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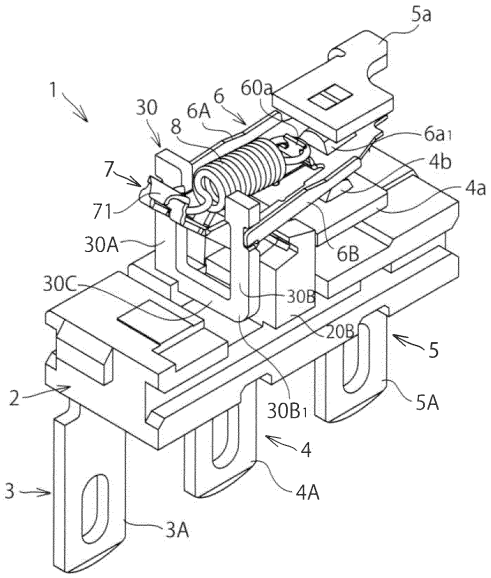
(54) **MICROSWITCH**

(57) The microswitch fully wipes the surface of the contact at the time of switching contacts and exfoliates the insulation coating of the surface of the contact. The microswitch (1) includes a movable member (6) one end of which has a movable contact (6a) contactable with first and second fixed contacts (5b, 4b) that are fixedly attached to a base (2) and disposed separately from one another and the other end of which is swingably supported by a support frame (30), an actuator (7) that reverse-operates the movable member (6) to move the movable contact (6a) from the side of the first fixed contact (5b) to the side of the second fixed contact (4b), and a tension spring (8) to impart a tensile force to one end of the movable member (6). The support frame (30) is disposed at both sides of the tension spring (8) . The first end portion ($30A_1$) of the support frame (30) on one end side of the tension spring (8) is fixed to the base (2) and the second end portion ($30B_1$) of the support frame (30) on the other end side of the tension spring (8) is not fixed to the base (2) .

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates generally to a microswitch for use as a detection switch, an operation switch and the like.

BACKGROUND ART

[0002] A microswitch disclosed in a Japanese utility model registration application publication No. 1988-129928 comprises a common terminal (2) fixed to a switch base (1), a normally-open terminal (3) and a normally-closed terminal (4), a movable contact piece (5) that is disposed between a normally-open contact (3b) of the normally-open terminal (3) and a normally-closed contact (4b) of the normally closed terminal (4) and that has switching contacts (5a, 5b) at one end of the movable contact piece (5) to alternatively contact the normally-open contact (3b) or the normally-closed contact (4b), a rotatable actuator (6) to rotate the movable contact piece (5), and a reversal spring (7) that is suspended between the movable contact piece (5) and the rotatable actuator (6) (see pages 2-4 and figures 4-5 of the above-mentioned publication).

[0003] In the above-mentioned microswitch, when the actuator (6) is pressed downwardly, the reversal spring (7) reverse-rotates to cause the movable contact piece (5) to move downwardly, such that thereby the contacts are switched and the switching contact (5b) comes into contact with the normally-open contact (3b) (see the double dotted line in figure 4 of the above-mentioned publication).

PRIOR ART REFERENCES

Patent Documents

[0004] Patent Document 1:
Japanese utility model registration application publication No. 1988-129928 (see pages 2-4, figures 4-5).

SUMMARY OF THE INVENTION

Objects to be Achieved by the Invention

[0005] In such a microswitch, an insulation coating due to oxidization or sulfurization may be formed on the surface of a contact, which lowers reliability as a switch. In order to prevent oxidization or sulfurization on the surface of the contact, a gold plating on the surface of the contact may be an option, but the gold plating is generally costly and a manufacturing cost is increased. Therefore, it is considered that the movable contact is moved to slide relative to the fixed contact at the time of switching contacts thus wiping the surface of the contact to exfoliate the insulation coating on the surface of the contact.

[0006] However, in the above-mentioned prior-art structure, at the time of switching contacts, the switching contact (5a) is merely moved downwardly away from the normally-closed contact (4b) and thus wiping on the surface of the contact was not considered.

[0007] The present invention has been made in view of these circumstances and its object is to provide a micro switch that can fully wipe the surface of a contact at the time of switching contacts and that can exfoliate the insulation coating on the surface of the contact. Furthermore, the present invention is directed to improving a wiping performance by causing the movable contact to slide sideways relative to the fixed contact at the time of switching contacts.

Means of Achieving the Objects

[0008] The microswitch according to the present invention includes a movable member one end of which includes a movable contact contactable with first and second fixed contacts that are fixedly attached to a base and disposed separately from one another and the other end of which is swingably supported by a support frame, an actuator that reverse-operates the movable member to move the movable contact from the side of the first fixed contact to the side of the second fixed contact, and a tension spring that imparts a tensile force to one end of the movable member. The support frame is disposed at both sides of the tension spring, a first end portion of the support frame on one end side of the tension spring is fixed to the base and a second end portion of the support frame on the other end side of the tension spring is not fixed to said base.

[0009] According to the present invention, when the actuator reverse-operates the movable member, the movable contact is moved from the side of the first fixed contact to the side of the second fixed contact, thus changing contacts . At this time, since the first end portion of the support frame to support the other end of the movable member is fixed to the base and the second end portion of the support frame to support the other end of the movable member is not fixed to the base, when a load is applied to the support frame in reverse-operating the movable member under the action of a tensile force by the tension spring at the time of changing contacts, the second end portion deforms relatively more largely than the first end portion. As a result, the other end of the movable member on the side of the second end portion of the support frame is more displaced than the other end of the movable member on the side of the first end portion of the support frame. In accordance with that, the movable contact disposed at one end of the movable member shifts to be displaced sideways with the movable contact contacted with the first fixed contact on the base side, such that thereby the movable member slides sideways relative to the fixed contact. In such a manner, the surface of the contact can be fully wiped and an insulation coating of the surface of the contact can be exfoliated.

[0010] The second end portion of the support frame may be displaced relative to the first end portion under the action of a tensile force of the tension spring at the time of a reverse-operation of the movable member.

[0011] The amount of displacement of the second end portion of the support frame may be larger than the amount of displacement of the first end portion under the action of a tensile force of the tension spring at the time of a reverse-operation of the movable member.

[0012] The movable contact may be displaced in the direction intersecting the axis of the tension spring prior to operation of the movable contact under the action of a tensile force of the tension spring at the time of a reverse-operation of the movable member, such that thereby the movable contact slides relative to the fixed contact.

[0013] The support frame may comprise a first pillar member that is disposed on one side of the tension spring, that includes the first end portion and that extends in a height direction, a second pillar member that is disposed on the other side of the tension spring, that includes the second end portion and that extends in a height direction, and a connection member that connects the first pillar member and the second pillar member.

[0014] The support frame may have a general U-shape formed by the first and second pillar members and the connection member.

[0015] The height dimension of the connection member may be made smaller from the side of the first pillar member toward the side of the second pillar member.

[0016] The connection member may be a tapered member.

[0017] The other end of the movable member may be bifurcated, one of the bifurcated other end is supported by the first pillar member of the support frame, and the other of the bifurcated other end may be supported by the second pillar member of the support frame.

[0018] One end of said tension spring may be engaged with one end of the movable member and the other end of the tension spring may be engaged with the actuator.

[0019] The movable member may rotate around the other end of the tension spring at the time of a reverse-operation of the movable member, whereby the movable contact may slide relative to the fixed contact.

[0020] There may be provided a regulating member to regulate a lateral movement of one end of the movable member on the side of one end of the movable member.

Effects of the Invention

[0021] As above-mentioned, according to the present invention, since the movable contact slides relative to the fixed contact at the time of switching contacts, the surface of the contact can be fully wiped and the insulation coating of the surface of the contact can be exfoliated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG. 1 is a top perspective view showing a main component of a microswitch according to an embodiment of the present invention;

FIG. 2 is a bottom perspective view of the microswitch of FIG. 1;

FIG. 3 is a front perspective view showing a main component of a microswitch according to an embodiment of the present invention, corresponding to FIG. 1;

FIG. 4 is a rear perspective view of the microswitch of FIG. 3;

FIG. 5 is a front elevational view of the microswitch of FIG. 3;

FIG. 6 is a rear elevational view of the microswitch of FIG. 3;

FIG. 7 is a left-side view of the microswitch of FIG. 3;

FIG. 8 is a right-side view of the microswitch of FIG. 3;

FIG. 9 is a cross sectional view of FIG. 5 taken along line IX-IX;

FIG. 10 is a cross sectional view of FIG. 5 taken along line X-X;

FIG. 11 is a top plan view of the microswitch of FIG. 3;

FIG. 12 is an exploded view of the microswitch of FIG. 3;

FIG. 13 is a general perspective view of the common terminal of the microswitch of FIG. 3;

FIG. 14 illustrates a state prior to operation of the actuator of the microswitch of FIG. 3;

FIG. 15 illustrates a state immediately after the actuator of the microswitch of FIG. 3 is operated, showing the state prior to a reverse-operation of the movable member;

FIG. 16 is a longitudinal sectional view of FIG. 14 taken along line XVI-XVI;

FIG. 17 is a longitudinal sectional view of FIG. 15 taken along line XVII-XVII; and

FIG. 18 is a front elevational view of a microswitch according to a fourth alternative embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0023] The present invention will now be described in detail with reference to embodiments thereof as illustrated in the accompanying drawings . Referring to the drawings, FIGS. 1 to 17 illustrate a microswitch according to an embodiment of the present invention. FIGS. 1 to 8 and 11 show a main component of the microswitch of the present embodiment, FIGS . 9 and 10 are side sectional views of the microswitch, FIG. 12 is a blown-up perspective view of the microswitch, FIG. 13 is a perspective view of the common terminal alone of the microswitch, and FIGS. 14 to 17 are views for explaining the effects of the present embodiment. In the following explanations, an elongated direction or a longer direction of the microswitch is referredto as a longitudinal direction, a shorter direction thereof is referred to as a lateral or transverse direction, and a direction perpendicular to the longitudinal

and lateral directions are referred to as an up-down direction or a height direction. That is, in the case of FIG. 5 for example, the left to right direction in FIG. 5 is a longitudinal direction, the vertical direction perpendicular to the page of FIG. 5 is a lateral direction or a width direction, and the up-down direction of FIG. 5 is an up-down direction.

[0024] As shown in FIGS. 1 to 8 and 12, a microswitch 1 of the present embodiment includes a base 2, which is an insulating base made of synthetic resin, and a common terminal 3, a normally-open fixed terminal 4 and a normally-closed fixed terminal 5 that are integrally fixed to the base 2 through an insert molding. These terminals respectively pass through the base 2 in the up-down direction and base end portions of the respective terminals have external connection terminals 3A, 4A, 5A, respectively, that extend below the base 2.

[0025] A distal end portion (or an end portion on the switching side) of the normally-open fixed contact 4 includes a normally-open fixed contact (or a second fixed contact) 4b disposed above the base 2, and a distal end portion (or an end portion on the switching side) of the normally-closed fixed terminal 5 includes a normally-closed fixed contact (or a first fixed contact) 5b that is disposed above the base 2 and located above and opposite the normally-open fixed contact 4b. The normally-open fixed contact 4b is fixed to a contact attaching portion 4a through caulking or the like, which is disposed above and near the base 2. The normally-closed fixed contact 5b is fixed to a contact attaching portion 5a through caulking or the like similarly, which is disposed above and away from the base 2.

[0026] The distal end portion of the common terminal 3 has a generally U-shaped support frame 30. The support frame 30 includes a first pillar member 30A extending in the up-down direction, a second pillar member 30B disposed opposite and spaced laterally away from the first pillar member 30A and extending in the up-down direction similarly, and a connection member 30 connecting the first and second pillar members 30A, 30B laterally.

[0027] As shown in FIG. 9 (a cross sectional view of FIG. 5 taken along line IX-IX) and FIG. 10 (a cross sectional view of FIG. 5 taken along line X-X), in the support frame 30, a part of a first end portion $30A_1$ of the first pillar member 30A that one end of the connection member 30C is connected to is buried or embedded in and fixed to the base 2, whereby the part of the first end portion $30A_1$ of the first pillar member 30A is a fixed end. In contrast, a second end portion $30B_1$ of the second pillar member 30B that the other end of the connection member 30C is connected to is not buried or embedded in the base 2 (thus, is not fixed to the base 2 and it is a free end) and is disposed above the base 2. Therefore, the connection member 30C that connects the respective end portions $30A_1$, $30B_1$ laterally is disposed above and spaced away from an upper surface 2A of the base 2.

[0028] Here, the common terminal 3, as shown in FIG. 13, is formed by bending a terminal plate sterically, and the support frame 30 is arranged in the direction generally perpendicular to the direction of the external connection terminal 3A. As shown in FIG. 13, the common terminal 3 includes an extension part $30A_2$ that extends from the first end portion $30A_1$ of the first pillar member 30A and below the connection portion 30C. As shown in FIGS. 9 and 10, the extension part $30A_2$ is buried or embedded in and fixed to the base 2. In addition, the common terminal 3 has three bending portions BP (see FIG. 13) between the extension part $30A_2$ and the external connection terminal 3A. The reason for that is as follows:

The common terminal 3, which is in a developed state that the normally-open fixed terminal 4 and the normally-closed fixed terminal 5 are integrally connected to one another, is stamped out. Thereafter, through the fixing process of the respective contacts 4b, 5b with the integral connection of the respective terminals 3, 4, 5 maintained, the respective terminals 3, 4, 5 are bent, insert-molded in the base 2, and then separated from one another. In that case, if there is a single bending portion of the common terminal 3, in the developed state, the support frame 30 of the common terminal 3 will interfere with the normally-open fixed terminal 4 adjacent to the support frame 30. In order to solve that problem, there are three bending portions BP.

[0029] Also, in an example shown in FIGS. 9 and 10, a measurement of the connection member 30C in the height direction (i.e. up-down direction), or a height dimension of the connection member 30C is determined to satisfy an inequality,

$$h_1 > h_2$$

wherein the height of the first end portion $30A_1$ is set at h_1, and the height of the second end portion $30B_1$ is set at h_2.

[0030] Moreover, in the example shown in FIGS. 9 and 10, the height of the connection member 30C is gradually lowered from the end portion $30A_1$ toward the end portion $30B_1$. The connection member 30C is formed in a tapered shape as viewed from a front-back direction.

[0031] As shown in FIGS. 1 to 8 and 12, the microswitch 1 includes a movable member 6 having a movable contact 6a at one end thereof and swingable in the up-down direction around the other end side as a fulcrum. The movable contact 6a is composed of a movable contact $6a_1$ disposed on the upper side and a movable contact $6a_2$ disposed on the lower side. The movable contact $6a_1$ on the upper side is provided contactable with the normally-closed fixed contact 5b and the movable contact $6a_2$ on the lower side is provided contactable with the normally-open fixed contact 4b.

[0032] As shown in FIGS. 11 and 12, the other end side of the movable member 6 is bifurcated and its distal ends have a rear end surface 60b respectively and a pair of sidewall portions 6A, 6B. The distal ends of the respective sidewall portions 6A, 6B are formed with notch-

es $6A_1$, $6B_1$. On the other hand, at the respective outer surfaces of the first and second pillar members 30A, 30B of the support frame 30 on the side of the base 2, there are formed engagement recesses $30A_3$, $30B_3$, respectively. The distal end portions of the respective sidewall portions 6A, 6B of the movable member 6 are engaged with the respective engagement recesses $30A_3$, $30B_3$ of the first and second pillar members 30A, 30B of the support frame 30, respectively, such that thereby the movable member 6 is supported swingably in the up-down direction at the respective engagement recesses $30A_3$, $30B_3$ of the support frame 30. Also, at this time, the respective rear end surfaces 60b at the distal end on the other end side of the movable member 6 are in contact with the first and second pillar members 30A, 30B (see FIG. 11).

[0033] As shown in FIGS. 1 to 6 and 12, the microswitch 1 includes an actuator 7 to reverse-operate the movable member 6 in such a way that the movable contact 6a of the movable member 6 is transferred from the upper position on the side of the normally-closed fixed contact 5b to the lower position on the side of the normally-open fixed contact 4b. The actuator 7 is located in the direction interesting the movable member 6 (see FIGS. 5 and 6).

[0034] As shown in FIG.12, the actuator 7 includes a pair of support plate portions 7a, 7b at one end thereof that projects to the both sides. On the other hand, there are provided a pair of support cradles 20A, 20B on the base 2 that protrudes upwardly. The respective support cradles 20A, 20B are formed with engagement depressions 20a, 20b, respectively. The respective support plate portions 7a, 7b of the actuator 7 are engaged with the respective engagement depressions 20a, 20b of the support cradles 20A, 20B (see FIGS. 5 and 6), such that thereby the actuator 7 is supported swingably in the up-down direction at the respective engagement depressions 20a, 20b. Also, the actuator 7 has an operation portion 71 at the other end thereof that is operated from the outside.

[0035] As shown in FIGS. 1 to 6, 11 and 12, the microswitch 1 includes a tension coil spring (or tension spring) 8. The tension coil spring 8 has hook portions 8a, 8b for engagement at both ends thereof. The hook portion 8a of the tension coil spring 8 is engaged with a protruding portion 60a for engagement (see FIG. 12) provided on one end side of the movable member 6 and the hook portion 8b is engaged with a protruding portion 70a for engagement (see FIG. 12) provided on the other end side of the actuator 7. Thereby, the tensile force of the tension coil spring 8 is imparted between one end side of the movable member 6 and the other end side of the actuator 7.

[0036] As shown in FIGS. 11, one end of the tension coil spring 8 is disposed between the first pillar member 30A and the second pillar member 30B of the support frame 30. That is, the first and second pillar members 30A, 30B of the support frame 30 are disposed on opposite ends of the tension coil spring 8. Also, as shown in FIG. 12, the actuator 7 includes a pair of projecting portions 7c, 7d that project upwardly at a longitudinally central potion of the actuator 7. On the other hand, as shown in FIG. 13, the first and second pillar members 30A, 30B of the support frame 30 have engagement recesses $30A_4$, $30B_4$ formed on the respective inside sidewall surfaces of the first and second pillar members 30A, 30B. The projecting portions 7c, 7d of the actuator 7 are respectively engaged with the engagement recesses $30A_4$, $30B_4$ of the first and second pillar members 30A, 30B of the support frame 30 (see FIG. 10), thus restricting an upward movement of the actuator 7.

[0037] Then, the effects of the present embodiment will be explained using FIGS. 14 to 17.

[0038] FIG. 14 shows the state prior to operation of the actuator 7 of the microswitch 1 and FIG. 15 shows the state immediately after operation of the actuator 7. Also, FIG. 16 is a sectional view of FIG. 14 taken along line XVI-XVI and FIG. 17 is a sectional view of FIG. 15 taken along line XVII-XVII.

[0039] In the state prior to operation shown in FIG. 14, the movable contact $6a_1$ of the movable member 6 is in contact with the normally-closed fixed contact 5b and a circuit between the common terminal 3 and the normally-closed fixed terminal 5 is closed. Between the respective contacts, a predetermined contact pressure is applied by a biasing force of the tension coil spring 8. Also, at this time, as shown in FIG. 16, an axis CL_0 of the tension coil spring 8 generally coincides with the respective centerlines of the movable contact $6a_1$ of the movable member 6 and the normally-closed fixed contact 5b. That is, the movable contact $6a_1$ and the normally-closed fixed contact 5b are placed in a state that the axis and the centerlines generally coincide with one another as viewed from above.

[0040] From that state, when the actuator 7 is operated, as shown in FIG. 15, the actuator 7 swings downwardly around the respective engagement recesses 20a, 20b (FIG. 12) of the support cradle 20A, 20B of the base 2 that the respective support plate portions 7a, 7b (FIG. 12) on one end side of the actuator 7 are engaged with. Thus, the operation portion 71 moves downwardly, such that thereby the movable member 6 is reverse-operated and the movable member 6 is about to move from the upper position on the side of the normally-closed fixed contact 5b to the lower position on the side of the normally-open fixed contact 4b.

[0041] In this case, immediately before the movable member 6 is reverse-operated by the actuator 7, as shown in FIG. 15, the movable contact $6a_1$ of the movable member 6 is still in contact with the normally-closed fixed contact 5b. Due to a downward swinging motion of the actuator 7, a space becomes large between the protruding engagement portion 60a on one side of the movable member 6 that the hook portion 8a of the tension coil spring 8 is engaged with and the protruding engagement portion 70a on the other side of the actuator 7 that the

hook portion 8b of the tension coil spring 8 is engaged with. The tension coil spring 8 is thus extended, thereby increasing a tensile force relative to one end side of the movable member 6.

[0042] At this moment, the first and second pillar members 30A, 30B of the support frame 30 is contacted by the respective rear end surfaces 60b of the bifurcated other end of the movable member 6, and a pressing force applied from the other end of the movable member 6 to the first and second pillar members 30A, 30B of the support frame 30 is increased. As mentioned above, since the first end portion $30A_1$ of the first pillar member 30A is fixed to the base 2 and the second end portion $30B_1$ of the second pillar member 30B is not fixed to the base 2, when the pressing force imparted from the other end of the movable member 6 is increased, the second end portion $30B_1$ of the second pillar member 30B deforms relatively largely than the first end portion $30A_1$ of the first pillar member 30A, and the amount of deformation of the second end portion $30B_1$ becomes large. In other words, at this juncture, the second end portion $30B_1$ of the second pillar member 30B is displaced relative to the first end portion $30A_1$ of the first pillar member 30A and the amount of displacement of the second end portion $30B_1$ is larger than the amount of displacement of the first end portion $30A_1$. The second pillar member 30B is rotated around the first pillar member 30A.

[0043] Moreover, in this case, as shown in FIG. 10, since the height h_1 of the first end portion $30A_1$ is greater than the height h_2 of the second end portion $30B_1$, preferably, the height of the connecting portion 30C is gradually lowered from the first end portion $30A_1$ toward the second end portion $30B_1$ and the connecting portion 30C is formed in a tapered shape, the amount of displacement of the second end portion $30B_1$ is further larger than the amount of displacement of the first end portion $30A_1$.

[0044] Also, sine the first end portion $30A_1$ of the first pillar member 30A is a fixed end and the second end portion $30B_1$ of the second pillar member 30B is a free end, when the pressing force imparted from the other end of the movable member 6 to the respective pillar members 30A, 30B is increased, the amount of displacement relative to the second end portion $30B_1$ of the second pillar member 30B is larger than the amount of displacement relative to the first end portion $30A_1$ of the first pillar member 30A.

[0045] Thereby, as shown in FIG. 17, under the action of the tensile force of the tension coil spring 8, one end side of the movable member 6 is displaced around the other end side of the movable member 6 in such a way as to deviate sideways (that is, rotates sideways). At this time, since the hook 8a of one end side of the tension coil spring 8 is engaged with the protruding engagement portion 60a of one end side of the movable member 6, a lateral displacement of the movable member 6 causes one end side of the tension coil spring 8 to be displaced sideways. As a result, as shown in a dash-and-dot-line and a double dotted line of FIG. 17, an axis CL_1 of the tension coil spring 8 is displaced sideways in a direction intersecting the axis CL_0 around the other end side of the tension coil spring 8 from the position of the axis CL_0. Concomitantly with that, the movable contact $6a_1$ (ditto for the movable contact $6a_2$) of one side of the movable member 6 is displaced in the direction intersecting the axis CL_0 of the tension coil spring 8 with the state of contact with the fixed contact 5b maintained. At this moment, as shown in FIG. 17, the movable contact $6a_1$ (ditto for the movable contact $6a_2$) is displaced in such a way as to slide sideways (that is, rotates sideways) relative to the normally-closed fixed contact 5b and thus the movable contact $6a_1$ slides along the normally-closed fixed contact 5b.

[0046] In such a manner, the surface of the contact can be fully wiped and the insulating coating on the surface of the contact can be exfoliated or separated from the surface of the contact.

[0047] In addition, the actuator 7 is further operated from the state of FIG. 15, the movable member 6 is reverse-operated and thus the movable member 6 moves from the upper position on the side of the normally-closed fixed contact 5b to the lower position on the side of the normally-open fixed contact 4b, thereby switching contacts.

<First Alternative Embodiment>

[0048] In the above-mentioned embodiment, an example was shown in which a part of the first end portion $30A_1$ of the first pillar member 30A of the support frame 30 is embedded or buried and fixed in the base 2, as shown in FIG. 10, but the application of the present invention is not restricted to such an example. The part that is buried and fixed in the base 2 may be all of the first end portion $30A_1$.

<Second Alternative Embodiment>

[0049] In the above-mentioned embodiment, an example was shown in which the extension part $30A_2$ of the common terminal 3 extends from the first end portion $30A_1$ of the first pillar member 30Aand below the connection portion 30C, that is, along an extension of the first end portion $30A_1$ (see FIGS. 9, 10 and 13), but the application of the present invention is not restricted to such an example. The extension part $30A_2$ maybe disposed at a position biased sideways relative to the first end portion $30A_1$. In this case, the extension part $30A_2$ is preferably disposed between the centerline of the support frame 30 and the centerline of the first pillar member 30A. At this time, the extension part $30A_2$ extends downwardly from the connection member 30C between the centerline of the support frame 30 and the centerline of the first pillar member 30A. Also, at this time, the first end portion $30A_1$ of the first pillar member 30A is buried in the base 2 and the extension part $30A_2$ may be buried or need not be buried in the base 2.

<Third Alternative Embodiment>

[0050] In the above-mentioned embodiment, an example was shown in which the extension part $30A_2$ is provided between the support frame 30 and the external connection terminal 3A, but the extension part $30A_2$ may be omitted. In that case, the common terminal 3 is formed of two components of the support frame 30 and the external contact terminal 3A and these components are separated from one another, but a jumper wire for example may electrically connect these components.

<Fourth Alternative Embodiment>

[0051] FIG. 18 shows a microswitch according to a fourth alternative embodiment of the present invention. In FIG. 18, like reference numbers indicate identical or functionally similar elements to those in the above-mentioned embodiment.

[0052] In the microswitch 1 shown in FIG. 18, there is provided a protruding portion 9, which protrudes inwardly (i.e. to the left side of the drawing) at an upper portion of an extending part 5c that extends upwardly from the base 2 to support the contact attaching portion 5a of the normally-closed fixed contact 5b from below. The protruding portion 9 is disposed at a predetermined lateral spacing from one end of the movable member 6 and overlapped with one end of the movable member 6 as viewed from the front (see FIG. 18). The protruding portion 9 functions as a regulating portion to regulate a lateral movement of one end of the movable member 6. In the above-mentioned embodiment, a similar protruding portion 9 is shown, but it is not disposed on the lateral side of one end of the movable member 6 and is not overlapped with one end of the movable member 6 as viewed from the front.

[0053] The reason why the protruding portion 9 as such a regulating member is provided is as follows:
Due to vibration or shock during transportation of the microswitch, or due to shock load by falling of the microswitch 1 at the time of installation, one end of the free end side of the movable member 6 may move excessively laterally. Also, when the movable contact 6a of one end side of the movable member 6 returns to the upper position on the side of the normally-closed fixed contact 5b from the lower position on the side of the normally-open fixed contact 4b, the movable contact 6a is going to be displaced relative to the normally-closed fixed contact 5b in a direction opposite the displacement direction at the time of the above-mentioned reverse-operation. Therefore, it is considered that due to inertia during such a displacement the amount of lateral movement of one end of the movable member 6 may become larger. In such a situation, by making one end of the movable member 6 contact with the protruding portion 9, an excessive amount of lateral movement of one end of the movable member 6 is prevented and an occurrence of the state is prevented in which the other end of the movable member 6 is slipped out of the first and second pillar members 30A, 30B of the support frame 30.

<Other Alternative Embodiment>

[0054] The above-mentioned embodiment and the respective alternative embodiments should be considered in all respects only as illustrative and not restrictive. Those skilled in the art to which the invention pertains may make modifications and other embodiments employing the principles of this invention without departing from its spirit and essential characteristics particularly upon considering the foregoing teachings, even if there are no explicit explanations in the description.

INDUSTRIAL APPLICABILITY

[0055] The present invention is useful to a micro switch for use as a detection switch, an operation switch and the like.

DESCRIPTION OF REFERENCE NUMERALS

[0056]

1: microswitch
2: base
4b: normally-open fixed contact (second fixed contact)
5b: normally-closed fixed contact (first fixed contact)
6: movable member
$6a_1$, $6a_2$, $6a_3$: movable contact
7: actuator
8: tension coil spring (tension spring)
9: regulating portion
30: support frame
30A: first pillar member
$30A_1$: first end portion
30B: second pillar member
$30B_1$: second end portion
30C: connection portion
CL_0, CL_1: axis

Claims

1. A microswitch comprising:

a movable member one end of which includes a movable contact contactable with first and second fixed contacts that are fixedly attached to a base and disposed separately from one another and the other end of which is swingably supported by a support frame;
an actuator that reverse-operates the movable member to move the movable contact from the side of the first fixed contact to the side of the second fixed contact; and

a tension spring that imparts a tensile force to the one end of the movable member,
wherein the support frame is disposed at both sides of the tension spring, a first end portion of the support frame on one side of the tension spring is fixed to the base, and a second end portion of the support frame on the other side of the tension spring is not fixed to the base.

2. The microswitch according to claim 1, wherein the second end portion of the support frame is displaced relative to the first end portion of the support frame under the action of the tensile force of the tension spring at the time of a reverse-operation of the movable member.

3. The microswitch according to claim 1, wherein the amount of displacement of the second end portion of the support frame is greater than the amount of displacement of the first end portion of the support frame under the action of the tensile force of the tension spring at the time of a reverse-operation of the movable member.

4. The microswitch according to claim 1, wherein under the action of the tensile force of the tension spring at the time of a reverse-operation of the movable member, the movable contact is displaced in a direction intersecting an axis of the tension spring before operation of the movable contact, whereby the movable contact slides relative to the fixed contact.

5. The microswitch according to claim 1, wherein the support frame comprises a first pillar member that is disposed on the one side of the tension spring, that includes the first end portion and that extends in a height direction, a second pillar member that is disposed on the other side of the tension spring, that includes the second end portion and that extends in a height direction, and a connection member that connects the first pillar member and the second pillar member.

6. The microswitch according to claim 5, wherein the support frame has a general U-shape formed by the first and second pillar members and the connection member .

7. The microswitch according to claim 5, wherein a height dimension of the connection member is made smaller from the side of the first pillar member toward the side of the second pillar member.

8. The microswitch according to claim 7, wherein the connection member is a tapered member.

9. The microswitch according to claim 5, wherein the other end of the movable member is bifurcated, one of the bifurcated other end is supported by the first pillar member of the support frame, and the other of the bifurcated other end is supported by the second pillar member of the support frame.

10. The microswitch according to claim 1, wherein the one end of the tension spring is engaged with the one end of the movable member and the other end of the tension spring is engaged with the actuator.

11. The microswitch according to claim 10, wherein at the time of a reverse-operation of the movable member the movable member rotates around the other end of the tension spring, whereby the movable contact slides relative to the fixed contact.

12. The microswitch according to claim 1, wherein on the side of the one end of the movable member, there is provided a regulating member to regulate a lateral movement of the one end of the movable member.

FIG. 1

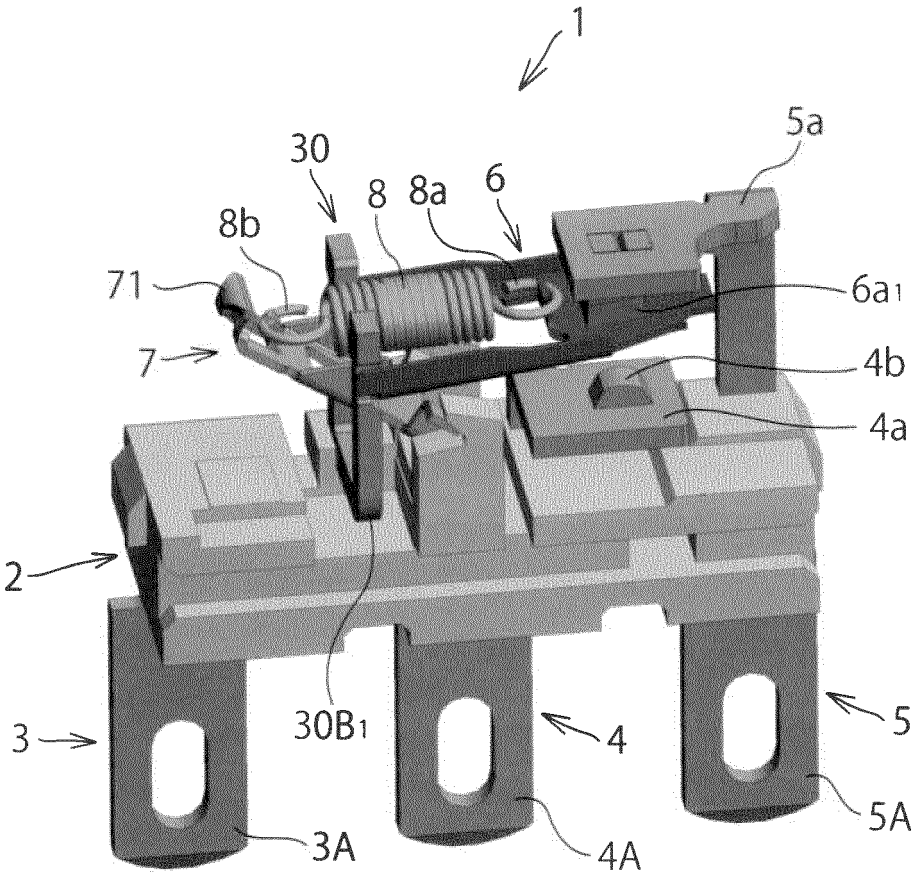


FIG. 2

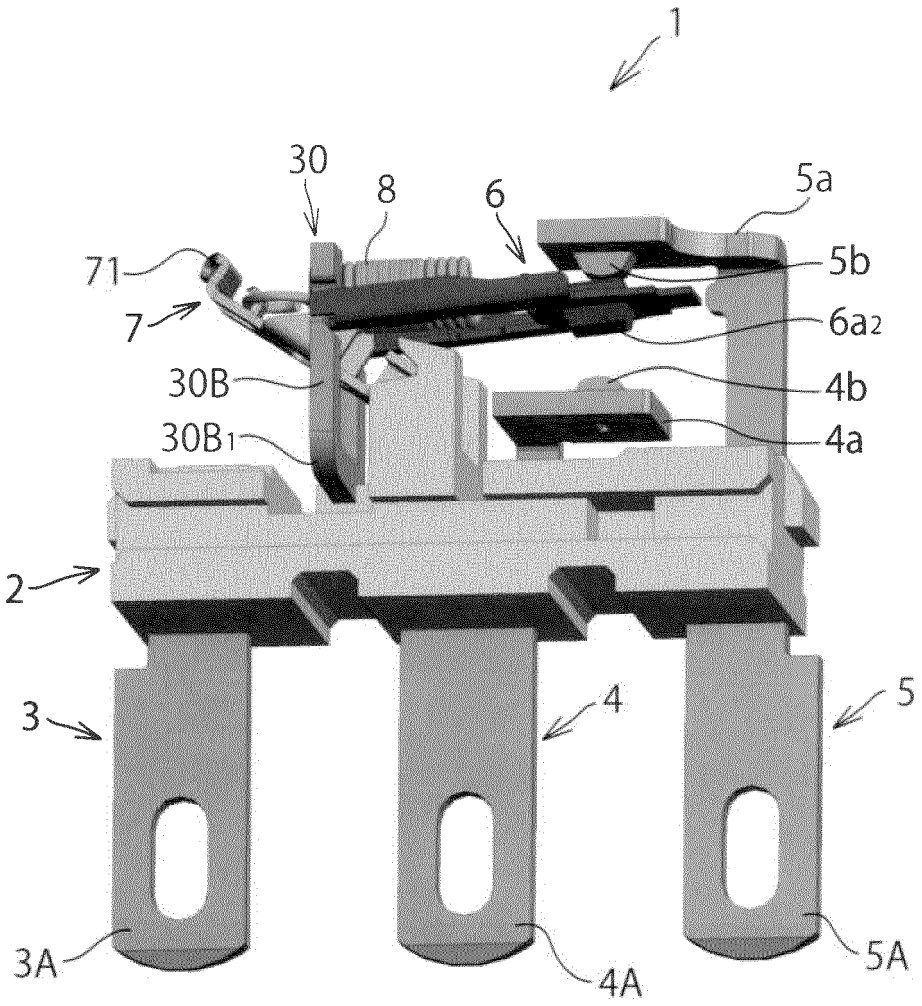
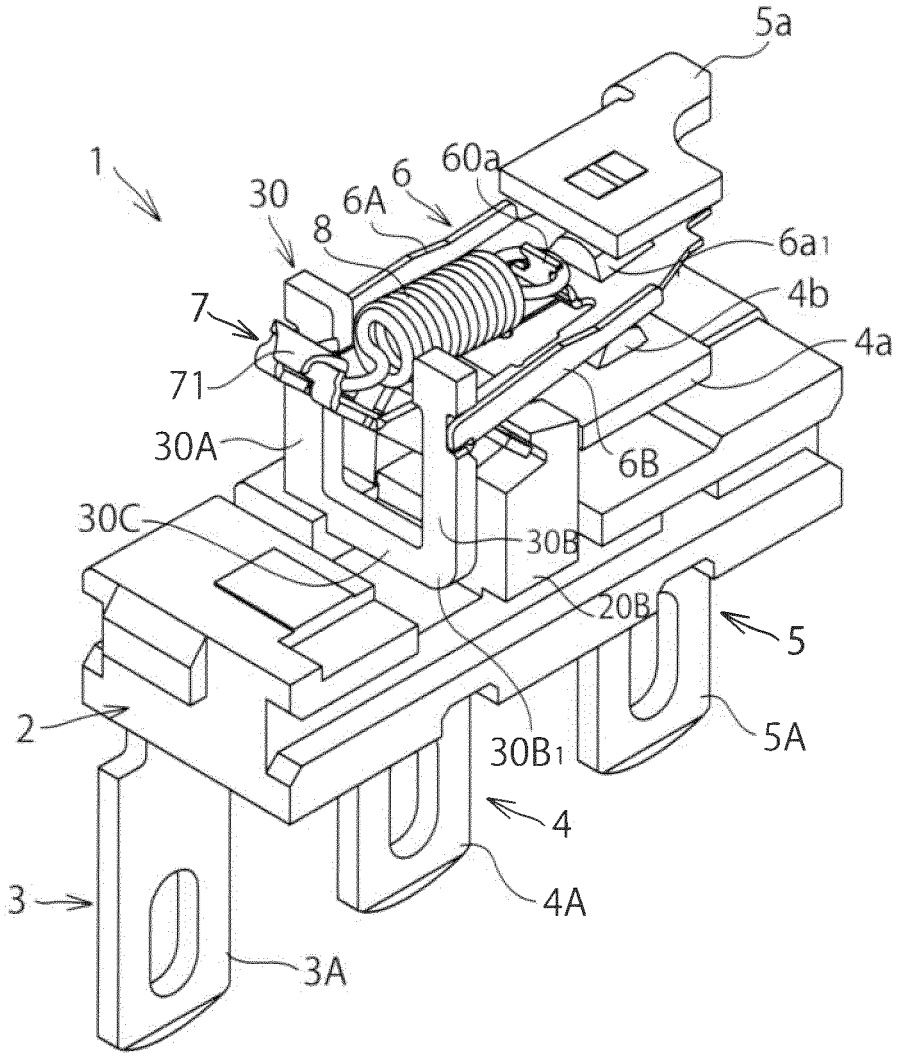


FIG. 3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2
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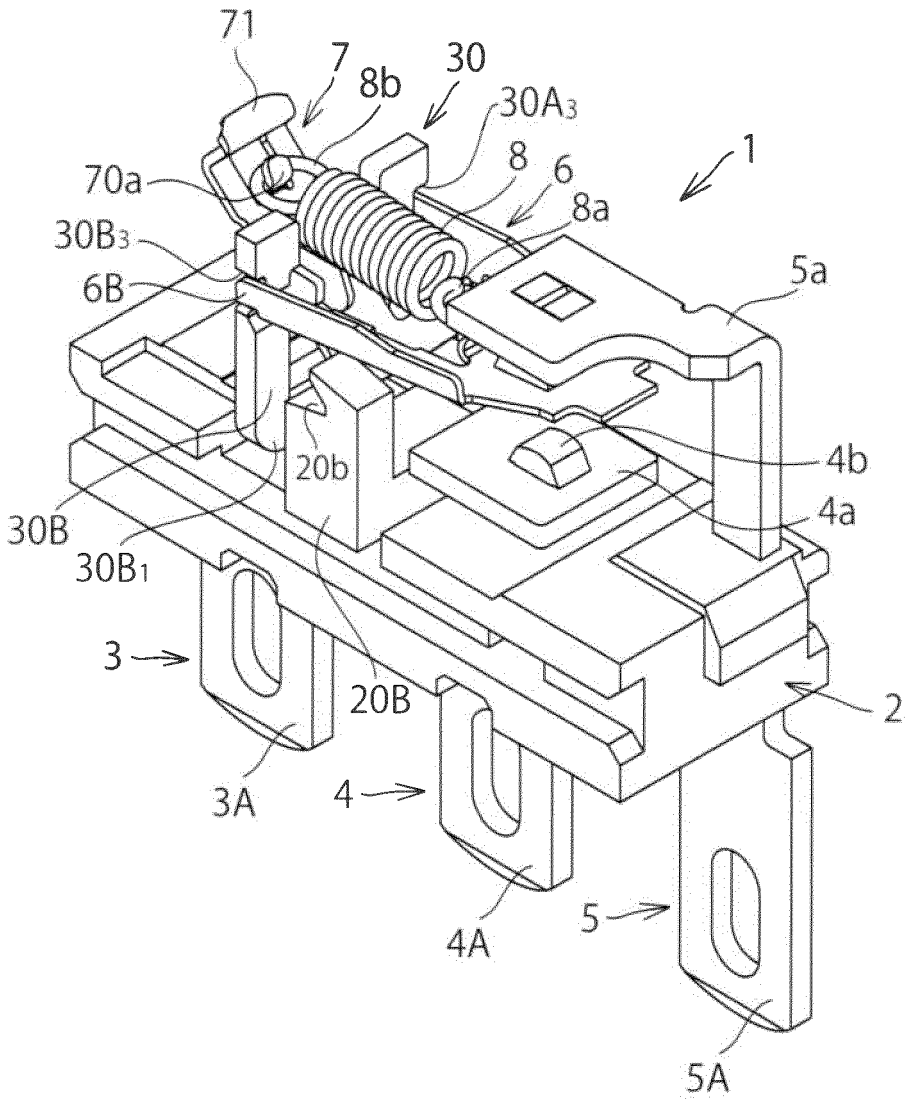
4
3
4A
3A

FIG. 4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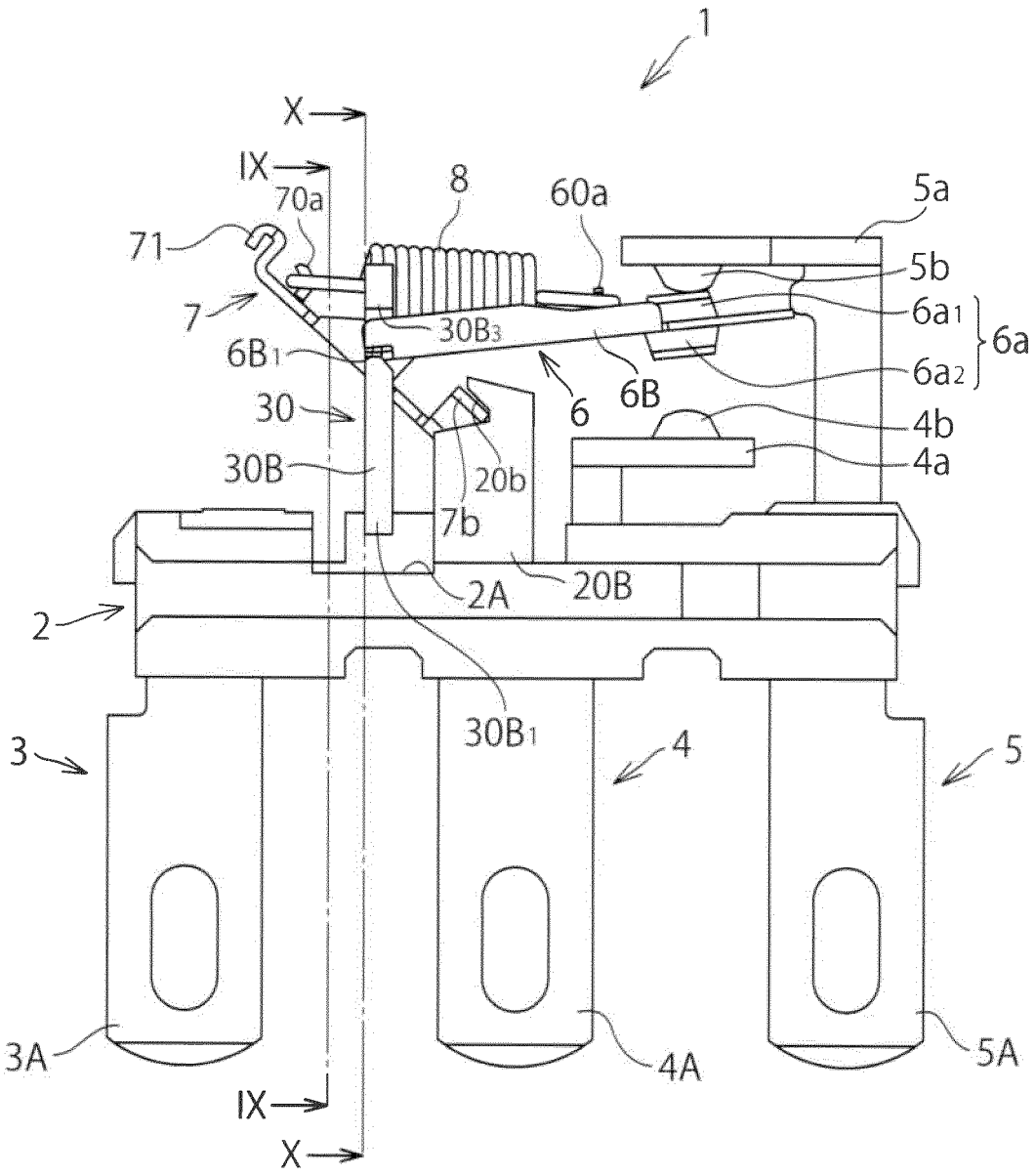
3A
4
4A
5
5A

FIG. 5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71
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6a1
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6B1
6a2
6B
6
30
4b
4a
30B
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20B
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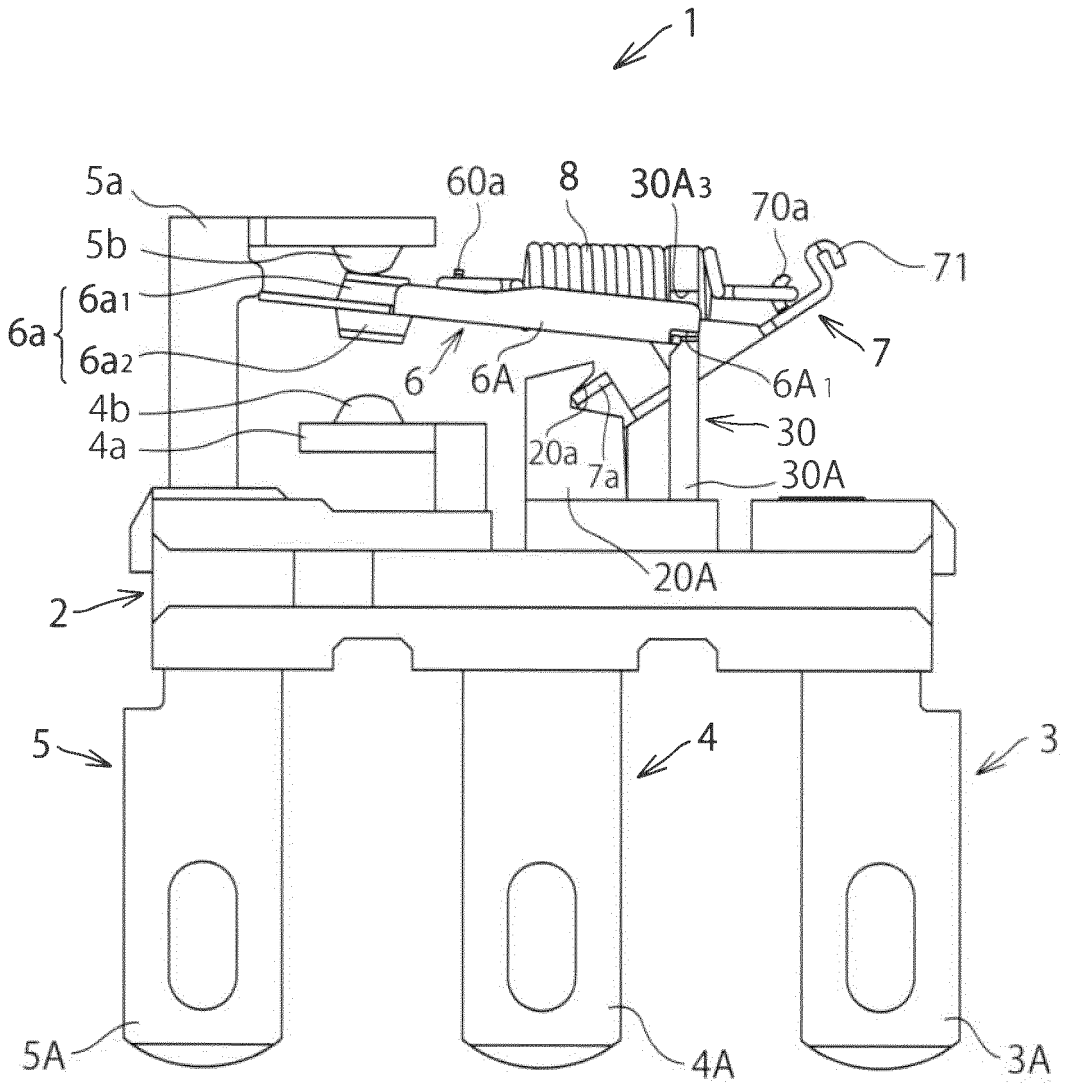
30B1
3
4
5
3A
4A
5A
IX
X

FIG. 6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30A
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4A
3A

FIG. 7

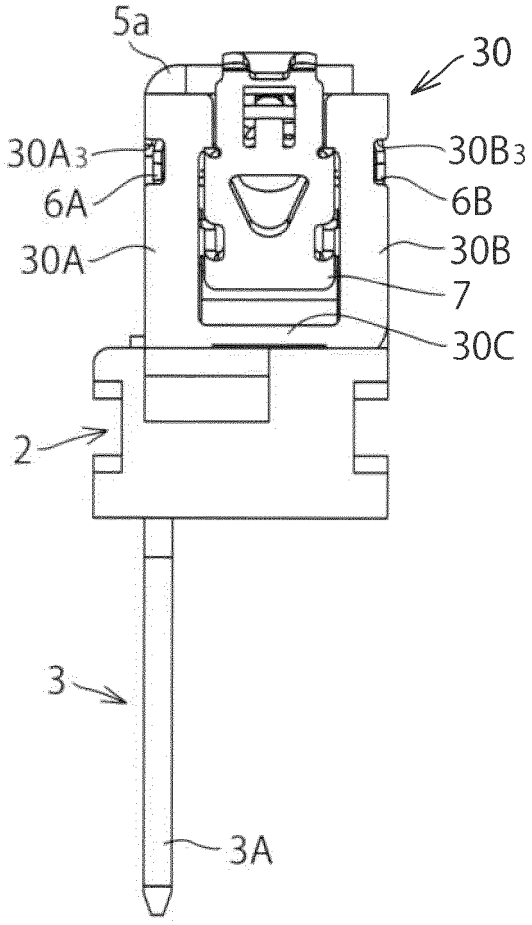


FIG. 8

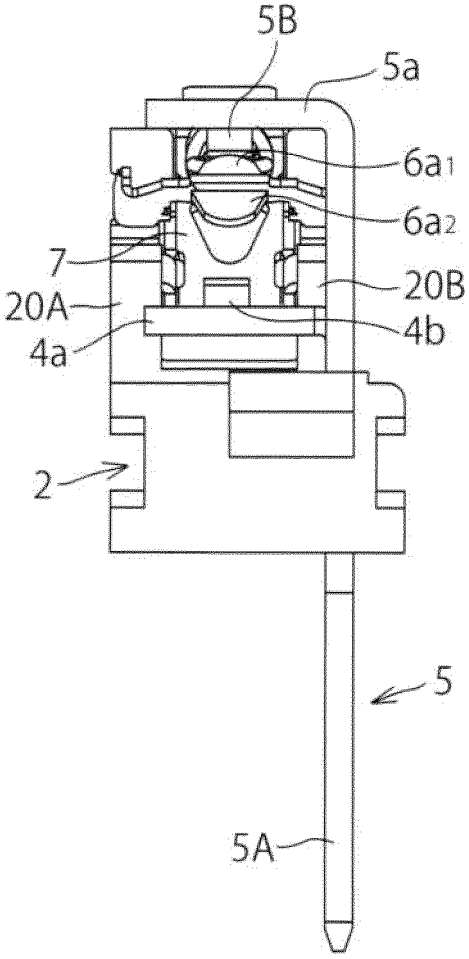


FIG. 9

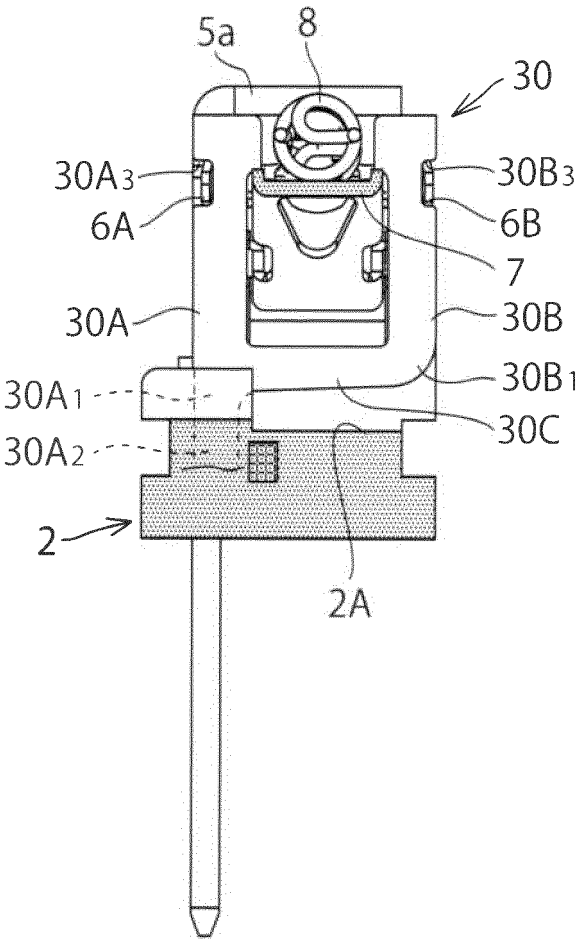
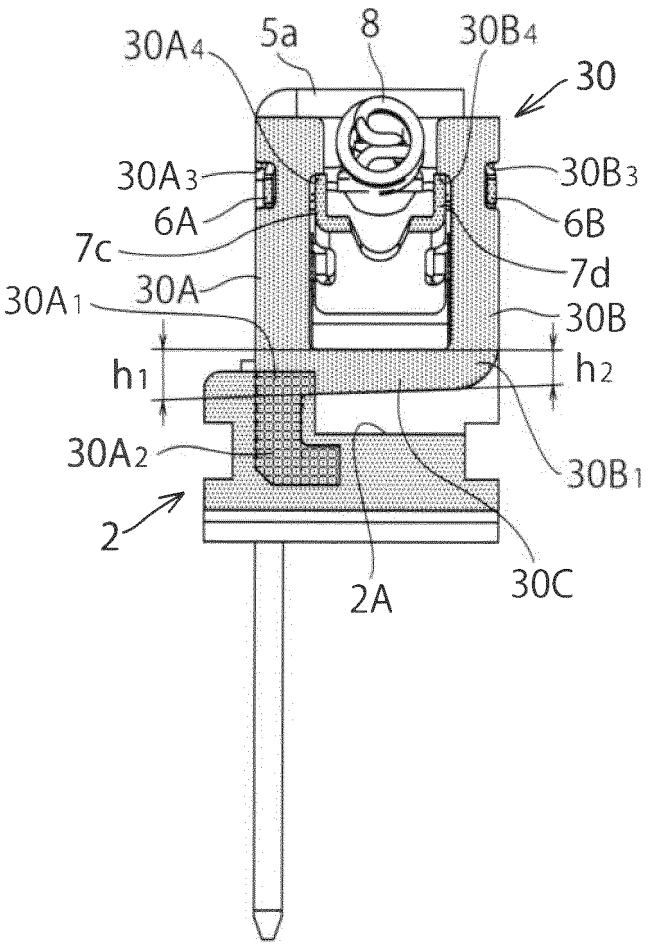


FIG. 10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h2
30A2
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2A
30C

FIG. 11

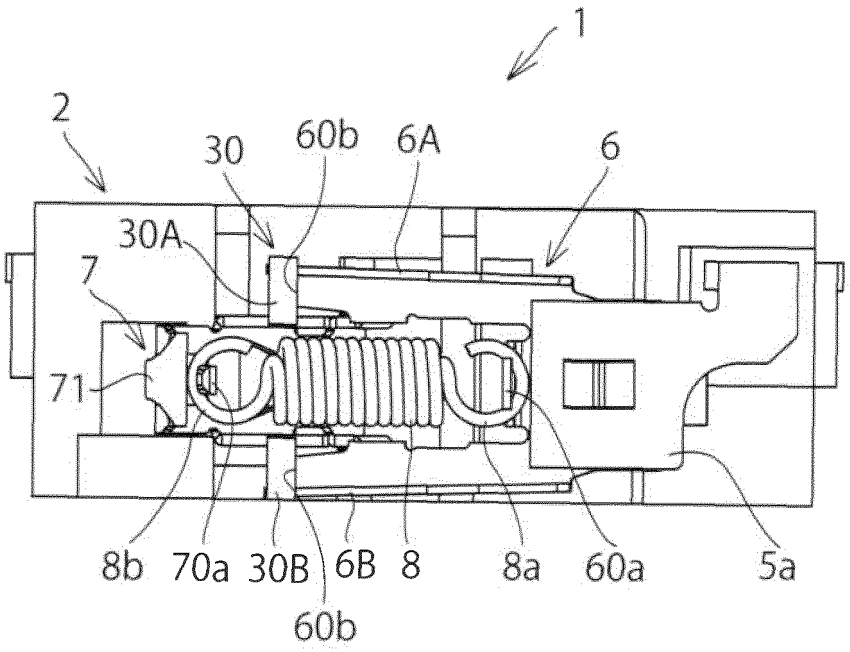
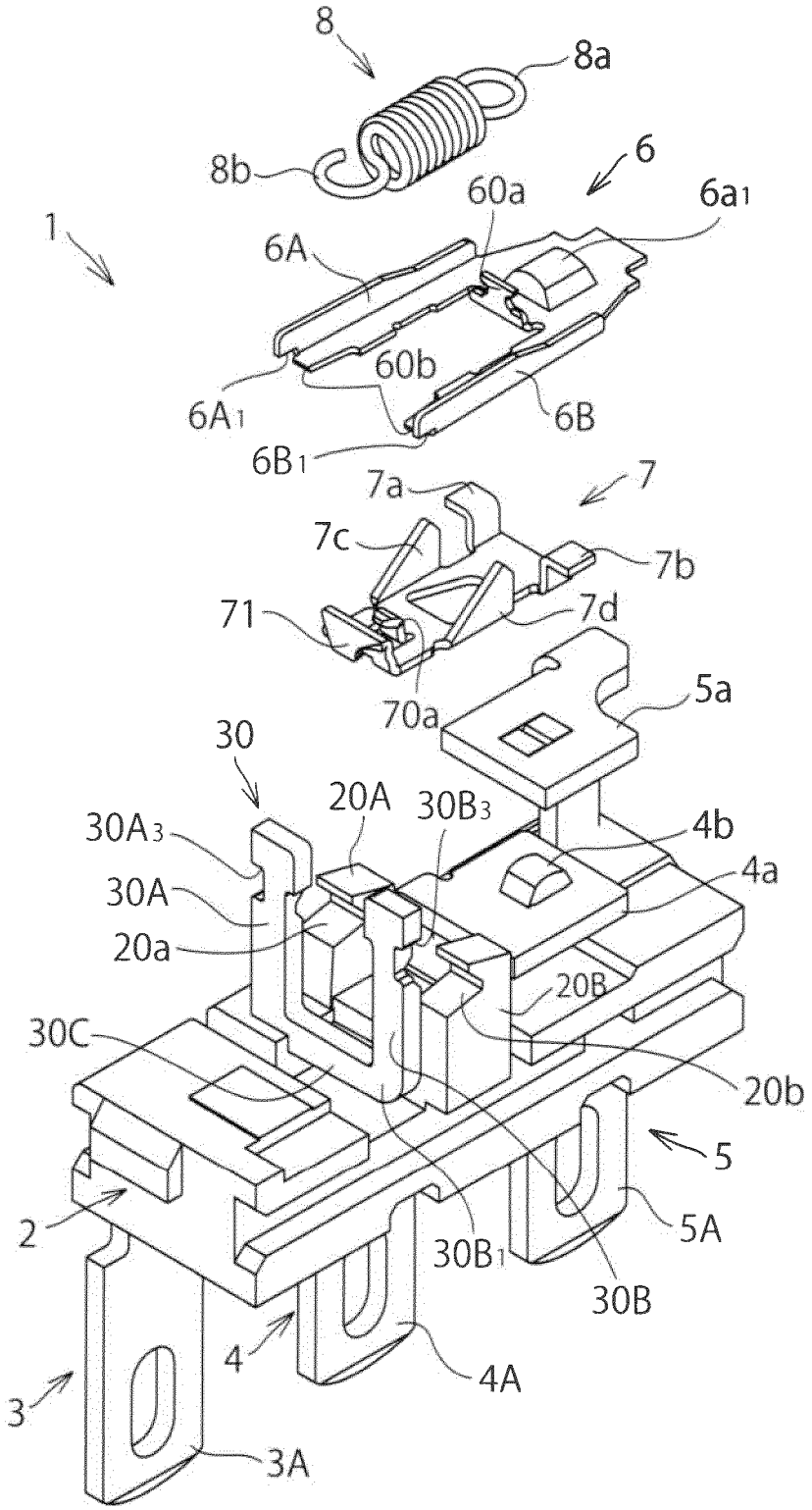


FIG. 12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6A1
6B
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7c
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30A3
4b
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30B
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3
3A

FIG. 13

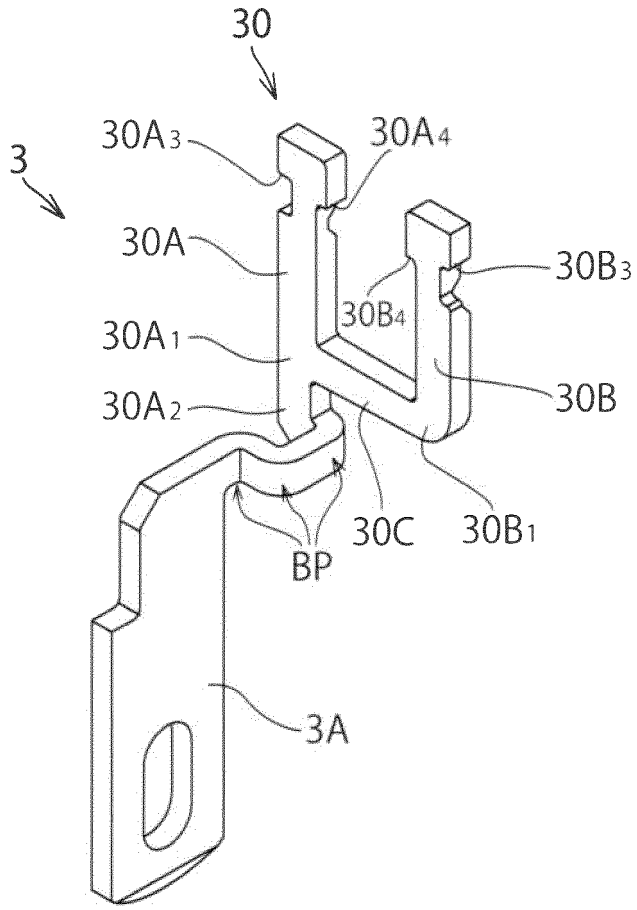
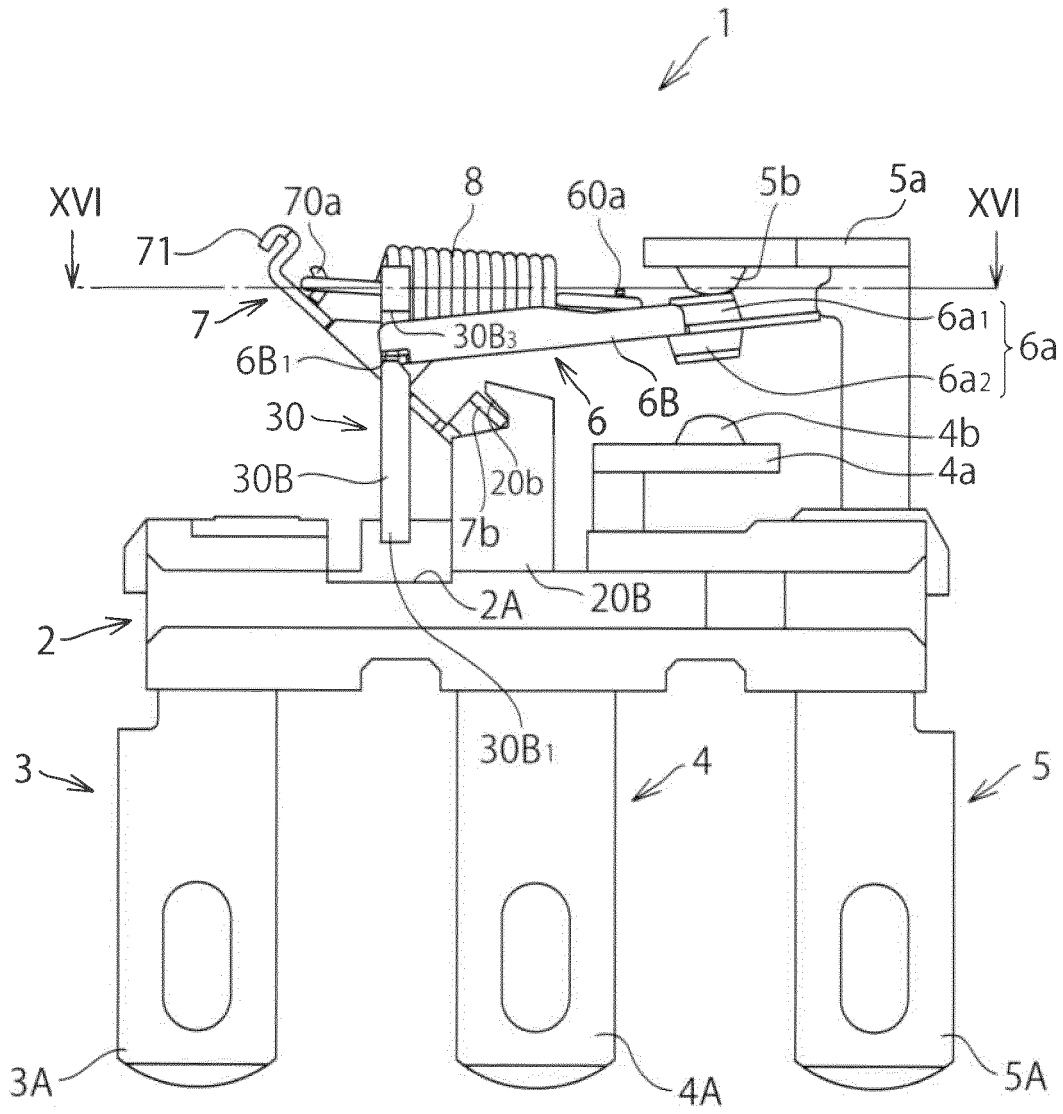


FIG. 14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6B
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4
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3A
4A
5A

FIG. 15

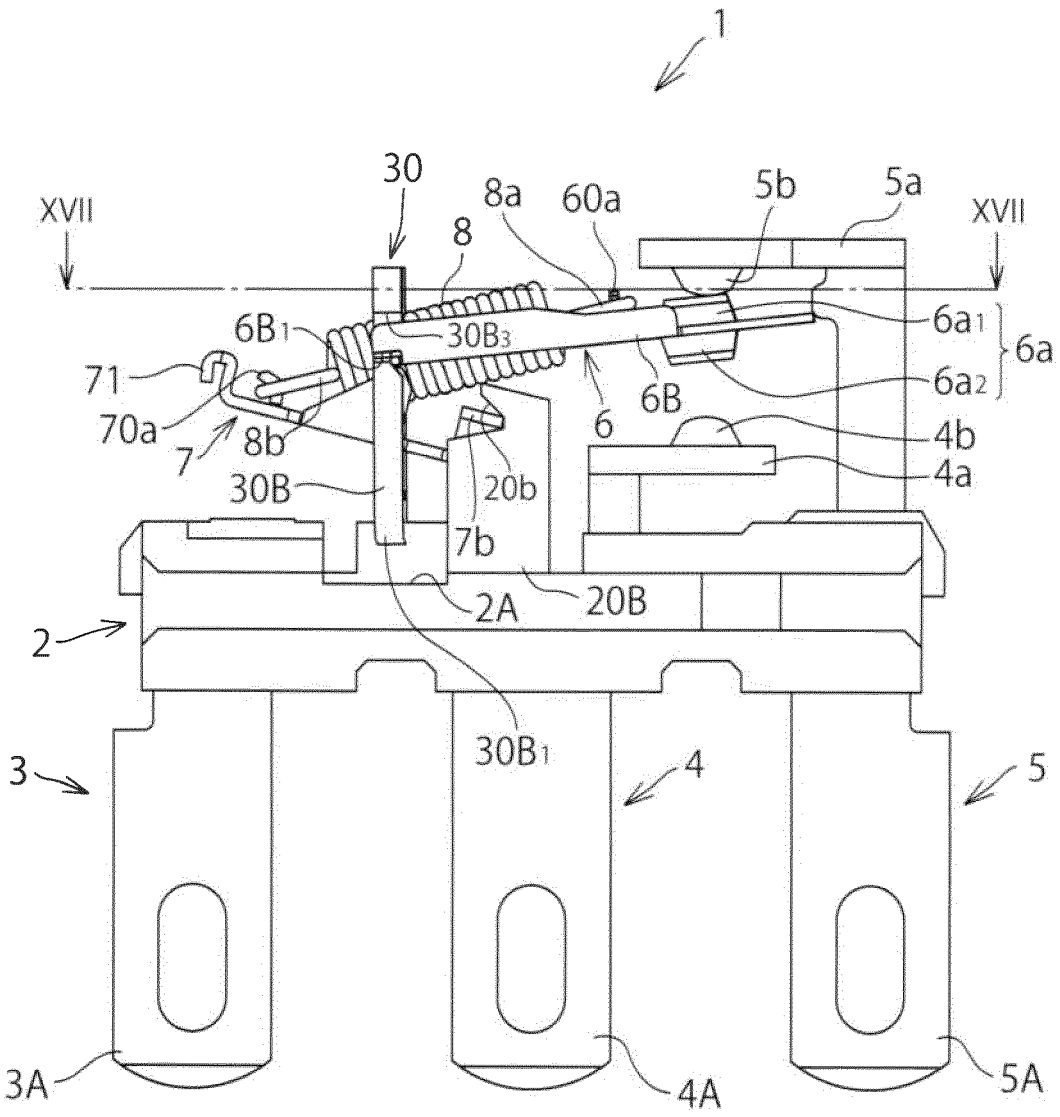
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FIG. 16

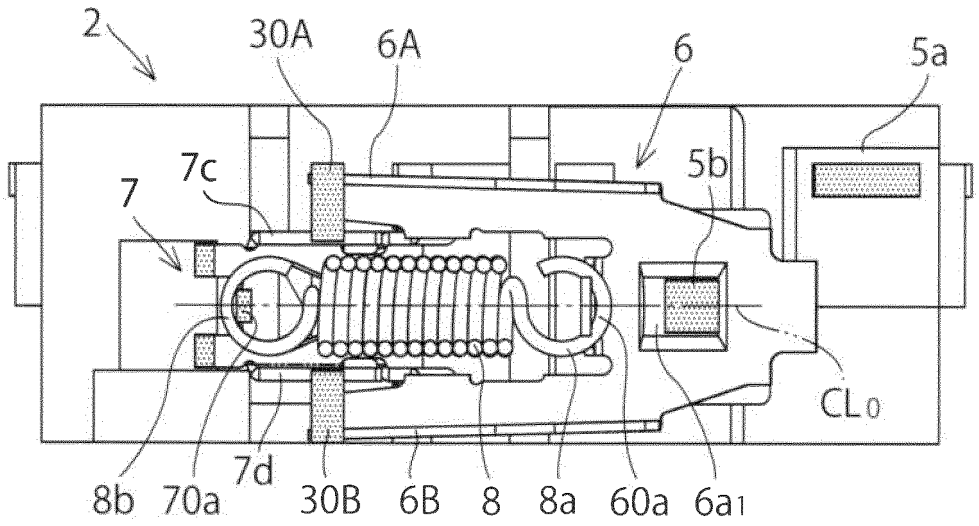


FIG. 17

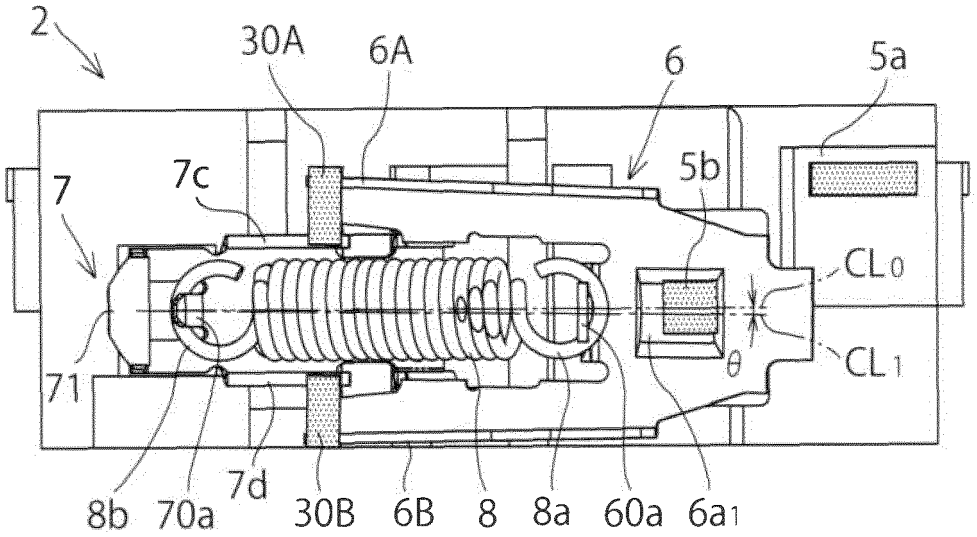
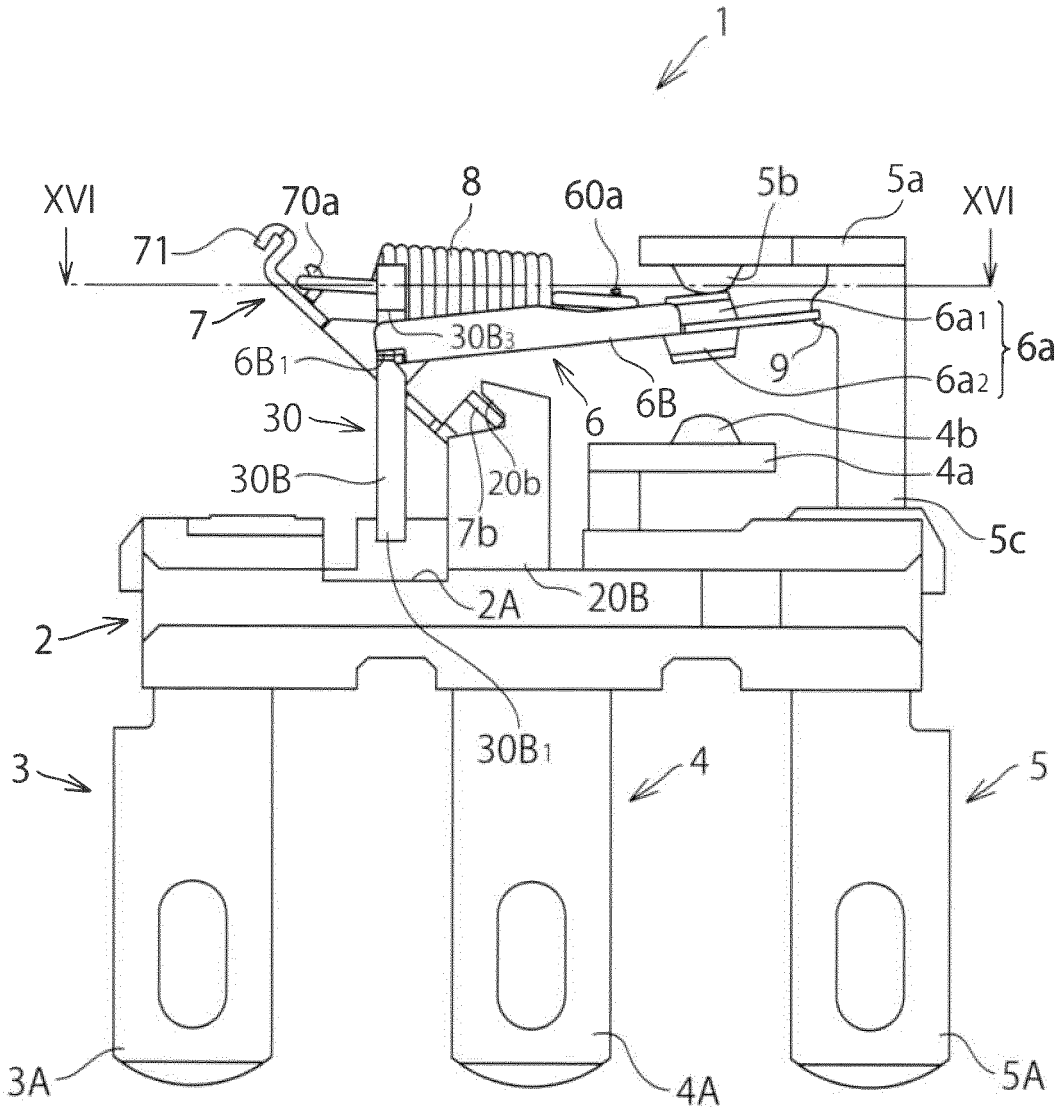


FIG. 18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3A
4A
5A

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/041526

A. CLASSIFICATION OF SUBJECT MATTER

H01H 1/18(2006.01)i; ***H01H 21/28***(2006.01)i; ***H01H 21/42***(2006.01)i
FI: H01H21/42; H01H1/18; H01H21/28 W

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H1/18; H01H21/28; H01H21/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2008-66082 A (FUJI ELECTRIC FA COMPONENTS & SYSTEMS CO LTD) 21 March 2008 (2008-03-21) paragraphs [0001], [0019]-[0032], fig. 1-2, 4-5	1-11
A		12
A	JP 2008-235218 A (FUJI ELECTRIC FA COMPONENTS & SYSTEMS CO LTD) 02 October 2008 (2008-10-02)	1-12
A	WO 2010/032814 A1 (ALPS ELECTRIC CO., LTD.) 25 March 2010 (2010-03-25)	1-12

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 December 2021	**11 January 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/041526

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2008-66082 A	21 March 2008	FR 2905513 A1	
		CN 101140831 A	
JP 2008-235218 A	02 October 2008	FR 2914107 A1	
		CN 101271794 A	
WO 2010/032814 A1	25 March 2010	US 2011/0147186 A1	
		EP 2346057 A1	
		KR 10-2011-0038726 A	
		CN 102144271 A	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 63129928 U **[0002] [0004]**