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(71) Applicant: **Idec Corporation**
Osaka-shi, Osaka 532-0004 (JP)

(72) Inventor: **NIINAI, Hideo**
Osaka-shi
Osaka 532-0004 (JP)

(74) Representative: **Müller-Boré & Partner**
Patentanwälte PartG mbB
Friedenheimer Brücke 21
80639 München (DE)

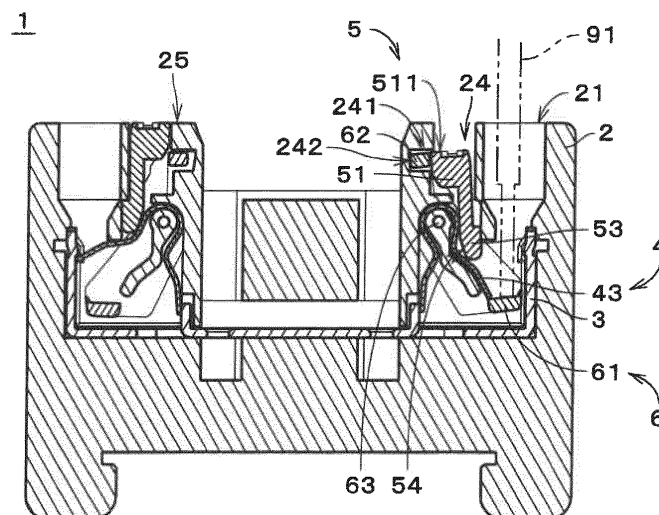
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(54) **CONNECTION DEVICE**

(57) A connector (1) includes a case (2), a terminal part (3), an elastic member (4), and an operation part (5). The terminal part (3) has conductivity and is fixed to the case (2). The elastic member (4) is mounted on the case (2). The elastic member (4) presses a wire (91) against and clamps the wire to the terminal part (3) by restoring force of the elastic member. The operation part (5) comes in contact with the elastic member (4) and maintains a non-connected state of the elastic member (4) in which the elastic member is bent more than in its connected

state in which the elastic member clamps the wire (91). In the connector (1), when the wire (91) is inserted between the terminal part (3) and the elastic member (4) in the non-connected state, a force is transmitted indirectly from the wire (91) to the operation part (5) to move the operation part (5) and to cause the elastic member (4) to transition from the non-connected state to the connected state. This facilitates connecting the wire (91) to the connector (1).

FIG. 5



Description**Technical Field**

5 [0001] The present invention relates to a connector to which wires are connected.

Background Art

10 [0002] So-called push-in connectors have conventionally been used in control boards or other mechanisms as connectors to which wires are connected. In the connectors, wires are inserted into insertion holes of a case and pressed against conducting terminals by flat springs provided in the case so as to establish electrical connection.

[0003] The wire connector disclosed in Japanese Patent No. 4202125 (Document 1) includes a rod-like operation button that is movable toward and away from a housing. In the wire connector, the rod-like operation button is pressed in toward the housing so that a flat spring in the housing becomes elastically deformed and separated from a conducting metal fitting. The tip of the rod-like operation button is engaged with the flat spring to maintain the shape of the flat spring. This maintains an open state in which the flat spring is separated from the conducting metal fitting. Then, a wire is inserted into the wire connector in the open state, and thereafter the rod-like operation button is taken out of the housing, which causes the flat spring to be elastically restored and clamp the wire between the conducting metal fitting and itself.

15 [0004] A wire fixing mechanism used in the plug disclosed in Japanese Patent No. 3357245 (Document 2) also includes a button member that is movable toward and away from a housing in the same manner as described above. In the wire fixing mechanism, the button member is pressed in toward the housing so that a spring in the housing becomes elastically deformed and enters an open state in which the spring is separated from a terminal metal fitting. The housing has a recess for holding the pressed-in button member. The housing also has another recess for holding the button member that has returned to its original position.

25 [0005] In the case where a wire is connected to the wire connector according to Document 1, it is necessary to pull the rod-like operation button out of the housing while maintaining a state in which the wire is inserted in the wire connector in the open state. This complicates the operation of connecting the wire and makes it difficult to shorten the time required for the connection operation. Besides, an operator is required to hold the wire with one of his/her hands and operate the rod-like operation button with the other hand. Thus, one-handed connection operation is difficult to perform. Accordingly, it is difficult for the operator to conduct the connection operation with one hand. The same can be said of the wire fixing mechanism in the plug according to Document 2.

Summary of Invention

35 [0006] The present invention is intended for a connector to which a wire is connected, and it is an object of the present invention to facilitate connecting the wire to the connector.

[0007] A connector according to a preferred embodiment of the present invention includes a case, a conductive terminal part fixed to the case, an elastic member that is mounted on the case and presses a wire against and clamps the wire to the terminal part by restoring force of the elastic member, and a state maintaining part that comes in contact with the elastic member and maintains a non-connected state of the elastic member in which the elastic member is bent more than in its connected state in which the elastic member clamps the wire. When the wire is inserted between the terminal part and the elastic member in the non-connected state, a force is transmitted directly or indirectly from the wire to the state maintaining part to move the state maintaining part and to cause the elastic member to transition from the non-connected state to the connected state. This connector facilitates connecting the wire to the connector.

45 [0008] Preferably, the state maintaining part is locked to a stepped portion of the case while in contact with the elastic member in the non-connected state to maintain the non-connected state of the elastic member.

[0009] More preferably, the connector further includes a state releasing part that, when the wire is inserted between the terminal part and the elastic member in the non-connected state, transmits a force from the wire to release the lock of the state maintaining part to the case.

50 [0010] Yet more preferably, the state releasing part includes a support portion rotatably mounted on the case, a first contact portion that comes in contact with the wire, and a second contact portion that comes in contact with the state maintaining part. When the wire is inserted, the first contact portion is pressed down to rotate the state releasing part about the support portion, and the second contact portion moves the state maintaining part in a direction away from the stepped portion.

55 [0011] Preferably, the state maintaining part is movable on a travel path provided in the case between a first position in which the state maintaining part comes in contact with the elastic member in the connected state and a second position in which the state maintaining part comes in contact with the elastic member in the non-connected state, and a surface of the state maintaining part located in the first position is located inside the case and inward of an area of a surface of

the case that is around the state maintaining part, or located in the same plane as the area.

[0012] Preferably, the connector includes an identifier that enables visual recognition of whether the state maintaining part maintains the non-connected state of the elastic member.

[0013] Preferably, the elastic member is a flat spring.

[0014] These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

Brief Description of Drawings

[0015]

Fig. 1 is a sectional view of a connector according to one embodiment;

Fig. 2 is a sectional view of the connector;

Fig. 3 is an exploded perspective view of the connector;

Fig. 4 is a front view of the connector;

Fig. 5 is a sectional view of the connector;

Fig. 6 is a sectional view of the connector;

Fig. 7 is a sectional view of the connector;

Fig. 8 is a front view of another connector;

Fig. 9 is a front view of another connector;

Fig. 10 is a sectional view of another connector;

Fig. 11 is a sectional view of the other connector;

Fig. 12 is a sectional view of another connector;

Fig. 13 is a sectional view of the other connector;

Fig. 14 is a sectional view of another connector;

Fig. 15 is a sectional view of the other connector;

Fig. 16 is a sectional view of another connector;

Fig. 17 is a sectional view of the other connector;

Fig. 18 is a sectional view of another connector;

Fig. 19 is a sectional view of the other connector;

Fig. 20 is a sectional view of the other connector;

Fig. 21 is a sectional view of the other connector;

Fig. 22 is a sectional view of the other connector;

Fig. 23 is a sectional view of the other connector;

Fig. 24 is a sectional view of another connector;

Fig. 25 is a sectional view of the other connector; and

Fig. 26 is a sectional view of the other connector.

Description of Embodiments

[0016] Fig. 1 is a sectional view of a connector 1 according to one embodiment of the present invention. Fig. 2 is a sectional view of the connector 1 taken at a position II-II in Fig. 1. Fig. 3 is an exploded perspective view of the connector 1. Fig. 4 is a front view of the connector 1. The connector 1 is a push-in connector to which wires are connected. Figs. 1 to 4 illustrate a state in which no wires are inserted in the connector 1. Fig. 1 also illustrates a configuration at the back of the section. For example, the connector 1 is used in the terminal strip of a control board or other mechanisms.

[0017] In the following description, the up-down direction and the right-left direction in Fig. 1 are simply referred to as the "up-down direction" and the "right-left direction." The direction perpendicular to the plane of Fig. 1 is referred to as a "thickness direction." Fig. 1 illustrates a section approximately in the center of the connector 1 in the thickness direction. The up-down direction, the right-left direction, and the thickness direction do not necessarily have to coincide with those at the timing of mounting during use of the connector 1. The up-down direction also does not necessarily have to coincide with the direction of Earth's gravity.

[0018] The connector 1 includes a case 2, a terminal part 3, an elastic member 4, an operation part 5, and a releasing part 6. The case 2 houses therein the terminal part 3, the elastic member 4, the operation part 5, and the releasing part 6. The case 2 is made of, for example, a resin. In the example illustrated in Fig. 1, the case 2 has two insertion holes 21 into which wires can be inserted. The case 2 houses therein two terminal parts 3, two elastic members 4, two operation parts 5, and two releasing parts 6. In other words, the connector 1 includes two sets of one terminal part 3, one elastic member 4, one operation part 5, and one releasing part 6. Alternatively, the connector 1 may include a single set or three or more sets of one terminal part 3, one elastic member 4, one operation part 5, and one releasing part 6.

[0019] Each set of one terminal part 3, one elastic member 4, one operation part 5, and one releasing part 6 is disposed corresponding to each insertion hole 21. The two sets of one terminal part 3, one elastic member 4, one operation part 5, and one releasing part 6 are identical in properties such as shape and size and are disposed opposing each other in the right-left direction. Focusing now on the insertion hole 21 on the right side in Fig. 1, the terminal part 3 is located on the right side of a lower end portion of the insertion hole 21 and extends downward from the lower end portion of the insertion hole 21. The elastic member 4 extends toward the left from the lower end portion of the insertion hole 21 and further extends downward. On the left side of the insertion hole 21, the operation part 5 is disposed on the upper side of the elastic member 4. The releasing part 6 expands from the left side of the insertion hole 21 to the lower side of the insertion hole 21 at the back of the operation part 5 and the elastic member 4 in Fig. 1 (i.e., on the front side of the connector). The releasing part 6 overlaps with the operation part 5 and the elastic member 4 in the thickness direction.

[0020] The terminal parts 3 are conductive members fixed to the case 2. The terminal parts 3 are made of, for example, a metal. The terminal part 3 on the right side in Fig. 1 is electrically connected to the terminal part 3 on the left side in Fig. 1. In the example illustrated in Figs. 1 to 5, the two terminal parts 3 form an integral member. Specifically, the lower ends of the two terminal parts 3 are connected by a conductive terminal connector 32 that extends in the right-left direction.

[0021] The elastic members 4 are elastically deformable members mounted on the case 2. In the example illustrated in Figs. 1 to 4, the elastic members 4 are generally band-like flat springs. The elastic members 4 are made of, for example, a metal. The elastic members 4 may be formed of a conductive material, or may be formed of an insulating material such as a resin. For example, the elastic members 4 are formed to bend in approximately an L-, V-, or U-shape at their central portions 41 in the longitudinal direction. The central portions 41 of the elastic members 4 are lodged by the case 2 so that each elastic member 4 is mounted on the case 2, with its opposite ends facing approximately downward. In the following description, portions 22 of the case 2 that come in contact with the central portions 41 from the underside are referred to as "support portions 22." The support portions 22 extend approximately downward from the central portions 41 of the elastic members 4.

[0022] Focusing now on the elastic member 4 on the right side in Fig. 1, a portion 42 of the elastic member 4 that extends from the central portion 41 to the left side of the support portion 22 is lodged between the support portion 22 and the other portion of the case 2 and approximately fixed. A portion 43 of the elastic member 4 that extends from the central portion 41 to the right side of the support portion 22 is in contact with the terminal part 3 extending in the up-down direction. When the portion 43 of the elastic member 4 is pressed down by the operation part 5 or other parts, the elastic member 4 becomes elastically deformed and bent downward while the upper end portion of the support portion 22 serves as a support. When the downward pressure applied to the portion 43 is eliminated, the portion 43 returns to its original state by its restoring force (i.e., becomes elastically restored). In the following description, the portions 42 and 43 of the elastic member 4 are respectively referred to as a "fixed portion 42" and a "movable portion 43." The fixed portion 42 and the movable portion 43 are approximately line symmetric with respect to a center line passing through the central portion 41.

[0023] In the state illustrated in Fig. 1, the tips of the movable portions 43 of the elastic members 4 are in contact with the terminal parts 3 below the insertion holes 21 as described above so as to close the lower ends of the insertion holes 21 from the underside. In the following description, the state illustrated in Fig. 1 is referred to as an "insertion-hole closed state." The insertion-hole closed state is a state before wires are inserted into the insertion holes 21, i.e., an initial state before the connector 1 is used.

[0024] The elastic members 4 in the insertion-hole closed state (i.e., in the initial state) slightly bend in directions in which the fixed portions 42 and the movable portions 43 come close to each other. This prevents the elastic members 4 from falling off the case 2. On the left side in Fig. 1, the dashed double-dotted line indicates the elastic member 4 that does not bend at all. In the example illustrated in Fig. 1, the support portions 22 of the case 2 serve as stoppers that restrict the bend of the elastic members 4 (i.e., flexion of the elastic members 4) in the directions in which the fixed portions 42 and the movable portions 43 come close to each other.

[0025] The operation parts 5 are generally columnar or plate-like members extending in the up-down direction. The operation parts 5 are located inside holes (hereinafter, referred to as "travel paths 24") provided in the case 2 and extending in the up-down direction. The operation parts 5 are movable in the up-down direction along the travel paths 24. The travel paths 24 are open to an upper face 25 of the case 2 and extend approximately downward from the upper face 25.

[0026] The operation parts 5 each include an upper end portion 51, a connecting portion 52, and a lower end portion 53. The upper end portion 51, the connecting portion 52, and the lower end portion 53 are connected from the upper side to the lower side in the order specified, thus forming an integral member. The operation parts 5 are made of, for example, a resin. For example, the upper end portions 51 of the operation parts 5 are generally rectangular parallelepiped portions. Upper faces 511 of the upper end portions 51 are flat surfaces that are generally perpendicular to the up-down direction. Each upper end portion 51 has a downward-opening recess 512 in the central portion of the upper face 511. The connecting portions 52 extend downward from the lower ends of the upper end portions 51 and connect the upper end portions 51 and the lower end portions 53. For example, the connecting portions 52 are generally plate-like portions

having a greater width in the thickness direction than their width in the right-left direction. The lower end portions 53 extend downward from the lower ends of the connecting portions 52. For example, the lower end portions 53 are generally plate-like or columnar portions.

[0027] The widths of the upper end portions 51 in the right-left direction are approximately constant along approximately the entire lengths of the upper end portions 51 in the up-down direction. The widths of the connecting portions 52 in the right-left direction are approximately constant along approximately the entire lengths of the connecting portions 52 in the up-down direction. The widths of the lower end portions 53 in the right-left direction are approximately constant in the upper parts of the lower end portions 53 and gradually decrease as the distance from the upper parts increases. The widths of the upper end portions 51 in the right-left direction are greater than the widths of the connecting portions 52 in the right-left direction. The widths of the upper ends of the lower end portions 53 in the right-left direction are greater than the widths of the lower ends of the connecting portions 52 in the right-left direction. Opposite side faces of the connecting portions 52 in the right-left direction are approximately perpendicular to the right-left direction and extend approximately parallel to the up-down direction.

[0028] Focusing now on the operation part 5 on the right side in Fig. 1, the upper end portion 51 of the operation part 5 protrudes toward the left from the upper end of the connecting portion 52. The left side face of the lower end portion 53 extends downward from the upper end in approximately parallel with the up-down direction and then extends toward the right as the distance from the lower end decreases. The elastic member 4 is partly in contact with the left side face of the connecting portion 52 or the lower end portion 53. In the following description, the left side faces of the connecting portion 52 and the lower end portion 53 are collectively referred to as an "elastic-member contact surface 54" of the operation part 5. The lower end portion 53 of the operation part 5 protrudes toward the right from the lower end of the connecting portion 52. This forms an operation stepped portion 55 that protrudes toward the right, at the lower end of the connecting portion 52 (i.e., at the upper end of the lower end portion 53).

[0029] In the insertion-hole closed state illustrated in Fig. 1, the operation stepped portions 55 of the operation parts 5 are locked to parts of the case 2 so as to restrict upward movement of the operation parts 5. The elastic-member contact surfaces 54 of the operation parts 5 are in contact with the movable portions 43 of the elastic members 4 as described above, and the operation stepped portions 55 are pressed against the aforementioned parts of the case 2 by the restoring force of the elastic members 4. This locks the operation parts 5 to the case 2 and prevents the operation parts 5 from moving upward above the positions illustrated in Fig. 1. When the connector 1 is assembled, the operation parts 5 are disposed in advance in areas where the movable portions 43 of the elastic members 4 that do not bend (i.e., in non-compressed state) are to be set, and the elastic members 4 are mounted on the case 2 while being bent. This achieves the above-described structure.

[0030] In the insertion-hole closed state illustrated in Fig. 1, the upper faces 511 of the upper end portions 51 of the operation parts 5 are located in approximately the same plane as areas of the upper face 25 of the case 2 that are around the operation parts 5. Alternatively, the upper faces 511 of the upper end portions 51 of the operation parts 5 may be located inside the case 2 and inward of the areas of the upper face 25 of the case 2 that are around the operation parts 5 (i.e., below the areas). Also, as illustrated in Fig. 2, opposite side faces 513 of the operation parts 5 in the thickness direction are located inside the case 2 and inward of areas of opposite side faces 26 of the case 2 in the thickness direction that are around the operation part 5, or located in approximately the same plane as these areas. The same can be said of the other surfaces of the operation parts 5. In other words, in the insertion-hole closed state illustrated in Fig. 1, the surfaces of the operation parts 5 are located inside the case and inward of the areas of the surfaces of the case 2 that are around the operation parts 5 (i.e., areas around the travel paths 24), or located in approximately the same plane as these areas.

[0031] The case 2 has stepped portions 241 that extend from the travel paths 24 in directions intersecting with the travel paths 24, below the upper faces 511 of the operation parts 5 illustrated in Fig. 1. In other words, the widths of the travel paths 24 in the right-left direction are enlarged suddenly at the positions of the stepped portions 241 in the up-down direction. In the travel path 24 on the right side in Fig. 1, the stepped portion 241 extends toward the left from the travel path 24 extending in the up-down direction. In other words, this travel path 24 has a recess 242 that extends toward the left on the underside of the stepped portion 241. In the travel path 24 on the left side in Fig. 1, the stepped portion 241 and the recess 242 extend toward the right from the travel path 24 extending in the up-down direction.

[0032] The releasing parts 6 each include a first contact portion 61, a second contact portion 62, a support portion 63, and a base portion 64. For example, the first contact portion 61, the second contact portion 62, the support portion 63, and the base portion 64 form an integral member made of an insulating material such as a resin. The base portions 64 are generally flat plate-like portions that expand from the left side of the insertion holes 21 to below the insertion holes 21 at the back of the operation parts 5 and the elastic members 4 in Fig. 1 (i.e., on the front side of the connector). The first contact portions 61, the second contact portions 62, and the support portions 63 protrude toward the front in Fig. 1 (i.e., toward the back of the connector) from the base portions 64.

[0033] The first contact portions 61 are generally flat plate-like portions that protrude toward the back from the lower end portions of the base portions 64. The first contact portions 61 are located below the insertion holes 21 and oppose

the lower ends of the insertion holes 21 in the up-down direction. For example, the upper faces of the first contact portions 61 are faces that are generally perpendicular to the up-down direction. The second contact portions 62 are generally flat plate-like or rod-like portions that protrude toward the back from the upper end portions of the base portions 64. The second contact portions 62 are disposed in the aforementioned recesses 242 that extend to the sides from the travel paths 24. Thus, the second contact portions 62 are located on the sides opposite to the insertion holes 21 in the right-left direction while clamping the operation parts 5 located in the travel paths 24. In other words, the operation parts 5 and the travel paths 24 are located between the insertion holes 21 and the second contact portions 62 and the recesses 242 in the right-left direction. The second contact portions 62 in the recesses 242 are separated from the operation parts 5 in the right-left direction.

[0034] The support portions 63 are generally columnar portions that protrude toward the back from approximately the central portions of the base portions 64 in the up-down direction. The support portions 63 are mounted on the case 2 so as to be rotatable about central axes parallel to the thickness direction. When mounted on the case 2, for example, the support portions 63 are inserted into through holes provided in the case 2 and extending in the thickness direction. In the example illustrated in Fig. 1, the support portions 63 are inserted from the front side into the through holes provided in the upper end portions of the support portions 22 of the case 2. Accordingly, the releasing parts 6 are mounted on the case 2 so as to be rotatable about the support portions 63 extending in the thickness direction.

[0035] Next, the procedure for connecting a wire to the connector 1 will be described with reference to Fig. 1 and Figs. 5 to 7. The following description is given of how a wire is connected to the insertion hole 21 on the right side in the drawings. Operations that the operator will perform when a wire is connected to the insertion hole 21 on the left side in the drawings are approximately the same, except that the right and left are opposite to those in the following description.

[0036] First, in the insertion-hole closed state illustrated in Fig. 1, the operation part 5 is pressed in toward the inside of the case 2 and moved downward along the travel path 24. In order to press in the operation part 5, for example, the operator brings the tip of an ordinary tool such as a minus driver into contact with the recess 512 of the upper end portion 51 of the operation part 5 and applies a downward force to the operation part 5 via the minus driver. As the operation part 5 moves downward, the elastic member 4 is bent and changes in shape. Specifically, as illustrated in Fig. 5, the movable portion 43 of the elastic member 4 is pressed down by the lower end portion 53 of the operation part 5 and spaced toward the left from the terminal part 3. This opens the lower end of the insertion hole 21. In the following description, the state of the connector 1 illustrated in Fig. 5 is referred to as an "insertion-hole open state."

[0037] In the insertion-hole open state illustrated in Fig. 5, the operation part 5 is locked to the case 2 and prevented from returning to the position illustrated in Fig. 1. Specifically, when the upper face 511 of the operation part 5 is moved down and located in approximately the same position as the aforementioned stepped portion 241 in the up-down direction, the lower end portion 53 of the operation part 5 is pressed toward the right by the restoring force of the elastic member 4, and the operation part 5 is inclined slightly. Accordingly, the lower end portion 53 of the operation part 5 moves toward the right, i.e., in a direction intersecting with the travel path 24, and the upper end portion 51 of the operation part 5 moves toward the left, i.e., in a direction intersecting with the travel path 24. The left end portion of the upper end portion 51 of the operation part 5 becomes embedded on the underside of the stepped portion 241 (i.e., in the recess 242), and the upper face 511 of the operation part 5 is pressed against the lower face of the stepped portion 241 from the underside. As a result, the operation part 5 is locked to the stepped portion 241.

[0038] In this way, the operation part 5 in contact with the elastic member 4 in the insertion-hole open state is locked to the stepped portion 241 of the case 2, thereby maintaining the insertion-hole open state of the elastic member 4. The elastic member 4 in the insertion-hole open state is bent more than in its connected state described later, and does not clamp a wire between the terminal part 3 and itself. In other words, the insertion-hole open state of the connector 1 illustrated in Fig. 5 is a "non-connected state." The operation part 5 serves as a state maintaining part that maintains the non-connected state of the elastic member 4.

[0039] In the recess 242, the upper end portion 51 of the operation part 5 comes in direct contact with the second contact portion 62 of the releasing part 6 from the side and moves the second contact portion 62 toward the left in the drawings. This causes the releasing part 6 to rotate counterclockwise in the drawings about the support portion 63. As a result, the first contact portion 61 moves upward while opposing the insertion hole 21 in the up-down direction below the insertion hole 21.

[0040] In the insertion-hole open state (i.e., non-connected state) illustrated in Fig. 5, the upper face 511 of the upper end portion 51 of the operation part 5 is located inside the case 2 and inward of the area of the upper face 25 of the case 2 that is around the operation part 5 (i.e., below the area). Alternatively, the upper face 511 of the upper end portion 51 of the operation part 5 may be located in approximately the same plane as the area of the upper face 25 of the case 2 that is around the operation part 5. The same can be said of the other surfaces of the operation part 5. In other words, in the insertion-hole open state illustrated in Fig. 5, the surfaces of the operation part 5 are located inside the case 2 and inward of the area of the surface of the case 2 that is around the operation part 5 (i.e., area around the travel path 24), or located in approximately the same plane as the area.

[0041] As indicated by the dashed double-dotted line in Fig. 5, a wire 91 is inserted into the insertion hole 21 of the

connector 1 in the insertion-hole open state. For example, the wire 91 may be a single wire, or may be a relatively thick stranded wire. As another alternative, the wire 91 may be a wire obtained by providing a rod-like crimp terminal or similar parts at the tip portion of a relatively thin stranded wire. The rod-like crimp terminal may be an insulation-coated crimp terminal in which an insulating sleeve or the like is provided at the root of a rod-like conductor, or may be a bare crimp terminal that includes no insulating sleeve or the like. Preferably, the tip portion of the wire 91 has a diameter greater than or equal to 0.42 mm, for example. In actuality, the diameter of the tip portion of the wire 91 is less than or equal to 2.3 mm. The diameter of the tip portion of the wire 91 may be changed to various values depending on the current-carrying capacity of the connector 1 to which the wire 91 is connected. The diameters of different portions of the wire 91 other than the tip portion may also be changed to various values. As will be described later, the tip portion of the wire 91 possesses such a degree or more of stiffness that it can press and move the first contact portion 61 of the releasing part 6 downward.

[0042] The wire 91 is moved downward in the insertion hole 21 and inserted in between the terminal part 3 and the elastic member 4 in the insertion-hole open state as illustrated in Fig. 5. The tip portion of the wire 91 comes in direct contact with the upper face of the first contact portion 61 of the releasing part 6. Then, as illustrated in Fig. 6, the wire 91 is further moved downward (i.e., further inserted into the case 2) so that the first contact portion 61 is pressed down. This causes the releasing part 6 to rotate clockwise in Fig. 6 about the support portion 63. As a result, the second contact portion 62 in contact with the operation part 5 moves toward the right in Fig. 6 and moves the operation part 5 in a direction away from the stepped portion 241.

[0043] The releasing part 6 that has received the force transmitted from the wire 91 pushes the upper end portion 51 of the operation part 5 toward the travel path 24 out of the recess 242 on the underside of the stepped portion 241. This releases the lock of the operation part 5 to the stepped portion 241. That is, the releasing part 6 serves as a state releasing part (i.e., releaser) that releases the lock of the operation part 5, which serves as the state maintaining part, to the case 2.

[0044] When the lock of the operation part 5 to the stepped portion 241 has been released, the movable portion 43 is moved diagonally upward toward the right by the restoring force of the elastic member 4 and comes in contact with the wire 91 from the left side as illustrated in Fig. 7. The movable portion 43 of the elastic member 4 presses the wire 91 against the terminal part 3 and clamps the wire 91 between the terminal part 3 and itself. Accordingly, the wire 91 and the terminal part 3 are electrically and mechanically connected to each other. In other words, the wire 91 is connected to the connector 1. In the following description, the state illustrated in Fig. 7 is referred to as a "connected state." As described above, the elastic member 4 in the connected state clamps the wire 91 between the terminal part 3 and itself. At the time when the lock of the operation part 5 is released and the wire 91 is pressed against the terminal part 3 by the elastic member 4, a sound (e.g., a cracking sound), a vibration, or other signs is generated due to, for example, a collision of the elastic member 4, the wire 91, and the terminal part 3. In this case, when a sound is heard, the operator is able to determine that the lock of the operation part 5 has been released. Or, when a vibration transmitted to his/her fingertip is sensed, the operator is able to determine that the lock of the operation part 5 has been released. The connector 1 may adopt various structures for stimulating the generation of such a sound and/or a vibration or for amplifying such a sound and/or a vibration.

[0045] When the lock of the operation part 5 has been released in the insertion-hole open state illustrated in Fig. 5, the operation part 5 is moved upward by the restoring force of the elastic member 4. The elastic-member contact surface 54 of the operation part 5 is in contact with the movable portion 43 of the elastic member 4. In the connected state, the upper face 511 of the operation part 5 is located above the stepped portion 241. In this way, in the connector 1, a force is transmitted indirectly from the wire 91 to the operation part 5 via the releasing part 6 so as to move the operation part 5 and to cause the elastic member 4 to transition from the insertion-hole open state (i.e., non-connected state) to the connected state. The connector 1 eliminates the need for the operator to apply a force to the operation part 5 and the releasing part 6 with a tool such as a minus driver during transition from the insertion-hole open state to the connected state.

[0046] In the connected state illustrated in Fig. 7, the upper face 511 of the upper end portion 51 of the operation part 5 is located inside the case 2 and inward of the area of the upper face 25 of the case 2 that is around the operation part 5 (i.e., below the area). Alternatively, the upper face 511 of the upper end portion 51 of the operation part 5 may be located in approximately the same plane as the area of the upper face 25 of the case 2 that is around the operation part 5. The same can be said of the other surfaces of the operation part 5. In other words, in the connected state illustrated in Fig. 5, the surfaces of the operation part 5 are located inside the case 2 and inward of areas of the surfaces of the case 2 that are around the operation part 5 (i.e., areas around the travel path 24), or located in approximately the same plane as these areas.

[0047] In the case where the connector 1 is disposed such that the upper side in Fig. 7 becomes the lower side in the direction of Earth's gravity in the connected state illustrated in Fig. 7, the operation part 5 is separated above from the elastic member 4 in Fig. 7 by the Earth's gravity. Then, in the same manner as in the insertion-hole closed state illustrated in Fig. 1, the operation stepped portion 55 of the operation part 5 is locked to part of the case 2 so as to restrict upward movement of the operation part 5. This prevents the operation part 5 from moving upward above the position illustrated

in Fig. 1.

[0048] In the case where the wire 91 is extracted from the connector 1, for example, the operator applies a downward force to the operation part 5 via an ordinary tool such as a minus driver by bringing the tip of the minus driver into contact with the recess 512 of the upper end portion 51 of the operation part 5. The operation part 5 is then moved downward and enters the insertion-hole open state as illustrated in Fig. 5. In the insertion-hole open state, the operation part 5 is locked to the stepped portion 241 as described above, and the elastic member 4 is bent so as to separate the movable portion 43 toward the left from the wire 91. In other words, the clamping of the wire 91 between the elastic member 4 and the terminal part 3 is released.

[0049] When the upper end portion 51 of the operation part 5 becomes embedded in the recess 242 on the underside of the stepped portion 241, the second contact portion 62 of the releasing part 6 moves toward the left (i.e., in a direction away from the travel path 24). This causes the releasing part 6 to rotate counterclockwise in Fig. 5 about the support portion 63. As a result, the first contact portion 61 moves upward, and the wire 91 in contact with the first contact portion 61 also moves upward. The connector 1 may adopt various structures for facilitating visual recognition of the upward movement of the wire 91. In this case, for example, the operator is able to determine that the connected state has been released, by visually recognizing the upward movement of the wire 91. The operator is able to easily extract the wire 91 out of the connector 1 by pulling the wire 91 out of the insertion hole 21.

[0050] In the connector 1, the elastic member 4 is deformable among the insertion-hole closed state illustrated in Fig. 1, the insertion-hole open state illustrated in Fig. 5, and the connected state illustrated in Fig. 7. In the following description, the position of the operation part 5 that is in contact with the elastic member 4 in the connected state as illustrated in Fig. 7 is referred to as a "first position." The position of the operation part 5 that is in contact with the elastic member 4 in the insertion-hole open state (i.e., non-connected state) as illustrated in Fig. 5 is referred to as a "second position." The position of the operation part 5 at which the operation stepped portion 55 is locked to part of the case 2 as illustrated in Fig. 1 is referred to as a "third position."

[0051] The aforementioned travel path 24 connects the third position, the first position, and the second position of the operation part 5 in the order specified. On the travel path 24, the third position is located on the side opposite to the second position, with the first position located therebetween. In the second position, the operation part 5 can be locked to the stepped portion 241 of the case 2 as described above. In the third position, the operation stepped portion 55 is locked to part of the case 2 so as to restrict upward movement of the operation part 5 (i.e., movement in a direction away from the second position). In the third position, only part of the operation part 5 may be locked to part of the case 2, and the operation stepped portion 55 does not necessarily have to be locked to part of the case 2.

[0052] As described thus far, the connector 1 to which the wire 91 is connected includes the case 2, the terminal part 3, the elastic member 4, and the operation part 5 serving as the state maintaining part. The terminal part 3 has conductivity and is fixed to the case 2. The elastic member 4 is mounted on the case 2. The elastic member 4 presses the wire 91 against and clamps the wire 91 to the terminal part 3 by restoring force of the elastic member 4. The operation part 5 comes in contact with the elastic member 4 to maintain the non-connected state (i.e., insertion-hole open state) of the elastic member 4 in which the elastic member 4 is bent more than in the connected state in which the elastic member 4 clamps the wire 91. In the connector 1, when the wire 91 is inserted between the terminal part 3 and the elastic member 4 in the non-connected state, a force is transmitted indirectly from the wire 91 to the operation part 5 so as to move the operation part 5 and to cause the elastic member 4 to transition from the non-connected state to the connected state.

[0053] This facilitates connecting the wire 91 to the connector 1, as compared with the structure in which transition to the connected state is implemented by the operator operating the operation part while maintaining a state in which wire is inserted. As a result, it is possible to reduce time and effort required for the operation of connecting the wire 91 to the connector 1.

[0054] A control board or any other mechanism including the connector 1 may couple a plurality of connectors 1 in the thickness direction and use them as a large-sized connector. In such a large-sized connector, for example a plurality of wires 91 (see Fig. 5) tied together by a tying band or the like may be connected to the insertion holes 21 of the plurality of connectors 1 aligned in the thickness direction. In this case, since each connector 1 is capable of reducing time and effort required for the operation of connecting the wire 91 as described above, it is possible to further enhance the effect of reducing the number of processing steps performed in the operation of connecting a plurality of wires 91.

[0055] In the connector 1, the operation part 5 in contact with the elastic member 4 in the non-connected state is locked to the stepped portion 241 of the case 2 so as to maintain the non-connected state of the elastic member 4. Accordingly, the connector 1 can easily achieve maintaining the non-connected state of the elastic member 4.

[0056] As described above, the connector 1 further includes the releasing part 6 serving as the state releasing part. When the wire 91 is inserted between the terminal part 3 and the elastic member 4 in the non-connected state, a force is transmitted from the wire 91 to the releasing part 6. This allows the releasing part 6 to release the lock of the operation part 5 to the case 2. With this structure, the lock of the operation part 5 to the case 2 can be released without the need to bring the operation part 5 into direct contact with the wire 91. Thus, it is possible to avoid a situation in which the shape of the operation part 5 and the structure of locking the operation part 5 to the case 2 are restricted by, for example,

the shape of the wire 91 and the positional relationship between the wire 91 and the operation part 5. This results in an improvement in the degree of design flexibility in the shape of the operation part 5 and the structure of locking the operation part 5 to the case 2. In the above-described example, the releasing part 6 moves the operation part 5 in the directions away from the stepped portion 241 in order to release the lock of the operation part 5 to the case 2, but the releasing part 6 may use other form to implement releasing the lock of the operation part 5.

[0057] As described above, the releasing part 6 includes the first contact portion 61, the second contact portion 62, and the support portion 63. The support portion 63 is rotatably mounted on the case 2. The first contact portion 61 comes in contact with the wire 91. The second contact portion 62 comes in contact with the operation part 5. In the connector 1, when the wire 91 is inserted, the first contact portion 61 is pressed down, so that the releasing part 6 rotates about the support portion 63, and the second contact portion 62 moves the operation part 5 in the directions away from the stepped portion 241. This facilitates releasing the lock of the operation part 5 to the case 2 described above.

[0058] In the connector 1, operation part 5 is movable in the travel path 24 provided in the case 2 between the first position in which the operation part 5 comes in contact with the elastic member 4 in the connected state and the second position in which the operation part 5 comes in contact with the elastic member 4 in the non-connected state. The surface of the operation part 5 located in the first position is located inside the case 2 and inward of the area of the surface of the case 2 that is around the operation part 5, or located in approximately the same plane as the area. In this way, in the connector 1, when the wire 91 is connected to the connector 1, the operation part 5 does not protrude from the case 2. This prevents the elastic member 4 from becoming deformed from the connected state due to, for example, an accidental collision of the operation part 5 with a tool or the like. As a result, it is possible to prevent the connected state from being unintentionally released due to unintended movement of the operation part 5.

[0059] As described above, the elastic member 4 of the connector 1 is a flat spring. Thus, it is possible to reduce the manufacturing cost of the connector 1. Alternatively, the elastic member 4 may be any of various member (e.g., helical spring) other than the flat springs.

[0060] In the connector 1, the surfaces of the operation part 5 that is located in the second position are also located inside the case 2 and inward of the area of the surface of the case 2 that is around the operation part 5, or located in the same plane as the area. In this way, even in the non-connected state, the operation part 5 does not protrude from the case 2. This prevents the elastic member 4 from becoming deformed from the non-connected state due to, for example, an accidental collision of the operation part 5 with a tool or the like. As a result, it is possible to prevent the non-connected state (i.e., insertion-hole open state) from being unintentionally released.

[0061] In the connector 1, the surfaces of the operation part 5 that is located in the third positions are also located inside the case 2 and inward of the area of the surface of the case 2 that is around the operation part 5, or located in the same plane as the area. In this way, the operation part 5 does not protrude from the case 2 in the insertion-hole closed state. This prevents the operation part 5 of the connector 1 from being accidentally pressed and causing the elastic member 4 to become deformed from the insertion-hole closed state (i.e., initial state). As a result, it is possible to prevent an unnecessary force from being applied to the elastic member 4 during shipment or other conditions.

[0062] The connector 1 may further include an identifier that enables visual recognition of whether the operation part 5 maintains the non-connected state of the elastic member 4. This facilitates determining the states of the elastic member 4. Specifically, for example as illustrated in Fig. 8, upper end portion 65 of the base portion 64 of the releasing part 6 extends to the vicinity of the upper face 25 of the case 2, and only when the elastic member 4 is in the non-connected state (i.e., the insertion-hole open state) as illustrated on the left side in Fig. 8, the upper end portion 65 becomes visually recognizable through opening 27 provided in the upper face 25 of the case 2. When the elastic member 4 is not in the non-connected state as illustrated on the right side in Fig. 8, the upper end portion 65 of the releasing part 6 is hidden under the upper face 25 of the case 2 and cannot be recognized visually through the opening 27 of the case 2. That is, the upper end portion 65 of the releasing part 6 serves as the aforementioned identifier. To facilitate visual recognition, the upper end portion 65 of the releasing part 6 is preferably colored with a different color from the color of the portion of the releasing part 6 other than the upper end portion 65.

[0063] In the connector 1, the shapes of the releasing parts 6 may be changed in various ways. For example, in a connector 1a illustrated in the front view in Fig. 9, releasing parts 6a each further include a leg portion 66, in addition to the first contact portion 61, the second contact portion 62, and the support portion 63 described above. The leg portions 66 are generally band-like portions that extend diagonally downward from either of the opposite edges of the base portion 64 in the right-left direction that is on the side opposite to the side where the first contact portion 61 is provided. The lower end portions of the leg portions 66 abut on the case 2.

[0064] The releasing part 6a on the left side in Fig. 9 is in the non-connected state (i.e., insertion-hole open state), and the releasing part 6a on the right side is not in the non-connected state (i.e., is in the insertion-hole closed state). In the releasing part 6a on the right side in Fig. 9, the distance in the right-left direction between the leg portion 66 and the base portion 64 is small, and the leg portion 66 is bent. The restoring force of the leg portion 66 acts as a force that causes the releasing part 6a to rotate counterclockwise and transition to the non-connected state. Accordingly, in the connector 1a illustrated in Fig. 9, the releasing part 6a in the insertion-hole closed state or the connected state can easily

transition to the non-connected state.

[0065] Releasing parts 6b of a connector 1b illustrated in Figs. 10 and 11 each include a generally V-shaped flat first contact portion 61b whose height in the up-down direction is smaller than its width in the right-left direction, instead of the generally flat plate-like first contact portion 61 illustrated in Fig. 1. The support portions 63b of the releasing parts 6b are rotatably mounted on the case 2 above the support portions 22. Fig. 10 illustrates the connector 1b in the insertion-hole closed state (i.e., initial state). Fig. 11 illustrates the connector 1b in the insertion-hole open state (i.e., non-connected state).

[0066] As illustrated in Figs. 10 and 11, in the connector 1b, the distance between the support portions 63 and the first contact portions 61b are greater than in the example illustrated in Fig. 1, and accordingly the ranges of rotation of the first contact portions 61b are also larger. The case 2 has recesses in portions around the first contact portions 61b, and these recesses prevent interference between the first contact portions 61b and the case 2 during rotation of the first contact portions 61b. Besides, because of the large distances between the support portions 63b and the first contact portions 61b in the connector 1b, even if the force of the wires 91 (see Fig. 11) pressing the first contact portions 61b downward is relatively small, the releasing parts 6b can rotate to release the lock of the operation parts 5 to the case 2 and connect the wires 91. Accordingly, the connector 1b is suitable for connecting wires 91 that have relatively low stiffness at their tip portions.

[0067] Figs. 12 to 23 illustrate other preferable examples of the connector. Figs. 12 to 23 illustrate part of the connectors (specifically, a portion in the vicinity of the insertion hole 21 on the right side) in section. In Figs. 12 to 23, the elastic member 4 is indicated by the thick solid line.

[0068] In a connector 1c illustrated in Figs. 12 and 13, the upper end portion 51 of an operation part 5c is a resin spring that bends in the right-left direction. The upper end portion 51 of the operation part 5c includes a protrusion 56 that protrudes on the side opposite to the insertion hole 21. Instead of the releasing part 6 illustrated in Fig. 1, the connector 1c includes a releasing part 6c having a different structure from that of the releasing part 6.

[0069] The releasing part 6c includes a first contact portion 61c, a second contact portion 62c, a support portion 63c, and a connecting portion 64c. The support portion 63c is mounted on the case 2 so as to be rotatable about a central axis parallel to the thickness direction. The connecting portion 64c is a generally rod-like member that extends approximately in the right-left direction and is fixed to the support portion 63c. The first contact portion 61c is a generally flat plate-like member connected to one end of the connecting portion 64c. The first contact portion 61c is disposed below the insertion hole 21 and comes in contact with the tip portion of the wire 91 that is inserted into the insertion hole 21. The second contact portion 62c includes a generally flat plate-like member connected to the other end of the connecting portion 64c, and a generally rod-like member extending upward from the flat plate-like member. The second contact portion 62c is disposed below the operation part 5c.

[0070] Fig. 12 illustrates the connector 1c in the non-connected state. Fig. 13 illustrates the connector 1c in the connected state. In the non-connected state illustrated in Fig. 12, the upper end portion 51 of the operation part 5c is not compressed in the right-left direction, and the protrusion 56 of the operation part 5c is locked to the stepped portion 241 of the case 2. When the first contact portion 61c of the connector 1c in the non-connected state is pressed down by the wire 91, the connecting portion 64c rotates clockwise in the drawing together with the support portion 63c, and the second contact portion 62c moves upward as illustrated in Fig. 13. Then, the upper end portion 51 of the operation part 5c is pushed out to the travel path 24 by the tip portion of the second contact portion 62c. Accordingly, the lock of the operation part 5c to the case 2 is released, and the movable portion 43 is moved diagonally upward toward the right by the restoring force of the elastic member 4 to clamp the wire 91 between the terminal part 3 and itself. The operation part 5c is pushed up by the movable part 43, so that the upper end portion 51 moves upward in the travel path 24 while being compressed in the right-left direction.

[0071] In the connector 1c as well, as in the connector 1 illustrated in Fig. 1, a force is transmitted indirectly from the wire 91 to the operation part 5c via the releasing part 6c so as to move the operation part 5c and to cause the elastic member 4 to transition from the non-connected state to the connected state. This facilitates connecting the wire 91 to the connector 1c. As a result, it is possible to reduce time and effort required for the operation of connecting the wire 91 to the connector 1c.

[0072] In a connector 1d illustrated in Figs. 14 and 15, an operation part 5d includes an operation-part main body 50, a connecting portion 57, and a contact portion 58. The operation-part main body 50 is a generally columnar portion that extends in the up-down direction. The operation-part main body 50 moves in the up-down direction in the travel path 24. The connecting portion 57 is a generally plate-like portion that extends downward from the lower end of the operation-part main body 50. The connecting portion 57 is located at the back of the elastic member 4 in Fig. 14. The contact portion 58 is a generally flat plate-like portion that protrudes toward the front in the drawings from the lower end portion of the connecting portion 57. The contact portion 58 extends diagonally downward toward the right in the drawings (i.e., in a direction toward the bottom as the distance from the insertion hole 21 in the right-left direction decreases) from the lower end portion of the connecting portion 57 and reaches a position under the insertion hole 21. For example, the operation-part main body 50, the connecting portion 57, and the contact portion 58 form an integral member. The

connector 1d does not include a member corresponding to the releasing part 6 in Fig. 1.

[0073] Fig. 14 illustrates the connector 1d in the non-connected state. Fig. 15 illustrates the connector 1d in the connected state. In the non-connected state illustrated in Fig. 14, an operation stepped portion 55d that protrudes toward the right from the operation-part main body 50 of the operation part 5d is locked to the stepped portion 241d of the case 2. When the contact portion 58 of the operation part 5d is pressed down by the wire 91 in the connector 1d in the non-connected state, the lower end portion of the connecting portion 57 moves toward the left in the drawings (i.e., in a direction away from the insertion hole 21 in the right-left direction) so as to release the lock of the operation stepped portion 55d to the case 2 as illustrated in Fig. 15. As a result, the movable portion 43 is moved diagonally upward toward the right by the restoring force of the elastic member 4 and clamps the wire 91 between the terminal part 3 and itself. The operation part 5d is pushed up by the movable portion 43 of the elastic member 4 and moved upward in the travel path 24.

[0074] In the connector 1d, when the wire 91 is inserted between the terminal part 3 and the elastic member 4 in the non-connected state, a force is transmitted directly from the wire 91 to the operation part 5d so as to move the operation part 5d and to cause the elastic member 4 to transition from the non-connected state to the connected state. This facilitates connecting the wire 91 to the connector 1d in the same manner as in the connector 1 illustrated in Fig. 1. As a result, it is possible to reduce time and effort required for the operation of connecting the wire 91 to the connector 1d.

[0075] In a connector 1e illustrated in Figs. 16 and 17, an operation part 5e has the same shape as the operation-part main body 50 illustrated in Figs. 14 and 15. The operation part 5e moves in the up-down direction in the travel path 24. The connector 1e also includes a releasing part 6e. The releasing part 6e includes a support portion 63e, a connecting portion 67, and a contact portion 68. For example, the support portion 63e, the connecting portion 67, and the contact portion 68 form an integral member.

[0076] The connecting portion 67 is a generally plate-like portion that extends in the up-down direction. The connecting portion 67 is located at the back of the operation part 5e and the elastic member 4 in the drawings. The upper part of the connecting portion 67 overlaps with the operation part 5e in the thickness direction, and the lower part of the connecting portion 67 extends downward from the lower end portion of the operation part 5e. The contact portion 68 is a generally flat plate-like portion that protrudes toward the front in the drawings from the lower end portion of the connecting portion 67. The contact portion 68 extends diagonally downward toward the right in the drawings (i.e., in a direction toward the bottom as the distance from the insertion hole 21 in the right-left direction decreases) from the lower end portion of the connecting portion 67 and reaches a position under the insertion hole 21. The support portion 63e is a generally columnar portion that protrudes toward the front in the drawings from approximately the central portion of the connecting portion 67 in the up-down direction. The support portion 63e is rotatably mounted on the operation part 5e. Specifically, the support portion 63e is inserted into a through hole provided in the operation part 5e and extending in the thickness direction.

[0077] Fig. 16 illustrates the connector 1e in the non-connected state. Fig. 17 illustrates the connector 1e in the connected state. In the non-connected state illustrated in Fig. 16, an operation stepped portion 55e that protrudes toward the right from the operation part 5e is locked to the stepped portion 241 of the case 2. When the contact portion 68 of the releasing part 6e is pressed down by the wire 91 in the connector 1e in the non-connected state, as illustrated in Fig. 17, the lower end portion of the connecting portion 67 is moved toward the left in the drawing (i.e., in a direction away from the insertion hole 21 in the right-left direction), and the upper end portion of the connecting portion 67 is moved toward the right in the drawings. The upper end portion of the connecting portion 67 comes in contact with the case 2 and presses the case 2 toward the right, which causes the operation part 5e to move toward the left and releases the lock of the operation stepped portion 55e to the case 2. Accordingly, the movable portion 43 is moved diagonally upward toward the right by the restoring force of the elastic member 4 and clamps the wire 91 between the terminal part 3 and itself. The operation part 5e is pushed up by the movable portion 43 of the elastic member 4 and moved upward together with the releasing part 6e in the travel path 24.

[0078] In the connector 1e, when the wire 91 is inserted between the terminal part 3 and the elastic member 4 in the non-connected state, a force is transmitted indirectly from the wire 91 to the operation part 5e so as to move the operation part 5e and to cause the elastic member 4 to transition from the non-connected state to the connected state. This facilitates connecting the wire 91 to the connector 1e in the same manner as in the connector 1 illustrated in Fig. 1. As a result, it is possible to reduce time and effort required for the operation of connecting the wire 91 to the connector 1e.

[0079] In a connector 1f illustrated in Figs. 18 to 23, an operation part 5f includes an operation-part main body 50f, a contact portion 58f, and a spring portion 59f. Fig. 20 is a sectional view taken at a position XX-XX in Fig. 19. Fig. 22 is a sectional view taken at a position XXII-XXII in Fig. 21.

[0080] The operation-part main body 50f is a generally flat plate-like portion that is approximately perpendicular to the thickness direction. The upper end portion of the operation-part main body 50f is fixed to the case 2. The operation-part main body 50f extends diagonally downward toward the right in the drawings (i.e., in a direction toward the bottom as the distance from the insertion hole 21 in the right-left direction decreases) from the upper end portion fixed to the case 2, and reaches a position under the insertion hole 21. The operation-part main body 50f is located at the back of the elastic member 4 in the drawings.

[0081] The contact portion 58f is a generally flat plate-like portion that protrudes toward the front in the drawings from the lower end portion of the operation-part main body 50f. The spring portion 59f protrudes toward the back in the drawings from the operation-part main body 50f at a position between the upper end portion of the operation-part main body 50f and the contact portion 58f. The spring portion 59f abuts on a side wall 26 at the back of the case 2 in the drawings. The operation-part main body 50f is separated from a side wall 26 at the front of the case 2 in the drawings. The distance in the thickness direction between this side wall 26 and the operation-part main body 50f is slightly smaller than the width of the movable portion 43 of the elastic member 4 in the thickness direction. For example, the operation-part main body 50f, the contact portion 58f, and the spring portion 59f form an integral member. In the connector 1f, the operation part 5f does not move in the up-down direction. Also, the connector 1f does not include a member corresponding to the releasing part 6 in Fig. 1.

[0082] Fig. 18 illustrates the connector 1f in the insertion-hole closed state (i.e., initial state). Figs. 19 to 22 illustrate the connector 1f in the non-connected state. Fig. 23 illustrates the connector 1f in the connected state. In the insertion-hole closed state illustrated in Fig. 18, the movable portion 43 of the elastic member 4 is located above the operation-part main body 50f of the operation part 5f.

[0083] In the connector 1f, as illustrated in Figs. 19 and 20, an operator inserts a tool 92 such as a minus driver into the case 2 from above so that the tip portion of the tool 92 comes in contact with the movable portion 43 of the elastic member 4 and moves the movable portion 43 downward. The movable portion 43 of the elastic member 4 is located in a position overlapping with the operation-part main body 50f of the operation part 5f in the thickness direction. The operation-part main body 50f is pressed toward the front in Fig. 19 (i.e., toward the left in Fig. 20) by the restoring force of the spring portion 59f, which causes the movable portion 43 of the elastic member 4 to be clamped between the operation-part main body 50f and the side wall 26 at the front of the case 2 (i.e., the side wall 26 on the left side in Fig. 20) and enter the non-connected state. The operation part 5f in contact with the elastic member 4 in the non-connected state presses the elastic member 4 against the case 2 so as to maintain the non-connected state of the elastic member 4. In other words, the elastic member 4 is maintained in the non-connected state by a frictional force acting between the movable portion 43, the operation-part main body 50f, and the aforementioned side wall 26.

[0084] In the connector 1f in the non-connected state, when the contact portion 58f of the operation part 5f is pressed down by the wire 91 as illustrated in Figs. 21 and 22, the lower portion of the operation-part main body 50f is slightly moved (i.e., bent) toward the right in Fig. 22 and separated from the movable portion 43 of the elastic member 4 while compressing the spring portion 59f. Alternatively, the frictional force acting between the operation-part main body 50f and the movable portion 43 decreases while the operation-part main body 50f and the movable portion 43 are in contact with each other. As a result, the movable portion 43 is moved diagonally upward toward the right in the drawings by the restoring force of the elastic member 4 and clamps the wire 91 between the terminal part 3 and itself as illustrated in Fig. 23.

[0085] In the connector 1f, when the wire 91 is inserted between the terminal part 3 and the elastic member 4 in the non-connected state, a force is transmitted directly from the wire 91 to the operation part 5f so as to move the operation part 5f and to cause the elastic member 4 to transition from the non-connected state to the connected state. This facilitates connecting the wire 91 to the connector 1f in the same manner as in the connector 1 illustrated in Fig. 1. As a result, it is possible to reduce time and effort required for the operation of connecting the wire 91 to the connector 1f.

[0086] The above-described connectors 1 and 1a to 1f may be modified in various ways.

[0087] For example, it is preferable in the connector 1 that the surfaces of each operation part 5 located in the first, second, or third position are located inside the case 2 and inward of the areas of the surfaces of the case 2 that are around the operation part 5, or located in approximately the same plane as the areas. Alternatively, part of the operation part 5 located in the first, second, or third position may protrude outward from the surface of the case 2. As another alternative, the operation part 5 may be connected to the elastic member 4 while in contact with the elastic member 4.

[0088] For example, the connector 1 may include an identifier having a different structure from that illustrated in Fig. 8, as the identifier that enables visual recognition of whether the operation parts 5 maintain the non-connected state of the elastic members 4. For example, the color of the inner faces of the upper end portions of the travel paths 24 illustrated in Fig. 5 may be different from the color of the upper faces 511 of the operation parts 5 and the color of the upper face 25 of the case 2. In this case, if an operation part 5 is located in the third position as illustrated on the left side in Fig. 5, the color of the inner surface of the travel path 24 can hardly be recognized visually from the upper face 25 of the case 2. On the other hand, if an operation part 5 is located in the second position and maintains the non-connected state as illustrated on the right side in Fig. 5, the color of the inner surface of the travel path 24 can be easily recognized visually. In this case, the upper end portion of the travel path 24 serves as the aforementioned identifier.

[0089] In the example illustrated in Fig. 24, portions 28 of the case 2 on the upper side of the recesses 242 of the travel path 24 are made of a transparent or semi-transparent material (e.g., transparent resin). This portion 28 (hereinafter, referred to as "light-transmitting portion 28") opposes the upper end portion 51 of the operation part 5 located in the third position in the right-left direction as illustrated on the left side in Fig. 24. This enables the operator to visually recognize the upper end portion 51 of the operation part 5 located in the third position through the light-transmitting part 28. On the other hand, when the operation part 5 is located in the second position as illustrated on the right side in Fig. 24, the

upper end portion 51 of the operation part 5 is located below the light transmitting part 28. Thus, the operator can hardly visually recognize the upper end portion 51 of the operation part 5 through the light transmitting part 28.

[0090] That is, in the example illustrated in Fig. 24, in the case where the operator can hardly visually recognize the upper end portion 51 of an operation part 5, it is determined that the elastic member 4 is maintained in the non-connected state. On the other hand, in the case where the operator can easily visually recognize the upper end portion 51 of an operation part 5 through the light transmitting part 28, it is determined that the elastic member 4 is not in the non-connected state (i.e., the elastic member 4 is either in the insertion-hole closed state or the connected state). In the example illustrated in Fig. 24, the light transmitting parts 28 and the upper end portions 51 of the operation parts 5 serve as the aforementioned identifier. Faces of the upper end portions 51 of the operation parts 5 that oppose the light transmitting parts 28 in the right-left direction are preferably colored with a different color from surrounding colors (e.g., the color of the inner faces of the upper portions of the travel paths 24) in order to facilitate visual recognition through the light transmitting parts 28.

[0091] In the example illustrated in Fig. 25, rotary members 71 are provided that rotate along with the movement of the operation parts 5 in the up-down direction. The rotary members 71 are, for example, generally rod-like members that extend approximately in the right-left direction. The central portions of the rotary members 71 in the right-left direction are rotatably connected to supports 29 provided in the case 2. The supports 29 are located above the recesses 242 of the travel path 24 and inward of the upper end portions 51 of the operation parts 5 in the right-left direction. The supports 29 are, for example, generally columnar portions that extend in the thickness direction. The rotary members 71 are rotatable about the supports 29 approximately in parallel with planes perpendicular to the thickness direction. One ends 72 of the rotary members 71 in the right-left direction are rotatably connected to the upper end portions 51 of the operation parts 5.

[0092] When an operation part 5 is located in the third position as illustrated on the left side in Fig. 25, the end 72 (hereinafter, referred to as a "connection end 72") of the rotary member 71 on the side closer to the operation part 5 is located above the support 29. The other end 73 (hereinafter, referred to as a "free end 73") of the rotary member 71 is located below the support 29 and protrudes diagonally downward from the case 2. On the other hand, when an operation part 5 is located in the second position and maintains the non-connected state as illustrated on the right side in Fig. 25, the connection end 72 of the rotary member 71 is located below the support 29. The free end 73 of the rotary member 71 is located above the support 29 and protrudes diagonally upward from the case 2. Therefore, when an operator views the connector 1 in the thickness direction and if the free end 73 of a rotary member 71 protrudes diagonally upward from the case 2, it is determined that the elastic member 4 is maintained in the non-connected state. In the example illustrated in Fig. 25, the free ends 73 of the rotary members 71 serve as the aforementioned identifier.

[0093] The positions of the aforementioned supports 29 and the connecting positions of the operation parts 5 and the connection ends 72 of the rotary members 71 may be approximately changed. For example, as illustrated on the left side in Fig. 26, the support 29 may be disposed at positions overlapping in the thickness direction with the upper end portion 51 of the operation part 5 located in the third position. In this case, the connection end 72 of the rotary member 71 is located above the support 29. The free end 73 of the rotary member 71 is located below the support 29 and overlaps with the case 2 in the thickness direction. Thus, when the operator views the connector 1 in the thickness direction, the free end 73 of the rotary member 71 cannot be recognized visually. On the other hand, when the operation part 5 is located in the second position and maintains the non-connected state as illustrated on the right side in Fig. 26, the connection end 72 of the rotary member 71 is located below the support 29. The free end 73 of the rotary member 71 is located above the support 29 and above the upper face 25 of the case 2. In other words, the rotary member 71 protrudes above from the upper face 25 of the case 2. Accordingly, when the operator views the connector 1 in the thickness direction, the free end 73 of the rotary member 71 can be easily recognized visually. That is, in the example illustrated in Fig. 26, in the case where the operator views the connector 1 in the thickness direction and can visually recognize the free end 73 of a rotary member 71, it is determined that the elastic member 4 is maintained in the non-connected state. In the example illustrated in Fig. 26 as well, the free ends 73 of the rotary members 71 serve as the aforementioned identifier.

[0094] In the connectors 1 and 1a to 1f, the elastic member 4 transitions from the non-connected state to the connected state as a result of the releasing part or the operation part being pressed by the tip portion of the wire 91, but the present invention is not limited to this example. For example, the releasing part or the operation part may be pushed and moved sideways by the wire 91 inserted into the insertion hole 21 when the wire 91 is contoured and the tip portion of the wire 91 is moved sideways. As a result, a force for bending the elastic member 4 is eliminated, and the elastic member 4 transitions from the non-connected state to the connected state.

[0095] Alternatively, the releasing part or the operation part may be pulled by the wire 91 inserted between the terminal part 3 and the elastic member 4. As a result, the force for bending the elastic member 4 is eliminated, and the elastic member 4 transitions from the non-connected state to the connected state. As another alternative, the releasing part or the operation part may be rotated when the wire 91 is inserted between the terminal part 3 and the elastic member 4 is run over the side portion of the releasing part or the operation part. As a result, the force for bending the elastic member

4 is eliminated, and the elastic member 4 transitions from the non-connected state to the connected state.

[0096] The connectors 1 and 1a to 1f described above may be used to connect wire to various devices. For example, the connectors 1 and 1a to 1f may be used in device such as relay socket or operation switch.

[0097] The configurations of the above-described preferred embodiments and variations may be appropriately combined as long as there are no mutual inconsistencies.

[0098] While the invention has been shown and described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is therefore to be understood that numerous modifications and variations can be devised without departing from the scope of the invention.

Reference Signs List

[0099]

1, 1a to 1f	Connector
2	Case
3	Terminal part
4	Elastic member
5, 5c, 5d, 5e, 5f	Operation part
6, 6a, 6b, 6c, 6e	Releasing part
24	Travel path
25	Upper face (of the case)
26	Side face (of the case)
61, 61b, 61c	First contact portion
62, 62c	Second contact portion
63, 63b, 63c, 63e	Support portion
65	Upper end portion (of the releasing part)
71	Rotary member
73	Free end (of the rotary member)
91	Wire
241, 241d, 241e	Stepped portion
511	Upper face (of the operation part)
513	Side face (of the operation part)

Claims

1. A connector to which a wire is connected, comprising:

a case;
 a conductive terminal part fixed to the case;
 an elastic member that is mounted on the case and presses a wire against and clamps the wire to the terminal part by restoring force of the elastic member; and
 a state maintaining part that comes in contact with the elastic member and maintains a non-connected state of the elastic member in which the elastic member is bent more than in its connected state in which the elastic member clamps the wire,
 wherein when the wire is inserted between the terminal part and the elastic member in the non-connected state, a force is transmitted directly or indirectly from the wire to the state maintaining part to move the state maintaining part and to cause the elastic member to transition from the non-connected state to the connected state.

2. The connector according to claim 1, wherein
 the state maintaining part is locked to a stepped portion of the case while in contact with the elastic member in the non-connected state to maintain the non-connected state of the elastic member.

3. The connector according to claim 2, further comprising:
 a state releasing part that, when the wire is inserted between the terminal part and the elastic member in the non-connected state, transmits a force from the wire to release the lock of the state maintaining part to the case.

4. The connector according to claim 3, wherein

the state releasing part includes:

a support portion rotatably mounted on the case;
a first contact portion that comes in contact with the wire; and
a second contact portion that comes in contact with the state maintaining part, and
when the wire is inserted, the first contact portion is pressed down to rotate the state releasing part about the
support portion, and the second contact portion moves the state maintaining part in a direction away from the
stepped portion.

5. The connector according to any one of claims 1 to 4, wherein
the state maintaining part is movable on a travel path provided in the case between a first position in which the state
maintaining part comes in contact with the elastic member in the connected state and a second position in which
the state maintaining part comes in contact with the elastic member in the non-connected state, and
a surface of the state maintaining part located in the first position is located inside the case and inward of an area
of a surface of the case that is around the state maintaining part, or located in the same plane as the area.
6. The connector according to any one of claims 1 to 5, comprising:
an identifier that enables visual recognition of whether the state maintaining part maintains the non-connected state
of the elastic member.
7. The connector according to any one of claims 1 to 6, wherein
the elastic member is a flat spring.

FIG. 1

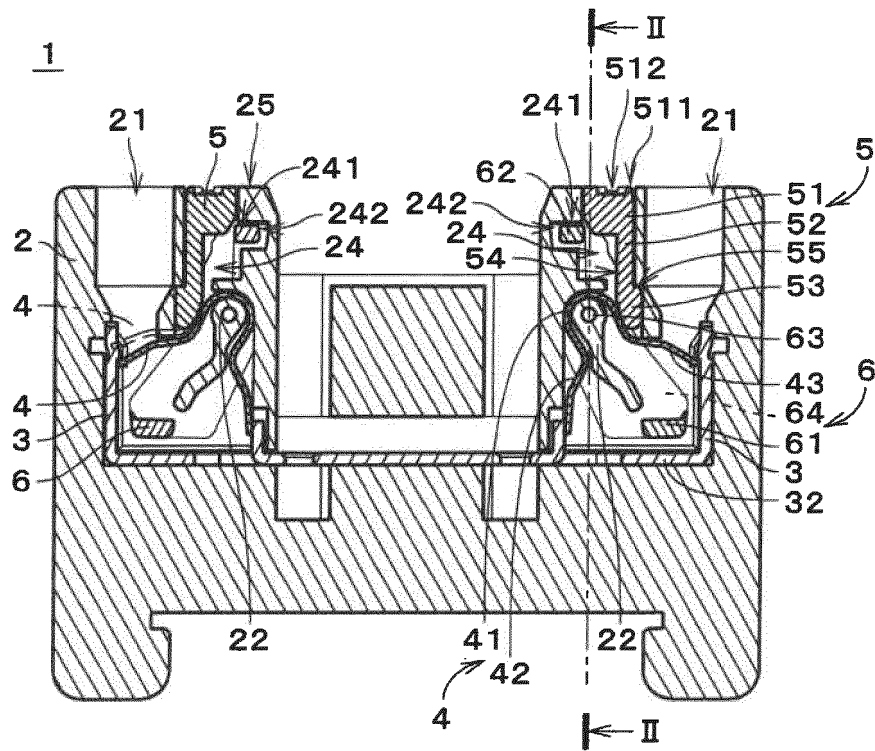


FIG. 2

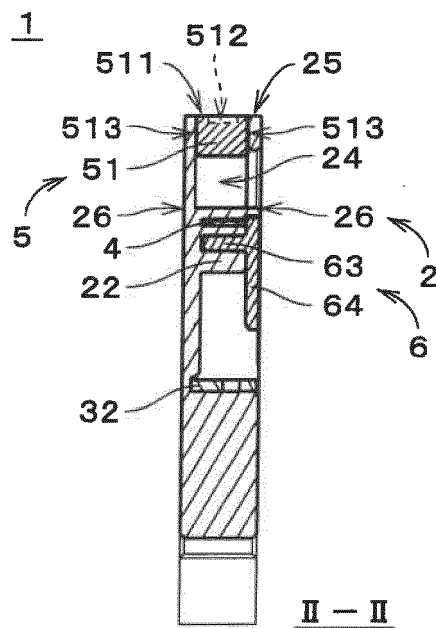


FIG. 3

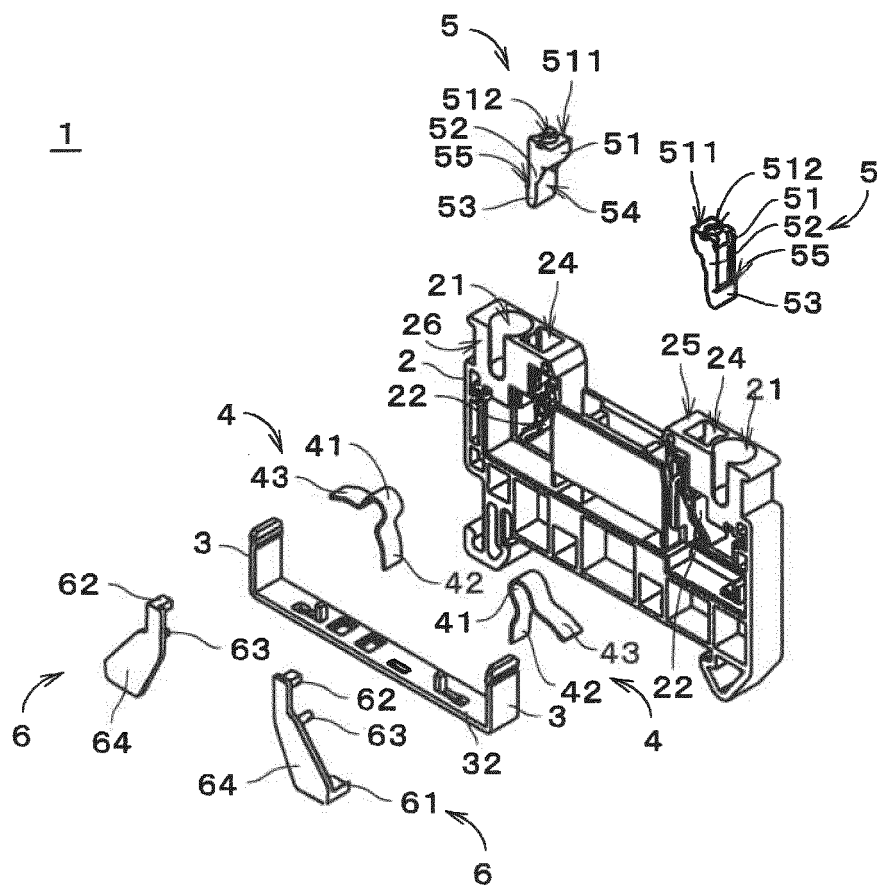


FIG. 4

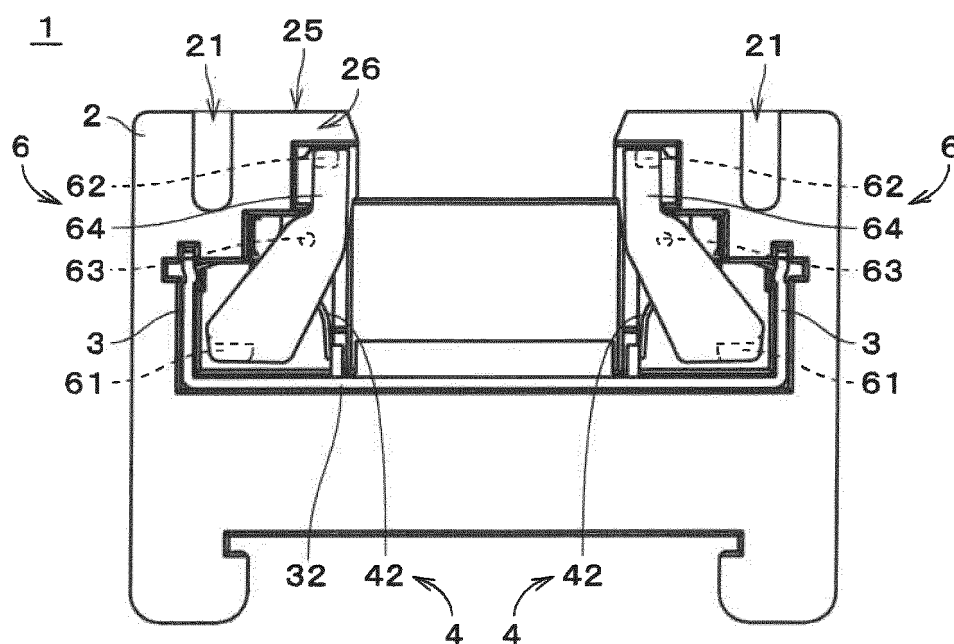


FIG. 5

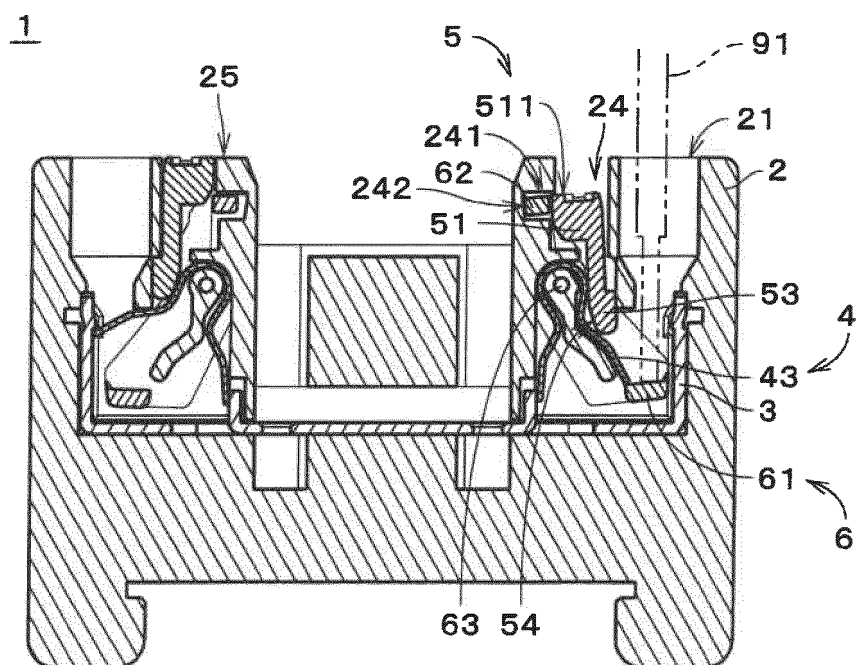


FIG. 6

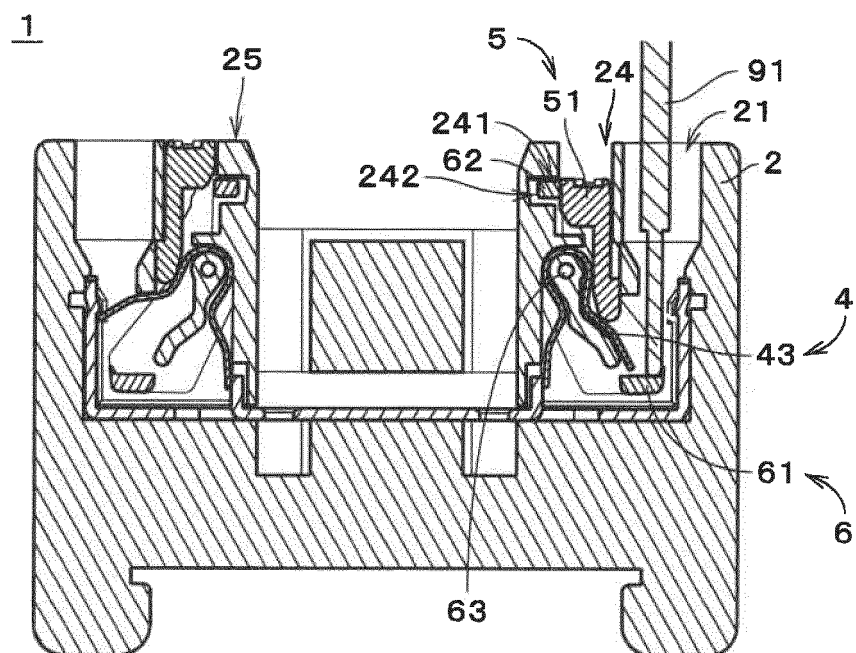


FIG. 7

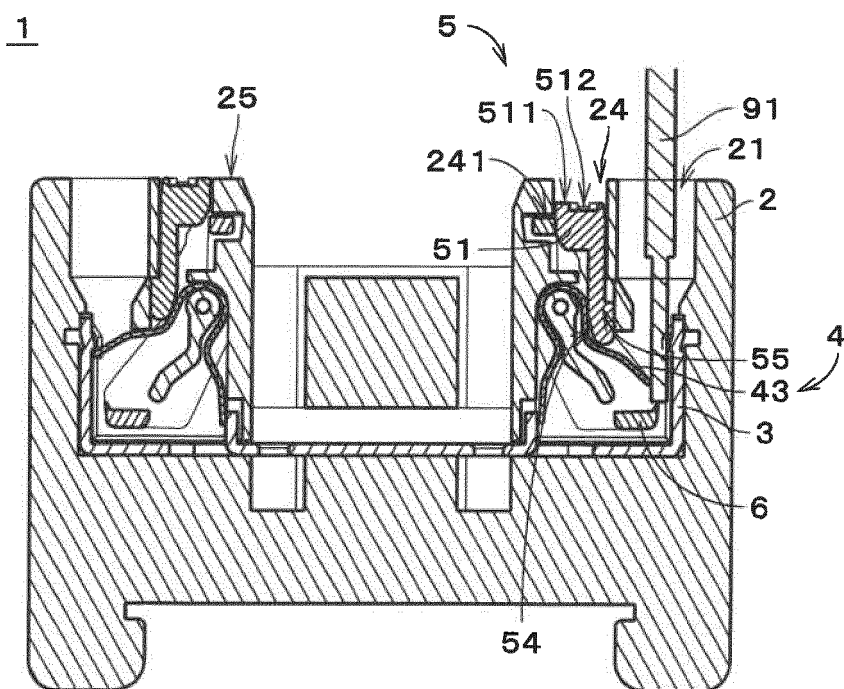


FIG. 8

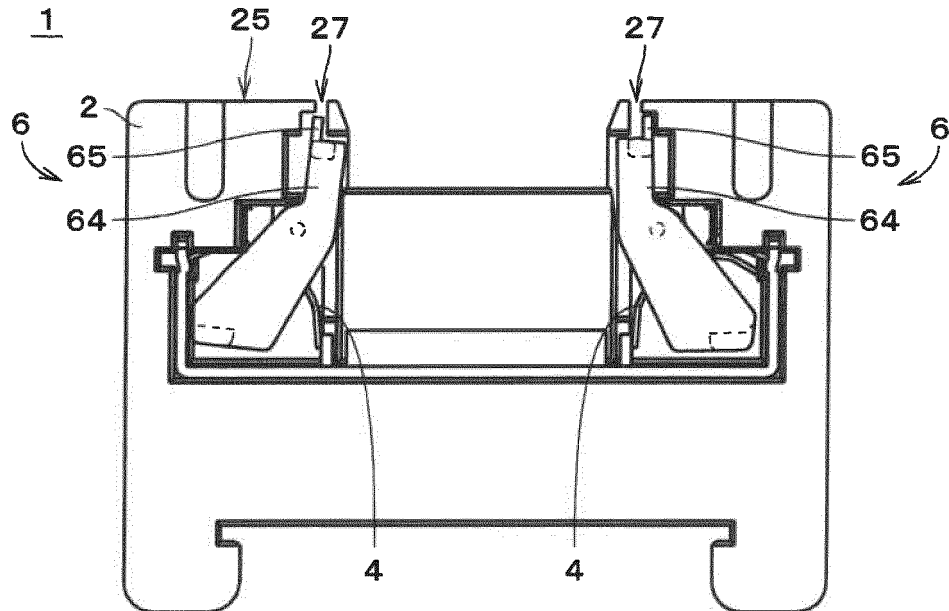


FIG. 9

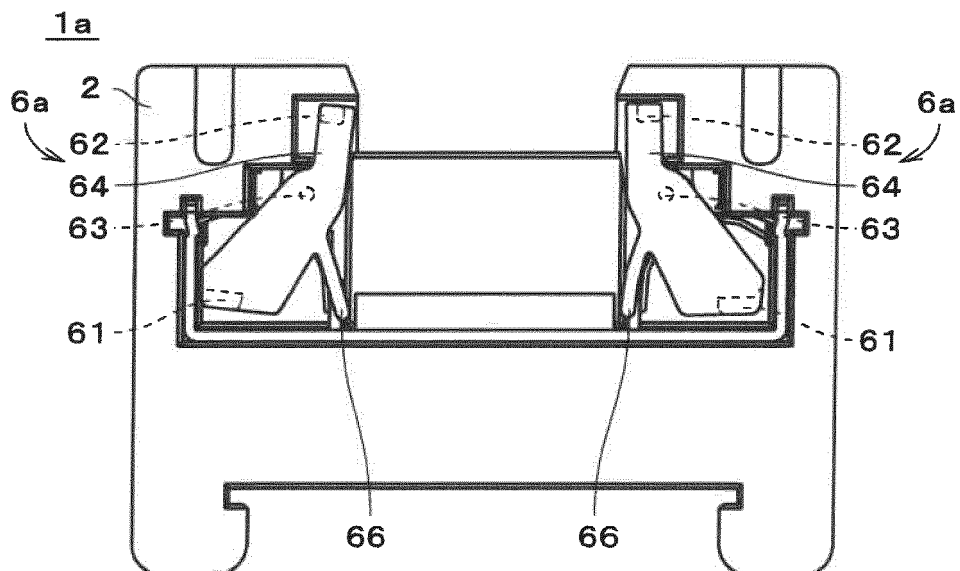


FIG. 10

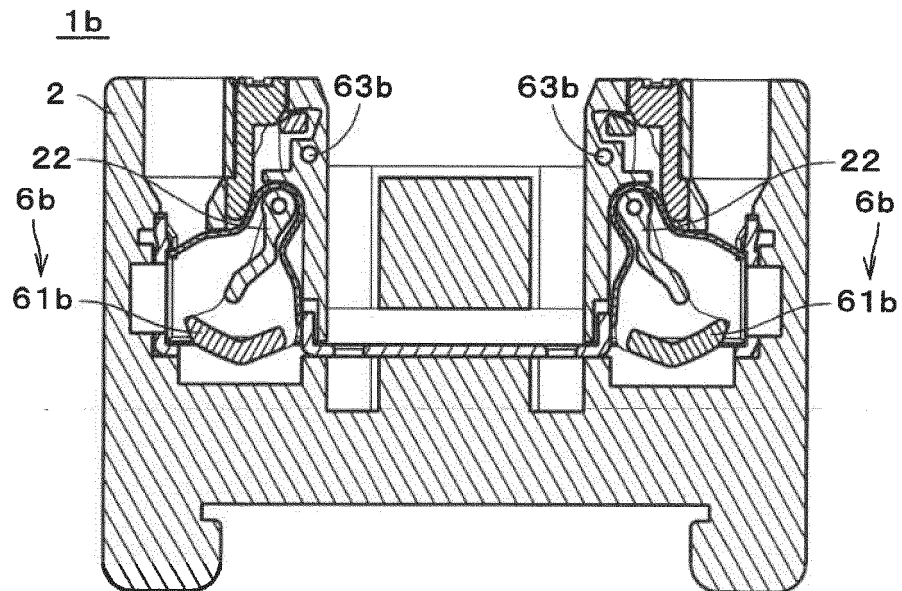


FIG. 11

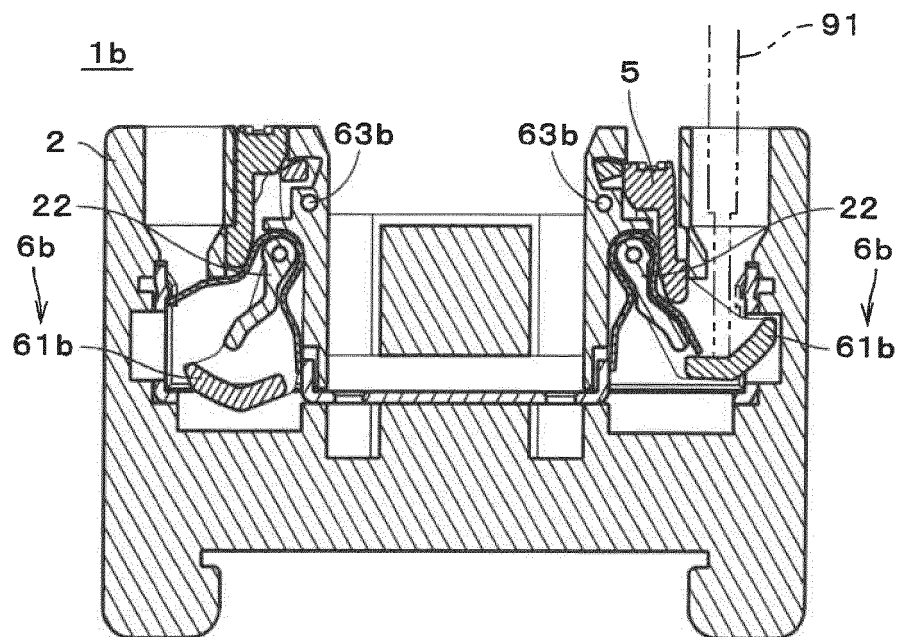


FIG. 12

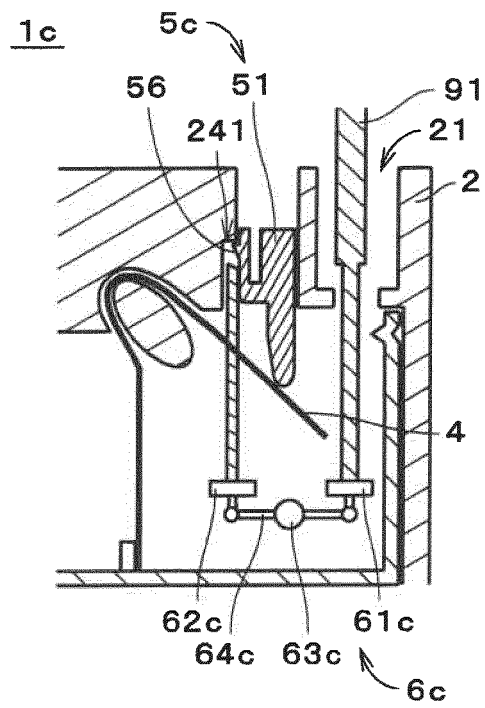


FIG. 13

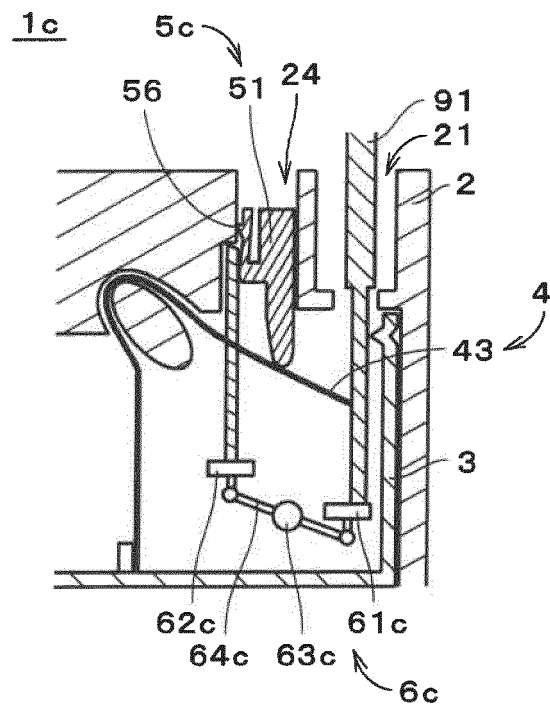


FIG. 14

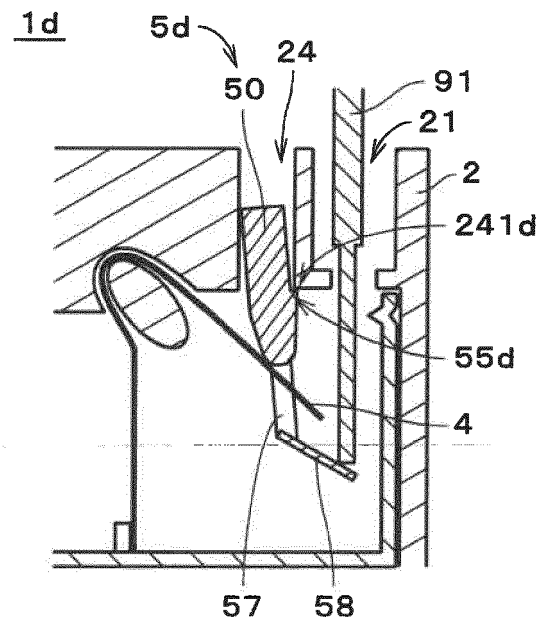


FIG. 15

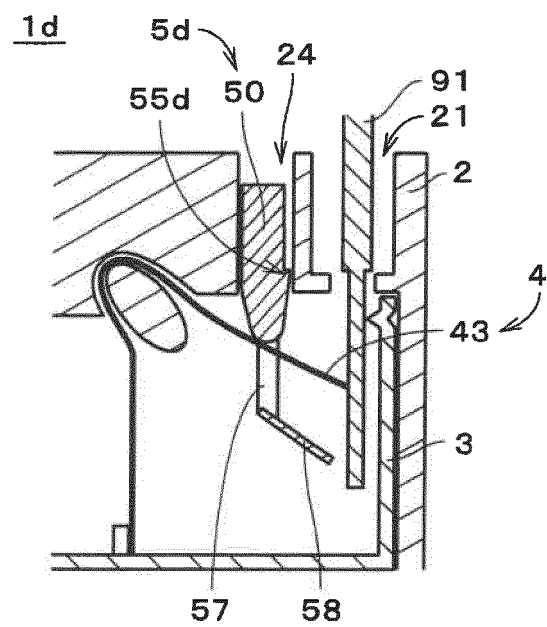


FIG. 16

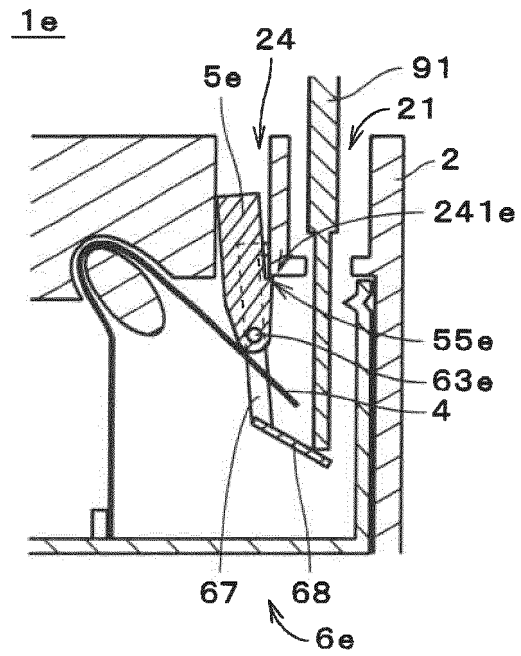


FIG. 17

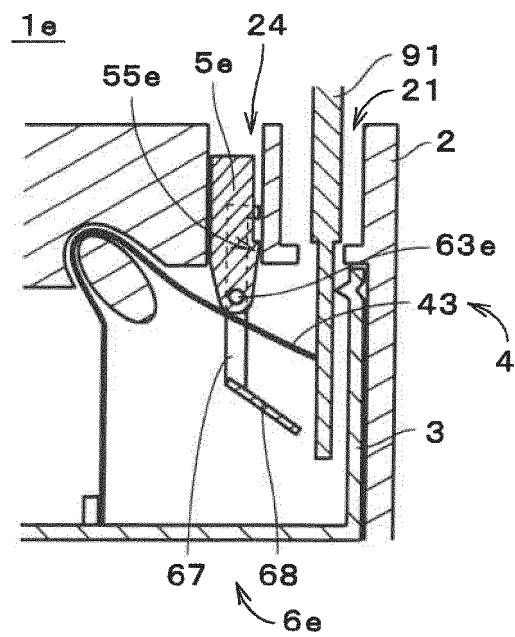


FIG. 18

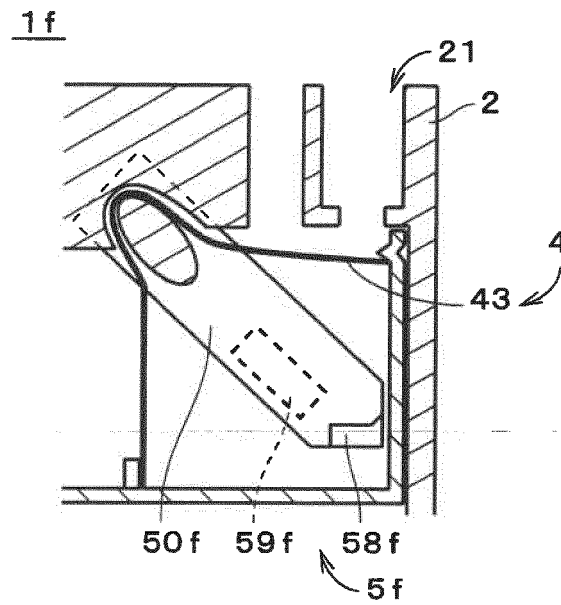


FIG. 19

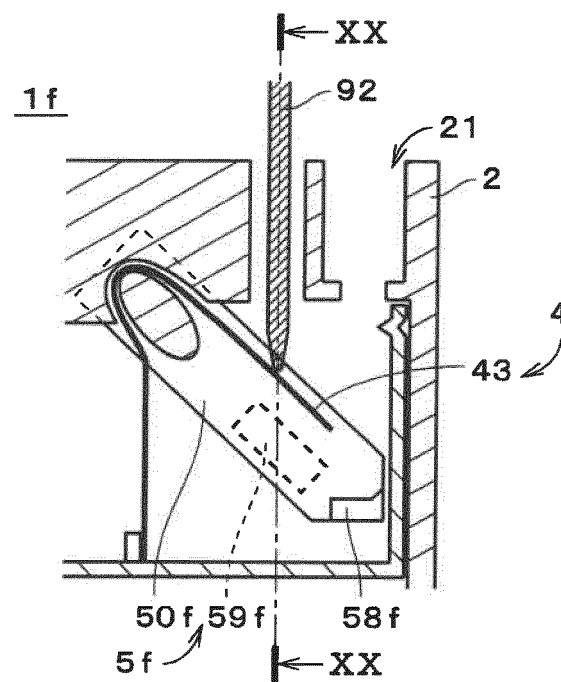


FIG. 20

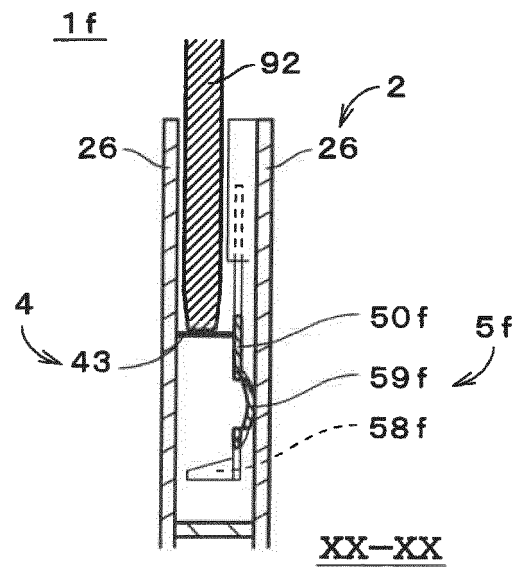


FIG. 21

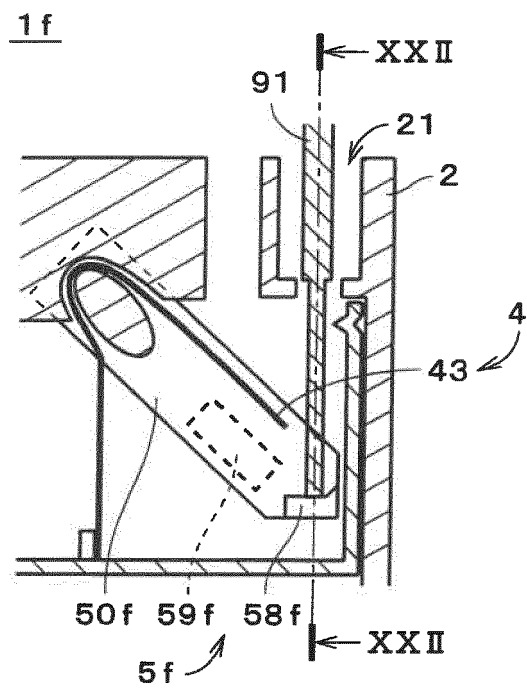


FIG. 22

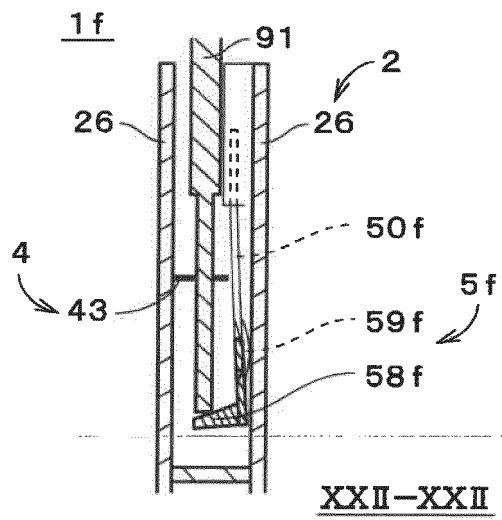


FIG. 23

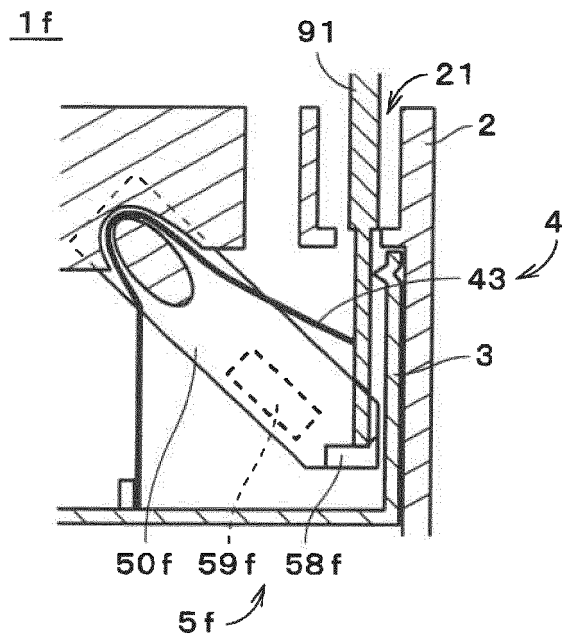


FIG. 24

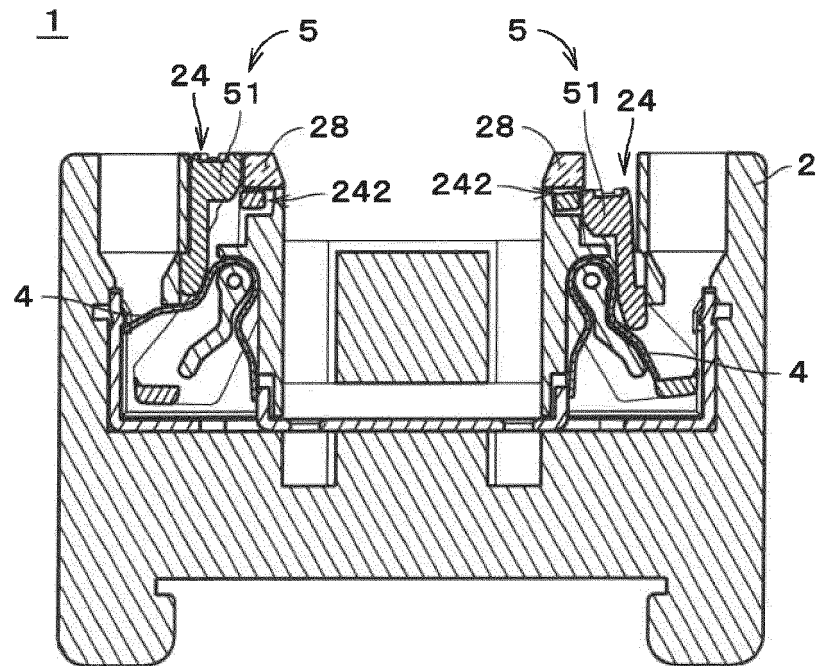


FIG. 25

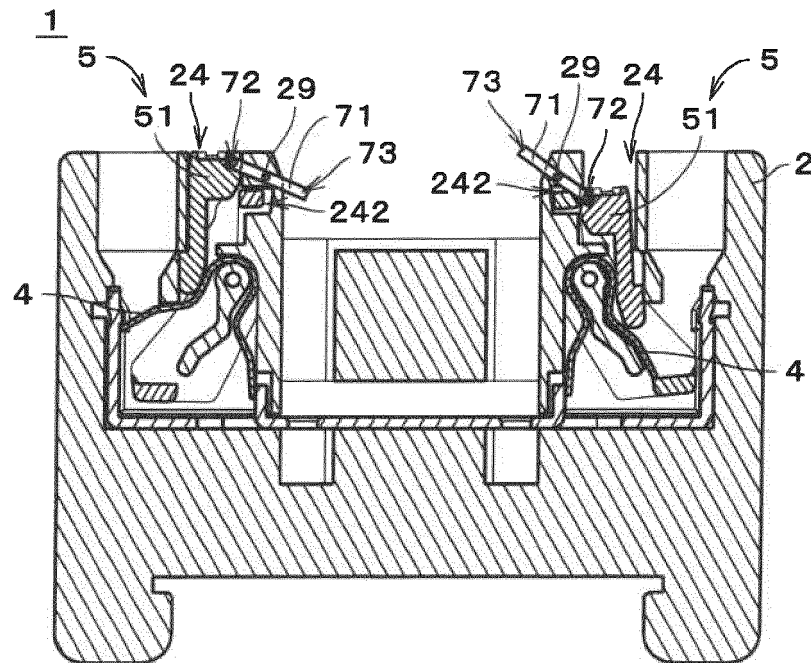
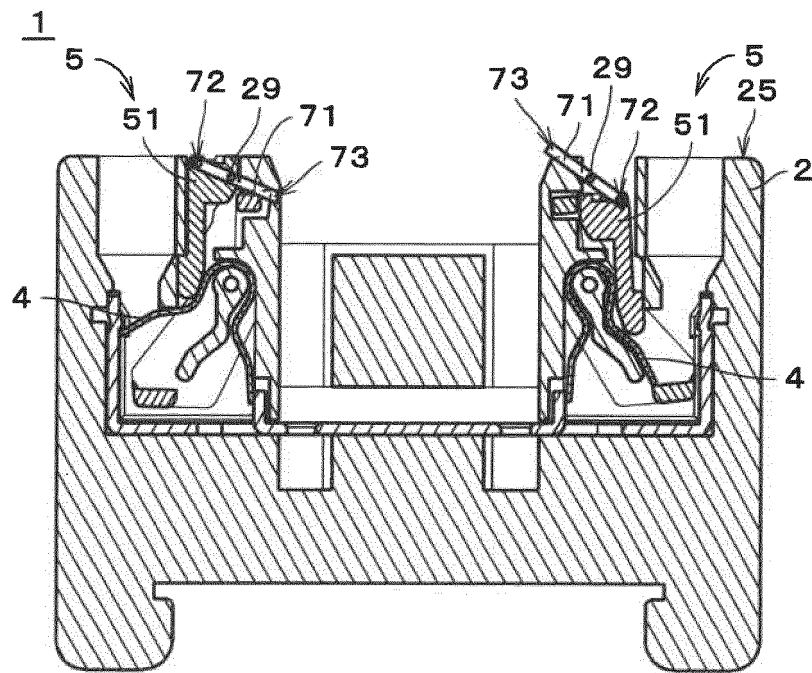


FIG. 26



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/019611

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. H01R4/48 (2006.01) i, H01R13/627 (2006.01) i

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)

Int.Cl. H01R4/48, H01R13/627

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 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

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 2006-019181 A (MATSUSHITA ELECTRIC WORKS, LTD.)	1, 5-7
A	19 January 2006, paragraphs [0039]-[0056], fig. 1-16 (Family: none)	2-4
A	JP 2005-293869 A (KYOKUTO ELECTRIC CO., LTD.) 20 October 2005, paragraphs [0020]-[0039], fig. 1-2 (Family: none)	1-7
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 030146/1992 (Laid-open No. 090822/1993) (MATSUSHITA ELECTRIC WORKS, LTD.) 10 December 1993 (Family: none)	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search
13 July 2018 (13.07.2018)Date of mailing of the international search report
31 July 2018 (31.07.2018)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/019611

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 10-050366 A (MATSUSHITA ELECTRIC WORKS, LTD.) 20 February 1998 (Family: none)	1-7

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4202125 B [0003]
- JP 3357245 B [0004]