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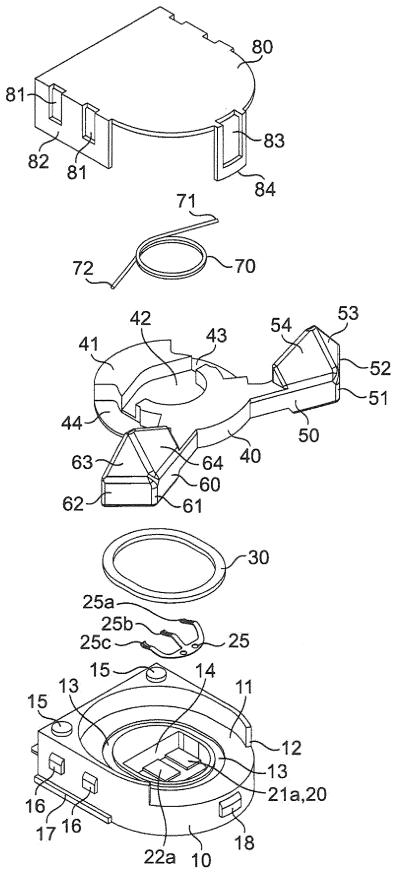
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(54) **SWITCH**

(57) Provided is a switch capable of singly detecting external forces loaded from multiple directions.

The switch is a switch including: a base (10); a cover (80) mounted on one surface of the base (10); an operation body (40) which is stored in an operation recess (11) formed on one surface of the base (10) and is held between the base (10) and the cover (80) rotatably from the outside; a return spring (70) which is supported between the cover (80) and the operation body (40) and is configured to apply a return force to the operation body (40); and a contact mechanism portion (20) which is disposed between the base (10) and the operation body (40), the switch operating the operation body (40) to drive the contact mechanism portion (20). In particular, at least one operation receiving portion (50) is extended from an outer peripheral surface of the operation body (40), and at least one operation surface (52) is extended from an apex (51) located at a free end of the operation receiving portion (50).

FIG. 2



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Description

FIELD

[0001] The present invention relates to a switch, and particularly to a switch capable of detecting external forces in multiple directions.

BACKGROUND

[0002] Conventionally, as a switch, for example, one limit switch detects operations of two filters in a cleaner installed in an air conditioner (cf., Japanese Patent No. 5020208).

SUMMARY

[0003] However, as shown in Fig. 3 of the above patent document, since a seesaw mechanism has been used in order for the limit switch to detect the operations of the two filters, a detectable operating direction is restricted to one vertical direction. Therefore, every time a position for mounting the limit switch changes, the seesaw mechanism is required to be redesigned. This makes the design complex and produces the need for remaking a mold, thus causing a problem of wasting the mold used so far.

[0004] In view of the above problem, an object of the present invention is to provide a switch capable of singly detecting external forces in multiple directions.

[0005] In order to solve the above problem, a switch according to the present invention is a switch including: a base; a cover mounted on one surface of the base; an operation body which is stored in an operation recess formed on one surface of the base and is held between the base and the cover rotatably from the outside; a return spring which is supported between the cover and the operation body and is configured to apply a return force to the operation body; and a contact mechanism portion which is disposed between the base and the operation body. The switch operates the operation body to drive the contact mechanism portion. The switch is configured such that at least one operation receiving portion is extended from an outer peripheral surface of the operation body, and at least one operation surface is extended outward from an apex located at a free end of the operation receiving portion.

[0006] According to the present invention, by receiving an external force loaded on the operation surface as well as an external force loaded on the apex of the operation receiving portion, the operation body is displayed or rotated, and it is thus possible to directly detect an external force from a different direction. Accordingly, it is possible to obtain a switch not requiring the seesaw mechanism as in the conventional example and thus having a simplified structure, while having high versatility.

[0007] As an embodiment of the present invention, an intersection angle between a straight line connecting from a rotational center of the operation body to an apex of the operation receiving portion and a reference line passing through the rotational center of the operation body and dividing the operation body into two sections in a width direction may be not smaller than 45 degrees and not larger than 90 degrees.

[0008] According to the embodiment, converting the external force loaded on the apex to a rotational motion allows efficient detection of the external force.

[0009] Further, an intersection angle between the reference line passing through the rotational center of the operation body and an extended line extended from a first operation surface as an operation surface extended in an extending direction of the operation receiving portion may be not smaller than 45 degrees and smaller than 90 degrees.

[0010] According to the embodiment, converting the external force loaded on the first operation surface to a rotational motion allows efficient detection of the external force.

[0011] As another embodiment of the present invention, a second operation surface may be extended from a front surface side edge of the operation receiving portion.

[0012] According to the embodiment, since an external force loaded on the rear from the front surface along a thickness direction can be detected, the number of detecting directions increases, and hence it is possible to obtain a switch with higher versatility.

[0013] In particular, an intersection angle between a reference surface dividing the operation body into two sections in the thickness direction and an extended line extended from the second operation surface may be not smaller than 45 degrees and smaller than 90 degrees.

[0014] According to the embodiment, converting the external force loaded on the second operation surface to a rotational motion allows efficient detection of the external force.

[0015] As another embodiment of the present invention, a third operation surface may be extended from a rear surface side edge of the operation receiving portion.

[0016] According to the embodiment, since an external force loaded on the front surface from the rear along the thickness direction can be detected, the number of detecting directions increases, and hence it is possible to obtain a switch with higher versatility.

[0017] In particular, an intersection angle between a reference surface dividing the operation body into two sections in the thickness direction and an extended line extended from the third operation surface may be not smaller than 45 degrees and smaller than 90 degrees.

[0018] According to the embodiment, converting the external force loaded on the second operation surface to a rotational motion allows efficient detection of the external force.

[0019] As a different embodiment of the present invention, the second operation surface and the third operation surface, which are disposed with the first operation sur-

face placed therebetween, may be coupled and integrated via a coupling surface including an inclined surface.

[0020] According to the embodiment, the coupling portion can also be used as the operation surface while mechanical strength of the operation receiving portion increases, and hence the versatility further increases.

[0021] As a different embodiment of the present invention, a pair of the operation receiving portions may be extended from the outer peripheral surface of the operation body.

[0022] According to the embodiment, the number of directions of detectable external forces increases, and hence it is possible to obtain a switch with high versatility.

[0023] In particular, a pair of the operation receiving portions may be bisymmetrically extended from the outer peripheral surface of the operation body.

[0024] According to the embodiment, there is an effect of obtaining a switch capable of also detecting an external force from above based on a pushing operation, and having high versatility.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 is a perspective view showing a first embodiment of a switch according to the present invention;
Fig. 2 is an exploded perspective view of the switch shown in Fig. 1;
Fig. 3 is an exploded perspective view of the switch shown in Fig. 1, seen from a different angle;
Figs. 4A and 4B are perspective views of a base and a contact mechanism portion shown in Fig. 1;
Figs. 5A and 5B are perspective views of an operation body shown in Fig. 1, seen from different angles;
Figs. 6A and 6B are a perspective view showing a state where a cover has been removed from the switch shown in Fig. 1, and a perspective view of the cover seen from the rear surface side;
Figs. 7A and 7B are a front view and a vertical sectional view of the operation body shown in Fig. 1;
Figs. 8A and 8B are a vertical sectional view and a cross sectional view showing the switch shown in Fig. 1 before it is operated;
Fig. 9 is a table for explaining a method for operating the switch shown in Fig. 1;
Figs. 10A and 10B are a perspective view and a front view for explaining the method for operating the switch shown in Fig. 1;
Figs. 11A and 11B are a vertical sectional view and a cross sectional view showing the switch in the operation state shown in Fig. 10;
Figs. 12A and 12B are a perspective view and a front view for explaining a different method for operating the switch shown in Fig. 1;
Figs. 13A and 13B are a vertical sectional view and a cross sectional view showing the switch in the operation state shown in Fig. 12;
Figs. 14A and 14B are a perspective view and a front view for explaining another method for operating the switch shown in Fig. 1;
Figs. 15A and 15B are a vertical sectional view and a cross sectional view showing the switch in the operation state shown in Fig. 14;
Figs. 16A and 16B are perspective views of an operation body and a contact mechanism portion showing a second embodiment of the switch according to the present invention, seen from different angles;
Fig. 17 is a perspective view of an operation body and a contact mechanism portion of a third embodiment of the switch according to the present invention;
Figs. 18A and 18B are a perspective view of a fourth embodiment of the switch according to the present invention, and a perspective view showing a state where a cover has been removed;
Fig. 19 is an exploded perspective view of the switch shown in Fig. 18;
Fig. 20 is an exploded perspective view of the switch shown in Fig. 18, seen from a different angle;
Figs. 21A and 21B are perspective views of an operation body and a contact mechanism portion shown in Fig. 18;
Fig. 22 is an exploded perspective view showing a fifth embodiment of the switch according to the present invention;
Fig. 23 is an exploded perspective view of the switch shown in Fig. 22, seen from a different angle;
Fig. 24 is a perspective view of a contact mechanism portion shown in Fig. 22;
Figs. 25A and 25B are a perspective view showing a state where a cover has been removed from a sixth embodiment of the switch according to the present invention, and a perspective view of the cover seen from the rear surface side;
Figs. 26A and 26B are a perspective view of a base and an operation body shown in Fig. 25, and a perspective view showing a contact mechanism portion;
Figs. 27A and 27B are perspective views showing a seventh embodiment of the switch according to the present invention, seen from different angles;
Figs. 28A and 28B are a plan view and a vertical sectional view of the switch shown in Fig. 27; and
Fig. 29 is a vertical sectional view of the switch shown in Fig. 27.

DETAILED DESCRIPTION

[0026] Embodiments of the switch according to the present invention will be described in accordance with the attached drawings from Figs. 1 to 29.

[0027] As shown in Figs. 1 to 8B, the switch according to a first embodiment is formed of a base 10, a contact mechanism portion 20 inserted and molded in the base 10, a sealing member 30, an operation body 40, a return spring 70, and a cover 80.

[0028] As shown in Fig. 4A, the base 10 has a thick plate shape with its one end side provided with an arc surface. The top surface of the base 10 is formed with an elliptical storage recess 11, and the arc surface side thereof is formed with a notched portion 12. Then, the bottom surface of the storage recess 11 is formed with an annular sealing groove 13, and the inside of the sealing groove 13 is formed with a substantially semicircular operation recessed portion 14. The bottom surface of the operation recessed portion 14 is disposed with first, second and third fixed contacts 21 a, 22a, 23a of later-mentioned first, second and third fixed contact terminals 21, 22, 23, and a connection portion 24a of a common terminal 24. Further, positioning projections 15, 15 are respectively projected from adjacent corner portions of the top surface of the base 10. Further, a pair of engagement projections 16, 16 is each provided in parallel on the outer side surface of each side of the base 10, and a positioning rib 17 is projectingly provided at the edge of the outer side surface. Meanwhile, an engagement projection 18 is projectingly provided on the outer side surface on the arc surface side of the base 10.

[0029] As shown in Fig. 4B, in the contact mechanism portion 20, the first, second and third fixed contact terminals 21, 22, 23 and the common terminal 24 are provided in parallel, and one end of the common terminal 24 is extended to form the connection portion 24a. Then, an elastic contact piece 25 is caulked and fixed to the connection portion 24a. Further, the first, second and third fixed contacts 21a, 22a, 23a extended in the same direction are provided in parallel in the first, second and third fixed contact terminals 21, 22, 23. Then, first, second and third movable contacts 25a, 25b, 25c, which are contactable to and separable from the first, second and third fixed contacts 21 a, 22a, 23a, are extended from the elastic contact piece 25. In particular, the first, second and third movable contacts 25a, 25b, 25c have a twin contact structure for ensuring contact reliability. Further, terminal portions 21 b, 22b, 23b of the first, second and third fixed contact terminals 21, 22, 23 inserted and molded in the base 10 and a terminal portion 24b of the common terminal 24 are projected from the same outer side surface of the base 10 and allayed on the same straight line.

[0030] It is to be noted that fixing the elastic contact piece 25 is not restricted to the case of caulking and fixing it to the connection portion 24a, but it may be fixed in an electrically conductive state. It is possible to apply a variety of connection methods such as bonding by welding or soldering or with a conductive adhesive, for example.

[0031] As shown in Fig. 2, the sealing member 30 has a ring shape fittable to the sealing groove 13 provided in the base 10, and a material therefor can be selected as appropriate from an elastic member such as rubber.

[0032] As shown in Figs. 6A and 6B, the operation body 40 includes an operation body main body 41 having a rotatable and slidable shape in the storage recess 11 of the base 10, and a pair of operation receiving portions 50, 60 is extended from the outer peripheral surface of the operation body main body 41.

[0033] As shown in Figs. 5A and 5B, the operation body main body 41 is formed with a fitting recessed portion 42, which can be fitted with and hold the later-mentioned return spring 70 on the opposing surface opposed to the later-mentioned cover 80, and notched step portions 43, 44, which communicate with both sides of the fitting recessed portion 42 and where both end portions 71, 72 of the later-mentioned return spring 70 are projected.

[0034] Further, a semicircular pedestal portion 45, movable in the operation recessed portion 14 of the base 10, is provided at the center of the opposite surface of the operation body main body 41 which is opposed to the base 10. Then, a pair of position controlling projections 45a, 45a is projectingly provided at the edge of the pedestal portion 45, and a semicircular arc cam portion 46 is projectingly provided in the pedestal portion 45. The cam portion 46 has operation edges 46a, 46b, 46c capable of operating the first, second and third movable contacts 25a, 25b, 25c.

[0035] It is to be noted that the operation edges 46a, 46c are not necessarily required to be disposed on the same straight line, and extended lines of those may be made to intersect at a predetermined angle as necessary.

[0036] Meanwhile, the operation receiving portion 50 is formed with a first operation surface 52 inclined from its apex 51 at a predetermined angle, and formed with a second operation surface 54 on the first operation surface 52 via a coupling surface 53. Similarly, the operation receiving portion 60 is formed with a first operation surface 62 inclined from its apex 61 at a predetermined angle, and formed with a second operation surface 64 on the first operation surface 62 via a coupling surface 63. Then, the first operation surfaces 52, 62, the coupling surfaces 53, 63 and the second operation surfaces 54, 64 form an inclination angle at which the operation body 40 can be operated by an operation from the side.

[0037] In particular, as shown in Fig. 7A, a reference line L passing through a rotational center of the operation body 40 and dividing it into two sections in a width direction intersects with a straight line M connecting from the rotational center of the operation body 40 to the apex 51 of the operation receiving portion 50 at an intersection angle α. The intersection angle α is preferably not smaller than 45 degrees and not larger than 90 degrees, and particularly preferably around 50 degrees. This is because, when it is smaller than 45 degrees, a rotational force based on a loaded operation force becomes small and a pushing force becomes large, resulting in that the operation body 40 is pushed and a desired rotational operation cannot be obtained. This is also because, when it is over 90 degrees, the operation member may slip and fall after coming into contact with the apexes 51, 61 of the operation receiving portions 50, 60.

[0038] Further, an extended line P from the first operation surface 52 intersects with the reference line L at an intersection angle β. The intersection angle β is preferably not smaller than 45 degrees and smaller than 90 de-

grees, and particularly preferably 45 degrees. This is because, when it is smaller than 45 degrees, a rotational force as a divided force along a vertical direction of an operation force loaded from the side becomes small, thus requiring a large operation force. This is also because, when it is not smaller than 90 degrees, a rotational force as a divided force along a vertical direction of an operation force loaded from the side is not generated, leading to an inoperative state.

[0039] Then, as shown in Fig. 7B, an extended line Q extended from the second operation surface 64 intersects with the reference surface N dividing the operation body 40 into two sections in a thickness direction, at an intersection angle γ. The intersection angle γ is preferably not smaller than 45 degrees and smaller than 90 degrees, and particularly preferably around 50 degrees. This is because, when it is smaller than 45 degrees, a rotational force as a divided force along a vertical direction of an operation force loaded from the side becomes small, thus requiring a large operation force. This is also because, when it is not smaller than 90 degrees, a rotational force as a divided force along a vertical direction of an operation force loaded from the side is not generated, leading to an inoperative state.

[0040] As shown in Figs. 6A and 6B, the return spring 70 includes a coil spring that is storable in the fitting recessed portion 42 of the operation body 40, and both end portions 71, 72 thereof are respectively projected in the notched step portions 43, 44. In addition, it is natural that the return spring 70 is not restricted to the coil spring, but a plate spring may be used.

[0041] As shown in Fig. 6B, the cover 80 has a plane shape that can cover the base 10. From an outer peripheral edge thereof, an engagement piece 82 provided with a pair of engagement holes 81, 81 is extended, and an engagement piece 84 provided with an engagement hole 83 is extended. Further, within the inward surface of the cover 80, position controlling projections 85, 86 are respectively projectingly provided in corresponding positions to the notched step portions 43, 44 of the operation body 40, and fitting receiving portions 87, 87 are provided in corner portions. Then, the both end portions 71, 72 of the return spring 70 are respectively locked to the position controlling projections 85, 86.

[0042] Next, a method for assembling the switch will be described.

[0043] That is, within the base 10 inserted and molded with the first, second and third fixed contact terminals 21, 22, 23 and the common terminal 24, the connection portion 24a of the common terminal 24 exposed from the operation recessed portion 14 is caulked and fitted with the elastic contact piece 25. At this time, the first, second and third movable contacts 25a, 25b, 25c of the elastic contact piece 25 are respectively opposed to the first, second and third fixed contacts 21 a, 22a, 23a of the first, second and third fixed contact terminals 21, 22, 23 in a contactable and separable manner, but they are not in contact. Then, the sealing member 30 is fitted to the sealing groove 13 of the base 10. Meanwhile, the return spring 70 is fitted to the fitting recessed portion 42 of the operation body 40, and the both end portions 71, 72 of the return spring 70 are projected in the notched step portions 43, 44. Subsequently, the semicircular arc cam portion 46 of the operation body 40 is fitted to the operation recessed portion 14 of the base 10, and the operation body main body 41 is stored in the storage recess 11 (Fig. 6A). Finally, the cover 80 is mounted on the base 10. The engagement hole 81 of the engagement piece 82 is engaged to the engagement projection 16 of the base 10, and the engagement piece 84 is engaged to the engagement projection 18. Therefore, the position controlling projections 85, 86 projectingly provided on the inward surface of the cover 80 are respectively fitted to the notched step portions 43, 44 of the operation body 40, and the both end portions 71, 72 of the return spring 70 are respectively locked to the position controlling projections 85, 86 (Fig. 6B). Hence the operation body 40 is prevented from coming off.

[0044] It is to be noted that as described above, fixing the elastic contact piece 25 is not restricted to the case of caulking and fixing it to the connection portion 24a, but it may be fixed in an electrically conductive state. It is possible to apply a variety of connection methods such as bonding by welding or soldering or with a conductive adhesive, for example.

[0045] An operation of the assembled switch will be described.

[0046] When an external force is not loaded on the operation receiving portions 50, 60 of the operation body, as shown in Figs. 6A and 6B, the both end portions 71, 72 of the return spring 70 are respectively locked to the pair of position controlling projections 85, 86 projectingly provided on the inward surface of the cover 80, and the position of the operation body 40 is controlled. Therefore, as shown in Fig. 8B, the cam portion 46 of the operation body 40 is not in contact with the first, second and third movable contacts 25a, 25b, 25c of the elastic contact piece 25. The first, second and third movable contacts 25a, 25b, 25c are respectively opened and separated from the first, second and third fixed contacts 21 a, 22a, 23a.

[0047] Then, as shown in Figs. 10A and 10B and 11A and 11B, when an external force is loaded on the apexes 51, 61 of the operation receiving portions 50, 60 from above, the operation body 40 descends against a spring force of the return spring 70. The operation edges 46a, 46b, 46c of the cam portion 46 then push down the first, second and third movable contacts 25a, 25b, 25c of the elastic contact piece (Figs. 11A and 11B). Therefore, the first, second and third movable contacts 25a, 25b, 25c simultaneously come into contact with the first, second and third fixed contacts 21 a, 22a, 23a (Fig. 11B), and the common terminal 24 is electrically connected with the first, second and third fixed contact terminals 21, 22, 23. As a result, it is possible to detect simultaneous loading of the external force on the operation receiving por-

tions 50, 60.

[0048] It is to be noted that the position controlling projections 45a, 45a provided in the pedestal portion 45 of the operation body 40 come into contact with the inner side surface of the operation recessed portion 14, thereby controlling the position of the operation body 40 (Fig. 11 A).

[0049] Further, in the embodiment, at the time of simultaneous contact of the respective first, second and third movable contacts 25a, 25b, 25c with the first, second and third fixed contacts 21 a, 22a, 23a, they come into contact while wiping. Hence it is possible to obtain a switch capable of preventing contact failure and having a long life.

[0050] Especially, since the first, second and third movable contacts 25a, 25b, 25c do not come into sliding contact with the surface of the base 10, abrasion powder is not generated from the base 10. Hence it is possible to obtain a switch where the contact failure further hardly occurs.

[0051] When the load of the external force is then removed, the operation body 40 returns to the original position by the spring force of the return spring 70, and the first, second and third movable contacts 25a, 25b, 25c are opened and separated from the first, second and third fixed contacts 21 a, 22a, 23a.

[0052] Although the case has been described where the external force is loaded on the apexes 51, 61 of the pair of the operation receiving portions 50, 60 from above in the foregoing operation, this is not restrictive. For example, when external forces are simultaneously loaded respectively on the inclined first operation surfaces 52, 62 of the operation receiving portions 50, 60 from the side, and also when external forces are simultaneously loaded respectively on the inclined second operation surfaces 54, 64 of the operation receiving portions 50, 60 from the side, the operation body 40 opens and closes the contacts in a similar manner.

[0053] Further, for example, as shown in Figs. 12A and 12B and Figs. 13A and 13B, when an external force is loaded only on the apex 51 of the one operation receiving portion 50 of the operation body 40 from above, the operation body 40 is rotated against a spring force of the return spring 70, and the operation edge 46a of the cam portion 46 pushes down the first movable contact 25a of the elastic contact piece 25 (Fig. 13A). Therefore, only the first movable contact 25a comes into contact with the first fixed contact 21 a (Fig. 13B), and the common terminal 24 is electrically connected with the first fixed contact terminal 21. As a result, it is possible to detect loading of the external force only on the operation receiving portion 50. It is to be noted that a position controlling surface 44a provided in the notched step portion 44 of the operation body 40 (Fig. 12B) comes into contact with the position controlling projection 86 of the cover 80, thereby controlling the position of the operation body 40.

[0054] When the load of the external force is then removed, the operation body 40 returns to the original position by the spring force of the return spring 70, and the first movable contact 25a is opened and separated from the first fixed contact 21 a.

[0055] As for the foregoing operation, even when an external force is loaded only on the inclined first operation surface 52 of the operation receiving portion 50 from the side, or when an external force is loaded only on the inclined second operation surface 54 of the operation receiving portion 50 from the side, the contacts can be opened and closed by a similar operation.

[0056] Further, even when an external force is loaded only on the apex 61 of the other operation receiving portion 60 of the operation body 40 from above, or even when an external force is loaded only on the inclined first operation surface 62, or the second operation surface 64, of the other operation receiving portion 60 from the side, the contacts are opened and closed by the operation body 40 performing a similar operation to the above.

[0057] Further, as shown in Figs. 14A and 14B and Figs. 15A and 15B, when an external force is loaded on the operation receiving portion 50 of the operation body 40 and the operation body 40 is pushed as rotated, the cam portion 46 is pushed as rotated. Therefore, the operation edge 46a of the cam portion 46 presses the first movable contact 25a to bring it into contact with the first fixed contact 21 a (Fig. 15B). Subsequently, when a different external force is loaded on the operation receiving portion 60, the cam portion 46 is further pushed down. The operation edges 46b, 46c thereof push down the second and third movable contacts 25b, 25c, and the second and third movable contacts 25b, 25c come into contact with the second and third fixed contacts 22a, 23a. Therefore, eventually, the first, second and third movable contacts 25a, 25b, 25c come into contact with the first, second and third fixed contacts 21a, 22a, 23a.

[0058] In the embodiment, there is an advantage in that, even when composite external forces are loaded with a time difference, the operation body 40 can be smoothly operated to open and close the contacts.

[0059] Further, an external force loaded on the operation body 40 is loaded not restrictively on the apexes 51, 61 and the first operation surfaces 52, 62 of the operation receiving portions 50, 60, but an external force may be loaded on the coupling surfaces 53, 63 and the second operation surfaces 54, 64 of the operation receiving portions 50, 60 from the side. According to the embodiment, there is an advantage in that, since external forces from multiple directions can be detected, it is possible to obtain a switch with excellent handleability and versatility.

[0060] As shown in Figs. 16A and 16B, a second embodiment is almost similar to the foregoing first embodiment, and what is different is a case where a click feeling step portion is formed in each of the operation edges 46a, 46b, 46c of the cam portion 46 of the operation body 40.

[0061] According to the embodiment, there is an advantage in that, when the operation edges 46a, 46b, 46c

of the cam portion 46 come into contact with the first, second and third movable contacts 25a, 25b, 25c, a click feeling is generated and operation can be confirmed.

[0062] It is to be noted that, although the case has been disclosed in the embodiment where only the first operation surfaces 52, 62 are extended from the apexes of the operation receiving portions 50, 60, the second operation surface may naturally be formed via the coupling surface as in the first embodiment.

[0063] Since others are similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0064] As shown in Fig. 17, a third embodiment is almost similar to the foregoing first embodiment, and what is different is a case where three independent cam portions 47a, 47b, 47c are integrally molded in the operation body 40.

[0065] According to the embodiment, the cam portions 47a, 47b, 47c are divided so as to respectively correspond to the first, second and third movable contacts 25a, 25b, 25c, and hence the shape of the cam portion can be selected as necessary. Hence there is an advantage in that designing becomes easier and the range of selection expands.

[0066] It is to be noted that, although the case has been disclosed in the embodiment where only the first operation surfaces 52, 62 are extended from the apexes of the operation receiving portions 50, 60, the second operation surface may naturally be formed via the coupling surface as in the first embodiment.

[0067] Since others are similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0068] As shown in Figs. 18A and 18B and Figs. 21A and 21B, a basic configuration of a fourth embodiment is almost similar to that of the first embodiment, and what is different is that an external force is detected only by a rotational operation.

[0069] That is, a switch according to the embodiment is formed of the base 10, the contact mechanism portion 20 inserted and molded in the base 10, the sealing member 30, the operation body 40, the return spring 70, and a cover 80.

[0070] As shown in Fig. 19, the top surface of the base is formed with the elliptical storage recess 11, and the arc surface side thereof is formed with the notched portion 12. Then, the bottom surface of the storage recess 11 is formed with the annular sealing groove 13, and the inside of the sealing groove 13 is formed with the substantially semicircular operation recessed portion 14. The operation recessed portion 14 is disposed with the first and second fixed contacts 21 a, 22a of the inserted and molded first and second fixed contact terminals 21, 22 and the connection portion 24a of the common terminal 24, and those terminal portions 21 b, 22b, 24b are projected from the same outer side surface. Further, the engagement projection 16 is projectingly provided on the outer side surface of each side of the base 10, and the positioning rib 17 in a substantially L-shape is projectingly provided on the outer side surface of the base 10. Moreover, the positioning projections 15, 15 are respectively projected from adjacent corner portions of the top surface of the base 10.

[0071] Further, as shown in Figs. 21A and 21B, in the contact mechanism portion 20, the common terminal 24 and the first and second fixed contact terminals 21, 22 are provided in parallel, and one end of the common terminal 24 is extended to form the connection portion 24a. Then, the elastic contact piece 25 is caulked and fixed to the connection portion 24a. Further, the first and second fixed contacts 21 a, 22a extending in the same direction are provided in parallel in the first and second fixed contact terminals 21, 22. Moreover, first and second movable contacts 25a, 25b, which are contactable to and separable from the first and second fixed contacts 21a, 22a, are extended from the elastic contact piece 25. The first and second movable contacts 25a, 25b each have a twin contact structure for ensuring contact reliability.

[0072] In addition, as described above, fixing the elastic contact piece 25 is not restricted to the case of caulking and fixing it to the connection portion 24a, but it may be fixed in an electrically conductive state. It is naturally possible to apply a variety of connection methods such as bonding by welding or soldering or with a conductive adhesive, for example.

[0073] The sealing member 30 has a ring shape fittable to the sealing groove 13 provided in the base 10, and a material therefor can be selected as appropriate from an elastic member such as rubber.

[0074] As shown in Fig. 21B, the operation body 40 includes the operation body main body 41 having a rotational shape in the storage recess 11 of the base 10, and a pair of substantially L-shaped operation receiving portions 50, 60 is extended from the outer peripheral surface of the operation body main body 41.

[0075] Further, the operation body main body 41 is formed with the fitting recessed portion 42, which can be stored in the return spring 70 on the opposing surface opposed to the later-mentioned cover 80, and the notched step portions 43, 44, which communicate with both sides of the fitting recessed portion 42 and where the both end portions 71, 72 of the return spring 70 are projected.

[0076] Meanwhile, the semicircular pedestal portion 45, having an outer peripheral shape fittable to the operation recessed portion 14 of the base 10, is formed at the center of the opposite surface of the operation body main body 41 which is opposed to the base 10. Further, a fan-shaped cam portion 46 is projectingly provided in the pedestal portion 45. The cam portion 46 is provided with substantially V-shaped operation edges 46a, 46b capable of operating the first and second movable contacts 25a, 25b. In particular, a click feeling step portion is provided in each of the operation edges 46a, 46b. Hence there is an advantage in that, when the operation edges 46a, 46b of the cam portion 46 come into contact

with the first and second movable contacts 25a, 25b, a click feeling is generated and the operation of the operation body 40 can be confirmed.

[0077] As shown in Fig. 18B, the return spring 70 has a shape storable in the fitting recessed portion 42 of the operation body 40, and the both end portions 71, 72 thereof are projected from the notched step portions 43, 44.

[0078] As shown in Fig. 20 and Figs. 21A and 21B, the cover 80 has a plane shape that can cover the base 10. From an outer peripheral edge thereof, the engagement piece 82 provided with the engagement hole 81 is extended, and the engagement piece 84 provided with an engagement hole 83 is extended.

[0079] It is to be noted that, since others are almost similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0080] Further, since the method for assembling the switch is also similar to that in the foregoing first embodiment, a description thereof will be omitted.

[0081] Next, an operation of the assembled switch will be described.

[0082] When an external force is not loaded on the operation receiving portions 50, 60 of the operation body 40, the both end portions 71, 72 of the return spring 70 are locked to the pair of position controlling projections 85, 86 projectingly provided on the inward surface of the cover 80, and the position of the operation body 40 is controlled. Therefore, the operation edges 46a, 46b of the cam portion 46 of the operation body 40 are not in contact with the first and second movable contacts 25a, 25b of the elastic contact piece 25. The first and second movable contacts 25a, 25b are opened and separated from the first and second fixed contacts 21a, 22a.

[0083] Then, when an external force is loaded on the operation receiving portion 50 of the operation body 40 from above, the operation body 40 is rotated against a spring force of the return spring 70, and the operation edge 46a of the cam portion 46 pushes down the first movable contact 25a of the elastic contact piece 25. Therefore, the first movable contact 25a comes into contact with the first fixed contact 21 a, and the common terminal 24 is electrically connected with the first fixed contact terminal 21. Hence it is possible to detect loading of the external force on the operation receiving portion 50. It is to be noted that the position controlling surface 44a provided in the notched step portion 44 of the operation body 40 comes into contact with the position controlling projection 86 of the cover 80, to perform positon control.

[0084] When the load of the external force is then removed, the operation body 40 returns to the original position by the spring force of the return spring 70, and the first movable contact 25a is opened and separated from the first fixed contact 21 a.

[0085] It should be noted that, also when an external force is loaded on the operation receiving portion 60 of the operation body 40, the contact can be opened and closed by performing a similar operation.

[0086] As shown in Figs. 22 to 24, a basic structure of a fifth embodiment is almost similar to that of the first embodiment, and what is different is that the switch is capable of detecting an external force only when it is simultaneously loaded on each of the operation receiving portions 50, 60.

[0087] That is, as shown in Fig. 22, the top surface of the base 10 is formed with the storage recess 11, and the arc surface side thereof is formed with the notched portion 12. Then, the bottom surface of the storage recess 11 is formed with the elliptical sealing groove 13, and the inside of the sealing groove 13 is formed with the substantially semicircular operation recessed portion 14. The bottom surface of the operation recessed portion 14 is disposed with the first fixed contact 21 a of the first fixed contact terminal 21 of the contact mechanism portion 20 and the connection portion 24a of the common terminal 24, and those terminal portions 21 b, 24b are projected from the same outer side surface.

[0088] As shown in Fig. 24, in the contact mechanism portion 20, the first fixed contact terminal 21 and the common terminal 24 are provided in parallel, and one end of the common terminal 24 is extended to form the connection portion 24a. Then, the elastic contact piece 25 is caulked and fixed to the connection portion 24a. Moreover, a first movable contact 25a, which is contactable to and separable from the first fixed contact 21 a, is extended from the elastic contact piece 25.

[0089] Since others including the method for fixing the elastic contact piece 25 are almost similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0090] According to the embodiment, when the operation receiving portions 50, 60 of the operation body 40 are simultaneously pressed down from above, the operation body 40 descends against a spring force of the return spring 70, and the operation edge 46b of the cam portion 46 pushes down the first movable contact 25a to bring it into contact with the first fixed contact 21 a.

[0091] However, for example when an external force is loaded only on the operation receiving portion 50 of the operation body 40, the operation body 40 is rotated, but the cam portion 46 cannot push down the first movable contact 25a. Therefore, the first movable contact 25a does not come into contact with the first fixed contact 21 a.

[0092] It is to be noted that, since others are almost similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0093] As shown in Figs. 25A and 25B and Figs. 26A and 26B, a sixth embodiment is almost similar to the foregoing first embodiment, and what is different is a case where the both end portions 71, 72 extended in a direction intersecting with a periphery of the return spring 70 are

respectively locked to the position controlling projections 85, 86 projectingly provided in the cover 80.

[0094] According to the embodiment, there is an advantage in that positions for projectingly providing the position controlling projections 85, 86 can be arbitrarily selected and the freedom of design becomes large, to facilitate designing and mounting the return spring 70.

[0095] Since others are almost similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0096] As shown in Figs 27A and 27B to Fig. 29, a seventh embodiment is almost similar to the foregoing first embodiment, and what is different is a case where the inclined first, second and third operation surfaces 52, 54, 56 are continuously formed in the operation receiving portion 50 of the operation body 40 via the coupling surfaces 53, 55. Similarly, the inclined first, second and third operation surfaces 62, 64, 56 are continuously formed in the operation receiving portion 60 via the coupling surfaces 63, 65.

[0097] Since inclination angles of the first, second and third operation surfaces and the coupling surfaces are formed in a similar manner to the foregoing first embodiment, descriptions thereof will be omitted.

[0098] According to the embodiment, there is an advantage in that it is possible to obtain a switch capable of detecting an external force loaded not only from above but also from the front, rear, right or left side.

[0099] Since others are almost similar to those in the foregoing first embodiment, the same numerals are provided to the same portions, and descriptions thereof will be omitted.

[0100] It is natural that not only the first, second and third operation surfaces but also the coupling surface can be used as operation surface.

[0101] Further, although the foregoing first, second and third operation surfaces and coupling surface are formed of the flat surfaces, it is natural that they are not necessarily be the flat surfaces, but may have a continuous curved shape.

[0102] Moreover, it is natural that the first operation surface may not be provided in the operation receiving portion, and only the second operation surface or the third operation surface, or the second and third operation surfaces, may be extended from the apex.

[0103] A switch according to the present invention is not restricted to the foregoing switches, and it may naturally be applicable to a contact switch device of another embodiment.

Claims

1. A switch, comprising:

a base (10);
a cover (80) mounted on one surface of the base (10);
an operation body (40) which is stored in an operation recess (11) formed on one surface of the base (10) and is held between the base (10) and the cover (80) rotatably from the outside;
a return spring (70) which is supported between the cover (80) and the operation body (40) and configured to apply a return force to the operation body (40); and
a contact mechanism portion (20) which is disposed between the base (10) and the operation body (40),
the switch operating the operation body (40) to drive the contact mechanism portion (20),
wherein at least one operation receiving portion (50) is extended from an outer peripheral surface of the operation body (40), and at least one operation surface (52) is extended outward from an apex (51) located at a free end of the operation receiving portion (50).

2. The switch according to claim 1, wherein an intersection angle between a straight line connecting from a rotational center of the operation body (40) to an apex (51) of the operation receiving portion (50) and a reference line passing through the rotational center of the operation body (40) and dividing the operation body (40) into two sections in a width direction is not smaller than 45 degrees and not larger than 90 degrees.

3. The switch according to claim 2, wherein an intersection angle between the reference line passing through the rotational center of the operation body (40) and an extended line extended from a first operation surface (52) as an operation surface extended in an extending direction of the operation receiving portion (50) is not smaller than 45 degrees and smaller than 90 degrees.

4. The switch according to any one of claims 1 to 3, wherein a second operation surface (54) is extended from a front surface side edge of the operation receiving portion (50).

5. The switch according to claim 4, wherein an intersection angle between a reference surface dividing the operation body (40) into two sections in a thickness direction and an extended line extended from the second operation surface (54) is not smaller than 45 degrees and smaller than 90 degrees.

6. The switch according to any one of claims 1 to 5, wherein a third operation surface (56) is extended from a rear surface side edge of the operation receiving portion (50).

7. The switch according to claim 6, wherein an inter-

section angle between
a reference surface dividing the operation body (40) into two sections in a thickness direction and
an extended line extended from the third operation surface (66) is not smaller than 45 degrees and smaller than 90 degrees.

8. The switch according to any one of claims 3 to 7, wherein the second operation surface (54) and the third operation surface (56), which are disposed with the first operation surface (52) placed therebetween, are coupled and integrated via a coupling surface including an inclined surface.

9. The switch according to any one of claims 1 to 8, wherein a pair of the operation receiving portions (50, 60) is extended from the outer peripheral surface of the operation body (40).

10. The switch according to any one of claims 1 to 9, wherein a pair of the operation receiving portion (50, 60) is bisymmetrically extended from the outer peripheral surface of the operation body (40).

FIG. 1

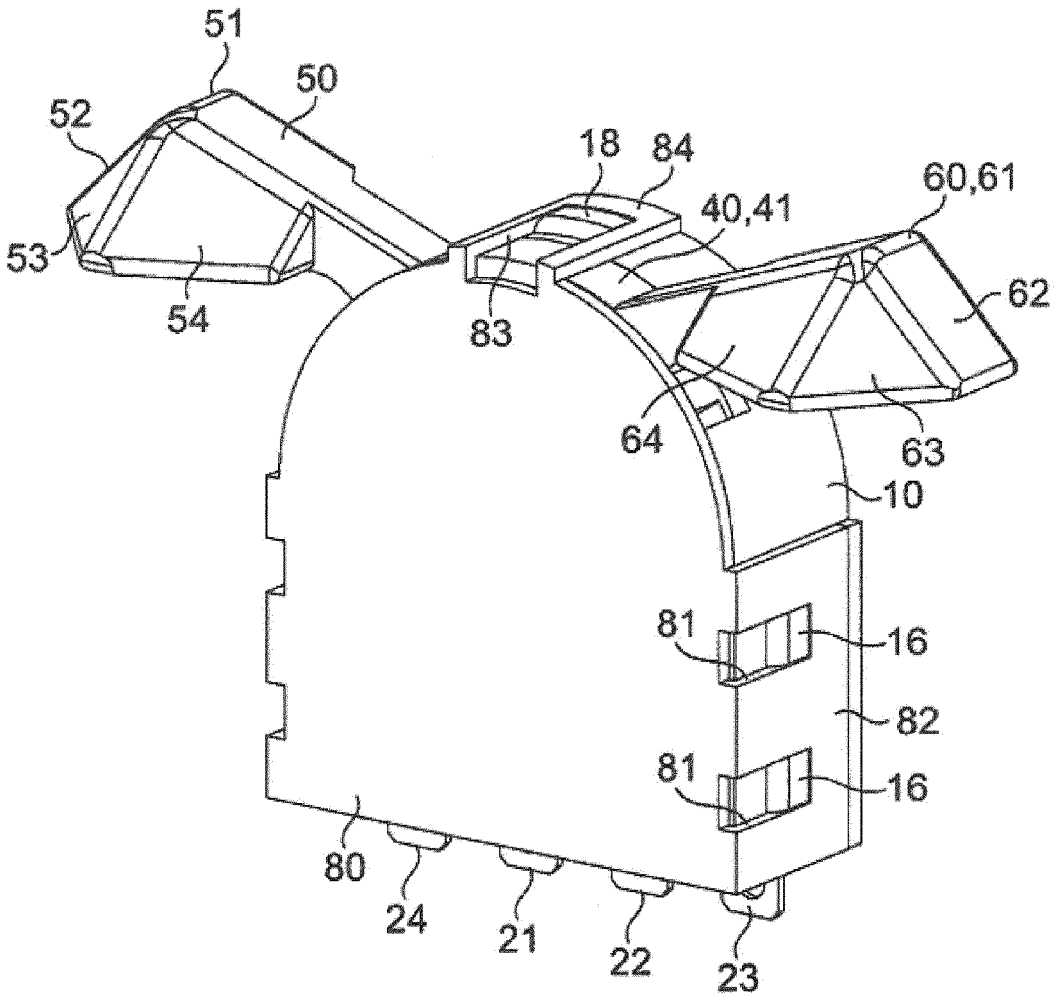

51
50
52
18
84
60,61
40,41
53
62
54
83
64
63
10
81
16
82
81
16
80
24
21
22
23

FIG. 2

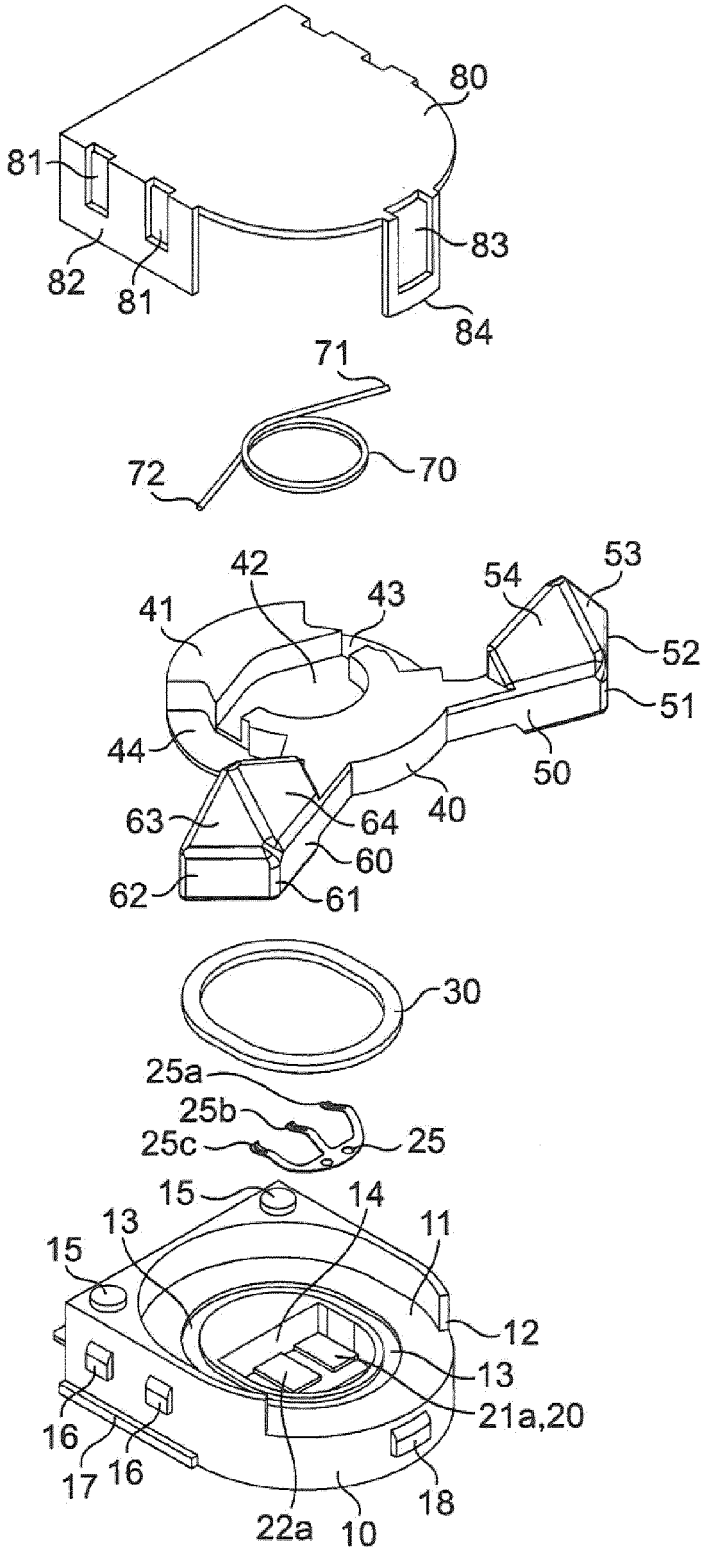

80
81
83
82
81
84
71
72
70
42
43
41
54
53
52
51
44
50
40
63
64
60
62
61
30
25a
25b
25c
25
15
14
13
11
15
12
13
21a,20
16
17
16
18
22a
10

FIG. 3

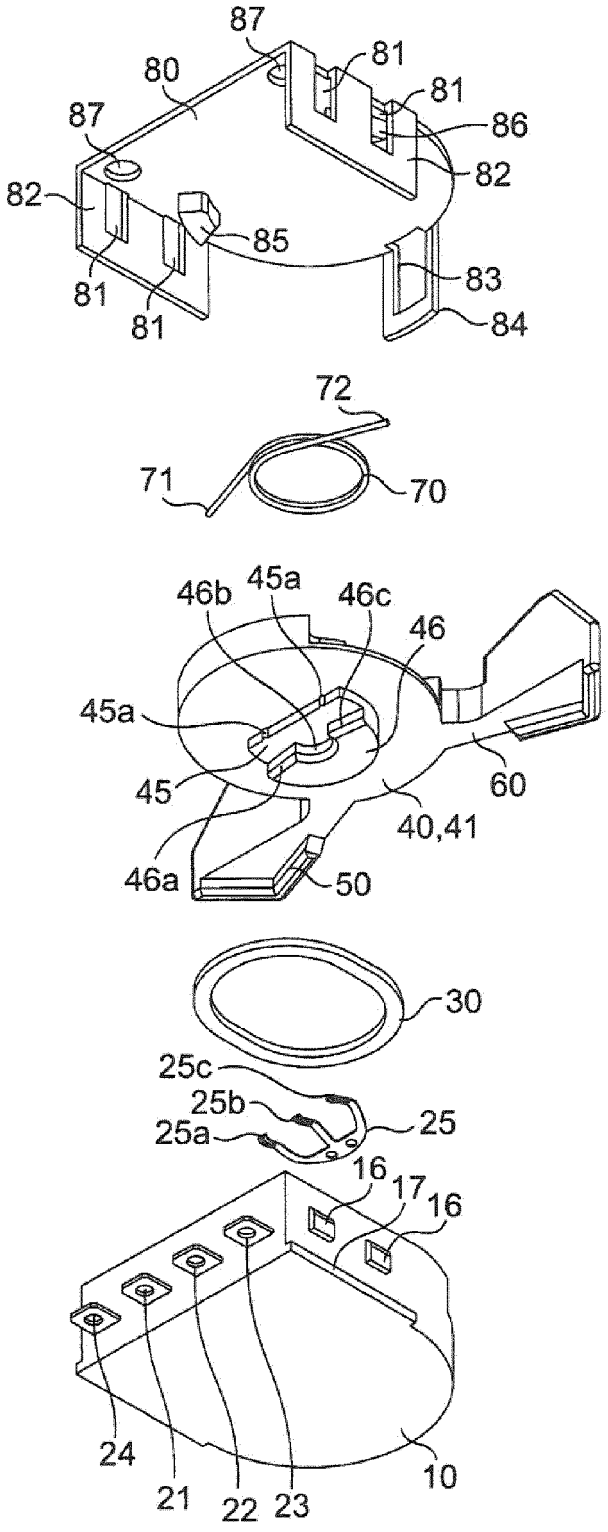

87
81
80
81
87
86
82
82
85
83
81
81
84
72
71
70
46b
45a
46c
46
45a
45
60
40,41
46a
50
30
25c
25b
25
25a
16
17
16
24
21
22
23
10

FIG. 4A

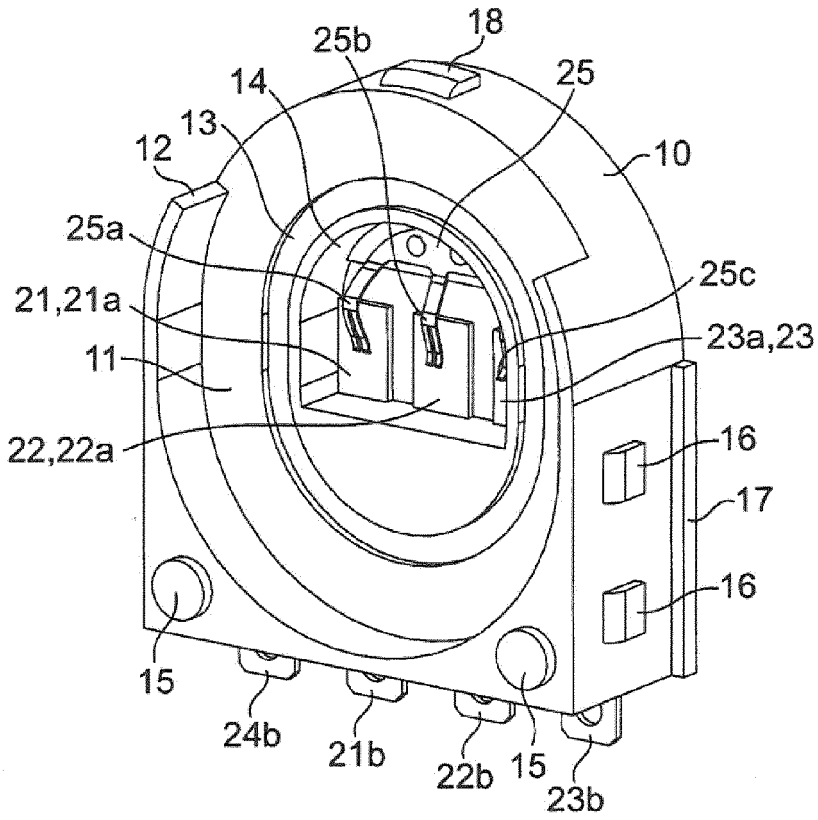

18
25b
25
14
13
12
10
25a
25c
21,21a
23a,23
11
22,22a
16
17
16
15
24b
21b
22b
15
23b

FIG. 4B

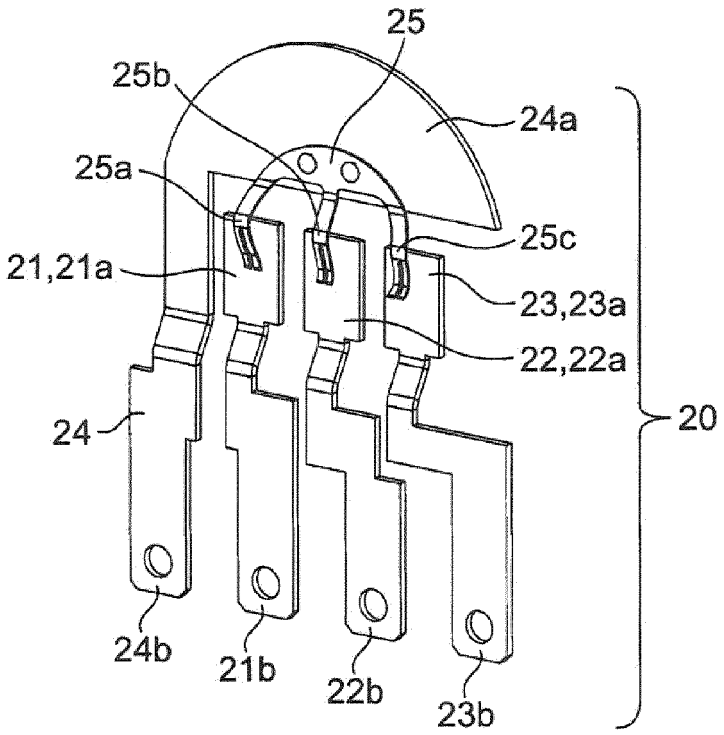

25
25b
24a
25a
25c
21,21a
23,23a
22,22a
20
24
24b
21b
22b
23b

FIG. 5A

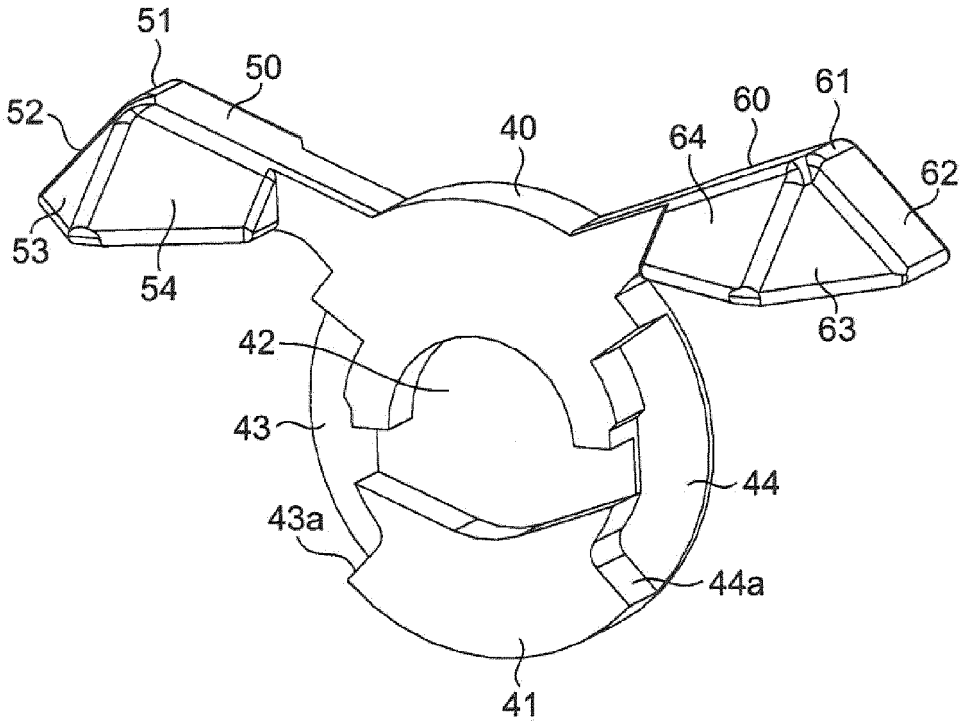

51
50
52
40
64
60
61
62
53
54
63
42
43
44
43a
44a
41

FIG. 5B

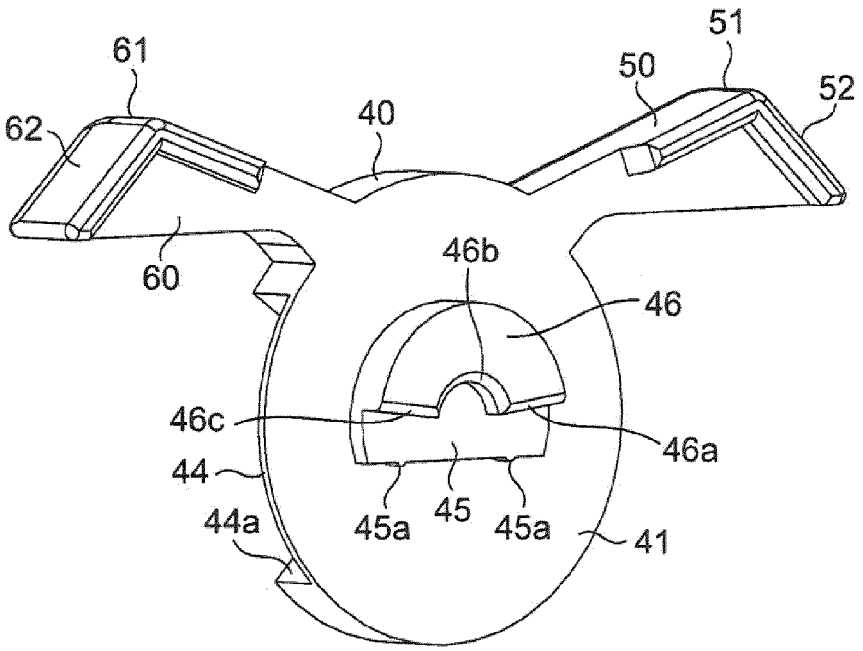

61
51
50
62
40
52
60
46b
46
46c
46a
44
44a
45a
45
45a
41

FIG. 6A

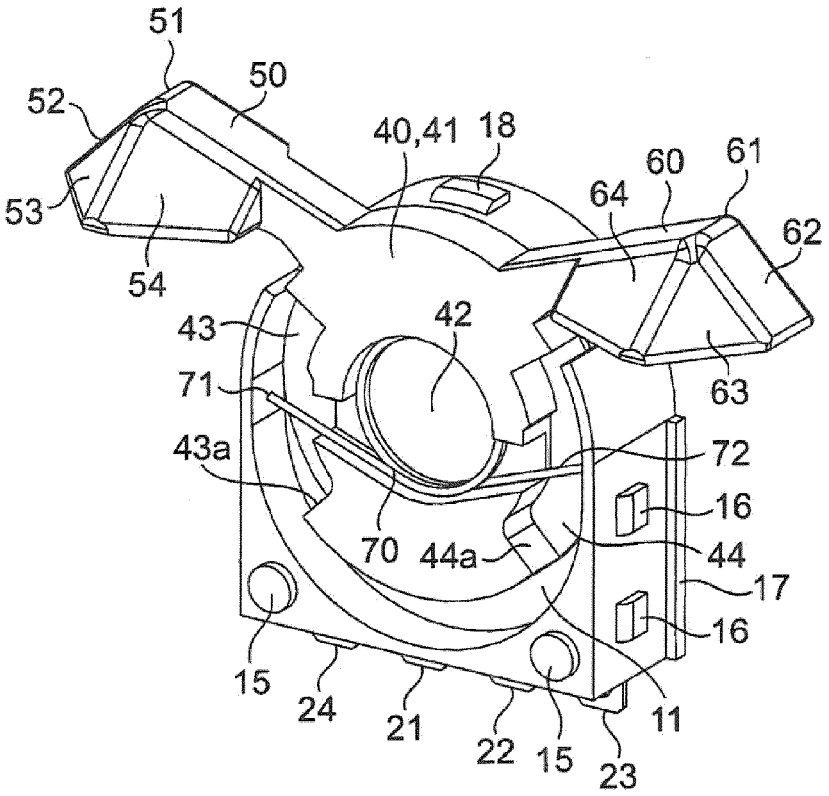

51
50
52
40,41
18
60
61
64
53
62
54
43
42
71
63
43a
72
16
70
44a
44
17
16
15
24
21
22
15
11
23

FIG. 6B

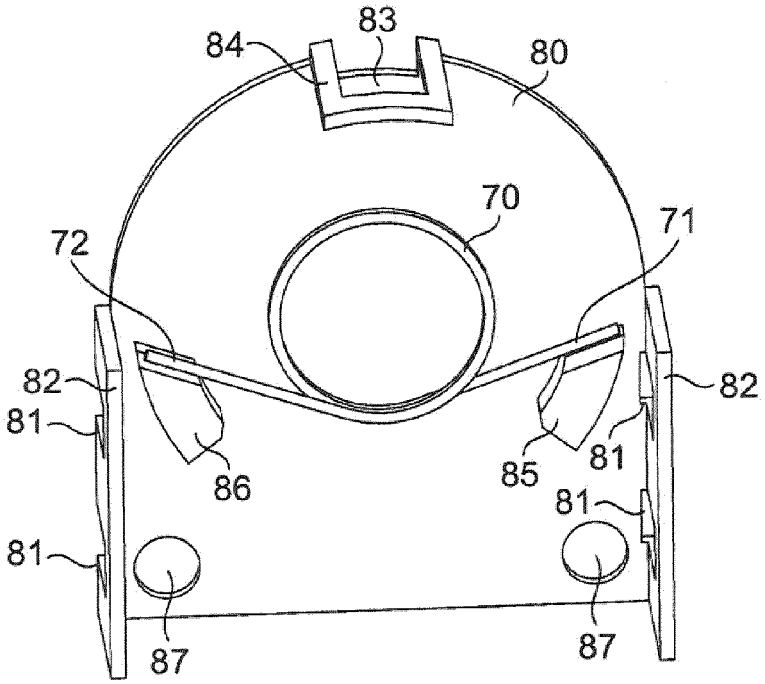

84
83
80
70
72
71
82
82
81
86
85
81
81
81
87
87

FIG. 7A

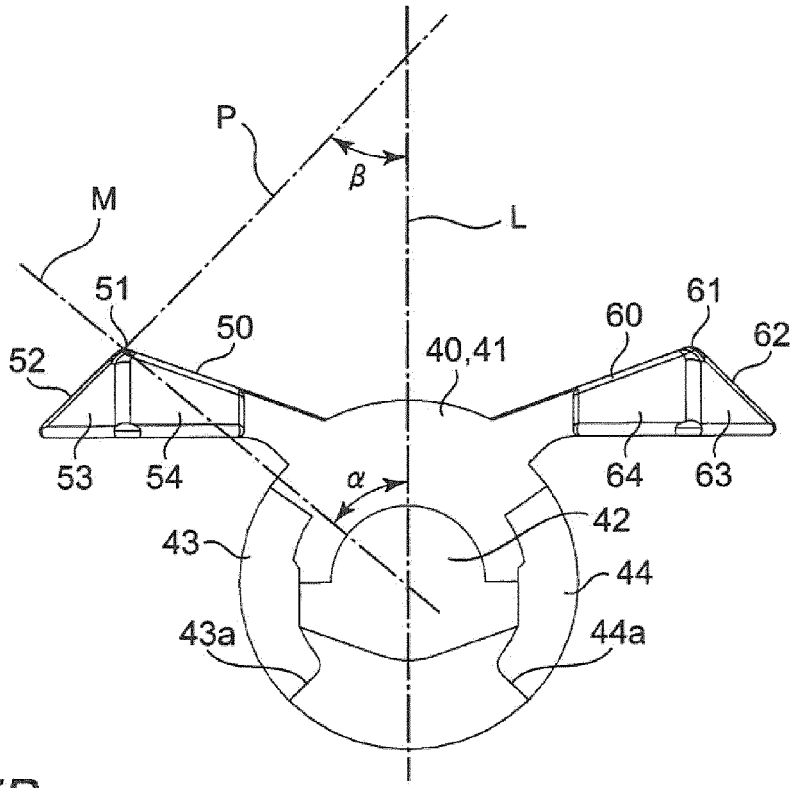

P
β
M
L
51
50
52
40,41
60
61
62
53
54
α
64
63
42
43
44
43a
44a

FIG. 7B

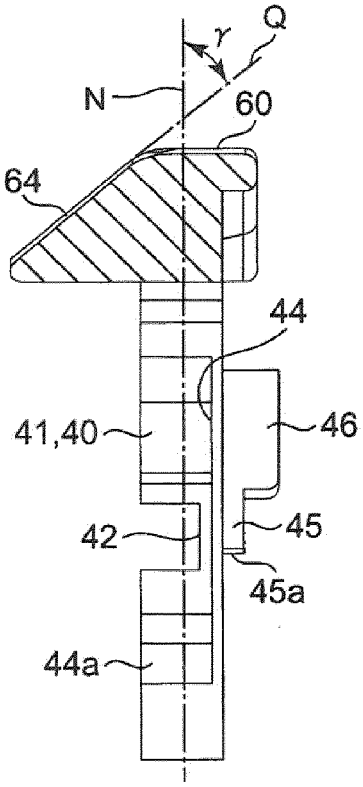

γ
Q
N
60
64
44
41,40
46
42
45
45a
44a

FIG. 8A

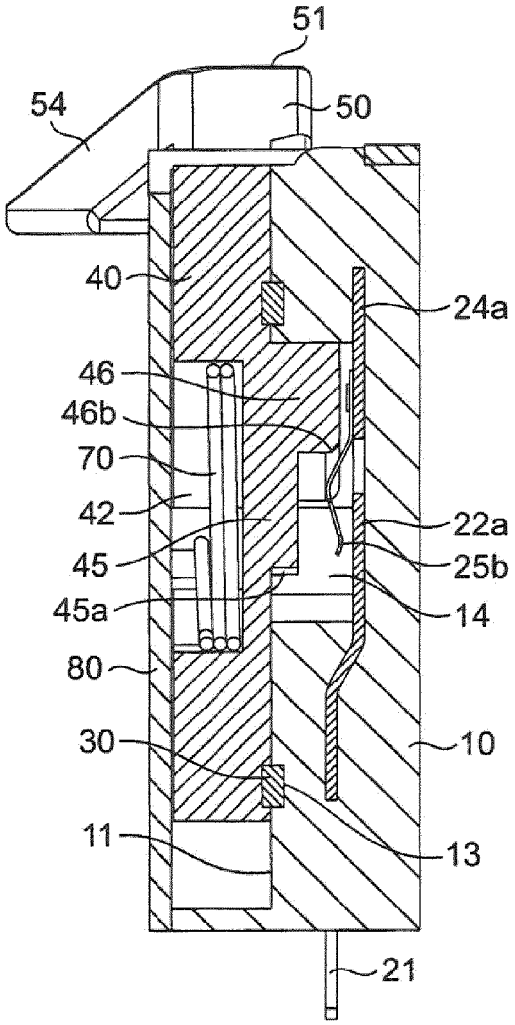

51
54
50
40
24a
46
46b
70
42
22a
45
25b
45a
14
80
30
10
11
13
21

FIG. 8B

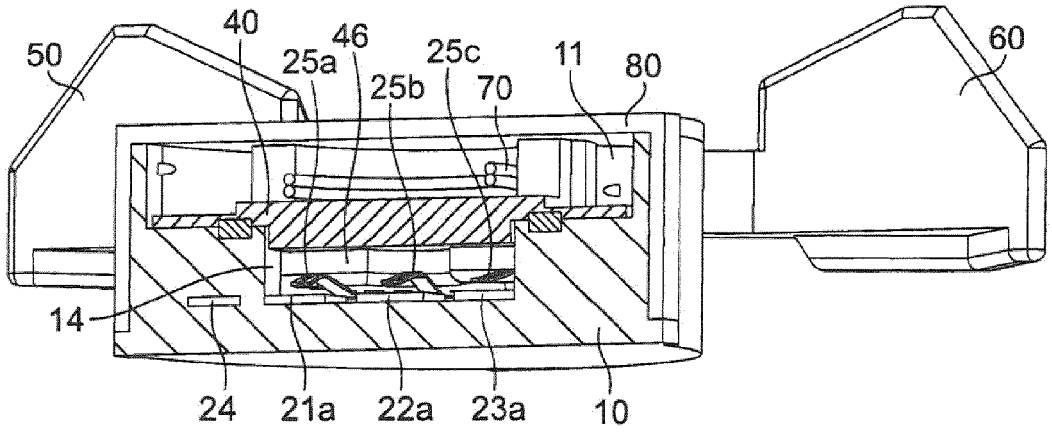

50
40
46
25a
25c
11
80
60
25b
70
14
24
21a
22a
23a
10

FIG. 9

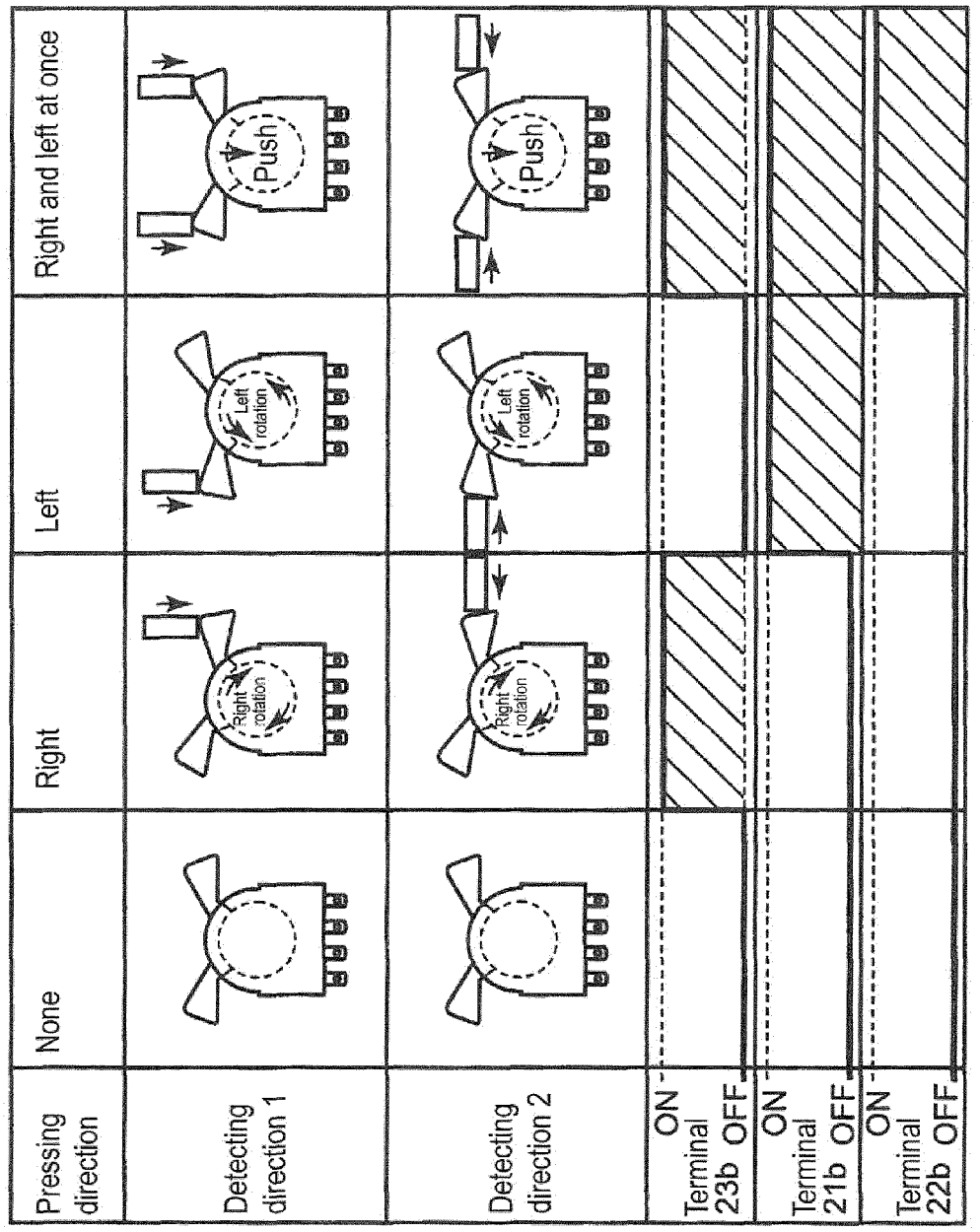

Pressing direction
None
Right
Left
Right and left at once
Detecting direction 1
Detecting direction 2
Right rotation
Left rotation
Push
ON
Terminal 23b OFF
ON
Terminal 21b OFF
ON
Terminal 22b OFF
<Detecting direction 1>
51
50
60
61
80
24b 21b 22b 23b
<Detecting direction 2>
52
50
60
62
80
24b 21b 22b 23b

FIG. 10A

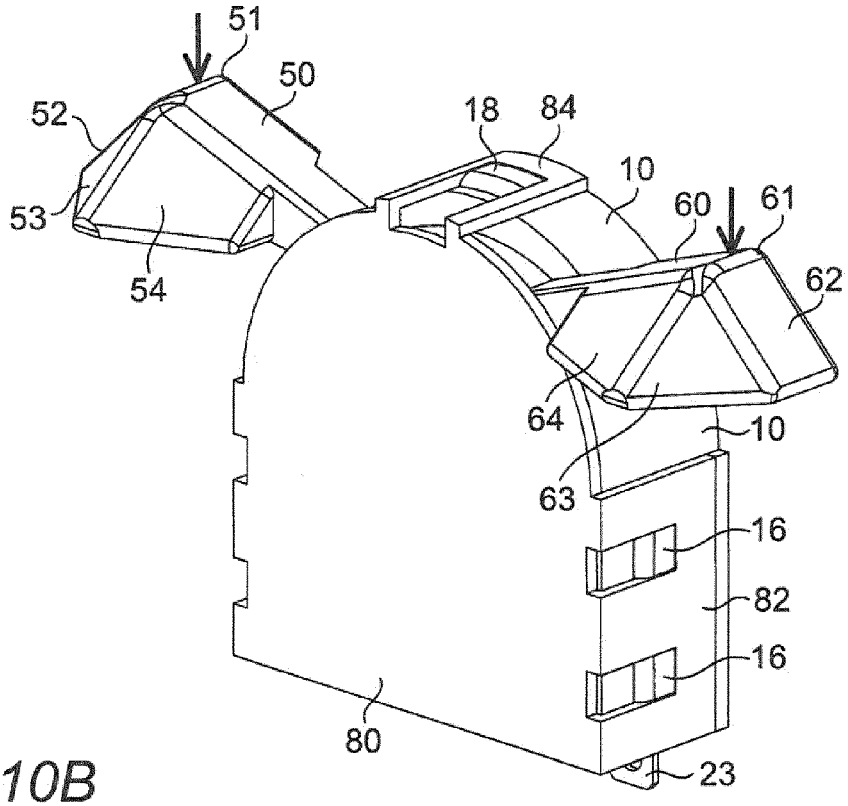


FIG. 10B

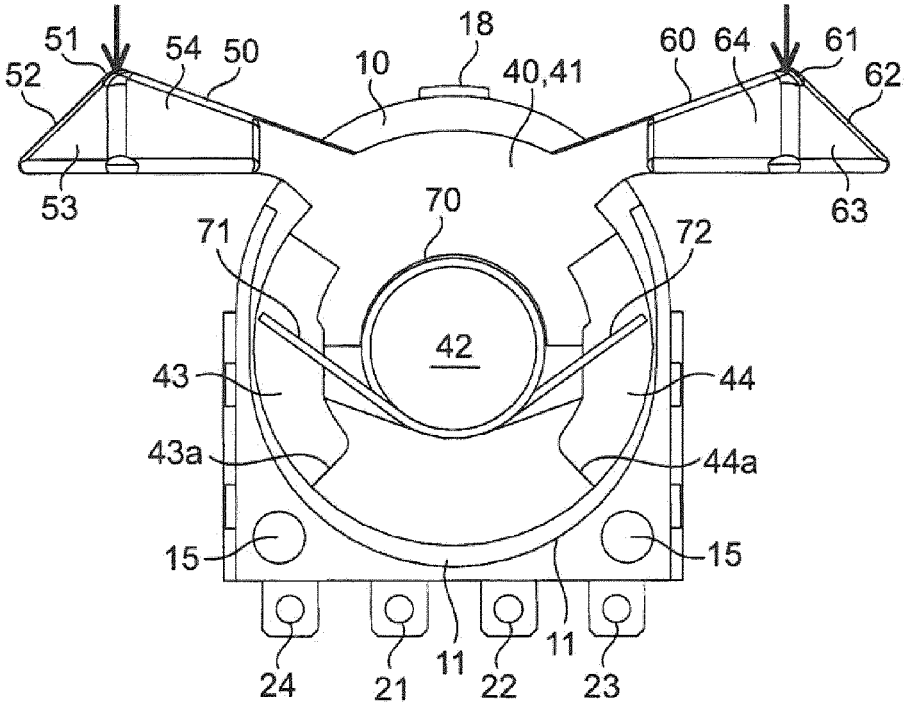


FIG. 11A

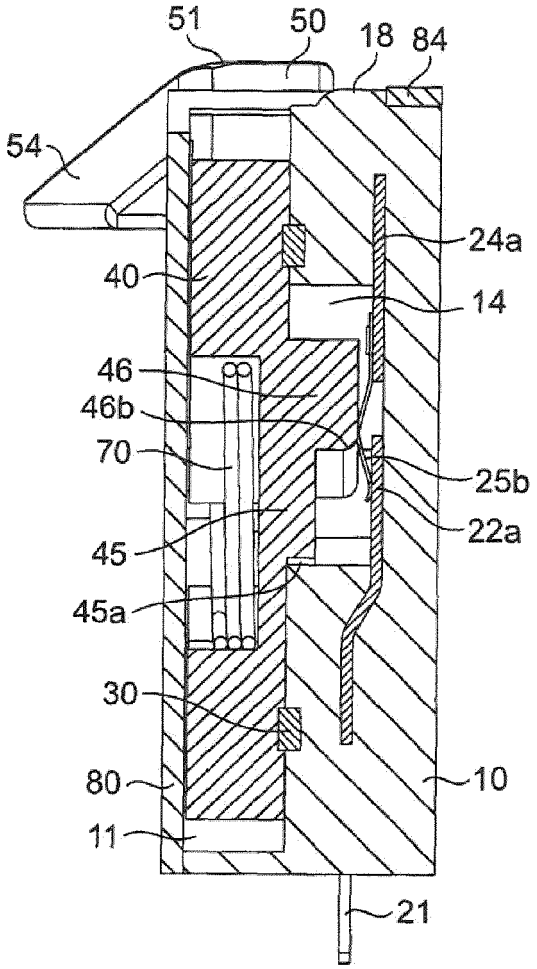


FIG. 11B

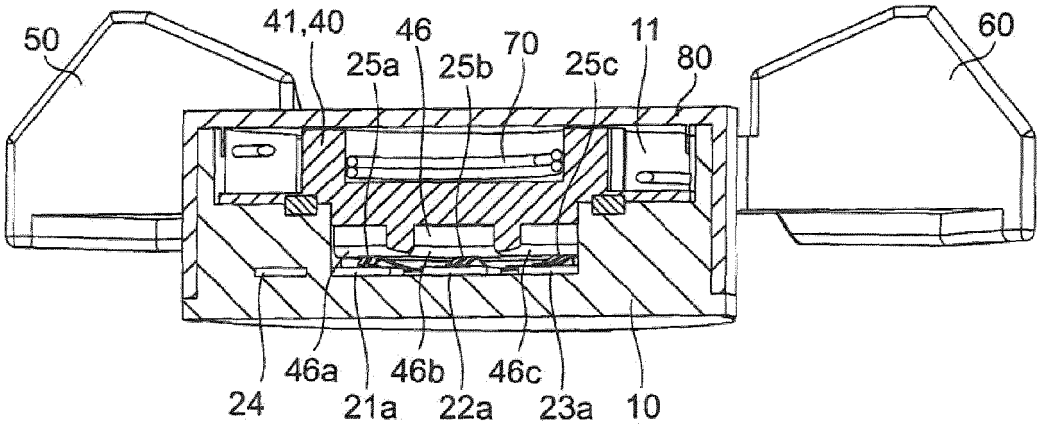


FIG. 12A

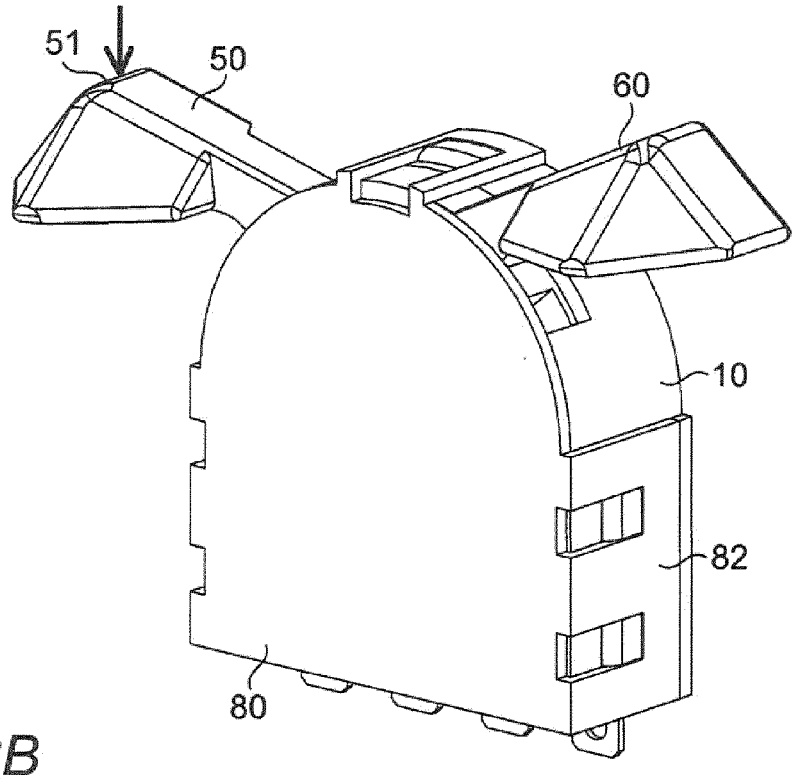


FIG. 12B

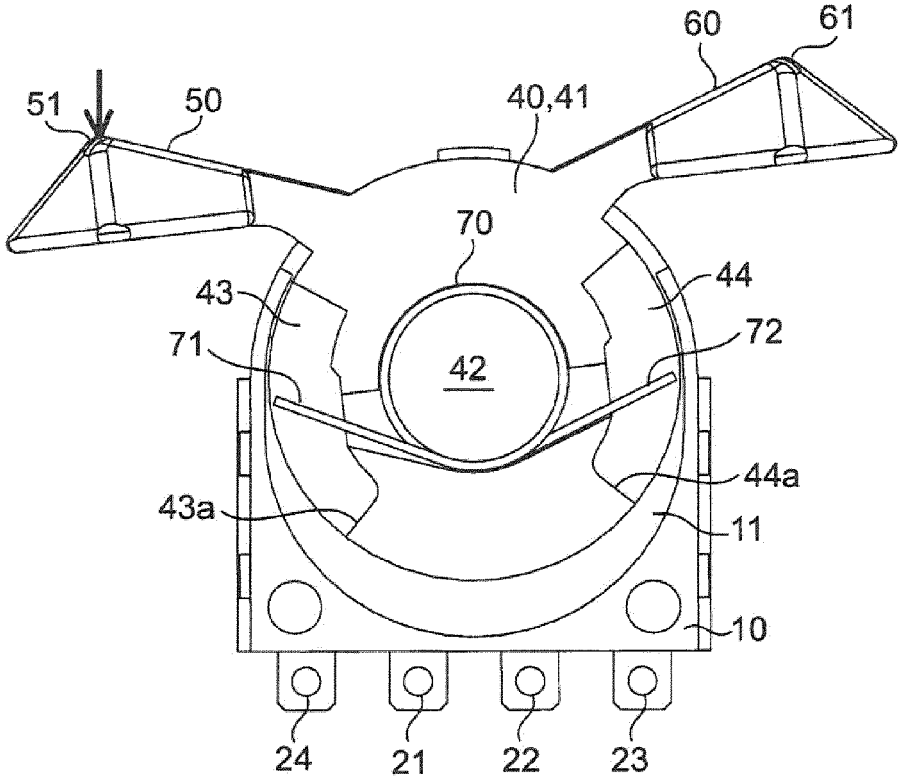


FIG. 13A

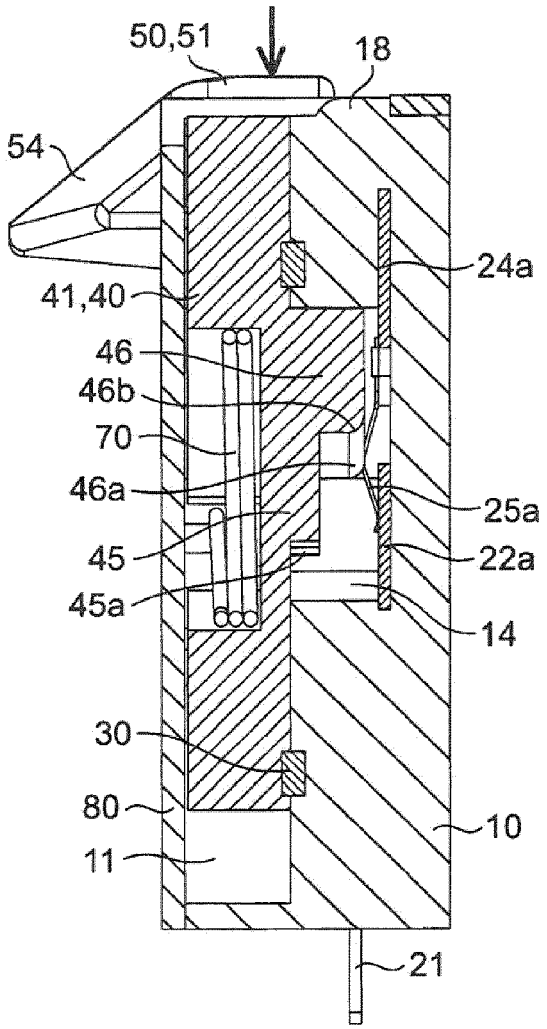


FIG. 13B

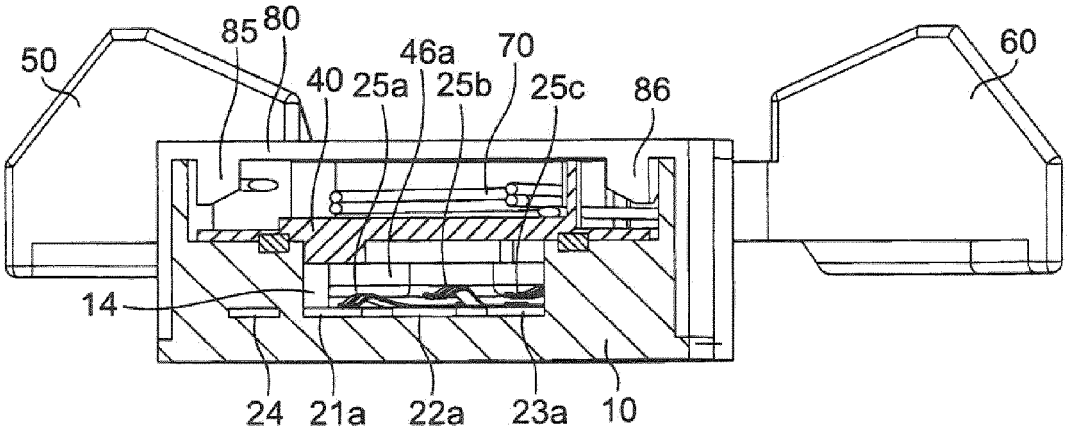


FIG. 14A

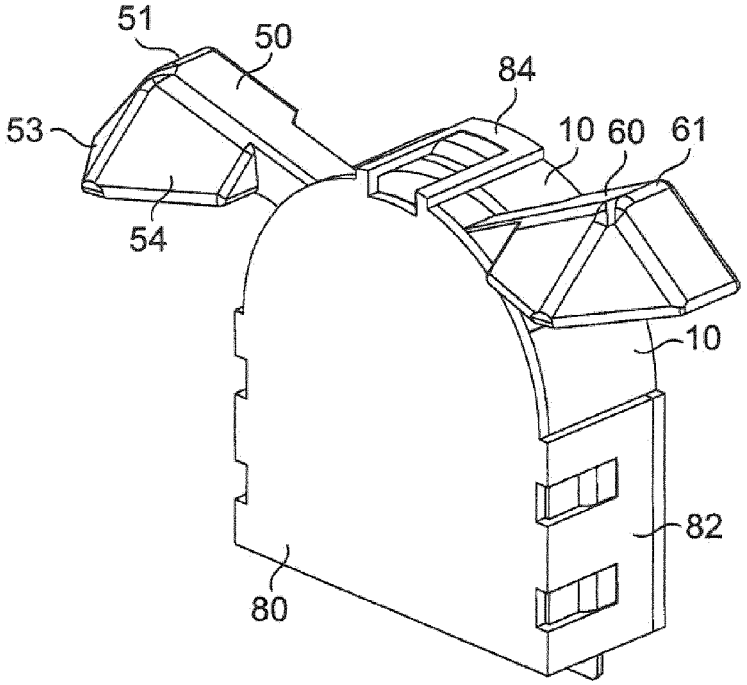


FIG. 14B

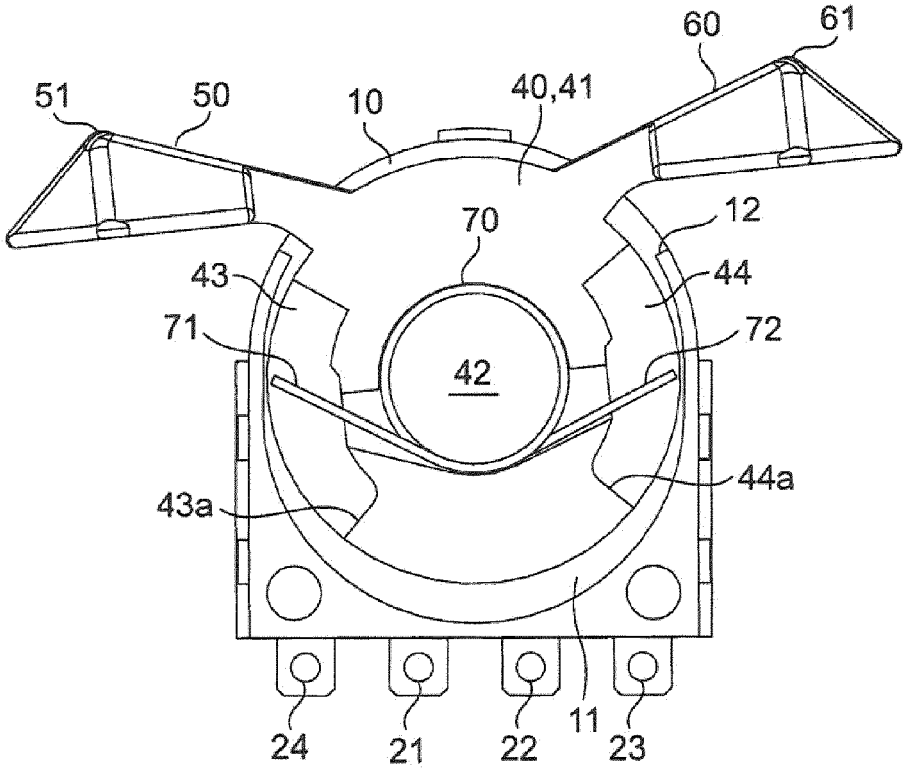


FIG. 15A

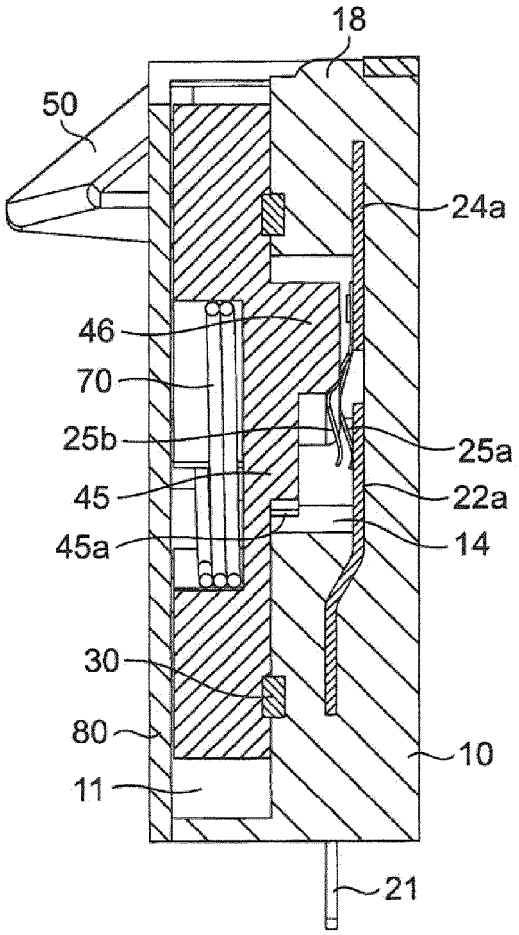


FIG. 15B

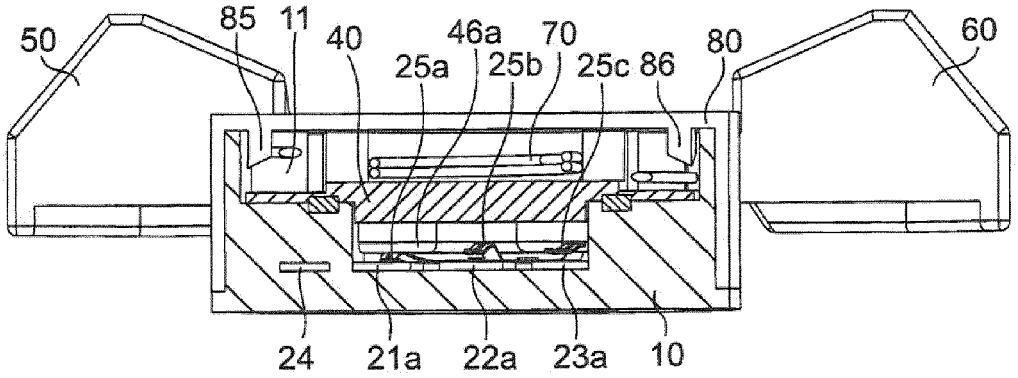


FIG. 16A

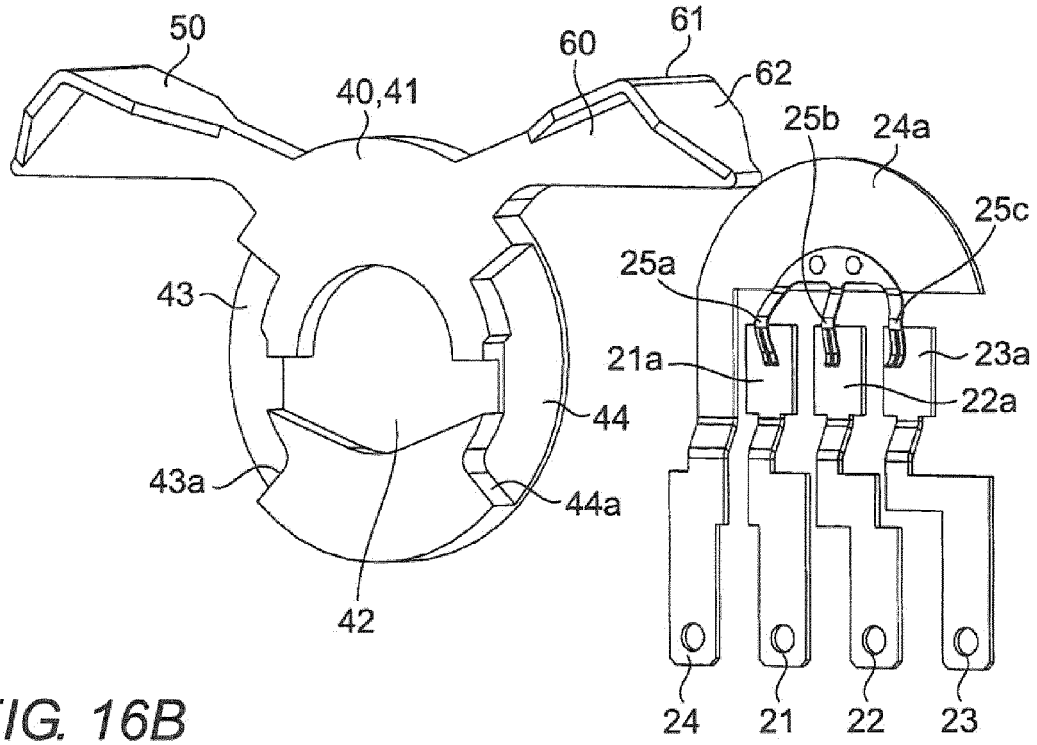


FIG. 16B

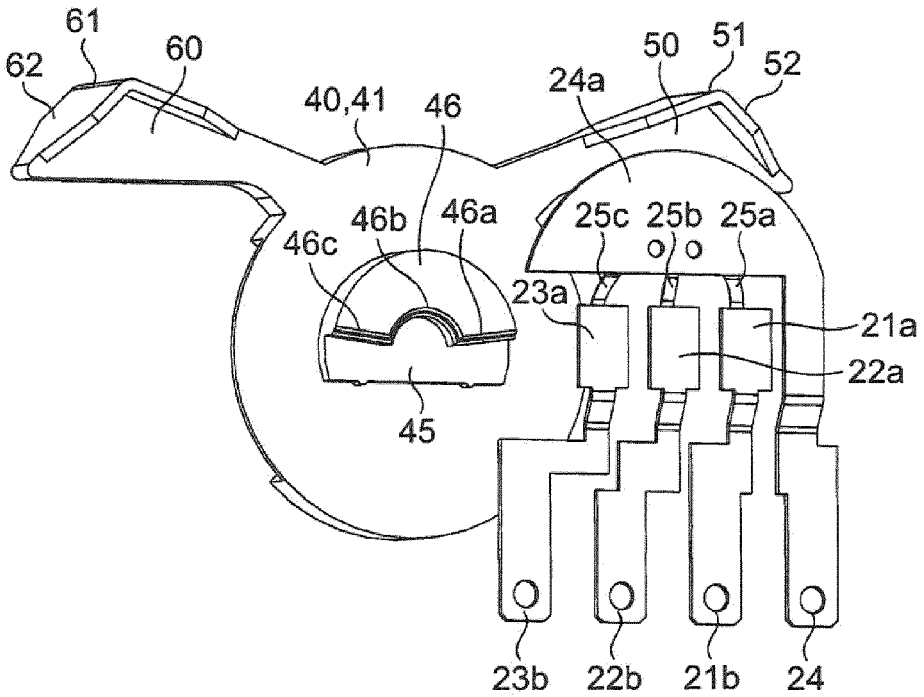


FIG. 17

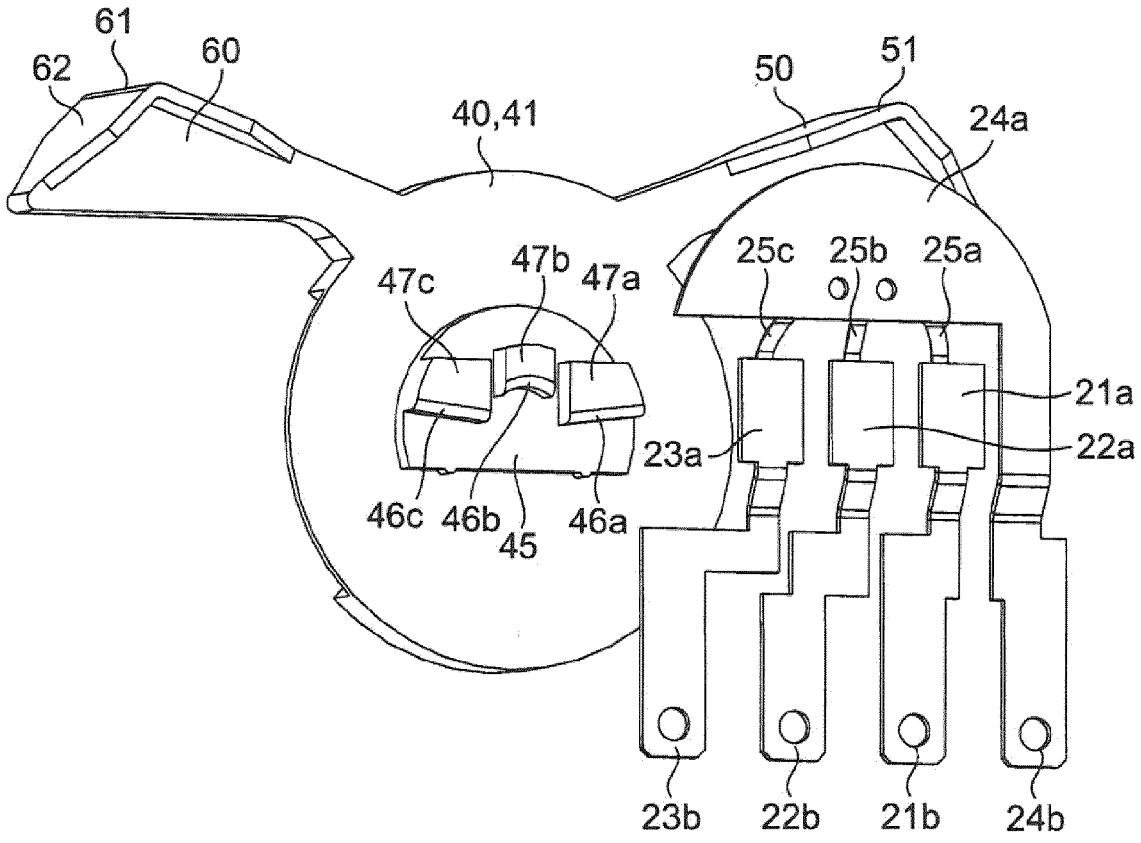

61
62
60
40,41
50
51
24a
47c
47b
47a
25c
25b
25a
21a
22a
23a
46c
46b
45
46a
23b
22b
21b
24b

FIG. 18A

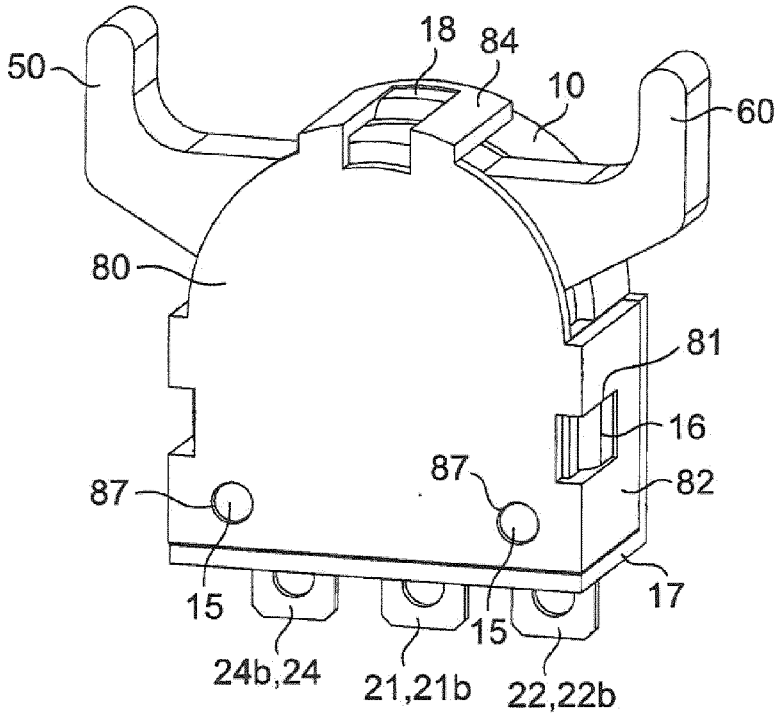


FIG. 18B

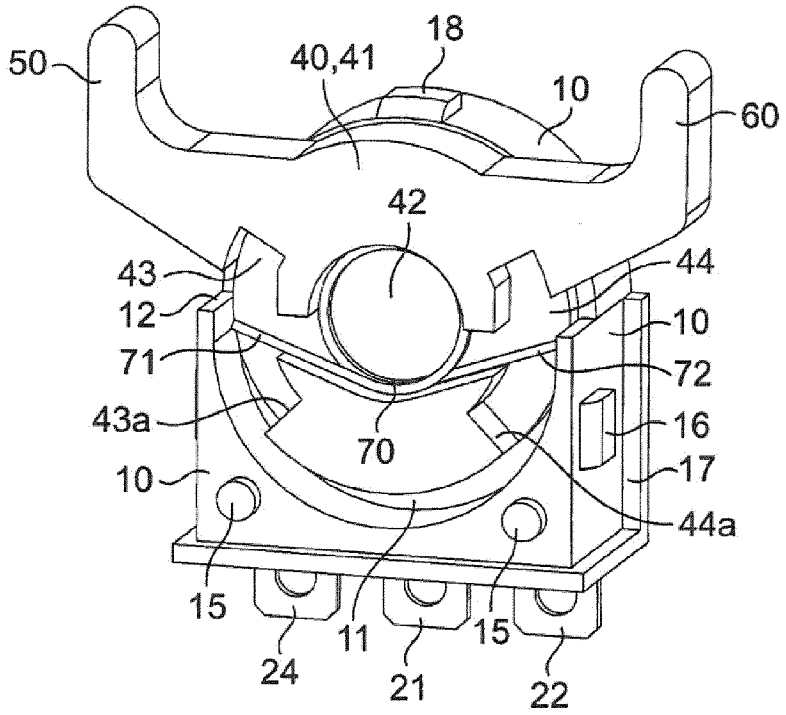


FIG. 19

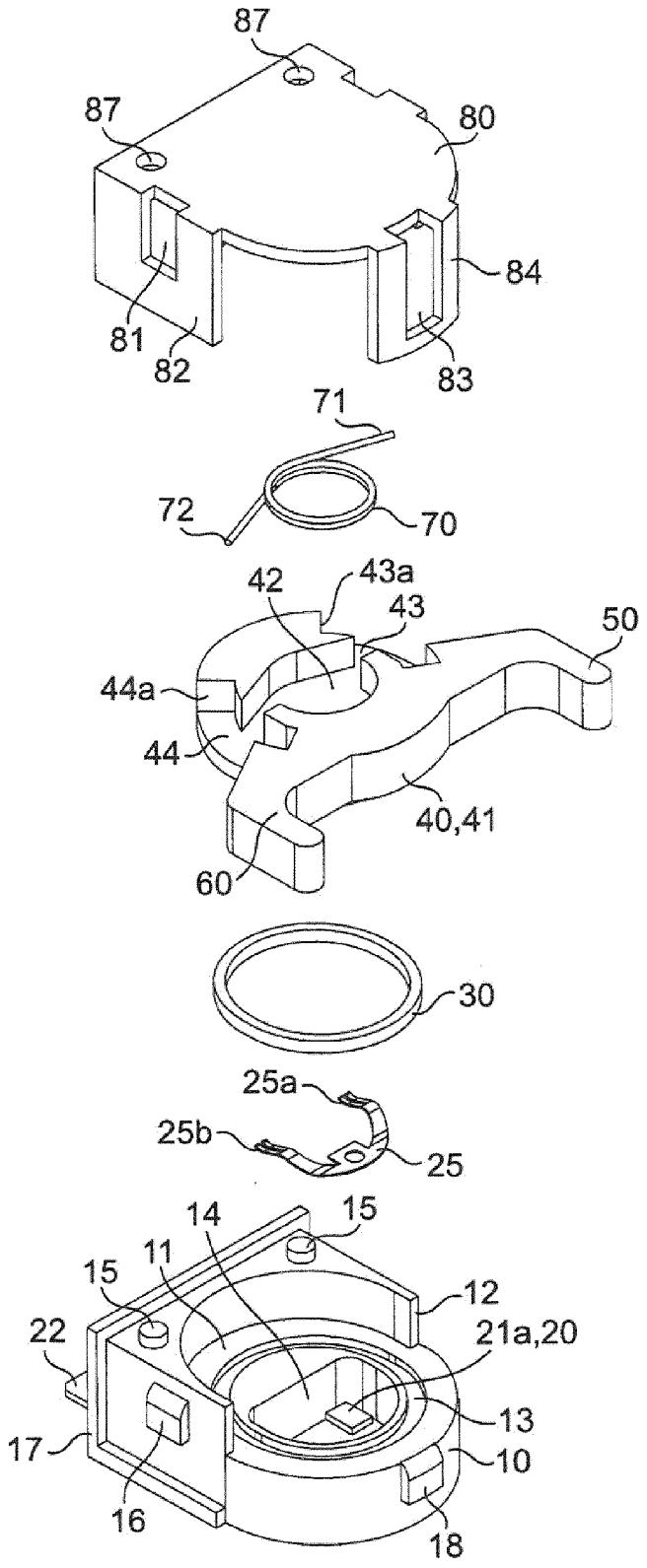

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FIG. 20

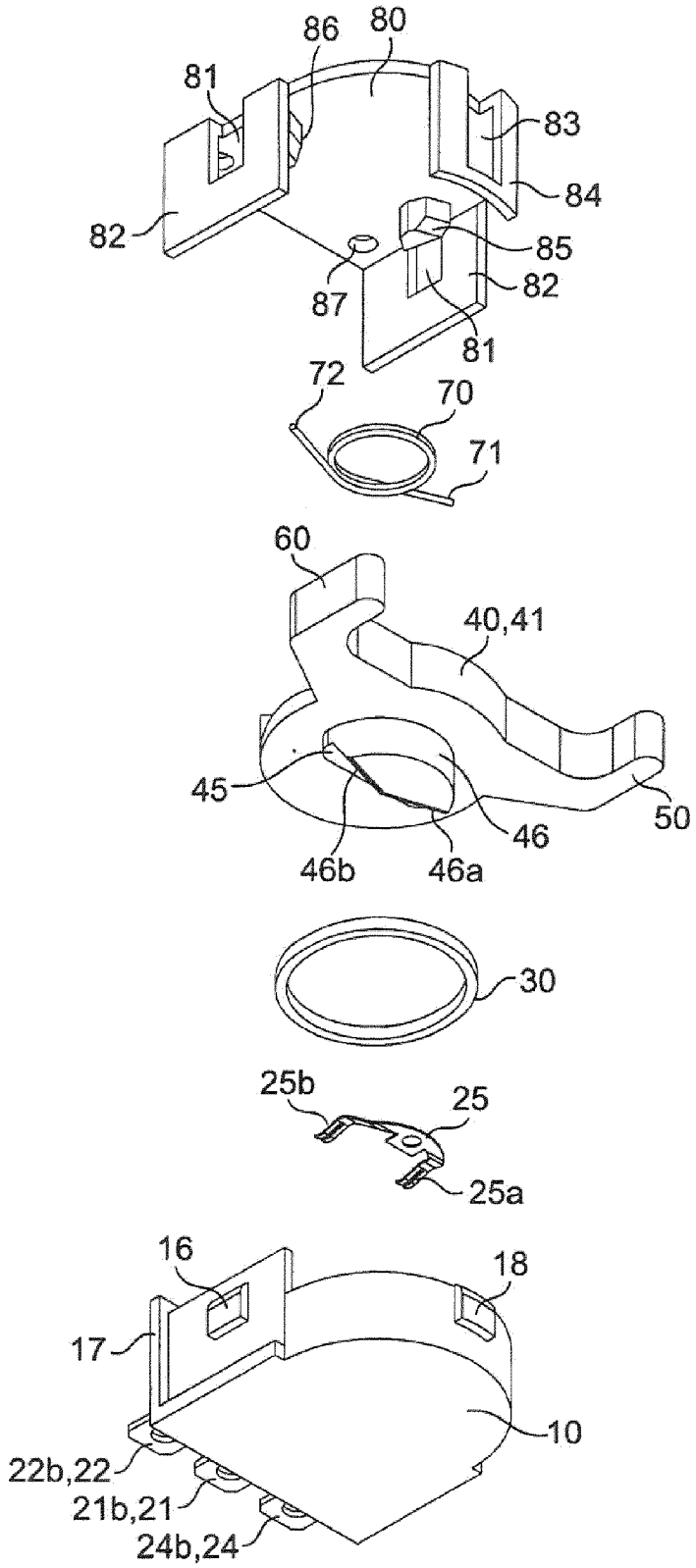

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FIG. 21A

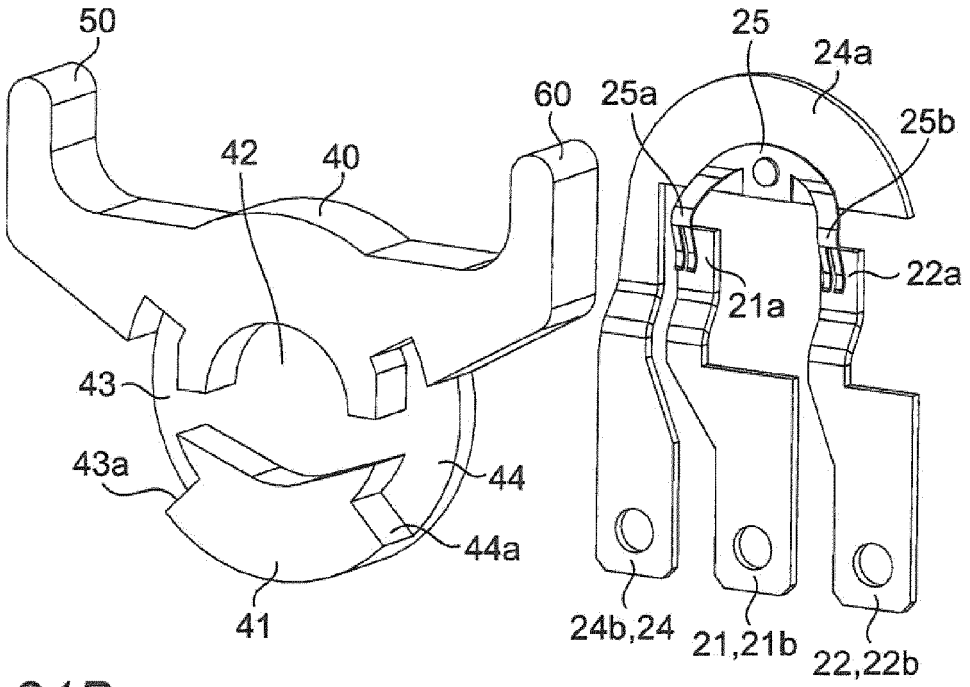


FIG. 21B

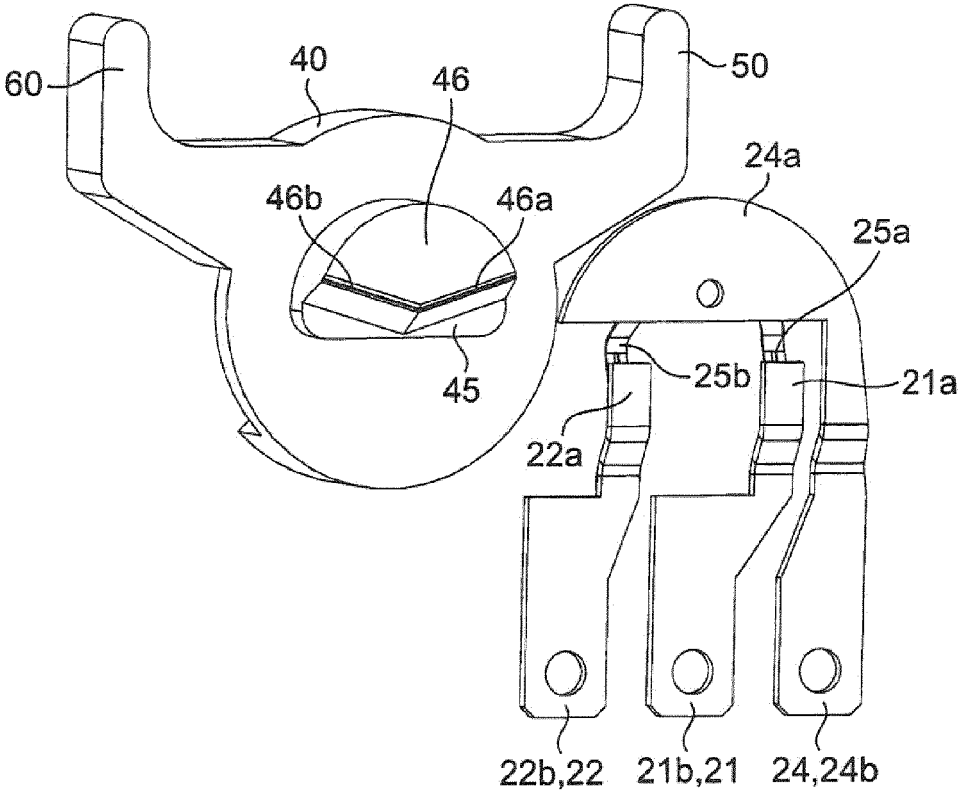


FIG. 22

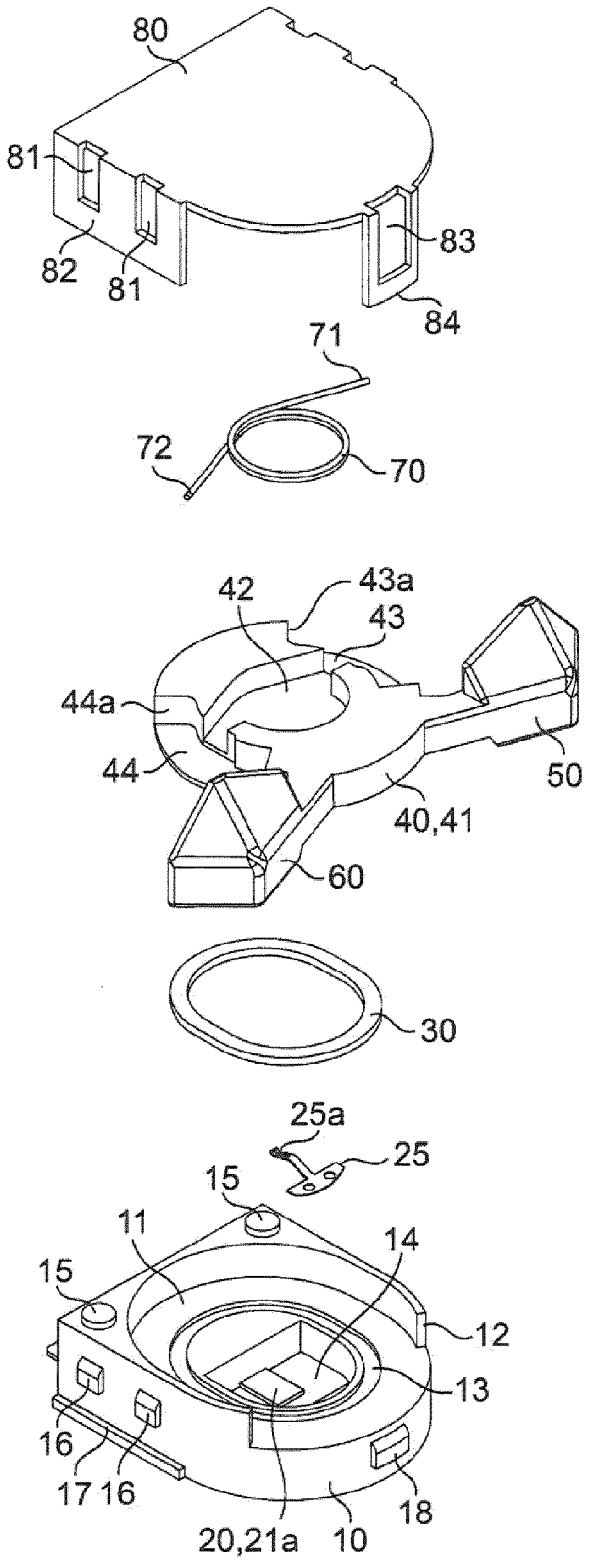

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FIG. 23

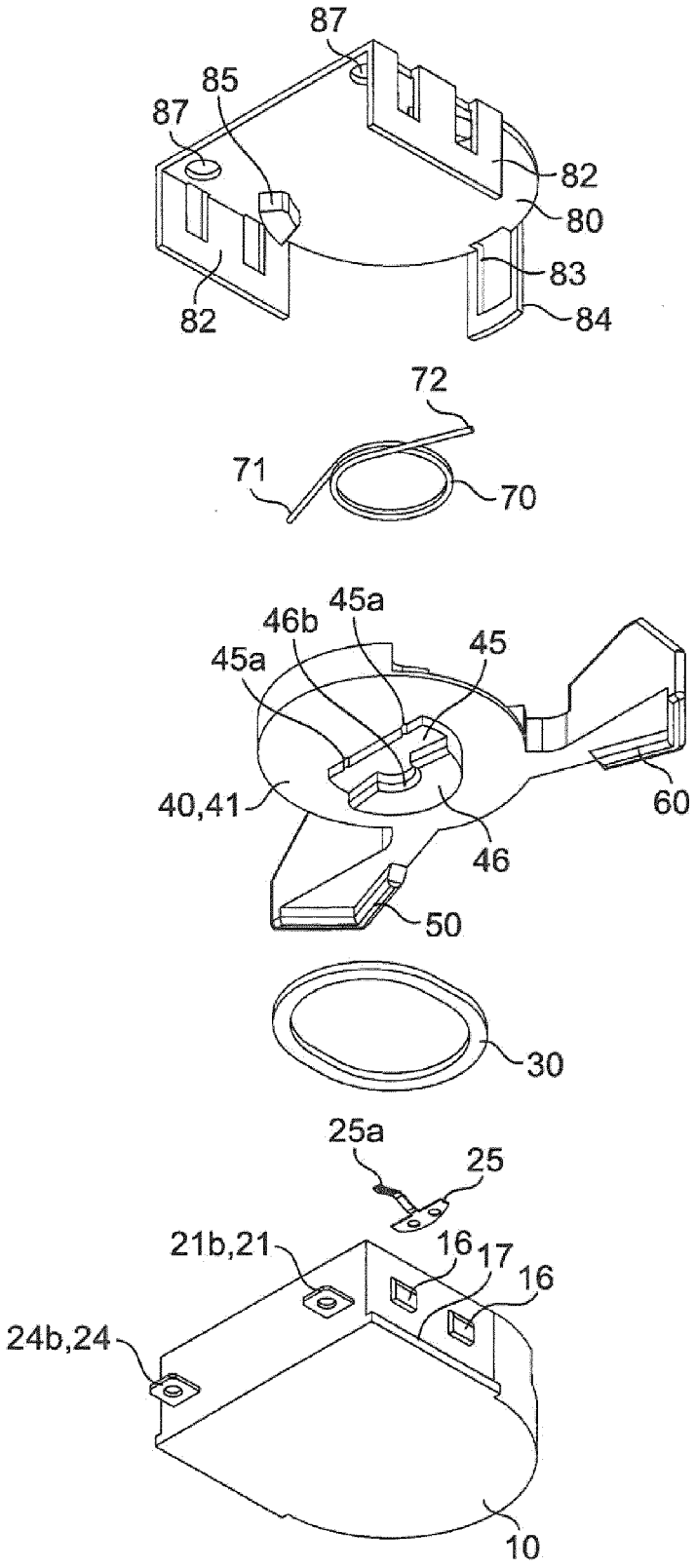

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FIG. 24

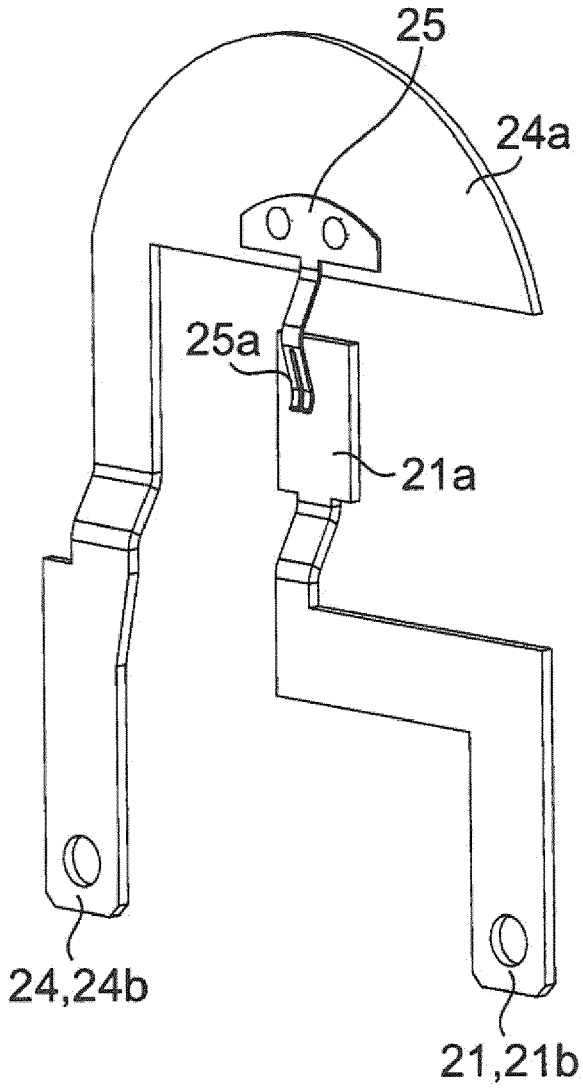


FIG. 25A

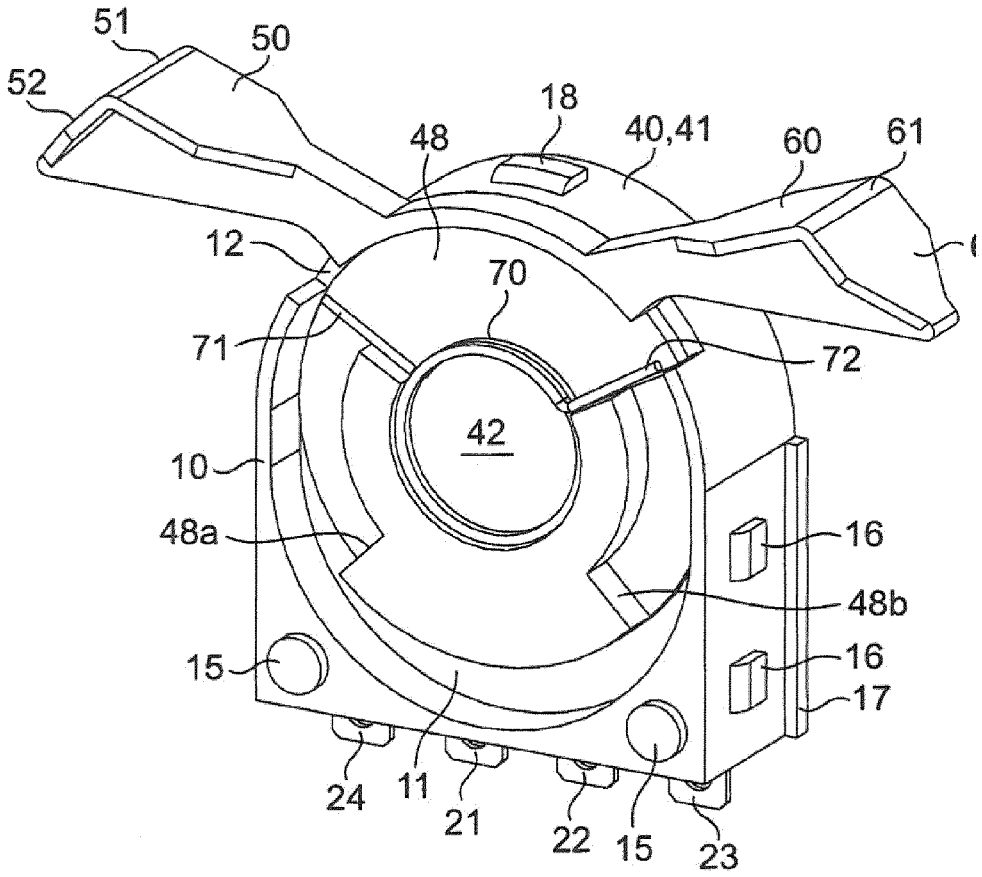


FIG. 25B

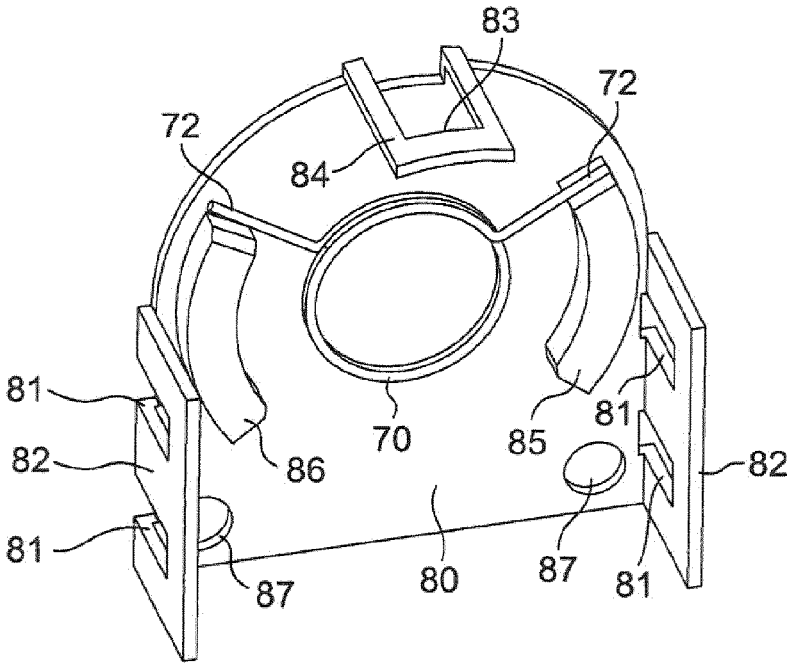


FIG. 26A

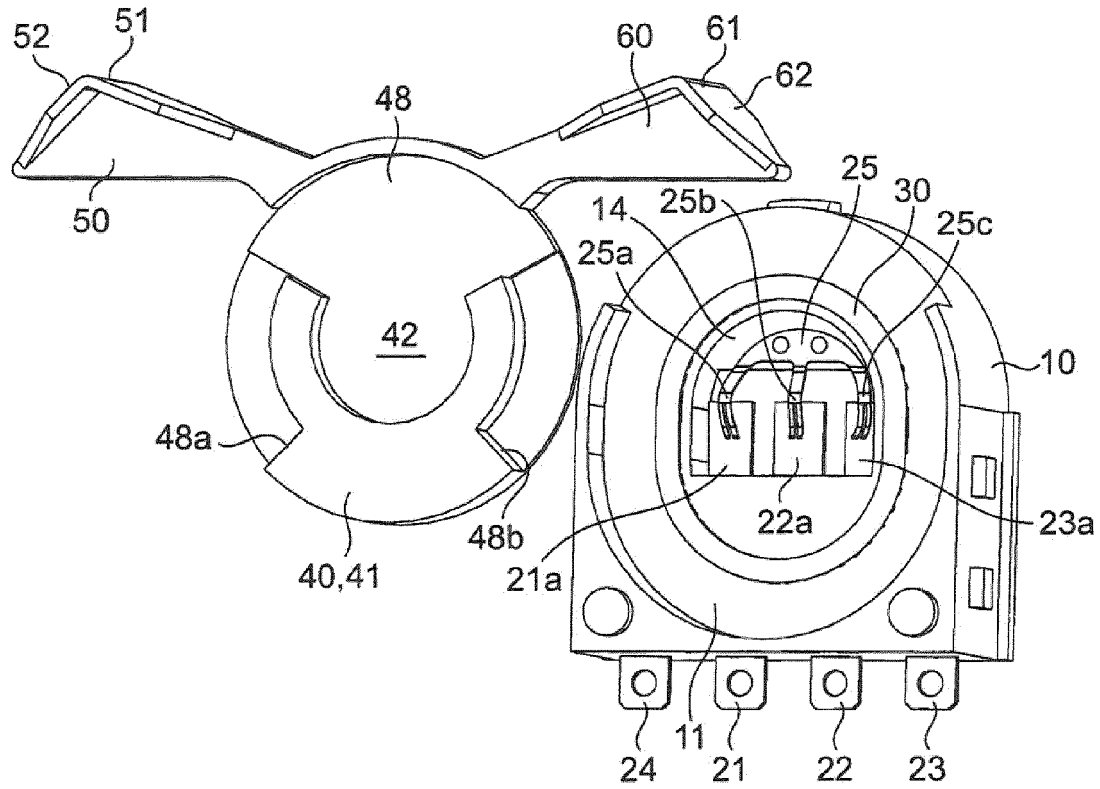


FIG. 26B

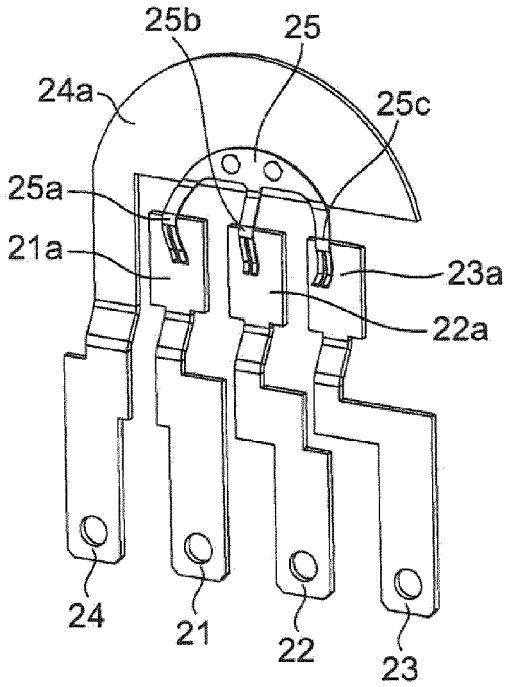


FIG. 27A

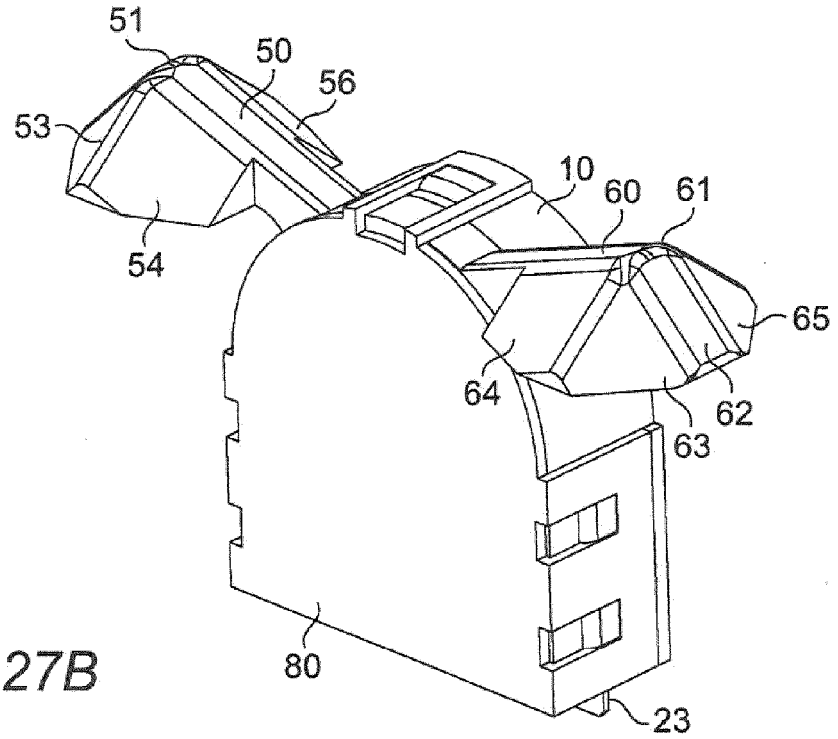


FIG. 27B

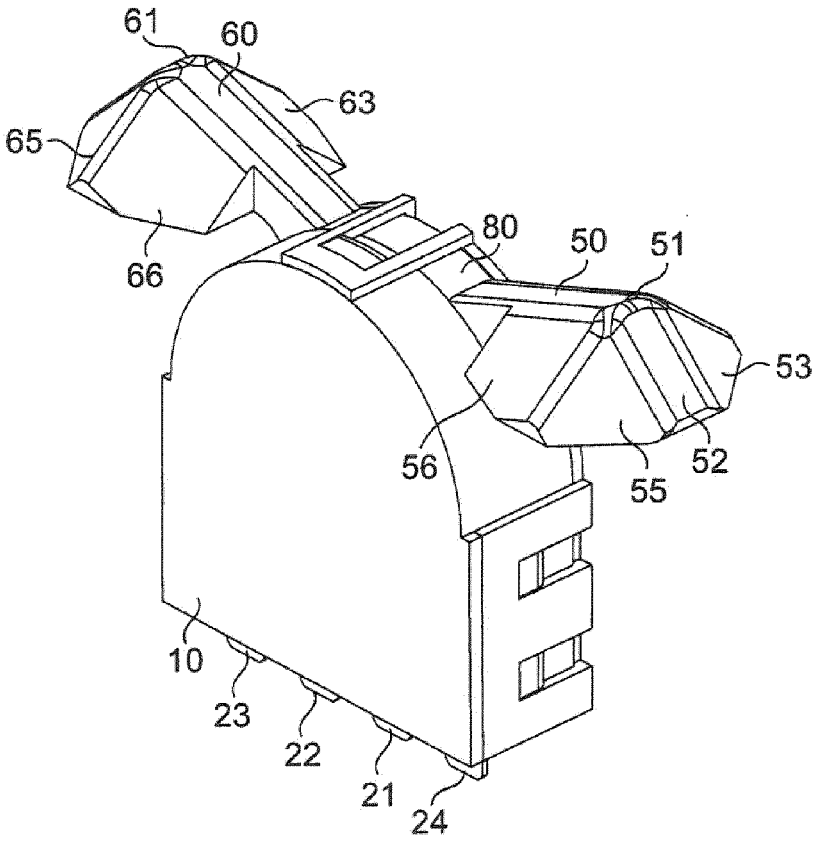


FIG. 28A

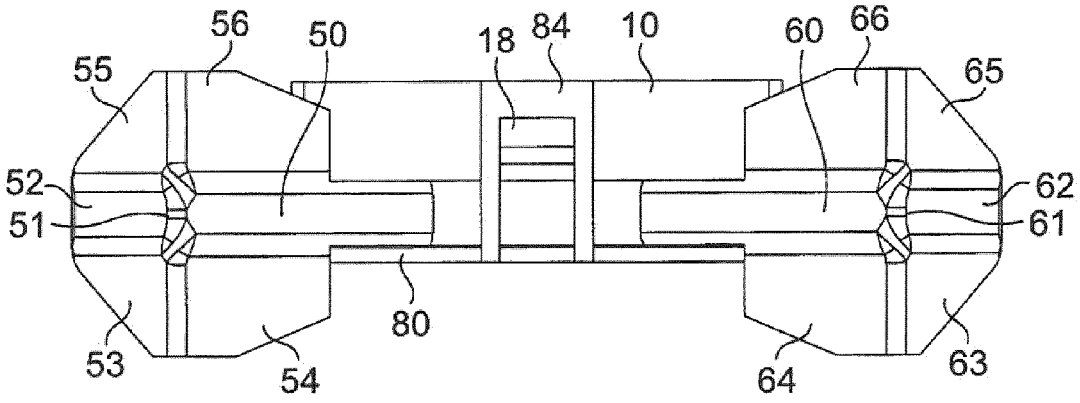


FIG. 28B

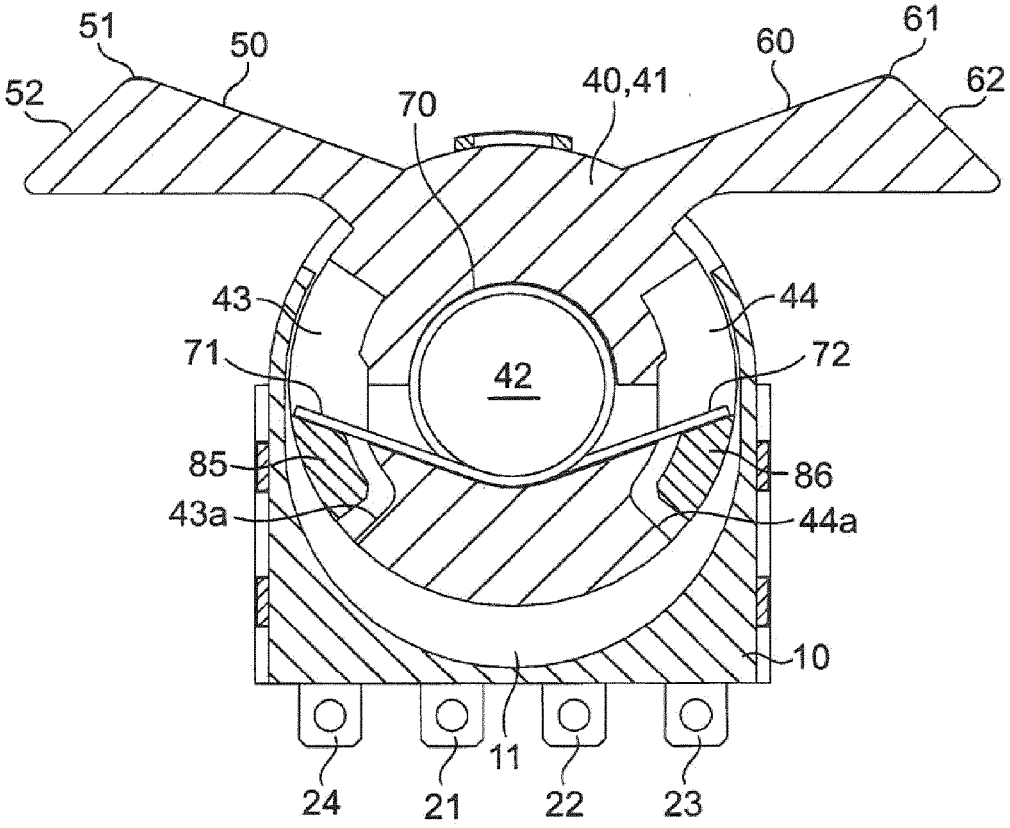
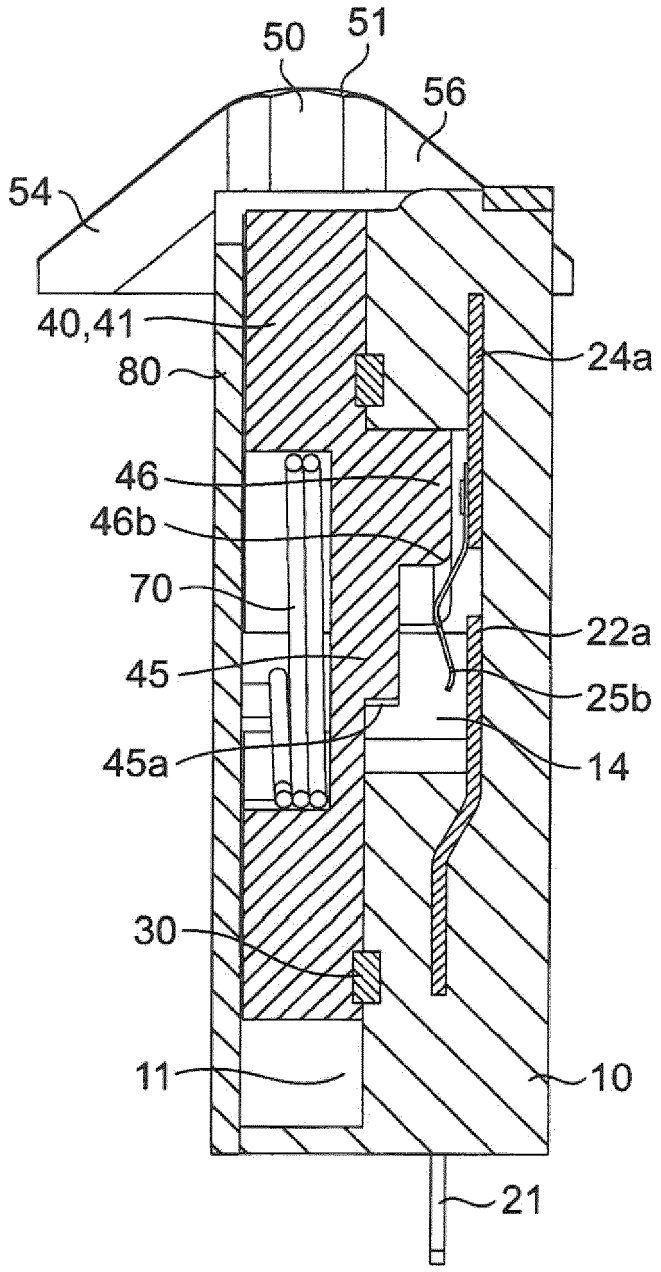


FIG. 29



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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 5061

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 101 341 A2 (HOSIDEN CORP [JP]) 16 September 2009 (2009-09-16) * paragraph [0036] - paragraph [0127]; figures 1-3,5, 6 *	1-10	INV. H01H25/00
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 December 2015	Dobbs, Harvey

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