Sept. 20, 1938. W. B. KERRICK 2,130,628

SPRAY DEVICE AND NOZZLE THEREFOR

Original Filed July 30, 1934

Fig. 1.

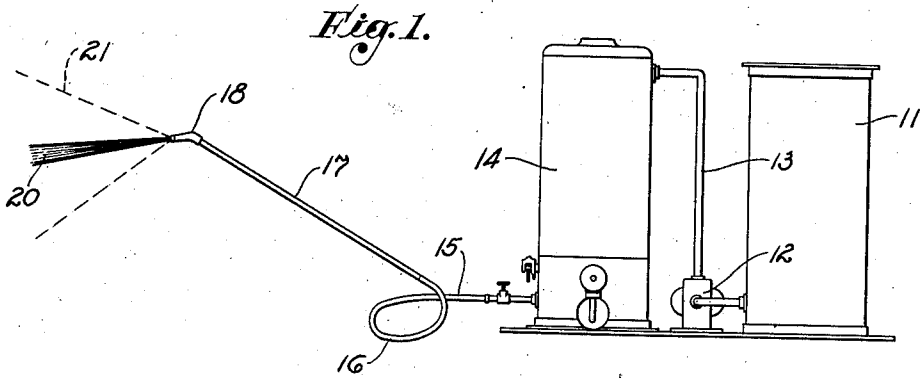


Fig. 3.

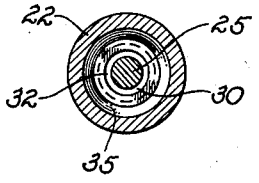


Fig. 2.

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Patented Sept. 20, 1938 2,130,628

UNITED STATES PATENT OFFICE

2,130,628

SPRAY DEVICE AND NOZZLE THEREFOR

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Application July 30, 1934, Serial No. 737,587
Renewed September 14, 1937

10 Claims. (Cl. 299—107)

My invention relates in general to means for spraying hot liquids, and relates in particular to means for spraying a hot detergent liquid against a surface which is to be cleaned. My present invention is an improvement on or addition to the invention disclosed in my co-pending application Serial No. 495,636, entitled "Fluid heater," filed November 14, 1930. The invention is of especial utility as a means for cleaning surfaces by the application of a detergent solution thereto, which detergent may consist of a mixture of soap and water heated to a temperature above the boiling point of water and released through a nozzle to form a cleaning jet. I find that surfaces, such as the walls of buildings, etc., can be very quickly and cheaply cleaned by the use of a stream of detergent solution in this condition, and it is thought that the improved results are largely due to finer comminution and diffusion of the soap particles in the liquid and due to the enhanced cleaning action of the detergent solution owing to its high temperature and to the fact that it is applied pressurally against the surface to be cleaned.

As the direct result of heating the detergent solution above the boiling point of water, the operation of my invention in its original form was accompanied by more or less difficulty due to the tendency for steam to separate in relatively large quantities in the atmosphere adjacent the discharge orifice of the ordinary type of spray nozzle employed, the clouds of such steam interfering with the operator's view of the surface being treated and causing a sputtering action of the steam adjacent the point of issue of the flow from the nozzle.

In my present invention I accomplish an improved cleaning result by the delivery of a more condensed stream of hot detergent fluid against the surface to be cleaned, and my present invention facilitates the operation of the device by reason of the fact that the spreading of steam is minimized and the popping or sputtering sound originally produced in the operation of the device is eliminated.

It is an object of the invention to provide a cleaning device of the above character which includes means for delivering the hot detergent fluid through an opening defined by walls of such character that a hollow stream of detergent fluid is delivered and a vacuum area is formed within the hollow stream which is believed to be instrumental in eliminating the popping of the discharge flow and in condensing or conforming the discharge flow to a stream of relatively small diameter and likewise of materially increased force even though the water content of the detergent fluid is heated to a temperature at which steam will readily form.

Another object of the invention is to provide a novel method for preventing excessive spreading of a jet by discharging a tubular stream and reducing the pressure therein in a manner tending to bring the stream together and prevent excessive spreading to form a more concentrated jet, particularly when the discharged stream contains vaporized and unvaporized materials.

A further object of the invention is to provide a discharge nozzle which may be readily applied to those of my original form of cleaner now in use, which nozzle will obtain in use with such cleaners the valuable results set forth in the preceding paragraph.

Further objects and advantages of my invention will be made evident throughout the following part of the specification.

Referring to the drawing, which is for illustrative purposes only,

Fig. 1 is an elevational view of a cleaner embodying my present invention.

Fig. 2 is an enlarged sectional view of the preferred form of nozzle employed in the practice of the invention.

Fig. 3 is a cross-section taken on a plane represented by the line 3—3 of Fig. 2.

As shown in Fig. 1, a cleaning device representative of the invention comprises a tank 11 in which the detergent solution is placed. This solution may be varied in accordance with the type of cleaning to be done. I have found that a mild solution of soap and water is very effective for cleaning road grime and oily deposits from vehicles and from garage and shop floors. The high temperature and force of application of the mild soap mixture make it possible to remove accumulations of grease and dirt which can be removed only with great difficulty and considerable labor by strong soap and caustic solutions applied in the ordinary manner. Accordingly, the mixture in the tank 11 may be made from ordinary household bar soap or soap chips in the proportions of nine ounces of soap to approximately thirty gallons of water. From the container 11 the detergent solution is conducted by a pump 12 through delivery means in the form of piping 13 into and through a heater 14 wherein the detergent solution is suitably heated. I find that satisfactory cleaning results may be accomplished where the solution is heated to nearly 300° F. The heater 14 delivers the

heated solution into a conduit 15 which may consist of a hose 16 and a straight tube or pipe 17 which may be readily handled by an operator. To the outer end of the pipe 17 a nozzle 18 is secured which is so formed that despite the high temperature of the aqueous content of the solution, a relatively narrow stream or jet 20 will be delivered. Ordinarily, there is a tendency for the hot fluid to abruptly expand as it leaves an ordinary type of discharge nozzle, the ordinary spreading of the jet being substantially as indicated by dotted lines 21. The expanded jet previously obtained was accompanied by a rapid loss of the force of the fluid upon its leaving the nozzle so as to make it necessary to hold the nozzle very close to the work if any reasonable force of application was to be obtained. The condensed jet or discharge stream 20 now obtained carries the heated detergent solution with considerable force and through a relatively great distance.

The nozzle disclosed in Figs. 2 and 3 comprises a tubular wall or member 22 which is preferably curved as shown so as to produce inlet and discharge end portions 23 and 24 on axes A—A and B—B which are disposed in angular relationship in order that a solid cylindrical or bar-like core 25 which extends within the discharge end 24 may be supported in a socket or opening 26 formed in the side wall 27 of the inlet end portion 23. The opening 26 is drilled through the wall 27 on the axis B—B, and the core 25 is held therein by the use of a welded body of metal 26a which fills the outer end of the opening 26. The discharge end 24 includes a removable bushing 28 through which the actual discharge opening 30 of the discharge nozzle 18 is formed. The wall of the outlet end portion 24 preferably tapers toward the opening 30 in the manner shown. The rightward or forward end 31 of the core 25 extends within the opening 30 of the bushing 28 and forms in such opening 30 an annular or tubular orifice 32. The core 25 is foreshortened with respect to the extreme outer end of the opening 30 so that a substantially flat end face 33 of such core 25 is disposed within the opening, or, in other words, in retracted position relative to the tip 34 of the bushing 28 which constitutes the extremity of the discharge end of the nozzle 24, and may be replaced by other bushings of similar form but with openings 30 of different size so as to vary the nozzle capacity. The detergent solution is heated to relatively high temperature, and passes from the pipe 17 into the tubular passage 35 within the tubular wall 22 and surrounding the core 25. When the flow of detergent solution issues at high velocity from the annular orifice 32, a conical vacuum space 36 is apparently formed adjacent the end face 33 of the core 25, with the result that the stream or jet 20 of fluid is contracted for a short distance beyond the end of the nozzle, as indicated at 37, and then expands, as indicated at 38. A resulting relatively slender jet 20 of the detergent solution is formed, and the force thereof is concentrated in such a manner that such jet will carry a considerable distance. Likewise, the popping of the jet is overcome, and a quiet action of the nozzle is produced, together with the effect of minimizing the formation of steam around the discharge of the nozzle. Accordingly, the operator obtains a satisfactory view of the surface which is being cleaned, and disturbance of persons in the vicinity is avoided by reason of the elimination of the popping or sputtering sound which ordinarily accompanies the discharge of water and steam, or water heated to vaporizing temperature, from the orifice.

Although I have herein shown and described my invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein, but is to be accorded the full scope of the following claims.

I claim as my invention:

1. A method of forming a jet containing vaporized and unvaporized material and for preventing excessive spreading of the resulting jet when moving in a discharge zone, which method includes the steps of: delivering under pressure to a tubular confined space a stream containing both vaporized and unvaporized material; restricting the cross-sectional area of this tubular stream before discharge into said discharge zone and then discharging the restricted stream in tubular form into said discharge zone; and reducing the pressure within the discharged tubular stream in a manner tending to draw the stream together thus preventing excessive spreading and forming a concentrated jet.

2. A method of forming a concentrated jet and eliminating popping and sputtering thereof, which method includes the steps of: producing a tubular stream containing water at a temperature above the boiling point of water at the pressure existing in the discharge zone in which said jet is to be projected; restricting the cross-sectional area of this tubular stream by forming it into a tubular stream of smaller cross-sectional area before discharging it into said zone and then discharging the restricted stream into said zone in tubular form; and expanding the steam in the resulting stream inward with respect to the tubularly-discharged stream at the point of discharge into said zone to draw the tubular stream together to form a concentrated jet.

3. A method of forming a concentrated jet and discharging same into a discharge zone while eliminating popping and sputtering, which method involves the use of a member providing a relatively blunt end surface and includes the steps of: confining around said member at a pressure higher than that in said discharge zone an enveloping stream containing steam; constricting this enveloping stream before discharge into said zone by causing it to flow through a restricted discharge orifice adjacent the forward end of said member while maintaining its enveloping relationship with this member; and projecting the enveloping stream past and beyond said relatively blunt end surface whereby the enveloping stream discharges into said zone in tubular form and whereby the steam tends to expand into the void immediately in front of said relatively blunt end surface to create a zone of reduced pressure acting to draw said tubular stream together.

4. In combination in a nozzle for producing a concentrated jet: a tubular member providing a discharge opening at one end, an intake opening spaced therefrom, and a passage therebetween, said passage and said discharge opening being coaxial; a core disposed in said tubular member and extending axially along said passage to define an annular space and extending into said discharge opening to define an annular discharge orifice, the cross-sectional area of said discharge

orifice being less than the cross-sectional area of said annular space to form a constriction through which fluid must flow in discharging from said annular space, the forward end of said core providing a relatively blunt end surface; means for rigidly securing said core to said tubular member in such position that said relatively blunt end surface terminates at such a point as to project no farther than the forward end of said discharge opening whereby the stream of fluid sweeps past said relatively blunt end surface as it flows through the constriction formed by said annular discharge orifice thereby creating a zone of reduced pressure immediately in front of said relatively blunt end surface which tends to draw the annularly-discharged stream together.

5. A combination as defined in claim 4 in which said relatively blunt end surface is disposed within said discharge opening to the rear of the forward end of this opening.

6. A combination as defined in claim 4 including a bushing detachably connected to said tubular member and providing said discharge opening into which said core extends to form said annular discharge orifice of reduced cross-sectional area.

7. A nozzle of the character described including: a tubular member having one end disposed to receive a fluid and the other end forming a discharge opening, said tubular member providing a tapered passage therebetween of progressively decreasing cross-sectional area toward said discharge opening; and a core extending axially in said tapered passage and into said discharge opening and being of substantially uniform cross-sectional area throughout that section lying in said tapered passage and in said discharge opening and cooperating with said discharge opening in defining a tubular orifice through which the fluid moves and from which the stream discharges into the space therebeyond, said core providing a relatively blunt end surface disposed just inside the forward end of said discharge opening whereby the resulting tubular stream creates a zone of reduced pressure immediately in front of said relatively blunt end surface tending to draw the tubularly-discharged stream together.

8. In combination in a nozzle for producing a concentrated jet: a curved tubular member providing a discharge opening at one end and an intake opening at the other end, the axes of said intake and discharge openings being angularly disposed relative to the other, said tubular member providing a passage connecting said intake and discharge openings and providing a side wall disposed at an angle with respect to the axis of said intake opening whereby a stream entering said intake opening is deflected by said side wall into a direction along the axis of said discharge opening, said side wall providing an opening therein; a core extending into said opening of said side wall and along said passage in a direction coaxial with the axis of said discharge opening, said core providing a forward portion which is at least as large as that portion of said core extending in said passage and which forward portion extends axially into said discharge opening to define an annular discharge orifice, the cross-sectional area of said discharge orifice being less than the cross-sectional area of said intake opening, the forward portion of said core providing a relatively blunt end surface; and means for rigidly mounting said core in said opening of said side wall in such position that said relatively blunt forward end surface of said core terminates inside and slightly back of the forward end of said discharge opening.

9. A method of forming a concentrated jet in a discharge zone, which method includes the steps of: producing a confined forward-moving tubular stream containing a liquid which is at a pressure higher than that in said discharge zone and which is at such a temperature that vapors will flash therefrom when introduced into said discharge zone; preventing sidewise expansion of said stream until it reaches said discharge zone, thereby permitting flashing of vapors from said liquid when the stream reaches the lower pressure of said discharge zone; and expanding the steam inward within said tubular stream to draw it together as it moves in said discharge zone to form a concentrated jet.

10. A method of forming a concentrated jet and discharging same into a discharge zone, which method involves the use of a member providing a relatively blunt end surface and includes the steps of: confining around said member to flow therealong a stream containing a liquid which is at a pressure higher than the pressure in said discharge zone and at such a temperature that vapors will flash therefrom when introduced into said discharge zone; preventing any substantial sidewise expansion of the stream until it reaches a point adjacent said relatively blunt end surface thereby permitting flashing of vapors when the stream discharges into said discharge zone; and expanding the vapors in said stream into the zone in front of said relatively blunt end surface to draw the discharged stream together and form a concentrated jet.

WALTER B. KERRICK.