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IMPROVEMENT IN HOLLOW CONE SPRAY NOZZLE

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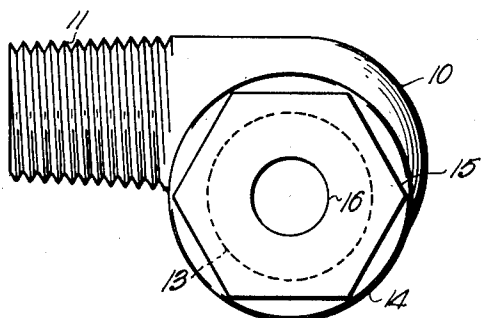


Fig. 1.

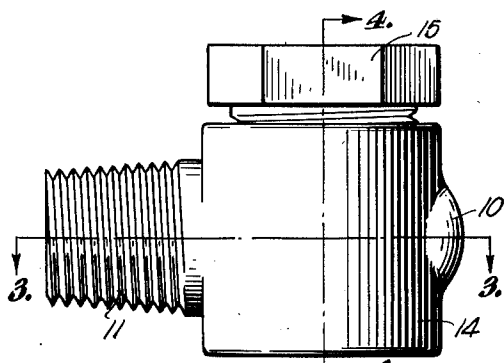


Fig. 2.

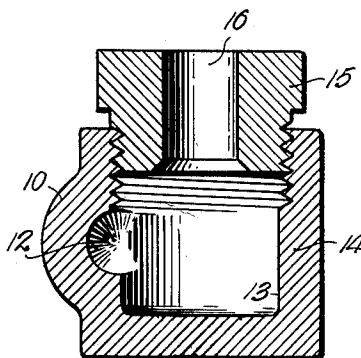


Fig. 4.

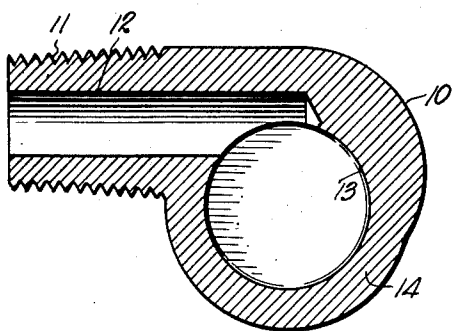


Fig. 3.

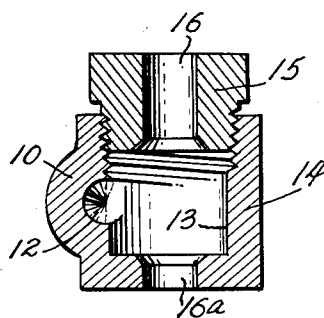


Fig. 5.

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UNITED STATES PATENT OFFICE

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IMPROVEMENT IN HOLLOW CONE SPRAY
NOZZLE

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6 Claims. (Cl. 299—114)

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This invention relates to a liquid spray nozzle and particularly to such a spray nozzle for distributing a source of water into a cone-shaped spray of very fine droplets. Such nozzles are particularly adapted for use in cooling ponds, air cooling units, evaporative condensers, for washing or humidifying air and the like.

Spray nozzles in present use are of two types, nozzles having two or more inlets and those having a single inlet. Nozzles having a plurality of inlets type deliver an even distribution of water, but they are subject to clogging by dirt or contamination that would readily pass through the single inlet type which is relatively non-clogging. Difficulty has been encountered in providing a single inlet type nozzle which will deliver an evenly distributed spray of water even though the water travels at low whirl velocity and the nozzle has a relatively large inlet opening and a smaller outlet opening. In the nozzle hereinafter disclosed, however, this disadvantage of the single inlet nozzles is overcome and there is provided a nozzle having relatively small inlet which delivers an evenly distributed spray.

A broad object of my invention, therefore, is to provide an improved spray nozzle having greater efficiency than devices heretofore developed.

Another object is to provide a spray nozzle in which a maximum of the pressure head is converted into kinetic energy of rotation, whereby the water is distributed substantially entirely by the centrifugal force of the whirling water.

The salient object of the invention is to provide a nozzle having a single inlet partially cut into the outer wall of the whirl chamber so that only part of the incoming water enters the whirl chamber tangent to the water already in the whirl chamber.

A further object is to provide a nozzle in which the axis of the inlet is symmetrical to the whirl chamber and the capacity of the nozzle is substantially independent of the outlet orifice.

Other and further objects and advantages of the invention will become apparent from the following description.

In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith and in which like reference numerals are employed to identify like parts of the various views,

Fig. 1 is a plan view of the nozzle made in accordance with the present invention,

Fig. 2 is a side view of the nozzle shown in Fig. 1,

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Fig. 3 is a sectional view taken along the line 3—3 in Fig. 2 in the direction of the arrows, and

Fig. 4 is a sectional view taken along the line 4—4 in Fig. 2 in the direction of the arrows.

Fig. 5 is a longitudinal sectional view of a modified nozzle constructed in accordance with my invention.

The instant application is an improvement over the nozzle construction shown in Letters Patent No. 2,161,016 granted June 6, 1939. The invention hereinafter disclosed, like the patent, relates to that type of nozzle having whirl chamber with an inlet connected into one side and an outlet orifice whose axis is substantially at right angles to the inlet. Such a nozzle is usually arranged with the outlet orifice at the top and due to the whirling motion of the water, it is discharged in the shape of an inverted cone. The inlet to the whirl chamber is cut a small distance beyond the center line of the whirl chamber and is partially embedded in its outer wall so the longitudinal center line of the inlet opening is tangent with the inner wall of the whirl chamber. By this arrangement, the size of the inlet opening may be larger than is normally allowable to accommodate greater capacity. By this construction about one-half of the liquid is delivered into the wall and the remainder directly into the whirl chamber, that part delivered into the wall is gradually released in the form of a whirling film into the water in the chamber. This action greatly decreases the turbulence produced by charging the entire stream of inlet liquid tangentially to the chamber wall as is usually done. When introduced tangentially the water tends to merge with the whirling film of water in the chamber and force the film away from the chamber wall causing the spray discharge to form imperfect cone of liquid. By partially embedding the inlet passage in the whirl chamber wall, a perfect outlet discharge cone of liquid results.

Heretofore spray nozzles of this general type have not been entirely satisfactory because of the uneven distribution of water over a portion of the discharge cone, the center or apex of which is the outlet orifice of the nozzle. Nozzles of this type are usually arranged in large groups and adjacent one another in order to utilize the minimum of the available space and yet operate efficiently. It is often desirable for some of these nozzles to operate with a small included angle between the sides of the conical shaped spray while others must operate with a much greater included angle; nozzles should therefore be capable of so operating simultaneously from a com-

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mon source of pressure. Heretofore nozzles designed to operate at a certain pressure would not operate efficiently at another pressure, nor would the included angle of the spray be the same for these different pressures because the design of the nozzle relied almost entirely upon the inlet pressure for atomization, the outlet orifice usually being smaller than the inlet. In all such devices velocity head is produced to a great extent by the vertical component resulting from pressure supplied from the inlet than the horizontal component produced by the whirling movement of the water in the whirl chamber. In such devices the horizontal component or whirling movement acts chiefly to spread the sides of the stream issuing from the outer orifice and relies principally upon the velocity at the outlet orifice for atomization. The evenness of the distribution of water discharged from such nozzles is greatly effected by the comparative size of the inlet to volume or size of the whirl chamber. Likewise the size or area covered by the conical spray, as well as the degree of atomization will be directly dependent upon the inlet pressure.

The present invention contemplates broadly a spray nozzle in which the outlet orifice is at least as large as the inlet to the whirl chamber and larger in some instances. It also contemplates the conversion of pressure head to velocity head at the entrance to the whirl chamber, the fast whirling water in said chamber being squeezed out under centrifugal force through an outlet orifice whose axis is at right angles to the plane of the whirl chamber.

Referring more particularly to the drawings, the spray nozzle 10 is adapted to be coupled to a suitable source of fluid under pressure, by means of an externally threaded coupling 11 which forms the outer wall of the inlet passage 12. The inlet opening or passage 12 enters the whirl chamber 13 internally threaded as shown at 14 to receive a spray cap 15. Spray cap 15 has a central aperture 16 which is the outlet orifice of the whirl chamber. The axis of this orifice is at substantially right angles to the plane of whirling liquid passing through the chamber. The inner wall of the whirl chamber 13 is cylindrical, its center being coincident with the axis of the outlet orifice. The inlet 12 is partially embedded in the side wall of the whirl chamber to an extent that its longitudinal center line is substantially tangent to the inner wall of the whirl chamber. In other words, one-half of the diameter of the inlet lies in the wall of the whirl chamber and one-half in the whirl chamber as contrasted with the usual tangential inlet. While the nozzle illustrated in the drawing shows the inlet passage 12 terminating beyond the center line of the whirl chamber, this is not critical, for the inlet may terminate at the center line or it may terminate ahead the center line without appreciable change in results.

The sizes of the outlet orifice, its relation to the whirl chamber and the inlet thereto is such that the width of the whirl chamber is approximately two and one-half times the maximum width of the inlet passage, that is, the same width whirl chamber may be used for smaller sizes of inlets. The maximum diameter of the inlet passage preferably is two-fifths ($\frac{2}{5}$) the diameter of the whirl chamber.

It is to be understood that in nozzles made in accordance with the present invention the inlet passage to the whirl chamber determines the capacity of the nozzle, the outlet orifice being of

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such a size that only a thin film of water is discharged as distinguished from a solid stream. It is desirable to keep the discharge in the form of a thin film in order to obtain proper atomization of the water. The invention also contemplates a nozzle design in which the cross sectional area of the inlet passage is less than the cross sectional area of the outlet orifice, for the smallest capacity up to those in which the cross sectional area of the inlet passage is substantially two-fifths ($\frac{2}{5}$) that of the whirl chamber. The size of the included angle of the conical spray can be controlled by changing the size of the inlet passage, since the smaller the inlet the lower the capacity, and the larger the angle of the included cone.

While I have described the outlet orifice as being in the cap 15, it will be evident to those versed in the art that the cap may be an imperforate plug and the outlet orifice disposed in the bottom wall of body 14. Alternatively, as shown in Fig. 5, two outlet orifices, one at 16 and the other at 16a, may be provided so that oppositely directed sprays will issue simultaneously from both ends of the whirl chamber.

Although water is referred to in the description, it is to be understood that any liquid with the desired fluidity would be acted upon by the nozzle in the same manner as that described.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinbefore set forth together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

Inasmuch as many possible embodiments of the invention may be made without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a non-clogging spray nozzle, a cylindrical whirl chamber having flat end walls perpendicular to the axis of said chamber, one of said end walls containing a circular outlet orifice concentric with said axis, a single fluid inlet to said chamber comprising a straight cylindrical bore extending through the annular side wall of the chamber, the center line of said bore being tangent to the inside annular surface of said chamber and substantially equidistant between the planes of said end walls, part of said bore being formed as a peripheral groove in the wall of said chamber terminating abruptly at a point adjacent a plane disposed radial to the axis of the chamber and normal to the axis of said bore, the diameter of said bore being less than the diameter of said outlet orifice and also materially less than the inside length of the chamber in an axial direction.

2. In a non-clogging nozzle, a cylindrical whirl chamber having flat end walls perpendicular to the axis of said chamber, one of said end walls containing a circular outlet orifice concentric with said axis, a single fluid inlet to said chamber comprising a straight cylindrical bore extending inwardly through the side wall with its longitudinal axis tangent to the inside annular wall of the chamber and terminating abruptly with its inner end at a point just beyond a plane disposed radial

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to the axis of the chamber and normal to the axis of said bore, the diameter of said bore being less than the diameter of said outlet orifice and also less than the inside length of the chamber in an axial direction, and the axis of said bore being substantially equidistant between the planes of said end walls.

3. In a non-clogging nozzle, a cylindrical whirl chamber having flat end walls perpendicular to the axis of said chamber, the length of said chamber in an axial direction being substantially equal to the diameter of the chamber, one of said end walls containing a circular outlet orifice concentric with said axis, the diameter of said orifice being more than two-fifths the diameter of said chamber, a single fluid inlet to said chamber comprising a straight cylindrical bore whose diameter is less than two-fifths the diameter of said chamber, said bore extending inwardly through said side wall with its longitudinal axis tangent to the inside annular surface of the chamber and terminating abruptly with its inner end just beyond a plane disposed radial to the axis of the chamber and normal to the axis of the bore, the axis of said bore being substantially equidistant between the planes of said end walls.

4. In a non-clogging spray nozzle, a cylindrical whirl chamber having end walls, one of said end walls containing a circular outlet orifice concentric with said axis, and a single fluid inlet to said chamber comprising a straight cylindrical bore extending through the annular side wall of the chamber, the center line of said bore being tangent to the inside annular surface of said chamber, part of said bore being formed as a peripheral groove in the wall of said chamber terminating abruptly at a point just beyond a plane disposed radial to the axis of the chamber and normal to the axis of said bore.

5. In a non-clogging spray nozzle, a cylindrical whirl chamber having flat end walls perpendicular to the axis of said chamber, one of said end walls containing a circular outlet or orifice concentric with said axis, and a single fluid inlet to said chamber comprising a straight cylindrical bore extending through the annular side wall of the chamber and substantially equidistant be-

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tween the planes of said end walls, the center line of said bore being tangent to the inside annular surface of said chamber, part of said bore being formed as a peripheral groove in the wall of said chamber terminating abruptly at a point just beyond a plane disposed radial to the axis of the chamber and normal to the axis of said bore, and the diameter of said bore being less than the diameter of said outlet orifice and also materially less than the inside length of the chamber in an axial direction.

6. In a non-clogging spray nozzle, a cylindrical whirl chamber having flat end walls perpendicular to the axis of said chamber, each of said end walls containing a circular outlet orifice concentric with said axis, a single fluid inlet to said chamber comprising a straight cylindrical bore extending through the annular side wall thereof, the center line of said bore being tangent to the inside annular surface of the chamber and substantially equidistant between the planes of said end walls, part of said bore being formed as a peripheral groove in the wall of said chamber terminating abruptly at a point adjacent a plane disposed radial to the axis of the chamber and normal to the axis of said bore, the diameter of said bore being less than the diameter of either outlet orifice and also materially less than the inside length of the chamber in an axial direction.

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