

PATENT SPECIFICATION

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(54) IMPROVEMENTS RELATING TO VALVES FOR FLUIDS

(71) We WHITEBY RESEARCH TOOL Co., domiciled at 5679 Landregan Street, Emeryville, State of California 94662, United States of America, a corporation organized and existing under the laws of the State of California, United States of America, (assignee of WILLIAM PATRICK TOBBE, ERNEST ARTHUR BENWAY, DAVID MICHAEL SIMKO, BERNARD JOHN GALLAGHER and JOHN ROBERT BOYLAN), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to valves for fluids.

The invention is particularly suited for valves used under high pressure conditions and will be described with particular reference thereto; however, as will become apparent, the invention could be embodied in valves for many types of service.

Plug-type valves are widely used for controlling highly abrasive and corrosive fluids. Typically, the valves include a body having a generally conical valve chamber with a correspondingly shaped replaceable seat insert positioned therein. A conically shaped plug is mounted for reciprocation into sealing engagement with the seat insert. The plugs are often attached to the operating stem through a rotatable connection. This permits the plug to rotate freely relative to the stem so that there is little or no relative rotation between the seat insert and plug during closing.

Even though the above mentioned features have been incorporated in the prior valves, poor functioning and failure problems have been common. For example, in the structure described, the pivotal connection between the stem and the plug is subjected to the fluid passing through the valve. This can cause abrasive particles in the

fluid to enter the connection causing it to become worn and eventually lock up. Thereafter, the plug cannot rotate relative to the stem. Thus, as the valve is closed, the plug rotates in the seat and abrasive particles trapped between the seat and the plug will score the plug. Similarly, the stem threads are exposed to the fluid and their lubricant can be washed away resulting in high operating torque and wear. As a consequence, the prior valves must be replaced at frequent intervals when used for fluids containing amounts of abrasive material.

According to the present invention, a valve comprises a valve body having inlet and outlet passages and having a bore extending laterally of said flow passages and terminating at a valve chamber which is of truncated conical configuration and with which the inlet and outlet flow passages are connected, a hollow, conically shaped seat insert formed from resilient material positioned in said valve chamber, said insert having ports formed therein in alignment with the inlet and outlet flow passages; a bonnet screw-threaded in the outer end of said bore, said bonnet having a cylindrical bore axially aligned with the valve chamber in said body, the inner end of said bonnet being in sealing engagement with the outer end of said seat insert and with a shoulder in the valve chamber in said body; an actuating stem extending axially through said bonnet bore; a valve plug releasably connected to the inner end of said stem, said plug having a cylindrically shaped section which is slidably received in said cylindrical bonnet bore and a conically shaped section adapted to sealingly engage said insert so that axial movement of the valve stem displaces the plug to control fluid flow between said ports of said insert; and at least one sealing ring carried by said cylindrical section of said

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plug and sealingly engaging said cylindrical bonnet bore. The seal ring means prevents fluid from passing from the valve chamber into the bonnet and seals both the stem-plug connection and, in the case wherein the stem is screw-threaded in the bonnet bore, the stem threads from the fluid.

According to a preferred aspect of the invention, the connection between the plug and the stem comprises a transverse opening in the cylindrical portion of the plug at a location axially outwardly of the seal ring. A narrow slot extends from the transverse opening to the outer end of the cylindrical section of the plug and the end of the stem is shaped so that it can be slid laterally into the transverse opening. For example, the transverse opening is preferably a T-slot and the end of the stem is T-shaped with a somewhat spherical end surface. Also, it is preferred that the stem has a length such that when the bonnet is removed from the body, the stem can be actuated to a position wherein the plug extends completely out of the bonnet opening without exposing the actuating threads. The plug on which the seal rings are mounted can thus be changed together with these seal rings while the stem remains in the bonnet. It is not necessary to remove the handle.

The invention also contemplates that the seal ring means will preferably comprise an assembly of at least three ring members including a resilient O-ring positioned between two polytetrafluoroethylene washers. The inner washer acts as a wiping ring to clean the bore of abrasive particles and prevent wear on the O-ring. The O-ring performs the primary fluid seal function and the outer washer prevents blow-out of the O-ring under operating pressure.

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

Fig. 1 is a side elevational view, partially sectioned, of a valve in accordance with the invention;

Fig. 2 is an enlargement of the circled region of Fig. 1;

Fig. 3 is a view taken on line 3-3 of Fig. 1 but showing only the seat insert; and,

Fig. 4 is a view showing the valve disassembled and the operating stem moved to a position for plug changing.

Referring to Fig. 1, the preferred embodiment of the valve comprises a one-piece body 10 having aligned inlet and outlet flow passages 12 and 14 which connect with a generally conically shaped valve chamber 16. The body 10 can be formed from many materials but is preferably formed from stainless steel. Additionally, although shown as a one-piece body, it could be made in separable sections if desired.

The body can be connected to flow lines or associated equipment through the use of a male screw thread end on the passage 14 and a female screw thread 20 formed in a counterbore 22. These connections could also be of many other types, e.g. flanges, swage fittings, etc.

The valve chamber 16 extends laterally into the valve body and has a screw-threaded cylindrical outer end portion 24 75 which receives a bonnet 25. Positioned within the generally conically shaped portion of the valve chamber 16 is a replaceable seat insert 26 which provides the valve seat and which has a hollow, truncated conical shape sized so as to be tightly received within the valve chamber. Inlet and outlet ports 28 and 30 are formed through the wall of the seat insert 26 at locations corresponding to the inlet and outlet flow passages 12 and 14, respectively. This provides a straight through path for maximum flow.

Means are provided to prevent rotation of the seat insert 26 in the valve chamber 16 while allowing it to be easily removed for replacement. These means can take many forms but, as best shown in Fig. 3, the preferred form comprises a cylindrical protuberance 34 which is received within a correspondingly shaped recess formed in the body 10. The protuberance 34 allows the insert 26 to be easily removed but prevents it from rotating in the body 10. This protuberance is sized so that it will hold the insert in place during reassembly on site, but the insert 26 can be removed easily with a small tool. The protuberance 34 maintains the seat insert 26 in a position in which the ports 28 and 30 are in proper alignment for straight through flow.

The bonnet 25 has a screw-threaded inner end 38 which is received in the threaded portion 24 of the valve chamber 16. The lower inner end 40 of the bonnet is arranged to engage the top surface of the seat insert 26 to provide a fluid seal. The dimensions of the insert 26 relative to the depth of the conical portion of the valve chamber 16 are such that when the bonnet 25 is screwed into the body, a compressive loading takes place between the end 40 and the upper edge of the insert 26. Additionally, a metal-to-metal surface contact takes place between the body and the bonnet at surfaces 42 and 44. This provides an additional seal which, in conjunction with the seal between the end face and the upper edge of the insert, prevents fluid from escaping between the bonnet and the body.

The bonnet 25 has an enlarged centre portion 45 provided with wrench flats so that the bonnet may be readily removed from and replaced in the body. Addition-

ally, a lock nut 46 is received on the screw-threaded portion 38 so that the bonnet can be locked to the body to protect against disassembly by inadvertance or because of vibration, etc. The bonnet can be readily removed from the body by first releasing the lock nut.

Extending through the bonnet is an axial bore 50 which includes a screw-threaded section 52. Immediately below the screw-threaded section 52 and aligned with the valve chamber is a smooth-walled cylindrical section 54. Slidably mounted within the cylindrical section 54 is a valve plug 56. As best shown in Fig. 1, the valve plug 56 has a truncated, conical end section 58 sized to mate with the internal opening in the valve seat insert 26. Extending from the truncated conical section 58 is a cylindrical section 60 which is closely received within the portion 54 of the bonnet bore 50.

Preferably, the insert 26 is formed from a material softer than that of the valve plug 56 so that if impurities or hard substances become positioned between the plug and the seat during a closing operation, they will tend to be driven into the replaceable insert 26 and no damage to the plug will take place. Many types of plastics, soft metals or the like can be used for the insert depending upon the operating conditions to which the valve will be subjected.

The arrangement for sealing the bonnet from the operating fluid while permitting free movement of the plug includes a seal ring assembly (see Figs. 2 and 4) carried in a circumferential recess 62 formed in the plug 56. The assembly comprises a resilient O-ring 64 and split washers 65, 66 formed from polytetrafluoroethylene or the like and positioned adjacent the O-ring 64. The O-ring 64 is formed from a material capable of withstanding the fluid handled by the valve and performs the primary sealing function. The washer 66 serves as a wiping ring and continually cleans the bonnet bore section 56 of abrasive particles which could damage the O-ring 64. The washer 65 also performs a wiping function but primarily acts as a back-up washer to prevent extrusion of the O-ring 64 under operating pressure.

In the embodiment shown, the valve plug 56 is reciprocated as desired by means of an operating stem 68. The stem 68 is screw-threaded throughout its centre section 70 and mates with the threads 52 of the bonnet 25.

The stem 68 is releasably connected to the plug 56 by means which permit free rotation of the plug relative to the stem. As shown, a reduced diameter end section 72 of the stem 68 terminates in a generally T-shaped end 74 which is closely received

within the outer end of the cylindrical section 60 of the plug 56. As shown in Figs. 1 and 4, a T-sectioned slot is formed in the plug 56 and receives the end of the stem. The end face of the stem has a generally spherical configuration as shown at 78.

Preferably, the length of the stem and the cooperating screw threads 52, 70 are such that the stem can be rotated to a position wherein the upper end 82 of the plug 56 is beneath the end 40 of the bonnet 25. At this location, the plug can then be slid laterally off the stem while the stem threads are still protected by the bonnet and the handle is still in place. This relationship is best shown in Fig. 4.

Carried or formed within the bore 50 of the bonnet 25 is an internal shoulder 84 (Fig. 1) formed at the juncture between the threads 52 and the cylindrical bore 54. The shoulder 84 serves to limit outward movement of the plug and stem during opening movement and thereby prevent accidental disassembly under pressure.

At the upper end of the bore 50, a recess 88 is formed circumferentially about the stem. A resilient seal washer 92 is received in the recess 88. The seal washer 92 comprises a cylindrical piece of polytetrafluoroethylene or the like which closely engages the outer circumference of the upper end of the stem. The primary functions of the seal washer 92 are to prevent dirt, etc. from entering the bonnet and to retain thread lubricant in the bonnet. The seal washer is so designed that it will not form a pressure seal that could trap pressure in this region.

For operating the stem, a transversely extending cylindrical handle 96 is removably affixed to the outer end of the stem by a socket head machine screw 98 which is screw-threadedly received within a bore 100 that intersects the stem receiving bore 102. Additionally, a flat 104 is formed on the stem. Preferably, the socket head machine screw 98 is of a length such that when properly in position, it is within the confines of the bore 100. This arrangement allows the handle to have a pleasing appearance and a comfortable feel and prevents releasing of the handle through the use of a wrench by unauthorized persons.

WHAT WE CLAIM IS:—

1. A valve comprising a valve body having inlet and outlet flow passages and having a bore extending laterally of said flow passages and terminating at a valve chamber which is of truncated conical configuration and with which the inlet and outlet flow passages are connected, a hollow, conically shaped seat insert formed from resilient material positioned in said valve chambers, said insert having ports



ally, a lock nut 46 is received on the screw-threaded portion 38 so that the bonnet can be locked to the body to protect against disassembly by inadvertance or because of vibration, etc. The bonnet can be readily removed from the body by first releasing the lock nut.

Extending through the bonnet is an axial bore 50 which includes a screw-threaded section 52. Immediately below the screw-threaded section 52 and aligned with the valve chamber is a smooth-walled cylindrical section 54. Slidably mounted within the cylindrical section 54 is a valve plug 56. As best shown in Fig. 1, the valve plug 56 has a truncated, conical end section 58 sized to mate with the internal opening in the valve seat insert 26. Extending from the truncated conical section 58 is a cylindrical section 60 which is closely received within the portion 54 of the bonnet bore 50.

Preferably, the insert 26 is formed from a material softer than that of the valve plug 56 so that if impurities or hard substances become positioned between the plug and the seat during a closing operation, they will tend to be driven into the replaceable insert 26 and no damage to the plug will take place. Many types of plastics, soft metals or the like can be used for the insert depending upon the operating conditions to which the valve will be subjected.

The arrangement for sealing the bonnet from the operating fluid while permitting free movement of the plug includes a seal ring assembly (see Figs. 2 and 4) carried in a circumferential recess 62 formed in the plug 56. The assembly comprises a resilient O-ring 64 and split washers 65, 66 formed from polytetrafluoroethylene or the like and positioned adjacent the O-ring 64. The O-ring 64 is formed from a material capable of withstanding the fluid handled by the valve and performs the primary sealing function. The washer 66 serves as a wiping ring and continually cleans the bonnet bore section 56 of abrasive particles which could damage the O-ring 64. The washer 65 also performs a wiping function but primarily acts as a back-up washer to prevent extrusion of the O-ring 64 under operating pressure.

In the embodiment shown, the valve plug 56 is reciprocated as desired by means of an operating stem 68. The stem 68 is screw-threaded throughout its centre section 70 and mates with the threads 52 of the bonnet 25.

The stem 68 is releasably connected to the plug 56 by means which permit free rotation of the plug relative to the stem. As shown, a reduced diameter end section 72 of the stem 68 terminates in a generally T-shaped end 74 which is closely received

within the outer end of the cylindrical section 60 of the plug 56. As shown in Figs. 1 and 4, a T-sectioned slot is formed in the plug 56 and receives the end of the stem. The end face of the stem has a generally spherical configuration as shown at 78.

Preferably, the length of the stem and the cooperating screw threads 52, 70 are such that the stem can be rotated to a position wherein the upper end 82 of the plug 56 is beneath the end 40 of the bonnet 25. At this location, the plug can then be slid laterally off the stem while the stem threads are still protected by the bonnet 80 and the handle is still in place. This relationship is best shown in Fig. 4.

Carried or formed within the bore 50 of the bonnet 25 is an internal shoulder 84 (Fig. 1) formed at the juncture between the threads 52 and the cylindrical bore 54. The shoulder 84 serves to limit outward movement of the plug and stem during opening movement and thereby prevent accidental disassembly under pressure.

At the upper end of the bore 50, a recess 88 is formed circumferentially about the stem. A resilient seal washer 92 is received in the recess 88. The seal washer 92 comprises a cylindrical piece of polytetrafluoroethylene or the like which closely engages the outer circumference of the upper end of the stem. The primary functions of the seal washer 92 are to prevent dirt, etc. from entering the bonnet and to retain thread lubricant in the bonnet. The seal washer is so designed that it will not form a pressure seal that could trap pressure in this region.

For operating the stem, a transversely extending cylindrical handle 96 is removably affixed to the outer end of the stem by a socket head machine screw 98 which is screw-threadedly received within a bore 100 that intersects the stem receiving bore 102. Additionally, a flat 104 is formed on the stem. Preferably, the socket head machine screw 98 is of a length such that when properly in position, it is within the confines of the bore 100. This arrangement allows the handle to have a pleasing appearance and a comfortable feel and prevents releasing of the handle through the use of a wrench by unauthorized persons.

WHAT WE CLAIM IS:—

1. A valve comprising a valve body having inlet and outlet flow passages and having a bore extending laterally of said flow passages and terminating at a valve chamber which is of truncated conical configuration and with which the inlet and outlet flow passages are connected, a hollow, conically shaped seat insert formed from resilient material positioned in said valve chambers, said insert having ports

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4 formed therein in alignment with the inlet and outlet flow passages; a bonnet screw-threaded in the outer end of said bore, said bonnet having a cylindrical bore axially
5 aligned with the valve chamber in said body, the inner end of said bonnet being in sealing engagement with the outer end of said seat insert and with a shoulder in the valve chamber in said body; an actuating
10 stem extending axially through said bonnet bore; a valve plug releasably connected to the inner end of said stem, said plug having a cylindrically shaped section which is slidably received in said cylindrical bonnet bore
15 and a conically shaped section adapted to sealingly engage said insert so that axial movement of the valve stem displaces the plug to control fluid flow between said ports of said insert; and at least one sealing
20 ring carried by said cylindrical section of said plug and sealingly engaging said cylindrical bonnet bore.

2. A valve as claimed in claim 1 in which the releasable connection between the stem
25 and the plug permits the stem to rotate relative to the plug.

3. A valve as claimed in claim 2 wherein said plug is releasably connected to the end of the stem by a transverse T-slot formed in
30 the cylindrical section of said plug and a T-head formed on said stem.

4. A valve as claimed in claim 3 wherein said sealing ring carried in said plug is located between said T-slot and said conic-
35 ally shaped section.

5. A valve as claimed in claim 3 or 4 wherein said stem is axially movable in said bonnet bore a distance sufficient such that when said bonnet is removed from said body, said valve member can be moved
40 completely out of said bonnet bore without disassembly of a handle from the valve stem.

6. A valve as claimed in any of claims 1 to 5 wherein said bonnet and said stem
45 include cooperating screwthreads located axially outwardly of said cylindrical bonnet bore.

7. A valve as claimed in any of claims 1 to 6 wherein said sealing ring comprises
50 an O-ring and is positioned between a pair of wiping rings.

8. A valve as claimed in any of claims 1 to 7 wherein said seat insert is provided with means to prevent rotation thereof in
55 said valve chamber.

9. A valve as claimed in any of claims 1 to 8 wherein said cylindrical section of said plug is closely received in said cylindrical bonnet bore and guided thereby
60 throughout movement of said stem.

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

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