

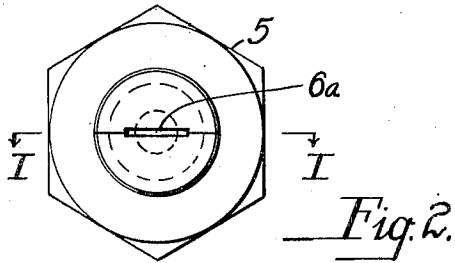
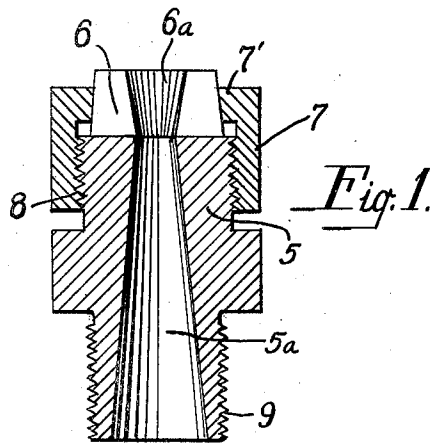
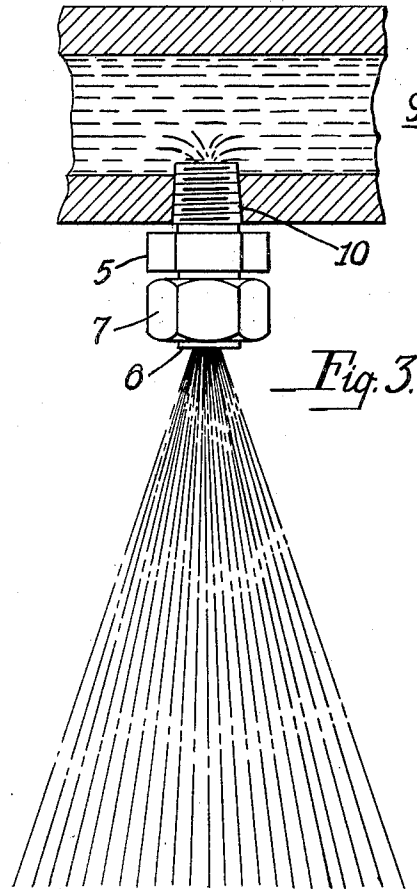
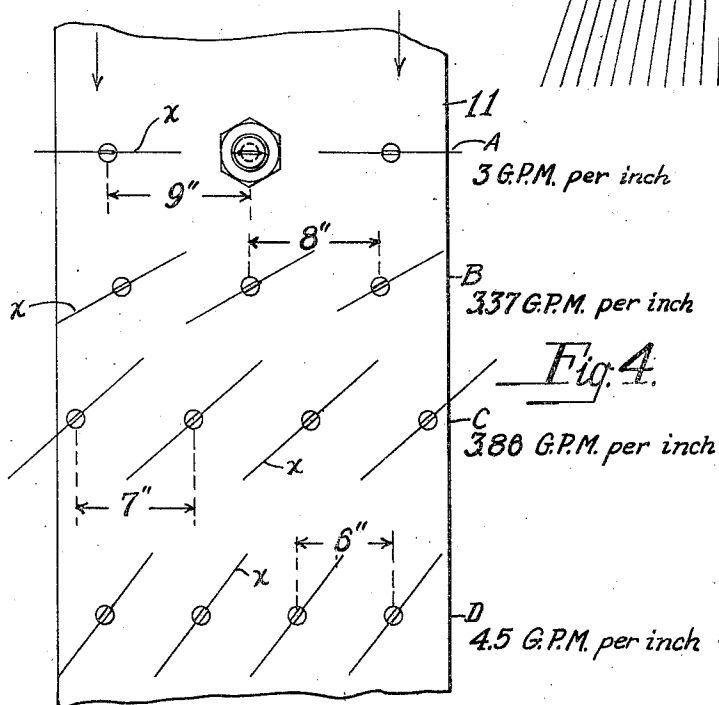
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J. E. HOLVECK

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SPRAY NOZZLE

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INVENTOR
Joseph E. Holveck
By Green & McCallister
His Attorneys

UNITED STATES PATENT OFFICE

JOSEPH E. HOLVECK, OF PITTSBURGH, PENNSYLVANIA

SPRAY NOZZLE

Application filed May 9, 1931. Serial No. 536,173.

This invention relates to nozzles, and more particularly to a new and improved spray nozzle intended primarily for use in the steel industry.

5 In the rolling of steel it is necessary to subject the metal to a cleaning or de-scaling process between passes. The present custom in the industry calls for the use of water to perform this function, and accordingly, sharp streams of the liquid are directed against the metal in the process of manufacture. Although this method is generally regarded as satisfactory, the manner in which it is carried out is not, it being well known that present apparatus for performing this function is grossly inefficient. Nozzles now in use are wasteful for both water and power in that they either direct too great a column against a given surface, or in attempting to determine the shape of the cleansing stream lose a considerable portion of the water by turning it into an ineffective spray which passes off into the air without accomplishing any beneficial purpose whatever. Tests have shown that the average nozzle in present day use in this field is only between sixty and seventy percent effective.

It is with the elimination of these faults, plus the solving of certain problems centering around the regulation of the quantity of water directed upon the metal under a given pressure, that this invention is concerned.

A purpose of this invention is to provide a spray nozzle which is more effective and efficient than those now in use and known to me.

A further purpose is to provide a spray nozzle which will deliver a predetermined fan-shaped stream intact against a given surface.

A still further purpose is to provide a spray nozzle in which the amount of water directed against a given surface may be positively regulated without varying the pressure of the water so delivered.

These and other objects made apparent throughout the further description of my invention are accomplished by means of my improved spray nozzle, and more particularly the nozzle disc thereof, the particular

construction and adjustability of which constitute an essential feature of this invention.

In the accompanying drawing;

Figure 1 is a sectional view along the line I—I of Fig. 2 showing in detail the construction of the nozzle and nozzle disc.

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

Fig. 3 is a side view showing the nozzle attached to a water supply pipe, and water issuing therefrom, the pipe being shown in section.

Fig. 4 is a more or less diagrammatic view showing how the quantity of water directed against a given surface may be regulated with one size of nozzle.

Like numbers indicate corresponding parts throughout the various figures of the drawing.

The illustrated embodiment of my invention includes a multi-part nozzle consisting of a body portion 5, a multi-part disc 6 and means, shown in the form of a ring nut 7, for removably securing the disc 6 in place on the body portion.

The fluid delivery passage 5a of the body portion 5 extends from end to end of the body portion, is substantially circular in cross section and, as shown, converges from the inlet toward the outlet end. The disc 6 is a multi-part disc, and, as shown, is formed of two semi-circular parts. This is for the purpose of simplifying the operation of accurately forming the fluid passage 6a, which extends through the disc. As shown, the two-part disc is substantially circular and the line of cleavage between its semi-circular parts is along one diameter or along a diametric plane passing through the central axis of the complete disc, so that half of the fluid passage 6a may be formed in each semi-circular part. This passage is circular at its inlet end and, at that point, is of substantially the same diameter as the outlet end of the converging passage 5a. It, however, changes shape toward the outlet end of the disc, and at that end terminates in a narrow slit-like aperture of greater length than the diameter of the circular inlet end.

From the foregoing it will be apparent that

the passage 6a is of a different cross sectional shape at all points along its length and that the change from the circular cross section at one end to the slit-like aperture at the other end is relatively gradual. The passage is preferably a converging passage, that is to say, the circular inlet end is preferably of greater cross sectional area than the slit-like aperture at the outlet end, and this change in area is also a gradual change. By making the disc 6 in two pieces it is possible to secure the desired degree of accuracy in the shape and dimensions of the passage 6a and the desired degree of finish for its bounding surfaces.

As stated, the assembled disc is substantially circular, however, its peripheral surface is tapered from a larger diameter at the inlet end to a smaller diameter at the outlet end of the disc, so that the disc is, in effect, a truncated cone. The base of this cone and the contacting face of the body portion 5 are both accurately machined to substantially true flat surfaces, so as to provide a water tight joint between the disc and the body portion when the disc is in place on the body portion. In order to provide a water tight joint between the separate halves of the disc, the adjacent or contacting faces of these halves—i. e., the diametric faces—are also accurately machined so as to provide substantially true flat surfaces, which are interrupted by the grooves which cooperate to form the passage 6a, and which are exactly at right angles to the base portion of each half.

With the construction above described, the operation of assembling the nozzle is relatively simple. The separate halves of the disc are placed together to form an assembled disc, and are located in place on the end of the body portion 5 with the base of the disc in contact with the plane surface at the outlet end of the portion 5. The ring nut is then screwed to place on the body and functions to hold the disc in place thereon and also to hold the separate halves of the disc in contact with each other. As shown, the ring nut is provided with internal threads which, however, do not extend throughout the full length of the nut. The unthreaded portion of the nut is provided with a re-entrant annular flange 7', which is adapted to engage the tapered peripheral surface of the disc 6 and is so formed that its inner peripheral edge is tapered to correspond to the taper of the disc.

The outlet end of the body portion is threaded, as shown at 8 in Fig. 1, for the purpose of receiving the ring nut, and the body portion is also provided with threads 9 at the inlet end for the purpose of screwing it into a threaded aperture of a supply pipe or for the purpose of otherwise connecting it to piping constituting a source of supply.

These screw threads are preferably tapered threads. The intermediate portion of the body is shown of hexagonal shape; this is merely for the purpose of facilitating the application of a wrench to the body in the operation of connecting it to piping or to such other source of fluid supply as may be employed. For the same purpose the ring nut is provided with a hexagonal exterior surface.

Throughout the foregoing description I have employed the term fluid in its broadest sense, i. e., to include liquids, but it will be apparent that with the contemplated use of the nozzle, the passages 5a and 6a will deliver a liquid, such as water. It is essential that these passages be accurately formed in order to maintain the continuity of the stream traversing them and in order also to change the shape of the stream without creating eddy currents or other disturbances within the stream. It is therefore highly desirable that the passage 6a be accurately formed so that its inlet end will accurately register with the outlet end of the passage 5a of the body when the disc is in place on the body, and so that the adjacent edges of the disc and the body do not occasion an interruption to the continuity of the passage, which will disturb the flow through the combined passages. Where the passages 5a and 6a are accurately located with relation to the parts in which they are formed and where those parts are also accurately machined, the ring nut 7 will function as a centering device for the disc and insure proper relationship between the passages 5a and 6a for all positions of the disc with relation to the central axis of the body portion.

The nozzle disc herein is especially constructed to meet the need previously discussed of directing an effective stream of water of given shape upon a surface to be cleaned or descaled. This is accomplished by constructing the nozzle disc with such a gradual changing section as to keep the fluid stream intact and thereby produce a fan-like jet, giving the greatest possible impinging force upon the surface to be cleaned.

Figure 3 shows the nozzle attached to a water supply pipe 9 by being screwed into a threaded aperture 10 formed in the pipe. Employing a nozzle disc with an end slit $3/64'' \times 1/2''$, a jet having an included angle of 41° giving a 9" spread 12" from the nozzle is developed. It might also be remarked that the body and ring nut of the nozzle are preferably made of rustless steel and the nozzle disc is preferably made of tool steel hardened to approximately 550 Brinell.

It is intended that a plurality of the nozzles herein shall be mounted on supply pipes at a determined spacing so as to supply water for the purpose indicated in the quantity required by the particular circumstances.

In Fig. 4 I have diagrammatically illustrated a method of varying the effective spraying force by varying the spacing of the nozzles and the angle at which the jets of liquid are directed. In the illustration I have shown the nozzles at various spacings and with their discs turned at various angles for the purpose of illustrating how the effectiveness of the liquid can be varied in spraying a strip of material 11 moving past the nozzles. If we assume that each nozzle is capable of delivering 27 gallons per minute to the strip 11 moving in the direction of the arrows in Fig. 4, and that the spread of each jet is 9 inches at the strip, then by spacing the nozzles 9 inches apart and by so turning the nozzle discs that the slit-like apertures thereof are in line, or are located at right angles to the direction of travel of the strip, as illustrated at A in Fig. 4, then 3 gallons per minute will be delivered to each inch of width of the moving strip. If the nozzles are spaced 8 inches apart and the apertures are turned to an angle, such as shown at B in Fig. 4, so that the effective force of the various sprays do not overlap on the moving strip, then the strip will in effect receive 3.37 gallons per minute per inch of width. If, however, the nozzles are spaced 6 inches apart and their slit-like apertures are turned to an angle, such as illustrated at D in Fig. 4, then the distribution of water from the jets across the strip will equal 4.5 gallons per minute per inch of strip.

It should be noted that lines α in Figure 4 indicate the spread of the jet at the plane of the surface of the moving strip 11. It will also be apparent that where a jet is projected, for example, vertically onto the surface of the strip and the nozzle disc is turned so that the fan-like jet occupies the position, with relation to the direction of movement of the strip, illustrated in Fig. 4, that then the impingement onto the surface of the strip will be at the rate of 3 gallons per minute per inch of width of the strip. If, however, the disc of this single nozzle is turned, for example, to the position shown at D, the fan-like jet will not act on as great a width of the moving strip as under the conditions illustrated at A in Fig. 4. It is therefore apparent that the jet, positioned as shown at D, will have the effect of delivering a greater volume of water per inch of width of the moving strip than the same nozzle will deliver under exactly the same pressure conditions if the disc is turned to the position illustrated at A in Fig. 4.

From the foregoing it will be apparent that the effectiveness of the jets may in this way be varied without varying the head or pressure of the liquid or without moving the jets closer to or farther from the strip to be sprayed, and without varying the angle of impingement of the jet on the surface of the

strip, and that by merely varying the spacing of the nozzles and by turning the slit-like apertures of the nozzles to different positions, the spraying effect on a continually moving strip may not only be varied, but be varied in a predetermined way.

From the foregoing it will be apparent that the effectiveness of the nozzle, or of a series of nozzles may be varied by merely loosening the ring nut 7 and adjusting the disc 6 to the proper angular relation to the material to be sprayed. It will also be apparent that by properly designing the fluid passage through the nozzle and particularly the passage 6a in the disc, each nozzle may be made most effective for the particular hydraulic pneumatic conditions encountered. That is to say, each nozzle may be designed so as to give the highest efficiency under the pressure encountered with each particular fluid. For example, I have found that a nozzle such as here illustrated and described will deliver an effective jet, having a 9 inch spread 12 inches from the tip of the nozzle when operating under a pressure of 1,000 pounds per inch, and that the continuity of the fan-shaped jet will be maintained for at least 12 inches from the tip without breaking up into a spray and without the formation of vapor or mist at any point along the jet. For the reasons above set forth, each nozzle may be made highly effective by properly designing its fluid passages for the conditions encountered or by fitting the body portion with a properly formed disc for the conditions encountered and by then adjusting the disc so as to obtain the desired delivery per inch of width of material sprayed as set forth in connection with the disclosure of Fig. 4.

Tests have shown that nozzles embodying the characterizing features of my invention herein described have an energy coefficient, that is the ratio between the impinging force of the spray and the theoretical energy, of approximately 92% when directed against a plate at right angles to the jet.

In accordance with the requirements of the patent statutes I have described what I now consider to be the preferred embodiment of my invention, but it will be apparent that various changes, modifications, additions and omissions may be made to the apparatus herein illustrated and described without departing from the spirit and scope of my invention as defined by the appended claims.

What I claim is:

1. A nozzle comprising a body having a fluid passage circular in section extending therethrough and of gradually reducing area from the inlet to the outlet end thereof, a two-part disc forming a tip for said nozzle and having a fluid passage formed in the parts thereof converging from a circular inlet end of substantially the same shape and size as the outlet end of the passage in said

body to a rectangular slit at the orifice, and means for removably securing the parts of the disc on the outlet end of said body to align the passages therein, the passage in the body of said nozzle being of much greater length than the passage in the tip to produce a solid jet or spray having its maximum impinging force at a point spaced from the orifice.

10 2. A spray nozzle comprising a body having a fluid delivery passage formed therein substantially circular in section and tapering from the inlet to the delivery end thereof, a disc having a fluid passage therethrough converging from a circular inlet end of substantially the same shape and size as the outlet of the passage in the body to a rectangular slit of greater length than the greatest diameter of the said passage, and means for
15 removably securing said disc to said body, the passage in said body being of much greater length than the passage in said disc to produce a solid jet or spray having its maximum impinging force at a point spaced
20 from the rectangular slit in said disc.

3. A spray nozzle comprising a relatively long body having a fluid delivery passage extending therethrough substantially circular in section and of gradually reducing area
30 from the inlet end to the delivery end thereof, and a relatively thin disc removably secured to the end of said body and having a fluid delivery passage therein converging from a circular inlet end of substantially the same shape and size as the delivery end of the passageway in said body to a rectangular slit
35 at the orifice to produce a solid jet or spray having its maximum impinging force at a point spaced from the orifice.

40 In testimony whereof, I have hereunto subscribed my name this 14th day of April, 1931.

JOSEPH E. HOLVECK.

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