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(54) **DIAPHRAGM VALVE**

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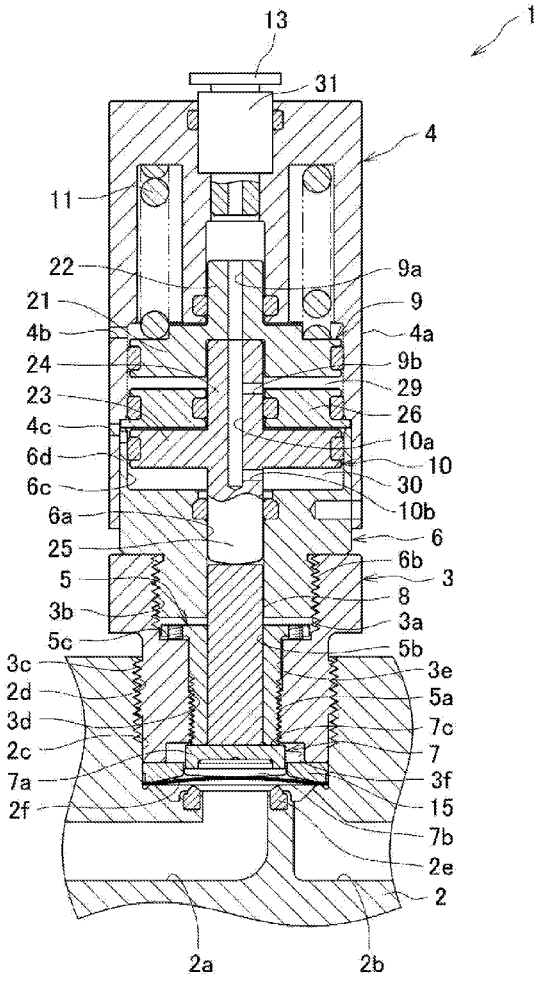
(57) **ABSTRACT**

A diaphragm valve configured to allow for adjustment of a Cv value during assembly of the diaphragm valve is provided. A valve body, a diaphragm, an actuator, a bonnet, a stem, and a diaphragm holder are provided, the bonnet includes a through hole coaxial with the stem and formed with a female thread, the cylindrical body formed with a male thread on an outer surface is screwed into the through hole in engagement with the female thread, the stem is inserted into the cylindrical body, a diaphragm side end surface of the cylindrical body protrudes from an opening surface of the through hole on the diaphragm side toward a diaphragm, a stem side end surface of the diaphragm holder comes into abutment with the diaphragm side end surface of the cylindrical body, so that a position of the abutted surfaces in an axial direction of the stem is adjusted by a degree of adjustment between the male thread and the female thread.



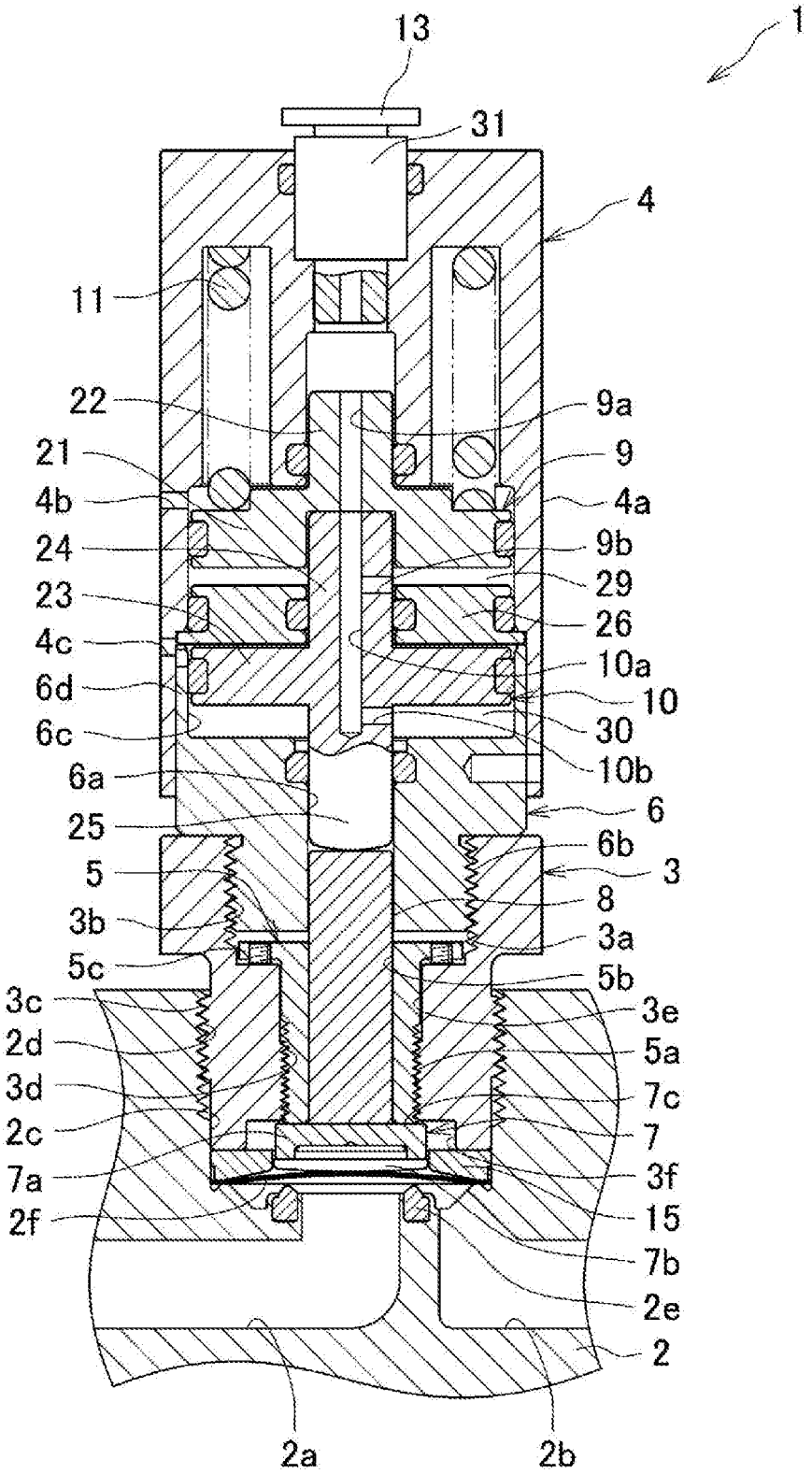

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FIG. 1

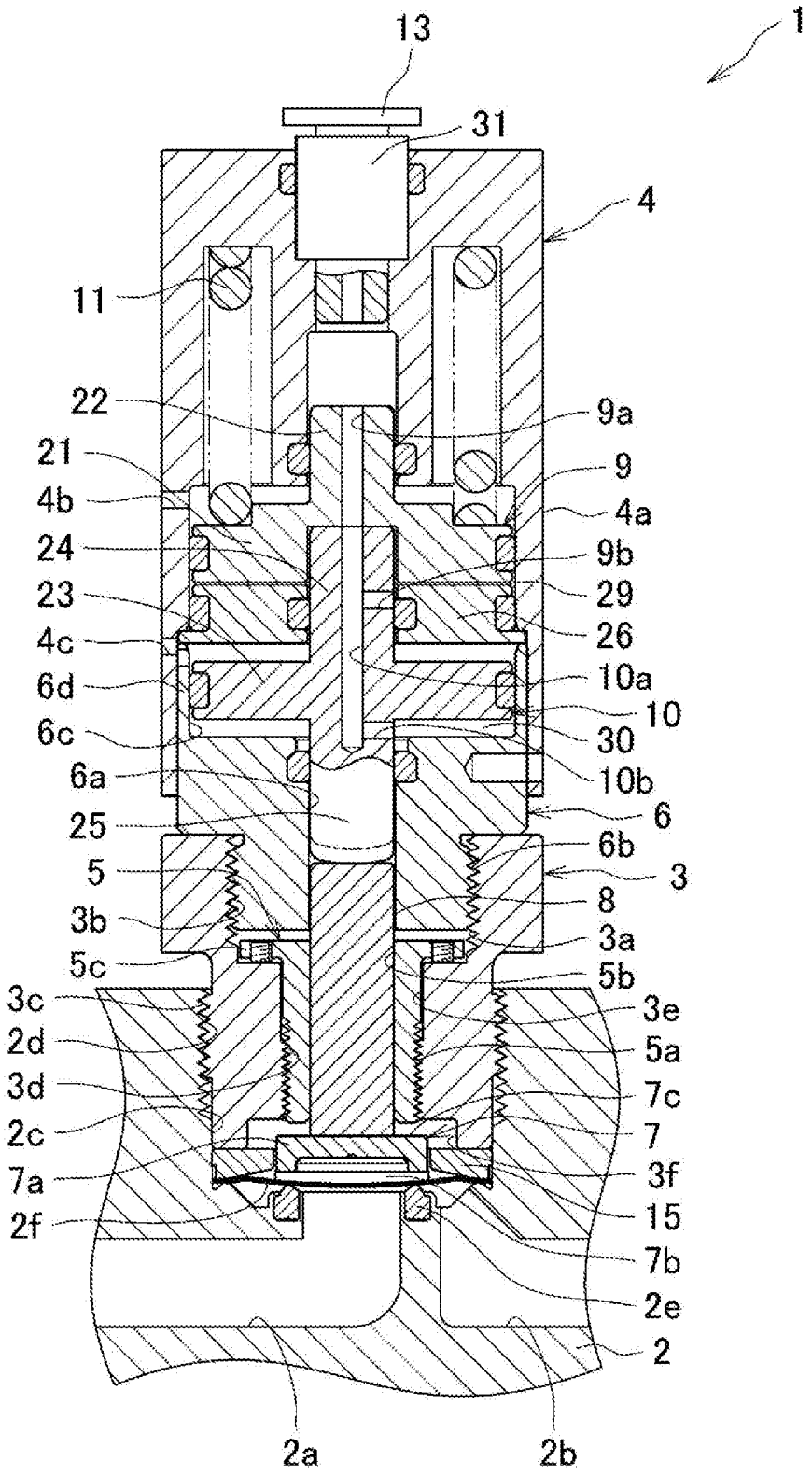
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FIG. 2

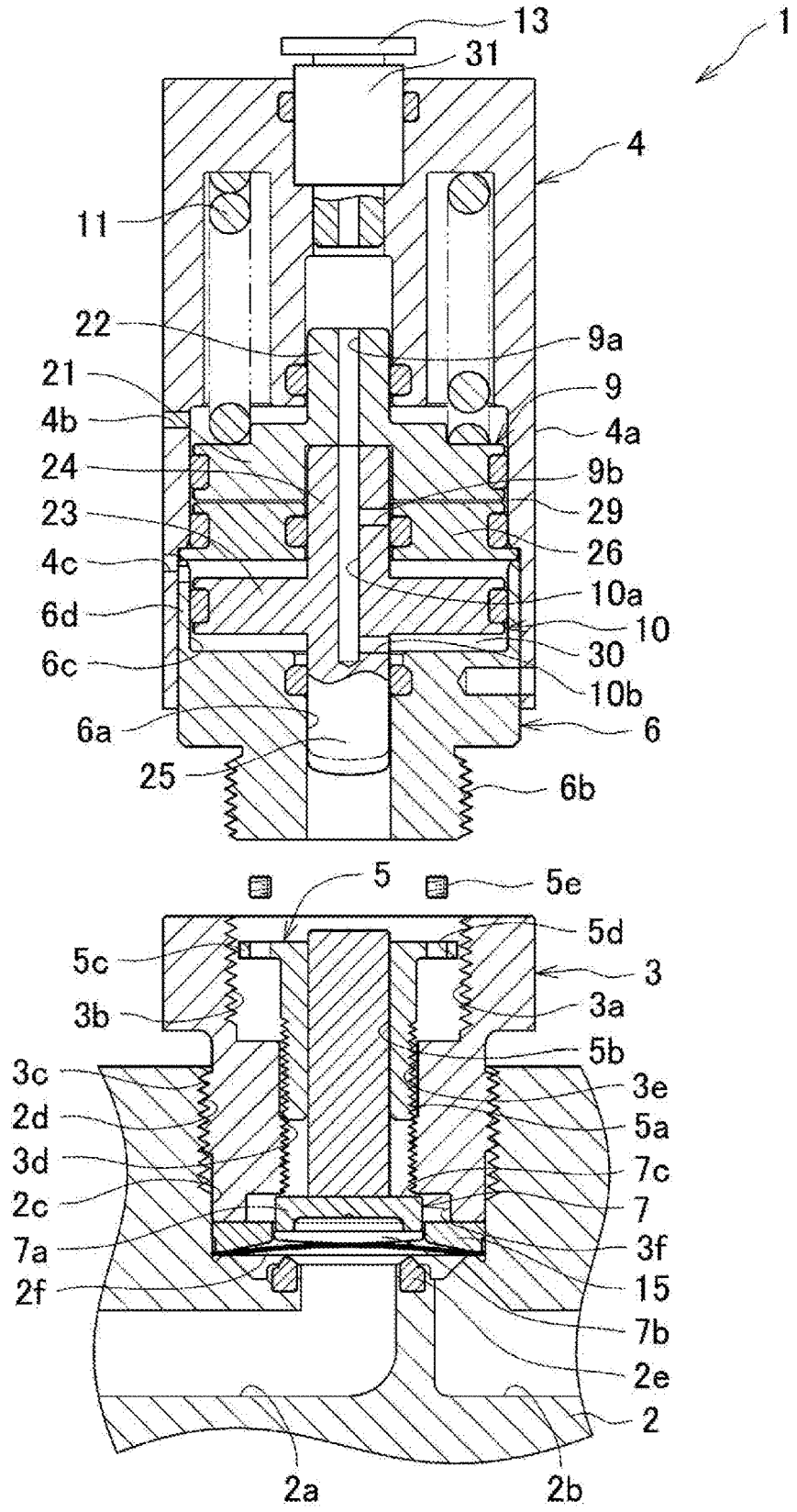
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FIG. 3

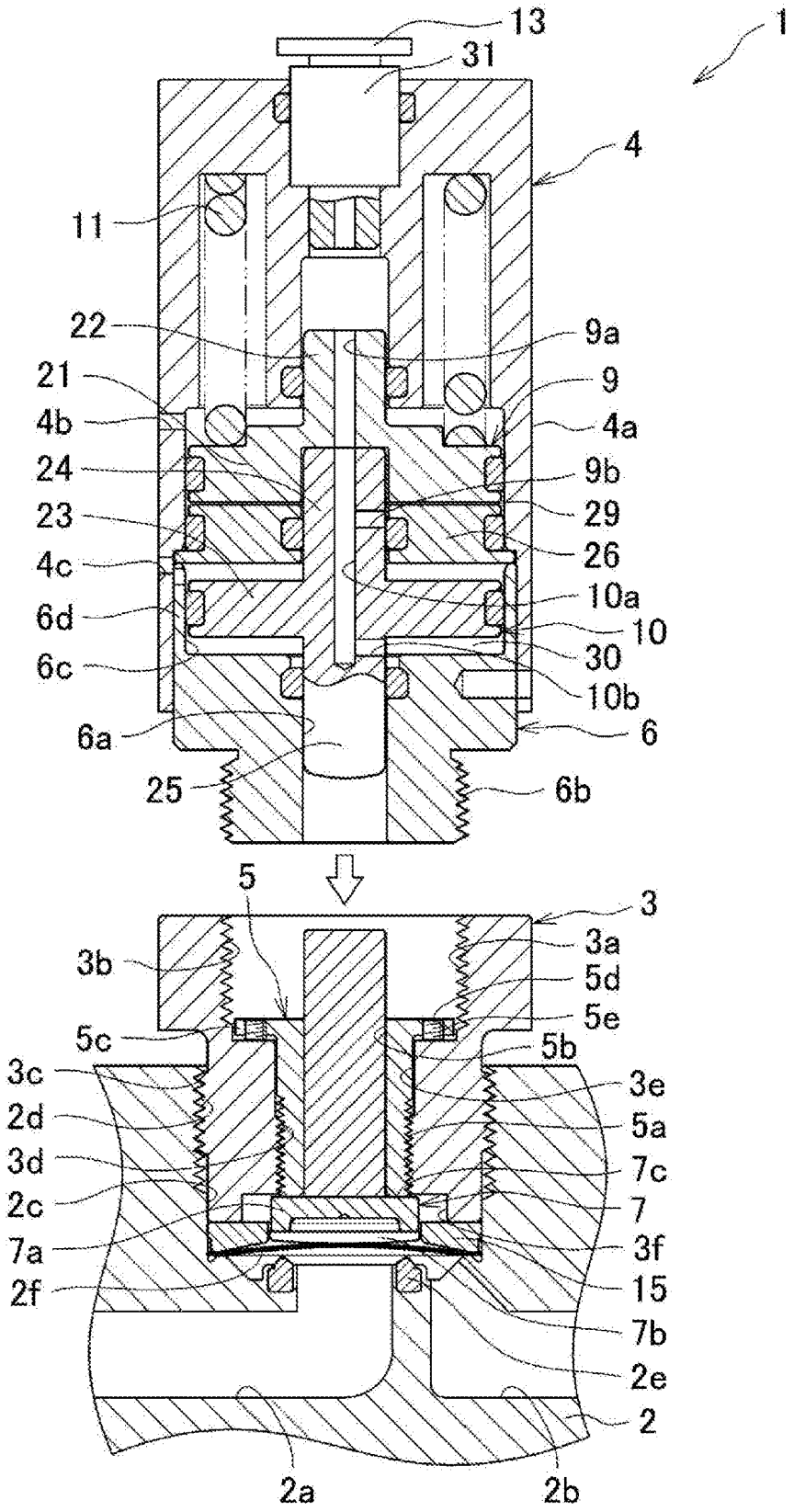
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FIG. 4

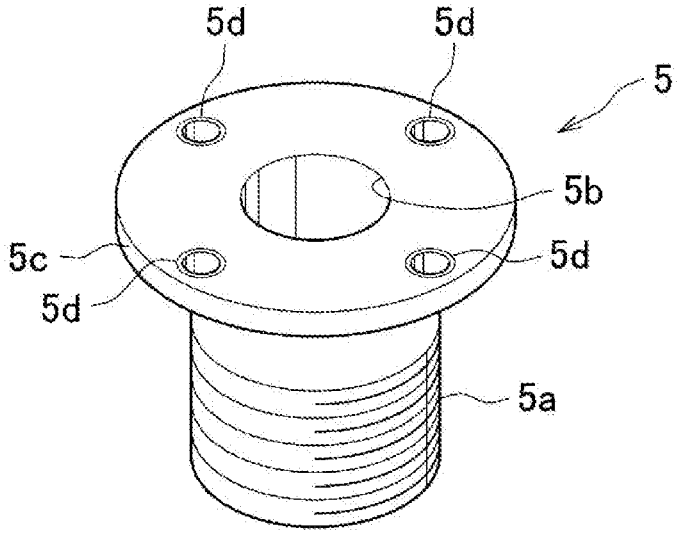

FIG. 5

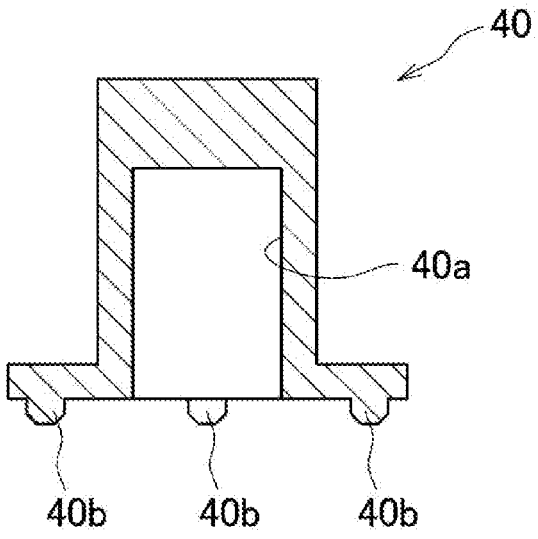

FIG. 6

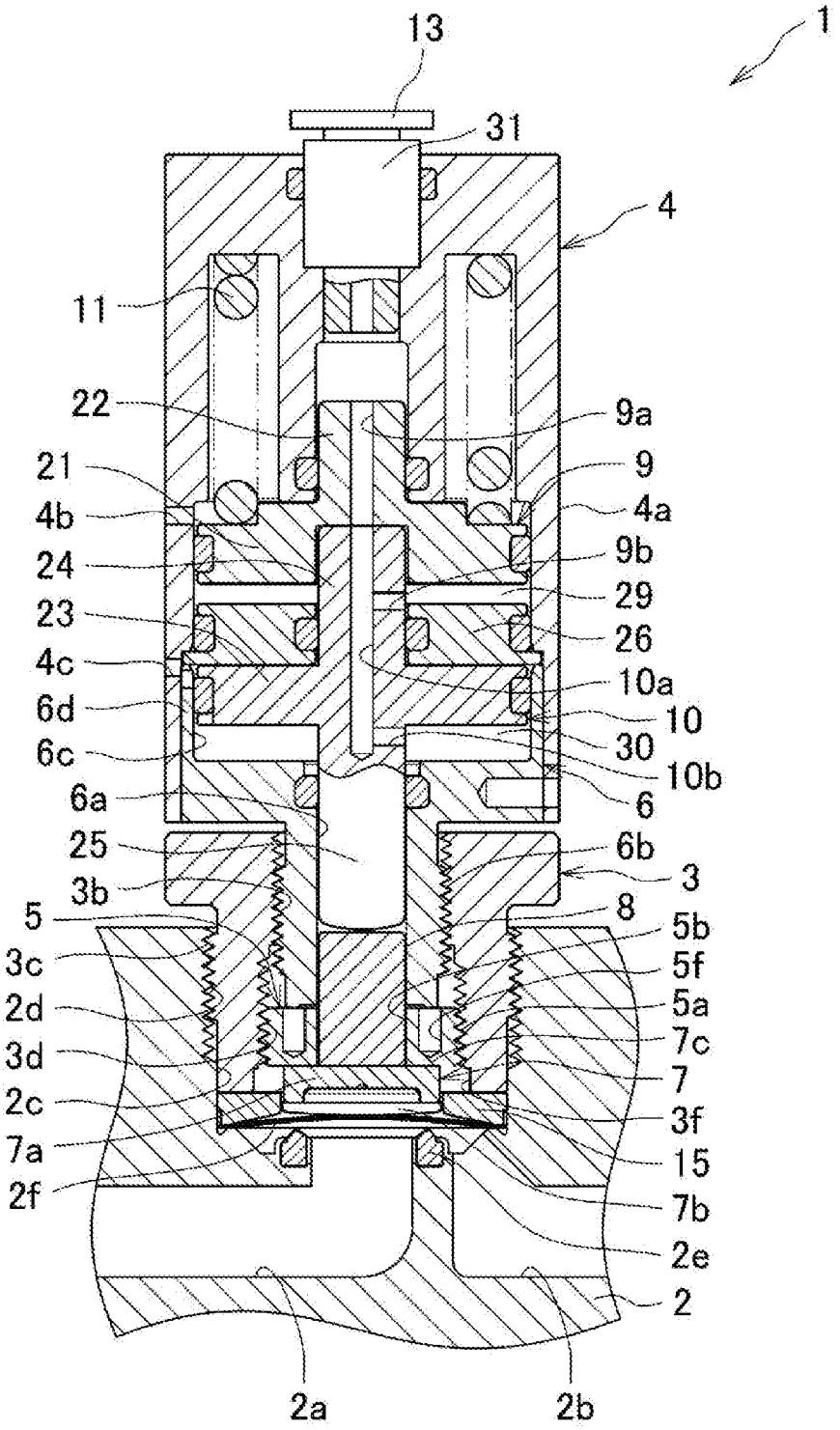
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FIG. 7

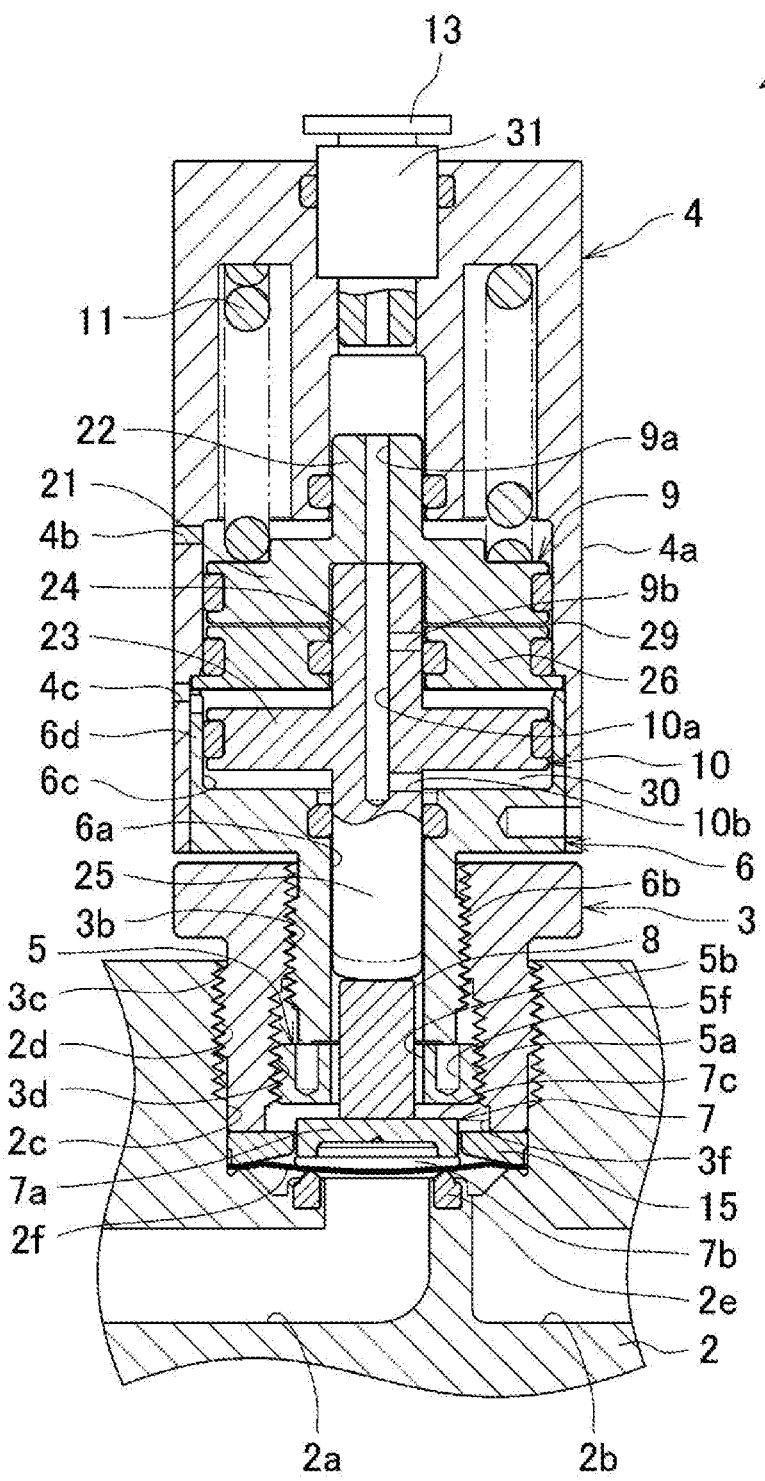
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FIG. 8

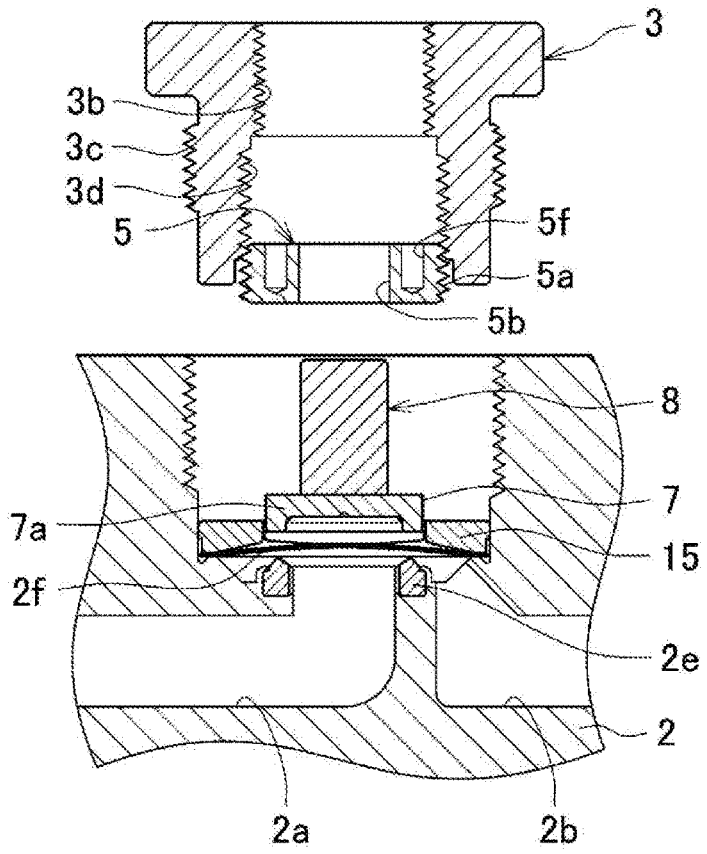
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FIG. 9

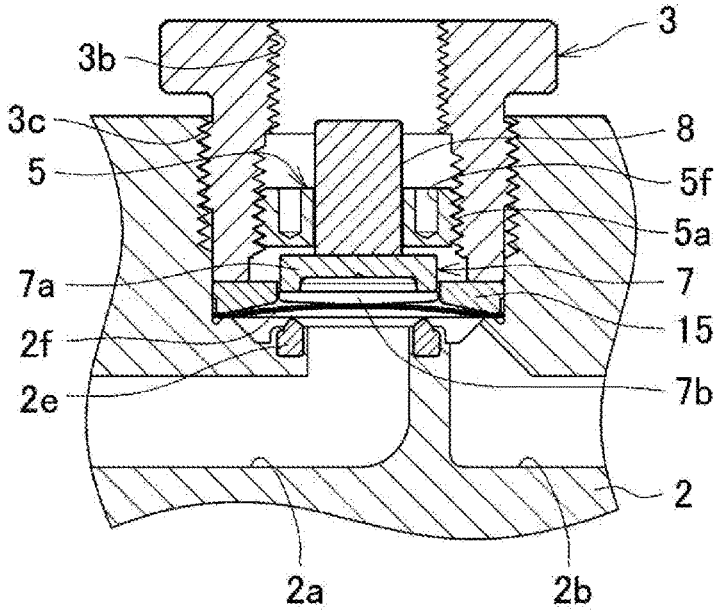
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FIG. 10

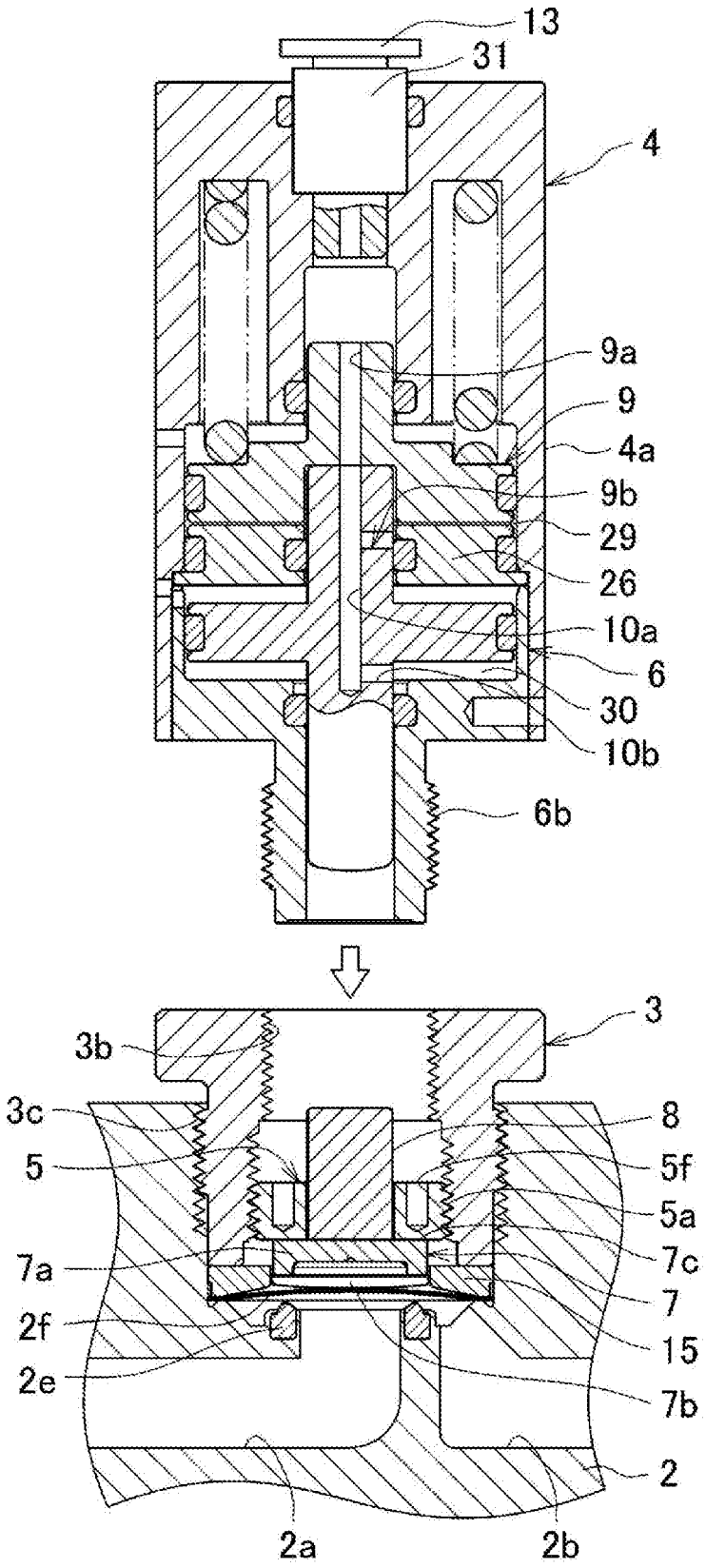
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FIG. 11

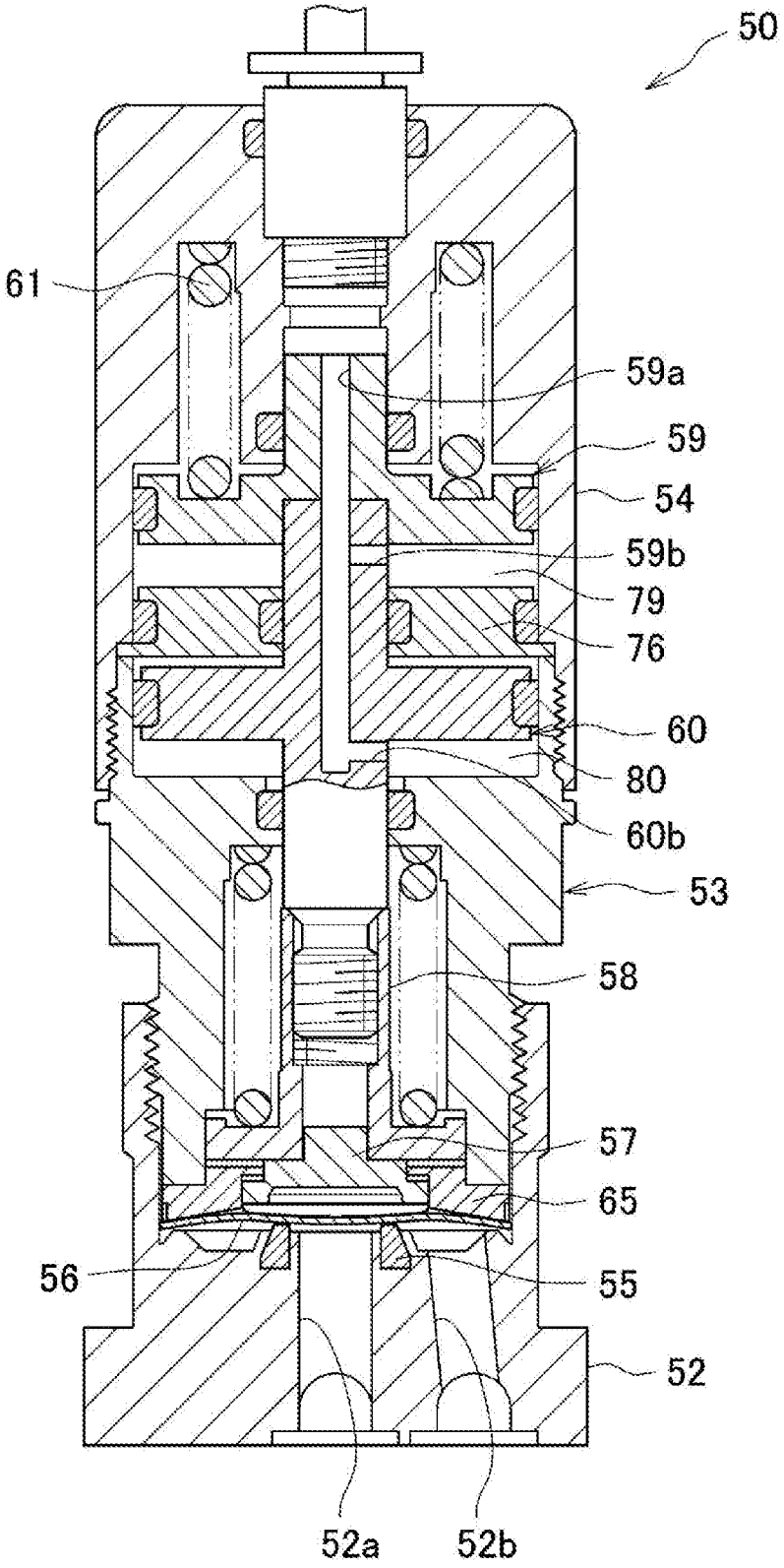

FIG. 12

DIAPHRAGM VALVE

TECHNICAL FIELD

[0001] The present invention relates to a diaphragm valve and a method of adjusting a Cv value of the diaphragm valve.

BACKGROUND ART

[0002] Valves such as ball valves are used in a number of product fields such as manufacturing apparatuses, plant apparatuses, and inspection devices as a device for controlling fluid flow.

[0003] A valve includes a valve body having a communicating part which communicates an inlet flow path and an outlet flow path, and a valve element disposed at the communicating part. The valve element is driven by a handle provided at an upper part thereof in a case of a manually operating valve and by a motor or the like in the case of an automatic valve, and a joint member referred to as a stem is interposed between the handle or the motor or the like and the valve element.

[0004] For example, an automatic diaphragm valve (see FIG. **12**) disclosed in Patent Literature 1 employs a diaphragm valve **50** which is referred to as a direct-touch type metallic diaphragm valve, including: a valve body **52** having a fluid inflow passage **52***a* and a fluid outflow passage **52***b;* a casing **54** mounted above the valve body **52** via a bonnet **53**; an annular valve seat **55** provided on a peripheral edge of the fluid inflow passage **52***a;* a metallic diaphragm **56** configured to open and close the fluid inflow passage **52***a* by being pushed against, or retracted away from, the annular valve seat **55**; a holding adapter **65** configured to secure the diaphragm **56**; a diaphragm holder **57** configured to press the diaphragm **56** downward; a stem **58** disposed in a casing **54** and configured to move the diaphragm **56** in an opening or closing direction by being moved upward or downward; upper and lower pistons **59**, **60**; a compression coil spring (biasing member) **61**; and a mechanism for introducing operation air for driving the upper and lower pistons **59**, **60**.

[0005] In order to move the stem **58** upward, the operation air is caused to act on the respective pistons **59** and **60**. For this purpose, an upper operation air introduction chamber **79** and a lower operation air introduction chamber **80** are formed below the pistons **59**, **60** respectively. The upper and lower pistons **59**, **60** are formed with an axial passage **59***a* and radial passages **59***b,* **60***b* for sending the introduced operation air to the respective operation air introduction chambers **79**, **80**. The operation air is introduced into the respective operation air introduction chambers **79**, **80**, thereby applying an upward force to the respective pistons **59**, **60**. A counter plate **76** is interposed between the pistons **59** and **60**.

CITATION LIST

Patent Literature

[0006] PTL 1: JP-A-2016-161022

SUMMARY OF INVENTION

Technical Problem

[0007] When the diaphragm holder **57** moves to an uppermost position and thus does not press the diaphragm **56**, a fully opened state is achieved. An amount of fluid flowing in this state relates to a capacitive coefficient of the valve, which is referred to as a Cv value. According to JIS standard, the Cv value is a flow rate value indicating a flow rate of freshwater at a temperature of 60 degrees F. flowing through the valve with a pressure difference of 1 Psi within a specific operation range, which is expressed by US gallon/min. The Cv value is proportional to an opening area where the fluid flows with the valve fully opened, and thus an adequate combination of components is required in order to minimize variation of the Cv value among the same products.

[0008] Components which may affect the opening area where the fluid flows with the valve fully opened in the diaphragm valve **50** of the related art illustrated in FIG. **12** include, for example, the valve body **52**, the annular valve seat **55**, the diaphragm **56**, the holding adapter **65**, and the diaphragm holder **57**, and therefore, manufacturing a diaphragm valve with least variation in Cv value with variations in dimensions of these components taken into consideration is significantly time-consuming and troublesome work. In addition, in order to adjust the Cv value, since the Cv value cannot be measured unless a fluid is actually flowed, it seems to be impossible to incorporate a step of positively adjusting the Cv value in a step of assembling a diaphragm valve. Therefore, a method of assembling the components with dimensions of components taken into consideration has been employed for a long time in the related art. In addition, when an actuator in the casing **54** encounters a failure, the bonnet **53** as a whole needs to be removed from the valve body **52**, which results in exposure of the fluid flowing in a flow path to the outside air.

[0009] It is an object of the present invention to provide a diaphragm valve configured to allow for adjustment of a Cv value during assembly of the diaphragm valve, and a method of adjusting the Cv value.

Solution to Problem

[0010] The present invention (1) provides a diaphragm valve including: a valve body provided with a fluid flow path; a diaphragm configured to open and close the fluid flow path; an actuator configured to press the diaphragm; a bonnet interposed between the valve body and a casing of the actuator; a stem moved by the actuator; and a diaphragm holder disposed between the stem and the diaphragm and including an outer edge having a diameter larger than an outer diameter of the stem, in which the bonnet includes a through hole coaxial with the stem and formed with a female thread, the through hole accommodates a cylindrical body screwed therein, the cylindrical body having a male thread formed on an outer surface thereof for engaging the female thread, the stem is inserted into the cylindrical body, the cylindrical body has a diaphragm-side end surface protruding from a diagram-side opening surface of the through hole toward the diaphragm, a stem-side end surface of the diaphragm holder at an outer edge thereof and the diaphragm-side end surface of the cylindrical body are in abutment with each other, the position of the abutted surfaces in a direction of a stem axis are allowed to be adjusted by a degree of engagement between the male thread and the female thread.

[0011] In the present invention (1), the cylindrical body is provided as a Cv value adjustment member which is not provided on the diaphragm valve in the related art. The cylindrical body is formed with the male thread, which is to be engaged with the female thread formed in an interior of

the bonnet, on an outer peripheral surface. The stem is inserted into the cylindrical body, and the diaphragm holder is disposed between the stem and the diaphragm. Once the bonnet is secured to the valve body, even when a fluid is flowed therethrough, the fluid is prevented from leaking out. Since the diaphragm-side end surface of the cylindrical body and the stem-side end surface of the diaphragm holder at the outer edge thereof are brought into abutment with each other, and the position of a plane of abutment may be adjusted by adjusting the degree of engagement between the male thread and the female thread, precise adjustment of the Cv value is achieved by assembling the diaphragm valve in association with such adjustment.

[0012] The present invention (2) is the valve of the present invention (1) characterized in that the bonnet is provided with a recess on an upper part thereof; the cylindrical body is provided at an upper part thereof with a cylindrical body flange having a diameter larger than the male thread and smaller than an inner diameter of the recess, and the cylindrical body flange is secured to a bottom surface of the recess by screw means.

[0013] As the Cv value is determined by the degree of engagement between the male thread and the female thread, if the cylindrical body rotates with respect to the bonnet, the Cv value changes correspondingly. In order to avoid such an event, the cylindrical body flange is secured to the bottom surface of the recess by the screw means to prevent an occurrence of changes in the Cv value after assembly.

[0014] The present invention (3) is the diaphragm valve according to the present invention (1), characterized in that the actuator is secured to the bonnet or the valve body with a diaphragm-side end surface of the actuator pressing an actuator-side end surface of the cylindrical body.

[0015] In the same manner as the present invention (2), the present invention (3) is devised to prevent changes in the Cv value after assembly of the diaphragm valve. With the configuration in which the diaphragm-side end surface of the actuator presses the actuator-side end surface of the cylindrical body to cause the actuator to be secured to the bonnet or the valve body, the occurrence of changes in the Cv value after assembly may be prevented.

[0016] The present invention (4) is a method of adjusting a Cv value of a diaphragm valve including: a step of placing a diaphragm configured to open and close a fluid flow path on a valve body provided with the fluid flow path, placing a holding adapter configured to press and hold an outer peripheral edge of the diaphragm on a valve body side on the diaphragm, and placing a stem configured to deform the diaphragm in an opening or closing direction on the diaphragm, the stem including, at a lower end portion thereof, a diaphragm holder having an outer edge with a diameter larger than an outer diameter of the stem; a step of screwing a male thread formed on an outer peripheral surface of a cylindrical-shaped cylindrical body into engagement with a female thread formed on an inner peripheral surface of the cylindrical-shaped bonnet to accommodate the cylindrical body in the interior of the bonnet; a step of inserting the stem in the cylindrical body, attaching the bonnet in which the cylindrical body is accommodated to the valve body, and pressing the holding adapter with a diaphragm-side end surface of the bonnet to secure the diaphragm to the valve body; a step of flowing a fluid into the fluid flow path and measure a Cv value; a step of bringing the diaphragm-side end surface of the cylindrical body into abutment with the stem side end surface of the diaphragm holder at the outer edge thereof; a step of repeating changing a degree of engagement between the male thread and the female thread, flowing a fluid through the fluid flow path, and measuring the Cv value until a target Cv value is achieved; and a step of securing the cylindrical body to the bonnet after the Cv value is adjusted to the target Cv value of the diaphragm valve.

[0017] A lower end surface of the bonnet presses an upper end surface of the holding adapter, so that the diaphragm is secured to the valve body. Accordingly, even when a fluid is flowed through the fluid flow path, the fluid is prevented from leaking out.

[0018] Before the diaphragm is secured to the valve body, the stem having the diaphragm holder at the lower end portion thereof is placed on the diaphragm without pressing the diaphragm, the stem is inserted through the interior of the cylindrical body, and the cylindrical body is accommodated in the interior of the bonnet by means of engagement or the like.

[0019] In a state in which hermeticity in the flow path is maintained, a fluid is flowed in a fully opened state, which corresponds to a state in which no pressing force is applied to the diaphragm, and the Cv value is measured. The Cv value at the initial measurement is preferably set to be slightly larger than the target Cv value. After the diaphragm-side end surface of the cylindrical body is brought into abutment with a stem-side end surface of the holding adapter, the degree of engagement between the female thread formed on the inner peripheral surface of the bonnet and the male thread formed on the outer peripheral surface of the cylindrical-shaped cylindrical body is adjusted in view of the result of measurement of the Cv value. When the position of a plane of abutment between the diaphragm-side end surface of the cylindrical body and the stem-side end surface of the diaphragm holder is moved toward the diaphragm, the position of the contact surface of the diaphragm holder with the diaphragm is lowered and thus the diaphragm is deflected, so that the Cv value is reduced. Repeating these procedures may results in the Cv value closer to the target value.

Advantageous Effect of Invention

[0020] According to the diaphragm valve of the present invention, the Cv value closer to the target Cv value is achieved without selecting members during assembly, and manufacture of diaphragm valve with less variation in the Cv value is achieved. In addition, even when the actuator encounters a failure, for example, removal of the bonnet from the valve body is not necessary, and thus the fluid in the flow path is not exposed to the outside air.

BRIEF DESCRIPTION OF DRAWINGS

[0021] FIG. **1** illustrates a diaphragm valve of Example 1 according to the present invention in a fully opened state.

[0022] FIG. **2** illustrates the diaphragm valve of Example 1 in a fully closed state.

[0023] FIG. **3** illustrates a state before a cylindrical body is set in a course of assembly of the diaphragm valve of Example 1.

[0024] FIG. **4** illustrates a state after the cylindrical body is set in the course of assembly of the diaphragm valve of Example 1.

[0025] FIG. **5** is a perspective view of the cylindrical body used in the diaphragm valve of Example 1.

[0026] FIG. **6** is a cross-sectional view of an adjustment jig for rotating the cylindrical body.

[0027] FIG. **7** illustrates a diaphragm valve of Example 2 according to the present invention in a fully opened state.

[0028] FIG. **8** illustrates the diaphragm valve of Example 2 in a fully closed state.

[0029] FIG. **9** illustrates a state before a stem is inserted into a cylindrical body in a course of assembly of the diaphragm valve of Example 2.

[0030] FIG. **10** illustrates a state after a holding adapter is secured to a valve body and the stem is inserted into the cylindrical body in the course of assembly of the diaphragm valve of Example 2.

[0031] FIG. **11** illustrates a state before a Cv value of the diaphragm valve of Example 2 is adjusted and an actuator is connected to a bonnet.

[0032] FIG. **12** is a cross-sectional view of a diaphragm valve of the related art disclosed in Patent Literature 1.

DESCRIPTION OF EMBODIMENTS

[0033] Referring now to the drawings, a detailed description of preferable examples of the present invention will be given below illustratively. Note that shapes, relative layouts, and the like of components described in these examples are illustrative only without limiting the scope of the invention unless otherwise specifically noted. Likewise, directions of the members may be referred to as up(per), low(er), left and right depending on the directions on the drawings for the sake of convenience, these terms are not intended to limit the scope of the present invention.

Embodiment 1

[0034] FIG. **1** illustrates a fully opened state of a diaphragm valve of Example 1 according to the present invention. The diaphragm valve includes three components; a valve body **2**, an actuator **4**, and a bonnet **3** provided therebetween.

[0035] The diaphragm valve **1** includes a valve body **2** including a fluid inflow passage **2***a* and a fluid outflow passage **2***b;* an actuator **4** mounted above the valve body **2** via a bonnet **3**; an annular valve seat **2***e* provided on a peripheral edge of a fluid inflow passage **2***a;* a metallic diaphragm **2***f* configured to open and close the fluid flow path by being pushed against, or retracted away from, the annular valve seat **2***e;* a diaphragm holder **7** configured to press the diaphragm **2***f* downward; a compression coil spring (biasing member) **11**; and a stem **8** configured to be moved downward by a pressing force of the compression coil spring **11** and moved upward by supplying a working fluid (hereinafter simply referred to as "operation air") to the actuator **4** to move the diaphragm **2***f* in opening or closing direction; upper and lower pistons **9**, **10**; and drive means **13** configured to drive the upper and lower pistons **9**,**10**. Note that the fluid inflow passage **2***a* and the fluid outflow passage **2***b* may work in an opposite way in terms of inflow and outflow.

[0036] The diaphragm **2***f* has an upwardly protruding arcuate shape which is formed into a spherical shell shape in a natural state. The diaphragm **2***f* is formed of, for example, a nickel alloy sheet and is formed into a spherical shell shape by cutting out the plate into a circular shape and making a center portion swelled upward. The diaphragm **2***f* may be formed of a stainless steel sheet or of a laminated body made of a stainless steel sheet and nickel-cobalt alloy sheet.

[0037] A holding adapter **15** is disposed between a lower end surface of the bonnet **3** and a bottom surface of the valve body recess **2***c* of the valve body **2**, and an outer peripheral edge of the diaphragm **2***f* is retained between the holding adapter **15** and the bottom surface of the valve body recess **2***c* of the valve body **2** and is secured by screwing the bonnet **3** inward.

[0038] The upper piston **9** includes a disc-shaped piston body **21** and a protruding shaft portion **22** extending upward from an upper surface of a center portion of the piston body **21**. The lower piston **10** includes a disc-shaped piston body **23**, an upper protruding shaft portion **24** extending upward from an upper surface of a center portion of the piston body **23**, and a lower protruding shaft portion **25** extending downward from a lower surface of the center portion of the piston body **23**.

[0039] A counter plate **26** is fixed so as to be positioned between the upper piston **9** and the lower piston **10**, whereby spaces of movement of the pistons **9**, **10** are defined above and below the counter plate **26**, respectively.

[0040] An upper end portion of the upper protruding shaft portion **24** of the lower piston **10** is fitted into a recess provided on a lower surface of the piston body **21** of the upper piston **9**. A compression coil spring **11** is provided so as to urge the upper piston **9** downward, whereby the upper and lower pistons **9**, **10** are moved integrally upward and downward.

[0041] The actuator **4** is principally accommodated in an interior of a casing **4***a* and is connected to the drive means **13** via a one-touch joint **31**. The drive means **13** is configured to cause the operation air to act on the respective pistons **9**, **10** for moving the stem **8** upward, and the upper operation air introduction chamber **29** and a lower operation air introduction chamber **30** therefor are formed below the respective pistons **9**, **10**. The upper and lower pistons **9**, **10** are formed with axial passages **9***a,* **10***b* and radial passages **9***b,* **10***b* for sending operation air introduced via the one-touch joint **31** to the respective operation air introduction chambers **29**, **30**. The operation air is introduced into the respective operation air introduction chambers **29**, **30**, thereby applying an upward force to the respective pistons **9**, **10**. In addition, exhaust ports **4***b,* **4***c* for releasing air in the respective operation air introduction chambers **29**, **30** are provided in the casing **4***a*.

[0042] In a state in which the operation air is not introduced into the respective operation air introduction chambers **29**, **30**, the stem **8** is in the closed position (see FIG. **2**) due to a biasing force of the compression coil spring **11**, while when the operating air is introduced into the respective operation air introduction chambers **29**, **30**, the stem **8** is moved upward against the biasing force of the compression coil spring **11**, so that an opened state, in which the diaphragm holder **7** is moved upward and the diaphragm **2***f* is deformed into a protruding shape, is achieved. FIG. **1** illustrates a fully opened state.

[0043] A joint member **6** is provided at a lower part of the actuator **4** as a part of the actuator **4** and is formed at an upper part thereof with a joint member recess **6***c* surrounded by a joint member upright wall **6***d,* and the piston body **23** is accommodated in the joint member recess **6***c*. The joint member **6** is formed with a joint member through hole **6***a* at a center thereof, and the lower protruding shaft portion **25**

and the stem **8** are inserted into the joint member through hole **6***a* from above and from below, respectively, and a lower end of the lower protruding shaft portion **25** and an upper end of the stem **8** are capable of coming into and out of contact with each other in the joint member through hole **6***a*. The actuator **4** and the joint member **6** are secured by forming threads on an outer peripheral surface of the joint member upright wall **6***d* and an inner peripheral surface of a lower part of the actuator **4**, screwing these threads into engagement with each other, and then fastening with fastening member such as a bolt from a side surface, or applying securing means such as welding.

[0044] The actuator **4** described above has a configuration of a so-called normally-closed type, which presses the diaphragm **2***f* to close the flow path when the operation air is not introduced. However, an actuator of a so-called normally-open type, which has the compression coil spring **11** on the diaphragm **2***f* side, presses the piston **23** away from the diaphragm to prevent the diaphragm **2***f* from being pressed when the operation air is not introduced, is also applicable.

[0045] A joint member male thread **6***b* is formed on a lower outer peripheral surface of the joint member **6**, and the joint member male thread **6***b* is screwed into engagement with a bonnet upper female thread **3***b* formed on a side surface of a bonnet upper recess **3***a* on an upper part of the bonnet **3**, so that the actuator **4** and the bonnet **3** are connected. By screwing a bonnet male thread **3***c* formed on the outer peripheral surface of the bonnet **3** and the valve body female thread **2***d* into engagement, the bonnet **3** is connected to the valve body **2**.

[0046] The lower end of the stem **8** is provided with the diaphragm holder **7** having a diameter larger than the outer diameter of the stem **8**, and an abutting part **7***b* is provided at a lower end portion of the diaphragm holder **7**. The amount of upward movement of the stem **8** and the Cv value have a correlative relationship, and thus adjustment of the amount of upward movement of the stem is required for achieving a required Cv value.

[0047] The bonnet **3** is formed with a bonnet through hole **3***e* at a center thereof, and the cylindrical body **5** is inserted into the through hole **3***e*. The cylindrical body **5** is a Cv value adjusting member, which is the most important component of the present invention. A cylindrical body male thread **5***a* is formed on a lower outer periphery of the cylindrical body **5**, and the cylindrical body male thread **5***a* is screwed into engagement with the bonnet lower female thread **3***d*.

[0048] The cylindrical body **5** is formed with a cylindrical through hole **5***b*, and the stem **8** is inserted into the interior of the cylindrical through hole **5***b*. The diaphragm holder **7** is attached to the lower end portion of the stem **8**. The diaphragm holder **7** may be formed integrally with the stem **8**. The diaphragm holder **7** is partly accommodated in a bonnet lower recess **3***f*. An outer edge portion **7***a* of the diaphragm holder **7** is in abutment with the lower end surface of the cylindrical body **5** at an upper surface **7***c* of the outer edge portion thereof. Accordingly, the Cv value can be adjusted by a vertical position of the abutted surfaces.

[0049] A cylindrical body flange **5***c* is formed on an upper part of the cylindrical body **5**, and the cylindrical body flange **5***c* is secured to a bottom surface of the bonnet upper recess **3***a* by screw means (see FIGS. **3**, **5**).

[0050] FIG. **2** illustrates a state in which the diaphragm valve of Example 1 illustrated in FIG. **1** is changed from the fully opened state to the fully closed state. From FIG. **2** onward, the same description as FIG. **1** will be omitted. Air is released from the operation air introduction chambers **29**, **30**, and the pistons **9**, **10** are pressed downward by a biasing force by the compression coil spring **11**, so that the stem **8** is also pressed downward, and the diaphragm **2***f* is deformed as illustrated in FIG. **2** and comes into abutment with the annular valve seat **2***e* to achieve the fully closed state.

[0051] FIG. **3** illustrates a state before a cylindrical body **5** is set in the course of assembly of the diaphragm valve **1** of Example 1. Illustrated are female threads **5***d* formed in the cylindrical body flange **5***c*, and setscrews **5***e* to engage the female thread **5***d*. The state illustrated in FIG. **3**, that is, in a state in which no pressing force is loaded on the diaphragm **2***f*, a fluid is flowed from the fluid inflow passage **2***a* to the fluid outflow passage **2***b* and the Cv value is measured. In this state, for example, when a desired Cv value required for shipping is 3.0, dimensions of the component are adjusted to achieve a value slightly larger than that value, for example, on the order of 3.2.

[0052] Next, the cylindrical body **5** is set as illustrated in FIG. **4**, the screws are adjusted so that the lower end surface of the cylindrical body **4** moves the outer edge upper surface **7***c*, which corresponds to an upper end surface of the outer edge **7***a* of the diaphragm holder **7**, downward, and then a fluid is flowed to measure the Cv value. By achieving a target value 3.0, the adjustment is completed. When the value is assumed to be 3.1, the adjustment is performed again and then the Cv value is measured. It is also possible to adjust the Cv value to a desired value by rotationally moving the cylindrical body **5** little by little in a state in which the fluid is flowing. In this manner, the Cv value can be adjusted to fall within an allowable range of a target value. After the adjustment of the Cv value, the setscrews **5***e* may be screwed into engagement with the female threads **5***d* to secure the cylindrical body flange **5***c* to the bottom surface of the bonnet upper recess **3***a*, thereby preventing the cylindrical body **5** from rotating after assembly. When the setscrews **5***e* are screwed in, a force is applied to the cylindrical body **5** to a direction opposite from the diaphragm side, so that the Cv value is slightly lowered. Therefore, in the adjustment described above, it is preferable to take changes in the Cv value generated when the setscrews **5***e* is secured by screw engagement into consideration in adjustment. Note that the female threads **5***d* are formed at four positions in the cylindrical body flange **5***c* at regular intervals as illustrated in the drawings but may be formed at two positions.

[0053] FIG. **5** illustrates a perspective view of the cylindrical body **5** used in the diaphragm valve of Example 1.

[0054] FIG. **6** illustrates a cross-sectional view of an adjustment jig **40** for rotating the cylindrical body **5** to adjust the Cv value. The adjustment jig **40** is formed with an adjustment jig recess **40***a* in which an upper part of the stem **8** is inserted, and four protrusions **40***b* on a lower end surface. The protrusions **40** are inserted into the female threads **5***d* and caught therein, so that the cylindrical body **5** can be rotated.

Embodiment 2

[0055] FIG. **7** illustrates a fully-opened state of a diaphragm valve of Example 2 according to the present invention. A point different from Example 1 in FIG. **1** is a shape of the cylindrical body **5** and how to fix the cylindrical body

5. In this example, the cylindrical body **5** has no cylindrical body flange **5***c*, which was present in Example 1. The upper surface of the cylindrical body **5** is pressed by the lower end surface of the joint member **6**, and thus the rotation is prevented. In this example, the actuator **4** is secured by the lower end surface of the joint member **6**, which is formed integrally with the actuator **4**, coming into abutment with the cylindrical body **5**. However, in Example 1, the lower end surface of the joint member **6** is secured by the actuator **4** in abutment with the upper end surface of the bonnet **3**, but not in abutment with the cylindrical body **5**. In addition, in this example, the cylindrical body **5** is prevented from rotating in association with the lower end surface of the joint member **6** by forming the threads of the cylindrical body male thread **5***a* and the bonnet lower female thread **3***d* in an inverse direction from the threads of the joint member male thread **6***b* of the joint member **6** and the bonnet upper female thread **3***b*.

[0056] FIG. **8** illustrates a fully closed state of the diaphragm valve of Example 2, and movement changing from fully open to fully close is the same as the description in conjunction with FIG. **2**.

[0057] FIG. **9** illustrates a state before the stem **8** is inserted into the cylindrical body **5** in the course of assembly of the diaphragm valve **1** of Example 2. In this state, a fluid cannot be flowed because leakage occurs if the fluid is flowed therein.

[0058] FIG. **10** illustrates a state after the holding adapter **15** is secured to the valve body **2** and the stem **8** is inserted into the cylindrical body **5** in the course of assembly of the diaphragm valve **1** of Example 2. In this state, the fluid can be flowed because no leakage occurs. The fluid is flowed from the fluid inflow passage **2***a* to the fluid outflow passage **2***b* in the state in FIG. **10**, and the Cv value is measured. In this state, for example, when a desired Cv value required for shipping is 3.0, dimensions of the component are adjusted to achieve a value slightly larger than that value, for example, on the order of 3.2, in the same manner as Example 1.

[0059] Next, the cylindrical body **5** is adjusted by screws as illustrated in FIG. **11** so that the lower end surface of the cylindrical body **5** moves the outer edge upper surface **7***c*, which corresponds to an upper end surface of the outer edge **7***a* of the diaphragm holder **7**, downward, then a fluid is flowed to measure the Cv value. When achieving the target value 3.0, the adjustment is completed. When the value is assumed to be 3.1, the adjustment is performed again and then the Cv value is measured. In this case, it is also possible to adjust the Cv value to a desired value by rotationally moving the cylindrical body **5** little by little in a state in which the fluid is flowing in the same manner as in Example 1. In this manner, the Cv value can be adjusted to fall within an allowable range of a target value. After the Cv value is adjusted, the joint member male thread **6***b* is screwed into engagement with the bonnet upper female thread **3***b* so that the lower end surface of the joint member **6** presses the upper end surface of the cylindrical body **5** to prevent movement of the cylindrical body **5**. In this manner, the rotation of the cylindrical body **5** after assembly of the diaphragm valve can be prevented.

REFERENCE SIGNS LIST

[0060] **1**; diaphragm valve
[0061] **2**; valve body
[0062] **2***a;* fluid inflow passage
[0063] **2***b;* fluid outflow passage
[0064] **2***c;* valve body recess
[0065] **2***d;* valve body female thread
[0066] **2***e;* annular valve seat
[0067] **2***f;* diaphragm
[0068] **3**; bonnet
[0069] **3***a;* bonnet upper recess
[0070] **3***b;* bonnet upper female thread
[0071] **3***c;* bonnet male thread
[0072] **3***e;* bonnet through hole
[0073] **3***d;* bonnet lower female thread
[0074] **3***f;* bonnet lower recess
[0075] **4**; actuator
[0076] **4***a;* casing
[0077] **4***b;* exhaust port
[0078] **4***c;* exhaust port
[0079] **5**; cylindrical body
[0080] **5***a;* cylindrical body male thread
[0081] **5***b;* cylindrical body through hole
[0082] **5***c;* cylindrical body flange
[0083] **6**; joint member
[0084] **6***a;* joint member through hole
[0085] **6***b;* joint member male thread
[0086] **6***c;* joint member recess
[0087] **6***d;* joint member upright wall
[0088] **7**; diaphragm holder
[0089] **7***a;* outer edge
[0090] **7***b;* abutting part
[0091] **7***c;* outer edge upper surface
[0092] **8**; stem
[0093] **9**; piston
[0094] **9***a;* axial passage
[0095] **9***b;* radial passage
[0096] **10**; piston
[0097] **10***a;* axial passage
[0098] **10***b;* radial passage
[0099] **11**; compression coil spring
[0100] **13**; drive means
[0101] **15**; holding adapter
[0102] **21**; piston body
[0103] **22**; protruding shaft portion
[0104] **23**; piston body
[0105] **24**; upper protruding shaft portion
[0106] **25**; lower protruding shaft portion
[0107] **26**; counter plate
[0108] **29**; operation air introduction chamber
[0109] **30**; operation air introduction chamber
[0110] **31**; one-touch joint

1. A diaphragm valve comprising:
a valve body provided with a fluid flow path;
a diaphragm configured to open and close the fluid flow path;
an actuator configured to press the diaphragm;
a bonnet interposed between the valve body and a casing of the actuator;
a stem moved by the actuator; and
a diaphragm holder disposed between the stem and the diaphragm and including an outer edge having a diameter larger than an outer diameter of the stem, wherein
the bonnet includes a through hole coaxial with the stem and formed with a female thread,

the through hole accommodates a cylindrical body screwed therein, the cylindrical body having a male thread formed on an outer surface thereof for engaging the female thread,

the stem is inserted into the cylindrical body,

the cylindrical body has a diaphragm-side end surface protruding from a diagram-side opening surface of the through hole toward the diaphragm,

a stem-side end surface of the diaphragm holder at an outer edge thereof and the diaphragm-side end surface of the cylindrical body are in abutment with each other, so that the position of the abutted surfaces in a direction of a stem axis are allowed to be adjusted by a degree of engagement between the male thread and the female thread.

2. The diaphragm valve according to claim **1**, wherein

the bonnet is provided with a recess on an upper part thereof;

the cylindrical body is provided at an upper part thereof with a cylindrical body flange having a diameter larger than the male thread and smaller than an inner diameter of the recess, and

the cylindrical body flange is secured to a bottom surface of the recess by screw means.

3. The diaphragm valve according to claim **1**, wherein the actuator is secured to the bonnet or the valve body with a diaphragm-side end surface of the actuator pressing an actuator-side end surface of the cylindrical body.

4. A method of adjusting a Cv value of a diaphragm valve comprising:

a step of placing a diaphragm configured to open and close a fluid flow path on a valve body provided with the fluid flow path, placing a holding adapter configured to press and hold an outer peripheral edge of the diaphragm on a valve body side on the diaphragm, and placing a stem configured to deform the diaphragm in an opening or closing direction on the diaphragm, the stem including, at a lower end portion thereof, a diaphragm holder having an outer edge with a diameter larger than an outer diameter of the stem,

a step of screwing a male thread formed on an outer peripheral surface of a cylindrical body into engagement with a female thread formed on an inner peripheral surface of the cylindrical-shaped bonnet to accommodate the cylindrical body in an interior of the bonnet;

a step of inserting the stem in the cylindrical body, attaching the bonnet in which the cylindrical body is accommodated to the valve body, and pressing the holding adapter with a diaphragm-side end surface of the bonnet to secure the diaphragm to the valve body;

a step of flowing a fluid into the fluid passage and measure a Cv value;

a step of bringing the diaphragm-side end surface of the cylindrical body into abutment with the stem side end surface of the outer edge of the diaphragm holder;

a step of repeating changing a degree of engagement between the male thread and the female thread, flowing a fluid through the fluid flow path, and measuring the Cv value until a target Cv value is achieved; and

a step of securing the cylindrical body to the bonnet after the Cv value of the diaphragm valve is adjusted to a target Cv value.

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