United States Patent

Calder

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[45] Feb. 29, 1972

[54] SOLIDS ABRADING DEVICE

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[21] Appl. No.: 39,621

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[51] Int. Cl. B05b 15/02

[58] Field of Search 239/114–118, 107, 239/108, 109, 532, 574, 587; 137/244, 243.2, 614.2

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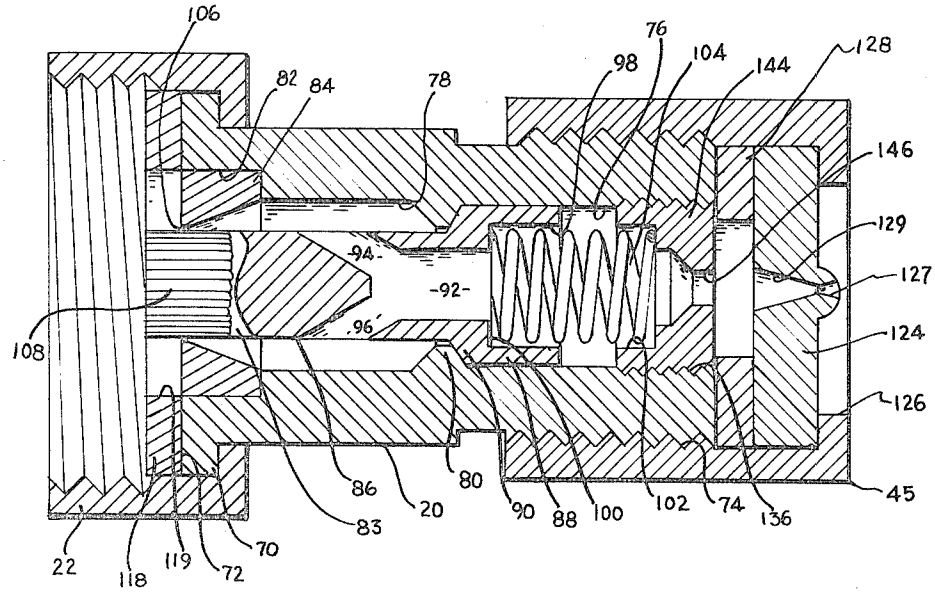
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Attorney—Robert E. Strauss

[57] ABSTRACT

Airless spray equipment is described that is free from clogging. The clogging is prevented by passing the liquid, upstream of the spray tip, through anticlogging means comprising a constricted orifice which surrounds a mandrel that has a fluted end and that extends past the orifice entrance. The mandrel is slidably mounted in the orifice with a spring to bias it against movement by fluid pressure. Any solids in the liquid that would clog the spray tip are abraded by the action of the mandrel. In a preferred embodiment, the orifice and mandrel assembly is used with a pole spray extension having a slave valve at its discharge end to eliminate any spitting of liquid. The pole assembly is formed from a plurality of sections that are readily attachable with a threaded male coupling.

17 Claims, 5 Drawing Figures



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2 Sheets-Sheet 1

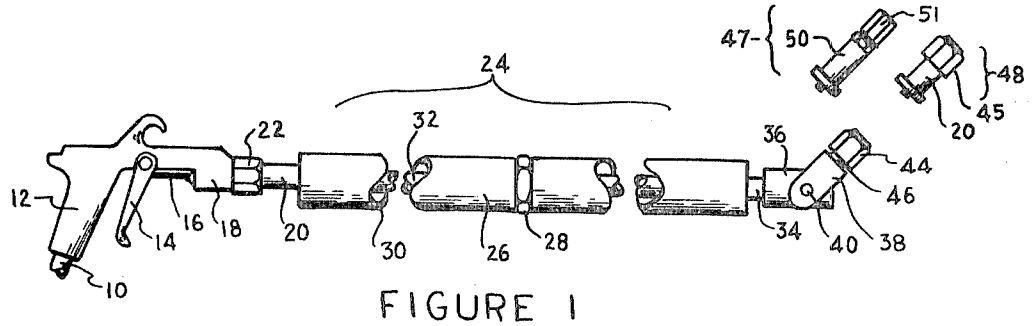


FIGURE 1

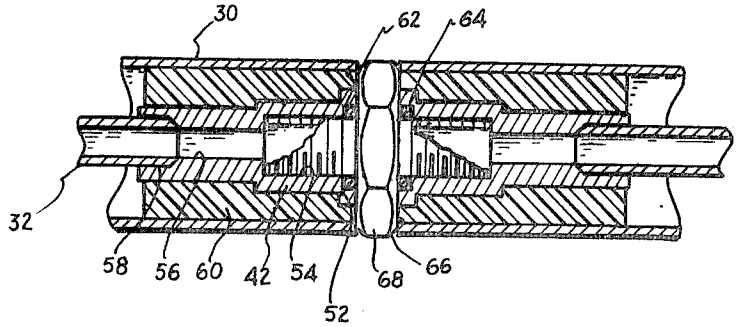


FIGURE 2

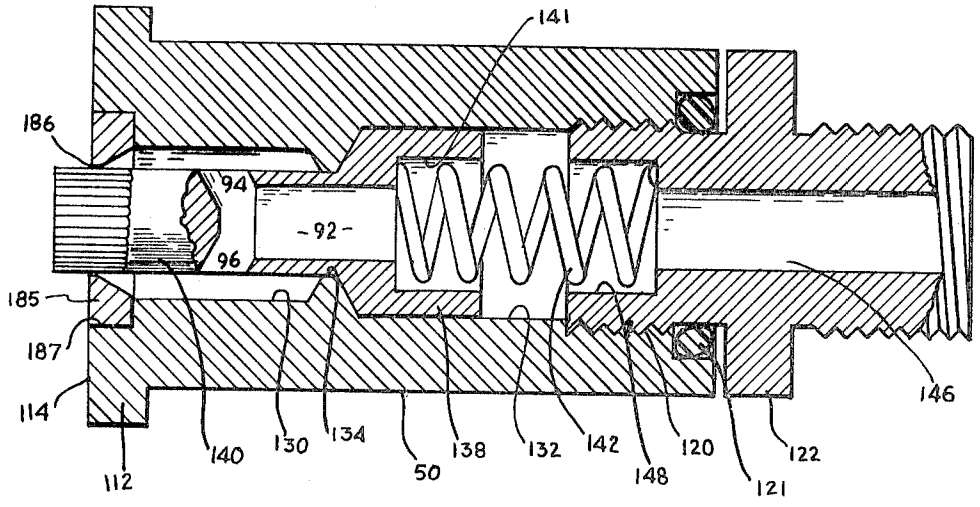
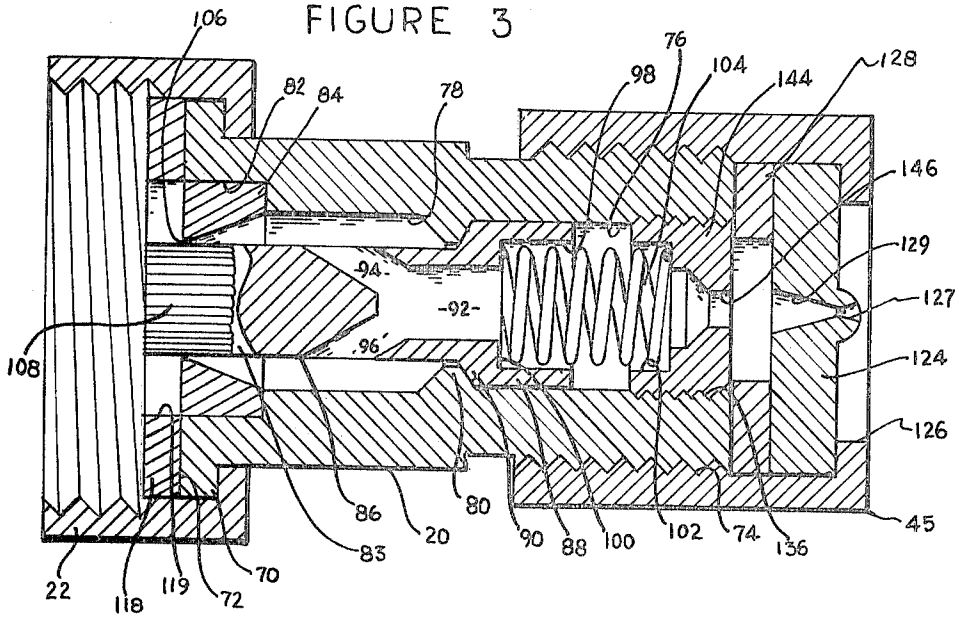


FIGURE 4

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FIGURE 3



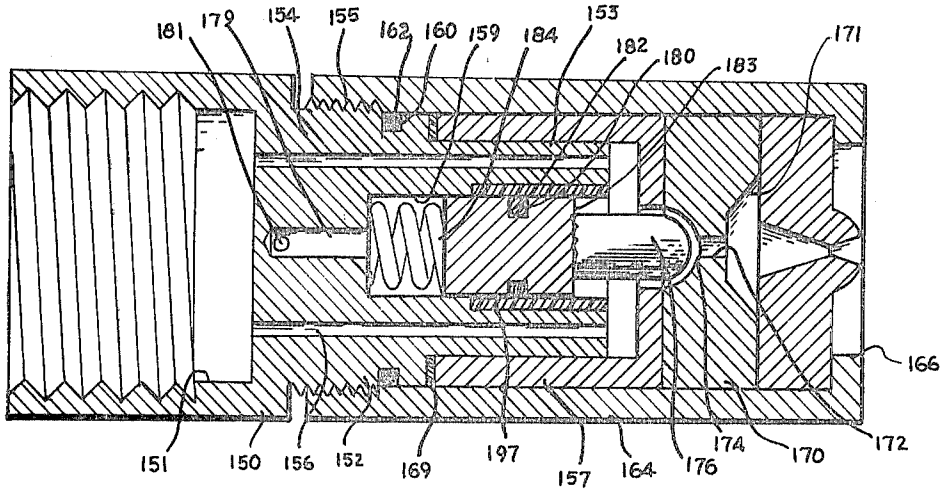


FIGURE 5

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SOLIDS ABRADING DEVICE

This invention relates to means useful in combination with spray equipment to prevent clogging of the spray tip and, in particular, relates to such means that is useful in airless paint spray equipment.

A major difficulty with all pressured liquid spray equipment is that solids in the liquid are forced into the spray tip orifice and trapped there, clogging the orifice. A commonly used solution to this problem is to mount the orifice in a rotatable housing so that it can be rotated and the pressure of the liquid can be applied to blow the obstruction from the clogged orifice. This, however, interrupts the spraying.

Another problem encountered in pressured spray equipment with extended tips is the tendency of the equipment to spit or discharge globules of liquid when the spray valve is opened or closed, thus damaging the quality of the work.

It is an object of this invention to provide means useful in combination with pressured spray equipment that will prevent clogging of the spray orifice.

It is also an object of this invention to provide an improved pressured liquid spray equipment with such means to prevent clogging.

It is an additional object of this invention to provide means in combination with pressured liquid spray equipment that will prevent spitting or discharge of liquid globules.

It is also an object of this invention to provide improved spray equipment employing all of the aforementioned improvements.

I have found that the clogging of pressured liquid spray equipment can be prevented by forcing the liquid to be sprayed through a constricted orifice which surrounds a member that extends slightly upstream of the orifice and that is movably mounted in the orifice with a resilient means to bias it against movement by the force of the liquid pressure. Either or both the movable member and the orifice have their opposed surfaces roughened to abrade any solids in the liquid when movement is caused by the applied pressure and the resilient means.

I have further found that the tendency for a sprayer to spit globules of liquid can be avoided by use of a slave valve at the discharge end of the spray equipment with means interconnecting the slave valve and the main spray valve to synchronize the action of the valves.

In a preferred embodiment, one or both of the aforementioned improvements is used in combination with a pole spray means having a spray boom formed from readily detachable sections.

The invention will now be described by reference to the figures, of which:

FIG. 1 illustrates the assembly of the improved spray means of this invention;

FIG. 2 illustrates the improved means permitting the facile attachment of the sections of the spray boom;

FIG. 3 illustrates the means for preventing clogging of the spray orifice;

FIG. 4 illustrates an alternative means for preventing clogging of the spray orifice; and

FIG. 5 illustrates the slave valve of the invention which prevents spitting of the liquid from the spray means.

Referring now to FIG. 1, the spray device is shown with a conventional spray gun assembly provided with a hose inlet 10 for pressured liquid, a hand grip 12 with a valve trigger 14 at a point intermediate its length which is coupled by rod 16 to a spray valve 18. The discharge end from the spray gun has a threaded male end and the device for preventing clogging is shown as tubular member 20 which is secured to spray gun by threaded cap 22. The spray boom extension, generally indicated at 24 comprises a plurality of sections 26 which have threaded female ends for attachment to the discharge end of the member 20 and to the male coupling member shown at 28. These sections comprise an outer sleeve 30 and an inner tubular member 32 in concentric arrangement.

At the terminal end of the boom is positioned a conventional swivel tip spray assembly. This comprises nipple 34 and

cap 36 which rotatably supports yoke 38 on shaft 40. A fluid passageway communicates from nipple 34, through cap 36 and yoke 38 to the spray head which is mounted on the yoke 38. A standard cap 44 which is threaded onto nipple 46 secures the spray tip to the device. In this assembly, the spray tip can be combined with the slave valve to prevent spitting or the device to prevent clogging can also be located at the spray tip end of the boom in combination with the spray tip rather than at the gun end. The subassembly of the spray tip and the device to prevent clogging is shown at 48 and comprises member 20 which contains the anticlogging means and cap 45 which secures the spray tip to member 20.

An alternate attachment for preventing any clogging of the spray tip is shown at 47 in FIG. 1. This attachment is shown in greater detail in FIG. 4. The orifice and movable member that prevent clogging are contained within the tubular member 50 which is secured by a cap such as 44 to nipple 46. The spray tip is secured to member 50 by cap 51 which is turned onto a male threaded end of member 50.

Referring now to FIG. 2, the detail of the construction of the boom sections 26 is shown in assembly with male coupling 28. The sections comprise an inner conduit 32 which forms the flow passageway for the liquid through the boom. Secured at each end of the conduits is a metal adapter formed from a sleeve 42 with an integral flange 52. The sleeve is bored and tapped at 54 with threads to fit the male end of coupling 28, and counterbored at 56. The counter bore 56 is enlarged slightly with bore 58 into which is press fitted the end of conduit 32. The tubular sleeve 42 is press fitted into a plastic sleeve 60 which is bored to receive the adapter. The outer sleeve member 30 of the section is mounted on the plastic sleeve 60 in concentric arrangement to the inner conduit 32.

An annular groove 62 is bored in the face of flange 52 to form a seat from the sealing O-ring 64. The O-ring seals against the shank of the male coupling. The coupling has a centrally positioned annular flange 66 which is preferably provided with wrench flats 68 or with a knurled surface to permit gripping of the flange sufficiently to remove the coupling. The boom sections can readily be hand tightened into a leakproof assembly without the need for tools by use of the male coupling 28.

Referring now to FIG. 3, the anticlogging means will be described. The device is shown in assembly with the spray tip as illustrated at 48 in FIG. 1. This subassembly can be attached to the end of the spray boom or can be secured directly onto the spray gun when a boom extension is not needed. Alternatively, the spray tip can be located at the spray gun and can have its discharge end threaded into an end of the spray boom as shown in FIG. 1. The anticlogging means is contained within tubular housing member 20 which has at its upstream end an annular rim 70 and flange face 72 for engagement against the discharge end of the spray gun by cap 22 or for engagement against nipple 46 by cap 44. An annular washer 118 with a central bore 119 is placed between flange face 72 and the end of the nipple 46 or the threaded discharge end of the spray gun. The opposite end of member 20 is male threaded at 74 for attachment to the boom or for attachment to cap 45 that contains the spray tip. Member 20 is bored at 76 for a portion of its length and then counterbored at 78. The bores do not completely intersect so that an annular shoulder 80 is formed internally of the member 20. The face of member 20 is grooved at 82 and ring 84 is placed in the groove. A second member 83 in the shape of a mandrel with a shank portion 86 and a base portion 88 of slightly enlarged diameter is positioned in bores 76 and 78 with its shoulder 90 between its shank and base bearing against the annular shoulder 80. The mandrel has a central bore 92 extending through its base and a portion of its shank and terminating at the intersection with transverse bores 94 and 96.

The bore 92 is enlarged at 98 to form an annular shoulder 100 against which is seated the upstream end of spring 104. The counterbore 78 is threaded at its downstream end as shown at 136 and a plug 144 is turned into the threads. The

plug **144** has a central bore **146** with an enlarged diameter **102** to form the seat for spring **104**. Cap **45** is shown secured to threads **74** with the spray tip **124** retained within the cap and bearing against washer **128**. The cap has a central opening **126**. The spray tip is conventional in construction, e.g., it is formed of a wear resistant material such as tungsten carbide and contains a converging entrance port **129** that intersects a diverging exit port **127**.

The anticlogging means of the device comprises ring **84** and member **83**. Ring **84** has an internal diameter that is slightly greater than the diameter of shank **86** of mandrel **83** to define an annular orifice **106** of a limited thickness. The shank end of member **83** is of sufficient length to extend slightly past the face of ring **84** so that it is never flush with this face. In the preferred construction, the shank end of member **86** is fluted at **108**. The length of this fluted portion should at least extend the entire distance of travel of member **83** so that a fluted surface is always within the annular orifice **106**. Alternatively, the shank could be smooth and the inside edge of the orifice could be fluted. Any suitable means for roughening the surface of one or both of these members can be used, e.g., the surfaces can be knurled or etched rather than fluted as shown.

From the preceding description, it can be seen that the member **83** is free for relative movement in its mounting within member **20**. The member can move axially or rotationally within its mounting within member **20**. The resilient biasing means, spring **104**, biases the member **83** against the force of the pressured liquid and against movement so that movement is induced when obstructions in the orifice flow area occur that resist the pressure of the liquid. It is believed that this movement is sufficient to cause abrasion of the obstruction so that any solids are reduced to a fineness sufficient to pass the orifice and the spray tip orifice.

For successful operation, it has been found that member **83** should extend slightly past the annular orifice, the orifice should have a short length, and member **83** should be free for movement in the orifice. For maximum efficiency the ratio of the orifice length to the travel of member **83** should be kept to a minimum. When this ratio becomes too high there is a tendency for the member **83** to bind in the orifice. Preferably the ratio of orifice length to travel should be less than about 1.0 and, most preferably, less than about 0.2. In the device as shown in FIG. **3**, member **83** has a diameter of 0.187 inch and a travel of about 0.100 inch. The end of member **83** should extend at least about 0.100 to 0.125 inch past the face of ring **84** and the grooves along its length can be about 0.001 to 0.010 inch deep, preferably about 0.007 inch deep. It has been found that maximum efficiency of the device of these dimensions is achieved at orifice lengths of 0.010 to 0.020 inch. When the orifice length was increased to about 0.125 inch, the device tended to clog. The clearance between the member **83** and the ring, i.e., the width of the annular orifice **106** should also be maintained at a minimum value. It has been found that for conventional spray tips, having an orifice width of about 0.0025 to 0.001 inch will prevent clogging of the spray tip.

The device shown in FIG. **4** is similar to that described in FIG. **3**. This device can be attached to the spray equipment immediately upstream of the spray tip as indicated at **47** in FIG. **1**. This device has a generally tubular housing **50** which has an annular rim **112** at its upstream end and a flange face **114**. The face is secured against a washer such as **118** of FIG. **3** and onto the end of nipple **46** by a cap such as **44**. The downstream end of housing **50** is threaded as shown at **120** to receive male coupling **122**. As shown at **47** in FIG. **1**, cap **51** can be threaded onto the discharge end of **122** to secure the spray tip to the device. The housing **50** is bored at **130** and is counterbored at **132** with the bores being terminated in a bore of reduced diameter shown at **134** to provide an annular shoulder within the housing **50**. The downstream end of bore **132** is threaded at **120**. Member **138** which is similar to member **83** shown in FIG. **3** is mounted in the counterbore **132** with its reduced diameter shank end **140** extending slightly past the end of housing **50**. This member is biased against the liquid pressure by the resilient means, spring **142**, which seats in the enlarged bore **141** in member **138** and which is secured in place by coupling **122** that is turned into threads **120**. The coupling **122** has a central bore **146** and an enlarged diameter bore **148** to form the seat for the spring **142**. The member **138** is similar in construction to that described in FIG. **3**. The face end of housing **50** is grooves at **187** and ring **185** is mounted in the groove to provide the annular orifice **186** about the fluted end of member **138**.

In operations, liquid is pressured through the orifice and any obstructions that form in the orifice induce movement of the member **138** so that the obstructions are abraded and forced through the orifice in a subdivided condition. The liquid passes into the annular chamber surrounding the shank end of the movable member and into bores **94** and **96** to bore **92**. From bore **92**, the fluid passes into the exit bore from the device, bore **146** of coupling **122** or bore **146** of plug **144** shown in FIG. **3**.

The slave valve used to prevent spitting is shown in FIG. **5**. This comprises a body member **150** having a boss **152** on its downstream face. The upstream end of member **150** is bored at **151** and threaded. The boss is bored centrally at **159** and longitudinally by one or more bores **156** which pass from the base of bore **151** through the entire length of boss **152**. Boss **152** has a reduced diameter shank **153** and a base portion **154** which is threaded at **155**. An annular groove **160** is cut about the periphery of the base **154** to form a seat for O-ring **162**. The shank **153** of boss **152** is surrounded by cap **157** with a gasket **169** between the face of base **154** and the upstream edge of the cap **157**. This cap is secured in place by cap **164** which has an open downstream end **166** and which is turned onto the threaded base **154**. This cap secures the spray tip, plate **170** and cap **157** in the assembly. Plate **170** has a central bore **172** and a concave depression **174** that forms a seat for valve member **176** which is slidably positioned in bore **159**. The valve member is formed from a rod with a reduced diameter section **178** at its downstream end which has a convex surface to mate with the concave surface **174**. Preferably, these surfaces are semicircular in cross section as shown. An annular groove **180** is cut about the periphery of the main section of the valve member **176** to form a seat for O-ring **182**. Bore **159** is enlarged opposite the O-ring and a Teflon sleeve **197** is press fitted into the enlarged bore to provide a low frictional cylinder wall about the O-ring.

Resilient means such as spring **184** is positioned between the upstream end of valve member **176** and the opposed face of member **150** to bias the valve member into the closed position against the concave seat **174**. A vent port from the cavity behind member **176** is provided by tap **179** and transverse bore **181**. The annular shoulder **183** between the main portion and the reduced diameter portion of valve member **176** is sized so that the fluid pressure acting on this surface can overcome the biasing force of spring **184** and open the valve when the main valve is opened. When this applied pressure is removed, the force of the spring is sufficient to urge valve member **176** closed, seating member **176** against the surface **174** of plate **170**. In this manner, the two valves of the spray assembly move in synchronization without any mechanical linkages.

The slave valve body **150** can be constructed from metals such as aluminum since the fluid pressure is applied to cap **157**. This cap is formed from metals capable of high stress so as to withstand the high line pressures. Examples of such are steel, stainless steel, etc.

The slave valve can be used in combination with the orifice and movable member assembly of either FIGS. **3** or **4**. When the device of FIG. **3** is used, the slave valve can simply be used at the tip end of the boom with the anticlogging means located between the spray gun and the boom. If the anticlogging device is to be located at the tip end of the boom, it can be combined with the slave valve by replacing the spray tip **168** shown in FIG. **5** with member **20** with its annular rim **70** secured within cap **164**. When used in this assembly, the

recessed surface 188 on the face of plate 170 provides the necessary clearance for the protruding end of member 83 shown in FIG. 3.

One feature of the device as illustrated is that the spray tip can readily be reversed when desired since the washer 128 of FIG. 3 is provided with a bore of sufficient diameter to accommodate the hemispherical bulge of the spray tip 124. Similarly, plate 170 of the slave valve has a recessed center 171 which provides clearance for the raised surface of the spray tip when the latter is reversed. In the event that any particles ever become clogged in the spray tip orifice, they can readily be cleared by reversing the position of the spray tip in the assembly and opening the spray valve to force the obstructions from the orifice.

The invention has been described with reference to the presently preferred mode of practice thereof. It is not intended that the invention be limited to the specifically illustrated device but that the elements and their obvious equivalents which are described herein and recited by the following claims be included in the scope of the invention.

1. A device for connection in a stream of pressured liquid and functioning to prevent the clogging of flow passageways encountered by said stream downstream of said device by solids in said liquid which comprises:
- a first member adapted to be connected to a supply of liquid under pressure,
- a flow passageway extending axially therethrough,
- orifice means defining a constructed flow passageway of reduced cross-sectional area,
- a second member having a base portion and a shank portion of a reduced diameter positioned in said flow passageway with said shank portion extending through and terminating slightly upstream of said orifice means,
- means retaining said second member within said passageway of said first member while permitting relative movement between said first and second members which comprises shoulder means downstream of said orifice means and engaged by said base portion of said second member,
- resilient means to urge relative movement between said first and second members in opposition to fluid pressure from said supply and to bias said base portion of said second member against said shoulder means, and
- a surface roughened to depths of from 0.001 to 0.010 inch on at least one of the opposed surfaces of said orifice and said second member whereby to abrade any solids in said stream to a sufficiently small size to permit their passage through said flow passageways downstream of said device.

2. The device of claim 1 wherein said first member is a tubular housing with an axial flow passageway therethrough and said second member is mounted therein.

3. The device of claim 1 wherein said orifice means is positioned on the upstream face of said first member.

4. The device of claim 1 wherein said orifice comprises a ring that is removably mounted in an annular groove about the upstream portion of the flow passageway through said first member.

5. The combination of the device of claim 1 mounted downstream of a first valve means in said fluid supply means and a second valve means remotely positioned downstream of said first valve means with means to apply pressure of said fluid to said second valve means to urge said second valve means into an open position, resilient means to urge said second valve means into a closed position whereby to synchronize the opening and closing of said first and second valve means.

6. The combination of claim 5 wherein said second valve means comprises a body member having a discontinuous bore, a face plate with a central bore with an annular seat about said central bore butted against said body member, valve closure means positioned in said discontinuous bore having a base and a reduced diameter downstream end with an annular shoulder therebetween, resilient means biasing said closure means against said annular seat and at least one fluid passageway through said body member and communicating with said discontinuous bore downstream of said annular shoulder.

7. The combination of claim 5 wherein at least one boom extension is removably mounted between said first and second valve means and comprises a central conduit having terminal threaded portions surrounded by bushing means and a second larger diameter conduit extending concentrically about said first conduit and mounted on said bushing means with the terminal faces of said extensions having annular grooves and resilient sealing means positioned in said grooves.

8. The device of claim 2 wherein said second member has an internal flow passageway communicating with said flow passageway at points upstream and downstream of said shoulder means.

9. The device of claim 1 wherein the ratio of the length of said orifice to the maximum movement of said members is less than 1.0.

10. The device of claim 9 wherein said second member has a shank portion extending through said orifice and wherein the surface of said shank portion is roughened.

11. The device of claim 1 wherein the width of said orifice is from 0.0025 to 0.001 inch.

12. The device of claim 10 wherein said shank portion is fluted with grooves having a depth from 0.001 to 0.010 inch.

13. The device of claim 9 wherein said shank portion extends from 0.100 to 0.125 inch upstream of said orifice means.

14. A device for connection in a stream of pressured liquid and functioning to prevent the clogging of flow passageways encountered by said stream downstream by solids in said liquid which comprises:
- a first member adapted to be connected to a supply of liquid under pressure;
- a flow passageway therethrough;
- orifice means defining a constricted flow passageway of reduced cross-sectional area and having a length along said flow passageway no greater than about 0.125 inch;
- a second member positioned in said flow passageway and extending through and terminating slightly upstream of said orifice means;
- means retaining said second member within said passageway of said first member while permitting relative movement between said first and second member;
- resilient means to urge relative movement between said first and second members in opposition to fluid pressure from said supply; and
- a roughened surface on at least one of the opposed surfaces of said orifice and said second member whereby any solids in said stream are abraded to a sufficiently small size to permit their passage through said flow passageways downstream of said orifice.

15. The device of claim 14 wherein said orifice has a length from 0.02 to 0.04 inch.

16. The device of claim 14 wherein said orifice has a length relative to the travel of said movement between said members less than 1.0.

17. The device of claim 14 wherein said second member has a base portion and a shank portion of a reduced diameter and said shank portion extends through said orifice with shoulder means downstream of said orifice and engaged by the base portion of said second member to retain said second member in said device against the bias of said resilient means and wherein the depth of surface roughening is from 0.001 to 0.010 inch.

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