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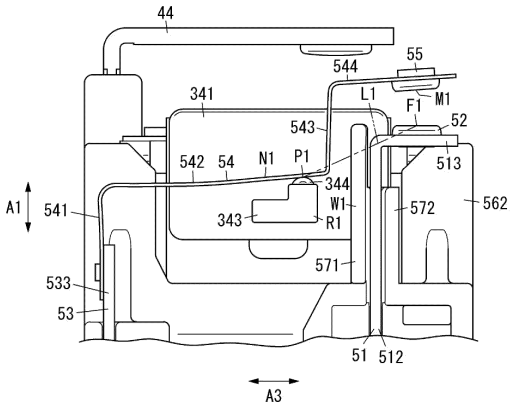
(54) CONTACT DEVICE AND ELECTROMAGNETIC RELAY

(57) A contact device includes a first terminal member, a second terminal member, a base that holds the first terminal member and the second terminal member, a fixed contact member having a fixed contact, the fixed contact member being provided on the first terminal member, a movable contactor connected to the second terminal member, the movable contactor having a lower surface facing the base, a movable contact member including a movable contact facing the fixed contact, the movable contact member being provided on the movable contactor, a moving member, and a wall. The moving member that brings the movable contact into contact with the fixed contact or separates the movable contact from the fixed contact The wall positioned between a contact point at which the moving member comes into contact with the movable contactor as viewed from above and the fixed contact.

FIG. 15



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Description

TECHNICAL FIELD

[0001] The present disclosure generally relates to a contact device and an electromagnetic relay. More specifically, the present disclosure relates to a contact device including a fixed contact and a movable contact, and an electromagnetic relay including the contact device.

BACKGROUND ART

[0002] PTL 1 discloses an electromagnetic relay. The electromagnetic relay of PTL 1 includes an auxiliary fixed terminal, an auxiliary movable terminal, and an auxiliary drive unit.

[0003] The auxiliary fixed terminal includes an auxiliary external input and output terminal and an auxiliary external output and input terminal which may be electrically connected to the auxiliary external input and output terminal. The auxiliary movable terminal may electrically connect the auxiliary external input and output terminal and the auxiliary external output and input terminal. The auxiliary external output and input terminal and the auxiliary movable terminal are integrally formed.

[0004] An auxiliary fixed contact is provided on a lower surface of a distal end portion of the auxiliary external input and output terminal. An auxiliary movable contact is provided on an upper surface of a bent distal end portion of the auxiliary movable terminal. The auxiliary fixed contact and the auxiliary movable contact face each other. The auxiliary movable contact is provided at a position coming into contact with the auxiliary fixed contact when the auxiliary movable terminal moves upward.

[0005] The auxiliary drive unit is made of a resin molded article. The auxiliary drive unit includes a push-up portion. The push-up portion brings the auxiliary movable contact into contact with the auxiliary fixed contact by pushing up the auxiliary movable terminal.

Citation List

Patent Literature

[0006] PTL 1: Unexamined Japanese Patent Publication No. 2015-115248

SUMMARY OF THE INVENTION

[0007] In the electromagnetic relay described in PTL 1, when the push-up portion comes into contact with the auxiliary movable terminal, when the push-up portion is separated from the auxiliary movable terminal, or the like, the push-up portion rubs against the auxiliary movable terminal, and foreign matter may be generated. When the generated foreign matter reaches between the auxiliary fixed contact and the auxiliary movable contact, the foreign matter is sandwiched between the auxiliary fixed contact and the auxiliary movable contact, and thus, there is a possibility that a defect such as a contact failure occurs.

[0008] A contact device according to an aspect of the present disclosure includes a first terminal member, a second terminal member, a base, a fixed contact member, a movable contactor, a movable contact member, a moving member, and a wall. The base holds the first terminal member and the second terminal member. The fixed contact member includes a fixed contact, and is provided on the first terminal member. The movable contactor is connected to the second terminal member and has a lower surface facing the base. The movable contact member includes a movable contact facing the fixed contact, and is provided on the movable contactor. The moving member brings the movable contact into contact with the fixed contact or separates the movable contact from the fixed contact. The wall is positioned between a contact point at which the moving member comes into contact with the movable contactor and the fixed contact as viewed from above.

[0009] An electromagnetic relay according to another aspect of the present disclosure includes the contact device, a third terminal member, a fourth terminal member, a second fixed contact member, a second movable contact member, a coil, and a bobbin. The third terminal member is held by the base. The fourth terminal member is held by the base. The second fixed contact member is different from a first fixed contact member as the fixed contact member, is provided on the third terminal member, and has a second fixed contact. The second movable contact member is different from a first movable contact member as the movable contact member, is provided on the fourth terminal member, and includes a second movable contact facing the second fixed contact. The coil is wound around the bobbin. The second movable contact comes into contact with or is separated from the second fixed contact according to turning on and off of energization of the coil. The bobbin is positioned between the first fixed contact and the second fixed contact as the fixed contact as viewed from above.

[0010] According to the present disclosure, there is an advantage that the occurrence of the defect can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a front view of an electromagnetic relay according to an exemplary embodiment.

Fig. 2 is an exploded perspective view of the electromagnetic relay.

Fig. 3 is an exploded perspective view of a relay body included in the electromagnetic relay.

Fig. 4 is an exploded perspective view of a first block included in the relay body.

Fig. 5 is a perspective view of a first holding base

included in the first block.
Fig. 6 is an exploded perspective view of a body block included in the relay body.
Fig. 7 is an exploded perspective view of an electromagnet block included in the body block.
Fig. 8 is a top view of a bobbin included in the electromagnet block.
Fig. 9 is a perspective view of the bobbin.
Fig. 10 is a perspective view of an insulating member included in the electromagnetic block.
Fig. 11 is an exploded perspective view of a movable block included in the body block.
Fig. 12 is an exploded perspective view of a second block included in the relay body.
Fig. 13 is a perspective view of a second holding base included in the second block.
Fig. **14** is a right side view of the relay body at the time of non-energization.
Fig. 15 is a right side view of main parts of the relay body at the time of energization.
Fig. 16 is a perspective view of a case included in the electromagnetic relay.
Fig. 17 is a sectional view of the electromagnetic relay at the time of non-energization.
Fig. 18 is a right side view of a relay body included in an electromagnetic relay according to Modification 1 at the time of non-energization.
Fig. 19 is a right side view of a relay body included in an electromagnetic relay according to Modification 2 at the time of non-energization.
Fig. 20 is a perspective view of a movable contactor included in the electromagnetic relay.
Fig. 21 is a side view of main parts of an electromagnetic relay according to Modification 3.
Fig. 22 is a perspective view of main parts of the electromagnetic relay.
Fig. 23 is a right side view of a relay body included in an electromagnetic relay according to Modification 4 at the time of non-energization.
Fig. **24** is a perspective view of a first holding base included in the relay body of the electromagnetic relay.
Fig. 25 is a perspective view of a movable contactor included in an electromagnetic relay according to Modification 5.
Fig. 26 is a right side view of main parts of a relay body included in the electromagnetic relay at the time of non-energization.
Fig. 27 is a right side view of main parts of the relay body included in the electromagnetic relay at the time of energization.
Fig. 28A is a side view of main parts of a modification of the movable contactor.
Fig. 28B is a bottom view of main parts of a modification of the movable contactor.
Fig. 28C is a sectional view of main parts of a modification of the movable contactor.
Fig. 29A is a side view of main parts of a modification of the movable contactor.
Fig. 29B is a bottom view of main parts of a modification of the movable contactor.
Fig. 30A is a side view of main parts of a modification of the movable contactor.
Fig. 30B is a bottom view of main parts of a modification of the movable contactor.
Fig. 31A is a side view of main parts of a modification of the movable contactor.
Fig. 31B is a bottom view of main parts of a modification of the movable contactor.
Fig. 31C is a sectional view of main parts of a modification of the movable contactor.
Fig. 32 is a right side view of main parts of an electromagnetic relay according to Modification 6.
Fig. 33 is a right side view of main parts of an electromagnetic relay according to Modification 7.
Fig. 34 is a right side view of main parts of an electromagnetic relay according to Modification 8.
Fig. 35A is a right side view of main parts of an electromagnetic relay according to Modification 9.
Fig. 35B is a right side view of main parts of an electromagnetic relay according to Modification 10.
Fig. 35C is a right side view of main parts of an electromagnetic relay according to Modification 11.
Fig. 35D is a right side view of main parts of an electromagnetic relay according to Modification 12.
Fig. 36A is a right side view of main parts of an electromagnetic relay according to Modification 13.
Fig. 36B is a right side view of main parts of an electromagnetic relay according to Modification 14.
Fig. 36C is a right side view of main parts of the electromagnetic relay according to Modification 15.
Fig. 36D is a right side view of main parts of an electromagnetic relay according to Modification 16.

DESCRIPTION OF EMBODIMENT

[0012] A contact device and an electromagnetic relay including the contact device according to an exemplary embodiment of the present disclosure will be described with reference to the drawings. Drawings described in the following exemplary embodiment are merely schematic diagrams, and ratios in size and thickness of components in the drawings do not always reflect actual dimensional ratios.

(1) Outline

[0013] As illustrated in Figs. 1 and 2, electromagnetic relay 100 according to the present exemplary embodiment includes contact device C1.

[0014] As illustrated in Figs. 2 to 4, contact device C1 includes first terminal member 51, second terminal member 53, fixed contact member 52, movable contact member 55, movable contactor N1, and moving member R1.

[0015] First terminal member 51 has first terminal T1. Second terminal member 53 has second terminal T2.

First terminal T1 and second terminal T2 are portions connected to an external electric device in contact device C1. First terminal member 51 and second terminal member 53 are held by base B1 (first holding base 56).

[0016] Fixed contact member 52 includes fixed contact F1. Fixed contact member 52 is provided on first terminal member 51.

[0017] movable contactor N1 is connected to second terminal member 53. A lower surface of movable contactor N1 is positioned above base B1 (first holding base 56) and faces base B1.

[0018] Movable contact member 55 includes movable contact M1. Movable contact M1 faces fixed contact F1. Movable contact member 55 is provided on movable contactor N1.

[0019] moving member R1 moves movable contactor N1 to bring movable contact M1 into contact with fixed contact F1 or to separate movable contact M1 from fixed contact F1 (as illustrated in Fig. 15, here, movable contact M1 is separated from fixed contact F1). Hereinafter, a portion of moving member R1 coming into contact with movable contactor N1 is also referred to as "contact point P1".

[0020] As illustrated in Fig. 15, contact device C1 further includes wall W1. Wall W1 is positioned between contact point P1 and fixed contact F1 as viewed from above.

[0021] As described above, in contact device C1 according to the present exemplary embodiment, wall W1 is interposed between contact point P1 and fixed contact F1. Thus, in contact device C1 according to the present exemplary embodiment, a spatial distance between contact point P1 and fixed contact F1 can be increased as compared with a case where there is no wall W1. Thus, even though foreign matter such as cutting residue is generated at contact point P1 by rubbing of moving member R1 against movable contactor N1, the foreign matter hardly reaches fixed contact F1 separated from contact point P1, and hardly reaches fixed contact F1 since the foreign matter is blocked by wall W1. Accordingly, it is possible to reduce the occurrence of a defect such as a contact failure between fixed contact F1 and movable contact M1.

[0022] As illustrated in Figs. 1 and 2, electromagnetic relay 100 according to the present exemplary embodiment includes second contact device C2 in addition to contact device C1 (hereinafter, also referred to as "first contact device C1").

[0023] As illustrated in Figs. 2 and 3, second contact device C2 includes third terminal member 42, fourth terminal member 30, second fixed contact member 43 different from fixed contact member 52 (hereinafter, also referred to as "first fixed contact member 52"), second movable contact member 32 different from movable contact member 55 (hereinafter, also referred to as "first movable contact member 55"), coil 21, and bobbin 22.

[0024] Third terminal member 42 has third terminal T3. Fourth terminal member 30 has fourth terminal T4. Third terminal T3 and fourth terminal T4 are portions of second contact device C2 connected to an external electric device. Third terminal member 42 is held by base B1 (second holding base 41). Fourth terminal member 30 is held by base B1 (bobbin 22 and insulating member 24).

[0025] As illustrated in Fig. 12, second fixed contact member 43 includes second fixed contact F2. Second fixed contact member 43 is provided on third terminal member 42.

[0026] As illustrated in Fig. 11, second movable contact member 32 includes second movable contact M2. Second movable contact member 32 is provided on fourth terminal member 30. Second movable contact M2 faces second fixed contact F2.

[0027] As illustrated in Figs. 2 and 3, coil 21 is wound around bobbin 22. In second contact device C2, second movable contact M2 comes into contact with or is separated from second fixed contact F2 in accordance with turning on and off of energization of coil 21. As illustrated in Fig. 17, bobbin 22 is positioned between first fixed contact F1 and second fixed contact F2 as fixed contact F1 as viewed from above.

[0028] As described above, in electromagnetic relay 100 according to the present exemplary embodiment, bobbin 22 is positioned between first fixed contact F1 and second fixed contact F2. That is, second fixed contact F2 is positioned on a side opposite to first fixed contact F1 with coil 21 and bobbin 22 interposed therebetween, and is spatially separated from first fixed contact F1 and contact point P1. Thus, even though the foreign matter such as the cutting residue is generated at contact point P1 by rubbing of moving member R1 against movable contactor N1, the foreign matter hardly reaches second fixed contact F2 separated from contact point P1. Accordingly, it is possible to reduce the occurrence of the defect such as the contact failure between second fixed contact F2 and second movable contact M2.

(2) Details

[0029] Hereinafter, electromagnetic relay 100 according to the present exemplary embodiment will be described in more detail with reference to the drawings. As illustrated in Fig. 2, electromagnetic relay 100 according to the present exemplary embodiment is a so-called hinge-type relay.

[0030] Electromagnetic relay 100 is mounted on, for example, an electric automobile. Electromagnetic relay 100 is used, for example, for turning on and off an electric path of a charging cable of the electric automobile.

[0031] As described above, electromagnetic relay 100 includes first contact device C1 including first movable contact M1 and first fixed contact F1, and second contact device C2 including second movable contact M2 and second fixed contact F2. Second contact device C2 is a main contact device forming a main electric path. Second contact device C2 is inserted into, for example, an electric path of the charging cable. First contact device

C1 is an auxiliary contact device forming an auxiliary electric path. First contact device C1 is used to monitor a state of second contact device C2, for example, to detect welding.

[0032] As illustrated in Figs. 1 and 2, electromagnetic relay 100 includes relay body 1 and case 9.

[0033] As illustrated in Figs. 2, 3, and 6, relay body 1 is formed by coupling a plurality of blocks. Relay body 1 includes first block (auxiliary block) 5, electromagnet block 2, movable block 3, and second block (fixed block) 4, which are coupled to each other. Hereinafter, the coupling of electromagnet block 2 and movable block 3 may be referred to as body block 10 (see Fig. 3).

[0034] As illustrated in Figs. 2 to 4, first block 5 includes first movable spring 54 (movable contactor N1) and first holding base 56 (base B1).

[0035] Hereinafter, a virtual axis connecting first movable spring 54 (movable contactor N1) and first holding base 56 (base B1) is also referred to as first axis A1. In addition, a virtual axis along which body block 10 and first block 5 are arranged is also referred to as second axis A2. Second axis A2 intersects with, and is orthogonal to, first axis A1. In addition, a virtual axis orthogonal to both first axis A1 and second axis A2 is also referred to as third axis A3. Here, third axis A3 is orthogonal to both first axis A1 and second axis A2. In addition, in first axis A1, a side on which first movable spring 54 is positioned as viewed from first holding base 56 is also referred to as "upper", and an opposite side is also referred to as "lower". In addition, in second axis A2, a side on which body block 10 is positioned as viewed from first block 5 is also referred to as "left", and an opposite side is also referred to as "right". In addition, both sides of third axis A3 are also referred to as "front" and "rear". The definition of these directions is for the sake of convenience in description, and does not limit a direction when electromagnetic relay 100 is used.

[0036] In addition, in the present disclosure, "top view" means viewing from above along first axis A1, "side view" means viewing from right or left along second axis A2, and "front view" means viewing from front along third axis A3. In addition, "a first component is positioned between a second component and a third component as viewed from above" means that the first component is positioned between the second component and the third component on an axis (second axis A2, third axis A3, or the like) orthogonal to first axis A1.

[0037] As illustrated in Fig. 3, first block 5 is assembled to body block 10 from a right side along second axis A2 and is fixed to body block 10. In addition, second block 4 is assembled to body block 10 from a left side along second axis A2 and is fixed to body block 10. Note that, in the present disclosure, "fixed" may include both of being detachably fixed by fitting or the like and being non-detachably fixed by adhesion, welding, or the like (either may be adopted).

(2.1) First block

[0038] As illustrated in Figs. 3 and 4, first block 5 includes first terminal member 51, first fixed contact member 52, second terminal member 53, first movable spring 54, first movable contact member 55, first holding base 56, and protective wall 57.

[0039] As illustrated in Fig. 4, first terminal member 51 includes leg piece 511, center piece 512, and holding piece 513. Leg piece 511, center piece 512, and holding piece 513 are integrally made of a conductive metal material.

[0040] Leg piece 511 has a plate shape extending along first axis A1. Leg piece 511 functions as a terminal (first terminal T1) connected to an external electric device. As illustrated in Fig. 1, leg piece 511 is exposed downward from case 9.

[0041] Center piece 512 has a plate shape having an L shape in side view including connecting piece 514 extending forward from an upper end of leg piece 511 and vertical plate piece 515 extending upward from a front end of connecting piece 514. A width (dimension along second axis A2) of connecting piece 514 is the same as a width of leg piece 511. A width (dimension along second axis A2) of vertical plate piece 515 is larger than the width of connecting piece 514. Two protrusions 516 protruding leftward along second axis A2 are formed on a left side surface of vertical plate piece 515. Recess 517 recessed rightward is formed between two protrusions 516.

[0042] Holding piece 513 has a plate shape extending rearward from an upper end of center piece 512. An extending direction of holding piece 513 intersects with an extending direction of vertical plate piece 515, and is orthogonal here. Holding piece 513 has through-hole 518.

[0043] First terminal member 51 has through-hole 519 at a joint portion between vertical plate piece 515 and holding piece 513.

[0044] First fixed contact member 52 is formed in a substantially columnar shape by, for example, a contact material containing silver as a main component. An upper surface of first fixed contact member 52 functions as first fixed contact F1. An upper surface of first fixed contact member 52 functioning as first fixed contact F1 has a spherical shape. Note that, the surface (upper surface) of first fixed contact member 52 functioning as first fixed contact F1 may have a planar shape or a dome shape. First fixed contact member 52 is inserted into through-hole 518 of holding piece 513 of first terminal member 51. First fixed contact member 52 is fixed to first terminal member 51 by caulking while passing through through-hole 518 of holding piece 513. Accordingly, first fixed contact member 52 is electrically connected to first terminal member 51.

[0045] Note that, first fixed contact member 52 may be formed integrally with first terminal member 51. For example, a part of a metal plate constituting first terminal member 51 may protrude upward, the protruding portion

may be used as first fixed contact member 52, and a distal end of the protruding portion may be used as first fixed contact F1.

[0046] As illustrated in Fig. 4, second terminal member 53 includes leg piece 531, center piece 532, and fixing piece 533. Leg piece 531, center piece 532, and fixing piece 533 are integrally made of a conductive metal material.

[0047] Leg piece 531 has a plate shape extending along first axis A1. Leg piece 531 functions as a terminal (second terminal T2) connected to an external electric device. As illustrated in Fig. 1, leg piece 531 is exposed downward from case 9.

[0048] Center piece 532 has a plate shape extending upward from an upper end of leg piece 531. A width (dimension along second axis A2) of center piece 532 is larger than a width of leg piece 531. Two protrusions 534 protruding leftward along second axis A2 are formed on a left side surface of center piece 532. Recess 535 recessed rightward is formed between two protrusions 534.

[0049] Fixing piece 533 has a plate shape extending upward from an upper end of center piece 532. Fixing piece 533 has two fixing protrusions 536 for fixing first movable spring 54 at an upper end portion on a front surface thereof. Fixing protrusion 536 may be formed, for example, by pushing out a portion of a rear surface of fixing piece 533 corresponding to fixing protrusion 536 from a rear side to a front side.

[0050] As illustrated in Fig. 4, first movable spring 54 includes fixing piece 541, spring piece 542, connecting piece 543, and holding piece 544. Fixing piece 541, spring piece 542, connecting piece 543, and holding piece 544 are integrally made of a conductive metal material.

[0051] Fixing piece 541 has a plate shape extending along first axis A1. Fixing piece 541 is a portion fixed to second terminal member 53. Fixing piece 541 has two fixing holes 545 into which two fixing protrusions 536 of second terminal member 53 are inserted. First movable spring 54 is fixed to second terminal member 53 by inserting two fixing protrusions 536 into two fixing holes 545 and crushing distal ends of fixing protrusions 536.

[0052] Spring piece 542 has a plate shape extending rearward from an upper end of fixing piece 541. Spring piece 542 has flexibility. Spring piece 542 has a first end (front end) connected to fixing piece 541 and a second end (rear end) connected to connecting piece 543, and the second end is movable up and down with the first end as a fulcrum. The second end of spring piece 542 is moved upward by being pushed by moving member R1 in a state where moving member R1 (protrusion 343 to be described later) comes into contact with the spring piece. As illustrated in Fig. 14, in a state where first movable contact M1 comes into contact with first fixed contact F1, the second end of spring piece 542 is positioned below the first end of the spring piece.

[0053] Connecting piece 543 has a plate shape extending upward from the second end (rear end) of spring piece 542. First movable spring 54 includes connecting piece 543, and thus, first movable contact M1 is easily positioned above contact point P1 (see Fig. 15).

[0054] Holding piece 544 has a plate shape extending rearward from an upper end of connecting piece 543. Holding piece 544 is movable up and down in accordance with deflection of spring piece 542 (movement of the second end up and down). Holding piece 544 has through-hole 546. First movable contact member 55 is fixed to through-hole 546.

[0055] As illustrated in Fig. 4, first movable spring 54 has a substantially Z shape in side view as viewed from a left side by holding piece 544, connecting piece 543, and spring piece 542.

[0056] First movable contact member 55 is formed in a substantially columnar shape by, for example, a contact material containing silver as a main component. A lower surface of first movable contact member 55 functions as first movable contact M1. The lower surface of first movable contact member 55 functioning as first movable contact M1 has a spherical shape. Note that, a surface (lower surface) of first movable contact member 55 functioning as first movable contact M1 may have a planar shape or a dome shape. First movable contact member 55 is inserted into through-hole 546 of holding piece 544 of first movable spring 54. First movable contact member 55 is fixed to first movable spring 54 by caulking while passing through through-hole 546 of holding piece 544. Accordingly, first movable contact member 55 is electrically connected to first movable spring 54.

[0057] Note that, first movable contact member 55 may be formed integrally with first movable spring 54 (movable contactor N1). For example, a part of a metal plate constituting first movable spring 54 may protrude downward, the protruding portion may be used as first movable contact member 55, and a distal end of the protruding portion may be used as first movable contact M1.

[0058] As illustrated in Figs. 4 and 5, first holding base 56 includes holding base body 561 and vertical wall 562. Holding base body 561 and vertical wall 562 are integrally formed as a synthetic resin molded body having electrical insulation properties.

[0059] Holding base body 561 is formed in a substantially rectangular parallelepiped shape. Holding base body 561 has a box shape with an opened left surface. First holding groove 563 is formed at a rear end portion of a right surface of holding base body 561. Second holding groove 564 is formed at a front end portion of the right surface of holding base body 561.

[0060] First holding groove 563 is a portion used for holding first terminal member 51. First holding groove 563 includes first groove extending along first axis A1, a second groove extending rearward from a lower end of the first groove, and a third groove extending downward from a rear end of the second groove. A lower portion of vertical plate piece 515 of center piece 512 of first terminal member 51 is fitted into the first groove. Connecting

piece 514 of center piece 512 is fitted into the second groove. An upper end portion of leg piece 511 is fitted into the third groove. In the bottom of the first groove, a portion corresponding to recess 517 on a left side surface of first terminal member 51 is a protruding base one step higher, and recess 517 of first terminal member 51 is fitted into the protruding base.

[0061] Second holding groove 564 is a portion used for holding second terminal member 53. Second holding groove 564 extends along first axis A1. In the bottom of second holding groove 564, a portion corresponding to recess 535 on a left side surface of second terminal member 53 is a protruding base one step higher, and recess 535 of second terminal member 53 is fitted into the protruding base.

[0062] As illustrated in Figs. 3, 14, and 15, first movable contact M1 and first fixed contact F1 face each other in a state where first terminal member 51, second terminal member 53, and first movable spring 54 are held on first holding base 56. In the present exemplary embodiment, first movable contact M1 is positioned on an upper side, and first fixed contact F1 is positioned on a lower side.

[0063] Holding piece 544 of first movable spring 54 moves up and down, and thus, first movable contact M1 comes into contact with or is separated from first fixed contact F1. That is, first movable spring 54 functions as movable contactor N1 that causes first movable contact M1 to come into contact with or be separated from first fixed contact F1. Fixing piece 541 and spring piece 542 of first movable spring 54 constitute a movable part connected to second terminal member 53 and coming into contact with moving member R1. Holding piece 544 of first movable spring 54 constitutes a contact part where first movable contact member 55 is provided. Connecting piece 543 of first movable spring 54 constitutes a connecting part connecting the contact part (holding piece 544) and the movable part (spring piece 542). Holding piece 544 (contact part) moves upward, and thus, first movable contact M1 is separated from first fixed contact F1 (see Fig. 15). Holding piece 544 (contact part) moves downward, and thus, first movable contact M1 approaches and comes into contact with first fixed contact F1 (see Fig. 14).

[0064] As illustrated in Fig. 5, a pair of first fitting recesses 565 recessed rightward is formed at a front end portion and a rear end portion of a lower end of the left surface of holding base body 561. Engagement hole 566 is formed in a lower wall constituting a lower surface of first fitting recess 565.

[0065] Vertical wall 562 extends upward along first axis A1 from a left end of an upper surface of holding base body 561. Recess 567 recessed downward from the upper end is formed at a center of third axis A3 of vertical wall 562. Here, recess 567 is formed along first axis A1 over substantially the entire length of vertical wall 562.

[0066] A pair of second fitting recesses 568 recessed rightward is formed at a front end portion and a rear end portion of a left surface of vertical wall 562. Second fitting recess 568 has an L shape (or an inverted L shape) in side view seen from a left side.

[0067] Protective wall 57 is integrally formed as a synthetic resin molded body having electrical insulation properties.

[0068] Here, protective wall 57 is formed integrally with first holding base 56. Protective wall 57 is integrally formed on the upper surface of holding base body 561.

[0069] As illustrated in Figs. 4 and 5, protective wall 57 includes first wall 571, second wall 572, and third wall 573.

[0070] First wall 571 has a plate shape. First wall 571 extends along first axis A1 and second axis A2. First wall 571 extends upward from an opening edge on a front side of first holding groove 563 on the upper surface of holding base body 561. First wall 571 extends along an axis (first axis A1) on which first fixed contact F1 and first movable contact M1 face each other.

[0071] Second wall 572 has a plate shape. Second wall 572 extends along first axis A1 and second axis A2. Second wall 572 extends upward from an opening edge on a rear side of first holding groove 563 on the upper surface of holding base body 561.

[0072] Third wall 573 extends along third axis A3. Third wall 573 connects first wall 571 and second wall 572.

[0073] Groove 574 is formed to be surrounded by first wall 571, second wall 572, and third wall 573. A lower end of groove 574 is connected (continuous) to an upper end of first holding groove 563. Groove 574 extends along first axis A1. An upper portion of vertical plate piece 515 of center piece 512 of first terminal member 51 is fitted into groove 574.

[0074] As illustrated in Fig. 15, first wall 571 is positioned between contact point P1 and first fixed contact F1 in a state where moving member R1 (protrusion 343) comes into contact with first movable spring 54. First wall 571 functions as wall W1 positioned between contact point P1 and first fixed contact F1 as viewed from above. As illustrated in Figs. 3, **14,** and 15, first wall 571 is positioned between vertical plate piece 515 of first terminal member 51 and spring piece 542 and connecting piece 543 of first movable spring 54. That is, first wall 571 (wall W1) is positioned between connecting piece 543 (connecting part) of first movable spring **54** (movable contactor N1) and first terminal member 51.

[0075] First wall 571 faces the upper portion of vertical plate piece 515 of first terminal member 51. First wall 571 covers the upper portion of vertical plate piece 515 from a front side. An upper end of first wall 571 is positioned above an upper end of first terminal member 51. The upper end of first wall 571 is positioned above first fixed contact F1 (upper surface of first fixed contact member 52). On first axis A1, the upper end of first wall 571 and first fixed contact F1 are positioned on the same side (upper side) as viewed from contact point P1.

[0076] A width (dimension along second axis A2) of first wall 571 is larger than a width of the upper portion of vertical plate piece 515 of first terminal member 51. In

front view, the entire upper portion of vertical plate piece 515 of first terminal member 51 is covered with first wall 571. In addition, in front view, entire first fixed contact member 52 is covered with first wall 571.

[0077] In addition, first wall 571 faces connecting piece 543 of first movable spring 54. That is, connecting piece 543 (connecting part) of first movable spring **54** (movable contactor N1) faces first wall 571 (wall W1). The width (dimension along second axis A2) of first wall 571 is larger than a width of connecting piece 543 and is larger than a width of spring piece 542.

[0078] As illustrated in Fig. **14,** in a state where first movable contact M1 comes into contact with first fixed contact F1, a lower surface of holding piece **544** of first movable spring **54** is separated without bringing into contact with the upper end of first wall 571. As described above, in a state where first movable contact M1 comes into contact with first fixed contact F1, gap G1 is formed between the upper end of first wall 571 (wall W1) and first movable spring **54** (movable contactor N1).

[0079] As illustrated in Fig. **14,** in a state where first movable contact M1 comes into contact with first fixed contact F1, a size of gap G1 (dimension along first axis A1) is smaller than a distance (dimension along first axis A1) between an upper surface of holding piece 513 of first terminal member 51 and the lower surface of holding piece **544** of first movable spring 54. In other words, the size of gap G1 is smaller than sum H1 of a distance (dimension along first axis A1) from an upper surface of first terminal member 51 to first fixed contact F1 (upper surface of first fixed contact member 52) and a distance (dimension along first axis A1) from a lower surface of first movable spring **54** to first movable contact M1 (lower surface of first movable contact member 55). As described above, the size of gap G1 is smaller than a sum of a protrusion dimension of first fixed contact member 52 from the upper surface of first terminal member 51 and a protrusion dimension of first movable contact member 55 from the lower surface of first movable spring **54** (movable contactor N1).

[0080] In addition, as illustrated in Fig. **14,** in a state where first movable contact M1 comes into contact with first fixed contact F1, the size of gap G1 (dimension along first axis A1) is smaller than distance H2 (dimension along first axis A1) from the lower surface of holding piece **544** of first movable spring **54** to first movable contact M1 (lower surface of first movable contact member 55). As described above, the size of gap G1 is smaller than the protrusion dimension of first movable contact member 55 from the lower surface of first movable spring **54** (movable contactor N1).

[0081] The size of gap G1 (dimension along first axis A1 is, for example, in a range from 0.10 mm to 5.0 mm inclusive. When the size of gap G1 is more than or equal to 0.10 mm, first movable spring **54** is less likely to come into contact with first wall 571 (wall W1) when first movable spring **54** (movable contactor N1) moves, and it is possible to suppress the generation of the foreign matter due to first wall 571 coming into contact with first movable spring 54. When the size of gap G1 is less than or equal to 5.0 mm, the size of the device can be reduced. The size of gap G1 may be, for example, more than or equal to 0.15 mm, or more than or equal to 0.20 mm. In addition, the size of gap G1 may be, for example, less than or equal to 2.0 mm, less than or equal to 1.0 mm, or less than or equal to 0.40 mm. The size of gap G1 may be about 0.30 mm.

[0082] Second wall 572 covers the upper portion of vertical plate piece 515 of first terminal member 51 from a rear side. A height of second wall 572 (dimension along first axis A1) is lower than a height of first wall 571.

[0083] Second wall 572 has a height (dimension along first axis A1) at which an upper end of second wall 572 is positioned below the upper end of first terminal member 51. A width (dimension along second axis A2) of second wall 572 is larger than the width of the upper portion of vertical plate piece 515 of first terminal member 51.

[0084] Third wall 573 covers the upper portion of vertical plate piece 515 of first terminal member 51 from a left side. A height of third wall 573 (dimension along first axis A1) is the same as the height of second wall 572. Third wall 573 connects first wall 571 and second wall 572 without a gap along third axis A3.

(2.2) Electromagnet block

[0085] As illustrated in Figs. 6 and 7, electromagnetic block 2 includes coil 21, bobbin 22, iron core 23, insulating member 24, yoke 25, and two coil terminals 26.

[0086] As illustrated in Fig. 7, bobbin 22 includes main body 61, upper flange 62 provided in an upper portion of main body 61, and lower flange 63 provided in a lower portion of main body 61. Main body 61, upper flange 62, and lower flange 63 are integrally formed as a synthetic resin molded body having electrical insulation properties.

[0087] Main body 61 has a hollow cylindrical shape whose axis is along first axis A1. Coil 21 is wound around main body 61. An axis of coil 21 (virtual axis around which the winding of coil 21 is wound) substantially coincides with the axis of main body 61.

[0088] As illustrated in Figs. 7 and 8, upper flange 62 includes plate-shaped upper flange body 621 having a substantially rectangular plate shape in top view. Upper flange body 621 has circular hole 622 connected to an internal space of main body 61 at a position on a left side of a center thereof. An annular support base 623 protruding upward is provided around hole 622 on an upper surface of upper flange body 621.

[0089] Upper flange 62 includes first wall 64, second wall 65, and third wall 66 on the upper surface of upper flange body 621.

[0090] First wall 64 is provided along a first side (front side) of upper flange body 621 along second axis A2. First wall 64 protrudes upward from the upper surface of upper flange body 621. First wall 64 is continuously formed along second axis A2. First wall 64 is provided at a position overlapping an imaginary line extending

forward along third axis A3 from a center of hole 622 of upper flange body 621. First wall 64 includes substantially rectangular parallelepiped base 641 formed on the upper surface of upper flange body 621 and extending along second axis A2, and substantially plate-shaped projection rib 642 formed on the upper surface of base 641 and having a thickness (dimension along third axis A3) smaller than base 641. A front surface (outer surface) of base 641 and a front surface of projection rib 642 are flush (flush), and there is a step between a rear surface (inner surface) of projection rib 642 and base 641.

[0091] There is a step between a left side surface of projection rib 642 and base 641, and there is a step between a right side surface of projection rib 642 and base 641. First wall 64 has two first recesses 643 positioned at both ends (left end and right end) of first wall 64 on second axis A2.

[0092] Second wall 65 is provided along a second side (rear side) of upper flange body 621 along second axis A2. Second wall 65 protrudes upward from the upper surface of upper flange body 621. Second wall 65 is continuously formed along second axis A2. Second wall 65 is provided at a position overlapping an imaginary line extending rearward along third axis A3 from the center of hole 622 of upper flange body 621.

[0093] Second wall 65 faces first wall 64 across hole 622 on third axis A3. In top view, first wall 64 and second wall 65 are symmetrical.

[0094] Second wall 65 includes substantially rectangular parallelepiped base 651 formed on the upper surface of upper flange body 621 and extending along second axis A2, and substantially plate-shaped projection rib 652 formed on an upper surface of base 651 and having a thickness (dimension along third axis A3) smaller than base 651. A rear surface (outer surface) of base 651 and a rear surface of projection rib 652 are flush (flush), and there is a step between a front surface (inner surface) of projection rib 652 and base 651.

[0095] There is a step between a left side surface of projection rib 652 and base 651, and there is a step between a right side surface of projection rib 652 and base 651. Second wall 65 has two second recesses 653 positioned at both ends (left end and right end) of second wall 65 on second axis A2.

[0096] Third wall 66 is provided along a third side (left side) along third axis A3 on the upper surface of upper flange body 621. Third wall 66 protrudes upward from the upper surface of upper flange body 621.

[0097] Third wall 66 is on a left side of hole 622.

[0098] Third wall 66 has a substantially rectangular parallelepiped shape extending along third axis A3. A height of third wall 66 (dimension along first axis A1) is substantially equal to a height of base 641 of first wall 64 and is substantially equal to a height of base 651 of second wall 65.

[0099] Third wall 66 connects a first end (left end) of first wall 64 and a first end (left end) of second wall 65. Third wall 66 is continuously formed along third axis A3. In upper flange 62, first wall 64, second wall 65, and third wall 66 have a C shape in top view.

[0100] As illustrated in Figs. 7 and 8, upper flange 62 further includes protruding plate part 624, holding protrusion 625, and positioning portion 626.

[0101] Protruding plate part 624 has a plate shape protruding leftward along second axis A2 from the third side (left piece) of upper flange body 621.

[0102] Holding protrusion 625 is a rib extending along second axis A2 at a position near a front end on an upper surface of protruding plate part 624. One end (right end) of holding protrusion 625 is connected to a left side surface of third wall 66.

[0103] Positioning portion 626 is provided along a fourth side (right side) along third axis A3 on the upper surface of upper flange body 621. A length (dimension along third axis A3) of positioning portion 626 is shorter than a length of the fourth side (right side) of upper flange body 621. Positioning portion 626 is provided at a center of the fourth side (right side) of upper flange body 621 on third axis A3.

[0104] As illustrated in Figs. 7 and 9, lower flange 63 includes upper wall 631, lower wall 632, front wall 633, rear wall 634, and left wall 635, and includes opening portion 630 on a right side surface. That is, lower flange 63 is formed in a hollow rectangular box shape in which a right side surface is opened by upper wall 631, lower wall 632, front wall 633, rear wall 634, and left wall 635.

[0105] Upper wall 631 has circular hole 636 connecting an internal space of main body 61 and an internal space of lower flange 63 at a center thereof. Lower wall 632 has circular hole 637 connecting the internal space and an external space of lower flange 63 at a center thereof. In top view, a center of hole 637 of lower wall 632 substantially coincides with a center of hole 636 of upper wall 631.

[0106] On a lower surface of lower wall 632, engagement protrusion 638 protruding downward is provided at a center of third axis A3 at a left end thereof.

[0107] Lower flange 63 has two holding grooves 639 for attaching two coil terminals 26 to both end portions (front end portion and rear end portion) of third axis A3 at a left end. Holding groove 639 is formed across upper wall 631, left wall 635, and lower wall 632.

[0108] As illustrated in Figs. 6 and 7, two coil terminals 26 are inserted into two holding grooves 639 of lower flange 63 and are held by lower flange 63.

[0109] As illustrated in Fig. 7, each coil terminal 26 includes first terminal 261 connected to coil 21, second terminal 262 connected to an external device, and coupling portion 263 connecting first terminal 261 and second terminal 262.

[0110] As illustrated in Fig. 7, iron core 23 is formed in a columnar shape. Iron core 23 is vertically inserted into bobbin 22 along first axis A1. Iron core 23 is inserted into main body 61 of bobbin 22. Iron core 23 has disk-shaped magnetic pole portion 231 at one end (upper end) of first axis A1. As illustrated in Fig. 6, magnetic pole portion 231 is exposed above bobbin 22. A lower surface of magnetic

pole portion 231 is supported by support base 623 of upper flange 62 of bobbin 22. Iron core 23 has small diameter portion 232 having a relatively small diameter at a lower end portion thereof.

[0111] As illustrated in Figs. 6 and 7, coil 21 is wound around bobbin 22. Coil 21 is wound around main body 61 of bobbin 22. Thus, coil 21 is wound around iron core 23. A first end of coil 21 is connected to (first terminal 261 of) one of two coil terminals 26, and a second end of coil 21 is connected to (first terminal 261 of) the other of two coil terminals 26.

[0112] As illustrated in Fig. 7, yoke 25 includes first yoke 251 and second yoke 252.

[0113] First yoke 251 has a rectangular plate shape extending along first axis A1. Second yoke 252 has a rectangular plate shape extending along second axis A2. A lower end of first yoke 251 is connected to a right end of second yoke 252, and has an inverted L shape in front view by first yoke 251 and second yoke.

[0114] First yoke 251 has two fixing protrusions 253 that protrude rightward and fix first movable spring 31 at both end portions (front end portion and rear end portion) of third axis A3 on a right surface. Second yoke 252 has through-hole 254 penetrating second yoke 252 along first axis A1.

[0115] As illustrated in Fig. 6, first yoke 251 is arranged on a right side of coil 21. In side view viewed from a right side, first yoke 251 covers substantially entire coil 21. Second yoke 252 is inserted into the internal space of lower flange 63 of bobbin 22 through opening portion 630 from a right side. Iron core 23 (more specifically, small diameter portion 232) is inserted into through-hole 254 of second yoke 252 from above (see Fig. 17). Yoke 25 forms a magnetic circuit together with iron core 23.

[0116] As illustrated in Figs. 6 and 7, insulating member 24 is arranged between bobbin 22 and yoke 25. Insulating member 24 is positioned between coil 21 and yoke 25. Insulating member 24 insulates coil 21 from yoke 25. Insulating member 24 covers coil 21 from a right side. Insulating member 24 is covered with yoke 25 from a right side.

[0117] As illustrated in Figs. 7 and 10, insulating member 24 includes main body 241, first cover 242, first joint 243, second cover 244, second joint 245, a pair of first protrusions 246, and a pair of second protrusions 247. Main body 241, first cover 242, first joint 243, second cover 244, second joint 245, the pair of first protrusions 246, and the pair of second protrusions 247 are integrally formed as a synthetic resin molded body having electrical insulation properties.

[0118] Main body 241 has a substantially C plate-shaped section orthogonal to first axis A1. Main body 241 covers coil 21 from a right side while facing a right side surface of coil 21. Main body 241 is covered with first yoke 251 from a right side.

[0119] First cover 242 is positioned below main body 241. First cover 242 has a plate shape having a width along second axis A2. First cover 242 covers a portion of second yoke 252 near a right end connected to first yoke 251 (see Fig. 17). First cover 242 covers second yoke 252 from three sides, that is, from the top, the front, and the rear. A portion of second yoke 252 where through-hole 254 is formed is exposed from first cover 242 without being covered with first cover 242.

[0120] First cover 242 is inserted into the internal space of lower flange 63 of bobbin 22 through opening portion 630 from a right side together with second yoke 252. In a state where first cover 242 and second yoke 252 are inserted into opening portion 630, an upper surface of first cover 242 is covered from above by upper wall 631 of lower flange 63 of bobbin 22 (see Fig. 17). In addition, a lower surface of second yoke 252 is covered with lower wall 632 of lower flange 63 from below.

[0121] As illustrated in Fig. 10, first joint 243 connects main body 241 and first cover 242.

[0122] Second cover 244 is positioned above main body 241. Second cover 244 has a plate shape having a width along second axis A2. As illustrated in Fig. 6, second cover 244 covers a portion of a right end of the upper surface of upper flange body 621. Magnetic pole portion 231 of iron core 23 is exposed without being covered with second cover 244. In top view, base 641 of first wall 64 of upper flange 62, third wall 66, base 651 of second wall 65, and second cover 244 of insulating member 24 are connected in a rectangular frame shape. In addition, in an upper surface of second cover 244, a height position (position on first axis A1) is substantially the same as a height position of base 641 of first wall 64 of upper flange 62 and a height position of base 651 of second wall 65.

[0123] As illustrated in Fig. 10, second joint 245 connects main body 241 and second cover 244. A groove is formed along third axis A3 between second cover 244, second joint 245, and main body 241. A right end portion of upper flange body 621 of upper flange 62 of bobbin 22 is fitted into the groove.

[0124] Recess 248 is formed along second axis A2 on a lower surface of second cover 244. Positioning portion 626 of upper flange 62 of bobbin 22 is fitted in recess 248 along second axis A2, and insulating member 24 is positioned with respect to bobbin 22.

[0125] The pair of first protrusions 246 protrudes rightward along second axis A2 from right surfaces of a front end portion and a rear end portion of first cover 242. First protrusion 246 has a substantially rectangular parallelepiped shape extending along second axis A2. Claw 249 protruding downward is formed in a lower surface of first protrusion 246. As illustrated in Figs. 2 and 3, the pair of first protrusions 246 is inserted into the pair of first fitting recesses 565 of holding base body 561 of first block 5. Claw 249 engages with engagement hole 566 formed in a lower wall of first fitting recess 565.

[0126] As illustrated in Figs. 7 and 10, the pair of second protrusions 247 protrudes rightward along second axis A2 from each of a front end portion and a rear end portion of an upper end on a right surface of main

body 241. Second protrusion 247 has an L shape (or an inverted L shape) in side view viewed from a right side. As illustrated in Figs. 2 and 3, the pair of second protrusions 247 is inserted into the pair of second fitting recesses 568 of holding base body 561 of first block 5.

[0127] First block 5 and electromagnetic block 2 are coupled to each other by inserting the pair of first protrusions 246 into the pair of first fitting recesses 565, and inserting the pair of second protrusions 247 into the pair of second fitting recesses 568.

(2.3) Movable block

[0128] As illustrated in Figs. 6 and 11, movable block 3 includes second movable spring 31, second movable contact member 32, armature 33, and card 34.

[0129] Second movable spring 31 includes (here, two) leg pieces 35, fixing piece 36, spring piece 37, and movable piece 38. Two leg pieces 35, fixing piece 36, spring piece 37, and movable piece 38 are integrally made of a conductive metal material.

[0130] Leg piece 35 has a rectangular plate shape extending along first axis A1. Two leg pieces 35 are arranged along third axis A3. Leg piece 35 functions as a terminal (fourth terminal T4) connected to an external electric device. As illustrated in Fig. 1, leg piece 35 is exposed downward from case 9.

[0131] Fixing piece 36 has a plate shape extending upward from an upper end of leg piece 35. Fixing piece 36 is a portion fixed to yoke 25, more specifically, first yoke 251. Fixing piece 36 has two fixing holes 311 into which two fixing protrusions 253 of first yoke 251 are inserted.

[0132] Spring piece 37 has an inverted L shaped plate shape in which upper and lower sides are inverted in front view. Spring piece 37 has flexibility. Second movable spring 31 has through-hole 312 extending in a long hole shape at a central portion of third axis A3 in spring piece 37.

[0133] Movable piece 38 has a plate shape extending leftward from a left end of spring piece 37. A joint portion between movable piece 38 and spring piece 37 is bent in a V shape in front view. Movable piece 38 is movable up and down along first axis A1 in accordance with deflection of spring piece 37. Movable piece 38 is inclined with respect to a normal direction of fixing piece 36.

[0134] Movable piece 38 includes armature holding portion 381 and contact holding portion 382. Armature holding portion 381 is positioned on a right side of contact holding portion 382.

[0135] Armature 33 is held by armature holding portion 381. In armature holding portion 381, three fixing holes 313 are formed to be arranged along third axis A3. Second movable contact member 32 is held by contact holding portion 382. Contact holding portion 382 has through-hole 314.

[0136] As illustrated in Fig. 11, armature 33 includes armature body 331, (here, three) fixing protrusions 332, (here, two) hook pieces 333, and protrusions 334. Armature body 331, three fixing protrusions 332, two hook pieces 333, and protrusions 334 are integrally made of a magnetic material.

[0137] Armature body 331 has a substantially rectangular plate shape in top view. Three fixing protrusions 332 are provided on an upper surface of armature body 331 to be arranged along third axis A3. Armature 33 is fixed to second movable spring 31 (armature holding portion 381) by inserting three fixing protrusions 332 of armature 33 into three fixing holes 313 of armature holding portion 381 of second movable spring 31 from a lower side and crushing distal ends of fixing protrusion 332. Armature 33 is arranged below second movable spring 31 and is fixed to second movable spring 31. That is, second movable spring 31 is fixed to an upper surface of armature 33.

[0138] As illustrated in Figs. 2 and 3, in a state where movable block 3 is fixed to electromagnetic block 2, the lower surface of armature 33 faces an upper surface of iron core 23 (upper surface of magnetic pole portion 231).

[0139] Two hook pieces 333 are at a right end of armature 33. Two hook pieces 333 protrude downward from a front end portion and a rear end portion of a right side surface of armature body 331. As illustrated in Fig. 3, hook piece 333 is hooked on an upper end portion of a right surface of first yoke 251. Thus, armature 33 rotates with hook piece 333 as a fulcrum in accordance with the presence or absence of an attraction force with iron core 23. Movable piece 38 of second movable spring 31 moves up and down along first axis A1 together with armature body 331.

[0140] Protrusion 334 is at the right end of armature 33. Protrusion 334 protrudes along a length axis of armature 33 from a center (portion between two hook pieces 333) of third axis A3 on the right side surface of armature body 331. Protrusion 334 is formed in a substantially rectangular parallelepiped shape. Protrusion 334 passes through through-hole 312 of second movable spring 31 and protrudes rightward from second movable spring 31.

[0141] As illustrated in Fig. 11, second movable contact member 32 includes head portion 321 and body portion 322.

[0142] A shape of head portion 321 is a truncated cone shape. An axis of head portion 321 is along first axis A1.

[0143] The lower surface of head portion 321 functions as second movable contact M2. The lower surface of second movable contact member 32 functioning as second movable contact M2 is made of, for example, a silver alloy (AgNi or $AgSnO_2$). A portion of second movable contact member 32 other than second movable contact M2 is made of, for example, a copper alloy such as tough pitch copper. A surface (lower surface) of second movable contact member 32 functioning as second movable contact M2 has a spherical shape. Note that, the surface (lower surface) of second movable contact member 32 functioning as second movable contact M2 may have a planar shape or a dome shape.

[0144] Body portion 322 protrudes from an upper end of head portion 321. Body portion 322 is inserted into

through-hole 314 of contact holding portion 382 of second movable spring 31. Second movable contact member 32 is fixed to second movable spring 31 by caulking in a state where body portion 322 passes through through-hole 314 of contact holding portion 382. Accordingly, second movable contact member 32 is electrically connected to second movable spring 31.

[0145] Note that, second movable contact member 32 may be formed integrally with second movable spring 31. For example, a part of a metal plate constituting second movable spring 31 may protrude downward, the protruding portion may be used as second movable contact member 32, and a distal end of the protruding portion may be used as second movable contact M2.

[0146] As illustrated in Figs. 6 and 11, card 34 is provided on a right end side of armature 33.

[0147] Card 34 is fixed to protrusion 334 of armature 33 by press fitting, for example.

[0148] Card 34 is a synthetic resin molded body having electrical insulation properties. Card 34 moves up and down along first axis A1 in accordance with the movement of armature 33. Since card 34 is on a side opposite to armature body 331 with respect to the fulcrum (hook piece 333) of armature 33, a moving direction thereof is opposite to armature body 331. That is, in a case where armature body 331 moves upward, card 34 moves downward, and in a case where armature body 331 moves downward, card 34 moves upward.

[0149] As illustrated in Fig. 11, card 34 includes card wall 341, tubular portion 342, protrusion 343, and protrusion 344.

[0150] Card wall 341 has a rectangular plate shape. Card wall 341 extends along first axis A1. In addition, card wall 341 extends along third axis A3.

[0151] Tubular portion 342 has a rectangular tubular shape and protrudes leftward from a first surface (left surface) of card wall 341. Card 34 is fixed to armature 33 by inserting protrusion 334 into tubular portion 342. Tubular portion 342 is fixed to protrusion 334 by press fitting, for example.

[0152] Protrusion 343 protrudes rightward from a second surface (right surface) of card wall 341. That is, protrusion 343 is disposed on a side opposite to a portion (tubular portion 342) of card 34 fixed to armature 33 with respect to card wall 341. Protrusion 343 protrudes from a position below a position at which tubular portion 342 protrudes in card wall 341. Protrusion 343 has a stepped shape having a step on an upper surface side in side view viewed from a right side.

[0153] As illustrated in Figs. 2, 14, and 15, in a state where first block 5 is assembled to body block 10, protrusion 343 faces a lower surface of spring piece 542 of first movable spring 54 of first block 5.

[0154] Protrusion 344 is provided on an upper surface of protrusion 343. Protrusion 344 has a dome shape protruding upward.

[0155] Protrusion 343 of card 34 moves up and down in accordance with the movement of armature 33 up and down (rotation with hook piece 333 as a fulcrum).

[0156] Protrusion 343 moves upward in accordance with the rotation of armature 33 to come into contact with the lower surface of first movable spring 54, and moves first movable spring 54 upward while pressing first movable spring 54. Accordingly, first movable contact M1 also moves upward and is separated from first fixed contact F1 (see Fig. 15). In short, protrusion 343 functions as moving member R1. Protrusion 343 separates first movable contact M1 from first fixed contact F1 by moving first movable spring 54 in a state of coming into contact with first movable spring 54 (movable contactor N1).

[0157] In addition, protrusion 343 is separated from first movable spring 54 by moving downward in accordance with the rotation of armature 33. First movable spring 54 moves downward by a spring force of first movable spring 54. Accordingly, first movable contact M1 also moves downward and comes into contact with first fixed contact F1 (see Fig. 14).

[0158] In short, in first contact device C1, first movable contact M1 comes into contact with or is separated from first fixed contact F1 in accordance with the movement of protrusion 343 (moving member R1) up and down corresponding to the turning on and off of the energization of coil 21.

[0159] As illustrated in Fig. 17, card 34 further includes reinforcing rib 345. Reinforcing rib 345 is provided to connect the first surface (left surface) of card wall 341 and the lower surface of tubular portion 342. Reinforcing rib 345 improves the strength of card 34.

(2.4) Second block

[0160] As illustrated in Figs. 3 and 12, second block 4 includes second holding base 41, third terminal member 42, second fixed contact member 43, and auxiliary member 44.

[0161] Second holding base 41 has a rectangular box shape with an opened right surface. As illustrated in Figs. 12 and 13, second holding base 41 includes left wall 45, front wall 46, rear wall 47, lower wall 48, upper wall 49, and auxiliary wall 40. Left wall 45, front wall 46, rear wall 47, lower wall 48, upper wall 49, and auxiliary wall 40 are integrally formed as a synthetic resin molded body having electrical insulation properties.

[0162] Engagement hole 411 is formed at a right end of lower wall 48. Recess 412 recessed leftward along second axis A2 is formed at an upper end of a right side surface of front wall 46. Recess 413 recessed leftward along second axis A2 is formed at an upper end of a right side surface of rear wall 47. Holding groove 414 extending along second axis A2 is formed at a front end portion of a lower surface of upper wall 49.

[0163] A front end portion and a rear end portion of protruding plate part 624 of upper flange 62 of bobbin 22 are inserted into recess 412 of front wall 46 and recess 413 of rear wall 47. Holding protrusion 625 of upper

flange 62 of bobbin 22 is inserted into holding groove 414 of upper wall 49. Engagement protrusion 638 of lower flange 63 of bobbin 22 is engaged with engagement hole 411 of lower wall 48. Accordingly, second block 4 is coupled to electromagnet block 2 (body block 10). In a state where second block 4 is coupled to electromagnetic block 2, left wall 45 of second holding base 41 faces a left side surface of coil 21 and covers coil 21 from a left side (see Fig. 2).

[0164] Protruding wall 415 protruding upward along first axis A1 is provided on an upper surface of upper wall 49. Protruding wall 415 extends forward and backward along third axis A3.

[0165] As illustrated in Fig. 13, holding recess 416 recessed rightward is formed at a lower end portion of a left surface of left wall 45. On a left surface of rear wall 47, holding recess 417 recessed rightward is formed along first axis A1.

[0166] Auxiliary wall 40 protrudes upward from an upper end of front wall 46. On a left surface of second holding base 41, holding groove 418 extending along first axis A1 is formed from auxiliary wall 40 to an upper portion of front wall 46. Holding groove 418 is used to hold auxiliary member 44.

[0167] As illustrated in Fig. 12, third terminal member 42 includes (here, two) leg pieces 421, center piece 422, first fixing piece 423, second fixing piece 424, and holding piece 425. Two leg pieces 421, center piece 422, first fixing piece 423, second fixing piece 424, and holding piece 425 are integrally made of a conductive metal material.

[0168] Leg piece 421 has a plate shape extending along first axis A1. Two leg pieces 421 are arranged along third axis A3. Leg piece 421 functions as a terminal (third terminal T3) connected to an external electric device. As illustrated in Fig. 1, leg piece 421 is exposed downward from case 9.

[0169] Center piece 422 has a plate shape extending upward from an upper end of leg piece 421. A right surface of center piece 422 faces a left surface of left wall 45 of second holding base 41.

[0170] First fixing piece 423 has a plate shape extending rightward from a lower end of center piece 422 along second axis A2. First fixing piece 423 extends from a portion between two leg pieces 421 at the lower end of center piece 422.

[0171] Second fixing piece 424 has a plate shape extending rightward from a rear edge of center piece 422 along second axis A2. Second fixing piece 424 extends from a center of first axis A1 at the rear edge of center piece 422.

[0172] First fixing piece 423 is inserted into holding recess 416 of second holding base 41 from a left side. Second fixing piece 424 is inserted into holding recess 417 of second holding base 41 from a left side. Accordingly, third terminal member 42 is held by second holding base 41.

[0173] Left wall 45 and protruding wall 415 of second holding base 41 are interposed between third terminal member 42 and coil 21. Thus, second holding base 41 is arranged between coil 21 and third terminal member 42 and functions as an insulating member that insulates coil 21 from third terminal member 42 (see Fig. 17).

[0174] Holding piece 425 has a plate shape whose thickness axis is along first axis A1. Holding piece 425 extends rightward from an upper end of center piece 422. Holding piece 425 is positioned above upper wall 49 of second holding base 41. Holding piece 425 has through-hole 426 at a center.

[0175] Third terminal member 42 has through-hole 427 at a joint portion between center piece 422 and holding piece 425. Thus, a current flowing through holding piece 425 includes not only a component along second axis A2 but also a component along third axis A3. The current component along third axis A3 applies a Lorentz force in an orientation intersecting with first axis A1 to an arc that may be generated along first axis A1 between first movable contact M1 and first fixed contact F1, and thus, extinction of the arc is prompted.

[0176] As illustrated in Fig. 12, second fixed contact member 43 includes head portion 431 and body portion 432.

[0177] A shape of head portion 431 is a truncated cone shape. An axis of head portion 431 is along first axis A1.

[0178] An upper surface of head portion 431 functions as second fixed contact F2. An upper surface of second fixed contact member 43 functioning as second fixed contact F2 is made of, for example, a silver alloy (AgNi or $AgSnO_2$). A portion of second fixed contact member 43 other than second fixed contact F2 is made of, for example, a copper alloy such as tough pitch copper. A surface (upper surface) of second fixed contact member 43 functioning as second fixed contact F2 has a spherical shape. Note that, the surface (upper surface) of second fixed contact member 43 functioning as second fixed contact F2 may have a planar shape or a dome shape.

[0179] Body portion 432 protrudes from a lower end of head portion 431. Body portion 432 is inserted into through-hole 426 of holding piece 425 of third terminal member 42. Second fixed contact member 43 is fixed to third terminal member 42 by caulking in a state where body portion 432 passes through through-hole 426 of holding piece 425. Accordingly, second fixed contact member 43 is electrically connected to third terminal member 42.

[0180] Note that, second fixed contact member 43 may be formed integrally with third terminal member 42. For example, a part of a metal plate constituting third terminal member 42 may protrude upward, the protruding portion may be used as second fixed contact member 43, and a distal end of the protruding portion may be used as second fixed contact F2.

[0181] As illustrated in Figs. 2 and 17, in a state where second block 4 is fixed to body block 10, second fixed contact F2 faces second movable contact M2 along first axis A1. Movable piece 38 of second movable spring 31

moves up and down, and thus, second movable contact M2 comes into contact with or is separated from second fixed contact F2. That is, in second contact device C2, second movable contact M2 comes into contact with or is separated from second fixed contact F2 in accordance with the rotation of armature 33 corresponding to the turning on and off of the energization of coil 21. In addition, protruding wall 415 is interposed between second fixed contact F2 and iron core 23 (magnetic pole portion 231).

[0182] As illustrated in Fig. 12, auxiliary member 44 includes side piece 441 and upper piece 442.

[0183] Side piece 441 and upper piece 442 are integrally made of a conductive metal material.

[0184] Side piece 441 has a plate shape extending along first axis A1. Side piece 441 has, on a right side surface, recess 443 recessed leftward along second axis A2. Recess 443 positions auxiliary member 44 with respect to second holding base 41 on first axis A1.

[0185] Upper piece 442 has a plate shape extending rearward from an upper end of side piece 441 along third axis A3. Protrusion 444 protruding downward from the other portion of upper piece 442 is provided on a lower surface of upper piece 442. A lower surface of protrusion 444 faces an upper surface of body portion 322 of second movable contact member 32.

[0186] Upper piece 442 of auxiliary member 44 is above second movable contact member 32, and thus, even though second movable spring 31 vibrates when second movable contact M2 is separated from second fixed contact F2 and second movable spring 31 moves upward, excessive vibration of second movable spring 31 is suppressed.

(2.5) Relay body

[0187] Relay body 1 is formed by coupling electromagnet block 2, movable block 3, first block 5, and second block 4.

[0188] For example, two fixing protrusions 253 of first yoke 251 of electromagnetic block 2 are inserted into two fixing holes 311 of fixing piece 36 of second movable spring 31 of movable block 3, and distal ends of fixing protrusion 253 are crushed. Accordingly, movable block 3 is fixed to electromagnet block 2. Accordingly, body block 10 in which electromagnet block 2 and movable block 3 are coupled to each other is formed (see Fig. 3).

[0189] In addition, protruding plate part 624 of upper flange 62 of bobbin 22 is inserted into recesses 412 and 413 of second holding base 41, holding protrusion 625 of upper flange 62 is inserted into holding groove 414 of second holding base 41, and engagement protrusion 638 (see Fig. 9) of lower flange 63 is engaged with engagement hole 411 of second holding base 41. Accordingly, second block 4 is fixed to body block 10 (see Fig. 2).

[0190] In addition, the pair of first protrusions 246 of insulating member 24 is inserted into the pair of first fitting recesses 565 of first holding base 56 to engage claw 249 with engagement hole 566, and the pair of second protrusions 247 of insulating member 24 is inserted (here, press-fitted) into the pair of second fitting recesses 568 of first holding base 56. Accordingly, first block 5 is fixed to body block 10 (see Fig. 2).

[0191] From another point of view, relay body 1 of electromagnetic relay 100 includes base B1 made of a material having electrical insulation properties, a plurality of conductive components held by base B1 to form an electric path (main electric path or auxiliary electric path), and an electromagnetic device held by base B1 to open or close the electric path.

[0192] Here, base B1 includes first holding base 56, second holding base 41, bobbin 22, and insulating member 24. First holding base 56, second holding base 41, bobbin 22, and insulating member 24 are coupled to each other.

[0193] Here, the plurality of conductive components include first terminal member 51, second terminal member 53, first movable spring 54 (movable contactor N1), third terminal member 42, and second movable spring 31 (fourth terminal member 30). The plurality of conductive components further include first fixed contact member 52, first movable contact member 55, second fixed contact member 43, and second movable contact member 32. First terminal member 51, second terminal member 53, and first movable spring 54 (in addition, first fixed contact member 52 and first movable contact member 55) form the auxiliary electric path. third terminal member 42 and second movable spring 31 (in addition, second fixed contact member 43 and second movable contact member 32) form the main electric path. The conductive component forming the main electric path and the conductive component forming the auxiliary electric path are electrically insulated.

[0194] In electromagnetic relay 100 according to the present exemplary embodiment, the conductive component forming the main electric path and the conductive component forming the auxiliary electric path are held by integrally coupled base B1. Accordingly, it is possible to reduce the size as compared with a case where a plurality of base bodies are separated from each other and a plurality of conductive components are held by the plurality of base bodies.

[0195] The electromagnetic device includes coil 21, yoke 25, coil terminal 26, armature 33, and card 34. The electromagnetic device opens or closes the main electric path and opens or closes the auxiliary electric path in accordance with the turning on and off of the energization to coil 21.

[0196] Next, an operation of relay body 1 according to the present exemplary embodiment (operation of electromagnetic relay 100) will be described.

[0197] In relay body 1, in a state where a voltage is not applied between two coil terminals 26 and coil 21 is not energized (hereinafter, also referred to as "at the time of non-energization"), second movable contact M2 is separated from second fixed contact F2 by a spring force of

second movable spring 31 as illustrated in Fig. 2. Thus, the electric path (main electric path) between leg piece 421 (third terminal T3) of third terminal member 42 and leg piece 35 (fourth terminal T4) of second movable spring 31 (fourth terminal member 30) is cut off.

[0198] In addition, at the time of non-energization, as illustrated in Figs. 2 and 14, first movable contact M1 comes into contact with first fixed contact F1 by the spring force of first movable spring 54. Thus, the electric path (auxiliary electric path) is formed between leg piece 511 (first terminal T1) of first terminal member 51 and leg piece 531 (second terminal T2) of second terminal member 53. As illustrated in Figs. 2 and 14, protrusion 343 (moving member R1) of card 34 is positioned below first movable spring 52 (movable contactor N1) and is separated from first movable spring 54.

[0199] In relay body 1, when a voltage is applied between two coil terminals 26 and coil 21 is energized (hereinafter, also referred to as "at the time of energization"), armature 33 is attracted downward toward magnetic pole portion 231 along first axis A1 by the attraction force generated between the armature and magnetic pole portion 231 of iron core 23. Accordingly, armature 33 rotates with hook piece 333 as a fulcrum (counterclockwise in front view), and the lower surface of armature 33 comes into contact with the upper surface of magnetic pole portion 231 of iron core 23. At the time of energization, a magnetic circuit through which a magnetic flux generated by coil 21 passes is formed by iron core 23, yoke 25, and armature 33.

[0200] At the time of energization, second movable contact M2 moves downward together with armature 33 by the rotation of armature 33. As a result, second movable contact M2 comes into contact with second fixed contact F2 at the time of energization. Thus, the main electric path is formed.

[0201] In addition, at the time of energization, card 34 is moved upward by the rotation of armature 33, and first movable spring 54 is pushed upward by protrusion 343 coming into contact with first movable spring 54 from below. Accordingly, first movable contact M1 is separated from first fixed contact F1 as illustrated in Fig. 15. Thus, the auxiliary electric path is cut off.

[0202] In relay body 1, when the energization of coil 21 is stopped, the attractive force between iron core 23 and armature 33 disappears. Thus, in relay body 1, armature 33 rotates with hook piece 333 as a fulcrum (clockwise in front view) by the spring force of first movable spring 31, and armature 33 is separated from iron core 23. By the rotation of armature 33, second movable contact M2 moves upward together with armature 33 and is separated from second fixed contact F2. Accordingly, the main electric path is cut off. In addition, by the rotation of armature 33, protrusion 343 of card 34 moves downward and is separated from first movable spring 52. First movable contact M1 moves downward by a spring force of first movable spring 52 and comes into contact with second fixed contact F2. Accordingly, the auxiliary electric path is formed.

[0203] As described above, in relay body 1 (electromagnetic relay 100) according to the present exemplary embodiment, first movable spring 54 (movable contactor N1) is movable between a first closed position and a first opened position in accordance with switching between excitation and non-excitation of coil 21. The first closed position is a position of first movable spring 54 at which first movable contact M1 comes into contact with first fixed contact F1 (see Fig. 14). The first opened position is a position of first movable spring 31 at which first movable contact M1 is separated from first fixed contact F1 (see Fig. 15). In electromagnetic relay 100 according to the present exemplary embodiment, protrusion 343 (moving member R1) of card 34 causes first movable contact M1 to come into contact with or be separated from first fixed contact F1 in accordance with switching between excitation and non-excitation of coil 21.

[0204] In addition, in relay body 1 (electromagnetic relay 100) according to the present exemplary embodiment, second movable spring 31 is movable between the second closed position and the second opened position in accordance with switching between excitation and non-excitation of coil 21. The second closed position is a position of second movable spring 31 at which second movable contact M2 comes into contact with second fixed contact F2. The second opened position is a position of second movable spring 52 at which second movable contact M2 is separated from second fixed contact F2.

[0205] In electromagnetic relay 100 according to the present exemplary embodiment, the main electric path is formed and the auxiliary electric path is cut off at the time of energization. In addition, in addition, the main electric path is cut off and the auxiliary electric path is formed at the time of non-energization. Thus, for example, in a case where it is detected that the auxiliary electric path is cut off even at the time of non-energization, it can be determined that a defect (welding between second fixed contact F2 and second movable contact M2, or the like) occurs in the main electric path.

[0206] Incidentally, when protrusion 343 (moving member R1) of card 34 moves upward from a state of being separated from first movable spring 54 (movable contactor N1) to come into contact with first movable spring 54, or moves upward to push up first movable spring 54 after the contact, protrusion 343 rubs against first movable spring 54 at contact point P1, and there is a possibility that cutting residue (foreign matter) is generated.

[0207] In addition, when protrusion 343 (moving member R1) moves downward from a state of pushing up first movable spring 54 (movable contactor N1), protrusion 343 rubs against first movable spring 54 at contact point P1, and thus, there is a possibility that the cutting residue (foreign matter) is generated. When the generated foreign matter reaches between first fixed contact F1 and first movable contact M1, the foreign matter is sand-

wiched between first fixed contact F1 and first movable contact M1, and thus, there is a possibility that the defect such as the contact failure occurs. When the contact failure occurs between first fixed contact F1 and first movable contact M1, since the auxiliary electric path is cut off even at the time of non-energization, there is a possibility that it is erroneously determined that the defect occurs in the main electric path.

[0208] As described above, first contact device C1 of electromagnetic relay 100 according to the present exemplary embodiment includes first wall 571 (wall W1) positioned between contact point P1 and first fixed contact F1 as viewed from above. Thus, even though the foreign matter is generated at contact point P1, the foreign matter hardly reaches fixed contact F1 spatially separated from contact point P1, and hardly reaches fixed contact F1 since the foreign matter is blocked by wall W1. Accordingly, in electromagnetic relay 100 according to the present exemplary embodiment, it is possible to reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

[0209] In addition, in first contact device C1 of electromagnetic relay 100, protrusion 343 (moving member R1) is positioned below first movable spring 54 (movable contactor N1), and comes into contact with the lower surface of first movable spring 54. Further, in first contact device C1, first fixed contact F1 is positioned below first movable contact M1. That is, contact point P1, first fixed contact F1, and first wall 571 (wall W1) are positioned on the same side (lower side) with respect to first movable spring 54 (movable contactor N1). In the case of this structure, as compared with a case where the contact point and the first fixed contact are positioned on sides opposite to each other with respect to the first movable spring, there is a high possibility that the foreign matter generated at the contact point reaches the first fixed contact. That is, in first contact device C1, in the structure in which contact point P1, first fixed contact F1, and first wall 571 (wall W1) are on the same side with respect to first movable spring 54 (movable contactor N1), since first wall 571 (wall W1) is provided, an effect of shielding the foreign matter by providing first wall 571 (wall W1) is large.

[0210] In addition, in first contact device C1 of electromagnetic relay 100, first movable spring 54 (movable contactor N1) includes holding piece 544 (contact part), spring piece 542 (movable part), and connecting piece 543 (connecting part). Connecting piece 543 faces first wall 571 (wall W1). In addition, first wall 571 is positioned between connecting piece 543 of first movable spring 54 and first terminal member 51. Accordingly, it is possible to block the foreign matter generated at contact point P1 from reaching first fixed contact F1 by connecting piece 543 (connecting part), and it is possible to further reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

[0211] In addition, in first contact device C1 of electromagnetic relay 100, first fixed contact F1 is positioned above contact point P1. Accordingly, for example, in a case where electromagnetic relay 100 is used in an orientation of Fig. 14, the generated foreign matter hardly reaches first fixed contact F1, and it is possible to reduce the occurrence of the defect in this use aspect. In addition, in a case where first fixed contact F1 is positioned above contact point P1 and first movable spring 54 has connecting piece 543, the foreign matter generated at contact point P1 is more easily blocked by connecting piece 543 (connecting part). In addition, first movable spring 54 (movable contactor N1) having the Z shape and including connecting piece 543 (connecting part) can be easily used.

[0212] In addition, in first contact device C1 of electromagnetic relay 100, as illustrated in Fig. 15, first wall 571 (wall W1) is positioned on line L1 connecting first fixed contact F1 and contact point P1.

[0213] In first contact device C1, connecting piece 543 (connecting part) of first movable spring 54 (movable contactor N1) is further positioned on line L1. Accordingly, it is possible to block the foreign matter generated at contact point P1 from reaching first fixed contact F1 by first wall 571 (wall W1) and connecting piece 543 (connecting part). The foreign matter hardly reaches first fixed contact F1, and it is possible to reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

[0214] In addition, in electromagnetic relay 100, second fixed contact F2 of second contact device C2 is positioned to be spatially separated from first fixed contact F1 and contact point P1 of first contact device C1. Thus, even though protrusion 343 (moving member R1) rubs against first movable spring 54 (movable contactor N1) at contact point P1 to generate the foreign matter, the foreign matter hardly reaches second fixed contact F2. Accordingly, it is possible to reduce the occurrence of the defect such as the contact failure between second fixed contact F2 and second movable contact M2.

[0215] In addition, in electromagnetic relay 100, on second axis A2, vertical wall 562 and card wall 341 are positioned between second fixed contact F2 of second contact device C2 and first fixed contact F1 and contact point P1 of first contact device C1. Accordingly, the foreign matter generated at contact point P1 further hardly reaches second fixed contact F2.

(2.6) Case

[0216] As illustrated in Figs. 1 and 2, case 9 houses relay body 1. Thus, case 9 houses coil 21, iron core 23, armature 33, first fixed contact F1, first movable spring 54, second fixed contact F2, second movable spring 31, and card 34. Case 9 also houses base B1. Case 9 is, for example, a synthetic resin molded body having electrical insulation properties, and has insulation properties.

[0217] As illustrated in Figs. 1, 2, and 16, case 9

includes case body 90. Case body 90 constitutes an outer shell of case 9. Case body 90 has a rectangular box shape with an opened lower surface. Case body 90 includes upper wall 91, front wall 92, rear wall 93, right wall 94, and left wall 95.

[0218] As illustrated in Fig. 16, case 9 further includes first ridge part 961 and two first connecting parts 962 inside case body 90. First ridge part 961 has a plate shape extending along first axis A1. First ridge part 961 extends along second axis A2. First ridge part 961 faces front wall 92 with a gap on third axis A3. Two first connecting parts 962 connect both end portions of first ridge part 961 on second axis A2 and a rear surface of front wall 92. First recess 96 having an opened lower surface is formed by front wall 92 of case body 90, first ridge part 961, and two first connecting parts 962.

[0219] Case 9 further includes second ridge part 971 (see Fig. 17) and two second connecting parts inside case body 90. Second ridge part 971 has a plate shape extending along first axis A1. Second ridge part 971 extends along second axis A2. The second ridge part faces rear wall 93 with a gap on third axis A3. The two second connecting parts connect both end portions of second ridge part 971 on second axis A2 and a front surface of rear wall 93. Rear wall 93, second ridge part 971, and the two second connecting parts of case body 90 form a second recess having an opened lower surface.

[0220] First wall 64 (more specifically, projection rib 642) of upper flange 62 of bobbin 22 is inserted into first recess 96. In addition, second wall 65 (more specifically, projection rib 652) of upper flange 62 of bobbin 22 is inserted into the second recess.

[0221] As illustrated in Fig. 16, case 9 further includes case wall 98 inside case body 90. Case wall 98 has a plate shape extending downward along first axis A1 from a lower surface of upper wall 91 of case body 90. Case wall 98 extends along third axis A3, and divides the lower surface of upper wall 91 of case body 90 into a left side and a right side. Recess 981 recessed upward is formed at a center of third axis A3 at a lower end of case wall 98.

[0222] As illustrated in Fig. 17, in electromagnetic relay 100, case wall 98 is arranged between armature 33 and first movable spring 54. In addition, as illustrated in Fig. 17, card wall 341 and case wall 98 overlap each other on second axis A2. In electromagnetic relay 100, case 9 includes case wall 98, and thus, the foreign matter generated at contact point P1 further hardly reaches second fixed contact F2.

[0223] As illustrated in Figs. 16 and 17, case 9 further includes guide rib 99 inside case body 90. Case 9 includes two guide ribs 99. Guide rib 99 has a plate shape extending downward from the lower surface of upper wall 91 of case body 90. Guide rib 99 is an inclined surface whose lower side surface is inclined from the upper left to the lower right. A right side surface of guide rib 99 is connected to a left surface of case wall 98. Guide ribs 99 prevent position deviation of case 9 with respect to first holding base 56 (relay body 1) when case 9 is assembled to relay body 1. That is, in a case where case 9 is to be assembled to relay body 1 in a state of being arranged on a left side relative to relay body 1, the lower side surface (inclined surface) of guide rib 99 comes into contact with an upper side surface of vertical wall 562 of relay body 1. Accordingly, case 9 is guided to move rightward along second axis A2, and position deviation of case 9 with respect to first holding base 56 (relay body 1) is prevented.

(3) Modifications

[0224] The exemplary embodiment described above is merely one of various exemplary embodiments of the present disclosure. The exemplary embodiment described above can be variously changed according to a design and the like as long as the object of the present disclosure can be achieved. Hereinafter, modifications of the exemplary embodiment will be listed. The exemplary embodiment described above and the modifications to be described below can be applied in appropriate combination.

(3.1) Modification 1

[0225] Contact device C1 and electromagnetic relay 100 according to the present modification will be described with reference to Fig. 18.

[0226] In contact device C1 and electromagnetic relay 100 according to the present modification, the description of the configuration similar to contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above may be appropriately omitted.

[0227] Contact device C1 according to the exemplary embodiment described above has a structure (hereinafter, also referred to as a "lift-off structure") in which a contact pressure between first movable contact M1 and first fixed contact F1 is secured by the spring force of first movable spring 54. On the other hand, electromagnetic relay 100 according to the present modification has a structure (hereinafter, also referred to as a "Friction Stir Welding") in which the contact pressure between first movable contact M1 and first fixed contact F1 is secured by pushing first movable spring 54A by protrusion 343A (moving member R1) of card 34A.

[0228] More specifically, as illustrated in Fig. 18, first movable spring 54A (movable contactor N1) includes fixing piece 541A and spring piece 542A (movable part), connecting piece 543A (connecting part), and holding piece 544A (contact part). In addition, card 34A includes card wall 341A and protrusion 343A (moving member R1). Protrusion 343A is positioned above first movable spring 51A. Protrusion 343A faces an upper surface of first movable spring 54A. Protrusion 343A comes into contact with an upper surface (contact point P1) of first movable spring 54A from above. Dome-shaped protru-

sion 344A protruding downward is provided on a lower surface of protrusion 343A.

[0229] At the time of non-energization, as illustrated in Fig. 18, first movable spring 54A is pushed from above at contact point P1 by protrusion 343A, and thus, first movable contact M1 on a lower surface of first movable contact member 55A held by first movable spring 54A comes into contact with first fixed contact F1 on an upper surface of first fixed contact member 52 held by first terminal member 51. Thus, the auxiliary electric path is formed.

[0230] At the time of energization, protrusion 343A (moving member R1) moves upward together with card wall 341A, and protrusion 343A is separated from first movable spring 54A. First movable contact M1 moves upward by a spring force of first movable spring 54A, and first movable contact M1 is separated from first fixed contact F1.

[0231] As described above, in contact device C1 and electromagnetic relay 100 according to the present modification, protrusion 343A (moving member R1) of card 34A moves first movable spring 54A (movable contactor N1) while coming into contact with the upper surface of first movable spring 54A, and thus, first movable contact M1 is brought into contact with first fixed contact F1.

[0232] Since contact device C1 and electromagnetic relay 100 according to the present modification also include first wall 571 (wall W1), the foreign matter generated at contact point P1 hardly reaches first fixed contact F1. Accordingly, it is possible to reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

[0233] In addition, contact device C1 and electromagnetic relay 100 according to the present modification have the Friction Stir Welding, and thus, first fixed contact F1 and contact point P1 are positioned on a side opposite to first movable spring 54A (movable contactor N1). Accordingly, it is possible to effectively block the foreign matter generated at contact point P1 from reaching first fixed contact F1 by first movable spring 54A (movable contactor N1) in addition to first wall 571 (wall W1).

[0234] Note that, in the lift-off structure, since first movable contact M1 is brought into contact with first fixed contact F1 by the spring force of first movable spring 54, there is an advantage that the contact pressure is easily stabilized as compared with the Friction Stir Welding. In addition, in the lift-off structure, there is an advantage that reliability of separation in a case where first movable contact M1 is separated from first fixed contact F1 is high. On the other hand, the Friction Stir Welding has an advantage that reliability of contact in a case where first movable contact M1 is brought into contact with first fixed contact F1 is high.

(3.2) Modification 2

[0235] Contact device C1 and electromagnetic relay 100 according to the present modification will be described with reference to Figs. 19 and 20. Contact device C1 and electromagnetic relay 100 according to the present modification include first movable spring 54B having a different shape from first movable spring 54 of contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above. In contact device C1 and electromagnetic relay 100 according to the present modification, the description of the configuration similar to contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above may be appropriately omitted.

[0236] As illustrated in Figs. 19 and 20, first terminal member 51B of contact device C1 according to the present modification includes leg piece 511B, center piece 512B, and holding piece 513B. An upper end of center piece 512B of contact device C1 according to the present modification is positioned lower than the upper end of center piece 512 of contact device C1 according to the exemplary embodiment.

[0237] In addition, first movable spring 54B includes fixing piece 541B, spring piece 542B, connecting piece 543B, and holding piece 544B.

[0238] Fixing piece 541B is fixed to fixing piece 533 of second terminal member 53. Spring piece 542B has a plate shape extending rearward from an upper end of fixing piece 541B, and has flexibility.

[0239] Connecting piece 543B connects spring piece 542B and holding piece 544B. As illustrated in Fig. 20, connecting piece 543B includes first connecting piece 547B, second connecting piece 548B, and third connecting piece 549B.

[0240] First connecting piece 547B has a plate shape extending upward from a rear end of spring piece 542B. First connecting piece 547B faces a front surface of first wall 571 (wall W1). First wall 571 (wall W1) is positioned between first connecting piece 547B and vertical plate piece 512B of center piece 515B of first terminal member 51B on third axis A3.

[0241] Second connecting piece 548B has a plate shape extending rearward from an upper end of first connecting piece 547B. Second connecting piece 548B faces an upper edge of first wall 571 (wall W1). Second connecting piece 548B covers first wall 571 (wall W1) from above. As illustrated in Fig. 19, in a state where first movable contact M1 comes into contact with first fixed contact F1, gap G1 is formed between an upper end of first wall 571 (wall W1) and a lower surface of first movable spring 54B (lower surface of second connecting piece 548B). A size of gap G1 may be, for example, more than or equal to 0.10 mm, more than or equal to 0.15 mm, or more than or equal to 0.20 mm. In addition, the size of gap G1 may be less than or equal to 5.0 mm, less than or equal to 2.0 mm, less than or equal to 1.0 mm, or less than or equal to 0.40 mm.

[0242] Third connecting piece 549B has a plate shape extending downward from a rear end of second connecting piece 548B. Third connecting piece 549B faces a rear surface of first wall 571 (wall W1). In a state where first

movable contact M1 comes into contact with first fixed contact F1 (see Fig. 19), a lower end of third connecting piece 549B is positioned below the upper end of first wall 571 (wall W1).

[0243] Holding piece 544B has a plate shape extending rearward from a rear end (here, lower end of third connecting piece 549B) of connecting piece 543B. Holding piece 544B holds first movable contact member 55B.

[0244] In a state where first movable contact M1 comes into contact with first fixed contact F1, entire holding piece 544B is positioned below the upper end of first wall 571 (wall W1).

[0245] In short, first movable spring 54B of electromagnetic relay 100 according to the present modification includes connecting piece 543B (connecting part) that connects spring piece 542B (movable part) and holding piece 544B (contact part).

[0246] Connecting piece 543B has an inverted U shape in side view and covers the upper end portion of first wall 571 (wall W1) from three sides of an upper side, a front side, and a rear side to surround the upper end portion.

[0247] Since contact device C1 and electromagnetic relay 100 according to the present modification also include first wall 571 (wall W1), the foreign matter generated at contact point P1 hardly reaches first fixed contact F1. Accordingly, it is possible to reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

[0248] In addition, in contact device C1 and electromagnetic relay 100 according to the modification, since a lower surface of holding piece 544B is positioned below the upper end of first wall 571 (wall W1), the foreign matter generated at contact point P1 further hardly reaches first fixed contact F1, and the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1 can further be reduced.

[0249] Note that, even in a state where first movable contact M1 is separated from first fixed contact F1, first movable contact M1 may be positioned below the upper end of first wall 571 (wall W1). It is possible to further reduce the occurrence of the defect.

(3.3) Modification 3

[0250] Contact device C1 and electromagnetic relay 100 according to the present modification will be described with reference to Figs. 21 and 22. Contact device C1 and electromagnetic relay 100 according to the present modification are different from contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above mainly in that wall W1 is formed as a separate body from first holding base 56 (base B1). In contact device C1 and electromagnetic relay 100 according to the present modification, the description of the configuration similar to contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above may be appropriately omitted.

[0251] Contact device C1 according to the present modification includes first terminal member 51C, first fixed contact member 52C, second terminal member 53C, first movable spring 54C (movable contactor N1), and first movable contact member 55C.

[0252] First terminal member 51C includes leg piece 511C, center piece 512C, and holding piece 513C.

[0253] Leg piece 511C has a plate shape extending along first axis A1. Leg piece 511C functions as a terminal (first terminal T1) connected to an external electric device.

[0254] Center piece 512C includes connecting piece 514C extending rearward from an upper end of leg piece 511C and vertical plate piece 515C extending along first axis A1. Connecting piece 514C extends forward from the middle of first axis A1 of vertical plate piece 515C.

[0255] Holding piece 513C has a plate shape extending forward from an upper end of center piece 512C.

[0256] First fixed contact member 52C is held by holding piece 513C. In contact device C1 according to the present modification, a lower surface of first fixed contact member 52C functions as first fixed contact F1.

[0257] Second terminal member 53C includes leg piece 531C, center piece 532C, and fixing piece 533C.

[0258] Leg piece 531C has a plate shape extending along first axis A1. Leg piece 531C functions as a terminal (second terminal T2) connected to an external electric device.

[0259] Center piece 532C has a plate shape extending upward from an upper end of leg piece 531C.

[0260] Fixing piece 533C has a plate shape extending upward from an upper end of center piece 532C. First movable spring 54C is fixed to fixing piece 533C.

[0261] First movable spring 54C includes fixing piece 541C, spring piece 542C, connecting piece 543C, and holding piece 544C.

[0262] Fixing piece 541C is fixed to second terminal member 53C. Spring piece 542C has a plate shape extending rearward from an upper end of fixing piece 541C, and has flexibility. Connecting piece 543C has a plate shape extending upward from a rear end of spring piece 542C. Holding piece 544C has a plate shape extending rearward from an upper end of connecting piece 543C.

[0263] First movable contact member 55C is held by holding piece 544C. In contact device C1 according to the present modification, an upper surface of first movable contact member 55C functions as first movable contact M1.

[0264] In electromagnetic relay 100 according to the present modification, first fixed contact F1 is positioned above first movable contact M1. That is, first fixed contact F1 and first movable contact M1 vertically face each other such that first movable contact M1 is positioned on a lower side and first fixed contact F1 is positioned on an upper side.

[0265] Card 34C moves up and down along first axis A1 in accordance with the movement of armature 33 (see Figs. 2 and 3). Card 34C includes card wall 341C, tubular portion 342C, protrusion 343C, and protrusion 344C.

[0266] Card wall 341C has a rectangular plate shape. Tubular portion 342 C has a rectangular tubular shape and protrudes leftward from a first surface (left surface) of card wall 341C. Card 34C is fixed to armature 33 by inserting protrusion 334 of armature 33 into tubular portion 342C. Protrusion 343C protrudes rightward from a second surface (right surface) of card wall 341C. Protrusion 343C has a stepped shape having a step on a lower surface side in side view viewed from a right side. Protrusion 344C is provided on a lower surface of protrusion 343C. Protrusion 344C has a dome shape protruding downward.

[0267] Protrusion 343C moves downward in accordance with the rotation of armature 33 to come into contact with an upper surface of first movable spring 54C and move first movable spring 54C downward while pressing first movable spring 54C. Accordingly, first movable contact M1 connected to first movable spring 54C also moves downward and is separated from first fixed contact F1.

[0268] In addition, protrusion 343C is separated from first movable spring 54C by moving upward in accordance with the rotation of armature 33. First movable spring 54C moves upward by a spring force of first movable spring 54C. Accordingly, first movable contact M1 connected to first movable spring 54C also moves upward and comes into contact with first fixed contact F1 (see Fig. 21).

[0269] In electromagnetic relay 100 according to the present modification, for example, when first movable contact M1 comes into contact with first fixed contact F1, second movable contact M2 also comes into contact with second fixed contact F2. In addition, when first movable contact M1 is separated from first fixed contact F1, second movable contact M2 is also separated from second fixed contact F2.

[0270] Contact device C1 according to the present modification includes support base 59 as a separate body from first holding base 56. Support base 59 is formed in an inverted U shape in side view by a pair of vertical plate parts 591 and horizontal plate part 592 connecting upper ends of vertical plate parts 591.

[0271] Contact device C1 further includes protruding wall 590 (wall W1). Protruding wall 590 has a plate shape extending downward from a lower surface of horizontal plate part 592. Protruding wall 590 is positioned between protrusion 343C (moving member R1) and first fixed contact member 52C on second axis A2. Thus, protruding wall 590 is positioned between contact point P1 and first fixed contact F1 as viewed from above.

[0272] Since contact device C1 and electromagnetic relay 100 according to the present modification also include protruding wall 590 (wall W1), the foreign matter generated at contact point P1 hardly reaches first fixed contact F1. Accordingly, it is possible to reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

(3.4) Modification 4

[0273] Contact device C1 and electromagnetic relay 100 according to the present modification will be described with reference to Figs. 23 and 24. Contact device C1 and electromagnetic relay 100 according to the present modification are different from contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above mainly in that wall W1 includes protruding wall 570. In contact device C1 and electromagnetic relay 100 according to the present modification, the description of the configuration similar to contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above may be appropriately omitted.

[0274] As illustrated in Figs. 23 and 24, protective wall 57 of contact device C1 according to the present modification includes protruding wall 570 in addition to first wall 571, second wall 572, and third wall 573.

[0275] Protruding wall 570 protrudes forward along third axis A3 from an upper end edge of first wall 571. Wall W1 includes protruding wall 570 and first wall 571, and has an inverted L shape in which upper and lower sides are inverted in side view as viewed from a right side. A protrusion dimension (dimension along third axis A3) of protruding wall 570 from first wall 571 is set to a size in which a distal end (front end) of protruding wall 570 does not come into contact with first movable spring 54. In a state where first movable contact M1 comes into contact with first fixed contact F1, gap G2 is formed between the distal end of protruding wall 570 and first movable spring 54 (movable contactor N1).

[0276] Wall W1 including protruding wall 570 and first wall 571 is positioned between contact point P1 at which protrusion 343 (moving member R1) of card 34 comes into contact with first movable spring 54 (movable contactor N1) and first fixed contact F1. In contact device C1 according to the present modification, wall W1 includes protruding wall 570, and thus, the foreign matter generated at contact point P1 is blocked by protruding wall 570 and hardly reaches first fixed contact F1. Thus, it is possible to further reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

[0277] Note that, in contact device C1 and electromagnetic relay 100 according to the modification, a protruding direction of protruding wall 570 is not limited to a direction along third axis A3, and may be inclined obliquely upward or obliquely downward with respect to third axis A3. In addition, protruding wall 570 may protrude from a portion other than the upper end of first wall 571 (a midway position in first axis A1). In addition, protective wall 57 may further include a protruding wall protruding rearward

along third axis A3 from the upper end edge of first wall 571, and wall W1 may have a T shape in side view. In addition, protective wall 57 may include only protruding wall 570 without including first wall 571, and for example, may be formed such that protruding wall 570 extends forward and rightward from an upper end of a front edge of third wall 573.

(3.5) Modification 5

[0278] Contact device C1 and electromagnetic relay 100 according to the present modification will be described with reference to Figs. 25 to 27. Contact device C1 and electromagnetic relay 100 according to the present modification are different from contact device C1 and electromagnetic relay 100 according to the exemplary embodiment described above mainly in a positional relationship between first fixed contact F1 and contact point P1 (moving member R1), a structure of first movable spring 54D (movable contactor N1), and protrusion S1.

[0279] As illustrated in Figs. 25 to 27, in first movable spring 54D, fixing piece 541D is fixed to second terminal member 53D, and spring piece 542D (movable part) extends rearward from a lower end of fixing piece 541D.

[0280] Connecting piece 543D (connecting part) extends downward from a second end (rear end) of spring piece 542D.

[0281] Accordingly, as illustrated in Figs. 26 and 27, first movable contact M1 on a lower surface of first movable contact member 55D provided on holding piece 544D (contact part) is positioned below spring piece 542D. In addition, an upper end of center piece 512D of first terminal member 51D of contact device C1 according to the present modification is positioned lower than the upper end of center piece 512 of contact device C1 (see Fig. 14) according to the exemplary embodiment. As illustrated in Fig. 27, first fixed contact F1 on an upper surface of first fixed contact member 52D provided on holding piece 513D is positioned below contact point P1. Accordingly, for example, in a case where contact device C1 is used in an orientation in which movable contact M1 is positioned below fixed contact F1, the foreign matter generated at contact point P1 hardly reaches fixed contact (F1).

[0282] In addition, connecting piece 543D according to the present modification is shorter than connecting piece 543 according to the exemplary embodiment. Thus, first movable spring 54D has higher rigidity and is less likely to vibrate than first movable spring 54 according to the exemplary embodiment. For example, when holding piece 544D moves upward (see Fig. 27) by spring piece 542D being pushed by moving member R1 from a state where first movable contact M1 comes into contact with first fixed contact F1 (see Fig. 26), holding piece 544D may vibrate up and down. However, in accordance with first movable spring 54D according to the present modification, the magnitude of the vibration can be suppressed by high rigidity. Accordingly, it is possible to reduce a possibility that first movable spring 54D (movable contactor N1) comes into contact with first wall 571D (wall W1). In addition, even though the foreign matter (cutting residue or the like) adheres to first movable spring 54D, a possibility that the foreign matter is peeled off from first movable spring 54D by vibration is reduced.

[0283] An upper end of first wall 571D of contact device C1 according to the present modification is positioned lower than the upper end of first wall 571 of contact device C1 (see Fig. 14) according to the exemplary embodiment. Connecting piece 543D is positioned between first wall 571D and fixed contact F1 on third axis A3 and faces first wall 571D.

[0284] Contact device C1 further includes protruding piece 580D (protrusion S1). As illustrated in Fig. 25, protruding piece 580D (protrusion S1) protrudes from spring piece 542D (movable part) of first movable spring 54D (movable contactor N1).

[0285] Protruding piece 580D (protrusion S1) is formed integrally with spring piece 542D (movable part). Here, protruding piece 580D (protrusion S1) is formed by cutting and raising a part of a plate material constituting spring piece 542D (movable part). Accordingly, spring piece 542D at which protruding piece 580D is provided can be easily formed from one member. As illustrated in Fig. 25, opening U1 is formed in a portion of spring piece 542D where protruding piece 580D is cut and raised.

[0286] Opening U1 (and protruding piece 580D) has, for example, a trapezoidal shape. Note that, in Figs. 26, 27, and the like, opening U1 is illustrated for the sake of convenience in order to specify a position of opening U1, but opening U1 is not actually seen by being hidden by spring piece 542D.

[0287] Protruding piece 580D is provided below spring piece 542D. In the present modification, protruding piece 580D (protrusion S1) is positioned on the same side (same side as moving member R1) as contact point P1 with respect to (movable part of) movable contactor N1. In addition, protruding piece 580D is provided at a position closer to first fixed contact F1 than a portion of spring piece 542D with which moving member R1 comes into contact. Protruding piece 580D (protrusion S1) is positioned between contact point P1 and first wall 571 (wall W1) as viewed from above.

[0288] (Surface close to spring piece 542D in) protruding piece 580D is inclined with respect to spring piece 542D.

[0289] As illustrated in Figs. 26 and 27, in contact device C1 according to the present modification, first movable contact M1 is positioned above first fixed contact F1, and moving member R1 is positioned below movable contactor N1. Protrusion S1 (protruding piece 580D) protrudes downward from the movable part (spring piece 542D), and is configured to approach moving member R1 as the protrusion extends downward. In contact device C1 according to the present modification,

a spatial distance between contact point P1 and first fixed contact F1 can be increased by providing such protrusion S1 (protruding piece 580D). Thus, even though the foreign matter is generated at contact point P1, the foreign matter hardly reaches first fixed contact F1. In addition, since the generated foreign matter is blocked by protruding piece 580D, the foreign matter hardly reaches first fixed contact F1. In addition, since the generated foreign matter is guided to an upper side of movable contactor N1 (side opposite to first fixed contact F1 with respect to movable contactor N1) through opening U1, it is further difficult for the foreign matter to reach first fixed contact F1. In addition, for example, in a case where contact device C1 is used such that third axis A3 is along a vertical direction, the foreign matter generated at contact point P1 can be received by protrusion S1. From the viewpoint of increasing the spatial distance between contact point P1 and first fixed contact F1 and from the viewpoint of blocking the foreign matter, an inclination angle of protruding piece 580D with respect to spring piece 542D may be more than or equal to 30 degrees, or may be more than or equal to 40 degrees. From the viewpoint of easily receiving the foreign matter, the inclination angle of protruding piece 580D with respect to spring piece 542D may be less than or equal to 90 degrees, less than or equal to 75 degrees, or less than or equal to 60 degrees.

[0290] Note that, a shape of protrusion S1 is not limited to the shape (protruding piece 580D) illustrated in Fig. 25. For example, protrusion S1 may be formed in a louver shape as illustrated in Figs. 28A to 28C.

[0291] Alternatively, as illustrated in Figs. 29A and 29B, protrusion S1 may be formed in a bridge shape (so-called "lance bending") by partially cutting and tightening the movable part (spring piece 542D) in a bridge shape. Alternatively, as illustrated in Figs. 30A and 30B, a part of the movable part (spring piece 542D) may be cut and bent in a Z-shape to form protrusion S1. Alternatively, as illustrated in Figs. 31A to 31C, protrusion S1 may be formed such that the movable part (spring piece 542) is beaded out. In addition, protrusion S1 may not be integrally formed with spring piece 542D (movable part), and may be formed by, for example, joining another member to spring piece 542D. In addition, protrusion S1 may be formed integrally with spring piece 542D by a method other than cutting and raising.

(3.6) Modification 6 to Modification 8

[0292] Contact device C1 and electromagnetic relay 100 according to Modification 6 to Modification 8 will be described with reference to Figs. 32 to 34. Main differences from contact device C1 and electromagnetic relay 100 of Modification 5 will be described below. Figs. 32 to 34 are side views illustrating main parts of relay body 1 of contact device C1 according to Modification 6 to Modification 8. Note that, Fig. 32 illustrates a state at the time of non-energization, and Figs. 33 and 34 illustrate states at the time of energization.

[0293] In contact device C1 according to Modification 6, as illustrated in Fig. 32, an upper surface of first fixed contact member 52E provided on first terminal member 51E functions as first fixed contact F1. In addition, a lower surface of first movable contact member 55E provided at a second end of first movable spring 54E (movable contactor N1) having a first end fixed to second terminal member 53E functions as first movable contact M1. Protruding piece 580E is provided in a movable part of first movable spring 54E (movable contactor N1). As illustrated in Fig. 32, first movable contact M1 is positioned above first fixed contact F1, and moving member R1 is positioned above movable contactor N1. Protrusion S1 (protruding piece 580E) protrudes upward from a movable part of movable contactor N1, and is configured to be separated from moving member R1 as the protrusion extends upward. In addition, wall W1 is arranged above movable contactor N1 (on the same side as contact point P1 with respect to movable contactor N1) such that a lower end of wall W1 is positioned between moving member R1 and first fixed contact F1.

[0294] In contact device C1 according to Modification 6, since first fixed contact F1 and moving member R1 are on sides opposite to movable contactor N1, the foreign matter generated at contact point P1 hardly reaches first fixed contact F1. In addition, the spatial distance between contact point P1 and first fixed contact F1 can be increased by providing protrusion S1, and the foreign matter further hardly reaches first fixed contact F1. Further, since protrusion S1 (protruding piece 580E) is positioned to block an imaginary line connecting contact point P1 and opening U1, it is possible to block the foreign matter generated at contact point P1 from reaching opening U1.

[0295] In contact device C1 according to Modification 7, as illustrated in Fig. 33, a lower surface of first fixed contact member 52F provided on first terminal member 51F functions as first fixed contact F1. In addition, an upper surface of first movable contact member 55F provided at a second end of first movable spring 54F (movable contactor N1) whose first end is fixed to second terminal member 53F functions as first movable contact M1. Protruding piece 580F is provided in a movable part of first movable spring 54F (movable contactor N1). As illustrated in Fig. 33, first movable contact M1 is positioned below first fixed contact F1, and moving member R1 is positioned above movable contactor N1. Protrusion S1 (protruding piece 580F) protrudes upward from a movable part of movable contactor N1, and is configured to approach moving member R1 as the protrusion extends upward. In addition, wall W1 is arranged above movable contactor N1 (on the same side as contact point P1 and first fixed contact F1 with respect to movable contactor N1) such that a lower end of wall W1 is positioned between moving member R1 and first fixed contact F1.

[0296] Similarly to Modification 5, in contact device C1 according to Modification 7, protrusion S1 (protruding

piece 580F) is provided, and thus, the spatial distance between contact point P1 and first fixed contact F1 can be increased. In addition, since the foreign matter generated at contact point P1 is guided to a lower side of movable contactor N1 (side opposite to first fixed contact F1 with respect to movable contactor N1) through opening U1, the foreign matter further hardly reaches first fixed contact F1.

[0297] In contact device C1 according to Modification 8, as illustrated in Fig. 34, a lower surface of first fixed contact member 52G provided on first terminal member 51G functions as first fixed contact F1. In addition, an upper surface of first movable contact member 55G provided at a second end of first movable spring 54G (movable contactor N1) having a first end fixed to second terminal member 53G functions as first movable contact M1. Protruding piece 580G is provided on a movable part of first movable spring 54G (movable contactor N1). As illustrated in Fig. 34, first movable contact M1 is positioned below first fixed contact F1, and moving member R1 is positioned below movable contactor N1. Protrusion S1 (protruding piece 580G) protrudes downward from a movable part of movable contactor N1, and is configured to be separated from moving member R1 as the protrusion extends downward. In addition, wall W1 is arranged below movable contactor N1 (on the same side as contact point P1 with respect to movable contactor N1) such that an upper end of wall W1 is positioned between moving member R1 and first fixed contact F1.

[0298] Similarly to Modification 6, in contact device C1 according to Modification 8, since first fixed contact F1 and moving member R1 are on sides opposite to movable contactor N1, the foreign matter generated at contact point P1 hardly reaches first fixed contact F1. In addition, the spatial distance between contact point P1 and first fixed contact F1 can be increased by providing protrusion S1, and the foreign matter further hardly reaches first fixed contact F1. Further, since protrusion S1 (protruding piece 580G) is positioned to block an imaginary line connecting contact point P1 and opening U1, it is possible to block the foreign matter generated at contact point P1 from reaching opening U1.

(3.7) Modification 9 to Modification 16

[0299] Protrusion S1 may be provided on a movable part of movable contactor N1 of contact device C1 according to the exemplary embodiment or Modification 1 to Modification 4. Figs. 35A to 35D are side views illustrating main parts of relay body 1 of contact device C1 according to Modification 9 to Modification 12. Figs. 36A to 36D are side views illustrating main parts of relay body 1 of contact device C1 according to Modification 13 to Modification 16. Note that, Figs. 35A and 35D illustrate states at the time of energization, and Figs. 35B and 35C illustrate states at the time of non-energization. In addition, Figs. 36A and 36D illustrate states at the time of energization, and Figs. 36B and 36C illustrate states at the time of non-energization.

[0300] As illustrated in Fig. 35A, contact device C1 according to Modification 9 has a structure in which protrusion S1 is provided on the movable part of movable contactor N1 of contact device C1 according to the exemplary embodiment (see Fig. 14).

[0301] As illustrated in Fig. 35B, contact device C1 according to Modification 10 has a structure in which protrusion S1 is provided on the movable part of movable contactor N1 of contact device C1 according to Modification 1 (see Fig. 18). However, in contact device C1 according to Modification 10, wall W1 is arranged above movable contactor N1 (on the same side as contact point P1 with respect to movable contactor N1). Of course, similarly to contact device C1 according to Modification 1, wall W1 may be arranged below movable contactor N1 (on the same side as first fixed contact F1 with respect to movable contactor N1).

[0302] As illustrated in Fig. 35C, contact device C1 according to Modification 11 has a structure in which protrusion S1 is provided on the movable part of movable contactor N1 of contact device C1 according to Modification 3 (see Fig. 21).

[0303] As illustrated in Fig. 35D, contact device C1 according to Modification 12 has a structure in which protrusion S1 is provided on the movable part of movable contactor N1 similar to contact device C1 according to Modification 3 (see Fig. 21), and the arrangement similar to contact device C1 according to Modification 8 (see Fig. 34) is adopted as a positional relationship among movable contactor N1, moving member R1, and first fixed contact F1.

[0304] As illustrated in Figs. 36A to 36D, contact device C1 according to each of Modification 13 to Modification 16 has a structure in which protrusion S1 is provided on the movable part of movable contactor N1 similar to contact device C1 according to Modification 2 (see Fig. 19), and the same arrangement as contact device C1 according to Modifications 5 to 8 (see Figs. 26 and 32 to 34) is adopted as a positional relationship among movable contactor N1, moving member R1, and first fixed contact F1.

[0305] In Modification 9 (see Fig. 35A) and Modification 13 (see Fig. 36A), first movable contact M1 is positioned above first fixed contact F1, and moving member R1 is positioned below movable contactor N1. Protrusion S1 protrudes downward from the movable part, and is configured to approach moving member R1 as the protrusion extends downward.

[0306] In addition, in Modification 10 (see Fig. 35B) and Modification **14** (see Fig. 36B), first movable contact M1 is positioned above first fixed contact F1, and moving member R1 is positioned above movable contactor N1. Protrusion S1 protrudes upward from the movable part, and is configured to be separated from moving member R1 as the protrusion extends upward.

[0307] In addition, in Modification 11 (see Fig. 35C) and Modification 15 (see Fig. 36C), first movable contact M1

is positioned below first fixed contact F1, and moving member R1 is positioned above movable contactor N1. Protrusion S1 protrudes upward from the movable part, and is configured to approach moving member R1 as the protrusion extends upward.

[0308] In addition, in Modification 12 (see Fig. 35D) and Modification 16 (see Fig. 36D), first movable contact M1 is positioned below first fixed contact F1, and moving member R1 is positioned below movable contactor N1. Protrusion S1 protrudes downward from the movable part, and is configured to be separated from moving member R1 as the protrusion extends downward.

[0309] In Modifications 9 to 16, it is possible to reduce the occurrence of the defect such as the contact failure between first fixed contact F1 and first movable contact M1.

(3.8) Another modifications

[0310] In one modification, each of first terminal member 51, second terminal member 53, third terminal member 42, and fourth terminal member 30 may not be a single member, and may be formed by connecting or combining two or more members, for example.

[0311] In one modification, first wall 571 may not cover entire first terminal member 51 on second axis A2. For example, a width (dimension along second axis A2) of first wall 571 may be smaller than a width of first terminal member 51.

[0312] In one modification, movable contactor N1 (first movable spring 343) may not have the connecting part (connecting piece 543), and for example, leaf springs functioning as spring piece 542 and holding piece 544 may extend obliquely backward and upward from the upper end of fixing piece 541.

[0313] In one modification, moving member R1 is not limited to have a structure in which movable contactor N1 (first movable spring 343) is pushed to move movable contactor N1, and may have a structure in which movable contactor N1 is pulled to move movable contactor N1. In addition, moving member R1 may not be separated from movable contactor N1 (first movable spring 54). For example, moving member R1 may be integrally formed with movable contactor N1 (first movable spring 54) (for example, insert-molded), and movable contactor N1 may move together with moving member R1.

[0314] In one modification, card 34 may cause second movable contact M2 to come into contact with or be separated from second fixed contact F2 in conjunction with switching between excitation and non-excitation of coil 21 (movement of armature 33), and may not be fixed to armature 33. For example, card 34 may be arranged to be spatially separated from armature 33, and may be moved by being pushed by armature 33 to push second movable spring 52.

[0315] In one modification, wall W1 may be formed integrally with card 34.

[0316] In one modification, wall W1 may be positioned between contact point P1 and fixed contact F1 as viewed from above (on third axis A3), and may be arranged on the same side as fixed contact F1 with respect to movable contactor N1, or may be arranged on the same side as contact point P1 with respect to movable contactor N1. Wall W1 is preferably arranged on the same side as at least one of fixed contact F1 and contact point P1 with respect to movable contactor N1.

[0317] In the exemplary embodiment and the modifications described above, second contact device C2 (main contact device) is a so-called a-contact (normally open contact) that cuts off the electric path at the time of non-energization, but the present disclosure is not limited thereto. In one modification, second contact device C2 may be a so-called b-contact (normally closed contact) that forms the electric path at the time of non-energization. In one modification, second contact device C2 may be a so-called c-contact that has two second fixed contacts F2, and second movable contact M2 comes into contact with different second fixed contacts F2 at the time of energization and at the time of non-energization. In a case where second contact device C2 is the b-contact or the c-contact, the lower surface of protrusion 444 of auxiliary member 44 may be used as second fixed contact F2.

[0318] In one modification, as long as protrusion S1 is formed in movable contactor N1, wall W1 may be omitted.

(4) Aspects

[0319] As is apparent from the above-described exemplary embodiment and modifications, the following aspects are disclosed in the present specification.

[0320] Contact device (C1) according to a first aspect includes first terminal member (51; 51B; 51C; 51D; 51E; 51F; 51G), second terminal member (53; 53C; 53D; 53E; 53F; 53G), base (B1), fixed contact member (52; 52B; 52C; 52D; 52E; 52F; 52G), movable contactor (N1), movable contact member (55; 55A; 55B; 55C; 55D; 55E; 55F; 55G), moving member (R1), and wall (W1). Base (B1) holds first terminal member (51; 51B; 51C; 51D; 51E; 51F; 51G) and second terminal member (53; 53C; 53D; 53E; 53F; 53G). Fixed contact member (52; 52B; 52C; 52D; 52E; 52F; 52G) has fixed contact (F1). Fixed contact member (52; 52B; 52C; 52D; 52E; 52F; 52G) is provided on first terminal member (51; 51B; 51C; 51D; 51E; 51F; 51G). Movable contactor (N1) is connected to second terminal member (53; 53C; 53D; 53E; 53F; 53G) and has a lower surface facing base (B1). Movable contact member (55; 55A; 55B; 55C; 55D; 55E; 55F; 55G) has movable contact (M1). Movable contact member (55; 55A; 55B; 55C; 55D; 55E; 55F; 55G) is provided in movable contactor (N1). Movable contact (M1) faces fixed contact (F1). Moving member (R1) brings movable contact (M1) into contact with fixed contact (F1) or separates movable contact (M1) from fixed contact (F1). Wall (W1) is positioned between contact point (P1) at which moving member (R1) comes into

contact with movable contactor (N1) and fixed contact (F1) as viewed from above.

[0321] According to this aspect, even though the foreign matter such as cutting residue is generated by rubbing of moving member (R1) against movable contactor (N1) at contact point (P1), the foreign matter hardly reaches fixed contact (F1). Thus, it is possible to reduce the occurrence of the defect such as the contact failure between fixed contact (F1) and movable contact (M1).

[0322] In contact device (C1) according to a second aspect, in the first aspect, moving member (R1) comes into contact with the lower surface of movable contactor (N1).

[0323] According to this aspect, moving member (R1) is positioned between base (B1) and movable contactor (N1), and in a case where contact device (C1) is used in an orientation in which movable contact (M1) is positioned above fixed contact (F1), the foreign matter generated at contact point (P1) further hardly reaches fixed contact (F1).

[0324] In contact device (C1) according to a third aspect, in the first or second aspect, fixed contact (F1) is positioned below movable contact (M1).

[0325] In this aspect, in a case where moving member (R1) comes into contact with the lower surface of movable contactor (N1), fixed contact (F1) and contact point (P1) are positioned on the same side (lower surface side) in a thickness direction of movable contactor (N1). In this case, wall (W1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0326] In contact device (C1) according to a fourth aspect, in any one of the first to third aspects, movable contactor (N1) has a contact part at which movable contact member (55; 55A; 55B; 55C; 55D; 55E; 55F; 55G) is provided, a movable part connected to second terminal member (53; 53C; 53D; 53E; 53F; 53G) and with which moving member (R1) comes into contact, and a connecting part that connects the contact part and the moving portion. Wall (W1) has a plate shape. The connecting part of movable contactor (N1) faces wall (W1).

[0327] According to this aspect, it is easy to position the connecting part between contact point (P1) and fixed contact (F1), and it is possible to block the foreign matter generated at contact point (P1) from reaching fixed contact (F1) by the connecting part.

[0328] In contact device (C1) according to a fifth aspect, in the fourth aspect, wall (W1) is positioned between the connecting part of movable contactor (N1) and first terminal member (51; 51B; 51E; 51F).

[0329] According to this aspect, wall (W1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0330] In the fourth or fifth aspect, contact device (C1) according to a sixth aspect further includes protrusion (S1) protruding from the movable part of movable contactor (N1). Protrusion (S1) is positioned between contact point (P1) and wall (W1) as viewed from above.

[0331] According to this aspect, protrusion (S1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0332] In contact device (C1) according to a seventh aspect, in the sixth aspect, protrusion (S1) is formed integrally with the movable part.

[0333] According to this aspect, protrusion (S1) is easily formed.

[0334] In contact device (C1) according to an eighth aspect, in the seventh aspect, protrusion (S1) is formed by cutting and raising a part of a plate material constituting the movable part.

[0335] According to this aspect, protrusion (S1) is easily formed.

[0336] In contact device (C1) according to a ninth aspect, in any one of the sixth to eighth aspects, protrusion (S1) is positioned on the same side as moving member (R1) with respect to movable contactor (N1).

[0337] According to this aspect, protrusion (S1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0338] In contact device (C1) according to a tenth aspect, in any one of the sixth to ninth aspects, movable contact (M1) is positioned above fixed contact (F1). Moving member (R1) is positioned below movable contactor (N1). Protrusion (S1) protrudes downward from the movable part, and is configured to approach moving member (R1) as the protrusion extends downward.

[0339] According to this aspect, protrusion (S1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0340] In contact device (C1) according to an eleventh aspect, in any one of the sixth to ninth aspects, movable contact (M1) is positioned above fixed contact (F1). Moving member (R1) is positioned above movable contactor (N1). Protrusion (S1) protrudes upward from the movable part, and is configured to be separated from moving member (R1) as the protrusion extends upward.

[0341] According to this aspect, protrusion (S1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0342] In contact device (C1) according to a twelfth aspect, in any one of the sixth to ninth aspects, movable contact (M1) is positioned below fixed contact (F1). Moving member (R1) is positioned above movable contactor (N1). Protrusion (S1) protrudes upward from the movable part, and is configured to approach moving member (R1) as the protrusion extends upward.

[0343] According to this aspect, protrusion (S1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0344] In contact device (C1) according to a thirteenth aspect, in any one of the sixth to ninth aspects, movable contact (M1) is positioned below fixed contact (F1). Moving member (R1) is positioned below movable contactor (N1). Protrusion (S1) protrudes downward from the movable part, and is configured to be separated from moving member (R1) as the protrusion extends downward.

[0345] According to this aspect, protrusion (S1) easily blocks the foreign matter generated at contact point (P1) from reaching fixed contact (F1).

[0346] In contact device (C1) according to a fourteenth aspect, in any one of the first to thirteenth aspects, fixed contact (F1) is positioned above contact point (P1).

[0347] According to this aspect, in a case where contact device (C1) is used in an orientation in which movable contact (M1) is positioned above fixed contact (F1), the foreign matter generated at contact point (P1) further hardly reaches fixed contact (F1). In addition, it is easy to form a part of movable contactor (N1) in a shape along wall (W1).

[0348] In contact device (C1) according to a fifteenth aspect, in any one of the first to thirteenth aspects, fixed contact (F1) is positioned below contact point (P1).

[0349] According to this aspect, in a case where contact device (C1) is used in an orientation in which movable contact (M1) is positioned below fixed contact (F1), the foreign matter generated at contact point (P1) further hardly reaches fixed contact (F1). In addition, it is easy to form a part of movable contactor (N1) in a shape along wall (W1).

[0350] In contact device (C1) according to a sixteenth aspect, in any one of the first to fifteenth aspects, gap (G1) is formed between wall (W1) and the lower surface of movable contactor (N1) while movable contact (M1) comes into contact with fixed contact (F1).

[0351] According to this aspect, it is possible to suppress the generation of the foreign matter due to wall (W1) coming into contact with movable contactor (N1) while reducing the size of contact device (C1).

[0352] In contact device (C1) according to a seventeenth aspect, in the sixteenth aspect, a size of gap (G1) is in a range from 0.20 mm to 0.40 mm inclusive.

[0353] According to this aspect, movable contactor (N1) is less likely to come into contact with wall (W1) when movable contactor (N1) moves, and it is possible to suppress the generation of the foreign matter due to wall (W1) coming into contact with movable contactor (N1).

[0354] In contact device (C1) according to an eighteen aspect, in the sixteenth or seventeenth aspect, fixed contact member (52; 52B; 52D; 52G) is a separate body from first terminal member (51; 51B; 51D; 51G) and is fixed to first terminal member (51; 51B; 51D; 51G). Movable contact member (55; 55A; 55B; 55D; 55G) is a separate body from movable contactor (N1), and is fixed to movable contactor (N1). A size of the gap (G1) is smaller than a sum of a protrusion dimension of fixed contact member (52; 52B; 52D; 52G) from an upper surface of first terminal member (51; 51B; 51D; 51G) and a protrusion dimension of the movable contact member from the lower surface of movable contactor (N1).

[0355] According to this aspect, movable contactor (N1) is less likely to come into contact with wall (W1) when movable contactor (N1) moves, and it is possible to suppress the generation of the foreign matter due to wall (W1) coming into contact with movable contactor (N1).

[0356] In contact device (C1) according to a nineteenth aspect, in any one of the sixteenth to eighteenth aspects, movable contact member (55; 55A; 55B; 55D; 55G) is a separate body from movable contactor (N1), and is fixed to movable contactor (N1). A size of the gap (G1) is smaller than a protrusion dimension of movable contact member (55; 55A; 55B; 55D; 55G) from the lower surface of movable contactor (N1).

[0357] According to this aspect, movable contactor (N1) is less likely to come into contact with wall (W1) when movable contactor (N1) moves, and it is possible to suppress the generation of the foreign matter due to wall (W1) coming into contact with movable contactor (N1).

[0358] In contact device (C1) according to a twentieth aspect, in any one of the first to seventeenth aspects, the fixed contact member is formed integrally with the first terminal member.

[0359] In contact device (C1) according to a twenty-first aspect, in any one of the first to seventeenth aspects, the movable contact member is formed integrally with movable contactor (N1).

[0360] In contact device (C1) according to a twenty-second aspect, in any one of the first to twenty-first aspects, wall (W1) is formed integrally with base (B1).

[0361] According to this aspect, wall (W1) is easily formed.

[0362] Electromagnetic relay (100) according to a twenty-third aspect includes contact device (C1) according to any one of the first to twenty-second aspects, third terminal member (42), fourth terminal member (30), second fixed contact member (43), second movable contact member (32), coil (21), and bobbin (22). Third terminal member (42) is held by base (B1). Fourth terminal member (30) is held by base (B1). Second fixed contact member (43) is different from a first fixed contact member as fixed contact member (52; 52B; 52D; 52E; 52F; 52G). Second fixed contact member (43) is provided on third terminal member (42). Second fixed contact member (43) includes second fixed contact (F2). Second movable contact member (32) is different from a first movable contact member as movable contact member (55; 55A; 55B; 55C; 55D; 55E; 55F; 55G). Second movable contact member (32) is provided on fourth terminal member (30). Second movable contact member (32) has second movable contact (M2) facing second fixed contact (F2). Coil (21) is wound around bobbin (22). Second movable contact (M2) comes into contact with or is separated from second fixed contact (F2) in accordance with turning on and off of the energization of coil (21). Bobbin (22) is positioned between first fixed contact as fixed contact (F1) and second fixed contact (F2) as viewed from above.

[0363] According to this aspect, even though moving member (R1) rubs against movable contactor (N1) to generate the foreign matter, the foreign matter hardly reaches second fixed contact (F2). Thus, it is possible to reduce the occurrence of the defect such as the contact failure between second fixed contact (F2) and second movable contact (M2).

REFERENCE MARKS IN THE DRAWINGS

[0364]

21: coil
22: bobbin
30: fourth terminal member
42: third terminal member
51, 51B, 51C, 51D, 51E, 51F, 51G: first terminal member
52, 52B, 52D, 52E, 52F, 52G: fixed contact member (first fixed contact member)
53, 53C, 53D, 53E, 53F, 53G: second terminal member
546: through-hole
55, 55A, 55B, 55C, 55D, 55E, 55F, 55G: movable contact member (first movable contact member)
100: electromagnetic relay
B1: base
C1: contact device
F1: fixed contact (first fixed contact)
F2: second fixed contact
G1: gap
M1: movable contact (first movable contact)
M2: second movable contact
N1: movable contactor
P1: contact point
R1: moving member
S1: protrusion
T1: first terminal
T2: second terminal
T3: third terminal
T4: fourth terminal
W1: wall

Claims

1. A contact device comprising:

a first terminal member;
a second terminal member;
a base that holds the first terminal member and the second terminal member;
a fixed contact member having a fixed contact, the fixed contact member being provided on the first terminal member;
a movable contactor connected to the second terminal member, the movable contactor having a lower surface facing the base;
a movable contact member including a movable contact facing the fixed contact, the movable contact member being provided on the movable contactor;
a moving member that brings the movable contact into contact with the fixed contact or separates the movable contact from the fixed contact; and
a wall positioned between a contact point at which the moving member comes into contact with the movable contactor as viewed from above and the fixed contact.

2. The contact device according to Claim 1, wherein the moving member comes into contact with the lower surface of the movable contactor.

3. The contact device according to Claim 1 or 2, wherein the fixed contact is positioned below the movable contact.

4. The contact device according to any one of Claims 1 to 3,

wherein the movable contactor includes
a contact part on which the movable contact member is provided,
a movable part connected to the second terminal member, the movable part coming into contact with the moving member, and
a connecting part that connects the contact part and the movable part,
the wall has a plate shape, and
the connecting part of the movable contactor faces the wall.

5. The contact device according to Claim 4, wherein the wall is positioned between the connecting part of the movable contactor and the first terminal member.

6. The contact device according to Claim 4 or 5, further comprising

a protrusion protruding from the movable part of the movable contactor,
wherein the protrusion is positioned between the contact point and the wall as viewed from above.

7. The contact device according to Claim 6, wherein the protrusion is provided integrally with the movable part.

8. The contact device according to Claim 7, wherein the protrusion is provided by cutting and raising a part of a plate material constituting the movable part.

9. The contact device according to any one of Claims 6 to 8, wherein the protrusion is positioned on a same side as the moving member with respect to the movable contactor.

10. The contact device according to any one of Claims 6 to 9,

wherein the movable contact is positioned

above the fixed contact,
the moving member is positioned below the movable contactor, and
the protrusion protrudes downward from the movable part, and approaches the moving member as the protrusion extends downward.

11. The contact device according to any one of Claims 6 to 9,

wherein the movable contact is positioned above the fixed contact,
the moving member is positioned above the movable contactor, and
the protrusion protrudes upward from the movable part, and is separated from the moving member as the protrusion extends upward.

12. The contact device according to any one of Claims 6 to 9,

wherein the movable contact is positioned below the fixed contact,
the moving member is positioned above the movable contactor, and
the protrusion protrudes upward from the movable part, and approaches the moving member as the protrusion extends upward.

13. The contact device according to any one of Claims 6 to 9,

wherein the movable contact is positioned below the fixed contact,
the moving member is positioned below the movable contactor, and
the protrusion protrudes downward from the movable part, and is separated from the moving member as the protrusion extends downward.

14. The contact device according to any one of Claims 1 to 13, wherein the fixed contact is positioned above the contact point.

15. The contact device according to any one of Claims 1 to 13, wherein the fixed contact is positioned below the contact point.

16. The contact device according to any one of Claims 1 to 15, wherein a gap is provided between the wall and the movable contactor in a state where the movable contact comes into contact with the fixed contact.

17. The contact device according to Claim 16, wherein a size of the gap is in a range from 0.20 mm to 0.40 mm inclusive.

18. The contact device according to Claim 16 or 17,

wherein the fixed contact member is a separate body from the first terminal member, the fixed contact member being fixed to the first terminal member,
the movable contact member is a separate body from the movable contactor, the movable contact member being fixed to the movable contactor, and
a size of the gap is smaller than a sum of a protrusion dimension of the fixed contact member from an upper surface of the first terminal member and a protrusion dimension of the movable contact member from the lower surface of the movable contactor.

19. The contact device according to any one of Claims 16 to 18,

wherein the movable contact member is a separate body from the movable contactor, the movable contact member being fixed to the movable contactor, and
the size of the gap is smaller than the protrusion dimension of the movable contact member from the lower surface of the movable contactor.

20. The contact device according to any one of Claims 1 to 17, wherein the fixed contact member is provided integrally with the first terminal member.

21. The contact device according to any one of Claims 1 to 17, wherein the movable contact member is provided integrally with the movable contactor.

22. The contact device according to any one of Claims 1 to 21, wherein the wall is provided integrally with the base.

23. An electromagnetic relay comprising:

the contact device according to any one of Claims 1 to 22;
a third terminal member held by the base;
a fourth terminal member held by the base;
a second fixed contact member provided on the third terminal member, the second fixed contact member being different from a first fixed contact member as the fixed contact member, and including a second fixed contact;
a second movable contact member provided on the fourth terminal member, the second movable contact member being different from a first movable contact member as the movable contact member, and including a second movable contact facing the second fixed contact;
a coil; and
a bobbin around which the coil is wound,
wherein the second movable contact comes into

contact with or is separated from the second fixed contact in accordance with turning on and off of energization to the coil, and

the bobbin is positioned between a first fixed contact as the fixed contact and the second fixed contact as viewed from above.

FIG. 1

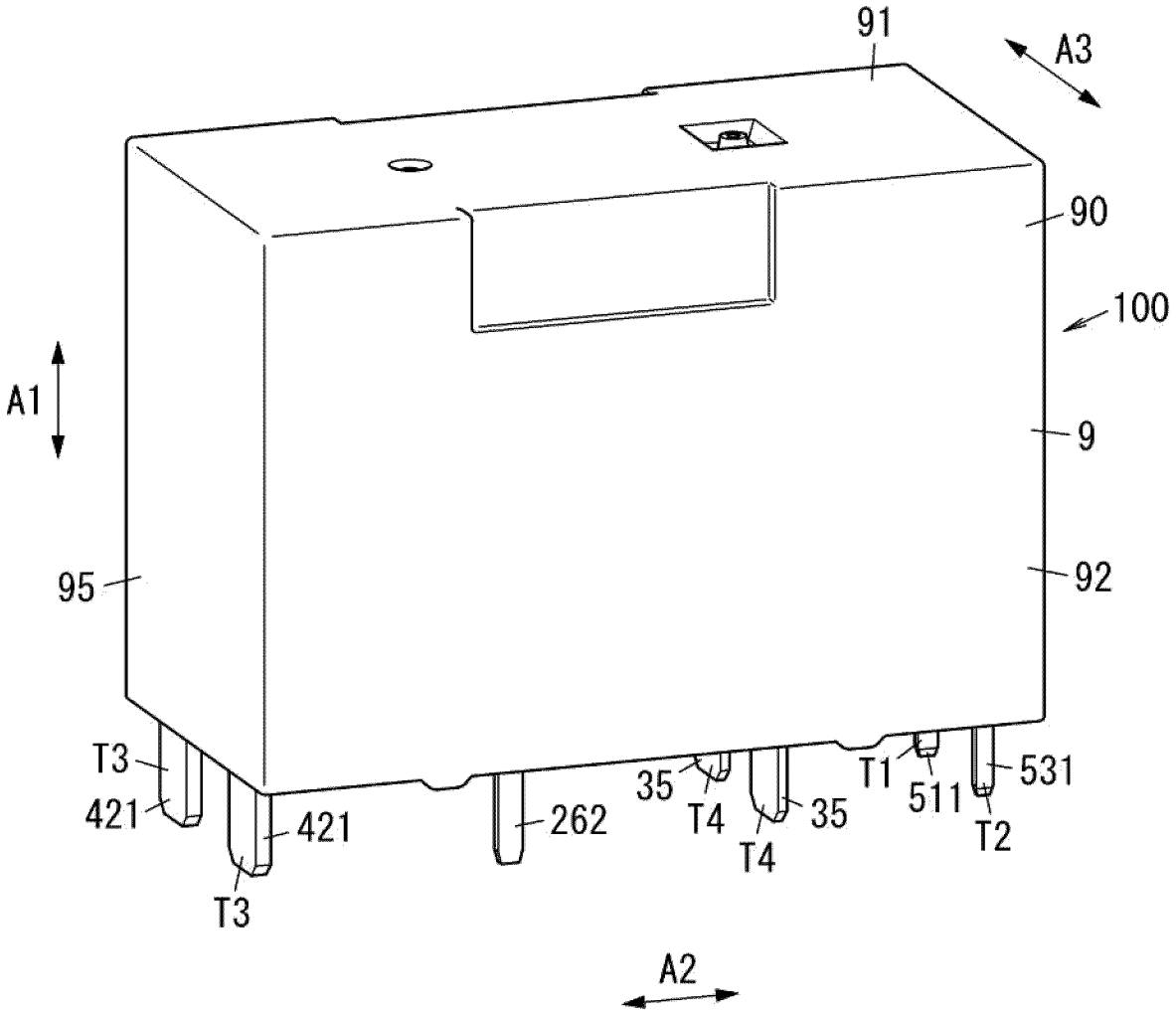
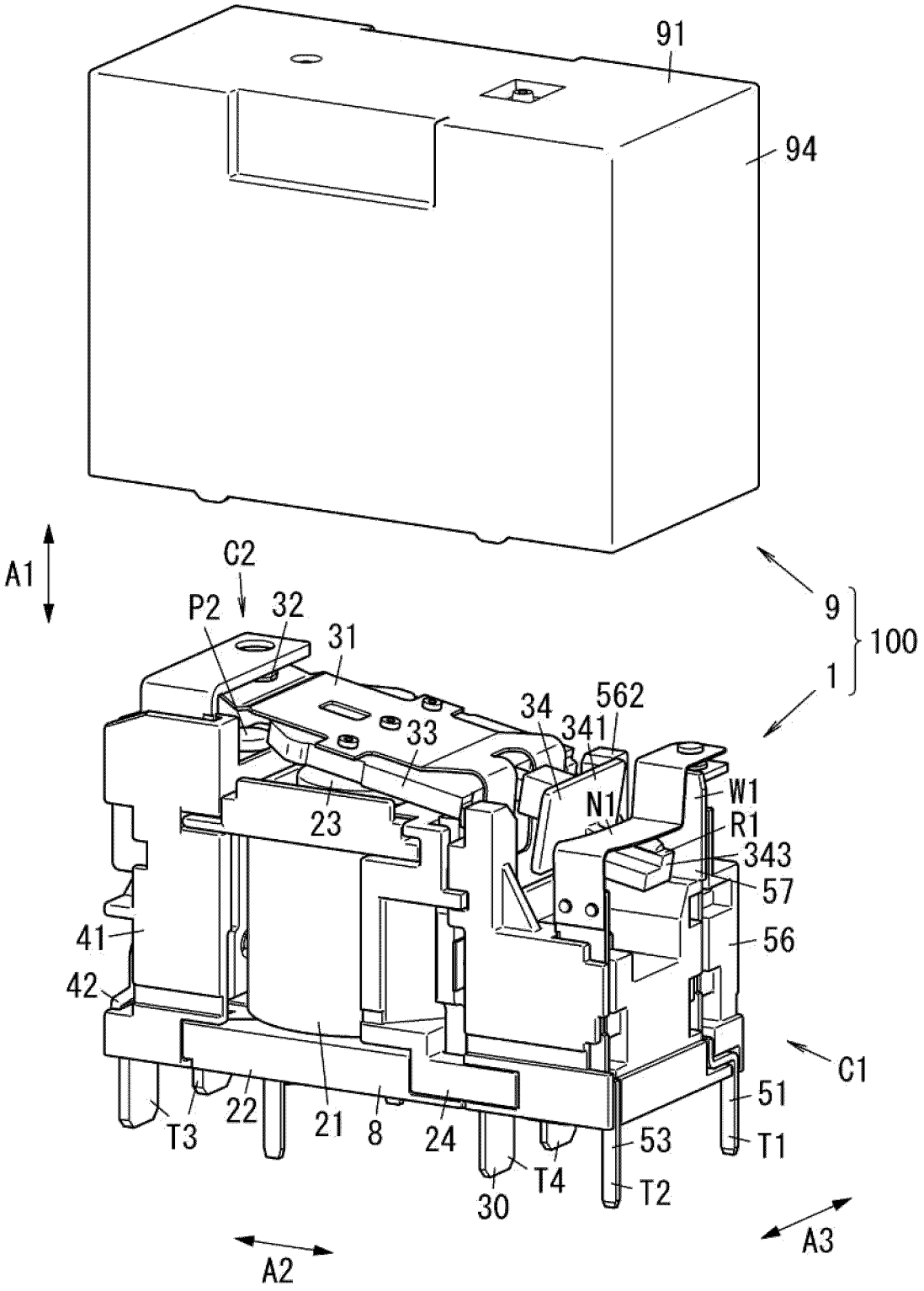


FIG. 2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C1
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T4
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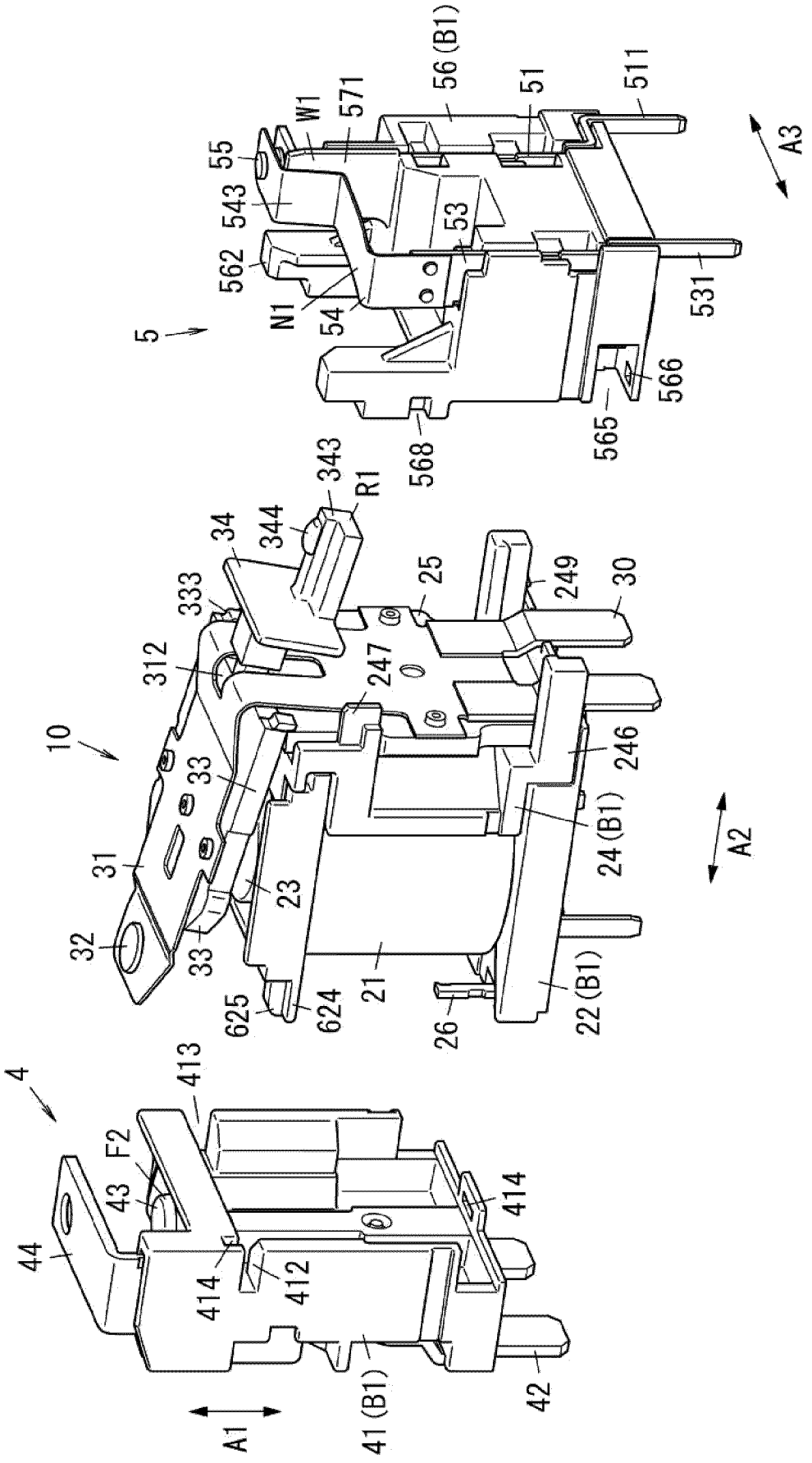
A3

FIG. 3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A3
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343
R1
344
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333
312
25
249
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33
24 (B1)
31
23
32
33
625
624
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22 (B1)
A2
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413
F2
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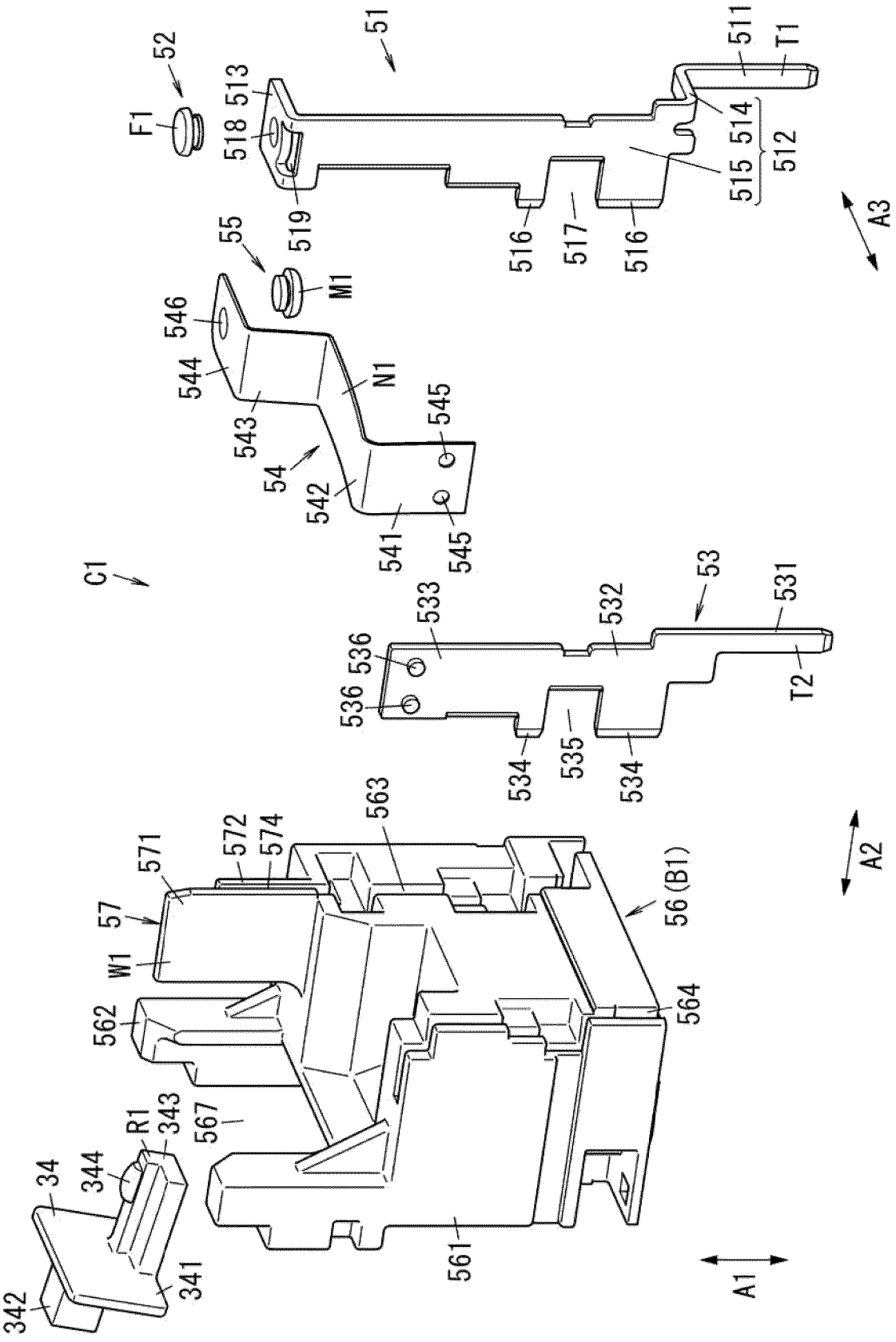
414
A1
41 (B1)
42

FIG. 4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F1
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T1
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N1
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T2
A2
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56 (B1)
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FIG. 5

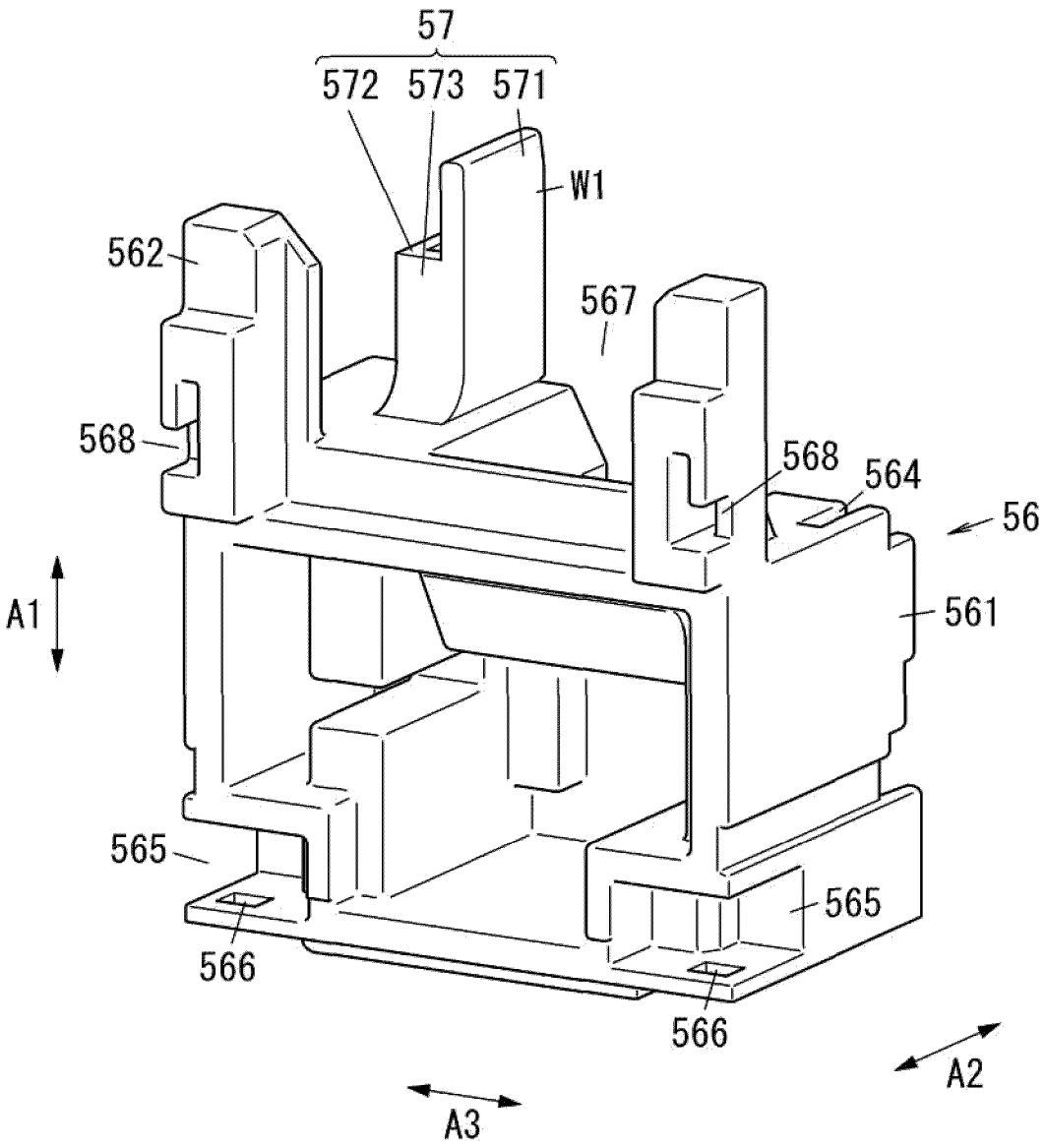
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FIG. 6

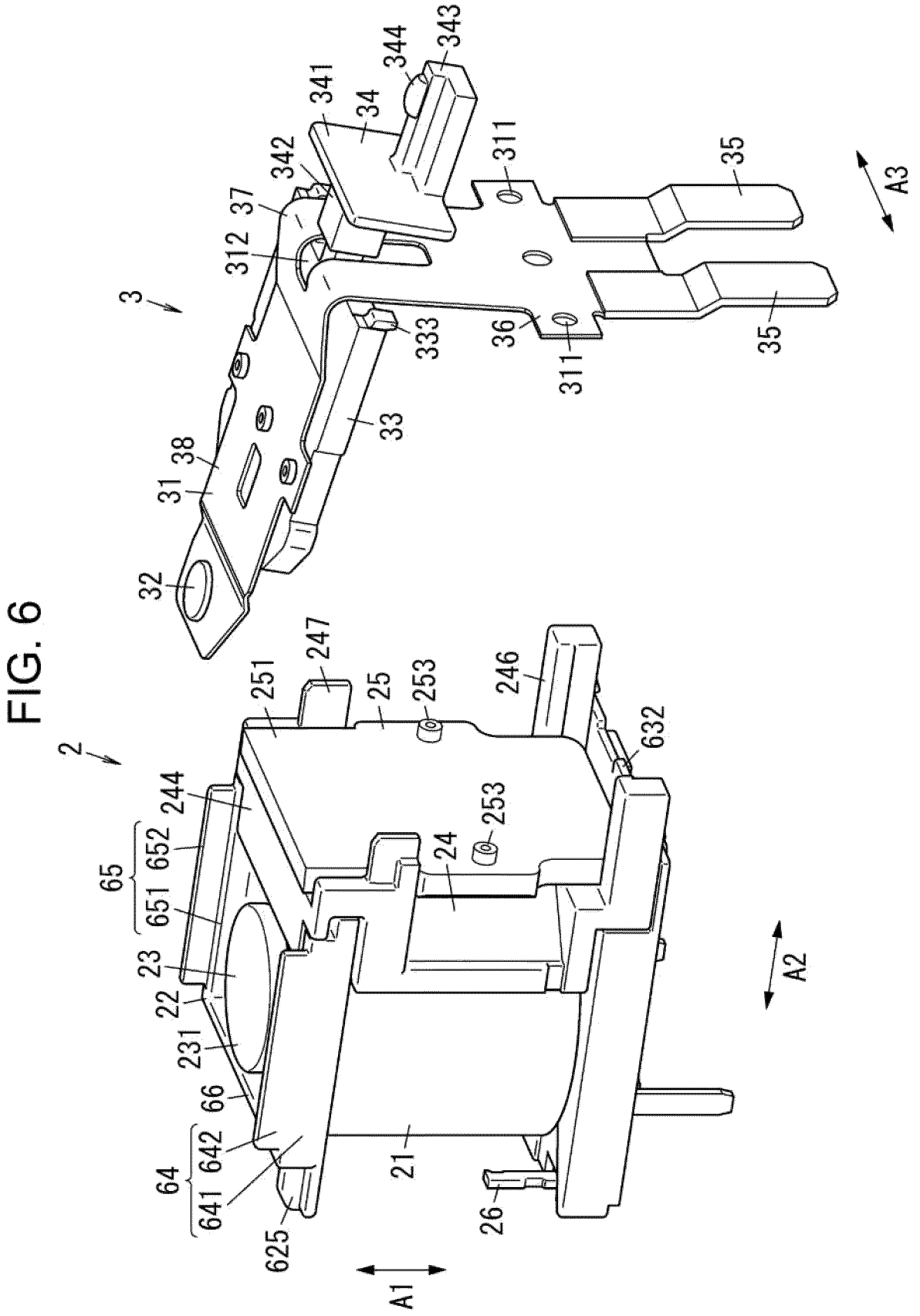
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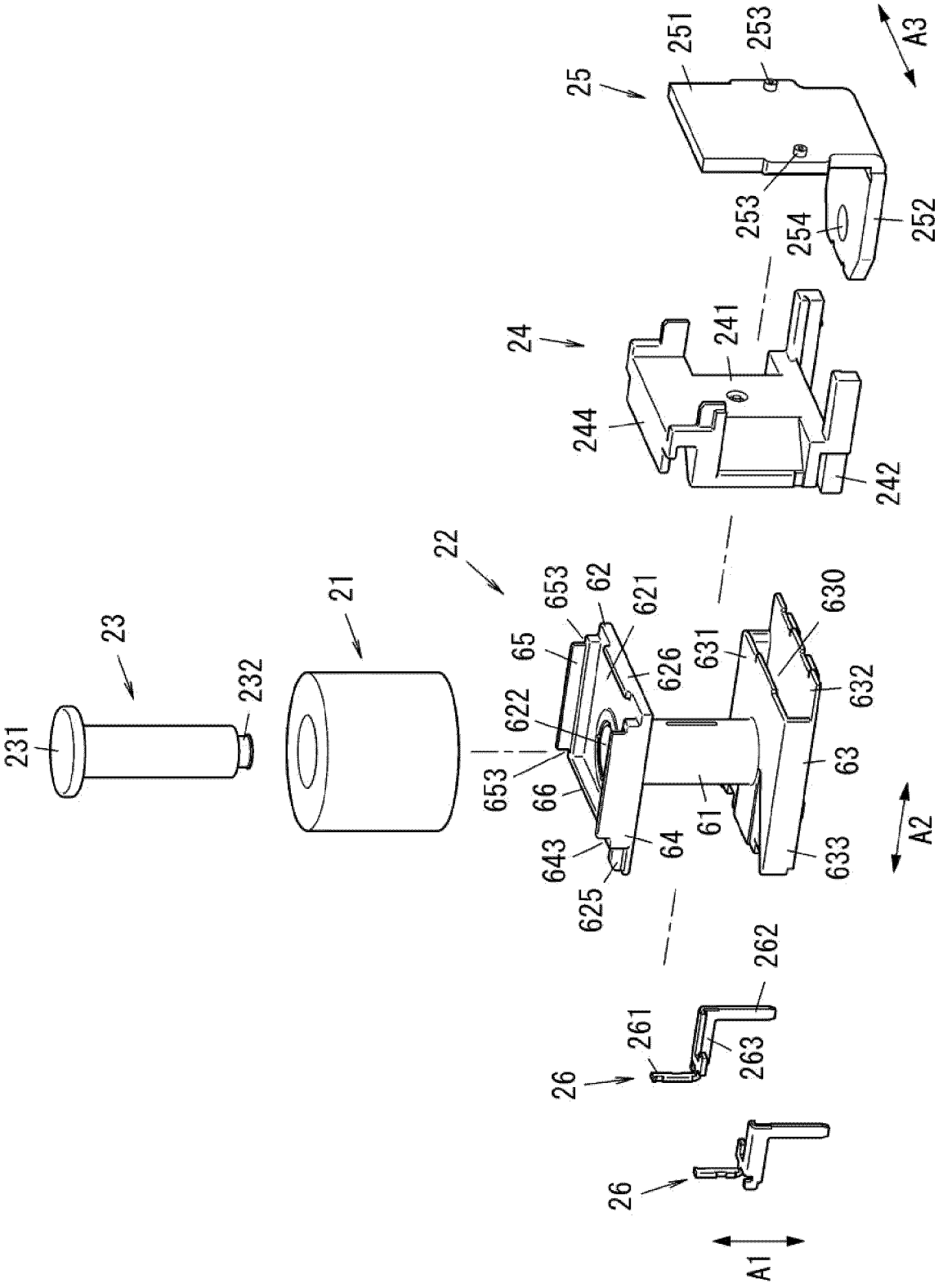
FIG. 7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A1

FIG. 8

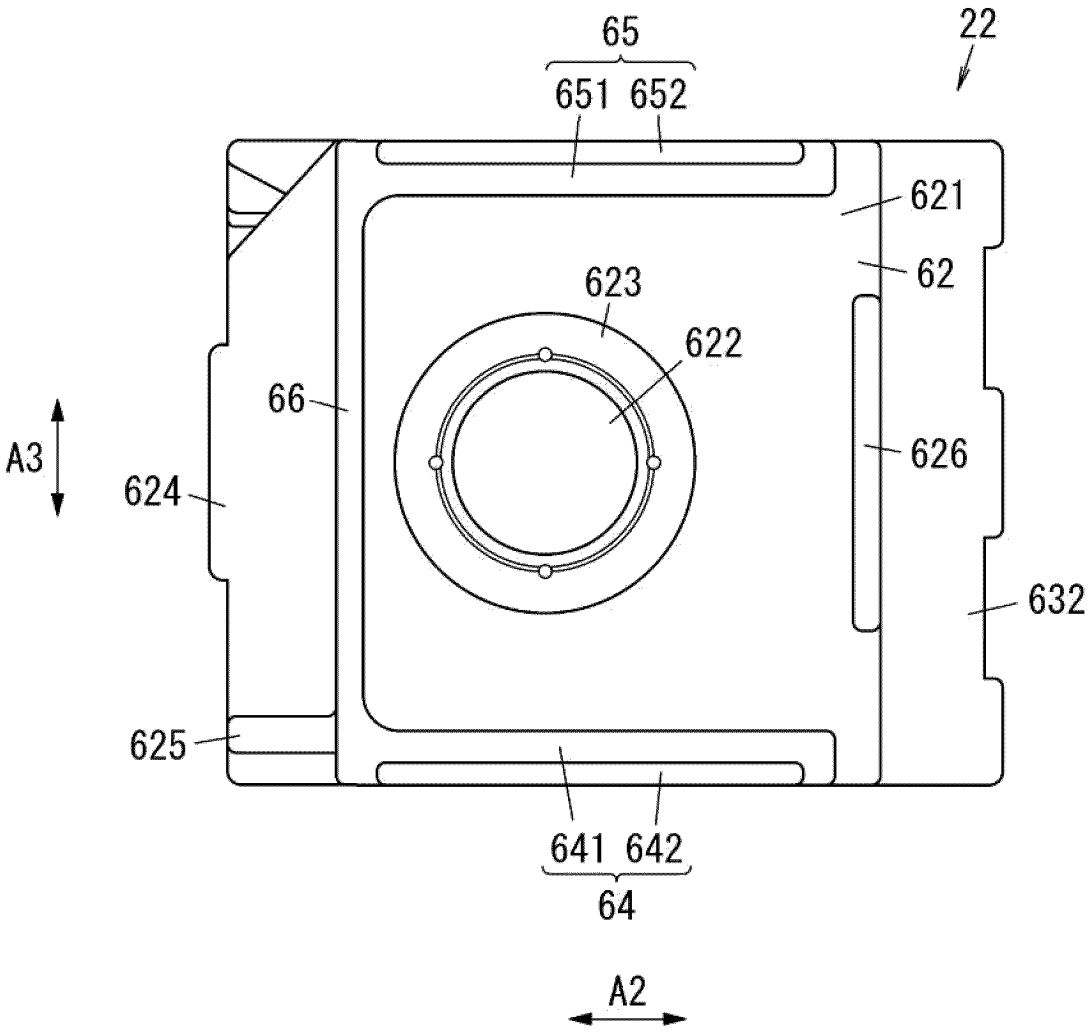


FIG. 9

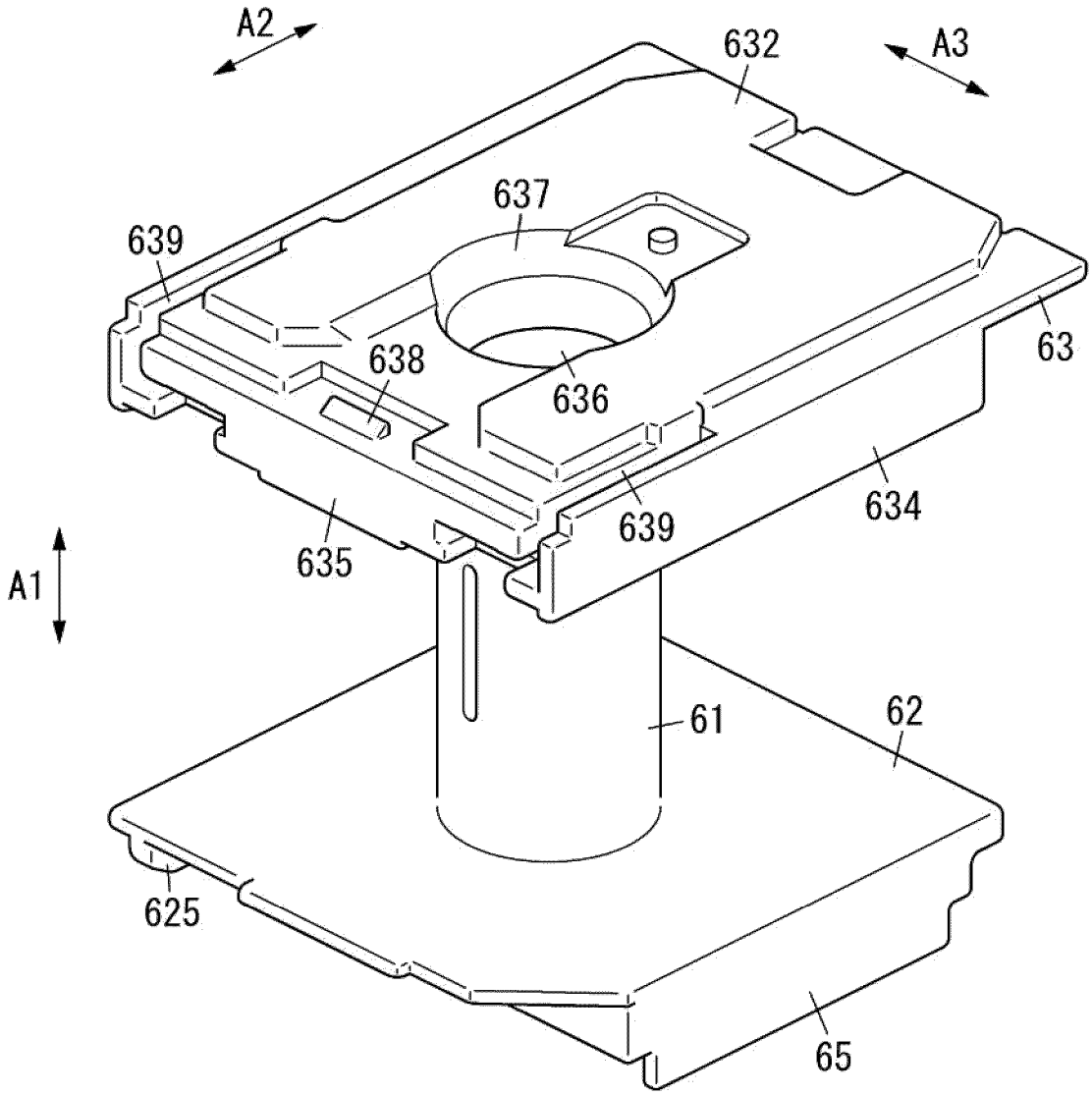


FIG. 10

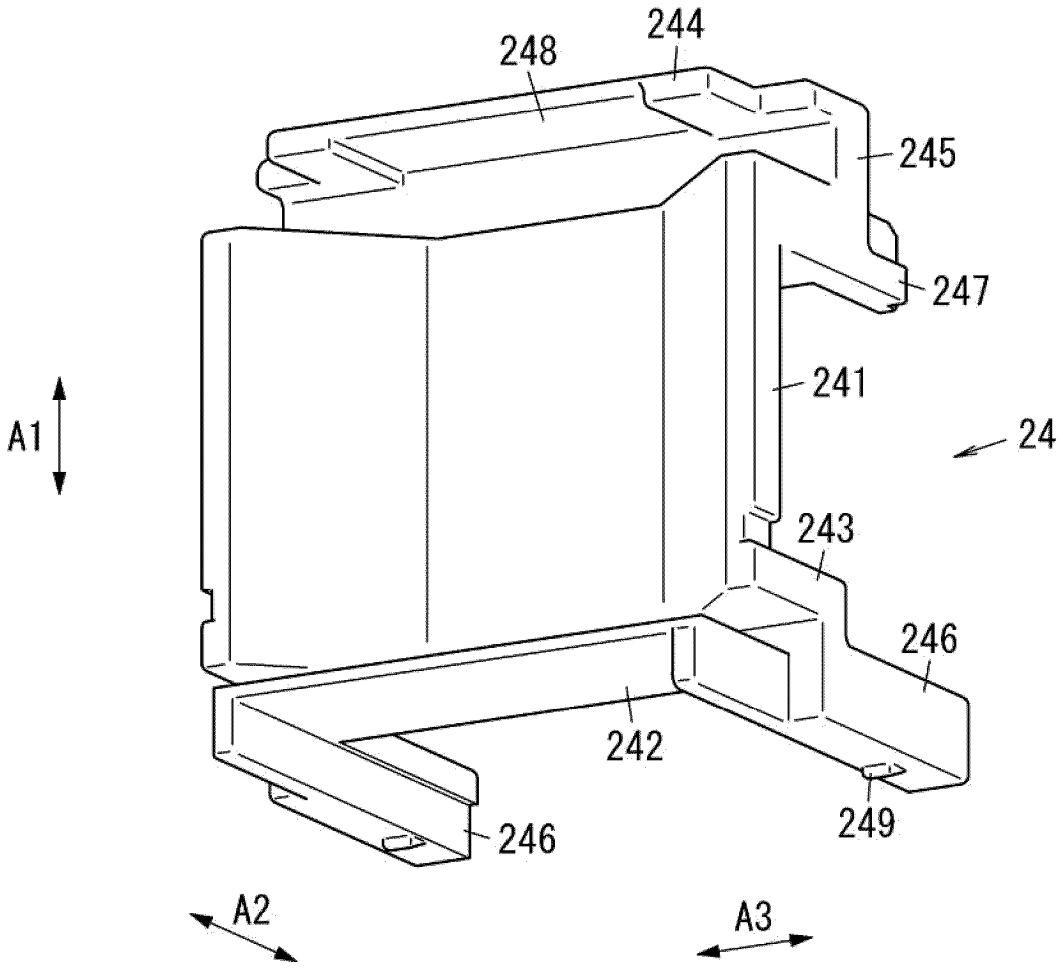
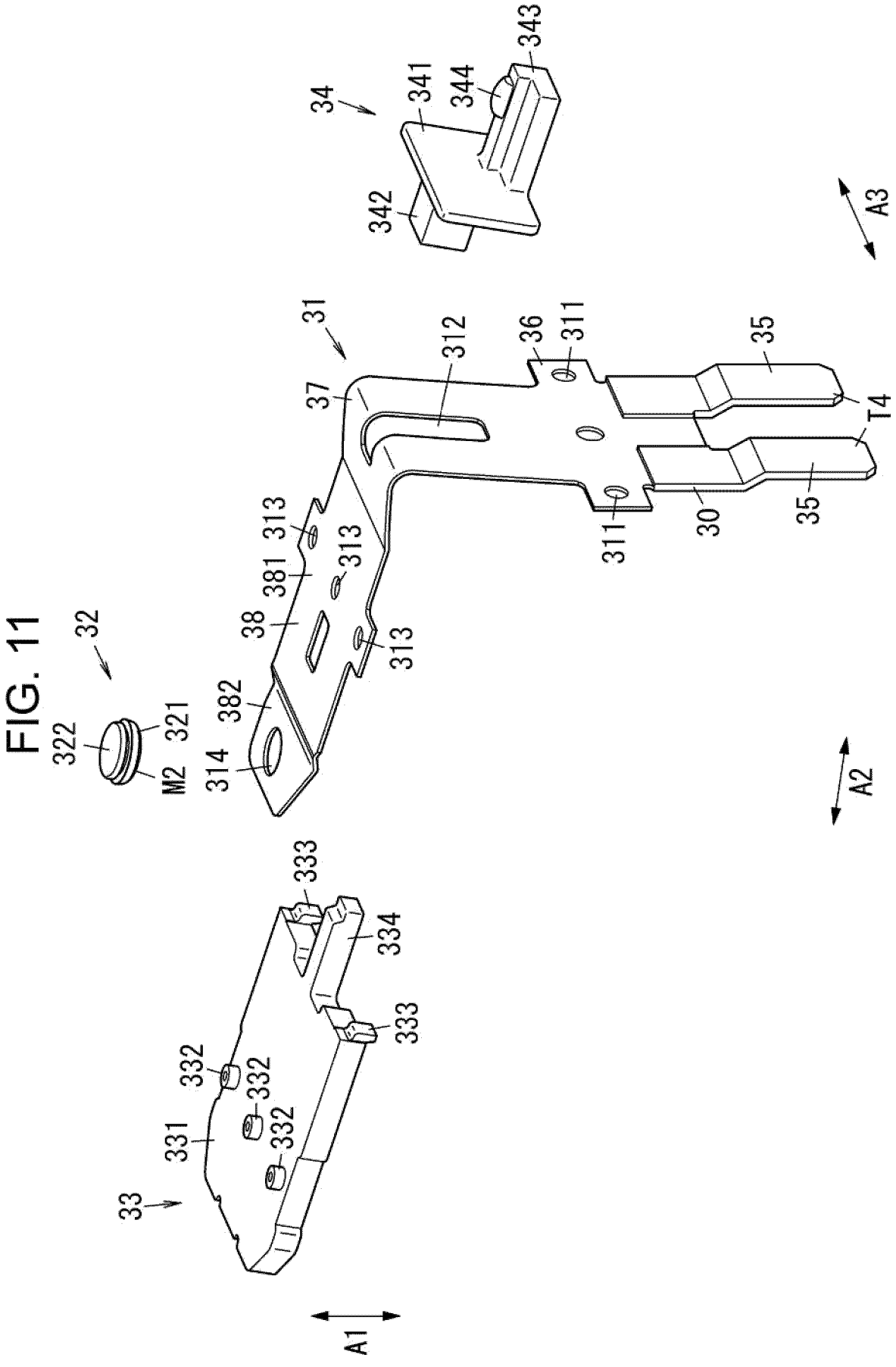


FIG. 11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T4
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A1

FIG. 12

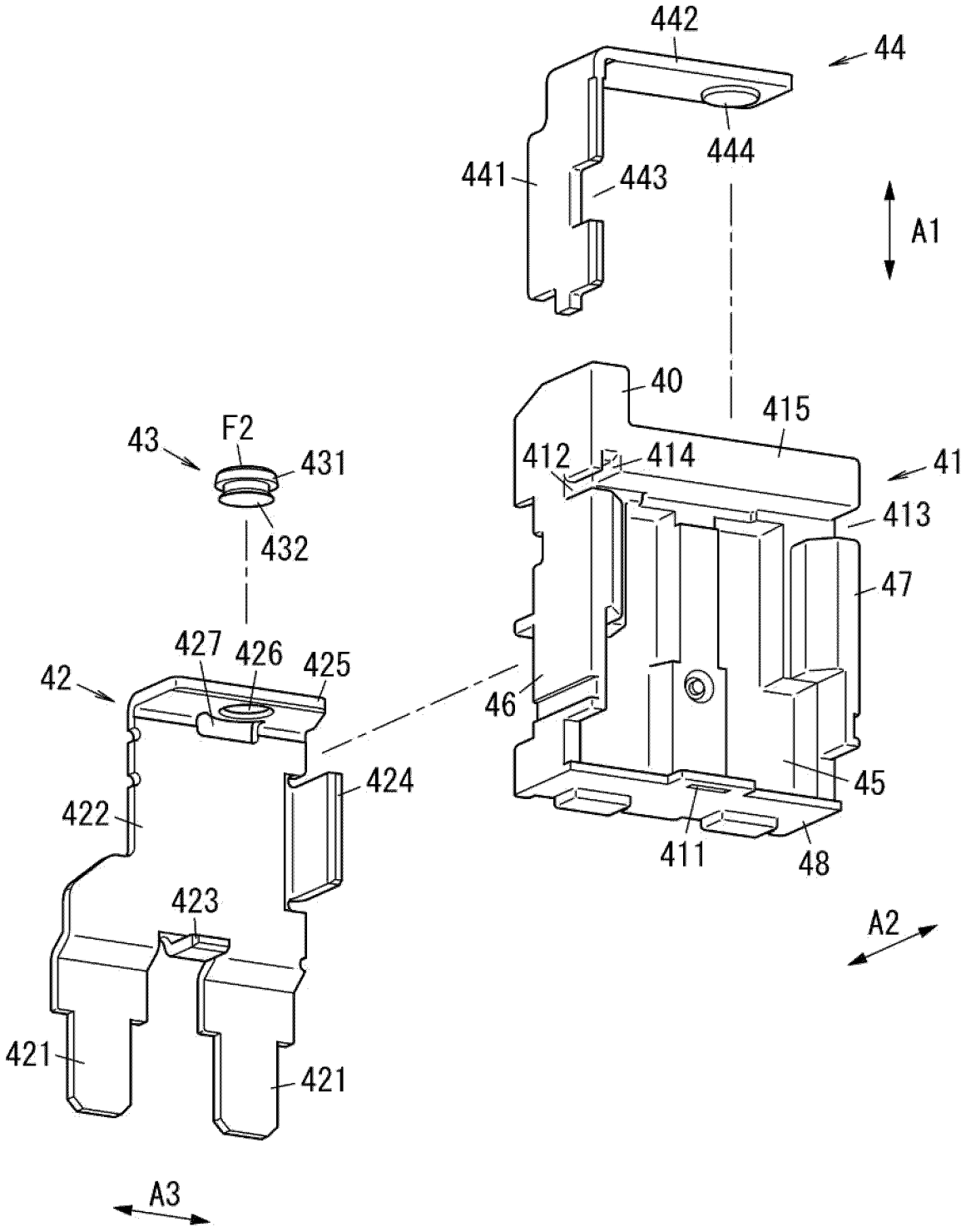
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FIG. 13

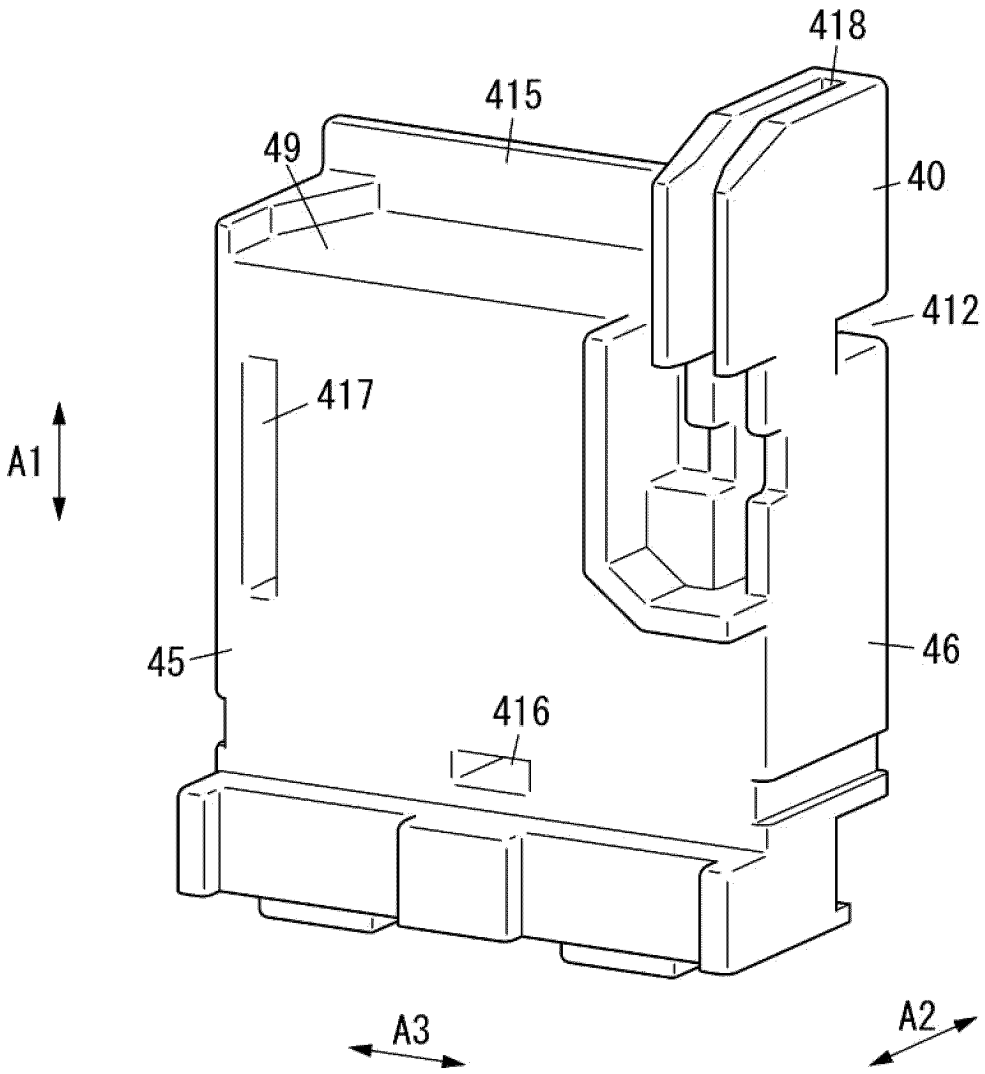

FIG. 14

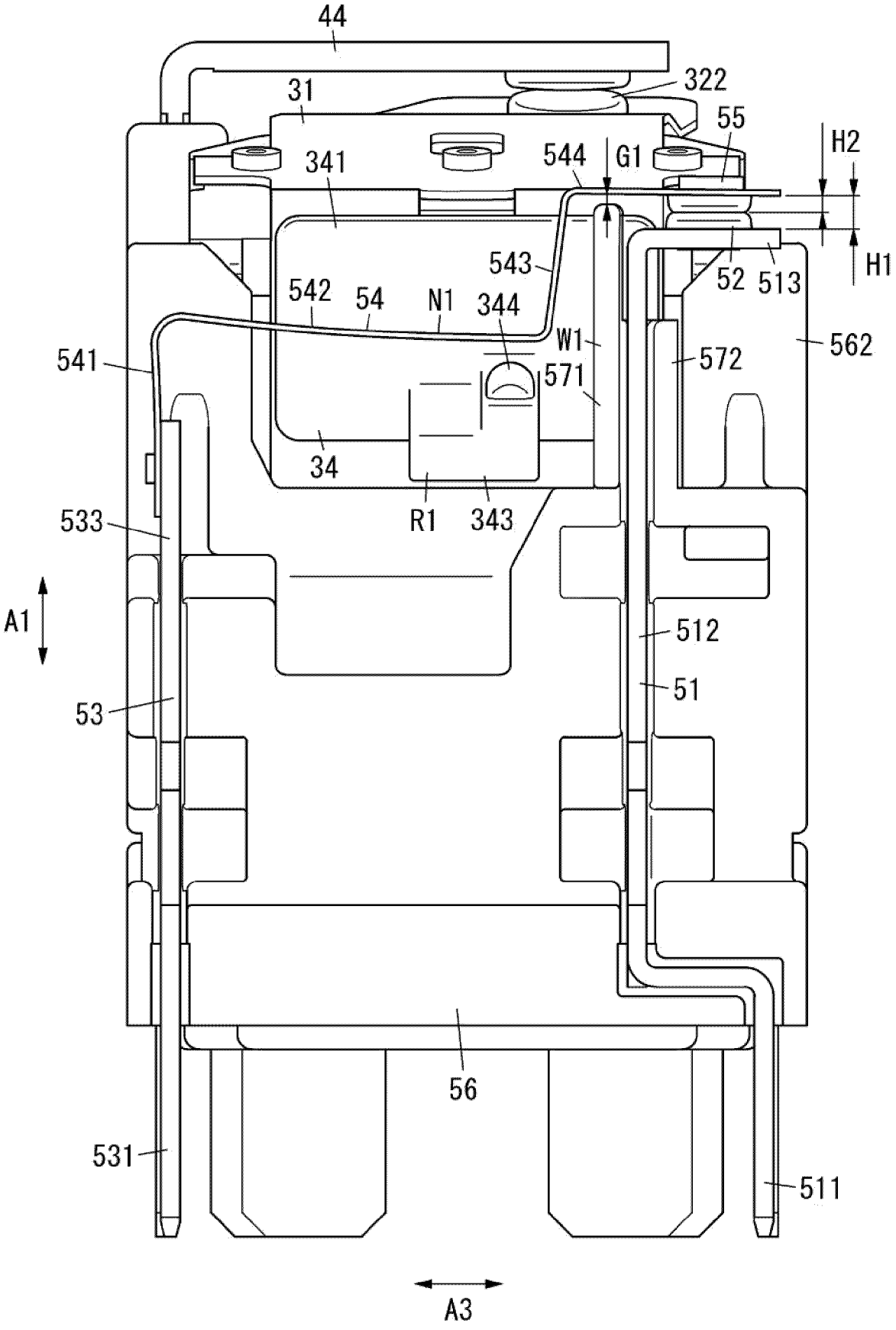
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FIG. 15

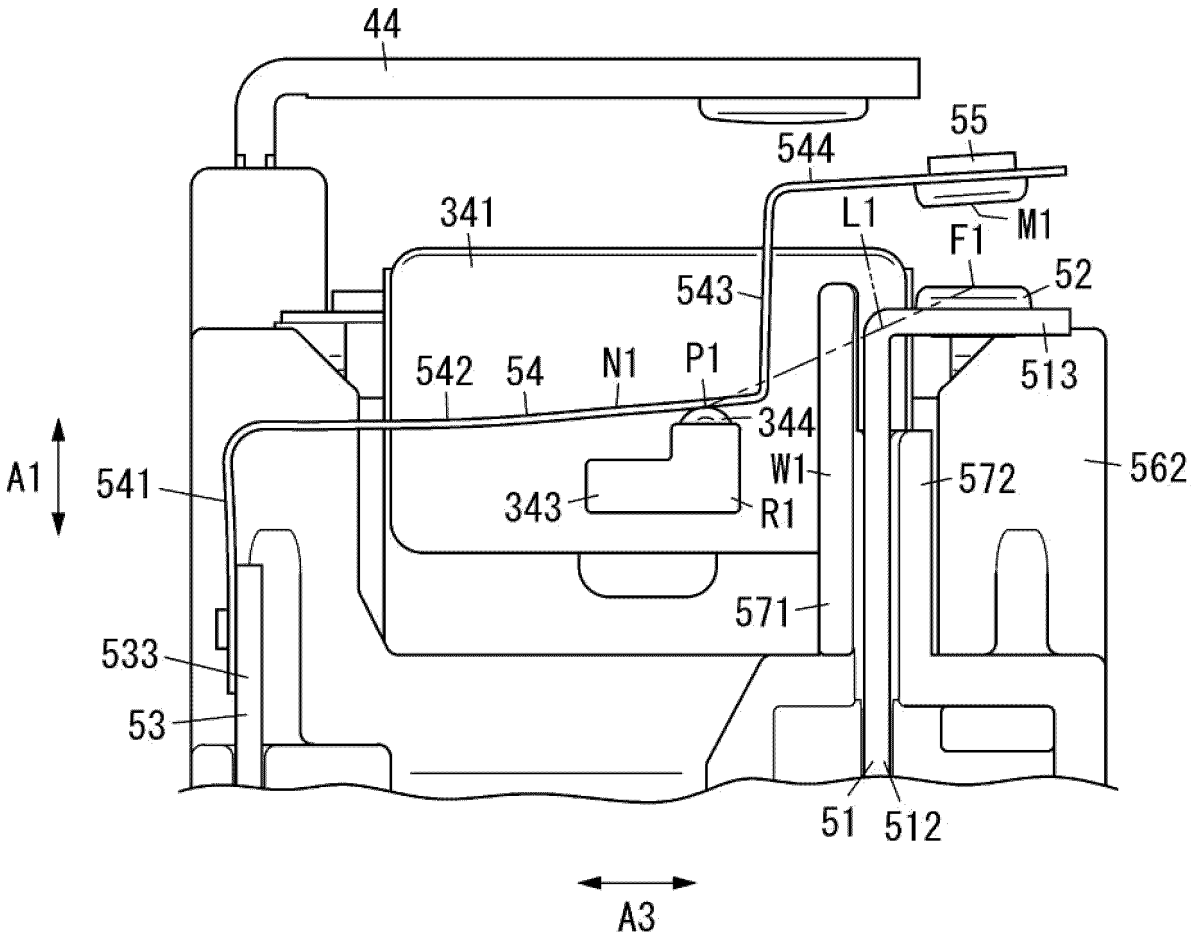
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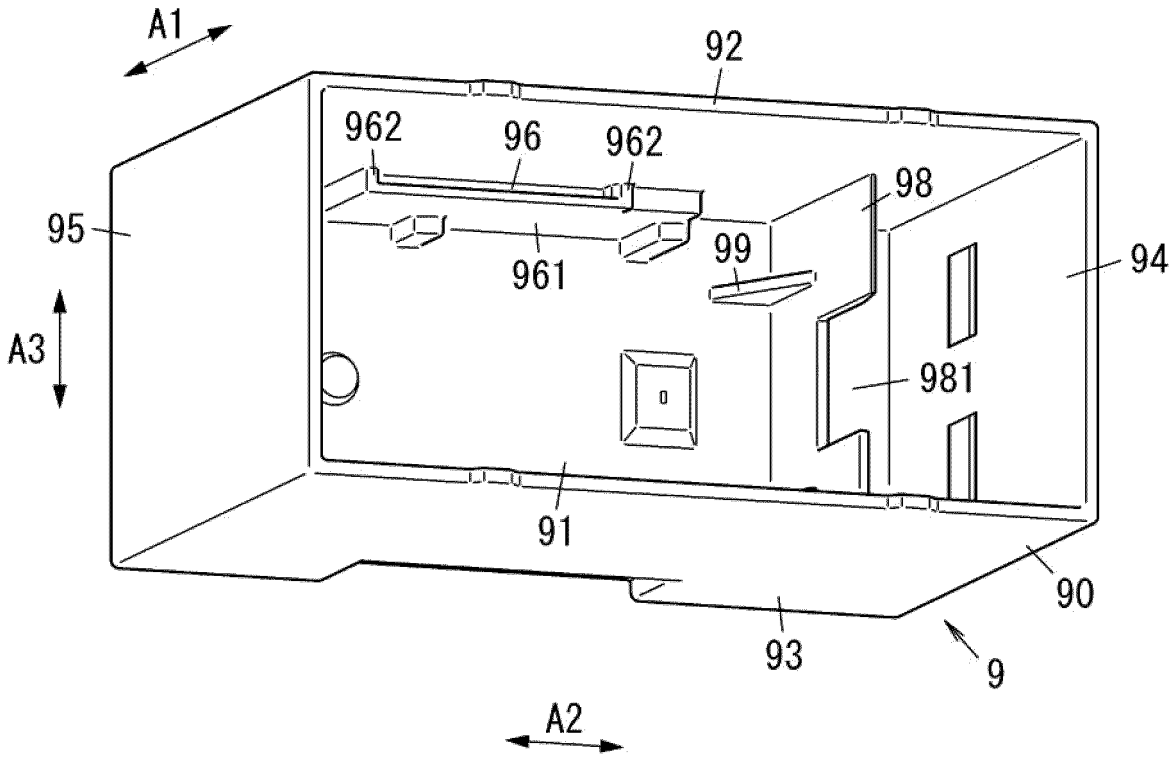
FIG. 16



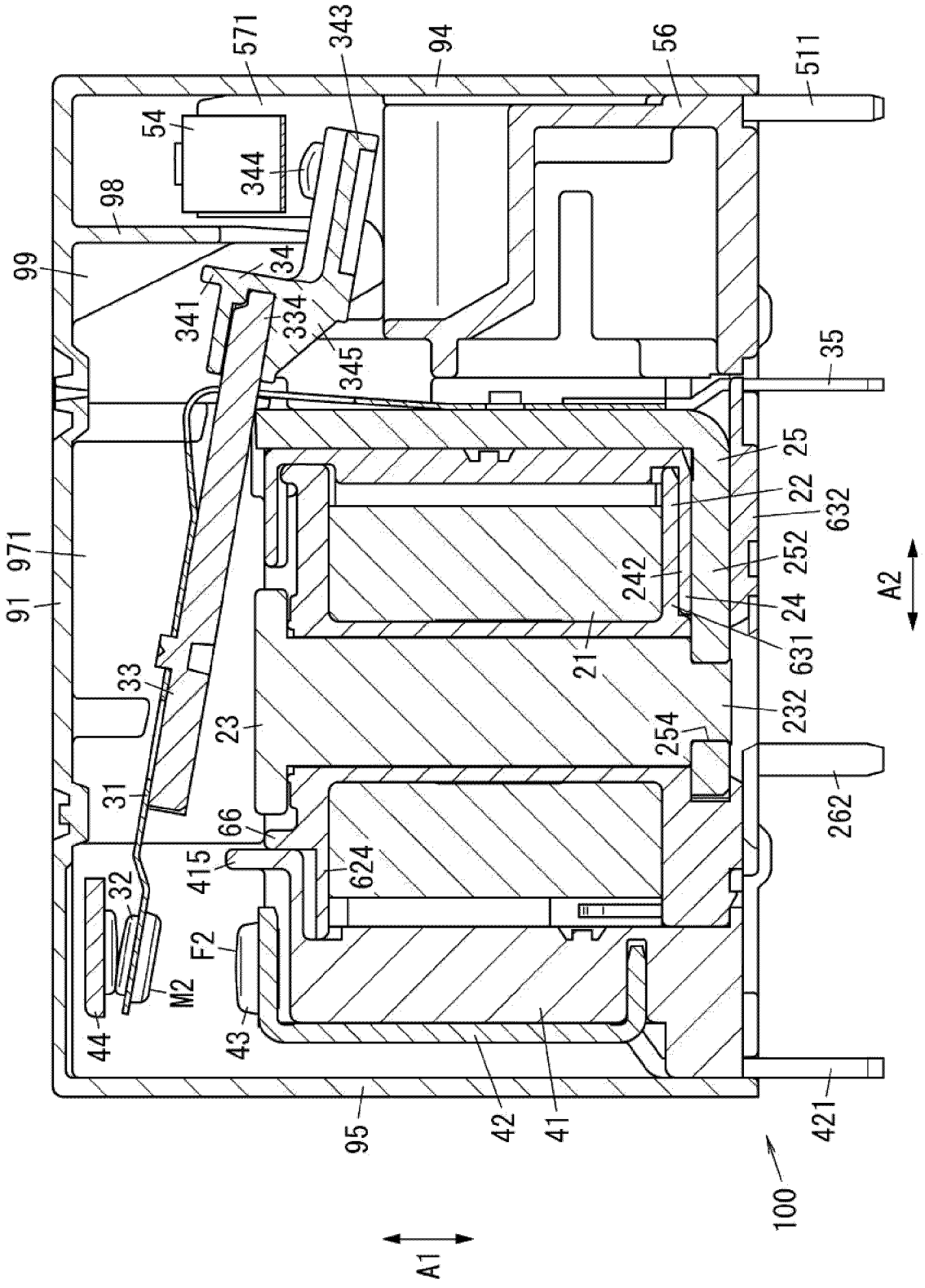

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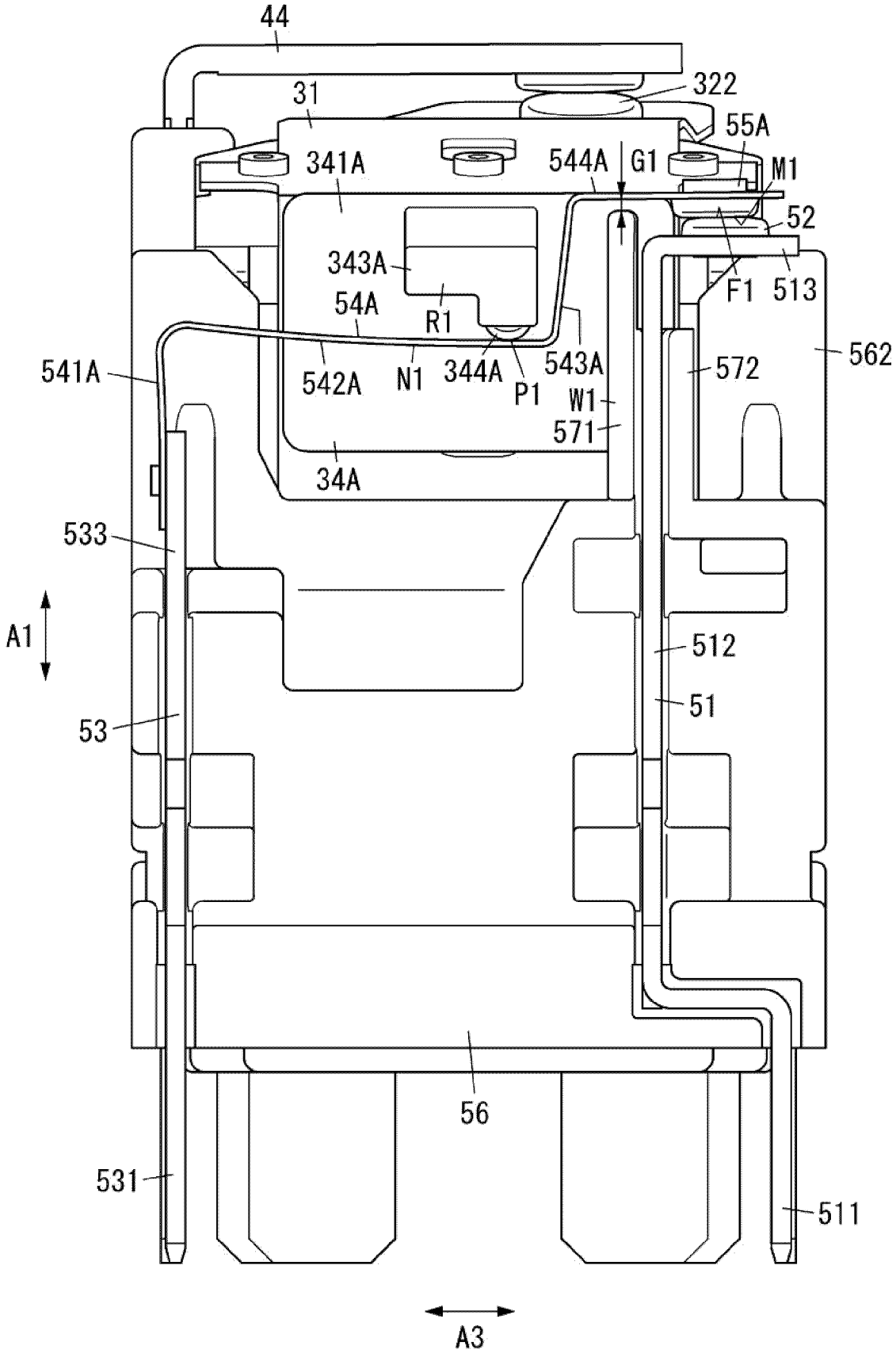
FIG. 17

FIG. 18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P1
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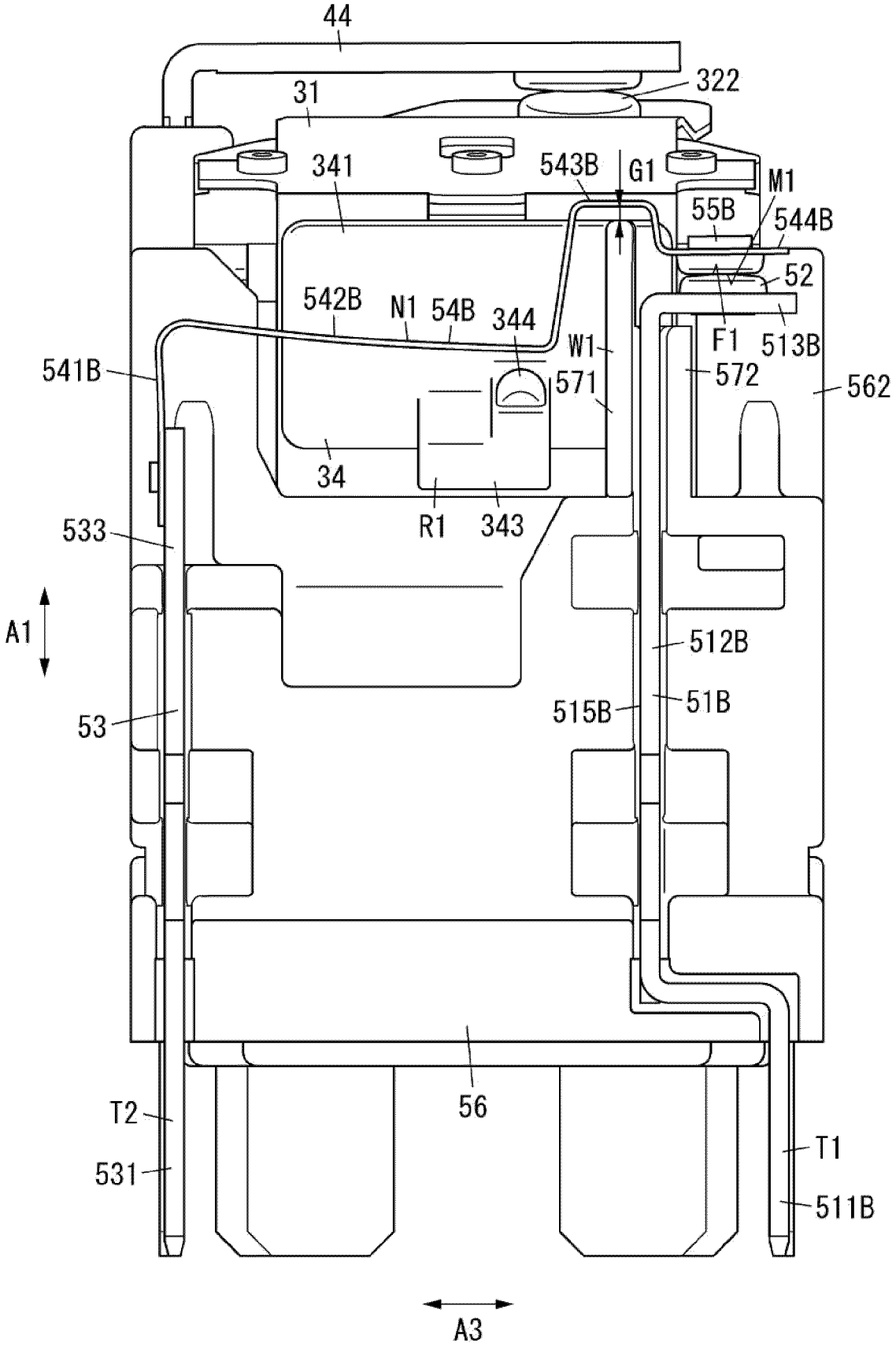
A3

FIG. 19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322
341
543B
G1
M1
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544B
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542B
N1
54B
344
W1
F1
513B
541B
571
572
562
34
R1
343
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A1
512B
515B
51B
53
56
T2
T1
531
511B
A3

FIG. 20

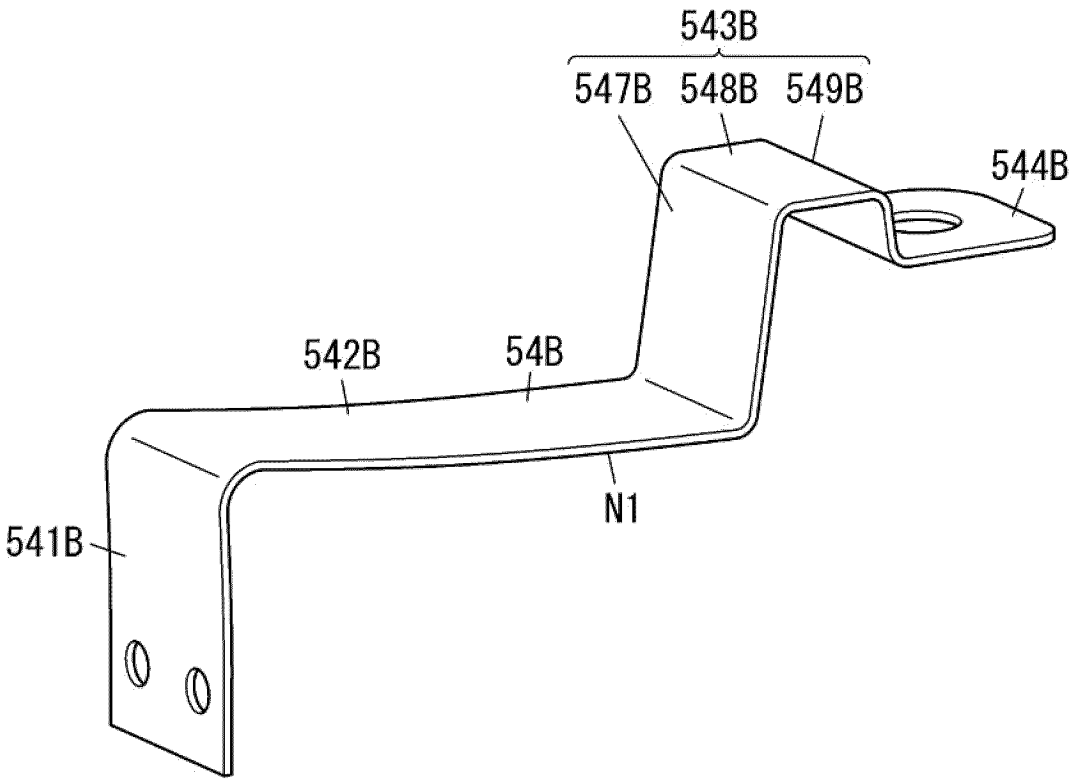
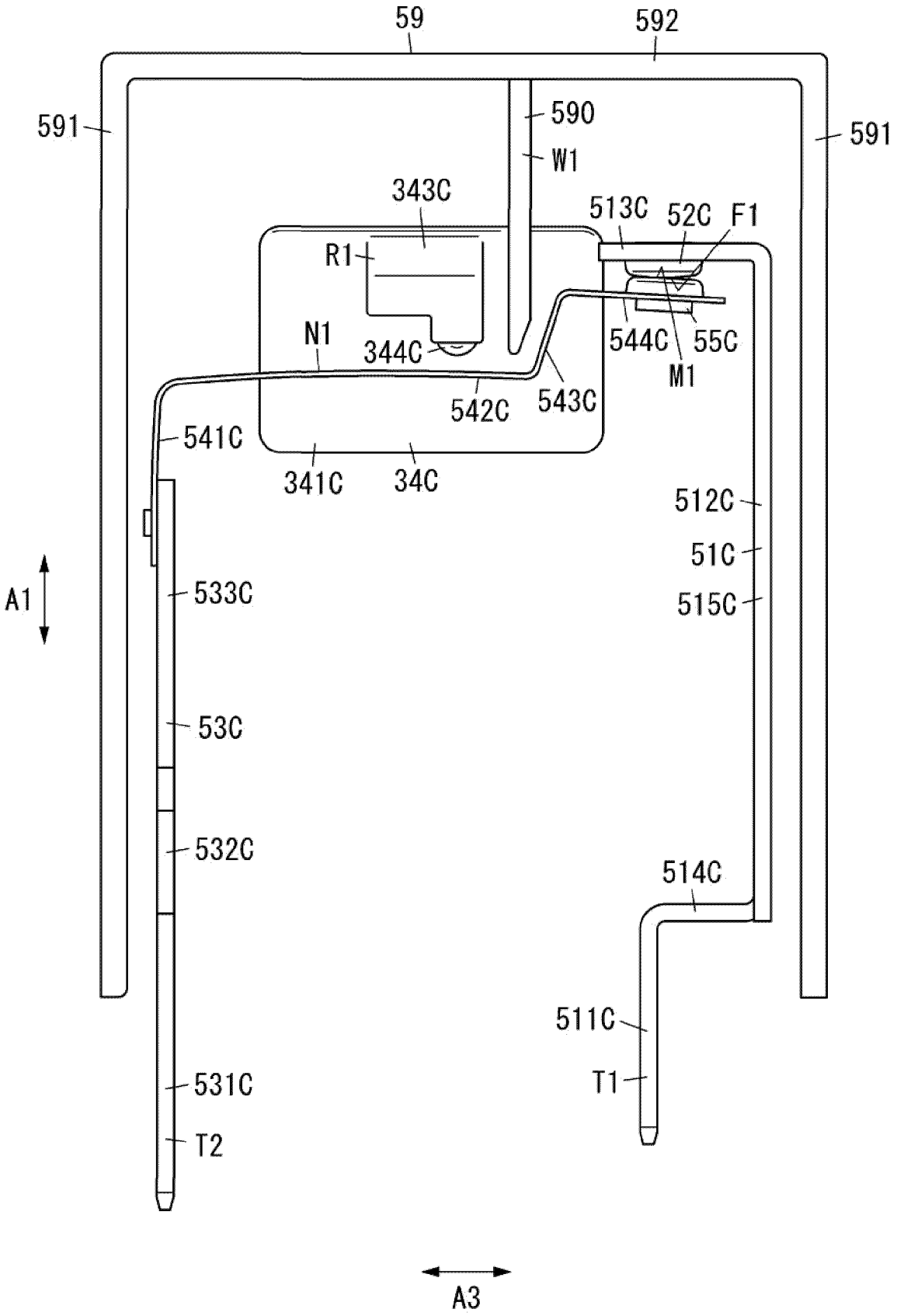


FIG. 21


59
592
591
591
590
W1
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F1
R1
N1
344C
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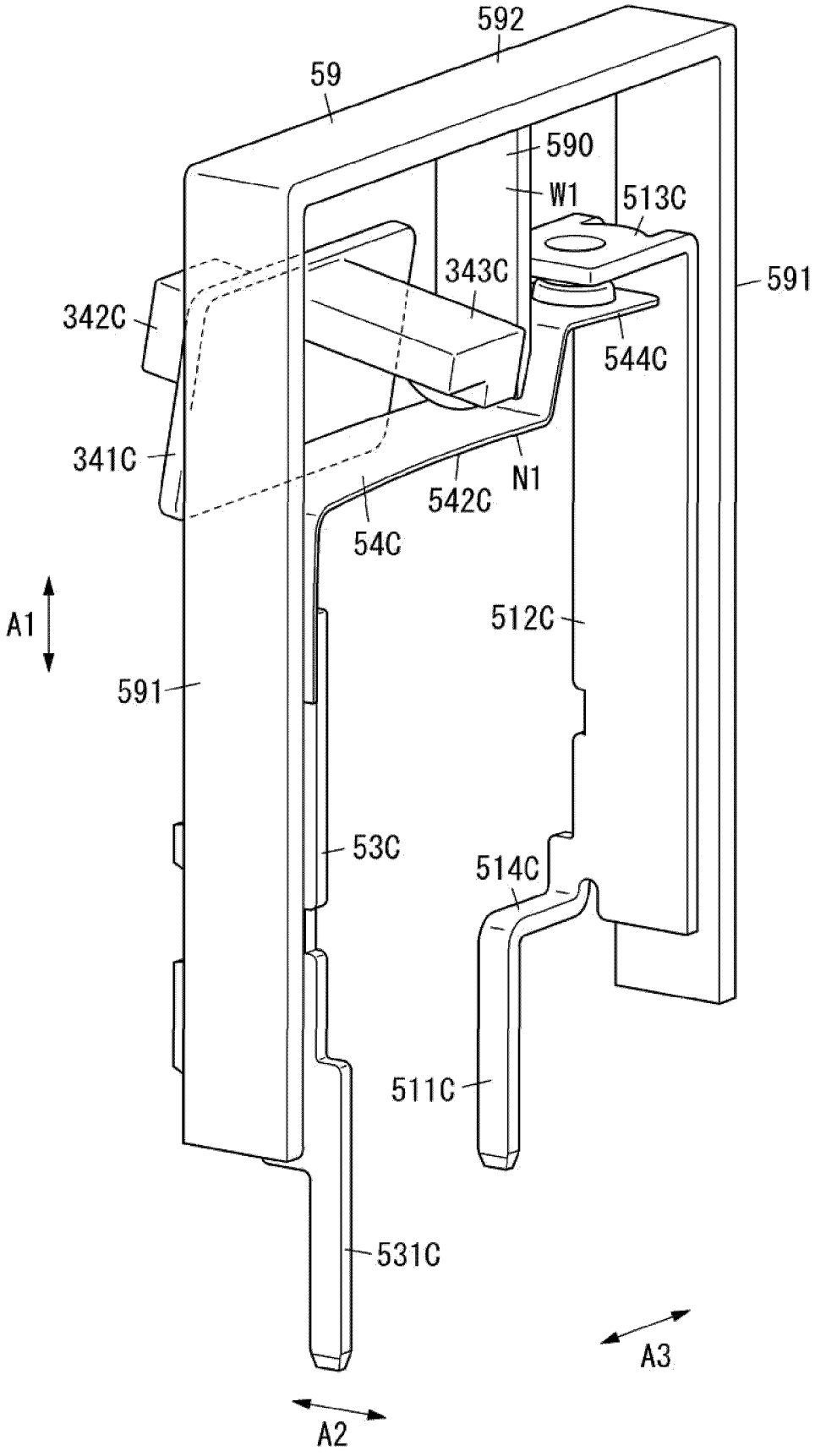
55C
M1
542C
543C
541C
341C
34C
512C
51C
515C
A1
533C
53C
532C
514C
511C
T1
531C
T2
A3

FIG. 22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590
W1
513C
343C
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342C
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341C
N1
542C
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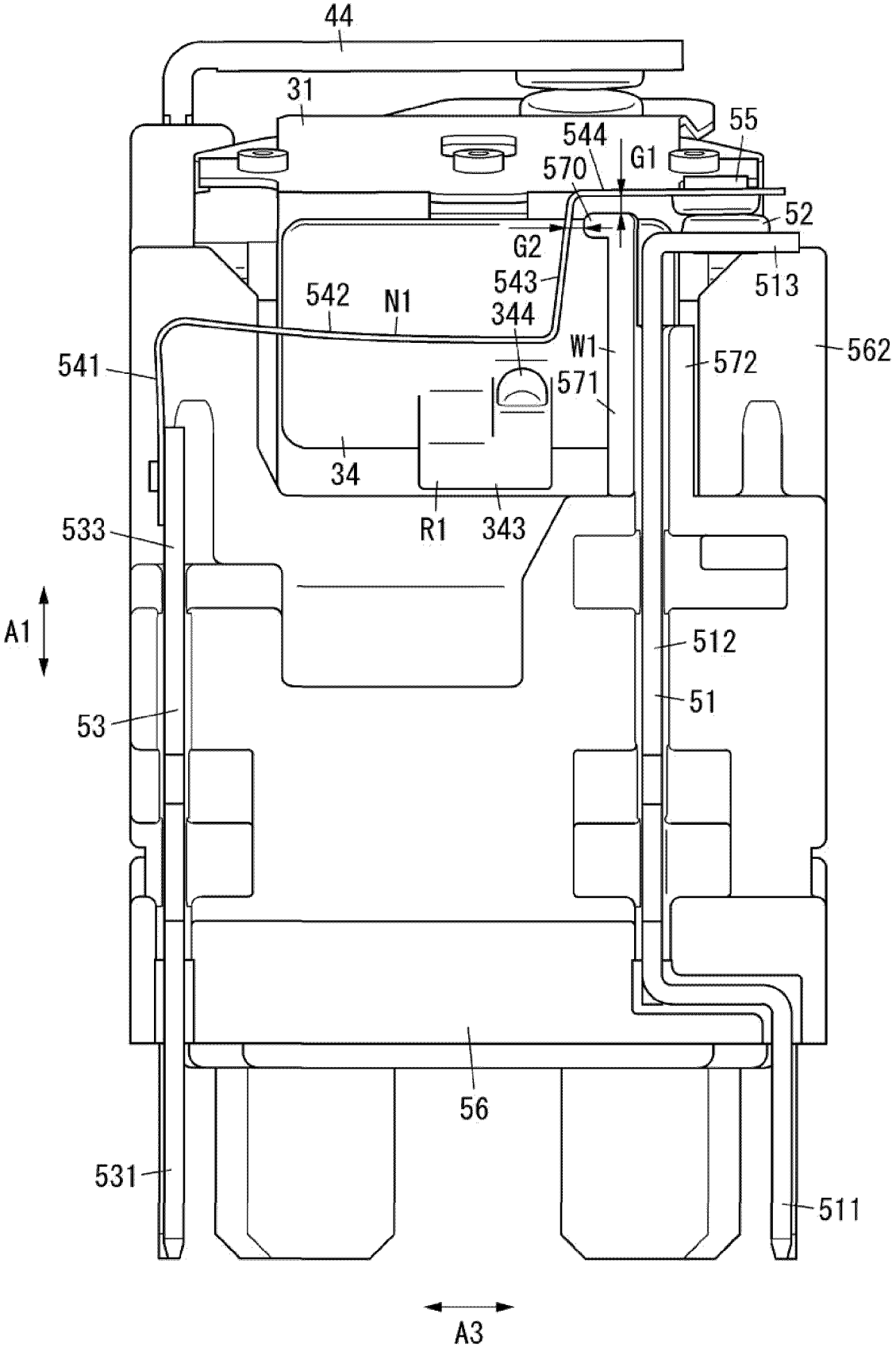
A1
512C
591
53C
514C
511C
531C
A3
A2

FIG. 23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570
G1
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G2
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542
N1
344
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571
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R1
343
533
A1
512
51
53
56
531
511
A3

FIG. 24

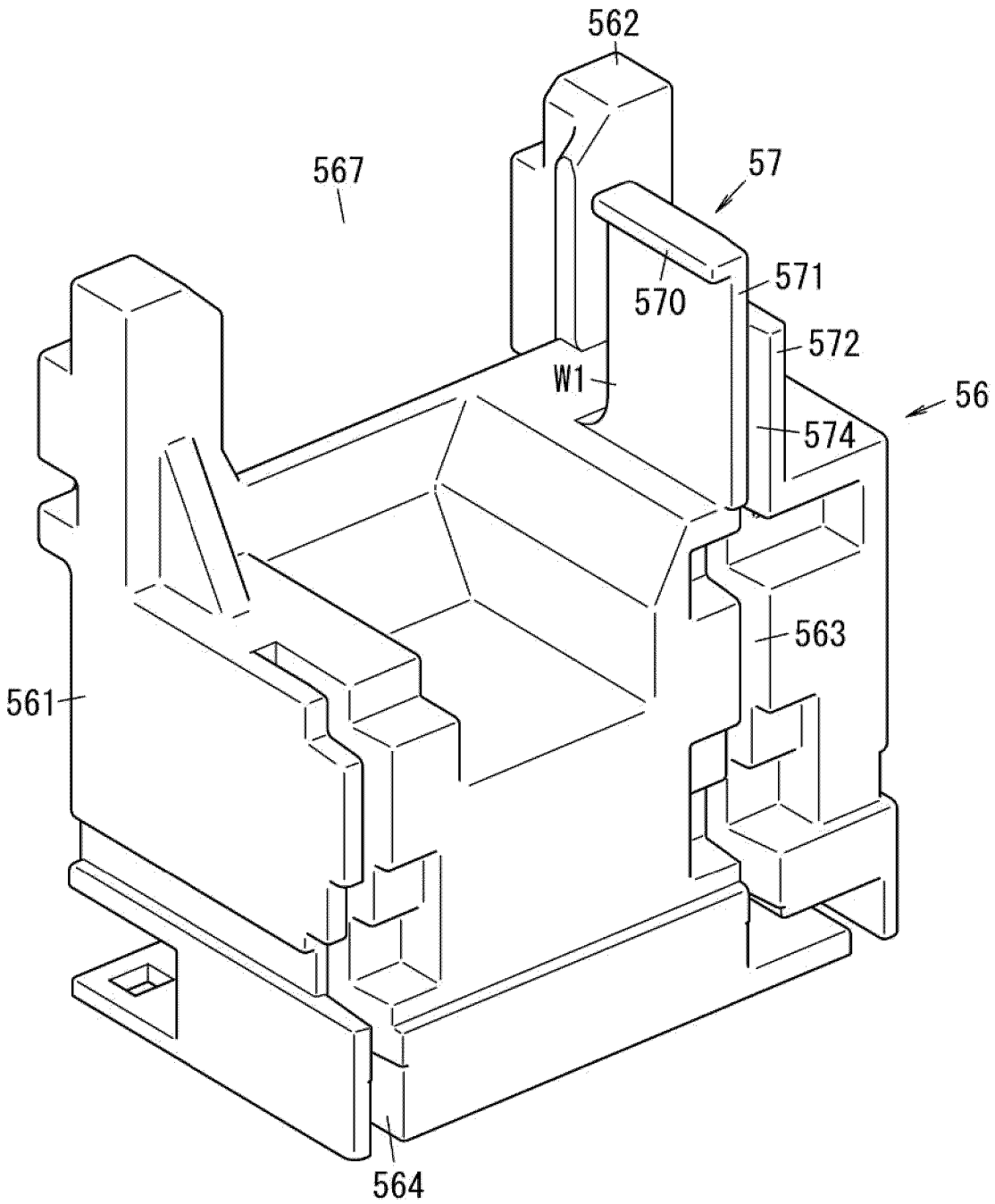


FIG. 25

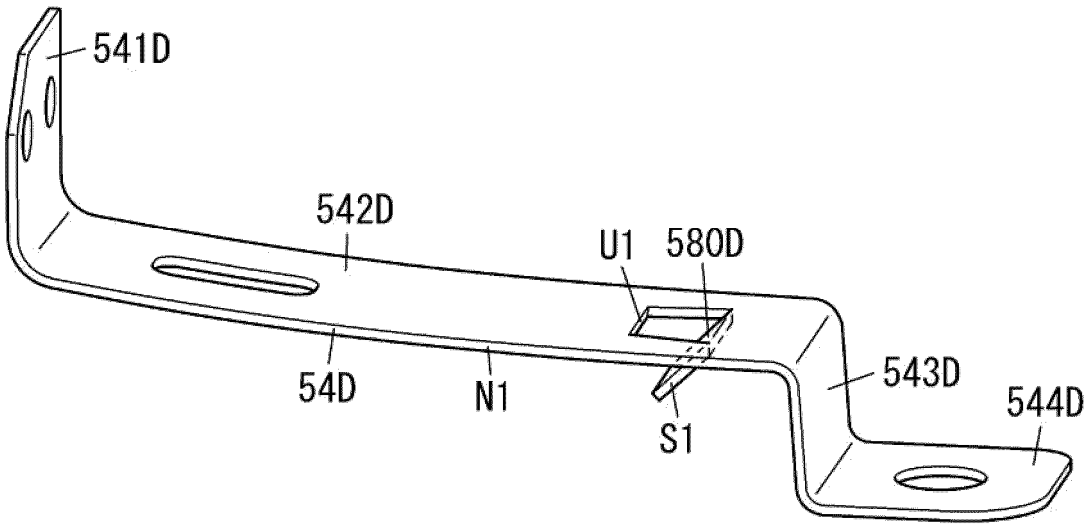
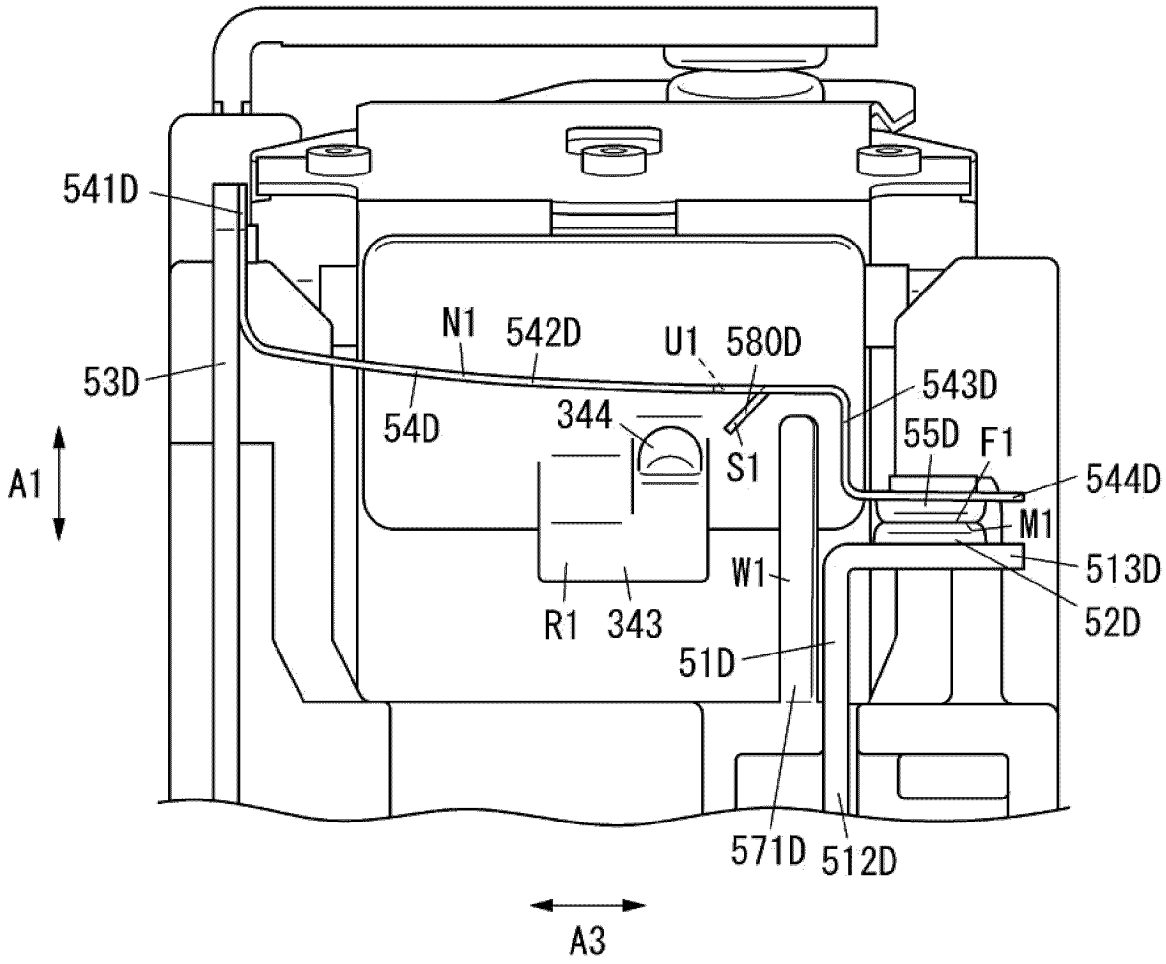


FIG. 26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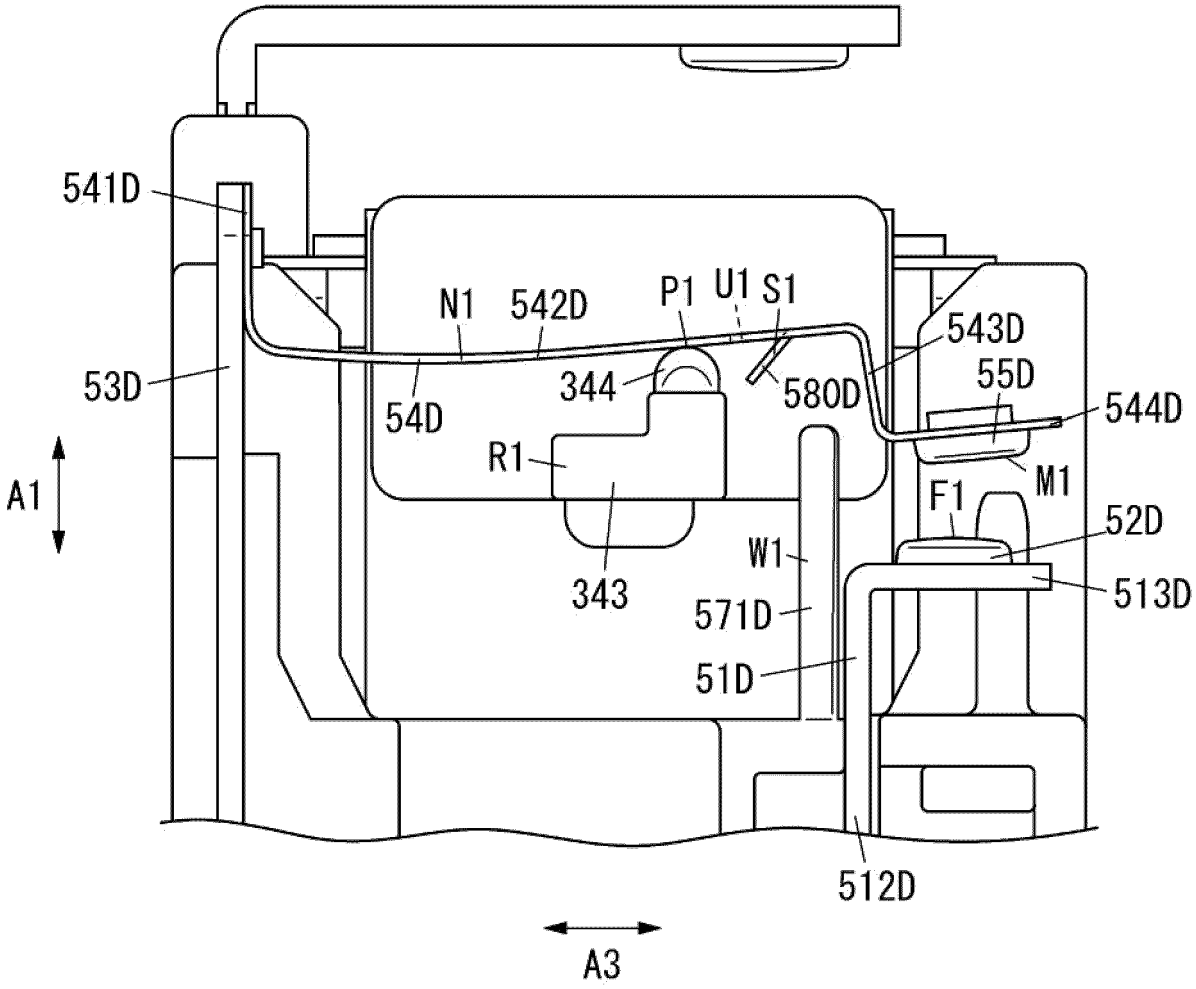
53D
A1
N1
542D
U1
580D
54D
344
S1
543D
55D
F1
544D
M1
513D
52D
W1
R1
343
51D
571D
512D
A3

FIG. 27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54D
N1
542D
P1
U1
S1
344
580D
543D
55D
544D
R1
M1
F1
52D
W1
513D
343
571D
51D
512D
A1
A3

FIG. 28A

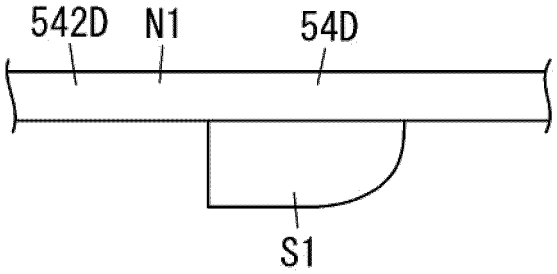


FIG. 28B

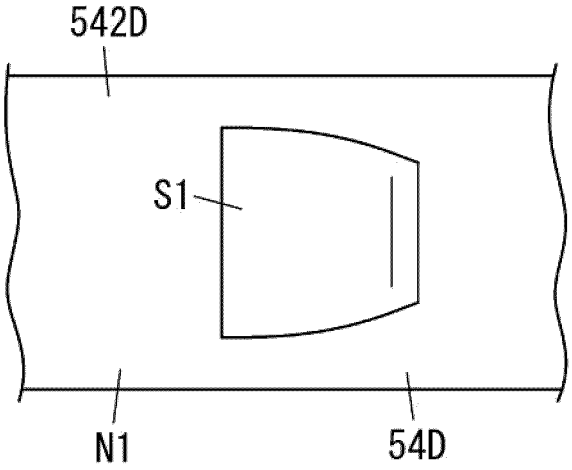


FIG. 28C

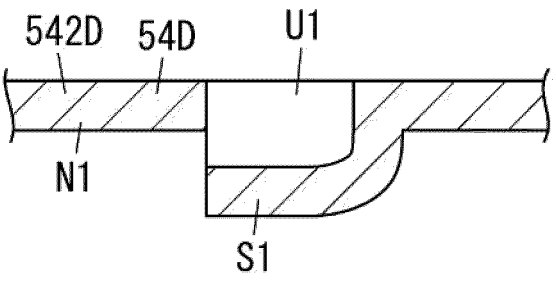


FIG. 29A

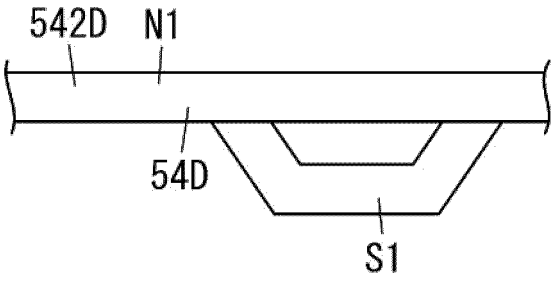


FIG. 29B

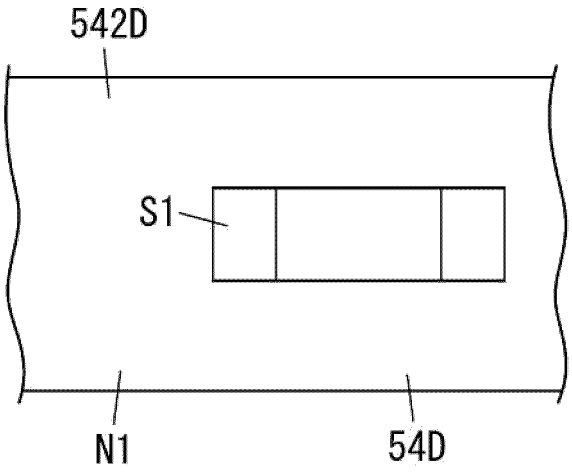


FIG. 30A

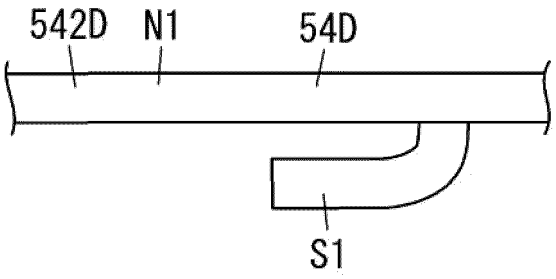


FIG. 30B

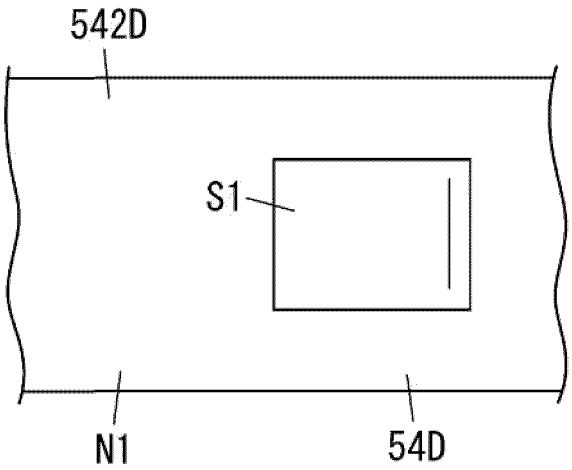


FIG. 31A

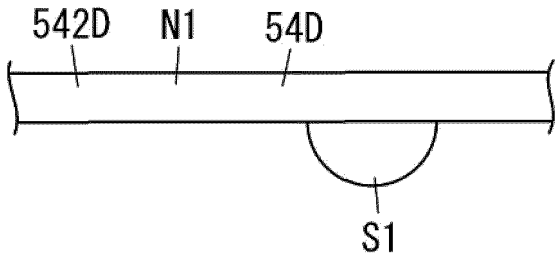


FIG. 31B

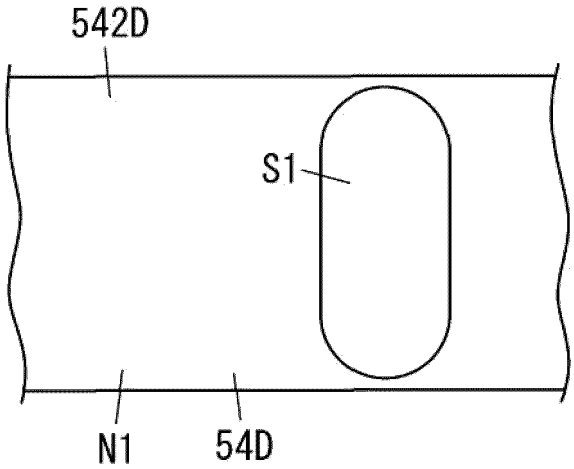


FIG. 31C

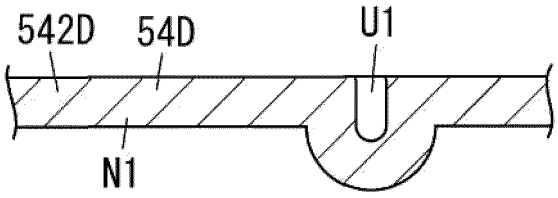


FIG. 32

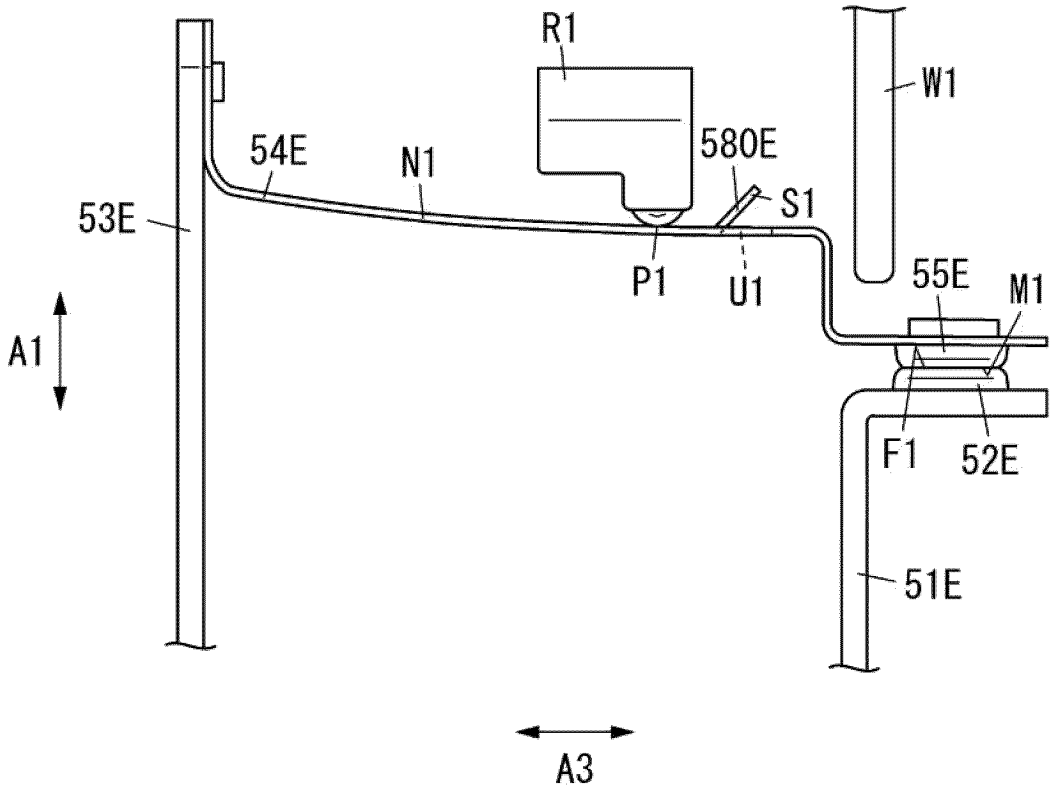


FIG. 33

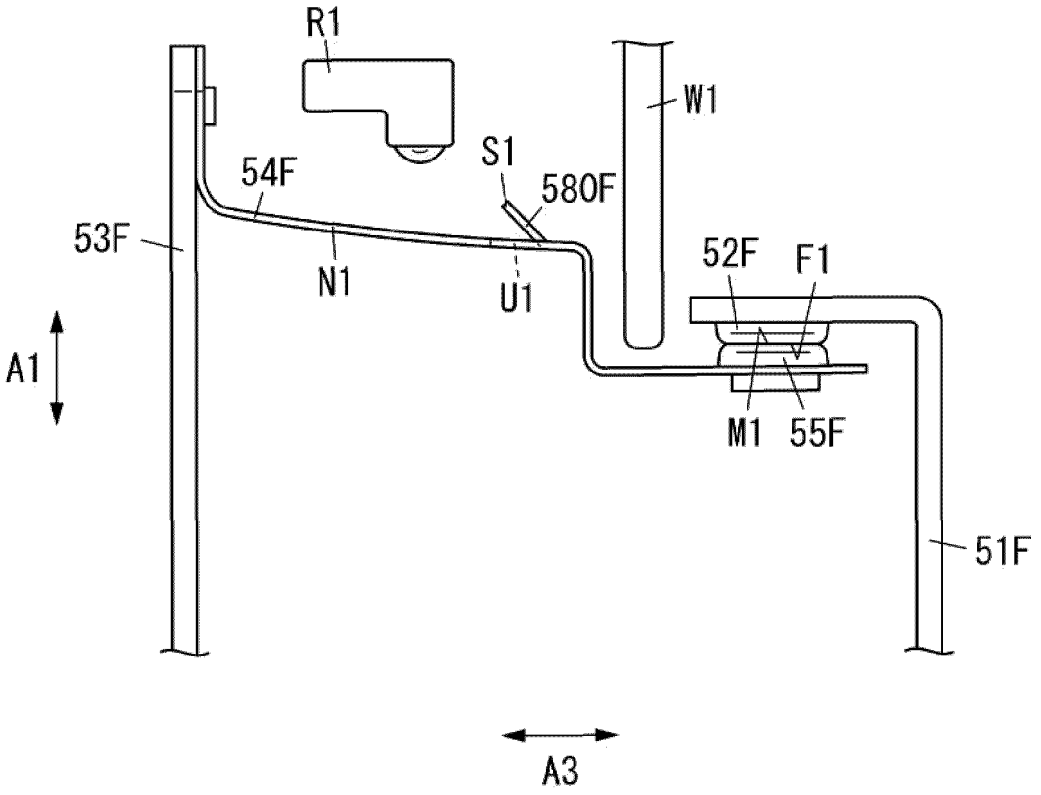
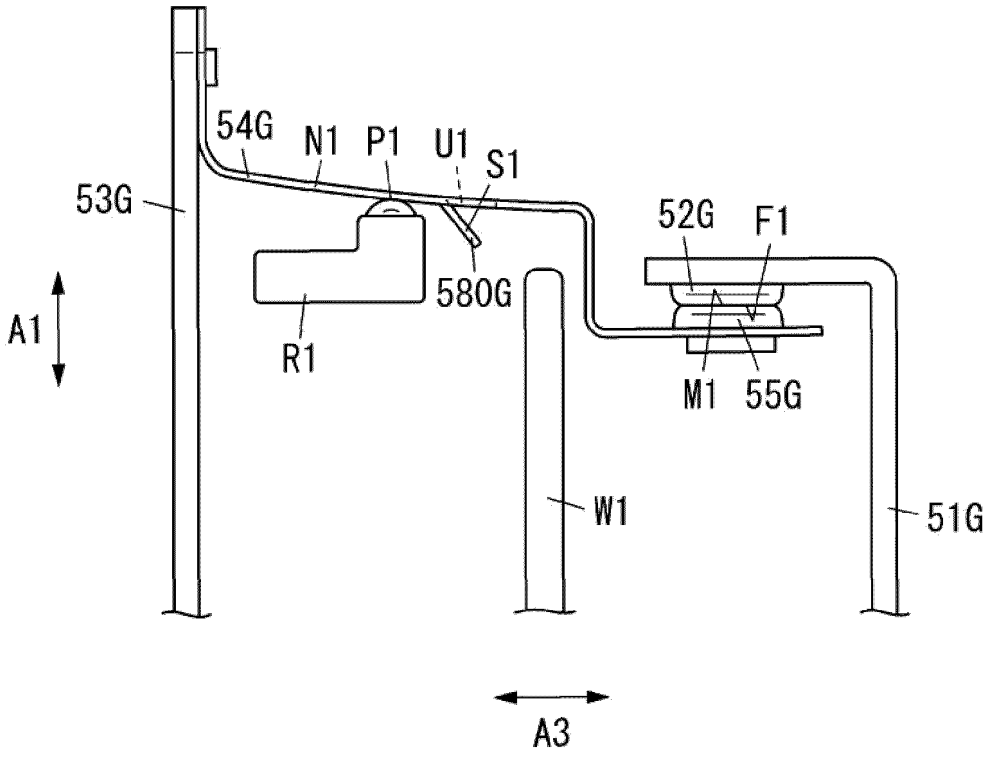

R1
W1
S1
54F
580F
53F
N1
U1
52F
F1
A1
M1
55F
51F
A3

FIG. 34


54G
N1
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U1
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52G
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A1
R1
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55G
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51G
A3

FIG. 35A

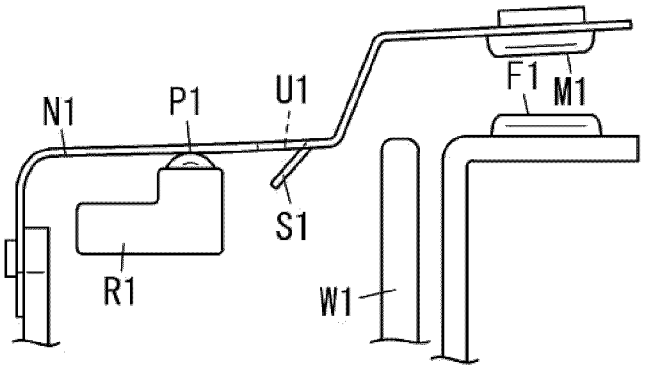


FIG. 35B

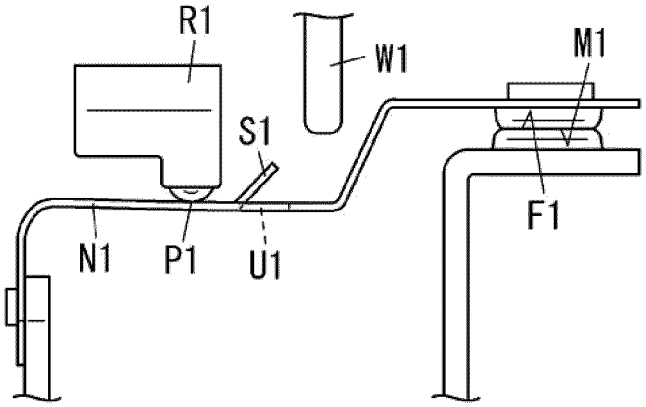


FIG. 35C

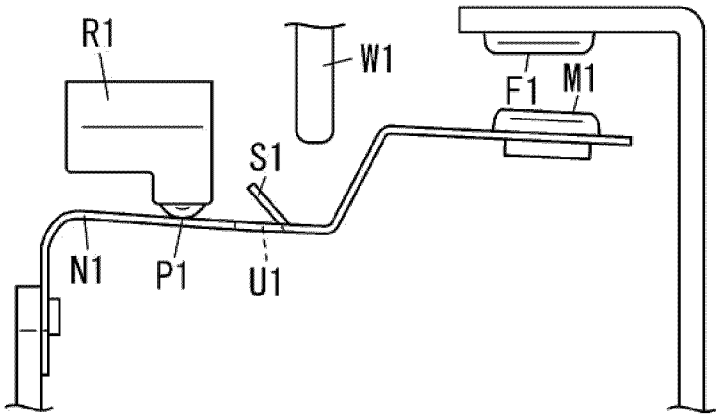


FIG. 35D

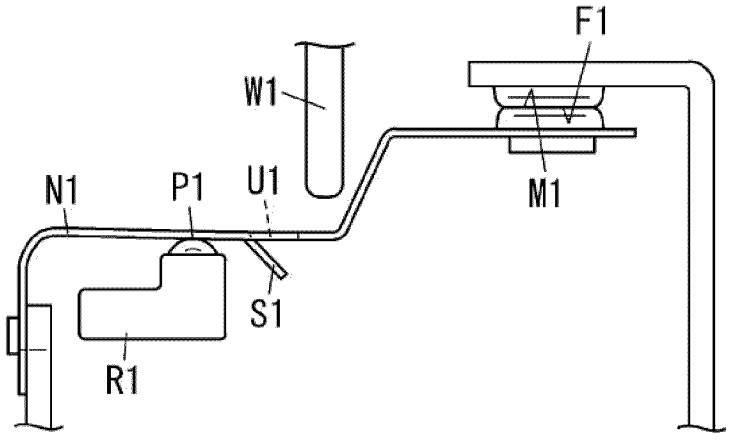


FIG. 36A

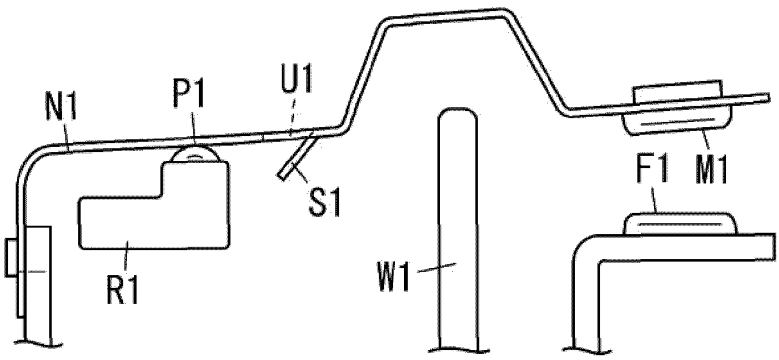


FIG. 36B

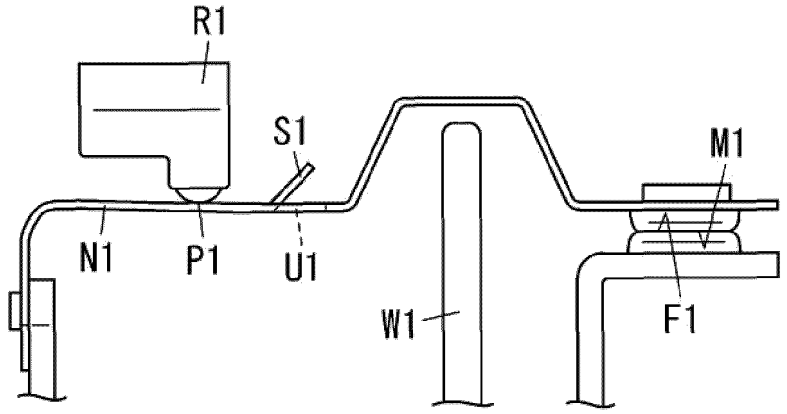


FIG. 36C

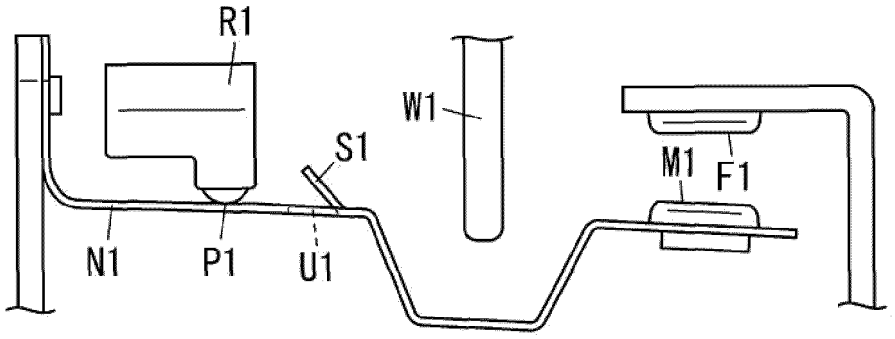
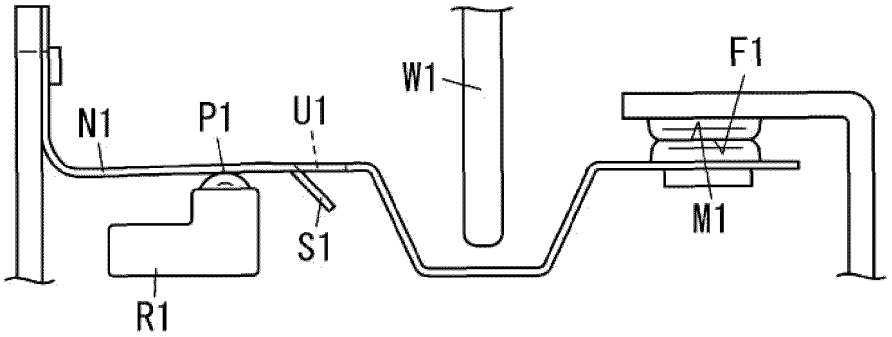


FIG. 36D



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/014381

A. CLASSIFICATION OF SUBJECT MATTER

H01H 50/00(2006.01)i; ***H01H 50/04***(2006.01)i; ***H01H 50/54***(2006.01)i; ***H01H 1/64***(2006.01)i
FI: H01H1/64; H01H50/04 N; H01H50/54 Z; H01H50/00 K; H01H50/54 R

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)

H01H50/00; H01H50/04; H01H50/54; H01H1/64

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 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 088795/1985 (Laid-open No. 206240/1986) (HITACHI LTD) 26 December 1986 (1986-12-26), fig. 1	1-5
Y		6-22
A		23
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 072278/1973 (Laid-open No. 021675/1975) (HITACHI LTD) 11 March 1975 (1975-03-11), specification, p. 2, line 16 to p. 3, line 2, fig. 3, 4	6-22
Y	JP 2020-027729 A (OMRON CORPORATION) 20 February 2020 (2020-02-20) paragraph [0090]	18-22
A	WO 2019/026944 A1 (OMRON CORPORATION) 07 February 2019 (2019-02-07) entire text, all drawings	1-23
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 051839/1991 (Laid-open No. 006638/1993) (NEC CORP) 29 January 1993 (1993-01-29), entire text, all drawings	1-23

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 June 2023	**20 June 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/014381

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2011-090816 A (PANASONIC ELECTRIC WORKS CO LTD) 06 May 2011 (2011-05-06) entire text, all drawings	1-23
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 081168/1982 (Laid-open No. 182321/1983) (THE NIHON KAIHEIKI IND. CO.) 05 December 1983 (1983-12-05), entire text, all drawings	1-23
A	JP 2015-115248 A (PANASONIC IP MAN CORP) 22 June 2015 (2015-06-22) entire text, all drawings	1-23

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/014381

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 61-206240 U1	26 December 1986	(Family: none)	
JP 50-021675 U1	11 March 1975	(Family: none)	
JP 2020-027729 A	20 February 2020	WO 2020/031402 A1 paragraph [0090] US 2021/304993 A1 DE 112019004018 T5 CN 112567491 A	
WO 2019/026944 A1	07 February 2019	JP 2019-032944 A	
JP 05-006638 U1	29 January 1993	(Family: none)	
JP 2011-090816 A	06 May 2011	(Family: none)	
JP 58-182321 U1	05 December 1983	(Family: none)	
JP 2015-115248 A	22 June 2015	WO 2015/087543 A1 entire text, all drawings US 2016/314920 A1 US 49318 E CN 105814659 A	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015115248 A **[0006]**