Aug. 26, 1924. 1,506,722

W. E. YUNKER

METHOD OF PRODUCING SPRAY NOZZLES

Filed Oct. 16, 1919

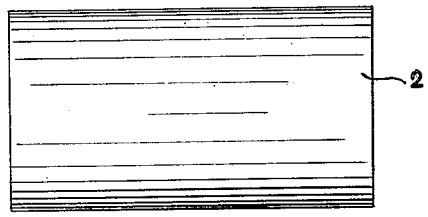

Fig. 1

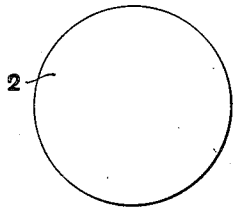

Fig. 2

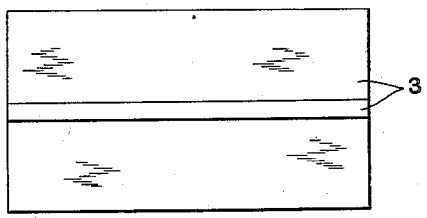

Fig. 3

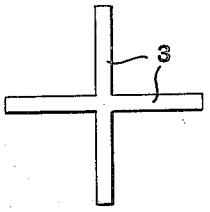

Fig. 4

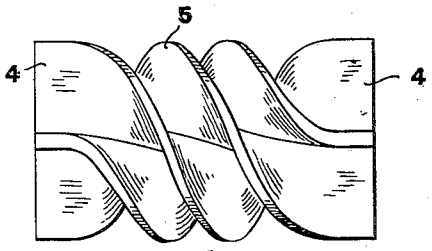

Fig. 5

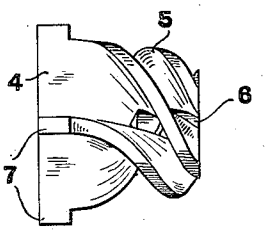

Fig. 6

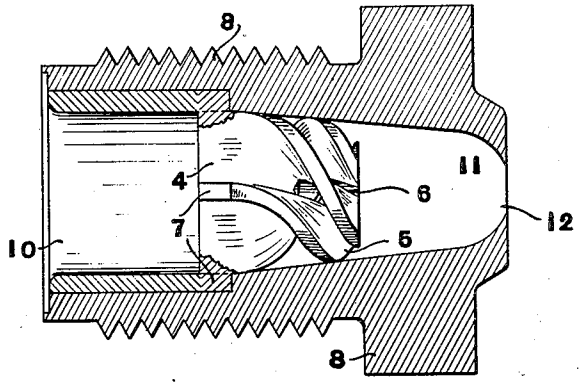

Fig. 8

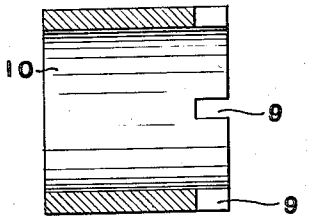

Fig. 7

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Patented Aug. 26, 1924.

1,506,722

UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING SPRAY NOZZLES.

Application filed October 16, 1919. Serial No. 331,739.

To all whom it may concern:

Be it known that WILLIAM E. YUNKER, a citizen of the United States of America, residing at West Allis, in the county of Milwaukee and State of Wisconsin, has invented a certain new and useful Improvement in Methods of Producing Spray Nozzles, of which the following is a specification.

This invention relates to improvements in the construction and operation of liquid spray-producing nozzles, and to an improved process of forming or producing such nozzles.

An object of the invention is to provide a simple, compact and efficient nozzle for producing a homogeneous spray of atomized liquid. Another object is to provide a nozzle which may be easily constructed and all parts of which are readily accessible for cleaning and inspection. A further object is to provide a simple and efficient process of constructing spray nozzles at minimum cost.

It is common knowledge that a homogeneous spray of atomized liquid may readily be produced by causing the liquid to swirl and by subsequently delivering the swirling liquid through a constricted orifice into free space. Swirling motion of the liquid is ordinarily produced by forcing a stream of liquid through a conduit having one or more helical vanes therein. If the liquid contains impurities it is practically impossible to prevent such impurities from lodging between the helical vanes of the nozzle and thereby destroying efficient operation thereof. It is therefore desirable to construct the nozzle in such a manner that the passages between the swirl-producing vanes are readily accessible for cleaning. The present invention has particular relation to an improved device for swirling the liquid, all portions of which are readily accessible for cleaning, and further relates to an improved process of manufacturing such swirl-producing devices in quantity and at minimum cost.

The nozzle structure and the method of producing the same forming the subject of the present invention, are improvements over the nozzle and method of producing the same which form the subject of a co-pending application for Letters Patent filed by Joseph Javorsky on or about October 6, 1919, Serial No. 329,405.

A clear conception of one form of nozzle constructed in accordance with the present invention, as well as of the process of producing such nozzles, may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is an elevation of a piece of stock such as is utilized in the construction of swirl-producing nozzle elements.

Fig. 2 is an end view of the piece of stock showing the cross section thereof.

Fig. 3 is an elevation of the piece of stock after having been partially machined preparatory to the formation of two nozzle elements therefrom.

Fig. 4 is an end view of the partially machined piece of stock showing the cross section thereof.

Fig. 5 is an elevation of the partially machined stock after it has been twisted during the course of construction of the nozzles.

Fig. 6 is an elevation of a completed swirl-producing element.

Fig. 7 is a longitudinal, central, vertical section through a bushing or sleeve for holding the swirl-producing element in place within the nozzle.

Fig. 8 is a longitudinal, central, vertical section through a completed nozzle.

As hereinabove stated, the present invention relates particularly to the construction and formation of that portion of a spray nozzle in which the liquid is caused to swirl. The completed swirl-producing element shown in enlarged form in Fig. 6, comprises generally four vanes having straight rear portions 4 extending parallel to the longitudinal axis of the element, and having curved forward portions 5 of helical formation. The straight rear portions 4 are joined or integrally united adjacent the axis of the element, and are provided with outwardly extending projections 7 remote from the element axis. The helical forward portions 5 are spaced apart adjacent the axis of the element by virtue of the formation of a hole 6 coaxial with the element.

When a swirl-producing element has been

completed as illustrated in Fig. 6, a bushing 10 shown in detail in Fig. 7, having notches or recesses 9 in one end thereof adapted to fit over the projections 7, is welded or otherwise rigidly secured to the projections 7 at the recesses 9. The combined bushing and swirl-producing element are insertable as a unit within a bore of the nozzle casing 8 as shown in Fig. 8, with the delivery end of the swirl-producing vane portions 5 adjacent a mixing chamber 11. The mixing chamber 11 is of forwardly converging form and communicates with the free space beyond the nozzle through a constricted orifice 12. The combined bushing and swirl-producing element may be held against displacement within the nozzle casing 8 by any suitable means coacting with the rear end or with the side of the bushing.

Having described generally the construction of the nozzle and of the spray-producing element, one process of forming the spray-producing element will be readily understood by reference to Figs. 1 to 6 inclusive and to the following description: A piece of stock of circular or any other suitable cross section, shown in Figs. 1 and 2, is cut to a length sufficient for the formation of two nozzle elements therefrom. The cross sectional area of this piece of stock is then reduced to the form shown in Figs. 3 and 4 by milling or otherwise cutting metal therefrom, to leave four straight vanes 3 radiating from the axis of the piece and extending at right angles to each other. After the stock has been thus machined the forward and rearward ends of the vanes 3 are gripped in suitable clamping devices and the pieces twisted to the form shown in Fig. 5. This twisting is preferably effected without heating the material and causes the vanes 3 to assume helical formations at the center of the piece and to remain straight at the opposite ends thereof. After the piece of material has been thus twisted, it is cut in two and is turned down at its periphery to the form shown in Fig. 6. The two nozzle elements which are thus formed from a single piece of material, are each drilled at their forward ends, thus separating the inner vane portions 5 from each other.

While the above process describes a method of simultaneously producing two swirl-producing elements, it is obvious that the end of a long piece of stock having a cross section such as shown in Fig. 4, may be twisted to form but one nozzle element at a time, thus permitting successive production of a large quantity of the nozzles in an automatic machine specially constructed for that purpose. It must also be obvious that the spray-producing element may be provided with a greater or less number of vanes than shown without departing from the present invention.

It has been found that this process of forming the swirl-producing elements is exceedingly simple and efficient and that the elements may be rapidly commercially constructed. The vanes may be readily twisted to any desired extent and to produce accurately formed helices. By eliminating peripheral housing portions formed integral with the vanes, the passages between the vanes are readily accessible to permit cleaning of the same. By eliminating the necessity of heating the swirl-producing elements during the formation thereof, the rapidity of construction is further augmented.

During the operation of the nozzle, liquid under pressure is admitted to the interior of the bushing 10 from the left hand side as viewed in Fig. 8. The liquid thus admitted is forced through the passages between the vane portions 4, 5 and is delivered into the mixing chamber 11 as a swirling mass. The swirling mass of liquid in passing through the tapered mixing chamber has its velocity increased and is eventually forced through the orifice 12. Upon delivery from the constricted orifice 12, the liquid suddenly expands and forms a homogeneous spray of atomized liquid of frusto-conical shape.

It will be observed that in the drawing the helical end portions 5 of the vanes are of gradually increasing pitch approaching the nozzle orifice. By thus forming the vanes, the velocity of the swirling liquid is gradually increased to a maximum at the point of delivery to the mixing chamber. In the mixing chamber the velocity is further gradually increased until the orifice 12 is reached, this augmentation of the velocity producing a more efficient spray than if the velocity of the traveling liquid were uniform.

It should be understood that it is not desired to limit the invention to the exact details of construction herein shown or to the exact steps of the process herein described, for various modifications may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. The method of producing spray nozzles, which comprises, forming a plurality of centrally united vanes which are free remote from said union, and removing the central union along a portion of the length of said vanes.

2. The method of producing spray nozzles, which comprises, forming a plurality of centrally united helical vanes which are free remote from said union, and removing the central union along a portion of the length of said vanes.

3. The method of producing spray nozzles, which comprises, forming a plurality of centrally united vanes which are free remote from said union, removing the central union along a portion of the length of said

vanes, and inserting said vanes within a conduit to peripherally close the passages between said vanes.

4. The method of producing spray nozzles, which comprises, forming a plurality of centrally united helical vanes which are free remote from said union, removing the central union along a portion of the length of said vanes, and inserting said vanes within a tapered conduit to peripherally close the passages between said vanes.

5. The method of producing spray nozzles, which comprises, forming a plurality of centrally united rectilineal vanes which are free remote from said union, helically bending corresponding portions of said vanes, and removing the central union along the bent portions of said vanes.

6. The method of producing spray nozzles, which comprises, forming a plurality of centrally united rectilineal vanes which are free remote from said union, helically bending corresponding portions of said vanes, removing the central union along a portion of the length of said vanes, and inserting said vanes within a casing to peripherally close the passages between the bent portions of said vanes.

7. The method of producing spray nozzles, which comprises, forming a plurality of centrally united rectilineal vanes which are free remote from said union, curving portions of said vanes by simultaneously twisting the same, and removing the central union along the twisted portion of said vanes.

8. The method of producing spray nozzles, which comprises, forming a plurality of centrally united rectilineal vanes which are free remote from said union, twisting said vanes to provide helical corresponding portions thereon, removing the central union along the helical portions of said vanes, and inserting the helical vane portions within a conduit to peripherally close the passages between said vanes.

In testimony whereof, the signature of the inventor is affixed hereto.

WILLIAM E. YUNKER.