

Description

The invention relates to ball valves.

The invention is particularly suited for use in small size ball valves used in control systems and the like and will be described with reference thereto; however, the invention is capable of broader application and can be incorporated in ball valves of a variety of sizes used for many different purposes.

In US-A-4,026,516 there is described a ball valve of the type wherein the flow-controlling ball is enclosed in a cartridge or capsule of a suitable resilient packing material, such as polytetrafluoroethylene or polyethylene. A compressive preloading is applied to the packing material to produce fluid sealing between the ball surface and the inner walls of the valve chamber.

The compressive preloading is applied through a stem packing and guide bushing arrangement. The arrangement includes a cylinder of resilient packing material surrounding the ball-operating stem and confined in a packing gland mounted to act against the ball-enclosing cartridge. A preload force is applied to the stem packing which is compressed thereby to cause the gland to act against the ball-enclosing cartridge with a spring-like biasing action.

The described arrangement is extremely satisfactory under most operating conditions and in most environments. However, when used under conditions of extreme temperature cycling or when subject to conditions which result in high levels of packing wear, the arrangement does not perform as well as would be desirable.

An object of the invention is to overcome the noted problems and provide a preloading system for the packing material which can handle extreme temperature cycling and high levels of wear of the packing material without requiring readjustment or replacement of the packing material.

Accordingly, another object of the invention is the provision of a ball valve of the general type described which is capable of extended operation between packing adjustments and which can function throughout wide ranges of temperature cycling.

A further object is the provision of a valve of the type described in which the compressive preload on the packing can be readily adjusted from the exterior of the valve.

A still further object is the provision of a packing preload arrangement for an encapsulated type ball valve which allows a wide variety of packing preload forces to be generated without the need for modifying the valve housing or associated components.

According to the present invention, a ball valve comprising a housing having a cylindrical bore extending inwardly from the exterior and defining a valve chamber with inlet and outlet passages leading from the exterior of said housing to said chamber; a ball valve member positioned axially of said chamber and having a cylindrical operating stem extending axially of said chamber to a

position exterior of said housing; a mass of resilient packing material surrounding said ball member and substantially filling said chamber; and means for applying a compressive load to said packing material to cause it to sealingly engage the inner walls of said chamber and the exterior of said ball member; the load applying means comprising a rigid circular gland member closely received in said bore and extending transversely thereof in engagement with said packing material, said gland member having a circular opening through which said operating stem extends, resilient biasing means surrounding said stem and positioned on said gland member on the side opposite said packing material, and a packing nut closely received in said bore outwardly of said resilient biasing means and having an inner surface engaging said resilient biasing means, the packing nut being adjustable within said bore towards said packing gland member to compress said resilient biasing means and apply a biasing force to said packing material, is characterised in that said resilient biasing means comprises at least one disk spring stacked between said gland member and said packing nut, the or each disk spring having an outer diameter closely received in said bore.

In one embodiment of the invention, a cylindrical sleeve member is positioned to extend from the gland member outwardly into the packing nut and the or each disk spring has its inner opening in relatively close engagement with the outer surface of the sleeve member.

By the use of the described arrangement, the packing material is loaded in a manner which compensates for packing wear and also compensates for expansion or contraction of the packing material due to temperature change. The arrangement significantly reduces the frequency with which packing adjustments are required. In addition, by varying the number or stacking arrangement of the disk springs it is possible to produce wide variations in biasing force or preload without changing the overall configuration and structure of the valve.

Through the use of the described sleeve member it is possible to further vary the size and type of disk springs used without modifying the external or internal valve housing or packing nut configurations. In addition, the sleeve member provides an extremely good disk spring guidance and prevents the disk springs from shifting and/or engaging, the operating stem in a deleterious manner.

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

Fig. 1 is a sectional view of a preferred embodiment of a ball valve in accordance with the present invention;

Fig. 2 is an exploded view showing certain components of the Fig. 1 embodiment; and

Fig. 3 is a partial sectional view, similar to Fig. 1, but showing a slightly modified form of the invention.

Referring to the drawings, Fig. 1 illustrates the

overall arrangement of a ball valve having the inventive packing preloading or precompressing structure. The valve 10 comprises a rigid housing 12 having a cylindrical bore 14 which extends inwardly from the exterior of the housing and terminates in a flat bottom wall 16. Preferably, bore 14 is of constant diameter substantially throughout its length. The lower end portion (as viewed in Fig. 1) of bore 14 defines a valve chamber 18.

In the present embodiment, the valve is shown as a three-way valve and includes a first port or passageway 20 and an aligned pair of ports 22 and 24. Inlet port 20 is shown as axially aligned with the bore 14. Ports 22, 24 are formed in alignment with their axes intersecting the axis of bore 14. Each of the ports 20, 22 and 24 is provided with conventional connecting means, such as pipe threads, for permitting the valve to be suitably attached to pipe, tube fittings, or the like.

While the valve is illustrated as a three-way valve it should be apparent that the invention is applicable to two-way vented or multi-port valves and that the particular valve body style forms no part of the invention.

Mounted axially within the valve chamber portion of bore 14 is a ball valve member 28 provided with a suitable internal passage 30 located such that port 20 can be connected with port 22 or 24 by selective rotation.

In the embodiment shown ball valve member 28 has an integral generally cylindrical operating stem or shaft 32 which extends from the ball member axially of bore 14 to a position exteriorly of the housing 12. A suitable handle 36 is mounted at the outer end of the stem 32 and provides means for selective rotation of the ball valve member 28. In the embodiment under consideration, handle 36 is moulded from a suitable plastic and includes a moulded-in metal insert member 38 having an internal bore 40 which receives the outer end of stem 32. A setscrew 42 or the like is provided for engaging a flat 44 formed on the outer end of stem 32 and locking the handle in its desired relationship with the stem and ball assembly.

Positioned within the valve chamber 18 and closely surrounding the ball member 28 is a cartridge or packing assembly 48 comprising a mass of suitable plastic or resinous material selected to have the desired characteristics for the environment which the valve is expected to encounter. Typically, for example, plastic materials, such as polytetrafluoroethylene and polyethylene, are used for the ball packing in valves of the type under consideration. Generally, and as described more fully in US-A-3,236,495 and US-A-4,026,516 the packing assembly 48 is formed as cooperating upper and lower halves 50, 52 (see Fig. 2).

Each of the two packing halves has a generally cylindrical outer surface adapted to fit closely within bore 14 and an inwardly extending hemispherical surface to engage closely the outer

surface of ball member 28. Additionally, the upper packing half 50 has an axially aligned opening 54 sized to closely engage about the stem 32. Suitable rings 56 formed of metal or rigid plastic are associated with the packing and are positioned about the various inlet and outlet ports to prevent extrusion of the packing material into the port area. Additionally, as described in the aforementioned US-A-3,236,495 and US-A-4,026,516, rigid disks 58 are preferably positioned on diametrically opposite sides of the ball valve member 28 and extend from the ball through the packing 48 into engagement with the walls of the valve chamber 18 to prevent extrusion of the packing into the ball passage 30 when the valve is in an off position. It should be appreciated that the arrangement of the rings and disks would vary depending upon the porting arrangement used.

Of particular importance is the means provided to apply a compressive preload to packing 48 to maintain the packing in sealing engagement with the outer surface of the ball member 28 and the interior surface and lower wall of the bore 14. In the present embodiment, this means includes a generally flat, relatively rigid, circular disk or gland member 62 having an outer diameter sized such that it is closely but freely received within bore 14. A central opening 64 extends axially through disk 62. Opening 64 is sized so as to be slidably received on stem 32. Disk 62 could be formed of a variety of materials having suitable strength characteristics; however in the present embodiment the disk is preferably formed of metal.

As shown, disk 62 is positioned with its lower surface 66 in engagement with the top surface of packing member 50. Carried on the opposite side of disk 62 is disk spring means 68. In the embodiment illustrated, disk spring means 68 comprises one or more metallic spring washer members 70 which have a generally dish shaped configuration in their unstressed condition as shown in Fig. 2. As will become apparent, the number and stacking arrangement of the metallic disk spring members 70 can be varied to suit the needs of the particular valve involved. In the present embodiment, four of the metallic disk spring members 70 are illustrated and they are positioned in alternating facing relationship, as shown in Fig. 2.

The disk spring members 70 have an internal opening 72 which is only slightly larger than the diameter of stem 32. This assures that the spring members are properly guided and maintained in their desired stacked relationship relative to the gland member 62. In addition, the outer diameter of the disk spring member 70 is preferably only slightly less than the internal diameter of the bore 14. This assures additional guidance of the disk spring members.

Positioned at the outer end of bore 14 and arranged to be adjustably moved towards and away from the gland member 62 is a nut member 80. An axial opening 82 extends through nut member 80 for freely and slidably receiving the stem 32. Means in the form of cooperating

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threads 84 are formed on the exterior of nut member 80 and the interior of the outer end of bore 14 to provide means for adjustably moving nut member 80 to compress the disk springs 70 and apply an adjustable compressive preload through gland 62 to packing 48.

As best shown in Fig. 2, the upper end of packing nut 80 is provided with a reduced diameter portion 86 provided with suitable tool-receiving surfaces such as wrench flats 87. The reduced diameter portion preferably extends outwardly of the body for convenient access for adjustment purposes. As shown, the handle insert 38 includes a counterbore 88 which closely receives the reduced diameter portion 86 of the packing nut 80. A suitable stop key or stop plate 90 is positioned on the outer end of bore 14 and includes an opening through which the reduced diameter portion 86 of nut member 80 passes. The member 90 serves to engage stops (not shown) on handle 36 and housing 12 at suitable alternative positions of stem 32 and valve 28.

Fig. 3 illustrates a slightly modified form of the invention. In Fig. 3, the same reference numerals in the Fig. 1 embodiment have been used to identify the corresponding components. The numerals in Fig. 3 are differentiated, however, from those of Fig. 1 by the addition of a prime suffix. Unless otherwise noted, commonly identified components in Fig. 3 are identical to those discussed with reference to Fig. 1. In the embodiment of Fig. 3, an elongated cylindrical sleeve member 94 extends from gland 62' upwardly through the disk spring means 68' and the nut member 80'. The internal diameter of sleeve 94 is sized to closely but slidably engage the outer surface of stem 32'. The outer diameter is sized so as to receive closely the inner diameter of the disk spring members 70' and nut member 80'. Preferably, and as shown in Fig. 3, sleeve 94 is integral with the gland 62'; however, it could be a separate element if desired. The sleeve member 94 acts as a guide for the spring members 70' and, further, prevents them from engaging the operating stem 32'. Through the use of the guide sleeve 94, a wider variety and selection of disk spring members can be incorporated in the valve and/or the same springs can be used for a range of valve sizes.

The present invention provides an extremely simple and compact arrangement for preloading the packing in a manner which readily compensates for wear and expansion or contraction of the packing due to temperature change or cycling. In addition, the preload can be readily varied without disassembling or removing the valve from the line.

Claims

1. A ball valve comprising a housing (12) having a cylindrical bore (14) extending inwardly from the exterior and defining a valve chamber (18) with inlet and outlet passages (20, 22, 24) leading from the exterior of said housing to said

chamber; a ball valve member (28) positioned axially of said chamber (18) and having a cylindrical operating stem (32) extending axially of said chamber to a position exterior of said housing; a mass of resilient packing material (48) surrounding said ball member (28) and substantially filling said chamber (18); and means (62-80) for applying a compressive load to said packing material (48) to cause it to sealingly engage the inner wall of said chamber (18) and the exterior of said ball member (28); the load applying means (62-80) comprising a rigid circular gland member (62) closely received in said bore (14) and extending transversely thereof in engagement with said packing material (48), said gland member having a circular opening (64) through which said operating stem extends, resilient biasing means (68) surrounding said stem and positioned on said gland member (62) on the side opposite said packing material (48), and a packing nut (80) closely received in said bore (14) outwardly of said resilient biasing means (68) and having an inner surface engaging said resilient biasing means, the packing nut (80) being adjustable within said bore (14) towards said packing gland member (62) to compress said resilient biasing means (68) and apply a biasing force to said packing material (48), characterised in that said resilient biasing means (68) comprises at least one disk spring (70) stacked between said gland member (62) and said packing nut (80), the or each disk spring (70) having an outer diameter closely received in said bore (14).

2. A valve as claimed in claim 1, wherein a cylindrical sleeve member (94) surrounds said stem (32') and extends from said gland member (62') outwardly through said packing nut (80'), said disk spring or springs (68') having an inner opening which closely engages said sleeve member (94).

3. A valve as claimed in claim 2, wherein said cylindrical sleeve member (94) is joined to said gland member (62') and has an inner diameter closely receiving said stem (32') and an outer diameter which is closely and slidably received in the nut (80').

4. A valve as claimed in claim 1, wherein said disk spring or springs (68) is or are closely received on said stem (32).

5. A valve as claimed in any preceding claim, wherein said means for adjustably moving said packing nut (80) include co-operating threads (84) formed on said packing nut and in said bore (14) and tool engaging surfaces (87) formed on said packing nut.

6. A valve as claimed in any preceding claim, wherein the inner surface of said packing nut (80) extends parallel to said gland member (62).

Patentansprüche

1. Kugelhahn, enthaltend: ein Gehäuse (12) mit einer sich von dem Äußeren nach innen erstreckenden und eine Ventilkammer (18) definierenden zylindrischen Bohrung (14) mit Einlaß- und Aus-



laßdurchgängen (20, 22, 24), die vom Äußeren des Gehäuses zu der Kammer führen; ein axial bezüglich der Kammer (18) positioniertes Kugelventil-Element (28) mit einem zylindrischen Betätigungsschaft (32), der sich axial bezüglich der Kammer zu einer Position außerhalb des Gehäuses erstreckt; eine Masse nachgiebigen Packungsmaterials (48), das das Kugelement (28) umgibt und die Kammer (18) im wesentlichen füllt; sowie Mittel (62-80) zum Anlegen einer Kompressionslast auf das Packungsmaterial (48), um dieses zu veranlassen, abdichtend an den Innenwänden der Kammer (18) und dem Äußeren des Kugelementes (28) anzugreifen; wobei die Lastanlegungsmittel (62-80) ein eng in der Bohrung (14) aufgenommenes kreisförmiges Stopfbüchselement, das sich quer zu dieser in Eingriff mit dem Packungsmaterial (48) erstreckt und eine kreisförmige Öffnung (64) enthält, durch die der Betätigungsschaft verläuft, eine nachgiebige Vorbeaufschlagungseinrichtung (68), die den Schaft umgibt und auf dem Stopfbüchselement (62) auf der dem Packungsmaterial (48) entgegengesetzten Seiten positioniert ist, sowie eine Packungsmutter (80) aufweisen, die eng toleriert in der Bohrung (14) außerhalb der nachgiebigen Beaufschlagungseinrichtung (68) aufgenommen ist, eine innere an der nachgiebigen Beaufschlagungseinrichtung angreifende Oberfläche aufweist und in der Bohrung (14) in Richtung auf das Packungsstopfbüchselement (62) einstellbar ist, um die nachgiebige Vorbeaufschlagungseinrichtung (68) zu komprimieren und eine Beaufschlagungskraft auf das Packungsmaterial (48) auszuüben, dadurch gekennzeichnet, daß die nachgiebige Beaufschlagungseinrichtung (68) mindestens eine Scheibenfeder (70) aufweist, die zwischen dem Stopfbüchselement (62) und der Packungsmutter (80) eingesetzt ist, wobei die bzw. jede Scheibenfeder (70) einen Außendurchmesser aufweist, der eng toleriert in der Bohrung (18) aufgenommen ist.

2. Ventil nach Anspruch 1, bei dem ein Zylindrisches Hülsenelement (94) den Schaft (32') umgibt und sich von dem Stopfbüchselement (62') nach außen durch die Packungsmutter (80') erstreckt, wobei die Scheibenfeder oder Federn (68') eine Innenöffnung aufweisen, die eng toleriert an dem Hülsenelement (94) angreift.

3. Ventil nach Anspruch 2, bei dem das zylindrische Hülsenelement (94) mit dem Stopfbüchselement (62') verbunden ist und einen inneren Durchmesser aufweist, der den Schaft (32') eng toleriert aufnimmt, sowie einen äußeren Durchmesser, der mit enger Toleranz und gleitbar in der Mutter (80) aufgenommen ist.

4. Ventil nach Anspruch 1, bei dem die Scheibenfeder oder Federn (68) mit enger Toleranz auf dem Schaft (32) aufgenommen ist bzw. sind.

5. Ventil nach einem der vorhergehenden Ansprüche, bei dem die Einrichtung zum einstellbaren Bewegen der Packungsmutter (80) zusammenwirkende, an der Packungsmutter und in der Bohrung (14) gebildete Gewinde (84) und an der Packungsmutter gebildete Werkzeugangriffsflächen (87) aufweist.

6. Ventil nach einem der vorhergehenden Ansprüche, bei dem die innere Oberfläche der Packungsmutter (80) parallel zu dem Stopfbüchselement (62) verläuft.

Revendications

1. Soupape à boisseau sphérique comprenant un carter (12) présentant un alésage cylindrique (14) s'étendant à l'intérieur en partant de l'extérieur et définissant une chambre de soupape (18) avec des passages d'entrée et de sortie (20, 22, 24) menant de l'extérieur dudit carter à ladite chambre; un organe de soupape sphérique (28) positionné dans l'axe de ladite chambre (18) et comportant une tige d'actionnement (32) cylindrique qui s'étend axialement, de ladite chambre jusqu'à une position extérieure audit carter; une masse de matériau de garniture (48) élastique, entourant ledit organe sphérique (28) et remplissant pratiquement ladite chambre (18); et des moyens (62 à 80) pour appliquer une charge de compression sur ledit matériau de garniture (48), afin de le placer en contact d'étanchéité sur les parois intérieures de ladite chambre (18) et sur l'extérieur dudit organe sphérique (28); les moyens d'application de charge (62 à 80) comprenant un presse-étoupe (62) circulaire rigide, logé ajusté dans ledit alésage (14) et s'étendant transversalement par rapport à celui-ci, en contact avec ledit matériau de garniture (48), ledit presse-étoupe comportant une ouverture circulaire (64) au travers de laquelle s'étend ladite tige d'actionnement, un moyen de rappel élastique (68) entourant ladite tige et positionné sur ledit presse-étoupe (62), du côté opposé audit matériau de garniture (48), et un écrou de garniture (80), logé ajusté dans ledit alésage (14), à l'extérieur dudit moyen de rappel élastique, l'écrou de garniture (80) étant réglable à l'intérieur dudit alésage (14), en direction dudit presse-étoupe (62), afin de comprimer ledit moyen de rappel élastique (62) et d'appliquer une force de rappel sur ledit matériau de garniture (48), caractérisée par le fait que ledit moyen de rappel élastique (68) comprend au moins un ressort à disques (70) empilé entre ledit presse-étoupe (62) et ledit écrou de garniture (80), le ou chaque ressort à disques (70) présentant un diamètre extérieur logé ajusté dans ledit alésage (14).

2. Soupape à boisseau sphérique selon la revendication 1, dans laquelle une douille (94) cylindrique entoure ladite tige (32') et s'étend à partir dudit presse-étoupe (62'), en allant à l'extérieur, en passant à travers ledit écrou de garniture (80'), ledit ou lesdits ressort(s) à disque (68') comportant une ouverture intérieure qui vient en contact ajusté avec ladite douille (94).

3. Soupape à boisseau sphérique selon la revendication 2, dans laquelle ladite douille cylindrique (94) est reliée audit presse-étoupe (62') et présente un diamètre intérieur logeant de manière ajustée ladite tige (32') et un diamètre extérieur qui est logé ajusté et coulissant dans l'écrou (80').

4. Soupape à boisseau sphérique selon la revendication 1, dans laquelle ledit ou lesdits ressort(s) à



disques (68) est ou sont disposés ajusté(s) sur ladite tige (32).

5. Soupape à boisseau sphérique selon l'une des revendications précédentes, dans laquelle lesdits moyens servant à déplacer de manière réglable ledit écrou de garniture (80) comprennent des filets (84) coopérants, formés sur ledit

écrou de garniture et dans ledit alésage (14) et des surfaces (87) servant à mettre en contact un outil, formées sur ledit écrou de garniture.

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6. Soupape à boisseau sphérique selon l'une des revendications précédentes, dans laquelle la surface intérieure dudit écrou de garniture (80) s'étend ' parallèlement audit presse-étoupe (62).

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