June 5, 1951 W. H. MASHINTER ET AL 2,555,803

SPRAY NOZZLE

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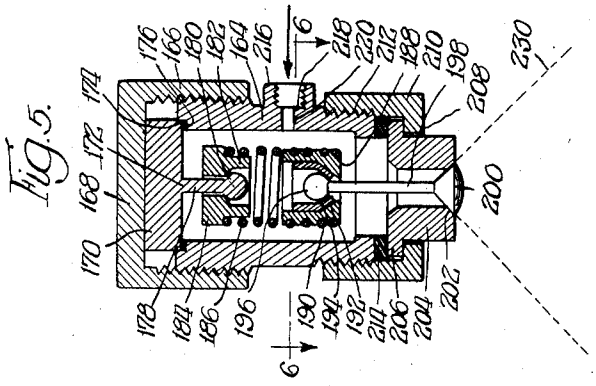


Fig. 5.

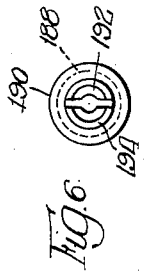


Fig. 6

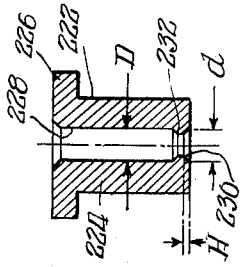


Fig. 7.

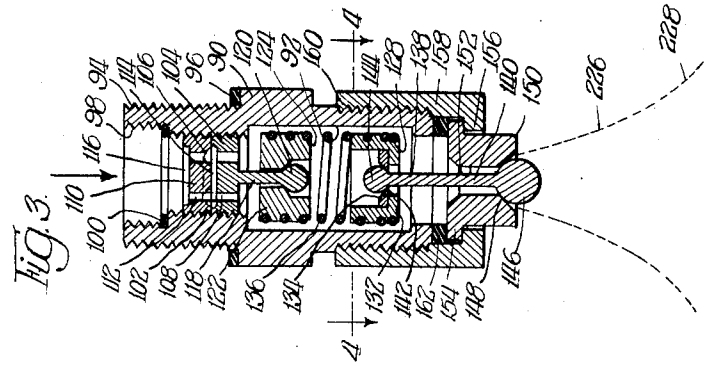


Fig. 3.

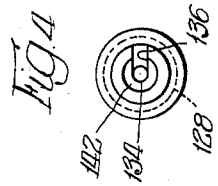


Fig. 4

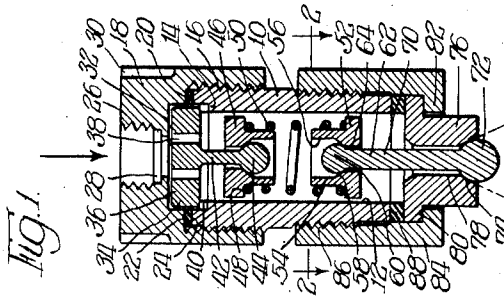


Fig. 1.



Fig. 2

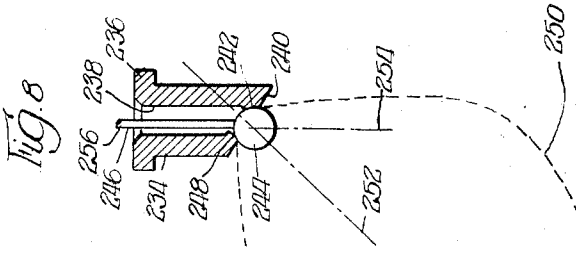


Fig. 8

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SPRAY NOZZLE

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Application September 21, 1945, Serial No. 617,752

11 Claims. (Cl. 299—133)

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This invention pertains to spray nozzles, and more particularly to valve constructions adapted to be used to control the passage of fluid of any composition, such as water, lubricating oils, abrasive liquids such as gasoline, various chemicals such as carbon dioxide and the like.

An object of the invention is to provide a spray nozzle having a discharge valve wherein there are no slidably engageable moving parts.

Another object of the invention is to provide a spray nozzle having a discharge valve wherein there is no side spray thrust.

Another object of the invention is to provide a spray nozzle having a discharge valve wherein manufacturing tolerances are large but valve action is positive.

Another object of the invention is to provide a spray nozzle having a discharge valve which functions equally well regardless of the mating parts.

Another object of the invention is to provide a spray nozzle having a discharge valve permitting a large variety of selected spray shapes.

Another object of the invention is to provide a spray nozzle having a discharge valve permitting passage of large particles of material.

Another object of the invention is to provide a spray nozzle having a discharge valve which sprays substantially any fluids or semi-fluids with equal facility and with high pressures.

Another object of the invention is to provide a spray nozzle having a discharge valve wherein there are relatively few moving parts, said nozzle being relatively cheap, easily assembled and is useful, efficient and effective in different sizes.

Another object of the invention is to provide a spray nozzle which may be designed for many uses, such as for feul injection, air conditioning, spray drying of foods, paint sprays, homogenizing processes, slurry pumping, refrigeration and the like.

Another object of the invention is to provide a spray nozzle having a discharge valve which is self-cleaning.

Another object of the invention is to provide a spray nozzle which opens uniformly, i. e., unseats uniformly to permit a spray to be ejected having a uniform configuration.

Another object of the invention is to provide a spray nozzle having a tension spring urging the valve to closed position whereby there is no tendency for the spring to induce or transmit a mechanical force to the valve which would tend to cause the valve to disrupt the hydraulic force of the fluid discharged through the nozzle.

Another object of the invention is to provide a

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spray nozzle wherein no guide action of the valve is necessary so that the nozzle or orifice entrance may be properly streamlined whereby proper atomization is attained on the discharge side of the valve.

Another object of the invention is to provide a spray nozzle which can be made of small diameter, yet the stem may be elongated, with no guide action, to permit operation through an extended distance, as no buckling stresses are imparted to the valve stem.

Another object of the invention is to provide a spray nozzle which can be constructed so that it can be angularly applied without sacrifice to the efficiency of the nozzle.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings which illustrate embodiments of the device and wherein like reference characters are used to designate like parts—

Figure 1 is a sectional elevation through one form of spray nozzle embodying the invention;

Figure 2 is a sectional plan view taken substantially in the plane as indicated by the line 2—2 of Figure 1;

Figure 3 is a sectional elevation through a modified form of spray nozzle embodying the invention;

Figure 4 is a sectional plan view taken substantially in the plane as indicated by the line 4—4 of Figure 3;

Figure 5 is a sectional elevation of another modified form of spray nozzle embodying the invention;

Figure 6 is a sectional plan view taken substantially in the plane as indicated by the line 6—6 of Figure 5;

Figure 7 is a sectional elevation of a modified form of nozzle or closure member embodying the invention; and

Figure 8 is a sectional elevation of another modified form of nozzle or closure member embodying the invention, showing the end portion of valve member therefor.

Referring first of all, more particularly, to the spray nozzle shown in Figures 1 and 2, said nozzle consists essentially of a body portion 10 provided with a bore 12, the bore adjacent one end thereof being provided with a shoulder 14. The body is threaded as at 16 for reception of corresponding threads of the head nut 18, the

nut being provided with an internal shoulder 20 seating on suitable packing 22 provided between the shoulder 20 and the shoulder 24 provided on one end of the body member 10.

The nut is internally threaded as at 26 for the reception of a suitable supply tube or pipe adapted to be connected to a suitable source of supply, the material to be sprayed entering in the direction as shown. The land or recess 28 is provided for the reception of a suitable gasket. The head is provided with suitable shoulders 30 for the reception of a suitable tool for assembly, and is provided with a shoulder 32 adapted to overlie and engage the spider 34 of the upper spring coupling member 36, the spider being apertured as at 38 for permitting the passage of fluid therethrough. The spider is adapted to seat on suitable rings or shims 40 seated on seat 14, the number of shims being determined by the desired positioning of the coupling member 36 for spring adjustment.

The spider is provided with the coupling stem 42 terminating in a spherical coupling or seat member 44 adapted to be received within the upper spring seat or retainer 46. The spring retainer 46 is provided with the shoulder 48 to which one end of the tension spring 50 is suitably secured as by welding. The lower end of the tension spring 50 is welded or otherwise secured to the shoulder 52 of the lower spring seat or retainer 54. The spring retainer 54 is provided with the enlarged bore 56 terminating in the seat 58 receiving the spherical portion or seat 60 of the valve 62.

The seat 58 terminates in the passage 64 which is of smaller diameter than the diameter of the spherical portion 60 and in order to assemble the valve 62 in position in the retainer, the spring retainer is drilled as at 66, the diameter of the drill hole being slightly greater than the diameter of the spherical end 60, and the hole 66 is connected to the passage 64 as by passage 68 of slightly greater width than the transverse diameter of the valve stem 70 of the valve 62. The valve stem 70 terminates in a spherical valve end 72 adapted to seat on the correspondingly shaped seat 74 of the nozzle or closure member 76, the seat communicating with bore 12 by passage 78 having a diameter greater than the diameter of the valve stem 70 whereby substantially no guide action is obtained from the walls of passage 78.

The nozzle 76 is provided with the flange 80 adapted to be engaged by the retaining flange 82 of the nozzle body retaining nut 84, said nut being provided with a threaded portion 86 adapted to have cooperative engagement with corresponding threads of the body 10. A suitable gasket 88 is interposed between the flange 80 and the end of the body 12 for making a fluid tight connection.

Referring now to the construction illustrated in Figure 3, the body 90 is provided with the bore 92 and is provided with the upper external threads 94 for the reception of suitable threads of supply means, such as a supply tube internally threaded, or the unit injector such as shown in application Serial No. 537,793, now Patent No. 2,530,128, dated November 14, 1950, a gasket 96 being provided to insure a tight joint. The body is also internally threaded as at 98 if it is to be secured to the external threads of a suitable supply tube, a gasket 100 being provided to insure a tight joint. The direction of flow of material (fluid) to be atomized is shown by the arrow. The body member is also internally threaded as at 102 for the reception of corresponding threads of a spring coupling member including the spider 104, adjustment of the spider being through a suitable tool slot 106, the spider being provided with suitable passages 108.

A retaining nut 110 is provided for locking the spider in place, the nut being provided with passages 112 adapted to be aligned with the passages 108, the passages 112 being connected by an annular passage 114 for insuring communication between the passages 112 and 108, a tool slot 116 being provided in the locking nut for adjustment thereof. The spider is provided with the coupling stem 118 terminating in the spherical coupling member 120 received in the spring seat or retainer member 122. The spring retainer member 122 is provided with a spiral passage 124 for the reception of one end of the spiral spring 126, the pitch of the passage 124 being such as to spread the convolutions of the spring 126, and the spring may be otherwise secured to the seat member as by welding.

The lower convolutions of the spring 126 are received in a passage 128 and is similar to passage 124 of the lower spring seat or retainer member 130 to spread the convolutions of the spring, and the spring may be otherwise secured to said retaining member 130 as by welding. The lower end of the spring retainer member is provided with the inwardly directing flange 132 adapted to support the substantially C-shaped valve seat member 134, said member being provided with the radial passage 136 (Figure 4) for the reception of the valve stem 138 of the valve member 140 for permitting ready assembly thereof, the passage terminating in a valve seat 142 of complementary shape to the spherical valve end 144. The lower end of the valve stem is provided with the spherical valve end 146, being adapted to seat on the conical seat 148 of the nozzle or closure member 150 whereby the valve end 146 seats on substantially a line. It is understood, of course, that the valve seat 148 may be of the same shape as valve seat 74.

As before the nozzle is provided with the passage 152 of substantially greater diameter than the diameter of valve stem 138 whereby no substantial guide action is obtained between the walls of the passage 152 and the valve stem 138.

The nozzle is provided with the external flange 154 adapted to be engaged by the inwardly directed flange 156 of the nozzle retaining nut 158, said nut being threaded as at 160 for the reception of suitable threads provided on the body 90. A suitable gasket 162 is interposed between flange 154 and the lower end of body 90 for insuring a fluid tight connection between the nozzle, nut and body.

In the construction illustrated in Figures 5 and 6, the body 164 is threaded as at 166 for the reception of corresponding threads on the cap 168. The cap is adapted to engage and position the upper coupling retaining disk 170 of the spring coupling member 172. Suitable shims 174 are interposed between the retaining disk 170 and recess 176 of the body member for adjustment purposes. The coupling is provided with the depending stem 178 terminating in a spherical member 180 adapted to be recessed in the upper spring seat or retainer member 182. The spring seat member 182 is provided with the flange 184 to which one end of the tension spring 186 is seated, being preferably secured thereto as by welding. The lower convolutions of the

spring 186 are adapted to be received in suitable spiral recess 188 provided in the lower spring seat or retainer member 190. As before, the recess is so arranged as to substantially spread the convolutions received therein, and said spring may be otherwise secured to the spring seat member as by welding.

The spring seat member 190 is provided with a pair of valve retaining collets 192 (Figure 6) providing a valve end seat 194 for the spherical valve end 196. The slopes of the seat 194 and the engaging surface between the seat and the member 188 are the same, whereby the collets may be readily assembled with the valve and member 188, the valve seats being retained in proper position. Thus the collets form a self-aligning valve seat.

The valve stem 198 terminates in a substantially conical valve 200 which is shown seated on a correspondingly conical seat 202 of the nozzle or closure member 204. The nozzle 204 is provided with an outwardly extending flange 206 received by the inwardly directed flange 208 of the nozzle retaining nut 210 which is threaded as at 212 for the reception of corresponding threads of the body 164. A suitable gasket 214 is disposed between the lower end of the body 164 and flange 206 for insuring a fluid tight connection beween the body, nut and nozzle, and the body is provided with a suitably threaded boss 216 for suitable connection to a source of supply. The direction of fluid to be atomized is shown by the arrow.

The boss is shouldered as at 218 for the reception of a gasket for insuring a tight connection with the supply tube or pipe, and the boss communicates through passage 220 with the bore of the body member 164.

While it is seen that the valve ends of Figures 1 and 3 are substantially the same, while the valve end of the modification illustrated in Figure 5 is different, and the shape of the valve seats of the nozzles vary, it is understood that these may be interchangeable in the various figures.

In operation it will be seen that the springs 50, 126 and 186 are always in tension whereby the valves are always self-aligning, they open uniformly with respect to the nozzle seats therefor, and no guide action of the valve stems is necessary. Fluid introduced to the bore of the body portions either in a pulsating manner or a steady flow, cause intermittent operation of the valve, or steady operation of the valve, relief of pressure permitting the tension spring to accurately and positively seat the discharge valve member without any other guide action being necessary.

In the construction illustrated in Figures 1 and 2 the fluid will be discharged in a substantially conical manner as illustrated at 222, the spray then assuming a reverse, substantially conical shape as illustrated at 224.

In the construction illustrated in Figures 3 and 4 the spray, assumes a substantially conical shape 226 for a distance, and then additionally spreads out as at 228.

In the construction illustrated in Figure 5 the spray assumes a substantially wide, constant conical shape as illustrated at 230.

Thus the nozzle and valves would be chosen in accordance with the shape of the spray desired, and this would depend largely upon the use to which the nozzle was to be put.

As indicated before, the nozzle is susceptible of a great number of uses, such as fuel injection, air conditioning, refrigerating, spray drying of foods, as for quick freezing dehydrated juices, paint spraying, homogenizing process, slurry pumping and the like.

This form of nozzle is also susceptible of use where a semi-solid (or slurry) is to be pumped. It is readily so adapted due to the fact that large clearances may be maintained between the valve stem, discharge valve and the discharge passage of the nozzle, and the valve is self-cleaning, tending to remove any particles which have a tendency to stick to the discharge valve seat.

In Figure 7 there is shown a modified form of nozzle or closure member 222, wherein the body portion 224 is provided with the securing flange 226 and the axial bore 228, having a diameter D, the outer end of the nozzle is provided with the valve seat 230 which may be similar to seats 74, 148 or 202, and has the diameter at the end of the nozzle or at the orifice represented by *d*. A cylindrical land 232 is provided, the depth of the land from the end of the nozzle being given as H. This depth H is determined depending upon the spray angle desired i. e., as H increases the spray angle decreases. The cylindrical land permits maintaining a controlled seat width while varying D and *d*. Another factor also enters into the spray angle, i. e., the stiffer the valve spring (as 50 in Figure 1), the wider the spray angle.

The ratio of D to *d* has a definite effect on

1. The ability of the valve to chatter.
2. The spray angle.
3. The distance from the orifice of the occurrence of the maximum spray width.

The tendency to chatter has been found to increase with the approach of the ratio of D to *d* to the value of "one," and as the ratio approaches "one" the valve "squeaks." The nearer the ratio approaches "one" the narrower the spray angle becomes and the farther the occurrence of the maximum spray width from the orifice.

In the nozzle or closure member illustrated in Figure 8 the body portion 234 is provided with the securing flange 236 and has an axial bore 238. Frequently it is difficult to place an injector in the head or wall of an engine and still obtain a proper spray of fluid. The end 240 of the nozzle member shown in Figure 8 is thus disposed at the desired angle and the ball seat 242 of the valve member 244 of valve 246 is disposed below the cylindrical land 248. Thus a spray as shown at 250 is provided of similar configuration to that shown in Figure 3 but so ejected that the center line 252 of the spray is angularly disposed to the center line 254 of the valve 246, the stem 256 of the valve extending through bore 238 and being similar to valve 140. Of course other shapes of sprays may be obtained as in Figure 1.

It is to be understood that while the parts have been described in certain positions, the nozzles operate equally well in any position and it is understood that this application is not to be limited by the exact embodiments of the device shown, which are merely by way of illustration and not limitation as various and other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

We claim:

1. A valve assembly comprising a body member having a spring seat therein, means for supporting said seat in said body member, a connection between said seat and body member, a second spring seat spaced from said first named spring

seat, a tension spring secured to said seats, said body member being provided with a closure member, said closure member having a passage terminating in an outer valve seat, and a valve seated on said seat and having a stem extending through said passage, the cross sectional area of said stem being less than that of said passage whereby said stem is unguided, a connection between said stem and said second spring seat, said valve opening against the tension of said spring, one of said connections of one of said spring seats being a substantially universal connection permitting relative movement of said last named spring seat in a plurality of directions with respect to said body member.

2. A nozzle assembly comprising a body member having a spring seat therein, means for supporting said seat in said body member, a second spring seat spaced from said first named spring seat, a tension spring secured to said seats and urging said seats toward each other, a nozzle secured to said body member, said nozzle having a passage terminating in an outer valve seat, and a valve seated on said outer valve seat and having a stem extending through said passage and connected for substantial universal movement to said second spring seat, said valve stem being of substantially less diameter than the diameter of said passage, said valve opening against the tension of said spring.

3. A nozzle assembly comprising a body member having a closure at one end, said closure being provided with a passage adapted to be connected to a source of supply, a spider secured between said body member and closure and having a coupling stem thereon terminating in a substantially spherical coupling member, a spring seat having a substantially spherical coupling portion engaging said coupling member, a second spring seat spaced from said first named spring seat having a spherical coupling portion, a tension spring secured to said seats and urging said seats toward each other, replaceable shims between said spider and body member for regulating the tension of said spring, a nozzle member secured to said body portion and having a substantially spherical outer valve seat, a passage from said valve seat through said nozzle member, and a valve member having a substantially spherical valve end seated on said seat, a stem extending from said valve end through said passage and being of substantially less cross section than that of the passage, said stem having a substantially spherical coupling member engageable with the coupling portion of said second seat whereby said valve end is urged toward closed position by said spring and opens against the tension of said spring and is connected to said second named seat for substantially universal movement with respect thereto.

4. A nozzle assembly comprising a body member having a closure at one end, said closure being provided with a passage adapted to be connected to a source of supply, a spider secured between said body member and closure and having a coupling stem thereon terminating in a coupling member, a spring seat having a pivotal connection with said coupling member, a second spring seat spaced from the first named spring seat, a tension spring secured to said seats urging said seats toward each other, a nozzle member secured to said body portion and having an outer valve seat, a passage from said valve seat through said nozzle member, and a valve member having a valve end seated on said seat, a stem extending from said valve end through said passage and being of substantially less cross section than that of the passage, said stem being connected to said second spring seat through means providing a substantially universal connection therebetween whereby said valve end is urged toward closed position by said spring and opens against the tension of said spring.

5. A nozzle assembly comprising a body member having a closure at one end, said closure being provided with a passage adapted to be connected to a source of supply, a spider secured between said body member and closure and having a coupling stem thereon terminating in a substantially spherical coupling member, a spring seat having a substantially spherical coupling portion engaging said coupling member, a second spring seat spaced from said first named spring seat having a spherical coupling portion, a tension spring secured to said seats and urging said seats toward each other, replaceable shims between said spider and body member for regulating the tension of said spring, a nozzle member secured to said body portion and having a substantially spherical outer valve seat, a passage from said valve seat through said nozzle member, and a valve member having a substantially spherical valve end seated on said seat, a stem extending from said valve end through said passage and being of substantially less cross section than that of the passage, said stem having a substantially spherical coupling member engageable with the coupling portion of said second seat whereby said valve end is urged toward closed position by said spring and opens against the tension of said spring and is connected to said second named seat for substantially universal movement with respect thereto, said second valve seat having an opening adjacent the coupling portion connected by a passage, the opening being of substantially greater cross section than the diameter of the valve coupling member, the cross section of said last named passage being less than the diameter of the valve coupling member but greater than the cross section of the stem whereby the valve can be assembled with said second seat.

6. A nozzle assembly comprising a body member having one end provided with means for connecting said nozzle to a source of supply, a spider disposed in said end, a nut for securing said spider in place and having passages therethrough corresponding to the passages through said spider, said nut having a passage connecting said nut passages and communicating with the spider passages, said spider having a coupling stem thereon terminating in a substantially spherical coupling member, a spring seat having a substantially spherical coupling portion engaging said coupling member, a second spring seat spaced from said first named spring seat having a spherical coupling portion, a tension spring secured to said seats and urging said seats toward each other, a nozzle member secured to said body portion and having an outer valve seat, a passage from said valve seat through said nozzle member, and a valve member having a substantially spherical valve end seated on said seat, a stem extending from said valve end through said passage and being of substantially less cross section than that of the passage, said stem having a substantially spherical coupling member engageable with the coupling portion of said second seat whereby said valve end is urged toward closed position by said spring and opens

against the tension of said spring and is connected to said second named seat for substantially universal movement with respect thereto.

7. A nozzle assembly comprising a body member having one end provided with means for connecting said nozzle to a source of supply, a spider disposed in said end, a nut for securing said spider in place and having passages therethrough corresponding to the passages through said spider, said nut having a passage connecting said nut passages and communicating with the spider passages, said spider having a coupling stem thereon terminating in a substantially spherical coupling member, a spring seat having a substantially spherical coupling portion engaging said coupling member, a second spring seat spaced from said first named spring seat having a spherical coupling portion, a tension spring secured to said seats and urging said seats toward each other, a nozzle member secured to said body portion and having a substantially conical outer valve seat, a passage from said valve seat through said nozzle member, and a valve member having a substantially spherical valve end seated on said seat, a stem extending from said valve end through said passage and being of substantially less cross section than that of the passage, said stem having a substantially spherical coupling member engageable with the coupling portion of said second seat whereby said valve end is urged toward closed position by said spring and opens against the tension of said spring and is connected to said second named seat for substantially universal movement with respect thereto, said coupling portion of said second named seat including a substantially C-shaped seat, the passage being of greater width than the cross section of said stem but less than the diameter of the valve coupling member.

8. A nozzle assembly comprising a body member having an opening for attachment to a source of supply and having a closure at one end, a coupling retaining disk disposed between said closure and body member, said disk having a coupling stem terminating in a substantially spherical coupling member, a spring seat having a substantially spherical coupling portion engaging said coupling member, a second spring seat spaced from the first spring seat having a coupling portion including spaced collets, a tension spring secured to said seats and urging said seats toward each other, replaceable shims between said disk and body member for regulating the tension of said spring, a nozzle member having a substantially conical outer valve seat, a passage from said valve seat through said nozzle member, and a valve member having a substantially conical valve end seated on said seat, a stem extending from said valve end through said passage and being of substantially less cross section than that of the passage, said stem having a substantially spherical coupling member engageable with the coupling portion of said second seat whereby said valve end is urged toward closed position by said spring and opens against the tension of said spring.

9. A valve assembly comprising a body member having a spring coupling member therein and a valve seat spaced from said spring coupling member, said body member having a passage, said spring coupling member comprising a stem having a substantially spherical coupling end, a valve member adapted to move between open and closed positions on said seat, said valve member having a stem extending through said passage and having less cross-sectional area than that of said passage and circumferentially spaced from the walls thereof, said valve stem extending toward said first named stem and having a substantially spherical coupling end, a tension spring, and connecting means between the opposite ends of said spring and the respective stems, said connecting means including a connection substantially freely embracing each of said spherical ends for permitting rotation between said stems and spring axially thereof, the axes of said stems and spring normally being substantially coaxial, said valve member opening against spring tension.

10. A valve assembly comprising a body member having a spring coupling member therein having a stem and a valve seat spaced from said spring coupling member, a valve member adapted to move between open and closed positions on said seat, said body member having a passage, said valve member having a stem extending through said passage and having less cross-sectional area than that of said passage and circumferentially spaced from the walls thereof, said valve stem extending toward said stem of said spring coupling member, a tension spring, and connecting means between the opposite ends of said spring and said stem of said coupling member and said other stem respectively, there being a universal connection between said stems and connecting means whereby free rotation is obtained between said valve member and spring axially thereof, the axes of said stems and spring normally being substantially coaxial, said valve member opening against spring tension.

11. A valve assembly comprising a body member having a spring coupling member therein and a valve seat spaced from said spring coupling member, a valve adapted to move between open and closed positions on said seat, said body member having a passage, said valve having a stem member extending toward said spring coupling member, the cross sectional area of said stem member being substantially less than that of said passage and circumferentially spaced from the wall thereof, a tension spring, and connecting means between the opposite ends of said spring and said coupling member and stem member respectively, there being a universal connection between one of said members and connecting means whereby free rotation is obtained between said stem member and spring axially thereof, the axes of said stem member and spring normally being substantially coaxial, said valve opening against spring tension.

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