

[Title of Invention] CHECK VALVE

[Document Name] Description

[Technical Field]

[0001]

The present invention relates to a check valve that opens and closes by fluid pressure and allows a fluid to flow unidirectionally.

[Background Art]

[0002]

There is a known check valve that includes a housing having a valve hole through which a fluid flows, with a valve seat formed on an outer periphery surface of the valve hole, a valve body disposed in the valve hole, which is movable between a valve-closing position where the valve body contacts with the valve seat to close the valve hole and a valve-opening position where the valve body separates from the valve seat toward a downstream side of the fluid to open the valve hole, and a coil spring for biasing the valve body toward the valve-closing position side (Patent Documents 1).

[0003]

A check valve is connected to a downstream side of a flow meter on mounting a water pipe, for example, especially a water-supply pipe for distributing water to individual homes, and prevents backflow of sewage water flowing from the downstream side which is caused by a water stoppage or a reduction of water-supply pressure. The valve body needs to be biased quickly and surely toward the valve-closing position side to close, as well as a pressure loss needs to be reduced so as to allow a fluid to surely flow to the downstream side, irrespective of fluid pressure and a flow volume.

[Citation List]

[Patent Literature]

[0004]

[Patent Literature 1]

Japanese Patent Laid-Open No. H09-72442

[Summary of Invention]

[Technical Problem]

[0005]

It is an object of the present inventions to provide a small and low-cost check valve that can reduce pressure loss and can securely prevent backflow of a fluid.

[Solution to Problem]

[0006]

To achieve the above objet, according to a fist aspect of the present invention, a check valve includes:

- a tubular body forming a part of a flow path through which a fluid flows;

- a first housing having a first valve hole through which the fluid flows, with a valve seat formed at a downstream side of an inner peripheral surface of the first valve hole;

- a valve body having a flat part at a top thereof and including a valve head and a supporting rod connected to the valve head, the valve head increasing in diameter in a tapered shape toward a downstream side thereof;

- a spring member for biasing the valve body toward the valve seat; and

- a second housing having a connecting section and a cylindrical body, the connecting section including a second valve hole, the cylindrical body being open to an upstream side thereof and including a receiving surface formed at a downstream side thereof for receiving one end of the spring member and a sliding hole formed at a central part thereof through which the supporting rod of the valve body slides, in which

the cylindrical body of the second housing decreases in diameter in a tapered shape toward the downstream side thereof, and has notches on an upper edge thereof opposing one surface at the downstream side of the valve head of the valve body.

[0007]

According to a second aspect of the present invention, the supporting rod of the valve body has a downstream-side end that protrudes from the sliding hole of the second housing when a fluid presses the valve body to cause the one surface at the downstream side of the valve head of the valve body to abut on the upper edge of the cylindrical body, the downstream-side end decreasing in diameter in a tapered shape.

[0008]

According to a third aspect of the present invention, a plurality of engagement grooves with respective hooks are formed at an upstream end of the first valve hole of the first housing, and a plurality of ribs with respective engagement recessed parts are formed on an outer surface of the cylindrical body of the second housing.

[0009]

To achieve the above object, according to a fourth aspect of the present invention, a check valve includes a first check valve according to any one of the first to third aspects of the present invention and a second check valve according to any one of the first to third aspects of the present invention, the second check valve being connected to the first check valve by engaging the plurality of ribs formed on the second housing of the second check valve to the plurality of engagement grooves formed on the first housing of the first check valve.

[Advantageous Effects of Invention]

[0010]

According to the first and second aspects of the present invention, a small and low-cost check valve that enables to reduce pressure loss and securely prevents backflow of a fluid can be provided.

According to the third aspect of the present invention, a plurality of check valves having identical structure can be easily connected to and separated from each other.

According to the fourth aspect of the present invention, a small and low-cost check valve that enables to reduce pressure loss by continuously connecting a plurality of check valves having identical structure and surely prevents backflow of a fluid can be provided.

[Brief Description of Drawings]

[0011]

[Fig. 1] Fig. 1 is a perspective view showing the components viewed from an inlet port side of a check-valve main body 2.

[Fig. 2] Fig. 2a is a vertical cross-sectional view showing a state that a check valve 1 is closed, and Fig.2b is a vertical cross-sectional view showing a state that a check valve 1 is opened.

[Fig. 3] Fig. 3a is a vertical cross-sectional view of a first housing 10, and Fig. 3b is a plane view of the first housing 10 at an inlet port side thereof.

[Fig. 4] Fig. 4a is a bottom view of a second housing 40 viewing from an outlet port side thereof, Fig. 4b is a vertical cross-sectional view of the second housing 40, and Fig. 4c is a plane view of the second housing 40 viewing from an inlet port side thereof.

[Fig. 5] Figs. 5 are vertical cross-sectional schematic views showing a fluid flow and a movement of valve body through the check valve 1, Fig. 5a shows a state that a valve-opening operation starts, and Fig. 5b shows a state of being open with a check valve 20 taking a full stroke operation.

[Fig. 6] Fig. 6 is a vertical cross-sectional schematic view showing a fluid flowing through the check valve 1 in a state that the valve body 20 is in the full stroke by fluid pressure.

[Fig. 7] Fig. 7a is a vertical cross-sectional schematic view showing a state that the check valve 1 starts the valve-closing operation, and Fig. 7b is a vertical cross-sectional schematic view showing a state that the check valve 1 is closed.

[Fig. 8] Fig. 8 is a vertical cross-sectional view showing a state that the check valve 1A is closed.

[Fig. 9] Fig. 9 is a vertical cross-sectional schematic view showing a fluid flow and movement of the valve body through the check valve 1A.

[Fig. 10] Fig. 10 is a vertical cross-sectional schematic view showing a state that the check valve 1A starts a valve-closing operation.

[Fig. 11] Fig. 11 is a flow volume characteristic graph (Relational diagram showing “pressure loss – flow volume”) showing the pressure loss of the check valve 1A in accordance with an example of the present invention and pressure loss of a check valve 200 of a comparative example in various fluid volumes.

[Fig. 12] Fig. 12 is a vertical cross-sectional view of the check valve 200 of the comparative example.

[Description of Embodiments]

[0012]

The present invention will be described in detail according to embodiments and examples described below with reference to the following drawings. The present invention shall not be limited to those embodiment nor examples.

It should be noted that, in the explanation by using following schematic drawings, the drawings are different from reality in ratio of each size and illustrations for components except those required for easy-to-understand are omitted.

[0013]

First Embodiment

(1) Structure of check valve

Fig. 1 is a perspective view showing the components viewed from an inlet port side of a check-valve main body 2, Fig. 2a is a vertical cross-sectional view showing a state that a check valve 1 is closed, and Fig.2b is a vertical cross-sectional view showing a stat that a check valve 1 is opened.

Entire components of the check valve 1 and the check-valve main body 2 will now be described with reference to the drawings.

[0014]

(1.1) Entire components of check valve

The check valve 1 includes the check-valve main body 2 and a tubular body 3 through which the check-valve main body 2 is inserted.

The check-valve main body 2 includes a first housing 10 having a flow path through which a fluid flows from an inlet port at one end thereof to an outlet port at the other end thereof, a valve body 20 that moves by fluid pressure, a spring member 30 for biasing the valve body 20 from an outlet port side to an inlet port side of the fluid, a second housing 40 that supports the valve body 20 and the spring member 30 for biasing the valve body 20 toward the upstream side thereof.

[0015]

The first housing 10 includes an inlet port 12 increasing in diameter in a tapered shape toward a downstream side thereof, and a valve seat 13 having a surface to/from which the valve body 20 contacts and separates.

The valve body 20 includes a valve head 21 receiving fluid pressure and a supporting rod 22 connected to the valve head 21. The spring member 30 biases the valve body 20 toward the valve seat 13.

A second housing 40 is fit to the first housing 10 to form a fluid flow path at the downstream side thereof with an inner surface 3a of a tubular body 3. A sliding hole 42a of the second housing 40 movably supports the valve body 20 in a fluid flow direction.

[0016]

In the check valve 1 configured as described above, the check-valve main body 2 works as a valve for preventing backflow of the fluid by being fitted into the tubular body 3. For example, when the check-valve main body 2 is disposed at the downstream side of a flow meter of a water pipe or a water-supply pipe as the tubular body 3, the check-valve main body 2 works as a check valve for preventing backflow of the fluid within the supply pipe.

[0017]

(1.2) Structure of first housing

Fig. 3a is a vertical cross-sectional view of the first housing 10, and Fig. 3b is a plane view of the first housing 10 at an inlet port side thereof.

The first housing 10 includes a first valve hole 11 through which the fluid flows, and the first valve hole 11 has the inlet port 12 of the fluid at the downstream side thereof. The inlet port 12 increases in diameter in a tapered shape from the inlet port side for the fluid toward the downstream side thereof. An annular convex part 12a is formed, in a ring shape, outside of the inlet port 12.

At the downstream side of the first valve hole 11, a valve seat 13 to/from which the valve body 20 contacts and separate towards the downstream side thereof.

[0018]

The valve seat 13 is made from an elastic material and formed in a ring integrally with the first housing 10. Ether urethane elastomer having a shore hardness of Hs 80 to 95 can be used as the elastic material. In a case where the first housing 10 is formed of synthetic resin, the valve seat 13 can be molded by injection molding integrally with the first housing 10.

The valve seat 13 may be formed by sandwiching an elastic material such as fluorine-contained rubber between the first housing 10 and a connecting section 41 of the second housing 40 which is to be described hereafter, after the valve seat 13 is molded by injection molding by using synthetic resin for the first housing 10.

[0019]

A plurality of engagement grooves 14 having respective hooks 14a at the end thereof are formed on a circumferential upper edge of the inlet port 12.

Specifically, the engagement grooves 14, 14 · · · are formed on the circumferential upper edge of the inlet port 12 of the first housing 10 at equal intervals of 90 degrees. Each of the engagement grooves 14 has a pair of hooks 14a and 14a disposed such that they are facing each other.

The engagement grooves 14 engage with a plurality of ribs 43 having the respective engagement recessed part 43a which are formed on a cylindrical body 42 of the second housing 40 that is to be described hereafter. Accordingly, a check valve with continuously connecting structure enables to be configured by mutually connecting a plurality of the check-valve main bodies 2 in a fluid-flow direction.

[0020]

In the check valve with continuously connecting structure, the check-valve main bodies 2 easily separates from each other by releasing the engagement between the hooks 14a formed on the engagement grooves 14 and the engagement recessed part 43a formed on the ribs 43.

[0021]

An annular O-ring S is mounted on the outer peripheral surface of the inlet port 12 of the first housing 10. The O-ring S is connected by pressure with the inner surface 3a of the tubular body 3 to prevent a fluid leakage in a gap between the check-valve main body 2 and the tubular body 3.

[0022]

(1.3) Structure of valve body

The valve body 20 includes a flat part 20a at a top formed on an upper surface side thereof which receives fluid pressure, the valve head 21 and a supporting rod 22, the valve

head 21 increases in diameter thereof in a tapered shape toward the downstream side thereof. The valve head 21 and the supporting rod 22 are integrally formed of, for example, synthetic resin.

[0023]

A flange 21a having a flat shape in a direction orthogonally crossing a fluid flow direction is formed at a side of the supporting rod 22 of the valve head 21. An annular recessed part 21b is formed on an outer side at which one end of the supporting rod 22 is formed (See Fig. 2a).

When the valve body 20 is in a valve-opening state by fluid pressure, the annular recessed part 21b is fitted with an end of the sliding hole 42a of the cylindrical body 42 of the second housing 40 that is to be described hereinafter to control leftward/rightward movement of the valve body 20 (See Fig. 2b).

[0024]

A downstream-side end 22a of the supporting rod 22 protrudes from the sliding hole 42a of the cylindrical body 42, when the valve body 20 is at the position where being pressed by the fluid to abut on an upstream-side end surface of the cylindrical body 42 of the second housing 40 that is to be described hereinafter. The protruding part of the downstream-side end 22a decreases in diameter in a tapered shape.

[0025]

(1.4) Structure of second housing

Fig. 4a is a bottom view of a second housing 40 viewing from an outlet port side thereof, Fig. 4b is a vertical cross-sectional view of the second housing 40, and Fig. 4c is a plane view of the second housing 40 viewing from an inlet port side thereof.

The second housing 40 includes a connecting section 41 that is open to an upstream side thereof and increase in diameter in a tapered shape toward a downstream side thereof to form a second valve hole, the cylindrical body 42 that is open to a downstream side thereof and has a receiving surface for one end of the spring member 30, and a plurality of ribs 43 that connect and support the connecting section 41 and the cylindrical body 42.

The cylindrical body 42 decreases in diameter in a tapered shape toward the downstream side thereof and has the sliding hole 42a supporting the supporting rod 22 of the valve body 20 at a central part thereof.

[0026]

The connecting section 41 has an annular recessed part 41a formed on an inner peripheral surface thereof in a ring shape, and a step 41b on an inner peripheral surface of an opening formed at the upstream side of the connecting section 41. In the connecting section 41, the step 41b presses the valve seat section 13 formed on the first housing 10, and at the same time, the recessed part 41a is engaged with the annular convex part 12a that is formed outer side of the inlet port 12 of the first housing 10 to configure the check-valve main body 2.

[0027]

The cylindrical body 42 has a plurality of the ribs 43 in all direction on an outer surface thereof which decreases in diameter in a tapered shape toward the downstream side thereof. The engagement recessed parts 43a are formed at the end of downstream side of the respective ribs 43 in a thickness direction of the rib.

Specifically, the ribs 43, 43 · · · are formed on the cylindrical body 42 of the housing 40 at equal intervals of 90 degrees. The engagement recessed parts 43a, 43a · · · are formed at the downstream-side end of the respective ribs 43 in the thickness direction of the rib.

The engagement recessed part 43a engages with the engagement grooves 14 formed on the upper peripheral edge of the inlet port 12 in the first housing 10. Accordingly, a check valve can be configured by continuously connecting a plurality of the check-valve main bodies 2 each other in a fluid-flow direction.

[0028]

A dual check valve can be configured by continuously connecting the two identical check-valve main bodies 2 each other. According to the dual check valve, each check-valve main body 2 allows to a fluid flowing from the upstream side thereof, and at the same time, fulfills a double-backflow stopper function against a fluid regurgitating from the downstream side thereof.

[0029]

The cylindrical body 42 is open to the upstream side thereof and has notches 44, 44 · · · on the upper edge thereof at equal intervals of 90 degrees. The valve body 20 is pressed by the fluid to move toward the downstream side thereof and abut on the upper edge of the cylindrical body 42 (described as “full stroke” hereinafter). Thus, a space C is formed by the inner surface 42b of the cylindrical body 42, an outer surface 42c of the sliding hole 42a and the flange 21a of the valve body 20.

The notch 44 of the cylindrical body 42 forms a communication hole 44a for communicating between the space C and a fluid path R defined by the cylindrical body 42 and the tubular body 3 (See Fig. 2b).

[0030]

The space C is filled with the fluid pressed by the flange 21a of the valve body 20 which is pressed by fluid pressure to move toward the downstream side thereof. When the fluid pressure within the space C increases with movement of the valve body 20, it works as a resistance against the movement of the valve body 20 in a downstream direction.

Especially, the pressure increases right before in the full stroke to block the valve body to move. A plurality of the communication holes 44a formed in the full stroke reduce the increase of the pressure within the space C. This function will be described hereinafter.

[0031]

Although material for the first housing 10, the valve body 20 and the second housing 40 is not especially limited, synthetic resin such as polyoxymethylene (POM) is preferable.

Particularly, frictional force between the supporting rod 22 of the valve body 20 and the sliding hole 42a for supporting the supporting rod 22 can be reduced by using the POM. The engagement recessed part 43a of the second housing 40 and the engagement groove 14 of the first housing 10 are easily elastically deformable when contacting and separating to/from each other to enable to reduce an attrition of the hook 14a and the engagement groove 43a.

[0032]

(2) Operation and function of check valve

Figs. 5 are vertical cross-sectional schematic views showing a fluid flow and a movement of the valve body 20 through the check valve 1. Fig. 5a shows a state that a

valve-opening operation starts, and Fig. 5b shows a state of being open with the check valve 20 taking a full stroke operation.

[0033]

(2.1) Whole operation of check valve

As shown by void arrows in Fig. 5, the check valve 20 separates from the valve body 13 by the pressure of the fluid flowing in. The supporting rod 22 of the valve body 20 is guided by the sliding hole 42a of the cylindrical body 42 of the second housing 40 to move toward the downstream side thereof.

Then, the flange 21a of the valve body 20 abuts on the upper edge of the cylindrical body 42 of the second housing 40. A gap between an outer diameter of the supporting rod 22 and the sliding hole 42a is retained around 0.05mm, for example, and the supporting rod 22 is controlled in movement in a radial direction. Accordingly, the check valve 20 is controlled in movement in the radial direction, thereby reducing a displacement of a center position of the valve body 20 and the valve seat 13.

[0034]

When the flange 21a of the valve body 20 abuts on the upper edge of the cylindrical body 42 in the second housing 40, a gap between the flange 21a and a bottom surface of the cylindrical body 42 becomes shorter and the spring member 30 is compressed.

As shown by arrows in Fig. 5b (F1, F2 and F3), the fluid passes through a gap between the valve head 21 and the valve seat 13, the valve head 21 increasing in diameter in a tapered shape toward the downstream side of the valve body 20, and then flows through the flow path R defined between the cylindrical body 42 and the inner surface 3a of the tubular 3 to flow out from the downstream side of the second housing 40.

[0035]

(2.2) Opening operation and function of check valve

Fig. 6 is a vertical cross-sectional schematic view showing a fluid flowing through the check valve 1 in a stated that the valve body 20 is in the full stroke by fluid pressure.

When the flow path opens at the downstream end and the fluid begins to flow, the valve body 20 separates from the valve seat 13 by pressure of the fluid flowing from the inlet port 12 to open the valve hole 11.

[0036]

When the sliding hole 42a in the second housing 40 guides the supporting rod 22 to move toward the downstream side thereof as the valve body 20 separates from the valve seat 13, the space C in the second housing 40 is filled with the fluid that is pressed into by the flange 21a of the valve body 20 which moves toward the downstream side by the fluid pressure.

The fluid pressure within the space C increases as the valve body 20 moves, and the fluid pressure especially further increases right before the full stroke.

Accordingly, when the pressure within the space C increases right before in the full stroke, the fluid that is pressed and filled into the space C flows out through a communication hole 44a for communicating between the space C and the flow path R (F5).

[0037]

The flow path R communicating from the valve hole 11 to the downstream side of the cylindrical body 42 of the second housing 40 includes a first flow path (R1) formed by a gap between the valve head 21 and the valve seat 13, and a second flow path (R2) formed between the cylindrical body 42 and the inner surface 3a of the tubular body 3.

The first flow path (R1) becomes narrower in width toward a downstream side thereof. On the other hand, since the cylindrical body 42 decrease in diameter in a tapered shape toward the downstream side thereof, the second flow path (R2) becomes wider in width toward the downstream side thereof.

As a result of that, an area where the first flow path (R1) and the second flow path (R2) is connected, that is, an area where the flange 21a of the valve body 20 abuts on the upper edge of cylindrical body 42 has the narrowest width for the flow path, whereby a speed of the fluid flow is increased at this area (F2).

[0038]

Accordingly, the fluid within the space C is extracted to flow out through the connection hole 44a by venturi effect (F5).

As a result of that, an increase in pressure in the space C is reduced and the valve body 20 is surely in the full stroke operation to reduce the pressure loss, and thereby enabling a stable fluid flow.

[0039]

(2.3) Closing operation and function of check valve

Fig. 7a is a vertical cross-sectional schematic view showing a state that the check valve 1 starts a closing operation, and Fig. 7b is a vertical cross-sectional schematic view showing a state that the check valve 1 is closed.

When the fluid path is closed at the end of downstream side to stop the fluid flow, pressure at the downstream side is higher than pressure at the upstream side. This pressure difference and biasing force of the spring member 30 allow the check valve 1 to switch from the opening state to the closing state.

[0040]

The valve head 21 of the valve body 20 seats on the valve seat 13 by the pressure difference and the biasing force of the spring member 30. The valve body 20 is guided by the sliding hole 42a of the second housing 40 to move toward the upstream side thereof. Thus, the valve body 20 is controlled in movement in a diameter direction.

When the valve head 21 seats on the valve seat 13, the valve head 21 increasing in diameter toward the downstream side thereof in a tapered shape, the gap between the flange 21a and the bottom surface of the cylindrical body 42 is made larger to elongate the spring member 30.

As shown by void arrows, the fluid which regurgitates from the downstream side is intercepted by sealing function of the valve head 21 and valve seat 13.

[0041]

Second embodiment

(1) Structure of check valve

Fig. 8 is a vertical cross-sectional view showing a state that a check valve 1A is closed. A whole structure of the check valve 1A will now be described with reference to the following drawings.

Since the check valve 1A is configured as a dual check valve by continuously connecting two check-valve main bodies 2 according to the first embodiment, components identical to those of the check valve 1 according to the first embodiment will be denoted by the same signs and detailed descriptions thereof will be omitted.

[0042]

(1.1) Entire components of check valve

The check valve 1A includes a check-valve main body 2A and a tubular body 3A through which the check-valve main body 2A is inserted.

The check-valve main body 2A is configured by continuously mutually connecting the two check-valve main bodies 2 according to the first embodiment in a fluid flow direction.

[0043]

(1.2) Structure of check-valve main body

As shown in Fig. 8, the check-valve main body 2A is configured by continuously connecting the identical two check-valve main body 2 each other.

A plurality of engagement grooves 14 having respective hooks 14a at an end thereof are formed on a circumferential upper edge of an inlet port 12 (See Fig. 3).

On the other hand, a plurality of ribs 43 are radially formed on an outer surface of a cylindrical body 42 of a second housing 40 in the check-valve main body 2, and engagement recessed parts 43a are respectively formed at a downstream-side end of the each ribs 43 in the thickness direction of the rib (See Fig. 4).

[0044]

Specifically, the engagement grooves 14, 14 . . . are formed on a circumferential upper edge of the inlet port 12 at equal intervals of 90 degrees. Each of the engagement grooves 14 has a pair of hooks 14a and 14b arranged such that they are facing each other.

The ribs 43, 43 . . . are formed on the cylindrical body 42 in the second housing 40 at equal intervals of 90 degrees. The engagement recessed parts 43a, 43a, . . . are formed at the downstream-side end of the each rib 43 in the thickness direction of the rib.

[0045]

The check-valve main body 2A configured by continuously connecting two identical check-valve main bodies 2 in a fluid flow direction is formed by engaging the engagement recessed parts 43a, 43a, . . . which are formed at the downstream-side end of the each ribs 43, with the engagement grooves 14 formed at the upper edge of the inlet port 12 of the first housing 10.

The engagement grooves 14, 14, . . . are formed at the circumferential upper edge of the inlet port 12 of the first housing 10, and the engagement recessed parts 43a, 43a, . . . are formed in the thickness direction of the rib at the downstream-side end of the each engaged ribs 43, 43, . . . of the second housing 40, thereby minimizing a space for engagement to enable the continuous connection without preventing the fluid flow at the engagement part.

[0046]

(2) Operation and function of check valve

(2.1) Opening operation and function for check valve

Fig. 9 is a vertical cross-sectional schematic view showing a fluid flow and movement of the valve body 20 through the check valve 1A.

As shown by void arrows, the check valve 20 of the check-valve main body 2 at the upstream side thereof separates from the valve body 13 by the pressure of the fluid flowing in. The supporting rod 22 of the valve body 20 is guided by the sliding hole 42a of the second housing 40 to move toward the downstream side thereof.

[0047]

Then, the flange 21a of the valve body 20 abuts on the upper edge of the cylindrical body 42 of the second housing 40.

When the flange 21a of the valve body 20 abuts on the upper edge of the cylindrical body 42 of the second housing 40, a gap between the flange 21a and the bottom surface of the cylindrical body 42 is made smaller to contract the spring member 30.

As shown by arrows in Fig. 9 (F1, F2 and F3), the fluid passes through the gap between the valve head 21 and the valve seat 13, the valve head 21 increasing in diameter in a tapered shape toward the downstream side of the valve body 20, and flows through the flow path R defined by the cylindrical body 42 and an inner surface of the tubular 3A to flow out from the downstream side of the second housing 40.

[0048]

The downstream side end 22a of the supporting rod 22 protrudes from the sliding hole 42a of the second housing 40 when the fluid presses the valve body 20 at the upstream side thereof in a full stroke operation.

Since the protruding downstream side end 22a of the supporting rod 22 decreases in diameter in a tapered shape to reduce resistance against the flow (F4) along an outer peripheral surface of the cylindrical body 42.

[0049]

The flow (F4) flowing along the cylindrical body 42 is guided toward the flat part 20a formed on the valve body 20 of the check-valve main body 2 at the downstream side.

As the result of that, the fluid flowing out from the check-valve main body 2 at the upstream side presses the flat part 20a formed on the valve body 20 of the check-valve main body 2 at the downstream side to easily open the check-valve main body 2 at the downstream side. Thus, the pressure loss due to a continuously-connected dual check valve can be reduced.

[0050]

Fig. 9 shows a state where the fluid which flows out from the downstream side of the check-valve main body 2 at the upstream side flows into the check-valve main body 2 at the downstream side, thereby starting a valve-opening operation. A valve opening operation similar to that for the check-valve main body 2 at the upstream side is also executed.

More specifically, the valve body 20 of the check-valve main body 2 at the downstream side is pressed by the pressure of the fluid flowing out from the downstream side of the check-valve main body 2 at the upstream side, and separates from the valve seat 13. Then, the supporting rod 22 of the valve body 20 is guided by the sliding hole 42a of the second housing 40 to move toward the downstream side thereof. That causes the flange 21a of the valve body 20 to abut on the upper edge of the cylindrical body 42 of the second housing 40.

[0051]

When the flange 21a of the valve body 20 abuts on the upper edge of the cylindrical body 42 in the second housing 40, the gap between the flange 21a and the bottom surface of the cylindrical body 42 becomes shorter and the spring member 30 is compressed.

The fluid passes through the gap between the valve head 21 and the valve seat 13, the valve head 21 increasing in diameter in a tapered shape toward the downstream side of the valve body 20, and flows through a flow path R defined between the cylindrical body 42 and

the inner surface 3Aa of the tubular 3A to flow out from the downstream side of the second housing 40.

[0052]

The check valve 1A according to the second embodiment has a function effect similar to that in the first embodiment, in which the fluids within the respective spaces C of the check-valve main bodies 2 at the upstream side and at the downstream side are extracted to flow out through the connection hole 44a by venturi effect (See F5 in Fig. 9).

As a result of that, increase in pressure within the space C is reduced and the valve body 20 is surely in the full stroke to reduce a pressure loss, and thereby enabling a stable fluid flow.

[0053]

(2.2) Closing operation and function of check valve

Fig. 10 is a vertical cross-sectional schematic view showing a state that the check valve 1A starts a valve-closing operation.

When the fluid flow stops at the downstream-side end, and pressure at the downstream side become to be higher than pressure at the upstream side, this pressure difference and biasing force of the spring member 30 allow the check valve 1A to switch from the opening state to the closing state.

The valve head 21 of the valve body 20 of the check-valve main body 2 at the downstream side seats on the valve seat 13 by the pressure difference and the biasing force of the spring member 30.

[0054]

At this time, the supporting rod 22 is guided by the sliding 42a of the second housing 40 to move toward the upstream side, whereby the valve body 20 is controlled in movement in a diameter direction. When the valve head 21 of the valve body 20 seats on the valve seat 13, the valve head 21 increasing in diameter toward the downstream side in a tapered shape, the gap between the flange 21a and a bottom surface of the cylindrical body 42 becomes longer and the spring member 30 is elongated.

As shown by void arrows, the fluid which regurgitates from the downstream side is intercepted by sealing function of the valve head 21 and valve seat 13. Namely, the flow path of the check-valve main body 2 at the downstream side is blocked.

[0055]

Next, the check-valve main body 2 at the upstream side configuring the check valve 1A is switched from the opening state to the closing state by the pressure difference and the biasing force of the spring member 30, which is similar to the check-valve main body 2 at the downstream side.

Namely, in the check valve 1A which is configured as a dual check valve by continuously connecting the two check-valve main bodies 2 each other, the check-valve main body 2 at the downstream side switches from the opening state to the closing state in advance, when the fluid flow at the downstream side is stopped.

After that, the check-valve main body 2 at the upstream side switches from the opening state to the closing state to be doubly-closing state against the fluid which regurgitates from the downstream side.

[0056]

As result of that, if a fault occurs in one of the check-valve main bodies 2 configuring the check valve 1A, the check valve 1A can surely prevents the flow which regurgitates from the downstream side by closing the other check-valve main body 2.

For example, when the valve is closed instantly at a downstream side end, a water shock wave occurs within a pipe. When the check valve which is used as a valve for preventing the backflow is closed, the water shock wave cannot escape to the upstream side and thus become to be a wave motion traveling back and forth between terminal equipment and the check valve.

The wave motion gradually attenuates to cease to exist.

It leads the high pressure to be contained between the terminal equipment and the check valve. The high pressure contained therebetween causes a water leakage due to a reason such as damage to a packing of the terminal equipment, and causes a backflow of the fluid due to damage to a close-contact part between the valve seat and the valve body in the check valve.

[0057]

According to a check valve 1A of the second embodiment, a dual check valve is configured by continuously connecting two check-valve main bodies 2, if the water shock wave occurs between the terminal equipment and the check valve 1A to make high pressure which is contained therebetween, the check-valve main body 2 at the upstream side is sure to keep the valve-closing state without being affected by the water shock wave.

[0058]

Because in the check-valve main body 2 at the upstream side and the check-valve main body 2 at the downstream side which are continuously connected each other, the engagement between the rib 43 at the upstream side and the engagement groove 14 formed on the upper edge of the inlet port 12 at the downstream side can be easily released, one of the check-valve main bodies 2 configuring the check valve 1A comes to be easily exchangeable.

[0059]

(3) Effect

Example

The check valve 1A according to the second embodiment is mounted to a pipe, as one example of the tubular 3A, provided at the downstream side of an electromagnetic flow meter, and the pressure loss is measured as compared with a comparative example in a case of making the fluid flow under the following conditions.

As shown in Fig. 12, a check valve 200 is used as the comparative example, the check valve 200 being configured by arranging a two check valve 100 in a fluid flow direction. The check valve 100 includes a valve seat member 110 forming an inlet port of a fluid, a housing 120 allowing the fluid to pass through, and a valve body 130 pressed by biasing means toward the valve seat member 110.

[0060]

Test condition

Nominal diameter of tubular body: 20mm

Flow volume: 160 to 3000L/hour (Rated flow volume: 2520L/hour)

Test body

Example: Check valve 1A according to the second embodiment

Comparative example: Check valve 200 shown in Fig. 12

[0061]

In the test body, the example and the comparative example are identically configured other than forms in the housing and the valve body. As shown in the test condition, the pressure losses of the embodiment and the comparative example in various flow volumes are respectively plotted on a flow volume characteristic graph (Relational diagram showing “pressure loss – flow volume”) by changing the flow volume (See Fig. 11).

[0062]

As a result of this test, in a case where the check valve 1A according to the second embodiment of the example has a rated flow volume (2520L/hour), the pressure loss is 0.023MPa. On the other hand, when the comparative example has also the rated flow volume (2520L/hour), the pressure loss is 0.050MPa.

Not only in the case that the fluid volume is in the rated flow volume, but also in a case where the flow volume is about 1000 to 3000L/hour, the pressure loss of the example is smaller in value comparing with that of the comparative example.

[0063]

Accordingly, when the flow path is opened at the downstream-side end and the fluid starts to flow, the valve body 20 separates from the valve seat 13 by pressure of the fluid flowing in. After that, the valve body 20 surely takes a full stroke operation to reduce the pressure loss, and thereby enabling a stable fluid flow.

When the fluid path at the downstream-side end is closed and the fluid stops to flow, the state changes from the opening state to the closing state.

A dual check valve is configured by continuously connecting two check-valve main bodies 2, if a water shock wave occurs between the terminal equipment and the check valve 1A and high pressure contained therebetween come to operate, the check-valve main body 2 at the upstream side is sure to keep the valve-closing state without being affected by the water shock wave.

[0064]

As described in the second embodiment on the check valve 1A configured by

continuously connecting the two identical check-valve main body 2, with reference to the specific example, the check-valve main body 2 can be multiple check-valve main body configured by continuously connecting more than one identical check-valve main body 2 in a fluid flow direction as necessary, by engaging the engagement recessed parts 43a, 43a, . . . formed on the downstream-side end of the rib 43 with the engagement grooves 14, 14, . . . formed on the upper edge of the inlet port 12.

[Industrial applicability]

[0065]

The check valves 1 and 1A according to the embodiments can be used as a check valve for preventing backflow of a fluid within a tubular body by combining them with a flow meter, a water shutoff valve and the like which are mounted on a tubular body such as a water pipe and a water-supply pipe.

The check valves 1 and 1A can be used as a unit-type check valve for surely preventing backflow of the fluid by reducing a pressure loss during flowing in a circulation pipe not only for liquid but also gas, mixture gas of gas and liquid, and the like.

[Reference Signs List]

[0066]

1, 1A, 100, 200	Check valve
2	Check-valve main body
3,3A	Tubular body
3a, 3Aa	Inner surface (Tubular body)
10	First housing
11	Valve hole
12	Inlet port
12a	Annular convex part (Inlet port)
13	Valve seat
14	Engagement groove
14a	Hook
20	Valve body
20a	Flat part

21	Valve head
21a	Flange
21b	Annular recessed part
22	Supporting rod
22a	Downstream-side end
30	Spring member
40	Second housing
41	Connecting Section
41a	Recessed part (Connecting Section)
41b	Step (Connecting Section)
42	Cylindrical body
42a	Sliding hole
42b	Inner surface (Cylindrical body)
42c	Outer surface (Sliding hole)
43	Rib
43a	Engagement recessed part
44	Notch
44a	Communication hole
R	Flow path
C	Space

[Document Name] Claims

[Claim 1]

A check valve, comprising:

a tubular body forming a part of a flow path through which a fluid flows;

a first housing having a first valve hole through which the fluid flows, with a valve seat formed at a downstream side of an inner peripheral surface of the first valve hole;

a valve body having a flat part at a top thereof and including a valve head and a supporting rod connected to the valve head, the valve head increasing in diameter in a tapered shape toward a downstream side thereof;

a spring member for biasing the valve body toward the valve seat; and

a second housing having a connecting section and a cylindrical body, the connecting section including a second valve hole, the cylindrical body being open to an upstream side thereof and including a receiving surface formed at a downstream side thereof for receiving one end of the spring member and a sliding hole formed at a central part thereof through which the supporting rod of the valve body slides, wherein

the cylindrical body of the second housing decreases in diameter in a tapered shape toward the downstream side thereof, and has notches on an upper edge thereof opposing one surface at the downstream side of the valve head of the valve body.

[Claim 2]

The check valve according to claim 1, wherein the supporting rod of the valve body has a downstream-side end that protrudes from the sliding hole of the second housing when a fluid presses the valve body to cause the one surface at the downstream side of the valve head of the valve body to abut on the upper edge of the cylindrical body, the downstream-side end decreasing in diameter in a tapered shape.

[Claim 3]

The check valve according to claim 1 or 2, wherein a plurality of engagement grooves with respective hooks are formed at an upstream end of the first valve hole of the first housing,

and a plurality of ribs with respective engagement recessed parts are formed on an outer surface of the cylindrical body of the second housing.

[Claim 4]

A check valve comprising a first check valve according to any one of claims 1 to 3 and a second check valve according to any one of claims 1 to 3, the second check valve being connected to the first check valve by engaging the plurality of ribs formed on the second housing of the second check valve to the plurality of engagement grooves formed on the first housing of the first check valve.