



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.04.2021 Bulletin 2021/14

(51) Int Cl.:
H01H 35/26 (2006.01) H01H 35/34 (2006.01)

(21) Application number: **20198846.6**

(22) Date of filing: **29.09.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **Yuguchi, Fumiaki**
Sayama-shi, Saitama 350-1395 (JP)
• **Kurosawa, Tomokazu**
Sayama-shi, Saitama 350-1395 (JP)
• **Asada, Yasuhiro**
Sayama-shi, Saitama 350-1395 (JP)
• **Suzuki, Ryusuke**
Sayama-shi, Saitama 350-1395 (JP)

(30) Priority: **03.10.2019 JP 2019182628**

(74) Representative: **Petraz, Gilberto Luigi et al**
GLP S.r.l.
Viale Europa Unità, 171
33100 Udine (IT)

(71) Applicant: **Saginomiya Seisakusho, Inc.**
Tokyo 165-0033 (JP)

(54) **PRESSURE SWITCH**

(57) An objective of the present invention is to provide a manually reset type of pressure switch which operates more precisely, including the reset state. The objective is achieved by a pressure switch 1 includes a diaphragm 44 (pressure-sensitive element), a transmission element 62 for transmitting deflection thereof, a microswitch 3 (switching means) for switching its conductive state from a first state to a second state when the transmission element 62 is moved forward to a first position, wherein the microswitch 3 is configured to switch its conductive state from the second state to the first state when the transmission element 62 is moved backward to a second position which is located more backward than the first position, and a positioning means 9 for positioning the transmission element 62 in a forward/backward movement direction D11 to an intermediate position between the first position and the second position, a reset means 10 for releasing positioning the transmission element 62 by the positioning means 9 to bring the transmission element 62 into a free state in which the transmission element 62 is movable along the forward/backward movement direction D11.

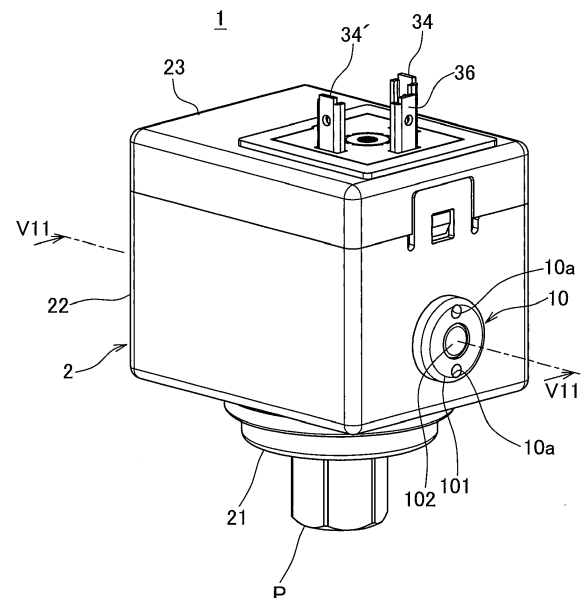


FIG.1

Description

BACKGROUND OF THE INVENTION

Technical Field

[0001] The present invention relates to a pressure switch with a pressure-sensitive element, such as a diaphragm and/or a bellows, which partitions a low pressure chamber and a high pressure chamber and is configured to be deflected depending on a pressure variation in the high pressure chamber.

Background Art

[0002] Conventionally, a pressure switch with a pressure-sensitive element is known. Some pressure switches are of a manually reset type, wherein they are configured to switch their conductive state in the event of an abnormal phenomenon, such as an abnormally high pressure in the high pressure chamber, and to keep the conductive state after the switching until an operator pushes a reset button (see e.g. Patent Document 1). This enables that maintenance etc. is performed without overlooking the abnormal phenomenon.

Citation List

Patent Literature

[0003] Patent Document 1: JP S53-13895 U

SUMMARY OF THE INVENTION

[0004] Here, how much pressure in the high pressure chamber is considered as the abnormal phenomenon to switch the conductive state is set adaptively in a design and/or production phase. For the manually reset type of pressure switch as described above, in a reset state where the reset button has been pressed, the reset button is in contact with a transmission means, wherein the transmission means is configured to transmit deflection of the pressure-sensitive element to a switching means for the conductive state in a subsequent stage. As a result, when the reset state which has been established by pressing the reset button is continued for some reason, a set value for switching the conductive state may be offset slightly from a value which was set in the design and/or production phase. Conventionally, such a slight offset of the set value in the reset state has been considered as negligible for such a manually reset type of pressure switch. However, in recent years, a manually reset type of pressure switch is desired which operates more precisely, including the reset state.

[0005] Therefore, the present invention is focused on the above-described problem and an objective of the present invention is to provide a manually reset type of pressure switch which operates more precisely, including

the reset state.

[0006] In order to achieve the above-mentioned objective, a pressure switch according to the present invention includes a pressure-sensitive element which partitions a low pressure chamber and a high pressure chamber and is configured to be deflected depending on a pressure variation in the high pressure chamber, a transmission element configured to transmit a deflection of the pressure-sensitive element to a portion in a subsequent stage by moving along a predetermined forward/backward movement direction upon receiving the deflection, a switching means configured to switch its conductive state from a first state into a second state when the transmission element has moved forward to a first position with regard to the forward/backward movement direction, wherein the switching means is further configured to switch its conductive state from the second state into the first state when the transmission element has moved backward to a second position, the second position being located more backward than the first position with regard to the forward/backward movement direction, a positioning means configured to position the transmission element in the forward/backward movement direction at an intermediate position between the first position and the second position in a freely releasable manner, and a reset means configured to release positioning the transmission element by the positioning means to bring the transmission element into a free state in which the transmission element is movable along the forward/backward movement direction.

[0007] According to the pressure switch of the present invention, once its conductive state has been switched from the first state into the second state, the transmission element is kept at the intermediate position and may not be moved backward to the second position until positioning the transmission element by the positioning means is released by the reset means, even if the pressure-sensitive element is deflected. This means that the pressure switch is configured as a manually reset type in which the second state after the switching is maintained until the pressure switch takes the reset state where the reset means has released the positioning. Then, in the reset state, the transmission element is configured to be brought into the free state in which the transmission element is movable along the forward/backward movement direction. In this manner, the transmission element can move along the forward/backward movement direction without being affected by contact with the reset means and/or the positioning means even in the reset state, wherein no offset for a set value may be caused, such as the first and/or second position for switching the conductive state which are set in the design phase and/or production phase. As such, the pressure switch according to the present invention can be operated more precisely including the reset state.

[0008] The pressure switch according to the present invention preferably includes a coupling element configured as a rotation element which is pivotably mounted

around a center axis on one end side and movable along the forward/backward movement direction on another opposite end side, wherein the transmission element is coupled to a position on the coupling element far from the center axis, wherein the coupling element is configured to move the transmission element along the forward/backward movement direction by rotation at a middle position between the center axis and a coupling portion to the transmission element upon receiving deflection of the pressure-sensitive element, wherein the positioning means is configured to position the other opposite end side at a position corresponding to the intermediate position of the transmission element by coming into contact with a back surface of the coupling element on the other opposite end side facing backward in the forward/backward movement direction and by pushing up the other opposite end side forward in the forward/backward movement direction, and wherein the reset means is configured to separate the positioning means away from the back surface on the other opposite end side to release positioning the transmission element.

[0009] According to the above-described configuration, the positioning means is configured to push up the other opposite end side of the coupling element to position the transmission element coupled thereto, wherein the reset means is configured to separate the positioning means away from the other opposite end side of the coupling element to release the positioning. This can effectively avoid offsets of the set value, such as the first position and/or the second position in the reset state, by separating the transmission element from the reset means.

[0010] In the above-described configuration, it is further preferably provided that the positioning means includes a stopper portion which extends in the forward/backward movement direction, wherein the stopper portion is capable of tilting down in an intersecting direction with regard to the forward/backward movement direction and configured to come into contact with the back surface on the other opposite end side in a standing state, and wherein the reset means is configured to push the stopper portion in the standing state along the intersecting direction and thereby tilt it down to separate the stopper portion away from the back surface on the other opposite end side.

[0011] With this configuration, the stopper portion can be effectively separated away from the other opposite end side of the coupling element by tilting down the stopper portion of the positioning means with the reset means.

[0012] Further, in the above-described configuration, it is more preferably provided that the reset means includes a bar-shaped portion and a biasing portion, the bar-shaped portion extending in the intersecting direction and being configured to push the stopper portion with one end, wherein the biasing portion is configured to bias the bar-shaped portion away from the stopper portion.

[0013] This configuration can increase operability since once the bar-shaped portion of the reset means is

released after an operator has pushed the bar-shaped portion and thereby the reset state has been established, the bar-shaped portion is automatically positioned back by the biasing portion.

[0014] Further, the pressure switch according to the present invention preferably includes an enclosure with an outer wall having a tubular shape, the enclosure being configured to accommodate the positioning means inside, wherein a through-hole is provided in the outer wall at a position corresponding to the positioning means and the reset means is inserted into the through-hole in the outer wall so as to be oriented from the outer wall toward the positioning means.

[0015] This configuration enables the reset means to be easily attached by insertion into the through-hole in the outer wall. Further, the pressure switch according to the present invention can be used as an automatically reset type of switch, wherein the returning to the first state after switching into the second state is automatically accomplished depending on the pressure variation in the high pressure chamber by removing the positioning means as described above. In this case, the basic structure of the pressure switch according to the present invention may be directly applied while remaining unchanged in order to easily construct such an automatically reset type of pressure switch, e.g. by closing the unnecessary through-hole for attaching the reset means with a predetermined lid element.

[0016] Further, the pressure switch according to the present invention preferably includes an adjustment means configured to adjust to which position the positioning means positions the transmission element with regard to the forward/backward movement direction, wherein the positioning means is configured to be pre-adjusted by the adjustment means so as to position the transmission element at the intermediate position.

[0017] With this configuration, the preadjustment by means of the adjustment means can ensure that the transmission element is positioned to the intermediate position by the positioning means.

[0018] Further, the above-described configuration more preferably includes a coupling element configured as a rotation element which is pivotably mounted around a center axis on one end side and movable along the forward/backward movement direction on another opposite end side, wherein the transmission element is coupled to a position on the coupling element far from the center axis, wherein the coupling element is configured to move the transmission element along the forward/backward movement direction by rotation at an intermediate position between the center axis and a coupling portion to the transmission element upon receiving deflection of the pressure-sensitive element, wherein the positioning means is configured to position the other opposite end side at a position corresponding to the intermediate position of the transmission element by coming into contact with a back surface of the coupling element on the other opposite end side facing backward in the

forward/backward movement direction and pushing up the other opposite end side forward in the forward/backward movement direction, and wherein the adjustment means is configured to adjust a contact position of the positioning means with the other opposite end side by moving it forward and/or backward in the forward/backward movement direction.

[0019] This configuration can ensure that the transmission element is positioned to the intermediate position by the positioning means using a method with better operability in which the contact position of the positioning means with the other opposite end side of the coupling element is adjusted by moving it forward and/or backward. Furthermore, a strict size management for components may be unnecessary, which can reduce an increase in component costs.

[0020] Moreover, the above-described configuration is further preferably provided so that the positioning means includes a stopper portion and a cantilever, wherein the stopper portion is configured to come into contact with the back surface on the other opposite end side and is coupled to the cantilever, wherein the cantilever has one end as a fixed end and another end as a free end which is movable with regard to the forward/backward movement direction, wherein the adjustment means is configured to move the free end with regard to the forward/backward movement direction in order to move the contact position of the stopper portion with the other opposite end side of the coupling element forward and/or backward along the forward/backward movement direction.

[0021] This configuration can ensure that the contact position and thereby the transmission element is positioned to the intermediate position as described above with better operability with which the free end of the cantilever is moved.

[0022] The present invention can provide a manually reset type of pressure switch which operates more precisely including the reset state.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig.1 is a perspective view of an appearance of a pressure switch according to an embodiment of the present invention;

Fig.2 is a schematic sectional view along the line V11-V11 in Fig.1 illustrating an internal structure of the pressure switch according to Fig.1;

Fig.3 is a perspective view with the positioning means and the reset means according to Fig.2 extracted for illustration;

Fig.4 is an enlarged perspective view of the positioning means according to Fig.3;

Fig.5 shows views of operation of the pressure switch in which a pressure in the high-pressure chamber rises to an abnormally high pressure and then drops down;

Fig.6 shows operation of the pressure switch following the operation according to Fig.5 when performing the reset operation for the reset means;

Fig.7 shows a procedure in preadjustment by the adjustment means according to Fig.4 until the positioning means has been moved to a position corresponding to a working point; and

Fig.8 shows a procedure following the procedure according to Fig.7 until the transmission element has been positioned to a reset adjustment position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Hereinafter, a pressure switch according to an embodiment of the present invention will be described. The pressure switch according to the present embodiment is provided for use in detection of fluid pressure of a working medium as a pressure fluid e.g. for an air conditioner, cold heat, an automobile, various actuators for control.

[0025] Fig.1 is a perspective view of an appearance of a pressure switch according to an embodiment of the present invention. Fig.2 is a schematic sectional view along the line V11-V11 in Fig.1 illustrating an internal structure of the pressure switch according to Fig.1.

[0026] The pressure switch 1 according to Figs. 1 and 2 includes a casing 2 generally having a box shape, a microswitch 3 as a switching means disposed in the casing 2 in its upper section, and a diaphragm assembly 4 fixed in the casing 2 in its lower section. Further, the pressure switch 1 includes an operation element 5 and a transmission mechanism 6, wherein the operation element 5 is supported so as to be freely movable forward and backward in an up-down direction with regard to the diaphragm assembly 4 and the transmission mechanism 6 is configured to transmit movement of the operation element 5 to the microswitch 3. Moreover, the pressure switch 1 includes a leaf spring 7 and a leaf spring adjustment means 8, wherein the leaf spring 7 is configured to bias a diaphragm (pressure-sensitive element) 44 of the diaphragm assembly 4 to apply an initial compressive force and the leaf spring adjustment means 8 is configured to adjust a biasing force of the leaf spring 7.

[0027] The casing 2 includes a base body 21 made of metal, a box body 22 for holding the base body 21 inside, and a lid body 23 (support body), wherein the lid body 23 is attached so as to close an upper opening of the box body 22. The base body 21 includes a tubular section 21a with a bottomed cylindrical shape, a flat plate section 21b, wherein the flat plate section 21b is continuous with an upper end of the tubular section 21a and extends outwardly in a horizontal direction, and wherein these sections are integral with each other. The tubular section 21a supports the diaphragm assembly 4 inside, wherein a joint element P included in the diaphragm assembly 4 extends through an opening at a center of a bottom surface of the tubular section 21a and is exposed to the

outside.

[0028] The lid body 23 is formed from an insulating resin. This lid body 23 is formed with a top plate section 23a, a ring-shaped section 23b, and hanging down sections 23c. The top plate section 23a is a wall section to which the microswitch 3 is mounted. The ring-shaped section 23b is a quadrilateral ring-shaped portion which is configured to be inserted into the box body 22 along a side section 22b. The hanging down sections 23c are portions extending downward from four corners of the ring-shaped section 23b and configured to come into contact with the flat plate section 21b of the base body 21. With such hanging down sections 23c, it is possible to assemble the pressure switch 1 so that strokes of a transmission element 62 as described later is stabilized. The ring-shaped section 23b is provided with engagement claws 23d configured to be engaged with engagement portions 22c of the box body 22. A water sealing element 24 is provided on an inner surface of the side section 22b of the box body 22, the water sealing element 24 having a ring shape and being configured to come into intimate contact with the ring-shaped section 23b.

[0029] The box body 22 is generally formed in a polygonal tube shape, wherein the base body 21 is held by inserting the tubular section 21a through a circular opening in a bottom section 22a of the box body 22. A plurality of engagement portions 22c are provided at the side section 22b of the box body 22 to be engaged with the lid body 23.

[0030] The microswitch 3 is provided within the lid body 23 of the casing 2, and includes a pair of fixed electrodes 31, 32 and a movable electrode 33, wherein the pair of fixed electrodes 31 and 32 is opposed to each other in the up-down direction within the lid body 23 and the movable electrode 33 is freely movable between the upper and lower fixed electrodes 31 and 32. The microswitch 3 further includes a pair of first terminals 34, 34' and a conductive connection element 35, wherein the pair of first terminals 34 and 34' is connected to the pair of fixed electrodes 31 and 32 and extends externally from the lid body 23, and the conductive connection element 35 is formed from a leaf spring with the movable electrode 33 jointed thereto. Furthermore, the microswitch 3 includes a second terminal 36 and an adjustment screw 37 for adjusting a position of the upper fixed electrode 31, wherein the second terminal 36 is connected to the conductive connection element 35 and extends externally from the lid body 23. The conductive connection element 35 includes a conductive connection piece 35a extending from the second terminal 36, a movable piece 35b extending from the second terminal 36, and a snap piece 35c, wherein the movable electrode 33 is fixed to a tip of the conductive connection piece 35a, the transmission mechanism 6 is connected to a middle portion of the movable piece 35b, and the snap piece 35c is configured to bias the movable electrode 33 toward one of the fixed electrode 31 or 32. As described later, deflection of the diaphragm 44 is transmitted to the movable piece 35b

via the transmission mechanism 6, wherein the movable piece 35b is moved depending on the deflection. The microswitch 3 detects a low pressure state and a high pressure state, wherein in the low pressure state, the movable electrode 33 is in contact with the upper fixed electrode 31 and these electrodes 31 and 33 are thereby connected conductively, wherein in the high pressure state, the movable electrode 33 is in contact with the lower fixed electrode 32 and these electrodes 32 and 33 are thereby connected conductively. In this manner, the microswitch 3 is configured to switch its conductive state depending on the deflection of the diaphragm 44 to switch between conductive connection and disconnection of the pair of first terminals 34, 34' to the second terminal 36.

[0031] The diaphragm assembly 4 includes a lower holding plate 42 supported by the tubular section 21a of the base body 21, a spacer 43, the diaphragm 44, a bottom plate element 45 and an upper holding plate 41, wherein the spacer 43, the diaphragm 44 and the bottom plate element 45 are held between the upper holding plate 41 and the lower holding plate 42. The upper holding plate 41 is generally formed in a circular disc shape with an insertion hole 41a which extends vertically through the upper holding plate 41 at its center portion, wherein the operation element 5 is inserted through the insertion hole 41a and guided vertically therethrough. The lower holding plate 42 is generally formed in a cylindrical shape with a step section 42a and a crimping tab 42b, wherein the step section 42a serves for holding the spacer 43, the diaphragm 44 and the bottom plate element 45, and the crimping tab 42b extends upwards and serves for fixing the upper holding plate 41 by crimping. In the diaphragm assembly 4, the spacer 43, the diaphragm 44 and the bottom plate element 45 are clamped between the upper holding plate 41 and the step section 42a of the lower holding plate 42. Then, by crimping the crimping tab 42b inwardly, the diaphragm 44 and the bottom plate element 45 are held at their peripheral edges between the upper holding plate 41 and the lower holding plate 42.

[0032] The diaphragm 44 is generally formed in a circular disc shape from multiple stacked metallic thin plates, wherein the diaphragm 44 has a convex portion 44a with a dome shape which is convex upward in a natural state. The bottom plate element 45 is formed in a dish shape which is bulged downward at its middle portion from the metallic plates generally having a circular disc shape, wherein a through-hole 45a is formed at the middle portion for fixing the joint element P in the through-hole 45a. The diaphragm 44, the bottom plate element 45 and the spacer 43 are jointed to each other e.g. via welding, so as to ensure gas tightness and pressure tightness. At the diaphragm assembly 4, a high pressure chamber 46 is defined by a space enclosed by the diaphragm 44 and the bottom plate element 45, wherein it is configured so that a high pressure fluid enters the high pressure chamber 46 via the joint member P. Further, a low pressure chamber 47 is defined by a space enclosed by the diaphragm 44, the spacer 43 and the upper holding

plate 41, wherein the low pressure chamber 47 has a pressure comparable with the atmospheric pressure by being in communication with an inner space within the box body 22 through the insertion hole 41a. Thus, the diaphragm 44 as the pressure-sensitive element is configured to deflect upward and downward depending pressure variation of the high pressure fluid which enters the high pressure chamber 46. In this manner, the diaphragm 44 forms the pressure-sensitive element which partitions the low pressure chamber 47 and the high pressure chamber 46 and is configured to deflect depending on the pressure variation in the high pressure chamber 46.

[0033] The leaf spring 7 is fixed at one end 71 with the base body 21 and coupled at the other end 72 with a leaf spring adjustment means 8. An insertion hole 73 is provided substantially at a middle portion of the leaf spring 7 in a top view for inserting a second shaft section 53 of the operation element 5 through the insertion hole 73, wherein it is configured so that an upper side of a diameter-increased section 52 of the operation element 5 partially comes into contact with a periphery of a lower side of the insertion hole 73. The leaf spring adjustment means 8 includes an adjustment screw 81 and a slider 82, the adjustment screw 81 extending through the flat plate section 21b of the base body 21, wherein the slider 82 is in contact with an upper side of the leaf spring 7 and screwed to the adjustment screw 81 which extends through the leaf spring 7. The adjustment screw 81 can be operated by rotation from the downward side of the flat plate section 21b before assembling the box body 22 with the base body 21. The slider 82 is supported within the casing 2 in a non-rotatable and vertically slidable manner. The slider 82 is configured to be moved vertically by rotating the adjustment screw 81. Consequently, it is configured so that the other end 72 of the leaf spring 7 is lowered by tightening the adjustment screw 81 and thereby moving the slider 82 downward, wherein the other end 72 of the leaf spring 7 is lifted by loosening the adjustment screw 81 and thereby moving the slider 82 upward, wherein this may adjust a biasing force of the leaf spring 7. Such a biasing force of the leaf spring 7 is transferred to the diaphragm 44 via the operation element 5, wherein an initial compressive force is applied by the convex portion 44a of the diaphragm 44 being pressed downward. Further, a pressing force of the diaphragm 44 can be adjusted by adjusting the biasing force of the leaf spring 7, which enables a range for a detected pressure value to be adjusted.

[0034] The operation element 5 includes the first shaft section 51, the diameter-increased section 52 and the second shaft section 53, wherein the first shaft section 51 extends vertically and is inserted through the insertion hole 41a in the upper holding plate 41, the diameter-increased section 52 is configured with a diameter being increased horizontally along an upper side of the upper holding plate 41, and the second shaft section 53 extends upward from the diameter-increased section 52. The operation element 5 is supported so as to be freely movable

forward and backward in the up-down direction by guiding the first shaft section 51 through the insertion hole 41a, wherein the operation element 5 is configured so that an lower end of the first shaft section 51 comes into contact with a center of the convex portion 44a of the diaphragm 44. Thus, it is configured so that the initial compressive force is applied to the diaphragm 44 by vertical movement of the operation element 5 accompanying the deflection of the diaphragm 44, and by biasing the diaphragm 44 toward the high pressure chamber 46 with the operation element 5 being exposed to the biasing force of the leaf spring 7.

[0035] The diameter-increased section 52 is configured so that its bottom surface can come into contact with a top surface of the upper holding plate 41, wherein the diameter-increased section 52 is provided for limiting movement of the operation element 5 under the contact position. Accordingly, deflection of the diaphragm 44 beyond the initial compressed state toward the high pressure chamber 46 is limited. Furthermore, the second shaft section 53 is rounded in a spherical shape at its upper end, wherein it is configured so that this upper end comes into contact with a coupling element 61 of the transmission mechanism 6 as described later.

[0036] The transmission mechanism 6 includes the coupling element 61, a transmission element 62, and a shaft element 63, the coupling element 61 being formed from a metal sheet, wherein the shaft element 63 supports the coupling element 61 in a freely movable manner. The coupling element 61 is disposed above the diaphragm assembly 4 opposing thereto with the leaf spring 7 being interposed therebetween, wherein the second shaft section 53 of the operation element 5 is configured to come into contact with the coupling element 61 from downward, wherein the transmission element 62 is coupled to the coupling element 61. This coupling element 61 is pivotably supported by the shaft element 63 in a freely rotatable manner with regard to the base body 21. The transmission element 62 extends upward from the coupling element 61, wherein an upper end of the transmission element 62 is engaged with the movable piece 35b of the conductive connection element 35 of the microswitch 3.

[0037] For this transmission mechanism 6, deflection of the diaphragm 44 is applied to the transmission element 62 via the operation element 5 and the coupling element 61. Upon receiving the deflection, the transmission element 62 is moved in a forward/backward movement direction D11 to transmit the deflection to the movable piece 35b of the conductive connection element 35 in the microswitch 3 as a portion in a subsequent stage, wherein the forward/backward movement direction D11 corresponds to the up-down direction in the Figure.

[0038] According to the present embodiment, under the assumption that a positioning means 9 is not provided which is related to a reset operation as described later, the microswitch 3 would be operated depending on movement of the transmission element 62 as follows,

since the microswitch 3 includes the snap piece 35c:

[0039] Under the assumption as described above, when the transmission element 62 moves forward to a first position with regard to the forward/backward movement direction D11, wherein the first position is located more forward than a limit position (above the limit position), at which the snap piece 35c can resist at the maximum, the microswitch 3 switches its conductive state from a first state to a second state. The first state is a state where the movable electrode 33 is in contact with the upper fixed electrode 31, while the second state is a state where the movable electrode 33 is in contact with the lower fixed electrode 32. The pressure switch 1 according to the present embodiment is configured as a switch with high-pressure cutting off which switches its conductive state from the first state to the second state in event of an abnormally high pressure in the high-pressure chamber 46.

[0040] Under the assumption as described above, after the switching, i.e. after the cutting off, when returning to the first state before switching, the microswitch 3 switches the conductive state from the above-described second state to the first state as soon as the transmission element 62 is moved backward to a second position, wherein the second position is located further backward (lower) than the first position. This means that the microswitch 3 is configured so that the first position (working point), i.e. a set value as a trigger for performing the high-pressure cutting off, does not coincide with the second position (return point), i.e. a set value as a trigger for return to an initial state.

[0041] According to the present embodiment, the pressure switch 1 is provided with a positioning means 9 as an element for retaining the second state where the movable electrode 33 is in contact with the lower fixed electrode 32 in event of the high-pressure cutting off, e.g. for the sake of subsequent maintenance by an operator. The pressure switch 1 is further provided with a reset means 10 for releasing the retained second state and returning the pressure switch 1 to the first state before cutting off where the movable electrode 33 is in contact with the upper fixed electrode 32.

[0042] Fig.3 is a perspective view with the positioning means and the reset means according to Fig.2 extracted for illustration, and Fig.4 is an enlarged perspective view of the positioning means according to Fig.3. Here, Fig.3 shows two views side by side, wherein one of the views illustrates the positioning means with the reset means being removed for better visibility, while the other view illustrates both of the positioning means and the reset means.

[0043] The positioning means 9 is an element which positions the transmission element 62 in the forward/backward movement direction D11 to an intermediate position between the first position and the second position, in a freely releasable manner, wherein the first position and the second position represent the working point for cutting off and the return point, respectively,

wherein the transmission element 62 is shown by means of dotted lines in Fig.3. This positioning is accomplished via the coupling element 61 which forms the transmission mechanism 6 together with the transmission element 62.

[0044] The coupling element 61 is a rotation element which is pivotably mounted around a center axis 63a along the shaft element 63 on one end side 611 and movable along the forward/backward movement direction D11 on another opposite end side 612. Then, the transmission element 62 is coupled to a position on the coupling element 61 far from the center axis 63a, wherein the coupling element 61 is rotated at an intermediate position 614 between the center axis 63a and a coupling portion 613 to the transmission element 62 upon receiving deflection of the diaphragm 44 to move the transmission element 62 along the forward/backward movement direction D11.

[0045] The positioning means 9 is configured to position the other opposite end side 612 to a position of the transmission element 62 corresponding to the above-mentioned intermediate position by coming into contact with a back surface of the coupling element 61 on the other opposite end side 612 and by pushing up the other opposite end side 612 forward in the forward/backward movement direction D11 (upward), the back surface facing backward in the forward/backward movement direction (downward).

[0046] The positioning means 9 is a metal sheet processing component which is formed by bending a metal sheet as shown in Fig.4, wherein the positioning means 9 includes a stopper portion 91 and a cantilever 92. The stopper portion 91 comes into contact with the back surface of the coupling element 61 on the other opposite end side 612. The cantilever 92 is a portion wherein one end forms a screwed fixed end 921 and another end forms a free end 922 which is movable along the forward/backward movement direction D11. The stopper portion 91 is coupled to the cantilever 92, being folded up substantially from a center of the cantilever 92 in a longitudinal direction.

[0047] The stopper portion 91 of the positioning means 9 extends along the forward/backward movement direction D11 and is capable of tilting down in an orthogonal direction D11 with regard to the forward/backward movement direction D11, i.e. in a folding back direction for the metal sheet processing. Then, the stopper portion 91 will come into contact with the back surface of the coupling element 61 on the other opposite end side 612 in a standing state as shown in Fig.2, wherein in the standing state, the stopper portion 91 is tilted slightly toward an outer wall.

[0048] Further, the positioning means 9 is configured to be preadjusted so as to position the transmission element 62 to the above-mentioned intermediate position. The pressure switch 1 according to the present embodiment is provided with an adjustment means 11 for such preadjustment. The adjustment means 11 is an element for adjusting to which position the stopper portion 91 of

the positioning means 9 positions the transmission element 62 with regard to the forward/backward movement direction D11 via the coupling element 61, wherein the adjustment means 11 adjusts a contact position of the stopper portion 91 with the other opposite end side 612 of the coupling element 61 by moving it forward and/or backward in the forward/backward movement direction D11. Specifically, the adjustment means 11 moves the contact position of the stopper portion 91 with the other opposite end side 612 of the coupling element 61 forward and/or backward in the forward/backward movement direction D11 by moving the free end 922 of the cantilever 92 of the positioning means 9 in the forward/backward movement direction D11. The adjustment means 11 is configured as an adjustment screw which is accessible only during an assembly step of the pressure switch 1.

[0049] The reset means 10 is an element which is configured to release the positioning of the transmission element 62 into a free state, wherein in the free state, the transmission element 62 is movable along the forward/backward movement direction D11. The reset means 10 separates the stopper portion 91 of the positioning means 9 away from the back surface of the coupling element 61 on the other opposite end side 612 to release the positioning of the transmission element 62. This means that the reset means 10 separates the stopper portion 91 away from the back surface on the other opposite end side 612 by pushing the stopper portion 9 and thereby tilting down the stopper portion 91 from the standing state in the above-mentioned orthogonal direction D121.

[0050] As shown in Fig.2, the reset means 10 is configured as a unit with a cylindrical casing 101 which accommodates a reset button 102 as a bar-shaped portion and a coil spring 103 as a biasing portion. The reset button 102 extends in the orthogonal direction D12 and presses the stopper portion 91 of the positioning means 9 with one end of the reset button 102. The coil spring 103 biases the reset button 102 away from the stopper portion 91.

[0051] Here, the box body 22 of the pressure switch 1 is configured as an enclosure with the side section 22b as a tubular outer wall which accommodates the above-mentioned positioning means 9 inside. The reset means 10 is inserted in a through-hole 22b-1 in the side section 22b so as to be oriented toward the positioning means 9 from the side section 22b, wherein the through-hole 22b-1 is provided at a position of the side section 22b corresponding to the positioning means 9. The through-hole 22b-1 has an internal thread formed on its inner circumferential surface, wherein the cylindrical casing 101 of the reset means 10 has an outer thread on its outer circumferential surface. The reset means 10 configured as a unit is attached by screwing it into the through-hole 22b-1. Furthermore, a ring-shaped packing 104 is interposed between the inner circumferential surface of the cylindrical casing 101 and the outer circumferential sur-

face of the bar-shaped reset button 102, whereby a hermetic seal is maintained between both circumferential surfaces.

[0052] Further, as shown in Fig.1, two small blind holes 10a with a so-called crab-eye shape are provided in portions of the cylindrical casing 101 for the reset means 10 which are exposed to the outside. The reset means 10 is screwed into the through-hole 22b-1 with protrusions of a dedicated machining tool being inserted into the small blind holes 10a.

[0053] The operation of the pressure switch 1 as described above will be explained with reference to Figs.5 and 6.

[0054] Fig.5 shows views of operation of the pressure switch in which a pressure in the high-pressure chamber rises to an abnormally high pressure and then drops down. Fig.6 shows operation of the pressure switch following the operation according to Fig.5 when performing the reset operation for the reset means. Figs.5 and 6 schematically show an operating state of internal components in the pressure switch 1 according to Fig.2 and switching operation of the microswitch 3 in response to the operation of these internal components, respectively. With regard to switching operation of the microswitch 3, the position of the transmission element 62 is indicated by means of the symbol "*" which represents the transmission element 62 responding to the other opposite end side 612 of the coupling element 61.

[0055] As indicated in step S11 according to Fig.5, during normal operation before an abnormally high pressure, the stopper portion 91 of the positioning means 9 is pushing up the other opposite end side 612 of the coupling element 61 forward in the forward/backward movement direction D11 (upward). Accordingly, the transmission element 62 is positioned to the intermediate position between a working point P11 for cutting off as the first position and a return point P12 as the second position which is located more backward (downward) than the working point P11. This intermediate position is configured as a reset adjustment position P13 which is adjusted by the positioning means 9, wherein positioning the positioning means 9 is then released by the reset means 10. In the stage of step S11, cutting off is not performed yet, wherein a first state is established as shown in Fig.2, in which the movable electrode 33 is in contact with the upper fixed electrode 31 of the microswitch 3 (ON-state).

[0056] Next, when an abnormally high pressure occurs as indicated in step S12, the coupling element 61 is rotated upon receiving deflection of the diaphragm 44 via the operation element 5. As a result, the transmission element 62 coupled to the other opposite end side 612 of the coupling element 61 is moved in a forward direction D11 of the forward/backward movement direction D11 to reach the working point P11. In response, the conductive state of the microswitch 3 is switched to a second state in which the movable electrode 33 is in contact with the lower fixed electrode 31 (OFF-state). The other opposite end side 612 of the coupling element 61 is then

moved away from the stopper portion 91 of the positioning means 9.

[0057] Then, when the pressure drops down as indicated in step S13, the coupling element 61 is moved in a direction opposite to that in case of the pressure rise upon receiving deflection of the diaphragm 44 via the operation element 5. As a result, the transmission element 62 is moved in a backward direction D112 of the forward/backward movement direction D11. However, the movement at this time is stopped when the other opposite end side 612 of the coupling element 61 has come into contact with the stopper portion 91 of the positioning means 9. In this manner, the transmission element 62 is positioned to the reset adjustment position P13 which is located more forward with regard to the forward/backward movement direction D11 than the return point P12, wherein the conductive state of the microswitch 3 will not be switched. As a result, the second state (OFF-state) which has been established during the pressure rise is maintained. An operator, such as maintenance staff, recognizes based on this conductive state of the microswitch 3 that the abnormally high pressure has occurred, even when the pressure has dropped down at this time, wherein the operator will then perform a predetermined maintenance operation under the recognition.

[0058] After finishing the maintenance operation, a reset operation is performed for returning the conductive state of the microswitch 3 to the first state (ON-state) according to step S11.

[0059] First, as indicated in step S14 according to Fig.6, the operator presses the reset button 102 of the reset means 10 in the orthogonal direction D12. Then, the stopper portion 91 of the positioning means 9 is pressed by this reset button 102 and tilted down in the tilt direction D121. This tilting causes that the positioning of the transmission element 62 is released which was performed by the stopper portion 91 via the other opposite end side 612 of the coupling element 61, and the transmission element 62 is lowered in a backward direction D112 of the forward/backward movement direction D11 without being interfered by the positioning means 9. This lowering proceeds past the above-mentioned return point P12 to reach an initial position at which the transmission element 62 was located before positioning by the positioning means 9. This initial position forms a position before reset adjustment P14 at which the transmission element 62 is located before positioning to the reset adjustment position P13 according to an adjustment procedure as described later. Since the position before reset adjustment P14 is located more backward with regard to the forward/backward movement direction D11 than the return point P12, the conductive state of the microswitch 3 is returned back to the first state (ON-state). In this phase, a gap is formed between the stopper portion 91 of the positioning means 9 and the other opposite end side 612 of the coupling element 61, whereby the transmission element 62 is in a free state in which it is movable along the forward/backward movement direction D11.

[0060] Subsequently, as indicated in step S15, when the operator releases the pressing the reset button 102 of the reset means 10, the reset button 102 is returned back in a direction of arrow D122 by biasing with the coil spring 103. As a result, the stopper portion 91 of the positioning means 9 is moved back in a direction of arrow D123 based on its own rigidity to be positioned back to a position corresponding to the reset adjustment position P13. Then, the stopper portion 91 which has been positioned back pushes up the other opposite end side 612 of the coupling element 61 from the back surface side, wherein in response, the transmission element 62 is moved in the forward direction D111 of the forward/backward movement direction D11 and positioned to the reset adjustment position P13 again. Since this reset adjustment position P13 is located more backward in the forward/backward movement direction D11 (downward) than the working point P11, the movement of the transmission element 62 at this time will not result in switching the conductive state of the microswitch 3, wherein the first state (ON-state) is maintained. In this phase, it returns back to the state of step S11 according to Fig.5 as described above.

[0061] Here, as described above, the transmission element 62 is positioned to the reset adjustment position P13 by preadjustment via the adjustment means 11 as shown in Fig.4. Hereinafter, a procedure for the preadjustment will be described with reference to Figs. 7 and 8.

[0062] Fig.7 shows a procedure in preadjustment by the adjustment means according to Fig.4 until the positioning means has been moved to a position corresponding to a working point, and Fig.8 shows a procedure following the procedure according to Fig. 7 until the transmission element has been positioned to a reset adjustment position. Again, Figs. 7 and 8 show schematically show an operating state of internal components in the pressure switch 1 according to Fig.2 and switching operation of the microswitch 3 in response to the operation of these internal components, respectively. With regard to switching operation of the microswitch 3, the position of the transmission element 62 is indicated by means of the symbol "*" which represents the transmission element 62 responding to the other opposite end side 612 of the coupling element 61, wherein the symbol "×" representing the positioning means 9 indicates its position, i.e. a position of the stopper portion 91 of the positioning means 9 which comes into contact with the other opposite end side 612 of the coupling element 61 and moves it.

[0063] First, in a non-adjusted state as indicated in step S21 according to Fig.7, the adjustment means 11 is sunk which is shown in Fig.4 as well, wherein the positioning means 9 is located to the non-adjusted position and separated away from the back surface of the coupling element 61 on the other opposite end side 612, wherein at the non-adjusted position, the cantilever 92 is in contact with the flat plate section 21b of the base body 21. As a result, the transmission element 62 is positioned at the position before reset adjustment P14 which is located

more backward with regard to the forward/backward movement direction D11 than both of the working point P11 and the return point P12.

[0064] In step S22 as a first step for the adjustment, the coupling element 61 is forced to move, and the transmission element 62 is moved in the forward direction D11 of the forward/backward movement direction D11. The forced movement of the transmission element 62 via the coupling element 61 is continued until the conductive state of the microswitch 3 exceeds the working point P11 for switching to the second state (OFF-state) in which the movable electrode 33 is in contact with the lower fixed electrode 31. During this, the positioning means 9 remains unmoved and is retained to the non-adjusted position. Here, according to the present embodiment, the forced movement of the transmission element 62 is performed by directly accessing the coupling element 61 and moving it. However, a method for forced movement of the transmission element 62 is not limited thereto, wherein e.g. a method may also be applied in which an inner pressure in the high pressure chamber 46 is forced to rise to move the coupling element 61 via the diaphragm 44 and the operation element 5.

[0065] In step S23 as a second step, the adjustment means 11 in form of an adjustment screw is screwed in the forward direction D11, and the positioning means 9 is then moved in the forward direction D11. Screwing the adjustment means 11 is continued until the stopper portion 91 of the positioning means 9 comes into contact with the back surface of the coupling element 61 on the other opposite end side 612 which has positioned the transmission element 62 to the working point P11. During this, the coupling element 61 is constrained and its position is maintained, which causes the transmission element 62 to be retained to a position which exceeds the working point P11.

[0066] In step S24 as a third step as shown in Fig.8, the constraint of the coupling element 61 is released, the adjustment means 11 is returned in the backward direction D112 and the positioning means 9 is moved backward in the backward direction D112, which is accompanied by movement of the coupling element 61 and backward movement of the transmission element 62. Returning the adjustment means 11 is continued until the transmission element 62 reaches the return point P12 at which the conductive state of the microswitch 3 is switched to the first state (ON-state), wherein in the first state, the movable electrode 33 is in contact with the upper fixed electrode 31. Operation in step S24 as the third step is configured as searching for the position of the return point P12 by moving the positioning means 9.

[0067] In step S25 as a last fourth step, the adjustment means 11 is screwed in the forward direction D11, i.e. in the direction opposite to that in step S24, and the positioning means 9 is moved forward in the forward direction D11, which is accompanied by movement of the coupling element 61 and forward movement of the transmission element 62 from the return point P12 toward the

working point P11. Screwing the adjustment means 11 at this time is stopped before the transmission element 62 reaches the working point P11. An amount of screwing at this time is predetermined e.g. based on a thread pitch. In this manner, the transmission element 62 is positioned to the reset adjustment position P13 which is an intermediate position between the working point P11 and the return point P12, and the preadjustment is completed herewith.

[0068] According to the pressure switch 1 of the embodiment as described above, the transmission element 62 is moved forward to the working point P11 as the first position, wherein once the conductive state of the microswitch 3 has been switched from the first state (ON-state) to the second state (OFF-state), the following state is established: even when the diaphragm 44 is deflected, the transmission element 62 is retained to the reset adjustment position P13 as the intermediate position and may not be moved backward to the return point P12 as the second position, until the reset means 10 release the positioning of the transmission element 62 by the positioning means 9. This means that this pressure switch 1 is configured as a manually reset type which maintains the second state (OFF-state) after switching until the pressure switch 1 is brought into the reset state, in which the positioning has been released by the reset means 10. Then, in the reset state, the transmission element 62 is brought into a free state in which it is movable along the forward/backward movement direction D11. This enables the transmission element 62 to be moved along the forward/backward movement direction D11 without being affected by contact of the reset means 10 and/or the positioning means 9, even in the reset state, wherein a set value such as the working point P11 and/or the return point P12 for switching the conductive state may not be offset, the set value being set during a design and/or production phase. Thus, even if the pressure switch 1 remains in the reset state which has been established by pressing the reset button 102 of the reset means 10 for some reason, a so-called trip-free operation is possible for the pressure switch 1. As used herein, the term "trip-free operation" means that even when remaining in the reset state, the transmission element 62 is moved forward and backward depending on deflection of the diaphragm 44 and it is possible to switch the conductive state of the microswitch 3, in a similar manner to a normal operation. As such, the pressure switch 1 according to the present embodiment allows a precise operation, including the trip-free operation in the reset state.

[0069] Further, according to the present embodiment, the positioning means 9 pushes up the other opposite end side 612 of the coupling element 61 to position the transmission element 62 coupled thereto, wherein the reset means 10 separates the positioning means 9 away from the other opposite end side 612 of the coupling element 61 to release the positioning. In this manner, it is possible to separate the transmission element 62 from the reset means 10 and to effectively avoid offset of the

set value, such as the working point P11 and/or the return point P12 in the reset state.

[0070] Furthermore, according to the present embodiment, the reset means 10 tilts down the stopper portion 91 of the positioning means 9 to enable the stopper portion 91 to be effectively separated away from the other opposite end side 612 of the coupling element 61.

[0071] Furthermore, according to the present embodiment, when the reset button 102 is released after the reset button 102 of the reset means 10 is pushed by an operator and the reset state is thereby established, the reset button 102 is automatically positioned back by the coil spring 103. This can increase operability with regard to the reset.

[0072] Moreover, according to the present embodiment, the reset means 10 can be easily attached by inserting it into the insertion hole 22b-1 which is provided in the side section 22b of the box body 22. Additionally, by removing the positioning means 9, it is possible to use the pressure switch 1 according to the present embodiment as an automatically reset type which is automatically returned to the first state (ON-state) depending on pressure variation in the high pressure chamber 46. In this case, the basic structure according to the present invention may be directly applied while remaining unchanged in order to easily construct such an automatically reset type of pressure switch, e.g. by closing the unnecessary through-hole 22b-1 for attaching the reset means 10 with a predetermined lid element.

[0073] Furthermore, by the preadjustment with the adjustment means 11, the present embodiment can ensure that the transmission element 62 is positioned to the reset adjustment position P13 by the positioning means 9.

[0074] Further, the present embodiment can ensure that the transmission element 62 is positioned to the reset adjustment position P13 by the positioning means 9 using a method with better operability in which the contact position of the positioning means 9 with the other opposite end side 612 of the coupling element 61 is adjusted by moving it forward and/or backward.

[0075] Moreover, the present embodiment can ensure that the contact position and thereby the transmission element 62 is positioned to the reset adjustment position P13 as described above by the positioning means 9 with better operability with which the free end 922 of the cantilever 92 is moved.

[0076] It is to be noted that the embodiment as described above merely shows representative configurations for the present invention and the present invention is not limited thereto. I.e., the embodiment may be modified and implemented in various manners within a scope which does not depart from the core of the present invention. It is obvious that such modifications are also included in the scope of the present invention as far as they include features of a pressure switch according to the present invention.

[0077] For example, the embodiment as described above shows the pressure switch 1 as an example for

the pressure switch, wherein the pressure switch 1 includes the pair of first terminals 34, 34' and a second terminal 36, wherein the conductive state of the micro-switch 3 as the switching means is switched to perform switching on/off between the three terminals. However, the pressure switch is not limited thereto, and it is possible to adapt a specific switch configuration in an appropriate manner, e.g. how many terminals are used and/or how the conductive state between the terminals is switched via switching the conductive state of the switching means.

[0078] Further, the embodiment as described above shows the pressure switch 1 as an example for the pressure switch, wherein the positioning means 9 positions the transmission element 62 by coming into contact with the back surface of the coupling element 61 on the other opposite end side 612 and pushing it up, the other opposite end side 612 being opposite to the one end side 611 which is pivotably mounted. Furthermore, according to this embodiment, the reset means 10 is configured to separate the positioning means 9 away from the coupling element 61 to release the positioning. However, specific configurations for positioning the transmission element by the positioning means and releasing the positioning by the reset means are not limited thereto, and may be adapted in any manner. However, as described above, the transmission element can be separated from the reset means and offset of the set value can be effectively avoided in the reset state by positioning via the coupling element 61 and/or by releasing the positioning via separation of the positioning means 9 away from the coupling element 61.

[0079] Furthermore, the embodiment as described above shows the pressure switch 1 as an example for the pressure switch, wherein the reset means 10 presses and tilts down the stopper portion 91 of the positioning means 9 to separate it away from the coupling element 61, so that the positioning is released for the transmission element 62. However, also with regard to configurations for separating the positioning means away from the coupling means, it is not limited how it is specifically configured, as long as the separation is possible. However, as described above as well, it is possible to effectively separate the stopper portion 91 away from the coupling element by applying the configuration in which the stopper portion 91 is tilted down.

[0080] Further, the embodiment as described above shows the pressure switch 1 as an example for the pressure switch, wherein the reset means 10 includes the reset button 102 as the bar-shaped portion and the coil spring 103 as the biasing portion. However, the reset means is not limited thereto, and it is not limited how it is specifically configured, as long as it can press and tilt down the stopper portion of the positioning means. However, as described above as well, the operability for the reset means may be increased by including the bar-shaped portion and the biasing portion.

[0081] Moreover, the embodiment as described above

shows the pressure switch 1 as an example for the pressure switch, wherein the reset means 10 is attached by inserting it into the through-hole 22b-1 which is provided in the side section 22b of the box body 22. However, configurations for attaching the reset means are not limited thereto, wherein it may be e.g. configured so that some part inside the enclosure of the pressure switch is used as a casing for the reset means. However, as described above, it is possible to easily attach the reset means 10 by applying the configuration where the reset means 10 is inserted into the through-hole 22b-1. Further, as described above as well, it is possible to easily construct an automatically reset type of pressure switch without attaching the reset means 10, e.g. by closing the through-hole 22b-1 by means of a lid element. Moreover, the embodiment as described above has such a structure that the reset means 10 has two small blind holes 10a with a so-called crab-eye shape in portions exposed to the outside, wherein the reset means 10 is fastened by inserting a dedicated machining tool into the small blind holes 10a. However, the reset means is not limited to the configuration, and may also have a structure with no blind holes in portions exposed to the outside, wherein the reset means has an outer circumference with a polygon shape, such as a regular hexagonal shape, and is configured to be fastened by means of a general purpose tool, such as a box-end wrench. Moreover, the reset means may also have a plane which is formed by partially cutting off a cylindrical part of a portion exposed to the outside in parallel, wherein the reset means is fastened at the plane by means of a general purpose tool, such as a spanner. A fastening method for the reset means is to be adaptively selected e.g. depending on the assemblability and/or fixture strength.

[0082] Further, the embodiment as described above shows the pressure switch 1 as an example for the pressure switch, wherein the adjustment means 11 in the form of adjustment screw is used in order to preadjust the position of the transmission element 62 to the reset adjustment position P13. However, the pressure switch is not limited thereto, and it is also conceivable to structurally complete the adjustment uniquely in a production phase without providing such an adjustment means. However, as described above as well, the preadjustment with the adjustment means can ensure that the transmission element 62 is positioned by the positioning means 9.

[0083] Moreover, the embodiment as described above shows the pressure switch 1 as an example for the pressure switch, wherein the adjustment means 11 moves the contact position of the positioning means 9 with the other opposite end side 612 of the coupling element 61 forward and/or backward in order to perform the preadjustment. However, the pressure switch is not limited thereto, and it is not limited how the preadjustment is specifically configured. However, as described above as well, the positioning the transmission element 62 with the positioning means 9 can be ensured by means of the method with better operability in which the contact posi-

tion of the positioning means 9 is moved forward and/or backward for adjustment.

[0084] Moreover, the embodiment as described above shows the pressure switch 1 as an example for the pressure switch, wherein the adjustment means 11 moves the free end 922 of the cantilever 92 of the positioning means 9 with the stopper portion 91 coupled thereto and thereby moves the contact position of the positioning means 9 forward and/or backward to accomplish the preadjustment. However, the pressure switch is not limited thereto, and it is not limited how it is specifically configured that the contact position of the positioning means 9 is moved forward and/or backward. However, as described above as well, the preadjustment for the position of the transmission element 62 by means of the positioning means 9 can be ensured with better operability with which the free end 922 of the cantilever 92 is moved.

Reference Signs List

[0085]

1	Pressure switch
2	Casing
3	Microswitch
4	Diaphragm assembly
5	Operation element
6	Transmission mechanism
7	Leaf spring
8	Leaf spring adjustment means
9	Positioning means
10	Reset means
11	Adjustment means
22	Box body
22b	Side section (outer wall)
22b-1	Through-hole
31, 32	Fixed electrodes
33	Movable electrode
34	First terminals
35	Conductive connection element
36	Second terminal
44	Diaphragm (pressure-sensitive element)
61	Coupling element
62	Transmission element
63	Shaft element
63a	Center axis
91	Stopper portion
92	Cantilever
101	Cylindrical casing
102	Reset button (bar-shaped portion)
103	Coil spring (biasing portion)
104	Packing
611	One end side
612	Another opposite end side
921	Fixed end
922	Free end
D11	Forward/backward movement direction
D12	Orthogonal direction

- P11 Working point (first position)
 P12 Return point (second position)
 P13 Reset adjustment position (intermediate position)
 P14 Position before reset adjustment

5

Claims

1. A pressure switch comprising:

10

a pressure-sensitive element which partitions a low pressure chamber and a high pressure chamber and is configured to be deflected depending on a pressure variation in the high pressure chamber;

15

a transmission element configured to transmit a deflection of the pressure-sensitive element to a portion in a subsequent stage by moving along a predetermined forward/backward movement direction upon receiving the deflection;

20

a switching means configured to switch its conductive state from a first state into a second state when the transmission element has moved forward to a first position with regard to the forward/backward movement direction, wherein the switching means is further configured to switch its conductive state from the second state into the first state when the transmission element has moved backward to a second position, the second position being located more backward than the first position with regard to the forward/backward movement direction;

25

a positioning means configured to position the transmission element in the forward/backward movement direction at an intermediate position between the first position and the second position in a freely releasable manner; and

30

a reset means configured to release positioning the transmission element by the positioning means to bring the transmission element into a free state in which the transmission element is movable along the forward/backward movement direction.

35

40

2. The pressure switch according to claim 1, comprising:

45

a coupling element configured as a rotation element which is pivotably mounted around a center axis on one end side and movable along the forward/backward movement direction on another opposite end side, wherein the transmission element is coupled to a position on the coupling element far from the center axis, wherein the coupling element is configured to move the transmission element along the forward/backward movement direction by rotation

50

55

at a middle position between the center axis and a coupling portion to the transmission element upon receiving deflection of the pressure-sensitive element,

wherein the positioning means is configured to position the other opposite end side at a position corresponding to the intermediate position of the transmission element by coming into contact with a back surface of the coupling element on the other opposite end side facing backward in the forward/backward movement direction and by pushing up the other opposite end side forward in the forward/backward movement direction, and

wherein the reset means is configured to separate the positioning means away from the back surface on the other opposite end side to release positioning the transmission element.

3. The pressure switch according to claim 1,

wherein the positioning means includes a stopper portion which extends in the forward/backward movement direction, wherein the stopper portion is capable of tilting down in an intersecting direction with regard to the forward/backward movement direction and configured to come into contact with the back surface on the other opposite end side in a standing state, and

wherein the reset means is configured to push the stopper portion in the standing state along the intersecting direction and thereby tilt it down to separate the stopper portion away from the back surface on the other opposite end side.

4. The pressure switch according to claim 3,

wherein the reset means includes a bar-shaped portion and a biasing portion, the bar-shaped portion extending in the intersecting direction and being configured to push the stopper portion with one end, wherein the biasing portion is configured to bias the bar-shaped portion away from the stopper portion.

5. The pressure switch according to any of claims 1 to 4, comprising:

an enclosure with an outer wall having a tubular shape, the enclosure being configured to accommodate the positioning means inside, wherein a through-hole is provided in the outer wall at a position corresponding to the positioning means and the reset means is inserted into the through-hole in the outer wall so as to be oriented from the outer wall toward the positioning means.

6. The pressure switch according to any of claims 1 to 5, comprising:

an adjustment means configured to adjust to which position the positioning means positions the transmission element with regard to the forward/backward movement direction, wherein the positioning means is configured to be preadjusted by the adjustment means so as to position the transmission element at the intermediate position. 5

7. The pressure switch according to claim 6, comprising: 10

a coupling element configured as a rotation element which is pivotably mounted around a center axis on one end side and movable along the forward/backward movement direction on another opposite end side, wherein the transmission element is coupled to a position on the coupling element far from the center axis, wherein the coupling element is configured to move the transmission element along the forward/backward movement direction by rotation at an intermediate position between the center axis and a coupling portion to the transmission element upon receiving deflection of the pressure-sensitive element, 15 20 25

wherein the positioning means is configured to position the other opposite end side at a position corresponding to the intermediate position of the transmission element by coming into contact with a back surface of the coupling element on the other opposite end side facing backward in the forward/backward movement direction and pushing up the other opposite end side forward in the forward/backward movement direction, 30 35

and

wherein the adjustment means is configured to adjust a contact position of the positioning means with the other opposite end side by moving it forward and/or backward in the forward/backward movement direction. 40

8. The pressure switch according to claim 7, wherein the positioning means includes a stopper portion and a cantilever, wherein the stopper portion is configured to come into contact with the back surface on the other opposite end side and is coupled to the cantilever, wherein the cantilever has one end as a fixed end and another end as a free end which is movable with regard to the forward/backward movement direction, and 45 50
- wherein the adjustment means is configured to move the free end with regard to the forward/backward movement direction in order to move the contact position of the stopper portion with the other opposite end side of the coupling element forward and/or backward along the forward/backward movement direction. 55

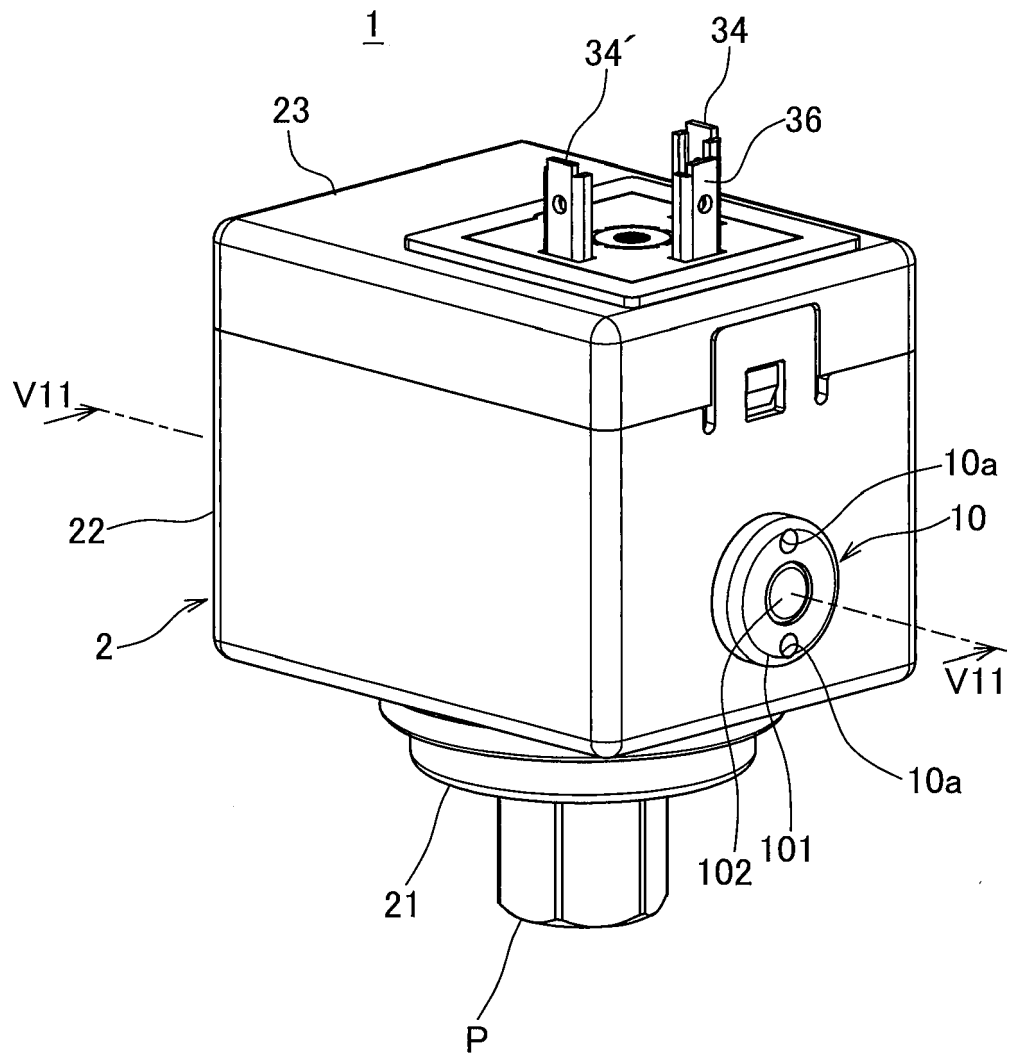


FIG.1

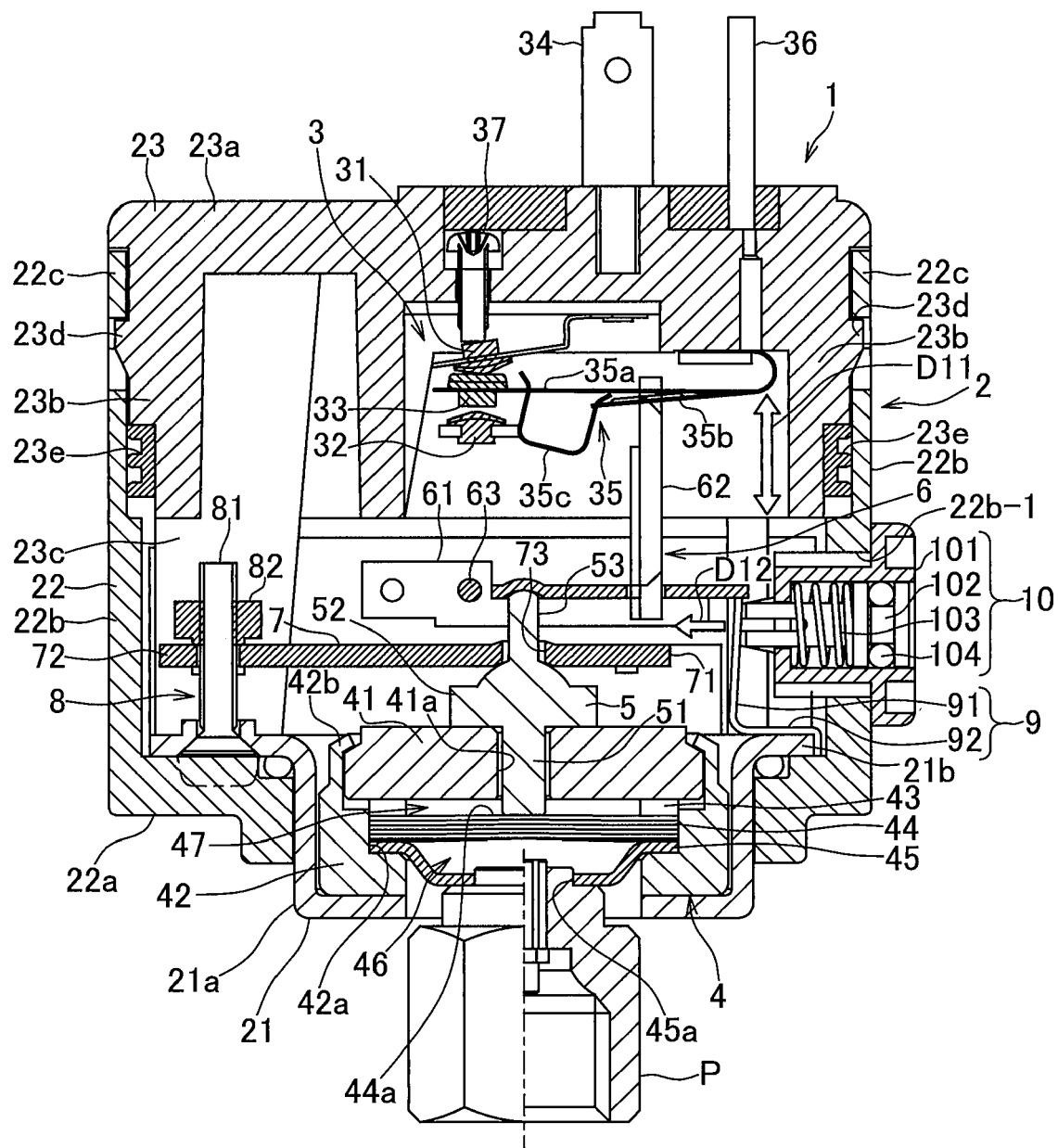


FIG.2

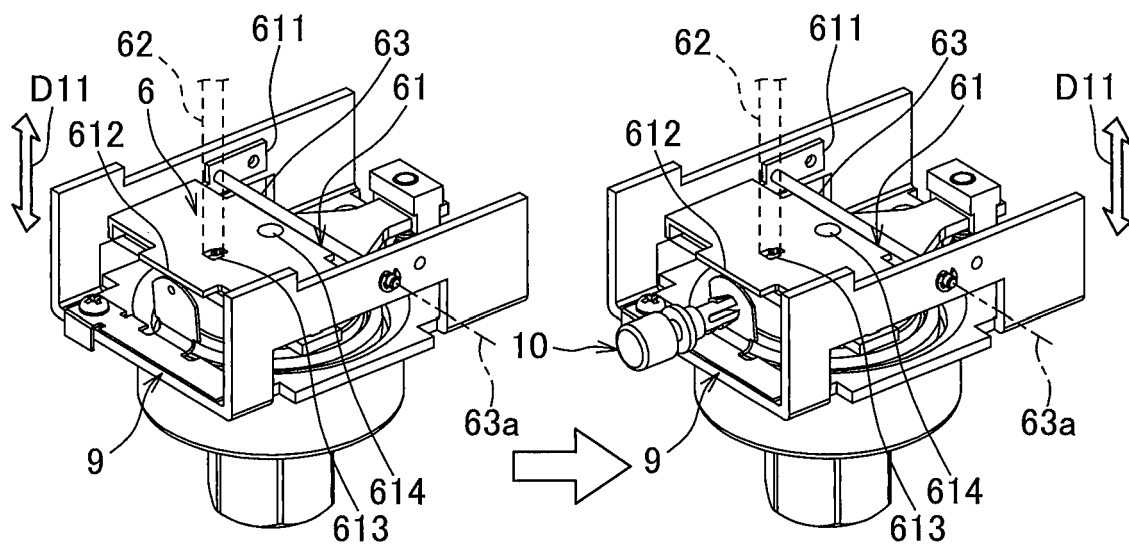


FIG.3

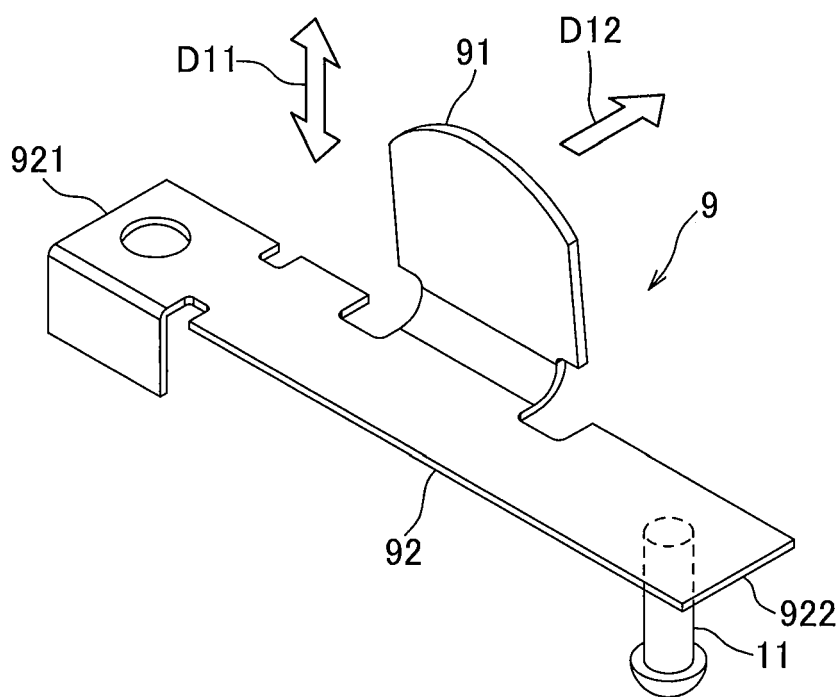
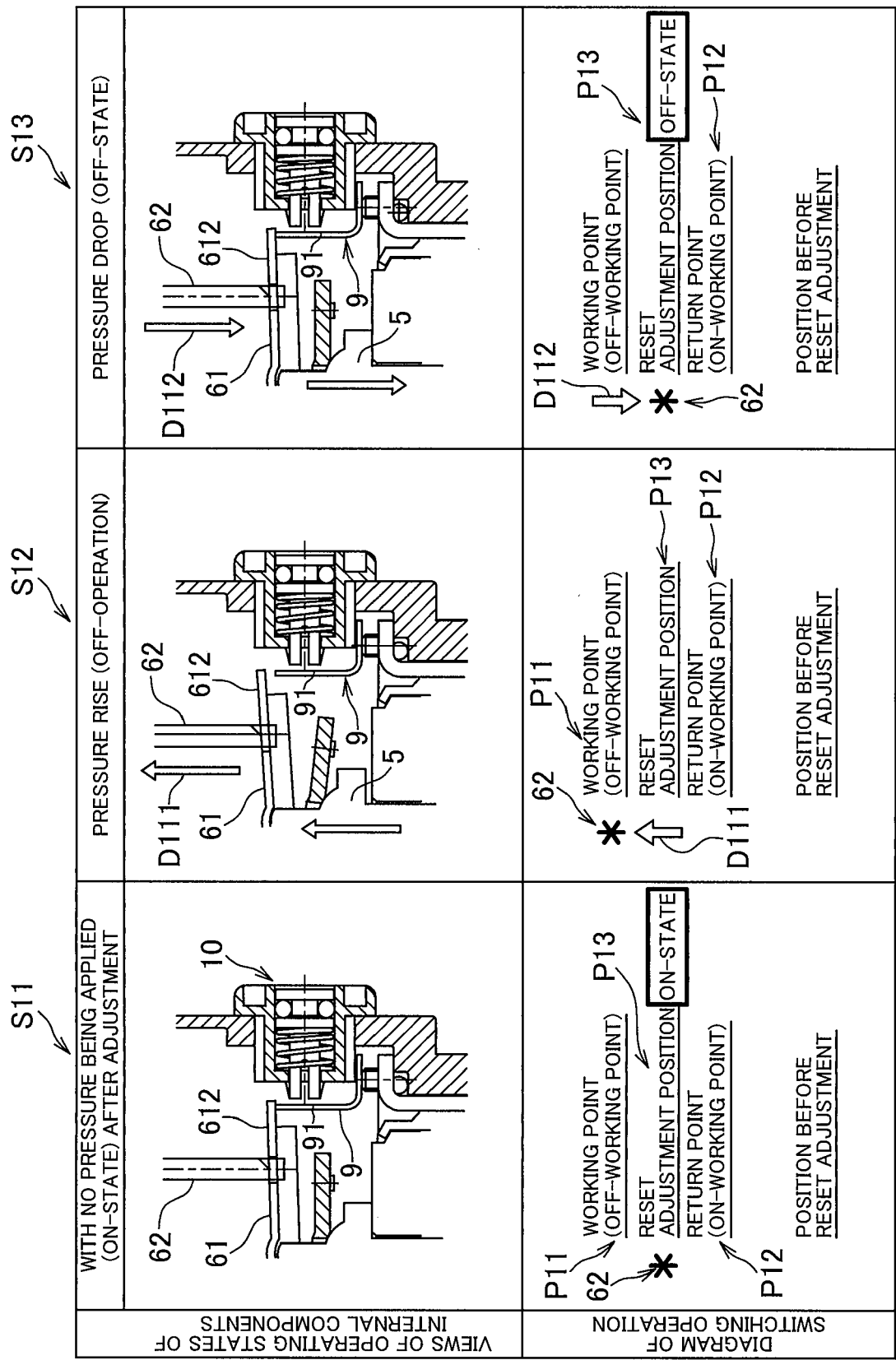
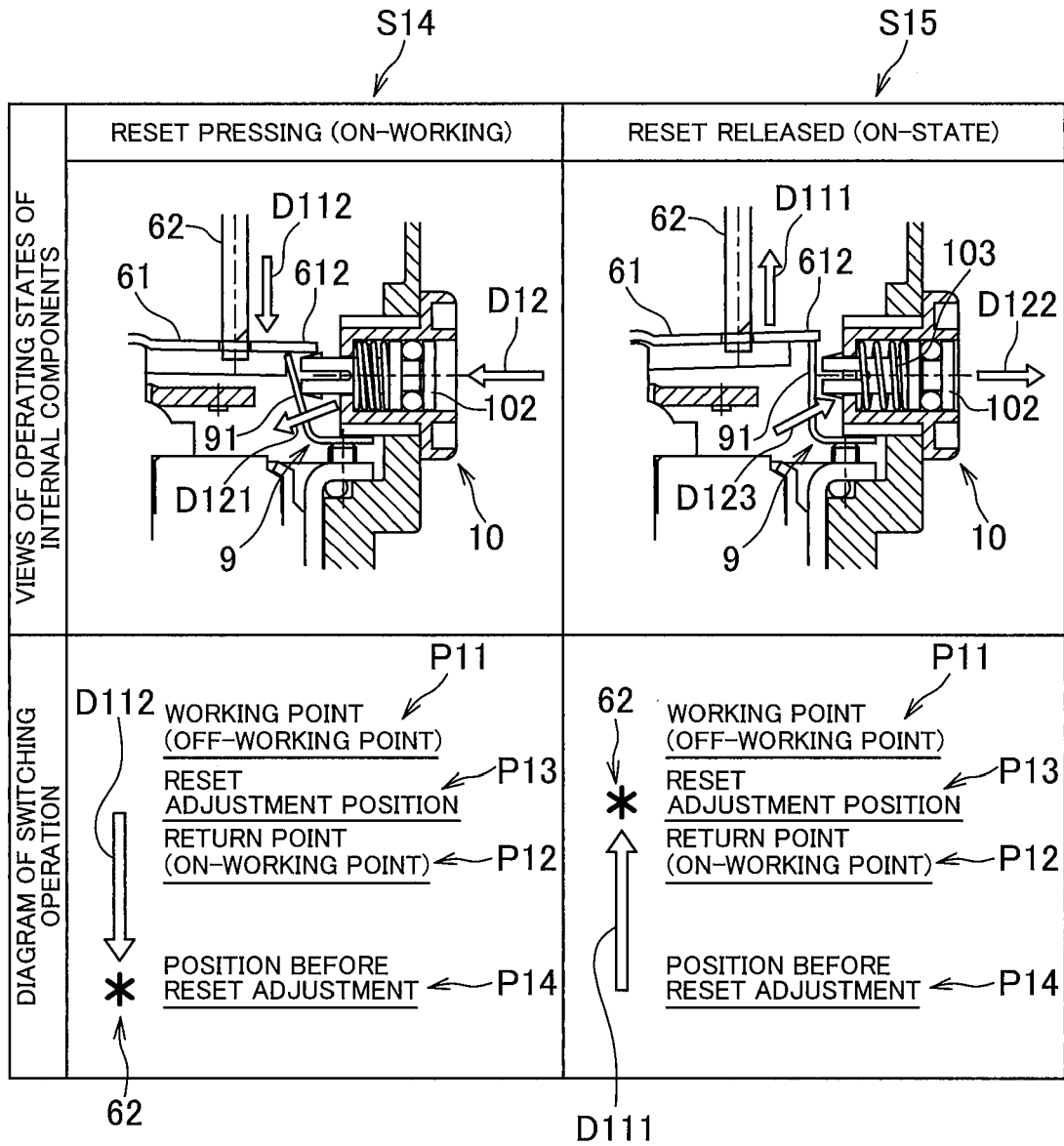


FIG.4



* : TRANSMISSION ELEMENT 62

FIG.5



* : TRANSMISSION ELEMENT 62

FIG.6

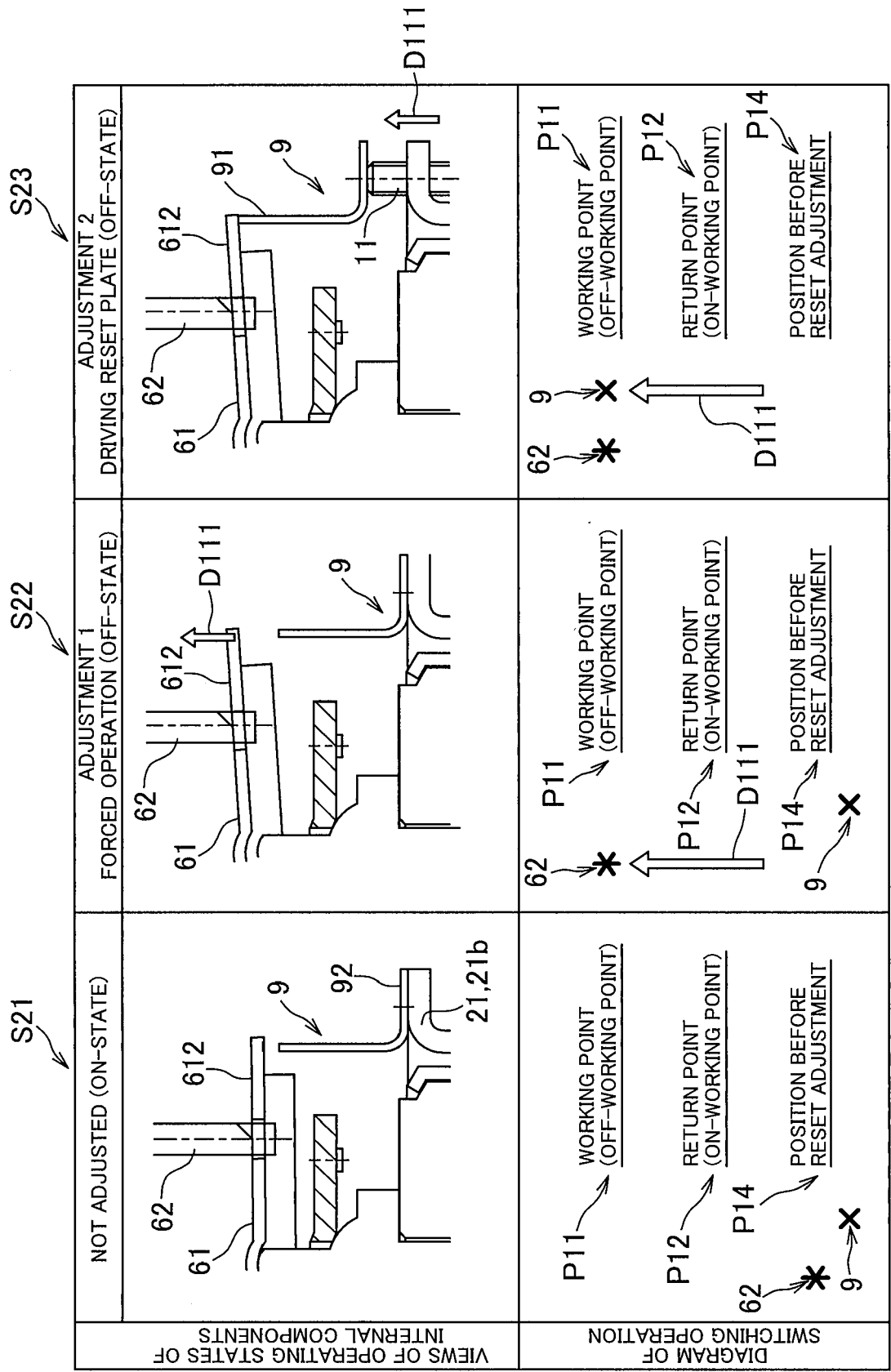
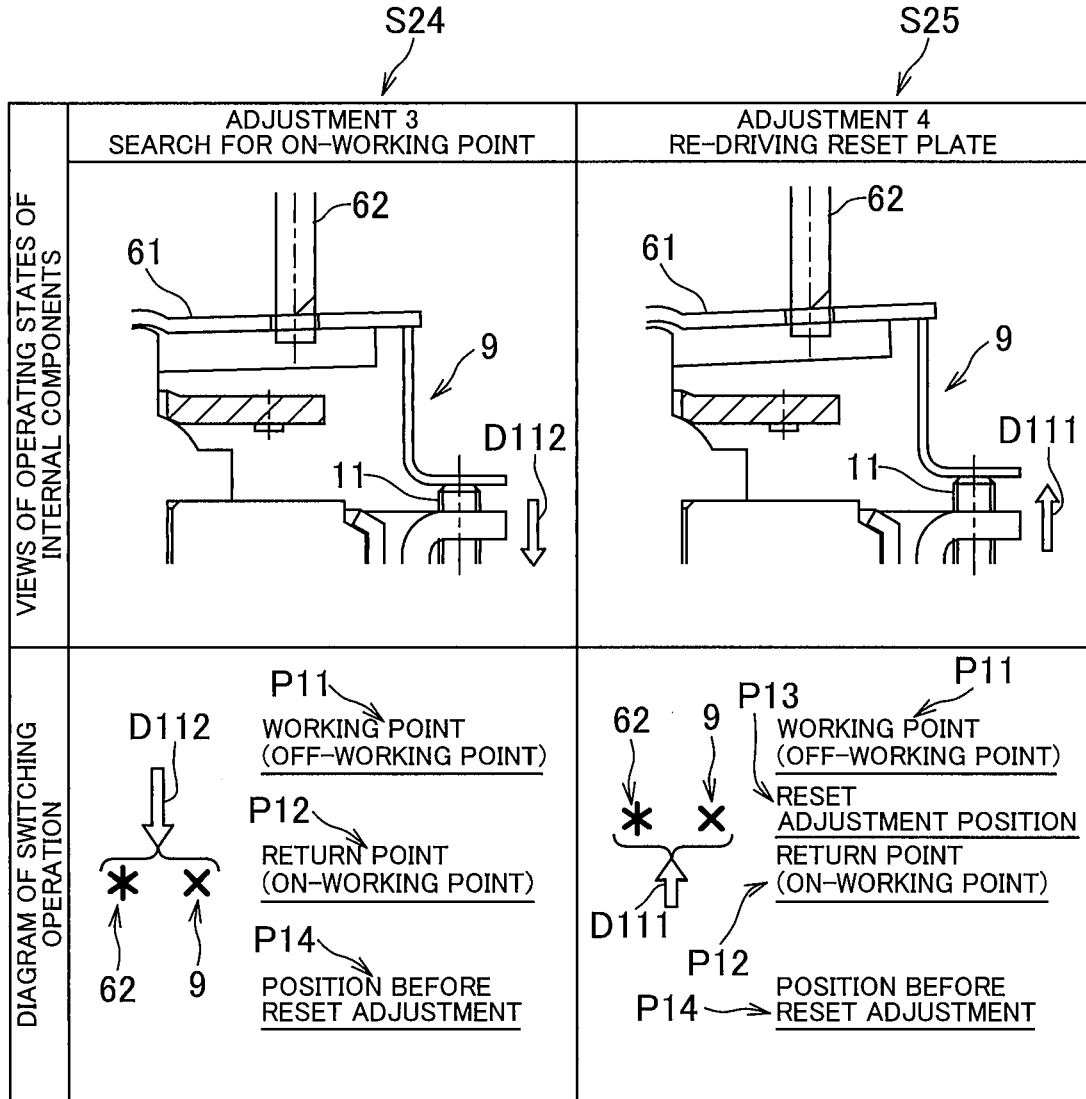


FIG.7

* : TRANSMISSION ELEMENT 62 X : POSITIONING MEANS 9



*: TRANSMISSION ELEMENT 62

✕: POSITIONING MEANS 9

FIG.8



EUROPEAN SEARCH REPORT

 Application Number
 EP 20 19 8846

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2000 348581 A (OMRON TATEISI ELECTRONICS CO) 15 December 2000 (2000-12-15) * abstract; figures 1, 2 *	1-8	INV. H01H35/26 H01H35/34
A	FR 2 264 381 A1 (UNITED GAS INDUSTRIES LTD [GB]) 10 October 1975 (1975-10-10) * page 1, line 37 - page 4, line 8 * * figures 1-3 *	1-8	
A	US 3 267 232 A (CHAPIN HOWARD R) 16 August 1966 (1966-08-16) * column 2, line 8 - column 5, line 2 * * figures 1-3 *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 February 2021	Examiner Ledoux, Serge
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

 1
 EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 19 8846

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-02-2021

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2000348581 A	15-12-2000	NONE	
FR 2264381 A1	10-10-1975	DE 7507607 U DK 99575 A FR 2264381 A1	24-07-1975 03-11-1975 10-10-1975
US 3267232 A	16-08-1966	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP S5313895 U [0003]