

EXPLOSION PROOF VALVE FOR GAS CONTAINER AND ASSEMBLY
METHOD THEREOF

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to an explosion proof valve for a gas container and an assembly method thereof, and more particularly, to an explosion proof valve for a gas container, which ejects overpressure gas outward from the gas container when interior pressure of the gas container excessively rises due to external pressure applied thereto or due to an increase in temperature, thereby preventing explosion of the gas container, and an assembly method thereof.

15 Description of the Related Art

In general, a gas container is charged with injection gas, such as Liquefied Petroleum Gas (LPG), Dimethylether (DME) gas, Freon gas, carbon dioxide, nitrogen, and oxygen, for example, and is adapted to inject the contents thereof to the outside using pressure of the injection gas in a hermetically sealed state. Examples of the gas container using injection gas include a portable butane container, a spray type mosquitocide container, a hair spray container, and a portable fire extinguisher container.

Such a gas container has a risk of deformation or damage if the interior pressure of the container rises under the condition of a temperature or pressure exceeding an allowable range. For example, if the gas container is exposed to direct sunlight for a long time, contents of the gas container expand by heat of direct sunlight, which may cause an excessive increase in the interior pressure of the gas container, resulting in a risk of explosion.

Korean Patent Laid Open Publication No. 2003-0002000 discloses an overpressure safety device for a gas container, which serves to prevent deformation of or damage to the container. To this end, the disclosed overpressure safety device is adapted to outwardly discharge a part of gas received in the gas container before the interior pressure of the gas container rises beyond a predetermined value thus causing deformation of or damage to the container.

As shown in FIG. 1, the overpressure safety device disclosed in the above patent includes a nozzle body 210 which internally defines a space 212 and is supported in the center of a support member 116, upper and lower valve stems 220 and 230 mounted in the space 212 of the nozzle body 210 to inject gas charged in an aerosol container 100, a sealing member 240 configured to open or close a gas inlet port 232 of the lower valve stem 230, an overpressure safety spring 250 installed to apply force to the sealing member 240 such

that the sealing member 240 always comes into close contact with an upper end surface of the gas inlet port 232 of the lower valve stem 230, an elastic spring 252 installed to apply force to the lower valve stem 230 such that the lower valve stem 230 always comes into close contact with a lower end surface of the upper valve stem 220.

With the overpressure safety device having the above described configuration, if the interior pressure of the aerosol container 100 rises beyond a predetermined value to be close to a deformation pressure or rupture pressure of the aerosol container 100 in a state in which no external force is applied to the upper valve stem 220, the sealing member 240 is lifted by the overpressure within the aerosol container 100. Thereby, as the gas inlet port 232 of the lower valve stem 230 is opened, overpressure gas within the aerosol container 100 is discharged outward through a gas injection port 222 of the upper valve stem 220.

In the meantime, if the interior pressure of the aerosol container 100 drops thanks to discharge of the overpressure gas, and thus becomes less than elastic force of the overpressure safety spring 250, the overpressure safety spring 250 is restored by tension to return the sealing member 240 to an original position thereof, i.e. to the upper end surface of the lower valve stem 230. Thereby, as the sealing member 240 closes the gas inlet port 232 of

the lower valve stem 230, discharge of the gas is interrupted.

However, in the case of the conventional valve assembly type overpressure safety device for a gas container having the above described configuration, due to the fact that both the upper and lower valve stems are mounted in the nozzle body, the nozzle body exhibits an excessively long length and a large size of the overpressure safety spring is necessary, which results in an increase in production cost.

Moreover, since there is provided only one gas inlet port for discharge of normal gas and discharge of overpressure gas, if the gas inlet port is plugged, it is impossible to discharge overpressure gas as well as normal gas.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide an explosion proof valve for a gas container, in which a main housing containing a valve stem and a sub housing containing a safety valve are separately provided to ensure outward ejection of overpressure gas, which may eliminate a need for an increase in the size of an internal element, such as a

spring, for example.

It is another object of the present invention to provide an explosion proof valve for a gas container, in which a main gas flow path for discharge of normal gas and an overpressure gas flow path for discharge of overpressure gas are separately provided to solve problems of the related art caused when normal gas and overpressure gas are discharged through a single gas inlet port.

It is another object of the present invention to provide a safety valve in which a fixing plate is fixed on a compression spring after pushing the compression spring until elastic force of the compression spring reaches a predetermined value to ensure that the safety valve is operated at a predetermined inner pressure of the gas container, whereby overpressure gas may be discharged outward by upwardly pushing an opening/closing member below the compression spring at a constant overpressure.

It is a further object of the present invention to provide an assembly method of an explosion proof valve for a gas container, in which a main housing and a sub housing of the explosion proof valve are integrally formed to ensure simplified assembly of a valve stem assembly into the housings, which may result in reduction in production cost.

In accordance with an aspect of the present

invention, the above and other objects can be accomplished by the provision of an assembly method of an explosion proof valve for a gas container, wherein the explosion proof valve includes a main housing which consists of the elbow shaped vertical portion having an inner space and a horizontal portion extending horizontally from a lower end of the vertical portion, and a sub housing connected to the main housing via a connection rib so as to be parallel to the vertical portion, the sub housing internally defining an overpressure gas flow path for discharge of overpressure gas, a lower end of the sub housing being configured to communicate with the horizontal portion of the main housing through an overpressure gas inlet hole of the horizontal portion, the assembly method including inserting a valve stem assembly into the vertical portion of the main housing, inserting a safety valve into the sub housing, positioning the sub housing such that the center of the sub housing is located on an imaginary line that interconnects the center of a fitting recess and the center of a notch of a mounting cap, press-fitting the vertical portion of the main housing into the fixing recess of the mounting cap, and securing the mounting cap to the vertical portion by compressing an outer circumference of the fitting recess using crimping means including a plurality of pneumatically operated arms.

The insertion of the valve stem assembly may include

placing a spring below a valve stem, locating an inner circumference of an opening/closing seal over an orifice of the valve stem to complete the valve stem assembly, and inserting the resulting valve stem assembly into the main housing.

The insertion of the safety valve into the sub housing may include inserting an opening/closing member used to open or close the overpressure gas inlet hole into the sub housing and inserting a compression spring so as to be seated over the opening/closing member, inserting a compression spring fixing plate having a center hole onto the compression spring such that the compression spring fixing plate, an outer diameter of which is greater than an inner diameter of the sub housing within an allowable tolerance range, is fixedly press-fitted to an inner surface of the sub housing until elastic force of the compression spring reaches a predetermined reference value, and inserting an airtight gasket onto the sub housing.

The press-fitting of the vertical portion of the main housing into the fitting recess of the mounting cap may include inserting an upper end of the main housing into the fitting recess of the mounting cap to allow a valve stem to protrude from a through-hole of an opening/closing seal, and inserting an airtight gasket between an overpressure gas discharge hole of the mounting cap and the sub housing.

The securing of the mounting cap to the vertical portion may include compressively securing an inner circumference of the fitting recess of the mounting cap to an upper recessed portion of the vertical portion by compressing the outer circumference of the fitting recess using the crimping means.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view showing an explosion proof valve for a gas container according to the related art;

FIG. 2 is an exploded perspective view showing an explosion proof valve for a gas container according to an embodiment of the present invention;

FIG. 3 is a bottom view of a mounting cap shown in FIG. 2;

FIG. 4 is a plan view showing a main housing and a sub housing shown in FIG. 2;

FIG. 5 is a longitudinal sectional view showing an installed state of the explosion proof valve for the gas container according to the embodiment of the present invention;

FIG. 6 is a longitudinal sectional view showing discharge of gas through a main gas flow path shown in FIG. 5; and

FIG. 7 is a longitudinal sectional view showing discharge of overpressure gas through an overpressure gas flow path shown in FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, characteristic configurations of an explosion proof valve for a gas container according to exemplary embodiments of the present invention will be described in more detail with reference to the accompanying drawings.

Of the accompanying drawings, FIG. 2 is an exploded perspective view showing an explosion proof valve for a gas container according to an embodiment of the present invention, FIG. 3 is a bottom view of a mounting cap shown in FIG. 2, and FIG. 4 is a plan view showing a main housing and a sub housing shown in FIG. 2. Also, FIG. 5 is a longitudinal sectional view showing an installed state of the explosion proof valve for the gas container according to the embodiment of the present invention, FIG. 6 is a longitudinal sectional view showing discharge of gas through a main gas flow path shown in FIG. 5, and FIG. 7 is a longitudinal sectional view showing discharge of

overpressure gas through an overpressure gas flow path shown in FIG. 5.

As shown in FIGS. 2 and 5, the explosion proof valve for the gas container according to the embodiment of the present invention, designated by reference numeral 1, includes a main housing 1 secured to a lower end of a mounting cap 3, a valve stem 20 elastically supported in the main housing 10, an opening/closing seal 40 interposed between the main housing 10 and the mounting cap 3, a sub housing 50 installed laterally to the main housing 10, and a safety valve 60 installed in the sub housing 50.

As shown in FIGS. 2, 4 and 5, the aforementioned main housing 10 has an elbow shape and internally defines a main gas flow path 10a. The main housing 10 consists of a vertical portion 11 having an inner space 11a for installation of the valve stem 20, and a horizontal portion 12 extending horizontally from a lower end of the vertical portion 11.

The main gas flow path 10a is connected to the space 11a and extends throughout the horizontal portion 12 from the lower end of the vertical portion 11. An upper end of the vertical portion 11 is inserted into and fixed in a fitting recess 3a indented in the center of the lower end of the mounting cap 3.

As shown in FIG. 2, the mounting cap 3 is provided at

a peripheral portion thereof with a notch, and an overpressure gas discharge hole 3c is formed in an imaginary line that interconnects the center of the fitting recess 3a and the center of the notch. When the main housing 10 is press-fitted into the mounting cap 3, the inner diameter center of the sub housing 50 is positioned on the imaginary line that interconnects the center of the fitting recess 3a and the center of the notch.

As shown in FIG. 4, an anti-movement protrusion 14 extends horizontally from an outer circumference of the vertical portion 11 at an opposite position of the sub housing 50. The anti-movement protrusion 14 is configured to come into contact with a lower surface of the mounting cap 3 and serves to prevent the main housing 10 and the sub housing 50 from being moved up and down by a compression spring 62 of a safety valve 60 that will be described hereinafter.

A plurality of stem guide ribs 11b radially protrude from an inner surface of the vertical portion 11 defining the space 11a. The stem guide ribs 11b serve not only to guide vertical movement of the valve stem 20, but also to define a movement passage of gas introduced from the main gas flow path 10a. Also, a plurality of spring guide ribs 11c is arranged in a lower region of the space 11a so as to radially protrude from the inner surface of the vertical

portion 11. The spring guide ribs 11c serve not only to prevent lateral movement of a spring 30 that will be described hereinafter, but also to define the movement passage of gas along with the stem guide ribs 11b.

5 Here, the spring guide ribs 11c protrude inward of the space 11a by a longer length than the stem guide ribs 11b.

As shown in FIGS. 2 and 5, the aforementioned valve stem 20 consists of an upper portion penetrating the center of the lower end of the mounting cap 3, and a lower portion elastically supported in the space 11a defined in the vertical portion 11 of the main housing 10 by the spring 30. The valve stem 20 includes a gas flow path 20a formed in the upper portion thereof, an annular recessed portion 20b formed in an outer circumference thereof on a center axis, and an orifice 20c horizontally formed in the center of the recessed portion 20b.

As shown in FIGS. 2 and 5, the aforementioned opening/closing seal 40 is interposed between an upper end of the main housing 10 and the mounting cap 3 and is seated in the fitting recess 3a of the mounting cap 3. The opening/closing seal 40 has a center through-hole 40a for penetration of the valve stem 20. Thus, while introduction or discharge of gas is not carried out, an inner circumference of the opening/closing seal 40 is inserted into the recessed portion 20b of the valve stem 20 to block

the orifice 20c, thereby preventing introduction or discharge of gas.

On the other hand, when the valve stem 20 is pushed down to enable introduction or discharge of gas, the inner circumference of the opening/closing seal 40 is separated from the recessed portion 20b of the valve stem 20 to open the orifice 20c, thereby allowing gas within the gas container 2 to be discharged outward through the valve stem 20.

As shown in FIGS. 2 and 4 and FIGS. 5 and 6, the sub housing 50 and the main housing 10 are integrally formed of a synthetic resin via injection molding. At least one connection rib 70 is formed between the sub housing 50 and the main housing 10 to connect and support the two housings 50 and 10.

The sub housing 50 internally defines an overpressure gas flow path 50a, through which overpressure gas is discharged. A lower end of the sub housing 50 is integrally formed with the horizontal portion 12 such that the overpressure gas flow path 50a and the main gas flow path 10a communicate with each other. More specifically, the lower end of the sub housing 50 is integrally formed at an outer circumferential position of the horizontal portion 12 of the main housing 10. An overpressure gas inlet hole 12a is formed at the outer circumferential position of the

horizontal portion 12, such that overpressure gas in the main gas flow path 10a is introduced into the sub housing 50 through the overpressure gas inlet hole 12a.

5 An airtight raised portion 12b is formed at an exit side of the overpressure gas inlet hole 12a to come into close contact with a lower surface of an opening/closing member 61 formed of rubber that will be described hereinafter. The airtight raised portion 12b serves to prevent gas from entering the sub housing 50 at normal times
10 when the opening/closing member 61 blocks off the overpressure gas inlet hole 12a.

The sub housing 50 is installed such that an upper end thereof communicates with the overpressure gas discharge hole 3c formed at one side of the fitting recess 3a of the mounting cap 3.
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Accordingly, when the opening/closing member 61, the compression spring 62, and a compression spring fixing plate 63 are sequentially inserted into the sub housing 50, the compression spring fixing plate 63 is press fitted to prevent separation of the compression spring 62. To this
20 end, the compression spring fixing plate 63 has a greater outer diameter than an inner diameter of the sub housing 50 within an allowable tolerance range. This configuration ensures that the compression spring fixing plate 63 is no longer pushed by press fitting force thereof even if the
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compression spring 62 applies force pushing the compression spring fixing plate 63 toward the upper end of the sub housing 50.

In the meantime, a plurality of opening/closing member guide ribs 52 radially protrude from an inner surface of the sub housing 50 below the compression spring fixing plate 63. The opening/closing member guide ribs 52 serve not only to guide vertical movement of the opening/closing member 61 that will be described hereinafter, but also to define a movement passage of overpressure gas introduced from the main gas flow path 10a of the main housing 10.

As shown in FIGS. 2, 5 and 7, the aforementioned safety valve 60 is installed in the sub housing 50 and is adapted to be opened when gas pressure in the gas container 2 exceeds a preset value and to be closed when the gas pressure drops to the preset value or less.

The safety valve 60, as described above, includes the opening/closing member 61 to open or close the overpressure gas inlet hole 12a, the compression spring 62 having a lower end seated on the opening/closing member 61, and the compression spring fixing plate 63 seated on the compression spring 62, the compression spring fixing plate 63 having a center hole 63a, all of which are mounted in the sub housing 50. The safety valve 60 further includes an airtight gasket 64, a lower end of which is inserted into an upper region of

the sub housing 50, and an upper end of which comes into contact with the lower surface of the mounting cap 3. The airtight gasket 64 has a hole 64a, which communicates with the overpressure gas discharge hole 3c and the hole 63a of the compression spring fixing plate 63. The airtight gasket 64 serves to maintain air-tightness between the sub housing 50 and the mounting cap 3.

Here, the opening/closing member 61 has a flat lower surface and is provided with a fixing portion 61a protruding upward from an upper surface thereof. The lower end of the compression spring 62 is fitted around an outer circumference of the fixing portion 61a so as to be supported by the fixing portion 61a, which prevents transversal deformation of the compression spring 62 against longitudinal compressive force.

As shown in FIG. 2, a plurality of spring movement preventing bosses 61b is radially formed at an outer circumference of the fixing portion 61a of the opening/closing member 61, and is adapted to come into close contact with an inner circumference of the lower end of the compression spring 62 to prevent lateral movement of the compression spring 62.

The compression spring fixing plate 63 is kept in close contact with a lower surface of the airtight gasket 64 by the compression spring 62. The compression spring fixing

plate 63 functions to support the compression spring 62 when the opening/closing member 61 is moved upward by an increased interior gas pressure of the gas container 2, or when the opening/closing member 61 is again moved downward.

5 The airtight gasket 64 closes a gap between the sub housing 50 and the mounting cap 3 to prevent leakage of gas in the container 2 through the gap between the sub housing 50 and the mounting cap 3. The airtight gasket 64 includes a primary airtight portion 64b, which is formed at an upper
10 end thereof and serves to shield the overpressure gas discharge hole 3c, and a secondary airtight portion 64c which is formed at an outer circumference thereof so as to be inserted into a stepped fixing portion 50b formed at the upper end of the sub housing 50 and serves to allow the
15 airtight gasket 64 to come into close contact with the sub housing 50.

 The compression spring fixing plate 63 has an insertion recess 63b indented in an upper surface thereof, into which the lower end of the airtight gasket 64 is
20 inserted. The hole 63a formed in the center of the compression spring fixing plate 63 and the hole 64a formed in the center of the airtight gasket 64 are connected to each other.

 Hereinafter, operation of the explosion proof valve
25 for the gas container according to the embodiment of the

present invention having the above described configuration will be described in detail.

First, a procedure of normally discharging or blocking off gas in the gas container 2 will be described.

5 If the valve stem 20 is pushed as shown in FIG. 6 to discharge gas outward from the gas container 2, the spring 30 used to elastically support the valve stem 20 is compressed, and simultaneously the valve stem 20 is moved downward, causing the opening/closing seal 40 to open the
10 orifice 20c.

 Once the orifice 20c has been opened, the gas charged in the gas container 2 is discharged outward through the main gas flow path 10a, the space 11a defined in the main housing 10, and the orifice 20c and the gas flow path 20a
15 defined in the valve stem 20 in sequence.

 Then, if push force applied to the valve stem 20 is removed after use of the gas container 2 is completed, the valve stem 20 is returned to an original position thereof by elastic force of the spring 30, causing the opening/closing
20 seal 40 to close the orifice 20c. In this way, discharge of gas is interrupted.

 In the meantime, if gas pressure in the gas container 2 becomes greater than elastic force of the compression spring 62 of the safety valve 60 (in the case of a butane
25 gas container, within a range of 10~12 kgf/cm²) regardless

of whether the gas container 2 is mounted to, for example, a gas oven, as shown in FIG. 7, the opening/closing member 61 that has closed the overpressure gas inlet hole 12a formed in the horizontal portion 12 of the main housing 10 is lifted within the sub housing 50, and simultaneously the compression spring 62 is compressed under the influence of the gas pressure.

Accordingly, the overpressure gas is introduced into the sub housing 50 through the overpressure gas inlet hole 12a, and the introduced overpressure gas is discharged outward through the opening/closing member guide ribs 52, the hole 63a of the compression spring fixing plate 63, the hole 64a of the airtight gasket 64, and the overpressure gas discharge hole 3c of the mounting cap 3.

As such, when the gas pressure in the gas container 2 becomes equal to or less than elastic force of the compression spring 62 of the safety valve 60 as a result of outwardly discharging a part of the overpressure gas via operation of the safety valve 60, the opening/closing member 61 is moved downward by elastic force of the compression spring 62, thereby blocking off the overpressure gas inlet hole 12a.

Once the overpressure gas inlet hole 12a has been blocked off via downward movement of the opening/closing member 61, discharge of gas through the sub housing 50 is

interrupted, which prevents unnecessary discharge of gas.

With relation to the explosion proof valve for the gas container including the main housing 10 which consists of the elbow shaped vertical portion 11 having the inner space 11a and the horizontal portion 12 extending horizontally from the lower end of the vertical portion 11, and the sub housing 50 connected to the main housing 10 via the connection rib 70 so as to be parallel to the vertical portion 11, the sub housing 50 having the overpressure gas flow path 50a for discharge of overpressure gas, the lower end of the sub housing 50 being configured to communicate with the horizontal portion 12 of the main housing 10 through the overpressure gas inlet hole 12a, an assembly method of the explosion proof valve according to the present invention includes inserting a valve stem assembly into the vertical portion 11 of the main housing 10; inserting the safety valve 60 into the sub housing 50; positioning the sub housing 50 such that the center of the sub housing 50 is located on an imaginary line between the center of the fitting recess 3a and the center of the notch formed in the mounting cap 3; press-fitting the vertical portion 11 of the main housing 10 into the fixing recess 3a of the mounting cap 3; and securing the mounting cap 3 to the vertical portion 11 by compressing an outer circumference of the fitting recess 3a using crimping means including a plurality

of pneumatically operated articulated arms.

The insertion of the valve stem assembly includes placing the spring 30 below the valve stem 20, locating an inner circumference of the opening/closing seal 40 over the orifice 20c to complete the valve stem assembly, and inserting the resulting valve stem assembly into the main housing 10.

The insertion of the safety valve 60 into the sub housing 50 includes inserting the opening/closing member 61 used to open or close the overpressure gas inlet hole 12a into the sub housing 50, inserting the compression spring 62 so as to be seated over the opening/closing member 61, inserting the compression spring fixing plate 63 having the center hole 63a onto the compression spring 62 such that the compression spring fixing plate 63, the outer diameter of which is greater than the inner diameter of the sub housing 50 within an allowable tolerance range, is fixedly press-fitted to the inner surface of the sub housing 50 until elastic force of the compression spring 62 reaches a predetermined reference value, and inserting the airtight gasket 64 onto the sub housing 50.

The press-fitting of the vertical portion 11 of the main housing 10 into the fitting recess 3a of the mounting cap 3 includes inserting the upper end of the main housing 10 into the fitting recess 3a of the mounting cap 3 to allow

the valve stem 20 to protrude from the through-hole 40a of the seal 40, and inserting the airtight gasket 64 between the overpressure gas discharge hole 3c of the mounting cap 3 and the sub housing 50.

5 The securing of the mounting cap 3 to the vertical portion 11 includes compressively securing an inner circumference of the fitting recess 3a of the mounting cap 3 to an upper recessed portion (not shown) of the vertical portion 11 by compressing the outer circumference of the fitting recess 3a using crimping means including a plurality
10 of pneumatically operated articulated arms.

As is apparent from the above description, according to an explosion proof valve for a gas container, a main housing containing a valve stem and a sub housing
15 containing a safety valve are separately provided to ensure outward ejection of overpressure gas when the gas container is overheated. This may eliminate a need for an increase in the length of an overpressure proof valve or in the size of an overpressure safety spring.

20 Further, as a result of separately providing a main gas flow path for discharge of normal gas and an overpressure gas flow path for discharge of overpressure gas, it is possible to solve problems of the related art caused when normal gas and overpressure gas are discharged
25 through a single gas inlet port.

Furthermore, a safety valve according to the present invention is configured such that a fixing plate is fixed on a compression spring after pushing the compression spring until elastic force of the compression spring reaches a predetermined value to ensure that the safety valve is operated at a predetermined inner pressure of the gas container. Thereby, an opening/closing member below the compression spring is pushed upward to enable discharge of gas when the gas reaches a predetermined overpressure, which results in enhanced stability of the valve.

Although the exemplary embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. An assembly method of an explosion proof valve for
a gas container, wherein the explosion proof valve
5 comprises: a main housing which consists of the elbow shaped
vertical portion having an inner space and a horizontal
portion extending horizontally from a lower end of the
vertical portion; and a sub housing connected to the main
housing via a connection rib so as to be parallel to the
10 vertical portion, the sub housing internally defining an
overpressure gas flow path for discharge of overpressure
gas, a lower end of the sub housing being configured to
communicate with the horizontal portion of the main housing
through an overpressure gas inlet hole of the horizontal
15 portion, the assembly method comprising:

inserting a valve stem assembly into the vertical
portion of the main housing;

inserting a safety valve into the sub housing;

20 positioning the sub housing such that the center of
the sub housing is located on an imaginary line that
interconnects the center of a fitting recess and the center
of a notch of a mounting cap;

press-fitting the vertical portion of the main housing
into the fixing recess of the mounting cap; and

25 securing the mounting cap to the vertical portion by

compressing an outer circumference of the fitting recess using crimping means including a plurality of pneumatically operated arms.

wherein the insertion of the safety valve into the sub housing includes:

inserting an opening/closing member used to open or close the overpressure gas inlet hole into the sub housing and inserting a compression spring so as to be seated over the opening/closing member;

inserting a compression spring fixing plate having a center hole onto the compression spring such that the compression spring fixing plate, an outer diameter of which is greater than an inner diameter of the sub housing within all allowable tolerance range, is fixedly press-fitted to an inner surface of the sub housing until elastic force of the compression spring reaches a predetermined reference value; and

inserting an airtight gasket onto the sub housing.

2. The assembly method according to claim 1, wherein the insertion of the valve stem assembly includes:

placing a spring below a valve stem;

locating an inner circumference of an opening/closing seal over an orifice of the valve stem to complete the valve stem assembly; and

inserting the resulting valve stem assembly into the main housing.

3. The assembly method according to claim 1,
5 wherein the press-fitting of the vertical portion of the main housing into the fitting recess of the mounting cap includes:

inserting an upper end of the main housing into the fitting recess of the mounting cap to allow a valve stem to
10 protrude from a through-hole of an opening/closing seal; and

inserting an airtight gasket between an overpressure gas discharge hole of the mounting cap and the sub housing.

4. The assembly method according to claim 1,
15 wherein the securing of the mounting cap to the vertical portion includes compressively securing an inner circumference of the fitting recess of the mounting cap to an upper recessed portion of the vertical portion by compressing the outer circumference of the fitting recess
20 using the crimping means.