

VACUUM BREAKER

Field of the Invention

[0001]

The present invention relates to a hose connection-type vacuum breaker having a check valve.

Background Art

[0002]

Japanese examined utility model application publication No. 3-19645 discloses this type of vacuum breaker.

The vacuum breaker includes a tuboid valve box having a inflow port in an upper end surface and an outflow port in a lower end surface, the outflow port having a plurality of intake holes in a periphery, and in the valve box, an annular inlet valve fixed to an inner wall at the periphery, the inlet valve having elasticity capable of shielding all of the intake holes, and a check valve detachably provided on a lower surface of an inner edge of the inlet valve, the inflow port of the valve box is attached to a spout hole of a water tap (tap of an aqueduct), and for example, a hose is coupled to the outflow port.

[0003]

In normal use, the inlet valve is immediately pushed down by a feed water pressure, and its lower surface comes into contact with an intake valve seat to shield the intake holes

and push down the check valve, thereby opening the check valve and passing water.

At this time, in the case where water flow interrupts for some reason and a primary side is brought into a negative pressure state, the check valve and the inlet valve are pushed up by a biasing force of a spring of the check valve to cover the inflow port and prevent back flow of water on a secondary side to the primary side. However, even when a foreign material is interposed between the inlet valve and the check valve, and a gap therebetween inhibits airtightness, external air continues to flow between the inlet valve and the check valve via the intake holes and therefore, fluid on the secondary side never flows backward to the primary side.

[0004]

Summary of the Invention

Problem to be Solved by the Invention

[0005]

Since the above-mentioned hose connection-type vacuum breaker is attached to the tap of the aqueduct, the entire device is light-weighted and compact. Thus, the plurality of intake holes of the outflow port located at the center of the lower end surface of the valve box each have a small diameter, and an intake amount at opening of the inlet valve is extremely small. At inhibition of airtightness of the check valve as described

above, disadvantageously, the breaker can only address a negative pressure of about -5 kPa (kilopascal) at most on the primary side.

Therefore, the present invention intends to provide a hose connection-type vacuum breaker having the check valve, which can sufficiently prevent back flow even in the case of a negative pressure exceeding -5 kPa being generated on the primary side at inhibition of airtightness of the check valve by forming intake holes capable of greatly increasing the intake amount.

Means for Solving Problem

[0006]

In consideration of the above-mentioned problem, a vacuum breaker of the present invention includes a tuboid valve box including an inflow port provided in an upper end surface, an outflow port provided in a lower end surface, and a plurality of intake holes provided on a circumference of a concentric circle of the outflow port at regular intervals; and in the valve box, a check valve detachably arranged in an anti-back flow valve seat provided around the inflow port; and an annular disc-like inlet valve detachably arranged in a concentric double circle-like intake valve seat surrounding inner ports of all of the intake holes, the inlet valve being biased in a seated direction in the intake valve seat, and an outer port

of each of the intake holes extends at a predetermined angle.

The outer port of the intake hole is extended by chamfering with a predetermined depth and a predetermined chamfering angle.

It is desirable that intake holes each have a cross section shaped like an arcuate or linear long hole capable of being surrounded by the concentric double circle-like intake valve seat. It is more preferable that the intake holes are diagonally formed toward the inflow port at an acute angle relative to an axis of the valve box.

Effect of the Invention

[0007]

In summary, the vacuum breaker of the present invention includes a tuboid valve box including an inflow port provided in an upper end surface, an outflow port provided in a lower end surface, and a plurality of intake holes provided on a circumference of a concentric circle of the outflow port at regular intervals; and in the valve box, a check valve detachably arranged in an anti-back flow valve seat provided around an inflow port; and an annular disc-like inlet valve detachably arranged in a concentric double circle-like intake valve seat surrounding inner ports of all of the intake holes, the inlet valve being biased in a seated direction in the intake valve seat. In the case where the primary side is in the

negative pressure state, and a foreign material between the check valve and the anti-back flow valve seat prevents opening of the check valve to inhibit airtightness (hereinafter referred to as inhibition of airtightness of the check valve), the inlet valve is separated from the intake valve seat by the negative pressure on the primary side, which exceeds the biasing force of an inlet valve spring, and is opened, and external air continues to flow from the intake holes to the primary side through a gap between the check valve and the anti-back flow valve seat, thereby preventing back flow of water on the secondary side to the primary side.

At inhibition of airtightness of the check valve, in the conventional product, when the negative pressure on the primary side is extremely high, back flow cannot be prevented due to lack of the intake amount. However, according to the present invention, the outer port of each intake hole extends at the predetermined angle. Thus, when air flow flowing from the outer ports into the intake holes through the inner ports passes the initial extended outer ports, a path of the air flow rapidly narrows and thus, the width of the air flow narrows. As a result, since air is compressed and increases its flowing speed, air passing a certain cross-section area for a certain time can be dramatically increased, and is blown out from the inner port as a jet flow and flows into the valve box.

Thus, since the vacuum breaker according to the present

invention can dramatically increase the intake amount through the intake holes at inhibition of airtightness of the check valve than conventional, even when a negative pressure exceeding -5 kPa occurs on the primary side as conventional, back flow can be sufficiently prevented.

[0008]

Since the outer port of the intake hole can be extended at the predetermined angle by chamfering with a predetermined depth and a predetermined chamfering angle, setting and forming of the effective extension corresponding to the shape of the outer port, which leads to an increase in the amount of air, can be achieved relatively easily.

[0009]

Since the intake holes each have a cross section shaped like an arcuate or linear long hole capable of being surrounded by the concentric double circle-like intake valve seat, the number of the intake holes can be made smaller and the cross-section area of one intake hole can be made larger than the intake holes having a circular cross section. This can reduce the resistance of air sucked by the intake holes, thereby further increasing the intake amount.

[0010]

Since the intake holes are diagonally formed toward the inflow port at an acute angle relative to the axis of the valve box, air flowing from each intake hole toward the valve box is

smoothly guided to the inflow port without any resistance and therefore, the intake amount into the valve box can be increased, which is practically effective.

Brief Description of the Drawings

[0011]

Fig. 1 is a vertical sectional view of a vacuum breaker at suspension of water feeding;

Fig. 2 is a bottom view of Fig. 1;

Fig. 3 is a sectional view taken along A-A in Fig. 1;

Fig. 4 is a vertical sectional view of the vacuum breaker at water feeding;

Fig. 5 is a vertical sectional view of the vacuum breaker at inhibition of airtightness of a check valve; and

Fig. 6 is a vertical sectional view of a vacuum breaker at occurrence of a negative pressure on a secondary side.

Preferred Embodiment of the Invention

[0012]

An embodiment of the present invention will be described with reference to figures.

A vacuum breaker according to the present invention is provided between a spout hole (not shown) of a water tap for water sprinkling and shower and a hose (not shown) to prevent back flow of water on a secondary side, and includes a tuboid

valve box 1 attached to the water tap, an in-line check valve 2 built in the valve box 1, and an inlet valve 3 for sucking external air at occurrence of a negative pressure in the valve box 1 to prevent back flow.

[0013]

In the valve box 1, an inflow port 4 formed by threading a female screw is provided at the center of an upper end surface 1a, an elongate tube-like outflow port 5 formed by threading a male screw is protrudingly provided at the center of a lower end surface 1b, and a plurality of intake holes 6 are provided on a circumference of a concentric circle of the outflow port 5 in the lower end surface 1b at regular intervals.

The lower end surface 1b, from which outer ports 6a of the intake holes 6 are exposed, is shaped like a conical surface gradually tapered from a lower end of a side surface of the valve box 1 toward a bottom end of the outflow port 5 in this figure and however, the lower end surface 1b may be a horizontal surface.

[0014]

An annular inner bottom (inner side surface of the lower end surface 1b) 1c of the valve box 1 is a horizontal surface, an annular groove 7 having a predetermined width is concavely provided on a circumference of a circle having a predetermined diameter, which is concentric with the inner bottom 1c, and inner ports 6b of the intake holes 6 are formed in the bottom

of the annular groove 7.

On the inner bottom 1c, a concentric double circle-like intake valve seat 8 surrounding the inner ports 6b of all of the intake holes 6 is provided on inner and outer circumferences of the annular groove 7, and the inlet valve 3 can be detachably attached to the valve sheet.

The annular groove 7 may be omitted, and the intake holes 6 may be provided on the horizontal inner bottom 1c.

[0015]

Each of the intake holes 6 is diagonally formed toward the inflow port 4 at an acute angle with respect to an axis 1d of the valve box 1, and the outer port 6a of each intake hole 6 extends at a predetermined angle α° relative to an axis 6c.

More specifically, each of the intake holes 6 has a cross section (cut surface vertical to the axis 6c) shaped like an arcuate long hole along the circumference of the concentric circle of the outflow port 5, and each of the outer ports 6a is chamfered with a predetermined depth d and a predetermined chamfering angle α° .

[0016]

In this embodiment, by diagonally forming each of the intake holes 6 toward the inflow port 4 at the acute angle relative to the axis 1d of the valve box 1, at opening of the inlet valve 3, air flow entering into the valve box 1 from each of the intake holes 6 is smoothly guided to the inflow port 4

without any resistance, resulting in that the intake amount in the valve box 1 can be increased. Although it is desirable to diagonally form each intake hole as described above, even when the intake hole is vertically passed through the inner bottom 1c such that the axis 6c is parallel to the axis 1d of the valve box, the intake amount can be dramatically increased than conventional by extending the intake holes 6 as described later and therefore, though not shown, the intake holes 6 each having the vertical axis 6c may be provided.

[0017]

In this embodiment, as shown in Figs. 2, 3, six arcuate long holes extending in the circumferential direction are formed as the intake holes 6, and the cross-section area of each intake hole 6 is increased, thereby reducing the resistance of sucked air. However, each of the intake holes 6 may be a concentric double circle being surrounded by the intake valve seat 8 and in this case, it is need to increase the number of holes such that the total area of the intake holes become substantially the same as that of the inner ports 6b of the arcuate intake holes 6 as illustrated in the figure, and allow the lower end surface 1b to keep the same strength as that at formation of the arcuate intake holes 6.

In this embodiment, each of the intake holes 6 has the cross section shaped like the arcuate long hole and however, each intake hole 6 may have the cross section shaped like a linear

long hole (not shown) as long as it is a concentric double circle of the intake valve seat 8 and can be surrounded by the intake valve seat 8.

[0018]

In any case, the outer port 6a of each intake hole 6 needs to extend at the predetermined angle α° .

As a result, when air flow flowing from the outer ports 6a into the intake holes 6 through the inner ports 6b passes the initial extended outer ports 6a, a path of the air flow rapidly narrows and thus, the width of the air flow narrows. As a result, since air is compressed and increases its flowing speed, the amount of air passing a certain cross-section area for a certain time can be increased, thereby dramatically increasing the intake amount flowing into the valve box 1 from the inner ports 6b.

[0019]

Depending on the shape of the intake holes 6, the outer ports 6a are not necessarily extended over the whole circumference. In summary, it is only required that the air flow entering into the intake holes 6 is compressed by the path that rapidly narrows when the air flow passes the outer ports 6a, and increases its flowing speed, thereby increasing the amount of air passing a certain cross-section area for a certain time. In this embodiment, as shown in the figures, the outer port 6a of each intake hole 6 is chamfered except for its inner arc.

When the intake holes 6 are circular, the circumference of the outer port 6a may be chamfered with the predetermined depth d and the predetermined chamfering angle α° .

[0020]

Actually, in the state where the valve box 1 including the shown intake holes 6, with all of the built-in devices such as the check valve 2 and the inlet valve 3 being removed, is mounted above an overflow surface of a water container by 200 mm (millimeters), when a pressure of -50 kPa (kilopascal) is applied from the primary side, a negative pressure break performance in which an increase in the water level in a transparent straight tube, which is connected to the outflow port 5 of the valve box 1 and has a front end port inserted into the water container, does not exceed 100 mm can be achieved.

[0021]

The check valve 2 is substantially shaped like a mushroom having a spherical top surface, and is detachably attached to an anti-back flow valve seat 9 provided in the periphery of the inflow port 4 in the valve box 1 so as to prevent back flow of water on the secondary side to the inside of the valve box 1.

The check valve 2 and the anti-back flow valve seat 9 are attached to a check valve unit 10 communicating with the inflow port 4 in the valve box 1.

[0022]

The check valve unit 10 includes a valve seat support

rings 10a inserted into an upper end of the valve box 1 such that the anti-back flow valve seat 9 is circumferentially arranged on the inner side of the inflow port 4, opposed valve axis sliding rings 10b below the valve seat support rings 10a on the same axis, and substantially L-like plate-shaped support pounders 10c coupling the valve axis sliding rings 10b to the valve seat support rings 10a in a cross shape, and a space S between the support pounders 10c forms a part of the path of the inflow port 4 and the outflow port 5 in the valve box 1.

[0023]

A valve shaft 2a protruding from a back of the check valve 2 is slidably inserted into each of the valve axis sliding rings 10b, and in the back of the check valve 2, a check valve spring 11 is interposed between a spring receiver 2b concavely provided around a bottom end of the valve shaft 2a and a flanged spring receiver 10d protruding outward from the valve axis sliding rings 10b, and the check valve spring 11 biases the check valve 2 in a valve opening direction.

[0024]

A communicating tube 13 constituting the path of the inflow port 4 and the outflow port 5 together with the space S between the support pounders 10c is interposed between the valve axis sliding ring 10b of the check valve unit 10 and retaining ring 12 protruding inwardly from appropriate position of the inner circumference of the outflow port 5.

[0025]

In the communicating tube 13, a lower end opening is inserted into the outflow port 5, a lower end surface is locked at the retaining ring 12, an upper end opening is covered with the valve axis sliding ring 10b, the valve shaft 2a passing through the valve axis sliding ring 10b is arranged at the center of the upper end opening with a gap, a vertical rectangular communicating port 13a is arranged so as to penetrate a circumferential wall of the communicating tube 13 protruding from the outflow port 5 in a cross direction, and a series of path communicating with the outflow port 5 from the communicating port 13a via the lower end opening is constituted.

[0026]

The inlet valve 3 is shaped like an annular plate that is wider than the annular groove 7 in the inner bottom 1c of the valve box, and the communicating tube 13 protruding from the outflow port 5 is inserted into a central hole of the inlet valve 3.

A spring receiver 15 that inserts the communicating tube 13 therethrough and has an inlet valve spring 14 provided between the spring receiver and a lower end of the support poulder 10c protruding from the valve axis sliding ring 10b is fixedly attached to the upper surface of the inlet valve 3, and the inlet valve spring 14 biases the inlet valve 3 in the seated direction in the intake valve seat 8 (opening direction of the

inlet valve 3).

[0027]

In the vacuum breaker thus configured, the inflow port 4 of the valve box 1 is connected to the spout hole of the water tap, a front end of the hose is inserted into a water tank and then, a bottom end of the hose is connected to the outflow port 5.

In a water-feed suspension state, as shown in Fig. 1, the check valve 2 is seated in the anti-back flow valve seat 9 by the biasing force of the check valve spring 11 to close the inflow port 4, and the inlet valve 3 is seated in the intake valve seat 8 by the biasing force of the inlet valve spring 14 to close the outer ports 6a of the intake holes 6.

[0028]

When the water tap is opened, the check valve 2 is separated from the anti-back flow valve seat 9 by the water flow pressure exceeding the biasing force of the check valve spring 11 to be opened, and water is passed from the inflow port 4 to the hose connected to the check valve through the space S between the support pounders 10c, the communicating port 13a, and the outflow port 5 (Refer to Fig. 4).

At this time, in the case where the primary side is put into the negative pressure state for some reason such as breakage of a water pipe and a large change in the pressure in the tube, since the check valve 2 is immediately seated in the

anti-back flow valve seat 9 and is closed, back flow of water on the secondary side (in the hose and in the water tank to which the front end port of the hose is inserted) is prevented, thereby the primary side is prevented from being contaminated with the water flown backward.

[0029]

In such circumstance, if a foreign material X existing between the check valve 2 and the anti-back flow valve seat 9 prevents closing of the check valve 2 to inhibit airtightness, since the inlet valve 3 is separated from the intake valve seat 8 by the negative pressure on the primary side, which exceeds the biasing force of the inlet valve spring 14 and is opened, and external air from the intake holes 6 continues to flow into the primary side through the gap between the check valve 2 and the anti-back flow valve seat 9, water on the secondary side never flows backward to the primary side (Refer to Fig. 5).

Since the outer port 6a of each intake hole 6 extends at the predetermined angle, when air flow flowing from the outer ports 6a into the intake holes 6 through the inner ports 6b passes the initial extended outer ports 6a, a path of the air flow rapidly narrows and thus, the width of the air flow narrows. As a result, since air is compressed and increases its flowing speed, the intake amount passing a certain cross-section area for a certain time can be dramatically increased, even when the primary side pressure occurring at inhibition of airtightness

of the check valve 2 is -50 kPa, back flow can be sufficiently prevented.

[0030]

In the case where, at suspension of water feeding in the normal water flow state, the pressure in the hose (secondary side) becomes negative pressure due to movement of water from the outflow port 5 toward the downstream side, the inlet valve 3 is opened by the negative pressure, and external air flows from the intake holes 6 to the secondary side through the communicating port 13a of the communicating tube 13, thereby preventing occurrence of negative pressure in the valve box 1 (Refer to Fig. 6).

CLAIMS

1. A vacuum breaker comprising:

a tuboid valve box including an inflow port provided in an upper end surface, an outflow port provided in a lower end surface, and a plurality of intake holes provided on a circumference of a concentric circle of the outflow port at regular intervals; and in the valve box,

a check valve detachably arranged in an anti-back flow valve seat provided around an inflow port; and

an annular disc-like inlet valve detachably arranged in a concentric double circle-like intake valve seat surrounding inner ports of all of the intake holes, the inlet valve being biased in a seated direction in the intake valve seat, wherein

an outer port of each of the intake holes extends at a predetermined angle.

2. The vacuum breaker according to claim 1, wherein

the outer port of the intake hole is extended by chamfering with a predetermined depth and a predetermined chamfering angle.

3. The vacuum breaker according to claim 1 or 2, wherein

the intake holes each have a cross section shaped like

an arcuate or linear long hole capable of being surrounded by the concentric double circle-like intake valve seat.

4. The vacuum breaker according to claim 1, 2 or 3, wherein the intake holes are diagonally formed toward the inflow port at an acute angle relative to an axis of the valve box.