

SPECIFICATION

Heat responsive back seat arrangement for valve operator

This invention relates to non-rising stem valves.

- 5 The present invention was made as a further development of the valve shown and described in U.S. Patent Specification No. 4,138,091 issued February 6, 1979 in the name of McGee for a drive nut and torque plate assembly for the valve, and U.S. Patent Specification No. 4,149,558
10 issued April 17, 1979 in the names of McGee et al for a selective back seat for the valve.

The foregoing, in turn, represent developments of valves described in the following prior U.S.

- 15 Patent Specifications:

Crain et al	3,349,789	Oct. 31, 1967
McGee	3,789,875	Feb. 5, 1974
Boitnott	3,990,679	Nov. 9, 1976

- 20 Others have worked with fusible materials in order to provide safety devices for valves. Examples are shown in the following prior patent specifications:

Wicke	3,771,540	Nov. 13, 1973
Allen	3,788,600	Jan. 29, 1974
Wicke	3,842,854	Oct. 22, 1974
25 Wicke	3,896,835	Jul. 29, 1975

- According to the invention there is provided a non-rising stem valve comprising a valve mounted in a valve chamber which intersects a flow passage within a valve housing, a valve stem
30 which projects out through a transverse passageway in a housing bonnet from an operative relation with the valve body, means defining an annular seat on said bonnet within said valve chamber peripherally of where said transverse passageway intersects said valve chamber, means defining an annular shoulder on said valve stem spaced axially below said annular seat, a first abrupt radial enlargement in said transverse passageway, providing a first upwardly
40 facing shoulder therein spaced axially above said annular seat, a second abrupt radial enlargement in said transverse passageway, providing a second upwardly facing shoulder therein spaced axially above said first upwardly facing shoulder, an annulus of packing surrounding said stem in said transverse passageway, said annulus of packing being bottomed on said first upwardly facing shoulder, an annular packing gland surrounding said stem in said transverse passageway, said annular packing gland being bottomed on said second upwardly facing shoulder and having a tubular portion extending downwardly into engagement with said annulus of packing, an annular bonnet gland surrounding said stem, a
55 band of external threading on the bonnet gland and a band of internal threading on the bonnet, within said transverse passageway, above said second upwardly facing shoulder, said bands being threadably engaged whereby rotation of the bonnet gland moves said gland to compress said

- packing gland against said annulus of packing, and bearing means for said stem, said bearing means being secured between said stem and said bonnet gland, whereby the annulus of packing may be
65 replaced even while the valve remains open and in service, by threadably backing out the bonnet gland, axially raising the stem until said annular shoulder on the stem abuts and seals against said annular seat on the bonnet, removing the bonnet gland, packing gland and annulus of packing from the transverse passageway, installing a sound replacement for said annulus of packing, reinstalling the packing gland and bonnet gland, and threadably tightening the bonnet gland
70 and again lowering the valve stem to disengage said annular shoulder on the stem from the annular seat on the bonnet, said bearing means including, axially interposed between the remainder of said bearing means and said annular bonnet gland, an annulus of heat-fusible material which is subject to melting and running away should the valve be subjected to a sufficiently hot event, such as a fire which would leave the integrity of the annulus of packing in question, so
85 that, upon melting and running away of the annulus of heat-fusible material, the bearing assembly is effectively axially shortened by an amount sufficient to permit the valve stem to rise until said annular shoulder on the stem abuts and seals against said annular seat on the bonnet.
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- The invention further provides a valve comprising a normally non-rising valve stem which is rotatable in order to raise and lower a valve gate, a valve bonnet having a tubular portion
95 surrounding the valve stem, a bearing assembly housed within said tubular portion and structurally interposed between the valve stem and the valve bonnet to journal the valve stem for rotation, but not normally for axial movement with respect to the valve bonnet, and means defining a first annular sealing surface on the valve stem and a second annular sealing surface on the valve bonnet, the first and second annular sealing surfaces normally being axially spaced out of mutual superficial sealing engagement, the bearing assembly including, as an adjunct thereof, a body of heat-fusible material effectively contributing to the axial extent of the bearing assembly, said body of heat-fusible material being
100 subject to melting and flowing away should the valve be subjected to an unusual condition of heat such as a fire, thereby effectively axially shortening the bearing assembly and permitting limited axial movement of the valve stem, sufficient to superficially sealingly engage the first and second annular sealing means at a back seat for the valve.
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- A valve operator that is provided with a back seat which comes into use when the normally non-rising stem operator and its bearing-enclosing bonnet gland are raised, e.g., so that stem packing can be replaced, is further provided with another way to actuate the back seat, one which will come into play should the valve be subjected to heat of sufficient intensity as to call the integrity of the
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stem packing or other critical parts into question. The further activation mode depends on the melting of fusible material which permits the operator and its bearings to rise relative to the bonnet.

The principles of the invention will be further discussed with reference to the drawings wherein a preferred embodiment is shown. The specifics illustrated in the drawings are intended to exemplify, rather than limit, aspects of the invention as defined in the claims.

Figure 1 is a fragmentary vertical longitudinal sectional view of a gate valve provided with the heat responsive back seat arrangement of the invention. To the right of its center line the valve gate is shown in a lowered, closed condition and to the left the valve gate is shown in a raised, open condition.

Figure 2 is a larger scale view of a portion of what is known in Figure 1 in order to better illustrate details of the preferred heat responsive back seat arrangement.

In the figures, there is shown a gate valve 10 having a housing 12 which includes a body 14. The body has a longitudinal throughbore 16 to provide a flow passageway. At the ends of the bore 16, the body is provided with flanges (not shown) wherewith the valve may be connected in a conduit to provide means for controlling fluid flow through the conduit.

Intermediate the ends of the bore 16 there is provided a valve chamber 20 which includes a transverse passageway which intersects with the bore 16 and opens outwardly through the body at a tubular boss 22. The boss 22 is provided with a flat outer end surface 24.

The housing 12 further includes a valve bonnet 26 that is mated with the surface 24 and secured to the body, e.g., by bolts 28. A sealing ring 30 is interposed between the body and bonnet to provide sealed integrity for this juncture.

The bonnet 26 is an annular or tubular element, in the sense that it has a coaxially disposed bore 32.

Within the chamber 20, valve seats 34 are provided at the intersections with the throughbore 16, and a valve gate 36 is received for sliding transversally of the throughbore 16. The gate 36 is shown including a pair of gate plates 38, and the valve is shown including an expander 40 which serves to force the plates against the seats 34 when the valve is closed, and to withdraw that force as the gate is opened.

In Figures 1 and 2, the gate is shown in its raised, open position at the left, and in its lowered, closed position at the right. When the gate is open, the openings 42 through the respective gate plates are both axially aligned with the valve body throughbore 16. Then the gate is closed, the blank regions of the respective gate plates are pressed against the respective valve seats 34.

A valve stem 44 is threadably connected to the gate and passes out of the housing 12 through the bore 32 of the bonnet. Outside the housing, an operator 46 is secured on the stem 44. In the

instance shown, the operator 46 is a handwheel that is designed to be manually rotated in one angular sense to raise the gate and open the valve, and to be manually rotated in the opposite angular sense to lower the gate and close the valve. Other operators that may be used are shown in the above mentioned prior U.S. Patents of Crain et al, McGee No. 3,789,875 and Boitnott.

The particular connecting means illustrated in the Figure for threadably connecting the gate to the valve stem are shown and described in detail in the aforementioned U.S. patent of Mc Gee, No. 4,138,091. Suffice it to say here that an upwardly semi-cylindrical half of the socket 48 is formed in the gate. The socket 48 includes a coaxially annular groove 50 near its upper end. A generally semi-cylindrical half of the socket 48 is formed in the inner side of each gate plate so the halves confront one another to constitute the socket 48.

An internally threaded, generally tubular drive nut is shown provided at 52. The drive nut 52 has a coaxially annular rib 54 formed on the exterior thereof axially intermediate the ends thereof. A coaxially annular flange 56 is formed on the upper end of the drive nut. The drive nut 52 is received in the socket 48 with the rib 54 projected into the groove 50 and the flange 56 abutting the upper ends 58 of the gate plates 38. The flange 56 is radially surrounded by a torque plate 60 which is pinned at 62 to each of the gate plates distally of the socket 48. The radially inner surface of the plate 60 and the radially outer surface of the flange 56 are provided with splines 64. These interdigitate to prevent relative rotation between the flange 56 and plate 60. Further locking means (not shown) may be provided to secure the flange 56 and plate 60 together and/or these elements may be formed integrally and the splines 64 omitted.

Further details of the valve stem 44 and bonnet 26 will now be described so that the structure and operation of the invention will become better understood.

The bonnet 26 includes a generally radially extending base flange 66 and a tubular portion 67 extending coaxially upwardly therefrom. The bore 32 passes through both portions. Where the bore 32 emerges into the valve chamber, there is a frusto-conical annular seat 68 coaxially formed at the juncture of the bore 32 with the underside 70 of the flange 66.

A short way axially above the seat 68, the generally cylindrical bore 32 undergoes a first abrupt enlargement in radius, providing a first upwardly facing shoulder 72. Axially further up, the bore 32 undergoes a second abrupt enlargement in radius, providing a second upwardly facing shoulder 74, within the tubular portion 67.

An axially intermediate portion of the bore 32 within the tubular portion 67 of the bonnet is internally threaded at 76. Above the threaded portion 76, the bore 32 is provided with a radially shallow, axially broad circumferential recess 78, delimited at the top by a radially inwardly

projecting annular rib 80. Above the rib 80, weather seal 82 is provided in the bore 32.

The valve stem 44 has an externally threaded lower portion 84 that is received within the gate socket and threadably connected with the gate as described above. Just axially above where the stem 44 emerges through the drive nut 52, there is a circumferentially extending boss 86 formed coaxially thereon. The axially upper end surface or shoulder 88 of the boss is frustoconically tapered, complementarily with the seat 68.

In normal use, as shown in Figures 1 and 2, the shoulder 88 remains clear of the seat 68 and there is a significant distance located axially between these two surfaces.

Above the boss 86, the stem 44 has an axially long, cylindrical, unthreaded portion 90. Axially beyond its emergence from the bore 32 of the bonnet, the stem undergoes a gradual reduction in radius to provide a tapered band 92. Above the band 92, the stem 44 has an externally threaded shank 94 leading to its upper end. The band 92 mounts the complementarily tapered hub 96 of a handwheel 98. A washer 100 and nut 102 are mounted on the shank 94 to removably secure the handwheel on the stem 44.

Within the tubular portion of the bonnet, the cylindrical portion 90 of the stem is coaxially provided with a radially shallow, axially broad recess 104, having opposed, facing shoulders 106, 108.

A packing assembly 110 comprising a stack of chevron packing elements is received in the annulus about the stem that is bottomed on the first shoulder 72. As shown, the assembly 110 is of the type that is energized by an injection of plastic material through an injection port 112 after installation.

An annular packing gland 114 is received in the annulus about the stem that is bottomed on the second shoulder 74 and projects therebelow, backing the packing assembly 110.

A bonnet gland 116 also is provided, generally in the form of an exteriorly threaded tubular element having an external, axially intermediate band of threading 118 and a throughbore 120 which undergoes an abrupt decrease in radius intermediate the axial extent thereof, to provide a downwardly facing shoulder 122. The larger radius portion leading portion to the shoulder 122 constitutes a cup for receipt of the bearing assembly 124 for the valve stem. As shown, there is provided a bearing bushing 126, a washer-like annular disk of fusible material 127, a roller bearing 128, a stem split 130, a roller bearing 138, and a spring washer 139.

After the packing assembly and packing gland are installed, the bearing assembly and bonnet gland are installed and the bonnet gland is threaded into place until the packing gland 114 is properly compressed.

Below the band of threading 118, the bonnet gland is coaxially provided with a shallow circumferential recess 140. A set screw 142 is installed through a threaded opening 143 in the

tubular portion of the bonnet 26 until it projects into the recess 140. When so installed, the set screw 142 prevents the bonnet gland from being rotationally backed out. (In practice several set screws 142 are provided angularly of the bonnet 26).

Above the band of threading 118, the bonnet gland is externally coaxially provided with a shallow recess 144, at least including a lower, generally upwardly facing shoulder 146.

A bonnet gland retainer wire 148 is snapped into the pocket formed by the confronting recesses 144 and 78. The pocket 144, 78 is axially longer than the gage of the wire 148.

In day-to-day operations under normal conditions, when the valve is opened, the drive brushing 52 shoulders against the underside of the enlargement 88. Thus, the back seat does not function in normal day-to-day use of the valve.

However, in use, with the valve open and subjected to pressure of fluid being confined or transported in the piping system in which the valve is installed, a leak may occur in the packing assembly. Under such circumstances it may be necessary to change the packing assembly while the valve remains installed in the line and open.

The construction just described makes such a repair feasible, by making the following procedure possible

The seat screws 142 are backed out until they are withdrawn from the recess 140. Then the bonnet gland 116 is backed out a few turns, limited by pinching of the retainer wire 148 between the upper end wall of the recess 78 and the lower end wall 146 of the recess 144.

The normally non-rising stem 44 may then be raised and tensioned to form a metal to metal seal between the shoulder 88 and the seat 68. While a positive seal remains established, the retainer wire 148 is snapped out, the gland 116 is backed out, the bearing assembly 124 is removed, the packing gland 114 is removed, the packing assembly 110 is removed and replaced, the packing gland 114 is reinstalled, the bearing assembly 124 is reinstalled, the gland 116 is threaded mostly in and the packing 110 is energized at 112. The packing is tested for leakage by reinstalling the retainer wire 148, tightening the gland 116 and turning the stem 44 which disengages the metal seal that was maintained at 88, 68.

The heat-responsive material of the annular disk 127 is a fusible, preferably metallic material, e.g., of a composition such as is disclosed in the above-mentioned patents of Allen and Wicke, and it is shown axially interposed between the upper stem bearing and the bonnet gland. Should a fire or the like occur, such as would likely destroy the stem packing 110, the annular disk 127 will melt and its molten residue will flow out the ports provided in communication with the site of the disk 127 through the bonnet gland. Then the remainder of the stem bearing assembly and the valve stem will rise, until the back seat is established at 88/68, preventing leakage. Later, the valve may be repaired, if damage is not too

great, by the replacement of the packing and of the fusible annular disk 127.

CLAIMS

1. A non-rising stem valve comprising a valve
5 body mounted in a valve chamber which intersects a flow passage within a valve housing, a valve stem which projects out through a transverse passageway in a housing bonnet from an operative relation with the valve body, means
10 defining an annular seat on said bonnet within said valve chamber peripherally of where said transverse passageway intersects said valve chamber, means defining an annular shoulder on said valve stem spaced axially below said annular
15 seat, a first abrupt enlargement in said transverse passageway, providing a first upwardly facing shoulder therein spaced axially above said annular seat, a second abrupt radial enlargement in said transverse passageway, providing a second
20 upwardly facing shoulder therein spaced axially above said first upwardly facing shoulder, an annulus of packing surrounding said stem in said transverse passageway, said annulus of packing being bottomed on said first upwardly facing
25 shoulder, an annular packing gland surrounding said stem in said transverse passageway, said annular packing gland being bottomed on said second upwardly facing shoulder and having a tubular portion extending downwardly into
30 engagement with said annulus of packing, an annulus bonnet gland surrounding said stem, a band of external threading on the bonnet gland and a band of internal threading on the bonnet, within said transverse passageway, above said
35 second upwardly facing shoulder, said bands being threadably engaged whereby rotation of the bonnet gland moves said gland to compress said packing gland against said annulus of packing, and bearing means for said stem, said bearing means
40 being secured between said stem and said bonnet gland, whereby the annulus of packing may be replaced even while the valve remains open and in service, by threadably backing out the bonnet gland, axially raising the stem until said annular
45 shoulder on the stem abuts and seals against said annular seat on the bonnet, removing the bonnet gland, packing gland and annulus of packing from the transverse passageway, installing a sound replacement for said annulus of packing,
50 reinstalling the packing gland and bonnet gland, and threadably tightening the bonnet gland and again lowering the valve stem to disengage said annular shoulder on the stem from the annular seat on the bonnet, said bearing means including,
55 axially interposed between the remainder of said bearing means and said annular bonnet gland, an annulus of heat-fusible material which is subject to melting and running away should the valve be subjected to a sufficient hot event, such as a fire
60 which would leave the integrity of the annulus of

packing in question, so that, upon melting and running away of the annulus of heat-fusible material, the bearing assembly is effectively axially shortened by an amount sufficient to permit the
65 valve to rise until said annular shoulder on the stem abuts and seals against said annular seat on the bonnet.

2. A valve according to claim 1, wherein said annular shoulder on said valve stem and said
70 annular seat on said bonnet are complementarily frustoconical in shape.

3. A valve according to claim 1 or 2, further comprising removable securement means between the bonnet and the bonnet gland for
75 preventing the bonnet gland from being unintentionally backed out while the bonnet gland is in place compressing said packing gland against said packing assembly.

4. A valve according to claim 3, further
80 comprising a bonnet gland retainer wire coaxially and removably received in a coaxially annular pocket between the bonnet, within said transverse passageway, and said bonnet gland, the pocket being axially broader than the gauge of said
85 retainer wire by an amount sufficient to permit the bonnet gland to be backed out, once said securement means is removed, enough to permit said annular shoulder on the valve stem to engage with said annular seat on the bonnet, but
90 insufficient to permit further backing out of the bonnet gland unless said retainer wire is removed.

5. A valve comprising a normally non-rising valve stem which is rotatable in order to raise and lower a valve gate, a valve bonnet having a tubular
95 portion surrounding the valve stem, a bearing assembly housed within said tubular portion and structurally interposed between the valve stem and the valve bonnet to journal the valve stem for rotation, but not normally for axial movement with
100 respect to the valve bonnet, and means defining a first annular sealing surface on the valve stem and a second annular sealing surface on the valve bonnet, the first and second annular sealing surfaces normally being axially spaced out of
105 mutual superficial sealing engagement, the bearing assembly including, as an adjunct thereof, a body of heat-fusible material effectively contributing to the axial extent of the bearing assembly, said body of heat-fusible material being
110 subject to melting and flowing away should the valve be subjected to an unusual condition of heat such as a fire, thereby effectively axially shortening the bearing assembly and permitting limited axial movement of the valve stem,
115 sufficient to superficially sealingly engage the first and second annular sealing means at a back seat for the valve.

6. A valve substantially as hereinbefore described with reference to the accompanying
120 drawings.



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5 body mounted in a valve chamber which intersects a flow passage within a valve housing, a valve stem which projects out through a transverse passageway in a housing bonnet from an operative relation with the valve body, means
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30 engagement with said annulus of packing, an annulus bonnet gland surrounding said stem, a band of external threading on the bonnet gland and a band of internal threading on the bonnet, within said transverse passageway, above said
35 second upwardly facing shoulder, said bands being threadably engaged whereby rotation of the bonnet gland moves said gland to compress said packing gland against said annulus of packing, and bearing means for said stem, said bearing means
40 being secured between said stem and said bonnet gland, whereby the annulus of packing may be replaced even while the valve remains open and in service, by threadably backing out the bonnet gland, axially raising the stem until said annular
45 shoulder on the stem abuts and seals against said annular seat on the bonnet, removing the bonnet gland, packing gland and annulus of packing from the transverse passageway, installing a sound replacement for said annulus of packing,
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