

VALVE

The invention relates to valves. Although the invention will be described with particular reference to diaphragm valves of the type having a diaphragm clamped between body and bonnet members and rotatably operable valve members, it will be appreciated that the invention has broader applications, and that certain individual features thereof may be used with other types of valves and/or in other environments.

Valves commonly include indicating means for indicating various flow positions of the valve member. In many applications where metal seal packless valves are used, indication of flow position is critical from a safety standpoint. In previous arrangements,

indication of flow position was designated by a simple marking or required the operator to recognize handle orientation relative to the valve body. In the latter case, some types of mountings prohibit this type of recognition.

In previous arrangements, the rotatable operating member is restricted from being moved beyond the set, off position of the valve. If overtravel beyond the off position without adjustment of the valve is not possible, two problems will result after seal wear has occurred. First, the valve cannot be shut off, and second, the handle could be broken by an operator attempting to forcibly close the valve.

When there is no stop means for stopping the operating member in its off position, the operating member may inherently overtravel beyond the off position due to seal wear. Only a highly skilled person would be aware that at some point such overtravel would signify that replacement of the seal

was necessary, and there was no associated means for indicating the point at which such seal replacement was necessary. Therefore, it would be desirable to have an alarming indicating means for clearly indicating to an operator that a seal is worn beyond its normal, useful life and that replacement is necessary.

5 The present invention resides in a valve including a valve body with a valve seat therein; a valve bonnet having a rotatable operating member for moving a valve member between open and closed positions, said valve member carrying a wearable seal co-operable
10 with said valve seat in said closed positions of said valve member; and having co-operating indicating means between said bonnet and said operating member for indicating overtravel of said operating member for its closed position and thereby indicating that replacement
15 of said seal is required.

Preferably, the closed position includes angular ranges over which the seal is effective. One range includes a normal angular range over which the seal is in satisfactory condition, and a second range
20 includes an overtravel or abnormal angular range over which the seal is still functional but should be replaced. When the operating member overtravels beyond the normal closed position, the operator will be readily aware that replacement of the seal is necessary.

14

In a preferred embodiment, the indicia for indicating overtravel of the operating member take the form of adjacent arcuate bands of different colour on the bonnet for cooperation with an indicator on the operating member. When the seal is satisfactory, the indicator on the operating member is aligned with the colour band indicating normal valve closure. When the seal is worn and requires replacement, the indicator on the operating member is aligned with the colour band indicating overtravel, signifying that replacement of the seal is required.

In one embodiment, the indicating means includes an indicating ring member mounted on the valve bonnet beneath the operating member. Specifically, the indicating ring member is mounted on an outer cylindrical end portion of the valve bonnet, and is held thereto by frictional engagement. The indicating ring member includes a central opening or hole receiving an outer cylindrical end portion of the valve bonnet, and has axially extending flange means surrounding the opening for frictionally gripping the outer end portion of the valve bonnet.

Locating means is provided between the locating ring member and the valve bonnet for locating the ring member in a desired rotated position for locating the indicia thereon at the desired angular location. The locating means may take many forms and, in one arrangement, includes a longitudinal groove in the outer end portion of the bonnet receiving an inwardly extending tab on the indicating ring member. The tab on the indicating ring member is located a predetermined distance from the indicia thereon, and the groove in the bonnet is located a predetermined distance from a stop surface which normally cooperates

with a stop projection on the operating member to stop same in the valve open position.

The indicating ring member advantageously includes an inclined surface having the indicia thereon and being visible in directions both parallel and perpendicular to the longitudinal axis of the operating member. The indicating ring member also advantageously includes an outer flange for concealing a panel mounting nut threaded on the bonnet.

According to another aspect of the present invention, a valve includes a valve bonnet having a rotatable operating member for moving a valve member between open and closed positions, said valve member having thereon a wearable seal co-operable with a valve seat in said closed position of said valve member, said closed position including a normal angular range for said operating member over which said seal is satisfactory and an abnormal angular range over which said seal is unduly worn and requires replacement; indicia on said bonnet for indicating said open position, said normal angular range and said abnormal angular range; and indicator means moveable with said operating member for alignment with said indicia to indicate when said operating member is located in said open position of said valve member and when said operating member is located within one or the other of said ranges.

According to a further aspect of the invention,

16

a valve includes a valve bonnet having a rotatable operating member for moving a valve member between open and closed positions, said valve member having a wearable seal co-operable with a valve seat in

5 said closed position of said valve member; and co-operating indicating means between said operating member and said bonnet for indicating positions of said valve member; said indicating means including an

indicating ring member mounted on said bonnet and

10 frictionally retained thereon for indicating over-travel of said operating member in its closed position and thereby signifying that replacement of said seal is required.

In a preferred embodiment, said bonnet has an

15 externally screw-threaded portion for receiving a panel nut and an outer cylindrical end portion; a ring member having a central hole receiving said cylindrical end portion; generally axially extending flange means on said ring member around said hole for gripping said

20 cylindrical end portion; and a generally axially extending outer flange on said ring member for surrounding and concealing the panel nut received on said threaded portion; said ring member having a circumferential inclined outer surface extending

25 between said hole and said outer flange.

In a diaphragm valve in accordance with a preferred embodiment of the invention, a generally circular diaphragm is axially clamped in a circumferential area inwardly of its outer periphery between opposed

5 substantially flat and parallel clamping surfaces on said bonnet and on a valve body which has said valve seat therein.

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

FIGURE 1 is a cross-sectional elevational view of a valve in accordance with the present invention;

FIGURE 2 is an enlarged partial cross-sectional elevational view of a peripheral edge
15 portion of the diaphragm in the valve of FIGURE 1, showing the specific arrangement of the diaphragm and the clamping surfaces between the valve body and valve bonnet;

FIGURE 3 is a partial cross-sectional elevational view showing the enlarged head of an
20 axially movable valve member being guided in a cylindrical bore;

FIGURE 4 is a cross-sectional elevational view taken generally along lines 4-4 of FIGURE 1 showing a
25 cylindrical portion of the valve member being axially guided through a non-circular opening in a guide washer received in a cylindrical bore;

FIGURE 5 is a partial cross-sectional view, taken generally along lines 5-5 of FIGURE 1, with the
30 indicating ring member and panel nut removed for clarity of illustration in showing the top end portion of the valve bonnet;

FIGURE 6 is a view similar to FIGURE 5 for showing a tab on the indicating ring member cooperating with a longitudinal groove in the valve bonnet to prevent relative rotation therebetween;

5 FIGURE 7 is a side elevational cross-sectional view taken generally along lines 7-7 of FIGURE 6;

FIGURE 8 is a view similar to FIGURE 7 for showing an alternative arrangement; and,

10 FIGURE 9 is a plan view of the valve handle shown in FIGURE 1.

Referring now to the drawings, wherein the showings are for purposes of illustrating certain preferred embodiments of the invention only and not for purposes of limiting same, FIGURE 1 shows a valve body
15 A and a valve bonnet B axially clamped together by a bonnet nut C in a known manner, and having a circular metal diaphragm D circumferentially clamped therebetween. Valve body A and bonnet nut C have cooperating threads therebetween generally indicated at
20 numeral 12 for providing axial movement of bonnet nut C relative to body A upon rotational movement of bonnet nut C. Bonnet member B and bonnet nut C have cooperating generally radial shoulders 14 which abut one another for moving bonnet member B towards
25 valve body A upon rotation of bonnet nut C in the appropriate direction to securely clamp diaphragm D therebetween.

An axially movable valve member E has an enlarged head portion 18 slidably guided in a large
30 diameter portion of a cylindrical bore 20. The outer end portion of enlarged head 18 facing toward diaphragm D is generally spherical and the outer periphery of enlarged head portion 18 is generally hexagonal so that

19

only the corners thereof are guided in the cylindrical bore 20, while the flats thereof provide fluid passages to accommodate valve purging. A cylindrical stem portion 24 of valve member E is slidably guided through
5 a guide washer 26 having a cylindrical outer surface closely received in a cylindrical small diameter bore portion 28, and having a hexagonal inner surface to provide passages to accommodate purging.

Inlet and outlet ports 32,34 in valve body A
10 communicate with the valve body bore on opposite sides of a circumferential upstanding seat 36. Fluid inlet and outlet lines (not shown) may be connected to inlet and outlet 32,34, respectively, by convenient known means. A plastic, elastomeric or metal circumferential
15 seal ring 38 is secured to an end portion of valve member E for selective cooperation with seat 36 to prevent or allow fluid flow through the valve. In the "standard" version of the subject new valve, seal ring 38 is constructed from polytetrafluoroethylene.

Seal 38 is attached to valve member E in the
20 manner disclosed in U.S.A. Pat. No. 3,623,699. Briefly, the end portion of valve member E includes a circumferential recess receiving seal ring 38, and inner and outer rims on valve member E are deformed
25 toward one another over the outer end face of the seal ring for holding same in position. This seal arrangement limits cold flow of the seal material which produces better control of the stroke of the valve. This consequently yields better control of diaphragm
30 life which is related to stroke.

A coil spring 40 under compression between guide washer 26 and enlarged head 18 normally urges the valve member E, i.e., seal ring 38, away from seat 36

9

(2)

to provide fluid communication between inlet 32 and outlet 34. In the open position of valve member E, fluid enters the entire cylindrical bore defined by large and small diameter portions 20,28. Upon closing

5 of valve member E by movement of seal 38 back into engagement with seat 36, purging of fluid pressure within the bore is possible because of the hexagonal shape of enlarged head 18 and of the interior surface of guide washer 26.

10 Bonnet B includes a stem G rotatably guided therein. Cooperating external and internal threads between stem member G and bonnet member B are generally indicated by numeral 44 to impart axial movement to

15 stem member G upon rotational movement thereof relative to the bonnet. Instead of using threads, it will be recognized that many different axial operators can be provided for imparting axial movement to valve member E to effect movement between its open and closed

20 positions, and that the manually operated rotatable operating member shown is only illustrative. An enlarged head 48 on valve stem G has a flat surface engaging a corresponding flat surface on a button 50 which, in turn, has a convex surface engaging diaphragm D on the opposite side thereof from enlarged head 18 of

25 valve member E. The stem head and button are cooperatively mounted so as to facilitate relative rotation therebetween around the longitudinal axis of the stem. Button 50 may be of plastic or other suitable materials, and the interface between stem head

30 48 and the button is lubricated to assist allowing relative rotation between the stem and button instead of having the button rotate relative to diaphragm D.

A rotatable operating member generally indicated at H is provided for moving valve member E

35 between its open and closed positions. Enlarged head

21

10

60 is splined onto stem G as at 62 for preventing relative rotation between the head and stem. An operating handle 62 is suitably connected to head 60, and may even be integral therewith. A nut 64 and lock washer 66 secure head 60 to stem G, and a cover plate 61 snaps into a circular recess in the top of head 60 in a known manner. It will be recognized that valve operating member H includes head 60, handle 62, and stem G, and that operating member H is rotatable for moving valve member E axially between its open and closed positions. However, it will be appreciated that other operators may be provided if so desired for cooperating with diaphragm D to move the valve member between its open and closed positions.

FIGURE 2 shows an enlarged peripheral edge portion of body A and bonnet B having diaphragm D axially clamped therebetween. As shown in FIGURE 1, bonnet member B has a generally conical surface portion 70 extending away from diaphragm D opposite from large diameter cylindrical bore portion 20 in the valve body. Conical portion 70 and cylindrical bore portion 20 are also generally shown in FIGURE 2 for reference purposes. Body member A and bonnet member B have spaced-apart opposite flat and parallel circumferential areas 76,78 between which an inner or primary circumferential area of diaphragm D is axially clamped over an inner circumferential area. Tightening of bonnet nut C in FIGURE 1 moves clamping surfaces 76,78 toward one another for squeezing diaphragm D therebetween. As will be noted in FIGURE 2, the circumferential area clamped between clamping surfaces 76,78 is spaced well inwardly from the diaphragm outer periphery.

Body member A and bonnet member B also include secondary flat and parallel clamping surfaces 80,82

spaced axially and radially from primary clamping surfaces 76,78. Primary surfaces 76,78 are separated from secondary surfaces 80,82 by relatively sharp corners 84,86 across which diaphragm D is bent axially as clearly shown in FIGURE 2. The axial spacing between corners 84,86 is less than the normal axial thickness of diaphragm D and less than the axial spacing between clamping surfaces 76,78. As a result, corners 84,86 provide excellent seals against the opposite face surfaces of the diaphragm. Flat and parallel circumferential surfaces 80,82 are spaced-apart from one another no less than, and preferably slightly greater than, the spacing between primary clamping surfaces 76,78. The machining tolerances for body member A and bonnet member B are chosen such that the spacing between surfaces 76,78 will always provide maximum squeeze or clamping action as compared to the amount of squeeze or clamping action between surfaces 80,82. Such action insures that primary diaphragm sealing occurs at areas 76,78 to better accommodate valve purging.

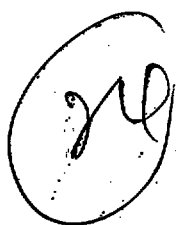
Continuing with reference to FIGURE 2, an outer circumferential flange 90 extends axially from secondary clamping surface 80 on body member A for protecting inner or primary clamping surface 76 against knicks and other damage during processing and assembly of the valve. The axial projection of flange 90 is substantially greater than the axial spacing between primary and secondary surfaces 76,80. Directly opposite from protective flange 90, bonnet member B is provided with an enlarged recess 94 for receiving a terminal end portion 96 of diaphragm D in a free and unclamped condition. Secondary corners generally indicated as 102,104 are axially spaced from one another a distance substantially less than the axial

(23)

spacing between corners 84,86 so that the outer end portion 96 of diaphragm D is axially deformed to a greater degree than the axial deformation thereof between corners 84,86.

5 As a result of the foregoing relationships, opposed pairs of flat clamping surfaces 76,78 and 80,82 define axially and radially spaced clamping surfaces for axially clamping diaphragm D at radially-spaced circumferential areas. Between the inner and outer
10 circumferential clamping areas, diaphragm D is axially bent between corners 84,86.

Diaphragm D is shown as comprising three discs or layers D1, D2, and D3 of equal thickness, although a greater or lesser number of such discs could be
15 suitably employed in some instances. It has been found that such an arrangement provides enhanced flexibility without substantially reducing the strength or life of the composite diaphragm construction. In the preferred arrangement, each disc diaphragm forming disc comprises
20 a flat circular member of austenitic type 316 stainless steel heat treated to a hardness of not less than 38 on the Rockwell C scale. Such hardness is considered to be a "fully hardened" condition for the particular material involved, and effectively enhances the overall
25 cycle life of diaphragm D. Normally, stainless steel diaphragms are constructed from material having a hardness of approximately 27 on the Rockwell C scale, i.e., "quarter hard". It has been found that an increase in diaphragm hardness increases its strength
30 which, in turn, increases its cycle life in a generally linear relationship. Thus, an increase in hardness from approximately 27 to approximately 38 on the Rockwell C scale increases the diaphragm cycle life by a factor of about two. This result indeed comprises a
35 significant improvement over prior art stainless steel



diaphragm constructions. While 316 stainless steel is employed in the preferred construction, it will be appreciated that other materials and hardness relationships could be used for different types of service.

Typically, discs D1, D2, and D3 are stamped from sheet form and thus include a burr around the outer periphery thereof. The improved arrangement of the present invention, however, securely clamps the diaphragm at circumferential areas spaced radially inward from the outer periphery, so any burrs cannot possibly interfere with obtaining secure clamping and sealing. Discs D1, D2, and D3 are physically separate and are not bonded together in any way. The discs are held together simply by the clamping force exerted between the valve body and bonnet as described above. The laminated or layered diaphragm construction requires less force to flex, but has a strength which is about as great as a single layer diaphragm having the same thickness as the combined thickness of discs D1, D2, and D3.

FIGURE 3 shows enlarged hexagonal head 14 on valve member E as having its corners axially guided in large diameter bore portion 20. The flat areas of the head are spaced from the wall of the bore to accommodate valve purging. FIGURE 4 shows cylindrical stem portion 24 of valve member E as being axially guided by flats defined by the internal hexagonal opening in guide washer 26. Spaces are advantageously defined between cylindrical stem 24 and the corners of the non-circular interior surface of washer 26 to facilitate purging.

Bonnet B is illustrated in FIGURE 1 as including an external threaded portion 108 receiving a panel nut 110. Threaded portion 108 is closely

receivable through an opening in a panel (not shown), and the panel is clamped between the panel nut 110 and bonnet nut C to securely mount the valve thereto.

Shims may be provided on the underside of the panel against bonnet nut C for desired location of panel nut 110 adjacent the outer end portion of bonnet B when the valve is in a mounted position.

As shown with primary reference to FIGURE 5 and with secondary reference to FIGURE 1, the outer end portion of bonnet B includes a generally cylindrical surface 114 spaced radially inward from threaded portion 108 and separated therefrom by a circumferential radial shoulder 116. Cylindrical end portion 114 is cut-away as generally indicated at 120 over an axial extent less than the distance from its outer terminal end to shoulder 116. Cut-away portion 120 has opposite axially extending end surfaces 122, 124, and the axial bottom of cut-away portion 120 is axially spaced slightly from radial shoulder 116 so that a substantially complete circumferential surface still exists around the outer end portion of the bonnet. End surfaces 122, 124 may be angularly spaced from one another substantially greater than 90° and less than 180°.

At least one end surface, i.e., end surface 124 defines a stop surface for stopping rotation of operating member H in its open position. A locating means in the form of an axial groove 130 is provided in the outer end portion of bonnet B. Groove 130 is angularly spaced approximately 90° from stop surface 124 as generally indicated by angle 134, and is used for purposes to be described.

With continued reference to FIGURES 1 and 5, an indicating ring member J has a central opening or hole therethrough and is frictionally received on outer

cylindrical end portion 114 of stem B. The central opening or hole includes generally axially extending flange means 138 for frictionally gripping bonnet outer cylindrical portion 114. It will be recognized that axially extending inner flange means 138 may be circumferentially continuous or may comprise a plurality of circumferentially-spaced flanges for frictionally or resiliently gripping the bonnet outer cylindrical portion.

10 Inner flange 138 includes a terminal end 140 which normally abuts shoulder 116 (FIGURE 5). Ring member J includes a generally axially extending outer circumferential flange 142 having a terminal end 144 axially spaced a substantial distance away from the
15 terminal end 140 of inner flange means 138. Outer flange 142 surrounds, covers, and conceals panel nut 110 when the valve is mounted to a panel. A circumferential inclined surface 150 extends from outer flange 142 toward the central opening in the ring
20 member. In the arrangement shown, inclined surface 150 is inclined at an angle of approximately 45° to longitudinal axis 152 of bonnet B, stem G and operating member H. A small circumferential horizontal portion 156 extends between inclined surface 150 and the
25 central opening in ring member J. Inclined surface 150 is located relative to head 60 and positioned such that it is visible in directions both parallel and perpendicular to longitudinal axis 152.

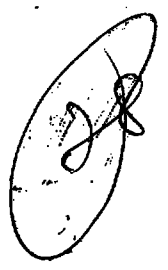
As shown in FIGURE 6, axially extending inner
30 flange 138 on ring member J includes a radially inward extending tab 160 for close reception in groove 130 of bonnet member B. Tab 160 may take many forms, including an inclined inwardly extending portion of flange 138, or a perpendicularly extending tab from the
35 bottom edge of the flange. Groove 130 and tab 160

cooperate with one another to properly locate indicating ring member J relative to bonnet B for positioning certain indicia on ring member J in the proper location.

5 As shown in FIGURE 7, tab 160 is shown as simply comprising an inwardly inclined slit portion from circumferential flange 138. FIGURE 8 shows tab 160a as comprising a generally radially inward
10 extending extension from the bottom end of inner flange 138.

Referring to FIGURES 1 and 9, operating means H includes a pointer or indicator means 180 and a stop pin 182. Upon rotation of operating member H to its full open position, pointer or indicator means 180 will
15 be aligned with an indicator line 184 on inclined surface 150 of indicating ring member J. In this position, stop pin 182 carried by head 60 will engage stop surface 124 (FIGURE 5) for stopping rotation of the valve operating member in its full open position.
20 In this position, coil spring 40 moves valve member E axially upward in the view of FIGURE 1 to its full open position wherein seal 38 is axially displaced from seat 36.

When the valve is closed, handle 62, i.e.,
25 operating member H, is rotated clockwise in the view of FIGURE 9 until pointer 180 is located in a closed normal angular range 202. This range is defined between radial lines 204, 206 arcuately spaced apart from each other by an angle of approximately 27.5° ,
30 with line 204 being located slightly less than 90° from line 184 and line 206 being located greater than 90° therefrom. An abnormal angular range generally indicated by numeral 208 extends between radial lines 206, 210 over an angle of approximately 22.5° adjacent
35 range 202. In the preferred arrangement, area 202 is



colored green between lines 204, 206 to provide an arcuate band of one color for indicating a normal closed position for the valve when pointer 180 is aligned therewith. When seal 38 is unduly worn so that replacement thereof is or soon may be necessary, pointer 180 will overtravel beyond normal closed range 202 into abnormal angular range 208. Range 208 is colored red for indicating and alarming an operator that replacement of seal 38 is necessary. In the event seal 38 is substantially worn and a replacement seal is not immediately available, it is possible to temporarily readjust operating member H on stem G for permitting the seal to sealingly engage seat 36 in the valve closed condition.

Cut-out end surface 122 (FIGURE 5) is angularly spaced well beyond warning band 208 so that stop pin 182 (FIGURE 1) on operating member H will not engage surface 122, even though pointer 180 is approaching travel beyond warning area 208. Adjacent contrasting color bands 202, 208 are located on inclined surface 150 so they are readily visible in directions both parallel and perpendicular to longitudinal axis 152.

It will be recognized that valve open position indicia 184 on ring member J has a predetermined angular relationship with locating means 160 and with indicating means 202, 208. This relationship is such that assembly or disassembly of the valve always ensures that indicating ring member J is installed in proper position because of the necessary alignment of locating means 130, 160. This properly locates color bands 202, 208 in the closed position of the valve member with respect to a rotatable valve operating member.

It will also be recognized that the improved

arrangement of the present application provides cooperating indicating means between operating member H and bonnet B for indicating overtravel of operating member H in its closed position to thereby indicate that replacement of seal 38 is required. In the arrangement shown and described, the indicating means takes the form of an indicator 180 on operating member H and indicating bands 202, 208 on an indicating ring member J attached to bonnet B. However, it will be recognized that many other arrangements are possible without departing from the scope of the invention. Furthermore, instead of merely indicating open and overtravel positions of an operating member, it will be appreciated that indicating ring member J can be used additionally for many other purposes, including concealment of panel nut 110 and the performance of other indicating functions having appropriate indicia thereon.

The improved indicia arrangement of the present invention indicates the open position of the valve, a normal angular range of closed positions, and an abnormal range of closed positions. Thus, the user of the valve can readily determine visually whether the valve is open, closed or that the seal requires replacement. The simplified manner of attaching the indicator ring member to the valve bonnet makes it possible to easily remove and replace the valve, or to renew its components. The indicating ring member accommodates this capability

by having locating means defined by cooperating groove 130 and tab 160 for properly positioning ring member J with its indicating bands 202,208 in the desired circumferential location.

- 5 Attention is drawn to divisional application No. 85 24981 in which a diaphragm clamping arrangement as described herein is claimed.



20

CLAIMS

1. A valve including a valve bonnet having a rotatable operating member for moving a valve member between open and closed positions, said valve member carrying a wearable seal co-operable with a valve seat in said closed position of said valve member; and having co-operating indicating means between said bonnet and said operating member for indicating overtravel of said operating member in its closed position and thereby indicating that replacement of said seal is required.

2. A valve as claimed in claim 1, wherein said operating member has a normal closed position extending over a normal angular range in which said seal is satisfactory and has an abnormal closed position extending over an abnormal angular range in which said seal is unduly worn and requires replacement, said indicating means being for indicating whether said operating member is in one or the other of said ranges.

3. A valve as claimed in claim 2, wherein said indicating means indicates said ranges by adjacent arcuate bands of different colours.

4. A valve as claimed in claim 1, 2 or 3, wherein said indicating means includes an indicating ring member associated with said bonnet.

5. A valve as claimed in claim 4, wherein said bonnet has a cylindrical outer end portion and said indicating ring member has a generally cylindrical inner flange received on said cylindrical outer end portion in frictional gripping relationship therewith.

6. A valve as claimed in claim 5, including co-operating locating means between said bonnet and said indicating ring member for preventing relative rotation therebetween.

7. A valve as claimed in claim 6, wherein said locating means includes a longitudinal groove in said



32

21

outer end portion of said bonnet and an inwardly extending tab on said inner flange of said indicating ring member received in said groove.

8. A valve as claimed in any of claims 1 to 3,
5 wherein said indicating means includes an indicating ring member mounted on said bonnet and having overtravel indicia thereon for indicating said overtravel of said operating member, and co-operating locating means between
10 said bonnet and said indicating ring member for locating said ring member with said overtravel indicia thereon in their proper circumferential position.

9. A valve as claimed in claim 8, wherein said bonnet and said operating member have co-operating stop means for stopping rotation of said operating member at
15 said open position thereof, and wherein said locating means provides location of said ring member with said overtravel indicia angularly spaced a predetermined degree from said stop means on said bonnet towards said closed position of said operating member.

20 10. A valve as claimed in claim 9, wherein said locating means comprises a longitudinal groove in said bonnet and an inwardly extending tab on said ring member received in said groove.

25 11. A valve as claimed in any of claim 4 to 10, wherein said indicating ring member has an outer circumferential inclined surface visible in directions both parallel and perpendicular to said axis, and said inclined surface having overtravel indicia thereon for indicating said overtravel of said operating member.

30 12. A valve including a valve bonnet having a rotatable operating member for moving a valve member between open and closed positions, said valve member having thereon a wearable seal co-operable with a valve seat in said closed position of said valve member, said
35 closed position including a normal angular range for



22

5 said operating member over which said seal is satisfactory and an abnormal angular range over which said seal is unduly worn and requires replacement; indicia on said bonnet for indicating said open position, said
10 normal angular range and said abnormal angular range; and indicator means movable with said operating member for alignment with said indicia to indicate when said operating member is located in said open position of said valve member and when said operating member is
15 located within one or the other of said ranges.

13. A valve as claimed in claim 12, wherein said indicia for indicating said ranges comprise adjacent arcuate bands of different colour.

15. 14. A valve as claimed in claim 12 or 13, wherein said indicia are on an indicating ring member mounted on said bonnet, and wherein co-operative locating means are provided between said bonnet and said ring member for rotationally orienting said ring member with said indicia thereon located in proper angular position for
20 co-operation with said indicator means.

25 15. A valve including a valve bonnet having a rotatable operating member for moving a valve member between open and closed positions, said valve member having a wearable seal co-operable with a valve seat in said closed position of said valve member; and co-operating
30 indicating means between said operating member and said bonnet for indicating positions of said valve member; said indicating means including an indicating ring member mounted on said bonnet and frictionally retained thereon for indicating overtravel of said operating member in its closed position and thereby signifying that replacement of said seal is required.

35 16. A valve as claimed in claim 15, wherein said bonnet has a cylindrical outer end portion and wherein said ring member has a central hole receiving said end



34

23

portion and flange means on said ring member around said hole and frictionally gripping said end portion.

17. A valve as claimed in claim 16, in which a tab on said ring member is received in a longitudinal groove in said bonnet.

18. A valve as claimed in claim 15, 16 or 17, wherein said ring member includes an outer circumferential inclined surface visible in directions both parallel and perpendicular to the longitudinal axis of said bonnet with said indicia being on said inclined surface.

19. A valve as claimed in any of claim 4 to 18, in which said bonnet has an externally screw-threaded portion for receiving a panel nut and an outer cylindrical end portion; and said ring member has a generally axially extending outer flange for surrounding and concealing the panel nut received on said threaded portion.

20. A valve as claimed in any of claims 1 to 19, wherein a generally circular diaphragm is axially clamped in a circumferential area inwardly of its outer periphery between opposed substantially flat and parallel clamping surfaces on said bonnet and on a valve body which has said valve seat therein.

21. A valve as claimed in claim 20, wherein said clamping surfaces are axially stepped at radially spaced locations outwardly of said circumferential area to define radially-spaced circumferential corners across



24

which said diaphragm is bent and axially displaced from said circumferential area.

22. A valve as claimed in claim 21, wherein said corners are axially-spaced from one another a distance
5 substantially less than the thickness of said diaphragm.

23. A valve as claimed in claim 20, including secondary clamping surfaces spaced radially and axially from said clamping surfaces, said diaphragm being axially clamped in a secondary circumferential area spaced
10 radially outward and axially from said circumferential area, said diaphragm being bent between said circumferential area and said secondary circumferential area.

24. A valve as claimed in any of claims 20 to 23 in which said valve member is disposed on one side of
15 said diaphragm and carries said seal and said valve member has a circumferential recess in an end face thereof, said seal being received in said recess, and inner and outer circumferential rims surrounding said recess and deformed over towards one another to retain
20 said seal in said recess.

25. A valve as claimed in any of claims 1 to 19, in which a diaphragm is clamped between said bonnet and a valve body having said valve seat therein; said valve member being disposed on one side of the said diaphragm
25 so as to be axially movable in a cylindrical bore between its open and closed positions; said valve member including

25



26

an enlarged head having a non-circular shape and being slidably guided in said bore and said valve member including a cylindrical stem guided through a non-circular hole in a guide washer received in
5 said bore.

26. A valve as claimed in any of claims 20 to 25, wherein said diaphragm is of austenitic stainless steel having a hardness of at least 38 on the Rockwell C scale.

10 27. A valve as claimed in claim 26, wherein said stainless steel is type 316.

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