Oct. 17, 1967 D. B. BAKER 3,347,463

SPRAY APPARATUS

Filed Sept. 7, 1965

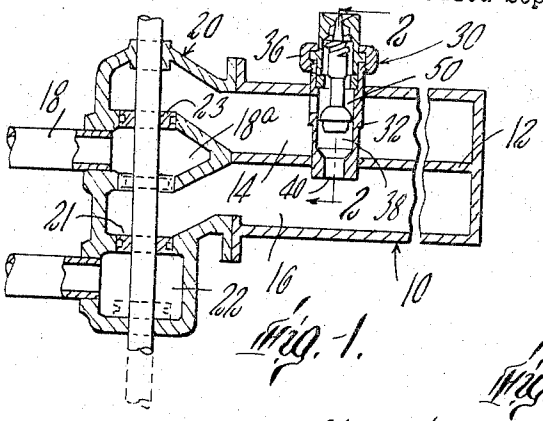


Fig. 1.

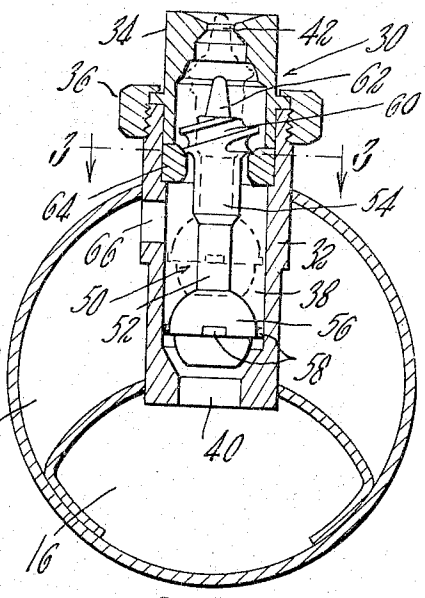


Fig. 2.

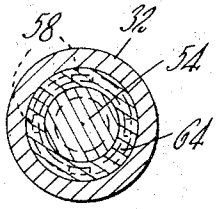


Fig. 3.

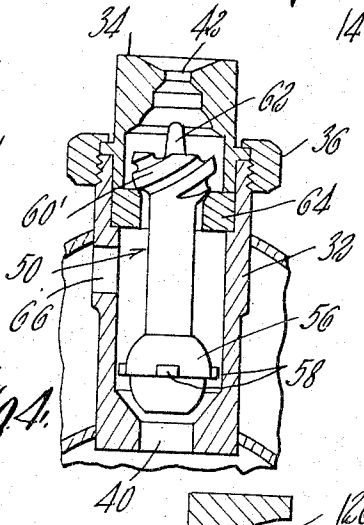


Fig. 4.

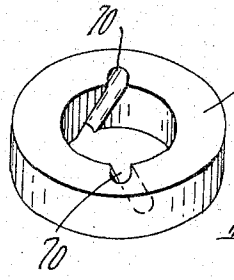


Fig. 5.

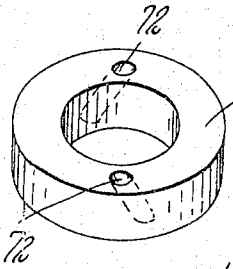


Fig. 6.

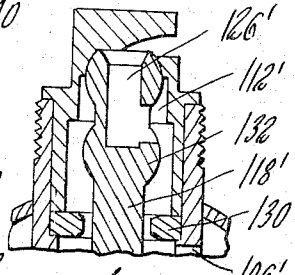


Fig. 7a

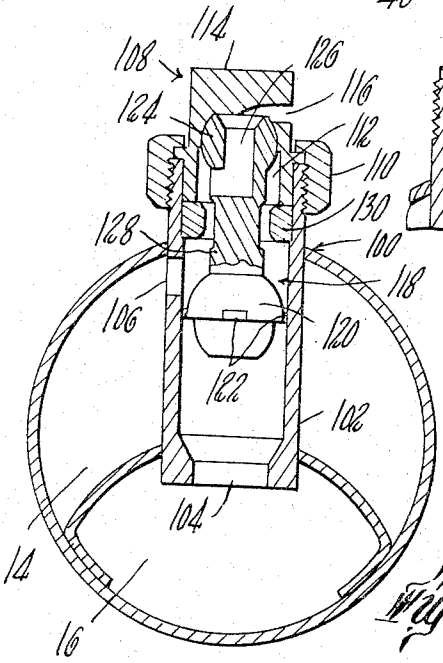


Fig. 7.

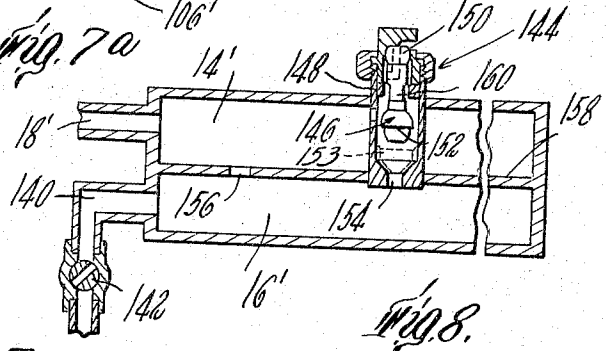


Fig. 8.

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3,347,463

SPRAY APPARATUS

Donald B. Baker, Foxboro, Mass., assignor to Bird Machine Company, South Walpole, Mass., a corporation of Massachusetts

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12 Claims. (Cl. 239—113)

This invention relates to spray nozzles suitable for shower pipe, particularly improved nozzles of the general type disclosed in my U.S. Patent No. 3,073,529 and U.S. Patent No. 3,249,305.

Said patent and application disclose nozzles of a so-called "self-cleaning" type, in which a body member within the nozzle is movable in response to fluid pressure and flow conditions in the nozzle between a normal spray position and a flushing position in which the nozzle is purged of impurities that have collected therein during the spray period. The nozzles are designed to provide an increased flow of fluid through an enlarged outlet during flushing. In the apparatus disclosed in said application the nozzle inlet for spray fluid includes a strainer which is momentarily back-flushed during purging.

One object of the invention is to provide an improved nozzle structure in which the nozzle inlet for spray fluid is provided with a strainer which is continually back-flushed throughout the purge period. Another object is to provide improved nozzle structure by which flow from the nozzle outlet during flushing is controlled or even eliminated.

The nozzles shown in my aforesaid patent and application produce a fan shaped spray. Another object of this invention is to provide novel nozzle structure of the general type concerned which produces a hollow cone shaped spray, as may be preferable or required for certain uses. Yet another object is to provide in such a nozzle means for producing a hollow cone spray during flushing as well as spraying as may be preferable or required for certain uses.

My aforesaid application discloses a movable control or valve member within the nozzle having a shank extending longitudinally of the nozzle and enlargements at either end. One of the enlargements is nearest the spray fluid inlet at one end of the nozzle and cooperates with the wall of the nozzle to form a strainer which stops the passage thereby of impurities in the entering spray fluid. The other enlargement is adjacent the nozzle outlet and restricts that outlet during the spray period. The present invention in one of its aspects utilizes such a valve member but improves its operation by providing in the interior of the nozzle body an inwardly projecting flange member which surrounds the shank of the valve member between the nozzle inlet for flushing fluid and the nozzle outlet.

This flange member may be utilized for several advantageous purposes.

One such purpose of the flange member is to meter the flow of spray fluid between its inner edge and the shank of the valve member, so that the valve member is subjected to greater pressure differential in the direction of its movement to flushing position during the flushing cycle. The flange may also advantageously be used as a stop engaging the enlarged end of the control member nearest the nozzle outlet when the control member is moved from spray to flushing positions, so that the enlarged other end of the control member is prevented from seating in the spray inlet port, and back-flushing through that port continues throughout the purge period. Also, the flange may desirably be adapted to cooperate with the enlarged end of the control member nearest the nozzle outlet to control the shape and amount of flushing fluid flow to the nozzle outlet.

The foregoing and other objects, features, and advantages of the invention will be more fully understood from the ensuing description of the preferred embodiments illustrated in the drawings, wherein:

FIG. 1 is a vertical, longitudinal cross-sectional view of shower pipe with control valving and equipped with nozzles according to one embodiment of the present invention, the control member being shown in elevation in spray position;

FIG. 2 is an enlarged vertical, cross-sectional view on line 2—2 of FIG. 1, with the nozzle control member shown in elevation in flushing position;

FIG. 3 is a transverse cross-sectional view on line 3—3 of FIG. 2;

FIG. 4 is a view similar to FIG. 2, showing a modified control member in flushing position;

FIGS. 5 and 6 are perspective views of modifications of a flange member shown in the previous figures;

FIG. 7 is a view similar to FIG. 2 showing a modified nozzle and control member;

FIG. 7*a* is a fragmentary view similar to FIG. 7 of another modification;

FIG. 8 is a view similar to FIG. 1 of shower pipe with modified control valving, nozzle and control member.

As shown in FIGS. 1–3 of the drawings, one embodiment of the present invention comprises an elongated, generally cylindrical pipe member **10** divided by means of a longitudinally extending web **12** into a pair of manifolds **14** and **16**. An inlet pipe **18**, together with a valve **20**, provide means for introducing a supply of fluid into manifold **16** with the valve in the location shown in solid lines, with valve disc **21** sealing the inlet passage from drain chamber **22** and valve disc **23** sealing the inlet chamber **18***a* from manifold **14**. The valve has an alternative position, in which it is shifted vertically carrying valve discs **21** and **23** to the dotted lines shown, connecting manifold **14** to the inlet chamber **18***a* while connecting manifold **16** to a drain pipe, e.g. to atmospheric pressure, at substantially reduced pressure from that at the inlet chamber **18***a*.

Mounted along the length of pipe **10** are a plurality of like spray nozzles **30**, one being illustrated in FIGS. 1–3 as sufficient. The spray nozzle **30** of the embodiment of FIGS. 1–3 is of a type adapted to produce a hollow cone spray. The nozzle comprises a body member **32** having a nozzle head **34** removably held in place by a threaded retaining ring **36** on the body member. The assembly provides an elongated, generally cylindrical valve chamber **38** which has at the end opposie nozzle head **34** a main inlet port **40** communicating with manifold **16**. An outlet port **42** extends through nozzle head **34**. In this embodiment, outlet **42** is of diminishing diameter toward its discharge end and has a stepped wall formation for a purpose hereinafter discussed. Confined within valve chamber **38** and free to move longitudinally thereof is an elongated valve member **50** having a shank **52**, an enlarged head **54** at one end and an enlarged base **56** at the other end.

The base **56** of the valve member is generally of spherical shape with the portion closest to inlet port **40** of somewhat smaller diameter than the remaining portion. The larger portion is of slightly smaller maximum diameter than the inside surrounding wall portion of chamber **38** and has projecting therefrom approximately to said wall portion lugs **58** which, by engagement with the wall, serve to maintain the valve member approximately centered in chamber **38**. There is thus provided between the enlarged portion of base **56** and the surrounding chamber wall a thin, annular passage, interrupted only by the lugs, which is sufficiently small to prevent the passage therethrough of impurities of significant size, such as fibers or flakes in white water, that may be present in the incoming spray water. Such impurities accumulate be-

neath the enlarged portion and about the smaller portion of base **56** until flushed out as hereinafter described.

The head **54** of the valve member has an enlarged spirally grooved portion **60** and beyond this a smaller tapering end member **62** which is smaller in diameter at its upper end than the minimum diameter of outlet **42**. When the valve member is in spray position as shown in FIG. 1 and in dotted lines in FIG. 2, the end of enlarged grooved portion **60** seats against the base of the largest diameter, inner end of the stepped wall of outlet **42** and thus the grooving cooperates with the surrounding wall portion to form a tubular spiral passage for the fluid which is thereby given a spiral motion as it passes through the outlet. A preferred embodiment includes end member **62** which projects through outlet **42** when the valve member is in spray position.

At the inlet end of nozzle head **34** there is formed an inwardly projecting annular flange **64** having a tapered central opening the minimum diameter of which is less than the diameter of the lower end of grooved portion **60**. When the valve member is in flushing position as shown in full lines in FIG. 2, the lower end of grooved portion **60** seats in the tapered upper end of the opening through flange **64** above its portion of minimum diameter, as shown in FIG. 3, thereby preventing flow of fluid into head **34** and from outlet **42** during flushing. In addition, said seating portion of the flange opening is located further from inlet port **40** than the length of valve member **50** below grooved portion **60**. As a consequence, flange **64** also serves to hold the end portion **56** of the valve member away from port **40** so that it does not seat therein or restrict it.

In addition to ports **40** and **42**, nozzle body **32** is provided with an auxiliary port **66** which is located below flange **64** and opens into manifold **14**. Port **66** is used during flushing when it becomes the inlet and port **40** the outlet as will be described.

In the operation of the embodiment of FIGS. 1–3, with the valve discs **21** and **23** in the full line positions of FIG. 1, fluid flow is from the inlet pipe **18** to manifold **16** and through ports **40** into the valve chambers within the nozzles **30**. The pressure and direction of flow forces the valve members **50** to the spray position shown in FIG. 1 and in dotted lines in FIG. 2. When it is desired to flush the nozzles valve discs **21** and **23** are shifted to the dotted line position, shifting the feed into manifold **14** and opening manifold **16** to drain chamber **22**, at substantially reduced pressure to that in manifold **14**. Fluid flow is now through the ports **66** into the valve chambers within nozzles **30** and out of port **40** into manifold **16**. The change in pressure and direction of flow causes the valve members to shift to the flushing position shown in full lines in FIG. 2.

In this position, flange **64** seating grooved portion **60** of the valve members prevents flow from port **42**. However, during the momentary movement of the valve member from spray to flushing positions fluid will continue to flow from port **42**, the effective area of which is now greatly increased by withdrawal of end member **62** therefrom. This momentary spurt of fluid from outlet **42** serves to purge th nozzles of any impurities that may have lodged between the enlarged ends **54** of the valve members and the surrounding walls of the nozzle caps. Moreover, movement of the valve member through the fluid to flushing position tends to flush off any impurities that may have lodged in the grooving of portion **60**. A like momentary purging takes place as the valve members are returned from flushing to spray positions. In view of the straining action of end portions **56** of the valve members during spraying, there will be few impurities in the spray fluid entering the nozzle heads **34** so that such momentary purging as takes place therein is adequate.

There are several reasons why closing off outlet **42** during flushing may be desirable. If spray fluid were allowed to flow freely from outlet **42** during flushing it would do so more as a stream than as a spray. This may not be acceptable for certain uses. Also, the entire pressure in manifold **14** is available for backflushing through ports **40** impurities that have collected below the upper part of end portions **56** of the valve members. Due to the fact that the valve members are held by flanges **64** away from closing or restricting ports **40**, a uniform continuous backflushing takes place.

When it is desired to terminate flushing, valve discs **21** and **23** are returned to the full line positions in FIG. 1, the resultant change in flow and pressure forcing the valve members to return to spray position. End members **62** will serve to eject any plug of debris that may have collected in outlet **42** during flushing.

In certain cases it may be required or preferred to have a continuous spray during flushing. FIG. 4 shows a modification of the grooved portion, here designated **60'**, of the valve members to accomplish this purpose. Since the other part shown in FIG. 4 may be the same as in FIGS. 1–3, they are designated by the same reference numerals. The grooving in portion **60'** is such that when that portion seats on flange **64**, the lower portion of the grooving is exposed to fluid in the opening through the flange. As a consequence, flushing fluid is permitted to enter the chamber within nozzle head **34** between the flange **64** and the contiguous grooved portion and is given a swirling motion due to the angularity of the grooving, such as to produce a cone spray from outlet **42** similar to that produced when the valve member is in spray position. Thus the flange cooperates with the valve member to control flow through port **42** during flushing. It also acts in the same manner as in FIGS. 1–3 to maintain the valve member sufficiently away from port **40** so that continuous backflushing is not interfered with.

FIGS. 5 and 6 show modifications of the flange **64** of FIGS. 1–3, designated **64'** in FIG. 5 and **64''** in FIG. 6, which may be used either in the embodiment of FIGS. 1–3 to provide a spray during flushing, or in the embodiment of FIG. 4 to assist in the provision of such spray. In FIG. 5, angled slots **70** are provided in the inner surface of the flange through which flushing fluid can pass by valve member portion **60** or **60'** seated thereon. The angularity of the slots imparts a swirling motion to the fluid entering nozzle head **34** and thus produces a cone type spray from outlet **42**. The angled apertures **72** through flange **64''** of FIG. 6 have a like effect.

The advantages of the flow controlling flange are not confined to nozzles and valve members adapted to produce a cone type spray as in FIGS. 1–4. FIG. 7 shows a modified nozzle and valve member adapted to produce a fan type spray, the modified nozzle **100** being shown substituted for the nozzle **30** in the apparatus of FIG. 1.

Nozzle **100** has a tubular body **102** having an end port **104** opening into manifold **16** and a side port **106** opening into manifold **14**. Nozzle head **108**, removably fastened to body **102** by retaining ring **110**, has a cavity **112** therein the upper end of which is spherically curved. A cap **114** overlies the upper end of the cavity and has a laterally directed slot **116** therein opening into the end of the cavity from the nozzle exterior. Valve member **118** has its lower enlarged end **120** formed like end **56** of the valve member of FIGS. 1–4 and is likewise provided with lugs **122**, the function of this part being the same as in the other figures. The valve member has an enlarged upper end portion **124** which is generally spherically curved to fit the curvature of the upper end of cavity **112** in which portion **124** seats in spray position as shown in FIG. 7. A passage **126** extends from the top of portion **124** axially therethrough into communication with a lateral opening in the stem. The stem of the valve member has a reduced portion **128** intermediate its ends. Nozzle head **108** is provided at its lower end with an inwardly projecting annular flange **130** which, in spray position of the valve member, is opposite reduced portion **128** of the stem thereof.

When manifold **16** is connected to the source of fluid, portion **124** of the valve member is seated in the upper portion of cavity **112** with a part of the upper end of passage **126** flush with and closed by part of cap **114** beyond slot **116**, the remainder of the upper end of the passage being exposed to the slot. Spray fluid flows from manifold **16** through port **104**, past enlargement **120** of the valve member which acts to strain out impurities, between flange **130** and reduced portion **128** of the stem of the valve member, into the lateral opening to passage **126**, and out the unclosed part of the upper end of said passage into slot **116**, from which it issues as a fan spray.

When manifold **16** is switched to drain and manifold **14** to feed for flushing by shifting valve discs **21**, **23**, greater pressure is exerted downwardly on portion **120** of the valve member than the upward pressure exerted on its upper part so that the valve member is forced downwardly to a position in which enlarged portion **124** of the valve member seats in the top of the opening through flange **130**. Flushing fluid now has access to cavity **112** only through passage **126**, the lateral opening to which is now disposed within the opening through flange **130**. Since the top of the passage is no longer restricted by cap **114** impurities that may have clogged therein due to the restriction will be washed out by the flushing flow through the passage. Moreover, the opening into slot **116** is now enlarged so that impurities that may have become lodged between the end **124** of the valve member and the wall of the slot will be washed out. Since the larger diameter portion of the stem of the valve member above the reduced portion **128** is now within the flange opening, flow to passage **126** is more restricted than with the valve member in spraying position, in which portion **128** provides greater clearance from the flange for fluid flow. Thus the downward pressure on enlarged portion **120** is increased which aids in insuring that the valve member will remain in flushing position despite continued fluid flow around portion **120** into manifold **16** and also from the opposite end of the valve member.

As in the embodiments of the previous figures, the length of the valve member below enlarged portion **124** is less than the distance from the upper end of flange **130** to port **104** so that enlarged portion **120** is held away from the port and backflushing continues without interference until the valve discs are returned to spray position.

In the modification of FIG. 7*a* spray is shut of during flushing, so that purging takes place only as backflushing through port **104**, as may be desirable for certain uses. This is accomplished by making the stem of the valve member **118'** longer than in FIG. 7, by spacing flange **130'** and port **106'** further from the nozzle outlet, and by providing a third enlargement **132** on the stem between passage **126'** and flange **130'**. In flushing position of the valve member, enlargement **132** seats in the end of the opening through the flange, shutting off flow into the spray head cavity **112'**.

FIG. 8 shows a modification of the manifold in FIG. 1 in which the fluid feed for both spraying and flushing is always through pipe **18'** into manifold **14'**. Drain pipe **140** from manifold **16'** has a valve **142** therein which is opened during flushing and closed during spraying. The nozzles **144**, of which but one is shown in the figure, and their valve members **146** are similar to nozzle **100** and valve member **118** of FIG. 7, except that the bore of the nozzle member may have a reduced portion **153** indicated by dotted lines at the end adjacent port **154** which opens to manifold **16'**, the diameter of portion **153** being small enough to clear very closely the larger portion **152** of the corresponding end of valve member **146**. Flange **148** may be spaced from the outlet end of the nozzle so that in flushing position it engages enlarged portion **150** of the valve member preventing enlarged portion **152** thereof from seating in and closing port **154**, in which case the reduced portion **153** is preferably provided. Alternatively, flange **148** may be spaced sufficiently below the outlet end of the nozzle so that, in flushing position of the member, its upper enlarged end does not engage the flange and the opposite enlarged end **152** of the member is permitted to seat in and close the port **154** to manifold **16'**.

During spray operation of this embodiment valve **142** is closed and the pressure in the two manifolds is equalized by a small leakage port **156** in wall **158** between them. Due to fluid flow through and from the nozzles the pressure therein above portions **152** of the valve members is less than the pressure below, maintaining the members in spray position. When valve **142** is opened, the pressure below portions **152** drops below the pressure above them so that the valve members are forced to flushing position. In this position, portions **152** of the valve members will be held just out of seating and closing engagement with ports **154** if flanges **148** are so located as to engage portions **150**. In such case there will be a small backflushing flow between portions **152** of the valve members and portions **153** of the nozzle bores if provided, the extent of which is governed by the amount of clearance of portions **152** from the surrounding nozzle wall. Such limited backflow may be desirable to insure flushing of ports **154** and manifold **16'**. Reduced portions **153** also serve to increase the pressure differential across portions **152** and thus increase the shifting forces on the valve members. If flanges **148** are so located as not to engage valve portions **150**, portions **152** thereof will seat in and close ports **154** so that continued flow therethrough is prevented.

Except that flow through ports **154** may be shut off, fluid flow during flushing is like that in the FIG. 7 embodiment, the larger diameter portion of each valve member stem above reduced portion **160** now being disposed in the opening through flange **148** and cooperating therewith to restrict flow into the cavity of the nozzle head, which takes place directly between the valve member and the flange as well as through the spray passage in the portion **150** of the valve member or only through the outlet passage in said portion depending on whether or not portions **152** are permitted to seat in and close ports **154**. This restricted flow, as in the FIG. 7 embodiment, aids in maintaining sufficient positive pressure differential above portions **152** to hold the valve members in flushing position. When valve **142** is again closed, fluid pressure in the two manifolds is soon equalized through port **156** and since this is more than the pressure above portions **152** of the valve members, the members are forced to return to spray position.

It will be appreciated that nozzles having valve members and flanges constructed as variously shown in FIGS. 1–6 may also be employed with the fluid manifold arrangement of FIG. 8.

While the nozzles have been shown and described as in upright or vertical position it will be understood that they may be disposed horizontally or at any angle to the horizontal without affecting their operation. Also, while specific embodiments of the invention have been shown and described herein, it is not intended thereby to limit the invention solely thereto, but to include obvious variations and modifications thereof within the spirit and scope of the appended claims.

I claim:

1. A self-cleaning spray forming device comprising a nozzle having a cavity therein, a spray outlet from said cavity and a pair of ports opening into said cavity, means for providing a supply of fluid under pressure at both of said ports, means for periodically changing the fluid pressure at one of said ports, a valve member within the cavity of said nozzle member movable in response to fluid pressure changes at said one of said ports to move away from a spraying position to a flushing position and to return to spraying position, a flange in said cavity extending about said valve member between said ports and said outlet, said valve member having portions of different diameter the smaller of which cooperates with

said flange to permit relatively free fluid flow into the outlet end of said cavity when said valve member is in spraying position and the larger of which cooperates with said flange to inhibit such fluid flow when said valve member is in flushing position.

2. A device according to claim 1 wherein said larger diameter portion of said valve member seats on said flange to stop fluid flow to the outlet end of said cavity while said valve member is in flushing position.

3. A self-cleaning spray forming device comprising a nozzle having a cavity therein and a spray outlet from the cavity, a first port into said cavity and a second port into said cavity between said first port and said spray outlet, means for providing a supply of fluid under pressure at both of said ports, means for periodically varying the fluid pressure at said first port so that at higher pressure said first port admits the fluid to said cavity to discharge as spray from said outlet and at lower pressure said first port drains fluid admitted to said cavity by said second port, a valve member movable in said cavity in response to fluid pressure changes at said first port toward and away from said first port, said valve member having thereon a first enlarged portion closely clearing the walls of said cavity between said two ports to prevent passage thereby of foreign particles in the fluid entering said cavity through said first port, a second enlarged portion on said valve member spaced from the first enlarged portion, and a flange in said cavity between said two enlarged portions of said valve member and engageable with the second of said enlarged portions when said valve member is moved toward said first port to a flushing position, thereby to maintain the first enlarged portion thereof out of closing engagement with said first port permitting continued flushing flow of fluid from said second port past said first enlargement and out said first port to remove impurities accumulated between said first enlargement and said first port.

4. A device according to claim 3 wherein said flange and said second enlarged portion of said valve member cooperate while engaged to prevent fluid flow to the outlet end of said cavity.

5. A device according to claim 3 wherein said second enlarged portion of said valve member is provided with a passage through which fluid is permitted to flow to the outlet end of said cavity while said portion is engaged with said flange.

6. A device according to claim 3 wherein said flange is provided with a passage through which fluid is permitted to flow to the outlet end of said cavity while said flange is engaged with said second enlarged portion of said valve member.

7. A device according to claim 5 wherein said passage is at an angle to the axis of said outlet.

8. A device according to claim 6 wherein said passage is at an angle to the axis of said outlet.

9. A self-cleaning spray forming device comprising a nozzle having a cavity therein and a spray outlet from said

cavity, a valve member movable in said cavity, means for periodically causing said valve member to move from a spray position with an end portion thereof contiguous to said outlet and a flushing position with said end portion removed from said outlet, the wall of said cavity adjacent said outlet and said end portion of said valve member being cooperatively shaped to provide between them a spiral passage for the flow of fluid to said outlet when said valve member is in spraying position, a flange member in said cavity extending about a portion of said valve member inward of said end portion with clearance to provide a passage for flow of liquid to the outlet end of said cavity when said valve member is in spray position, said end portion of said valve member and said flange member being provided with cooperating means to cause the fluid to flow spirally into the outlet end of said cavity when said valve member is moved to flushing position.

10. A device according to claim 9 wherein said cooperating means include a part of said end portion of said valve member engageable with said flange member to close said passage to fluid flow axially thereof, and a passage in one of said members for admitting fluid to said outlet end of said cavity at an angle to the axis of said outlet.

11. A device according to claim 9 wherein said end portion of said member is provided with a tip of smaller diameter than said outlet which extends axially into said outlet when said valve member is in spraying position and is removed from said outlet when said valve member is in flushing position.

12. A self-cleaning spray forming device comprising a nozzle having a cavity therein and a spray outlet from said cavity, a valve member movable in said cavity, means for periodically causing said valve member to move from a spray position with an end portion thereof contiguous to said outlet and a flushing position with said end portion removed from said outlet, the wall of said cavity adjacent said outlet and said end portion of said valve member being cooperatively shaped to provide between them a spiral passage for the flow of fluid to said outlet when said valve member is in spraying position, said end portion of said valve member having a tip of smaller diameter than said spray outlet which is projected into said outlet when said valve member is in spray position to restrict the area of said outlet and which is removed from said outlet to enlarge the same when said valve member is moved to flushing position.

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M. HENSON WOOD, JR., *Primary Examiner.*

M. MAR, *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,347,463 October 17, 1967

Donald B. Baker

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, lines 31 and 32, for "patent and application" read -- patents --; column 3, line 61, for "th" read -- the --; column 5, line 46, for "of" read -- off --; column 8, line 12, for "liquid" read -- fluid --.

Signed and sealed this 12th day of November 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents