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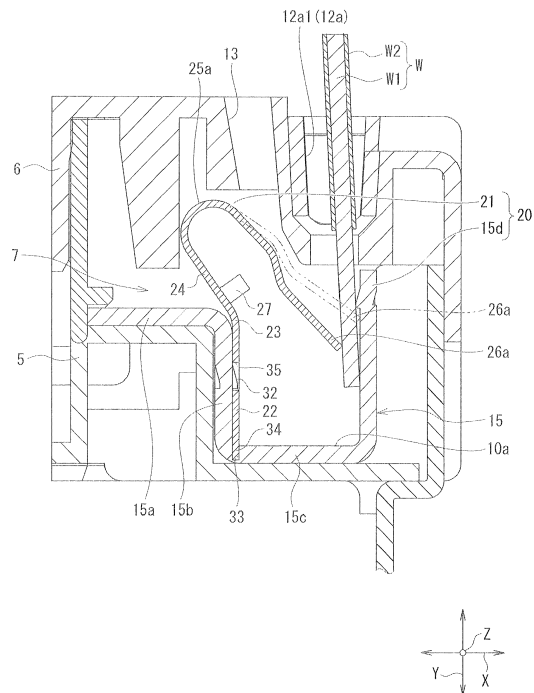
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(54) **CONNECTION STRUCTURE OF ELECTRICAL EQUIPMENT**

(57) Provided is a connection structure of electrical equipment configured to enable improvement in durability of a plate spring while reducing manufacturing cost by reducing the number of components and reducing the number of assembly steps. A plate spring 21 includes a fixed portion 22, an electrical wire retaining portion 26 continuing from a circular arc-shaped circular arc bent portion 25 provided between the fixed portion and the electrical wire retaining portion, and plastic deformation preventing portions 27 extending from the fixed portion toward the electrical wire retaining portion. The plate spring is arranged in an electrical wire insertion space 10a such that the fixed portion is fixed to a fixed contact 15 at a position facing a contact point portion 15d, the circular arc bent portion is arranged to protrude in a direction away from the contact point portion, and the electrical wire retaining portion traverses near an opening portion of an electrical wire insertion inlet 12a to allow a leading end of the electrical wire retaining portion to extend toward the contact point portion. When the electrical wire retaining portion is moved in the direction away from the contact point portion by a tool S inserted from a tool insertion hole 13, the electrical wire retaining portion abuts with the plastic deformation preventing portion to prevent plastic deformation of the circular arc bent portion.

FIG. 5



Description

Technical Field

[0001] The present invention relates to connection structures of electrical equipment by which an electrical wire to be connected to an electromagnetic contactor or the like is elastically retained.

Background Art

[0002] PTL 1 is one example of the connection structures of electrical equipment by which an electrical wire is elastically retained and connected.

[0003] The connection structure of electrical equipment disclosed in PTL 1 includes a case formed with electrical wire insertion inlets and tool insertion holes communicating with electrical wire insertion spaces inside the case. Additionally, inside the case are provided terminal devices, plate springs, and plastic deformation preventing members (referred to as ribs in PTL 1) for preventing plastic deformation of the plate springs.

[0004] Each plate spring includes a base portion and a tabular electrical wire retaining portion (referred to as plate spring portion in PTL 1) formed from the base portion via a curved portion therebetween, in which the electrical wire retaining portion traverses near an opening portion of the electrical wire insertion inlet inside the case, and a leading end of the electrical wire retaining portion is arranged facing the terminal device.

[0005] When an electrical wire inserted from one of the electrical wire insertion inlets enters between the leading end of the electrical wire retaining portion and the terminal device, the leading end of the electrical wire retaining portion presses the electrical wire against the terminal device side by elastic force of the curved portion to elastically retain the electrical wire.

[0006] In addition, when a tool inserted from the corresponding one of the tool insertion holes is brought into contact with the electrical wire retaining portion to deform the curved portion such that the electrical wire retaining portion moves to the base portion side, retention of the electrical wire between the leading end of the electrical wire retaining portion and the terminal device is released, whereby the electrical wire can be pulled out.

[0007] Herein, to prevent plastic deformation of the curved portion of the plate spring due to excessive deformation when pulling out the electrical wire by using a tool such as a flathead screwdriver, the electrical wire retaining portion is adapted to abut with the plastic deformation preventing members arranged inside the case in a region where the curved portion of the plate spring elastically deforms.

Citation List

Patent Literature

5 **[0008]** PTL 1: JP 2018-56077 A

Summary of Invention

Technical Problem

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[0009] As described above, in the connection structure of electrical equipment disclosed in PTL 1, the plastic deformation preventing members are arranged inside the case to prevent plastic deformation of the curved portion of the plate spring, thereby improving durability of the plate spring. However, arranging the plastic deformation preventing members increases the number of components in electrical equipment, and also increases the number of assembly steps, which may increase manufacturing cost.

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[0010] Accordingly, it is an object of the present invention to provide a connection structure of electrical equipment that enables improvement in durability of a plate spring while achieving reduction of manufacturing cost by reducing the number of components and reducing the number of assembly steps.

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Solution to Problem

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[0011] To achieve the above object, a connection structure of electrical equipment according to one aspect of the present invention includes a case including an electrical wire insertion space inside the case, an electrical wire insertion inlet included in the case to insert an electrical wire into the electrical wire insertion space from outside through the inlet, a tool insertion hole included in the case to insert a tool into the electrical wire insertion space from outside through the hole, a fixed contact including a contact point portion arranged along a direction in which the electrical wire is inserted in the electrical wire insertion space, the electrical wire being electrically connected to the contact point portion, and a plate spring arranged in the electrical wire insertion space and configured to press the electrical wire inserted through the electrical wire insertion inlet against the contact point portion by elastic force. Additionally, the plate spring includes a tabular fixed portion to be fixed to the fixed contact, a tabular electrical wire retaining portion continuing from a circular arc-shaped circular arc bent portion provided between the fixed portion and the electrical wire retaining portion, and a plastic deformation preventing portion extending from the fixed portion toward the electrical wire retaining portion. Then, the plate spring is configured such that when the tool inserted through the tool insertion hole contacts with the electrical wire retaining portion, and moves the electrical wire retaining portion in a direction away from the contact point portion, the electrical wire retaining portion abuts with the plastic de-

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formation preventing portion to prevent plastic deformation of the circular arc bent portion.

Advantageous Effects of Invention

[0012] The connection structure of electrical equipment according to the present invention enables improvement in durability of a plate spring while achieving reduction of manufacturing cost by reducing the number of components and reducing the number of assembly steps.

Brief Description of Drawings

[0013]

FIG. 1 is a perspective view illustrating an electromagnetic contactor according to the present invention;

FIG. 2 is a plan view illustrating the electromagnetic contactor according to the present invention;

FIG. 3 is a plan view of the electromagnetic contactor according to the present invention, in which a case cover body thereof is removed;

FIG. 4 is a diagram taken along arrow line II-II of FIG. 2 including a connection structure of a first embodiment according to the present invention;

FIG. 5 is a diagram illustrating a state where an electrical wire is elastically retained in the connection structure of the first embodiment;

FIGS. 6A and 6B are diagrams illustrating a plate spring included in the connection structure of the first embodiment;

FIG. 7 is a diagram illustrating a state where elastic retention of the electrical wire is released by using a tool in the connection structure of the first embodiment;

FIG. 8 is a diagram illustrating a plate spring of a second embodiment; and

FIG. 9 is a diagram illustrating a plate spring of a third embodiment.

Description of Embodiments

[0014] Next, the first through third embodiments of the present invention will be described with reference to the drawings. In the following description of the drawings, the same or similar portions are denoted by the same or similar reference signs. However, it should be noted that the drawings are schematic, and the relationships between thickness and planar dimensions, the thickness ratios between respective layers, and the like are different from actual ones. Thus, specific thicknesses and dimensions should be determined in consideration of the following description. Moreover, it is obvious that there are some differences in mutual dimensional relationships and ratios between the drawings.

[0015] In addition, the first through third embodiments

depicted below exemplify devices and methods for embodying the technological idea of the present invention, in which the technological idea of the invention does not specify the materials, shapes, structures, arrangements, and the like of components to those described below. Various modifications can be made to the technological idea of the present invention without departing from the technological scope prescribed by the claims.

[Structure of Electromagnetic Contactor of First Embodiment]

[0016] FIGS. 1 to 7 illustrate an electromagnetic contactor 1 according to the present invention configured to open and close a current path between a power source and a load. Note that, in FIGS. 1 to 5 and FIG. 7, sign X represents a first direction, sign Y represents a second direction orthogonal to the first direction X, and sign Z represents a third direction orthogonal to a virtual plane including the first direction X and the second direction Y.

[0017] The electromagnetic contactor 1 includes a case 2 (see FIG. 1), a contact point mechanism 3 (see FIG. 3) housed in the case 2, and an electromagnet unit 4 (see FIG. 4) housed in the case 2 and configured to drive the contact point mechanism 3.

[0018] The case 2 includes a case main body 5 having a bottomed rectangular parallelepiped shape and including an opening portion formed on one side of the third direction Z and a case cover body 6 detachably mounted on the case main body 5 while covering the opening portion, as illustrated in FIG. 1 and FIG. 4.

[0019] As illustrated in FIG. 4, in a central region of the case main body 5 are formed a contact point mechanism housing portion 7 configured to house the contact point mechanism 3 and an electromagnet unit housing portion 8. The contact point mechanism housing portion 7 houses the contact point mechanism 3, and the electromagnet unit housing portion 8 houses the electromagnet unit 4.

[0020] As illustrated in FIG. 3, on both sides of the first direction X of the case main body 5 with the contact point mechanism housing portion 7 therebetween are formed a plurality of pairs of electrical wire insertion spaces 10a to 10e, and partition walls 11 are provided between the adjacent electrical wire insertion spaces 10a to 10e.

[0021] Additionally, as illustrated in FIG. 4, on a front plate 6a of the case cover body 6 are provided a pair of electrical wire insertion inlets 12a configured to communicate with a pair of electrical wire insertion spaces 10a.

[0022] The pair of electrical wire insertion inlets 12a each includes two electrical wire insertion inlets 12a1 and 12a2 for each of the electrical wire insertion spaces 10a, as illustrated in FIG. 2.

[0023] In addition, on the front plate 6a of the case cover body 6 are formed a plurality of pairs of electrical wire insertion inlets 12b to 12e aligned in the second direction Y with respect to the pair of electrical wire insertion inlets 12a. The plurality of pairs of electrical wire insertion inlets 12b to 12e allow for communication be-

tween an outside of the case cover body 6 and the plurality of pairs of electrical wire insertion spaces 10b to 10e. The plurality of pairs of electrical wire insertion inlets 12b to 12e also include each two electrical wire insertion inlets for the electrical wire insertion spaces 10b to 10e.

[0024] In the electromagnetic contactor 1 of the first embodiment, among the plurality of pairs of electrical wire insertion inlets 12a to 12e, six pairs of electrical wire insertion inlets 12a to 12c are used for main circuit terminals, a pair of electrical wire insertion inlets 12d are used for auxiliary terminals, and a pair of electrical wire insertion inlets 12e are used for coil terminals of the electromagnet unit 4.

[0025] Additionally, as illustrated in FIGS. 1, 2, and 4, insertion holes 13 are formed on the front plate 6a of the case cover body 6 to insert a tool S, which will be described later. The insertion holes 13 communicate with the electrical wire insertion spaces 10a to 10e near the plurality of pairs of electrical wire insertion inlets 12b to 12e. The insertion holes 13 are formed corresponding to each two electrical wire insertion inlets of the plurality of pairs of electrical wire insertion inlets 12a to 12e.

[0026] On the other hand, the contact point mechanism 3 includes a plurality of pairs of fixed contacts 15 spaced apart from each other in the first direction X and fixed to the case main body 5 and a plurality of movable contacts 16 contactable with and separable from each pair of fixed contacts 15, as illustrated in FIG. 3.

[0027] The plurality of movable contacts 16 are fixed to a movable contact support member 17 extending in an elongated manner in the second direction Y at a predetermined interval along the first direction X. When a coil of the electromagnet unit 4 is excited, the movable contact support member 17 moves to a downward direction in FIG. 3 in the second direction Y via an unillustrated drive lever, whereby each of the plurality of movable contacts 16 fixed to the movable contact support member 17 contacts with each pair of fixed contacts 15. As a result, the fixed contacts 15 on one side of the first direction X are electrically conducted with the fixed contacts 15 on the other side of the first direction X via the movable contacts 16, whereby the current path is closed.

[0028] On the other hand, when the coil of the electromagnet unit 4 goes into a non-excited state, the movable contact support member 17 moves to an upward direction in FIG. 3 in the second direction Y due to action of an unillustrated return spring, whereby each of the plurality of movable contacts 16 fixed to the movable contact support member 17 is separated from each pair of fixed contacts 15. As a result, the fixed contacts 15 on the one side of the first direction X are disconnected from the fixed contacts 15 on the other side thereof.

[0029] As illustrated in FIG. 4, in each of the pair of electrical wire insertion spaces 10a provided in the case main body 5 is arranged a spring terminal 20 configured to connect an electrical wire W, which will be described later, to the fixed contact 15.

[0030] In each of the other plurality of pairs of electrical

wire insertion spaces 10b to 10e as well is arranged a spring terminal 20 having the same structure as the spring terminal 20 configured to connect the electrical wire W arranged in each of the pair of electrical wire insertion spaces 10a of FIG. 4 to the fixed contact 15.

[0031] As illustrated in FIG. 5, the electrical wire W includes a core wire W1 formed using multiple metal wires and an insulative coating W2 coating an outer periphery of the core wire W1. When connecting the electrical wire W to the fixed contact 15, a leading end portion of the insulative coating W2 is removed to expose only a predetermined part of the core wire W1.

[0032] The structure of the fixed contacts 15 will be described with reference to FIG. 3 and FIG. 5.

[0033] Each fixed contact 15 includes a tabular fixed contact point portion 15a with which each movable contact 16 contacts, a tabular base plate portion 15b bent in a direction extending in the third direction Z, a tabular seat plate portion 15c bent in a direction extending in the first direction X from the base plate portion 15b, and a tabular, plate spring-side contact point portion 15d bent parallel with the base plate 15b from the seat plate portion 15c in a direction extending in the third direction Z. The fixed contacts 15 are formed by punching out and bending a metal plate.

[0034] As illustrated in FIG. 3, the fixed contact 15 provided in the electrical wire insertion space 10a is fixed to the case main body 5 in such a state that the fixed contact point portion 15a is positioned in the contact point mechanism housing portion 7, and the base plate portion 15b, the seat plate portion 15c, and the plate spring-side contact point portion 15d are arranged along an inner wall of the case main body 5 forming the electrical wire insertion space 10a.

[0035] The fixed contacts 15 provided in the other plurality of pairs of electrical wire insertion spaces 10b to 10e are also fixed to the case main body 5 in such a state that the fixed contact point portion 15a is positioned in the contact point mechanism housing portion 7, and the base plate portion 15b, the seat plate portion 15c, and the plate spring-side contact point portion 15d are positioned in the electrical wire insertion spaces 10b to 10e.

[0036] As illustrated in FIG. 5, an engagement claw 32 serving as a come-off stopping portion is formed to protrude on an inner wall of the base plate portion 15b of the fixed contact 15.

[0037] A fitting hole 33 serving as a movement restraining portion is formed on the seat plate portion 15c at a position close to the base plate portion 15b of the fixed contact 15.

[0038] The above-mentioned spring terminal 20 includes a plate spring 21 and the plate spring-side contact point portion 15d of the fixed contact 15, as illustrated in FIG. 5.

[0039] As illustrated in FIG. 6A, the plate spring 21 includes a tabular fixed portion 22, a tabular first inclined portion 24 continuing from an obtuse angle-shaped obtuse angular bent portion 23 provided between a longi-

tudinal end of the fixed portion 22 and the first inclined portion 24, a tabular electrical wire retaining portion 26 extending in substantially the same direction as the first inclined portion 24 from a circular arc-shaped circular arc bent portion 25 provided between the first inclined portion 24 and the electrical wire retaining portion 26, and a pair of plastic deformation preventing portions 27 and 27 extending from both widthwise sides of the first inclined portion 24 toward the electrical wire retaining portion 26.

[0040] As illustrated in FIG. 6B, in the plate spring 21 is formed a slit 28 extending in a widthwise central portion of the electrical wire retaining portion 26, whereby the circular arc bent portion 25 is divided into two divided circular arc bent portions 25a and 25b, and the electrical wire retaining portion 26 is also divided into two divided electrical wire retaining portions 26a and 26b.

[0041] The fixed portion 22, the obtuse angular bent portion 23, the first inclined portion 24, the circular arc bent portion 25 (the divided circular arc bent portions 25a and 25b), the electrical wire retaining portion 26 (the divided electrical wire retaining portions 26a and 26b), and the pair of plastic deformation preventing portions 27 and 27 forming the plate spring 21 are formed by bending a single long metal plate.

[0042] A fitting protrusion 34 is formed at a lower end of the fixed portion 22 of the plate spring 21, and an engagement through hole 35 is formed in the fixed portion 22.

[0043] Then, as illustrated in FIG. 5, the plate spring 21 is connected to the fixed contact 15 in such a state that the fixed portion 22 of the plate spring 21 is arranged along the base plate portion 15b of the fixed contact 15 arranged in one of the pair of electrical wire insertion spaces 10a, the fitting protrusion 34 at the lower end of the fixed portion 22 is fitted into the fitting hole 33 of the base plate portion 15b, and the engagement claw 32 of the base plate portion 15b is engaged in the engagement through hole 35 of the fixed portion 22.

[0044] The plate spring 21 in the same structure is also connected to the fixed contact 15 arranged in the other one of the pair of electrical wire insertion spaces 10a, as well as the plate spring 21 in the same structure is also connected to the fixed contacts 15 arranged in the other plurality of pairs of electrical wire insertion spaces 10b to 10e.

[0045] When the case cover body 6 is mounted on the case main body 5, the divided electrical wire retaining portion 26a of the plate spring 21 arranged in each of the plurality of pairs of electrical wire insertion spaces 10a of the case main body 5 is arranged at a position facing one of the two electrical wire insertion inlets 12a1 and 12a2 forming the electrical wire insertion inlet 12a illustrated in FIG. 2. Additionally, the divided electrical wire retaining portion 26b of the plate spring 21 is arranged at a position facing the other one of the two electrical wire insertion inlets 12a1 and 12a2. In addition, at each two electrical wire insertion inlets forming each of the other plurality of pairs of electrical wire insertion inlets 12b to

12e is arranged the divided electrical wire retaining portion 26a or 26b at a position facing each inlet.

[0046] Then, as illustrated in FIG. 5, the core wire W1 of the electrical wire W inserted in the electrical wire insertion space 10a from the electrical wire insertion inlet 12a1, which is one of the electrical wire insertion inlets 12a, is elastically retained between the leading end of the divided electrical wire retaining portion 26a of the plate spring 21 and the plate spring-side contact point portion 15d of the fixed contact 15. In addition, although not illustrated, the core wire W1 of the electrical wire W inserted in the electrical wire insertion space 10a from the electrical wire insertion inlet 12a2, which is the other one of the electrical wire insertion inlets 12a, and the core wires W1 of the electrical wires W inserted in each of the other pairs of electrical wire insertion inlets 12b to 12e are also each elastically retained between the leading end of the divided electrical wire retaining portion 26b of the plate spring 21 and the plate spring-side contact point portion 15d of the fixed contact 15.

[0047] Furthermore, as illustrated in FIG. 7, when the divided electrical wire retaining portion 26a is moved in a direction away from the plate spring-side contact point portion 15d by the tool S such as a flathead screwdriver inserted into the electrical wire insertion space 10a from the insertion hole 13, the elastic retention of the core wire W1 between the plate spring-side contact point portion 15d of the fixed contact 15 and the divided electrical wire retaining portion 26a is released. The divided electrical wire retaining portion 26a moved in the direction away from the plate spring-side contact point portion 15d abuts with a leading end of the plastic deformation preventing portion 27 extending from one of both widthwise sides of the first inclined portion 24. In this manner, the divided electrical wire retaining portion 26a abutting with the plastic deformation preventing portion 27 is restrained from moving in the direction away from the plate spring-side contact point portion 15d.

[0048] Thus, abutment of the divided electrical wire retaining portion 26a with the plastic deformation preventing portion 27 restrains the divided electrical wire retaining portion 26a from moving in the direction away from the plate spring-side contact point portion 15d, thereby allowing movement of the divided electrical wire retaining portion 26a in a region where the divided circular arc bent portion 25a elastically deforms, and restraining the divided electrical wire retaining portion 26a from moving so much as to cause plastic deformation of the divided circular arc bent portion 25a, so that plastic deformation of the divided circular arc bent portion 25a is prevented.

[0049] In addition, although not illustrated, even when the divided electrical wire retaining portion 26b is moved in the direction away from the plate spring-side contact point portion 15d by using the tool S, elastic retention of the core wire W1 between the divided electrical wire retaining portion 26b and the plate spring-side contact point portion 15d is released. Then, the divided electrical wire retaining portion 26b moved in the direction away from

the plate spring-side contact point portion 15d abuts with a leading end of the plastic deformation preventing portion 27 extending from the other one of both widthwise sides of the first inclined portion 24. This allows movement of the divided electrical wire retaining portion 26b in the region where the divided circular arc bent portion 25b elastically deforms, and restrains the divided electrical wire retaining portion 26b from moving so much as to cause plastic deformation of the divided circular arc bent portion 25b, so that plastic deformation of the divided circular arc bent portion 25b is prevented.

[0050] It should be noted that the tool insertion hole described in the present invention corresponds to the insertion hole 13, the contact point portion described in the present invention corresponds to the plate spring-side contact point portion 15d, the electrical wire retaining portion described in the present invention corresponds to the divided electrical wire retaining portion 26a or 26b, and the plastic deformation preventing portion described in the present invention corresponds to the pair of plastic deformation preventing portions 27 and 27.

[0051] Next, a description will be given of advantageous effects of the connection structure of the electromagnetic contactor 1 of the above-described first embodiment including the spring terminal 20.

[0052] In the first embodiment, the movement of the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) in the direction away from the plate spring side-contact point portion 15d by the tool S inserted in the electrical wire insertion space 10a from the insertion hole 13 releases the elastic retention of the core wire W1 between the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) and the plate spring-side contact point portion 15d of the fixed contact 15. Then, the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) moved in the direction away from the plate spring-side contact point portion 15d abuts with the leading end of the plastic deformation preventing portion 27 extending from the first inclined portion 24. As a result, the plate spring 21 allows movement of the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) in the region where the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b) elastically deforms, and restrains the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) from moving so much as to cause plastic deformation of the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b). Accordingly, since plastic deformation of the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b) is prevented, durability of the plate spring 21 can be improved.

[0053] In addition, the connection structure of the electromagnetic contactor 1 of the first embodiment is a structure in which the plastic deformation preventing portions 27 configured to improve durability of the plate spring 21 are integrated with the plate spring 21, and it is therefore

unnecessary to arrange a component for improving the durability of the plate spring 21 in the case 2, as in the conventional equipment. Thus, the number of components is reduced, and also the number of assembly steps is reduced, thereby enabling reduction of manufacturing cost.

[0054] Additionally, since the plate spring 21 of the first embodiment includes the obtuse angular bent portion 23, the divided electrical wire retaining portions 26a and 26b having a desired length can be provided to obtain a large elastic retaining force. In other words, providing the obtuse angular bent portion 23 in the plate spring 21 of the first embodiment allows the plate spring 21 to be a member having low height, and also allows the divided electrical wire retaining portions 26a and 26b to be provided with a desired length. As a result, using the plate spring 21 having low height enables the electrical wire insertion spaces 10a to 10e in the entire case 2 to be designed into small spaces, so that the electromagnetic contactor 1 can be miniaturized. At the same time, providing the divided electrical wire retaining portions 26a and 26b having a desired length can ensure retention of the core wire W1 of the electrical wire W.

[0055] Furthermore, since the obtuse angular bent portion 23 is formed, the first inclined portion 24 and the electrical wire retaining portion 26 (the divided electrical wire retaining portions 26a and 26b) are arranged substantially parallel to and close to each other at both longitudinal ends of the circular arc bent portion 25 (the divided circular arc bent portions 25a and 25b), and the pair of plastic deformation preventing portions 27 and 27 having short length extend from the first inclined portion 24 toward the electrical wire retaining portion 26. Due to formation of the pair of plastic deformation preventing portions 27 and 27 into the shape short in length, stress applied upon abutment of the divided electrical wire retaining portions 26a and 26b therewith is distributed to the first inclined portion 24, so that deformation of the pair of plastic deformation preventing portions 27 and 27 due to stress concentration can also be prevented.

[Plate Spring of Second Embodiment]

[0056] Next, FIG. 8 illustrates the structure of a plate spring 40 of a second embodiment included in the above-described spring terminal 20. Note that the same components as those illustrated in FIGS. 1 to 7 are denoted by the same signs, and a description thereof will be omitted.

[0057] The plate spring 40 of FIG. 8 includes a pair of plastic deformation preventing portions 41 and 41 extending from both widthwise sides of the first inclined portion 24 toward the electrical wire retaining portion 26 (the divided electrical wire retaining portions 26a and 26b).

[0058] A description will be given of the shape of the plastic deformation preventing portions 41.

[0059] Both widthwise edge portions of the first inclined

portion 24 of the plate spring 40 are formed by cutting out along a longitudinal direction of the first inclined portion 24 by a predetermined length. As a result, the cutout portions are each formed into a rectangular plate member with a longitudinal one end connected to the first inclined portion 24.

[0060] Then, the rectangular plate members are formed into a curved shape so as to protrude toward the fixed portion 22 side, thereby forming the plastic deformation preventing portions 41.

[0061] When the spring terminal 20 including the plate spring 40 of the second embodiment formed as above is employed in the connection structure of the electromagnetic contactor 1, elastic retention of the core wire W1 between the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) and the plate spring-side contact point portion 15d of the fixed contact 15 is released by moving the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) of the plate spring 40 in a direction away from the plate spring-side contact point portion 15d by the tool S inserted into the electrical wire insertion space 10a from the insertion hole 13. The divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) moved in the direction away from the plate spring-side contact point portion 15d abuts with a leading end of the plastic deformation preventing portion 41 extending from one of both widthwise sides of the first inclined portion 24 of the plate spring 40. Then, the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) abutting with the plastic deformation preventing portion 41 is restrained from moving in the direction away from the plate spring-side contact point portion 15d. In this manner, the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) is restrained from moving in the direction away from the plate spring-side contact point portion 15d by abutment thereof with one of the plastic deformation preventing portions 41, thereby allowing the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) to move in the region where the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b) elastically deforms, and restraining the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) from moving so much as to cause plastic deformation of the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b) to prevent plastic deformation of the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b), so that durability of the plate spring 40 can be improved.

[0062] In addition, the plate spring 40 of the second embodiment also is of a structure in which the plastic deformation preventing portions 41 are integrated with the plate spring 40. Thus, manufacturing cost can be reduced by reducing the number of components and reducing the number of assembly steps.

[0063] Additionally, the pair of plastic deformation pre-

venting portions 41 and 41 formed on both widthwise sides of the first inclined portion 24 of the plate spring 40 of the second embodiment are formed into the curved shape so as to protrude toward the fixed portion 22 side.

Thus, impact applied upon abutment with the divided electrical wire retaining portions 26a and 26b can be absorbed by elastic deformation of the plastic deformation preventing portions 41 due to change in curvature of their own curved shape by themselves. Accordingly, the plate spring 40 including the pair of plastic deformation preventing portions 41 and 41 having the curved shape can further improve its durability.

[Plate Spring of Third Embodiment]

[0064] Next, FIG. 9 illustrates the structure of a plate spring 42 of a third embodiment.

[0065] The plate spring 42 of FIG. 9 includes a pair of plastic deformation preventing portions 43 and 43 extending from both widthwise sides of the fixed portion 22 toward the electrical wire retaining portion 26 (the divided electrical wire retaining portions 26a and 26b).

[0066] The plastic deformation preventing portions 43 are formed by bending rectangular portions formed to protrude from both widthwise sides of the tabular fixed portion 22 at a right angle to the fixed portion 22.

[0067] When the spring terminal 20 including the plate spring 42 of the third embodiment formed as above is employed in the connection structure of the electromagnetic contactor 1, elastic retention of the core wire W1 between the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) and the plate spring-side contact point portion 15d of the fixed contact 15 is released by moving the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) of the plate spring 42 in a direction away from the plate spring-side contact point portion 15d by the tool S inserted into the electrical wire insertion space 10a from the insertion hole 13. The divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) moved in the direction away from the plate spring-side contact point portion 15d abuts with a leading end of the plastic deformation preventing portion 43 extending from one of both widthwise sides of the fixed portion 22 of the plate spring 42. Then, the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) abutting with the plastic deformation preventing portion 43 is restrained from moving in the direction away from the plate spring-side contact point portion 15d. In this manner, the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) is restrained from moving in the direction away from the plate spring-side contact point portion 15d by abutment thereof with the plastic deformation preventing portion 43, thereby allowing the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) to move in the region where the divided circular arc bent portion 25a (or the

divided circular arc bent portion 25b) elastically deforms, and restraining the divided electrical wire retaining portion 26a (or the divided electrical wire retaining portion 26b) from moving so much as to cause plastic deformation of the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b) to prevent plastic deformation of the divided circular arc bent portion 25a (or the divided circular arc bent portion 25b), so that durability of the plate spring 42 can be improved.

[0068] In addition, the plate spring 42 of the third embodiment also is of a structure in which the plastic deformation preventing portions 43 are integrated with the plate spring 42. Thus, manufacturing cost can be reduced by reducing the number of components and reducing the number of assembly steps.

[0069] Additionally, since the pair of plastic deformation preventing portions 43 and 43 of the plate spring 42 of the third embodiment has a simple shape formed by bending portions protruding from both sides of the tabular fixed portion 22 at a right angle, manufacturing cost of the plate spring 42 can be reduced.

[0070] Note that while the first embodiment has been described with respect to the connection structure of the electromagnetic contactor 1, the same advantageous effects can be obtained even when the invention is employed in connection structures of various kinds of electrical equipment such as molded case circuit breakers, electromagnetic switches, and circuit protectors.

[0071] Furthermore, as with the plastic deformation preventing portions 41 of the plate spring 40 of the second embodiment formed into the curved shape, when the plastic deformation preventing portions 27 of the plate spring 21 of the first embodiment and the plastic deformation preventing portions 43 of the plate spring 42 of the third embodiment are formed into a curved shape, impact applied upon abutment with the divided electrical wire retaining portions 26a and 26b can be absorbed by elastic deformation of the plastic deformation preventing portions 27 or 43 due to change in curvature of their own curved shape by themselves.

Reference Signs List

[0072]

- 1: Electromagnetic contactor
- 2: Case
- 3: Contact point mechanism
- 4: Electromagnet unit
- 5: Case main body
- 6: Case cover body
- 6a: Front plate
- 7: Contact point mechanism housing portion
- 8: Electromagnet unit housing portion
- 10a to 10e: Electrical wire insertion space
- 11: Partition wall
- 12a to 12e: Electrical wire insertion inlet
- 12a1, 12a2: Electrical wire insertion inlet

- 13: Insertion hole
- 15: Fixed contact
- 15a: Fixed contact point portion
- 15b: Base plate portion
- 15c: Seat plate portion
- 15d: Plate spring-side contact point portion
- 17: Movable contact support member
- 20 Spring terminal
- 21, 40, 42: Plate spring
- 22: Fixed portion
- 23: Obtuse angular bent portion
- 24: First inclined portion
- 25: Circular arc bent portion
- 25a, 25b: Divided circular arc bent portion
- 26: Electrical wire retaining portion
- 26a, 26b: Divided electrical wire retaining portion
- 27, 41, 43: Plastic deformation preventing portion
- 28: Slit
- 32: Engagement claw
- 33: Fitting hole
- 34: Fitting protrusion
- 35: Engagement through hole
- X: First direction
- Y: Second direction
- Z: Third direction
- W: Electrical wire
- W1: Core wire
- W2: Insulative coating
- S: Tool

Claims

1. A connection structure of electrical equipment comprising:

a case including an electrical wire insertion space inside the case;
 an electrical wire insertion inlet included in the case to insert an electrical wire into the electrical wire insertion space from outside through the inlet;
 a tool insertion hole included in the case to insert a tool into the electrical wire insertion space from outside through the hole;
 a fixed contact including a contact point portion arranged along a direction in which the electrical wire is inserted in the electrical wire insertion space, the electrical wire being electrically connected to the contact point portion; and
 a plate spring arranged in the electrical wire insertion space and configured to press the electrical wire inserted through the electrical wire insertion inlet against the contact point portion by elastic force,
 wherein the plate spring comprises a tabular fixed portion to be fixed to the fixed contact, a tabular electrical wire retaining portion continu-

ing from a circular arc-shaped circular arc bent portion provided between the fixed portion and the electrical wire retaining portion, and a plastic deformation preventing portion extending from the fixed portion toward the electrical wire retaining portion, and when the tool inserted through the tool insertion hole contacts with the electrical wire retaining portion, and moves the electrical wire retaining portion in a direction away from the contact point portion, the electrical wire retaining portion abuts with the plastic deformation preventing portion to prevent plastic deformation of the circular arc bent portion.

2. The connection structure of electrical equipment according to claim 1, wherein the plastic deformation preventing portion extends continuously from both widthwise side portions of the fixed portion toward the electrical wire retaining portion.
3. The connection structure of electrical equipment according to claim 1, wherein the circular arc bent portion side of the fixed portion is bent into an obtuse angular shape to form a first inclined portion extending substantially parallel to and close to the electrical wire retaining portion, and the plastic deformation preventing portion extends continuously from both widthwise side portions of the first inclined portion toward the electrical wire retaining portion.
4. The connection structure of electrical equipment according to any one of claims 1 to 3, wherein the plastic deformation preventing portion is formed into a curved shape.

FIG. 1

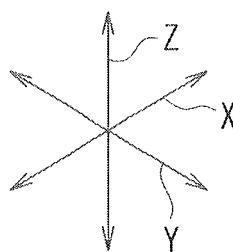
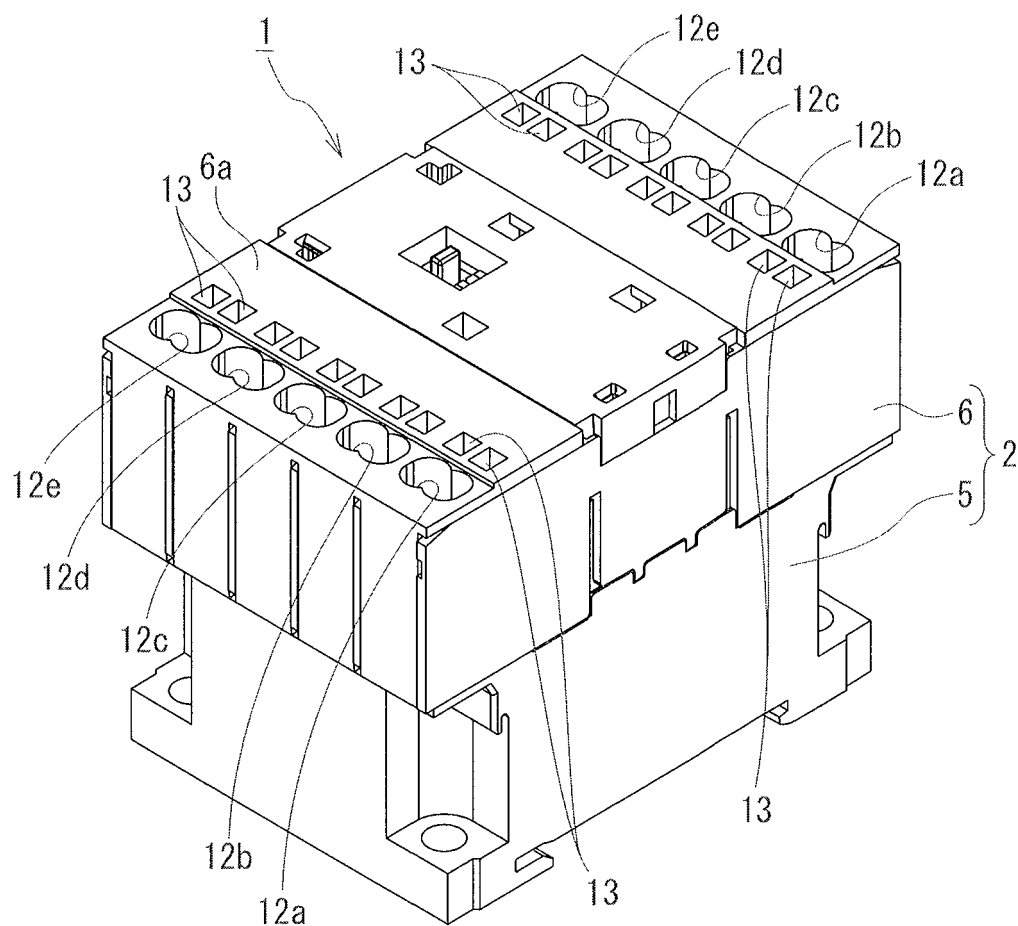


FIG. 2

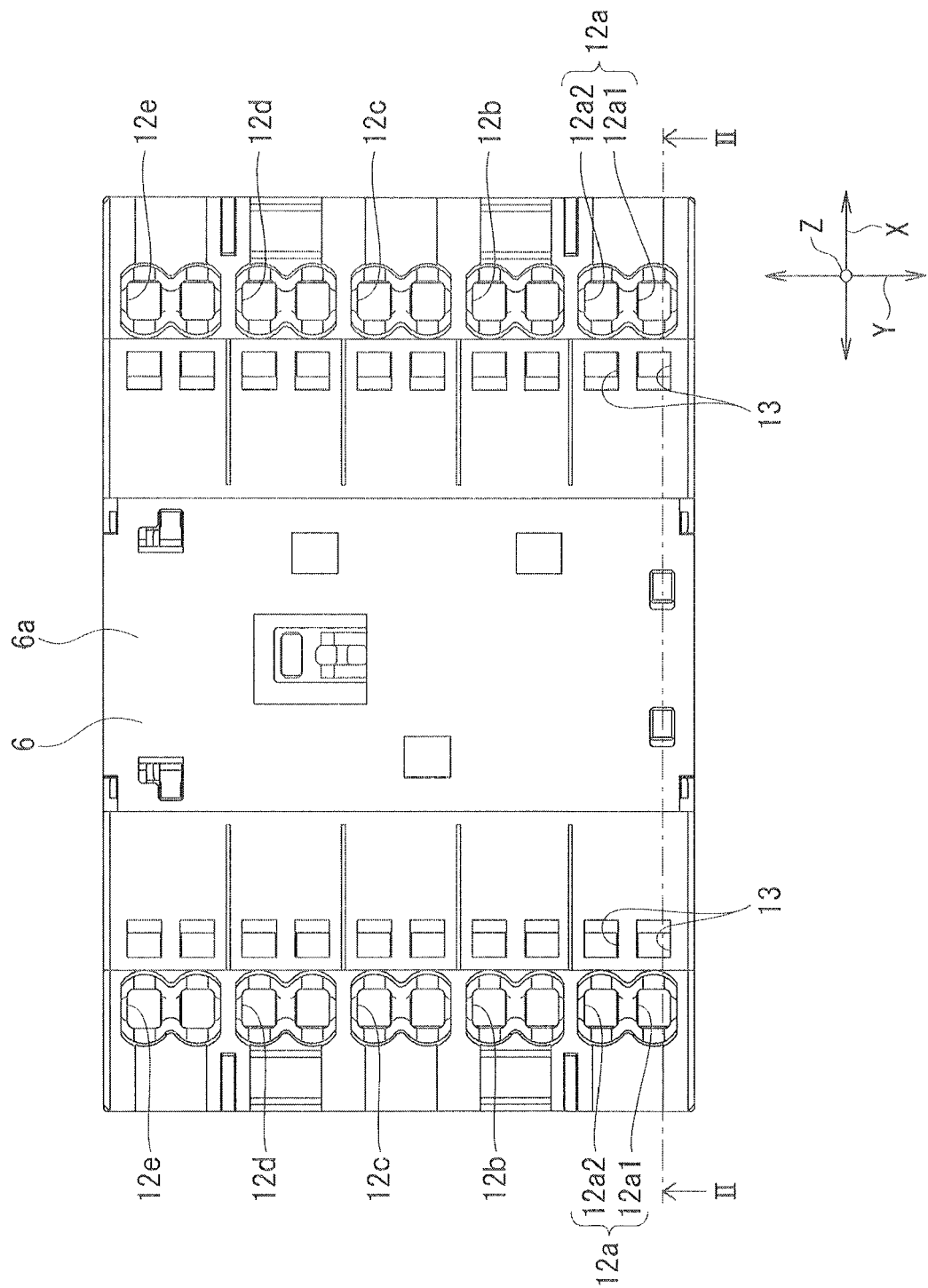
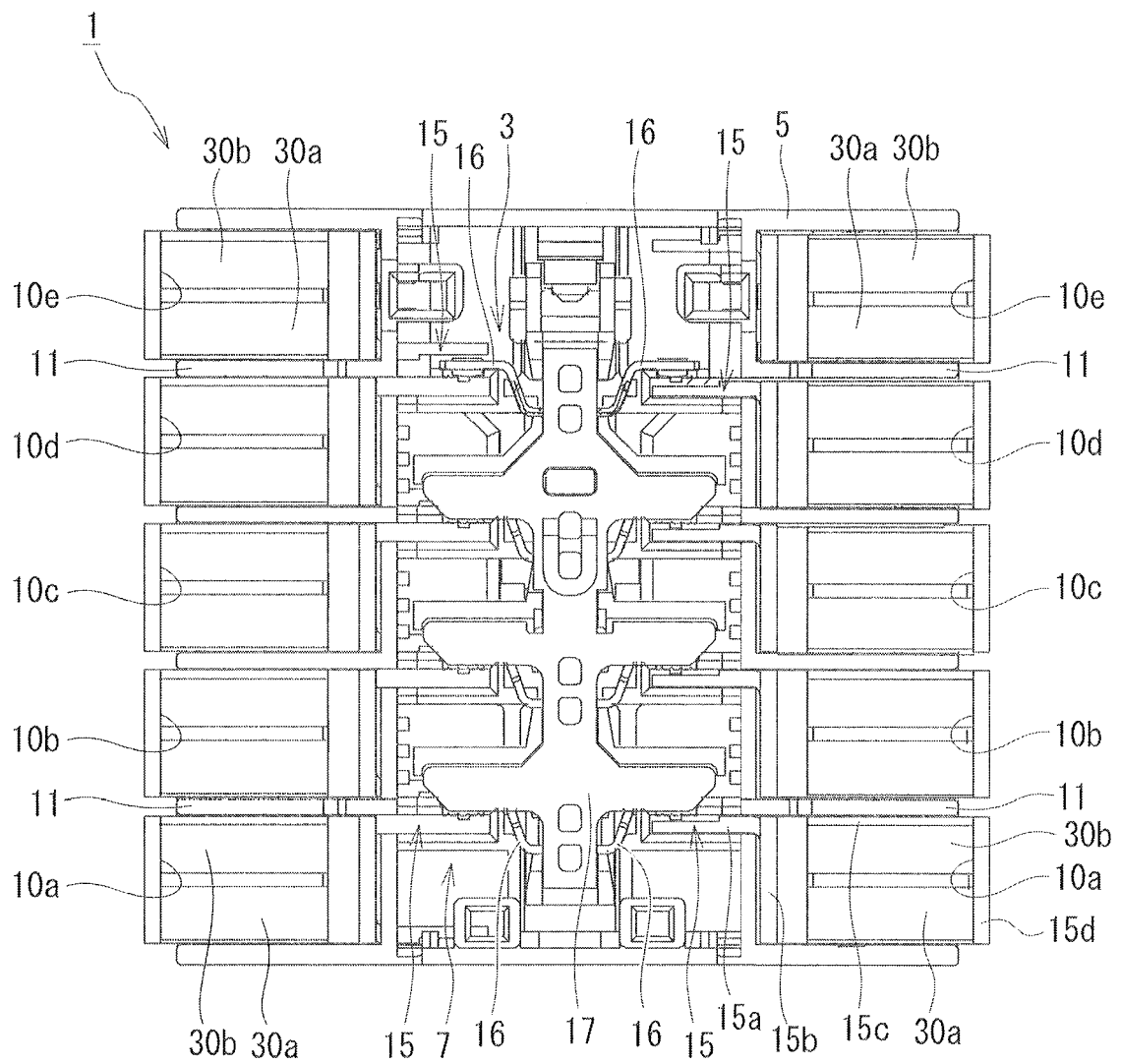


FIG. 3



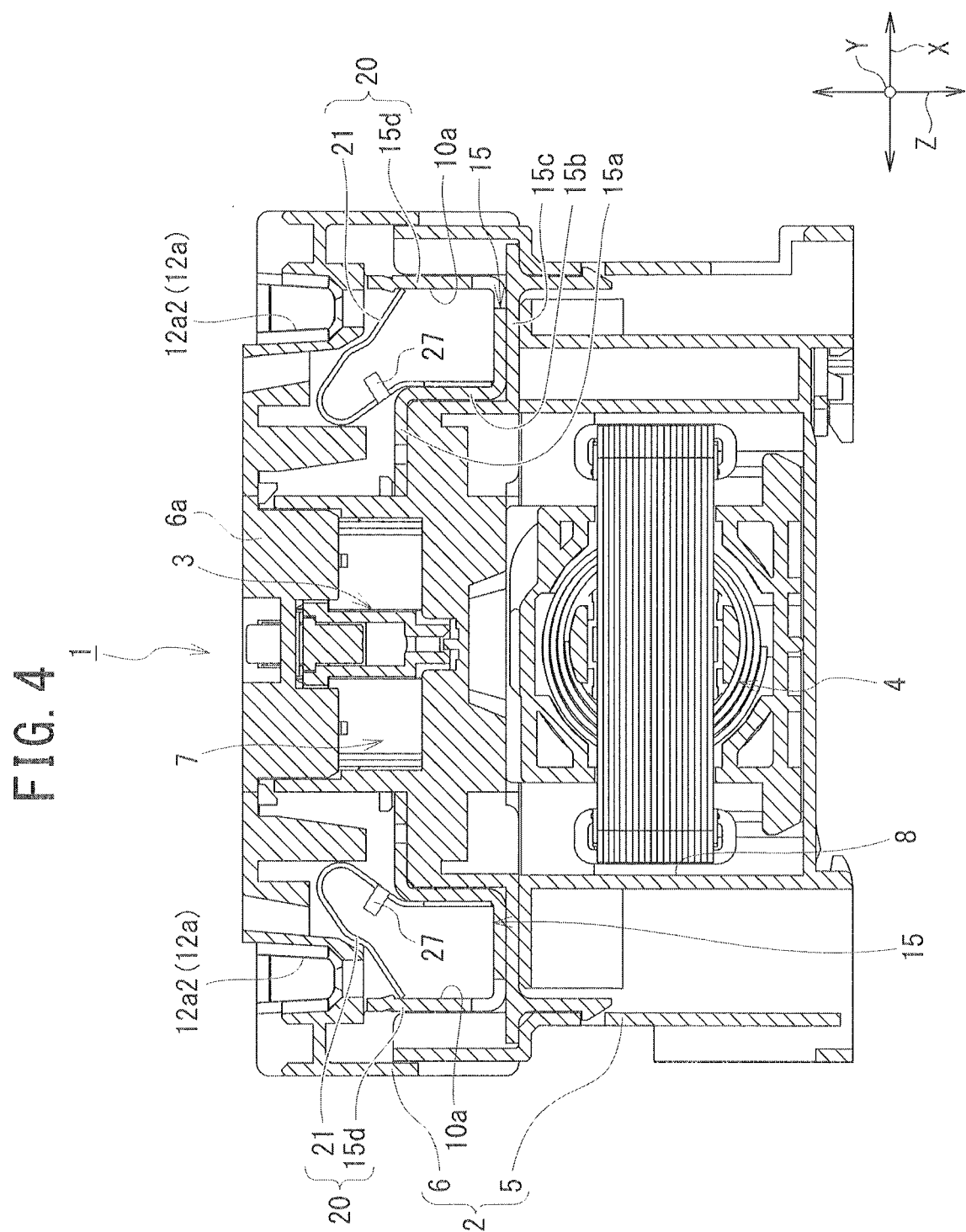


FIG. 5

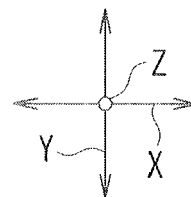
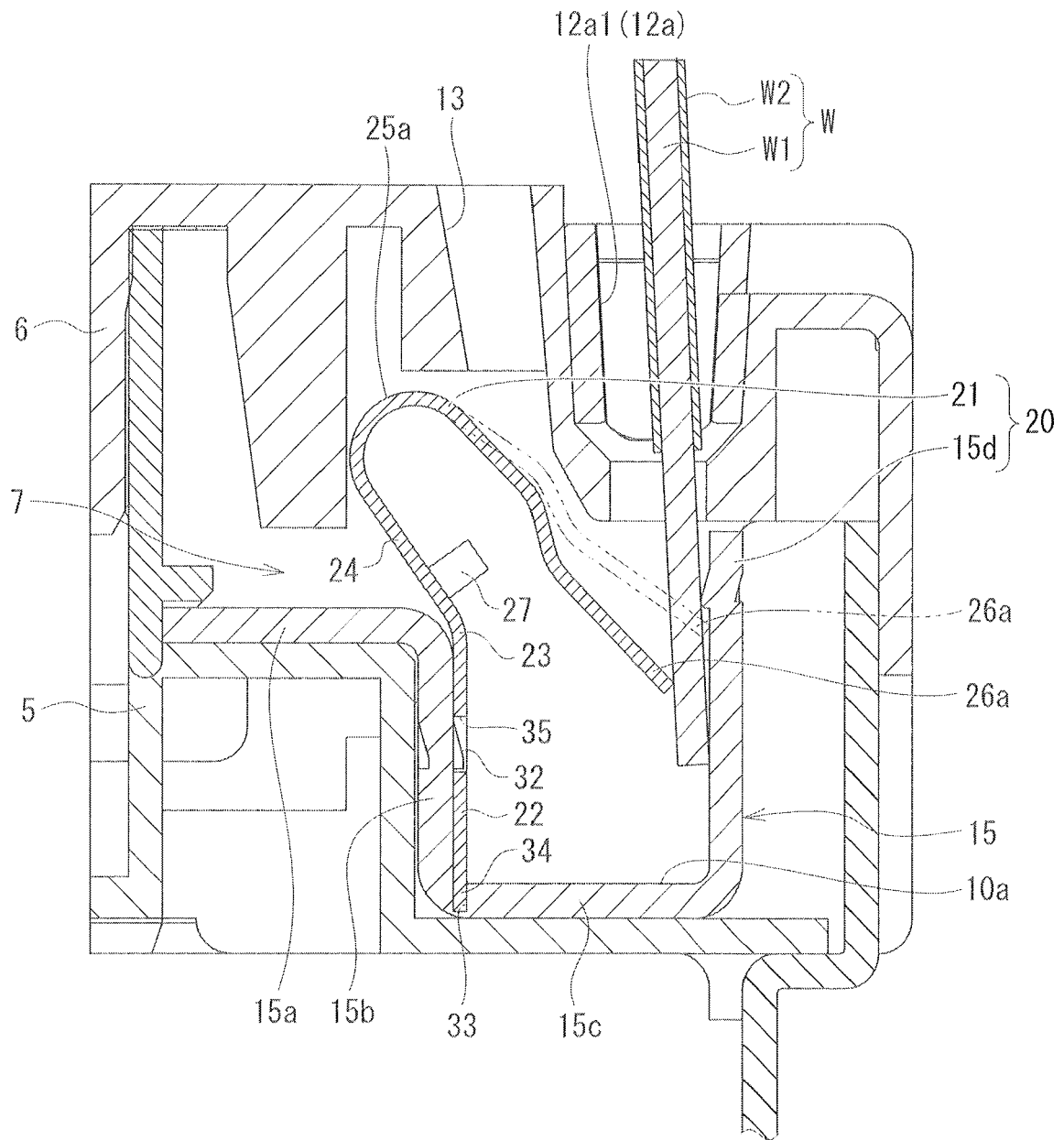


FIG. 6A

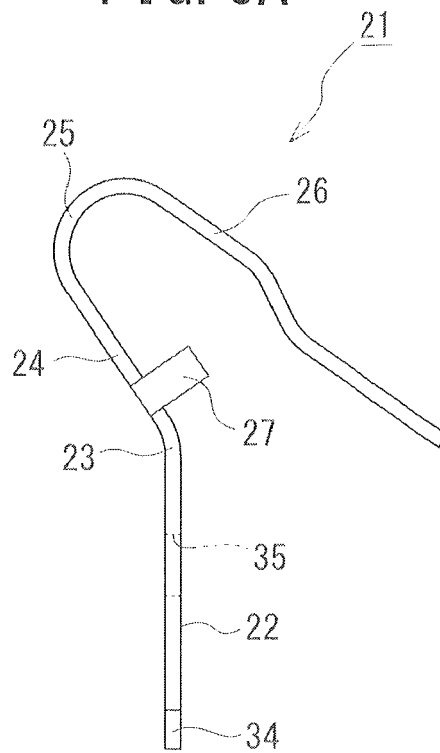


FIG. 6B

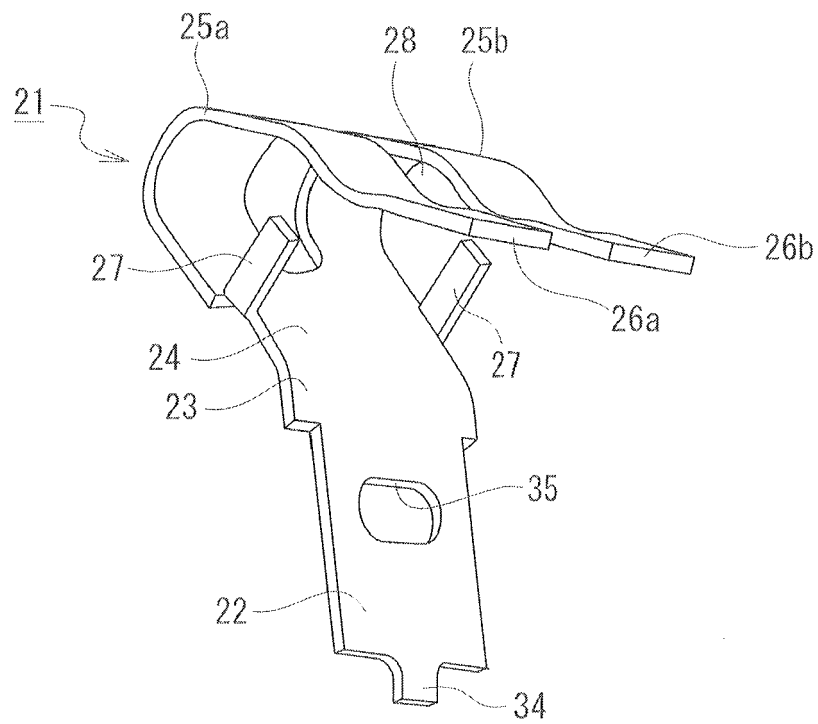


FIG. 7

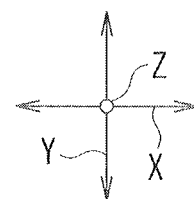
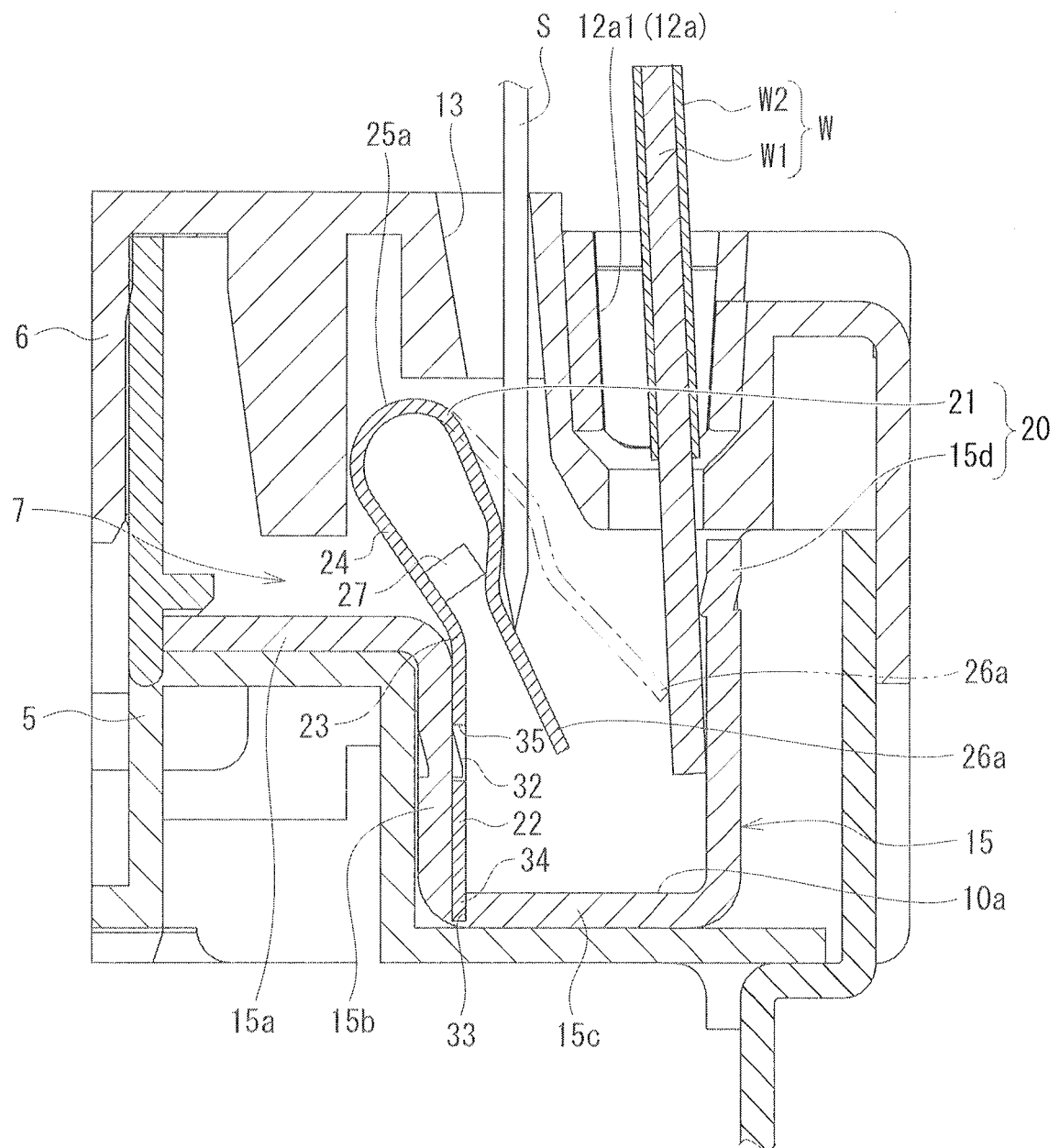


FIG. 8

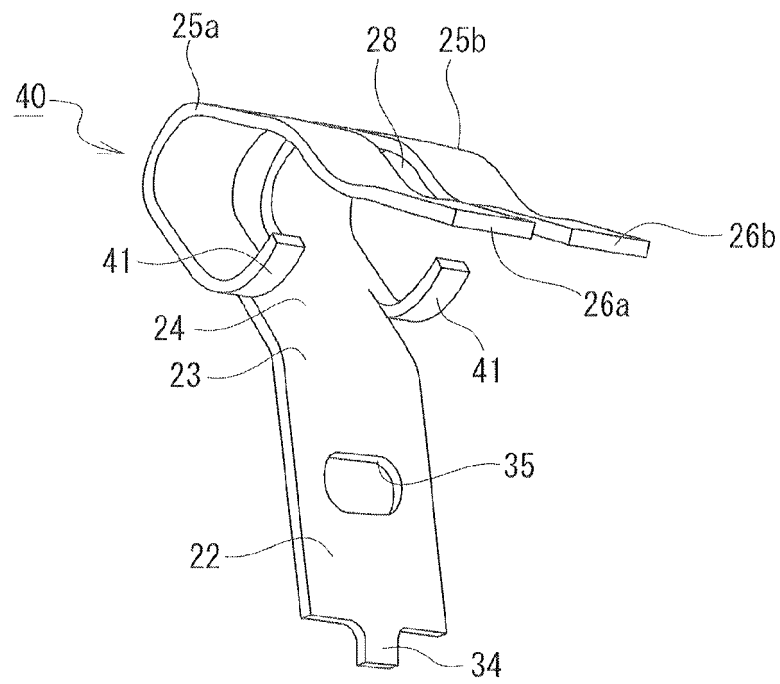
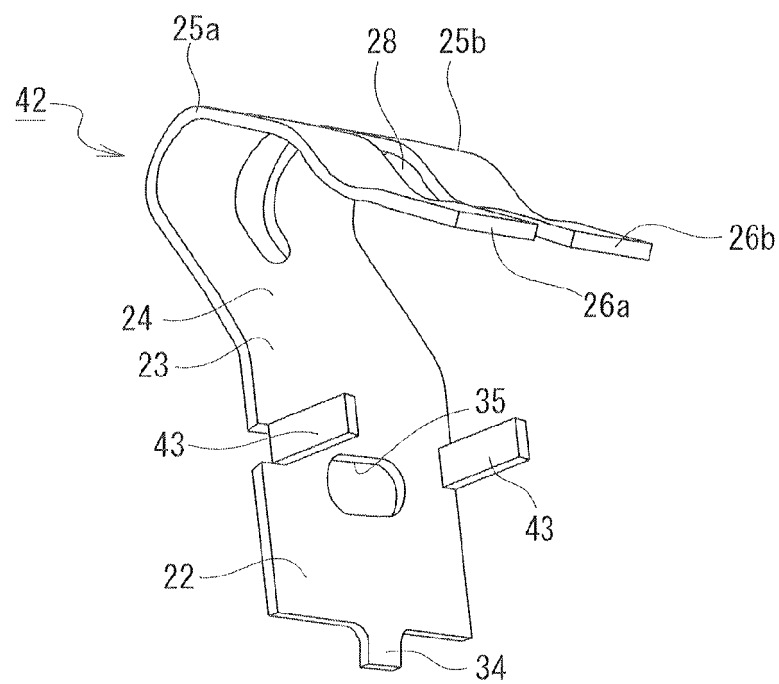


FIG. 9





EUROPEAN SEARCH REPORT

Application Number
EP 19 15 8747

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			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 24 September 2019	Examiner Philippot, Bertrand
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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24-09-2019

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