

## Description

The present invention relates to a check valve comprising a valve body having at least first and second ports, one of said ports being an inlet port and the other of said ports being an outlet port, a valve seat adjacent to said first port, a clapper configured to sealingly mate with said valve seat, said clapper pivotally attached adjacent to said valve seat to pivot about a first axis between a first position wherein said clapper sealingly mates with said valve seat and at least a second position spaced from said valve seat, first means for biasing said clapper in said first position.

## BACKGROUND OF THE INVENTION

Check valves are well known for use in assuring that a flow through a conduit occurs only in a predefined direction. Check valves are used, for example, in backflow prevention assemblies to prevent backflow of one fluid body into another. Backflow prevention is often used in connection with protecting potable water supplies from contaminants which could otherwise be introduced into it via back-siphonage or back-pressure.

Typically, a check valve is designed to maintain its open configuration as long as there is flow through the valve. Once the flow stops or drops below a predetermined value, the check valve closes. Typically, check valves are designed so that, once the valve is closed, the inlet pressure must exceed a predetermined threshold before the valve will open. Usually, a single structure, typically a spring, is used both to provide the force to hold the valve closed (until the threshold is reached), and to provide the biasing force which moves the valve from the opened to the closed position. Because the biasing device provides some force tending to close the valve, even during normal flow conditions, a countervailing force must be provided to counteract the closing force and maintain the valve open, during normal flow conditions. Typically, the countervailing force is provided by the fluid moving through the valve. Accordingly, as the pressurized fluid moves through the valve, some amount of work is expended in holding the valve in the open position in opposition to the biasing force tending to close the valve. This expenditure of work causes a pressure drop across the check valve, so that the check valve itself necessarily creates a certain amount of loss of the pressure head. The amount of pressure minimally required at the inlet in order to maintain the valve in the open position is termed the "hold-open pressure." It is desirable to minimize the pressure drop or head loss during transit through the check valve, and, thus, it is desirable to reduce the hold-open force. Particu-

larly, it is desirable that the hold-open force should be less than that from the threshold pressure. Accordingly, a number of previous check valves having a biasing device have been produced, which create a greater force on the valve when it is in the closed position than when in the open position.

Many previous designs for reduced hold-open pressure check valves involve providing a linkage of one or more rigid pivoting arms connecting the clapper to the wall or body of the valve. U.S. Patent No. 980,188, issued January 3, 1911, to Blauvelt, for example, discloses a flap or swing-type valve having a clapper which can pivot toward or away from a valve seat. The clapper is pivotally connected to a rigid link or arm which, in turn, is pivotally connected to a spring.

Other valving devices include a knuckle or toggle-type linkage having two or more relatively pivoting arms or links.

From DE-A-1 013 936 a check valve is known, in which the clapper is biased towards the valve seat by an overcentre arrangement using a spring device. The closing force delivered by the spring device to the clapper initially increases, as the angled spring device moves towards a vertical position, whereupon the maximum closing force is developed. Thereafter, as the spring device continues to move toward the open position, the closing force decreases. The disadvantage of such an arrangement is, that initially the required force to open the clapper increases.

Since valves containing a relatively large number of moving parts, such as pivoting rigid arms, are typically susceptible to wear or deterioration, particularly in corrosive, contaminated, or depositional environments, such as in hard water, and are furthermore expensive to design, produce, install and maintain, the object of the invention is to provide a simple and sturdy check valve in which the hold-open force is less than the force holding the valve in a closed configuration.

These objects are achieved according to the invention by said means for biasing having a first end and a second end, forming a compressible connection between said clapper and said first position and said valve body, wherein said means for biasing produces a force which increases monotonically as the said clapper moves from said second position to said first position, second means, adjacent said first end, for attaching said means for biasing to said valve body at an attachment point and third means, adjacent said second end, for pivotally attaching said means for biasing to said clapper device to permit pivoting of said means for biasing with respect to said clapper about a second axis, wherein the position of said second axis with respect to said clapper and with respect to said second end, remains fixed during

movement of said clapper from said first position to said second position.

In a preferred embodiment of the present invention the spring connects the valve clapper to the valve body. Preferably the spring connects the clapper to a removable cover portion of the valve body. The spring can be viewed as taking the place of one or more of the rigid links of previous devices. Preferably, the spring is directly connected to the clapper device, i.e., without an intervening linkage, and forms the sole connection between the clapper device and the valve wall (preferably the cover portion of the valve wall). The spring pivots with respect to the clapper about a pivot point, with the pivot point remaining in a fixed position with respect to both the end of the spring and the clapper device during opening and closing of the valve. The spring provides a force along its longitudinal axis without a lateral component.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view through a check valving device showing a closed check valve and an opened check valve;

Fig. 2 is a cross-sectional view taken along line 2-2 of Fig. 1; and

Figs. 3A and 3B depict, schematically, the triangles formed by the pivoting or attachment axes or points in the closed and opened configurations, respectively;

Figs. 4A and 4B depict, schematically, an unstressed helical spring and a compressed and bowed helical spring; and

Figs. 5A and 5B depict, schematically, two end-joined helical springs, according to the preferred embodiment of the present invention in unstressed and stressed configurations, respectively.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As depicted in Fig. 1, a check valving device 10 is provided having a first check valve 12 and a second check valve 14. Although Fig. 1 depicts the first check valve 12 in a closed position, and the second check valve 14 in an open position, in actual operation, as described more fully below, the first and second valves 12, 14 will open and close substantially simultaneously or within a short time interval of one another. The valving device includes a valve body 16 made up of a wall 18. The valve body 16 can be formed of a number of materials, including ductile iron, brass, stainless, steel, or other metals, plastic, resin, glass, and/or ceramic and the like. The valve body 16 defines an inlet port 22 and an outlet port 24, preferably having a substantially circular cross-section. Preferably, the

inlet port and outlet port include devices, such as flanges 26, for connecting the valving device 10 to fluid conduits. Adjacent to the inlet port 22 is a valve seat 28, such as an annular seat formed, for example, of iron.

A disk-shaped clapper 32 is rigidly connected, such as by using a bolt 34 and nut 36, to a clapper arm 38. A first end 39 of the arm 38 is pivotally mounted adjacent the valve seat 28 by connection to a portion of the valve body 16 by a pivot joint 42a, 42b to permit pivoting of the arm 38, and rigidly attached to disk 32 about a first axis 43.

The lower surface of the clapper 32 includes a seat disk 44 configured to sealingly mate with the valve seat 28 when the clapper 32 is pivoted to its closed position, as depicted in the left portion of Fig. 1. The disk 44 can be made of a number of materials, including plastic, rubber, resin, and the like, and is preferably a soft (such as about 40 durometer) elastomer material, such as a synthetic rubber e.g., EPDM (ethylene-propylene terpolymer). The disk 44 is reversible so that after it experiences wear, it can be removed, rotated 180° about a horizontal plane, and reinstalled.

The second end 48 of the clapper arm 38 is pivotally connected to a spring 52. The spring 52 is contained between first and second spring seats 54, 56. The spring 52 is preferably a helical spring which is compressional, i.e., is reduced in length as the valve 12 opens. The spring 52 can be formed of a number of materials, such as spring steel, plastic, or rubber. A single helical spring 52', such as that depicted in Fig. 4A, is commonly subject to deformation when compressed. As shown in Fig. 4B, a compressed helical spring commonly assumes a bowed or arcuate configuration. Although such a spring can be used in accordance with the present invention, according to the preferred embodiment, two springs 52A, 52B are joined end-to-end by connection to a plate-like or annular device, such as a washer 53, as depicted in Fig. 5A. Under compression, as depicted in Fig. 5B, such a spring 52 tends to maintain its linear configuration and is not subject to bowing or distortion to the degree an ordinary helical spring 52B is.

The first spring seat 54 is pivotally attached to the second end 48 of the clapper arm 38 to permit pivoting of the spring 52 about a second axis 64.

The second spring seat 56 is pivotally connected to the valve body wall 18. In the preferred embodiment, the portion of the valve wall which the second spring seat 56 connects to is a removable cover 65 which can be attached to the remainder of the valve body wall 18, by e.g., bolts, screws, clamps, or the like (not shown). As shown in Fig. 1, the second spring 56 can be connected within a pocket 58 at an attachment point 62, to permit pivotal movement of the spring 52 about a third

axis 66.

In the embodiment depicted in Fig. 1, the second valve 14 is positioned downstream from the first valve 12. Preferably, the second valve 14 is identical in construction to the first valve 12, and includes a clapper 72, a biasing device, such as a spring 74, and a valve seat 76. It will be understood, however, that the present invention can be used in single check valve configurations or other types of valve configurations.

Viewed in cross-section, each of the two valves 12, 14 define a triangle having vertices at the first axis 43, 43', second axis 64, 64', and third axis 66, 66', respectfully. When the valve 12 is closed, the spring biasing device 52 provides a force to the clapper 32, tending to hold the clapper 32 in the closed position. The amount of force is dependent upon two factors: (1) the magnitude of the longitudinal force provided by the spring 52; and (2) the component of that force which acts in a direction tending to close the clapper 32. As depicted in Figs. 3A and 3B, the spring closing force can be described as

$$\sin(180^\circ - \alpha) \cdot F \quad (1)$$

where  $\alpha$  77, 77' is the angle formed between the lines containing the first and second axes 43, 64, and the line containing the second and third axes 64, 66, and  $F$  79, 79' is the vector force provided by the spring along the longitudinal spring axis which intersects the second axis 64 and third axis 66.

When the inlet pressure exceeds the outlet pressure, an opening force is created. When the opening force on the clapper 32 exceeds the spring closing force (shown in equation (1)) plus any closing forces provided by other sources, such as fluid pressure the clapper 32 moves away from the valve seat 28, opening the valve 12 to provide fluid communication between the inlet port and the outlet port 24. During the opening movement of the valve 12, the position of the second axis 64 changes with respect to the valve body 10, but does not change with respect to the clapper 32 or with respect to the adjacent end of the spring 52.

As the clapper 32 pivots about the first axis 43, and angle  $\alpha$  increases from a value of about  $118^\circ$  77 in the configuration shown on the lefthand portion of Fig. 1 (depicted schematically in Fig. 3A) to a value of about  $164^\circ$  77' when in the fully opened configuration of the valve 14, shown on the right-hand portion of Fig. 1 (depicted schematically in Fig. 3B). The closing force provided to the clapper 32 thus changes from about 87% of the spring force  $F$  79 to about 27% of the spring force  $F$  79'. However, during this time, the spring force  $F$  also changes, since it is proportional to the length of the

spring 52, becoming larger as the valve 12 opens. In order to produce a valve 12 having a reduced hold-open force, the extreme values of the angle  $\alpha$  77, 77', the distance between the first and third axes 43, 65, and first and second axes 43, 64 are selected so that equation (1) yields a smaller closing force in the opened position of the valve (Fig. 3B) than in the closed position of the valve (Fig. 3A).

The particular values for the hold-open force, maximum tolerable head loss, and the threshold opening pressure will depend upon the particular use or application of the valving device 10. In one embodiment of the present invention, valving device 10 opens when the inlet pressure exceeds the outlet pressure by about 2-5 psi (about 14-35 kPa), and closes when the outlet pressure equals or exceeds the inlet pressure. Preferably, this embodiment has a head loss of less than 2 psi in a static or no-flow (limiting) condition, and there is little increase in head loss as the flow increases, such as a head loss of about 3 psi (about 20 kPa) with an operational flow velocity of about 7.5 ft./sec. (about 2.3 meters/sec.), or a rated flow velocity, e.g., 18 ft/sec. (about 5.5 meters/sec.) In another embodiment, the static condition head loss is about 8 psi (about 56 kPa), and the head loss during flow conditions remains below about 10 psi (about 70 kPa).

Based on the above description, a number of advantages of the present invention are apparent. The valve of the present invention reduces or eliminates rigid pivoting links. By reducing or eliminating links, the valve is made easier to design, produce, install, and maintain, and, in the preferred embodiment, can be installed and maintained without the use of special tools. The valve provides sufficient closing force and hold-closed force, while having a hold-open force which is low enough to produce a small head loss.

A number of modifications and variations of the invention can be used. A single check valve can be used without being provided in conjunction with a second check valve. The valve can be used for purposes other than as a backflow preventer. The check valve of the present invention can be used in combination with other valves or fluid-control devices. The valve can be used with fluids other than liquids. The valve can be configured without using a clapper arm, such as by directly pivoting the spring to the clapper and/or directly pivoting the clapper adjacent the valve seat. Other shapes and geometries of the clapper, ports, valve seats, and other components can be used. Other types of biasing devices can be used, including springs other than helical springs, hydraulic biasing devices, and the like.

Although the description of the invention has included a description of a preferred embodiment and certain modifications and variations, other modifications and variations can also be used, within the scope of the invention, which are described by the following claims.

#### Claims

1. A check valve comprising: a valve body (16) having at least first and second ports, one of said ports being an inlet port (22) and the other of said ports being an outlet port (24); a valve seat (28) adjacent to said first port; a clapper (32) configured to sealingly mate with said valve seat (28), said clapper (32) pivotally attached adjacent to said valve seat (28) to pivot about the first axis (43) between a first position, wherein said clapper (32) sealingly mates with said valve seat (28) and at least a second position spaced from said valve seat (28); first means (52) for biasing said clapper (32) in said first position, characterised by said means (52) for biasing having a first end (54) and a second end (56) and forming a compressible connection between said clapper (32) in said first position and said valve body (16), wherein said means (52) for biasing produces a force which increases monotonically as said clapper (32) moves from said second position to said first position, a second means (54), adjacent said first end, for attaching said means for biasing to said valve body (16) at an attachment point (62); and a third means (56), adjacent said second end, for pivotally attaching said means for biasing to said clapper device (32) to permit pivoting of said means for biasing with respect to said clapper (32) about a second axis (64) wherein the position of said second axis (64) with respect to said clapper (32) and with respect to said second end remains fixed during movement of said clapper (32) from said first position to said second position.
2. A check valve, as claimed in claim 1, wherein said second means (54) pivotally attaches said means for biasing to said valve body (16) to permit pivoting of said means for biasing about a third axis (66).
3. A check valve, as claimed in claim 1 or 2, wherein said means for biasing is directly attached to said clapper (32) in the absence of an intervening toggling linkage.
4. A check valve, as claimed in one of claims 1 to 3, wherein said first means (52) includes first and second helical spring sections joined end-to-end by connection to a plate.
5. A check valve, as claimed in one of claims 1 to 4, wherein said clapper (32) is connected to said valve body (16) only by said pivotal attachment about said first axis (23) and by said means for biasing (52), without rigid links connecting said clapper (32) to said valve body (16).
6. A check valve, as claimed in one of claims 1 to 5, characterised by compressional spring means providing a force having a component which biases said clapper device (32) in a direction toward said first position, said means for biasing (52) providing said force along a first longitudinal spring axis definable with respect to a first spring end and a second spring end, said spring force being directed along a line passing through said first attachment point (62) and said second axis (64) substantially without a lateral force component.
7. A check valve, as claimed in one of claims 1 to 6, wherein said clapper device includes a disk (32) and an arm (38) rigidly attached to said disk (32).
8. A check valve, as claimed in one of claims 1 to 7, characterised by the valve seat (28) adjacent to said inlet port being annular and the clapper (32) configured to sealingly mate with said annular valve seat (28) being disk-shaped.
9. A check valve, as claimed in one of claims 1 to 8, characterised by said biasing means (52) being a helical compression spring (52) having first and second spring ends, said first spring end pivotally attached to said valve body (16) to permit pivoting of said spring about a second axis (64), said second spring end being directly pivotally attached to said second end of said arm (38), said spring producing a force along a first longitudinal spring axis definable with respect to said first spring end and said second spring end, said force having a closing component which biases said clapper (32) to move in a direction toward said first position, said force being directed along a line passing through said second axis (64) and said third axis (66) substantially without a lateral force component in any clapper position, said closing component being greater when said clapper (32) is in said first position than when said clapper (32) is in said second position.

Although the description of the invention has included a description of a preferred embodiment and certain modifications and variations, other modifications and variations can also be used, within the scope of the invention, which are described by the following claims.

#### Claims

1. A check valve comprising: a valve body (16) having at least first and second ports, one of said ports being an inlet port (22) and the other of said ports being an outlet port (24); a valve seat (28) adjacent to said first port; a clapper (32) configured to sealingly mate with said valve seat (28), said clapper (32) pivotally attached adjacent to said valve seat (28) to pivot about the first axis (43) between a first position, wherein said clapper (32) sealingly mates with said valve seat (28) and at least a second position spaced from said valve seat (28); first means (52) for biasing said clapper (32) in said first position, characterised by said means (52) for biasing having a first end (54) and a second end (56) and forming a compressible connection between said clapper (32) in said first position and said valve body (16), wherein said means (52) for biasing produces a force which increases monotonically as said clapper (32) moves from said second position to said first position, a second means (54), adjacent said first end, for attaching said means for biasing to said valve body (16) at an attachment point (62); and a third means (56), adjacent said second end, for pivotally attaching said means for biasing to said clapper device (32) to permit pivoting of said means for biasing with respect to said clapper (32) about a second axis (64) wherein the position of said second axis (64) with respect to said clapper (32) and with respect to said second end remains fixed during movement of said clapper (32) from said first position to said second position.
2. A check valve, as claimed in claim 1, wherein said second means (54) pivotally attaches said means for biasing to said valve body (16) to permit pivoting of said means for biasing about a third axis (66).
3. A check valve, as claimed in claim 1 or 2, wherein said means for biasing is directly attached to said clapper (32) in the absence of an intervening toggling linkage.
4. A check valve, as claimed in one of claims 1 to 3, wherein said first means (52) includes first and second helical spring sections joined end-to-end by connection to a plate.
5. A check valve, as claimed in one of claims 1 to 4, wherein said clapper (32) is connected to said valve body (16) only by said pivotal attachment about said first axis (23) and by said means for biasing (52), without rigid links connecting said clapper (32) to said valve body (16).
6. A check valve, as claimed in one of claims 1 to 5, characterised by compressional spring means providing a force having a component which biases said clapper device (32) in a direction toward said first position, said means for biasing (52) providing said force along a first longitudinal spring axis definable with respect to a first spring end and a second spring end, said spring force being directed along a line passing through said first attachment point (62) and said second axis (64) substantially without a lateral force component.
7. A check valve, as claimed in one of claims 1 to 6, wherein said clapper device includes a disk (32) and an arm (38) rigidly attached to said disk (32).
8. A check valve, as claimed in one of claims 1 to 7, characterised by the valve seat (28) adjacent to said inlet port being annular and the clapper (32) configured to sealingly mate with said annular valve seat (28) being disk-shaped.
9. A check valve, as claimed in one of claims 1 to 8, characterised by said biasing means (52) being a helical compression spring (52) having first and second spring ends, said first spring end pivotally attached to said valve body (16) to permit pivoting of said spring about a second axis (64), said second spring end being directly pivotally attached to said second end of said arm (38), said spring producing a force along a first longitudinal spring axis definable with respect to said first spring end and said second spring end, said force having a closing component which biases said clapper (32) to move in a direction toward said first position, said force being directed along a line passing through said second axis (64) and said third axis (66) substantially without a lateral force component in any clapper position, said closing component being greater when said clapper (32) is in said first position than when said clapper (32) is in said second position.



10. A check valve, as claimed in one of claims 1 to 9, comprising a second valve seat (76) positioned in said valve body (16) downstream from said first valve seat (28), a second clapper (72) attached to move from a first position sealingly mating with said valve seat (76) to a second open position, and means for biasing (74) said second clapper (72) in a direction toward said first position.

11. A check valve, as claimed in one of claims 1 to 11, characterised by said first spring end being attached to said valve body (16) to pivot about said second axis (64) and said second spring end being pivotally attached directly to said clapper device (32) in the absence of an intervening linkage.

#### Patentansprüche

##### 1. Rückschlagventil mit:

einem Ventilkörper (16), der zumindest erste und zweite Öffnungen aufweist, von denen eine der Öffnungen eine Einlaßöffnung (22) und die andere der Öffnungen eine Auslaßöffnung (24) ist; einem Ventilsitz (28), der an die ersten Öffnung angrenzt; einer Klappe (32), die so gestaltet ist, daß sie abdichtend mit dem Ventilsitz (28) zusammenpaßt, wobei die Klappe (32) schwenkbar angrenzend an dem Ventilsitz (28) befestigt ist, um um eine erste Achse (43) schwenkbar zwischen einer ersten Stellung, in welcher die Klappe (32) abdichtend mit dem Ventilsitz (28) zusammenpaßt und zumindest einer zweiten, von dem Ventilsitz (28) beabstandeten, Stellung zu sein; einer ersten Einrichtung (52) zum Vorspannen der Klappe (32) in der ersten Stellung;

**dadurch gekennzeichnet,**

daß die Einrichtung (52) zum Vorspannen ein erstes Ende (54) und ein zweites Ende (56) aufweist und eine komprimierbare Verbindung zwischen der Klappe (32) in der ersten Stellung und dem Ventilkörper (16) bildet, wobei die Einrichtung (52) zum Vorspannen eine Kraft erzeugt, die monoton ansteigt, sobald die Klappe (32) sich von der zweiten Stellung zur ersten Stellung bewegt, mit einer zweiten Einrichtung (54) angrenzend an das erste Ende, zum Befestigen der Einrichtung zum Vorspannen an dem Ventilkörper (16) an einem Befestigungspunkt (62); und mit einer dritten Einrichtung (56), angrenzend an das zweite Ende, zum schwenkbaren Befestigen der Einrichtung zum Vorspannen der Klappenvorrichtung (32), um ein Schwenken der Einrichtung zum Vorspannen relativ zur Klappe (32) um eine zweite Achse (64) zu erlauben, wobei die Stellung der

zweiten Achse (64) relativ zur Klappe (32) relativ zum zweiten Ende während des Bewegens der Klappe (32) von der ersten in die zweite Stellung fest bleibt.

2. Rückschlagventil nach Anspruch 1, bei dem die zweite Einrichtung (54) schwenkbar die Einrichtung zum Vorspannen am Ventilkörper (16) befestigt, um ein Schwenken der Einrichtung zum Vorspannen um eine dritte Achse zu erlauben.

3. Rückschlagventil nach Anspruch 1 oder 2, bei dem die Einrichtung zum Vorspannen direkt an der Klappe (32) befestigt ist, in Abwesenheit einer eingreifenden Kipphebelverbindung.

4. Rückschlagventil nach einem der Ansprüche 1 bis 3, bei dem die erste Einrichtung (52) erste und zweite schraubenförmige Federabschnitte aufweist, die von einem Ende zum anderen Ende durch Verbinden mit einer Platte verbunden sind.

5. Rückschlagventil nach einem der Ansprüche 1 bis 4, bei dem die Klappe (32) mit dem Ventilkörper (16) nur durch die schwenkbare Befestigung um die erste Achse und durch die Einrichtung zum Vorspannen (52) verbunden ist, ohne daß feste Verbindungen die Klappe (32) mit dem Ventilkörper (16) verbinden.

6. Rückschlagventil nach einem der Ansprüche 1 bis 5, gekennzeichnet durch eine zusammendrückbare Federeinrichtung, welche eine Kraft zur Verfügung stellt, die eine Komponente aufweist, die die Klappenvorrichtung (32) in eine Richtung in Richtung der ersten Stellung vorspannt, wobei die Einrichtung zum Vorspannen (52) die Kraft entlang einer ersten Federachse in Längsrichtung der Feder zur Verfügung stellt, die relativ zu einem ersten und einem zweiten Federende definierbar ist, wobei die Federkraft entlang einer Linie gerichtet ist, die durch den ersten Befestigungspunkt (62) und die zweite Achse (64) verläuft, im wesentlichen ohne eine Querkraftkomponente.

7. Rückschlagventil nach einem der Ansprüche 1 bis 6, bei dem die Klappenvorrichtung eine Scheibe (32) und einen Arm (38) aufweist, der fest mit der Scheibe (32) verbunden ist.

8. Rückschlagventil nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet,** daß der Ventilsitz (28) angrenzend an die Einlaßöffnung ringförmig ist und die Klappe (32)



so gestaltet ist, daß sie abdichtend mit dem ringförmigen Ventilsystem (28) scheibenförmig zusammenpaßt.

9. Rückschlagventil nach einem der Ansprüche 1 bis 8,

**dadurch gekennzeichnet,**

daß die Einrichtung zum Vorspannen (52) eine schraubenförmige Druckfeder (52) ist, die erste und zweite Federenden aufweist, wobei das erste Federende schwenkbar an dem Ventilkörper (16) befestigt ist, um ein Schwenken der Feder um eine zweite Achse (64) zu ermöglichen, wobei das zweite Federende direkt schwenkbar an dem zweiten Ende des Armes (38) befestigt ist, wobei die Feder eine Kraft entlang einer ersten Längsfederachse erzeugt, die relativ zum ersten Federende und dem zweiten Federende definierbar ist, wobei die Kraft eine Schließkomponente aufweist, die die Klappe (32) vorspannt, um sich in eine Richtung zur ersten Stellung zu bewegen, wobei die Kraft entlang einer Linie gerichtet ist, die durch die zweite Achse (64) und die dritte Achse (66) durchgeht, im wesentlichen ohne eine Querkraftkomponente in irgendeiner Klappenstellung, wobei die Schließkomponente größer ist, wenn die Klappe (32) sich in der ersten Stellung befindet, als wenn die Klappe sich in der zweiten Stellung befindet.

10. Rückschlagventil nach einem der Ansprüche 1 bis 9, mit einem zweiten Ventilsitz (76), der in dem Ventilkörper stromabwärts von dem ersten Ventilsitz (28) angeordnet ist, einer zweiten Klappe (72), die befestigt ist, um von einer ersten Stellung abdichtend mit dem Ventilsitz (76) zusammenpassend, in eine zweite offene Stellung überführt zu werden, und einer Einrichtung (74) zum Vorspannen der zweiten Klappe (72) in eine Richtung zur ersten Stellung.

11. Rückschlagventil nach einem der Ansprüche 1 bis 10,

**dadurch gekennzeichnet,**

daß das erste Federende an dem Ventilkörper (16) befestigt ist, um um die zweite Achse (64) zu schwenken, und das zweite Federende schwenkbar direkt an der Klappenvorrichtung (32) befestigt ist, in Abwesenheit einer eingreifenden gelenkigen Verbindung.

#### Revendications

1. Clapet antiretour composé de : un corps de clapet (16) comportant au moins un premier et un second orifices, l'un de ces orifices étant un

orifice d'entrée (22) et l'autre orifice étant un orifice de sortie (24); un siège de clapet (28) adjacent audit premier orifice; un battant (32) configuré de manière à s'accoupler de façon étanche avec ledit siège de clapet (28), ce battant (32) étant fixé avec possibilité de pivoter au voisinage immédiat dudit siège de clapet (28) de manière à pivoter autour du premier axe (43) entre une première position, dans laquelle ledit battant (32) s'accouple de façon étanche avec ledit siège de clapet (28) et au moins une seconde position écartée dudit siège de clapet (28); un premier moyen (52) destiné à précharger ledit battant (32) dans ladite première position, caractérisé en ce que ledit moyen (52) de préchargement a une première extrémité (54) et une seconde extrémité (56) et forme une liaison compressible entre ledit battant (32) dans ladite première position et ledit corps de clapet (16), ledit moyen de préchargement (52) exerçant une force qui augmente uniformément à mesure que ledit battant (32) se déplace de ladite seconde position à ladite première position, un second moyen (54), adjacent à ladite première extrémité, destiné à fixer ledit moyen de préchargement audit corps de clapet (16) à un point de fixation (62); et un troisième moyen (56), adjacent à ladite seconde extrémité, destiné à fixer avec possibilité de pivoter ledit moyen de préchargement audit dispositif de battant (32) de manière à permettre audit moyen de préchargement de pivoter par rapport audit battant (32) autour d'un second axe (64), la position dudit second axe (64) par rapport audit battant (32) et par rapport à ladite seconde extrémité restant fixe Pendant le déplacement dudit battant (32) de ladite première position à ladite seconde position.

2. Clapet antiretour selon la revendication 1, dans lequel ledit second moyen (54) fixe avec possibilité de pivoter ledit moyen de préchargement au corps de clapet (16) de manière à permettre audit moyen de préchargement de pivoter autour d'un troisième axe (66).
3. Clapet antiretour selon la revendication 1 ou 2, dans lequel ledit moyen de préchargement est fixé directement audit battant (32) sans qu'il y ait intervention d'une liaison articulée.
4. Clapet antiretour selon l'une des revendications 1 à 3, dans lequel ledit premier moyen (52) comporte une première et une seconde parties avec ressorts hélicoïdaux jointes bout à bout par liaison à une plaque.



5. Clapet antiretour selon l'une des revendications 1 à 4, dans lequel ledit battant (32) n'est relié audit corps de clapet (16) que par ladite fixation avec possibilité de pivoter autour dudit premier axe (23) et par ledit moyen de préchargement (52), sans liaison par éléments rigides entre ledit battant (32) et ledit corps de clapet (16).

6. Clapet antiretour selon l'une des revendications 1 à 5, caractérisé en ce qu'un moyen de compression à ressort exerce une force dont une composante précharge ledit dispositif de battant (32) en direction de ladite première position, en ce que ledit moyen (52) de préchargement exerce ladite force selon un premier axe de ressort longitudinal définissable par rapport à une première extrémité de ressort et une seconde extrémité de ressort, et en ce que ladite force de ressort est dirigée selon une ligne passant par ledit premier point de fixation (62) et ledit second axe (64) pratiquement sans composante de force latérale.

7. Clapet antiretour selon l'une des revendications 1 à 6, dans lequel ledit dispositif de battant comporte un disque (32) et un bras (38) fixés rigidement à ce disque (32).

8. Clapet antiretour selon l'une des revendications 1 à 7, caractérisé en ce que le siège de clapet (28) adjacent audit orifice d'entrée est annulaire et en ce que le battant (32) configuré pour s'accoupler d'une manière étanche avec ledit siège de clapet annulaire (28) a une forme de disque.

9. Clapet antiretour selon l'une des revendications 1 à 8, caractérisé en ce que ledit moyen de préchargement (52) est un ressort de compression hélicoïdal (52) ayant une première et une seconde extrémités de ressort, en ce que ladite première extrémité de ressort est fixée avec possibilité de pivoter audit corps de clapet (16) de manière à permettre audit ressort de pivoter autour d'un second axe (64), en ce que ladite seconde extrémité de ressort est directement fixée avec possibilité de pivoter à ladite seconde extrémité dudit bras (38), en ce que ledit ressort exerce une force selon un premier axe de ressort longitudinal définissable par rapport à ladite première extrémité de ressort et ladite seconde extrémité de ressort, en ce que ladite force a une composante de fermeture qui applique une précharge sur ledit battant (32) de manière à le déplacer en direction de ladite première position, en ce que cette force est dirigée selon une ligne passant

par ledit second axe (64) et ledit troisième axe (66) pratiquement sans composante de force latérale dans aucune position du battant, et en ce que cette composante de fermeture est plus grande lorsque ledit battant (32) est dans ladite première position que lorsque ledit battant (32) est dans ladite seconde position.

10. Clapet antiretour selon l'une des revendications 1 à 9, comportant un second siège de clapet (76) placé dans ledit corps de clapet (16) en aval dudit premier siège de clapet (28), un second battant (72) fixé de manière à se déplacer d'une première position à accouplement étanche avec ledit siège de clapet (76) à une seconde position ouverte, et un moyen (74) destiné à précharger ledit second battant (72) en direction de ladite première position.

11. Clapet antiretour selon l'une des revendications 1 à 10, caractérisé en ce que ladite première extrémité du ressort est fixée audit corps de clapet (16) de manière à pivoter autour dudit second axe (64) et en ce que ladite seconde extrémité du ressort est fixée avec possibilité de pivoter directement audit dispositif de battant (32) sans qu'il y ait intervention d'une liaison par tiges.

