangement illustrates the manner in which the device

may be installed for use as a lawn sprinkler, for example.

The illustrated device 10 is formed of hard plastics, the end walls 18 and 19 being fitted frictionally tight within the cylindrical tube, their relative spacing with respect to the outlet opening 27, presently to be described, affecting the extent and frequency of the flutter in the water spray. In the device 10, the space between the outlet opening 27 and the inside surface 22 of the upper end wall is about one-sixth of that between the outlet opening and the inside surface 23 of the lower end wall.

The outlet opening 27 is formed in the side wall 17 and in the illustrated embodiment extends circumferentially about 220° of the side wall as appears best in FIG. 3, and its medial plane is normal to the longitudinal axis of the chamber 25. The surfaces defining such outlet opening 27 are an upper lip surface 29, lower lip surface 30, and two concave end surfaces 31 and 32. Lip surfaces 29 and 30 are substantially parallel to each other and are inclined slightly upwardly from an inside edge 33 in the case of upper lip 29 to its outside edge 34.

The inlet opening of the device 10 is formed in the lower end wall 19 and is designated by reference numeral 36. It is eccentric of the longitudinal axis of the chamber 25. In the illustrated instance, the inlet opening 36 is substantially square, extending through the periphery of the lower end wall 19 whereby the inside surface of the cylindrical tube 17 defines one side of the inlet opening. Also, the center of the inlet opening and the mid-point of the outlet opening 27 are in a common axial plane of the chamber. The inlet opening is smaller in size than the outlet opening, here being about one-fifth the size of the outlet opening.

In operation, liquid passes from the supply pipe 12 through the inlet opening 36 and is discharged through the outlet opening 27. The spray of liquid from the device appears to vibrate or swing up and down, and the discharge is broken up into discrete droplets.

With the view to presenting a complete description of the specific embodiment shown in the drawing, the relative sizes and spacing of its parts have been set forth above; however, such detailed description, with nothing more, fails to explain enough for a comprehensive understanding of the invention. The illustrated device is especially well suited for discharging water at a relatively high rate in terms of volume per unit of time. Though the pressure of water in the supply pipe 12 is a factor determining the distance to which the spray will reach, break-up of water and up and down fluttering of the spray are not affected to any practical extent by variations in pressure. Up and down flutter of the spray is strikingly noticeable in the case of a device having a relatively wide outlet opening. In the case of a slit-like outlet opening which is relatively narrow with respect to the thickness of the side wall 17, the lip surfaces 29 and 30, if parallel to each other and not divergent outwardly from each other, tend to confine and straighten out the stream of liquid being discharged and thus neutralize or reduce the extent of flutter of the spray. A practical specific for appreciable flutter is that the greatest dimension of the outlet opening taken in a direction axially of the chamber 25 be at least as great as the thickness of the side wall 17. As to the circumferential extent of the outlet opening, this is a matter only of what width is desired for the spray, an opening of 90° extent circumferentially of the chamber producing a quadrant spray pattern, and one of 180°, for example, producing a semi-circular spray pattern.

As to the relative sizes of the inlet and outlet openings the outlet opening should be larger than the inlet opening and preferably at least twice the size of the inlet opening. Whether the inlet opening be square or

otherwise has no apparent effect on the action of the spray.

The discharge opening 27 need not extend generally in a plane normal to the longitudinal axis of the chamber as in the illustrated embodiment but may be upwardly or downwardly inclined, in which cases the matter of inclining the lip surfaces 29 and 30, as for example upwardly in the illustrated case to effect upward bias to the spray, is of inappreciable consequence. I have found that if the lower end wall 23 is rotated slightly on the longitudinal axis of the chamber 25 such that the inlet opening 36 is out of longitudinal alignment with the outlet opening 27, then the spray becomes canted. In the case where the device has its discharge opening 27 extending generally in a plane normal to the longitudinal axis of the chamber, and disregarding the effect of any inclination for beveling of the lip surfaces 29 and 30 upwardly or downwardly, the spray will be directed slightly upwardly when the inlet opening 36 is on the same side of the device as the outlet opening 27, and the spray will be directed slightly downwardly when the inlet opening is at the opposite side of the device. In either case of upward or downward biasing of the spray, the spray is horizontal when the center of the inlet opening is in the same axial plane through the chamber 25 as the center of the outlet opening.

Several embodiments having concave inside surfaces 22 and 23 were tested but such constructions had no apparent effect on the characteristics of the spray. So long as the chamber 25 extends appreciably above and below the outlet opening 27, the characteristic flutter of the spray will be produced. Practical limits for substantial flutter are that the inside surfaces 22 and 23 of end walls be spaced from the outlet opening by at least one-half the radius of the chamber 25.

Devices of this invention may be employed as nozzles with the longitudinal axis of the chamber 25 extending horizontally, for example, rather than vertically as in the illustrated installation.

While the invention has been shown and described in what is conceived to be a preferred embodiment for its particular use as for quick flushing purposes with a large rate of liquid discharge, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details of the illustrated embodiment, but is to be accorded the full scope of the claims.

Having thus described the invention what is claimed as new in support of Letters Patent is:

1. A liquid discharging device comprising a hollow body having an inside chamber and two ends, the body being adapted for connection to a liquid supply pipe adjacent one end, said one end having an inlet opening to said chamber within the circumference of the chamber and eccentric of the longitudinal axis of the chamber, the body having an outlet opening from said chamber larger in size than said inlet opening and spaced between the said ends, the extent of the outlet opening taken transversely of the chamber being greater than its extent taken in the direction of said longitudinal axis, and the inside surfaces of said ends being spaced from the outlet opening by at least one-fourth of the largest transverse diameter of the chamber.

2. A liquid discharging device according to claim 1 in which the mid-point of said outlet opening and the center of said inlet opening are in a common axial plane of said chamber.

3. A liquid discharging device according to claim 1 in which the circumferential extent of the outlet opening is greater than that of the inlet opening.

4. A liquid discharging device comprising a hollow body having a tubular side wall and two end walls defining an elongate chamber, one end wall having an inlet opening to said chamber eccentric of the longitudinal axis of the chamber with the center of the inlet opening being spaced inwardly from the inside of said side wall, a liquid supply pipe connected to the body for flow of liquid under pressure through said inlet opening into the chamber, the other end wall having an inside surface for reflecting liquid in said chamber in a direction generally opposite to that of the flow of liquid through the inlet opening, said side wall having an outlet opening spaced from the inside surfaces of said end walls by at least one-fourth of the largest transverse diameter of the chamber, and the transverse dimension of the outlet opening being greater than that taken in the direction of said longitudinal axis.

5. A liquid discharging device comprising a hollow body having a side wall and two end walls defining a cylindrical chamber of circular cross-section, means for connecting a liquid supply pipe to the body adjacent one end wall, said one end wall having an inlet opening to said chamber eccentric of the longitudinal axis of the chamber and within the circumference of the chamber, said side wall having an outlet opening from said chamber spaced from and between the inside surfaces of said end walls, the circumferential extent of the outlet opening being greater than its dimension taken in the direction of the longitudinal axis of the chamber, the inside surfaces of said end walls being spaced from the outlet opening by at least one-half the radius of the chamber, and the centers of the outlet and inlet openings being in the same axial plane through the chamber.

6. A liquid discharging device according to claim 5 in which said inlet opening extends to the inside surface of said side wall.

7. A liquid discharging device according to claim 5 in which the inlet opening is aligned longitudinally of the chamber with the outlet opening.

8. A liquid discharging device according to claim 5 in which the greatest dimension of the outlet opening taken in a direction axially of the chamber is at least as great as the thickness of said side wall.

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