(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 772 081 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
02.11.2022 Bulletin 2022/44

(21) Application number: **20187209.0**

(22) Date of filing: **22.07.2020**

(51) International Patent Classification (IPC):
H01H 35/34 *(2006.01)* ***H01H 1/34*** *(2006.01)*
H01H 35/32 *(2006.01)* ***H01H 5/18*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
H01H 35/34; H01H 1/34; H01H 35/2607; H01H 35/2614; H01H 35/265; H01H 35/343; H01H 35/346

(54) **PRESSURE SWITCH**

DRUCKSCHALTER

COMMUTATEUR DE PRESSION

(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

(30) Priority: **31.07.2019 JP 2019141049**

(43) Date of publication of application:
03.02.2021 Bulletin 2021/05

(73) Proprietor: **Saginomiya Seisakusho, Inc.**
Tokyo 165-0033 (JP)

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

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

(56) References cited:
EP-A2- 0 058 409
EP-A2- 0 177 035
WO-A1-2020/012917
FR-A1- 2 717 616
JP-A- 2015 099 781
US-A- 4 703 140

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 3 772 081 B1

Description

BACHGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a pressure switch provided with a pressure-sensitive member such as a diaphragm or a bellows, which partitions a low-pressure chamber and a high-pressure chamber and is displaced by pressure fluctuation in the high-pressure chamber.

Description of the Related Art

[0002] Conventionally, a pressure-responsive switch (pressure switch) for detecting pressure of a fluid such as a refrigerant in a compressor of a refrigeration cycle has been proposed (for example, see Patent Literature 1). The pressure-responsive switch described in Patent Literature 1 includes a joint unit having a bellows (pressure-sensitive member), an operating portion having a coil spring-like operation pressure adjusting spring (biasing member) and an operation lever (switching member), and when the bellows is deformed due to change in pressure, the operation lever rotates against spring force of the operation pressure adjusting spring to switch the switch on and off.

[0003] US 4,703,140 disclose an electric circuit controlling device having a housing and a snap action means for discrete snap action movement between a stable configuration and an unstable configuration thereof. Means is provided in the housing for seating the snap action means, and means is also provided for directly urging the snap action means from the seating means. Force transmitting means is operable generally for initially moving the snap action means into seating engagement with the seating means and for thereafter effecting the discrete snap action movement of the snap action means from the stable configuration toward the unstable configuration.

[0004] FR 2717616 discloses a pressure switch comprising a set of levers, a membrane and a leaf spring urging the levers against the membrane, and a switching member actuated when the membrane presses against the levers so that the force of the leaf spring is overcome. The switching member is directly attached to the leaf spring, without any transmission member.

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Patent Laid-Open No. 2015-99781
Patent Literature 2: United States Patent No 4,703,140
Patent Literature 3: French Patent No 2717616

SUMMARY OF THE INVENTION

[0006] However, in the conventional pressure switch as described in Patent Literature 1, since the coil spring is used as the biasing member, there is a disadvantage that the entire switch tends to be large in an axis direction of the coil spring. Further, if the biasing member is simply downsized, a large force may be locally applied to each member constituting the pressure switch and a contact portion between each member. In this case, the member to which a large force is applied may be worn and the switching characteristics of the switch may change. As described above, it is difficult to reduce the change in the switching characteristics of the switch while reducing the size of the pressure switch.

[0007] The object of the present invention is to provide a pressure switch that can be downsized and reduce changes in the switching characteristics of the switch.

[0008] A pressure switch of the present invention is described in claim 1.

[0009] According to the present invention as described above, it is possible to reduce the size of the entire pressure switch by providing the biasing member with the leaf spring. In addition, the operation member moves along with the displacement of the pressure-sensitive member, and this movement is transmitted to the switching member by the transmission member. At this time, the leaf spring exerts the biasing force on the operation member, thereby avoiding directly exerting the biasing force on the transmission member. As a result, even if the large biasing force acts on the operation member via the leaf spring, it is possible to suppress wear of the transmission member and a member that abuts on the transmission member, and reduce changes in the switching characteristics of the switch.

[0010] At this time, the biasing member has one end side of the leaf spring fixed and the other end side movably supported, and the other end of the leaf spring is preferably provided with an adjusting member to adjust the biasing force to the pressure-sensitive member.

[0011] According to this configuration, the biasing force of the pressure-sensitive member can be adjusted by adjusting the biasing force of the biasing member by the adjusting member, and the range of a pressure value to be detected can be adjusted. Therefore, even if the specifications of the pressure-sensitive member are the same, it is possible to configure a pressure switch that can handle a wide pressure detection range from low-pressure to high-pressure. Further, even if there is variation in the rigidity of pressure-sensitive member due to processing accuracy, by adjusting the biasing force of the biasing member by the adjusting member, the pressure force of the pressure-sensitive member can be adjusted according to a predetermined pressure value, improving detection accuracy.

[0012] Further, the leaf spring has an insertion hole through which the operation member is inserted, and the operation member has a shaft portion penetrating the insertion hole, and has an enlarged-diameter portion on the pressure-sensitive member side more than the shaft portion. It is preferable that the first position is a position where the enlarged-diameter portion of the operation member contacts a peripheral portion of the insertion hole in the leaf spring. According to this structure, the leaf spring allows the biasing force to easily be applied to the operation member.

[0013] Further, the peripheral portion of the insertion hole of the leaf spring is formed in a spherical concave shape, the enlarged-diameter portion of the operation member is formed in a spherical convex shape, and the peripheral portion and the enlarged-diameter portion are preferably configured to be in surface contact or line contact. With this configuration, the peripheral portion of the insertion hole of the leaf spring and the enlarged-diameter portion of the operation member can be stably brought into contact with each other, and the biasing force of the leaf spring can be easily applied to the operation member.

[0014] Further, it is preferable that the first position and the second position are provided on a straight line along the motion direction of the operation member. With this configuration, it is possible to reduce shear stress that acts on the operation member due to displacement of the first position and the second position within a plane orthogonal to the motion direction.

[0015] Further, the transmission member is rotatably provided around a fulcrum, and it is preferable that a second action distance from an action point to the fulcrum of the switching member is set larger than a first action distance from an action point to the fulcrum of the operation member.

[0016] According to this configuration, the movement of the operation member is transmitted to the switching member by the transmission member rotatable about the fulcrum, and the second action distance is set larger than the first action distance. The movement amount of the operation member can thus be amplified and transmitted to the switching member. Therefore, by expanding the movement amount via the transmission member, the range of the pressure value detected by the switching member can be expanded, and the detection accuracy can be further improved. The first action distance and the second action distance refer to a moment arm (distance between the fulcrum and a perpendicular line perpendicular to the force vector) between force point or action point and the fulcrum of each lever. Thus, the movement of the operation member (or the force from the operation member) is transmitted as the amplified movement amount (the force is reduced) to the switching member via the transmission member by principle of leverage.

[0017] Furthermore, the ratio between the first action distance and the second action distance can be preferably configured to be changed. With this configuration, an amplification factor of the movement amount can be changed according to the pressure value to be detected, and the pressure detection range can be widened.

[0018] The pressure-sensitive member is formed of a thin metal plate in an entire disc shape and is composed of a diaphragm having a dome-shaped convex portion that is convex toward the low-pressure chamber. The operation member is provided in contact with the convex portion and movably following the displacement of the diaphragm, and it is preferable that in the initial compressed state in which the convex portion is biased by the biasing member toward the high-pressure chamber side from the natural state, the convex shape of the convex portion is maintained toward the low-pressure chamber.

[0019] According to this configuration, since the pressure-sensitive member is composed of the diaphragm having the dome-shaped convex portion that becomes convex toward the low-pressure chamber, and the convex portion maintains convex shape toward the low-pressure chamber side in the initial compressed state, the diaphragm does not cause a reversing operation, and the diaphragm can be displaced while always having a convex shape on the low-pressure chamber side. Therefore, since a large on/off difference due to the reversing operation does not occur, it is possible to improve the detection accuracy of the pressure value when switching, and it becomes difficult for local deformation and stress concentration in the diaphragm to occur, which makes the product compatible with high-pressure, and the life extended.

[0020] Further, it is preferable that a displacement restricting unit for regulating the displacement of the diaphragm beyond the initial compressed state toward the high-pressure chamber side is provided.

[0021] According to this configuration, restricting the displacement of the diaphragm by the displacement restricting unit makes it possible to prevent the diaphragm from being largely displaced to the side of the high-pressure chamber beyond the initial compressed state, and to prevent the convex portion of the diaphragm from reversing. Furthermore, by applying the biasing force of the biasing member to the diaphragm whose displacement is regulated in the initial compressed state, and by supporting this additional biasing force by the displacement restricting unit, the displacement start pressure of the diaphragm can be increased by the additional force acting on the displacement restricting unit. Therefore, even when the diaphragm having the same specifications is used, it is possible to deal with the pressure detection in a higher-pressure region, and the applicable range of the pressure switch can be expanded.

[0022] According to the pressure switch of the present invention, the biasing member applies the biasing force to the operation member via the leaf spring, so that the pressure switch can be downsized and the change in the switching characteristics of the switch can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a sectional view showing a pressure switch according to an embodiment of the present invention;
FIG. 2 is a cross-sectional view showing an operation of the pressure switch;
Fig. 3 is a perspective view showing an operation member and a biasing member of the pressure switch;
Fig. 4 is a perspective view showing the operation member, a biasing member, and a transmission member of the pressure switch;
Fig. 5 is a cross-sectional view showing a contact mode between the operation member and the biasing member; and
FIG. 6A and 6B are sectional views showing details of the transmission member.

DETAILED DESCRIPTION OF THE PREFFERRED EMBODIMENTS

[0024] A pressure switch according to an embodiment of the present invention will be described with reference to FIGS. 1 to 6B. As shown in FIG. 1, a pressure switch 1 according to the present embodiment includes a case 2 having an overall box shape, a micro switch 3 as a switching member provided on a top of the case 2, and a diaphragm assembly 4 fixed to a bottom of the case 2. Further, the pressure switch 1 includes an operation member 5 which is supported to move up and down with respect to the diaphragm assembly 4, a transmission member 6 for transmitting movement of the operation member 5 to the micro switch 3, and a leaf spring 7 as a biasing member for urging a diaphragm (pressure-sensitive member) 44 of the diaphragm assembly 4 to apply an initial compression force, and an adjusting member 8 for adjusting the biasing force of the leaf spring 7.

[0025] The case 2 includes a metal base body 21, a box body 22 that holds the base body 21 inside, and a lid body 23 that is attached by closing an upper opening of the box body 22. As shown in FIGS. 3 and 4, the base body 21 has and is integrally formed of, a bottomed cylindrical tubular portion 21a, a flat plate portion 21b continuously extending outward in the horizontal direction from the upper end of the tubular portion 21a, and a pair of upright plate portions 21c that is provided upright from both end edges of the flat plate portion 21b. The diaphragm assembly 4 is supported inside the tubular portion 21a, and a joint member P is connected to the diaphragm assembly 4 through an opening provided at the center of the bottom surface of the tubular portion 21a.

[0026] The box body 22 is formed in a rectangular tube shape as a whole, and the cylindrical body portion 21a is inserted into a circular opening provided in the bottom surface portion 22a to hold the base body 21. A plurality of locking portions 22c is formed on the side surface portion 22b of the box body 22. The lid body 23 has a top plate portion 23a, a square annular ring portion 23b inserted into the box body 22 along the side surface portion 22b, and a hanging down piece 23c extending downward from the four corners of the ring portion 23b and abutting on a flat plate portion 21b of the base body 21. The annular portion 23b is provided with a locking claw 23d that locks with the locking portion 22c of the box body 22. On the inner surface of the side surface portion 22b of the box body 22, an annular water stop portion 23e is provided that is in close contact with the annular portion 23b.

[0027] The micro switch 3 is provided inside the lid body 23 of the case 2, and is provided with a pair of fixed electrodes 31 and 32 that is vertically opposed to each other inside the lid body 23, and a movable electrode 33 freely movable between the upper and lower fixed electrodes 31 and 32. Further, the micro switch 3 is provided with a pair of first terminals 34 and 34 ' connected to the pair of fixed electrodes 31 and 32 and extending outside the lid body 23, a conduction member 35 formed of a leaf spring to which the movable electrode 33 is joined, a second terminal 36 connected to the conduction member 35 and extending outside the lid body 23, and an adjusting screw 37 for adjusting a position of the upper fixed electrode 31. The conductive member 35 includes a conductive piece 35a extending from the second terminal 36 and having the movable electrode 33 fixed at its tip, a movable piece 35b extending from the second terminal 36 to have the transmission member 6 connected to an intermediate portion thereof, and a snap piece 35c for urging the movable electrode 33 toward one of the fixed electrodes 31 and 32. The micro switch 3 is configured to detect a low pressure state in which the movable electrode 33 contacts the upper fixed electrode 31 to conduct them and a high pressure state in which the movable electrode 33 contacts the lower fixed electrode 32 to conduct them, and to switch depending on the difference in the conduction state.

[0028] The diaphragm assembly 4 includes an upper holding plate 41 and a lower holding plate 42 supported by the tubular portion 21a of the base body 21, a spacer 43 held between the upper holding plate 41 and the lower holding plate 42, a diaphragm 44, and a bottom plate member 45. The upper holding plate 41 is formed in an entire disc shape, and has an insertion hole 41a that vertically penetrates through the central portion of the upper holding plate 41 to insert therethrough and guide the operation member 5 in the vertical direction. The lower holding plate 42 is formed into a cylindrical shape as a whole, and has a step portion 42a for holding the spacer 43, the diaphragm 44 and the bottom plate member 45, and a swaged piece 42b extending upward and fixing the upper holding plate 41 by caulking. The diaphragm assembly 4 sandwiches the spacer 43, the diaphragm 44 and the bottom plate member 45 between the upper holding plate 41 and the step portion 42a of the lower holding plate 42 and swages the swaged piece 42b inward, so as to hold

the diaphragm 44 and the peripheral portion of the bottom plate member 45 between the upper holding plate 41 and the lower holding plate 42.

[0029] The diaphragm 44 is formed by stacking a plurality of metal thin plate materials into an entire disc shape and has a dome-shaped convex portion 44a that is convex upward in natural state. The bottom plate member 45 is formed in a plate shape in which a central portion bulges downward from a metal plate material having an entire disc shape, and a through hole 45a for fixing a joint member P is formed in the central portion. The diaphragm 44 and the bottom plate member 45 are joined to each other by welding or the like so as to ensure airtightness and pressure resistance. In the diaphragm assembly 4, a high-pressure chamber 46 is formed by a space surrounded by the diaphragm 44 and the bottom plate member 45, and a high-pressure fluid flows into the high-pressure chamber 46 via the joint member P. Further, a low-pressure chamber 47 is formed by a space surrounded by the diaphragm 44, the spacer 43, and the upper holding plate 41, and the low-pressure chamber 47 communicates with an internal space of the box body 22 through the insertion hole 41a, so that an internal pressure is the same as the atmospheric pressure. Therefore, the diaphragm 44, which is a pressure-sensitive member, is configured to be vertically displaced according to pressure fluctuation of the high-pressure fluid flowing into the high-pressure chamber 46.

[0030] The operation member 5 includes a first shaft portion 51 that extends vertically and is inserted into the insertion hole 41a of the upper holding plate 41, and an enlarged-diameter portion 52 that is horizontally enlarged along the upper surface of the upper holding plate 41 and a second shaft portion 53 that extends upward from the enlarged-diameter portion 52. The operation member 5 is provided to be supported movably to go back and forth in the vertical direction by the first shaft portion 51 being guided by the insertion hole 41a, such that a lower end of the first shaft portion 51 contacts the center of the convex portion 44a of the diaphragm 44. Therefore, the operation member 5 moves up and down in accordance with the displacement of the diaphragm 44, and the diaphragm 44 is biased toward the high-pressure chamber 46 by the operation member 5 which receives the biasing force of the leaf spring 7, applying an initial compression force to the diaphragm 44.

[0031] The enlarged-diameter portion 52 is provided so that a lower surface thereof can come into contact with the upper surface of the upper holding plate 41 in order to restrict the operation member 5 from moving below this contact position. Therefore, the diaphragm 44 is restricted of displacement beyond the initial compressed state toward the high-pressure chamber 46 side. That is, the enlarged-diameter portion 52 constitutes a displacement restricting unit. As shown in FIG. 5, a spherical convex portion 52a having a spherical convex shape is provided on the upper surface of the enlarged-diameter portion 52, and the spherical portion 52a contacts the leaf spring 7. That is, a position where the spherical portion 52a and the leaf spring 7 contact and the biasing force acts is a first position. An upper end of the second shaft portion 53 is chamfered in a spherical shape, and the upper end comes into contact with a contacted portion 61c of the transmission member 6 described later. That is, a position where the upper end of the second shaft portion 53 and the contacted portion 61c of the transmission member 6 contact and the movement is transmitted is a second position.

[0032] The first position where the biasing force acts as described above and the second position where the movement is transmitted are separated from each other and are aligned in an axial direction of the first shaft portion 51 and the second shaft portion 53. That is, they are provided on a straight line along the motion direction of the operation member 5.

[0033] The transmission member 6 includes a first transmission member 61 formed of a metal plate material, a second transmission member 62, and a shaft member 63 that rotatably supports a first transmission member 61. The first transmission member 61 is formed having an opposed plate portion 61a facing above the diaphragm assembly 4 with the leaf spring 7 interposed therebetween, and a pair of left and right support plate portions 61b extending vertically from both end edges of the opposed plate portion 61a. The opposed plate portion 61a is provided with a contacted portion 61c with which the second shaft portion 53 of the operation member 5 abuts from below, and a connection portion 61d to which the second transmission member 62 is connected. The pair of support plate portions 61b is provided with two shaft support holes 61e and 61f, respectively, into which the shaft member 63 can be inserted. In the shaft member 63, the tips of both ends inserted into the shaft support hole 61e or the shaft support hole 61f are connected to the upright plate portion 21c of the base body 21, and the shaft member 63 causes the first transmission member 61 to be supported rotatably with respect to the base body 21. The second transmission member 62 extends upward from the connection portion 61d, and the upper end portion thereof is engaged with the movable piece 35b of the conduction member 35 of the micro switch 3.

[0034] As shown in FIG. 3, the leaf spring 7 is formed in a triangular shape in a plan view, and one end portion 71 formed of a portion including one side and both end angles is fixed to the upright plate portion 21c of the base body 21, and the other end 72 formed of a portion including another corner is connected to the adjusting member 8. An insertion hole 73 through which the second shaft portion 53 of the operation member 5 is inserted is provided at a substantially central portion of the leaf spring 7 in a plan view, and the spherical portion 52a of the operation member 5 with respect to a peripheral lower surface 73 a of the insertion hole 73 is configured to be in contact with each other. At this time, the peripheral lower surface 73a of the peripheral portion is formed in a spherical concave shape, and the peripheral lower sur-

face 73a and the spherical portion 52a contact in surface or line.

[0035] The adjusting member 8 is configured to include an adjusting screw 81 penetrating the flat portion 21b of the base body 21, and a slider 82 that is provided in contact with the upper surface of the leaf spring 7 and to be screwed into the adjusting screw 81 penetrating the leaf spring 7. The adjusting screw 81 can be rotationally operated from the lower side of the flat plate portion 21b before the box body 22 and the base body 21 are assembled together, and the slider 82 is supported in the case 2 rotatably and slidably in vertical direction. The slider 82 is configured to move up and down by rotating the adjusting screw 81. Therefore, when the adjusting screw 81 is tightened to move the slider 82 downward, the other end 72 of the leaf spring 7 is lowered, and when the adjusting screw 81 is loosened to move the slider 82 upward, the other end 72 of the leaf spring 7 is raised so that the biasing force of the leaf spring 7 is adjusted. The biasing force of the leaf spring 7 is transmitted to the diaphragm 44 via the operation member 5, and the convex portion 44a of the diaphragm 44 is pressed downward to apply an initial compression force.

[0036] The operation of the pressure switch 1 will be described with reference to FIGS. 1 and 2. FIG. 1 is a diagram showing the pressure switch 1 in a low-pressure state in which the refrigerant pressure in the high-pressure chamber 46 is lower than a first threshold value, and FIG. 2 is in a high-pressure state in which the refrigerant pressure in the high-pressure chamber 46 is higher than a second threshold value.

[0037] In the low-pressure state shown in FIG. 1, the biasing force of the leaf spring 7 acts on the operation member 5, so that the biasing force acts on the diaphragm 44 via the operation member 5 and the convex portion 44a is pressed downward so that the diaphragm 44 is displaced downward. At this time, since the second transmission member 62 is located below, the conductive piece 35a of the micro switch 3 is biased upward by a snap piece 35c, and the movable electrode 33 fixed to the conductive piece 35a abuts on the upper fixed electrode 31. As a result, a state in the low-pressure state is detected. On the other hand, the diaphragm 44 is displaced downward from the natural state by a predetermined initial displacement amount, and an initial compression force corresponding to this displacement amount is applied. In such initial compressed state, the convex portion 44a of the diaphragm 44 is not inverted to the high-pressure chamber 46 side, but the convex shape to the low-pressure chamber 46 side is maintained. Further, in the low-pressure state, the lower surface of the enlarged-diameter portion 52 of the operation member 5 contacts the upper surface of the upper holding plate 41.

[0038] Next, when the refrigerant pressure in the high-pressure chamber 46 rises and the pressure acts on the diaphragm 44, the operation member 5 moves upward against the biasing force of the leaf spring 7 as the diaphragm 44 displaces, and the first transmission member 61 rotates about the shaft member 63, and the second transmission member 62 moves upward via the first transmission member 61. Even if the second transmission member 62 moves upward, the movable electrode 33 fixed to the conduction piece 35a biased upward by the snap piece 35c contacts the upper fixed electrode 31 until the deformation amount of the snap piece 35c of the micro switch 3 reaches a certain amount, and the low-pressure state is thus continuously detected.

[0039] Furthermore, when the refrigerant pressure in the high-pressure chamber 46 rises and exceeds the second threshold value, the second transmission member 62 moves further upward as the displacement of the diaphragm 44 increases, and the snap pieces 35c whose amount of deformation exceeds a certain amount is reversed and a downward biasing force acts on the conductive piece 35a as shown in FIG. 2, and the movable electrode 33 fixed to the conductive piece 35a contacts the lower fixed electrode 32. As the movable electrode 33 and the lower fixed electrode 32 are electrically connected, the micro switch 3 detects that the refrigerant pressure has exceeded the second threshold value and is switched to the high-pressure state. Here, even if the refrigerant pressure in the high-pressure chamber 46 falls below the second threshold value and the second transmission member 62 starts moving downward, the snap piece 35c reverses not immediately but with a slight delay. That is, the shape and biasing force of the piece 35c are set such that the displacement and pressure of the operating position (reversal position of the snap piece 35c) when the pressure rises become slightly larger than the displacement and pressure of the operating position (reverse reversal position of the snap piece 35c) when the pressure decreases.

[0040] The deformation mode of the leaf spring 7 in the operation of the pressure switch 1 as described above will be described. First, in the low-pressure state shown in FIG. 1, it extends along a plane substantially orthogonal to the axial direction of the first shaft portion 51 and the second shaft portion 53 of the operation member 5. That is, the leaf spring 7 is along an orthogonal surface (intersection surface) that is substantially orthogonal to the motion direction of the operation member 5. When the operation member 5 moves from the low-pressure state, the leaf spring 7, as immovable as the end portions 71 and 72 on both sides are held, bends and deforms to project upward about the first position which is the pressure receiving position. In addition, in the low-pressure state, the leaf spring 7 may be slightly deformed upward from the flat state.

[0041] The transmission mechanism by the transmission member 6 in the operation of the pressure switch 1 as described above will be described based on FIGS. 6A and 6B. FIG. 6A shows a state in which the shaft member 63 is inserted into the right shaft support hole 61e of the two shaft support holes 61e and 61f in the support plate portion 61b. The opposed plate portion 61a is provided

so as to be rotatable around the center of the shaft member 63 as a fulcrum, and the second position, which is the contact position with the second shaft portion 53, serves as action point for the operation member 5 and the distance from the fulcrum to the action point on the operation member 5 is referred to as a first action distance L1.

[0042] A connection portion of the opposed plate portion 61a that is connected to the second transmission member 62 serves as the action point for the micro switch 3 as the switching member, and the distance from the fulcrum to the action point for the micro switch 3 is a second action distance L2. The action distances L1 and L2 refer to the distance from the fulcrum to the center of each action point, and mean moment arm (the distance from the fulcrum to the perpendicular line perpendicular to the force vector) between the action point and the fulcrum in the lever.

[0043] The second action distance L2 is set larger than the first action distance L1 (L1 <L2). Therefore, the moving amount of the second transmission member 62 becomes larger than the moving amount of the operation member 5 moving up and down due to the displacement of the diaphragm 44, and the displacement of the diaphragm 44 is supposed to be amplified by the first transmission member 61 and is transmitted to the micro switch 3.

[0044] FIG. 6B shows a state in which the shaft member 63 is inserted into the left shaft support hole 61f of the two shaft support holes 61e and 61f in the support plate portion 61b. The first action distance L3 when the left shaft support hole 61f is used is larger than the first action distance L1 when the right shaft support hole 61e is used by the center-to-center distance between the shaft support holes 61e and 61f. Further, the second action distance L4 when the left shaft supporting hole 61f is used is larger than the second action distance L2 when the right shaft supporting hole 61e is used by the center-to-center distance between the shaft supporting holes 61e and 61f.

[0045] Even when the left shaft support hole 61f is used, the second action distance L4 is set larger than the first action distance L3 (L3 <L4). The amplification factor (L4/L3) of the movement amount when the left shaft support hole 61f is used is smaller than the amplification amount (L2/L1) of the movement amount when the right shaft support hole 61e is used. As described above, the ratio between the first action distance and the second action distance is different between the case where the left side shaft support hole 61f is used and the case where the right side shaft support hole 61e is used, and this ratio can be changed depending on which one is used.

[0046] According to the present embodiment described above, by using the leaf spring 7 as the biasing member, the pressure switch 1 as a whole can be downsized, and particularly it is easy to downsize in the motion direction of the operation member 5. Further, since the leaf spring 7 exerts an biasing force on the operation member 5 and the biasing force does not directly act on the transmission member 6, it is possible to suppress wear where the contacted portion 61c of the transmission member 6 and the second shaft portion 53 of the operation member 5 contact each other even when the leaf spring 7 exerts a large biasing force on the operation member 5. Further, the wear of the shaft member 63 and the two shaft support holes 61e and 61f can be suppressed at the same time. As a result, it is possible to reduce the change in the switching characteristics of the micro switch 3.

[0047] Further, since the one end 71 of the leaf spring 7 is fixed and the other end 72 is provided with the adjusting member 8, adjustment of the biasing force of the diaphragm 44 by the biasing force of the leaf spring 7 can adjust the pressure force of the diaphragm 44, adjusting a range of the pressure value to be detected. Therefore, even if the specifications of the diaphragm 44 are the same, the pressure switch 1 that can handle a wide pressure detection range from low-pressure to high-pressure can be configured. Even if there is variation in the rigidity of the diaphragm 44 due to machining accuracy the adjusting member 8 adjusts the biasing force of the biasing member to adjust the pressure force of the diaphragm 44 according to a predetermined pressure value. Therefore, the detection accuracy can be improved.

[0048] Further, the leaf spring 7 has an insertion hole 73, the operation member 5 has a second shaft portion 53 and an enlarged-diameter portion 52, and the enlarged-diameter portion 52 abuts on the peripheral lower surface 73a of the insertion hole 73. Thus, the leaf spring 7 makes it easy to apply a biasing force to the operation member 5.

[0049] Further, the peripheral lower surface 73a of the insertion hole 73 of the leaf spring 7 is formed in a spherical concave shape, and the spherical portion 52a of the spherical convex shape is formed on the upper surface of the enlarged-diameter portion 52, and the peripheral lower surface 73a and the spherical portion 52a can contact by surface or line. Thus, the peripheral lower surface 73a and the spherical portion 52a can be stably contacted, and the biasing force of the leaf spring 7 can be easily applied to the operation member 5.

[0050] Further, the first position where the leaf spring 7 applies a biasing force to the operation member 5 and the second position where the movement of the operation member 5 is transmitted to the transmission member 6 are provided on a straight line along the motion direction of the operation member 5. Thus, it is possible to reduce the shear stress acting on the operation member 5 due to the displacement of the first position and the second position in the plane orthogonal to the motion direction.

[0051] Further, the transmission member 6 is rotatably provided around the shaft member 63, and the second action distance L2 (L4) to the shaft member 63 from the action point on the micro switch 3 to the shaft member 63 is set larger than the action distance L1 (L3) from the

action point on the operation member 5 to the shaft member 63. Thus, the movement amount of the operation member 5 can be amplified and transmitted to the micro switch 3. Therefore, the amplification of the movement amount via the transmission member 6 can expand the range of the pressure value detected by the micro switch 3, and further improve the detection accuracy.

[0052] Furthermore, since the ratio of the first action distance L1, L3 and the second action distance L2, L4 is configured to be changeable, the amplification factor of the movement amount can be changed according to the pressure value to be detected. Therefore, the pressure detection range can be widened.

[0053] Further, the diaphragm 44 has a dome-shaped convex portion 44a that is convex toward the low-pressure chamber 47, and the convex portion 44a maintains the convex shape toward the low-pressure chamber 47 side in the initial compressed state. The diaphragm 44 does not cause a reversing operation, and the diaphragm 44 can always be displaced while being convex toward the low-pressure chamber 47 side. Therefore, since a large on/off difference due to the reversing operation does not occur, it is possible to improve the detection accuracy of the pressure value when switching the switch, and it becomes difficult for locally deformation or stress concentration in the diaphragm 44 to occur, so that high-pressuring of the product and a longer life can be achieved.

[0054] Further, since the enlarged-diameter portion 52 is provided as the displacement restricting unit that restricts the diaphragm 44 from moving beyond the initial compressed state toward the high-pressure chamber 46 side, the diaphragm 44 can be prevented from being largely displaced to the side of the high-pressure chamber 46 exceeding the initial compressed state, and the convex portion 44a of the diaphragm can be prevented from being reversed. Further, the biasing force of the leaf spring 7 is further applied to the diaphragm 44 whose displacement is restricted in the initial compressed state, and the additional biasing force is supported by the enlarged-diameter portion 52, thereby increasing the displacement start pressure of the diaphragm 44 by the amount of the additional biasing force acting on the enlarged-diameter portion 52. Therefore, even when the diaphragm 44 having the same specifications are used, it is possible to deal with pressure detection in a higher-pressure region, and the applicable range of the pressure switch 1 can be expanded.

[0055] The present invention is not limited to the above-described embodiment, but includes other configurations and the like that can achieve the object of the present invention, and the following modifications and the like are also included in the present invention. For example, in the above-described embodiment, the one end 71 of the leaf spring 7 is fixed and the other end 72 is provided with the adjusting member 8. However, providing the adjusting member at both ends may adjust the biasing force. If a wide pressure detection range is not required, both ends of the leaf spring may be configured to be fixed so that the biasing force cannot be adjusted.

[0056] Further, though in the above-described embodiment, the peripheral lower surface with spherical concave shape 73a of the leaf spring 7 and the spherical portion with spherical convex shape 52a of the operation member 5 are brought into contact with each other by surface contact or line contact, the invention is not limited to such configuration. For example, by forming the peripheral portion of the insertion hole in the leaf spring in a convex shape and forming the upper surface of the enlarged-diameter portion in a concave shape, the convex portion and the concave portion may be brought into contact with each other by surface contact or line contact. Further, for the purpose of further improving wear resistance, a receiving member formed of a material having excellent wear resistance may be interposed between the leaf spring and the operation member and contact by surface contact or line contact. Further, the contact between the leaf spring and the operation member may be stabilized by forming a concavo-convex portion in which the leaf spring and the enlarged-diameter portion are fitted to each other at a position different from the insertion hole. Also, when the amount of deformation of the leaf spring is small and the contact position between the leaf spring and the operation member is difficult to shift, the peripheral portion of the insertion hole and the upper surface of the enlarged-diameter portion may be configured to contact with each other in point-like, or flat surface contact.

[0057] Further, in the above-described embodiment, the leaf spring 7 has the insertion hole 73, the operation member 5 has the second shaft portion 53 and the enlarged-diameter portion 52, and the enlarged-diameter portion 52 abuts on the peripheral lower surface 73a of the insertion hole 73. However, the manner of contact between the leaf spring and the operation member is not limited to this. For example, a notch may be formed in the leaf spring and the peripheral portion of the notch may be in contact with the operation member, or an edge portion of the leaf spring may be in contact with the operation member. Further, the biasing force may be applied by fixing a part of the leaf spring to the operation member.

[0058] Further, in the above-described embodiment, the first position where the leaf spring 7 applies the biasing force to the operation member 5, and the second position where the movement of the operation member 5 is transmitted to the transmission member 6 are assumed to be provided on a straight line along the motion direction of the operation member 5. However, the relationship between the first position and the second position may be appropriately set according to the size, shape, arrangement, etc. of each part of the pressure switch, but does not need to be provided on a straight line along the motion direction of the operation member.

[0059] Further, in the above-described embodiment, the ratio of the first action distances L1 and L3 and the

second action distances L2 and L4 is configured to be changeable in two steps. However, the ratio can be changed in three or more steps. Alternatively, the shaft support hole may be a long hole so that the ratio can be changed steplessly. Further, when a wide pressure detection range is not required, the ratio of action distances may not be changeable.

[0060] Further, in the above-described embodiment, the second action distance L2 (L4) is set to be larger than the first action distance L1 (L3), and the movement amount of the operation member 5 is amplified. When wide pressure detection_range is not required, the movement amount may not be amplified, that is, the ratio of the action distances may be substantially equal to each other, or the second action distance may be smaller than the first action distance.

[0061] Further, in the above-described embodiment, the diaphragm 44 is configured by stacking a plurality of metal thin plate materials, but the diaphragm 44 is not limited to this, and the diaphragm is configured by one metal thin plate material. According to the diaphragm formed of one sheet metal material, the structure can be simplified and the on/off difference due to hysteresis can be reduced. Further, although the peripheral edge of the diaphragm 44 of the above-described embodiment is held between the upper holding plate 41 and the lower holding plate 42, the present invention is not limited to this, and the peripheral edge of the diaphragm and the case such as the bottom plate member 45 may be integrally joined by welding.

[0062] The pressure-sensitive member that divides the low-pressure chamber and the high-pressure chamber and is displaced by pressure fluctuation is not limited to the diaphragm, and may be a bellows or the like, and these may be appropriately combined.

Reference Signs List

[0063]

1	pressure switch
3	micro switch (switching member)
44	diaphragm (pressure-sensitive member)
44a	convex portion
46	high-pressure chamber
47	low-pressure chamber
5	operation member
52	enlarged-diameter portion (displacement restricting unit)
52a	spherical portion
53	second shaft portion
6	transmission member
63	shaft member
7	leaf springs (biasing member)
71	one end
72	other end
73	insertion hole
73a	peripheral lower surface
8	adjusting member

Claims

1. A pressure switch (1) comprising:

a pressure-sensitive member (44) that divides a low-pressure chamber (47) and a high-pressure chamber (46) and is displaced by pressure fluctuation in the high-pressure chamber (46), is adapted to be in contact with a high-pressure fluid;
an operation member (5) that is provided in the low-pressure chamber (47) and moves with displacement of the pressure-sensitive member (44);
a switching member (3) for switching a switch with movement of the operation member (5);
a transmission member (6) for transmitting the movement of the operation member (5) to the switching member (3); and
a biasing member (7) for biasing the operation member (5) toward the high-pressure chamber (46) to apply an initial compression force to the pressure-sensitive member (44), wherein the biasing member (7) has a leaf spring (7) that applies a biasing force to the operation member (5) at a first position along an intersecting surface intersecting a motion direction of the operation member (5), the biasing force of the leaf spring (7) is applied to the pressure-sensitive member (44) via the operation member (5), and wherein

the movement of the operation member (5) is transmitted to the transmission member (6) at a second position separated from the first position.

2. The pressure switch (1) according to claim 1, wherein
the biasing member (7) has one end (71) side of the leaf spring (7) fixed and an other end (72) side movably supported, and the other end (72) side of the leaf spring (7) is provided with an adjusting member (8) for adjusting the biasing force applied to the pressure-sensitive member (44).

3. The pressure switch (1) according to claim 1 or 2, wherein

the leaf spring (7) includes an insertion hole (73) through which the operation member (5) is inserted, wherein
the operation member (5) includes a shaft portion (53) that penetrates the insertion hole (73), and an enlarged-diameter portion (52) that is enlarged-diameter on a side of the pressure-sen-

sitive member (44) more than the shaft portion (53), and wherein
the first position is a position where the enlarged-diameter portion (52) of the operation member (5) contacts a peripheral portion of the insertion hole (73) in the leaf spring (7).

4. The pressure switch (1) according to claim 3, wherein
the peripheral portion of the insertion hole (73) of the leaf spring (7) is formed in a spherical concave shape, the enlarged-diameter portion (52) of the operation member (5) is formed in a spherical convex shape, and the peripheral portion and the enlarged-diameter portion (52) are configured abuttable in surface contact or line contact.

5. The pressure switch (1) according to any one of claims 1 to 4, wherein
the first position and the second position are provided on a straight line along the motion direction of the operation member (5).

6. The pressure switch (1) according to any one of claims 1 to 5, wherein
the transmission member (6) is rotatably provided about a fulcrum (63), and a second action distance from an action point with respect to the switching member (3) to the fulcrum (63) is set longer than a first action distance from an action point with respect to the operation member (5) to the fulcrum (63).

7. The pressure switch (1) according to claim 6, wherein
a ratio of the first action distance and the second action distance is configured changeable.

8. The pressure switch (1) according to any one of claims 1 to 7, wherein

the pressure-sensitive member (44) is formed of a thin metal plate in an entire disc shape, and is composed of a diaphragm (44) having a dome-shaped convex portion (44a) that is convex toward the low-pressure chamber (47), wherein
the operation member (5) is provided in contact with the convex portion (44a) and to move following displacement of the diaphragm (44), and wherein
in an initial compressed state in which the convex portion (44a) is more biased by the biasing member (7) toward the high-pressure chamber (46) side than a natural state, the convex portion (44a) has a convex shape thereof maintained toward the low-pressure chamber (47) side.

9. The pressure switch (1) according to claim 8, further comprising a displacement restricting unit that restricts displacement of the diaphragm (44) beyond the initial compressed state toward the high-pressure chamber (46) side.

Patentansprüche

1. Druckschalter (1), umfassend:

ein druckempfindliches Element (44), das eine Niederdruckkammer (47) und eine Hochdruckkammer (46) teilt und durch Druckschwankung in der Hochdruckkammer (46) verschoben wird und dafür geeignet ist, mit einem Hochdruckfluid in Kontakt zu stehen;
ein Betriebselement (5), das in der Niederdruckkammer (47) vorgesehen ist und sich mit der Verschiebung des druckempfindlichen Elements (44) bewegt;
ein Schaltelement (3) zum Schalten eines Schalters mit der Bewegung des Betriebselements (5);
ein Übertragungselement (6) zum Übertragen der Bewegung des Betriebselements (5) zum Schaltelement (3); und
ein Vorspannelement (7) zum Vorspannen des Betriebselements (5) zu der Hochdruckkammer (46), um eine anfängliche Kompressionskraft an das druckempfindliche Element (44) anzulegen, wobei das Vorspannelement (7) eine Blattfeder (7) aufweist, die an einer ersten Position entlang einer kreuzenden Oberfläche, die eine Bewegungsrichtung des Betriebselements (5) kreuzt, eine Vorspannkraft an das Betriebselement (5) anlegt, wobei die Vorspannkraft der Blattfeder (7) über das Betriebselement (5) an das druckempfindliche Element (44) angelegt wird, und wobei

die Bewegung des Betriebselements (5) an einer zweiten Position, die von der ersten Position getrennt ist, an das Übertragungselement (6) übertragen wird.

2. Druckschalter (1) nach Anspruch 1, wobei
bei dem Vorspannelement (7) eine Seite des Endes (71) der Blattfeder (7) festgelegt ist und eine Seite des anderen Endes (72) beweglich gehalten wird und die Seite des anderen Endes (72) der Blattfeder (7) mit einem Einstellelement (8) versehen ist, um die Vorspannkraft einzustellen, die an das druckempfindliche Element (44) angelegt wird.

3. Druckschalter (1) nach Anspruch 1 oder 2, wobei

die Blattfeder (7) ein Einführloch (73) einschließt, durch welches das Betriebselement (5)

eingeführt wird, wobei
das Betriebselement (5) einen Schaftabschnitt (53), der in das Einführloch (73) eindringt, und einen Abschnitt mit vergrößertem Durchmesser (52) einschließt, der einen vergrößerten Durchmesser auf einer Seite des druckempfindlichen Elements (44) aufweist, der größer als der Schaftabschnitt (53) ist, und wobei
der erste Abschnitt eine Position ist, in der der Abschnitt mit dem vergrößerten Durchmesser (52) des Betriebselements (5) einen Umfangsabschnitt des Einführlochs (73) in der Blattfeder (7) kontaktiert.

4. Druckschalter (1) nach Anspruch 3, wobei
der Umfangsabschnitt des Einführlochs (73) der Blattfeder (7) in einer kugelförmigen konkaven Form ausgebildet ist, der Abschnitt mit dem vergrößerten Durchmesser (52) des Betriebselements (5) in einer kugelförmigen konvexen Form ausgebildet ist und der Umfangsabschnitt und der Abschnitt mit dem vergrößerten Durchmesser (52) aneinanderstoßbar in einem Oberflächenkontakt oder einem Linienkontakt konfiguriert sind.

5. Druckschalter (1) nach einem der Ansprüche 1 bis 4, wobei
die erste Position und die zweite Position auf einer geraden Linie entlang der Bewegungsrichtung des Betriebselements (5) vorgesehen sind.

6. Druckschalter (1) nach einem der Ansprüche 1 bis 5, wobei
das Übertragungselement (6) drehbar um einen Hebelpunkt (63) vorgesehen ist und eine zweite Wirkdistanz von einem Wirkpunkt in Bezug auf das Schaltelement (3) zum Hebelpunkt (63) länger eingestellt ist als eine erste Wirkdistanz von einem Wirkpunkt in Bezug auf das Betriebselement (5) zum Hebelpunkt (63).

7. Druckschalter (1) nach Anspruch 6, wobei
ein Verhältnis der ersten Wirkdistanz und der zweiten Wirkdistanz veränderbar konfiguriert ist.

8. Druckschalter (1) nach einem der Ansprüche 1 bis 7, wobei

das druckempfindliche Element (44) aus einer dünnen Metallplatte in einer vollständig scheibenförmigen Form ausgebildet ist und aus einer Membran (44) mit einem kuppelförmigen konvexen Abschnitt (44a) zusammengesetzt ist, der zu der Niederdruckkammer (47) hin konvex ist, wobei
das Betriebselement (5) in Kontakt mit dem konvexen Abschnitt (44a) und so vorgesehen ist, dass es sich der Verschiebung der Membran (44) folgend bewegt, und wobei in einem anfänglichen komprimierten Zustand, in dem der konvexe Abschnitt (44a) durch das Vorspannelement (7) stärker zu der Seite der Hochdruckkammer (46) hin vorgespannt ist als in einem natürlichen Zustand, der konvexe Abschnitt (44a) eine konvexe Form aufweist, die zu der Seite der Niederdruckkammer (47) hin gehalten wird.

9. Druckschalter (1) nach Anspruch 8, ferner umfassend eine die Verschiebung einschränkende Einheit, die die Verschiebung der Membran (44) über den anfänglichen komprimierten Zustand hinaus zu der Seite der Hochdruckkammer (46) hin beschränkt.

Revendications

1. Commutateur de pression (1) comprenant :

un élément sensible à la pression (44) qui divise une chambre basse pression (47) et une chambre haute pression (46) et est déplacé par une fluctuation de pression dans la chambre haute pression (46), est adapté pour être en contact avec un fluide haute pression ;
un élément d'actionnement (5) qui est prévu dans la chambre basse pression (47) et se déplace avec le déplacement de l'élément sensible à la pression (44) ;
un élément de commutation (3) pour commuter un commutateur avec un déplacement de l'élément d'actionnement (5) ;
un élément de transmission (6) pour transmettre le déplacement de l'élément d'actionnement (5) à l'élément de commutation (3) ; et
un élément de sollicitation (7) pour solliciter l'élément d'actionnement (5) vers la chambre haute pression (46) afin d'appliquer une force de compression initiale à l'élément sensible à la pression (44), dans lequel l'élément de sollicitation (7) présente un ressort à lame (7) qui applique une force de sollicitation à l'élément d'actionnement (5) au niveau d'une première position le long d'une surface d'intersection recoupant une direction de déplacement de l'élément d'actionnement (5), la force de sollicitation du ressort à lame (7) est appliquée à l'élément sensible à la pression (44) via l'élément d'actionnement (5), et dans lequel
le déplacement de l'élément d'actionnement (5) est transmis à l'élément de transmission (6) dans une seconde position séparée de la première position.

2. Commutateur de pression (1) selon la revendication

1, dans lequel
l'élément de sollicitation (7) présente un côté de première extrémité (71) du ressort à lame (7) fixe et un côté d'autre extrémité (72) supporté de manière mobile, et le côté d'autre d'extrémité (72) du ressort à lame (7) est pourvu d'un élément d'ajustement (8) pour ajuster la force de sollicitation appliquée à l'élément sensible à la pression (44).

3. Commutateur de pression (1) selon la revendication 1 ou 2, dans lequel

le ressort à lame (7) inclut un trou d'insertion (73) à travers lequel l'élément d'actionnement (5) est inséré, dans lequel
l'élément d'actionnement (5) inclut une partie de tige (53) qui pénètre dans le trou d'insertion (73), et une partie de diamètre agrandi (52) qui est de diamètre agrandi sur un côté de l'élément sensible à la pression (44) plus que la partie de tige (53), et dans lequel
la première position est une position où la partie de diamètre agrandi (52) de l'élément d'actionnement (5) vient en contact avec une partie périphérique du trou d'insertion (73) dans le ressort à lame (7).

4. Commutateur de pression (1) selon la revendication 3, dans lequel
la partie périphérique du trou d'insertion (73) du ressort à lame (7) est formée en une forme sphérique concave, la partie de diamètre agrandi (52) de l'élément d'actionnement (5) est formée en une forme sphérique convexe, et la partie périphérique et la partie de diamètre agrandi (52) sont configurées pour pouvoir être mises en butée en contact de surface ou en contact linéaire.

5. Commutateur de pression (1) selon l'une quelconque des revendications 1 à 4, dans lequel
la première position et la seconde position sont prévues sur une ligne droite le long de la direction de déplacement de l'élément d'actionnement (5).

6. Commutateur de pression (1) selon l'une quelconque des revendications 1 à 5, dans lequel
l'élément de transmission (6) est prévu de manière rotative autour d'un point d'appui (63), et une seconde distance d'action à partir d'un point d'action par rapport à l'élément de commutation (3) jusqu'au point d'appui (63) est réglée plus longue qu'une première distance d'action d'un point d'action par rapport à l'élément d'actionnement (5) jusqu'au point d'appui (63).

7. Commutateur de pression (1) selon la revendication 6, dans lequel
un rapport de la première distance d'action et de la seconde distance d'action est configuré pouvant être modifié.

8. Commutateur de pression (1) selon l'une quelconque des revendications 1 à 7, dans lequel

l'élément sensible à la pression (44) est formé d'une plaque métallique mince en forme de disque entier, et est composé d'un diaphragme (44) présentant une partie convexe en forme de dôme (44a) qui est convexe vers la chambre basse pression (47), dans lequel
l'élément d'actionnement (5) est prévu en contact avec la partie convexe (44a) et pour se déplacer suite au déplacement du diaphragme (44), et dans lequel
dans un état comprimé initial dans lequel la partie convexe (44a) est davantage sollicitée par l'élément de sollicitation (7) vers le côté de la chambre haute pression (46) qu'un état naturel, la partie convexe (44a) présente une forme convexe de celle-ci maintenue vers le côté de la chambre basse pression (47).

9. Commutateur de pression (1) selon la revendication 8, comprenant en outre une unité de limitation de déplacement qui limite le déplacement du diaphragme (44) au-delà de l'état comprimé initial vers le côté de la chambre haute pression (46).

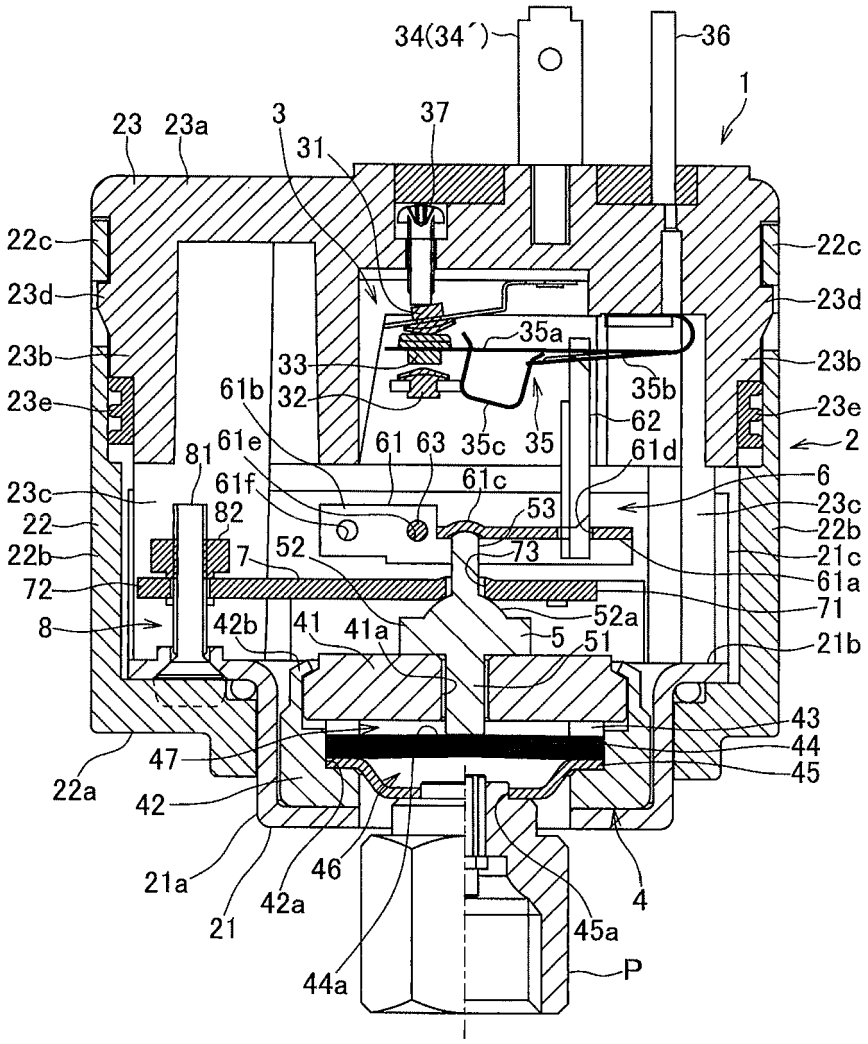

34(34´)
36
1
23
23a
3
37
31
22c
23d
23b
23e
35a
33
61b
32
35b
62
61e
61
63
35c
35
61d
2
81
61f
61c
6
23c
82
53
22
22b
52
73
7
72
61a
71
8
42b
41
41a
52a
5
51
21b
43
47
44
22a
45
42
21a
46
42a
4
21
45a
44a
P

FIG.1

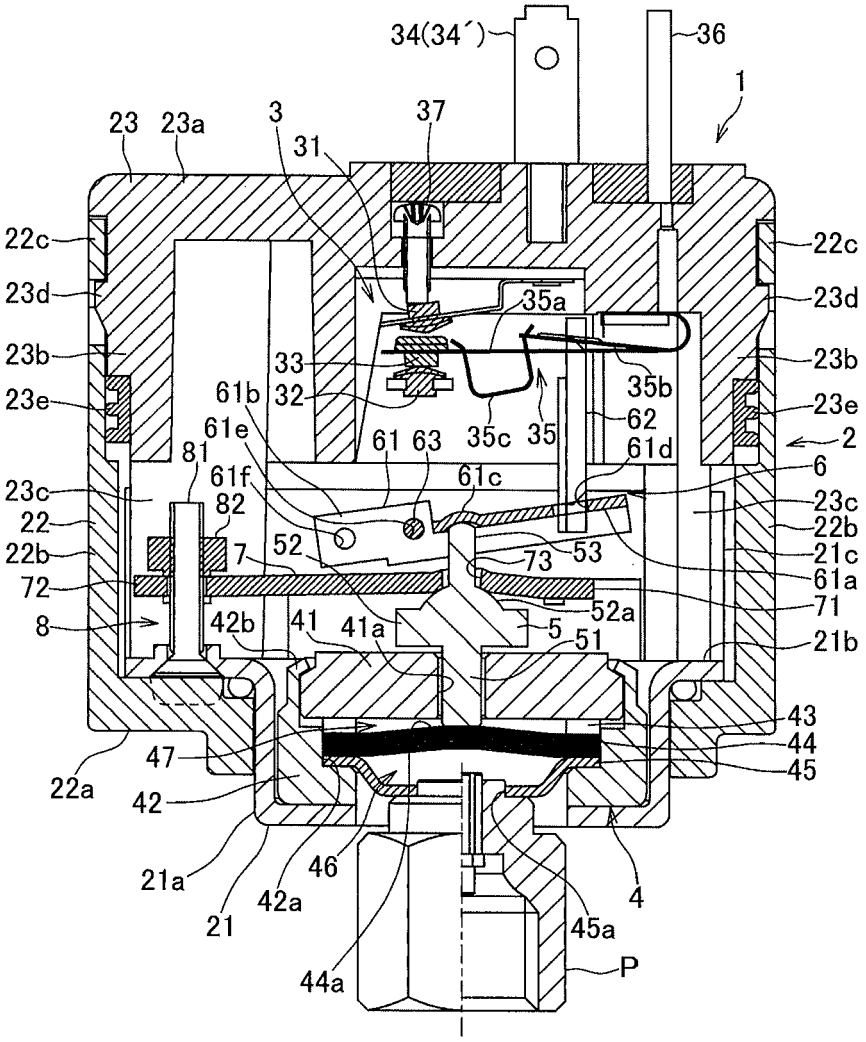

34(34´)
36
1
23
23a
3
37
31
22c
23d
23b
23e
35a
33
61b
32
35b
62
61e
61
63
35c
35
61d
2
81
61f
61c
6
23c
82
22
22b
7
52
73
53
72
52a
8
42b
41
41a
5
51
21b
43
47
44
45
22a
42
21a
46
42a
4
21
45a
44a
P

FIG.2

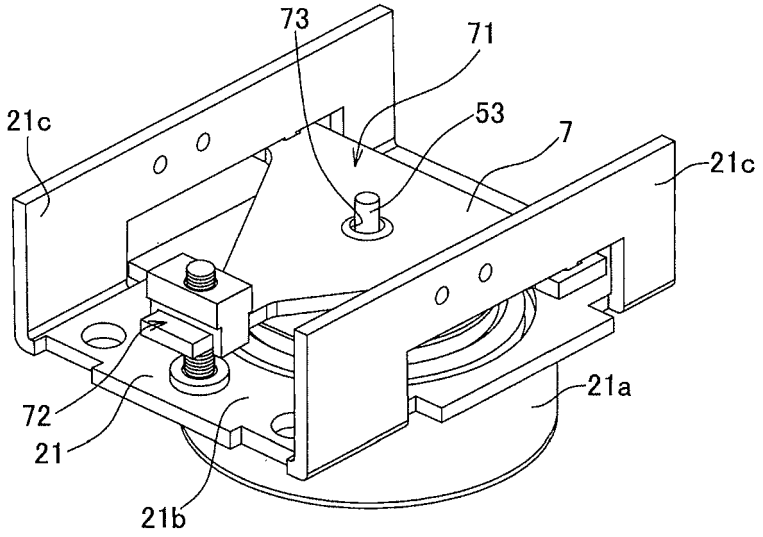

73
71
53
7
21c
21c
21a
72
21
21b

FIG.3

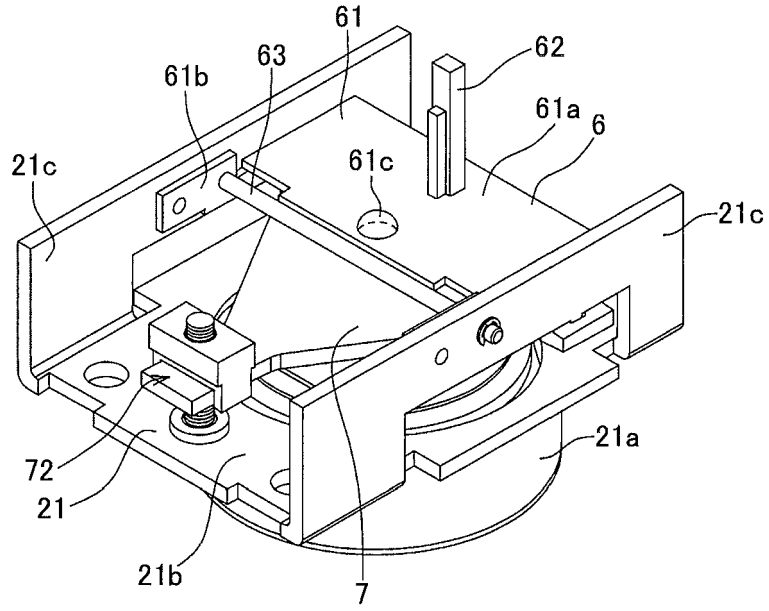

61
63
62
61b
61a
6
61c
21c
21c
21a
72
21
21b
7

FIG.4

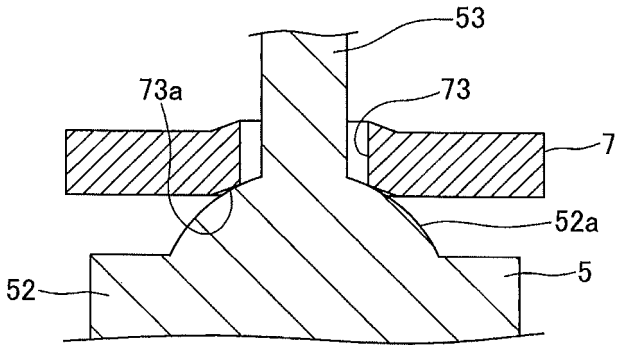


FIG.5

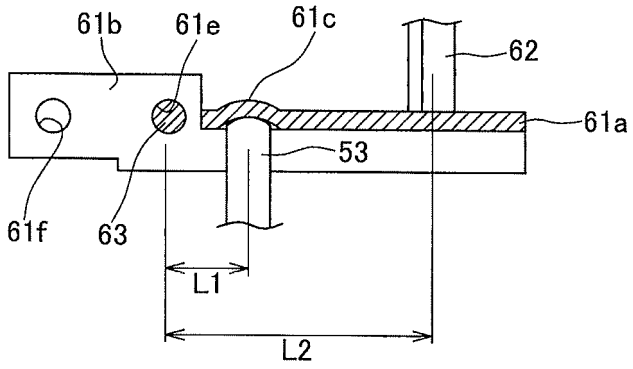


FIG.6A

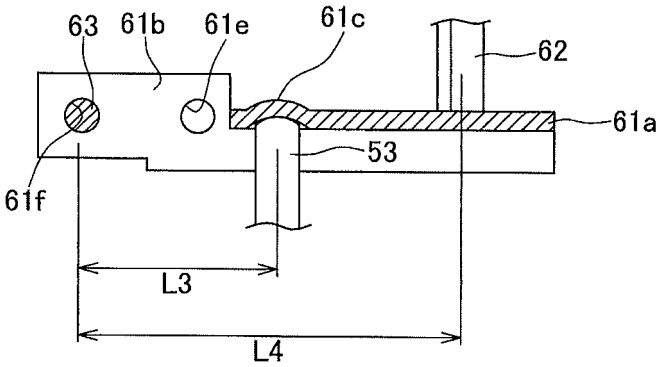


FIG.6B

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

- US 4703140 A **[0003] [0005]**
- FR 2717616 **[0004] [0005]**
- JP 2015099781 A **[0005]**