

July 26, 1960

R. Y. BELLMAN

2,946,519

LIQUID MIXING APPARATUS

Filed Sept. 15, 1958

2 Sheets-Sheet 1

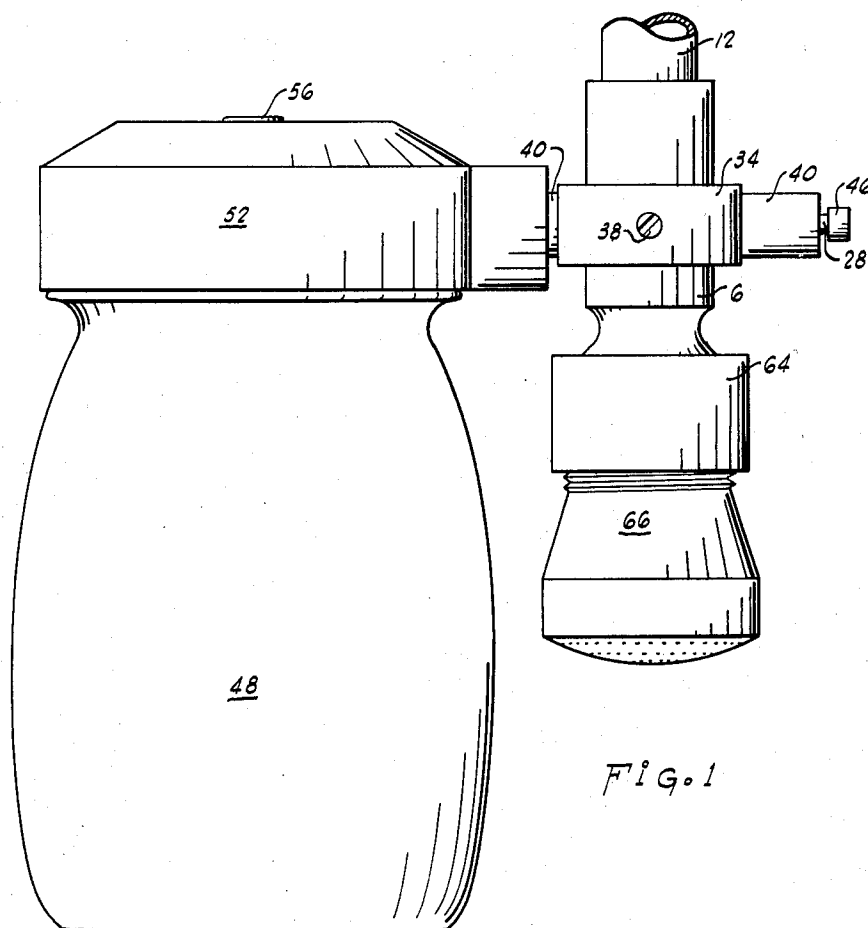


FIG. 1

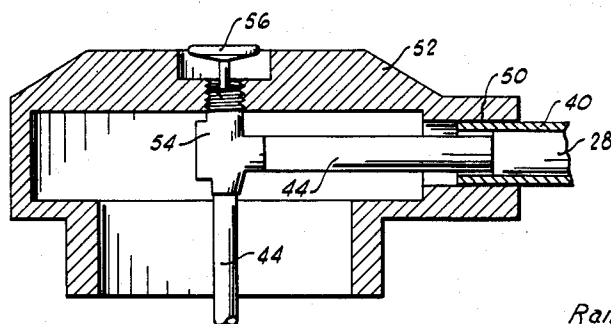


FIG. 5

INVENTOR.
Randall Y. Bellman
BY *Jerry J. Swinley*
ATTORNEY

July 26, 1960

R. Y. BELLMAN

2,946,519

LIQUID MIXING APPARATUS

Filed Sept. 15, 1958

2 Sheets-Sheet 2

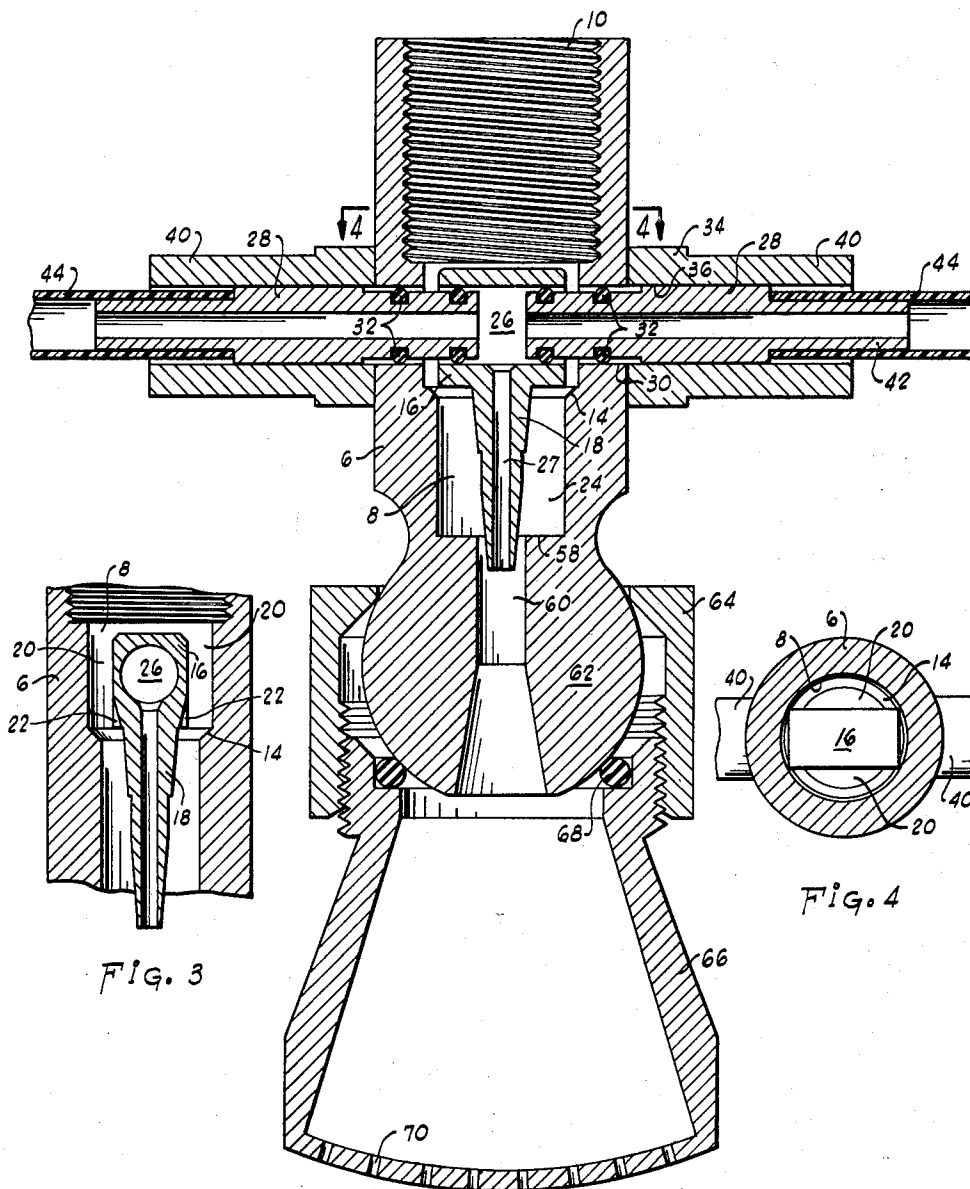


FIG. 3

FIG. 2

FIG. 4

INVENTOR.
Randall Y. Bellman
BY *Jerry J. Dunlop*
ATTORNEY

1

2,946,519

LIQUID MIXING APPARATUS

Randall Y. Bellman, P.O. Box 66, Billings, Okla.

Filed Sept. 15, 1958, Ser. No. 761,128

6 Claims. (Cl. 239—318)

This invention relates generally to improvements in apparatus for mixing liquids, and more particularly, but not by way of limitation, to an improved apparatus for mixing a liquid additive in a parent liquid when the parent liquid is in the form of a stream of liquid.

Many devices have been developed for mixing a liquid additive or a treatment liquid with a stream of water being applied to plants and for mixing soap or a water softener in water being dispensed from a shower or the like. In all of these mixing devices, a supply of the treatment liquid is retained in a suitable container, with the container being connected to the flow line through which the parent liquid is being conveyed. In most prior mixing devices a portion of the parent liquid is directed into the top of the treatment liquid container to force the treatment liquid into the flow line and mixing the treatment liquid with the parent liquid. In these devices the treatment liquid is continuously diluted, such that the concentration of the treatment liquid being injected into the parent liquid will progressively decrease during a mixing operation and prevent precise control of the mixing operation. Those prior mixing devices which rely upon a suction created in the flow line through which the parent fluid flows for forcing the treatment liquid into the flow line require a complicated construction which is easily placed out of order by inadvertent jars or blows against the apparatus. In all of these prior mixing devices, the treatment liquid is injected into the outer portion of the stream of the parent liquid, such that the mixture must be subjected to appreciable agitation downstream of the mixing point in order to assure that the treatment liquid is thoroughly mixed with the parent liquid.

The present invention contemplates a novel mixing apparatus wherein the additive or the treatment liquid is injected into the central portion of a stream of the parent liquid, and the parent liquid is preferably made turbulent at the injection point, such that the treatment liquid will be immediately mixed with the parent liquid and the mixture may be used an extremely short distance downstream of the mixing point. The present apparatus contemplates the use of a novel nozzle construction wherein the nozzle is supported along the centerline of a passage through which the parent liquid is directed, such that the parent liquid will flow around the nozzle and create an appreciable suction at the outlet end of the nozzle for sucking the treatment liquid into the parent liquid, without the necessity of placing any additional force on the treatment liquid. The present invention also contemplates the directing of the parent liquid through a housing containing the nozzle, and supporting the nozzle in the housing in such a manner that the treatment liquid is injected into the parent liquid at the most restricted portion of the passageway for the parent liquid, whereby the maximum suction will be provided on the nozzle to draw the treatment liquid into the parent liquid. Furthermore, the present invention contemplates the use of only one valve mechanism, and this

2

valve mechanism is positioned in the supply line for the treatment liquid, such that the valve may be simply constructed and the apparatus will operate effectively even though the valve is out of operation. The present apparatus requires no other moving parts.

An important object of this invention is to provide an apparatus for mixing a treatment liquid with a parent liquid which will provide precise control of the amount of treatment liquid injected into the parent liquid when the pressure of the parent liquid is maintained substantially constant.

Another object of this invention is to provide maximum mixing of a treatment liquid with a parent liquid immediately upon injection of the treatment liquid in the parent liquid.

A further object of this invention is to provide a liquid mixing apparatus requiring no moving parts.

Another object of this invention is to inject a treatment liquid into the central portion of a stream of a parent liquid without the use of a pump or the like.

Another object of this invention is to provide a sturdily constructed liquid mixing apparatus which will not be rendered inoperative by inadvertent blows or jars.

A further object of this invention is to provide a mixing apparatus wherein the mixing operation cannot be fouled by an unskilled operator.

A still further object of this invention is to provide a simply constructed liquid mixing apparatus which may be economically manufactured and which will have a long service life.

Other objects and advantages of the invention will be evident from the following detailed description, when read in conjunction with the accompanying drawings which illustrate my invention.

In the drawings:

Figure 1 is an elevational view of a mixing apparatus constructed in accordance with this invention and adapted for use with a shower.

Figure 2 is a vertical sectional view through the complete housing through which the parent fluid is passed and illustrating the positioning of the nozzle in the housing.

Figure 3 is a vertical sectional view through the nozzle and a portion of the housing taken at substantially 90 degrees from the sectional view shown in Fig. 2.

Figure 4 is a reduced horizontal sectional view as taken substantially along lines 4—4 of Fig. 2.

Figure 5 is a vertical sectional view through the upper portion of the container for housing the treatment liquid to illustrate the valve controlling the flow of the treatment liquid to the nozzle.

Referring to the drawings in detail, and particularly Figs. 1 and 2, reference character 6 designates a generally cylindrical housing or body having a passageway 8 extending longitudinally therethrough for passage of the parent liquid. The upper end portion 10 of the passageway 8 is threaded to receive the end portion 12 of a flow line through which the parent liquid is conveyed, such that the parent liquid will be conducted downwardly through the passageway 8 in the body 6. The passageway 8 is reduced in diameter at 14 below the threaded portion 10 to provide an inwardly extending and upwardly facing circumferential shoulder which supports the head portion 16 of a tubular nozzle 18.

As illustrated most clearly in Figs. 3 and 4, the head portion 16 of the nozzle 18 is substantially rectangular in cross-section, such that the opposite end portions of the head 16 rest on the shoulder 14 in the housing 6. Also, the width of the head 16 is substantially smaller than the diameter of the passageway 8 above the shoulder 14, such that substantial openings 20 are provided between the opposite sides of the head 16 and the inner

3

periphery of the passage 8 for the passage of the parent liquid downwardly around the head 16 without substantial restriction. Furthermore, as shown in Fig. 3, the lower edges 22 along the sides of the head 16 may be tapered downwardly and inwardly to increase the openings between the head 16 and the shoulder 14 on the opposite sides of the head and facilitate the downward flow of the parent liquid around the head. The outer periphery of the nozzle 18 is tapered downwardly and inwardly from the head portion 16, and the outer diameter of the nozzle 18 is substantially smaller than the diameter of the portion 24 of the passageway 8 immediately below the shoulder 14 to provide a substantially free flow of the parent liquid on downwardly through the passageway 8 around the nozzle 18.

A bore 26 extends lengthwise through the head 16 to receive the inner end portions of a pair of tubular connectors 28 as illustrated in Fig. 2. Each tubular connector 28 extends through an aperture 30 formed in the respective side wall of the body 6 in alignment with the bore 26 in the nozzle head 16, and a pair of O-rings 32 are provided on each of the connectors 28 to seal the respective connector in the bore 26 and the respective aperture 30. It will be observed that the innermost O-ring 32 on each connector 28 is positioned within the bore 26 in the nozzle head 16, and the O-rings 32 are so spaced that the outer O-ring is positioned within the respective aperture 30 in the body 6, such that the parent liquid flowing downwardly through the passageway 8 in the body 6 will not enter the bore 26 or flow outwardly through the apertures 30.

A ring 34 extends around the body 6 and has a pair of diametrically opposed apertures 36 therethrough to receive the connectors 28, such that the ring 34 supports the connectors 28 in the desired positions with respect to the body 6. A suitable set screw 38 (Fig. 1) extends through the ring 34 into engagement with the outer periphery of the body 6 to rigidly secure the ring 34 on the body 6. Also, a sleeve or tubular extension 40 is preferably formed on the ring 34 around each of the apertures 36 to further support the connectors 28 in alignment with the bore 26 in the nozzle head 16. The outer end portion 42 of each connector 28 is preferably reduced in diameter to receive either an end portion of a tube 44 which conveys treatment liquid to the connectors 28, as will be described, or a suitable cap 46 (as shown in Fig. 1) to close off the respective connector 28. Either or both of the connectors 28 may be used to convey treatment liquid to the nozzle 18. When a single treatment liquid is being mixed with the parent liquid, one of the connectors 28 is closed off by a cap 46 as shown in Fig. 1, and the opposite connector is secured to a tube 44 leading to a container 48 of the treatment liquid, as illustrated in Figs. 1 and 5.

In a preferred embodiment of this invention, when the invention is being used to mix liquid soap or the like with water being used in a shower, one of the sleeves 40 of the ring 34 is extended into a complementary bore 50 provided in the cap or cover portion 52 (Fig. 5) of the container 48. The tube 44 extending into the container 48 is connected to the outer end of the respective connector 28 to convey treatment liquid from the container 48 to the connector 28 and hence the nozzle 18. The tube 44 may be continually open to provide a continuous injection of the treatment liquid into the nozzle 18. However, I prefer to interpose a suitable valve 54 in the tube 44 within the cap 52 of the container 48 to alternately open and close the tube 44. The valve 54 may be of any desired construction which will substantially open or substantially close the tube 44, preferably in a simple operation by the person using the shower. For example, the valve 54 may have a button 56 projecting above the top of the cap 52 for opening and closing the valve. In other words, the valve 54 may be easily constructed to provide

4

a closing thereof when the button 56 is in its uppermost position, and an opening of the valve when the button 56 is pressed downwardly. In this event, the button 56 will be spring-loaded (not shown) to retain the button in its uppermost position and normally close the tube 44. The tube 44 extends downwardly from the valve 54 to the lower portion of the container 48, such that treatment liquid stored in the container 48 may be effectively conveyed through the tube 44 as long as any appreciable amount of treatment liquid is present in the container 48.

In the embodiment shown in Figs. 1 and 5, the container 48 may be easily formed out of a light-weight material such as plastic, and the ring 34 and extensions 40 may be formed with substantial strength, such that the container 48 will be supported by the ring 34 on the body 6 and will not require separate supporting brackets.

Referring again to Fig. 2, it will be observed that the diameter of the passageway 8 is reduced at 58, substantially below the shoulder 14, to provide a restricted portion 60 for the passageway. The nozzle 18 is of a length to extend downwardly through the portion 24 of the passageway 8 and into at least the upper end portion of the restricted passageway portion 60. The passageway 8 is tapered outwardly, or gradually increased in diameter from the lower end of the restricted portion 60 substantially below the lower end of the nozzle 18, such that the portion 60 of the passageway 8 will be the most restricted portion of the passageway. It may also be noted that the effective cross-sectional area of the restricted portion 60 is smaller than the combined openings 20 around the head portion 16 of the nozzle 18.

When the present invention is used to mix a soap or the like with water in a shower, the lower end portion 62 of the body 6 is rounded into substantially spherical form to receive a ring or bracket 64 supporting the shower head 66. The upper end of the shower head 66 is usually threaded into the lower end portion of the ring 64, and a suitable sealing ring 68 is supported in the upper end portion of the shower head 66 in engagement with the outer periphery of the lower end portion 62 of the body 6. It will thus be observed that the shower head 66 may be pivoted with respect to the body 6 to direct the shower spray in any desired direction from the lower end of the passageway 8. The usual apertures 70 are provided in the lower end of the shower head 66 to spray the water in the usual manner. When the present invention is used, the combined cross-sectional area of the apertures 70 should be greater than the effective cross-sectional area of the restricted portion 60 of the passageway 8.

Operation

To illustrate the operation of the present mixing apparatus, let it be assumed the apparatus is used in conjunction with a shower to mix soap with the shower water for the convenience of the bather. The conduit 12 will then be connected to the household water supply and will have a suitable valve (not shown) therein to control the flow of water through the passageway 8 of the body 6. It should also be noted that this water will be forced through the passageway 8 at a substantially uniform pressure which facilitates regulation of the amount of the soap which will be mixed with the water. Also, the container 48 is filled with soap and the mixing apparatus is assembled as illustrated in the drawings.

When the desired water flow is established through the passageway 8, and it is desired to mix a quantity of soap with the water, the button 56 (Fig. 5) is pushed downwardly to open the valve 54 and establish communication through the tube 44 and the respective connector 28 to the bore 26 in the head portion 16 of the nozzle 18. As the water flows from the portion 24 to the restricted portion 60 of the passageway 8, a suction is created at the discharge end of the nozzle 18 to suck a portion of the liquid soap from the bore 26 in the head portion 16 through the bore 27 of the nozzle 18 into the central

5

portion of the flowing stream of water. The shoulder 58 between the portions 24 and 60 of the passageway 8 also causes turbulence in the stream of water, such that the soap injected into the central portion of the stream will be quickly mixed with the water to provide a uniform soap and water mixture by the time the stream is discharged through the apertures 70 in the shower head 66. When it is again desired only to have water discharging from the shower head 66, the button 56 is released and the valve 54 is closed to prevent the further flow of soap from the container 48 to the nozzle 18.

As previously indicated, the effective cross-sectional area of the portion 60 of the passageway 8 is the smallest portion of the flow path of the stream of water. It will be noted that since the width of the head portion 16 of the nozzle 18 is substantially less than the diameter of the passageway 8 above the shoulder 14, the openings 20 on the opposite sides of the nozzle head portion 16 provide a larger passageway than does the restricted portion 60 of the passageway 8. When the nozzle 18 is extended into the restricted portion 60 of the passageway, the water flows downwardly around the outer periphery of the nozzle 18 and creates a suction at the discharge end of the nozzle to provide an injection of soap into the water as described above. It should also be noted that the position of the nozzle 18 is fixed and will not be moved by blows inadvertently imposed on the body 6 nor by any adjustment of the shower head 66.

I have found that the lower end of the nozzle 18 must be extended into the restricted portion 60 to provide any appreciable suction of soap from the nozzle into a stream flowing downwardly around the nozzle. Also, the extent that the nozzle 18 is extended into the restricted portion 60 controls the rate at which soap will be injected into the stream of water. For example, with the nozzle 18 being tapered downwardly and inwardly at an angle of about 5 degrees and having an outer diameter at its lower or outer end of about 0.100 inch, and when the restricted portion 60 of the passageway 8 is of a diameter of 0.193 and of a length of 0.500 inch, the maximum amount of soap is injected into water flowing downwardly through the passageway 8 when the nozzle 18 is extended into the restricted portion 60 a distance of 0.126 inch. If the nozzle 18 is extended into the restricted portion 60 either a greater or lesser extent, the amount of soap injected into the water is decreased. Therefore, the mixing apparatus may be designed to inject a predetermined amount of soap or other treatment liquid into a stream of liquid being forced through the passageway 8; and when the apparatus is once assembled, the same proportion of treatment liquid will be injected each time the valve 54 is opened. In the embodiment having the dimensions mentioned above, it may also be noted that the diameter of the bore 27 through the nozzle 18 was 0.070 inch and the tapered portion of the passageway 8 directly below the restricted portion 60 was 0.500 inch long and tapered at an angle of 10 degrees.

In the event it is desired to inject a second type of treatment liquid into the liquid stream being forced through the passageway 8, the opposite connector 28 is placed in communication with the other treatment liquid. It will therefore be apparent that a suction created on the discharge end of the nozzle 18 will suck treatment liquid through either or both of the connectors 28. In this event, it is preferred to inject only one treatment liquid at a time, such that the proportions of the treatment liquids mixed with the liquid stream may be more closely controlled.

In the event any portion of the apparatus becomes clogged with foreign matter, the apparatus may be easily disassembled for cleaning. The connectors 28 may be pulled lengthwise out of the extensions 40 on the ring 34, and the body 6 easily disconnected from the supply line 12. Upon inversion of the body 6, the nozzle 18 will fall out of the end 10 of the passageway 8 and may be

6

easily cleaned. If it is desired to remove the shower head 66, the ring 34 is first removed from the body 6 by unthreading the set screw 38 and then the ring 64 may be moved off of the end 10 of the body (after the shower head 66 is unthreaded from the ring 64) such that the complete apparatus may be disassembled.

When reassembling the apparatus, the connectors 28 must be forced into the bore 26 of the nozzle head 16 a sufficient distance that each pair of sealing rings 32 straddles the space provided between the respective end of the nozzle head portion 16 and the wall of the body 6. In other words, each of the innermost sealing rings 32 must be inserted into the respective end of the nozzle bore 26 and the respective outer sealing ring 32 must be placed in the aperture 30 of the body 6 to assure that the stream of liquid being forced through the passageway 8 will not leak either into the bore 26 or outwardly through the apertures 30.

From the foregoing it will be apparent that the present invention provides a mixing apparatus requiring the use of no moving parts, except for a simply constructed valve in the supply line of the treatment liquid when it is desired to only periodically inject the treatment liquid into the stream. The apparatus provides an injection of a fixed proportion of treatment liquid into a parent liquid, and the treatment liquid is injected into the center portion of the parent liquid stream to provide a thorough mixing of the two liquids substantially immediately upon injection of the treatment liquid. The apparatus will not become fouled by inadvertent adjustments or by blows inadvertently imposed on the apparatus during a normal operation. It will be further apparent that the present mixing apparatus is simply constructed, may be economically manufactured, and will have a long service life.

Changes may be made in the combination and arrangement of parts or elements as heretofore set forth in the specification and shown in the drawings, it being understood that changes may be made in the precise embodiment disclosed without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. Apparatus for mixing a treatment liquid in a liquid stream, comprising a body having a first end and a second end and a bore extending therethrough from the first end to the second end, means for directing the stream into said bore at the first end of the body for passage of the stream through the body and out of the second end, said bore being reduced in diameter in the medial portion thereof to form a circumferential shoulder therein facing the first end of the body, said bore being further reduced in diameter between said circumferential shoulder and the second end of the body and then increased in diameter adjacent the second end of the body to provide a restricted portion between said circumferential shoulder and the second end of the body, an elongated head extending transversely in the bore into engagement with said circumferential shoulder at the opposite sides of said bore, the width of said head being less than the diameter of said bore to provide clearance around the head, a tubular nozzle extending from said head along the center line of said bore into the restricted portion of said bore, said nozzle having an outer diameter less than the diameter of the adjacent portions of the bore to provide clearance for flow of the stream around the nozzle, a treatment liquid supply, and means providing communication between said supply and the end of the nozzle closest to the first end of the body.

2. Apparatus as defined in claim 1 wherein the smallest effective cross-sectional area of said bore is around that portion of the nozzle extending into said restricted portion of the bore.

3. Apparatus as defined in claim 1 wherein the outer diameter of said nozzle is progressively reduced in a direction toward the end of the nozzle extending into said restricted portion of the bore.

7

4. Apparatus as defined in claim 1 wherein the diameter of said restricted portion of the bore is slightly less than twice the outer diameter of the end of the nozzle projecting into said restricted portion, and the nozzle is extended into said restricted portion a distance slightly greater than the outer diameter of the respective end of the nozzle.

5. Apparatus as defined in claim 1 wherein said means for providing communication between the treatment liquid supply and the nozzle includes a bore extending into one end of said elongated head into communication with the passageway through the nozzle, and a tube extending from said last-mentioned bore through one side of the body to the treatment liquid supply.

6. Apparatus as defined in claim 1 wherein the second end of the body is spherically-shaped, and characterized

8

further to include a shower head secured on the second end of the body, said shower head having discharge apertures therein which have a combined cross-sectional area greater than the effective cross-sectional area of the restricted portion of the bore in the body.

References Cited in the file of this patent

UNITED STATES PATENTS

1,748,604	Heimbürger	Feb. 25, 1930
2,316,781	Fox	Apr. 20, 1943
2,325,242	Gordon	July 27, 1943
2,808,294	Tamminga	Oct. 1, 1957

FOREIGN PATENTS

683,612	France	Mar. 4, 1930
---------	--------	--------------