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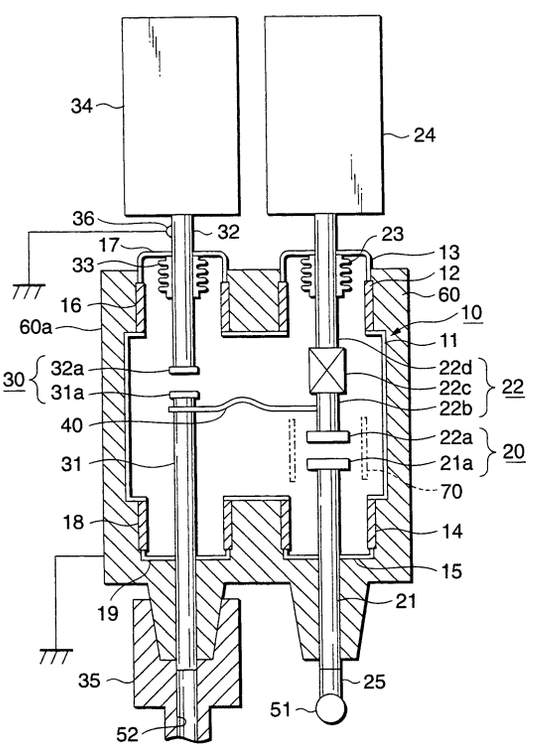
(54) Switch gear and power switching apparatus

(57) The switch gear comprises: a switching mechanism including a first fixed contact piece 21a to be electrically connected to a bus, a first movable contact piece 22a to be contacted with and removed from the first fixed contact piece 21a, a second fixed contact piece 31a to be electrically connected to the first movable contact piece 22a and also to be electrically connected to a transmission cable, and a second movable contact piece 32a to be contacted with and removed from the second fixed contact piece 31a and also to be grounded externally; a vacuum container 10 for storing the switching mechanism therein; and, an insulating mold 60 for covering the vacuum container 10, the mold 60 including on the surface thereof a conductive layer 60a for grounding.

FIG.1



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Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to a switch gear which comprises switching mechanisms such as a main circuit switching portion for connecting a bus side conductor and a load side conductor to each other and for disconnecting them from each other, and a grounding switching portion for connecting a load side conductor and a ground side conductor to each other and for disconnecting them from each other, and, in particular, to the switch gear which not only can secure safety but also can be made compact.

2. DESCRIPTION OF THE RELATED ART

[0002] A switch gear, which is used to distribute power received from a bus to various load devices or to other electric chambers through transmission cables, comprises a metal container which is grounded. And, the switch gear also comprises, within this metal container, a main circuit switching device which includes a bus side conductor for receiving power from a bus and a load side conductor for distributing the power through transmission cables in such a manner that they are exposed to the outside thereof and also which is capable of connecting the bus side and load side conductors to each other and disconnecting them from each other; and, a grounding switching device which is used to ground the load side conductor.

[0003] Now, Fig. 28 is a side section view of a conventional switch gear disclosed in Japanese Patent Publication No. 7-28488 of Heisei, and Fig. 29 is an electrical connection view of the conventional switch gear. In these figures, reference character 100 designates a metal container in which there is enclosed insulating gas such as SF_6.

[0004] The metal container 100 includes, on the outer walls thereof, two transmission side bushings 110, 110 which respectively extend through their associated outer walls to communicate with the interior and exterior portions of the metal container 100 and also to which the transmission cables can be connected, and a bus side bushing 120 (see Fig. 29) which extends through the outer wall to communicate with the interior and exterior portions of the metal container 100 and also to which the bus can be connected. Further, in the interior portion of the metal container 100, there is disposed a vacuum arc extinguishing chamber 200 which is kept at a high vacuum.

[0005] The vacuum arc extinguishing chamber 200 includes, in the interior portion thereof, a switching contact 201 which is shown in Fig. 29 and is used to connect the bus side and transmission cable side thereof to each other and disconnect them from each other; and, a bus side branch conductor 121 to be connected to the bus side is supported on a first insulating support insulator 122 disposed on the inner wall of the metal container 100 and is connected through the bus side bushing 120 to a bus provided externally.

[0006] The transmission cable side of the vacuum arc extinguishing chamber 200 is connected to an intermediate conductor 160 supported on a second insulating support insulator 161 disposed on the inner wall of the metal container 100 through a first switching device 130 which is capable of switching of closed, ground and cut-off positions. The intermediate conductor 160 branches in two directions: in particular, one of the two branching portions thereof is connected to a first load side conductor 111 through a second switching device 140 which is capable of switching of closed, ground and cut-off positions; and, the other is connected to a second load side conductor 112 through a third switching device 150 which is capable of switching of closed, ground and cut-off positions.

[0007] The first load side conductor 111 is connected to a first transmission cable provided externally through one transmission side bushing 110, whereas the second load side conductor 112 is connected to a second transmission cable provided externally through the other conduction side bushing 110.

[0008] By the way, the first, second and third switching devices 130, 140 and 150 are respectively structured such that their respective drive portions (not shown) drive and swing their respective insulating links 170, 170, 170 and metal links 180, 180, 180 to thereby switch the closed, ground, and cut-off positions. In particular, in the first switching device 130, at the closed position thereof, the switching contact 201 within the vacuum arc extinguishing chamber 200 is connected to the intermediate conductor 160; at the ground position, the switching contact 201 is connected to a ground conductor 131 which is to be ground connected to the peripheral wall of the metal container 100; and, at the cut-off position, the switching contact 201 is connected to neither of the intermediate conductor 160 nor ground conductor 131.

[0009] In the second and third switching devices 140 and 150, at their respective closed positions, the first and second load side conductors 111 and 112 are respectively connected to the intermediate conductor 160; at their respective ground positions, the first and second load side conductors 111 and 112 are respectively connected to their corresponding ground conductors 141 and 151; and, at their respective cut-off positions, the first and second load side conductors 111 and 112 are not connected to the intermediate conductor 160 nor to the ground conductors 141 and 151.

[0010] In Fig. 28, there is shown only one circuit that corresponds to the above-mentioned one phase of the switch gear. However, actually, in the deep direction in Fig. 28, there are arranged side by side three similar circuit sections corresponding to the three phases of the switch gear. That is, the conventional switch gear is

structured such that, as shown in Fig. 29, the three-phase circuit sections form a complete circuit.

[0011] As described above, in the conventional switch gear, the three similar circuit sections, which respectively correspond to the three phases of the switch gear and form a single complete circuit, are arranged within the metal container in which the insulating gas is enclosed and also which is grounded; the conventional switch gear can be switched to the closed position where it connects the bus side and transmission cable side to each other, the ground position where it can be connected to a ground potential, and the cut-off position where neither of the above connections are carried out; and, the switching contact, in which there occurs an electric arc when the switch gear is cut off and also which is used to open and close a circuit between the bus side and transmission cable, is disposed within the vacuum arc extinguishing chamber formed in the interior portion of the vacuum container.

[0012] However, in the conventional switch gear, since the three-phase circuit sections forming a complete circuit of the switch gear are disposed within the same metal container, it is necessary not only to secure an insulated space for prevention of occurrences of short-circuits between the phases but also to form the vacuum arc extinguishing chamber in the interior portion of the metal container. This complicates the structure of the switch gear and increases the size of the switch gear, which in turn limits the installation space of the switch gear as well as provides an obstacle to the reduction of the production cost of the switch gear.

[0013] On the other hand, in case where the vacuum arc extinguishing chamber is not formed in the interior portion of the metal container but insulating gas is enclosed in the interior portion of the metal container, there arises a problem that the internal pressure of the metal container is increased due to the electric arc which occurs when the switch gear is cut off; and, especially, when SF_6 is used as the insulating gas, since SF_6 is specified as one of gases to be regulated against discharge for prevention of global warming, there arises another problem that SF_6 is difficult to handle and control.

SUMMARY OF THE INVENTION

[0014] The present invention aims at eliminating the drawbacks found in the above-mentioned conventional switch gear.

[0015] Accordingly, it is a main object of the invention to provide a switch gear in which switching mechanisms such as a main circuit switching device for switching a main circuit to thereby connect a bus and a load device to each other and disconnect them from each other, and a grounding switching device are disposed in the interior portion of a vacuum container, the vacuum container is covered with an insulating mold, and there is disposed on the surface of this mold a conductive layer to be grounded, whereby safety can be secured and a ground fault can be prevented, the production cost of the switch gear can be reduced, the freedom of installation of the switch gear can be enhanced, and the handling and control of the switch gear can be facilitated.

[0016] It is a second object of the invention to provide a switch gear in which a power receiving member to be connected to a bus is composed of a wire connecting terminal such as a connector to thereby be able to enhance the freedom of installation of the switch gear.

[0017] It is a third object of the invention to provide a switch gear which is grounded through an external switching device switchable in linking with a grounding switching device, so that the possibility of a ground fault occurring in the switch gear can be reduced down to a very low level.

[0018] It is a fourth object of the invention to provide a switch gear in which a vacuum container including a circuit composed of two or more phases is formed as an integrated body by a mold to thereby be able to enhance the freedom of installation of the switch gear.

[0019] It is a fifth object of the invention to provide a switch gear in which a vacuum container is stored in a grounding conductive member, which is molded of conductive material such as conductive resin into a box shape, and the grounding conductive member and vacuum container are unified as an integrated body by a mold in such a manner that the grounding conductive member is exposed to the surface of the switch gear, thereby being able to facilitate the production of the switch gear.

[0020] It is a sixth object of the invention to provide a switch gear in which a conductive member such as a metal shield is embedded in a mold in such a manner that it is opposed to a load side conductor, thereby being able to facilitate the checking operations of the switch gear such as the detection of the voltage thereof.

[0021] It is a seventh object of the invention to provide a switch gear in which a vacuum container is covered with buffer material and the vacuum container and buffer material are unified as an integrated body by a mold, thereby being able to prevent the vacuum container and mold from being detached from each other because of their respective different coefficients of linear expansion.

[0022] It is an eighth object of the invention to provide a power switching apparatus which can prevent the connecting portions of the vacuum container from being damaged mechanically as well as can prevent electric discharge due to the concentrated electric field in a more reasonable manner.

[0023] It is a ninth aspect object of the invention to provide a power switching apparatus which is enhanced in productivity and is more compact in size.

[0024] In attaining the above objects, according to a first aspect of the invention, there is provided a switch gear, comprising: a switching mechanism; a container for storing the switching mechanism therein; and, an in-

sulating member for covering the container, wherein there is formed a conductive layer on the outer surface of the insulating member.

[0025] According to a second aspect of the invention, there is provided a switch gear, comprising: a switching mechanism; a container for storing the switching mechanism therein; and, an insulating mold for covering the container, wherein there is formed a conductive layer on the surface of the mold.

[0026] According to a third aspect of the invention, there is provided a switch gear as set forth in the second aspect of the invention, wherein the switching mechanism comprises a first fixed contact piece, a second fixed contact piece, a first movable contact piece contactable with and removable from the first fixed contact piece and electrically connected to the second fixed contact piece, and a second movable contact piece contactable with and removable from the second fixed contact piece.

[0027] According to a fourth aspect of the invention, there is provided a switch gear as set forth in the third aspect of the invention, further including a power receiving member electrically connected to the first fixed contact piece, a grounding member electrically connected to the second movable contact piece, and a power distributing member electrically connected to the second fixed contact piece.

[0028] In the switch gear according to the first, second, third and fourth aspects of the invention, switching mechanisms such as a main circuit switching device for opening and closing a circuit between a bus and a load device and a grounding switching device are disposed within a container, the container is covered with an insulating mold, and a conductive layer is formed on the surface of the mold for grounding, thereby being able not only to secure safety but also to reduce the areas of the interior portion of the container that provide grounding potentials so as to prevent a ground fault. And, the whole of the interior portion of the container is kept at a high vacuum to thereby eliminate the need for provision of a protect shield in the periphery of a contact where an arc is to be vacuum extinguished, which can simplify and make compact the structure of the present switch gear to thereby reduce the production cost of the switch gear as well as enhance easily the freedom of installation of the switch gear. Further, since an insulating gas such as SF_6 is not used, the handling and control of the switch gear can be facilitated.

[0029] According to a fifth aspect of the invention, there is provided a switch gear as set forth in the fourth aspect of the invention, wherein the power receiving member is a terminal portion to be connected to a conductor.

[0030] In the switch gear according to the fifth aspect of the invention, since the power receiving member is a terminal portion to be connected to a conductor such as a connector, a plurality of switch gears can be arranged side by side in a limited space and can be connected to a bus easily. This can further enhance the freedom of installation of the switch gear.

[0031] According to a sixth aspect of the invention, there is provided a switch gear as set forth in the fourth or fifth aspect of the invention, further including an external switching device switchable in linking with the second movable contact piece, wherein the grounding member is insulated from the conductive layer formed on the surface of the mold and is grounded through the external switching device.

[0032] In the switch gear according to the sixth aspect of the invention, by eliminating the areas of the interior portion of a container that provide grounding potentials, it is possible to prevent a ground fault from occurring in the interior portion of the container. Thanks to this, the reliability and safety of the present switch gear can be enhanced, the structure of the switch gear can be simplified and made compact, the production cost of the switch gear can be reduced, the freedom of installation of the switch gear can be increased, and the handling and control of the switch gear can be facilitated.

[0033] According to a seventh aspect of the invention, there is provided a switch gear as set forth in any one of the second to sixth aspects of the invention, wherein the container consists of two or more containers and the two or more containers are united together into an integrated body by the mold.

[0034] In the switch gear according to the seventh aspect of the invention, by uniting the two or more vacuum containers together into an integrated body using the mold, the switch gear can be made compact and thus the freedom of installation of the switch gear can be enhanced.

[0035] According to an eighth aspect of the invention, there is provided a switch gear as set forth in any one of the second to seventh aspects of the invention, further including a grounding conductive member, wherein the conductive layer formed on the surface of the mold layer is united together with the grounding conductive member as an integrated body by the mold in such a manner that the grounding conductive member is exposed onto the surface of the conductive layer formed on the surface of the mold layer.

[0036] In the switch gear according to the eighth embodiment of the invention, conductive material such as conductive resin is molded into a cylindrical or rectangular box shape to thereby produce a grounding conductive member, a vacuum container is stored into the grounding conductive member, and these are united together as an integrated body by the mold in such a manner that the grounding conductive member is exposed to the surface of the vacuum container. This can facilitate the formation of the conductive layer on the surface of the mold when the switch gear is manufactured.

[0037] According to a ninth aspect of the invention, there is provided a switch gear as set forth in any one of the second to eighth aspects of the invention, further including a conductive member to be embedded, where-

in the embedding conductive member is united together with the containers as an integrated body by the mold in such a manner that the conductive member to be embedded is embedded in the mold.

[0038] In the switch gear according to the ninth aspect of the invention, a conductive member to be embedded such as a metal shield is embedded in a mold in such a manner that it is opposed to a load side conductor, thereby being able to realize a circuit which is equivalent to a capacitor. This can facilitate the checking operations of the conditions of the switch gear such as the voltage detection of the switch gear.

[0039] According to a tenth aspect of the invention, there is provided a switch gear as set forth in any one of the second to ninth aspects of the invention, further including buffer material which is to be held by and between the containers and mold.

[0040] In the switch gear according to the tenth aspect of the invention, a vacuum container is covered with buffer material, they are united together as an integrated body by a mold, and the buffer material is held by and between the vacuum container and mold, which can prevent the mutual separation between the vacuum container and mold that could be otherwise caused due to their different coefficients of linear expansion.

[0041] According to an eleventh aspect of the invention, there is provided a vacuum insulation switch gear comprising a vacuum container and a required number of switching devices to be installed in the interior portion of the vacuum container, wherein the vacuum container is made of metal material and is molded by an insulation.

[0042] According to a twelfth aspect of the invention, in a vacuum insulation switch gear as set forth in the first aspect of the invention, the surface of the mold is conduction treated to thereby provide a grounding potential.

[0043] According to a thirteenth aspect of the invention, in a vacuum insulation switch gear as set forth in the first or second aspect of the invention, the circuits of the switching devices are stored in the vacuum container for every phase.

[0044] According to a fourteenth aspect of the invention, in a vacuum insulation switch gear as set forth in any one of the first to third aspects, the vacuum container is composed of a cylindrical-shaped body member and two end members respectively for closing the two ends of the body member.

[0045] According to a fifteenth aspect of the invention, in a vacuum insulation switch gear as set forth in any one of the first to third aspects, the vacuum container is composed of a bottomed cylindrical-shaped body member with one end side thereof opened and an end member for closing the opened end of the body member.

[0046] According to a sixteenth aspect of the invention, in a vacuum insulation switch gear as set forth in any one of the first to third aspects, the vacuum container is composed of two bottomed cylindrical-shaped body members each with one end side thereof opened, while the two body members are combined together in such a manner that their respective opened ends are contacted with each other.

[0047] According to a seventeenth aspect of the invention, in a vacuum insulation switch gear as set forth in the fourth or fifth aspect, in an end member against which a body member is to be butted, there is formed a positioning portion in which the butting end portion of the body member can be stored.

[0048] According to an eighteenth aspect of the invention, in a vacuum insulation switch gear as set forth in the sixth aspect, in one of the opened end portions of the two body members to be butted against each other, there is formed a positioning portion with which the other can be fitted.

[0049] According to a nineteenth aspect of the invention, in a vacuum insulation switch gear as set forth in any one of the first to eighth aspects, for a main circuit conductor to be installed in such a manner that it extends not only through the vacuum container but also inwardly and outwardly thereof, in the inner edge of a hole which allows the main circuit conductor to extend in the above-mentioned manner, there is formed an electric field buffering ring portion for buffering an electric field.

[0050] According to a twentieth aspect of the invention, in a vacuum insulation switch gear as set forth in the ninth aspect, the electric field buffering ring portion is formed by extending the inner edge of the hole outwardly.

[0051] According to a twenty-first aspect of the invention, there is provided a power switching apparatus in which the neighboring portions of connecting portions between the insulation cylinders of the vacuum container and the metal-made parts of a vacuum container are covered by the cushion rings each made of conductive rubber, and the thus ring-covered portions, together with the vacuum container outer surface, are covered from the outside thereof with a resin insulation layer.

[0052] According to a twenty-second aspect of the invention, there is provided a power switching apparatus in which, the respective one-end portions of the conductive rubber cushion rings cover the outer peripheral end portions of the insulation cylinders, the other end portions of the conductive rubber cushion rings cover the outer peripheries of the metal-made vacuum container parts, the end portion corners of the cushion rings covering the outer peripheral end portions of the insulation cylinders are rounded with a radius slightly smaller than the thickness of the present corners, the end portion outer peripheral surfaces of the cushion rings covering the outer peripheries of the metal-made vacuum container parts are respectively formed in a conical surface in which the thickness of the projecting end thereof provides almost zero, and the stepped portions of the inner peripheral surfaces of the cushion rings are respectively chamfered with a dimension larger than the dimension of the brazed fillets formed in the connecting portions.

[0053] According to a twenty-third aspect of the inven-

tion, there is provided a power switching apparatus in which the respective one-end portions of the conductive rubber cushion rings cover the outer peripheral end portions of the insulation cylinders, the other end portions of the conductive rubber cushion rings cover the outer peripheries of the metal-made vacuum container parts, the end portion corners of the cushion rings covering the outer peripheral end portions of the insulation cylinders are rounded with a radius slightly smaller than the thickness of the present corners, the end portions of the cushion rings covering the outer peripheries of the metal-made vacuum container parts are respectively formed in a plane surface which it intersects with the axial direction of the insulation cylinder, and the inside diameter side end portions corners of the cushing rings covering the stepped portions of the inner peripheral surfaces of the insulation cylinders as well as the outer peripheries of the metal-made vacuum container parts are respectively chamfered with a dimension larger than the dimension of the brazed fillets formed in the connecting portions.

[0054] And, in the power switching apparatus, the connecting conductors for connecting the electrodes of the element switches to the outside of the power switching apparatus are connected by fastening means in the interior portion of the resin insulation layer.

[0055] Also, as the fastening means, there is used a bolt whose which head portion has an arc-shaped section.

[0056] Further, there is provided a voltage dividing electrode in the outer periphery of the connecting conductor within the resin insulation layer and the voltage dividing electrode is to be positioned by an insulator fixed to the connecting conductor.

[0057] In addition, in the interior portion of the resin insulation layer, there is disposed a voltage dividing capacitor structured such that one electrode thereof is connected to the connecting conductor and its electrostatic capacity is larger than a floating capacity between electrodes as well as between phases with respect to the connecting conductors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058] Fig. 1 is a side section view of a switch gear according to an embodiment 1 of the invention.

[0059] Fig. 2 is a front view of the switch gear according the embodiment 1 of the invention, showing a state thereof when it is arranged as a whole.

[0060] Fig. 3 is an electrical connection view of the switch gear according the embodiment 1 of the invention, showing a phase section thereof.

[0061] Fig. 4 is a side section view of a switch gear according to an embodiment 2 of the invention.

[0062] Fig. 5 is a front view of the switch gear according to the embodiment 2 of the invention, showing a state thereof when it is arranged as a whole.

[0063] Fig. 6 is a side section view of a switch gear according to an embodiment 3 of the invention.

[0064] Fig. 7 is a front view of the switch gear according to the embodiment 3 of the invention, showing a state thereof when it is arranged as a whole.

[0065] Fig. 8 is a side section view of a switch gear according to an embodiment 4 of the invention.

[0066] Fig. 9 is a side section view of a grounding conductive box used in the switch gear according to the embodiment 4 of the invention.

[0067] Fig. 10 is a side section view of a conductive shield used in the switch gear according to the embodiment 4 of the invention.

[0068] Fig. 11A is a side section view of a mold having a conductive shield embedded in the periphery of a second fixed conductive rod used in the switch gear according to the embodiment 4 of the invention; and, Fig. 11B is a circuit diagram of a circuit equivalent to the mold.

[0069] Fig. 12 is a front view of the structure of an embodiment 5 of a vacuum insulation switch gear according to the invention, showing a state thereof in which it is arranged as a whole.

[0070] Fig. 13 is a side section view of the structure of the embodiment 5.

[0071] Fig. 14 is a side section view of the structure of an embodiment 6.

[0072] Fig. 15 is a side section view of the structure of an embodiment 7.

[0073] Fig. 16 is a side section view of the structure of an embodiment 8.

[0074] Fig. 17 is an enlarged section view of the main portions of the structure of an embodiment 9.

[0075] Fig. 18 is another enlarged section view of the main portions of the structure of the embodiment 9.

[0076] Fig. 19 is still another enlarged section view of the main portions of the structure of the embodiment 9.

[0077] Fig. 20 is an enlarged section view of the main portions of the structure of an embodiment 10.

[0078] Fig. 21 is an enlarged section view of the main portions of the structure of an embodiment 11.

[0079] Fig. 22 is another enlarged section view of the main portions of the structure of the embodiment 11.

[0080] Fig. 23 is s section view of the main portions of a first embodiment of a power switching apparatus according to the invention.

[0081] Figs. 24A and 24B are section views of cushion rings respectively employed in a power switching apparatus according to the invention.

[0082] Fig. 25 is a section view of the main portions of a modification of the power switching apparatus shown in Fig. 23.

[0083] Fig. 26 is s section view of the main portions of a second embodiment of a power switching apparatus according to the invention.

[0084] Fig. 27 is a section view of the main portions of a modification of the power switching apparatus shown in Fig. 26.

[0085] Fig. 28 is a side section view of a conventional switch gear.

[0086] Fig. 29 is an electrical connection view of the conventional switch gear.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

(EMBODIMENT 1)

[0087] Now, description will be given below in detail of a first embodiment of a switch gear according to the invention with reference to the accompanying drawings.

[0088] Fig. 1 is side section view of a switch gear according to a first embodiment 1 of the invention, Fig. 2 is a front view of the switch gear, showing a state thereof when it is actually arranged, and Fig. 3 is an electrical connection view of a section of the switch gear which corresponds to one of the three phases of the switch gear. The present embodiment 1 provides a switching mechanism which, as shown in Fig. 3, when power received from a bus is distributed to a transmission cable, closes a main circuit contact 20 and, when grounding, closes a grounding contact 30.

[0089] In Fig. 1, reference character 10 designates a vacuum container (corresponding to one phase of the switch gear) including a side surface having an H shape formed by a transverse pipe and four vertical pipes which are respectively mounted on the upper and lower portions of the two ends of the transverse pipe; and, the vacuum container 10 is formed airtight and the interior portion of the vacuum container 10 is kept at a high vacuum.

[0090] The transverse pipe portion 11 of the vacuum container 10 is made of metal such as SUS. Specifically, a vertical pipe portion of the vacuum container 10, which is located on the upper portion of one end side of the transverse pipe portion 11, is formed in a cylindrical shape and is composed of an insulated pipe 12, which is made of ceramics and forms the side portion of the transverse pipe portion 11, and a metal pipe 13 which is formed in an inverted bottomed cylindrical shape and forms the upper portion of the transverse pipe portion 11. And, a vertical pipe portion of the vacuum container 10, which is located on the lower portion of one end side of the transverse pipe portion 11, is formed in a cylindrical shape and is composed of an insulated pipe 14, which is made of ceramics and forms the side portion of the transverse pipe portion 11, and a metal pipe 15 which is formed in an inverted bottomed cylindrical shape and forms the lower portion of the transverse pipe portion 11.

[0091] Similarly, a vertical pipe portion of the vacuum container 10, which is located on the upper portion of the other end side of the transverse pipe portion 11, is formed in a cylindrical shape and is composed of an insulated pipe 16, which is made of ceramics and forms the side portion of the transverse pipe portion 11, and a metal pipe 17 which is formed in an inverted bottomed cylindrical shape and forms upper portion of the transverse pipe portion 11. And, a vertical pipe portion of the vacuum container 10, which is located on the lower portion of one end side of the transverse pipe portion 11, is formed in a cylindrical shape and is composed of an insulated pipe 18, which is made of ceramics and forms the side portion of the transverse pipe portion 11, and a metal pipe 19 which is formed in an inverted bottomed cylindrical shape and forms lower portion of the transverse pipe portion 11.

[0092] To the lower surface of the metal pipe 15 located in the lower portion of one end side of the transverse pipe portion 11, there is fixed a first fixed conductor rod 21 which not only extends through the vacuum container 10 but also extends outwardly and inwardly thereof; the lower end of the first fixed conductor rod 21, which is situated outwardly of the vacuum container 10, provides a terminal 25 to be connected to a bus 51; and, to the upper end of the first fixed conductor rod 21, which is situated inwardly of the vacuum container 10, there is fixedly secured a first fixed contact 21a which is formed in a disk shape.

[0093] Upwardly of the first fixed contact 21a, there is disposed a first movable contact 22a which is formed in a disk shape and can be contacted with and removed from the first fixed contact 21a; and, the first fixed contact 21a and first movable contact 22a cooperate together in forming a main circuit point 20.

[0094] The first movable contact 22a is fixedly secured to the lower end of a first movable conductive rod 22 which, in the upper surface of the metal plate 13 located in the upper portion of one end side of the transverse pipe portion 11, not only extends through the vacuum container 10 but also extends inwardly and outwardly thereof; and, the first movable conductor rod 22 is supported movably in the vertical direction through a first bellows 23 which is sealingly secured to the inner portion of the upper surface of the metal pipe 13. The expansion and contraction of the first bellows 23 caused by the vertical motion of the first movable conductor rod 22 can keep the vacuum container 10 airtight.

[0095] The upper end of the first movable conductor rod 22, which is located outwardly of the vacuum container 10, is connected to a main circuit drive part 24 which is used to drive the first movable conductor rod 22 in the vertical direction.

[0096] By the way, the first movable conductive rod 22 is composed of a first movable conductive rod lower portion 22b with the first movable contact 22a fixed thereto, a first movable conductive rod upper portion 22d to be connected to the main circuit drive part 24, and a ceramics-made insulating member 22c which is situated in the interior portion of the vacuum container 10 and is held by and between the first movable conductive rod lower portion 22b and first movable conductor rod upper portion 22d, while the insulating member 22c insulates the first movable conductive rod lower portion 22b and first movable conductive rod upper portion 22d from each other.

[0097] To the lower surface of the metal pipe 18 located in the lower portion of the other end side of the transverse pipe portion 11 of the vacuum container 10, there is fixed a second fixed conductive rod 31 which extends outwardly and inwardly through the vacuum container 10; the lower end of the first fixed conductive rod 31, which is present outwardly of the vacuum container 10, provides a terminal 35 to be connected to a transmission cable 52 which is used to distribute power to various load devices or other electric chambers; and, to the upper end of the first fixed conductive rod 31, which is situated inwardly of the vacuum container 10, there is fixedly secured a second fixed contact 31a which is formed in a disk shape.

[0098] By the way, on and between the upper portion of the second fixed conductive rod 31 and first movable conductive rod lower portion 22b, there is interposed a flexible conductor 40 and, therefore, the second fixed conductive rod 31 and first movable conductive rod lower portion 22b are electrically connected to each other.

[0099] Upwardly of the second fixed contact 31a, there is disposed a second movable contact 32a which is formed in a disk shape and can be contacted with and removed from the second fixed contact 31a; and, the second fixed contact 31a and second movable contact 32a cooperate together in forming a grounding contact point 30.

[0100] The second movable contact 32a is fixedly secured to the lower end of a second movable conductive rod 32 which, in the upper surface of the metal plate 17 located in the upper portion of the other end side of the transverse pipe portion 11, extends not only through the vacuum container 10 but also inwardly and outwardly thereof; and, the second movable conductive rod 32 is supported movably in the vertical direction through a second bellows 33 which is sealingly secured to the inner portion of the upper surface of the metal pipe 17. The expansion and contraction of the second bellows 33 caused by the vertical motion of the second movable conductive rod 32 can keep the vacuum container 10 airtight.

[0101] The second movable conductive rod 32 is connected, in the outside of the vacuum container 10, to a grounding potential through a terminal 36, and also the upper end of the second movable conductive rod 32 is connected to a grounding circuit drive part 34 which is used to drive the second movable conductive rod 32 in the vertical direction.

[0102] And, the vacuum container 10 is covered with a mold 60 formed of insulating resin such as epoxy in such a manner that the metal pipes 13 and 17 respectively located in the upper portions of the one and the other end sides of the transverse pipe portion 11 are exposed; and, on the surface of the mold 60 covering the vacuum container 10, there is disposed a conductive layer 60a formed of, for example, evaporated metal, so that the surface of the mold 60 can be grounded.

[0103] By the way, since the conductive layer 60a is conducting with the metal pipes 13 and 17 as well, the metal pipes 13 and 17 also provide grounding potentials.

[0104] Three switch gears each corresponding to the above-mentioned one phase are arranged side by side in the horizontal direction as shown in Fig. 2 to thereby form a switch gear corresponding to a complete circuit. Also, the respective main circuit drive parts 24, 24, 24 as well as the respective grounding circuit drive parts 34, 34, 34 can be arranged so as to adjoin each other, which makes it possible to facilitate the formation of control mechanisms such as interlocks between the respective drive parts.

[0105] In the above-mentioned embodiment, as the switching mechanism which is stored within the vacuum container, there is shown the structure in which the main circuit switching devices and grounding switching devices are arranged in parallel. However, this is not limitative but there can also be employed other various structures: for example, a structure in which only the main circuit switching devices are stored within the vacuum container; and, a structure in which the movable conductors can be contacted and removed in the horizontal direction.

[0106] In the switch gear according to the first embodiment 1 of the invention structured in this manner, each vacuum container is covered with the mold formed of insulating resin and the conductive layer is disposed on the surface of the mold for grounding, which makes it possible not only to prevent ground a fault while securing safety but also to simplify and make compact the switch gear.

(EMBODIMENT 2)

[0107] Now, Fig. 4 is a side section view of a switch gear according to a second embodiment 2 of the invention, and Fig. 5 is a front view of the whole arrangement of the present switch gear. By the way, an electrical connection view of the second embodiment 2 is similar to Fig. 3.

[0108] In the embodiment 2, three vacuum containers 10, 10, 10 respectively corresponding to the three phases of a circuit are united as an integrated body by a mold 60 to thereby shorten the distance H between the respective phases. By the way, since the vacuum containers are respectively insulated from each other by the mold 60 formed of insulating resin, a short-circuit is hard to occur between the phases and the distance H between the phases can be shortened when compared with a structure in which three circuit sections respectively corresponding to the three phases of a complete circuit are disposed within a single vacuum container.

[0109] Further, as a terminal to be connected to a bus 51, there is used a conductor connecting terminal 26 such as a connector, which makes it easy to connect two or more switch gears, which correspond to two or more circuits, to the but 51 in such a manner that they are arranged in a limited space. By the way, in the

present embodiment 2, the parts thereof corresponding to those of the embodiment 1 are given the same designations and thus the description thereof is omitted here.

[0110] In the switch gear according to the embodiment 2 of the invention structured in this manner, the three vacuum containers corresponding to the three phases of a complete circuit are unified as an integrated body by the mold, and the conductor connecting terminal is used as the terminal to be connected to the bus, which makes it possible to enhance the productivity of the switch gear, reduce the size of the switch gear, and enhance the freedom of installation of the switch gear.

(EMBODIMENT 3)

[0111] Now, Fig. 6 is a side section view of a switch gear according to a third embodiment 3 of the invention, and Fig. 7 is a front view of the whole arrangement of the present switch gear. By the way, an electrical connection view of the third embodiment 3 is almost similar to Fig. 3.

[0112] In the embodiment 3, between the upper portion of a first movable conductive rod 22 located outwardly of a vacuum container 10 and a main circuit drive part 24, as well as, between the upper portion of a second movable conductive rod 32 and a grounding circuit drive part 34, there are respectively interposed a main circuit drive part insulating member 22e and a grounding drive part insulating member 32b, thereby insulating the first movable conductive rod 22 and main circuit drive part 24 from each other as well as insulating the second movable conductive rod 32 and grounding circuit drive part 34 from each other.

[0113] And, on a connecting line which extends from the second movable conductive rod 32 and is to be connected to a grounding potential, there is disposed a switch 80 which can be opened and closed in linking with a grounding contact 30, so that, when the grounding contact 30 is opened, the second movable conductive rod 32 can be disconnected from the ground. By the way, the switch 80 may be installed in the air, or in the vacuum, or in an insulating gas and, especially when it is installed in the vacuum or in the insulating gas, the switch 80 can be further reduced in size.

[0114] Further, in the upper surface of a mold 60, there is formed a recessed portion 60b excluding the conductive layer 60a to thereby eliminate not only the insulating pipe 12 located in the upper portion of the one end side of the vacuum container 10 but also the insulating pipe 16 located in the upper portion of the other end side of the vacuum container 10, whereby not only the metal plate 13 and the metal pipe 17 respectively located in the upper portions of the one and the other end sides of the vacuum container 10 are insulated from the ground, but also the transverse pipe portion 11, metal pipe 13 and metal pipe 17 of the vacuum container 10 are made equal in potential to one another. By the way, in the present embodiment 3, the parts thereof corresponding to those of the embodiment 1 are given the same designations and thus the description thereof is omitted here.

[0115] As described above, in the embodiment 3 according to the invention, there are eliminated, from the inside portion of the vacuum portion 10, the portions which, when the grounding contact 30 is opened, can provide a grounding potential, thereby being able to prevent a ground fault from occurring in the interior portion of the vacuum container 10.

[0116] Also, since the vacuum container 10 provides an intermediate potential, the main circuit drive part insulating member 22e and grounding drive part insulating member 32b may respectively have a pressure endurance performance equal to or less than half of the rated pressure endurance value, which makes it possible to reduce the size of the present switch gear.

[0117] Further, by applying a voltage using the switch 80, a pressure endurance test on cables can be conducted.

(EMBODIMENT 4)

[0118] Now, Fig. 8 is a side section view of a switch gear according to a fourth embodiment 4 of the invention. By the way, an electrical connection view of the fourth embodiment 4 is similar to Fig. 3.

[0119] In the switch gear according to the present embodiment 4, the periphery of a transverse pipe portion 11 formed of metal such as SUS is covered with conductive buffer material 91 such as conductive rubber; and, the peripheries of metal pipes 13, 15, 17 and 19 respectively located in the upper and lower portions of the two ends of the transverse pipe portion 11 are covered with insulating buffer material 92, 92, 92, 92 such as silicone-system rubber, respectively.

[0120] And, conductive material such as conductive resin is molded into a box shape having a similar outer shape to a mold 60 to thereby provide a grounding conductive box 90, a vacuum container 10 is stored into the grounding conductive box 90, insulating resin is poured into the interior portion of the grounding conductive box 90, and the above components of the present switch gear are unified into an integrated body by the mold 60 that is formed of the insulating resin poured. As a result of this, the conductive buffer material 91 and insulating buffer material 92, 92, 92, 92 are respectively held by and between the vacuum container 10 and mold 60, while the grounding conductive box 90 is exposed to the surface of the mold 60.

[0121] Now, Fig. 9 is a side section view of the grounding conductive box 90. As shown in Fig. 9, the grounding conductive box 90 is formed in a rectangular box shape similar to the conductive layer that is disposed on the mold 60 in the first embodiment 1.

[0122] This not only can prevent the vacuum container 10 and mold 60 from separating from each other due

to their different coefficients of linear expansion, but also can eliminate the need for formation of the conductive layer 60a in the surface of the mold 60 to thereby simplify the production steps of the present switch gear.

[0123] Also, a metal foil 93b is bonded or metal is evaporated to a cylindrical-shaped base member 93a including a collar portion to thereby produce a conductive shield 93 which has been conduction machined, and the conductive shield 93 is embedded into the periphery of a second fixed conductive rod 31 disposed within the mold 60 in such a manner that the conductive shield 93 is disposed opposed to the second fixed conductive rod 31 through an insulating layer. And, a terminal for voltage detection is disposed on the outer portion of the mold 60 to thereby electrically connect the mold 60 to the conductive shield 93. By the way, the components of the present embodiment 4 are given the same designations and thus the description thereof is omitted here.

[0124] Now, Fig. 10 is a side section view of the conductive shield 93. As shown in Fig. 10, in the conductive shield 93, the metal foil 93b is bonded to the inner side of the cylindrical-shaped base member 93a, that is, the side thereof that is opposed to the second fixed conductive rod 31, thereby allowing the conductive shield 93 to have an electrically conductive property.

[0125] Here, Fig. 11A is a side section view of the mold 60 in which the conductive shield 93 is embedded in the periphery of the second fixed conductive rod 31 to thereby allow the mold 60 to detect the voltage, and Fig. 11B is a circuit diagram of an equivalent circuit which corresponds to the voltage detect circuit of the mold 60.

[0126] As shown in Figs. 11A and 11B, since the second fixed conductive rod 31 and conductive shield 93, both of which are electrically conductive, are embedded in such a manner that they are opposed to each other with the insulating mold 60 between them, this arrangement acts as a capacitor C1 and thus, in the conductive shield 93, there are stored electric charges which correspond to electric charges flowing on the bus side.

[0127] A circuit to be grounded through a voltage detecting cable 94 serving as a capacitor C2 is connected to a terminal which is connected to the conductive shield 93 so as to detect the stored electric charges, and an LED and an element or a device capable of voltage detection such as a voltmeter are connected in parallel to the voltage detecting cable 94, whereby the potential of the second fixed conductive rod 31 can be detected qualitatively or quantitatively.

[0128] In the present embodiment 4 according to the invention structured in this manner, the grounding conductive box, buffer material and conductive shield are unified as an integrated body by the mold, which can simplify the production process of the switch gear, can prevent the mutual separation between the vacuum container and mold, and can facilitate the detecting operations such as voltage detection.

(EMBODIMENT 5)

[0129] A vacuum insulation switch gear according to an embodiment 5 of the invention is structured in the following manner: that is, for example, a main circuit switching portion composed of a main circuit switching device fixed electrode, a main circuit switching device movable electrode, and an insulated rod, a grounding switching portion composed of a grounding switching device grounding electrode and a grounding switching device movable electrode, and a flexible conductor are respectively stored in the interior portion of a metal-made vacuum container in every phases; and, the outer surface of the vacuum container is molded using an insulation, the molded surface of the vacuum container is conduction treated to thereby provide a grounding potential, and the vacuum container is connected to the outside through an insulation bushing. Now, description will be given below of the present embodiment 5 with reference to Figs. 12 and 13. Fig. 12 is a front view of the present switch gear, showing a state thereof in which it is actually arranged; and, Fig. 13 is a side section view of the switch gear.

[0130] In Figs. 12 and 13, a vacuum container 1011 is a metal-made container which is molded of a metal member. Specifically, in the vacuum container 1011, a cylindrical-shaped body member and two end portions respectively for closing the two open end sides of the body member are unified as an integrated body; and, in the two end portions of the vacuum container 11, there are opened up a proper number of holes into which a required number of devices can be inserted in the extending-through manner, that is, in such a manner that they extend not only through the vacuum container but also inwardly and outwardly thereof.

[0131] In the illustrated embodiment, in the respective upper and lower ends of the vacuum container 1011, there are opened up holes by twos, that is, a total of four holes A, B, C and D. To these holes A, B, C and D, there are brazed ceramics-made insulation cylinders 1018, 1019, 1020 and 1021 in such a manner that they are respectively inserted into their associated holes.

[0132] In Fig. 13, a main circuit switching device fixed electrode 1004 and a grounding switching device fixed electrode 1007 are respectively brazed to the center portions of the insulation cylinders 1018 (hole A) and 1019 (hole B) in such a manner that they are respectively inserted into their associated center portions. The main circuit switching device fixed electrode 1004 is connected to a bus 1013 externally of the vacuum container 1001, while the grounding switching device fixed electrode 1007 is connected to a transmission cable 1014 externally of the vacuum container 1001.

[0133] On the opposed position side (in Fig. 13, on the upper side) of the main circuit switching device fixed electrode 1004, a main circuit switching device movable electrode 1005 provides an insulation rod 1015 with a ceramics-made insulation 1009 between them, and the

insulation rod 15 is inserted into the insulation cylinder 20 (hole C) in such a manner that it is free to move in the vertical direction.

[0134] And, the main circuit switching device movable electrode 1005 and grounding switching device fixed electrode 1007 are, within the vacuum container 1011, connected to each other through a flexible conductor 1010 in such a manner that they are free to move. Also, on the opposed position side (in Fig. 13, on the upper side) of the grounding switching device fixed electrode 1007, a grounding switching device movable electrode 108 is inserted into the central portion of the insulation cylinder 1021 (hole D) in such a manner that it is free to move in the vertical direction.

[0135] The main circuit switching device movable electrode 1005 is movable in the vertical direction in Fig. 13 and forms a main circuit switching portion (1004, 1005) which can be contacted with and disconnected with the main circuit switching device fixed electrode 1004 to thereby open and close a main circuit. Also, the grounding switching device movable electrode 1008, similarly, is movable in the vertical direction in Fig. 13 and forms a grounding switching portion (1007, 1008) which can be contacted with and disconnected with the grounding switching device fixed electrode 1007.

[0136] The two ends of an expansion bellows 1006 are respectively fixed to the insulation rod 1015 of the main circuit switching device movable electrode 1005, to the insulation cylinder 1020 (hole C), to the grounding switching device movable electrode 1008, and to the insulation cylinder 1021 (hole D); that is, the bellows 1006 not only seals the interior portion of the vacuum container 1011 in an airtight manner, but also allows the main circuit switching device movable electrode 1005 and grounding switching device movable electrode 1008 to move freely in the vertical direction.

[0137] In the present embodiment 5, as described above, the main circuit switching portion (1004, 1005) and grounding switching portion (1007, 1008) are stored as a set in the interior portion of a single vacuum container 1011 formed of metal; (in case where a switch gear is composed of three phases), three vacuum containers 11 are arranged and they are molded all together by an insulation to provide a mold 1012; and, the surface of the mold 1012 is conduction treated and is connected to the ground.

[0138] By the way, the term "cylindrical shape" used in the present invention means not only a simple cylindrical shape but also other various cylindrical shapes including an angular shape such as a square shape or an elliptical shape regardless of the shapes of the sections thereof.

[0139] According to the embodiment 1005, since the main circuit switching portion (1004, 1005) and grounding switching portion (1007, 1008) are stored in the interior portion of the vacuum container 1011 and the connection from the vacuum container 1011 to the outside is made through the insulation rod 1015, the switch gear can be structured according to an insulation design, that is, a vacuum design which can provide excellent electric insulation performance; that is, the switch gear can be made compact.

[0140] Also, because the three vacuum containers 1011 (in the case of three phases) are molded all together to provide the mold 1012 and the surface of the mold 1012 is conduction treated and grounded, the switch gear is easy to handle.

[0141] Further, since the vacuum container 1011 is a metal container which can be easily molded into a desired shape, when compared with the conventional cylindrical-shaped container formed of ceramics, the vacuum container 1011 can be installed freely.

(EMBODIMENT 6)

[0142] An embodiment 6 according to the invention provides a modification of the structure of the metal-made vacuum container 11 employed in the previously described embodiment 5; and, the other remaining portions of the structure of the embodiment 6, for example, various switching devices (1004, 1005, 1007, 1008) to be stored within the vacuum container 1011, other various installation devices and the arrangement of these devices are similar to those of the previously described embodiment 5.

[0143] That is, in a metal-made vacuum container 1011A according to the embodiment 1006, as shown in Fig. 14, a cylindrical-shaped body member 1023 is combined with two end members 1022A and 1022B respectively for closing the two open ends of the body portion 1023; and, two connecting portions 1024 between two end plates 1022A, 1022B serving as the end members and a body plate 1023 serving as the body member are vacuum brazed as final brazing surfaces to thereby realize vacuum sealing.

[0144] According to the embodiment 6, not only there can be obtained effects similar to the embodiment 5, but also the body member 1023 can be produced simply by cutting a pipe member and the end member 1022A, 1022B can be produced simply by cutting a plate member to thereby be able to manufacture the vacuum container 1011A easily. Therefore, the efficiency of an operation to work the vacuum container 1011A can be improved.

[0145] Also, since a vacuum sealing step, which takes the most time in the manufacturing process, can be carried out by vacuum brazing the connecting portions 1024 between the end plates 1022 and body plate 1023 respectively forming the metal-made vacuum container 1011A as the final brazing surfaces, the manufacturing time of the vacuum container 1011A can be reduced greatly.

[0146] Further, because the vacuum container 1011A is made of metal, holes A, B, C and D respectively serving as the openings of the vacuum container 1011A can be formed easily to a desired size and, by forming them

large in size, the main circuit switching device fixed electrode 1004, main circuit switching device movable electrode 1005, insulation rod 1015, grounding switching device fixed electrode 1007, grounding switching device movable electrode 1008, and flexible conductor fixed electrode 1010 can be greatly improved in the assembling efficiency.

(EMBODIMENT 7)

[0147] An embodiment 7 according to the invention also employs a modification of the structure of the metal-made vacuum container 1011 employed in the previously described embodiment 5; and, the other remaining portions of the structure of the embodiment 7 are similar to those of the embodiment 5.

[0148] That is, in a metal-made vacuum container 1011B according to the embodiment 7, as shown in Fig. 15, a bottomed cylindrical-shaped body member 1025 with one end side opened is combined with an end member 1022 for closing the opened end side of the body member 1025; and, a connecting portion 1024 between an end plate 1022 serving as the end member 1022 and a body plate 1025 serving as the body member are brazed as a final brazing surface to thereby realize vacuum sealing.

[0149] According to the embodiment 7, not only there can be obtained effects similar to the embodiment 5, but also, since the end member 1022 can be produced by cutting a plate member and the body member 1025 can be produced by press molding its blank member, that is, they can be manufactured comparatively easily, the workability of the vacuum container 1011B can be improved greatly.

[0150] Also, since a vacuum sealing step, which takes the most time in the manufacturing process, can be carried out by vacuum brazing the connecting portion 1024 between the end plate 1022 and body plate 1025 of the bottomed metal-made vacuum container 1011B as the final brazing surfaces, the manufacturing time of the vacuum container 1011B can be reduced greatly.

[0151] Further, similarly to the embodiment 6, because the vacuum container 1011B is made of metal, holes A, B, C and D respectively serving as the openings of the vacuum container 1011B can be formed easily to a desired size and, by forming them large in size, the main circuit switching device fixed electrode 1004, main circuit switching device movable electrode 1005, insulation rod 1015, grounding switching device fixed electrode 1007, grounding switching device movable electrode 1008, and flexible conductor fixed electrode 1010 can be greatly improved in the assembling efficiency.

[0152] In addition, since the metal-made vacuum container 1011B is divided into two members, that is, the end plate 1022 and bottomed body plate 1025, there is required only one connecting portion 1024, which enhances the efficiency of the brazing operation further. Further, because the number of connecting portions 1024 is smaller by one than the embodiment 6, the reliability of the vacuum container 1011B as to airtightness can also be enhanced.

(EMBODIMENT 8)

[0153] An embodiment 8 according to the invention also provides another modification of the structure of the metal-made vacuum container 1011 employed in the previously described embodiment 5; and, the other remaining portions of the structure of the embodiment 8 are similar to those of the embodiment 5.

[0154] That is, in a metal-made vacuum container 1011C according to the embodiment 8, as shown in Fig. 16, two bottomed cylindrical-shaped body members 1025 each with one end side opened are combined with each other in such a manner that their respective opened ends are butted against each other; and, a connecting portion 1024 between the body plates 1025 is brazed as a final brazing surface to thereby realize vacuum sealing.

[0155] According to the embodiment 8, not only there can be obtained effects similar to the embodiment 5, but also, since the two body members 1025 can be easily produced by press molding their respective blank members, the workability of the vacuum container 11C can be improved greatly.

[0156] Also, since the metal-made vacuum container 1011C is divided into two members, that is, two bottomed body plates 1025, there is required only one connecting portion 1024, which can enhance the efficiency of the brazing operation further. Further, because the number of connecting portions 1024 is smaller by one than the embodiment 6, the reliability of the vacuum container 1011B as to airtightness can also be enhanced.

[0157] Further, since a vacuum sealing step, which takes the most time in the manufacturing process, can be carried out by vacuum brazing the connecting portion 1024 between the two bottomed body plates 1025 of the metal-made vacuum container 1011C as the final brazing surfaces, the manufacturing time of the vacuum container 11C can be reduced greatly.

[0158] Moreover, because the metal-made vacuum container 1011C is composed of the two body plates 1025 used as two bottomed body members, as the two bottomed body members 1025, which are to be combined together in the vertical direction, there can be used the members of the same type, which allows use of the components of the same type. Also, when compared with the embodiment 7, the depth of the vacuum container 11C can be reduced, which can enhance the workability of the bottomed body plates 1025 when they are molded.

[0159] In addition, when compared with the embodiment 5, since the number of connecting portions 1024 is reduced down to one, the efficiency of the brazing operation can be improved and the airtightness reliability thereof can also be enhanced.

(EMBODIMENT 9)

[0160] Now, according to an embodiment 9 of the invention, in the above-mentioned embodiments 2 and 3, as shown in Fig. 17, on the side of the end member 1022 against which the body member 1023 is butted, there is formed a positioning portion 1026 into which the butting end portion of the body member 1023 can be stored. Here, Fig. 17 is an enlarged view of the main portions of the vacuum container where the positioning portion 1026 is formed.

[0161] The positioning portion 1026 shown in Fig. 17 is formed as a groove into which the edge portion of the body member 1023 on the opening side thereof can be stored. Of course, the shape of the positioning portion 1026 is not limited to the groove shown in the present embodiment 9 but, as the positioning portion 1026, there can be employed any other worked portion formed in the end member 1022, provided that it permits easy decision of the position where the body member 1023 is to be contacted with the end member 1022. By the way, for vacuum sealing, the groove portion 1026 serving as the positioning portion 1026 is vacuum brazed as the brazing surface.

[0162] According to the embodiment 9, not only there can be obtained effects similar to the embodiments 1 to 3, but also, due to provision of the positioning portion 1026 in the connecting portion of the vacuum container 1011D made of metal, the efficiency of the brazing operation can be further enhanced as well as a brazing jig can be simplified and the brazing position precision can be enhanced.

[0163] By the way, as the positioning portion 1026, as shown in Fig. 18, on the side of the end plate 1022 serving as the end member, there may be worked a bent portion 1027 for positioning the body plate 1023 serving as the body member; or, as shown in Fig. 19, on the side of the end plate 1022, there may be worked a bent groove 1028 for positioning the body plate 1023. In either of them, there can be obtained similar effects to the positioning portion 1026.

(EMBODIMENT 10)

[0164] Now, according to an embodiment 10 of the invention, in the embodiment 8, two bottomed cylindrical-shaped body members 1025A and 1025B each with one end side opened are combined together in such a manner that their respective opened ends are contacted with each other. In the present embodiment 10, there is formed a positioning portion 1029 where one (1025A) of the opened end portions of the two mutually butted body members can be fitted coaxially with the other (1025B).

[0165] In an example shown in Fig. 20, the diameter of the end portion of the opening of the body member 1025A, which is situated in the lower portion of Fig. 20 with the opening facing upwardly, is enlarged slightly with respect to the body member 1025B which is situated in the upper portion of Fig. 20 with the opening facing downwardly, thereby forming a positioning portion 1029; and, the end portion of the opening of the upwardly situated body member 1025B can be fitted with the positioning portion 1029. By the way, the fitting portion is vacuum brazed as the brazing surface.

[0166] According to the embodiment 10, not only there can be obtained similar effects to the embodiment 5 but also, since the positioning portion 1029 is formed in the fitting portion used as the connecting portion of the vacuum container 1011E, the efficiency of the brazing operation can be enhanced as well as a brazing jig can be simplified and the brazing position precision can also be enhanced.

(EMBODIMENT 11)

[0167] Now, in an embodiment 11 according to the invention, in the embodiments 1 to 6, for a main circuit conductor which extends not only through the metal-made vacuum container but also inwardly and outwardly thereof, in the inner edge of a hole which allows the through-extension of the main circuit conductor, there is formed an electric field buffering ring portion which is used to buffer an electric field.

[0168] Specifically, in a structure shown in Fig. 21, the portion of the hole A of the end plate 1022 in the metal-made vacuum container 1011 (1011A to 1011E) that is disposed on the opposed side of a main circuit conductor 1030 which extends through the hole A of the end plate 1022, that is, the opening edge portion of the hole A of the end plate 1022 is extended outwardly to thereby form an electric field buffering ring portion 31 which surrounds annularly the main circuit conductor 1030 with a proper clearance with respect to the body portion of the main circuit conductor 1030.

[0169] According to the present embodiment 11, there can be obtained similar effects to the embodiment 5. At the same time, since, in a portion where an electric field intensity become high, a portion of the metal-made vacuum container 1011 (1011A to 1011E) is extended to thereby provide the electric field buffering ring portion 1031, the electric field can be buffered without increasing the number of parts as well as the voltage resisting performance of the switch gear can be enhanced.

[0170] By the way, as shown in Fig. 22, the electric field buffering ring portion 1031 may be formed in the hole A of the end plate 1022 serving as the end member which, when manufacturing the metal-made vacuum container 1011 (1011A to 1011E), is molded together with the body plate 1025 as an integrated body. Of course, in this case as well, there can be obtained similar effects.

(EMBODIMENT 12)

[0171] Now, description will be given below of a power

switching apparatus according to the present invention with reference to the accompanying drawings. By the way, in the drawings respectively showing the preferred embodiments of the invention, equivalent or similar parts are given the same designations and thus the duplicated description thereof is omitted.

[0172] Fig. 23 is a section view of the main portions of a power switching apparatus according to a first embodiment of the invention. The present power switching apparatus consists mainly of a main circuit switching portion 2001, a grounding switching portion 2002, a vacuum container 2003 in which the main circuit switching portion 2001 and grounding switching portion 2002 are to be enclosed, and a sheathing insulator 2004 for wrapping up the vacuum container 2003.

[0173] The main circuit switching portion 2001 is composed of a first movable electrode 2011 and a first fixed electrode 2012 with their intermediate portions connected together by an insulator, the grounding switching portion 2002 is composed of a second movable electrode 2021 and a second fixed electrode 2022, and the first movable electrode 2011 and second fixed electrode 2022 are connected to each other by a flexible connecting conductor 2018. The vacuum container 2003 comprises a metal-made container body portion 2031 with four openings 2031a and 2031b which respectively have an elliptical section and also through which the main circuit switching portion 2001 and grounding switching portion 2002 extend in parallel to each other, insulation cylinders 2321 - 2323 respectively made of ceramics, cylindrical-shaped sealing members 2331 and 2332, cup-shaped sealing members 2341 - 2344 through the bottom portion of which any one of the first movable electrode 2011, second movable electrode 2022, first fixed electrode 2012 and second fixed electrode 2022 is allowed to extend, a cylindrical-shaped arc shield 2035, bellows 2361 and 2362, and electric field buffer rings 2371 and 2372. The sheathing insulator 2004 is composed of cushion rings 2411 - 2414 and a resin insulation layer 2042.

[0174] Referring in detail to the structure of the vacuum container 2003, either of the cylindrical-shaped sealing members 2331 or 2332, any one of the insulation cylinders 2321 - 2323, and any one of cup-shaped sealing members 2341 - 2344 are connected airtight to and piled up on the outsides of the four openings 2031a and 2031b respectively formed in the container body portion 2031 by brazing, one end of the bellows 2361 or 2362 is connected by brazing to the peripheral edge of the opening of the bottom surface of the cup-shaped sealing member 2341 or 2342, the electric field buffer ring 2371 is connected by brazing to the peripheral edge of the opening 2031a and to the bottom surface of the cup-shaped sealing member 2343 which is disposed opposed to the opening 2031a peripheral edge, and the electric field buffer ring 2372 is connected by brazing to the peripheral edge of the opening 2031b and to the bottom surface of the cup-shaped sealing member 2344 which is disposed opposed to the opening 2031b peripheral edge, respectively. By the way, the insulation cylinder 2322 includes a stepped portion in the central portion of the inner surface thereof and, on the stepped portion, there is mounted the arc shield 2035 with a uniform clearance between the inner peripheral wall surface of the stepped portion and the arc shield 2035. The diameters of the insulation cylinders 2321 and 2322 are set larger than the diameter of the insulation cylinder 2323. The reason for this is that the first movable electrode 2011 includes an insulation rod 2011a and a rod shield 2011b respectively in the central portion thereof, and also that the arc shield 2035 is mounted on the central portion of the inner surface of the insulation cylinder 2322.

[0175] The main circuit switching portion 2001 is mounted in the central portion of an internal space which is formed by the container body portion 2031, insulation cylinders 2321 and 2322, cylindrical-shaped sealing member 2331, and cup-shaped sealing members 2341 and 2343; the grounding switching portion 2002 is mounted in the central portion of an internal space which is formed by the container body portion 2031, insulation cylinders 2323, cylindrical-shaped sealing member 2332, and cup-shaped sealing members 2342 and 2344; the main circuit switching portion 2001 and grounding switching portion 2002 are connected to each other by the connecting conductor 2018; and, the first movable electrode 2011 is connected and sealed airtight by brazing to the other end of the bellows 2361, the second movable electrode 2021 is connected and sealed airtight by brazing to the other end of the bellows 2362, the first fixed electrode 2012 is connected and sealed airtight by brazing to the peripheral edge of the opening of the bottom surface of the cup-shaped sealing member 2343, and the second fixed electrode 2022 is connected and sealed airtight by brazing to the peripheral edge of the opening of the bottom surface of the cup-shaped sealing member 2344, respectively. As in the conventional vacuum switch, to reduce residual stresses which occur in brazing in the connecting portions between the insulation cylinders 2321 - 2323 made of ceramics and metal-made members to be connected thereto because of their different coefficients of thermal expansion, the materials and shapes of the metal-made members must be selected properly.

[0176] The cushing rings 2411 - 2414 are respectively placed over an area ranging from the outer peripheral surface of the cylindrical-shaped sealing member 2331 or 2332 in an integrated manner, over the neighboring portion of the connecting portion between the insulation cylinder 2321 and cup-shaped sealing member 2341, and over the neighboring portions of the connecting portions between the insulation cylinders 2321 - 2323 and cup-shaped sealing members 2341 - 2344; and, the outer surfaces of the vacuum container 2003 and fixed electrodes 2012 and 2022 as well as the outer surfaces of the cushion rings 2411 - 2414 are covered with the

resin insulation layer 2042, except for the bottom side end portions of the cup-shaped sealing members 2341 and 2342 as well as the circuit connecting side end portions of the first and second fixed electrodes 2012 and 2022.

[0177] The cushion rings 2411 - 2414 are produced by molding conductive rubber according to a compression molding method and, in the molded state thereof, the inside diameter of each cushion ring is set slightly smaller than the outside dimension of the portion thereof which is to be fitted with the vacuum container 2003. The shapes of the sections of the cushion rings 2411 - 2414 are shown in Figs. 24A and 24B.

[0178] Specifically, Fig. 24A shows the section shapes of the cushion rings 2411 and 2412, in which an X1 portion covers the end portions of the insulation cylinders 2321 - 2323, whereas a Y1 portion covers the end portions of the outer peripheral surfaces of the cup-shaped sealing members 2341 - 2344. The outside diameter side corner of the X1 portion is rounded with a radius smaller than the thickness of this corner, whereby, when the cushion rings 2411 and 2412 are mounted into the vacuum container 2003, the electric field in this corner can be buffered. And, the outside diameter side of the Y1 portion is formed in a conical surface in such a manner that the thickness of the end portion of the conical surface is almost zero. Also, the corner portion of the inside diameter side of the Y1 portion that adjoins the X1 portion is chamfered in order to avoid interference with fillets which are to be formed in the connecting portions between the insulation cylinders 2321 - 2323 and cup-shaped sealing members 2341 - 2344.

[0179] On the other hand, Fig. 24B shows the section shapes of the cushion rings 2413 and 2414, in which an X2 portion covers the end portions of the insulation cylinders 2321 - 2323, whereas a Y2 portion covers the outer peripheral surfaces of the cylindrical-shaped sealing members 2331 - 2332. And, the end face that is to be contacted with the container body portion 2031 is designated by Z. The outside diameter side corner of the X2 portion is rounded with a radius smaller than the thickness of this corner, whereby, when the cushion rings 2413 and 2414 are mounted into the vacuum container 2003, the electric field in this corner can be buffered. And, the corner portion of the inside diameter side of the Y2 portion that adjoins the X2 portion as well as the corner portion of the end face Z are respectively chamfered in order to avoid interference with fillets which are to be formed in the connecting portions between the insulation cylinders 2321 - 2323 and cylindrical-shaped sealing members 2331 or 2332 as well as between the container body portion 31 and cylindrical-shaped sealing member 2331 or 2332. The end face Z is formed as a plane surface so that it can be closely contacted with the container body portion 2031.

[0180] The cushion rings 2411 - 2414 are respectively used to buffer the concentration of the electric field in the outer peripheral edges of the metalided layers formed in the end portions of the insulation cylinders 2321 - 2323 of the vacuum container 2003 or in the outer peripheral edge portions of the brazed fillets formed in the connecting portions between the insulation cylinders 2321 - 2323 and other members. By the way, the cushion rings 2411 - 2414, further, not only can prevent resin from penetrating into the brazed fillets when the resin insulation layer 2043 is formed by cast molding but also can buffer the contraction stress of the resin insulation layer 43 and thermal stresses produced due to variations in temperature when the power switching apparatus is in operation.

[0181] The main circuit switching portion 2001 and grounding switching portion 2002 are assembled into the vacuum container 2003, the cushion rings 2411 - 2414 are mounted in the above-mentioned manner, and they are fixed into a given metal mold; and, after then, the resin insulation layer 2042 is formed of epoxy resin by cast molding.

[0182] According to the power switching apparatus structured in the above-mentioned manner, two element switches enclosed in the interior portion of the vacuum container 2003 are used to form the main circuit switching portion 2001 and grounding switching portion 2002 respectively, the cushion rings are mounted on the outer peripheries of the connecting portions between the insulation cylinders of the vacuum container 2003 and metal-made sealing members, and the outer surfaces of the power switching apparatus, except for the terminal portions and the neighboring portions of the sealingly mounted portions of the movable electrodes, are enclosed by the sheathing insulator 2004. This structure can prevent the strength of the connecting portions of the vacuum container 2003 from being lowered and can reduce the necessary insulation distances between the power charging portions of the power switching apparatus, thereby being able to realize the equivalent function to that of the conventional ring main switching gear in a small occupation area. Further, in case where there occurs a short-circuit in the interior portion of the power switching apparatus, because the present portion is kept at a vacuum, there is no possibility that the pressure can increase in the mounting portion of the power switching apparatus. Therefore, it is easy to structure a power switching apparatus which is highly safe and very economical.

[0183] In the foregoing description, the power switching apparatus is structured such that it encloses therein two element switches corresponding one phase composed of a pair of portions, that is, a main circuit switching portion and a grounding switching portion. However, this is not limitative but, for example, the power switching apparatus may be structured such that it encloses element switches corresponding in number to three phases unified as an integrated body.

[0184] Now, Fig. 25 is a section view of the main portions of a modification of the power switching apparatus shown in Fig. 23. This modification is different from the

power switching apparatus shown in Fig. 23 in the following points.

[0185] That is, of two openings formed on the main circuit switching portion 2001 side in the container body portion 2031, an opening 2031c formed on the first fixed electrode 2012 side is equal in size to the arc shield 35, and one end of the arc shield 2035 is connected by brazing to the peripheral edge of the opening 2031c. The insulation cylinder 2322 gradually decreases in diameter in the neighboring portion of one end portion thereof, while the insulation cylinder 2322 is, in the end portion thereof, equal in size to the insulation cylinder 2323.

[0186] Since the present modification is structured in the above-mentioned manner, the cup-shaped sealing member to be connected to the fixed electrode 2012 on the main circuit switching portion 2001 side can also be used as the cup-shaped sealing member to be connected to the fixed electrode 2022 on the grounding switching portion 2002 side, which makes it possible to reduce the number of kinds of sealing members.

(EMBODIMENT 13)

[0187] Now, Fig. 26 is a partial section view of a fixed electrode pull-out portion of a composite vacuum switch according to a second embodiment 13 of the invention.

[0188] A first fixed electrode 2012 terminates in the interior portion of a resin insulation layer 2042 and is connected through a connecting conductor 2051 to a bus side connecting terminal 2052. And, a second fixed electrode 2022 also terminates in the interior portion of the resin insulation layer 2042 and is connected through a connecting conductor 2053 to a load side connecting terminal 2054. On the outer periphery of the load side connecting terminal 2054 in the interior portion of the resin insulation layer 2042, there is disposed a cylindrical-shaped voltage dividing electrode 2055 for voltage detection through a support insulation 2056 in such a manner that it is coaxial with the load side connecting terminal 2054.

[0189] In connecting the first fixed electrode 2012, connecting conductor 2051 and bus side connecting terminal 2052 together, as well as in connecting the second fixed electrode 2022, connecting conductor 2053 and load side connecting terminal 2054 together, their respective head portions are fastened together using bolts 2060 each having an arc-shaped section.

[0190] Since the second embodiment 2013 is structured in the above-mentioned manner, when it is fixed in a metal mold for forming a resin insulation layer in such a manner that the vacuum container, main circuit switching portion and grounding switching portion are unified as an integrated body, there is produced room or an allowance in the relative dimension error which is allowed in the position relationships between the respective movable electrodes and fixed electrodes that are determined by the allowed stresses of the respective brazed portions. This is because the connecting portions between the first fixed electrode 2012, connecting conductor 2051 and bus side connecting terminal 2052 as well as the connecting portions between the second fixed electrode 2022, connecting conductor 2053 and load side connecting terminal 2054 can be adjusted in dimension. For example, with a proper adjusting allowance given to the respective connecting portions, the connecting conductor 2051 and bus side connecting terminal 2052 may be connected together as well as the second fixed electrode 2022, connecting conductor 2053 and load side connecting terminal 2054 may be connected together respectively on an assembling jig which corresponds to the metal mold.

[0191] This structure can enhance the productivity of the power switching apparatus and reduce the manufacturing cost thereof. Also, since the electric field in the neighboring portions of the conductor connecting portions can be buffered, the thicknesses of the portions of the resin insulation layer 2042 that correspond to such portions can be reduced, which in turn makes it possible to reduce the size of the power switching apparatus.

[0192] Also, since the positioning of the voltage dividing electrode 2055 with respect to the metal mold is determined by the position of the load side connecting terminal 2054, there is eliminated the need to position the voltage dividing electrode 2055 from the metal mold side, thereby being able to improve the efficiency of the positioning operation. Also, because the voltage dividing electrode 2055 can be mounted at an arbitrary position in the load side connecting terminal 2054, the power distribution of the interior portion of the resin insulation layer 2421 can be easily optimized, which can contribute to reduction of the size of the power switching apparatus.

[0193] In the above description, the voltage dividing electrode is disposed in the periphery of the load side connecting terminal. However, this is not limitative but, for example, there can also be employed a structure in which, as shown in Fig. 27, there is connected a capacitor 2006 from the connecting conductor 2053 through a connecting line 2055 and there is disposed a capacitor terminal 2061 on the outside portion of the mold.

[0194] In case where the capacity of the capacitor 2006 is set larger than a floating capacity between electrodes or a floating capacity between phases, the voltage can be detected even while the bus side or mutually adjoining phases are being electrically charged.

[0195] As has been described heretofore in detail, in a switch gear according to the invention, switching mechanisms such as a main circuit switching device for opening and closing a circuit between a bus and a load device and a grounding switching device are respectively disposed within a container, the container is covered with an insulating mold, and a conductive layer is formed on the surface of the mold for grounding, thereby being able not only to secure safety but also to reduce the areas of the interior portion of the container that provide grounding potentials so as to prevent a ground fault.

And, the whole of the interior portion of the container is kept at a high vacuum to thereby eliminate the need for provision of a protect shield in the periphery of a contact where an arc is to be vacuum extinguished, which can simplify and make compact the present switch gear to thereby reduce the production cost of the switch gear as well as enhance easily the freedom of installation of the switch gear. Further, since an insulating gas such as SF_6 is not used, the handling and control of the switch gear can be facilitated.

[0196] And, in a switch gear according to the invention, a power receiving member for electrically connecting a switching mechanism and a bus to each other is composed of a conductor connecting terminal portion such as a connector. Thanks to this, a plurality of switch gears can be arranged side by side in a limited space and can be connected to a bus, thereby being able to enhance further the freedom of installation of the switch gear.

[0197] Further, in a switch gear according to the invention, there is disposed an external switching device which can be switched in linking with a grounding switching device, and the switch gear is grounded through the external switching device to thereby eliminate the areas of the interior portion of a container that provide grounding potentials, which can prevent a ground fault from occurring in the interior portion of the container. Thanks to this, the reliability and safety of the present switch gear can be enhanced, the structure of the switch gear can be simplified and made compact, the production cost of the switch gear can be reduced, the freedom of installation of the switch gear can be increased, and the handling and control of the switch gear can be facilitated.

[0198] Also, in a switch gear according to the invention, a plurality of vacuum containers can be unified as an integrated body by a mold. Thanks to this, the size of the switch gear can be reduced and also the freedom of installation of the switch gear can be increased.

[0199] And, in a switch gear according to the invention, conductive material such as conductive resin is molded into a cylindrical or rectangular box shape to thereby produce a grounding conductive member, a vacuum container is stored into the grounding conductive member, and these are unified as an integrated body by a mold in such a manner that the grounding conductive member is exposed to the surface of the vacuum container. This can facilitate the formation of a conductive layer on the surface of the mold when the switch gear is manufactured.

[0200] Further, in a switch gear according to the invention, a conductive member to be embedded such as a metal shield is embedded in a mold in such a manner that it is opposed to a load side conductor, thereby being able to realize a circuit equivalent to a capacitor. This can facilitate the checking operations of the conditions of the switch gear such as the voltage detection of the switch gear.

[0201] Also, in a switch gear according to the invention, a vacuum container is covered with buffer material, they are unified as an integrated body by a mold, and the buffer material is held by and between the vacuum container and mold, which can prevent the mutual separation between the vacuum container and mold that could be otherwise caused due to their different coefficients of linear expansion.

[0202] According to the inventions, a main circuit switching portion and a grounding switching device grounding portion can be arranged relatively freely in the interior portion of a vacuum container. Thanks to this, there can be supplied a vacuum insulation switch gear which is compact, can be manufactured at a reduced cost, is easy to handle and is excellent in performance.

[0203] According to the inventions, since a vacuum sealing step, which takes the most time in the manufacturing process of the switch gear, can be carried out by vacuum brazing, the manufacturing time of the switch gear can be reduced greatly.

[0204] Also, because a vacuum container is structured of a plurality members which are divided properly, the workability of the vacuum container can be improved.

[0205] Further, since the vacuum container is made of metal, the opening of the vacuum container can be set large optionally, which makes it possible to improve the efficiency of assembly of various devices such as a main circuit switching device fixed electrode, main circuit switching device movable electrode, insulation rod, grounding switching device fixed electrode, grounding switching device movable electrode, and flexible conductor fixed electrode.

[0206] According to the inventions, because a metal-made vacuum container requires only one connecting portion, the efficiency of the brazing operation of the vacuum container can be enhanced.

[0207] Also, the reduced number of vacuum containers can enhance the reliability of the airtightness of the vacuum container.

[0208] According to the inventions, since there is executed a positioning operation on the connecting portion of a metal-made vacuum container which is molded of two or more members, not only the efficiency of the brazing operation of the vacuum container can be enhanced but also a brazing jig can be simplified and the brazing position precision can also be enhanced.

[0209] According to the inventions, because, in a portion where an electric field intensity becomes high, a portion of a metal-made vacuum portion is extended to thereby form a ring portion for buffering an electric field, the electric field can be buffered without increasing the number of parts and thus the voltage resisting performance of the switch gear can be enhanced.

[0210] In the power switching apparatus according to the invention, since the neighboring portions of the connecting portions between the insulation cylinders of the vacuum container and metal-made vacuum container

parts are covered by the cushion rings each made of conductive rubber as well as the thus ring-covered portions, together with the vacuum container outer surface, are covered with the resin insulation layer from the outside thereof, the concentration of the electric field in the outer peripheral edge portions of the fillets formed in the connecting portions can be buffered. Also, the present power switching apparatus can prevent resin from being penetrated into the brazed fillet portions when the resin insulation layer is formed by cast molding, and can buffer the contraction stress of the resin insulation layer as well as the thermal stress thereof due to variations in temperature when the present power switching apparatus is in operation.

[0211] Also, the respective one-end portions of the conductive rubber cushion rings cover the outer peripheral end portions of the insulation cylinders, the other end portions of the conductive rubber cushion rings cover the outer peripheries of the metal-made vacuum container parts, the end portion corners of the cushion rings covering the outer peripheral end portions of the insulation cylinders are rounded with a radius slightly smaller than the thickness of the present corners, the end portion outer peripheral surfaces of the cushion rings covering the outer peripheries of the metal-made vacuum container parts are respectively formed in a conical surface in which the thickness of the projecting end thereof provides almost zero, and the stepped portions of the inner peripheral surfaces of the cushion rings are respectively chamfered with a dimension larger than the dimension of the brazed fillets formed in the connecting portions. Thanks to this structure, the concentration of the electric field in the outer peripheral edge portions of the fillets formed in the connecting portions can be buffered more positively.

[0212] Further, the respective one-end portions of the conductive rubber cushion rings cover the outer peripheral end portions of the insulation cylinders, the other end portions of the conductive rubber cushion rings cover the outer peripheries of the metal-made vacuum container parts, the end portion corners of the cushion rings covering the outer peripheral end portions of the insulation cylinders are rounded with a radius slightly smaller than the thickness of the present corners, the end portions of the cushion rings covering the outer peripheries of the metal-made vacuum container parts are respectively formed in a plane surface which it intersects with the axial direction of the insulation cylinder, and the inside diameter side end portions corners of the cushing rings covering the stepped portions of the inner peripheral surfaces of the cushion rings as well as the outer peripheries of the metal-made vacuum container parts are respectively chamfered with a dimension larger than the dimension of the brazed fillets formed in the connecting portions. This structure can buffer more positively the concentration of the electric field in the outer peripheral edge portions of the fillets formed in the connecting portions.

[0213] And, since the connecting conductors for connecting the electrodes of the element switches to the outside of the power switching apparatus are connected by fastening means in the interior portion of the resin insulation layer, the productivity of the power switching apparatus can be enhanced as well as the manufacturing cost thereof can be reduced.

[0214] Also, because, as the fastening means, there is used a bolt whose head portion has an arc-shaped section. Thanks to this, the electric field in the neighboring portions of the conductor connecting portionscan be buffered, and the thickness of the portions of the resin insulation layer corresponding to the present neighboring portions can be reduced to thereby be able to reduce the size of the power switching apparatus.

[0215] Further, since there is provided a voltage dividing electrode in the outer periphery of the connecting conductor within the resin insulation layer and the voltage dividing electrode is to be positioned by an insulator fixed to the connecting conductor, there is eliminated the need to position the voltage dividing electrode on the side of a metal mold, which makes it possible to improve the efficiency of the positioning operation. Also, because the voltage dividing electrode can be mounted at an arbitrary position in the connecting conductor, the potential distribution in the interior portion of the resin insulation layer can be optimized easily as well as the power switching apparatus can be reduced in size.

[0216] In addition, in the interior portion of the resin insulation layer, there is disposed a voltage dividing capacitor structured such that one electrode thereof is connected to the connecting conductors and its electrostatic capacity is set larger than a floating capacity between electrodes as well as between phases with respect to the connecting conductors. Thanks to this, voltage detection is possible even while the bus side or mutually adjoining phases are under electric charge.

Claims

1. A switch gear, comprising:

a switching mechanism;
a vacuum container for storing the switching mechanism therein; and,
an insulating member for covering the container, wherein there is formed a conductive layer on the outer surface of the insulating member.

2. The switch gear as set forth in claim 1, wherein the switching mechanism comprises:

a first fixed contact piece;
a second fixed contact piece;
a first movable contact piece contactable with and removable from the first fixed contact piece, the first movable contact piece electrical-

ly connected to the second fixed contact piece; and
a second movable contact piece contactable with and removable from the second fixed contact piece.

3. The switch gear as set forth in claim 2, further comprising:

a power receiving member electrically connected to the first fixed contact piece;
a grounding member electrically connected to the second movable contact piece; and
a power distributing member electrically connected to the second fixed contact piece.

4. The switch gear as set forth in claim 3, further comprising:

an external switching device switchable in linking with the second movable contact piece,
wherein the grounding member is insulated from the conductive layer on the surface of the mold and is grounded through the external switching device.

5. The switch gear as set forth in any one of claims 2 to 4, wherein the container comprising two or more containers united together into an integrated body by the mold.

6. The switch gear as set forth in claim 1, wherein the vacuum container is composed of a cylindrical-shaped body member and two end members respectively for closing the two ends of the body member.

7. The switch gear as set forth in claim 1, wherein the vacuum container is composed of a bottomed cylindrical-shaped body member with one end side thereof opened and an end member for closing the opened end of the body member.

8. The switch gear as set forth in claim 1, wherein the vacuum container is composed of two bottomed cylindrical-shaped body members each with one end side thereof opened, the two body members being combined together in such a manner that their respective opened ends are contacted with each other.

9. The switch gear as set forth in claim 1, wherein an insulation cylinder forms the vacuum container, the vacuum container has a metal-mad part, a neighboring portion of connecting portions between the insulation cylinder and the metal-made part of the vacuum container are covered with cushion rings each made of conductive rubber, and the resin insulation layer covers the ring-covered portions from the outside thereof together with the outer surface of the vacuum container.

10. The switch gear as set forth in claim 9, wherein the respective one-end portions of the conductive rubber cushion rings cover the outer peripheral end portions of the insulation cylinders, the other end portions of the conductive rubber cushion rings cover the outer peripheries of the metal-made vacuum container parts, the end portion corners of the cushion rings covering the outer peripheral end portions of the insulation cylinders are rounded with a radius slightly smaller than the thickness of the corners, the end portion outer peripheral surfaces of the cushion rings covering the outer peripheries of the metal-made vacuum container parts are respectively formed in a conical surface in which the thickness of the projecting end thereof provides almost zero, and the stepped portions of the inner peripheral surfaces of the cushion rings are respectively chamfered with a dimension larger than the dimension of the brazed fillets to be formed in the connecting portions.

FIG.1

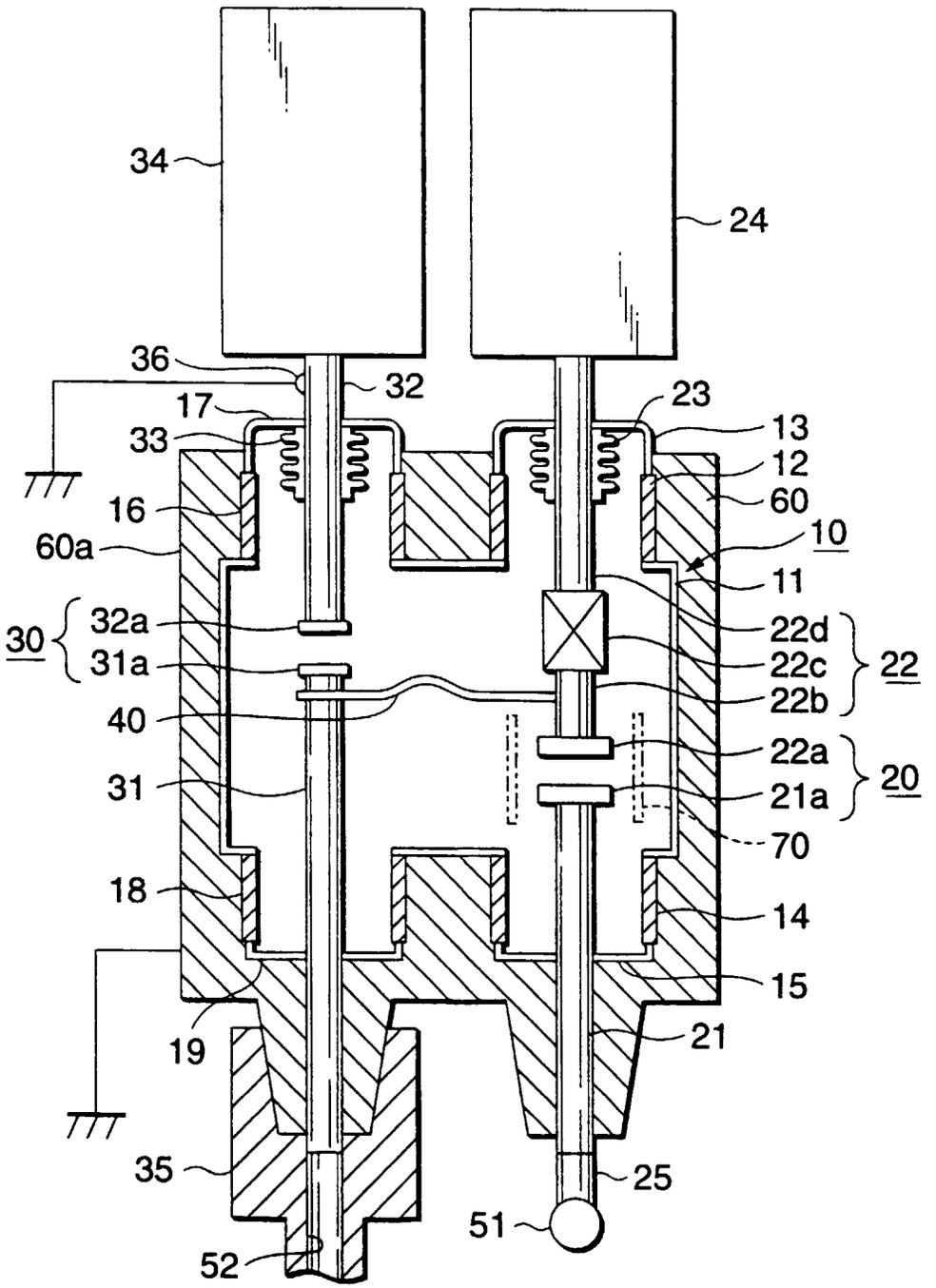
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FIG.2

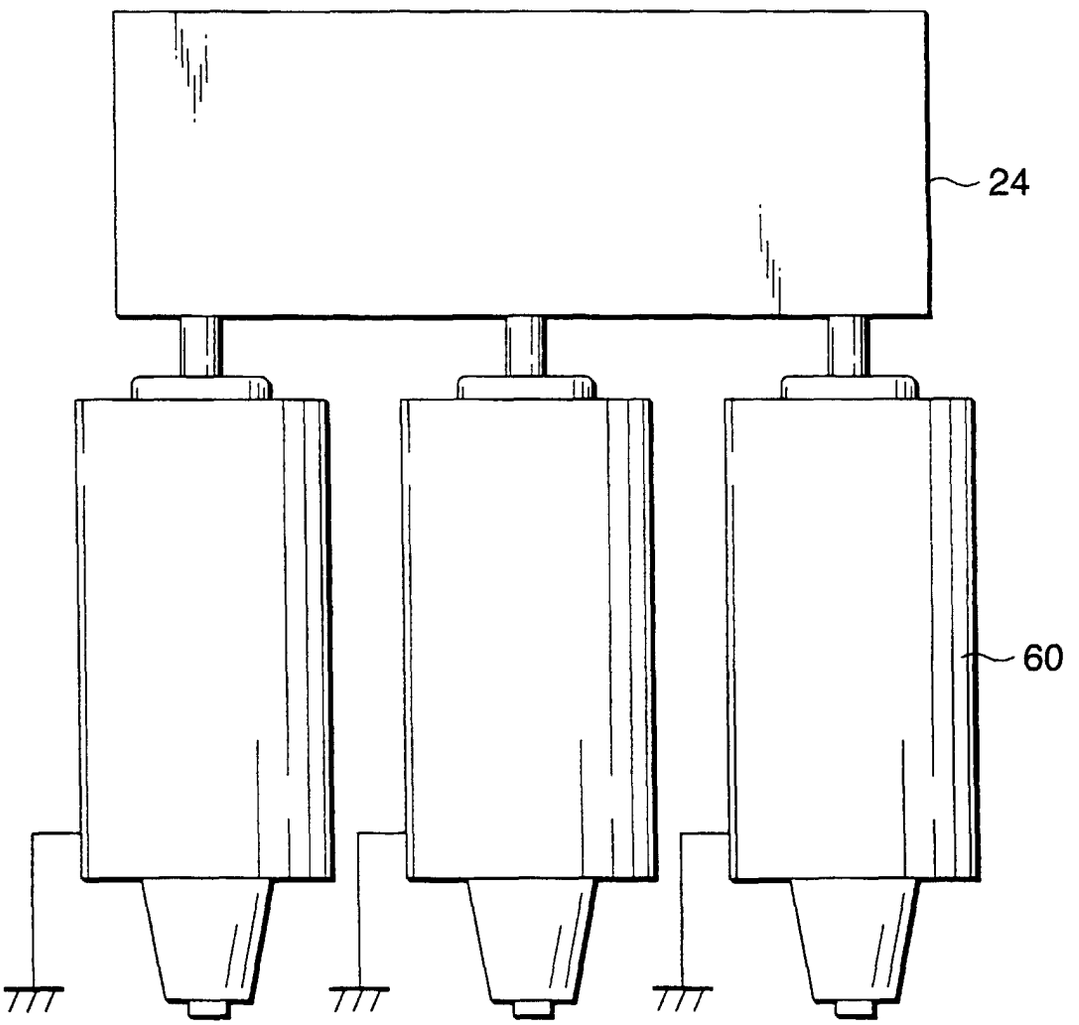

FIG.3

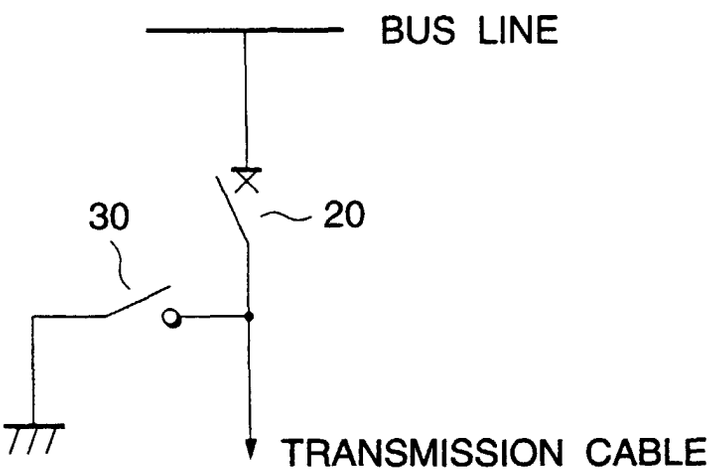

FIG.4

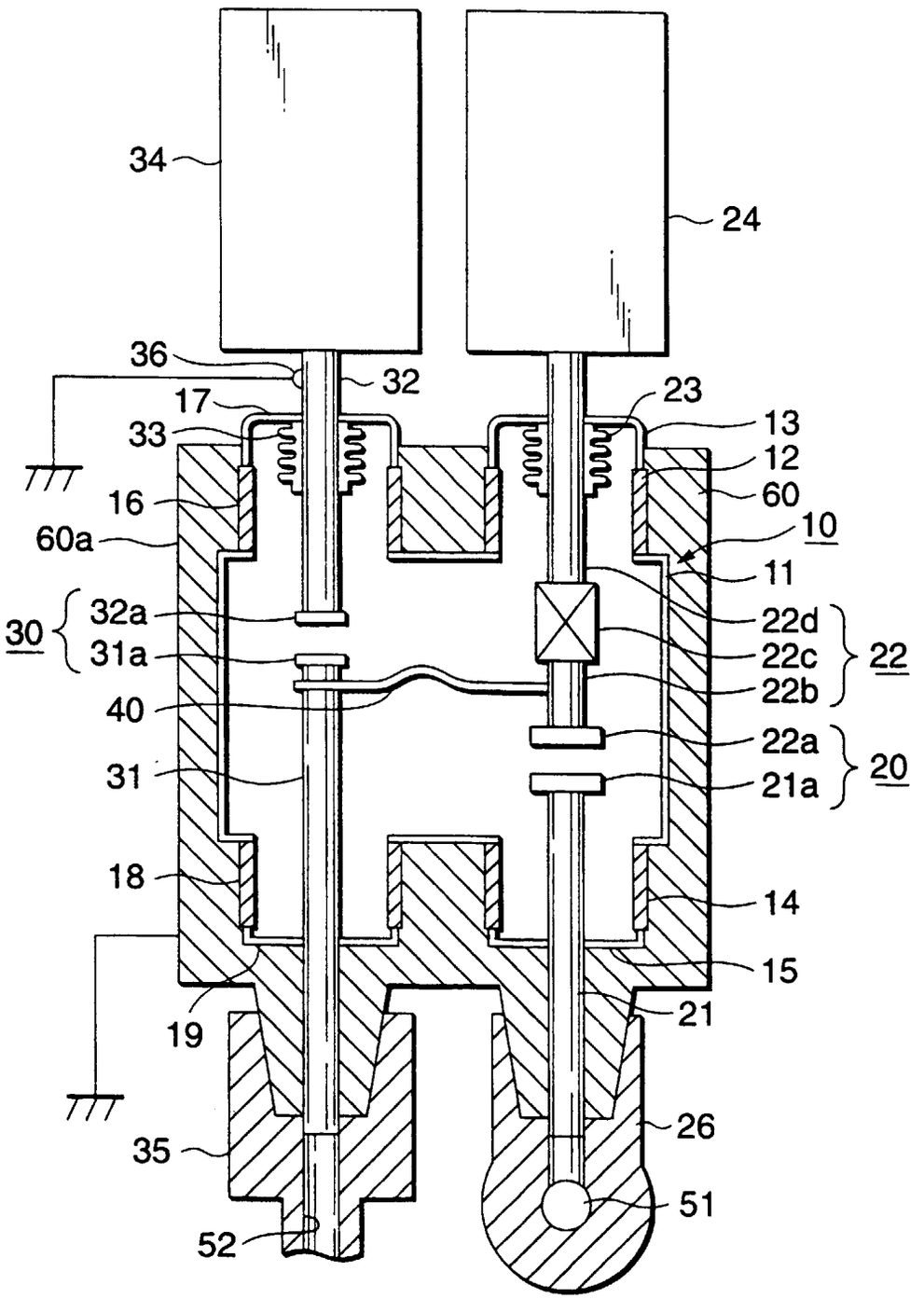
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FIG.5

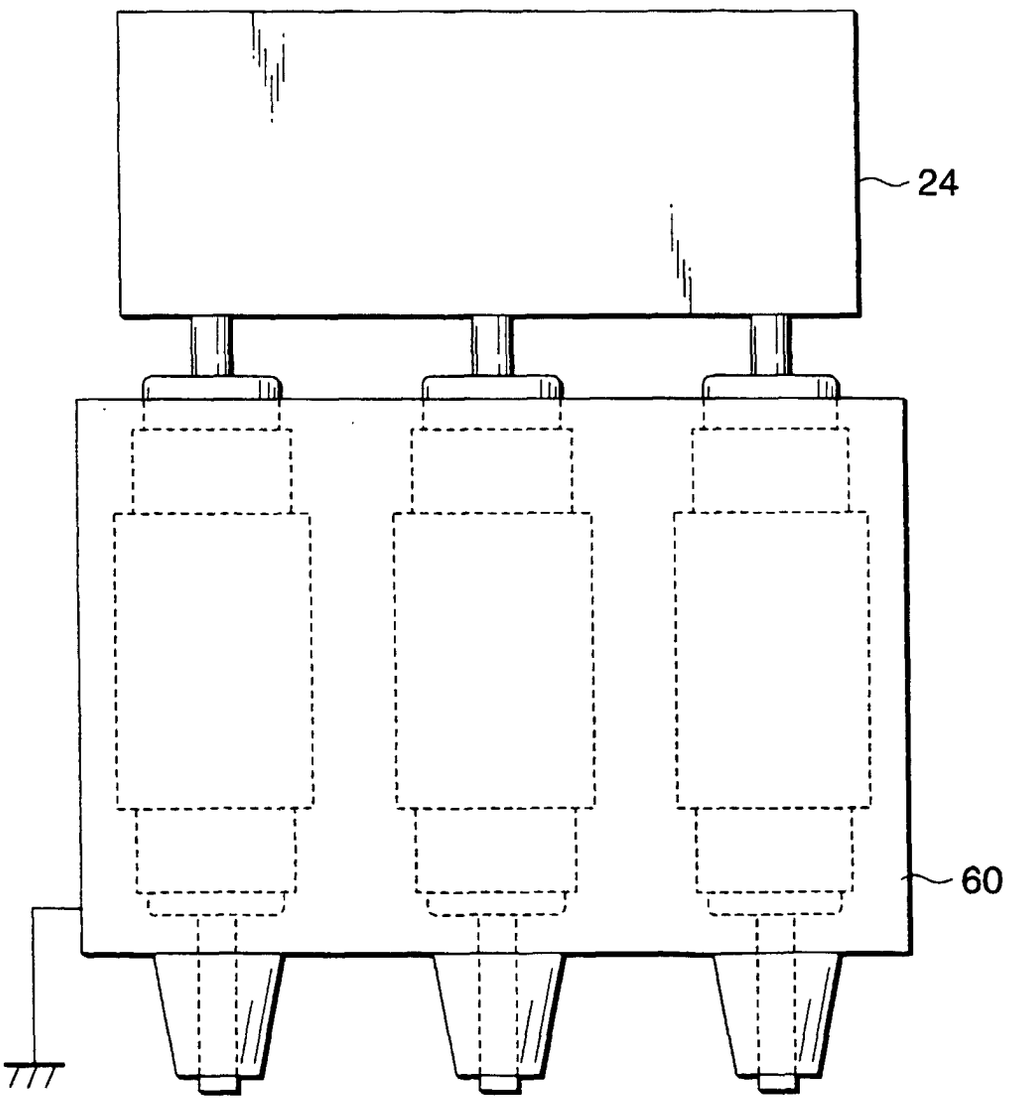

FIG.6

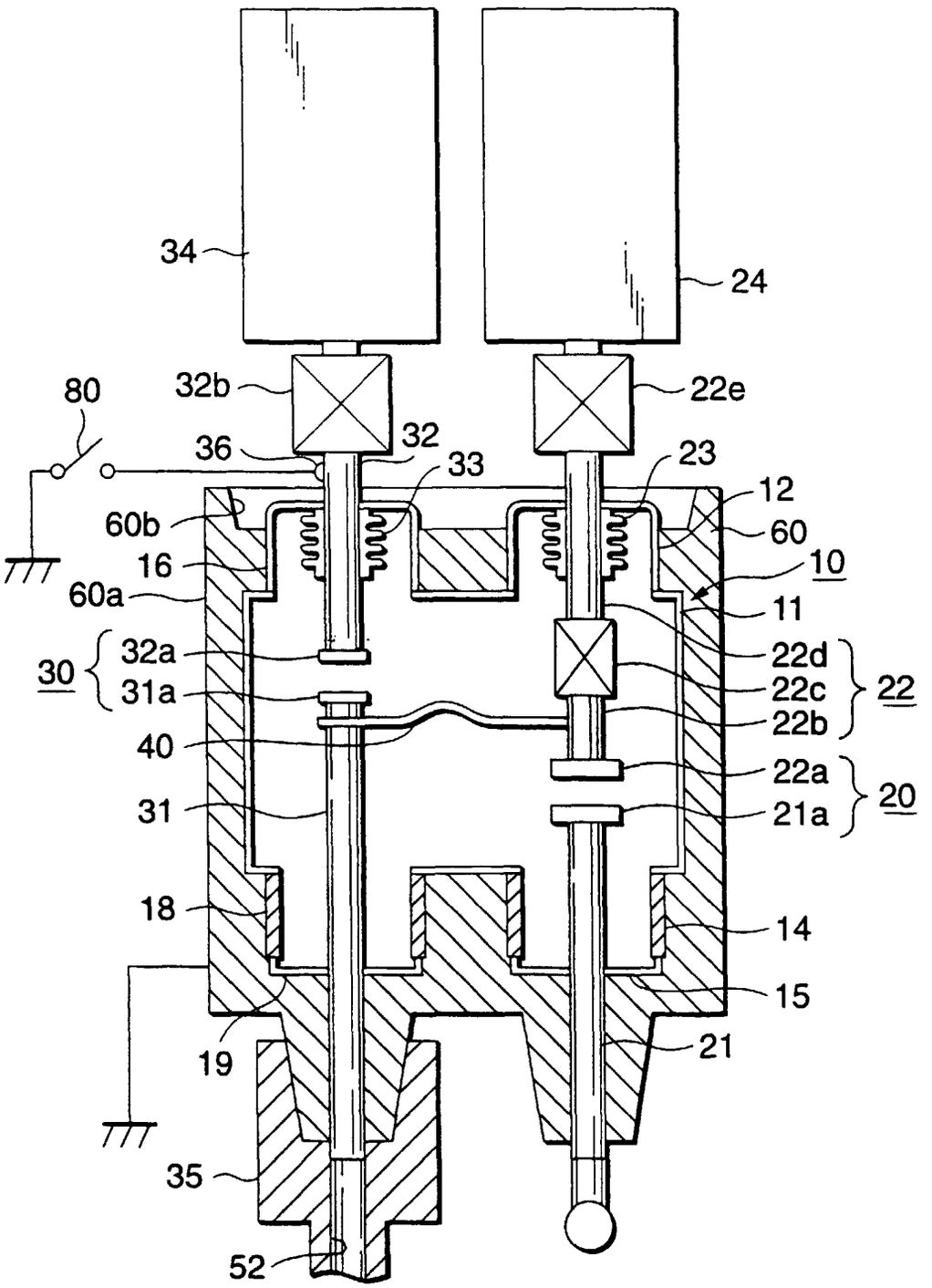
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FIG.7

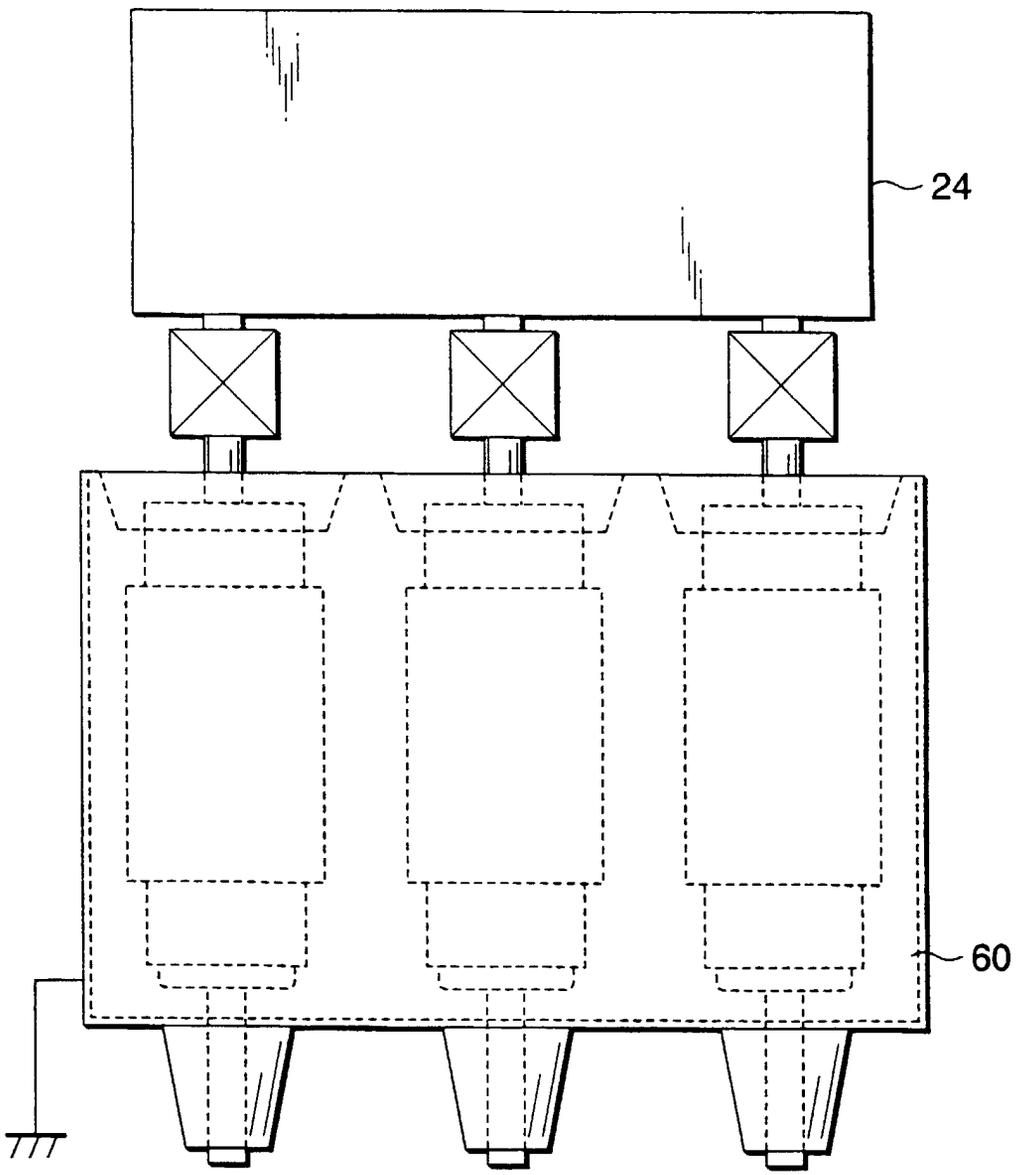

FIG.8

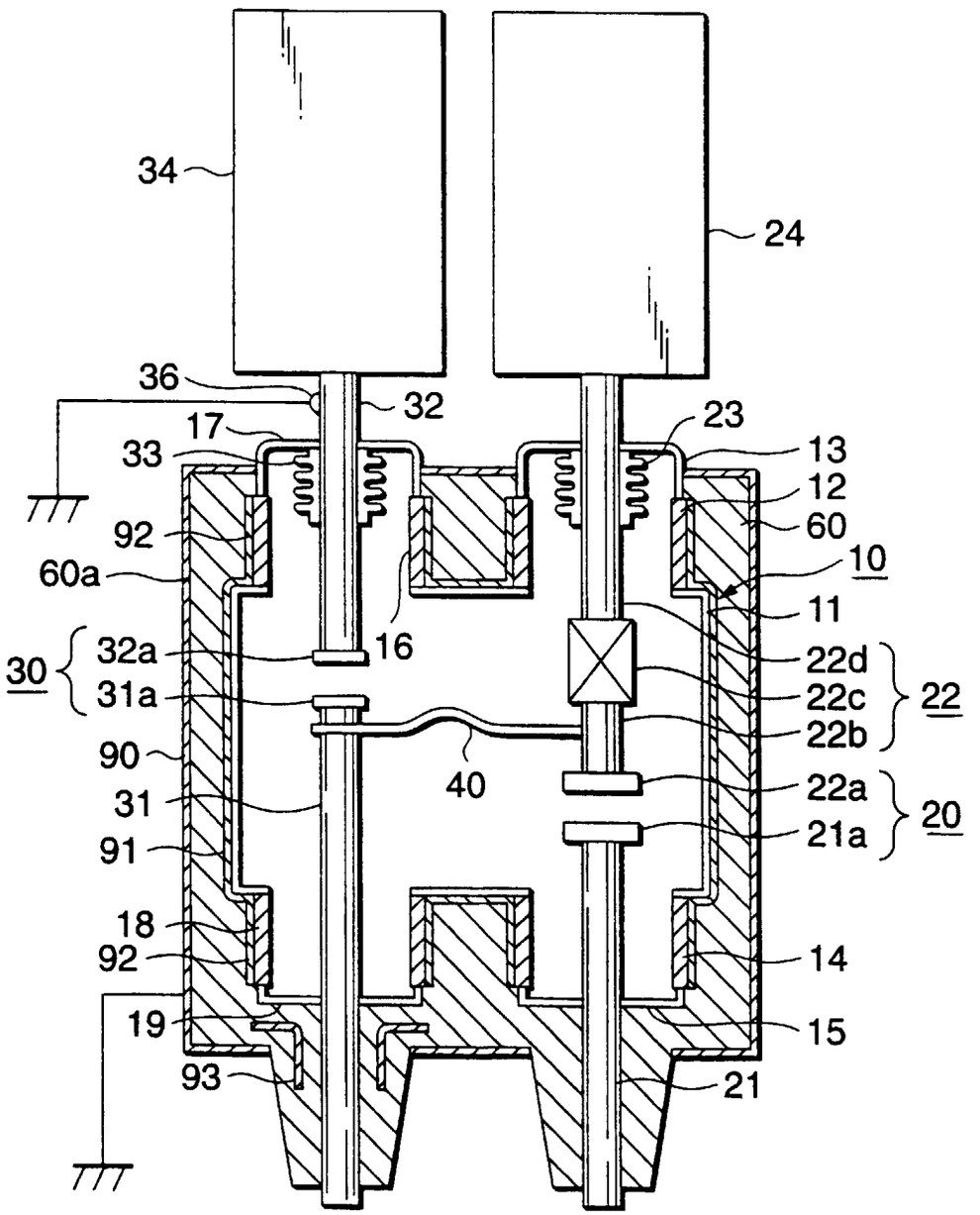
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FIG.9

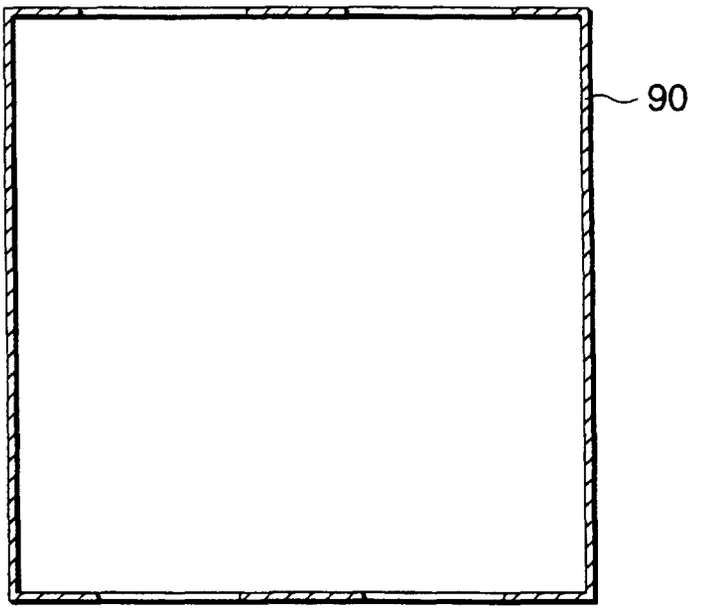


FIG.10

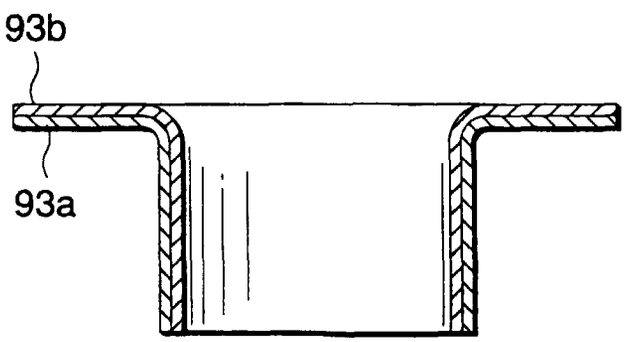


FIG.11A

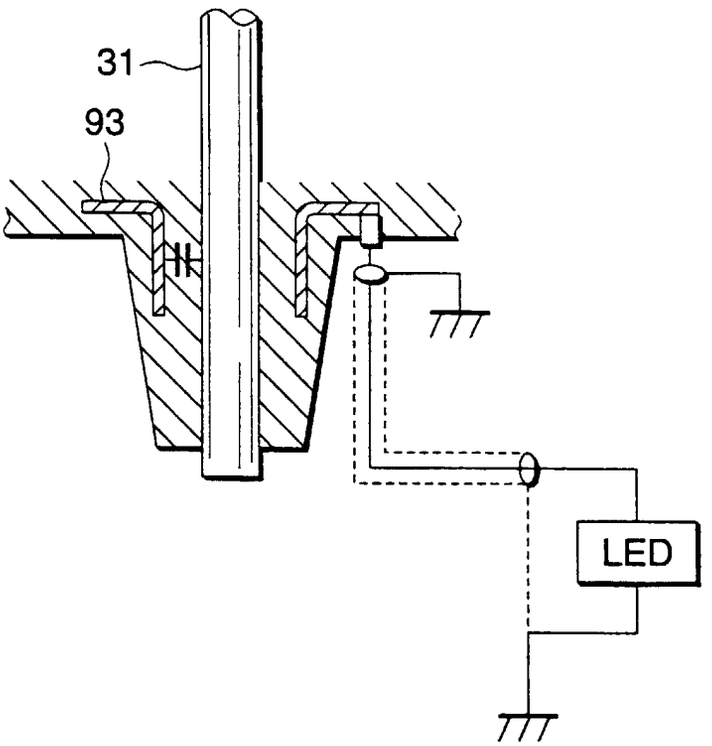


FIG.11B

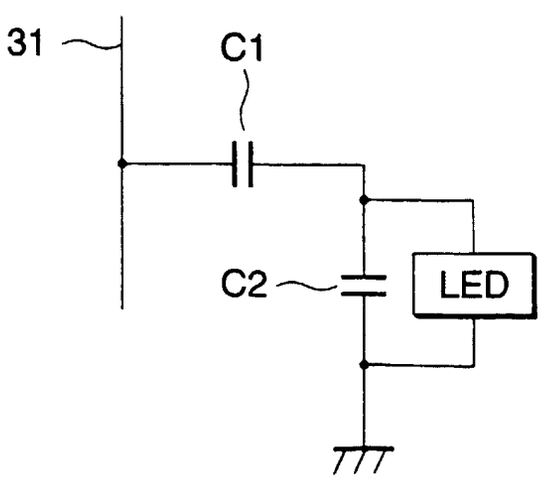


FIG.12

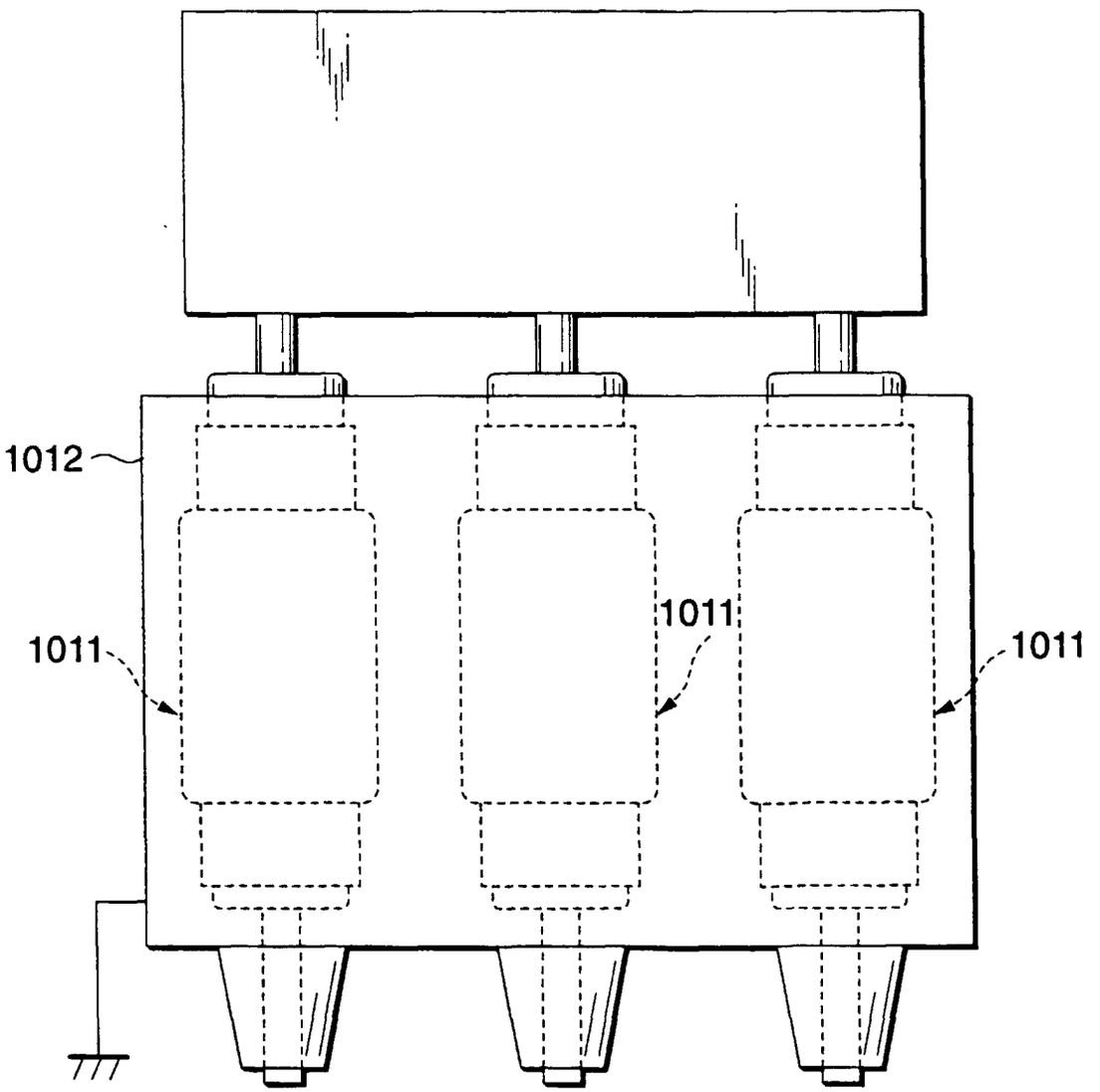
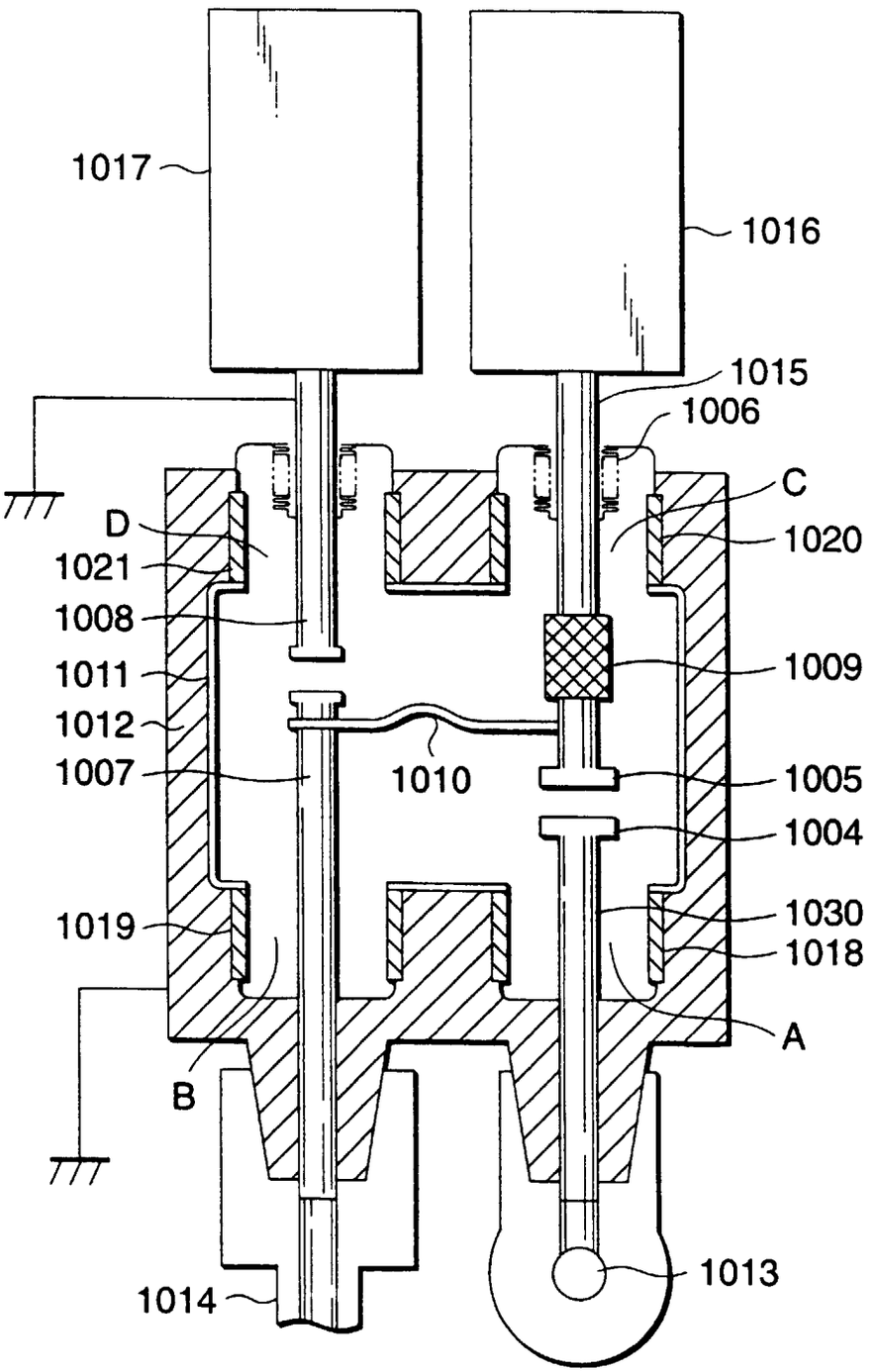


FIG.13


1017
1016
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B
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FIG.14

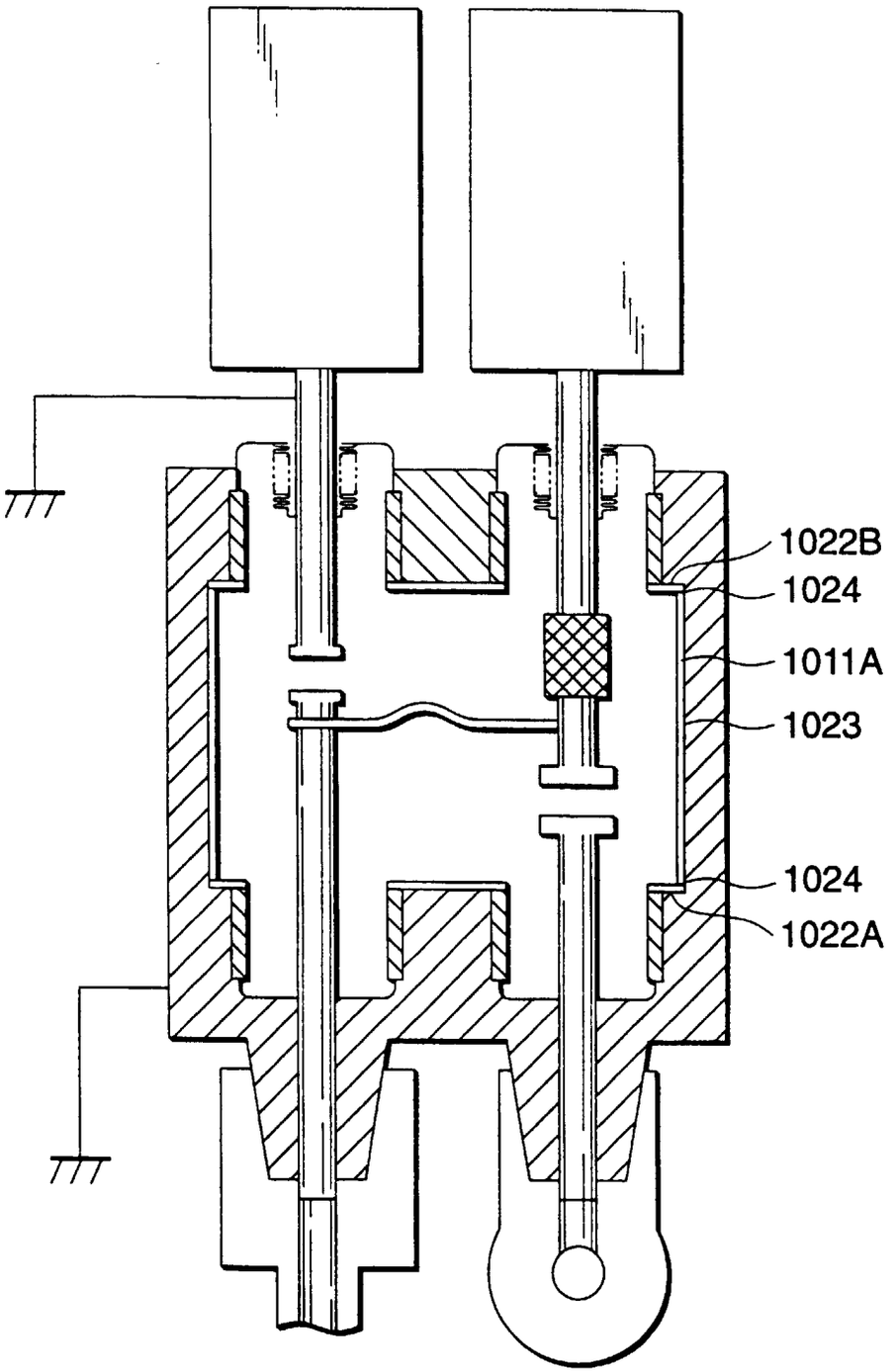


FIG.15

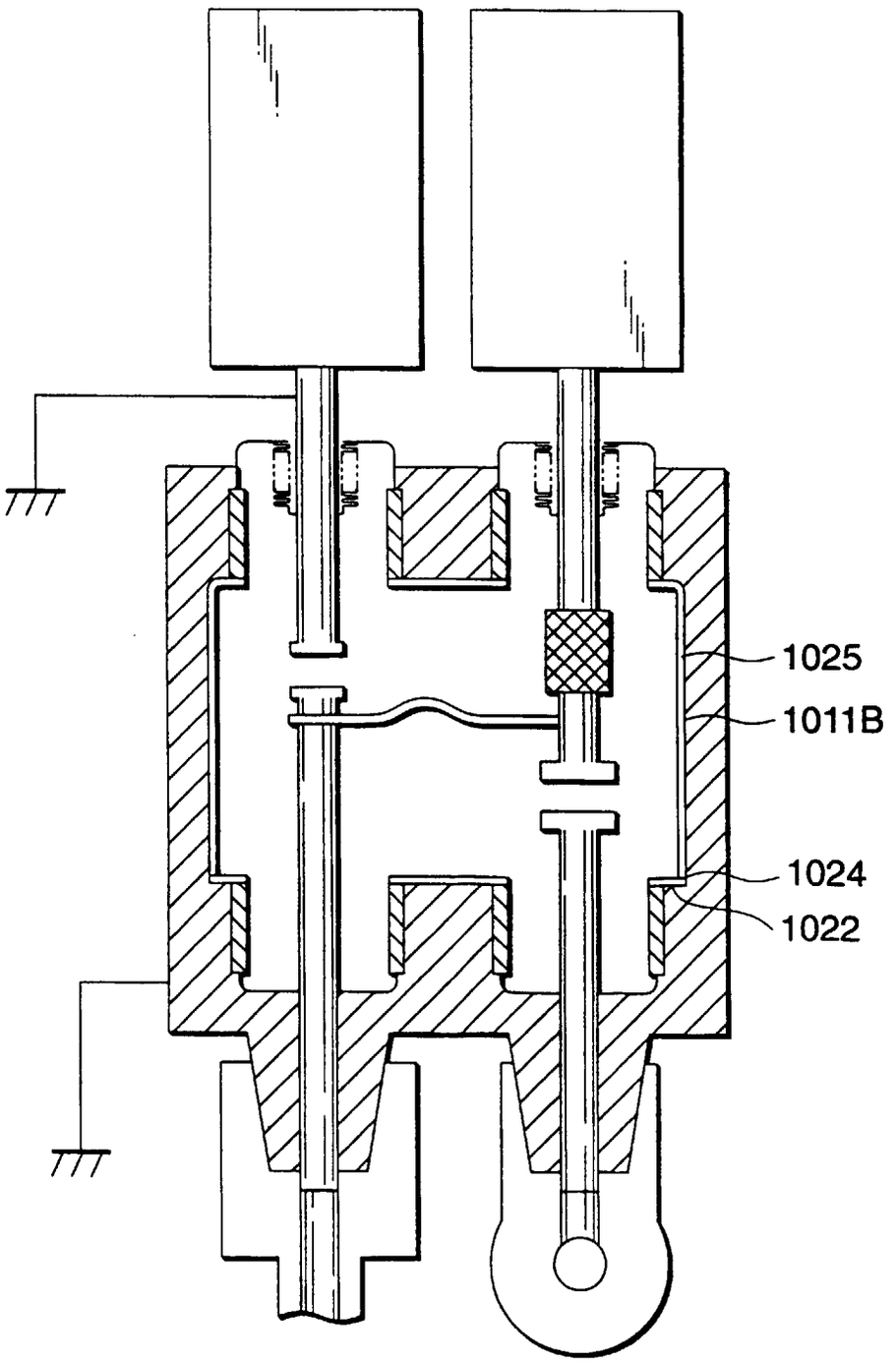


FIG.16

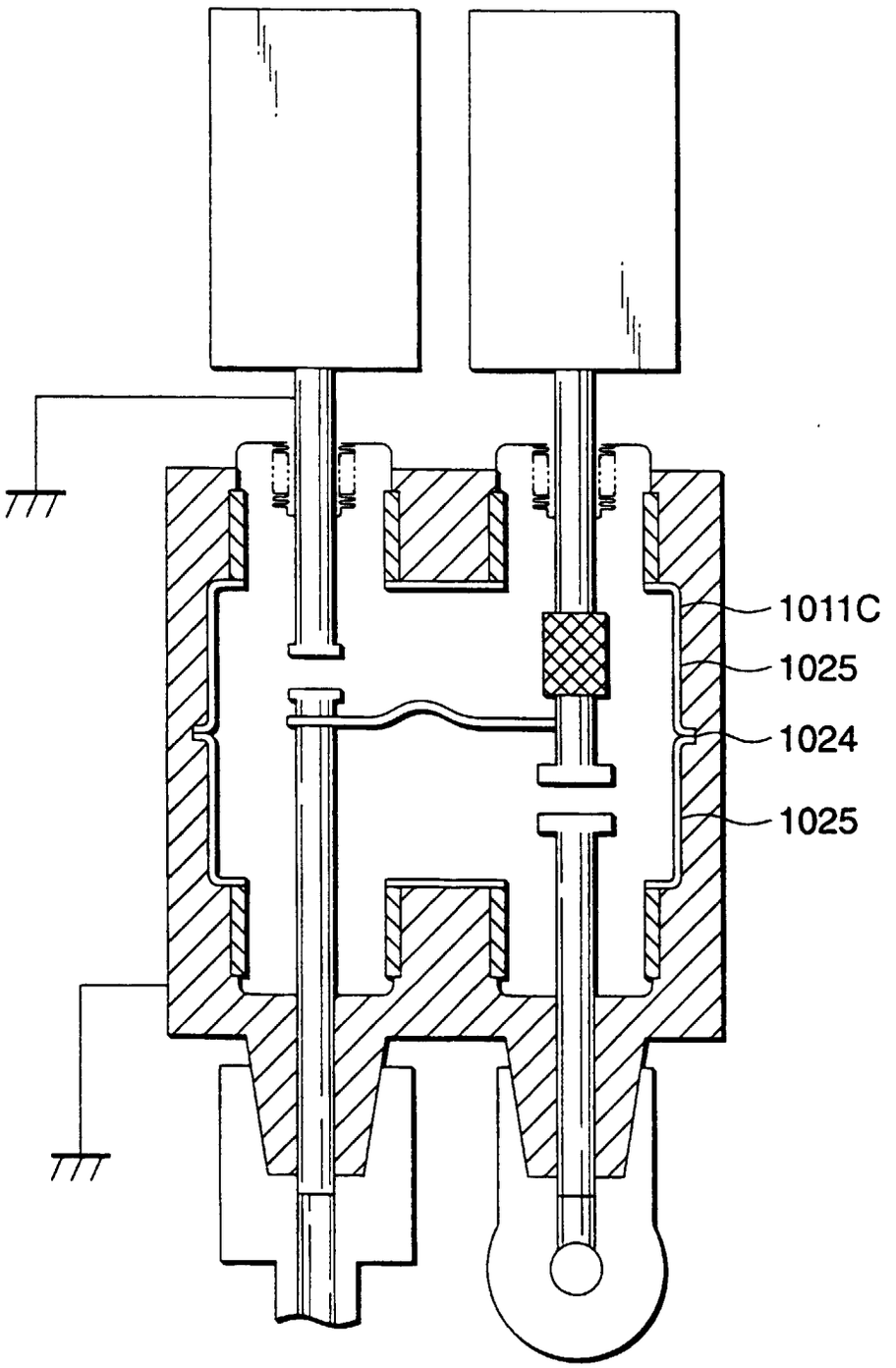


FIG.17

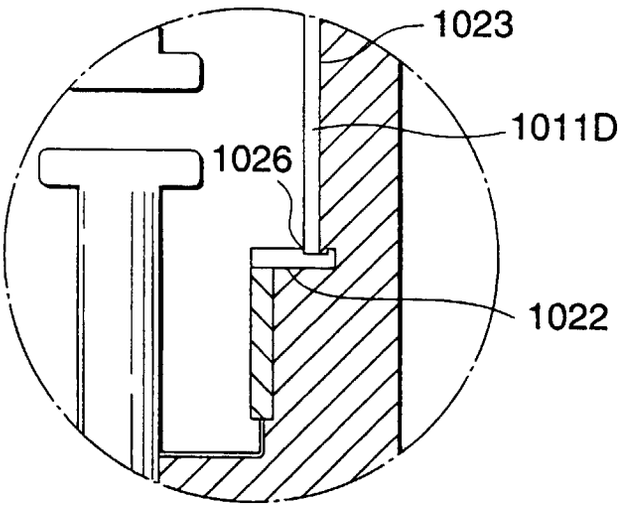


FIG.18

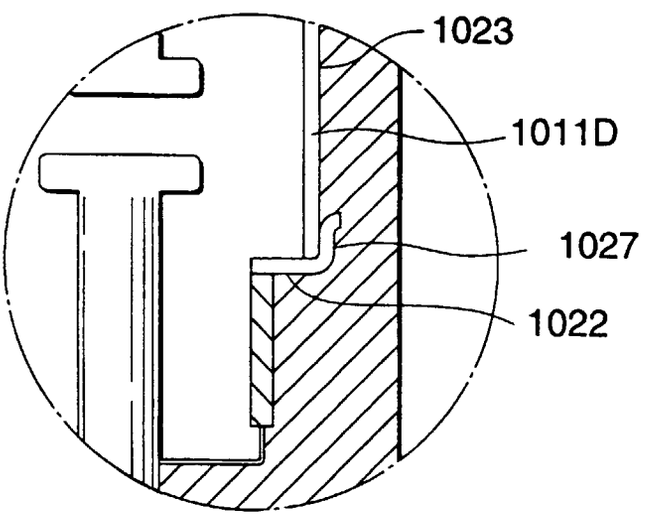


FIG.19

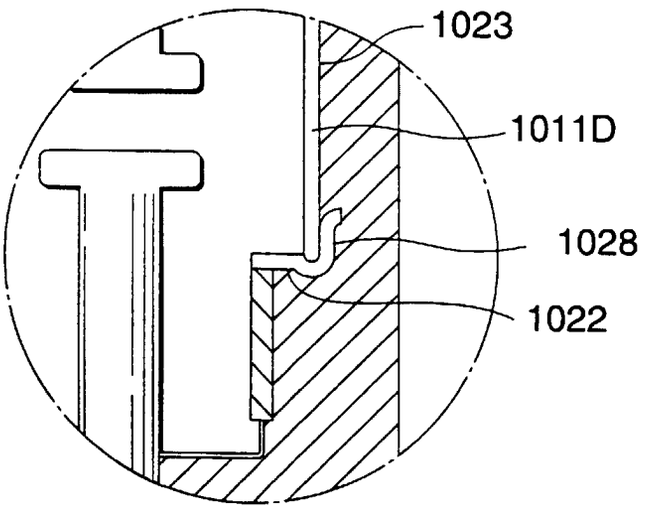


FIG.20

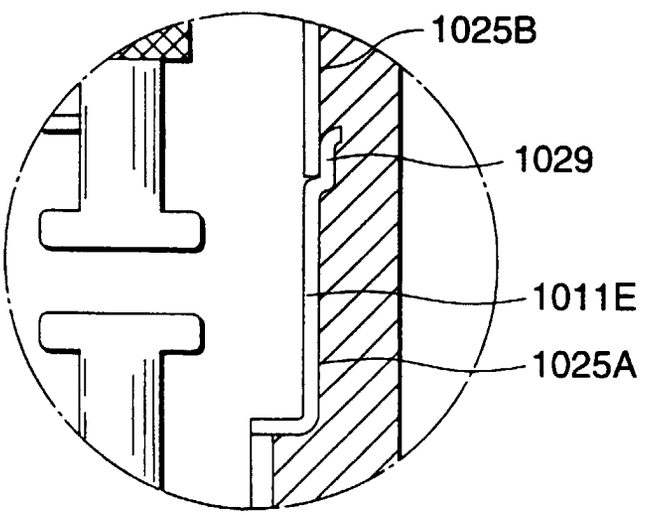


FIG.21

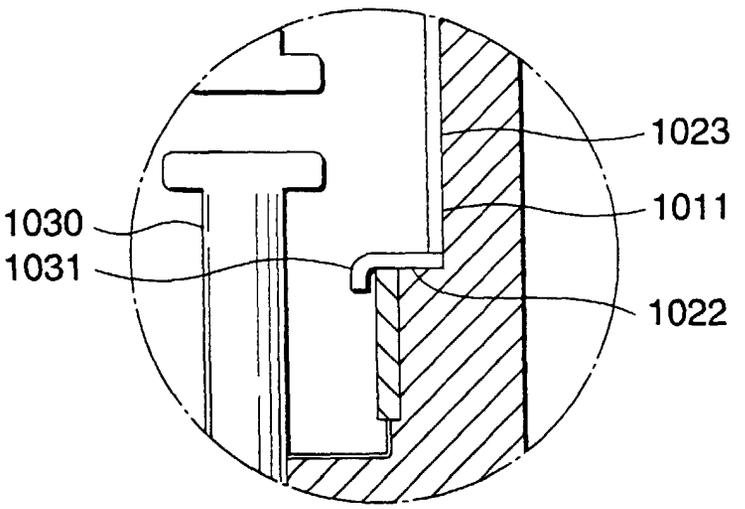


FIG.22

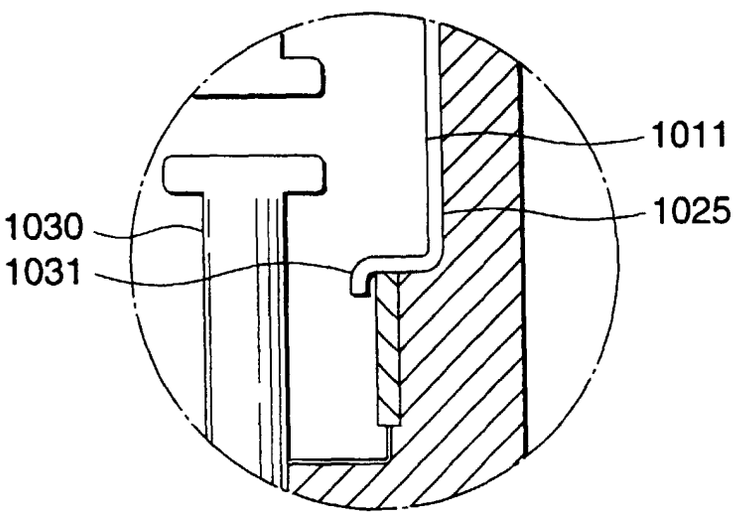
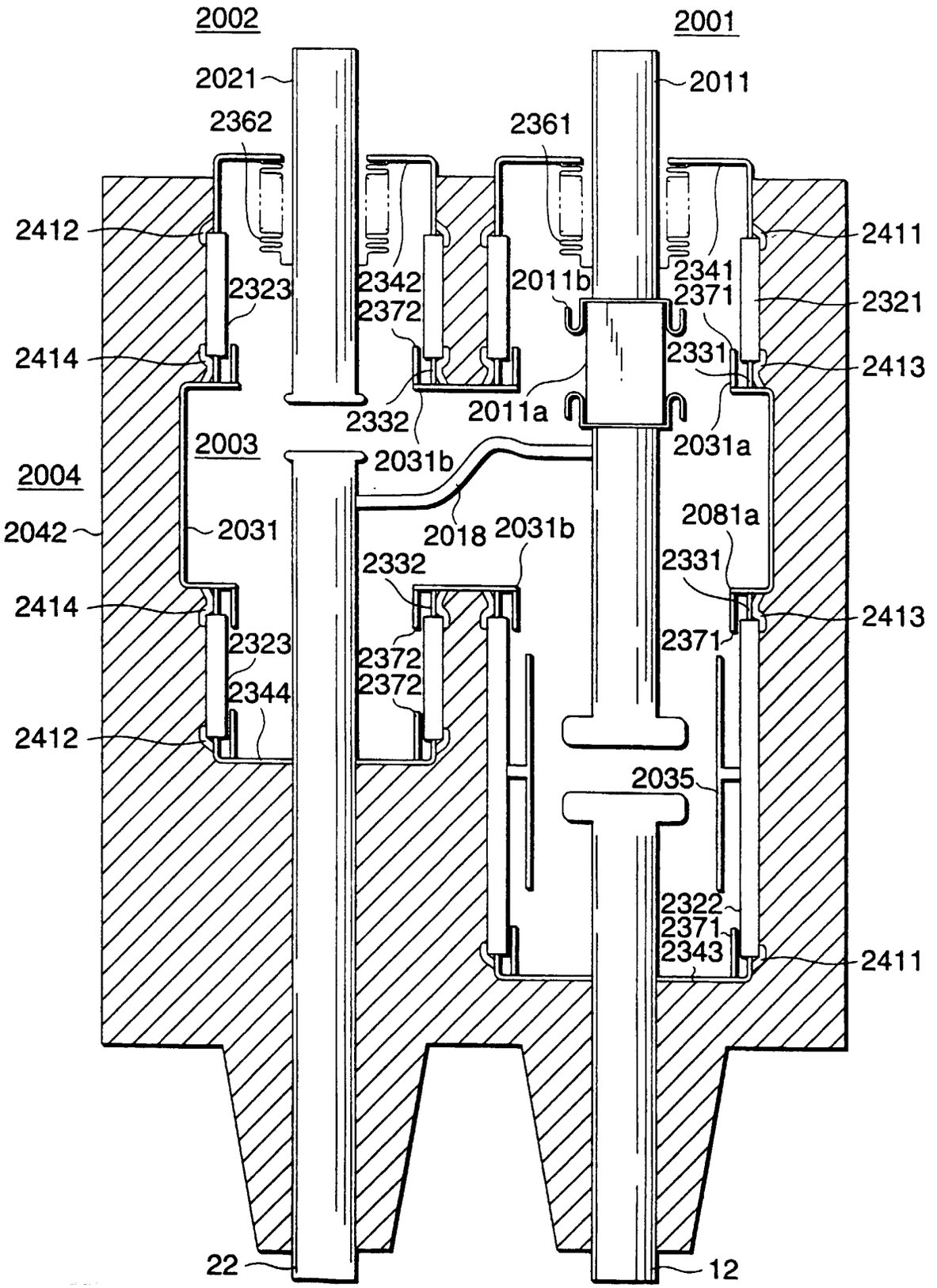


FIG.23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2011a
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2031b
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2031
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FIG.24A

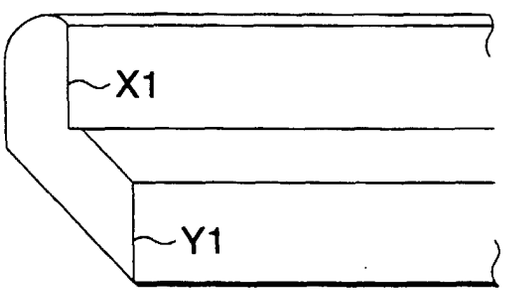

FIG.24B

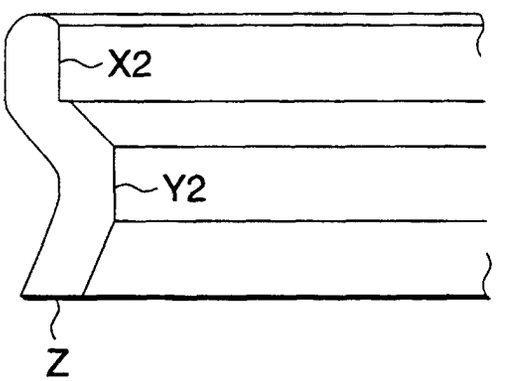

FIG.25

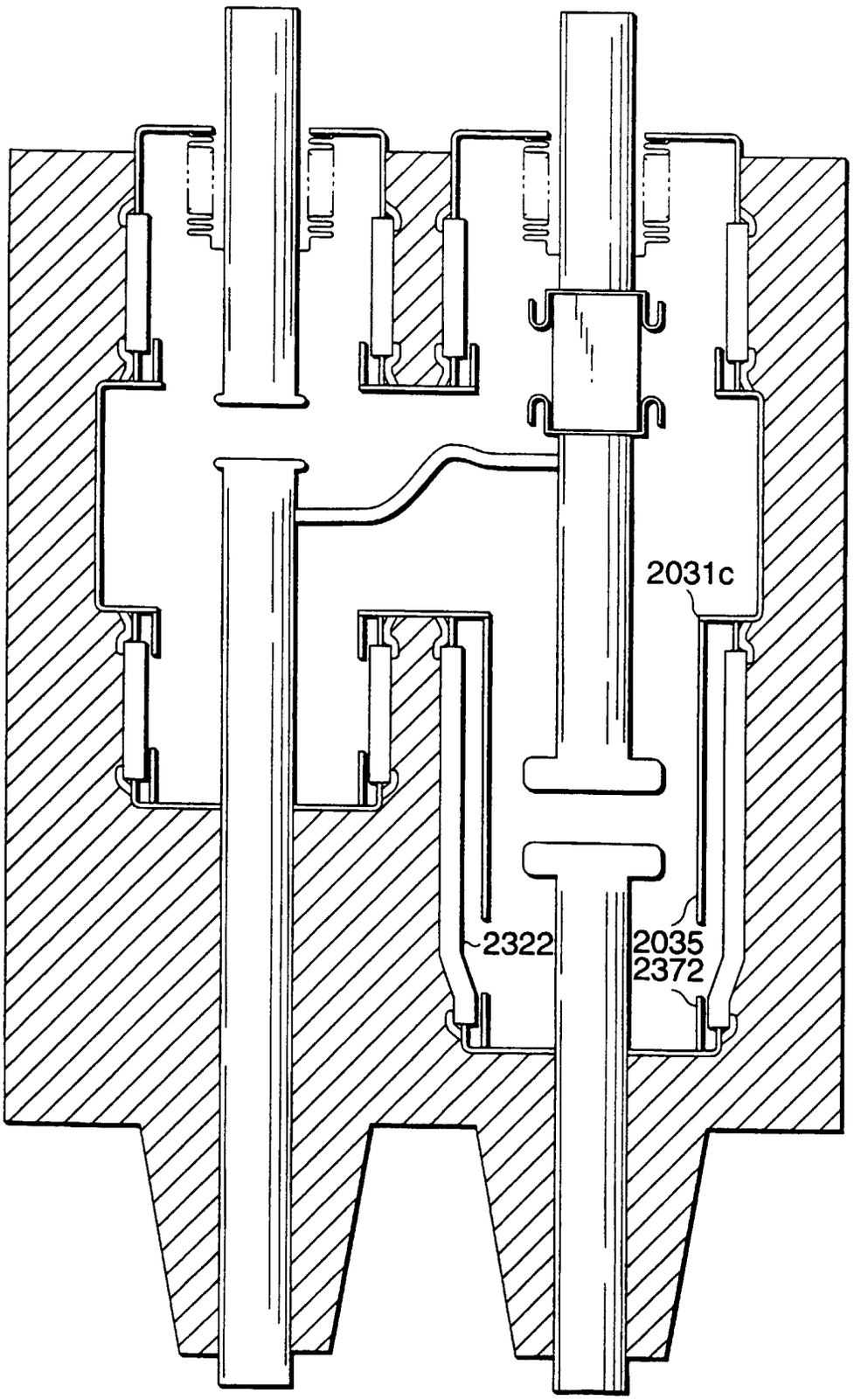

FIG.26

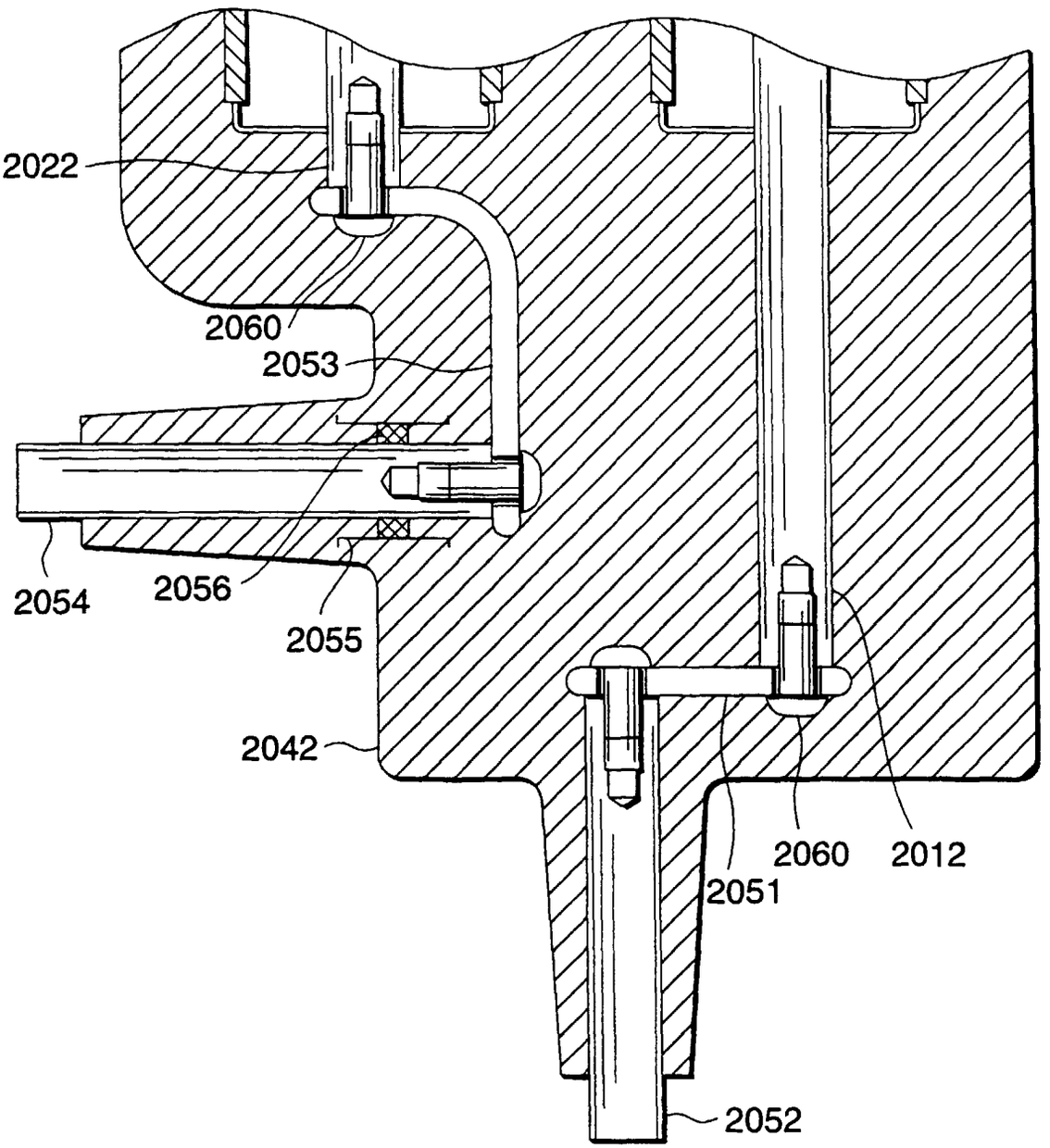

FIG.27

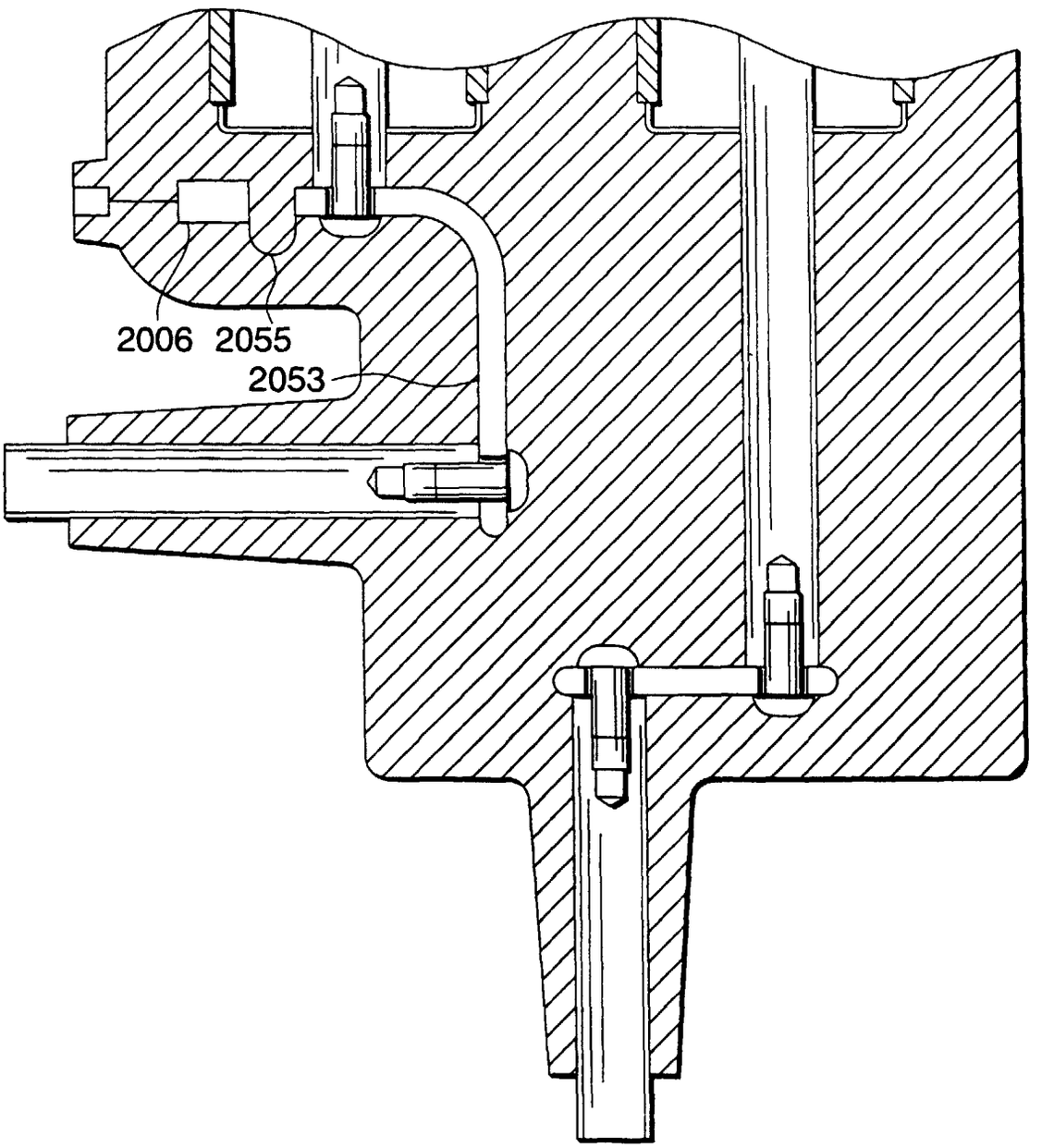

FIG.28

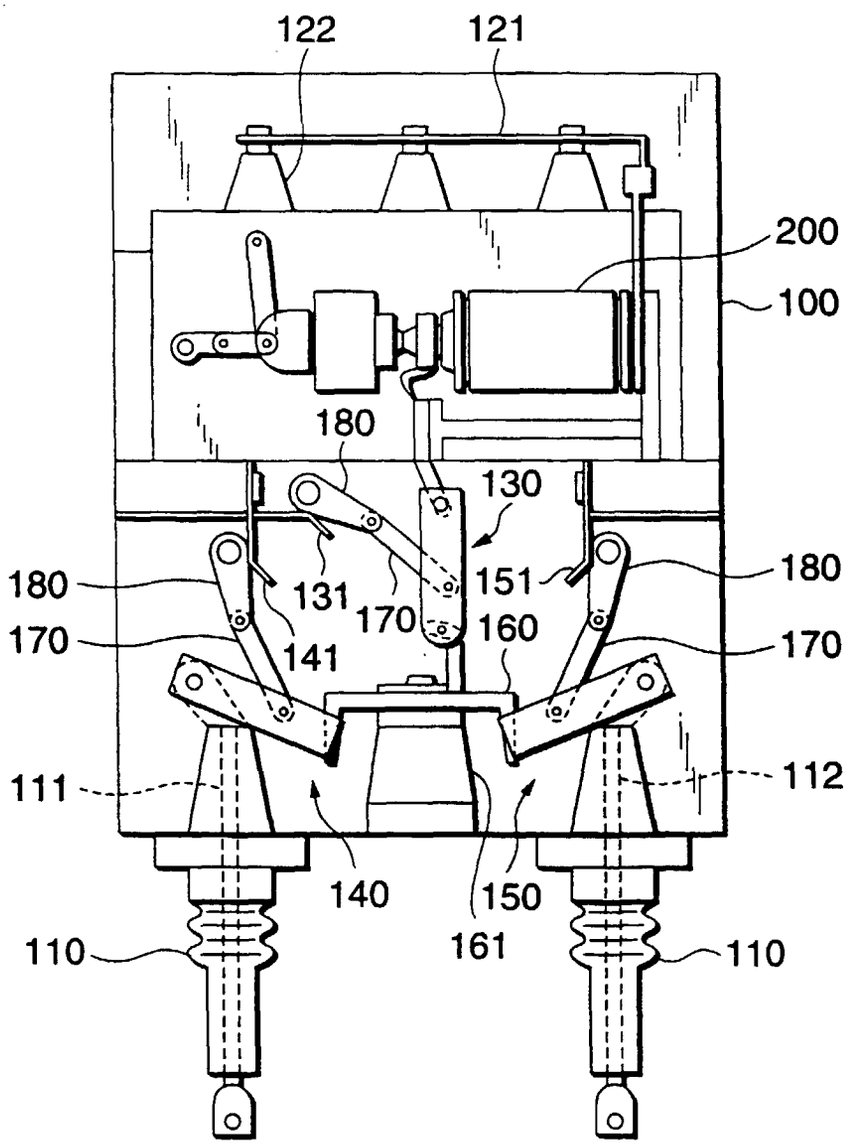
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FIG.29