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(54) IMPROVEMENTS IN VALVES FOR FLUIDS

(71) We, NUPRO COMPANY, of 15635 Saranac Road, Cleveland, State of Ohio 44110, United States of America, a corporation of the State of Ohio, United States of America, (assignee of BERNARD JOHN GALLAGHER, EARL DAVID SHUFFLEBARGER, DAVID MICHAEL SIMKO, RICHARD JOHN MEDVICK, JOHN ROBERT BOYLAN and OLIVER LASZLO DANKO), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to butterfly valves.

The invention is especially suited for use as a high vacuum valve and will be described with particular reference thereto; however, as will become apparent, the invention could be used for many different types of service.

Generally in systems wherein it is desired to achieve vacuums below 10^{-6} Torr, it is not practical to use valves having rubber or the like rubbing seals between the system and the atmosphere. The reason for this is that there is a permeability problem which results in the migration of molecules of unknown impurities through the rubber seals and subsequent introduction of them into the vacuum system. As a consequence, the use of statically sealed valves is preferred. Statically sealed valves are, of course already known in connection with high vacuum service. Customarily, the statically sealed valves are of the reciprocating stem type sealed with a bellows or diaphragm. Although reciprocating valves are generally satisfactory, they do have certain disadvantages in that they are not particularly quick acting and they have low conductance.

Butterfly valves are theoretically ideal for vacuum systems because they are quick acting, have high conductance, and are generally more compact and more simply constructed than reciprocating valves. The

main difficulty with using butterfly valves in vacuum systems has been that none are available which are statically sealed. The primary reason for this is that bellows and diaphragms which can be used in statically sealed systems are not usable in torsion. That is, it is not generally possible to satisfactorily transmit a rotating force through a bellows or diaphragm as is required to shift a butterfly valve. As a consequence, butterfly valves generally require the use of rubber or plastic stem seals which suffer from the disadvantage of molecular migration into the vacuum system.

A feature of the invention is to provide a butterfly valve which is statically sealed and does not require any type of rotary seal, resilient gaskets or the like. All joints in the operating assembly can be metal-to-metal seals, bonded or welded, if desired.

In accordance with the invention, a valve comprises a body having a through flow passage of generally circular cross-section; a valve disc member positioned in said passage and having an outer periphery adapted to close said passage when the disc member is rotated to a position generally transverse to the axis of said passage; a rotatable operating stem connected to said valve disc and extending outwardly through said body; an actuating stem positively connected to said operating stem and having an outer end portion inclined relative to the axis of rotation of said operating stem; a bellows assembly enclosing said actuating stem and having an inner end portion joined to said body and an outer end portion inclined at an angle generally corresponding to the angle of inclination of said actuating stem and rotatably engaged therewith; and actuating means for applying a generally laterally acting force to the outer end of said actuating stem via the outer end portion of the bellows assembly, whereby rotation of said operating stem produces deflection of said bellows assembly substantially without torsional loading of said bellows assembly.

The invention includes a valve comprising

a body having a through flow passage; a valve member positioned in said passage and adapted to open and close said passage when rotated between a first position and a second position; a rotatable operating stem connected to said valve member and extending outwardly through said body; an actuating stem positively connected to said operating stem and having an outer end portion inclined relative to the axis of rotation of said operating stem, a bellows assembly enclosing said actuating stem and having an inner end portion joined to said body and an outer end portion inclined at an angle generally corresponding to the angle of inclination of said actuating stem and rotatably engaged therewith; and actuating means for applying a generally laterally acting force to the outer end of said actuating stem whereby rotation of said operating stem produces deflection of said bellows assembly substantially without torsional loading of said bellows assembly; said actuating means including an actuating member mounted for rotation about the axis of rotation of said operating stem, said actuating member having an inclined opening receiving said outer end portion of said bellows assembly, a portion of said actuating member being engaged by at least one thrust bearing surface on a bonnet which extends upwardly from said body and encloses said bellows assembly, retaining means for holding said actuating member against said one thrust bearing surface, and a handle member connected to said actuating member and having a downwardly extending skirt portion rotatable about said bonnet.

Another feature of the invention is to make the valve disc and operating stem somewhat freely floating in the body so that the disc has a self-centering action. Preferably, the operating stem is guided by bearing means located at at least two spaced points but arranged so as to permit some axial movement of the operating stem.

The invention is further described, by way of example, with reference to the accompanying drawings wherein:—

Figure 1 is an elevational view showing a preferred embodiment of a valve constructed in accordance with the invention;

Figure 2 is a cross-sectional view taken on line 2—2 of Figure 1 and showing the valve in a closed position;

Figure 3 is a cross-sectional view taken on line 3—3 of Figure 2;

Figure 4 is a detail view of bearing means of Figure 2, to a larger scale;

Figure 5 is a view taken on line 5—5 of Figure 2;

Figure 6 is an elevational view (partially in section) showing a second embodiment of the invention (in this view the valve is shown

in the open position); and,

Figure 7 is a detail cross-sectional view showing a slightly modified form of actuator assembly for the Figure 6 embodiment.

Referring more particularly to Figures 1 and 2 of the drawings, a valve includes a body 10 and an actuating assembly 12 which is connected to the body and extends outwardly therefrom. In the illustrated embodiment, the body 10 is formed as one piece of cylindrical cross-section and provided with an axially extending through passage 14. The passage 14 includes a first cylindrical section 16, a tapered, seat defining section 18 and a cylindrical section 20. It will be noted that a spaced series of bolt holes 22 is provided for connecting the body to standard vacuum flanges. Further, gasket recesses 24 are formed about the outer ends of the passage 14 to receive a standard soft metal gasket of the type typically used in high vacuum systems. Although not shown, the recesses 24 are normally provided with some type of gasket engaging protuberances. It should be appreciated that other types of connecting arrangements could equally well be provided, depending upon system requirements, etc.

Positioned within the through passage 14 is a circular valve disc 26 formed from any suitable material and having a peripherally extending seal 28 carried thereon. The seal can be formed from many materials depending upon the system requirements; however, some of the new fluorocarbon compounds are particularly satisfactory. The disc itself is, in the preferred embodiment, formed from stainless steel and is connected to an operating stem 30 by a pair of screws 32. The screws 32 extend through openings formed in the stem 30 into tapped openings in the disc 26. The screws 32 are preferably slotted throughout their length to provide an air passage along the threads to facilitate pump-down and help prevent virtual leaks in the valve. (A virtual leak results from gas being trapped in a small cavity or the like and slowly leaking therefrom during use of the valve in a high vacuum environment.)

As shown, the stem 30 is preferably provided with a flat 34 which engages the face of the valve disc and holds it positioned.

The lower end of the stem 30 is relatively loosely received within a bore 36 formed in the valve body 10. It should be noted that the length of the lower end portion of the stem 30 is less than the total depth of the bore 36. This permits some vertical freedom so that the disc and stem assembly can be somewhat self-centering. Further, a flat 38 is formed longitudinally along the lower end of the stem to provide an air passage.

The upper end of the operating stem 30 passes through an opening 40 which connects with an enlarged counterbore 42. Adjacent the opening 40, a slot 44 is formed through the body so as to provide free communication with the counterbore 42.

The upper end of the stem 30 is directly connected to an actuating arm 48. In the embodiment under consideration, the operating stem 30 and the actuating stem 48 are formed integrally from a single piece of stock; however, these can obviously be formed as separate elements and positively interconnected, if desired. The details and arrangement of the operating stem 48 will subsequently be described.

A bonnet member 50 with a centrebore 52 of a diameter substantially equal to the diameter of the counterbore 42 is joined to the valve body. In the present embodiment, the bonnet member 50 has an axially extending nose portion 54 which mates with a recess 56 formed about the outer end of the counterbore 42. Preferably, the nose portion 54 is welded to the body 10 about the joint 58 as shown in Figure 2.

The operating stem 30 and the actuating stem 48 are guided in the bonnet member 50 by a bearing means 60. Many different types of bearings could be used, for example, simple sleeve bearings or the like; however, in the present embodiment, a ball bearing assembly is shown. In particular, as seen in Figure 3, the bearing means 60 comprises a cylindrical cage 62 having a plurality of openings 64 formed therethrough. Balls 66 are received in the openings and are sized so as to engage the inner wall of the bore 52 and the outer surface of the actuating stem 48. As best shown in Figure 2, at the juncture between the actuating stem 48 and the operating stem 30, there is radially extending flange 68 having a fillet 70. The lower balls in the assembly rest on the flange 68 for support in the bore 52. This particular bearing assembly is excellently suited for the specific application. It creates few, if any, virtual leaks, it leaves wide-open paths for pump-down, and it properly supports the stems so they can transform a linear force into rotary motion with little wear or frictional loss without the use of lubricants which would be undesirable in a high-vacuum system.

Of particular importance is the arrangement of the actuating assembly 12 whereby the operating and actuating stems can be given a rotary motion without the need for a rotary seal. Referring in particular to Figure 2, the actuating stem 48 has its outer end portion bent at an incline relative to the axis of rotation of the stem 30. In the present embodiment, the incline is shown as in the range of approximately 10 to

20 degrees; however, this could obviously vary.

Enclosing the actuating stem 48 is a bellows assembly 71 which includes a gas-imperious, flexible metal bellows member 72. The bellows member 72 has an open lower end which is connected to the bonnet member 50. The connection between the lower end of the bellows member 72 and the bonnet member 50 is best shown in Figure 4. It will be noted that a relatively rigid annular flange member 74 is joined to the lower edge of the bellows 72 and extends radially outwardly therefrom. Preferably the flange member 74 is fusion bonded to the bellows as shown at 76. The member 74 extends outwardly over a small recess 78 formed about the top surface of the bonnet member 50. A small, upwardly extending spigot 80 is positioned about the top of the bonnet member 50 and acts as a positioning spigot or shoulder for a metal O-ring 82 and for the flange member 74. The metal O-ring 82 serves as a seal between the bonnet member 50 and the flange member 74. Referring again to Figure 2, a clamp or bonnet nut member 84 is threadedly connected to the bonnet member 50 and has an inwardly extending shoulder 86 which, as shown in Figure 4, engages the top surface of the flange member 74. By tightening the bonnet nut member 84, substantial sealing pressure is applied to form a tight metal-to-seal between the metal O-ring 82, the top of the bonnet member 50 and the under surface of the flange 74. In certain instances, the metal O-ring could be eliminated and a tight metal-to-metal seal made between the flange member 74 and the top of the bonnet member 50. The flange member 74 also could be fusion bonded to bonnet member 50.

As previously mentioned, the upper end portion of the bellows member 72 is inclined at an angle corresponding to the angle of inclination of the outer end of the actuating stem 48. As shown in Figure 2, the end of the bellows member 72 is closed by a generally cup-shaped cap member 87 which has a laterally extending flange 88 welded or otherwise positively and sealingly joined to the upper edge of the bellows member 72. The outer free end of the actuating stem 48 is rotatably received and guided within the rigid cap member 87. A bore 89 is formed inwardly of the cap member 87 and receives the free end of the actuating stem 48.

The cap member 87 is rotatably received in a bore 90 which is formed at a corresponding angle in a member 92. The member 92 is rotatably received in the upper end of the bonnet nut member 84. A reduced diameter end portion of the member 92 extends outwardly through a sleeve bearing 94 carried in the nut member 84.

With the arrangement thus far described, rotation of the member 92 applies a lateral force to the cap member 87 and will produce rotation of the stem and consequent rotation of the valve disc 26. Because of the rotating connection between the actuating stem 48 and the cap member 87, the rotation of the stem takes place with only lateral deflection of the bellows. That is, the bellows does not rotate or undergo any torsional loading. Thus, all connections between the bellows and the valve body can be positive, nonrotating connections. Consequently, the valve is particularly suited for critical vacuum uses where rotary seals are not satisfactory.

Although the assembly thus far described could be used without additional structure, it is preferable to provide a cup-shaped handle member 100 that is connected to the reduced diameter portion of the member 92. As shown, the handle member 100 is releasably connected to the members 92 by a set screw 102. Although the embodiment shown is intended for manual operation, it could obviously be used with various types of power actuators, air, electric or the like.

In order to provide positive stops for the movement of the disc, a stop 110 extends downwardly from the handle member 100 (see Figs. 2 and 5). A ring member 106 is connected to the bonnet nut member 84 and has a groove 108. The groove 108 has a circumferential extent of approximately 90 degrees and receives the end of the stop 110. As shown in Figure 5, this limits the extent of movement of the valve disc to a first closed position (shown solid) and a second open position.

Figure 6 illustrates a second embodiment of the valve constructed in accordance with the present invention. The valve of Figure 6 is generally similar in overall construction and operation to the embodiment of Figures 1 to 5. Differences, however, reside primarily in the actuating portion of the valve. The differences are such as to permit the overall height of the valve to be reduced from that of the first embodiment of Figures 1 to 5. Additionally, the actuator arrangement is such that a somewhat more rigid and stable actuation is achieved than with the Figure 1 embodiment. Certain other differences will become apparent.

In general, the valve of the Figure 6 embodiment comprises a body section 10' and an actuator section 12'. The body section 10' is substantially identical to that described with respect to the first embodiment. Accordingly, like reference numerals have been used to identify corresponding parts or components of the Figure 6 embodiment. A description of a correspondingly numbered element of the first embodiment is to be taken as equally

applicable to the Figure 6 embodiment unless otherwise noted.

In the Figure 6 embodiment, the stem 30' extends outwardly of the body through an opening 120 which is formed slightly different from the corresponding opening of the first embodiment. As shown, opening 120 includes three stepped diameter portions 121, 122 and 123. A 90-degree slot or recess 124 is formed in the bottom wall of the portion 123 and serves as a stop to limit rotary movement of the stem 30'. A stop pin 126 extends outwardly from the stem 30' for engagement with the ends of the slot 124. The pin 126 is received in an opening 128 formed in the stem 30'. A bleed opening 129 serves to facilitate pump-down when the valve is used in vacuum systems so that air trapped beneath the pin 126 will be evacuated and will not present virtual leak problems.

The portion 130 of the stem 30' includes a somewhat larger diameter portion 132 having a radially outwardly extending flange 134. The upper surface of the flange 134 is curved as shown and supports a ball bearing assembly 136. In this embodiment, the ball bearing assembly 136, although similar to the previously mentioned ball bearing assembly 60, differs therefrom in that it comprises a single row of balls 138 maintained in position by a cylindrical metal cage 140 which has spaced openings adapted to rotatably receive the balls 138. The ball bearing assembly 136 rotatably supports the upper end or actuating portion of the stem 30'.

Received in the outer section 121 of the opening 120 is a bonnet member 142. The lower end of the bonnet member 142 is welded or otherwise positively joined to the body 10' as shown. A bonnet screw member 144 is threadably received in the outer end of the bonnet member 142. Suitable wrench-receiving flats or the like 146 are formed about the bonnet screw member 144 so that it may be tightened or removed from the bonnet member 142.

Positioned over the inclined upper end of the actuating stem 30' is a bellows assembly 150 which is generally identical to the previously-discussed bellows assembly 71. The bellows assembly 150 includes a metal bellows member 152 welded at its lower end to a flange member 154. At its upper end, the bellows member 152 is welded or otherwise positively and sealingly joined to the lower flanged end 156 of a cap member 158. The flange member 154 is clamped to the body by the lower end of the bonnet screw member 144. A seal is formed between the lower face of the flange member 154 and the body 10' by an O-ring member 160 (preferably metal) positioned in the portion 122 of the opening 120.

The cap member 158 rotatably receives the upper end of the actuating portion 130 of the stem 30'. The cap member 158 is rotatably received in an opening 161 formed in an actuating member 162. As can be appreciated, rotation of the actuating member 162 applies a lateral force to the cap member 158 to produce a rotation of the stem and rotation of the valve disc 26'. As discussed with reference to the first embodiment, since the actuating portion 130 of the stem 30' is rotatably received in the cap member 158, the rotation of the stem takes place with only lateral deflection of the bellows. For this reason, the bellows does not rotate or is not subject to any torsional loading and has a particularly long and reliable life.

The actuating member 162 is rotatably held in the bonnet screw member 144 between a pair of thrust bearing washer members 164 and 166. Preferably, the thrust bearing members are formed from a suitable bearing material such as bronze. The lower bearing washer 166 rests on a shoulder 168. The upper bearing member 164 rests on the upper surface or shoulder 170 formed on the actuating member 162. The actuating member 162 and the thrust bearing washers 166 are prevented from moving outwardly while being permitted to rotate freely by a ring member 172 which is releasably locked in the upper end of the bonnet screw member 144 in any convenient manner such as by a set screw 174.

Preferably, the actuator also includes a handle member 176 which encloses the upper end of the actuating member 162 and is releasably connected thereto by a set screw 178. In the embodiment shown, the handle member 176 includes a downwardly-extending skirt portion 180 which is closely received on the outer portion of the upper end of the bonnet screw member 144.

Figure 7 illustrates a slightly modified form for the actuating assembly of the Figure 6 embodiment. In this embodiment, the overall height of the actuating assembly is further reduced by elimination of the thrust bearing washers 164 and 166, as well as the ring member 172. This permits the reduced diameter end portion of the actuating member 162 and the upper end of the bonnet screw member 144 to be reduced in height. The actuator member 162 is held in position by the bonnet screw member by a retaining ring member 182 which is rotatably received about the outer surface of the bonnet member 142 and engages the shoulder 184 formed on the bonnet screw member 144. The ring member 182 is locked to the extended lower portion of the handle skirt portion 180 by a set screw 186. The handle member 176 thus serves to maintain the actuating member 162 firmly in position

in the bonnet screw member 144. Preferably, both the actuating member 162 and the ring member 182 should be made from materials which are suitable as bearings in relationship to the bonnet screw member 144.

Figure 7 also illustrates the manner by which the handle actuating movement can be stabilized or dampened. For example, an O-ring 189 can be carried in a groove 190 formed about the upper portion of the bonnet screw member 144. By properly sizing the O-ring relative to the groove 190, a sufficient portion of the O-ring can extend out of the groove to engage the inner surface of the handle member 176. The O-ring 189 is not intended to perform any sealing functions but, rather, merely damps or applies a slight frictional force to the movement of the handle member 176.

In both the Figure 6 and the Figure 7 embodiment, separate bonnet and bonnet screw members are provided. In certain environments, however, it may be advisable to form these two members integrally and weld them to both the flange member 154 and the valve body. This has the advantage of eliminating the necessity of a sealing O-ring member 160.

WHAT WE CLAIM IS:—

1. A valve comprising a body having a through flow passage of generally circular cross-section; a valve disc member positioned in said passage and having an outer periphery adapted to close said passage when the disc member is rotated to a position generally transverse to the axis of said passage; a rotatable operating stem connected to said valve disc and extending outwardly through said body; an actuating stem positively connected to said operating stem and having an outer end portion inclined relative to the axis of rotation of said operating stem; a bellows assembly enclosing said actuating stem and having an inner end portion joined to said body and an outer end portion inclined at an angle generally corresponding to the angle of inclination of said actuating stem and rotatably engaged therewith; and actuating means for applying a generally laterally acting force to the outer end of said actuating stem via the outer end portion of the bellows assembly whereby rotation of said operating stem produces deflection of said bellows assembly substantially without torsional loading of said bellows assembly.

2. A valve as claimed in claim 1 wherein said operating stem and said actuating stem are integrally formed.

3. A valve as claimed in claim 1 or 2 wherein said operating stem is supported from said valve disc and axially loosely guided in aligned openings in said body.



The cap member 158 rotatably receives the upper end of the actuating portion 130 of the stem 30'. The cap member 158 is rotatably received in an opening 161 formed in an actuating member 162. As can be appreciated, rotation of the actuating member 162 applies a lateral force to the cap member 158 to produce a rotation of the stem and rotation of the valve disc 26'. As discussed with reference to the first embodiment, since the actuating portion 130 of the stem 30' is rotatably received in the cap member 158, the rotation of the stem takes place with only lateral deflection of the bellows. For this reason, the bellows does not rotate or is not subject to any torsional loading and has a particularly long and reliable life.

The actuating member 162 is rotatably held in the bonnet screw member 144 between a pair of thrust bearing washer members 164 and 166. Preferably, the thrust bearing members are formed from a suitable bearing material such as bronze. The lower bearing washer 166 rests on a shoulder 168. The upper bearing member 164 rests on the upper surface or shoulder 170 formed on the actuating member 162. The actuating member 162 and the thrust bearing washers 166 are prevented from moving outwardly while being permitted to rotate freely by a ring member 172 which is releasably locked in the upper end of the bonnet screw member 144 in any convenient manner such as by a set screw 174.

Preferably, the actuator also includes a handle member 176 which encloses the upper end of the actuating member 162 and is releasably connected thereto by a set screw 178. In the embodiment shown, the handle member 176 includes a downwardly-extending skirt portion 180 which is closely received on the outer portion of the upper end of the bonnet screw member 144.

Figure 7 illustrates a slightly modified form for the actuating assembly of the Figure 6 embodiment. In this embodiment, the overall height of the actuating assembly is further reduced by elimination of the thrust bearing washers 164 and 166, as well as the ring member 172. This permits the reduced diameter end portion of the actuating member 162 and the upper end of the bonnet screw member 144 to be reduced in height. The actuator member 162 is held in position by the bonnet screw member by a retaining ring member 182 which is rotatably received about the outer surface of the bonnet member 142 and engages the shoulder 184 formed on the bonnet screw member 144. The ring member 182 is locked to the extended lower portion of the handle skirt portion 180 by a set screw 186. The handle member 176 thus serves to maintain the actuating member 162 firmly in position

in the bonnet screw member 144. Preferably, both the actuating member 162 and the ring member 182 should be made from materials which are suitable as bearings in relationship to the bonnet screw member 144.

Figure 7 also illustrates the manner by which the handle actuating movement can be stabilized or dampened. For example, an O-ring 189 can be carried in a groove 190 formed about the upper portion of the bonnet screw member 144. By properly sizing the O-ring relative to the groove 190, a sufficient portion of the O-ring can extend out of the groove to engage the inner surface of the handle member 176. The O-ring 189 is not intended to perform any sealing functions but, rather, merely damps or applies a slight frictional force to the movement of the handle member 176.

In both the Figure 6 and the Figure 7 embodiment, separate bonnet and bonnet screw members are provided. In certain environments, however, it may be advisable to form these two members integrally and weld them to both the flange member 154 and the valve body. This has the advantage of eliminating the necessity of a sealing O-ring member 160.

WHAT WE CLAIM IS:—

1. A valve comprising a body having a through flow passage of generally circular cross-section; a valve disc member positioned in said passage and having an outer periphery adapted to close said passage when the disc member is rotated to a position generally transverse to the axis of said passage; a rotatable operating stem connected to said valve disc and extending outwardly through said body; an actuating stem positively connected to said operating stem and having an outer end portion inclined relative to the axis of rotation of said operating stem; a bellows assembly enclosing said actuating stem and having an inner end portion joined to said body and an outer end portion inclined at an angle generally corresponding to the angle of inclination of said actuating stem and rotatably engaged therewith; and actuating means for applying a generally laterally acting force to the outer end of said actuating stem via the outer end portion of the bellows assembly whereby rotation of said operating stem produces deflection of said bellows assembly substantially without torsional loading of said bellows assembly.

2. A valve as claimed in claim 1 wherein said operating stem and said actuating stem are integrally formed.

3. A valve as claimed in claim 1 or 2 wherein said operating stem is supported from said valve disc and axially loosely guided in aligned openings in said body.



4. A valve as claimed in claim 1, 2 or 3 wherein said operating stem is rotatably guided at at least two points by bearing means.
5. A valve as claimed in claim 4 in which said two points are at opposite sides of the valve disc and the bearing means at the point adjacent the actuating stem comprises a ball bearing.
6. A valve as claimed in any of claims 1 to 5 wherein said bellows assembly includes a hollow, generally cylindrical bellows member having an open inner end positioned about said operating stem with said inner end sealingly secured to said body.
7. A valve as claimed in claim 6 including a clamping member having a shoulder which overlies a flange joined to the inner end of said bellows member.
8. A valve as claimed in any of claims 1 to 7 wherein the outer end of said bellows assembly comprises a rigid cap member having an opening which rotatably receives the inclined end portion of said actuating stem.
9. A valve as claimed in claim 8 wherein said actuating means for applying a lateral force to said stem includes a rigid, cup-shaped member rotatably joined to said body for rotation about the axis of said operating stem, and wherein said cap member is rotatably eccentrically received in an opening in said cup-shaped member.
10. A valve as claimed in any of claims 1 to 8 in which said actuating means includes an actuating member mounted for rotation about the axis of rotation of said operating stem, said actuating member having an inclined opening receiving said outer end portion of said bellows assembly, a portion on said actuating member being engaged by at least one thrust bearing surface on a bonnet which extends upwardly from said body and encloses said bellows assembly, retaining means for holding said actuating member against said one thrust bearing surface, and handle member connected to said actuating member and having a downwardly extending skirt portion rotatable about said bonnet.
11. A valve comprising a body having a through flow passage; a valve member positioned in said passage and adapted to open and close said passage when rotated between a first position and a second position; a rotatable operating stem connected to said valve member and extending outwardly through said body; an actuating stem positively connected to said operating stem and having an outer end portion inclined relative to the axis of rotation of said operating stem; a bellows assembly enclosing said actuating stem and having an inner end portion joined to said body and an outer end portion inclined at an angle generally corresponding to the angle of inclination of said actuating stem and rotatably engaged therewith; and actuating means for applying a generally laterally acting force to the outer end of said actuating stem whereby rotation of said operating stem produces deflection of said bellows assembly substantially without torsional loading of said bellows assembly; said actuating means including an actuating member mounted for rotation about the axis of rotation of said operating stem, said actuating member having an inclined opening receiving said outer end portion of said bellows assembly, a portion of said actuating member being engaged by at least one thrust bearing surface on a bonnet which extends upwardly from said body and encloses said bellows assembly, retaining means for holding said actuating member against said one thrust bearing surface, and a handle member connected to said actuating member and having a downwardly extending skirt portion rotatable about said bonnet.
12. A valve as claimed in claim 10 or 11 wherein said thrust bearing surface extends circumferentially about said actuating member.
13. A valve as claimed in claim 10, 11 or 12 wherein two thrust bearing surfaces are positioned on axially opposite sides of a radially extending portion of said actuating member.
14. A valve as claimed in claim 10, 11 or 12 wherein said bonnet includes a radially outwardly extending shoulder and wherein said handle member extends below said shoulder and a retaining ring is connected to said handle member beneath said shoulder.
15. A valve as claimed in claim 10, 11 or 12 wherein said retaining means comprises a ring member carried by said member.
16. A valve as claimed in claim 10, 11, 12, 14 or 15 including a resilient member positioned between said handle member and said bonnet to frictionally retard movement of said handle member.
17. A valve constructed substantially as herein described with reference to and as illustrated in Figs. 1 to 5 of the accompanying drawings.
18. A valve constructed substantially as herein described with reference to and as illustrated in Fig. 6 of the accompanying drawings.
19. A valve constructed substantially as herein described with reference to and as illustrated in Fig. 7 of the accompanying drawings.



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