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(54) **VALVES**

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Description

[0001] The present invention relates to valves, such as check valves, and particularly, though not exclusively, relates to lubrication fittings for use in lubricating pressurised vessels or cavities.

[0002] There are currently many different types of lubrication fittings providing a means to inject lubricant into pressurised vessels while also providing a means of retaining the lubricant within the vessel in question. For example, a lubrication fitting, fitted to a vessel to be internally lubricated, may function as a simple check valve allowing a flow of lubricant from an opening of the valve external to the vessel, to an opening of the valve internal to the vessel thereby to permit lubricant to be injected into the vessel by forcing the lubricant from the external opening to the internal opening and thereafter into the vessel itself. Many such valves comprise a simple one-way check valve mechanism allowing the flow of lubricant into the vessel while preventing the flow of lubricant out of the vessel via the fitting.

[0003] For example, Figure 1 illustrates a simple such lubrication fitting including a one-way check valve mechanism. The lubrication fitting comprises a valve body 1 through which passes a valve bore 2 from an outer valve opening 3 serving as a lubricant inlet opening, to an inner valve opening 4 serving as a lubricant outlet. A helical spring 5 is housed within the valve bore and arranged to urge a spherical ball 6 against a valve seat 7 adjacent the first valve opening such that the spherical ball closes the valve when so seated. In use, the fitting is attached to a pressurised vessel or cavity such that the inner valve opening is placed in fluid communication with the internal volume of the vessel while the outer valve opening is in communication with regions outside the vessel. The action of the helical spring to urge the spherical ball into the seated position closes the valve preventing the escape of pressurised fluid (e.g. lubricant) from within the pressurised vessel via the valve bore.

[0004] Lubricant may be injected into the pressurised vessel by unseating the spherical ball from the valve seat (i.e. moving the spherical ball towards the inner valve opening) thereby to open the valve and to direct the passage of pressurised lubricant from the outer valve opening to the inner valve opening, via the valve bore, and then into the vessel or cavity to be lubricated. Unseating of the spherical ball may be achieved by inserting an end of a pin or rod into the outer valve opening and into contact with the exposed outer surface of the spherical ball. Pushing the inserted end of the rod or pin against the ball with sufficient force unseats the ball. This process of unseating the ball of such a valve is commonly known as "stinging" the valve, and the rod or pin is commonly known as a "stinger" or part of a "stinger" means.

[0005] In this way, the lubrication fitting acts as a means of allowing the injection of lubricant into a pressurised vessel while preventing fluids or substances from escaping from within the pressurised vessel. This is especially important when pressures involved are high.

[0006] For example, a vessel such as a gate valve or a plug valve typically requires filling with a lubricant. In extreme cases, pressures from within such vessels may be as high as 2070 bar (30,000 p.s.i).

[0007] Pressurised fluid vessels or cavities may often include internal valves such as gate valves or plug valves which include moving components requiring lubrication. It is not uncommon for trapped pressures within such vessels and cavities to act on the internal mechanism of the valve (e.g. the gate or the plug) with such force as to clamp the moving members such that they can no longer be moved by use of the ordinary means for opening and closing the valve mechanism. Under such circumstances, a means is required to release unwanted internal pressures from within the body of the vessel or cavity in order to unclamp the otherwise movable internal valve mechanisms to allow the valve to be operated. In such situations, or for any other situation requiring release of pressures from within a vessel or cavity, the vessel or cavity may be depressurised if it is fitted with an appropriate lubrication fitting such as illustrated in Figure 1, by unseating the spherical ball to open the valve and depressurise the vessel of cavity.

[0008] Of course, in normal use, the body of a lubrication fitting such as illustrated in Figure 1, is internally subjected to the pressures within the vessel to which it is fitted. The seated spherical ball within the valve seat of the fitting aims to prevent escape of pressure. However, such a simple mechanism is vulnerable to failure when internal vessel pressures are high.

[0009] JP2005-77275 discloses a valve arrangement for use in sealing a container holding radioactive waste.

[0010] The present invention aims to provide a valve with reduced vulnerability to such failures whilst still being usable as a check valve and/or as a lubrication fitting for use in lubricating pressurised vessels or cavities.

[0011] At its most general, the invention proposed is a double check valve with two separate elements individually moveable to close (e.g. individually but simultaneously or concurrently close) the valve and collectively moveable to open the valve. In this way, the valve may be less vulnerable to failure or leakage in having separate elements for independently (e.g. concurrently) closing the valve, yet being collectively controllable to open the valve to allow pressure release or to allow injection of fluid (e.g. lubricant). For example, the double check valve may include two separate check valves with a "stinger" element between them which is operable to internally "sting" the one check valve when (e.g. by action of) the other check valve is "stung" by a user (e.g. using a stinger means) thereby to open both check valves individually and the double check valve as a whole.

[0012] In a first of its aspects, the invention may provide a valve including a valve body through which a valve bore passes from a first valve opening to a second valve opening, a first closure member moveable within the valve bore to close the valve, a second closure member move-

able within the valve bore to concurrently close the valve when the valve is also closed by the first closure member, a rigid intermediate member within the valve bore between the first closure member and the second closure member and moveable by action of movement of the second closure member to urge movement of (and preferably move) the first closure member to render the first valve opening in fluid communication with the second valve opening, wherein the length of the intermediate member matches the separation of opposing nearmost surfaces of the first and second closure members when both of the first and second closure members are in a respective position within the valve bore which closes the valve.

[0013] For example, each of the first and second closure members may be dimensioned and arranged to be moveable to a respective position within the valve bore in which the respective closure member engages with an internal surface of the valve bore to sealing prevent fluid communication between the first and second valve openings. As such, each of the first and second closure members may independently close the valve. In this way, failure of the closed valve would require failure of the first and the second closure members separately. Nevertheless, each of the first and second closure members may be movable along the valve bore collectively and in unison such that movement of the second closure member away from the location within the valve bore at which it closes the valve, also results in a movement of the first closure member away from its valve-closing position. Thus, pushing the second closure member away from its valve-closing position may cause the second closure member to urge against the nearmost surface of the rigid intermediate member thereby to urge that intermediate member against the first closure member and to urge the first closure member away from its valve-closing position. Thus, the user may render the valve open by only applying action upon the second closure member. The first and/or second closure member may be a spherical ball of rigid metal or other rigid and sufficiently strong material. The rigid intermediate member may be a pin or rod or other elongate body positioned within the valve bore to extend along the axis of the bore between the first and second closure members. The valve bore preferably has a diameter which decreases in value as the bore extends from the first valve opening to the second valve opening. The first closure member may be dimensioned to be movable within a first section of valve bore adjacent the first valve opening, but too large to pass along the valve bore beyond (i.e. further towards the second valve opening) the position along the valve bore at which it closes the valve. The second closure member may be dimensioned to be movable along those portions of the valve bore along which the first closure member is movable, and also along a narrower section of the valve bore along which the first closure member cannot pass. The second closure member may be dimensioned to prevent it passing along a section of the valve leading to or immediately adjacent the second valve opening. In this way both the first and second closure members may be movable along the valve bore towards the second valve opening, such that passage of the first closure member along the valve bore is blocked at a point further from the second valve opening (closer to the first valve opening) than the position at which continued passage of the second closure member is blocked. The second closure member may have a dimension transverse to the axis of the valve bore which is less than the dimension of the first closure member transverse to the axis of the valve bore.

[0014] In an example not forming part of the claimed invention, the rigid intermediate member may be dimensioned to be not placeable in contact with both the first closure member and the second closure member simultaneously (but very close to being so) when both the first and second closure members are in a respective position within the valve bore which closes the valve. Consequently, a small movement of the second closure member substantially immediately away from its valve-closing position will result in an urging by the intermediate member of a movement of the first closure member from its valve-closing position. This dimensioning of the rigid intermediate member ensures that it does not prevent the simultaneous closure of the valve by both of the first and second closure members. It is preferable that the rigid intermediate member is dimensioned such that it is placeable in contact with one of the first and second closure members when each closure member is in a respective position within the valve bore which closes the valve while being intimately close to, but not in contact with, the other of the first and second closure members. When so placed, the spacing between the opposing adjacent nearmost surfaces of the intimately close rigid intermediate member and closure member may be less than 5%, or 4%, or 3%, or 2%, or preferably 1% of the axial length of the rigid intermediate member. This spacing may be less than 1 mm or less than 0.5 mm, or less than 0.1 mm. The opening of the valve may be finely controlled as a result.

[0015] The rigid intermediate member has a major axial length matching the distance between nearmost opposing surfaces of the first and second closure members when both closure members are in respective positions within the valve bore which close the valve.

[0016] The rigid intermediate member may have an axially transverse width less than the width of the portion of the valve bore between the first and second closure members therein.

[0017] Preferably, the material from which the rigid intermediate member is made is softer than the material from which each/either of the first and second closure members are made. This aims to prevent damage being caused to the seating surfaces of the closure members by the rigid intermediate member by contact between them. The material of the rigid intermediate member and/or the closure members is most preferably resistant (i.e. to corrosion) to the substance retained/inserted within the vessel served by the valve.

[0018] The material of the valve body, the closure members and the intermediate rigid member may be a plastic, a metal or a ceramic.

[0019] The rigid intermediate member may be a metal or ceramic rod or pin, or a plastic rod or pin made from sufficiently strong plastic material. The body of the valve may be made from ferric or non-ferric steel, brass, bronze or an aluminium alloy. The, or either of the, valve closure members may be made from ferric or non-ferric steel, brass, bronze, aluminium alloy, elastomer, ceramic, tungsten carbide or a plastic. The appropriate choice of materials for the parts will depend to some extent upon the type of fluid (e.g. liquid or gas) being retained and the pressure involved.

[0020] The valve bore may define a first valve seat and the first closure member may be moveable within the valve bore to engage the first valve seat and dimensioned to close the valve when so seated.

[0021] The rigid intermediate member may be moveable by action of a movement of the second closure member towards the first valve seat to urge movement of the first closure member away from the first valve seat.

[0022] The valve bore may define a second valve seat and the second closure member may be located between the first and second valve seats and may be moveable within the valve bore to engage the second valve seat and dimensioned to close the valve when so seated. When so seated, either or both of the first and second closure members may sealingly interface with respective valve seats to form a circumferentially closed, sealing interface fully isolating the parts of the valve bore either-side of the interface.

[0023] Each of the first and second closure members may be moveable by action of a fluid pressure within the valve bore to a respective static position (e.g. the seated position described above) within the valve bore which closes the valve.

[0024] The valve may include urging means arranged to urge the first and/or second closure member(s) to a position(s) within the valve bore which closes the valve. The urging means may include a spring or springs housed within the valve bore and bearing against the first and/or second valve closure member(s) to urge the respective closure member into the aforesaid position(s). The urging means may include a first spring bearing against the first closure member to urge that closure member to a valve-closing position, and may include a second spring located within the valve bore between the first and second closure members and arranged to bear against the fist closure member to urge it into a position which closes the valve.

[0025] The diameter (or transverse dimension) of any part of the valve bore may be a value from the range 0.3175 cm to 1.27 cm (1/8 inch to 1/2 inch), and the diameters (or transverse dimension) of either of the first and second closure members may be a value within the above range. The length of the valve bore may be a value from the range 1.27 cm to 2.54 cm (1/2 to 1 inch). The compression strength of the first spring is preferably greater than the compression strength (i.e. resistance to compression, stiffness) of the second spring. Preferably, when the first and second closure members are in respective positions within the valve bore which each close the valve, the urging force applied to the first closure member by the urging means is greater than the urging force applied to the second closure member by the urging means. The second spring may bear against the first and second closure members, being located between them. The suitable choice of urging force and/or compression strength described above may ensure that the urging force of the urging means does not unseat the first closure member.

[0026] Where the urging means includes a spring located between the first and second closure members, the spring may be a helical spring within the windings of which is housed the rigid intermediate member. In this way, the windings of the helical spring may act as a cage retaining the rigid intermediate member in a desired position in between the first and second closure members. Where the urging means includes a spring urging the first closure member into its valve-closing position, the end of the spring furthest from the first closure member may be seated against a spring-seating arranged within the valve bore adjacent or immediately adjacent the first valve opening. For example, the diameter of the first valve opening may be less than the diameter of the valve bore immediately adjacent the opening, wherein the first valve opening is defined by a circumferential lip extending over the peripheral edges of the valve bore to reduce the aperture of the valve bore at the first valve opening. The inwardly-facing surface of this lip may act as a seat against which the distal end of a spring may be seated to act as a means of urging the first closure member into its valve-closing position.

[0027] In another of its aspects, the invention may provide a check valve including the valve according to the invention in its first aspect. In a further of its aspects, the invention may provide a gate valve, or a plug valve, or a globe valve, or a ball valve including the valve of any preceding aspect of the invention.

[0028] In an additional aspect, the invention may provide a lubrication fitting including a valve according to the invention in any of the above aspects in which the valve bore is a lubricant conduit, or is arranged to be a lubricant conduit.

[0029] In yet a further of its aspects, the invention may provide a means for decompressing a pressurised region, vessel or cavity including a valve according to any preceding aspect described above. The invention may provide a valve or a vessel containing or for containing pressurised substance including the valve according to any aspect above.

[0030] It will be understood that the invention described above in its various aspects implements an equivalent method of controlling fluid communication between a pressurised region, vessel or cavity and a region of rel-

atively lower pressure. The invention encompasses such equivalent methods.

[0031] In a second of its aspects, the invention may provide a method of controlling fluid communication with a pressurised region including, providing a valve body through which a valve bore passes from a first valve opening in communication with the pressurised region to a second valve opening, providing a first closure member moveable within the valve bore by action of fluid pressure therein to close the valve, providing a second closure member moveable within the valve bore by action of fluid pressure therein to concurrently close the valve when the valve is also closed by the first closure member, providing a rigid intermediate member within the valve bore between the first closure member and the second closure member and moving the rigid intermediate member by action of moving the second closure member to urge movement of (and preferably move) the first closure member to render the first valve opening in fluid communication with the second valve opening, wherein the length of the intermediate member matches the separation of opposing nearmost surfaces of the first and second closure members when both of the first and second closure members are in a respective position within the valve bore which closes the valve.

[0032] The invention may provide a method of releasing pressure from a pressurised cavity according to the invention in its second aspect.

[0033] The method may include providing a first valve seat defined by the valve bore, and moving the first closure member within the valve bore from a position of engagement with the first valve seat thereby to unseat the first closure member therefrom.

[0034] The method may include moving the rigid intermediate member by action of moving the second closure member towards the first valve seat to urge movement of the first closure member away from the first valve seat.

[0035] The method may include providing a second valve seat defined by the valve bore and moving the second closure member within the valve bore from a position of engagement with the second valve seat thereby to unseat the second closure member therefrom.

[0036] The moving of each of the first and second closure members may be achieved by action of a fluid pressure within the valve bore to a respective static position within the valve bore which closes the valve.

[0037] In an additional aspect, the invention may provide a method of supplying a fluid (e.g. a lubricant) to a pressurised cavity including the method according described above in which the valve bore is a fluid (e.g. lubricant) conduit.

[0038] There now follows a non-limiting example of the invention described with reference to the following drawings:

Figure 1 illustrates a cross-sectional view of a lubrication fitting;

Figure 2 illustrates a cross-sectional view of a valve operable as a lubrication fitting including a double-check mechanism;

Figure 3 illustrates the valve of figure 2 together with a means for opening the valve (e.g. a "stinger").

[0039] In the drawings, light items are assigned like reference symbols.

[0040] Figure 2 illustrates a cross-sectional view of a valve according to an embodiment of the invention. The valve includes a valve body 10 through which a valve bore 11 passes from a first valve opening 12 to a second valve opening 13.

[0041] The outer surface of the valve body adjacent and surrounding the first valve opening defines nozzle 14 extending along a direction parallel with the axis of the valve bore. The outer surface of the nozzle is threaded to enable the nozzle to be coupled into a reciprocally threaded aperture of a vessel or cavity wall so as to couple the valve body to the vessel or cavity and to form a sealing fit therewith. The terminal end surface of the nozzle is shaped to define the first valve opening which serves, in use, to admit into the valve bore substances (e.g. pressurised fluid) from within the vessel or cavity to which the valve is coupled, and to admit into the vessel or cavity substances (e.g. lubricant) to be injected into the vessel or cavity via the valve.

[0042] The second valve opening, at an end of the valve bore opposite to that at which the first valve opening is defined, provides an opening, in use, to admit substances (e.g. lubricant) into the valve bore for injection into a cavity or vessel and to exude substances (e.g. pressurised fluid) emanating from the cavity or vessel via the valve.

[0043] The valve bore includes a first bore length 15 extending linearly from the first valve opening towards the second valve opening, being of uniform circular cross-section and diameter along that length. The first bore length terminates at a first valve seat 16 formed by a reduction in the diameter of the valve bore which defines an end of a second bore length 17. In this way the junction between the first and second bore lengths defines a circumferential step of shoulder 16 within the inner bore surface at which the diameter of the bore reduces.

[0044] The second bore length 17 extends linearly from the first valve seat 16 towards the second valve opening and is uniformly circular in cross-section along that length. The second bore length terminates at a second valve seat 19 formed by a reduction in the diameter of the valve bore which defines the second valve opening. Thus, the junction between the second bore length and the second valve opening defines a circumferential shoulder or step 19 within the bore surface at which the diameter of the bore reduces.

[0045] A first ball 20 is located within the first bore length and has a diameter which is less than the diameter of the first bore length, but greater than the diameter of

the second bore length. A helical spring 21 is housed within the first bore length and engages a surface of the first ball at one spring end. The opposite end of the first spring is seated, and engages, a circumferential step, shoulder or lip 22 formed by a narrowing of the diameter of the valve bore which defines the first bore opening. The long axis of the first helical spring extends along the axis of the first bore length from the first bore opening to a facing surface of the first ball and is in a state of compression. The compressed spring urges against the facing surface of the first ball so as to urge the first ball towards the second valve opening and against the first valve seat thereby to form a sealing interface therewith to place the first bore length in fluid isolation from the second bore length - thereby to close the valve.

[0046] The diameters of both the first ball and the first helical spring are such as to permit each (or parts thereof) to move along the first bore length away from the first valve seat to permit a flow of fluid, or other flowing substance, around them and along the valve bore (unless the first ball is seated at the first valve seat).

[0047] Thus, the first bore length, the first valve seat, the first ball and first helical spring collectively define a first check-valve which, in its quiescent state, acts to close the valve to prevent a flow of substance from the first valve opening to the second valve opening until the first ball is unseated from the first valve seat.

[0048] A second ball 25 (smaller than the first ball) is located within the second bore length and has a diameter which is less than the diameter of the second bore length but greater than the diameter of the second valve opening at the second valve seat.

[0049] A second helical spring 26 is housed within the second bore length and, at one of its ends, engages a facing surface of the second ball, while, at the other of its ends, it engages a facing surface of the first ball. The long axis of the second helical spring extends along the axis of the second bore length from the first ball to the second ball and is in a state of compression so as to urge the second ball towards the second valve opening, and against the second valve seat, when the first ball is against the first valve seat. When so urged against the second valve seat, the second ball forms a sealing interface therewith, so as to place the second bore length in fluid isolation from the second valve opening - thereby to close the valve.

[0050] The diameters of the second ball and second helical spring are such as to permit each (or a part thereof) to move along the second bore length away from the second valve seat and to permit a flow of fluid, or the like, around them and along the valve bore when the valve is open. In this way, the second bore length, second valve seat, second ball and second helical spring act together to define a second check-valve which, in its quiescent state, acts to close the valve to prevent a flow of substance from the first valve opening to the second valve opening. The valve is maintained closed until the second ball is unseated from the second valve seat.

[0051] A rigid pin 30 is located within the second bore length intermediate the first ball and the second ball, and is housed or caged within the windings of the second helical spring. The pin extends along the long axis of the second helical spring and of the second bore length. The length of the rigid pin matches the separation of opposing nearmost surfaces of the first ball and second ball when each are seated in their respective valve seats. Consequently, when both the first ball and second ball are seated to individually close the valve, the intermediate rigid pin touches opposing surfaces of the two balls. A movement of the second ball away from the second valve seat and towards the first ball is transmitted along the intermediate rigid pin to the first ball thereby to urge an unseating of the first ball from the first valve seat to simultaneously open the valve.

[0052] In this way, the double-check valve may be opened by acting directly upon only the second-check valve, accessible through the second valve opening, which acts to open the first check-valve, via the intermediate pin, to substantially simultaneously open the first check-valve (which is otherwise inaccessible when used).

[0053] Each of the first and second balls may be a metal sphere. The surface of the first and/or second valve seat may be inclined relative to the axis of the valve bore so as to present to a respective first and/or second ball a flat or continuous surface tangential to the surface of the ball when seated thereat. This may assist in forming a sealing interface between the valve seat and the seated ball.

[0054] In use, a rod 40 may be inserted into the closed valve 10 via the second valve opening 13 (as is shown in Figure 3) so as to urge the second ball 25 away from its valve seat, and simultaneously to unseat the first ball, thereby to open the valve.

[0055] Figure 3 illustrates a typical valve opening tool 100 arranged for opening the valve 10. The opening tool comprises a hollow body 130 through which passes a rod 40 passes from a distal opening beyond which a handle-bearing end 110 of the rod protrudes, to an operative end at which is formed an aperture exposing a terminal operative end of the rod. The aperture of the opening tool is dimensioned to admit an end of the valve 10 containing the second valve opening, from which end flanges outwardly project in opposite directions transverse to the axis of the valve bore. Opposing grooves formed in the body of the opening tool adjacent the operative end of the tool and extending transversely to the axis of the rod, are arranged and dimensioned to simultaneously intimately admit and fit to a respective flange of the valve end thereby to hold the valve to the operative end of the tool with the axis of the rod collinear with the axis of the valve bore.

[0056] The terminal operative end of the rod 40 is dimensioned to be admissible into the valve bore via the second valve opening and to be moveable along the axis of the valve bore to engage with a facing surface of the

second ball 25 seated at the second valve seat. The rod is further moveable to unseat the second ball from the second valve seat and, in so doing indirectly unseat the first ball from the first valve seat thereby to open the valve.

[0057] The external surface of a length 80 of the rod 40 intermediate the ends of the rod, is threaded and engages a reciprocally threaded bore (not shown) such that a clockwise (or anticlockwise) turning 120 of the handle-bearing end 110 of the rod results in a linear movement 50 to project (or retract) the terminal operative end of the rod. When the terminal end of the rod is engaged with the second ball 25 of the valve as shown in figure 3, this projection (retraction) results in a corresponding linear movement 60 of the second ball, the intermediate pin 30 and the second ball 20 along the valve bore to unseat (or reseat) both balls and to open (or close) the valve.

[0058] In normal use, and when retaining medium to high-pressure fluids, the body 10 of the valve may be made from low alloy steel such as AISI 4140, the two spherical balls may be made from stainless steel or a corrosion resistant ally such as Inconel. The intermediate rigid pin may be made from a stainless steel such as AISI 316 or bronze.

[0059] The above embodiments are intended as non-limiting examples of the invention and variants or modifications of these embodiments such as would be readily apparent to the skilled person are encompassed within the invention.

Claims

1. A valve including:

a valve body (10) through which a valve bore (11) passes from a first valve opening (12) to a second valve opening (13);
a first closure member (20) moveable within the valve bore (11) to close the valve;
a second closure member (25) moveable within the valve bore (11) to concurrently close the valve when the valve is also closed by the first closure member (20);
a rigid intermediate member (30) within the valve bore (11) between the first closure member (20) and the second closure member (25) and moveable by action of movement of the second closure member (25) to urge movement of the first closure member (20) to render the first valve opening (12) in fluid communication with the second valve opening (13), the valve being **characterised in that** the length of the intermediate member (30) matches the separation of opposing nearmost surfaces of the first and second closure members (20, 25) when both the first and second closure members (20, 25) are in a respective position within the valve bore (11) which closes the valve.

2. A valve according to claim 1 wherein the rigid intermediate member (30) has an axially transverse width less than the width of the valve bore (11).

3. A valve according to any preceding claim in which the rigid intermediate member (30) is a metal rod.

4. A valve according to any preceding claim in which the valve bore (11) defines a first valve seat (16) and the first closure member (20) is moveable within the valve bore (11) to engage the first valve seat (16) and dimensioned to close the valve when so seated.

5. A valve according to Claim 4 in which the rigid intermediate member (30) is moveable by action of a movement of the second closure member (25) towards the first valve seat (16) to urge movement of the first closure member (20) away from the first valve seat (16).

6. A valve according to Claim 4 or 5 or 6 in which the valve bore (11) defines a second valve seat (19) and the second closure member (25) is between the first and second valve seats (16, 19) and is moveable within the valve bore (11) to engage the second valve seat (19) and dimensioned to close the valve when so seated.

7. A valve according to any preceding claim in which each of the first and second closure members (20, 25) is moveable, in use, by action of a fluid pressure within the valve bore (11) to a respective static position within the valve bore (11) which closes the valve.

8. A check valve including the valve according to any preceding claim.

9. A gate valve, or plug valve, or globe valve, or ball valve including the valve of any preceding claim.

10. A lubrication fitting including a valve according to any preceding claim in which the valve bore (11) is a lubricant conduit, or is arranged to be a lubricant conduit.

11. A valve or vessel containing or for containing pressurised substance including the valve according to any preceding claim.

12. A method of controlling fluid communication with a pressurised region including:

providing a valve body (10) through which a valve bore (11) passes from a first valve opening (12) in communication with the pressurised region to a second valve opening (13);
providing a first closure member (20) moveable

within the valve bore (11) by action of fluid pressure therein to close the valve;
providing a second closure member (25) moveable within the valve bore (11) by action of fluid pressure therein to concurrently close the valve when the valve is also closed by the first closure member (20);
providing a rigid intermediate member (30) within the valve bore (11) between the first closure member (20) and the second closure member (25) and moving the rigid intermediate member (30) by action of moving the second closure member (25) to urge movement of the first closure member (20) to render the first valve opening (12) in fluid communication with the second valve opening (13), the method being **characterised in that** the length of the intermediate member (30) matches the separation of opposing nearmost surfaces of the first and second closure members (20, 25) when both the first and second closure members (20, 25) are in a respective position within the valve bore (11) which closes the valve.

13. A method of releasing pressure from a pressurised cavity according to claim 12.

14. A method according to claim 12 or 13 including providing a first valve seat (16) defined by the valve bore (11) and moving the first closure member (20) within the valve bore (11) from a position of engagement with the first valve seat (16) thereby to unseat the first closure member (20) therefrom.

15. A method according to Claim 14 including moving the rigid intermediate member (30) by action of moving the second closure member (25) towards the first valve seat (16) to urge movement of the first closure member (20) away from the first valve seat (16).

16. A method according to Claim 14 or 15 including providing a second valve seat (19) defined by the valve bore (11) and moving the second closure member (25) within the valve bore (11) from a position of engagement with the second valve seat (19) thereby to unseat the second closure member (25) therefrom.

17. A method according to any of claims 12 to 16 including moving each of the first and second closure members (20, 25) by action of a fluid pressure within the valve bore (11) to a respective static position within the valve bore (11) which closes the valve.

18. A method of supplying a lubricant to a pressurised cavity including the method according to any of claims 12 to 17 in which the valve bore (11) is a lubricant conduit.

Patentansprüche

1. Ventil, umfassend:

einen Ventilkörper (10), durch den eine Ventilbohrung (11) von einer ersten Ventilöffnung (12) zu einer zweiten Ventilöffnung (13) führt;
ein erstes Verschlusselement (20), das innerhalb der Ventilbohrung (11) beweglich ist, um das Ventil zu verschließen;
ein zweites Verschlusselement (25), das innerhalb der Ventilbohrung (11) beweglich ist, um das Ventil gleichzeitig zu verschließen, wenn das Ventil auch durch das erste Verschlusselement (20) verschlossen ist;
ein starres Zwischenelement (30) innerhalb der Ventilbohrung (11) zwischen dem ersten Verschlusselement (20) und dem zweiten Verschlusselement (25), das durch die Bewegungswirkung des zweiten Verschlusselements (25) beweglich ist, um eine Bewegung des ersten Verschlusselements (20) zu erzwingen, um die erste Ventilöffnung (12) in Fluidkommunikation mit der zweiten Ventilöffnung (13) zu bringen, wobei das Ventil **dadurch gekennzeichnet ist, dass** die Länge des Zwischenelements (30) an den Abstand zwischen den nächstgelegenen gegenüberliegenden Oberflächen des ersten und des zweiten Verschlusselements (20, 25) angeglichen ist, wenn sich sowohl das erste als auch das zweite Verschlusselement (20, 25) in ihrer jeweiligen Position innerhalb der Ventilbohrung (11) befinden, um das Ventil zu verschließen.

2. Ventil nach Anspruch 1, wobei das starre Zwischenelement (30) eine geringere achsentransversale Breite aufweist als die Breite der Ventilbohrung (11).

3. Ventil nach einem der vorangegangenen Ansprüche, wobei das starre Zwischenelement (30) ein Metallstab ist.

4. Ventil nach einem der vorangegangenen Ansprüche, wobei die Ventilbohrung (11) einen ersten Ventilsitz (16) definiert und das erste Verschlusselement (20) innerhalb der Ventilbohrung (11) beweglich ist, um in den ersten Ventilsitz (16) einzugreifen, und so dimensioniert ist, dass es das Ventil verschließt, wenn es so sitzt.

5. Ventil nach Anspruch 4, wobei das starre Zwischenelement (30) durch die Bewegungswirkung des zweiten Verschlusselements (25) zum ersten Ventilsitz (16) hin beweglich ist, um die Bewegung des ersten Verschlusselements (20) vom ersten Ventilsitz (16) weg zu erzwingen.

6. Ventil nach Anspruch 4, 5 oder 6, wobei die Ventilbohrung (11) einen zweiten Ventilsitz (19) definiert und sich das zweite Verschlusselement (25) zwischen dem ersten und dem zweiten Ventilsitz (16, 19) befindet und innerhalb der Ventilbohrung (11) beweglich ist, um in den zweiten Ventilsitz (19) einzugreifen, und so dimensioniert ist, dass es das Ventil verschließt, wenn es so sitzt.

7. Ventil nach einem der vorangegangenen Ansprüche, wobei beim Gebrauch sowohl das erste als auch das zweite Verschlusselement (20, 25) durch die Wirkung eines Fluiddrucks innerhalb der Ventilbohrung (11) zu einer entsprechenden Ruheposition innerhalb der Ventilbohrung (11) beweglich ist, in der das Ventil verschlossen ist.

8. Rückschlagventil, das ein Ventil nach einem der vorangegangenen Ansprüche umfasst.

9. Absperrventil, Auslaufventil, Sitzventil oder Kugelventil, das ein Ventil nach einem der vorangegangenen Ansprüche umfasst.

10. Schmiernippel, der ein Ventil nach einem der vorangegangenen Ansprüche umfasst, wobei die Ventilbohrung (11) eine Schmiermittelleitung ist oder angeordnet ist, um eine Schmiermittelleitung zu bilden.

11. Ventil oder Gefäß, das eine unter Überdruck stehende Substanz enthält oder dafür bestimmt ist und ein Ventil nach einem der vorangegangenen Ansprüche umfasst.

12. Verfahren zur Steuerung der Fluidkommunikation mit einem Überdruckbereich, umfassend:

das Bereitstellen eines Ventilkörpers (10), durch den eine Ventilbohrung (11) von einer ersten Ventilöffnung (12), die mit dem Überdruckbereich kommuniziert, zu einer zweiten Ventilöffnung (13) führt;
das Bereitstellen eines ersten Verschlusselements (20), das durch die Wirkung des Fluiddrucks darin innerhalb der Ventilbohrung (11) beweglich ist, um das Ventil zu verschließen;
das Bereitstellen eines zweiten Verschlusselements (25), das durch die Wirkung des Fluiddrucks darin innerhalb der Ventilbohrung (11) beweglich ist, um das Ventil gleichzeitig zu verschließen, wenn das Ventil auch durch das erste Verschlusselement (20) verschlossen ist;
das Bereitstellen eines starren Zwischenelements (30) innerhalb der Ventilbohrung (11) zwischen dem ersten Verschlusselement (20) und dem zweiten Verschlusselement (25) und das Bewegen des starren Zwischenelements (30) durch die Bewegungswirkung des zweiten Verschlusselements (25), um eine Bewegung des ersten Verschlusselements (20) zu erzwingen, um die erste Ventilöffnung (12) in Fluidkommunikation mit der zweiten Ventilöffnung (13) zu bringen, wobei das Verfahren **dadurch gekennzeichnet ist, dass** die Länge des Zwischenelements (30) an den Abstand zwischen den nächstgelegenen gegenüberliegenden Oberflächen des ersten und des zweiten Verschlusselements (20, 25) angeglichen ist, wenn sich sowohl das erste als auch das zweite Verschlusselement (20, 25) in ihrer jeweiligen Position innerhalb der Ventilbohrung (11) befinden, um das Ventil zu verschließen.

13. Verfahren zur Druckverringerung in einem Überdruckhohlraum nach Anspruch 12.

14. Verfahren nach Anspruch 12 oder 13, welches das Bereitstellen eines einen ersten Ventilsitzes (16), der durch die Ventilbohrung (11) definiert ist, und das Bewegen des ersten Verschlusselements (20) innerhalb der Ventilbohrung (11) von einer Eingriffsposition mit dem ersten Ventilsitz (16) weg, um so das erste Verschlusselement (20) vom Eingriff damit zu lösen, umfasst.

15. Verfahren nach Anspruch 14, welches das Bewegen des starren Zwischenelements (30) durch die Bewegungswirkung des zweiten Verschlusselements (25) zum ersten Ventilsitz (16) hin umfasst, um eine Bewegung des ersten Verschlusselements (20) vom ersten Ventilsitz (16) weg zu erzwingen.

16. Verfahren nach Anspruch 14 oder 15, welches das Bereitstellen eines zweiten Ventilsitzes (19), der durch die Ventilbohrung (11) definiert ist, und das Bewegen des zweiten Verschlusselements (25) innerhalb der Ventilbohrung (11) von einer Eingriffsposition mit dem zweiten Ventilsitz 819) weg, um so das zweite Verschlusselement (25) vom Eingriff damit zu lösen, umfasst.

17. Verfahren nach einem der Ansprüche 12 bis 16, welches das Bewegen des ersten und des zweiten Verschlusselements (20, 25) durch die Wirkung eines Fluiddrucks innerhalb der Ventilbohrung (11) zu einer entsprechenden Ruheposition innerhalb der Ventilbohrung (11) beweglich ist, in der das Ventil verschlossen ist.

18. Verfahren zur Zuführung eines Schmiermittels zu einem Überdruckhohlraum, das ein Verfahren nach einem der Ansprüche 12 bis 17 umfasst, bei dem die Ventilbohrung (11) eine Schmiermittelleitung ist.

Revendications

1. Soupape comprenant:

un corps de soupape (10) à travers lequel un alésage de soupape (11) passe, d'une première ouverture de soupape (12) à une seconde ouverture de soupape (13);
un premier élément de fermeture (20) mobile à l'intérieur de l'alésage de soupape (11) pour fermer la soupape;
un second élément de fermeture (25) mobile à l'intérieur de l'alésage de soupape (11) pour fermer simultanément la soupape lorsque la soupape est aussi fermée par le premier élément de fermeture (20);
un élément intermédiaire rigide (30) à l'intérieur de l'alésage de soupape (11) entre le premier élément de fermeture (20) et le second élément de fermeture (25) et mobile par l'action du déplacement du second élément de fermeture (25) pour faire avancer le premier élément de fermeture (20) afin de permettre à la première ouverture de soupape (12) d'être en communication de fluide avec la seconde ouverture de soupape (13), la soupape étant **caractérisée en ce que** la longueur de l'élément intermédiaire (30) correspond à la séparation des surfaces les plus proches opposées des premier et second éléments de fermeture (20, 25) lorsque, à la fois les premier et second éléments de fermeture (20, 25) sont dans une position respective à l'intérieur de l'alésage de soupape (11) qui ferme la soupape.

2. Soupape selon la revendication 1, dans laquelle l'élément intermédiaire rigide (30) a une largeur axialement transversale inférieure à la largeur de l'alésage de soupape (11).

3. Soupape selon l'une quelconque des revendications précédentes, dans laquelle l'élément intermédiaire rigide (30) est une tige métallique.

4. Soupape selon l'une quelconque des revendications précédentes, dans laquelle l'alésage de soupape (11) définit un premier siège de soupape (16) et le premier élément de fermeture (20) est mobile à l'intérieur de l'alésage de soupape (11) pour mettre en prise le premier siège de soupape (16) et est dimensionné pour fermer la soupape lorsqu'elle est ainsi installée.

5. Soupape selon la revendication 4, dans laquelle l'élément intermédiaire rigide (30) est mobile par l'action d'un déplacement du second élément de fermeture (25) vers le premier siège de soupape (16) pour éloigner le premier élément de fermeture (20) du premier siège de soupape (16).

6. Soupape selon la revendication 4 ou 5 ou 6, dans laquelle l'alésage de soupape (11) définit un second siège de soupape (19) et le second élément de fermeture (25) est entre les premier et second sièges de soupape (16, 19) et est mobile à l'intérieur de l'alésage de soupape (11) pour mettre en prise le second siège de soupape (19) et est dimensionné pour fermer la soupape lorsqu'elle est ainsi installée.

7. Soupape selon l'une quelconque des revendications précédentes, dans laquelle chacun des premier et second éléments de fermeture (20, 25) est mobile, à l'usage, par l'action d'une pression de fluide à l'intérieur de l'alésage de soupape (11) dans une position statique respective à l'intérieur de l'alésage de soupape (11) qui ferme la soupape.

8. Soupape de non retour comprenant la soupape selon l'une quelconque des revendications précédentes.

9. Soupape à tiroir ou robinet à boisseau ou soupape globulaire ou clapet à bille comprenant la soupape selon l'une quelconque des revendications précédentes.

10. Raccord de lubrification comprenant une soupape selon l'une quelconque des revendications précédentes, dans lequel l'alésage de soupape (11) est un conduit de lubrifiant ou est agencé pour être un conduit de lubrifiant.

11. Soupape ou récipient contenant ou pour contenir une substance sous pression comprenant la soupape selon l'une quelconque des revendications précédentes.

12. Procédé pour réguler la communication de fluide avec une région sous pression, comprenant les étapes consistant à:

prévoir un corps de soupape (10) à travers lequel un alésage de soupape (11) passe d'une première ouverture de soupape (12) en communication avec la région sous pression à une seconde ouverture de soupape (13);
prévoir un premier élément de fermeture (20) mobile à l'intérieur de l'alésage de soupape (11) par l'action de la pression de fluide à l'intérieur de ce dernier pour fermer la soupape;
prévoir un second élément de fermeture (25) mobile à l'intérieur de l'alésage de soupape (11) par l'action de la pression de fluide à l'intérieur de ce dernier pour fermer simultanément la soupape lorsque la soupape est également fermée par le premier élément de fermeture (20);

prévoir un élément intermédiaire rigide (30) à l'intérieur de l'alésage de soupape (11) entre le premier élément de fermeture (20) et le second élément de fermeture (25) et déplacer l'élément intermédiaire rigide (30) par l'action du déplacement du second élément de fermeture (25) pour faire avancer le premier élément de fermeture (20) afin de permettre à la première ouverture de soupape (12) d'être en communication de fluide avec la seconde ouverture de soupape (13), le procédé étant **caractérisé en ce que** la longueur de l'élément intermédiaire (30) correspond à la séparation des surfaces les plus proches opposées des premier et second éléments de fermeture (20, 25) lorsque, à la fois les premier et second éléments de fermeture (20, 25) sont dans une position respective à l'intérieur de l'alésage de soupape (11) qui ferme la soupape.

13. Procédé pour libérer la pression d'une cavité sous pression selon la revendication 12.

14. Procédé selon la revendication 12 ou 13, comprenant l'étape consistant à prévoir un premier siège de soupape (16) défini par l'alésage de soupape (11) et déplacer le premier élément de fermeture (20) à l'intérieur de l'alésage de soupape (11) d'une position de mise en prise avec le premier siège de soupape (16) pour désinstaller ainsi le premier élément de fermeture (20) de ce dernier.

15. Procédé selon la revendication 14, comprenant l'étape consistant à déplacer l'élément intermédiaire rigide (30) par l'action du déplacement du second élément de fermeture (25) vers le premier siège de soupape (16) pour éloigner le premier élément de fermeture (20) du premier siège de soupape (16).

16. Procédé selon la revendication 14 ou 15, comprenant les étapes consistant à prévoir un second siège de soupape (19) défini par l'alésage de soupape (11) et à déplacer le second élément de fermeture (25) à l'intérieur de l'alésage de soupape (11) d'une position de mise en prise avec le second siège de soupape (19) afin de désinstaller ainsi le second élément de fermeture (25) de ce dernier.

17. Procédé selon l'une quelconque des revendications 12 à 16, comprenant l'étape consistant à déplacer chacun parmi les premier et second éléments de fermeture (20, 25) par l'action d'une pression de fluide à l'intérieur de l'alésage de soupape (11) dans une position statique respective à l'intérieur de l'alésage de soupape (11) qui ferme la soupape.

18. Procédé pour amener un lubrifiant à une cavité sous pression comprenant le procédé selon l'une quelconque des revendications 12 à 17 dans lequel l'alésage de soupape (11) est un conduit de lubrifiant.

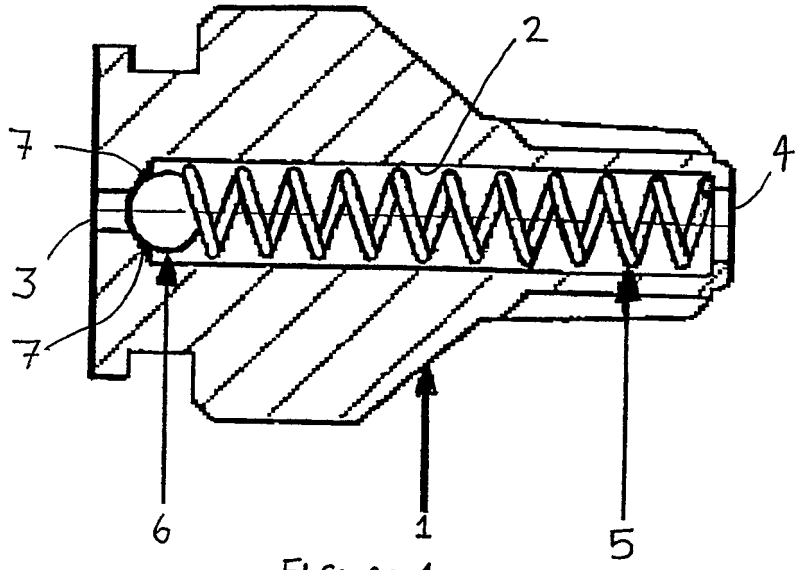

FIGURE 1

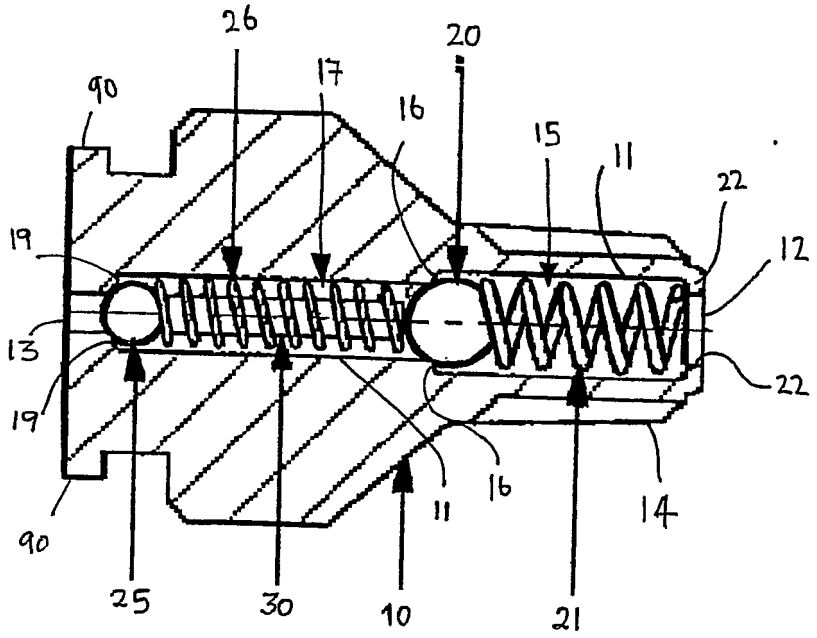

FIGURE 2

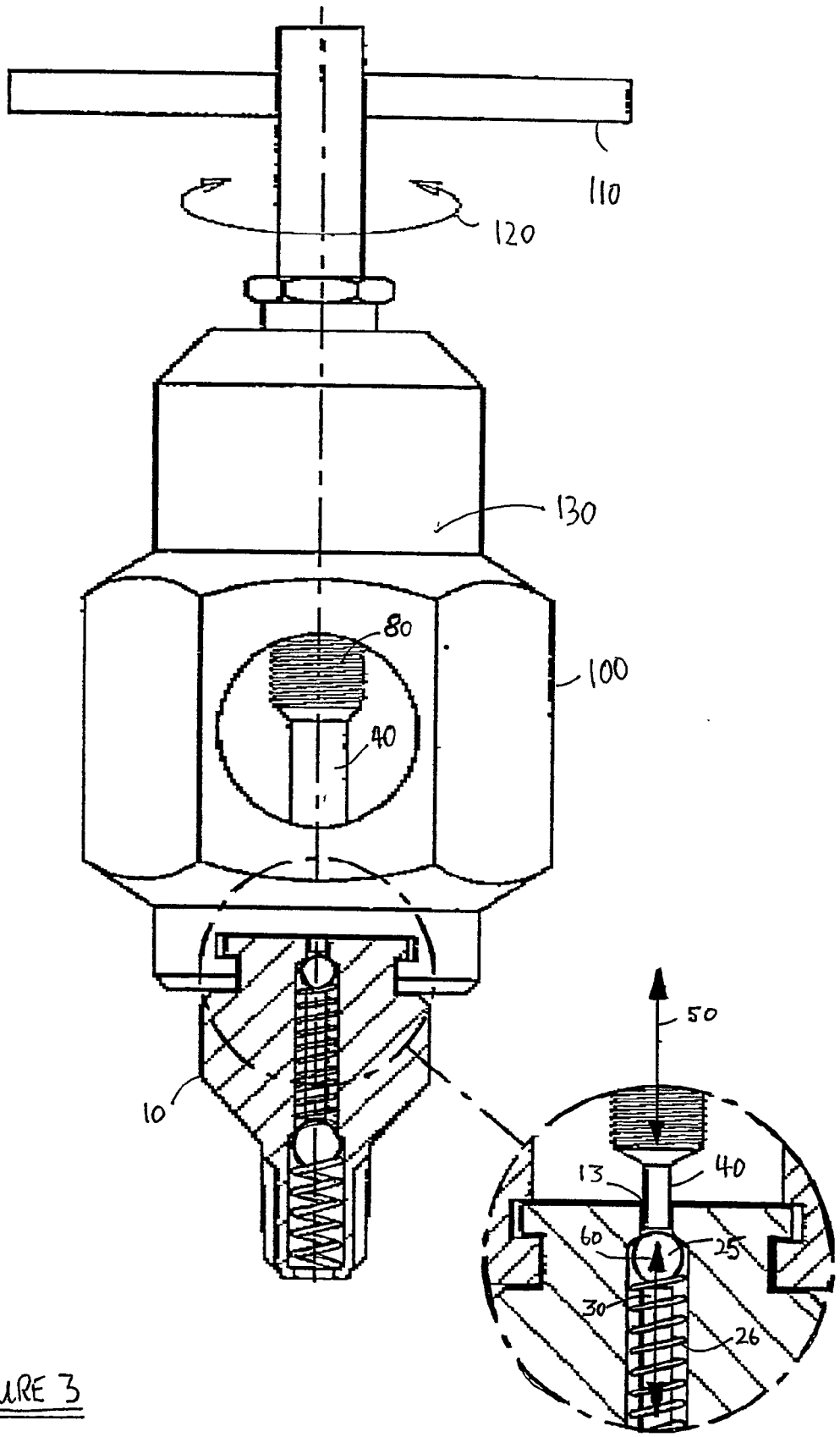

FIGURE 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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