Dec. 5, 1933. F. WAHLIN 1,938,000

HOLLOW CONE SPRAYING NOZZLE

Filed May 28, 1932

Fig. 1

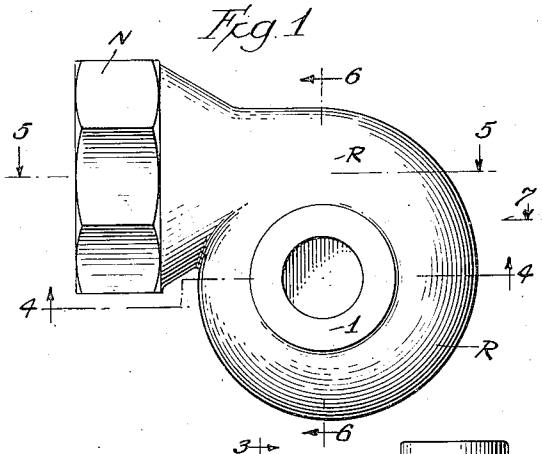


Fig. 4

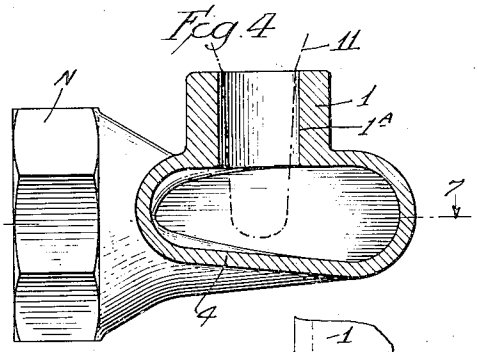


Fig. 8

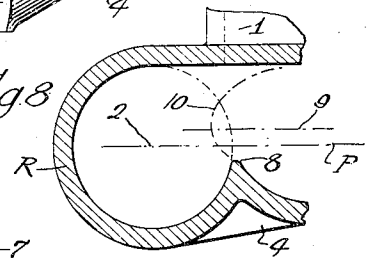


Fig. 2

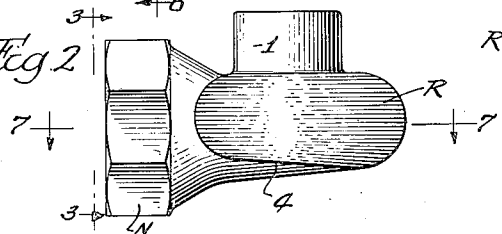


Fig. 6

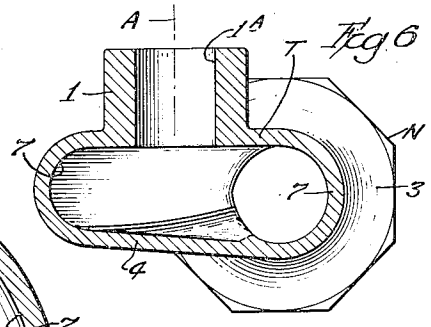


Fig. 7

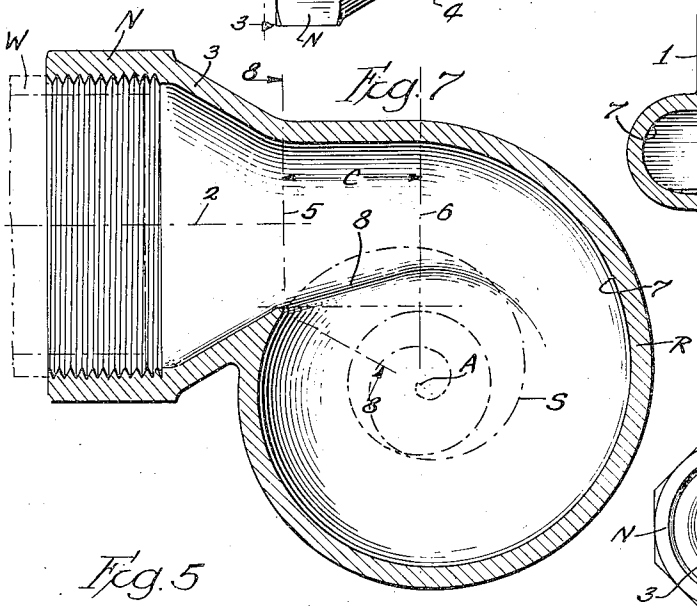


Fig. 3

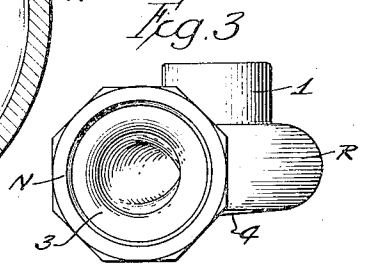
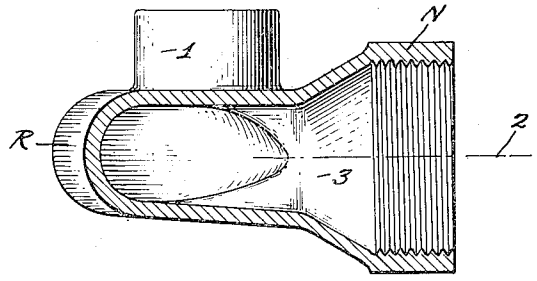


Fig. 5



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Patented Dec. 5, 1933 1,938,000

UNITED STATES PATENT OFFICE

1,938,000

HOLLOW-CONE-SPRAYING NOZZLE

Fritz Wahlin, Chicago, Ill., assignor to Binks Manufacturing Company, Chicago, Ill., a corporation of Delaware

Application May 28, 1932. Serial No. 614,120

12 Claims. (Cl. 299—114)

My invention relates to spray nozzles of the rigid spray head type, designed for projecting liquid in the form of a hollow conical spray.

Generally speaking, the objects of my invention are those of providing a spray head of this class which can be easily and cheaply manufactured in a single-piece construction; which will depend entirely on the guiding of the liquid for the hollow conical projection of that liquid, without requiring the use of riser posts or the like within the spray head; and which will have a high liquid-spraying capacity in proportion to the size of its inlet and the pressure at which the liquid is supplied. Moreover, my invention aims to provide a spray head of this class which will afford a highly uniform atomization of the resulting spray with widely differing liquid pressures, including even relatively low pressures, and one in which the cone angle of the emitted spray can readily be varied by a mere change in the shape of the outlet bore of the spray head. In addition my invention aims to provide a spray head of this class which can readily consist of an easily cored casting, which will require very little interior machining, and which can be employed with equal effectiveness in a wide range of sizes.

Still further and also more detailed objects will appear from the following specification and from the accompanying drawing, in which drawing

Fig. 1 is a plan view of a spray head embodying my invention.

Fig. 2 is a side view of the same, looking upwards in Fig. 1, and drawn on a reduced scale.

Fig. 3 is an end view of the same spray head, drawn on the same scale as Fig. 2.

Figs. 4, 5 and 6 are vertical sections taken respectively along the correspondingly numbered lines in Fig. 1.

Fig. 7 is an enlarged horizontal section taken along the line 7—7 of Fig. 2.

Fig. 8 is a fragmentary vertical section taken along the angular line 8—8 in Fig. 7, with dotted lines showing the initial shape of the stream of water entering the spiraling chamber and the shape of that stream when it has spiraled for part of a turn and is intersecting another stream portion of the initial section.

In accomplishing the purposes of my invention in a spray head which has the axis of its inlet horizontal, I employ the principle of guiding the stream of liquid in a spiral converging path toward an upwardly directed outlet, so as to have the liquid flow within this outlet in a spirally advancing tubular form, and also assist the movement of the liquid into the outlet by employing a sloping bottom portion in my spray head.

Such a spiral guiding of the liquid has heretofore been employed in water spray nozzles or spray heads of this class, and heretofore proposed types have also been provided with liquid-lifting bottom formations. But to make these operative, it has heretofore been customary to change the cross-section of the liquid stream from a circular to a rectangular section before the spiraling motion is imparted to it, with the longer sides of the rectangle parallel to the axis of the outlet of the spray head.

When this axis is also upright, the outer wall of the liquid stream which has swirled adjacent to the riser wall of the spiraling chamber is upright when it first intercepts the also upright wall of the additional water entering the nozzle, so that it slices an upright rectangular section of considerable height off the inner edge of the entering stream of water, so as to lift the water into the outlet in the form of a relatively thick annular stream unless the spiraling is at a so slowly decreasing rate that the water must spiral a large number of times within the nozzle.

But if the nozzle is designed so that the water (or other liquid) within the nozzle must spiral a large number of times within the nozzle, the resulting frictional loss due to the repeated impacts of spiraling water portions upon one another within the nozzle retards the velocity at which the water is projected from the outlet, thereby reducing the number of gallons of water which a nozzle with a given size of inlet will project with the water admitted at a given pressure. Moreover, when a spray head is so designed as to spiral the water for the large number of returns required when the spiraling chamber has a straight-edged inner wall, a reduction in the pressure of the admitted water will reduce the number of these turns so that the thickness of the annular stream which is advanced spirally within the outlet of the spray head is too great to permit the emitted water to be finely atomized, thereby preventing the spray head from being used effectively at water pressures considerably below the maximum for which the appliance was designed.

My present invention aims to overcome these objections by providing a spiraling chamber with an inner wall so shaped that at the end of the first spiraling turn the water within that chamber tends to lift only a relatively small portion of the subsequently entering water which it intersects, thereby causing the water to be advanced

out of that chamber into the outlet of the spray head in an annular stream of relatively small thickness with both high and low pressures of the water supply. Furthermore, my invention aims to eliminate the heretofore customary initial throttling of the water pressure by changing the section of the liquid stream before this enters the spiraling chamber, so as to increase the hourly liquid spraying capacity of the spray head in proportion to the size of the nozzle inlet and the pressure at which the water is supplied.

In the illustrated embodiment, my spray head is a single piece casting, desirably of bronze or other non-corrosive metal, which includes a casing affording a whirling chamber of considerably less interior height than diameter, an outlet 1 rising from the top of this casing and having a vertical axis A coincident with the axis about which the major portion of the interior face of the riser wall R of the whirling casing is spiraled, and an inlet nipple N leading to the interior of this casing.

This nipple N has its axis 2 in a plane at right angles to the outlet axis A and approximately at the midheight of the said casing, as shown in Fig. 5, the outer end portion of the nipple being threaded for direct attachment to a horizontal water supply pipe W which supports the spray head with the axis of the outlet 1 vertical. The inner end of the nipple opens into the interior (or whirling chamber) of the said casing through an inlet which—in the plane of Fig. 8, namely a vertical plane at right angles to the inlet axis 2—is circular and of considerably smaller diameter than the bore of the water supply pipe W. In practice, the diameter of this circular chamber inlet is desirably about five-eighths the diameter of the bore of the water supply pipe, and the portion 3 of the nipple N between this chamber inlet and the threaded nipple end has its bore of a corresponding frustro-conical taper, so that the stream of water supplied to the nipple is reduced as to the diameter of its continuously maintained circular section and increased in velocity by the time it enters the whirling casing.

The riser wall R of the whirling casing has its inner face of an arcuate section tangential to both the upper face of the bottom 4 of the casing and the lower face of the top T of the casing, this arcuate section being preferably a semi-circle.

The portion C of this inner face of the riser wall between the plane 5 of the chamber inlet and a plane 6 parallel to the aforesaid plane through the axis A of the outlet 1 is a portion of a semi-cylindrical surface concentric with the axis 2 of the nipple and the said chamber inlet; but the remaining portion 7 of this inner face of the riser wall has its semi-circular vertical section of a radius which decreases continuously up to the juncture of that wall with the inlet nipple. This reduction in section is obtained by a corresponding continuous upward sloping of the bottom 4 of the casing from the juncture J (Fig. 7) of the spiralled riser wall with the said portion C to the diametrically opposite side of the casing, thereby producing an interior ridge 8 on the upper face of the casing bottom (Fig. 8) at the juncture of the sloping bottom with the part of the casing bottom to which the nipple leads, and leaving the major part of the casing bottom in a plane sloping upwards (in a direction at right angles to the axis of the inlet) toward the last named side, as shown in Fig. 2.

The part of the top T between the arcuate riser wall and the outlet 1 has its lower face at right angles to the axis A of the outlet, and the portion of this face adjacent to the bore of the outlet is desirably machined to afford a sharply right-angled juncture between the chamber top and the outlet bore. This outlet bore may be either cylindrical as illustrated, or frustro-conical with an upward taper of not more than about one degree (too small to illustrate in the scale of the drawing), according to the desired conical spread of the emitted spray, but in either case the outlet bore preferably presents a straight-edged section in any plane taken along its axis.

When water under pressure is supplied through the water pipe, the stream of water admitted to the casing through the circular inlet has a continuously semi-circular section in its radially outer portion (considered with reference to radii about the outlet and spiraling axis A), but the radius of this section continuously decreases while the stream is initially moving from the plane 6 of Fig. 7 to the ridge 8, owing to the corresponding upward sloping of the bottom 4 of the said casing.

As the result, this initial whirling part of the stream not only has its mid-height raised from the horizontal plane through the inlet axis 2 to a higher plane 9, as indicated in Fig. 8, but also is expanded in its horizontal section. Consequently, instead of tangentially engaging the subsequently entering part of the liquid stream, as implied by the tangency to the inner casing portions in Fig. 8, the initially circling part of the stream will tend to cut across the subsequently entering part of the stream adjacent to the ridge 8 along a section line such as the dotted line 10 in this figure; namely in such a manner that the already whirled stream portion will lift part of the subsequently entering stream, while a lower portion of this subsequently entering stream will also lift the already whirled stream portion which is intercepting it.

To secure a high efficiency, the spacing of the outlet axis A from the nipple axis 2 in a plane along the outlet axis desirably is approximately equal to the sum of the radii of these axes, as shown in Fig. 7.

As the result of these combined actions—and particularly when the spiraling of the inner face of the riser wall at midheight is such that this spiral S, if continued as shown in dotted lines in Fig. 7, will intersect the outlet bore 1A at only about a half-turn beyond the vertical plane 6 at which the upward sloping of the bottom begins—my spray head starts the desired upward spiraling of water within the bore of the outlet when the water has advanced only for a small fraction of a spiral turn within the whirling casing.

This is also made possible partly because of the relatively large diameter of the outlet bore with respect to that of the circular inlet—since the outlet bore diameter may be approximately ¾ or ⅞ that of the casing inlet—and because the cylindrical surface of the bore 1A of this outlet (in the plane of Fig. 7) is substantially tangential to a cylindrical stream admitted by the said inlet. Moreover, since the arcuate vertical section of the riser wall of the whirling chamber confines the lifting action to stream portions of much less height than the interior height of the casing, the tubular stream of liquid which spirals upwardly within the outlet of my spray head can be of a quite thin wall, as shown by the dotted line 11 of Fig. 4, thereby enabling me to obtain

a fine atomization even when the water is supplied at relatively low pressure, which has not been found possible with spray heads in which the whirling chamber has an upright riser wall.

By admitting a stream of circular cross-section, instead of first changing it to a rectangular section in the heretofore customary manner, and by constructing my spray head so that the outlet can be almost as large as that of the inlet to the whirling chamber, I also greatly reduce the friction within the spray head and for that reason am able to atomize a much larger quantity of water under a given pressure with a given size of spray head than has heretofore been customary.

In practice, I have found it advantageous to make the length of the outlet bore somewhat less than its diameter, but not less than three-fourths of the latter. I have also found it advantageous to have the spiraled portion of the riser wall extend through an arc of about 300 degrees, and to dispose the sloping upper face portion of the casing bottom at an angle (in any plane radial of the outlet) of about three degrees to the top of the casing so as to secure a very gradual lifting action.

However, I do not wish to be limited as to these or other details of the construction and arrangement here disclosed, since many changes might obviously be made without departing either from the spirit of my invention or from the appended claims. Nor do I wish to be limited as to the liquids in connection with which my spray head is employed, although I have found it particularly advantageous for water spraying.

I claim as my invention:

1. In a spray head, a casing having a lateral inlet and an upwardly directed outlet, the riser wall of the casing having an inwardly concaved substantially semi-circular vertical section into which the bore of the inlet merges, all except a relatively short portion of the riser wall adjacent to the inlet having a spiral formation decreasing toward the inlet in its radius from the axis of the outlet, the casing bottom presenting an upwardly facing ridge extending from the side of the inlet toward which the spiraled formation of the riser wall decreases in radius, the said ridge extending at a sharply acute angle to a plane which is diametric of the axis inlet and parallel to the axis of the outlet.

2. In a spray-head, a hollow body affording a flat-topped whirling chamber having a riser wall of inwardly concaved arcuate section, a horizontal inlet tangential to one side of the riser wall of the chamber, an upright outlet extending upwardly from the top of the chamber, and a bottom having its major portion flat and sloping upwards away from the said riser wall side, the connection of the whirling chamber to the inlet being of a circular section corresponding in height to the maximum interior height of the said chamber.

3. In a spray-head, a hollow body affording a flat-topped whirling chamber having a riser wall of inwardly concaved semi-circular section, a horizontal inlet tangential to a portion of the riser wall of the chamber, and a generally flat bottom, and an upright outlet coaxial with the axis toward which liquid admitted through the inlet will whirl within the chamber; the opening of the inlet to the chamber and the bore of the outlet being both circular and substantially equal in diameter, and the chamber bottom sloping upwardly away from the inlet side of the chamber in a direction at right angles to the axis of the inlet.

4. In a spray-head, a hollow body affording a flat-topped whirling chamber, horizontal inlet tangential to one side of the riser wall of the chamber, an upright outlet extending upwardly from the top of the chamber, and a bottom having its major portion flat and sloping upwards away from the said riser wall side, the said slope being such that the elevation of the upper face of the bottom differs at the said riser wall side and at the opposite side by not more than one-fourth the maximum interior height of the chamber.

5. In a spray head, a hollow body affording an unobstructed whirling chamber and having a horizontal inlet of continuously circular cross-section leading to the chamber tangential to one side of the body, the body having a generally flat top and a generally flat bottom converging toward the said top away from the said side; the body including an upright tubular outlet extending upwardly from the said top, and the riser wall of the body having a semi-circular vertical section and being peripherally a portion of a spiral having the axis of the outlet as its generating axis, the said spiral having its longest radius tangential to the inlet.

6. In a spray head, a hollow body affording an unobstructed chamber and including a horizontal inlet of continuously circular cross-section leading to the said chamber, and an upright outlet leading from the top of the chamber, the riser wall of the chamber being of semi-circular vertical section, the portion of this wall adjacent to the inlet being part of a cylindrical surface coaxial with the inlet, the remainder of the said wall being spiralled about the axis of the outlet and having a semi-cylindrical vertical section which decreases in radius away from the inner end of the aforesaid wall portion, the casing having a horizontal top and having the major portion of its bottom in a plane tangential to the lower end of the said riser wall and sloping upwards in a direction at right angles to the axis of the inlet.

7. In a spray head, a casing having a lateral inlet and an upwardly directed outlet, the riser wall of the casing having an inwardly concaved substantially semi-circular vertical section into which the bore of the inlet merges, all except a relatively short portion of the riser wall adjacent to the inlet having a spiral formation decreasing toward the inlet in its radius from the axis of the outlet, the inner face of the said riser wall part having the axis of the outlet as the generating axis of its spiral formation; the casing having a flat top wall at right angles to the said axis and a generally flat and imperforate bottom tangential to the lower end of the riser wall and oblique to the axis of the outlet.

8. In a spray head, a casing having an upright tubular outlet and a horizontal inlet both of circular and substantially equal bore, and having a riser wall of inwardly concaved semi-circular section, the inlet being tangential to a portion of this wall, the top of the casing being horizontal and the riser wall being formed as part of a spiral generated about the axis of the outlet, the radius of the said section decreasing from the said portion of the wall in a direction forwardly with respect to the flow of liquid admitted to the casing through the inlet, the bottom of the casing having its major portion flat and tangential to the lower end of the said riser wall.

9. In a spray head, a generally flat-topped and

flat-bottomed casing having a horizontal top, a lateral inlet and an upwardly directed tubular outlet both of substantially equal circular section, the riser wall of the casing having an inwardly concaved substantially semi-circular vertical section; the major portion of this riser wall decreasing, both in its height and in its radius from the axis of the outlet, in a forward direction with respect to liquid admitted to the casing through the inlet, and the inlet being tangential to the said riser wall at the portion of that wall which is largest in radius.

10. In a spray head, a hollow body affording a whirling chamber having a riser wall of inwardly concaved semi-circular section; the body including a horizontal and flat top wall tangential to the upper end of the riser wall, an upright tubular outlet rising from the top wall, and a horizontal inlet opening into the said chamber through a circular opening tangential to the riser wall, the said riser wall decreasing forwardly of liquid admitted through the inlet both in its radius and in its spacing from the axis of the outlet; the bottom of the body being tangential to the lower end of the riser wall and generally flat.

11. A spray head as per claim 10, in which the extent of the said decrease in height is such that the minimum interior height of the riser wall is less than three-fourths and more than one-half the diameter of the said inlet opening.

12. In a spray head, a hollow body having a horizontal top and affording a whirling chamber having a riser wall of inwardly concaved semi-circular section, the body also including a horizontal inlet leading to the said chamber through a circular inlet opening tangential to the said riser wall and including an upright outlet having a substantially cylindrical bore corresponding in diameter to the said inlet opening, the mid-height line of the said riser wall forming part of a spiral generated about the axis of the outlet, the minimum radius of the said line from the axis of the outlet being three-tenths of the maximum radius, and the bottom of the said chamber sloping upwards from the body side tangential to the inlet to the opposite side of the body at an angle of approximately five degrees.

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