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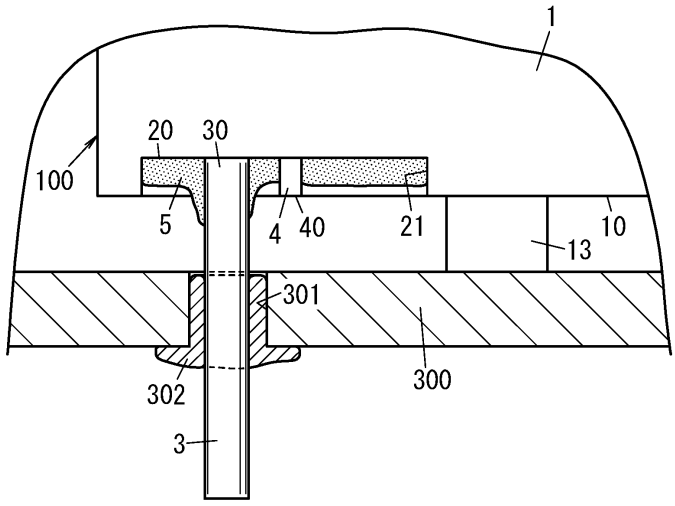
(54) ELECTRIC APPARATUS AND ELECTROMAGNETIC RELAY

(57) An electric apparatus (100) includes a resin member (1), a wall section (21), at least one terminal (3), and a projection section (4). The resin member (1) includes an attachment surface (10) facing a substrate (300). The wall section (21) surrounds a specific area (20) of the attachment surface (10). The at least one terminal (3) protrudes from the specific area (20) to an outer side of the resin member (1). The projection section (4) is provided between the wall section (21) and a base (30) of the at least one terminal (3). The projection section (4) has a tip end (40) exposed from a seal member (5) covering the base (30) of the at least one terminal (3) in a state where the seal member (5) is in the specific area (20). The tip end (40) is provided apart from the at least one terminal (3) and the wall section (21).

FIG. 1A



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Description

Technical Field

[0001] The present disclosure relates generally to electric apparatuses and electromagnetic relays and, specifically, to an electric apparatus and an electromagnetic relay which include a terminal.

Background Art

[0002] JP H05-234447 (hereinafter referred to as "Document 1") discloses a terminal seal structure of an electric apparatus. In this terminal seal structure, a seal groove is formed in an electric apparatus body, a terminal protrudes from a terminal hole formed in the seal groove, and a seal member is injected in the seal groove to seal a gap between the terminal and the terminal hole.

[0003] In the terminal seal structure of Document 1, the seal member may cure in a state where the seal member creeps up a surface of the terminal. When the terminal in this state is bound to a printed wiring board with solder, the seal member on the surface of the terminal may result in that the terminal is not strongly bound to a printed wiring board.

Summary of Invention

[0004] It is an object of the present disclosure to provide an electric apparatus and an electromagnetic relay which reduce creeping up of a seal member on a surface of a terminal.

[0005] An electric apparatus according to one aspect of the present disclosure includes a resin member, a wall section, at least one terminal, and a projection section. The resin member includes an attachment surface facing a substrate. The wall section surrounds a specific area of the attachment surface. The at least one terminal protrudes from the specific area to an outer side of the resin member. The projection section is provided between the wall section and a base of the at least one terminal. The projection section has a tip end exposed from a seal member covering the base of the at least one terminal in a state where the seal member is in the specific area. The tip end is provided apart from the at least one terminal and the wall section.

[0006] An electromagnetic relay according to one aspect of the present disclosure includes the electric apparatus, a fixed contact, a movable contact configured to come into contact with or come out of contact with the fixed contact, and a driver configured to bring the movable contact into contact with or out of contact with the fixed contact.

Brief Description of Drawings

[0007]

FIG. 1A is a sectional view schematically illustrating connection of an electric apparatus according to one embodiment of the present disclosure to a substrate;
FIG. 1B is a sectional view schematically illustrating connection of a conventional electric apparatus to a substrate;
FIG. 2A is a bottom surface perspective view schematically illustrating a state where a seal member is removed from the electric apparatus of the embodiment;
FIG. 2B is a bottom surface perspective view schematically illustrating the electric apparatus;
FIG. 3 is a plan view schematically illustrating a main part in a state where a seal member is removed from the electric apparatus;
FIG. 4 is a sectional view taken along line X-X of FIG. 3;
FIG. 5A is a plan view schematically illustrating a specific area of a first variation of the electric apparatus;
FIG. 5B is a plan view schematically illustrating a specific area of a second variation of the electric apparatus;
FIG. 5C is a plan view schematically illustrating a specific area of a third variation of the electric apparatus;
FIG. 5D is a plan view schematically illustrating a specific area of a fourth variation of the electric apparatus;
FIG. 5E is a plan view schematically illustrating a specific area of a fifth variation of the electric apparatus;
FIG. 5F is a plan view schematically illustrating a specific area of a sixth variation of the electric apparatus;
FIG. 6A is a plan view schematically illustrating a specific area of a seventh variation of the electric apparatus;
FIG. 6B is a plan view schematically illustrating a specific area of an eighth variation of the electric apparatus;
FIG. 6C is a plan view schematically illustrating a specific area of a ninth variation of the electric apparatus;
FIG. 6D is a plan view schematically illustrating a specific area of a tenth variation of the electric apparatus;
FIG. 6E is a plan view schematically illustrating a specific area of an eleventh variation of the electric apparatus; and
FIG. 7 is a partially transparent side view schematically illustrating an electromagnetic relay according to one embodiment of the present disclosure.

Description of Embodiments

1. Schema

[0008] As illustrated in FIG. 1A, an electric apparatus 100 according to one embodiment of the present disclosure includes a resin member 1, a wall section 21, a terminal 3, and a projection section 4. The resin member 1 includes an attachment surface 10 facing a substrate 300. The wall section 21 surrounds a specific area 20 of the attachment surface 10. The terminal 3 protrudes from the specific area 20 to an outer side of the resin member 1. The projection section 4 is provided between the wall section 21 and a base 30 of the terminal 3. The projection section 4 has a tip end 40 exposed from a seal member 5 covering the base 30 of the terminal 3 in a state where the seal member 5 is formed in the specific area 20. The tip end 40 is provided apart from the terminal 3 and the wall section 21.

[0009] To attach the electric apparatus 100 to the substrate 300, the terminal 3 is disposed in a pore 301 formed in the substrate 300, and in this state, for example, solder 302 which is melted is poured into the pore 301 and cures, which enables the terminal 3 to be bound to the substrate 300.

[0010] FIG. 1B shows a conventional electric apparatus 100 in which a resin member 1 is not provided with a projection section 4. As illustrated in FIG. 1B, a base 30 of a terminal 3 is sealed with a seal member 5. The seal member 5 before curing is in a liquid state (hereinafter the seal member 5 before curing is also referred to as seal liquid). When the base 30 is covered with the seal liquid, the seal liquid may creep up a surface of the terminal 3. A reason for the creeping up is that the seal liquid disposed around the base 30 moves along the surface of the terminal 3 due to surface tension. A reason for the movement is probably that the wettability of the terminal 3 made of metal is higher than that of the resin member 1.

[0011] To attach the electric apparatus 100 shown in FIG. 1B to a substrate 300, the terminal 3 is disposed in a pore 301, and in this state, solder 302 which is melted is poured into the pore 301, but at this time, part of the seal member 5 which is located in the pore 301 may hinder the solder 302 from flowing into the pore 301. In this case, it may not be possible to strongly bind the terminal 3 to the substrate 300.

[0012] In contrast, the electric apparatus 100 of the present embodiment includes the projection section 4 as illustrated in FIG. 1A, and the tip end 40 of the projection section 4 is apart from the terminal 3 and the wall section 21. That is, between the terminal 3 and the wall section 21, the projection section 4 is provided. Due to the projection section 4, a location from where the seal liquid starts creeping up is close to the terminal 3, and therefore, it is possible to reduce the creeping up of the seal liquid on the surface of the terminal 3.

[0013] Moreover, in the electric apparatus 100 of the present embodiment, the tip end 40 of the projection section 4 is exposed from the seal member 5, and therefore, it is also possible to reduce spreading of the seal liquid around the projection section 4 to creep up the surface of the terminal 3.

[0014] Moreover, when the electric apparatus 100 of the present embodiment is attached to the substrate 300, the creeping up of the seal member 5 is reduced, and therefore, when the solder 302, which is melted, is poured into the pore 301 formed in the substrate 300 with the terminal 3 being disposed in the pore 301, the seal member 5 is less likely to hinder the solder 302 to flow into the pore 301. Thus, the solder 302 easily flows into the pore 301, and therefore, it is easy to strongly bind the terminal 3 to the substrate 300.

2. Details

[0015] The electric apparatus 100 according to the present embodiment will be described in detail below.

2-1. Electric apparatus

[0016] As described above, the electric apparatus 100 includes the resin member 1. First, the resin member 1 will be described.

2-1-1. Resin Member

[0017] As described above, the resin member 1 includes the attachment surface 10, and the shape of the resin member 1 is not particularly limited. As illustrated in FIG. 2A, the resin member 1 of the present embodiment has a rectangular box shape. Specifically, the resin member 1 includes the attachment surface 10, an opposite surface 11 which is apart from the attachment surface 10 and which is on an opposite side of the attachment surface 10, and four side surfaces 12 located between the attachment surface 10 and the opposite surface 11. Thus, the resin member 1 of the present embodiment has a shape of a box including the opposite surface 11, the attachment surface 10, and the four side surfaces 12. The attachment surface 10, the side surfaces 12, and the opposite surface 11 may be a surface of a single member or surfaces of separate members. For example, in the resin member 1 of the present embodiment, a member including the attachment surface 10 and the four side surfaces 12 and a member including the opposite surface 11 are separate members. In this case, the member including the opposite surface 11 may function as a lid of a container which is the member including the attachment surface 10 and the four side surfaces 12. Moreover, when the container is hollow, various components may be accommodated in a space in the container.

[0018] The material for the resin member 1 is not particularly limited as long as a resin is adopted. The material for the resin member 1 may be, for example, a thermoplastic resin or a thermosetting resin. Examples of the thermoplastic resin include polyethylene (PE), polypro-

pylene (PP), polystyrene (PS), an AS resin, an ABS resin, a methacrylate (PMMA) resin , a polyvinyl chloride (PVC) resin, polyoxymethylene (POM), polyamide (PA), polycarbonate (PC), modified polyphenylene ether (PPE), polybutylene terephthalate (PBT), polyethylene terephthalate (PET), polysulfone (PSF), polyethersulfone (PES), polyphenylene sulfide (PPS), polyamideimide (PEI), polymethylpentene (TPX), and liquid crystal polymer (LCP). Examples of the thermosetting resin include phenolic (PF) resin, a urea (UF) resin, a melamine (MF) resin, an epoxy (EP) resin, a diallyl phthalate (PDAP) resin, an unsaturated polyester (UP) resin, polyimide (PI), and polyurethane (PUR). In the resin member 1 of the present embodiment, the member (container) including the attachment surface 10 and the side surfaces 12 and the member (lid) including the opposite surface 11 are separate members. The member including the attachment surface 10 and the side surfaces 12 and the member including the opposite surface 11 may be made of the same material or may be made of different materials.

[0019] In the present embodiment, the attachment surface 10 has a rectangular shape and includes a plurality of seal areas 2 in each of which the seal member 5 is to be formed. Specifically, the attachment surface 10 includes four seal areas 2 (see FIG. 2A). Each of the seal areas 2 is surrounded by the wall section 21 rising to the outer side of the resin member 1. From each of the seal areas 2, the terminal 3 protrudes to the outer side of the resin member 1. The plurality of seal areas 2 include one or more specific areas 20. In the present embodiment, the four seal areas 2 include two specific areas 20. The specific area 20 means an area which is included in the plurality of seal areas 2 and in which the projection section 4 is further provided. In the present embodiment, one terminal 3 protrudes from one specific area 20. In this case, it is possible to more securely seal the base 30 of the terminal 3 with the seal member 5.

[0020] The attachment surface 10 is provided with a plurality of leg sections 13 (see FIG. 2A). The leg sections 13 enable a gap to be provided between the substrate 300 and the attachment surface 10 when the electric apparatus 100 is attached to the substrate 300. That is, the leg sections 13 are configured to serve as spacers. The shape and the height of the leg sections 13 are not particularly limited as long as they enable a gap to be provided between the substrate 300 and the attachment surface 10. Moreover, locations where the leg sections 13 are provided on the attachment surface 10 are not particularly limited as long as they enable a gap to be provided between the substrate 300 and the attachment surface 10. Moreover, the number of leg sections 13 provided on the attachment surface 10 is not particularly limited as long as it enables a gap to be provided between the substrate 300 and the attachment surface 10.

[0021] The base 30 of the terminal 3 protruding from each seal area 2 is covered with the seal member 5 (see FIG. 2B). Thus, in the plurality of seal areas 2, respective seal members 5 are formed. Specifically, the seal member 5 is accommodated in a space surrounded by one seal area 2 and one wall section 21, and one terminal 3 protrudes from the seal member 5. The seal member 5 is formed in each of the four seal areas 2.

[0022] In the present embodiment, at least two of the plurality of seal areas 2 preferably align to at least partially overlap with each other in a direction along one side of the attachment surface 10. For example, as illustrated in FIG. 2B, in a direction along a side 101, two seal areas 2 (two specific areas 20) align to partially overlap with each other. To form the seal members 5 in the two seal areas 2, the seal liquid is supplied to one of the seal areas 2, and then, the seal liquid is supplied to the other of the seal areas 2. Here, the two seal areas 2 align to partially overlap with each other in the direction along the side 101. Therefore, it is possible to reduce a travel distance of a device for supplying the seal liquid and to efficiently supply the seal liquid. Moreover, for example, in each of a direction along a side 102 and a direction along a side 104, two seal areas 2 (one specific area 20 and one seal area 2) align to partially overlap with each other. Furthermore, for example, in a direction along a side 103, two seal areas 2 align to partially overlap with each other.

[0023] The material for the seal member 5 is not particularly limited as long as a resin is adopted, but the seal member 5 is preferably made of a thermosetting resin. In the present embodiment, the seal member 5 is preferably made of a thermosetting resin. The thermosetting resin has a property of liquefying before curing. Therefore, supplying the seal liquid to the seal area 2 enables the seal liquid to cure with the seal liquid being provided in the seal area 2. Thus, the seal member 5 easily seals the base 30 of the terminal 3. As the thermosetting resin, for example, an epoxy resin may be used.

2-1-2. As to Specific Area, Wall Section, Terminal, and Projection Section

[0024] The specific area 20, the wall section 21, the terminal 3 and the projection section 4 will be described in detail below.

(1) Specific Area and Wall Section

[0025] In the electric apparatus 100 of the present embodiment, the attachment surface 10 includes the specific areas 20. The shape of each specific area 20 is not particularly limited, but each specific area 20 of the present embodiment has a rectangular shape (see FIG. 3). As long as the specific area 20 surrounds the terminal 3, the location of the specific area 20 in the attachment surface 10 is not particularly limited. In other words, the location of the specific area 20 in the attachment surface 10 is determined based on the location of the terminal 3.

[0026] The wall section 21 surrounds, as described above, the specific area 20. Thus, the wall section 21 is continuous to the specific area 20 and rises from the spe-

cific area 20. The angle between the specific area 20 and the wall section 21 may be 90°, may be larger than or equal to 90°, or may be smaller than or equal to 90°. The height of the wall section 21 is not particularly limited but is determined such that the seal member 5 can be accommodated in a space formed by the specific area 20 and the wall section 21. The height of the wall section 21 may be uniform or may be non-uniform.

[0027] In the electric apparatus 100 of the present embodiment, as illustrated in FIG. 2A, each specific area 20 and its corresponding wall section 21 form a recess in the attachment surface 10 (see FIG. 2A). In the present embodiment, the seal member 5 can be accommodated in the recess formed by the specific area 20 and the wall section 21. In the recess, the specific area 20 is a bottom surface, and the wall section 21 is a sidewall.

[0028] In the present embodiment, each wall section 21 surrounds its corresponding specific area 20. Thus, an upper edge of the wall section 21 defines an opening. A virtual surface including the opening is referred to as an opening surface 210 (see FIG. 4). In the present embodiment, the specific area 20 and the wall section 21 form the recess in the attachment surface 10, and therefore, the opening surface 210 is also a virtual surface representing a case where the recess is not formed in the attachment surface 10.

(2) As the Specific Area and Terminal

[0029] As described above, the terminal 3 protrudes from the specific area 20 to the outer side of the resin member 1. Specifically, the terminal 3 protrudes from an inner part of the resin member 1 through the opening formed in the specific area 20 to the outer side of the resin member 1. In the present embodiment, the terminal 3 protrudes from a location deviated from the center of the specific area 20. The base 30 of the terminal 3 in the present disclosure is a base of a portion of the terminal 3 protruding from the resin member 1, in other words, a root part (part close to the specific area 20) of the terminal 3 of portion protruding from the specific area 20 (opening of the specific area 20).

[0030] The terminal 3 of the present embodiment has a flat plate shape and includes a flat surface 31 and a flat surface 32 located on an opposite side of the flat surface 31 (see FIG. 3). The specific area 20 is divided into a region at the side of the flat surface 31 and a region at the side of the flat surface 32 with the terminal 3 as a boarder. When the terminal 3 protrudes from the center of the specific area 20, the area of the region at the side of the flat surface 31 is equal to the region at the side of the flat surface 32. In contrast, when the terminal 3 protrudes from a location deviated from the center of the specific area 20, the area of the region at the side of the flat surface 31 is not equal to the area of the region at the side of the flat surface 32. In this case, when ease of supply of the seal liquid is taken into consideration, the seal liquid is preferably supplied to the larger in area of the region at the side of the flat surface 31 and the region at the side of the flat surface 32. In the present embodiment, the area of the region at the side of the flat surface 32 is larger than the area of the region at the side of the flat surface 31, and therefore, the seal liquid is more easily supplied to the region of the specific area 20 at the side of the flat surface 32.

(3) As to Projection Section

[0031] As illustrated in FIG. 3, the projection section 4 of the present embodiment has a rectangular shape and extends in a width direction of the flat surface 32 of the terminal 3. As described above, the projection section 4 reduces creeping up of the seal liquid on the surface of the terminal 3, the seal liquid being formed in the specific area 20 (see FIG. 1A). As in the present embodiment, when the terminal 3 has flat plate shape having a flat surface 32, the seal liquid attempts to creep up the flat surface 32, but the projection section 4 extending in the width direction of the flat surface 32 enables creeping up of the seal liquid on the flat surface 32 to effectively be reduced.

[0032] As illustrated in FIG. 3, in the present embodiment, in a direction in which the wall section 21, the projection section 4, and the terminal 3 are aligned in this order (first order), the distance L1 between the wall section 21 and the projection section 4 in the first order is preferably longer than a distance L2 between the terminal 3 and the projection section 4. Providing the projection section 4 can reduce the creeping up of the seal liquid more than not providing the projection section 4, but when the distance L2 is longer than the distance L1, the projection section 4 may not satisfactorily reduce the creeping up of the seal liquid. In contrast, when the distance L1 is longer than the distance L2, the projection section 4 satisfactorily reduce the creeping up of the seal liquid on the surface of the terminal 3.

[0033] Moreover, in the present embodiment, the projection section 4 is provided in each specific area 20. Specifically, the projection section 4 is provided between the wall section 21 and the terminal 3 in the specific area 20. More specifically, the projection section 4 is provided between the flat surface 32 of the terminal 3 and a portion of the wall section 21 facing the flat surface 32 in the specific area 20.

[0034] When the seal liquid is supplied to the region at the side of the flat surface 32 in the specific area 20, the seal liquid cannot linearly reach the flat surface 31 but has to spread in a curved manner toward the flat surface 31. Thus, the seal liquid at first reaches the flat surface 32 and then reaches the flat surface 31. In the course of flow of the seal liquid, the viscosity of the seal liquid continues increasing. Thus, the viscosity of the seal liquid reaching the flat surface 32 tends to be lower than the viscosity of the seal liquid reaching the flat surface 31. When the viscosity of the seal liquid is low, the seal liquid easily creeps up the surface of the terminal 3, and there-

fore, the seal liquid reaching the flat surface 32 more easily creeps up the surface of the terminal 3 than the seal liquid reaching the flat surface 31 does.

[0035] As in the present embodiment, providing the projection section 4 between the flat surface 32 of the terminal 3 and a portion of the wall section 21 facing the flat surface 32 enables a time required for the seal liquid to reach the flat surface 32 and to cover the flat surface 32 to be increased, and thereby, it is possible to increase the viscosity of the seal liquid when the seal liquid covers the flat surface 32. This enables creeping up of the seal liquid on the flat surface 32 to effectively be reduced. Moreover, the projection section 4 has a flat surface (counter surface) facing the flat surface 32 of the terminal 3. Here, the dimension in a width direction of the flat surface (counter surface) of the projection section 4 is larger than the dimension in a width direction of the flat surface 32 of the terminal 3. In this case, it is possible to further increase a time required for the seal liquid to reach the flat surface 32.

[0036] Moreover, as illustrated in FIG. 3, in the present embodiment, in a direction in which the projection section 4, the terminal 3, and the wall section 21 are aligned in this order (second order), the distance L2 between the projection section 4 and the terminal 3 is preferably shorter than a distance L3 between the wall section 21 and the terminal 3 in the second order. When the distance L2 is shorter than the distance L3, it is possible to increase a time required for the seal liquid to reach the flat surface 32, which enables an increase of the viscosity of the seal liquid reaching the flat surface 32. Thus, it is easy to further reduce creeping up of the seal liquid on the flat surface 32. Moreover, the seal liquid is less likely to spread between the flat surface 31 of the terminal 3 and the wall section 21, but when the distance L3 is longer than the distance L2, it is possible to facilitate spreading of the seal liquid between the flat surface 32 of the terminal 3 and the wall section 21.

[0037] Moreover, when the projection section 4 is compared with the specific area 20 in terms of surface roughness, in the present embodiment, the surface roughness of the specific area 20 facing the opening surface 210 of the wall section 21 is preferably greater than the surface roughness of projection section 4. In general, the seal liquid easily flows in a region having a greater surface roughness. In the present embodiment, the surface roughness of the specific area 20 is greater than the surface roughness of the side surface of the projection section 4, which enables the seal liquid to easily flow on the specific area 20. Thus, the seal liquid supplied to the specific area 20 easily covers the base 30 of the terminal 3, and it becomes easy to seal the base 30 of the terminal 3 by the seal member 5. An example of a method for increasing the surface roughness of the specific area 20 is, for example, emboss processing or the like performed on the surface of the specific area 20.

(4) As to Slope Section and Guide Section

[0038] In the present embodiment, as illustrated in FIGS. 3 and 4, each specific area 20 preferably has a slope section 201 formed such that the distance (L4 in FIG. 4) between the opening surface 210 of the wall section 21 and the specific area 20 facing the opening surface 210 increases as the distance from the wall section 21 to the terminal 3 decreases. The seal liquid is supplied to the slope section 201, thereby allowing the seal liquid to spread along the slope of the slope section 201. Since the slope section 201 of the present embodiment slopes from the wall section 21 toward the terminal 3, it is possible to allow the seal liquid to spread toward the terminal 3. Thus, it becomes easy to cover the base 30 of the terminal 3 with the seal liquid, and it becomes easy to seal the base 30 of the terminal 3 with the seal member 5. In particular, when the seal member 5 is made of a thermosetting resin, the viscosity of the seal liquid continues increasing also during a period from supplying of the seal liquid to the specific area 20 to covering of the base 30 of the terminal 3. Thus, the slope section 201 reduces the time required for the seal liquid to cover the base 30 of the terminal 3, and thereby, it is easy to cover the base 30 of the terminal 3 with the seal liquid before the viscosity of the seal liquid is excessively increased. Moreover, in the present embodiment, the specific area 20 has the slope section 201, but it is also preferable, as illustrated in FIG. 2A, that the seal area 2 provided with no projection section 4 has the slope section 201. Also in this case, it is easy to cover, with the seal liquid, the base 30 of the terminal 3 protruding from the seal area 2. Moreover, when each of the plurality of seal areas 2 has the slope section 201, the seal liquid is supplied to the slope section 201 of each seal area 2. Thus, the slope sections 201 of at least two of the plurality of seal areas 2 preferably align to partially overlap with each other in a direction along one side of the attachment surface 10. It is possible to reduce a travel distance of a device for supplying the seal liquid, which enables the seal liquid to be efficiently supplied.

[0039] As illustrated in FIGS. 3 and 4, the electric apparatus 100 of the present embodiment includes a guide section 202 provided in the specific area 20 and extending in a direction from the wall section 21 toward the terminal 3. The guide section 202 is preferably a projection or a groove. When the seal liquid supplied to the specific area 20 comes into contact with the guide section 202, the seal liquid flows along the guide section 202. The guide section 202 of the present embodiment extends in the direction from the wall section 21 toward the terminal 3 and thus allows the seal liquid to flow toward the terminal 3. Thus, it becomes easy to cover the base 30 of the terminal 3 with the seal liquid, and it becomes easy to seal the base 30 of the terminal 3 with the seal member 5. In particular, when the seal member 5 is made of a thermosetting resin, the viscosity of the seal liquid continues increasing also during a period from supplying of

the seal liquid to the specific area 20 to covering of the base 30 of the terminal 3. Thus, the guide section 202 reduces the time required for the seal liquid to cover the base 30 of the terminal 3, and thereby, it is possible to cover the base 30 of the terminal 3 with the seal liquid before the viscosity of the seal liquid is excessively increased. Only one guide section 202 may be provided, two guide sections 202 may be provided, or three or more guide sections 202 may be provided. In the electric apparatus 100 of the present embodiment, two guide sections 202 are provided. Moreover, in the present embodiment, the guide sections 202 are provided in the specific area 20, but as illustrated in FIG. 2A, it is also preferable that the guide sections 202 are provided in the seal area 2 provided with no projection section 4. Also in this case, it is easy to cover the base 30 of the terminal 3 protruding from the seal area 2 with the seal liquid.

[0040] Moreover, as illustrated in FIGS. 3 and 4, it is also preferable that the specific area 20 has the slope section 201 and the guide sections 202, and the guide sections 202 are provided in the slope section 201. In this case, the seal liquid supplied to the slope section 201 flows to spread toward the terminal 3, and additionally, the guide section 202 enables the seal liquid to spread toward the terminal 3. Thus, it becomes easy to particularly cover the base 30 of the terminal 3 with the seal liquid, and it becomes easy to particularly seal the base 30 of the terminal 3 with the seal member 5. Moreover, the slope section 201 and the guide sections 202 particularly reduces a time required for the seal liquid to cover the bae 30 of the terminal 3. Thus, it is easy to cover the base 30 of the terminal 3 with the seal liquid before the viscosity of the seal liquid is excessively increased.

(5) As to Area Other than Specific Area

[0041] Of the plurality of seal areas 2, a seal area 2 other than the specific area 20 is not provided with the projection section 4. In the specific area 20, the projection section 4 enables creeping up of the seal liquid on the surface of the terminal 3 to be reduced. In contrast, in the seal area 2 provided with no projection section 4, for example, the distance between the flat surface 31 of the terminal 3 and the wall section 21 and the distance between the flat surface 32 of the terminal 3 and the wall section 21 are reduced, thereby reducing creeping up of the seal liquid. The distance between the flat surface 31 and the wall section 21 and the distance between the flat surface 32 and the wall section 21 are adjustable by the location at which the terminal 3 protrudes from the seal area 2 or the shape of the seal area 2. For example, as illustrated in FIG. 2A, the seal area 2 is determined at least such that each of the distance between the flat surface 31 and the wall section 21 and the distance between the flat surface 32 and the wall section 21 is larger than the distance between the side surface of the terminal 3 and the wall section 21.

2-1-3. Variation of Electric apparatus

[0042] The configuration of the electric apparatus 100 is not limited to the above-described example.

[0043] In the electric apparatus 100 shown in FIG. 2A, the specific area 20 and the wall section 21 form a recess in the attachment surface 10. That is, the specific area 20 is surrounded by the wall section 21 recessed from the attachment surface 10, but this should not be construed as limiting. For example, the specific area 20 may be surrounded by the wall section 21 protruding from the attachment surface 10. Also in this case, the seal member 5 can be accommodated in a space surrounded by the specific area 20 and the wall section 21.

[0044] In the electric apparatus 100 shown in FIG. 2A, the seal area 2 provided with no projection section 4 is also surround by the wall section 21 recessed from the attachment surface 10, but this should not be construed as limiting. For example, the seal area 2 may be surrounded by the wall section 21 protruding from the attachment surface 10.

[0045] In the electric apparatus 100 shown in FIG. 2A, the specific area 20 has the slope section 201, but this should not be construed as limiting. For example, the specific area 20 does not have to have the slope section 201.

[0046] In the electric apparatus 100 shown in FIG. 2A, the guide sections 202 are provided in the specific area 20, but this should not be construed as limiting. For example, the guide sections 202 do not have to be provided in the specific area 20.

[0047] In the electric apparatus 100 shown in FIG. 2A, the guide sections 202 are projections provided in the specific area 20, but this should not be construed as limiting. For example, the guide sections 202 may be grooves formed in the specific area 20.

[0048] Moreover, in the electric apparatus 100 shown in FIG. 3, the terminal 3 has a flat plate shape having the flat surface 32, and the projection section 4 extends in a width direction of the flat surface 32, but this should not be construed as limiting.

[0049] Preferably, for example, the terminal 3 has a flat plate shape having the flat surface 32, and in a width direction of the flat surface 32, a central part of the projection section 4 is located between the terminal 3 and an end of the projection section 4. When the seal liquid creeps up the flat surface 32 of the terminal 3, the seal liquid more easily creeps up at the central part than at the end in the width direction of the flat surface 32. When the central part of the projection section 4 is between the end and the terminal 3, it is possible to reduce creeping up of the seal liquid at the central part in the width direction of the flat surface 32. This enables creeping up of the seal liquid to effectively be reduced.

[0050] For example, in a first variation of the electric apparatus 100 shown in FIG. 5A, a projection section 4 is provided in a specific area 20, and the center of the projection section 4 is closest to a flat surface 32 of a

terminal 3 in a width direction of the flat surface 32 of the terminal 3. Moreover, a distance between the projection section 4 and the terminal 3 (flat surface 32) increases as a distance from the center to each end of the projection section 4 decreases.

[0051] For example, in a second variation of the electric apparatus 100 shown in FIG. 5B, a projection section 4 is provided in a specific area 20, and the center of the projection section 4 and a peripheral part of the center are closest to a flat surface 32 of a terminal 3 in a width direction of the flat surface 32 of the terminal 3. Moreover, a distance between the projection section 4 and the terminal 3 (flat surface 32) increases as a distance from the peripheral part of the center to each end of the projection section 4 decreases.

[0052] For example, in a third variation of the electric apparatus 100 shown in FIG. 5C, a projection section 4 is provided in a specific area 20, the center of the projection section 4 is closest to a flat surface 32 of a terminal 3 in a width direction of the flat surface 32 of the terminal 3. Moreover, a distance between the projection section 4 and the terminal 3 (flat surface 32) gradually increases as a distance from the center to each end of the projection section 4 decreases.

[0053] For example, in a fourth variation of the electric apparatus 100 shown in FIG. 5D, a projection section 4 is provided in a specific area 20, and the center of the projection section 4 is closest to a flat surface 32 of a terminal 3 in a width direction of the flat surface 32 of the terminal 3. Moreover, a distance between the projection section 4 and the terminal 3 (flat surface 32) gradually increases as a distance from the center to each end of the projection section 4 decreases. The projection section 4 shown in FIG. 5D has a round shape in plan view.

[0054] For example, in a fifth variation of the electric apparatus 100 shown in FIG. 5E, the projection section 4 is provided in the specific area 20 and includes a first projection section 41 and a second projection section 42. The first projection section 41 is located, in a width direction of a flat surface 32 of a terminal 3, at a central part of the flat surface 32 of the terminal 3 and is located between the second projection section 42 and the flat surface 32. The second projection section 42 is located farther away from the flat surface 32 than the first projection section 41 is, and the second projection section 42 extends in the width direction of the flat surface 32 of the terminal 3. The projection section 4 in FIG. 5E also has a central part and ends in the width direction of the flat surface 32 of the terminal 3, and the central part is closer to the terminal 3 than the ends are.

[0055] For example, in a sixth variation of the electric apparatus 100 shown in FIG. 5F, a projection section 4 is provided in a specific area 20, and the center of the projection section 4 is closest to a flat surface 32 of a terminal 3 in a width direction of the flat surface 32 of the terminal 3. Moreover, a distance between the projection section 4 and the terminal 3 (flat surface 32) increases as a distance from the center to each end of the projection section 4 decreases. The projection section 4 shown in FIG. 5F has a triangular shape in plan view.

[0056] For example, in a seventh variation of the electric apparatus 100 shown in FIG. 6A, a projection section 4 is provided in a specific area 20, and the center of the projection section 4 and a peripheral part of the center are closest to a flat surface 32 of a terminal 3 in a width direction of the flat surface 32 of the terminal 3. Moreover, a distance between the projection section 4 and the terminal 3 (flat surface 32) increases as a distance from the peripheral part of the center to each end of the projection section 4 decreases. The projection section 4 shown in FIG. 6A has a trapezoidal shape in plan view.

[0057] Moreover, in the electric apparatus 100 shown in FIG. 3, the terminal 3 has a flat plate shape having the flat surface 32, and the projection section 4 extends in a width direction of the flat surface 32, but this should not be construed as limiting. For example, also when the terminal 3 has a flat plate shape having the flat surface 32, the projection section 4 does not have to extend in the width direction of the flat surface 32 of the terminal 3. For example, in an eighth variation of the electric apparatus 100 shown in FIG. 6B, a projection section 4 provided in a specific area 20 is provided only in the periphery of the center in a width direction of a flat surface 32 of a terminal 3.

[0058] In the electric apparatus 100 shown in FIG. 3, the terminal 3 protrudes from the location deviated from the center of the specific area 20, but this should not be construed as limiting. For example, the terminal 3 may protrude from the center of the specific area 20.

[0059] For example, in a ninth variation of the electric apparatus 100 shown in FIG. 6C, a terminal 3 which has a flat plate shape protrudes from the center of a specific area 20. Between a flat surface 31 of the terminal 3 and a wall section 21, a projection section 4 is provided, and between a flat surface 32 of the terminal 3 and the wall section 21, a projection section 4 is provided. The projection section 4 provided between the flat surface 31 and the wall section 21 is divided at the center of the projection section 4 in a width direction of the flat surface 31. The projection section 4 provided between the flat surface 32 and the wall section 21 is divided at the center of the projection section 4 in a width direction of the flat surface 32. When the projection section 4 is divided at the center in the width direction of the flat surface 31 (flat surface 32), seal liquid more easily reaches the flat surface 31 (flat surface 32) of the terminal 3 than when the projection section 4 is not divided at the center. Thus, it is possible to facilitate covering of a base of the terminal 3 with the seal liquid.

[0060] For example, in each of a tenth variation of the electric apparatus 100 shown in FIG. 6D and an eleventh variation of the electric apparatus 100 shown in FIG. 6E, a terminal 3 having a columnar shape protrudes from the center of the specific area 20. Moreover, two projection sections 4 are provided in the circumference of the terminal 3. The projection sections 4 are located along the

circumference of the terminal 3, and it is thus possible to effectively reduce creeping up of the seal liquid on the surface of the terminal 3.

2-2. Electromagnetic Relay

[0061] An electromagnetic relay 600 of the present embodiment will be described below with reference to FIG. 7. Note that the electromagnetic relay 600 shown in FIG. 7 is a mere example, and design of the dimension, shape, and the like of the electromagnetic relay 600 may accordingly be changed and is not limited to the configuration shown in FIG. 7.

[0062] The electromagnetic relay 600 includes, for example, the electric apparatus 100 as shown in FIG. 2A. Thus, the electromagnetic relay 600 shown in FIG. 7 includes one resin member 1 and four terminals 3. In the resin member 1, a fixed contact 60, a movable contact 61, and a driver are accommodated. The driver includes a coil 63 and an armature 62. The armature 62 is driven by magnetic flux generated by energization of the coil 63. The armature 62 drives the movable contact 61. Thus, the electromagnetic relay 600 includes the fixed contact 60, the movable contact 61, and the driver. Of the four terminals 3, one terminal 3 is electrically connected to the fixed contact 60, one terminal 3 is electrically connected to the movable contact 61, and two terminals 3 are electrically connected to the coil 63 included in the driver.

[0063] The movable contact 61 is configured to come into contact with or come out of contact with the fixed contact 60. The driver is configured to bring the movable contact 61 into contact with or out of contact with the fixed contact 60. The driver may bring the movable contact 61 out of contact with the fixed contact 60 into contact with the fixed contact 60, and the driver may bring the movable contact 61 in contact with the fixed contact 60 out of contact with the fixed contact 60.

[0064] In the electric apparatus 100 of the present embodiment, creeping up of the seal member 5 is reduced, and therefore, the solder 302 is easily injected into the pore 301 with the terminal 3 being disposed in the pore 301 formed in the substrate 300, and therefore, it is possible to strongly bind the terminal 3 to the substrate 300. Thus, in the electromagnetic relay 600 including the electric apparatus 100, the terminal 3 can be strongly bound to the substrate 300.

2-3. Other Electric apparatus

[0065] FIG. 7 shows the electromagnetic relay 600 including the electric apparatus 100. However, the electric apparatus 100 is applicable to components other than the electromagnetic relay 600.

3. Summary

[0066] An electric apparatus (100) of a first aspect includes a resin member (1), a wall section (21), at least one terminal (3), and a projection section (4). The resin member (1) includes an attachment surface (10) facing a substrate (300). The wall section (21) surrounds a specific area (20) of the attachment surface (10). The at least one terminal (3) protrudes from the specific area (20) to an outer side of the resin member (1). The projection section (4) is provided between the wall section (21) and a base (30) of the at least one terminal (3). The projection section (4) has a tip end (40) exposed from a seal member (5) covering the base (30) of the at least one terminal (3) in a state where the seal member (5) is in the specific area (20). The tip end (40) is provided apart from the at least one terminal (3) and the wall section (21).

[0067] In this case, due to the projection section (4), a location from where seal liquid starts creeping up is close to the at least one terminal (3), the seal liquid being to cure to be the seal member (5), and therefore, it is possible to reduce the creeping up of the seal liquid on the surface of the at least one terminal (3). Moreover, the tip end (40) of the projection section (4) is exposed from the seal member (5), and therefore, it is also possible to reduce spreading of the seal liquid beyond the projection section (4) to creep up the surface of the at least one terminal (3). The base (30) of the at least one terminal (3) is, for example, a base of a portion of the at least one terminal (3), the portion protruding from the resin member (1). The base (30) of the at least one terminal (3) is, for example, a root portion (portion close to the specific area (20)) of a portion of the at least one terminal (3), the portion protruding from the specific area (20).

[0068] In an electric apparatus (100) of a second aspect referring to the first aspect, the at least one terminal (3) includes only one terminal (3), and the only one terminal (3) protrudes from the specific area (20).

[0069] This configuration enables the base (30) of the only one terminal (3) to be more securely sealed with the seal member (5).

[0070] In an electric apparatus (100) of a third aspect referring to the first or second aspect, the specific area (20) has a slope section (201) formed such that a distance (L4) between an opening surface (210) of the wall section (21) and the specific area (20) facing the opening surface (210) increases as a distance from the wall section (21) to the at least one terminal (3) decreases.

[0071] In this case, since the slope section (201) slopes from the wall section (21) toward the at least one terminal (3), the seal liquid is allowed to flow to spread toward the at least one terminal (3). Thus, it becomes easy to cover the base (30) of the at least one terminal (3) with the seal liquid, and it becomes easy to seal the base (30) of the at least one terminal (3) with the seal member (5).

[0072] In an electric apparatus (100) of a fourth aspect referring to any one of the first to third aspects, in a direction in which the wall section (21), the projection section (4), and the at least one terminal (3) are aligned in a first order, a distance (L1) between the wall section (21) and the projection section (4) in the first order is longer

than a distance (L2) between the at least one terminal (3) and the projection section (4).

[0073] In this case, since the distance (LI) is longer than the distance (L2), the projection section (4) satisfactorily reduce the creeping up of the seal liquid on the surface of the at least one terminal (3).

[0074] In an electric apparatus (100) of a fifth aspect referring to any one of the first to fourth aspects, the at least one terminal (3) has a flat plate shape having a flat surface (32), and the projection section (4) extends in a width direction of the flat surface (32) of the at least one terminal (3).

[0075] In this case, since the at least one terminal (3) has a flat plate shape having the flat surface (32), the seal liquid attempts to creep up the flat surface (32), but since the projection section (4) extends in the width direction of the flat surface (32), it is possible to reduce creeping up of the seal liquid on the flat surface (32) of the at least one terminal (3).

[0076] In an electric apparatus (100) of a sixth aspect referring to any one of the first to fourth aspects, the at least one terminal (3) has a flat plate shape having the flat surface (32), and in a width direction of the flat surface (32) of the at least one terminal (3), a central part of the projection section (4) is located between the at least one terminal (3) and an end of the projection section (4).

[0077] When the seal liquid creeps up the flat surface (32) of the at least one terminal (3), the seal liquid more easily creeps up at the central part than at the end in the width direction of the flat surface (32). When the central part of the projection section (4) is between the end and the at least one terminal (3), it is possible to reduce creeping up of the seal liquid at the central part in the width direction of the flat surface (32). This enables creeping up of the seal liquid to effectively be reduced.

[0078] An electric apparatus (100) of a seventh aspect referring to any one of the first to sixth aspects further includes a guide section (202) provided in the specific area (20) and extending in a direction from the wall section (21) toward the at least one terminal (3). The guide section (202) is a projection or a groove.

[0079] In this case, when the seal liquid comes into contact with the guide section (202), the seal liquid flows along the guide section (202). The guide section (202) extends in the direction from the wall section (21) toward the at least one terminal (3) and thus allows the seal liquid to flow toward the at least one terminal (3). Thus, it becomes easy to cover the base (30) of the at least one terminal (3) with the seal liquid, and it becomes easy to seal the base (30) of the at least one terminal (3) with the seal member (5).

[0080] In an electric apparatus (100) of an eighth aspect referring to any one of the first to seventh aspects, the seal member (5) is made of a thermosetting resin.

[0081] In this case, since the thermosetting resin has a property of liquefying when heated, and therefore, supplying the seal liquid to the seal area (2) enables the seal liquid to cure in a state where the seal member (5) is provided on the seal area (2). Thus, the seal member (5) easily seals the base (30) of the at least one terminal (3).

[0082] In an electric apparatus (100) of a ninth aspect referring to any one of the first to eighth aspects, a surface roughness of the specific area (20) facing an opening surface (210) of the wall section (21) is greater than a surface roughness of the projection section (4).

[0083] In this case, the surface roughness of the specific area (20) is greater than the surface roughness of the side surface of the projection section 4, which enables the seal liquid to easily flow on the specific area (20). Thus, it becomes easy to cover the base (30) of the at least one terminal (3) with the seal liquid supplied to the specific area (20), and it becomes easy to seal the base (30) of the at least one terminal (3) with the seal member (5).

[0084] In an electric apparatus (100) of a tenth aspect referring to any one of the first to ninth aspects, in a direction in which the projection section (4), the at least one terminal (3), and the wall section (21) are aligned in a second order, a distance (L2) between the projection section (4) and the at least one terminal (3) is shorter than a distance (L3) between the wall section (21) and the at least one terminal (3) in the second order.

[0085] In this case, since the distance (L2) is shorter than the distance (L3), it is possible to increase a time required for the seal liquid to reach the at least one terminal (3) (more specifically, the flat surface (32)), and it is possible to increase the viscosity of the seal liquid reaching the at least one terminal (3). This enables creeping up of the seal liquid on the surface of the at least one terminal 3 (more specifically the flat surface (32)) to be reduced. Moreover, the seal liquid is less likely to spread between the at least one terminal (3) (more specifically, the flat surface (31)) and the wall section (21), but when the distance (L3) is longer than the distance (L2), it is possible to facilitate spreading of the seal liquid between the at least one terminal (3) and the wall section (21).

[0086] In an electric apparatus (100) of an eleventh aspect referring to any one of the first to tenth aspects, the attachment surface (10) has a rectangular shape, and the attachment surface (10) includes a plurality of seal areas (2) which includes the specific area (20) and in each of which the seal member (5) is to be formed. Each of the plurality of seal areas (2) is surrounded by a corresponding one of a plurality of wall sections (21) including the wall section (21), and a plurality of terminals (3) including the at least one terminal (3) protrude from the plurality of seal areas (2) to the outer side of the resin member (1). At least two of the plurality of seal areas (2) align to at least partially overlap with each other in a direction along one side (101, 102, 103, or 104) of the attachment surface (10).

[0087] In this case, to form the seal member (5) in the two seal areas (2), the seal liquid is supplied to one of the two seal areas (2), and then, the seal liquid is supplied to the other of the two seal areas (2). At this time, the two seal areas (2) align to partially overlap with each other

in a direction along the one side of the attachment surface (10). Therefore, it is possible to reduce a travel distance of a device for supplying the seal liquid, and to efficiently supply the seal liquid.

[0088] An electromagnetic relay (600) of a twelfth aspect includes the electric apparatus (100) of any one of the first to eleventh aspects, a fixed contact (60), a movable contact (61), and a driver. The movable contact (61) is configured to come into contact with or come out of contact with the fixed contact (60). The driver is configured to bring the movable contact (61) into contact with or out of contact with the fixed contact (60).

[0089] In this case, the electric apparatus (100) is configured to strongly bind the at least one terminal (3) to the substrate (300), and therefore, the electromagnetic relay (600) including the electric apparatus (100) is also configured to strongly bind the at least one terminal (3) to the substrate (300).

Reference Signs List

[0090]

1	RESIN MEMBER
10	ATTACHMENT SURFACE
100	ELECTRIC APPARATUS
2	SEAL AREA
20	SPECIFIC AREA
21	WALL SECTION
210	OPENING SURFACE
201	SLOPE SECTION
202	GUIDE SECTION
3	TERMINAL
30	BASE
31, 32	FLAT SURFACE
4	PROJECTION SECTION
40	TIP END
5	SEAL MEMBER
60	FIXED CONTACT
61	MOVABLE CONTACT
600	ELECTROMAGNETIC RELAY

Claims

1. An electric apparatus (100), comprising:

a resin member (1) having an attachment surface (10) facing a substrate (300);
a wall section (21) surrounding a specific area (20) of the attachment surface (10);
at least one terminal (3) protruding from the specific area (20) to an outer side of the resin member (1); and
a projection section (4) provided between the wall section (21) and a base (30) of the at least one terminal (3),
the projection section (4) having a tip end (40) exposed from a seal member (5) covering the base (30) of the at least one terminal (3) in a state where the seal member (5) is in the specific area (20),
the tip end (40) being provided apart from the at least one terminal (3) and the wall section (21).

2. The electric apparatus of claim 1, wherein
the at least one terminal (3) includes only one terminal (3), and
the only one terminal (3) protrudes from the specific area (20).

3. The electric apparatus (100) of claim 1 or 2, wherein
the specific area (20) has a slope section (201) formed such that a distance (L4) between an opening surface (210) of the wall section (21) and the specific area (20) facing the opening surface (210) increases as a distance from the wall section (21) to the at least one terminal (3) decreases.

4. The electric apparatus (100) of any one of claims 1 to 3, wherein
in a direction in which the wall section (21), the projection section (4), and the at least one terminal (3) are aligned in a first order, a distance (L1) between the wall section (21) and the projection section (4) in the first order is longer than a distance (L2) between the at least one terminal (3) and the projection section (4).

5. The electric apparatus (100) of any one of claims 1 to 4, wherein
the at least one terminal (3) has a flat plate shape having a flat surface (32), and
the projection section (4) extends in a width direction of the flat surface (32) of the at least one terminal (3).

6. The electric apparatus (100) of any one of claims 1 to 4, wherein
the at least one terminal (3) is a flat plate shape having a flat surface (32), and
in a width direction of the flat surface (32) of the at least one terminal (3), a central part of the projection section (4) is located between the at least one terminal (3) and an end of the projection section (4).

7. The electric apparatus (100) of any one of claims 1 to 6, further comprising a guide section (202) provided in the specific area (20) and extending in a direction from the wall section (21) toward the at least one terminal (3), wherein
the guide section (202) is a projection or a groove.

8. The electric apparatus (100) of any one of claims 1 to 7, wherein
the seal member (5) is made of a thermosetting resin.

9. The electric apparatus (100) of any one of claims 1 to 8, wherein
a surface roughness of the specific area (20) facing an opening surface (210) of the wall section (21) is greater than a surface roughness of the projection section (4).

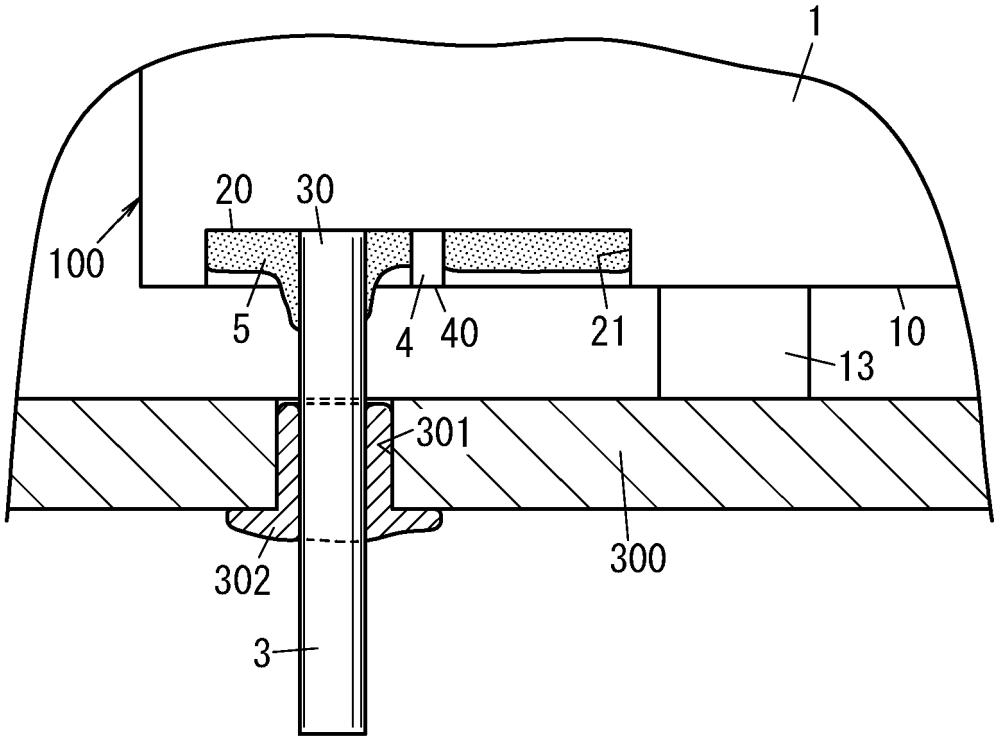
10. The electric apparatus (100) of any one of claims 1 to 9, wherein
in a direction in which the projection section (4), the at least one terminal (3), and the wall section (21) are aligned in a second order, a distance (L2) between the projection section (4) and the at least one terminal (3) is shorter than a distance (L3) between the wall section (21) and the at least one terminal (3) in the second order.

11. The electric apparatus (100) of any one of claims 1 to 10, wherein
the attachment surface (10) has a rectangular shape, the attachment surface (10) includes a plurality of seal areas (2) which includes the specific area (20) and in each of which the seal member (5) is to be formed,
each of the plurality of seal areas (2) is surrounded by a corresponding one of a plurality of wall sections (21) including the wall section (21),
a plurality of terminals (3) including the at least one terminal (3) protrude from the plurality of seal areas (2) to the outer side of the resin member (1), and
at least two of the plurality of seal areas (2) align to at least partially overlap with each other in a direction along one side of the attachment surface (10).

12. An electromagnetic relay (600), comprising:

the electric apparatus (100) of any one of claims 1 to 11;
a fixed contact (60);
a movable contact (61) configured to come into contact with or come out of contact with the fixed contact (60); and
a driver configured to bring the movable contact (61) into contact with or out of contact with the fixed contact (60).

FIG. 1A


1
20
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100
5
4
40
21
10
13
301
300
302
3

FIG. 1B

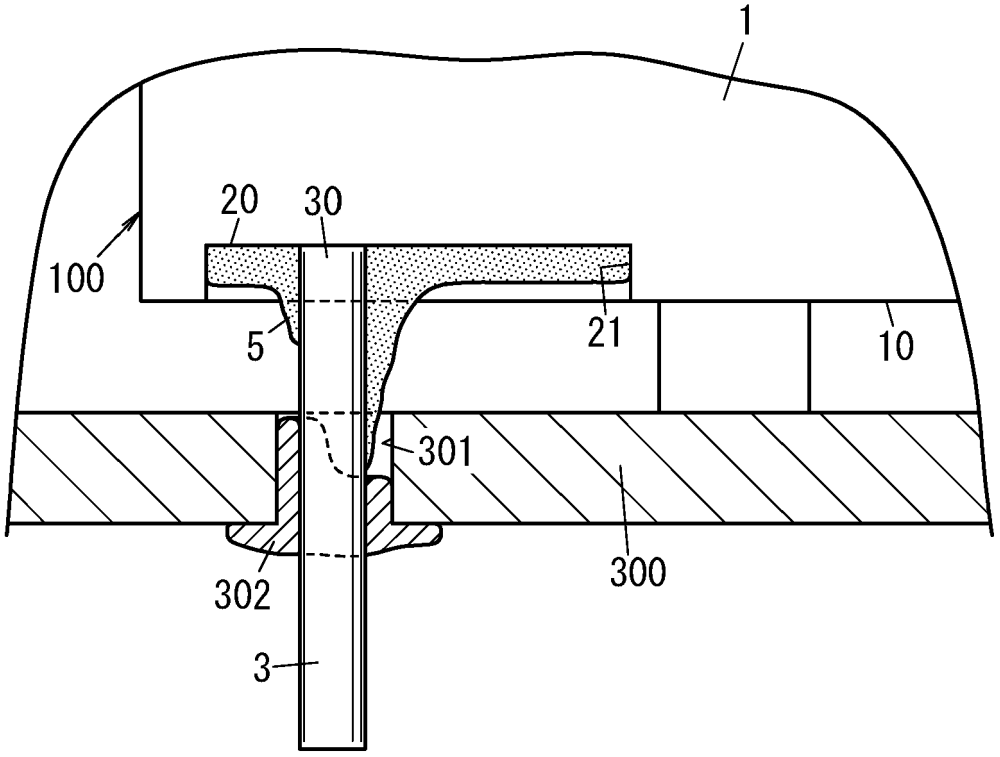
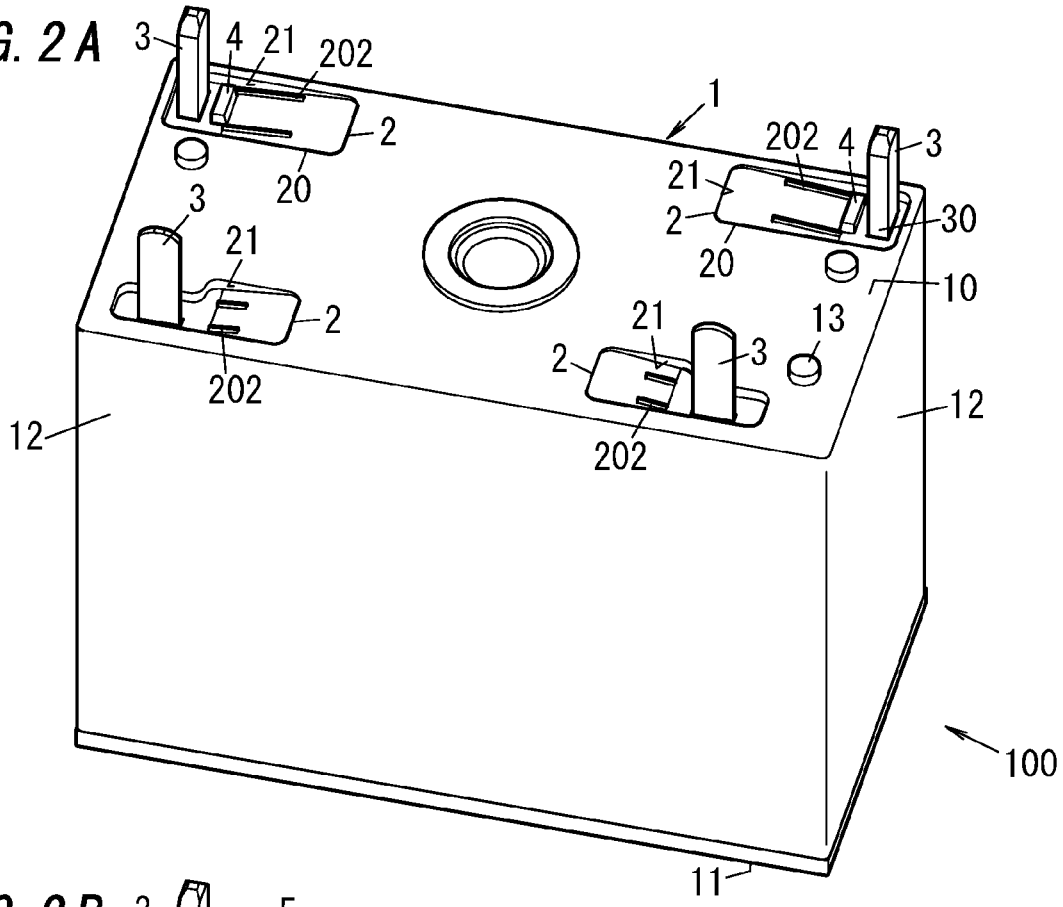

1
20
30
100
5
21
10
301
300
302
3

FIG. 2A


3
4
21
202
1
2
20
202
4
3
21
2
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21
2
20
10
21
13
2
3
202
12
12
202
100
11

FIG. 2B

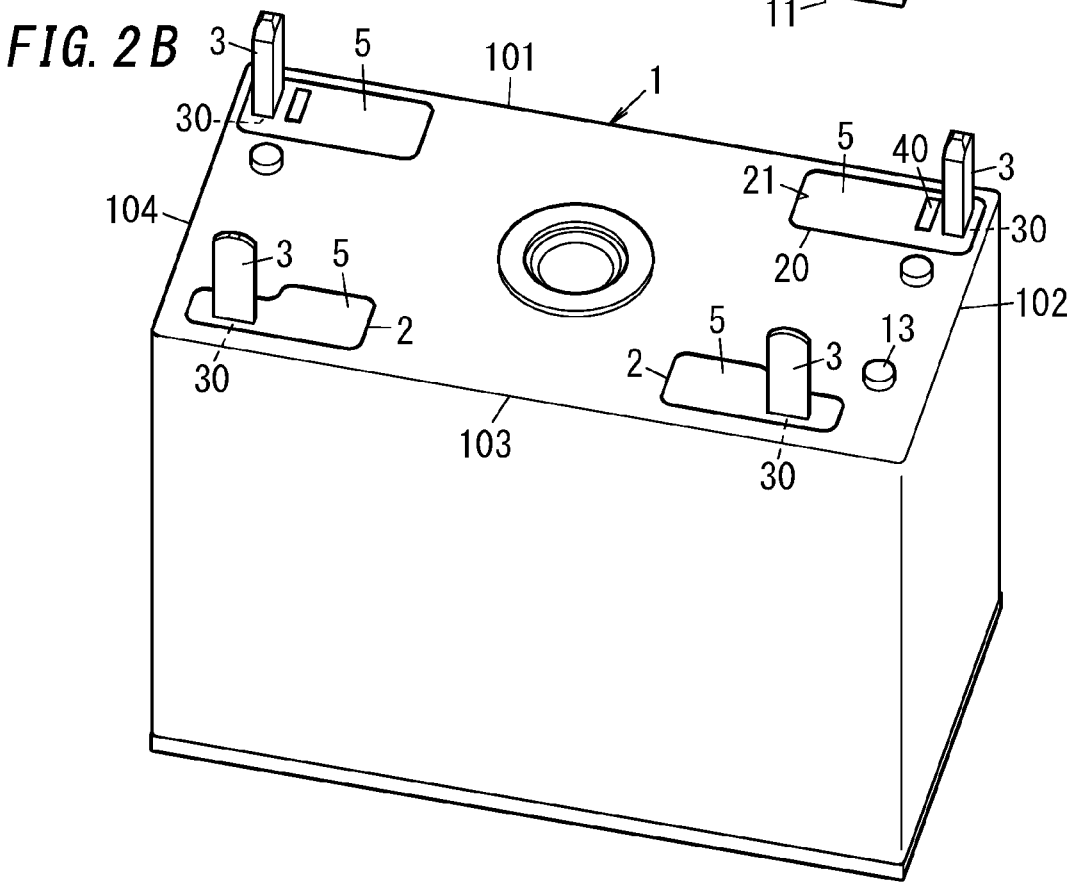

3
5
101
1
30
5
40
3
21
104
3
5
30
20
2
102
5
13
2
3
30
103
30

FIG. 3

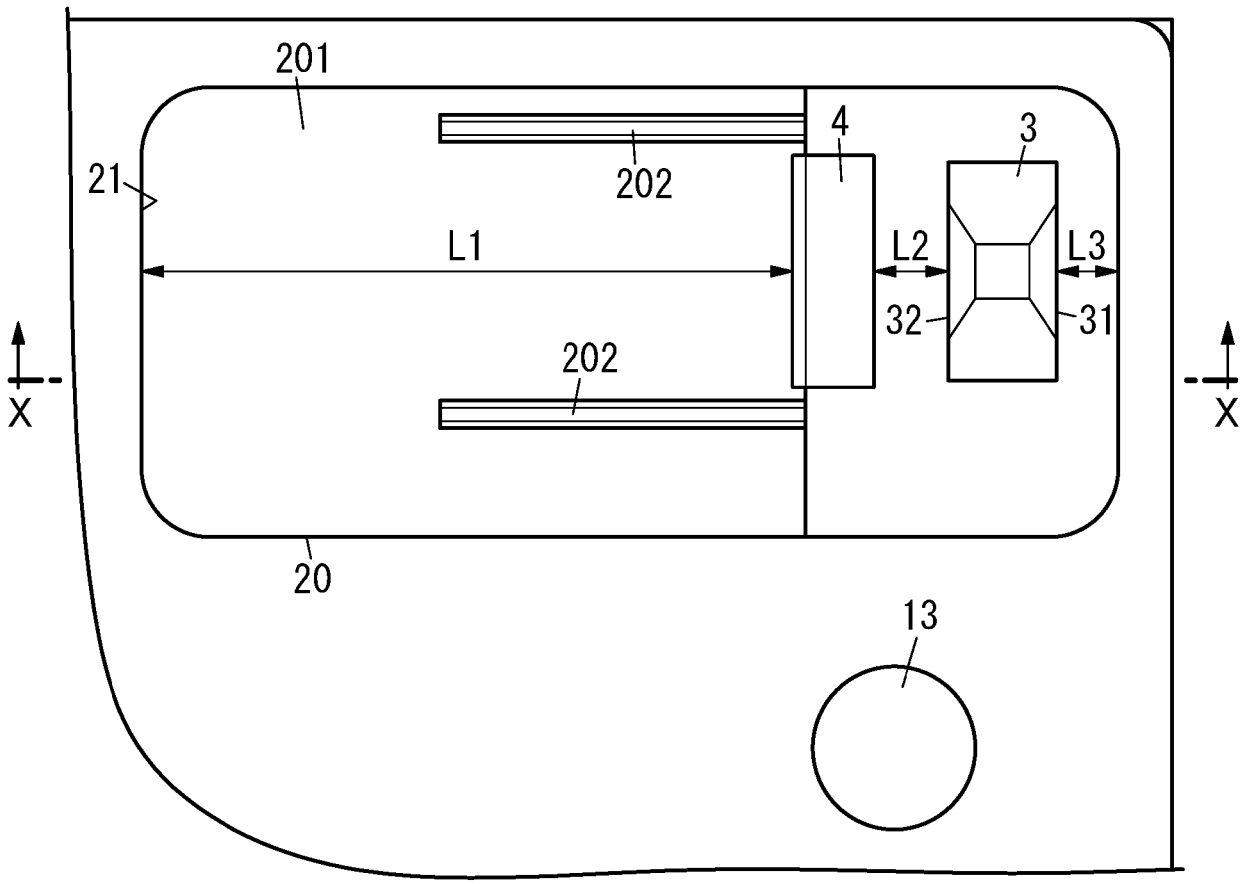


FIG. 4

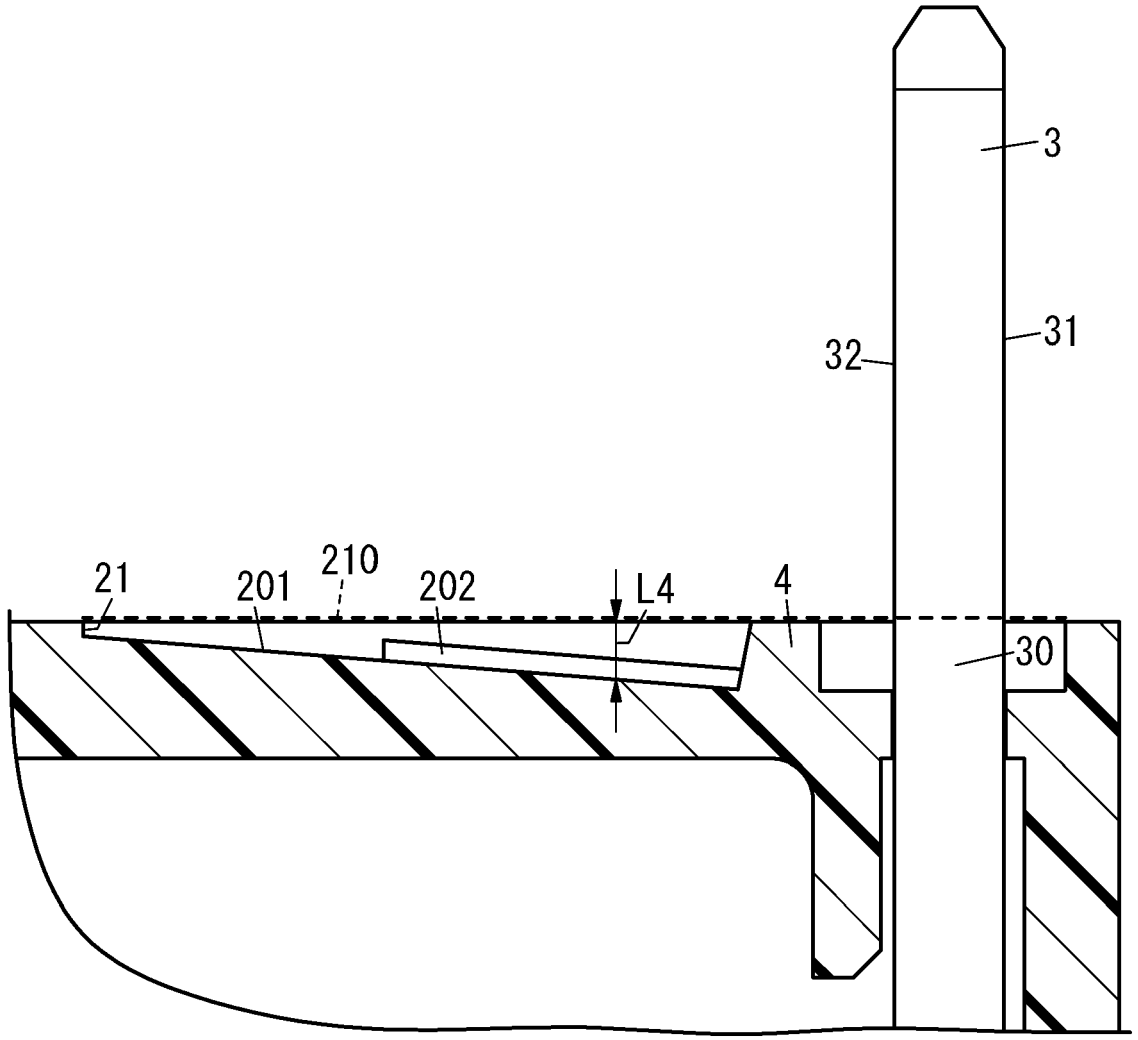


FIG. 5A

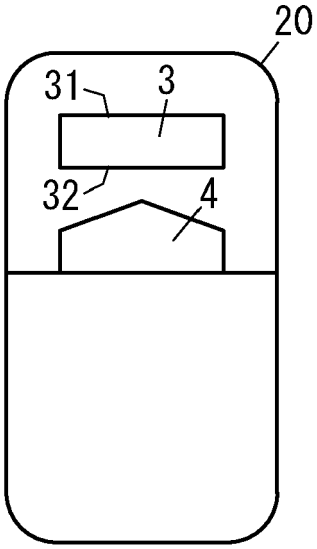


FIG. 5B

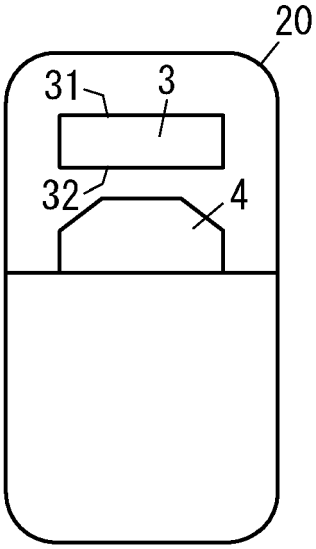


FIG. 5C

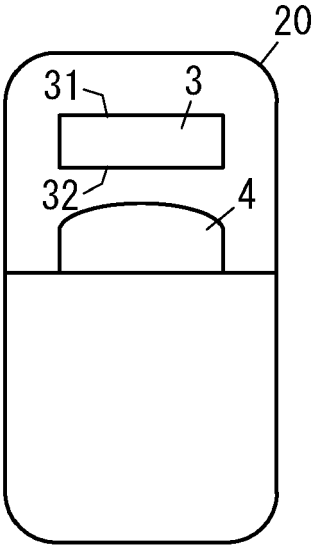


FIG. 5D

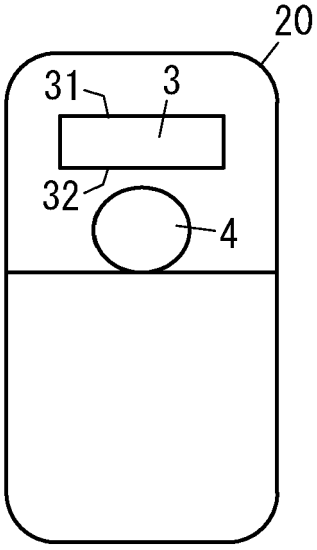


FIG. 5E

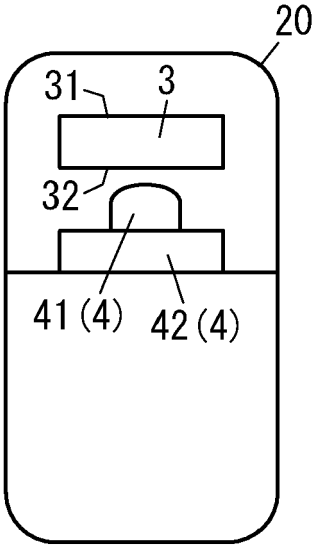


FIG. 5F

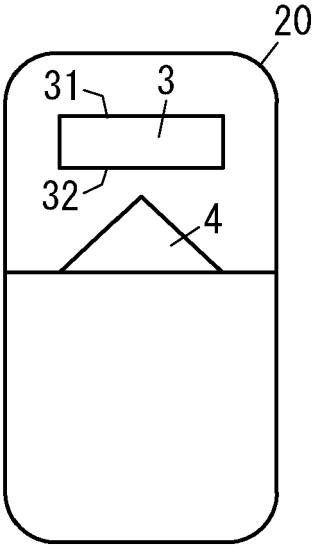


FIG. 6A

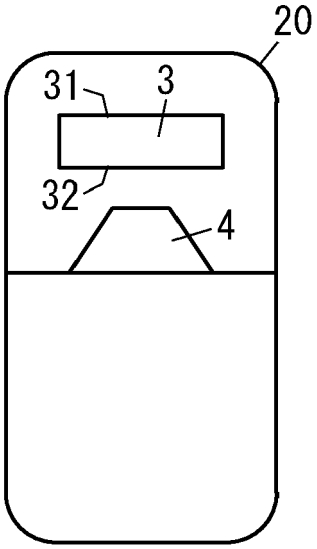


FIG. 6B

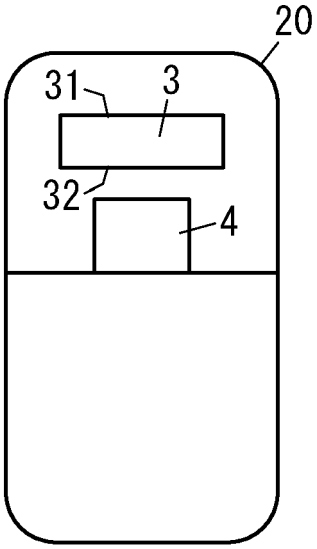


FIG. 6C

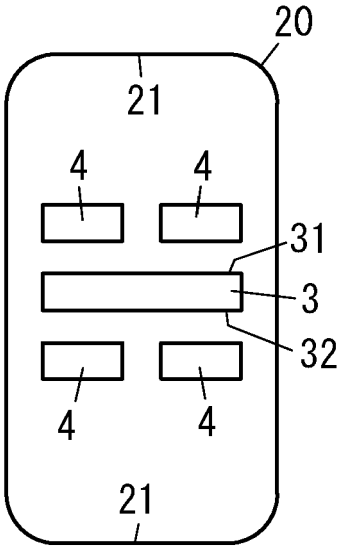


FIG. 6D

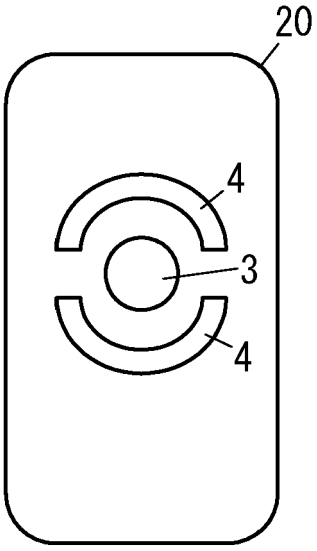


FIG. 6E

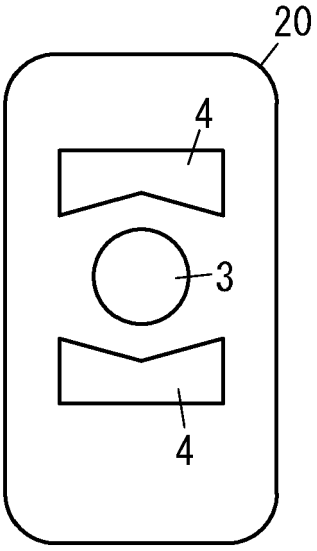
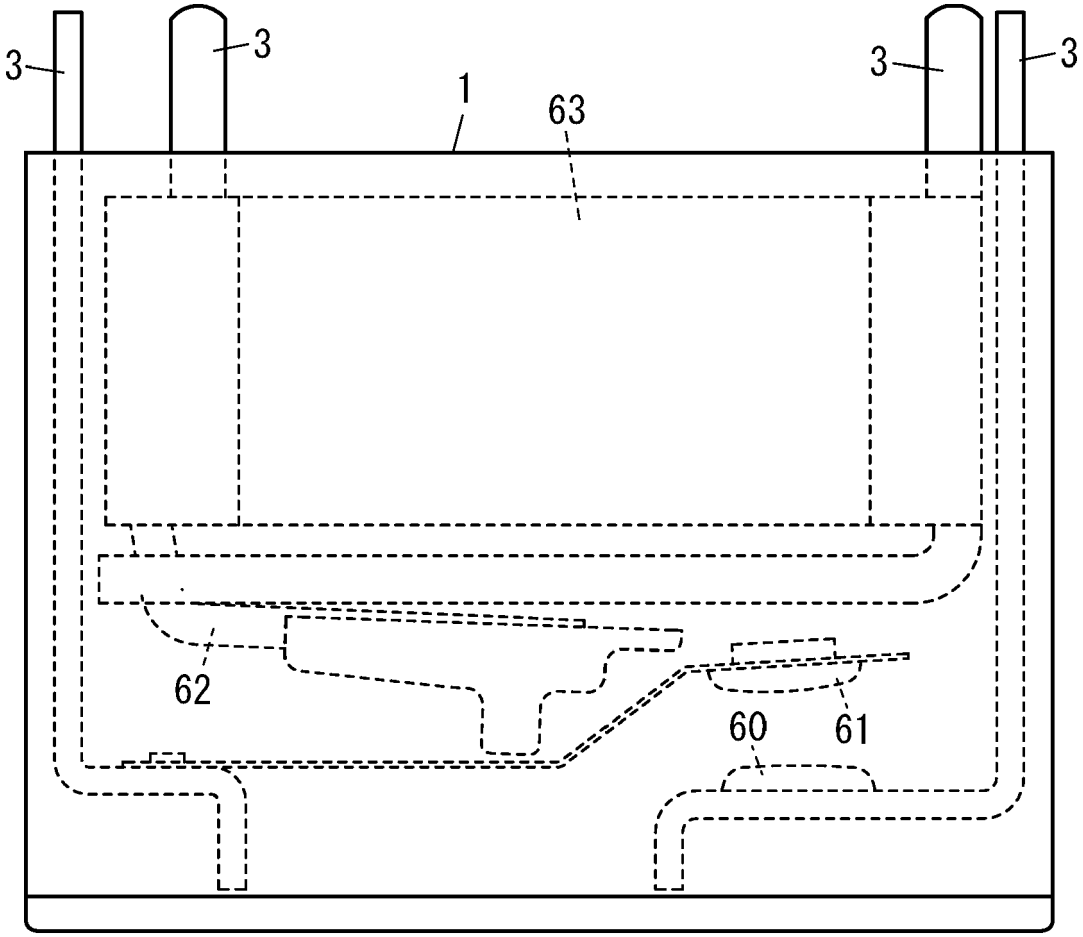


FIG. 7



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Application Number
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