

SPECIFICATION
Bellows Valve

5 The present invention relates to valves and more particularly to valves of the type commonly referred to as bellows valves.

The invention is an improvement in the bellows valves described in U.S.A. Patents Nos. 3,278,156 and 3,787,023.

10 Characterized by a bellows component serving to seal off the interior of the valve from the atmosphere and at the same time, to accommodate movements of the valve stem during the operating cycle, bellows valves have found increasingly wide acceptance. In principle, 15 the bellows valve concept presents notable advantages in so-called "closed system" applications involving the handling of corrosive and/or hazardous fluids at high temperatures and pressures. Most known prior art bellows valves 20 have, however, failed for various reasons to meet or exceed the rising standards imposed by increasingly sophisticated systems.

The bellows valves described in the aforementioned U.S.A. Patents Nos. 3,295,191 25 and 3,278,156 have proved to be valuable advances in the state of the art, but it has now been found desirable to further improve the basic design for purposes of permitting valve use in higher pressure and temperature applications 30 than has heretofore been possible.

In accordance with the present invention, there is provided a bellows valve having a valve body and a reciprocable valve stem with a valve closure 35 member at its forward or inner end cooperable with a valve seat in the valve body and having a bellows type seal between the valve stem and the valve body, a forward or inner end of the bellows being attached to a forward or inner end of the valve stem adjacent the valve closure member 40 and its rearward or outer end being attached to a rearward or outer end of an adapter bush which is sealingly secured to the valve body with the bellows extending through at least a part of the adapter bush and with the stem extending 45 through the bellows, the adapter bush the bellows and the valve stem with the valve closure member thereon, forming an assembly of which the adapter bush is closely received in an opening in a bonnet portion of the valve body, a forward or 50 inner end of the adapter member serving as a stop with which the valve closure member cooperates to limit movement of the valve closure member in the opening direction, and furthermore having urging means cooperating with the rear or outer 55 end of the valve stem for moving the valve stem forwardly in its closing direction and separate urging means also cooperating with the rear or outer end of the valve stem for moving it rearwardly in its opening direction.

60 Preferably the bonnet opening has a diameter greater than the diameter of the passageway with the bonnet opening and passageway merging at a radially disposed circumferential bonnet shoulder and the adapter bush has an innermost portion

65 including the adapter inner end closely received in the passageway and a main adapter body closely received in the bonnet opening. The adapter innermost portion and main body merge at a radially disposed circumferential adapter shoulder 70 adapted to closely mate with the bonnet shoulder. Seal means is disposed between the adapter and bonnet shoulders to prevent fluid flow from the valve therepast.

The first and second urging means can 75 comprise respectively a handle and spring biasing means, to facilitate manual valve operation, or operative portions of an actuator device to facilitate remote valve operation.

The valve closure member can include a 80 separate valve plug or insert member retained by the valve closure member, which plug is adapted to selectively engage the valve seat for closing the valve.

The bellows may include connecting flanges at 85 the opposite ends thereof, one of these flanges being welded to the adapter bush and the other flange being welded to the valve stem adjacent the valve member.

The said assembly may be readily removable 90 from the valve body for repair or replacement purposes.

The valve plug is preferably constructed from a 95 non-metallic material which is softer than the valve seat itself for eliminating metal to metal sealing contact.

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

Figure 1 is a side elevational view of a bellows 100 valve constructed according to one embodiment of the invention;

Figure 2 is a larger-scale sectional view of the valve shown in Figure 1;

Figure 3 is a view of a valve assembly of the 105 bellows valve shown in Figure 2 with portions thereof shown in cross-section;

Figure 4 is a larger-scale view of the upper circled area in Figure 2;

Figure 5 is a larger-scale view of the lower 110 circled area in Figure 2;

Figure 6 is a side elevation, partly sectioned, showing a remote actuator mounted on the valve of Figures 1 to 5;

Figure 7 is a side elevational view, partially 115 sectioned, of a slightly modified form of the valve body; and

Figure 8 is an inverted plan view of the valve body shown in Figure 7.

Referring now to the drawings which illustrate 120 preferred and alternative embodiments of the invention by way of example only and not for purposes of limiting same, a bellows valve has a valve body A, a valve assembly B and valve control means C.

125 With reference to Figures 1 to 3, the valve body A includes a generally cubic body portion 10 having an inlet passage 12 and an outlet passage 14 both communicating with a cylindrical valve chamber 16. The chamber 16 is defined by a

passageway extending inwardly into the body portion 10 from an open seat or upper end 18 towards a closed forward or lower end 20. The inlet and outlet passages 12, 14 communicate with the valve chamber 16 on opposite sides of a valve seat 22 formed therein.

Screw-threaded outward extensions 30, 32 on opposite sides of the body portion 10 have the passages 12, 14 passing therethrough. These threaded extensions are adapted to receive conventional tube or pipe fittings 34 for connecting the valve into a fluid system. An external screw-thread 36 disposed on the upper surface of the valve body is adapted to receive a lock nut 38 for conveniently panel mounting the valve on a panel P, as shown in Figure 1.

A bonnet 40 is integral with and extends rearwardly or upwardly from the body portion 10 and includes a bonnet opening 42 disposed coaxially with the valve chamber 16. The bonnet opening 42 has a larger diameter than does the valve chamber 16 with the opening and chamber meeting at a radially extending circumferential bonnet shoulder 44. The function of the shoulder 44 will be described in greater detail hereinafter. Extending axially inwardly from the outer open end of bonnet opening 42 are internal screw threads 46 and extending axially inwardly from the outer end of the bonnet 40 are external screw threads 48.

While the valve body A could be constructed from any one of a number of materials, in the preferred embodiment brass is advantageously employed. However, stainless steel or the like could also be employed to enable valve use in different or special environments without in any way departing from the overall intent or scope of the present invention.

In the manually operated valve of Figs. 1 to 3, the valve assembly B comprises an adapter bush 60 (hereinafter called an "adapter nut 60"), a valve stem 62, a valve member 64, a biasing means 66 and a bellows 68. This valve assembly is shown in an installed position in Figure 2 and by itself in Figure 3. The arrangement of the valve assembly itself and the co-operative relationships when it is received in the valve body are deemed to provide improved structural and operational benefits than have heretofore been obtainable with prior art bellows valves.

More particularly, the adapter nut 60 has an adapter nut opening 80 passing therethrough from a rear or outer end face 82 to the forward or inner end 84 thereof. When the adapter nut 60 is in position in the valve body as shown in Figure 2, the opening 80 is disposed coaxially with the valve chamber 16 and the bonnet opening 42. A sleeve-like portion 86 extends from the adapter nut inner end 84 towards the adapter nut outer end face 82 and merges at a radially disposed circumferential adapter nut shoulder 88 with the upper adapter nut portion 90. The sleeve-like portion 86 is dimensioned to be closely slidably received in the valve chamber 16 and the adapter nut shoulder 88 is dimensioned to co-operate

with the bonnet shoulder 44 in a manner to be described. The upper adapter nut portion 90 includes an external screw thread 92 thereon adapted to threadedly co-operate with the

internal threads 46 in the bonnet opening 42. A generally flat seal ring 94 is closely received over the sleeve-like portion 86 against the shoulder 88 as shown in Figure 3. When the valve assembly B is inserted into the valve body A as shown in Figure 2, the seal ring is compressed between the shoulders 44, 48 to facilitate fluid sealing between the valve assembly B and the valve body A. A radially outwardly extending circumferential flange 96 is disposed about the upper adapter nut portion 90 at the rear end face 82 thereof to facilitate ease of installation of the valve assembly in the valve body. To this end, the flange 96 has a polygonal configuration to provide convenient wrench flats. A groove 98 is formed in the adapter nut portion 90 to extend longitudinally along the screw thread 92. This groove facilitates convenient leak testing of the seal ring 94.

In the preferred embodiment, the adapter nut 60 is constructed from bronze and the seal ring 94 is constructed from KEL-F (Registered Trade Mark) or the like. Other types of materials could also be advantageously employed without in any way departing from the overall intent or scope of the invention. Indeed, and as to seal ring 84, other materials more compatible with the fluid system in which the valve is to be used could well be more desirably employed.

The valve stem 62 comprises an elongated shaft 100 dimensioned to extend through the adapter nut 60 and protrude outwardly from both ends thereof and including a domed rear or outer end 102 and a flanged forward or inner end 104. The valve member 64 is disposed at the stem forward end 104 and comprises a guide portion 106 and a valve portion or plug 108. The guide portion 106 has a generally polygonal cross-section comprising a plurality of alternating sides 110 and transition zones 112. In the preferred arrangement, the guide member is dimensioned to be fairly closely slidably received in the valve chamber 16 and has a generally hexagonal configuration although other configurations could also be advantageously employed. This provides for equal guiding and piloting of the valve member 64 as well as a reduction in the amount of contact with the chamber side wall to thereby reduce rubbing and the like. The polygonal configuration further provides a good "pump down" feature for the valve.

The valve portion or plug 108 comprises a cylindrical body 116 having a frusto-conical end area 118 with a substantial portion of the body 116 being received in a blind sleeve-like cavity 120 at the innermost end of the valve member at guide portion 106. Frusto-conical area 118 is dimensioned so that it may be selectively received against valve seat 22 (Figure 2) for purposes of controlling fluid flow through the valve. An inwardly rolled area 122 extends circumferentially

valve portion 108 in position in the cavity 120.

5 In the preferred embodiment the stem 62 and the guide member portion 106 of the valve member 64 are constructed from bronze with the valve portion 108 being constructed from KEL-F (Registered Trade Mark) or the like. Other materials could also be advantageously employed without in any way departing from the overall intent or scope of the invention for
10 accommodating particular valve applications and be compatible with the system fluid.

The bellows 68 has a hollow open ended accordian-like configuration. In the preferred
15 arrangement, the bellows is constructed from bronze and includes a bellows body 130 having a rear or outer end 132 and a forward or inner end 134. As best shown in Figures 4 and 5, a first flange 136 is provided at the bellows rear end and a second flange 138 is provided adjacent the
20 bellows forward end. As with prior designs, the bellows is designed to prevent valve leakage and replaces the more conventional stem packing seal arrangements. The diameter of the bellows body 130 is such that it may be received through the adapter nut opening 80 and be expanded and contracted without causing any interference relationship between the bellows and the side walls of the opening. In Figure 4, it will be seen
30 that flange 136 is closely received against the side wall of the adapter nut opening 80 adjacent the rear end face 82. The bellows rear end is retained in this position by inert welding techniques to eliminate use of brazing or soldering which has been widely utilized heretofore. Because of the use of inert welding techniques, there is no residue from flux or the like formed when using brazing or soldering which could contaminate the fluid system when the
40 valve is placed into actual use. Figure 5 shows the flange 138 at the bellows forward end 134 closely received against the outside surface of the flanged inner end 104 of the stem. The bellows forward end 134 is retained in this position by the same inert gas welding techniques discussed above and the details of the inert gas welding techniques may vary if desired to accommodate valve applications. With the bellows so installed, a portion of the elongated stem shaft 100 is
50 sealingly surrounded thereby.

Referring particularly again to Figure 3, the biasing means 66 comprises a compression spring 150 interposed between a flat retaining washer 152 and the rear end face 82 of the
55 adapter nut 60. A conventional snap ring 154 or the like is received in a groove 156 for retaining the washer 152 in position. As shown in Figure 3, the spring 150 acts against the washer 152 continuously to urge the stem and the valve member outwardly or rearwardly of the adapter
60 nut 60 until the inner end 84 thereof is engaged by the rear surface of the valve member as defined by the guide portion 106.

Referring again to Figure 2, the entire valve
65 assembly B is mounted in the valve body A by

internal threads 46 on the bonnet opening 42 and the external threads 92 on the upper adapter nut portion. The adapter nut 60 is threadedly
70 advanced into the bonnet opening until the shoulders 44, 88 compressingly engage the seal ring 94 so as to provide a fluid tight relationship therebetween. As noted above, the bellows 68 seals the stem area. Once so installed, the stem
75 62 may be moved inwardly or outwardly of the adapter nut 60 to cause a corresponding movement of the valve member in the valve chamber 16 for controlling fluid flow through the valve. In the arrangement shown in Figure 2, the
80 frusto-conical area 118 of the valve portion or plug is in engagement with the valve seat area 22 for preventing fluid flow from the inlet passage 12 to the outlet passage 14. If desired, the flange 96 of the adapter nut 60 may be brazed to the outer end face of the bonnet area 40 when an
85 hermetically sealed valve is desired. Since the soft valve portion or plug is spaced from this area, no heat damage will be imparted thereto.

To enable selective opening and closing of the
90 valve, valve control means C is provided. In the arrangement shown in Figures 1 and 2, this means comprises a knob or handle member 160 having a radially outwardly flanged portion 162 and a hollow cup-shaped main body portion 164.
95 This hollow cup-shaped body portion includes internal screw threads 166 adapted to threadedly mate with the external threads 48 on the bonnet 40. Also, a conical recess 168 co-operates with the domed outer end 102 of the stem shaft 100 and a fluid test port 170 communicates through
100 the side wall of the body portion 164. As the knob 160 is threadedly advanced onto the bonnet 40, the outward urging force of the spring 150 is overcome and the valve stem and valve member are urged forwardly for inwardly into the valve chamber 16 until the frusto-conical area 118 of the valve portion or plug engages the valve seat 22. As the knob is threadedly retracted from the bonnet 40, the spring 150 causes the stem and
110 valve member to be moved rearwardly or axially outwardly through the valve chamber and permit fluid flow from the inlet passage 12 to the outlet passage 14. Due to the relationship between the conical area 168 of the knob and the domed configuration of the stem outer end 102, threaded
115 movement of the knob 160 relative to the bonnet 40 causes only translatory movement of the stem and valve member without appreciable torque transmission so as to not disturb or destroy the bellows or its mounted relationship at the
120 opposite ends thereof. In the preferred arrangement, the stem and valve member stroke may be in the range of only 1.6 mm or so. When the valve member requires maintenance or replacement, it is simply necessary to remove the entire valve assembly B from the valve body A for
125 easy access thereto.

Figure 6 shows the bellows valve of Figures 1 to 5 with knob or handle 160 replaced by a
130 remotely controlled actuator arrangement 172.

While this actuator arrangement may take many forms or be of several different types, a double acting air operated actuator has been generally shown for illustrative purposes.

5 In this arrangement for accommodating an actuator, the knob or handle is removed from the valve and the snap ring 154, the washer 152 and the spring 150 are removed from the valve assembly B in order that a cup shaped adapter fitting 174 having an internal screw thread 176 may be threadedly received on the external threads 48 of the bonnet 40. An externally screw threaded spigot 178 extends outwardly from the adapter fitting 174 on the other side thereof from the cup-shaped portion and a bore 180 passes through the spigot 178 into communication with the inside of the cup-shaped portion. When the adapter fitting 174 is installed on the bonnet, the bore 180 is coaxial with the shaft 100 in order that the shaft may be received therein. An actuator body 182 having a screw-threaded cavity 184 is threadedly mounted on the spigot 178 with a washer 186 advantageously disposed therebetween.

25 A multi-diameter bore 188 extends through the actuator body 182 and receives an actuator rod 190 therethrough. The lowermost end of the rod includes an enlarged head 192 having a stem receiving cavity 194 extending axially inwardly from the lowermost end thereof for receiving the uppermost end of the shaft 100. A retaining pin 196 passing through the head 192 and the shaft 100 maintains these components in co-operative engagement with each other. The uppermost end of the rod 190 is conveniently affixed to a diaphragm assembly 198 which is employed to selectively open and close the valve by causing translatory movement of the valve stem and the valve member through the rod 190. A fluid port 200 penetrates the side wall of the actuator body 182 and facilitates passing air under pressure through a passage 202 to a cavity area 204 on one side of the diaphragm assembly 198 for selectively moving the valve to an open position.

45 An actuator body cap 208 is screw-threadedly received at 210 on the actuator body 182. A fluid port 212 penetrates the top wall of the cap and facilitates passing air under pressure into a cavity 214 on the other side of the diaphragm assembly 198 for selectively moving the valve to a closed position.

Appropriate conventional control means (not shown) may be provided to control opening and closing of the valve as may be necessary and/or desired. While the arrangement of Figure 6 shows a double acting air actuator with the separate ports 200 and 212 serving as the means for moving the valve stem rearwardly and forwardly, other types and styles of actuators are equally applicable to use with the present bellows valve. For example, normally open and normally closed types of actuators as well as actuators other than air operated actuators could also be advantageously employed. Moreover, other means for affixing the actuator to the valve could

be used for accommodating different system environments or valve applications and which other means may not necessarily require removal of the snap ring 154, the washer 152 and the spring 150 from association with the valve assembly B.

Several features of the illustrated bellows valve are deemed to aid in providing improvements. First, its design facilitates use of a soft seat type valve portion 108 which can be made from a KEL-F (Registered Trade Mark) or other soft materials compatible with a fluid system in which the valve is to be used. This then eliminates any metal-to-metal contact between the valve member and the valve seat as has heretofore been the case for some prior bellows valve designs. One reason that metal valve members have previously been employed was simply due to the nature of construction and assembly for some prior valves. In this regard, the bellows valve arrangement shown in U.S.A. Patent No. 3,295,191 requires brazing or soldering closely adjacent the valve member during valve assembly. Such brazing or soldering would adversely affect the physical integrity of the soft valve portion or plug 108.

With the present bellows valve, however, all welding brazing or soldering required for valve assembly B can be performed prior to the time that the soft valve portion or plug type insert is inserted into the sleeve-like cavity 120. Moreover, and since a soft valve member is so readily employable with the valve, the valve is more readily adapted to use with air or other remote actuators or operators. While it was possible to employ air operators or the like with prior bellows valve designs having metal-to-metal contacting valve members and valve seats, it was necessary to employ oversized actuators to insure a good positive sealing relationship between the valve members and the valve seats. Thus, the present design permits use of smaller air operators or remote actuators such as that shown in Figure 6 while still insuring good valve sealing results.

Still another advantage to the bellows valve is in the reduced annular sealing area between the valve assembly B and the valve body A. That is, the present design provides a reduced sealing area between the bonnet shoulder 44, the adapter shoulder 88 and the sealing ring 94. Because this sealing area or diameter is smaller than that employed in many prior bellows valves designs, it permits higher pressure ratings for the valve due to a corresponding reduction in thrust exerted at the sealing area during valve use.

Still further, the bellows 68 in the present design is inverted or reversed from some prior designs over which the present valve is deemed to provide a specific improvement. That is, in the new design, fluid pressure from system fluid is exerted on the outside surface of the bellows rather than the inside. Since the bellows can withstand greater external or compressive forces than internal or tensional ones, this feature aids in allowing the valve to be useable at higher system pressures. Moreover, overall valve design permits

- the diameter of the bellows 68 to be less than the bellows diameter of many prior valve designs for reducing the pressure load. This too aids in permitting valve use at higher fluid system pressures. Prior valves for which the present design provides a specific improvement have been rated at $4.14 \times 10^6 \text{ N/m}^2$ maximum whereas the present design has a rating of $6.9 \times 10^6 \text{ N/m}^2$ maximum. Moreover, prior such valves have a maximum temperature rating of $149^\circ \text{ Celsius}$ at $6.9 \times 10^5 \text{ N/m}^2$ whereas the present design has a maximum temperature rating of $149^\circ \text{ Celsius}$ at $3.45 \times 10^6 \text{ N/m}^2$. Thus, the overall design of the present valve provides much improved valve capabilities over far wider pressure ranges.

- Finally, the valve assembly B is such that it may be removed as a unit from co-operation with the valve body A. This feature is advantageous from a valve servicing and maintenance point of view.
- Many prior bellows valves have incorporated such designs that rendered it very difficult and, in some instances, impossible to gain access to the valve assembly for repair or replacement purposes thereby necessitating costly repair time or replacement of the entire valve in the event of valve malfunction.

- Referring now to Figures 7 and 8, a slight modification to the valve body is shown therein. For ease of illustration and appreciation of the changes, like components are identified by like numerals and new components are identified by new numerals. Here, a tube stub 220 is closely received in and associated with the inlet passage 12' and a tube stub 222 is similarly closely received in and associated with the outlet passage 14'. These tube stubs merely facilitate placement of the valve in a fluid system by other conventional means. Here also, the body portion 10' of the valve body A' has a generally cylindrical configuration which thereby facilitates machining of the valve body from conventional round stock. As shown in Figure 8, suitable tapped holes 230, 232 are provided in the bottom wall of the valve body to facilitate bracket mounting in the event that the panel mounting feature through use of the nut 38' is not possible or feasible. The remaining features of the overall design for the Figures 7 and 8 embodiment are substantially the same as hereinbefore previously discussed with reference to Figures 1 to 6.

- The new and improved bellows valve structure has been described with reference to the preferred and alternative embodiments. Obviously, modifications and alterations will occur to others upon the reading and understanding of this description. All such modifications and alterations are included insofar as they come within the scope of the claims or the equivalents thereof.

60 Claims

1. A bellows valve having a valve body and a reciprocable valve stem with a valve closure member at its forward or inner end cooperable with a valve seat in the valve body and having a

- bellows type seal between the valve stem and the valve body, a forward or inner end of the bellows being attached to a forward or inner end of the valve stem adjacent the valve closure member and its rearward or outer end being attached to a rearward or outer end of an adapter bush which is sealingly secured to the valve body with the bellows extending through at least a part of the adapter bush and with the stem extending through the bellows, the adapter bush the bellows and the valve stem with the valve closure member thereon, forming an assembly of which the adapter bush is closely received in an opening in a bonnet portion of the valve body, a forward or inner end of the adapter member serving as a stop with which the valve closure member cooperates to limit movement of the valve closure member in the opening direction, and furthermore having urging means cooperating with the rear or outer end of the valve stem for moving the valve stem forwardly in its closing direction and separate urging means also cooperating with the rear or outer end of the valve stem for moving it rearwardly in its opening direction.

2. A bellows valve according to Claim 1 in which the adapter bush has a shoulder at or adjacent its forward or inner end and the housing has a complementary shoulder disposed forwardly or inwardly of the bonnet opening, the shoulders being held in abutment with one another with sealing means disposed therebetween.

3. A bellows valve according to Claim 2 in which the rear or outer portion of the adapter bush has screw threads which mate with internal threads in the bonnet opening.

4. A bellows valve according to Claim 2 or 3 in which the adapter bush has a sleeve-like portion which projects forwardly or inwardly within a reduced diameter cylindrical portion of the bonnet opening and the forward end of which provides the stop for the valve closure member.

5. A bellows valve according to any of Claims 1 to 4 in which the valve closure member has a separate valve portion thereon sealingly engageable with the valve seat.

6. A bellows valve according to Claim 5 in which the material of the separate valve portion is softer than the material of the valve seat.

7. A bellows valve according to any of Claims 1 to 6 in which the valve closure member has a guide portion which is slidably guided in a bore in the valve body.

8. A bellows valve according to Claim 7 in which the guide portion of the valve closure member is of polygonal cross section.

9. A bellows valve according to any of Claims 1 to 8 in which the bellows has at its rearward or outer end a connecting flange which is welded to the rearward or outer end of the opening in the adapter bush and has at its forward or inner end a connecting flange which is welded to the forward or inner end of the valve stem.

10. A bellows valve according to any of Claims 1 to 9 in which the means for moving the valve

bellows diameter of many prior valve designs for reducing the pressure load. This too aids in permitting valve use at higher fluid system pressures. Prior valves for which the present design provides a specific improvement have been rated at 4.14×10^6 N/m² maximum whereas the present design has a rating of 6.9×10^6 N/m² maximum. Moreover, prior such valves have a maximum temperature rating of 149° Celsius at 6.9×10^6 N/m² whereas the present design has a maximum temperature rating of 149° Celsius at 3.45×10^6 N/m². Thus, the overall design of the present valve provides much improved valve capabilities over far wider pressure ranges.

Finally, the valve assembly B is such that it may be removed as a unit from co-operation with the valve body A. This feature is advantageous from a valve servicing and maintenance point of view. Many prior bellows valves have incorporated such designs that rendered it very difficult and, in some instances, impossible to gain access to the valve assembly for repair or replacement purposes thereby necessitating costly repair time or replacement of the entire valve in the event of valve malfunction.

Referring now to Figures 7 and 8, a slight modification to the valve body is shown therein. For ease of illustration and appreciation of the changes, like components are identified by like numerals and new components are identified by new numerals. Here, a tube stub 220 is closely received in and associated with the inlet passage 12' and a tube stub 222 is similarly closely received in and associated with the outlet passage 14'. These tube stubs merely facilitate placement of the valve in a fluid system by other conventional means. Here also, the body portion 10' of the valve body A' has a generally cylindrical configuration which thereby facilitates machining of the valve body from conventional round stock. As shown in Figure 8, suitable tapped holes 230, 232 are provided in the bottom wall of the valve body to facilitate bracket mounting in the event that the panel mounting feature through use of the nut 38' is not possible or feasible. The remaining features of the overall design for the Figures 7 and 8 embodiment are substantially the same as hereinbefore previously discussed with reference to Figures 1 to 6.

The new and improved bellows valve structure has been described with reference to the preferred and alternative embodiments. Obviously, modifications and alterations will occur to others upon the reading and understanding of this description. All such modifications and alterations are included insofar as they come within the scope of the claims or the equivalents thereof.

60 Claims

1. A bellows valve having a valve body and a reciprocable valve stem with a valve closure member at its forward or inner end cooperable with a valve seat in the valve body and having a

valve body, a forward or inner end of the bellows being attached to a forward or inner end of the valve stem adjacent the valve closure member and its rearward or outer end being attached to a rearward or outer end of an adapter bush which is sealingly secured to the valve body with the bellows extending through at least a part of the adapter bush and with the stem extending through the bellows, the adapter bush the bellows and the valve stem with the valve closure member thereon, forming an assembly of which the adapter bush is closely received in an opening in a bonnet portion of the valve body, a forward or inner end of the adapter member serving as a stop with which the valve closure member cooperates to limit movement of the valve closure member in the opening direction, and furthermore having urging means cooperating with the rear or outer end of the valve stem for moving the valve stem forwardly in its closing direction and separate urging means also cooperating with the rear or outer end of the valve stem for moving it rearwardly in its opening direction.

2. A bellows valve according to Claim 1 in which the adapter bush has a shoulder at or adjacent its forward or inner end and the housing has a complementary shoulder disposed forwardly or inwardly of the bonnet opening, the shoulders being held in abutment with one another with sealing means disposed therebetween.

3. A bellows valve according to Claim 2 in which the rear or outer portion of the adapter bush has screw threads which mate with internal threads in the bonnet opening.

4. A bellows valve according to Claim 2 or 3 in which the adapter bush has a sleeve-like portion which projects forwardly or inwardly within a reduced diameter cylindrical portion of the bonnet opening and the forward end of which provides the stop for the valve closure member.

5. A bellows valve according to any of Claims 1 to 4 in which the valve closure member has a separate valve portion thereon sealingly engageable with the valve seat.

6. A bellows valve according to Claim 5 in which the material of the separate valve portion is softer than the material of the valve seat.

7. A bellows valve according to any of Claims 1 to 6 in which the valve closure member has a guide portion which is slidably guided in a bore in the valve body.

8. A bellows valve according to Claim 7 in which the guide portion of the valve closure member is of polygonal cross section.

9. A bellows valve according to any of Claims 1 to 8 in which the bellows has at its rearward or outer end a connecting flange which is welded to the rearward or outer end of the opening in the adapter bush and has at its forward or inner end a connecting flange which is welded to the forward or inner end of the valve stem.

10. A bellows valve according to any of Claims 1 to 9 in which the means for moving the valve

stem forwardly in its opening direction comprises spring forming part of the valve assembly.

5 11. A bellows valve according to Claim 10 in which the means for moving the valve stem forwardly in its closing direction overcomes the force of the spring.

10 12. A bellows valve according to Claim 11 in which the means for moving the valve stem forwardly comprises an actuating knob screw-threadedly received on the bonnet portion and in driving engagement with the outer end of the valve stem.

15 13. A bellows valve according to any of Claims 1 to 9 in which at least one of the means for moving the valve stem comprises an actuator.

14. A bellows valve according to Claim 13 in

which one of the means for moving the valve stem comprises an actuator and the other comprises a spring.

20 15. A bellows valve according to Claim 13 in which each of the means for moving the valve stem comprises a fluid-operated actuator.

25 16. A bellows valve according to Claim 15 in which the two actuators have a common actuating diaphragm or piston separating respective actuator chambers.

30 17. A bellows valve according to any of Claims 1 to 16 in which the bonnet portion is integral with the valve body.

18. A bellows valve constructed substantially as herein described with reference to and as illustrated in the drawings.