United States Patent [19]

Bender

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[54] **ROTATABLE SPRAY NOZZLE ASSEMBLY**

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[52] **U.S. Cl.**..... **239/251,** 239/261, 239/DIG. 13

[51] **Int. Cl.**..... **B05b 3/06**

[58] **Field of Search**..... 239/251, 261, DIG. 13; 134/57

[56] **References Cited**

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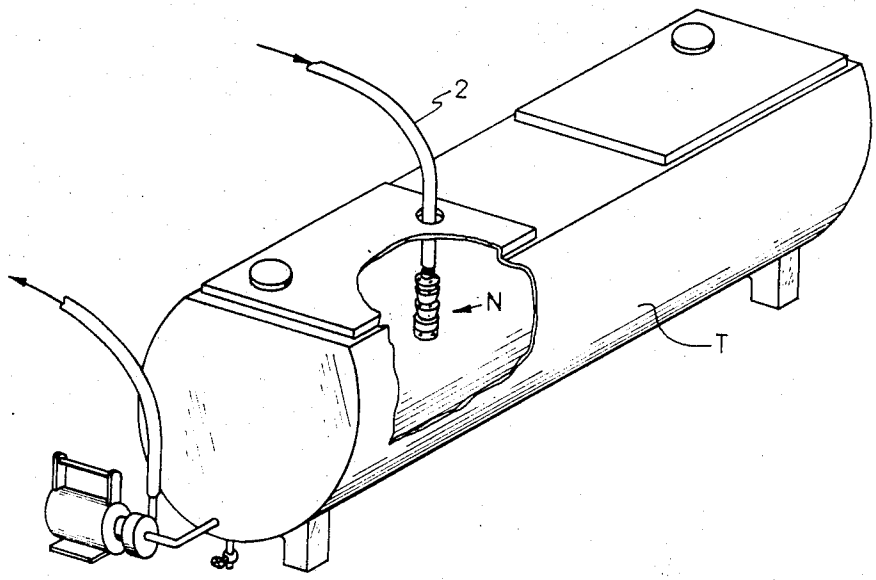
Primary Examiner—Lloyd L. King

Attorney, Agent, or Firm—James E. Nilles

[57] **ABSTRACT**

A rotatable spray nozzle assembly for cleaning the interior of a bulk liquid storage tank or the like including a rotatable nozzle member and a stationary inner, central member which together define two interior chambers separated by an automatically operable valve. Water pressure acts first in one chamber to eject water through apertures of the nozzle member, and then when a sufficient head of pressure is built up through the apertures to effect a spraying action, the valve opens automatically to cause pressurization in the second chamber and consequent rotation of the device by means of a stream of fluid directed at an angle to a radius of said nozzle member.

10 Claims, 7 Drawing Figures



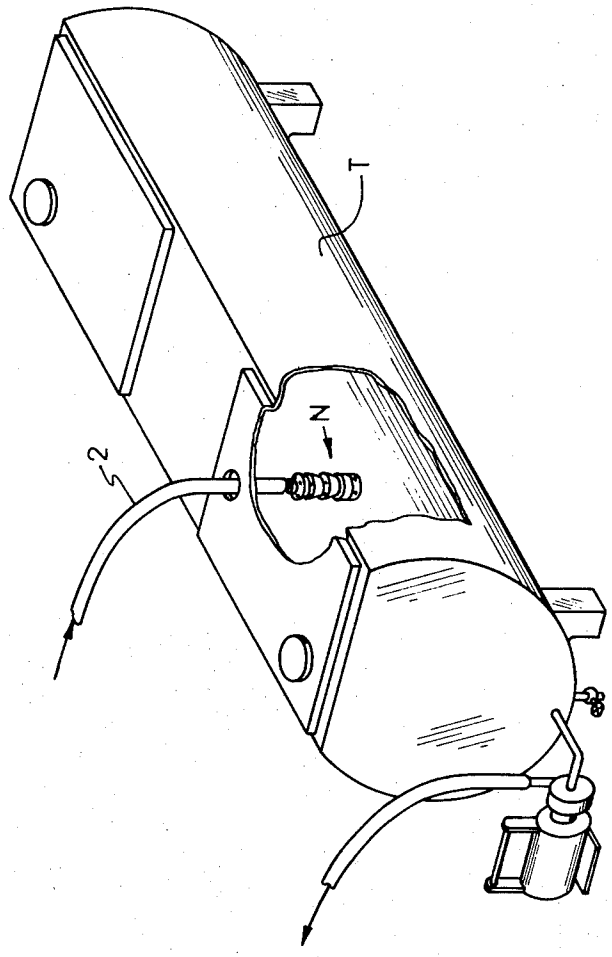


FIG. 1

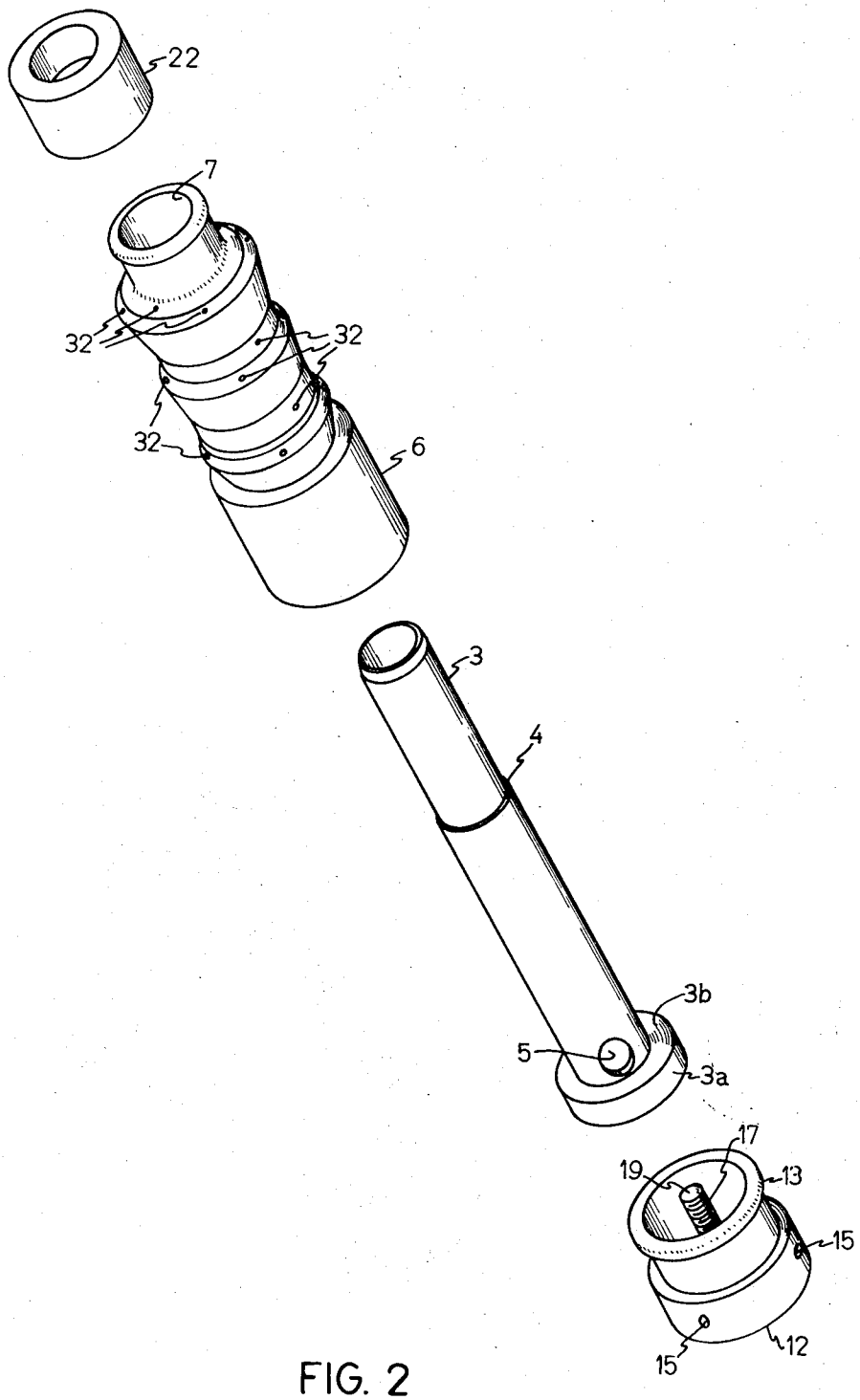


FIG. 2

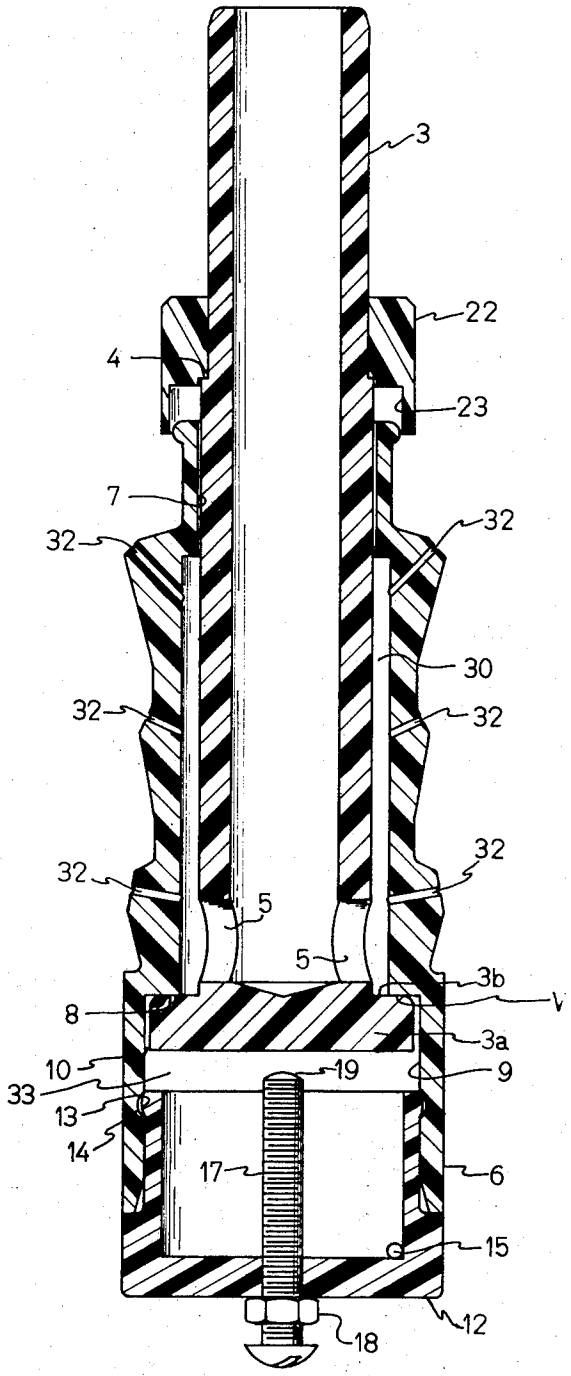


FIG. 3

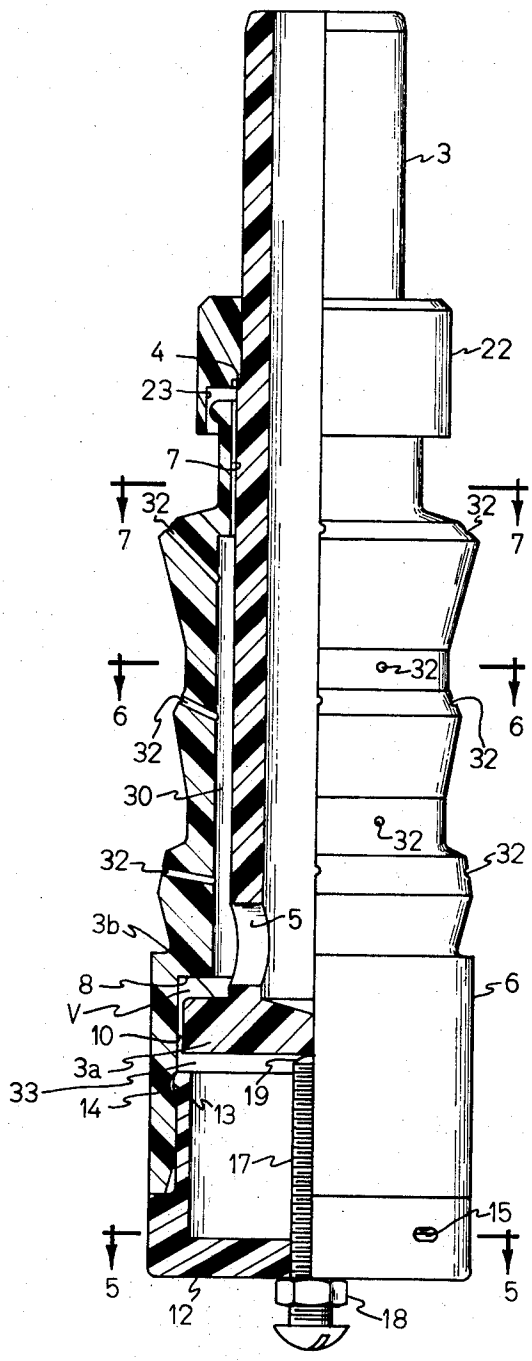

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FIG. 4

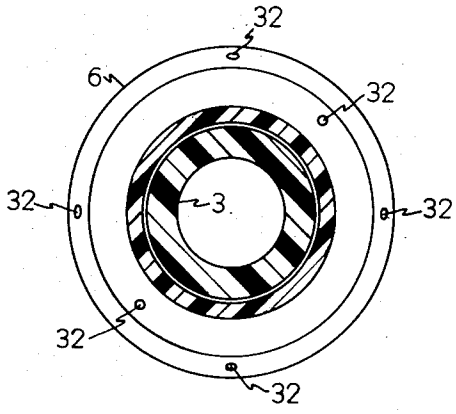


FIG. 7

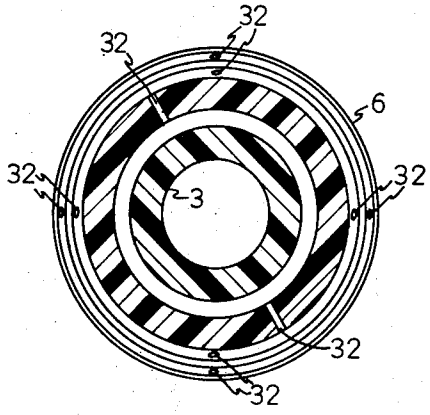


FIG. 6

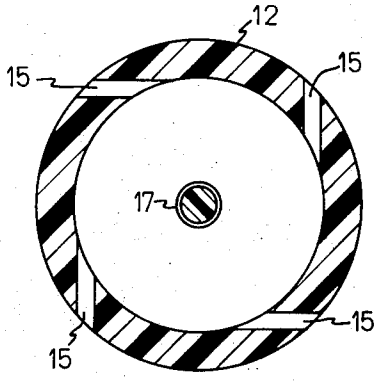


FIG. 5

ROTATABLE SPRAY NOZZLE ASSEMBLY

BACKGROUND OF THE INVENTION

The invention pertains to cleaning apparatus for the interior of a tank, said apparatus being of the type which has a rotatable spray nozzle which directs the cleaning solution thoroughly in all directions to the interior surfaces of the tank to be cleaned.

One example of prior art apparatus of this general character is shown in the U.S. Patent to Booth No. 3,402,725 issued Sept. 24, 1968 and entitled "Bulk Tank Washing Apparatus."

Another type of prior art cleaning apparatus of this general character utilizes a rotatable spray head having a series of apertures extending therethrough at an angle so as to diffuse jets of cleaning solution in all directions and also cause rotation of the nozzle. Such a device did not efficiently use the horsepower of the liquid pump, and did not always operate satisfactorily because of the friction and binding created between the relatively moving parts.

An example of this nozzle is shown in my U.S. Pat. No. 3,448,742 issued June 10, 1969 and entitled "Portable, Automatic Washing Unit for Tanks." That patent as well as my U.S. Pat. No. 3,583,412, issued June 8, 1971 entitled "Automatic Washer Unit for Storage Tank or the Like" both show tank apparatus of the type with which the present invention finds particular utility.

SUMMARY OF THE INVENTION

The present invention provides a rotatable spray nozzle assembly for cleaning the interior of a tank, and which nozzle assembly includes an outer, rotatable nozzle member and an inner, stationary member which together define two separate chambers that are separated by an automatic operating valve. Fluid pressure enters the first chamber and is directed through the apertures in the rotatable nozzle member to cause a series of jets of fluid to be emitted in all directions. After the pressure has sufficiently built up in the first chamber to cause the said establishment of such jets of fluid, the valve between the chambers automatically opens and fluid pressure is admitted to the second chamber where it is then directed outwardly through angularly disposed passages to consequently cause rotation of the nozzle member.

The above nozzle furthermore includes a single point bearing between the outer rotatable nozzle member and the relatively stationary interior member. In addition, a fluid bearing is formed at each of two widely spaced locations between the outer rotatable nozzle member and the relatively stationary inner member, thus providing good lubrication and minimizing binding between the parts.

The construction and arrangement of the improved nozzle assembly is such that a relatively small fluid pump may be used in a particularly efficient manner in that pressure is established first in one chamber to thereby create the jets of fluid from the nozzle, and then the second chamber is pressurized to rotate the nozzle. The sequence of pressurizing the chambers is automatic in that after the first chamber is pressurized, the outer rotatable nozzle member shifts axially relative to the inner stationary portion, that is to say it shifts in an upward direction, thereby automatically opening

the fluid valve which is formed between and by the two members. When the outer member is thus shifted upwardly due to fluid pressure which is built up in the first chamber, a single centrally located bearing is established between the relatively rotating parts thereby providing a low friction bearing.

These and other objects and advantages of the present invention will appear hereinafter as this disclosure progresses, reference being made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view of a bulk tank, certain parts being broken away for clarity and showing the nozzle assembly of the present invention located therein;

FIG. **2** is a perspective exploded view of a spray nozzle assembly embodying the present invention;

FIG. **3** is a vertical, cross-sectional view through the assembly when the valve between the relatively moving members is closed;

FIG. **4** is a view similar to FIG. **3**, but showing the valve open when the assembly is in full operation and the outer member is rotating;

FIG. **5** is a generally horizontal sectional view taken along line **5—5** in FIG. **3**; and

FIGS. **6** and **7** are cross-sectional views taken along line **6—6** and **7—7**, respectively, in FIG. **3**.

DESCRIPTION OF A PREFERRED EMBODIMENT

As shown in FIG. **1**, the nozzle assembly N provided by the present invention is located in a bulk tank T and it may be suspended rather loosely in a downwardly hanging direction by a conduit **2** which is attached to the upper end of the assembly, and which conduit supplies fluid under pressure, such as a cleaning solution, to the nozzle from a pump (not shown). It is desirable to be able to use as small a fluid pump as possible for these devices, for the sake of economy. At the same time these pumps must deliver sufficient volumes of water at sufficient pressures in order to do a satisfactory job of cleaning the tank.

More specifically, the nozzle assembly includes a central tubular member **3** having a shoulder **4** formed on its outer periphery and generally adjacent its upper end. The conduit **2** is slipped over the upper end of member **3** and is frictionally held in sealing engagement therewith. Adjacent the lower end of member **3** is a pair of diametrically opposed, rather large openings **5**, and the lower end of the member **3** is closed by the diametrically enlarged portion **3***a*, which includes a radially extending annular shoulder **3***b*. An outer, generally hollow cylindrical member **6** has a bore **7** which adjacent its upper end forms a relatively loose fit with member **3**. That is to say, the fit is such that pressurized fluid is permitted to flow upwardly between the juncture of the member **3** and the bore **7**, providing a fluid bearing at one end of the rotatable member **6**. The lower end of the member **6** has a radially extending annular shoulder **8** which cooperates with shoulder **3***b* to form a fluid valve V, as will appear. The diameter of the enlarged bore **9** of member **6** is larger than the diameter of the enlarged portion **3***a* of the stationary part **3**, so that fluid can flow through the annular space **10** therebetween and into the lower end of member **6**. The lower end of member **6** is closed by a removable end cap **12** which has an annular sealing rib **13** cooperating with a

complementary annular groove **14** in the interior of member **6.** The end cap **12** has a plurality of circumferentially spaced apertures **15** extending therethrough and which are arranged at an angle to a radius so that pressurized fluid being ejected therefrom causes rotation of the nozzle member.

A single, centrally located bearing means is provided in the end cap **12** in the form of a threaded cap screw **17** having a lock nut **18** so that the end **19,** which forms a single point of bearing surface, can be adjusted axially. As shown in FIG. **4,** when the outer portion **6** is raised, as when the device is operating fully, the end **19** bears against the lower central portion of inner member **3** and insures a low friction bearing for the rotating member **6.** When it is in this position, the upper end of member **6** is spaced a distance from an upper collar **22.** Thus, cleaning solution fluid can flow upwardly through the annular space **7** and is directed downwardly by the overhanging flange **23** of the upper collar, thereby providing the fluid seal previously mentioned.

The collar **22** abuts tightly against shoulder **4** and the collar **22** is press fit on member **3** to form a fluid seal therewith.

With the above construction, a first chamber **30** is formed by and between the rotatable member **6** and the stationary member **3** and when pressure fluid is introduced via the conduit **2,** it flows through the openings **5** of member **3** and pressurizes chamber **30,** causing fluid to be ejected through the series of apertures **32** which extend through the wall of member **6.** The apertures **32** are arranged at different angles so as to create a series of jet sprays of cleaning solution in all directions. After these jet sprays have been thus established and are in operation, the pressure in chamber **30** lifts member **6** upwardly to the position shown in FIG. **4** thereby opening the valve V formed between flange surface *3b* and flange surface **8.** This permits pressurized fluid to flow into a second chamber **33** at the underside of member **3** and this pressure fluid then is forced outwardly through the angled apertures **15** thereby causing rotation of the outer member **6.** The nozzle is then in full operation and may rotate at a relatively slow rate.

Resume

The spray nozzle apparatus of the present invention includes a two-chamber, rotatable nozzle wherein the pressure must build up sufficiently in a first chamber to thereby establish a series of pressurized jets, and then the outer rotatable nozzle member raises to open the valve defined by and between the rotatable nozzle member and the stationary member. Then the fluid causes the second chamber to be pressurized resulting in rotation of the nozzle after the jets have been established. The single point bearing is brought into contact with the stationary member and together with the two widely spaced water bearings provides efficient operation of the unit with a minimum size fluid pump. The upper end of the assembly need not be made with close manufacturing tolerances between the rotatable parts, and there is no binding when the nozzle may be tipped from the vertical position as when hanging in a tank.

I claim:

1. A rotatable spray nozzle assembly comprising a central member having means for being secured to a fluid supply conduit and also having a fluid connecting passage therein, a rotatable spray nozzle member mounted on and for rotation relative to said central member and defining first and second fluid chambers therewith, said central member and said rotatable nozzle member together also defining valve means located between said first and second chambers, said rotatable nozzle member having a series of apertures for directing jets of pressurized fluid outwardly at various angles from said assembly, said conducting passage being in fluid communication with said first chamber for supplying pressurized fluid to said apertures, said rotatable nozzle member being shiftably mounted on said central member between a valve closed position and a valve open position; said rotatable nozzle member also having outwardly extending passages from said second chamber and arranged at an angle to a radius of said rotatable nozzle member for directing pressurized fluid to cause spinning of said nozzle member, whereby when pressurized fluid in said first chamber is directed outwardly through said apertures to establish said jets of fluid, said nozzle member will shift from said valve closed position to said valve open position to cause pressure fluid through said angularly disposed passages to rotate said nozzle member.

2. The combination set forth in claim **1** including a centrally located bearing means carried by said nozzle member and located beneath said central member and engageable with the latter to form a bearing for said nozzle member when said nozzle member shifts to said valve open position.

3. The combination set forth in claim **1** wherein said central member and said nozzle member form fluid bearings therebetween at two spaced locations along their length.

4. The combination set forth in claim **2** wherein said central member and said nozzle member form fluid bearings therebetween at two spaced locations along their length.

5. The combination set forth in claim **3** further characterized in that a collar is positioned in sealing relationship with an upper portion of said central member, said collar having an annular flange overlying one of said water bearings to direct fluid therefrom in a generally downward direction when said apparatus is in operating position.

6. The assembly as defined in claim **2** further characterized in that said nozzle member includes a lower, removable end cap, said end cap containing said angularly disposed passages, said end cap also supporting said centrally located bearing means.

7. The combination set forth in claim **6** further characterized in that said bearing means comprises an adjustable screw whereby the location of said bearing means can be varied relative to said central member.

8. The assembly as defined in claim **4** further characterized in that said nozzle member includes a lower, removable end cap, said end cap containing said angularly disposed passages, said end cap also supporting said centrally located bearing means.

9. A rotatable spray nozzle assembly for washing the interior of a tank or the like, said assembly comprising a central member having means for being secured to a fluid supply conduit for receiving fluid under pressure, said member having a fluid conducting passage therein and adapted to be relatively stationarily suspended in said tank or the like, a rotatable spray nozzle member mounted on and for rotation relative to said central

member and defining first and second fluid chambers therewith, said central member and said rotatable nozzle member together also defining valve means located between said first and second chambers, said rotatable nozzle means having a series of apertures extending outwardly from said first chamber for directing jets of pressurized fluid outwardly at various angles from said assembly, said conducting passage in said central member being in fluid communication with said first chamber for supplying pressurized fluid to said apertures, said rotatable nozzle member being shiftably mounted on said central member between a lower, valve closed position and an upper, valve open position; said rotatable nozzle member also having outwardly extending passages from said second chamber, which passages are arranged at an angle to a radius of said rotatable nozzle member for directing pressurized fluid outwardly therefrom to cause spinning of said nozzle member, whereby when pressurized fluid in said first chamber is directed outwardly through said apertures to establish said jets of fluid, said nozzle member will shift from said valve closed position to said valve open position, thereby permitting pressure fluid to enter said second chamber and be directed outwardly through said angularly disposed passages to thereby cause rotation of said nozzle member, and centrally located bearing means between said nozzle member and said central member and operative when said nozzle member is in said valve open position.

10. A rotatable spray nozzle assembly comprising a central member for receiving fluid under pressure having a fluid conducting passage therein, a rotatable spray nozzle member for rotation on and relative to said central member, first and second fluid chambers between said members, and an automatic valve means located therebetween, said rotatable nozzle member having a series of apertures for directing jets of pressurized fluid outwardly from said assembly, said conducting passage in said central member being in fluid communication with said first chamber for supplying pressurized fluid to said apertures, said rotatable nozzle member being shiftably mounted in said central member between a lower position in which said valve means is closed and an upper position in which said valve means is open, said rotatable nozzle member also having outwardly extending passages from said second chamber arranged at an angle to a radius of said rotatable nozzle member, whereby when pressurized fluid in said first chamber is directed outwardly through said apertures to establish said jets of fluid, said nozzle member will shift to said upper position, thereby permitting pressure fluid to enter said second chamber via said valve means and cause rotation of said nozzle member when directed outwardly through said angularly disposed passages.

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