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VALVE AND STEM SEAL THEREFOR

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5 The present invention relates to an improved
valve having an improved stem seal which will maintain
its seal against high pressures, elevated temperatures
and with rotary and axial cycling of the valve stem.

10 Prior stem seals have utilized inverted U-shaped
ring seals having a plurality of sealing lips on the
interior and exterior sealing surfaces and with a
spring within the opening of the ring to urge the lips
outward and inward into sealing engagement. An
example of such a seal structure is shown in U.S.
15 Patent No. 4,103,909. Such seal structure has not
been satisfactory because the sealing lips wear
responsive to movement, they are not held in their
desired sealing position when they are exposed to
pressure, and there is no protection against extrusion
20 of the lips.

 An object of the present invention is to provide
an improved valve with an improved stem seal which can
be used to seal against high pressure even when
exposed to elevated temperatures.

25 According to one aspect of the present invention

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there is provided a valve comprising a body having a chamber, an inlet and an outlet communicating into the chamber, and a valve seat surrounding said outlet in said chamber, a valve member positioned in the chamber, actuating means, a valve stem connecting said actuating means to said valve member to move said valve member between positions allowing flow through said outlet and preventing flow through said outlet, a sealing assembly between said stem and said body, and having a resilient annular body with a plurality of internal lips for sealing against said stem and a plurality of external lips for sealing against said body, and a plurality of grooves between said internal lips and between said external lips, and a support ring positioned in each of said grooves and substantially filling the groove in which it is positioned, each of said lips extending slightly beyond its adjacent support rings for sealing engagement with the surface against which it is to seal.

According to another aspect of the present invention there is provided a stem seal for a valve comprising an annular resilient body having a plurality of sealing lips on its outer and inner surfaces with grooves between said lips, and a support

ring positioned in each of said grooves and substantially filling the groove in which it is positioned, each said lips extending slightly beyond its adjacent support rings for sealing engagement with the surface against which it is to seal.

The invention will be described now by way of example only with particular reference to the accompanying drawings. In the drawings:-

FIGURE 1 is a sectional view of the improved valve of the present invention;

FIGURE 2 is a sectional view of one form of improved stem seal assembly of the present invention; and

FIGURE 3 is a sectional view of another form of improved stem seal assembly of the present invention.

Valve 10, shown in FIGURE 1, is a gate valve and includes body 12 having inlet 14 into chamber 16, outlet 18 from chamber 16 with valve seat 20 surrounding outlet 18 in chamber 16 and opening 22 from chamber 16. Valve member 24 is positioned in chamber 16 and movable to allow or prevent flow through outlet 18 by its engagement of valve seat 20. Stem 26 is threaded into valve member 24 so that as it is rotated valve member 24 is moved in chamber 16 with

respect to valve seat 20. Stem 26 extends through opening 22 and into bonnet 28 which is secured to body 12 around opening 22. The interior of bonnet 28 includes sealing surface 30 surrounding and spaced radially outward from stem 26 to provide the annular space 32 in which the improved sealing assembly 34 of the present invention is positioned to seal between stem 26 and surface 30. Hand wheel 36 is secured to stem 26 to provide actuation means for moving valve member 24. Packing nut 38 threads into bonnet 28 around stem 26 to retain seal assembly 34 in its preselected position in space 32.

Sealing assembly 34 shown in detail in FIGURE 2 includes U-shaped resilient annular body or seal ring 40 having its closed end facing away from the pressure in valve body 12 and its two legs with the annular opening therebetween facing the high pressure in body 12. Ring 40 includes a plurality of sealing lips 42 with grooves 44 therebetween on its inner and outer annular surfaces. Support rings 46, which are split rings as shown, are positioned within grooves 44 and substantially fill their respective grooves. When rings 46 are positioned in grooves 44, lips 42 extend a slight distance (approximately 0.254 mm (.010 inches)) beyond the wear surface of rings 46 to assure that

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they will be in sealing engagement with the surface against which they are to seal. Preload ring 48 is positioned within the open end of U-shaped ring 40. Ring 48 is slightly thicker than the free radial dimension of the interior of the opening in ring 40. Thus, ring 48 moves the sides of ring 40 outward so that lips 42 are in sealing engagement with sealing surface 30 on bonnet 28 and the exterior surface of stem 26.

Wedge rings 50 engage the inner and outer portions of the closed end of ring 40 to prevent its extrusion and back-up ring 52 is positioned between the closed end of ring 40 and the inner end of packing nut 38 and supports wedge rings 50 as shown. Wedge rings 50 are positioned as shown so that any increase in axial loading of ring 40 also results in an increase loading of rings 50 against their respective cylindrical surfaces to ensure that ring 40 is not extruded.

Sealing assembly 34, when positioned as shown in FIGURE 1, has provided sealing between stem 26 and sealing surface 30 against a pressure of 20,000 psi ($1.406 \times 10^7 \text{ kg/m}^2$), with thermal cycling up to 300°F (149°C) and under both rotary and linear cycling

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movement of stem 26. In the unit tested, seal ring 40 was a polytetrafluoroethylene such as sold by W. S. Shamban & Co., under the trademark "Turcite 99".

Preload ring 48 and back-up ring 52 were a titanium alloy identified as TI-6AL-4V. Support rings 46 and wedge rings 50 were a beryllium copper alloy identified as C17200.

Modified sealing assembly 54, shown in FIGURE 3, includes U-shaped seal ring 56 having a plurality of internal and external sealing lips 58 with grooves 60 therebetween,

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preload ring 62 positioned in the open end of seal ring 56, wedge rings 66 abutting the inner and outer portions of the closed end of seal ring 56, and support rings 64 positioned in grooves 60, all as described with respect to sealing assembly 34. Sealing assembly 54 also includes bearing support ring 68 engaging the closed end of seal ring 56 and wedge ring 66 as shown, back-up seal ring 70 having inner and outer tapered surfaces 72 engaging the mating surfaces 74 on back-up seal 76 and anti-extrusion ring 78 having inner and outer tapered surfaces 80 engaging the mating surfaces 82 of ring 78. Thus, sealing assembly 54 is substantially the same as sealing assembly 34 except that it includes the elements providing a secondary seal and the anti-extrusion means.

The materials of the components of sealing assembly 54 are preferably the same as set forth above for sealing assembly 34. Bearing support ring 68 and anti-extrusion ring 78 are preferably a beryllium copper alloy identified as C17200. Back-up seal ring 70 is preferably a polytetrafluoroethylene material and back-up seal 76 is preferably a material similar to U-shaped ring 56 as sold by W.S. Shamban & Co. under the trademark "TURCITE 1022".

Since sealing assembly 54 is substantially the same as sealing assembly 34, it has the same improved useful life under conditions of high pressure, cycling temperature and cycling rotary and axial stem movement.

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CLAIMS

1. A valve comprising a body having a chamber,
an inlet and an outlet communicating into the chamber,
5 and a valve seat surrounding said outlet in said
chamber, a valve member positioned in the chamber,
actuating means, a valve stem connecting said
actuating means to said valve member to move said
valve member between positions allowing flow through
10 said outlet and preventing flow through said outlet, a
sealing assembly between said stem and said body, and
having a resilient annular body with a plurality of
internal lips for sealing against said stem and a
plurality of external lips for sealing against said
15 body, and a plurality of grooves between said internal
lips and between said external lips, and a support
ring positioned in each of said grooves and
substantially filling the groove in which it is
positioned, each of said lips extending slightly
20 beyond its adjacent support rings for sealing
engagement with the surface against which it is to
seal.

2. A valve according to claim 1 including means
for expanding said annular body both outward and
25 inward toward the surfaces against which it is to



seal.

3. A valve according to claim 1 wherein said annular body has a U-shape in section.

5 4. A valve according to claim 3 including a preload ring positioned in the open end of annular body and having a thickness greater than the radial dimension of the annular body opening to urge said lips into sealing engagement.

10 5. A valve according to claim 1 including anti-extrusion means engaging the low pressure end of said annular body.

15 6. A valve according to claim 5 wherein said anti-extrusion means includes inner and outer wedge rings engaging the tapered corners of the closed end of said annular body, and a back-up ring engaging the closed end of said annular body and the low pressure surfaces of said wedge rings.

20 7. A valve according to claim 6 including a back-up seal ring beyond said wedge rings, and anti-extrusion means engaging said back-up seal ring to prevent its extrusion along the surfaces against which it is to seal.

8. A valve according to claim 1 wherein said support rings are made from a bearing type material.

25 9. A valve according to claim 8 wherein the

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material of said support rings is a beryllium copper alloy.

5 10. A valve according to claim 1 wherein said annular body is made of a polytetrafluoroethylene material.

10 11. A stem seal for a valve comprising an annular resilient body having a plurality of sealing lips on its outer and inner surfaces with grooves between said lips, and a support ring positioned in each of said grooves and substantially filling the groove in which it is positioned, each said lips extending slightly beyond its adjacent support rings for sealing engagement with the surface against which it is to seal.

15 12. A stem seal according to claim 11 including means for expanding said annular body both outward and inward toward the surfaces against which it is to seal.

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13. A stem seal according to claim 11 wherein said annular body has a U-shape in section.

14. A stem seal according to claim 13 including a preload ring positioned in the open end of annular body and
05 having a thickness greater than the radial dimension of the annular body opening to urge said lips into sealing engagement.

15. A stem seal according to claim 11 including anti-extrusion means engaging the low pressure end of said
10 annular body.

16. A stem seal according to claim 15 inner and outer wedge rings engaging the tapered corners of the closed end of said annular body, and a back-up ring engaging the closed end of said annular body and the low pressure surfaces of said
15 wedge rings.

17. A stem seal according to claim 16 including a back-up seal ring beyond said wedge rings, and anti-extrusion means engaging said back-up seal ring to prevent its extrusion along the surfaces against which it is to seal.

20 18. A stem seal according to claim 11 wherein said support rings are made from a bearing type material.

19. A stem seal according to claim 18 wherein the material of said support rings is a beryllium copper alloy.

25 20. A valve according to claim 11 wherein said annular body is made of a polytetrafluoroethylene material.

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21. A valve substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

5 22. A stem seal for a valve substantially as hereinbefore described with reference to and as shown in Figure 2 or Figure 3 of the accompanying drawings.
