

VALVEField of the Invention

The present invention relates to a valve assembly in which the flow control member is actuated by a rotary and reciprocating stem which is connected to the flow control member by a connecting means that permits the stem to reciprocate relative to the flow control member.

Brief Description of Prior Art

In a rotary valve the closure member is rotated between open and closed positions of the valve and the rotation of the closure member is done by means of a stem connected to the closure member. In a ball valve, the stem only rotates and does not reciprocate. In a rotary tapered plug valve, e.g. a sleeve-lined plug valve, the stem also rotates and does not reciprocate. In another kind of rotary tapered plug valve, the plug lifts off the valve body seats and then rotates with the help of a stem that is integrally connected to the plug which therefore also reciprocates with the stem. Hence some cavity space needs to be provided inside the valve body to accommodate the lifting of the plug. When this plug is resealed onto the valve body seats, suspended particles in the fluid medium get trapped between the plug and the valve body seats thereby compromising sealing integrity. So a lifting type of plug can be used only for clean fluids without suspended particles and not for slurries, etc.

In many of the valves in use today, the sealing integrity is compromised when the sealing surfaces wear out with valve usage and the valve starts to leak. The dead cavity space in a valve body contributes to the accumulation of debris in the body cavity. This is disadvantageous particularly for sanitary applications of the valve.

The above are some of the drawbacks of the prior art valves that are in use today. Therefore there exists a need for a valve with negligible dead cavity space in the valve body, for a valve that automatically self-adjusts for wear of the sealing surfaces, and for a valve that can be used for clean fluids as well as for fluids with suspended particles. Some prior art valves like ball valves, depend on fluid pressure to cause a seal and since the closure member is rotated under full load of fluid pressure acting on it, a large break-away torque is

required in order to rotate the closure member to the selected valve position. Therefore, there also exists a need for a valve in which a seal is caused independent of fluid pressure and for a valve with lower break-away torque.

In prior art, only non-rotary valves with reciprocating stems are provided with stem back-seats that can be loaded with externally variable stem seating force in order to seal the stem passageway from the valve body cavity for preventing fugitive emissions. So far it has been found difficult and elusive to provide back-seats on rotary valve stems to prevent fugitive emissions. The current method of containing fugitive emissions in rotary valves is to put the stem packing under "live loading" with springs which provides a constant compressive force on the stem packing. This compressive force on the stem packing is not automatically self-adjusting and merely "contains" fugitive emissions in contrast with "preventing". Therefore, there exists a need for a rotary valve which could be provided with stem back-seat whereby the back-seating force automatically self-adjusts for wear of the sealing surfaces in order to PREVENT fugitive emissions and not just to "contain" them as is the case with live loading.

Brief Description of the Present Invention

The present invention is concerned with obtaining a better seal in a valve assembly that is actuated by a rotary and reciprocating stem.

A valve comprises a valve body having a body cavity and a fluid flow passageway therethrough intersecting the body cavity. A flow control member consisting of a rotary member or a reciprocating member is disposed in the body cavity for selectively closing or opening the fluid flow passageway. A valve operator is connected to the flow control member for selectively moving the flow control member to a flow closed position or to a flow open position. The valve operator comprises a stem connected to the flow control member by a connecting means that allows axial movement of the stem relative to the flow control member but substantially no rotary movement between the stem and the flow control member. In other words, the connecting means is such that if the flow control member is held stationary, the stem cannot be rotated but can be moved only axially in relation to the flow control member. Examples of such connecting means are splines or a tongue and groove joint as in a ball valve. The flow control member has stop means for arresting axial movement of the stem towards the flow control member thereby transmitting the stem force to the flow control member so as to provide a better seal in the selected valve position.

A stem moving means such as a Lift-and-Turn Mechanism is associated with the valve operator and the stem whereby the said stem moving means causes the stem to move in a sequence of steps that provides only axial motion away from the flow control member and then rotary motion in response to movement of the valve operator in one direction, and rotary motion and then only axial motion towards the flow control member in response to movement of the valve operator in another direction. Thus, movement of the valve operator in said one direction causes the flow control member to be substantially unloaded of axial force from the stem and the stem then rotated in order to selectively move the flow control member, and movement of the valve operator in said another direction causes the stem to be rotated in order to selectively move the flow control member and the flow control member then loaded with axial force by the stem so as to provide a better sealing of the fluid flow passageway in the selected valve position than when the axial force by the stem has not been applied to the flow control member.

In one embodiment of the present invention, the valve body has a stem seating surface surrounding the stem passageway which is in fluid communication with the valve body cavity. The stem which passes through the stem passageway, has a back-seat that sealingly engages the stem seating surface so as to seal the stem passageway from the valve body cavity for preventing fugitive emissions around the stem.

In another embodiment of the present invention, the flow control member has a hollow conduit therethrough alignable with the fluid flow passageway in the valve open position. A stem moving means in the form of a Lift-Turn-and-Reseat Mechanism causes the stem to move in a sequence of steps that provides only axial motion away from the flow control member, then rotary motion, and then only axial motion towards the flow control member in response to movement of the valve operator in one direction. The said stem moving means causes the stem to move in a sequence of steps that provides only axial motion away from the flow control member, then rotary motion, and then only axial motion towards the flow control member in response to movement of the valve operator in another direction. Thus, by using a Lift-Turn-and-Reseat Mechanism for the stem moving means, the fluid flow passageway can be sealed from the valve body cavity in the valve closed position as well as in the valve open position, when so desired.

In the present invention the stem reciprocates relative to the flow control member, but the flow control member need not reciprocate with the stem when the stem moves away from the flow control member. Therefore, the bonnet can be placed very close to the top of the flow control member in the valve assembly so as to minimize the dead cavity space in the valve body. This is particularly important for sanitary applications of the valve assembly. The present invention therefore teaches a new valve in which the flow control member does not have to lift clear off the valve body seats, thereby permitting the use of the valve for handling clean fluids as well as fluids having particles in suspension, e.g. slurry.

The flow control member is provided with a rotatable trunnion at the bottom for a rotary valve to render sealing independent of fluid pressure. Without the trunnion, sealing function is aided by fluid pressure acting on the flow control member, but the break-away torque increases. On the other hand, when the flow control member with a trunnion is unloaded of axial force from the stem, the sealing load on the downstream seat is substantially reduced and the break-away torque is also reduced for rotating the flow control member.

In a ball valve the ball is rotated under full load acting on the downstream seat. Therefore, the flow control member with a trunnion of the present invention has a lower break-away torque than in a ball valve.

The stop means on the flow control member of the present invention arrests axial movement of the stem towards the flow control member thereby transmitting the stem force to the flow control member so as to provide a better seal in the selected valve position. The valve operator reciprocates the stem and when the sealing surfaces wear out, the stem needs to travel a little further towards the flow control member in order to maintain effective sealing. The valve operator not only provides this additional stem travel, but also automatically self-adjusts the stem force needed to maintain sealing integrity.

The present invention is a very simple concept for a valve that is actuated by a reciprocating and rotating stem. It is a "NEW USE" concept for a stem moving means such as a Lift-and-Turn Mechanism and a novel concept at that. This concept teaches that by using a stop means to arrest axial motion of the stem towards the flow control member, the flow control member can be loaded with additional force when such is needed for a better seal and the valve operator automatically provides the necessary externally variable stem force to be loaded onto the flow control member. The connecting means between the stem and the flow control member thus constitutes a one-way clutch system by which the stem force is transmitted to the flow control member in one direction of stem movement, and in the opposite direction of stem movement, the flow control member is unloaded of the stem force thereby reducing the break-away torque required to move the flow control member to the selected valve position.

It should be clearly understood here that the flow control member of the present invention can be rotary type or reciprocating type. That is, the flow control member is disposed in the valve body cavity either to rotate or to reciprocate between open and closed positions of the valve. In a rotary valve, the rotary motion of the stem is directly translated into rotary motion of the flow control member. In a reciprocating valve of the present invention, the connecting means between the stem and the flow control member comprises means by which the rotary motion of the stem is translated into reciprocating motion of the flow control member transverse to the stem axis, such as a rack-and-pinion arrangement, or a Scotch Yoke-and-pin arrangement.

For example, in a traditional wedge gate valve, the gate reciprocates along the stem axis thereby lifting the gate sealing surface clear off the valve body seating surface. But in a reciprocating wedge gate valve as constructed in accordance with features of the present invention, the wedge gate reciprocates in a direction transverse to the stem axis. Consequently, the wedge gate sealing surface does not lift clear off the valve body seating surface, but slides along the plane of the valve body seating surface when the gate reciprocates transverse to the stem axis. Thus there is a sort of scraping action between the gate and the valve body seats thereby permitting the wedge gate valve of the present invention to be used for handling fluids with particles in suspension, e.g. slurry. In a traditional wedge gate valve in which the wedge gate reciprocates along the stem axis, particles in suspension in the fluid get trapped in-between the sealing surfaces when the gate reseats onto the valve body seats, thereby compromising sealing integrity. Hence a traditional wedge gate valve cannot be used for slurries. On the other hand, a wedge gate valve as constructed in accordance with features of the present invention can be used for slurries.

An object of the present invention is to provide for a valve in which the stem reciprocates relative to the flow control member and the stem force is transmitted to the flow control member so as to provide a better seal in the selected valve position.

Another object of the present invention is to provide for a valve which automatically self-adjusts for wear of the sealing surfaces in order to maintain sealing integrity.

A further object of the present invention is to provide for a valve which comprises negligible dead cavity space in the valve body.

Another object of the present invention is to provide for a valve with lower break-away torque.

A further object of the present invention is to provide for a valve that can be used for handling clean fluids as well as fluids with particles in suspension.

Other objects and advantages of the present invention will become apparent as the following detailed description is read in conjunction with the accompanying drawings and the appended claims.

Brief Description of the Drawings

Fig. 1 is a side elevational, partially cross-sectioned view of a rotary plug valve constructed in accordance with the present invention.

Fig.2 is a partially detailed cross-sectional view of a reciprocating wedge gate valve constructed in accordance with the present invention.

Fig.2-A is a partially detailed cross-sectional view of the valve in Fig.2, generally taken along 2A-2A showing the valve in the closed position.

Detailed Description

With reference to Fig. 1, a valve assembly 100 comprising a rotary plug is shown as constructed in accordance with features of the present invention.

A valve body 110 includes fluid flow passageways 112 and 114 on opposite sides of the valve body cavity 116 which opens to one side of the valve body 110 to communicate upwardly with the bonnet 142.

A flow control member assembly 118 comprising a tapered plug closure member 119 is disposed in the body cavity 116 to open or close the fluid flow passageways 112-114. The plug 119 has a fluid flow conduit 113 therethrough alignable with the fluid flow passageways 112-114. The valve body 110 is lined with an elastomeric sleeve 134 with openings for fluid flow surrounding the fluid flow passageways 112, 114 to sealingly engage the plug 119.

The flow control member 118 is rotated by a valve operator 150 which comprises a stem 120 that passes through the stem passageway 121 in the bonnet 142. The stem passageway 121 communicates with the body cavity 116 and has a stem seating ring 132 disposed around the stem passageway 121. The upper end 123 of the stem 120 is connected to the valve operator 150 by a stem moving means 152 by which the stem 120 is rotated and reciprocated along the stem axis. The lower end of the stem 120 has an enlarged end 125 in the form of a socket with splines 122 on inside diameter. The plug 119 has a solid shaft at the upper end with splines 124 on outside diameter. The female splines 122 of the stem meshes with male splines 124 of the plug, thereby permitting the stem 120 to move axially relative to the flow control member 118. The stem 125 has a stem sealing surface 128, also called the stem back-seat, that sealingly engages the stem seating surface 132 in order to prevent fugitive emissions. It should be made clear that the male/female splines 124/122 in Fig.1 can be interchanged.

Fugitive emissions arise when fluids in the valve body cavity 116 escape from around the stem. A packing gland 138 exerts compressive force on the stem packing 140 surrounding the stem 123 to maintain effective sealing engagement around the stem thereby sealing the stem passageway 121 from the valve body cavity 116.

The stem moving means 152 is a form of a "Lift-Turn-and-Reseat" Mechanism and causes the stem 120 to move in a sequence of steps that provides only axial motion away from the flow control member 118, then rotary motion, and then only axial motion towards the flow control member 118 in response to movement of the valve operator 150 in one direction. In response to movement of the valve operator 150 in the opposite direction, the stem moving means 152 causes the stem 120 to move in a sequence of steps that provides only axial motion away from the flow control member 118, then rotary motion, and then only axial motion towards the flow control member 118. The top surface 130 of the plug 119 acts as stop means to arrest further axial motion of the stem 120 towards the plug 119, thereby transmitting the stem force to the plug 119 when the bottom surface 126 of the stem 125 engages the top surface 130 of the plug 119. When the stem 120 moves axially away from the plug 119, the plug 119 is unloaded of the stem force and thus less torque is needed by the valve operator 150 to rotate the plug 119.

When the valve operator 150 is moved in one direction to open the valve, the stem 120 moves only axially away from the plug 119 which is then unloaded of the stem force, the stem 120 then rotates together with the flow control member 118 through a pre-determined interval of rotation, in this case 90 degrees, to open the fluid flow passageways 112-114 by aligning the conduit 113 of the plug 119 with the fluid flow passageways 112-114. With further movement of the valve operator 150 in the same direction to open the valve, the stem 120 moves only axially in the opposite direction towards the plug 119 until the bottom surface 126 of the stem 125 engages the plug stop 130 thereby transmitting the stem force to the plug 119 to provide additional load to the plug 119 for achieving a higher sealing integrity than when the stem does not transmit force to the plug. Thus the fluid flow passageways 112-114 are sealed from the valve body cavity 116 in the valve open position of the flow control member 118.

When the valve operator 150 is moved in the opposite direction to close the valve, the said sequence of stem movement described hereinabove is repeated. That is, the stem 120 moves only axially away from the

plug 119 to unload the plug of axial force from the stem, the stem then rotates through 90 degrees together with the plug 119, and the stem 120 then moves only axially towards the plug 119 until the stem surface 126 engages the stop 130 on the plug 119 thereby transmitting the stem force to the plug 119 to sealingly close the fluid flow passageways 112-114 in the valve closed position. The plug 119 carries trunnion 136 at the bottom by which the sealing function is rendered independent of fluid pressure. Nevertheless, fluid pressure aids in the sealing function by pushing the plug onto the downstream seat surrounding the fluid flow passageway.

The fluid flow passageway 112-114 is sealed from the valve body cavity 116 in the valve open position as well as in the valve closed position of the flow control member 118, and this sealing is obtained by using a "Lift-and-Turn" mechanism for the stem moving means 152. The stem moving means 152 that causes the stem to move in a sequence of steps that provides only axial motion away from the plug 119, then rotary motion, and then only axial motion towards the plug 119, is generally called a "Lift-Turn-and-Reseat" means. The stem moving means 152 that causes the stem to move in a sequence of steps that provides only axial motion away from the plug and then rotary motion, is generally called a "Lift-and-Turn" means. As the sleeve 134 wears out, the stem 120 needs to travel a little further towards the plug 119 in order to maintain effective sealing, and the valve operator 150 automatically provides externally variable stem force needed to maintain sealing integrity. An example of a stem moving means in the form of a "Lift-Turn-and-Reseat" means and a "Lift-and-Turn" means is explained in great details in USA Patent No. 5,407,176 April 18, 1995 by Nevrekar. Other examples of "Lift-Turn-and-Reseat" means are:

- USA 2,392,880 Jan. 15, 1946 by Reed;
- USA 2,443,995 June 22, 1948 by Snyder;
- USA 2,501,150 March 21, 1950 by Anderson
- USA 2,795,960 June 18, 1957 by Heinen et al.
- USA 2,858,097 October 28, 1958 by Blomstran et al;

Other examples of "Lift-and-Turn" means are:

- USA 2,076,841 April 13, 1937 by Heggem;
- USA 2,383,549 August 28, 1945 by Hilker;
- USA 4,234,157 November 18, 1980 by Hodgeman et al;
- USA 5,342,028 August 30, 1994 by Nevrekar.

The valve body 110 in Fig. 1 is shown lined with an elastomeric sleeve 134. However, valve body seat rings or simply sealing rings on the plug 119 can also be used. The stem 125 is connected to the plug 119 by a connecting means that allows axial movement of the stem 125 relative to the plug 119 but substantially no rotary movement between the stem 125 and the plug 119. Said another way, the connecting means between the stem 125 and the plug 119 is such that if the plug 119 is held stationary, the stem 125 cannot rotate but can move only axially relative to the plug 119.

The flow control member 118 shown in Fig. 1 is a tapered plug. However, it should be clearly understood here that the flow control member can be any other kind of closure member that can benefit from additional force from the stem to achieve a higher sealing integrity than when the stem force is not used, e.g. a segmented tapered plug, a tapered ball, a cylindrical plug with wedging segments or any other closure member that uses a wedging principle to obtain sealing by mechanical means. Also, the flow control member can comprise a reciprocating wedge gate constructed in accordance with features of the present invention. In such a construction, the connecting means between the stem and the wedge gate shall comprise means by which the rotary motion of the stem is translated into a reciprocating motion of the wedge gate in a direction perpendicular to the stem axis. The present invention thus can be used for a reciprocating gate valve in which the flow control member is a wedge gate that is disposed in the valve body cavity to reciprocate in a direction transverse to the stem axis.

The splines 122/124 in Fig. 1 are shown positioned inside the bonnet 142. However, these splines could be repositioned outside the bonnet 142 just above the stem packing gland 138, thereby reducing the stem travel within the stem packing 140 and thus extending the life of the stem packing.

In prior art of a traditional wedge gate valve or a tapered plug valve using a Lift-and-Turn mechanism, the stem reciprocates along the stem axis and the flow control member is loaded and unloaded of the stem force. But the flow control member also reciprocates concurrently with the stem, thereby making the valve unsuitable for use with fluids with particles in suspension. The present invention of Fig. 1 retains the good features of the prior art and in sharp contrast to prior art, the flow control member 118 of the present invention does not reciprocate with the stem 120 but is certainly loaded and unloaded of the stem force by the reciprocating stem. This is an important distinction of the present invention over prior art.

Regarding Figs. 2,2-A, only important details are shown for the sake of brevity only to illustrate how rotary motion of the stem is translated into reciprocating motion of the flow control member in a direction transverse to the stem axis.

A reciprocating wedge gate valve assembly 200 comprises a valve body 210 and a bonnet 242 through which the lower end 225 of the stem extends into the body cavity 216. A flow control member assembly 218 comprises two segments 219 and 220 that wedge against each other and are held together in a floating connection by springs (not shown). The flow control member 218 is disposed in the body cavity 216 and reciprocates in a direction perpendicular to the stem axis to selectively close or open the fluid flow passageway 212-214. The stem 225 has splines 222 on the outer diameter. The splines 222 mesh with like splines on the inner diameter of the pinion 226 and permit the stem 225 to move along the stem axis relative to the flow control member 218 until the bottom surface 228 of the stem 225 engages the top surface 230 of the segment 219 thereby transmitting the stem force to the flow control member 218. During the rotary motion of the stem 225 the pinion 226 rotates with stem and at the same time engages the rack 224 on the flow control member segment 220 thereby causing the flow control member 218 to reciprocate in a direction perpendicular to the stem axis as shown in Fig. 2-A. It should be made clear that only one segment 219 will suffice to constitute the flow control member 218 instead of two segments 219,220 and in that case the rack 224 should be placed on the segment 219. Variations in the rack-and-pinion arrangement are also possible. For example, the rack 224 can be linear or curved and the flow control member shaped accordingly, along with the body cavity and the valve body seats.

The taper angle of the plug 119 in Fig.1 and the wedge angle in Fig.2 is extremely important in bringing about the release of the wedging forces from the valve body seats after the flow control member 118, 218 respectively is unloaded of axial force from the stem when the stem moves away from the flow control member. This angle must be greater than the angle of repose for the materials used. Deciding on this optimum angle for the flow control member requires extraordinary technical skill in the subject matter and is generally beyond the comprehension of one of ordinary skill in the art.

Thus, the present invention is applicable to a valve in which the flow control member consists of a rotary member or a reciprocating member and is loaded with additional force from the stem to achieve a better seal than when the stem force is not applied to the flow control member and the stem moving means transmits the stem force to the flow control member precisely when the additional force is needed.

From the above description it is clear that the present invention is well adapted to carry out the objects and to attain the ends and advantages mentioned herein as well as those inherent in the invention. While presently preferred embodiments have been described for purposes of this disclosure, it will be understood that numerous changes may be made which will readily suggest themselves to those skilled in the art and which are accomplished within the spirit of the invention disclosed and as defined in the appended claims.

What is claimed:

1. A valve comprising:

a valve body having a body cavity with a fluid flow passageway therethrough defining a fluid flow path intersecting the body cavity;

a flow control means disposed in the body cavity for selectively closing and opening the fluid flow passageway;

a valve operator means connected to the flow control means and comprising:

a valve operator;



a stem having a stem axis and connected to said flow control means by a connecting means that allows axial movement of the stem relative to the flow control means but substantially no rotary movement between the stem and the flow control means;

a stem moving means associated with the valve operator and the stem, said stem moving means causing the stem to move in a sequence of steps that provides only axial motion away from the flow control means and then rotary motion in response to movement of the valve operator in one direction, and rotary motion and then only axial motion towards the flow control means in response to movement of the valve operator in another direction; and

stop means disposed on the flow control means for arresting axial movement of the stem towards the flow control means and thereby transmitting a stem force to the flow control means, whereby movement of the valve operator in said one direction causes the flow control means to be substantially unloaded of axial force from the stem and then the stem rotated, and movement of the valve operator in said another direction causes the stem to be rotated and then the flow





control means loaded with an axial force by the stem so as to provide a better sealing function in a selected valve position than when an axial force by the stem has not been applied to the flow control means.

2. The valve as defined in claim 1, wherein said stem moving means causes the stem to move in a sequence of steps that provides only axial motion away from the flow control means, then rotary motion and then only axial motion towards the flow control means in response to movement of the valve operator in said one direction.
3. The valve as defined in claim 1, wherein said stem moving means causes the stem to move in a sequence of steps that provides only axial motion away from the flow control means, then rotary motion and then only axial motion towards the flow control means in response to movement of the valve operator in said another direction.
4. The valve as defined in claim 1, wherein the flow control means further comprises a trunnion on the valve body rotatable about the stem axis and disposed on a side of the flow control means opposite the stem.
5. The valve as defined in claim 1, wherein the flow control means further comprises a hollow conduit therethrough alignable with the fluid flow passageway in the valve body.
6. The valve as defined in claim 1, wherein the stem moving means further comprises a lift-and-turn means for causing only an axial movement of the stem during a limited interval of movement of the valve operator and for causing the stem to rotate during a time of movement of the valve operator other than the limited interval.
7. The valve as defined in claim 1, wherein the flow control means further comprises a plug rotatably disposed in the valve body cavity.

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8. The valve as defined in claim 1, wherein the valve body further comprises:

a stem passageway in fluid communication with the body cavity and a stem seating surface surrounding the stem passageway and the stem passing through the stem passageway; and



the stem further having a stem sealing surface disposed around said stem to sealingly engage the stem seating surface surrounding the stem passageway in response to movement of the stem away from the flow control means whereby the valve operator means automatically provides a self adjusting and externally variable stem force for sealing the stem passageway from the valve body cavity.

9. The valve as defined in claim 1, wherein the connecting means between the stem and the flow control means further comprises means for causing the flow control means to reciprocate in a direction transverse to the stem axis in response to rotary movement of the stem.
10. The valve as defined in claim 1, wherein the connecting means between the stem and the flow control means further comprises a rack-and-pinion arrangement between the flow control means and the stem.

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[received by the International Bureau on 12 December 1996 (12.12.96);
original claims 1 and 10 amended; remaining claims unchanged (2 pages)]

1. A valve comprising:

a valve body having a body cavity with a fluid flow passageway
therethrough defining a fluid flow path intersecting the body cavity;

a flow control means disposed in the body cavity for selectively
closing and opening the fluid flow passageway;

a valve operator means connected to the flow control means
and comprising:

a valve operator;



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a stem having a stem axis and connected to said flow control
means by a connecting means that allows axial movement of
the stem relative to the flow control means but
substantially no rotary movement between the stem and the
flow control means;

a stem moving means associated with the valve operator and
the stem, said stem moving means causing the stem to move
in a sequence of steps that provides only axial motion
away from the flow control means and then rotary motion in
response to movement of the valve operator in one direction,
and rotary motion and then only axial motion towards the
flow control means in response to movement of the valve
operator in another direction; and

stop means disposed on the flow control means for arresting
axial movement of the stem towards the flow control means
and thereby transmitting a stem force to the flow control
means, whereby movement of the valve operator in said one
direction causes the flow control means to be substantially
unloaded of axial force from the stem and then the stem
rotated, and movement of the valve operator in said another
direction causes the stem to be rotated and then the flow

AMENDED SHEET (ARTICLE 19)

8. The valve as defined in claim 1, wherein the valve body further comprises:

a stem passageway in fluid communication with the body cavity and a stem seating surface surrounding the stem passageway and the stem passing through the stem passageway; and



the stem further having a stem sealing surface disposed around said stem to sealingly engage the stem seating surface surrounding the stem passageway in response to movement of the stem away from the flow control means whereby the valve operator means automatically provides a self adjusting and externally variable stem force for sealing the stem passageway from the valve body cavity.

9. The valve as defined in claim 1, wherein the connecting means between the stem and the flow control means further comprises means for causing the flow control means to reciprocate in a direction transverse to the stem axis in response to rotary movement of the stem.
10. The valve as defined in claim 1, wherein the connecting means between the stem and the flow control means further comprises a rack-and-pinion arrangement between the flow control means and the stem.