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(54) **HIGH-VOLTAGE ASSEMBLY OF TRANSFORMER, AND TRANSFORMER AND POWER DEVICE**

(57) This application relates to a high voltage component of a transformer, a transformer, and electric power equipment. The high voltage component (20) includes a high voltage coil (21), an insulator (22), a grounding structure (23), and a grounding layer (24). The grounding structure includes an embedded member (231) and a connector (232) that are interconnected. The embedded member is located inside the insulator, and a part of a surface of the embedded member is exposed and is configured to fasten a grounding connector (90). The connector (232) is located on an outer surface of the insulator and is connected to the grounding layer. The grounding layer covers outer surfaces of the insulator and the connector (232), and the grounding layer (24), the connector (232), the embedded member (231), and the grounding connector (90) are sequentially electrically connected to form a grounding path. The high voltage component provided in embodiments of this application has the stable and reliable grounding path.

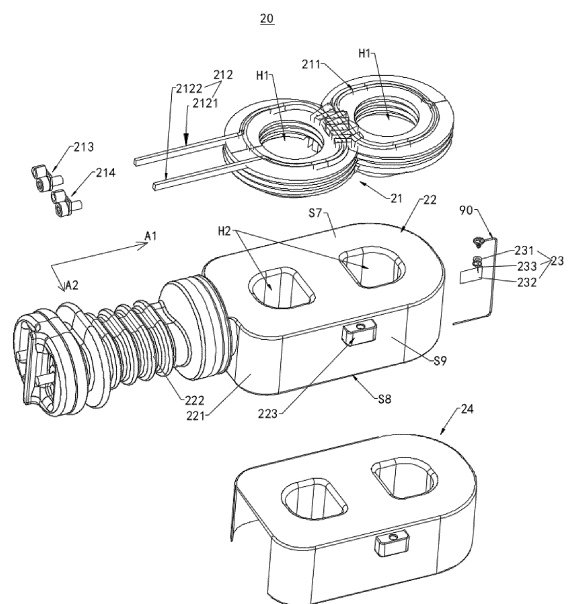


FIG. 2B

Description

[0001] This application claims priority to Chinese Patent Application No. 202210227744.1, filed with the China National Intellectual Property Administration on March 7, 2022 and entitled "HIGH VOLTAGE COMPONENT OF TRANSFORMER, TRANSFORMER, AND ELECTRIC POWER EQUIPMENT", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This application relates to the field of transformer grounding technologies, and in particular, to a high voltage component of a transformer, a transformer, and electric power equipment.

BACKGROUND

[0003] In a process of designing a transformer, a grounding design of the transformer is always an important and difficult topic. For example, a high voltage coil in the transformer is wrapped with an insulation layer. If a grounding layer is electrically connected to a system ground by spraying the grounding layer on an outer surface of the insulation layer, a grounding design of the high voltage coil may be implemented. In this design solution, stability and strength of a connection between the grounding layer and the insulation layer determine reliability of a grounding structure. Because the grounding layer sprayed on the outer surface of the insulation layer is only in contact with the outer surface of the insulation layer, stability of a combination between the grounding layer and the insulation layer is poor, and the grounding layer may fall off. Consequently, the reliability of the grounding structure is reduced.

SUMMARY

[0004] Embodiments of this application provide a high voltage component of a transformer, a transformer, and electric power equipment. The high voltage component of a transformer has a reliable grounding structure.

[0005] According to a first aspect, an embodiment of this application provides a high voltage component of a transformer, including a high voltage coil, an insulator, a grounding structure, and a grounding layer. The insulator wraps the high voltage coil. The grounding structure includes an embedded member and a connector that are electrically conductive, where the embedded member is isolated from the high voltage coil by using the insulator, at least a part of the embedded member is located inside the insulator, a part of a surface of the embedded member is exposed and is configured to fasten a grounding connector, the connector is located on an outer surface of the insulator, and the connector is directly or indirectly connected to the embedded member. A part of the grounding layer is connected to a sur-

face that is of the connector and that is away from the insulator, and a part of the grounding layer is connected to at least a part of the outer surface of the insulator. The grounding layer, the connector, the embedded member, and the grounding connector are electrically connected in sequence to form a grounding path.

[0006] The grounding path of the high voltage component provided in this solution forms a reliable grounding connection relationship, so that safety of the high voltage component can be improved. A specific analysis is as follows: The grounding layer is formed on the surface of the connector through electroplating, spraying, or the like, to implement electrical connection between the grounding layer and the connector. In an assembly process and a use process of the high voltage component, a connection position between the grounding layer and the connector is static, and no external force acts on the position. For example, a fixed connector similar to a screw is not disposed at this position. Therefore, an electrical connection structure between the grounding layer and the connector is not easily damaged, and an open circuit is not easily generated. An electrical connection between the grounding connector and the embedded member is a direct connection relationship, and does not depend on the grounding layer. Even if the grounding layer between the grounding connector and the embedded member is damaged and fractures occur, the electrical connection relationship between the grounding connector and the embedded member is not affected. Therefore, the grounding path of the high voltage component is stable, and a risk of a grounding failure is low.

[0007] In a possible implementation, the embedded member includes a first end face and a side surface that face different directions and that are adjacent to each other, the first end face is configured to fasten the grounding connector, the grounding structure further includes an intermediate member, and the intermediate member is located inside the insulator and is configured to connect the side surface and the connector. This solution provides a specific architecture of the grounding structure. The embedded member and the connector are connected by using the intermediate member, so that the connector can be more flexibly disposed on the outer surface of the insulator, and can adapt to the high voltage component in different application scenarios.

[0008] In a possible implementation, the embedded member includes a first end face and a side surface that face different directions and that are adjacent to each other, the first end face is configured to fasten the grounding connector, the side surface includes a first region and a second region, the first region is connected between the second region and the first end face, the second region is located inside the insulator, and the first region is located outside the insulator and is connected to the connector. The connector in the grounding structure provided in this solution is directly connected to the first region on the side surface of the embedded member. For the grounding

structure, a structure of the grounding structure is simpler, so that a manufacturing process of a process of connecting the grounding structure to the insulator is not complex, and low manufacturing costs are easily implemented.

[0009] In a possible implementation, the surface that is of the connector and that is away from the insulator is flush and coplanar with the first end face. It may be understood that the outer surface of the connector and the first end face may jointly form a planar structure or an arc-shaped surface, and there is no step structure between the outer surface and the first end face. In this solution, the outer surface of the connector and the first end face are coplanar, so that the surface of the grounding structure exposed outside the insulator is an integrated surface architecture of smooth transition. A grounding layer is disposed on the surface of such smooth transition, so that the connection between the grounding layer and the grounding structure is more reliable.

[0010] In a possible implementation, the embedded member includes a first end face, the connector includes a first connection area and a second connection area, the first connection area is connected to the first end face, the second connection area is connected to the outer surface of the insulator, and the grounding connector is connected to the first connection area. This solution provides a specific solution of a position relationship between the connector and the embedded member. Because the first connection area of the connector is connected to the first end face of the embedded member, the embedded member may be first fastened to the insulator, and then the connector is connected to the embedded member. After the embedded member and the insulator are assembled, the first end face is a part that is of the embedded member and that is exposed on the surface of the insulator, and it is easy to connect the connector to the first end face.

[0011] In a possible implementation, the first end face is flush and coplanar with the outer surface of the insulator for connecting the connector. In this solution, a relationship between the first end face and the outer surface of the insulator is limited, so that the connector may be of a flat structure, and a connection between the connector and the insulator is simple and stable.

[0012] In a possible implementation, the second connection area is distributed on two sides of the first connection area; or the second connection area is disposed around the first connection area. This solution provides two specific connector arrangement solutions, and a degree of application freedom is high. A proper connector arrangement solution may be selected based on a specific structure form of the high voltage component.

[0013] In a possible implementation, the connector includes a hollow region, and a part of the grounding layer is in the hollow region and is connected to the insulator. This solution helps improve the stability of the connection between the connector and the grounding layer.

[0014] In a possible implementation, the connector is of a mesh structure. The mesh structure of the connector helps improve the stability of the connection between the connector and the grounding layer.

[0015] In a possible implementation, the insulator includes a main body insulation part and a bump, the main body insulation part wraps the high voltage coil, the main body insulation part includes a top surface, a bottom surface, and a side surface connected between the top surface and the bottom surface, the top surface is configured to face towards a low voltage coil of the transformer, the bump is protrudingly disposed on the side surface, at least a part of the embedded member is located inside the bump, and a part of a surface that is of the embedded member and that is configured to connect the grounding connector faces a same direction as the top surface. In this solution, a size of the main body insulation part of the insulator can be miniaturized, and a grounding structure is disposed on the bump. The grounding structure does not affect a safe isolation distance of the high voltage coil. This helps ensure safety of the high voltage component.

[0016] In a possible implementation, the connector is located on an outer surface of the bump and/or the side surface. This solution provides different arrangement solutions of the connector of the grounding structure. A proper solution may be selected based on a specific application requirement, and flexibility is good.

[0017] In a possible implementation, the insulator includes a top surface, a bottom surface, and a side surface connected between the top surface and the bottom surface, the top surface and/or the bottom surface are/is configured to face towards a low voltage coil of the transformer, the connector is located on the side surface, and a part of a surface that is of the embedded member and that is configured to connect the grounding connector faces a same direction as the side surface. This solution helps simplify a manufacturing process of an insulation member. Because there is no bump structure on an outer surface of the main body insulation part of the insulation member, a process of disposing a grounding layer on the outer surface of the main body insulation part is also easy to control. This helps improve reliability of the connection between the grounding layer and the main body insulation part.

[0018] In a possible implementation, the high voltage coil includes a winding part and a lead-out part, the lead-out part and the winding part are adjacently disposed in a first direction, the insulator includes a main body insulation part and a lead insulation part, the main body insulation part wraps the winding part, the lead insulation part wraps the lead-out part, the grounding structure is disposed on the main body insulation part, and in the first direction, the grounding structure is located on a side that is of the winding part and that is away from the lead-out part. For the transformer in which the high voltage component is located, the high voltage component provided in this implementation is applicable to an application

environment in which installation space is sufficient in the first direction.

[0019] In a possible implementation, the high voltage coil includes a winding part and a lead-out part, the lead-out part and the winding part are adjacently disposed in a first direction, the insulator includes a main body insulation part and a lead insulation part, the main body insulation part wraps the winding part, the lead insulation part wraps the lead-out part, the grounding structure is disposed on the main body insulation part, the grounding structure and the winding part are spaced in a second direction, and the second direction and the first direction are disposed at an included angle. For the transformer in which the high voltage component is located, the high voltage component provided in this solution is applicable to an application environment in which installation space is sufficient in the second direction. A size of the high voltage component in the first direction can be controlled, so that the size of the transformer in the first direction is easy to implement miniaturization.

[0020] In a possible implementation, a hollow part is disposed on a part that is of the grounding layer and that is connected to the insulator, and the hollow part is disposed to increase resistance of the grounding layer. In another implementation, the grounding layer includes a conductor material or a semiconductor material, and the high voltage coil is within a radiation range of a leakage flux of the transformer. In this way, in an operating process of the high voltage component, the grounding layer forms a closed grounding loop. The existence of the grounding layer causes an extra loss generated by the transformer due to induction electromotive force in the operating process. A higher resistivity of a material used by the grounding layer indicates a poorer potential limiting effect of the grounding layer and a smaller loss caused by electromagnetic induction. On the contrary, a lower resistivity of a material used by the grounding layer indicates a better potential limiting effect of the grounding layer and a higher loss caused by electromagnetic induction. Therefore, the grounding layer is limited to a semi-conductive material in this application, and the loss and the potential limiting effect are balanced.

[0021] In a possible implementation, the grounding layer is formed on surfaces of the insulator and the connector through spraying or electroplating; or the grounding layer is a flexible strip having semi-conductive performance. This solution provides a plurality of solutions for preparing the grounding layer. A proper solution may be selected based on actual requirements.

[0022] In a possible implementation, a resistivity of the grounding structure is lower than a resistivity of the grounding layer. This solution ensures stability of grounding.

[0023] According to a second aspect, an embodiment of this application provides a transformer, including a magnetic core and the high voltage component according to any one of the possible implementations of the first aspect, where the high voltage component is sleeved on

a part of the magnetic core. The transformer provided in this solution has the high voltage component provided in the first aspect, and has a reliable high voltage grounding path, so that safety and a service life of the transformer can be ensured.

[0024] In a possible implementation, the transformer includes a low voltage coil, a shielding member, and a conductive cover, the low voltage coil includes a first low voltage coil and a second low voltage coil, the shielding member includes a first shielding member and a second shielding member, the conductive cover includes a first conductive cover and a second conductive cover, the magnetic core includes a first magnetic cover, a second magnetic cover, and a magnetic cylinder connected between the first magnetic cover and the second magnetic cover that are disposed opposite to each other, the first conductive cover, a part of the first shielding member, the first magnetic cover, the first low voltage coil, the high voltage component, the second low voltage coil, the second magnetic cover, a part of the second shielding member, and the second conductive cover are sequentially stacked, the low voltage coil and the high voltage component surround the magnetic cylinder, the part of the first shielding member is located at a periphery of the first magnetic cover and the first low voltage coil, the part of the second shielding member is located at a periphery of the second magnetic cover and the second low voltage coil, the conductive cover is configured to be grounded, and a resistivity of the shielding member is higher than a resistivity of the conductive cover.

[0025] According to the transformer provided in embodiments of this application, an insulator is disposed in the high voltage component, and a high voltage coil is wrapped by using the insulator, to isolate the high voltage coil from the low voltage coil, thereby facilitating a design of miniaturization of a transformer size. A grounding layer and a grounding structure of the high voltage coil are configured to realize a potential of an outer surface of the high voltage component as a ground potential, and the shielding member and the conductive cover are configured to realize isolation and grounding of the low voltage coil, to realize reliable grounding of the transformer. By controlling a resistivity of the grounding layer and a resistivity of the shielding member (specifically, the grounding layer includes a semi-conductive material, and the shielding member is of a mesh structure), an eddy current loss caused by a high frequency magnetic field of the transformer can be reduced, and operating efficiency of the transformer can be improved. Specifically, the transformer generates a changing magnetic flux in an operating process. The magnetic flux is classified into a main magnetic flux and a leakage flux. The main magnetic flux is restricted to perform electromagnetic capability conversion in the magnetic core, but the leakage flux is scattered in a transformer system. The grounding layer on the surface of the high voltage component and the structure of the shielding member generate an induced voltage under influence of the leakage flux, and

consequently, a loss is generated. If resistance values of the grounding layer and the shielding member increase, the eddy current loss decreases accordingly. Therefore, the eddy current loss may be reduced by controlling the resistivity of the grounding layer and the resistivity of the shielding member.

[0026] In a possible implementation, the transformer further includes a fastener, the fastener is electrically conductive, the fastener is fastened to the first conductive cover and the second conductive cover, and the high voltage component, the low voltage coil, and the shielding member are fastened between the first conductive cover and the second conductive cover by using the fastener. In this solution, by disposing the fastener, on one hand, components of the transformer can be fastened, and on the other hand, the fastener is also configured to implement grounding of the low voltage coil, so that an overall structure of the transformer has an advantage of compactness and simplicity, and is conducive to a design of miniaturization of a size of the transformer.

[0027] In a possible implementation, the first shielding member includes a first part and a second part, the first part is disposed between the first magnetic cover and the first conductive cover in a stacked manner, the second part is connected to an edge of the first part and extends from the edge of the first part towards the high voltage component, and the second part is disposed around the periphery of the first magnetic cover and the first low voltage coil. In this solution, a specific structure design is performed on the second part and the first part of the second shielding member, so that the second shielding member can cover a larger area of the second low voltage coil, thereby improving a protection and isolation effect of the low voltage coil.

[0028] In a possible implementation, the second part includes a top edge, a bottom edge, a first side edge, and a second side edge, the top edge is connected to the first part, the bottom edge is in contact with the high voltage component or forms a gap with the high voltage component, an opening is formed between the first side edge and the second side edge, and the opening is configured to accommodate at least a lead-out member of the first low voltage coil. In this solution, the second part is disposed as an open-loop architecture, and the opening is disposed, so that the lead-out member of the low voltage coil is conveniently installed, and assembly is flexible.

[0029] In a possible implementation, the first shielding member includes a sheet-like main body and a plurality of through holes disposed on the main body. In this solution, the through hole is disposed on the sheet-like main body, so that resistance of the shielding member can be improved, and an eddy current loss phenomenon of the transformer can be improved.

[0030] In a possible implementation, the transformer includes a low voltage coil, a shielding member, and a conductive cover, the magnetic core includes a first magnetic cover, a second magnetic cover, and a magnetic cylinder connected between the first magnetic cov-

er and the second magnetic cover that are disposed opposite to each other, the high voltage component and the low voltage coil surround the magnetic cylinder, the high voltage component, the low voltage coil, the first magnetic cover, a part of the shielding member, and the conductive cover are sequentially stacked, the part of the shielding member is located on a periphery of the first magnetic cover and the low voltage coil, the conductive cover is configured to be grounded, and a resistivity of the shielding member is higher than a resistivity of the conductive cover. This solution provides a specific transformer architecture. An insulator is disposed in a high voltage component, and the high voltage coil is wrapped by using the insulator, to implement isolation between the high voltage coil and the low voltage coil. A grounding layer and a grounding structure of the high voltage coil are configured to realize a potential of an outer surface of the high voltage component as a ground potential, and the shielding member and the conductive cover are configured to realize isolation and grounding of the low voltage coil, to realize reliable grounding of the transformer.

[0031] In a possible implementation, the grounding connector is connected between the embedded member and the conductive cover. In this solution, the conductive cover is configured to collect grounding of the high voltage component and grounding of the low voltage coil. For the transformer, the design of the grounding structure can save space of the transformer, and is conducive to the design of miniaturization of the transformer size.

[0032] In a possible implementation, the shielding member is in contact with the high voltage component. The shielding member is designed to be in contact with the high voltage component, so that the shielding member is connected to the grounding layer of the high voltage component. In this way, all-round isolation protection is formed for the low voltage coil. This helps improve performance of the transformer.

[0033] According to a third aspect, an embodiment of this application provides electric power equipment, including a high voltage circuit, a low voltage circuit, and a transformer connected between the high voltage circuit and the low voltage circuit, where the transformer is the transformer according to any one of the possible implementations of the second aspect. Because the electric power equipment provided in this solution has the foregoing transformer structure, voltage conversion of the electric power equipment is more stable, and performance and a life of the electric power equipment can be guaranteed.

[0034] According to a fourth aspect, an embodiment of this application provides a transformer, including a magnetic core, a high voltage component, a low voltage coil, a shielding member, and a conductive cover. The magnetic core includes a first magnetic cover, a second magnetic cover, and a magnetic cylinder connected between the first magnetic cover and the second magnetic cover that are disposed opposite to each other. The high voltage

component, includes a high voltage coil, an insulator, and a grounding layer, where the insulator wraps the high voltage coil, and the grounding layer covers at least a part of an outer surface of the insulator. The low voltage coil and the high voltage component are stacked, and the low voltage coil and the high voltage component surround the magnetic cylinder. The high voltage component, the low voltage coil, the first magnetic cover, a part of the shielding member, and the conductive cover are sequentially stacked, the part of the shielding member is located at a periphery of the first magnetic cover and the low voltage coil, the conductive cover is configured to be grounded, and a resistivity of the shielding member is higher than a resistivity of the conductive cover. The grounding layer of the high voltage component is electrically connected to the conductive cover.

[0035] According to the transformer provided in this solution, an insulator is disposed in the high voltage component, and a high voltage coil is wrapped by using the insulator, to isolate the high voltage coil from the low voltage coil, thereby facilitating a design of miniaturization of a transformer size. The grounding layer and a grounding structure of the high voltage coil are configured to realize a potential of an outer surface of the high voltage component as a ground potential, and the shielding member and the conductive cover are configured to realize isolation and grounding of the low voltage coil, to realize reliable grounding of the transformer.

BRIEF DESCRIPTION OF DRAWINGS

[0036]

FIG. 1A is a schematic diagram of electric power equipment according to an implementation of this application;

FIG. 1B is a schematic diagram of a transformer according to a possible implementation of the electric power equipment shown in FIG. 1A;

FIG. 2A is a three-dimensional schematic diagram of a high voltage component according to an implementation of this application;

FIG. 2B is a three-dimensional exploded schematic diagram of a high voltage component according to an implementation of this application;

FIG. 3 is a partial sectional view of a high voltage component according to an implementation of this application;

FIG. 4 is a three-dimensional schematic diagram of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 5 is a grounding structure of a high voltage component in the conventional technology;

FIG. 6A is a schematic diagram of an embedded member of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 6B is a schematic diagram of an assembly

relationship between the embedded member shown in FIG. 6A and an insulator;

FIG. 7A is a schematic diagram of an embedded member of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 7B is a schematic diagram of an assembly relationship between the embedded member shown in FIG. 7A and an insulator;

FIG. 8A is a schematic diagram of an embedded member of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 8B is a schematic diagram of an assembly relationship between the embedded member shown in FIG. 8A and an insulator;

FIG. 8C is a schematic diagram of another assembly relationship between the embedded member shown in FIG. 8A and an insulator;

FIG. 9A is a schematic diagram of a connector of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 9B is a schematic diagram of a connector of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 9C is a schematic diagram of a connector of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 10 is a partial sectional view of a high voltage component according to an implementation of this application;

FIG. 11 is a three-dimensional exploded schematic diagram of a high voltage component according to an implementation of this application;

FIG. 12 is a schematic diagram of a high voltage component according to an implementation of this application;

FIG. 13 is a three-dimensional schematic diagram of a grounding structure of a high voltage component according to an implementation of this application;

FIG. 14 is a partial sectional view of a high voltage component according to an implementation of this application;

FIG. 15 is a partial sectional view of a high voltage component according to an implementation of this application;

FIG. 16 is a partial sectional view of a high voltage component according to an implementation of this application;

FIG. 17 is a partial sectional view of a grounding layer of a high voltage component according to an implementation of this application;

FIG. 18 is a three-dimensional diagram of a transformer according to an implementation of this application;

FIG. 19 is a side view of a transformer according to an implementation of this application;

FIG. 20 is a three-dimensional exploded diagram of a

transformer according to an implementation of this application; and

FIG. 21 is a schematic diagram of a second shielding member of a transformer according to an implementation of this application.

DESCRIPTION OF EMBODIMENTS

[0037] The following describes embodiments of this application with reference to the accompanying drawings in embodiments of this application.

[0038] FIG. 1A is a schematic diagram of electric power equipment according to an implementation of this application. The electric power equipment may be a power electronic transformer, a direct current microgrid, direct current microgrid equipment, flexible power supply equipment, or converter equipment. The electric power equipment includes a high voltage circuit, a low voltage circuit, and a transformer. The transformer is connected between the high voltage circuit and the low voltage circuit, and is configured to implement functions such as voltage boosting and lowering, impedance matching, and security isolation. In an implementation, the transformer provided in embodiments of this application performs functions such as high voltage isolation and insulation in the electric power equipment. Specifically, the transformer includes a low voltage coil, a high voltage coil, and a magnetic core. The low voltage coil is electrically connected to the low voltage circuit, and the high voltage coil is electrically connected to the high voltage circuit. Energy conversion between the low voltage circuit and the high voltage circuit is implemented according to an electromagnetic induction principle through interaction between the low voltage coil, the high voltage coil, and the magnetic core. In this implementation, the high voltage circuit and the low voltage circuit may be understood as two circuits with different voltages. A specific high voltage range of a voltage of the high voltage circuit is not limited, and a specific low voltage range of a voltage of the low voltage circuit is not limited, provided that a voltage to ground of the high voltage circuit is higher than a voltage to ground of the low voltage circuit.

[0039] The electric power equipment provided in embodiments of this application may be a power converter, and may be used in a plurality of application fields such as a new energy smart microgrid field, a power transmission and distribution field, a new energy field (for example, a photovoltaic grid-connected field or a wind power grid-connected field), a photovoltaic power generation field (for example, a home device (such as a refrigerator or an air conditioner) or power grid power supplying), a wind power generation field, or a high-power converter field (for example, converting a direct current into a high-power high-voltage alternating current). This may be specifically determined based on an actual application scenario, and is not limited herein.

[0040] FIG. 1B is a schematic diagram of a transformer according to a possible implementation of the electric

power equipment shown in FIG. 1A. The transformer includes a magnetic core 10, a high voltage component 20, and a low voltage component 30. The low voltage component 30 is distributed on two opposite sides of the high voltage component 20, and the low voltage component 30 and the high voltage component 20 are stacked. A coil lead-out structure WH of the high voltage component 20 is configured to electrically connect to the high voltage circuit in FIG. 1A, and a coil lead-out structure WL of the low voltage component 30 is configured to electrically connect to the low voltage circuit in FIG. 1A.

[0041] FIG. 2A is a three-dimensional schematic assembly diagram of the high voltage component 20 of the transformer according to an implementation of this application. FIG. 2B is a schematic three-dimensional exploded diagram of the high voltage component 20 of the transformer shown in FIG. 2A. Refer to FIG. 2B. The high voltage component 20 of the transformer includes a high voltage coil 21, an insulator 22, a grounding structure 23, and a grounding layer 24.

[0042] In a specific implementation, the high voltage coil 21 is electrically connected to a high voltage circuit, and the high voltage coil 21 is formed by a plurality of turns of conductor coils. The high voltage coil 21 includes a winding part 211, a lead-out part 212, a first terminal 213, and a second terminal 214. In an implementation, the lead-out part 212 includes a first lead section 2121 and a second lead section 2122. The first lead section 2121 and the second lead section 2122 are spaced at a same side of the winding part 211. The winding part 211 is connected in series between the first lead section 2121 and the second lead section 2122. One end that is of the first lead section 2121 and that is away from the winding part 211 is connected to the second terminal 214. One end that is of the second lead section 2122 and that is away from the winding part 211 is connected to the first terminal 213. The winding part 211 is surrounded to form two through holes H1, and the two through holes H1 are configured to accommodate a part of the magnetic core. In an implementation, the winding part 211 is 8-shaped, or the winding part 211 includes two ring structures that are disposed side by side and adjacent to each other.

[0043] The insulator 22 wraps the high voltage coil 21. Specifically, the winding part 211 and the lead-out part 212 that are of the high voltage coil 21 are completely wrapped by the insulator 22. A part of the second terminal 214 and a part of the first terminal 213 are located in the insulator 22. A part of the second terminal 214 and a part of the first terminal 213 extend out of the insulator 22 and are exposed. The exposed part of the second terminal 214 and the first terminal 213 are configured to electrically connect to the high voltage circuit. In an implementation, at a position of the through hole H1 of the winding part 211, the insulator 22 forms a mounting hole H2, and the mounting hole H2 is configured to accommodate a part of the magnetic core.

[0044] The insulator 22 wraps the high voltage coil 21 through casting, so that stability of a connection between

the high voltage coil 21 and the insulator 22 can be improved, and a risk of moving the high voltage coil 21 relative to the insulator 22 is reduced. This improves operating stability and use safety of the transformer. The insulator 22 obtained through casting or die casting manufacturing has a low risk of having an air cavity inside the insulator 22, so that isolation effect of the insulator 22 can be ensured. A material of the insulator 22 may be epoxy resin, insulation rubber, or the like. The material of the insulator 22 is not specially limited in embodiments of this application.

[0045] The grounding layer 24 is located on an outer surface of the insulator 22, to implement grounding of the high voltage component 20, and limit a potential of the outer surface of the insulator 22 to a low potential, for example, a potential the same as that of the system ground. A potential of the grounding layer 24 is the potential of the system ground, and is specifically a low potential. For example, the potential of the grounding layer 24 is zero. The grounding layer 24 is disposed on the outer surface of the insulator 22, so that a risk of breakdown of an air layer around the high voltage component can be reduced, and the use safety of the transformer can be improved. In an implementation, the grounding layer 24 is a semi-conductive layer.

[0046] The thickness of the insulator 22 may be defined as a minimum distance between the outer surface of the high voltage coil 21 and the outer surface of the insulator 22. For the high voltage component, a voltage of a high voltage circuit connected to the high voltage coil 21 is a high voltage, and a voltage difference between the high voltage and the ground is M kilovolts (KV). When $M \geq 1$, a minimum thickness T of the insulator 22 needs to meet: $T \geq 0.3 \text{ mm/KV}$.

[0047] In this application, to improve grounding stability of the high voltage component, the grounding structure 23 is disposed, and the grounding structure 23 includes a conductive material or a semi-conductive material. A part of the grounding structure 23 is implanted inside the insulator 22. The partial grounding structure 23 is disposed on the outer surface of the insulator 22. The grounding layer 24 is connected to the part of the grounding structure 23 located on the outer surface of the insulator 22. The part of the grounding structure 23 implanted inside the insulator 22 is electrically connected to the system ground by using a grounding connector. In this way, the grounding layer 24, the part of the grounding structure 23 located on the outer surface of the insulator 22, a part of grounding structure 23 embedded in the insulator 22, and the grounding connector are electrically connected in sequence to form a grounding path of the high voltage component 20. In a process of assembling or using the high voltage component 20, the grounding path is not affected by any loss. Therefore, the high voltage component 20 provided in the specific implementation of this application has a reliable grounding path. In summary, in this application, the grounding stability of the high voltage component 20 can be improved by disposing the

grounding structure 23. A specific structure of the grounding structure 23 is described as follows.

[0048] FIG. 3 is a partial sectional view of a high voltage component according to an implementation of this application. FIG. 4 is a three-dimensional schematic diagram of a grounding structure of a high voltage component according to an implementation of this application. Refer to FIG. 2A, FIG. 2B, FIG. 3, and FIG. 4. The grounding structure 23 includes an embedded member 231 and a connector 232 that are electrically conductive, where the embedded member 231 is isolated from the high voltage coil 21 by using the insulator 22, at least a part of the embedded member 231 is located inside the insulator 22, a part of a surface of the embedded member 231 is exposed and is configured to fasten a grounding connector 90, the connector 232 is located on an outer surface of the insulator 22, and the connector 232 is directly or indirectly connected to the embedded member 231. Direct connection means that there is no other connection medium between the connector 232 and the embedded member 231, and the connector 232 and the embedded member 231 are in contact and are connected to each other. Indirect connection means that there is a gap between the connector 232 and the embedded member 231, and the connector 232 and the embedded member 231 are connected between the connector 232 and the embedded member 231 by using another connection structure. In the implementations shown in FIG. 3 and FIG. 4, the connector 232 and the embedded member 231 are in an indirect connection relationship, the grounding structure 23 further includes an intermediate member 233, and the intermediate member 233 is located inside the insulator 22 and is connected between the connector 232 and the embedded member 231. A part of the grounding layer 24 is connected to a surface that is of the connector 232 and that is away from the insulator 22. A part of the grounding layer 24 is connected to at least a part of an outer surface of the insulator 22. A grounding path of the high voltage component 20 is implemented through a connection between the grounding layer 24 and the connector 232, a connection between the connector 232 and the embedded member 231, and a connection between the embedded member 231 and the grounding connector 90. Because the embedded member 231 of the grounding structure 23 is located inside the insulator 22, a reliable grounding connection relationship is formed between the connector 232 and the embedded member 231, and between the grounding layer 24 and the connector 232, so that safety of the high voltage component 20 can be improved.

[0049] For the high voltage component 20, a grounding path is formed from the grounding layer 24 to the grounding connector 90. The high voltage component 20 provided in this application includes two grounding paths. A first grounding path is a grounding path formed by the grounding layer 24 (a part of the grounding layer 24 that covers the surface of the connector 232), the connector 232, the embedded member 231, and the grounding

connector 90 that are electrically connected in sequence. A second grounding path is a grounding path formed by electrically connecting the grounding layer 24 (the grounding layer 24 covering the part that is of the embedded member 231 and that is exposed on the surface of the insulator 22) between the grounding connector 90 and the embedded member 231. For the second grounding path, in a process of fastening the grounding connector 90, an external force acts on the grounding layer 24, which may damage the grounding layer 24 that covers the part of the embedded member 231 exposed on the surface of the insulator 22, and cause the second grounding path to be disconnected. When the second grounding path is damaged, the high voltage component 20 provided in this application further has the first grounding path. The first grounding path is not affected by the external force in a process of assembling the high voltage component and the transformer, and is not easy to be damaged or fail.

[0050] FIG. 5 shows a grounding structure of a high voltage component in the conventional technology. A grounding layer 24' is disposed on an outer surface of an insulator 22', and a protruding structure 221' is disposed on the insulator 22'. The protruding structure 221' is configured to be grounded, and the outer surface of the protruding structure 221' also covers the grounding layer 24'. The protruding structure 221' is provided with a grounding hole 222'. The grounding hole 222' is configured to work with a fastener 25'. The fastener 25' is configured to connect a grounding connector. For example, the fastener 25' includes a bolt 251' and a nut 252'. In a process of assembling the grounding connector, the bolt and the nut need to be tightened by using a tool. After assembly, the grounding layer 24', the bolt 251', and the grounding connector between the bolt 251' and the insulator 22' are electrically connected in sequence to form a grounding path. In an assembly process, the grounding layer 24' on an outer surface of the grounding hole 222' is easily cracked under the effect of a tightening force, and breakage of the grounding layer 24' inevitably causes disconnection of the grounding path, so that the high voltage component fails to be grounded.

[0051] Compared with the grounding structure of the high voltage component shown in FIG. 5, a grounding path failure risk of the high voltage component provided in embodiments of this application is lower. Specifically, refer to FIG. 2B and FIG. 3. The grounding layer 24 is formed on a surface of the connector 232 through electroplating, spraying, or the like, to implement an electrical connection between the grounding layer 24 and the connector 232. In an assembly process and a use process of the high voltage component 20, a connection position between the grounding layer 24 and the connector 232 is static, and no external force acts on this position. For example, a fixed connector similar to a screw is not disposed at this position. Therefore, an electrical connection structure between the grounding layer 24 and the connector 232 is not easily damaged,

and an open circuit is not easily generated. An electrical connection between the grounding connector 90 and the embedded member 231 is a direct connection relationship, and does not depend on the grounding layer 24. Even if the grounding layer 24 between the grounding connector 90 and the embedded member 231 is damaged and fractures occur, the electrical connection relationship between the grounding connector 90 and the embedded member 231 is not affected. Therefore, the grounding path of the high voltage component 20 is stable, and a risk of a grounding failure is low.

[0052] FIG. 6A is a structure of an embedded member 231 in an implementation. FIG. 6B is a schematic diagram of an assembly relationship between the embedded member 231 shown in FIG. 6A and an insulator 22. Refer to FIG. 6A and FIG. 6B. In this implementation, the embedded member 231 is of a three-segment structure, including a first segment 231A, a second segment 231B, and a third segment 231C. The second segment 231B is connected between the first segment 231A and the third segment 231C. Diameters of the first segment 231A and the third segment 231C are greater than a diameter of the second segment 231B. The second segment 231B is approximately cylindrical. The embedded member 231 includes a first end face S1, a second end face S2, and a side surface S3. The first end face S1 is a surface that is of the first segment 231A and that is away from the second segment 231B. The second end face S2 is a surface that is of the third segment 231C and that is away from the second segment 231B. The first end face S1 and the second end face S2 may be parallel to each other. A surface other than the first end face S1 on the first segment 231A, an outer surface of the second segment 231B, and a surface other than the second end face S2 on the third segment 231C jointly form a side surface S3. As shown in FIG. 6B, the side surface S3 and the second end face S2 are located inside the insulator 22, and the first end face S1 is located on the outer surface of the insulator 22. In this implementation, the embedded member 231 is designed as a three-segment structure, so that the side surface S3 forms an inner concave architecture, and a bonding surface between the insulator 22 and the embedded member 231 forms a bent and extended state. This improves a bonding force between the embedded member 231 and the insulator 22.

[0053] In this implementation, the embedded member 231 is provided with a mounting hole 2311, and an opening position of the mounting hole 2311 is on the first end face S1. That is, the mounting hole 2311 extends from the first end face S1 to the embedded member 231, and the mounting hole 2311 is configured to fasten the grounding connector 90. Specifically, the mounting hole 2311 may be a threaded hole, and the grounding connector 90 may be fixed through a screw and the mounting hole 2311 (refer to FIG. 2A). In another implementation, the grounding connector 90 may also have a threaded structure, and directly work with the threaded hole. In another imple-

mentation, the grounding connector 90 may also be fastened to the embedded member 231 through welding, or may be connected to the embedded member 231 through a fastener. For example, a slot is disposed on the embedded member 231, and the grounding connector 90 has a fastener structure that works with the slot.

[0054] The embedded member 231 includes the first end face S1 and the side surface S3 that are adjacent to each other and that face different directions. The first end face S1 is configured to fasten the grounding connector 90. The grounding structure 23 further includes an intermediate member 233, and the intermediate member 233 is connected between the side surface S3 and the connector 232. This solution provides a specific architecture of the grounding structure 23. The embedded member 231 and the connector 232 are connected by using the intermediate member 233, so that the connector 232 can be more flexibly disposed on the outer surface of the insulator 22, and can adapt to the high voltage component 20 in different application scenarios.

[0055] FIG. 7A is a structure of an embedded member 231 in an implementation. FIG. 7B is a schematic diagram of an assembly relationship between the embedded member 231 shown in FIG. 7A and an insulator 22. Refer to FIG. 7A and FIG. 7B. The embedded member 231 includes a first end face S1, a second end face S2, and a side surface S3, where the first end face S1 and the second end face S2 have an equal area, the first end face S1 is located on an outer surface of the insulator 22, and the second end face S2 and the side surface S3 are located inside the insulator 22. The embedded member 231 is provided with a mounting hole 2311, and an opening position of the mounting hole 2311 is on the first end face S1. In this implementation, the embedded member 231 is cylindrical, and the side surface S3 is of a cylindrical surface structure. The embedded member 231 of this structure may also be reliably combined with the insulator 22, and has advantages of simple structure and low manufacturing costs.

[0056] FIG. 8A is a structure of an embedded member 231 in an implementation. FIG. 8B is a schematic diagram of an assembly relationship between the embedded member 231 shown in FIG. 8A and the insulator 22. FIG. 8C is a schematic diagram of another assembly relationship between the embedded member 231 shown in FIG. 8A and the insulator 22. The embedded member 231 is in a round table shape. The embedded member 231 includes a first end face S1, a second end face S2, and a side surface S3. An area of the first end face S1 is greater than an area of the second end face S2. A mounting hole is disposed on the embedded member 231, the mounting hole is in a through hole shape, and the mounting hole extends from the first end face S1 to the second end face S2. Refer to FIG. 8A and FIG. 8B. In an assembly manner, the first end face S1 is located on the outer surface of the insulator 22, and the second end face S2 and the side surface S3 are located inside the insulator 22. In this assembly manner, after the insulator 22 is

cast on the surface of the high voltage coil 21, the embedded member 231 may be installed inside the insulator 22, and the second end face S2 may be placed inside the insulator 22. This has an advantage of convenient assembly. Refer to FIG. 8A and FIG. 8C. In another assembly manner, the second end face S2 is located on the outer surface of the insulator, and the first end face S1 and the side surface S3 are located inside the insulator 22. In this assembly manner, in a process of casting the insulator, the embedded member 231 may be cast inside the insulator 22, and then the second end face S2 is exposed through mechanical processing. Because an area of the first end face S1 is greater than an area of the second end face S2, a force exerted by the insulator 22 on the side surface S3 helps fasten the embedded member 231 in the insulator 22, and the embedded member 231 is not easily detached from the insulator 22. Therefore, this implementation has an advantage of stable and firm combination.

[0057] In the implementation shown in FIG. 4, the connector 232 is of a sheet-like structure, and no hole or hollow structure is disposed on the connector 232. In another implementation, a hollow region may be disposed on the connector 232. When the connector 232 is installed on the surface of the insulator 22, a part of the grounding layer 24 may be located in the hollow region and connected to the insulator 22, or a part of the insulator 22 may be located in the hollow region and connected to the connector 232. Therefore, in this solution, reliability of combination between the connector 232 and the insulator 22 and between the grounding layer 24 and the connector 232 and the insulator 22 can be increased.

[0058] Refer to FIG. 9A. The connector 232 may be of a mesh structure. It may be understood that the connector 232 may be obtained by using metal wires or metal strips to form a mesh, and a through hole formed between the metal wires or the metal strips is a hollow region.

[0059] Refer to FIG. 9B. The connector 232 may be of a sheet-like structure, a plurality of through holes are disposed on the sheet-like structure, and the plurality of through holes form the hollow region of the connector 232. In this implementation, the hollow region is of a circular through hole structure. In another implementation, a shape of the through hole is not limited to a circle, and may alternatively be another shape, for example, a rectangle or a triangle. As shown in FIG. 9C, through holes of different shapes are disposed on the connector 232.

[0060] In a specific implementation, the connector 232 is of a flexible structure, and the connector 232 of the flexible structure may form gapless bonding with a surface of the insulator 22, thereby improving structural strength and stability.

[0061] Refer to FIG. 10. In an implementation, an outer surface of the insulator 22 includes a first surface S5 and a second surface S6. The first surface S5 and the second surface S6 face different directions (which may be understood as that the first surface S5 and the second surface

S6 are not coplanar), and the second surface S6 and the second surface S6 may be adjacent. The embedded member 231 includes a first end face S1 and a side surface S3. The first end face S1 and the side surface S3 are adjacent to each other and face different directions. The first end face S1 is located on the first surface S5 of the insulator 22, the side surface S3 is located inside the insulator 22, the connector 232 is connected between the side surface S3 of the embedded member 231 and the connector 232, and the connector 232 is located on the second surface S6 of the insulator 22.

[0062] In an implementation shown in FIG. 2B, the insulator 22 includes a main body insulation part 221, a lead insulation part 222, and a bump 223. The main body insulation part 221 wraps a winding part 211 of the high voltage coil 21. The main body insulation part 221 includes a top surface S7, a bottom surface S8, and an insulation side surface S9 connected between the top surface S7 and the bottom surface S8. The top surface S7 is configured to face towards a low voltage coil of a transformer. The bump 223 is protrudingly disposed on the insulation side surface S9. At least a part of the embedded member 231 is located inside the bump 223, and a part of a surface (the first end face S1) that is of the embedded member 231 and that is configured to connect to the grounding connector 90 faces the same direction as the top surface S7. In this solution, a size of the main body insulation part of the insulator can be miniaturized, and a grounding structure is disposed on the bump. The grounding structure does not affect a safe isolation distance of the high voltage coil. This helps ensure safety of the high voltage component.

[0063] The connector 232 may be located on an outer surface of the bump 223, the connector 232 may also be located on the insulation side surface S9 of the main body insulation part 221, and the connector 232 may also be disposed on the outer surface of the bump 223 and the insulation side surface S9 of the main body insulation part 221. This solution provides different arrangement solutions of the connector of the grounding structure. A proper solution may be selected based on a specific application requirement, and flexibility is good. The lead insulation part 222 wraps the lead-out part 212 of the high voltage coil 21. The main body insulation part 221 and the lead insulation part 222 are adjacently disposed in a first direction A1. The bump 223 and the main body insulation part 221 are adjacently disposed in a second direction A2. An included angle is formed between the second direction A2 and the first direction A1. In this implementation, the lead-out part 212 and the winding part 211 of the high voltage coil 21 are adjacently disposed in the first direction A1, and the grounding structure 23 and the winding part 211 of the high voltage coil 21 are spaced in the second direction A2. For the transformer in which the high voltage component 20 is located, the high voltage component 20 provided in this solution is applicable to an application environment in which installation space is sufficient in the second direction A2. A size of the high

voltage component 20 in the first direction A1 can be controlled, so that the size of the transformer in the first direction is easy to implement miniaturization.

[0064] Refer to FIG. 11. In an implementation shown in FIG. 11, the grounding structure 23 is disposed on the bump 223, and a part of a surface that is of the embedded member 231 and that is configured to connect the grounding connector 90 and that faces the same direction as the top surface of the main body insulation part 221. Compared with the implementation shown in FIG. 2B, in this implementation, a specific position of the bump 223 is adjusted. In this implementation, the lead insulation part 222, the main body insulation part 221, and the bump 223 are sequentially arranged along the first direction. The lead-out part 212 and the winding part 211 of the high voltage coil 21 are adjacently disposed in a first direction. In the first direction, the grounding structure 23 is located on a side that is of the winding part 211 and that is away from the lead-out part 212. It may be understood that the lead-out part 212, the winding part 211, and the grounding structure 23 are sequentially arranged in the first direction. For the transformer in which the high voltage component is located, the high voltage component provided in this implementation is applicable to an application environment in which installation space is sufficient in the first direction.

[0065] In an implementation of this application, the bump 223 is disposed on the insulation side surface S9 of the main body insulation part 221 of the insulator 22, and the grounding structure 23 is disposed at a position of the bump 223. This can ensure that an overall size of the insulator 22 is miniaturized. A position of the bump 223 on the side surface S3 may be set based on a specific use environment and an assembly requirement. This is not limited in this application.

[0066] Refer to FIG. 12. In an implementation shown in FIG. 12, the insulator 22 includes only a main body insulation part 221 and a lead insulation part 222, and no bump 223 is disposed on an insulation side surface S9 of the main body insulation part 221. In this implementation, the main body insulation part 221 includes a top surface S7, a bottom surface (on an opposite side of the top surface S7, which cannot be shown in the figure), and an insulation side surface S9 connected between the top surface S7 and the bottom surface. The grounding structure 23 is disposed on the main body insulation part 221. In a specific implementation, the embedded member 231 of the grounding structure 23 includes a first end face S1, the first end face S1 is exposed on an insulation side surface S9 of the main body insulation part 221, and the first end face S1 is configured to fasten a grounding connector 90. The connector 232 of the grounding structure 23 is directly connected to the embedded member 231, and the connector 232 is located on the insulation side surface S9 of the main body insulation part 221. A direction of the first end face S1 is the same as a direction of the insulation side surface S9 of the main body insulation part 221. This solution helps simplify a manufacturing

process of an insulation member. Because there is no bump 223 structure on an outer surface of the main body insulation part 221 of the insulation member, a process of disposing a grounding layer 24 on the outer surface of the main body insulation part 221 is also easy to control. This helps improve reliability of the connection between the grounding layer 24 and the main body insulation part 221.

[0067] Refer to FIG. 13. In an implementation, the embedded member 231 includes a first end face S1 and a side surface S3 that are adjacent to each other and that face different directions. The first end face S1 is configured to fasten a grounding connector 90. Specifically, a mounting hole 2311 is disposed on the first end face S1, and the mounting hole 2311 is configured to connect to the grounding connector 90. The side surface S3 includes a first region S31 and a second region S32. The first region S31 is connected between the second region S32 and the first end face S1. The connector 232 is connected to the first region S31. A position relationship between the grounding structure 23 and the insulator 22 is as follows: The second region S32 is located inside the insulator 22, and the first region S31 is located outside the insulator 22. In an implementation, a surface that is of the connector 232 and that is away from the insulator 22 may be flush and coplanar with the first end face S1. It may be understood that an outer surface of the connector 232 and the first end face S1 may jointly form a planar structure or an arc-shaped surface, and there is no step structure between the outer surface and the first end face S1. In this solution, the outer surface of the connector 232 and the first end face S1 are coplanar, so that the surface of the grounding structure exposed outside the insulator is an integrated surface architecture of smooth transition. A grounding layer is disposed on the surface of such smooth transition, so that the connection between the grounding layer 24 and the grounding structure 23 is more reliable.

[0068] Refer to FIG. 14. In an implementation, a connector 232 is directly connected to an embedded member 231. The embedded member 231 is columnar. The embedded member 231 includes a first end face S1 and a side surface S3. The side surface S3 includes a first region S31 and a second region S32. The first region S31 is located between the second region S32 and the first end face S1. The second region S32 is located inside the insulator 22. The first region S31 extends out of the insulator 22, and the first end face S1 is located outside the insulator 22. The connector 232 is connected to the first region S31. The connector 232 includes an outer surface 2321. The outer surface 2321 of the connector 232 is located on an outer surface of the insulator 22 and is not covered by the insulator 22. All surfaces of the connector 232 except the outer surface 2321 of the connector 232 are connected to the insulator 22. The outer surface 2321 of the connector 232 is configured to connect to a grounding layer 24. In this implementation, the first end face S1 and the outer surface 2321 of the connector 232 are not coplanar. In other words, the first

end face S1 is connected to the outer surface 2321 of the connector 232 by using a part of the side surface S3. The connector 232 in the grounding structure 23 provided in this solution is directly connected to the first region S31 of the side surface S3 of the embedded member 231. For the grounding structure 23, a structure of the grounding structure 23 is simpler, so that a manufacturing process of a process of connecting the grounding structure 23 to the insulator 22 is not complex, and low manufacturing costs are easily implemented.

[0069] Refer to FIG. 15. In an implementation, a connector 232 is connected to a first end face S1 of an embedded member 231. Specifically, the connector 232 includes a first connection area 2322 and a second connection area 2323. The first connection area 2322 is connected to the first end face S1, the second connection area 2323 is connected to an outer surface of the insulator 22, and the grounding connector 90 is connected to the first connection area. The first end face S1 and the outer surface of the insulator 22 that is configured to connect the connector 232 are flush and coplanar. In this solution, a relationship between the first end face S1 and the outer surface position of the insulator 22 is limited, so that the connector 232 may be a flat structure, and a connection between the connector 232 and the insulator 22 has an advantage of simplicity and stability. In an implementation shown in FIG. 15, the second connection area 2323 is distributed on one side of the first connection area 2322. In another implementation, as shown in FIG. 16, the second connection areas 2323 may also be distributed on two sides of the first connection area 2322, or the second connection area 2323 may be disposed around the first connection area 2322. This solution provides two specific connector arrangement solutions, and a degree of application freedom is high. A proper connector arrangement solution may be selected based on a specific structure form of the high voltage component. This solution provides a specific solution of a position relationship between the connector 232 and the embedded member 231. Because the first connection area 2322 of the connector 232 is connected to the first end face S1 of the embedded member 231, the embedded member 231 may be first fastened to the insulator 22, and then the connector 232 is connected to the first end face S1. After the embedded member 231 and the insulator 22 are assembled, the first end face S1 is exposed on the surface of the insulator 22. In this case, it is easy to connect the connector 232 to the first end face S1. For example, connection and fastening may be implemented through welding. The embedded member 231 and the insulator 22 may be of an integrated structure. In other words, in a process of casting the insulator 22, the embedded member 231 is disposed in the insulator 22. **[0070]** In the implementations shown in FIG. 14, FIG. 15, and FIG. 16, a part of an insulator between a surface that is of the embedded member 231 and that is away from the first end face S1 and the high voltage coil 21 is a thinnest position of the insulator 22, and it needs to be

ensured that a thickness of the part of the insulator 22 is within a safe distance range (for example, greater than or equal to 0.3 mm/KV).

[0071] In the implementations shown in FIG. 14, FIG. 15, and FIG. 16, the connector 232 may be of an integrated structure, and may be distributed on one side of the first end face S1 or disposed around the first end face S1. Alternatively, the connector 232 may be of a split structure, and the connector 232 includes a plurality of independent components, and the plurality of independent components are directly connected to the embedded member 231 and distributed on a periphery of the first end face S1.

[0072] In an implementation shown in FIG. 2B, the grounding layer 24 covers all areas of the main body insulation part 221 of the insulator 22, and no hole structure is disposed on the grounding layer 24.

[0073] Refer to FIG. 17. In an implementation, a grounding layer 24 is provided with a hollow part 242, and the hollow part 242 is disposed to increase resistance of the grounding layer 24. In this implementation, the grounding layer 24 forms a closed grounding loop around the insulator 22, so that a potential of an outer surface of the insulator 22 is a ground potential. This implements reliability of grounding of the high voltage component 20, and effectively reduces partial discharge of the surface of the high voltage component 20.

[0074] A function of the grounding layer 24 is mainly to encircle a surface of the insulator 22, so that a potential of the surface of the insulator 22 is limited to a low potential. The grounding layer 24 includes a conductor material or a semiconductor material, and the high voltage coil 21 is within a radiation range of a leakage flux of the transformer. In this way, in an operating process of the high voltage component, the grounding layer 24 forms a closed grounding loop. The existence of the grounding layer 24 causes an extra loss generated by the transformer due to induction electromotive force in the operating process. A higher resistivity of a material used by the grounding layer 24 indicates a poorer potential limiting effect of the grounding layer 24 and a smaller loss caused by electromagnetic induction. On the contrary, a lower resistivity of a material used by the grounding layer 24 indicates a better potential limiting effect of the grounding layer 24 and a higher loss caused by electromagnetic induction. Therefore, the grounding layer 24 is limited to a semi-conductive material in this application, and the loss and the potential limiting effect are balanced.

[0075] Specifically, the grounding layer 24 is formed on the surfaces of the insulator 22 and the connector 232 in a spraying or electroplating manner. In another implementation, the grounding layer 24 may also be a flexible strip having semi-conductive performance. The flexible strip is wound around the outer surface of the insulator 22, and the flexible strip may also be fastened to the outer surface of the insulator 22 through adhesive or the like.

[0076] In an implementation, a resistivity of the grounding structure 23 is lower than a resistivity of the grounding

layer 24. The grounding layer 24 includes the semi-conductive material, and the resistivity of the grounding layer 24 may be within a range of $0.01 \Omega \cdot \text{cm}$ to $100000 \Omega \cdot \text{cm}$, for example, $1000 \Omega \cdot \text{cm}$. For the grounding structure 23, a resistance value of the grounding structure 23 is less than 1 ohm/unit cm , and the resistivity of the grounding structure 23 is low. This can ensure that grounding resistance is as small as possible, can ensure good grounding protection, and can reliably pull down a potential of a semi-conductive layer to a potential of PE (0). On the contrary, if the resistance of the grounding structure 23 is excessively large, a poor grounding effect may be caused, so that the potential of the grounding layer 24 on the surface of the high voltage component is not fixed, and an insulation effect is poor. In a specific application scenario, the safety standard has a requirement on the grounding resistance, for example, $<1 \text{ ohm/unit cm}$.

[0077] In this application, the embedded member 231 and the insulator 22 of the grounding structure 23 are combined, and the connector 232 is connected to the grounding layer 24, so that not only structural stability of the grounding layer 24 is improved, but also reliability of grounding of the high voltage component is implemented, thereby effectively reducing partial placement on the surface of the high voltage component. The outer surface of the insulator 22 is disposed through the grounding layer 24, so that a potential of the outer surface that is of the high voltage component and that is in contact with the air is zero, thereby reducing electric field strength between the high voltage component and the low voltage coil, reducing a voltage difference between the high voltage component and a magnetic core and electric field strength in the air, reducing a risk of air breakdown between the high voltage component and the low voltage coil and between the high voltage component and the magnetic core, and improving use safety of the transformer.

[0078] FIG. 18 is a three-dimensional diagram of a transformer 100 according to an implementation of this application. FIG. 19 is a side view of the transformer 100 according to an implementation of this application. FIG. 20 is a three-dimensional exploded diagram of the transformer 100 according to an implementation of this application.

[0079] Refer to FIG. 18, FIG. 19, and FIG. 20. The transformer 100 includes a magnetic core 10, a high voltage component 20, a low voltage coil 31, a shielding member 32, a conductive cover 40, and a fastener 50.

[0080] In an implementation, the high voltage component 20 may be the high voltage component described in the foregoing implementation.

[0081] In another implementation, the high voltage component 20 may also be different from the high voltage component described in the foregoing implementation. The high voltage component includes a high voltage coil, an insulator, and a grounding layer. The insulator wraps the high voltage coil, and the grounding layer covers at least a part of an outer surface of the insulator, so that a

potential of the outer surface of the insulator is a ground potential.

[0082] Both the two specific high voltage components may be used in the transformer provided in embodiments of this application, and may be used in combination with another element in the transformer.

[0083] A specific form of the low voltage coil 31 may be the same as a form of the high voltage coil 21 of the high voltage component 20 in the implementation shown in FIG. 2B. For example, the low voltage coil 31 includes a coil body 311 and a lead-out member 312. The coil body 311 forms two through holes H1. The two through holes H1 are configured to assemble the magnetic core 10. The lead-out member 312 extends from the coil body 311 and is configured to connect a low voltage circuit. Specifically, the coil body 311 of the low voltage coil 31 may be formed by a plurality of turns of conductor coils wound around a low voltage framework. In an implementation, there are two low voltage coils 31, which are respectively a first low voltage coil 31A and a second low voltage coil 31B. The first low voltage coil 31A is located on a top side of the high voltage component 20, and the second low voltage coil 31B is located on a bottom side of the high voltage component 20. In other words, the high voltage component 20 is located between the first low voltage coil 31A and the second low voltage coil 31B. The first low voltage coil 31A and the second low voltage coil 31B may be connected in series or in parallel.

[0084] The magnetic core 10 includes a first magnetic cover 11, a second magnetic cover 12, and a magnetic cylinder 13 connected between the first magnetic cover 11 and the second magnetic cover 12 that are disposed opposite to each other. The low voltage coil 31 and the high voltage component 20 are configured to surround the magnetic cylinder 13. In an implementation, the magnetic core 10 is of a two-piece structure. The magnetic cylinder 13 includes a first cylinder 131 and a second cylinder 132. The first cylinder 131 is connected to the first magnetic cover 11 to form a first magnetic member 10A. The second cylinder 132 is connected to the second magnetic cover 12 to form a second magnetic member 10B. The first magnetic member 10A and the second magnetic member 10B are connected to form the magnetic core 10. Specifically, there are two magnetic cylinders 13, that is, the first magnetic cover 11 is connected to two first cylinders 131, and the second magnetic cover 12 is connected to two second cylinders 132. The first magnetic member 10A and the second magnetic member 10B have a same structure form and size.

[0085] During assembly, a winding part 211 of the high voltage coil 21 of the high voltage component 20 and the coil body 311 of the low voltage coil 31 are stacked to form a coil component D. Specifically, the high voltage component 20 is stacked between the first low voltage coil 31A and the second low voltage coil 31B. The mounting hole H2 on the insulator 22 of the high voltage component 20 is connected to the through hole H1 formed by the coil body 311 of the low voltage coil 31, to form an assembly

through hole H12. The lead-out part 212 of the high voltage coil 21 of the high voltage component 20 and the lead-out member 312 of the low voltage coil 31 are respectively located on two opposite sides of the coil component D, to facilitate wiring between the transformer and the high voltage circuit and the low voltage circuit, and isolation between the high voltage circuit and the low voltage circuit. The first cylinder 131 of the first magnetic member 10A extends into the assembly through hole H12 from one side of the coil component D, and the second cylinder 132 of the second magnetic member 10B extends into the assembly through hole H12 from the other side of the coil component D. The first cylinder 131 and the second cylinder 132 may be connected and fastened, and a gap may also be reserved between the first cylinder 131 and the second cylinder 132. The first magnetic cover 11 is stacked on a side that is of the first low voltage coil 31A and that is away from the high voltage component 20. The second magnetic cover 12 is stacked on a side that is of the second low voltage coil 31B and that is away from the high voltage component 20.

[0086] The shielding member 32 includes a first shielding member 32A and a second shielding member 32B. The conductive cover 40 includes a first conductive cover 40A and a second conductive cover 40B.

[0087] The first shielding member 32A is assembled on a side that is of the first magnetic cover 11 and that is away from the first low voltage coil 31A. The first shielding member 32A shields a part of the first magnetic cover 11 and the first low voltage coil 31A. The first shielding member 32A and the second shielding member 32B have a same structure. For ease of description, the second shielding member 32B is used as an example to describe a structure of the second shielding member 32B in detail. The second shielding member 32B includes a first part 321 and a second part 322. The first part 321 is disposed between the second magnetic cover 12 and the second conductive cover 40B in a stacked manner. The second part 322 is connected to an edge of the first part 321, and extends from the edge of the first part 321 towards the high voltage component 20. The second part 322 is disposed around a periphery of the second magnetic cover 12 and the second low voltage coil 31B. In this solution, a specific structure design is performed on the second part and the first part of the second shielding member 32B, so that the second shielding member can cover a larger area of the second low voltage coil 31B, thereby improving a protection and isolation effect of the low voltage coil.

[0088] In an implementation, the second part 322 forms an open-loop architecture around a part of the second magnetic cover 12 and the second low voltage coil 31B. Specifically, the second part 322 includes a top edge 3221, a bottom edge 3222, a first side edge 3223, and a second side edge 3224. The top edge 3221 is connected to the first part 321, and the bottom edge 3222 is in contact with the high voltage component 20 or forms

a gap with the high voltage component 20. An opening 323 is formed between the first side edge 3223 and the second side edge 3224, and the opening 323 is configured to accommodate at least the lead-out member of the second low voltage coil 31B. In this solution, the second part 322 is disposed as an open-loop architecture, and the opening 323 is disposed, so that the lead-out member of the low voltage coil is conveniently installed, and assembly is flexible.

[0089] The shielding member is designed to be in contact with the high voltage component, so that the shielding member is connected to the grounding layer of the high voltage component. In this way, all-round isolation protection is formed for the low voltage coil. This helps improve performance of the transformer.

[0090] The top edge 3221 and the bottom edge 3222 are U-shaped or C-shaped, and a part of the second magnetic cover 12 and a part of the second low voltage coil 31B are located in the opening 323. In an implementation, the second part 322 is in a closed-loop architecture around a periphery of the second magnetic cover 12 and the second low voltage coil 31B. As shown in FIG. 21, both the top edge 3221 and the bottom edge 3222 of the second part 322 are in a closed ring shape (a circle, an ellipse, an oblong circle, or a rectangle). A lead-out hole 3225 is disposed on the second part 322, so that the lead-out member of the low voltage coil extends out.

[0091] In a specific implementation, the first shielding member 32A includes a sheet-like main body 325 and a plurality of through holes 326 disposed on the main body. A shape of the through hole 326 may be a circle, a square, a diamond, or the like, and a maximum horizontal or vertical size of the shape of the through hole 326 does not exceed 10 mm. The second shielding member 32B may have a same structure as the first shielding member 32A. In this solution, the through hole is disposed on the sheet-like main body, so that resistance of the shielding member can be improved, and an eddy current loss phenomenon of the transformer can be improved.

[0092] The first conductive cover 40A is located on a side that is of the first shielding member 32A and that is away from the first magnetic cover 11. The second conductive cover 40B is located on a side that is of the second shielding member 32B and that is away from the second magnetic cover 12. The conductive cover 40 is configured to be grounded.

[0093] A resistivity of the shielding member 32 is higher than a resistivity of the conductive cover 40. In an implementation, an area of the first conductive cover 40A is less than an area of the second conductive cover 40B. The second conductive cover 40B is configured to install the transformer 100 in the electric power equipment. The grounding structure 23 of the high voltage component 20 is connected to the second conductive cover 40B by using the grounding connector 90. Specifically, the grounding connector 90 may be of a metal wire structure, one end of the grounding connector 90 is fastened to the embedded member 231 of the grounding structure 23 of

the high voltage component through a screw, and the other end is fastened to the second conductive cover 40B through a screw. The second conductive cover 40B is an element connected between the high voltage component 20 and the system ground. In this solution, the second conductive cover is configured to collect grounding of the high voltage component and grounding of the low voltage coil. For the transformer, the design of the grounding structure can save space of the transformer, and is conducive to the design of miniaturization of the transformer size.

[0094] In summary, the first conductive cover 40A, the part of the first shielding member 32A, the first magnetic cover 11, the first low voltage coil 31A, the high voltage component 20, the second low voltage coil 31B, the second magnetic cover 12, the part of the second shielding member 32B, and the second conductive cover 40B are sequentially stacked.

[0095] The fastener 50 is electrically conductive, and the fastener 50 may include a metal material. The fastener 50 is configured to be fastened to the first conductive cover 40A and the second conductive cover 40B, and fasten the high voltage component 20, the low voltage coil 31, and the shielding member 32 between the first conductive cover 40A and the second conductive cover 40B. In this solution, by disposing the fastener, on one hand, components of the transformer can be fastened, and on the other hand, the fastener is also configured to implement grounding of the low voltage coil, so that an overall structure of the transformer has an advantage of compactness and simplicity, and is conducive to a design of miniaturization of a size of the transformer. In an implementation, the fastener 50 is in a strip shape or annular shape. The high voltage component 20, the low voltage coil 31, the shielding member 32, and the conductive cover 40 are assembled to form a transformer module. The fastener 50 is wound around a periphery of the transformer module. In another implementation, the fastener 50 may also be of a bolt structure. The bolt passes through the first conductive cover 40A and the second conductive cover 40B, and works with the nut, to fasten the high voltage component 20, the low voltage coil 31, and the shielding member 32 between the first conductive cover 40A and the second conductive cover 40B.

[0096] In another implementation, there may be one low voltage coil 31. In this way, there is one shielding member 32, and there are two conductive covers 40. The high voltage component 20, the low voltage coil 31, and the shielding member 32 are sequentially disposed between the two conductive covers 40 in a stacked manner.

[0097] According to the transformer 100 provided in embodiments of this application, the insulator 22 is disposed in a high voltage component, and the high voltage coil 21 is wrapped by using the insulator 22, to isolate the high voltage coil 21 from the low voltage coil 31. A grounding layer 24 and a grounding structure 23 of the high voltage coil 21 are configured to realize a potential of

an outer surface of the high voltage component 20 as a ground potential, and the shielding member 32 and the conductive cover 40 are configured to realize isolation and grounding of the low voltage coil 31, to realize reliable grounding of the transformer 100. By controlling a resistivity of the grounding layer 24 and a resistivity of the shielding member 32 (specifically, the grounding layer 24 includes a semi-conductive material, and the shielding member is of a mesh structure), an eddy current loss caused by a high frequency magnetic field of the transformer 100 can be reduced, and operating efficiency of the transformer 100 can be improved. Specifically, the transformer 100 generates a changing magnetic flux in an operating process. The magnetic flux is classified into a main magnetic flux and a leakage flux. The main magnetic flux is restricted to perform electromagnetic capability conversion in the magnetic core, but the leakage flux is scattered in a transformer system. The grounding layer 24 on the surface of the high voltage component 20 and the structure of the shielding member 32 generate an induced voltage under influence of the leakage flux, and consequently, a loss is generated. If resistance values of the grounding layer 24 and the shielding member 32 increase, the eddy current loss decreases accordingly. Therefore, the eddy current loss may be reduced by controlling the resistivity of the grounding layer 24 and the shielding member 32 of the shielding member.

[0098] "First", "second", "third", "fourth", and various numbers in this specification are merely used for differentiation for ease of description, and are not construed as any limitation on the scope of this application.

[0099] It should be understood that sequence numbers of the foregoing processes do not mean execution sequences in various embodiments of this application. The execution sequences of the processes should be determined according to functions and internal logic of the processes, and should not be construed as any limitation on the implementation processes of embodiments of this application.

[0100] The foregoing embodiments are merely intended for describing the technical solutions of this application, but not for limiting this application. Although this application is described in detail with reference to the foregoing embodiments, a person of ordinary skilled in the art should understand that modifications may still be made to the technical solutions described in the foregoing embodiments or equivalent replacements may be made to some technical features, and such modifications or replacements do not cause the essence of the corresponding technical solutions to depart from the scope of embodiments of this application.

Claims

1. A high voltage component of a transformer, comprising:

a high voltage coil;
 an insulator that wraps the high voltage coil;
 a grounding structure, comprising an embedded member and a connector that are electrically conductive, wherein the embedded member is isolated from the high voltage coil by using the insulator, at least a part of the embedded member is located inside the insulator, a part of a surface of the embedded member is exposed and is configured to fasten a grounding connector, the connector is located on an outer surface of the insulator, and the connector is directly or indirectly connected to the embedded member; and
 a grounding layer, wherein a part of the grounding layer is connected to a surface that is of the connector and that is away from the insulator, and a part of the grounding layer is connected to at least a part of the outer surface of the insulator, wherein
 the grounding layer, the connector, the embedded member, and the grounding connector are electrically connected in sequence to form a grounding path.

2. The high voltage component of the transformer according to claim 1, wherein the embedded member comprises a first end face and a side surface that face different directions and that are adjacent to each other, the first end face is configured to fasten the grounding connector, the grounding structure further comprises an intermediate member, and the intermediate member is located inside the insulator and is configured to connect the side surface and the connector.
3. The high voltage component of the transformer according to claim 1, wherein the embedded member comprises a first end face and a side surface that face different directions and that are adjacent to each other, the first end face is configured to fasten the grounding connector, the side surface comprises a first region and a second region, the first region is connected between the second region and the first end face, the second region is located inside the insulator, and the first region is located outside the insulator and is connected to the connector.
4. The high voltage component of the transformer according to claim 3, wherein the surface that is of the connector and that is away from the insulator is flush and coplanar with the first end face.
5. The high voltage component of the transformer according to claim 1, wherein the embedded member comprises a first end face, the connector comprises a first connection area and a second connection area, the first connection area is connected to the

first end face, the second connection area is connected to the outer surface of the insulator, and the grounding connector is connected to the first connection area.

6. The high voltage component of the transformer according to claim 5, wherein the first end face is flush and coplanar with the outer surface of the insulator for connecting the connector.
7. The high voltage component of the transformer according to claim 5, wherein the second connection area is distributed on two sides of the first connection area; or the second connection area is disposed around the first connection area.
8. The high voltage component of the transformer according to any one of claims 1 to 7, wherein the connector comprises a hollow region, and a part of the grounding layer is in the hollow region and is connected to the insulator.
9. The high voltage component of the transformer according to claim 8, wherein the connector is of a mesh structure.
10. The high voltage component of the transformer according to any one of claims 1 to 9, wherein the insulator comprises a main body insulation part and a bump, the main body insulation part wraps the high voltage coil, the main body insulation part comprises a top surface, a bottom surface, and a side surface connected between the top surface and the bottom surface, the top surface is configured to face towards a low voltage coil of the transformer, the bump is protrudingly disposed on the side surface, at least a part of the embedded member is located inside the bump, and a part of a surface that is of the embedded member and that is configured to connect the grounding connector faces a same direction as the top surface.
11. The high voltage component of the transformer according to claim 10, wherein the connector is located on an outer surface of the bump and/or the side surface.
12. The high voltage component of the transformer according to any one of claims 1 to 9, wherein the insulator comprises a top surface, a bottom surface, and a side surface connected between the top surface and the bottom surface, the top surface and/or the bottom surface are/is configured to face towards a low voltage coil of the transformer, the connector is located on the side surface, and a part of a surface that is of the embedded member and that is configured to connect the grounding connector faces a same direction as the side surface.

13. The high voltage component of the transformer according to any one of claims 10 to 12, wherein the high voltage coil comprises a winding part and a lead-out part, the lead-out part and the winding part are adjacently disposed in a first direction, the insulator comprises a main body insulation part and a lead insulation part, the main body insulation part wraps the winding part, the lead insulation part wraps the lead-out part, the grounding structure is disposed on the main body insulation part, and in the first direction, the grounding structure is located on a side that is of the winding part and that is away from the lead-out part.

14. The high voltage component of the transformer according to any one of claims 10 to 12, wherein the high voltage coil comprises a winding part and a lead-out part, the lead-out part and the winding part are adjacently disposed in a first direction, the insulator comprises a main body insulation part and a lead insulation part, the main body insulation part wraps the winding part, the lead insulation part wraps the lead-out part, the grounding structure is disposed on the main body insulation part, the grounding structure and the winding part are spaced in a second direction, and the second direction and the first direction are disposed at an included angle.

15. The high voltage component of the transformer according to any one of claims 1 to 14, wherein a hollow part is disposed on a part that is of the grounding layer and that is connected to the insulator, and the hollow part is disposed to increase resistance of the grounding layer.

16. The high voltage component of the transformer according to any one of claims 1 to 15, wherein the grounding layer is formed on surfaces of the insulator and the connector through spraying or electroplating; or the grounding layer is a flexible strip having semi-conductive performance.

17. The high voltage component of the transformer according to any one of claims 1 to 16, wherein a resistivity of the grounding structure is lower than a resistivity of the grounding layer.

18. A transformer, comprising a magnetic core and the high voltage component according to any one of claims 1 to 17, wherein the high voltage component is sleeved on a part of the magnetic core.

19. The transformer according to claim 18, wherein the transformer comprises a low voltage coil, a shielding member, and a conductive cover, the low voltage coil comprises a first low voltage coil and a second low voltage coil, the shielding member comprises a first shielding member and a second shielding member,

- the conductive cover comprises a first conductive cover and a second conductive cover, the magnetic core comprises a first magnetic cover, a second magnetic cover, and a magnetic cylinder connected between the first magnetic cover and the second magnetic cover that are disposed opposite to each other, the first conductive cover, a part of the first shielding member, the first magnetic cover, the first low voltage coil, the high voltage component, the second low voltage coil, the second magnetic cover, a part of the second shielding member, and the second conductive cover are sequentially stacked, the low voltage coil and the high voltage component surround the magnetic cylinder, the part of the first shielding member is located at a periphery of the first magnetic cover and the first low voltage coil, the part of the second shielding member is located at a periphery of the second magnetic cover and the second low voltage coil, the conductive cover is configured to be grounded, and a resistivity of the shielding member is higher than a resistivity of the conductive cover.
20. The transformer according to claim 19, wherein the transformer further comprises a fastener, the fastener is electrically conductive, the fastener is fastened to the first conductive cover and the second conductive cover, and the high voltage component, the low voltage coil, and the shielding member are fastened between the first conductive cover and the second conductive cover by using the fastener.
21. The transformer according to claim 19 or 20, wherein the first shielding member comprises a first part and a second part, the first part is disposed between the first magnetic cover and the first conductive cover in a stacked manner, the second part is connected to an edge of the first part and extends from the edge of the first part towards the high voltage component, and the second part is disposed around the periphery of the first magnetic cover and the first low voltage coil.
22. The transformer according to claim 21, wherein the second part comprises a top edge, a bottom edge, a first side edge, and a second side edge, the top edge is connected to the first part, the bottom edge is in contact with the high voltage component or forms a gap with the high voltage component, an opening is formed between the first side edge and the second side edge, and the opening is configured to accommodate at least a lead-out member of the first low voltage coil.
23. The transformer according to any one of claims 19 to 22, wherein the first shielding member comprises a sheet-like main body and a plurality of through holes disposed on the main body.
24. The transformer according to claim 18, wherein the transformer comprises a low voltage coil, a shielding member, and a conductive cover, the magnetic core comprises a first magnetic cover, a second magnetic cover, and a magnetic cylinder connected between the first magnetic cover and the second magnetic cover that are disposed opposite to each other, the high voltage component and the low voltage coil surround the magnetic cylinder, the high voltage component, the low voltage coil, the first magnetic cover, a part of the shielding member, and the conductive cover are sequentially stacked, the part of the shielding member is located on a periphery of the first magnetic cover and the low voltage coil, the conductive cover is configured to be grounded, and a resistivity of the shielding member is higher than a resistivity of the conductive cover.
25. The transformer according to any one of claims 18 to 24, wherein the grounding connector is connected between the embedded member and the conductive cover.
26. The transformer according to any one of claims 18 to 25, wherein the shielding member is in contact with the high voltage component.
27. Electric power equipment, comprising a high voltage circuit, a low voltage circuit, and a transformer according to any one of claims 18 to 26 connected between the high voltage circuit and the low voltage circuit.
28. A transformer, comprising:
- a magnetic core, comprising a first magnetic cover, a second magnetic cover, and a magnetic cylinder connected between the first magnetic cover and the second magnetic cover that are disposed opposite to each other;
 - a high voltage component, comprising a high voltage coil, an insulator, and a grounding layer, wherein the insulator wraps the high voltage coil, and the grounding layer covers at least a part of an outer surface of the insulator;
 - a low voltage coil, wherein the low voltage coil and the high voltage component are stacked, and the low voltage coil and the high voltage component surround the magnetic cylinder; and
 - a shielding member and a conductive cover, wherein the high voltage component, the low voltage coil, the first magnetic cover, a part of the shielding member, and the conductive cover are sequentially stacked, the part of the shielding member is located at a periphery of the first magnetic cover and the low voltage coil, the conductive cover is configured to be grounded, and a resistivity of the shielding member is high-

er than a resistivity of the conductive cover,
wherein
the grounding layer of the high voltage compo-
nent is electrically connected to the conductive
cover.

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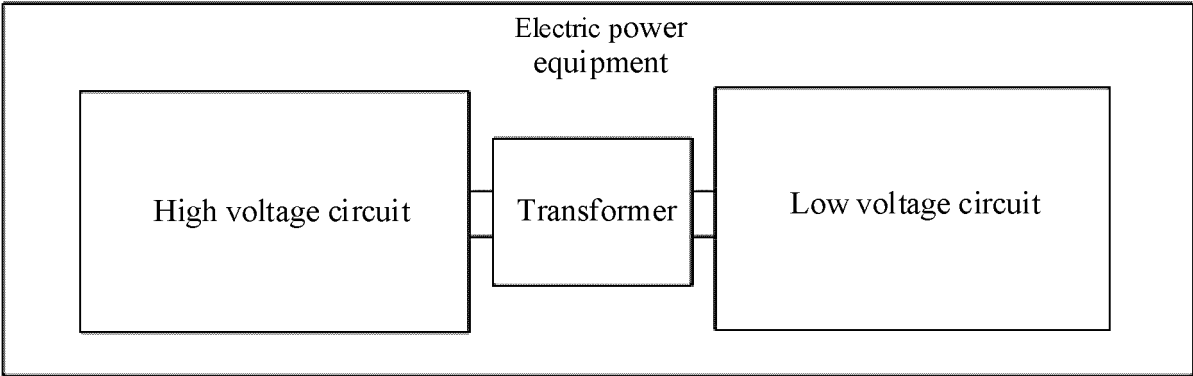


FIG. 1A

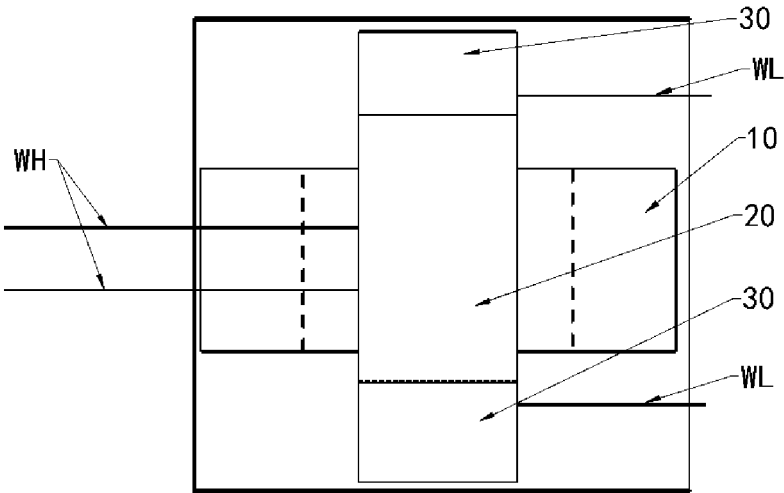


FIG. 1B

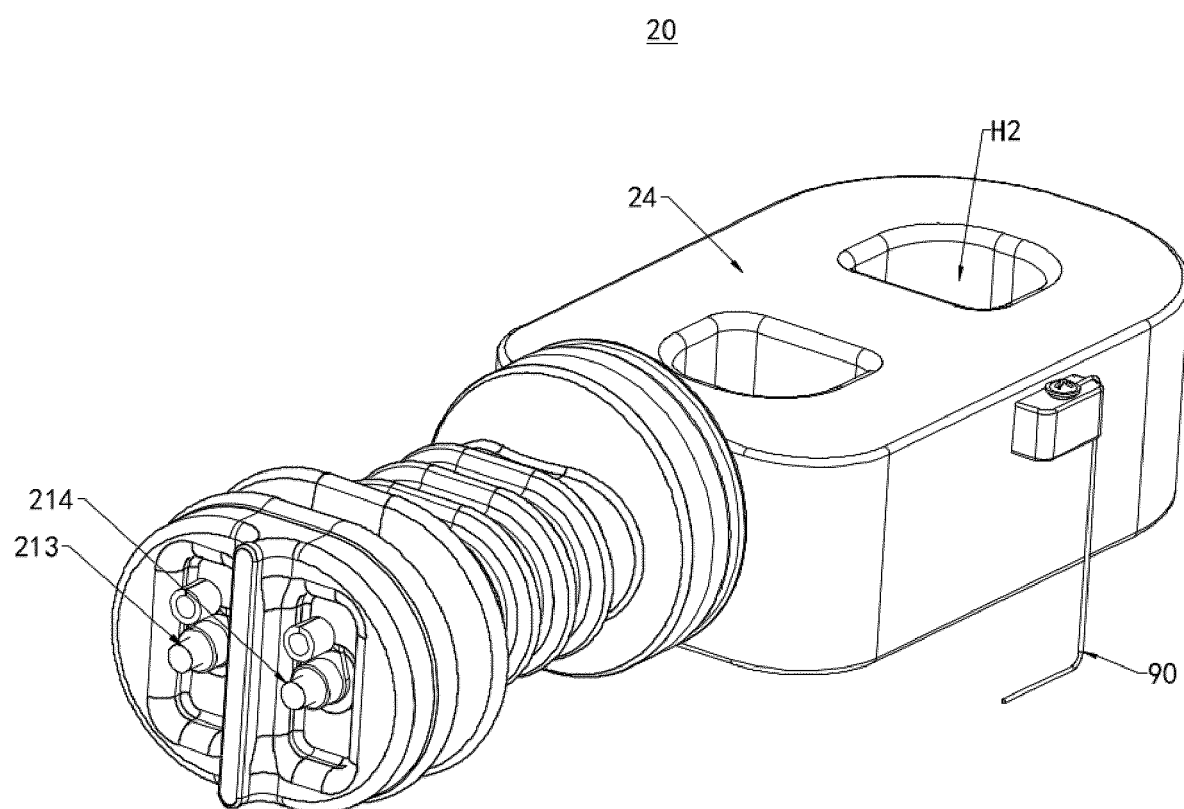


FIG. 2A

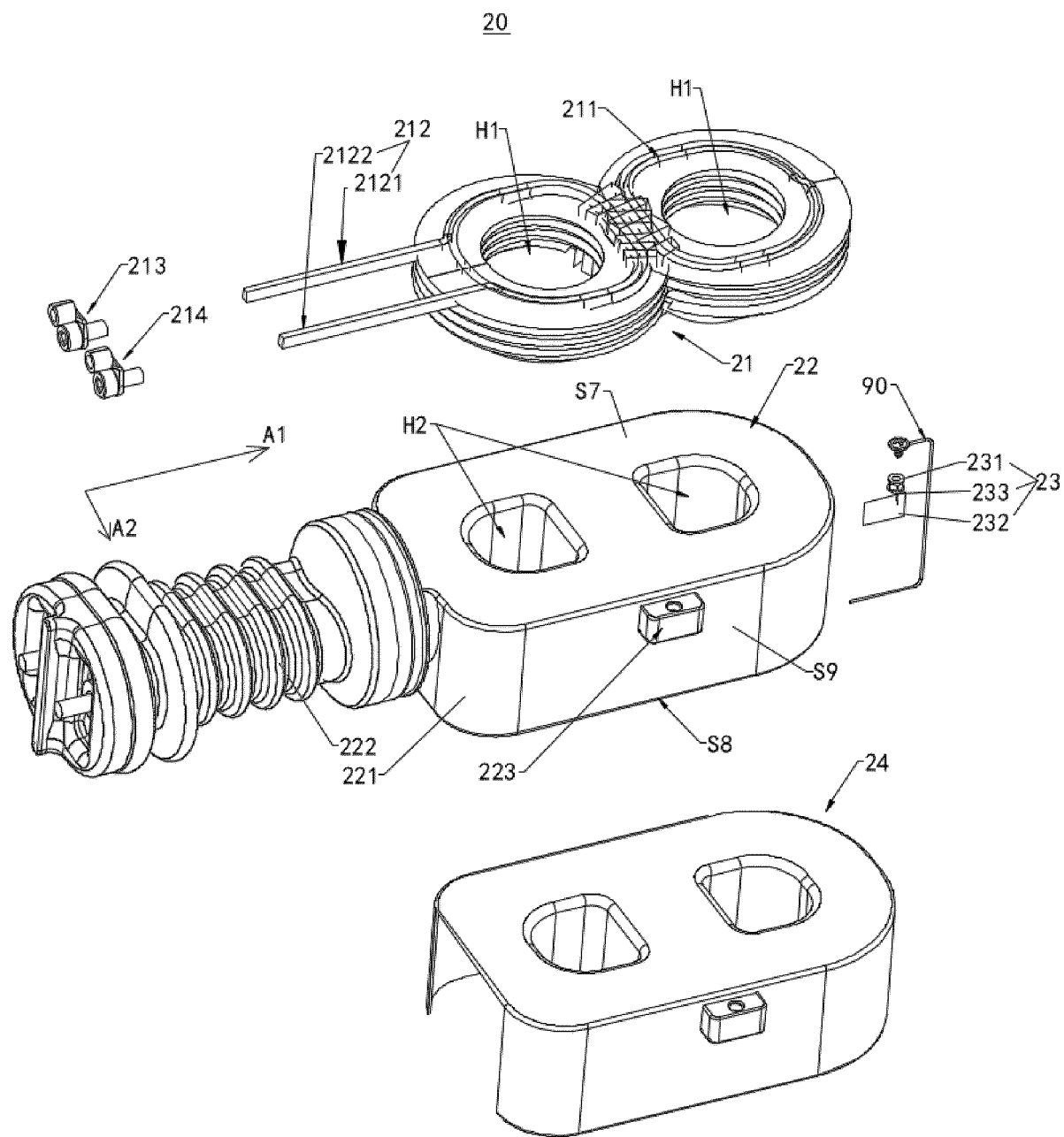


FIG. 2B

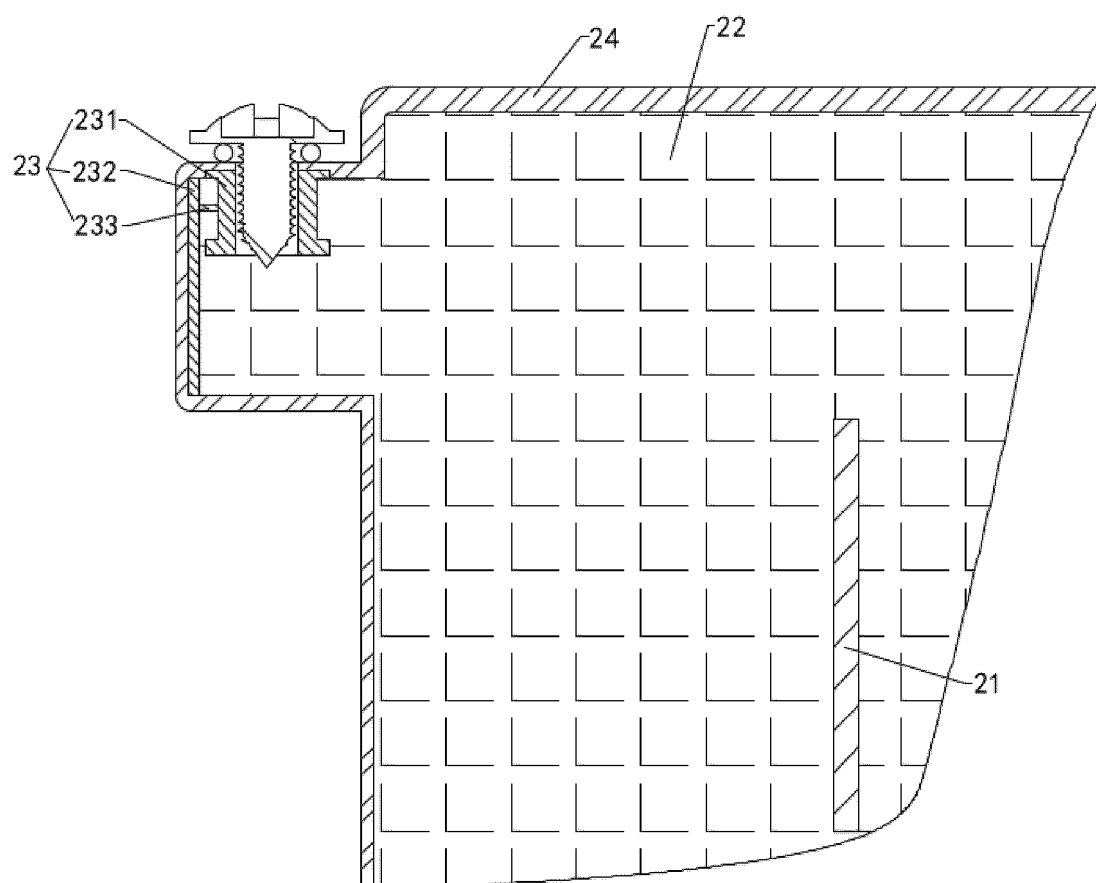


FIG. 3

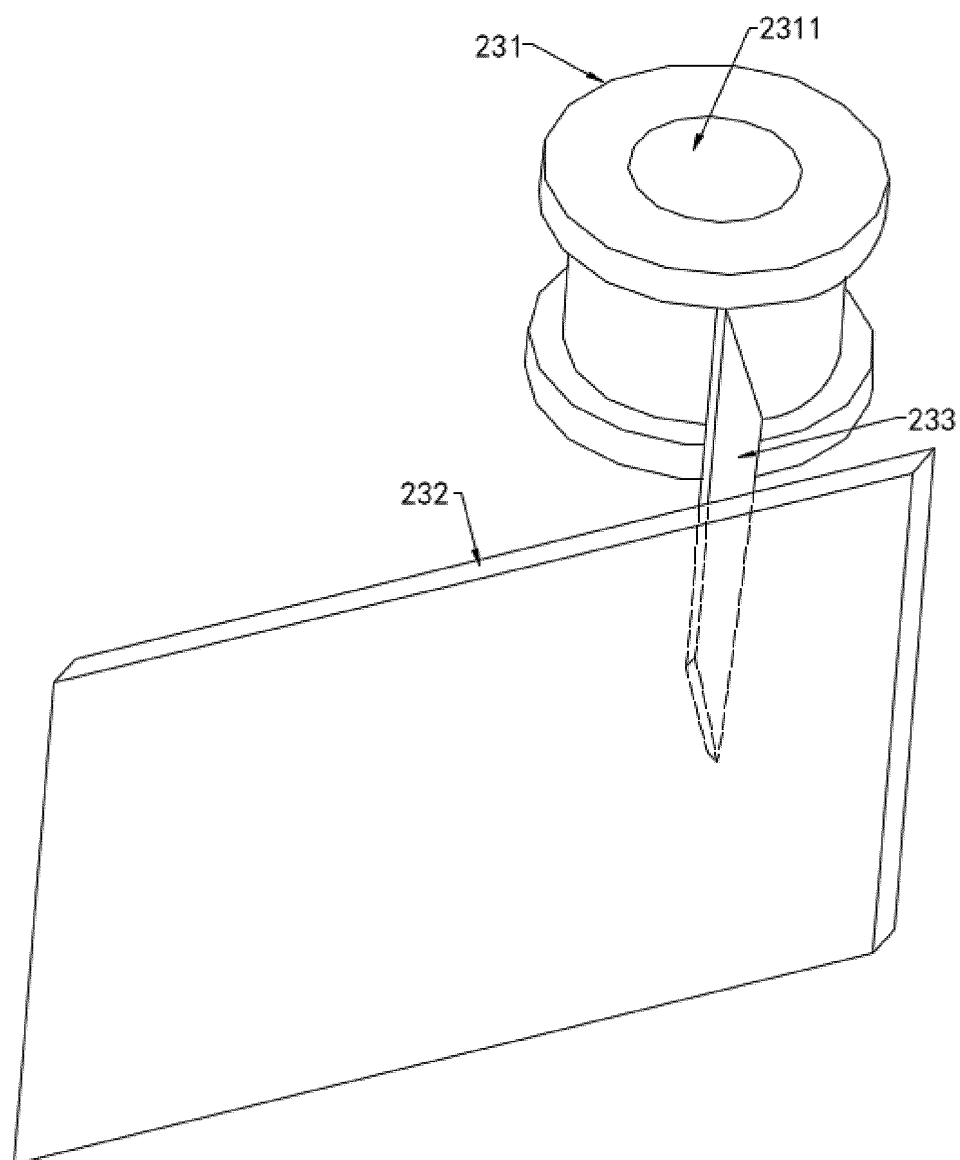


FIG. 4

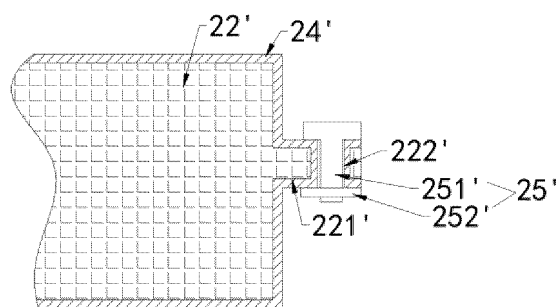


FIG. 5

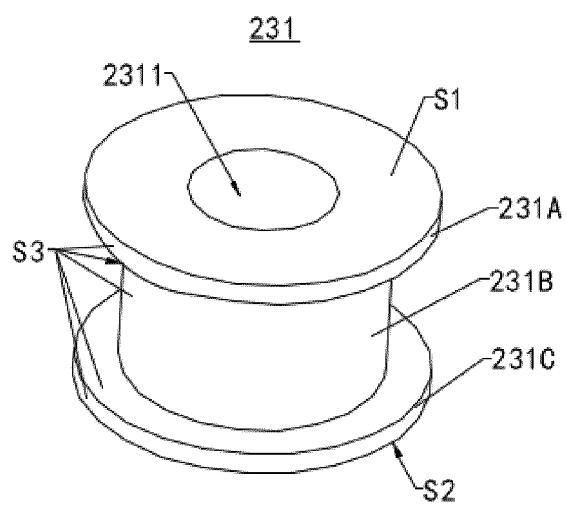


FIG. 6A

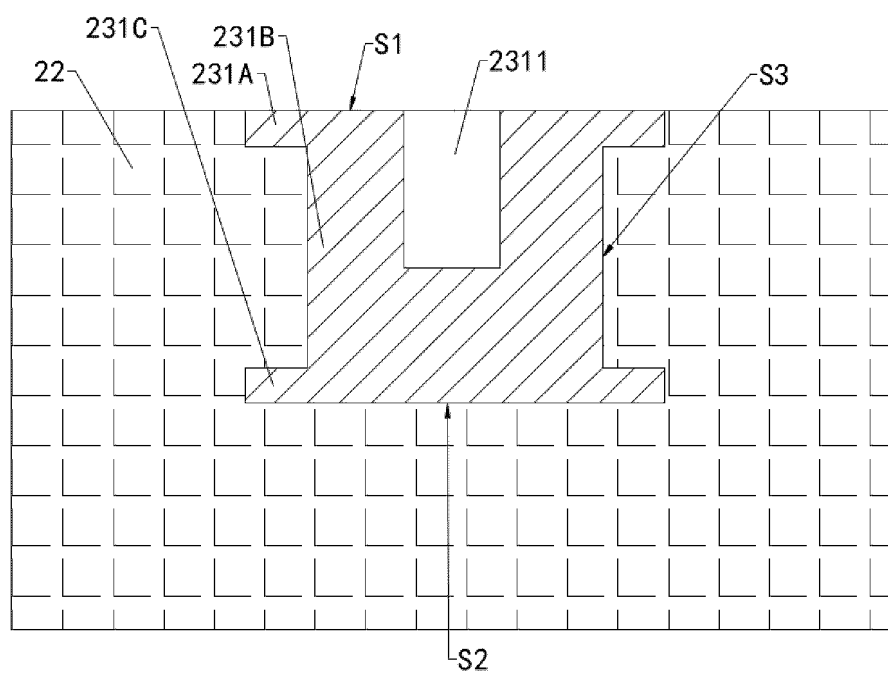


FIG. 6B

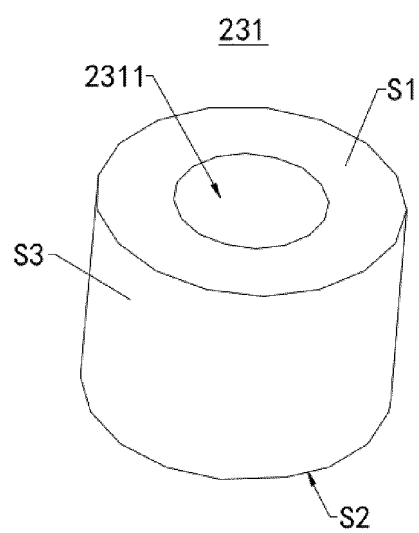


FIG. 7A

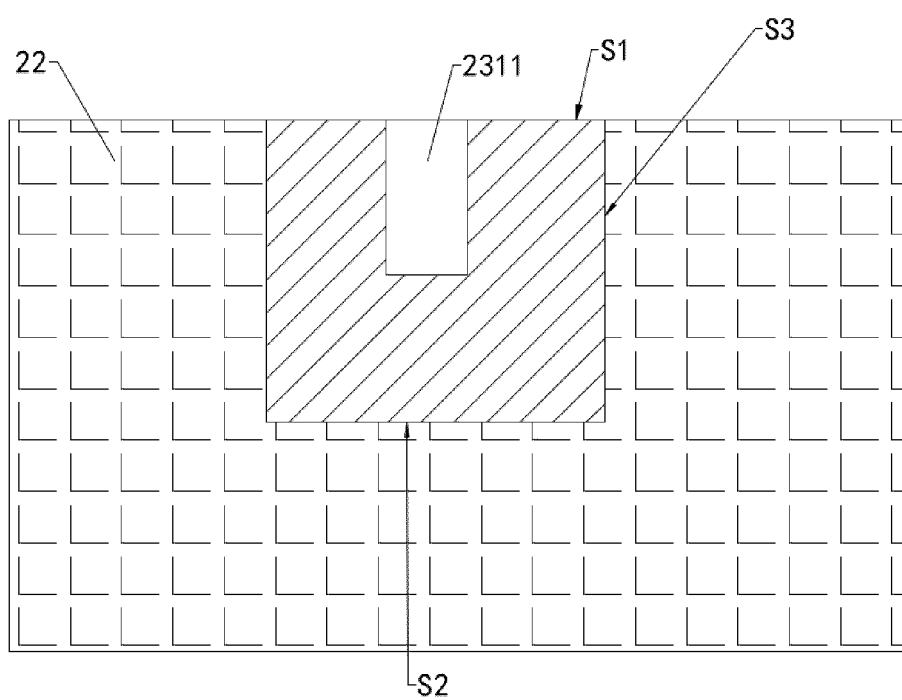


FIG. 7B

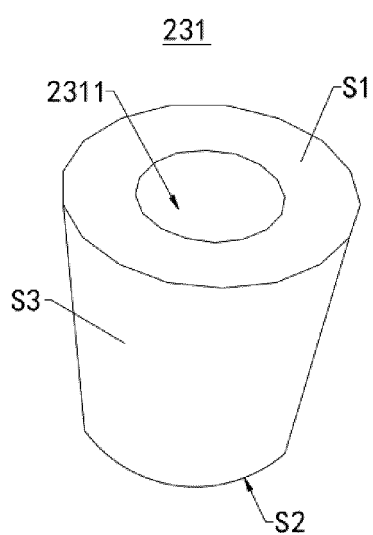


FIG. 8A

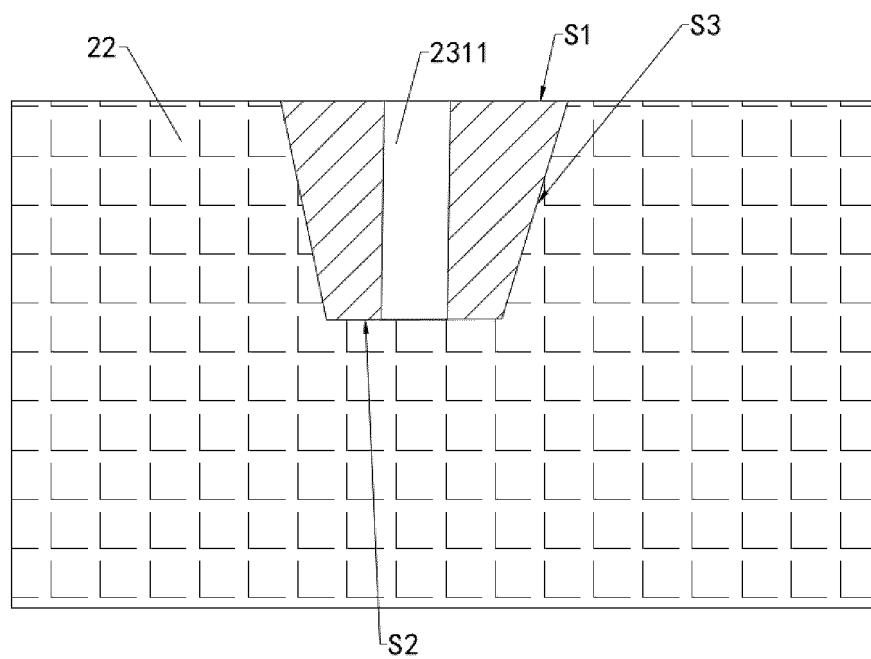


FIG. 8B

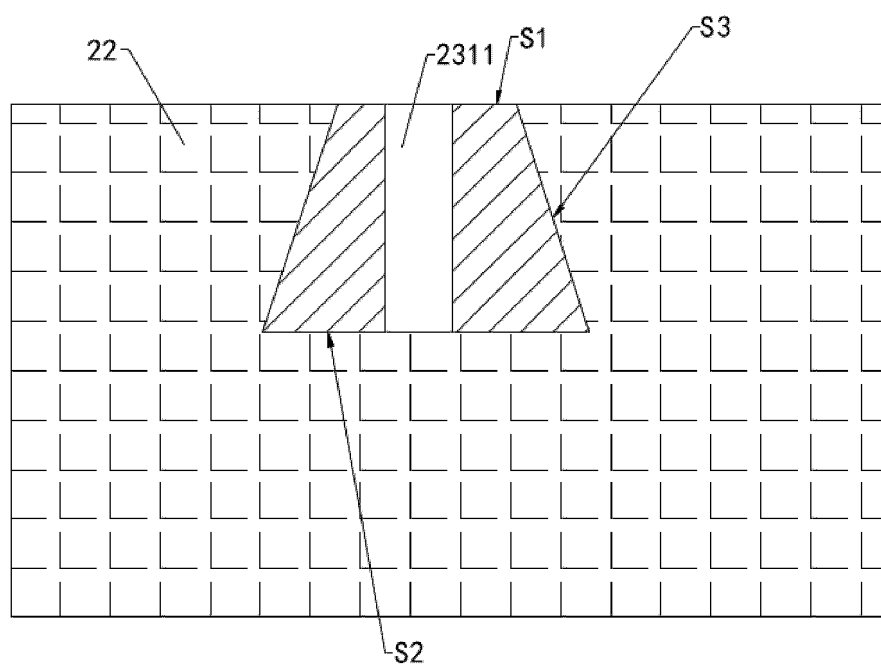


FIG. 8C

232

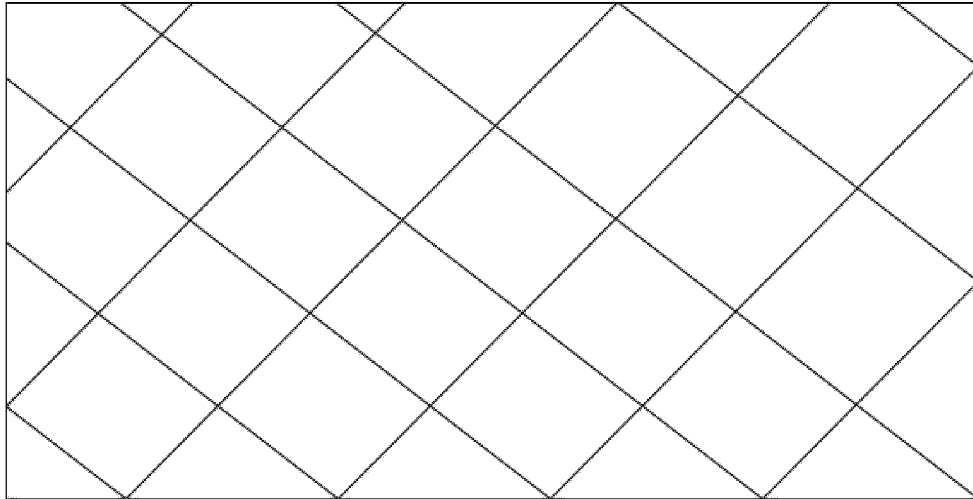


FIG. 9A

232

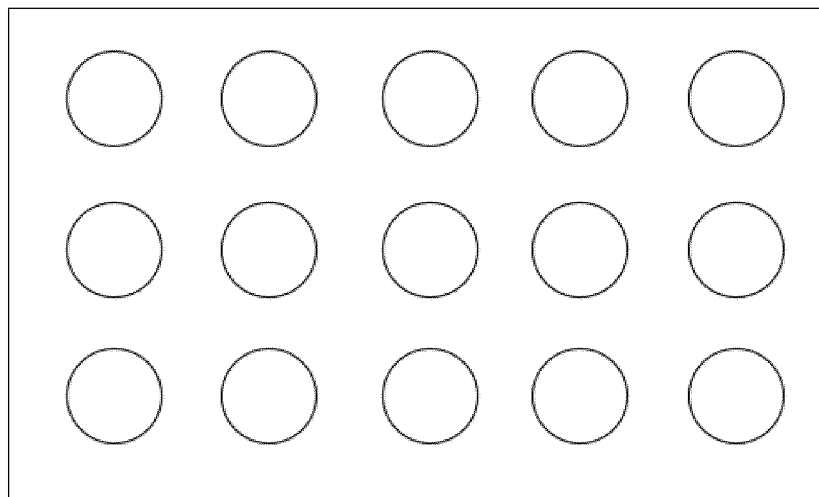


FIG. 9B

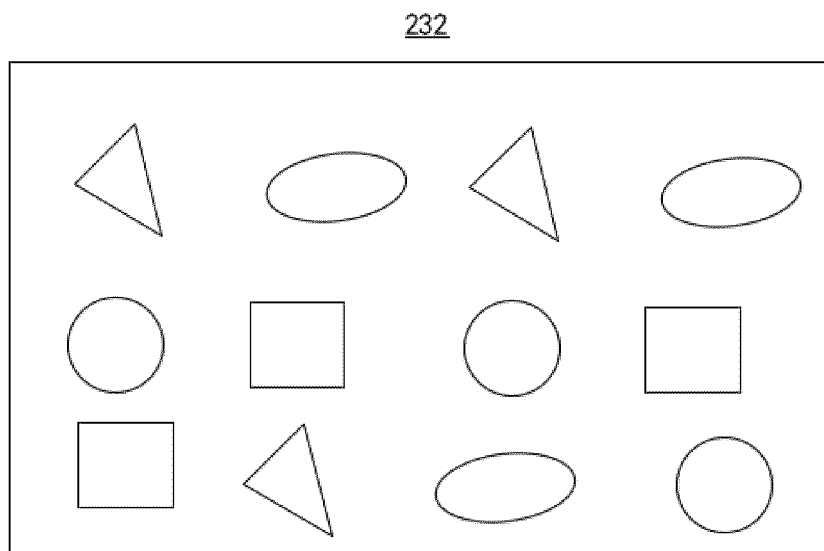


FIG. 9C

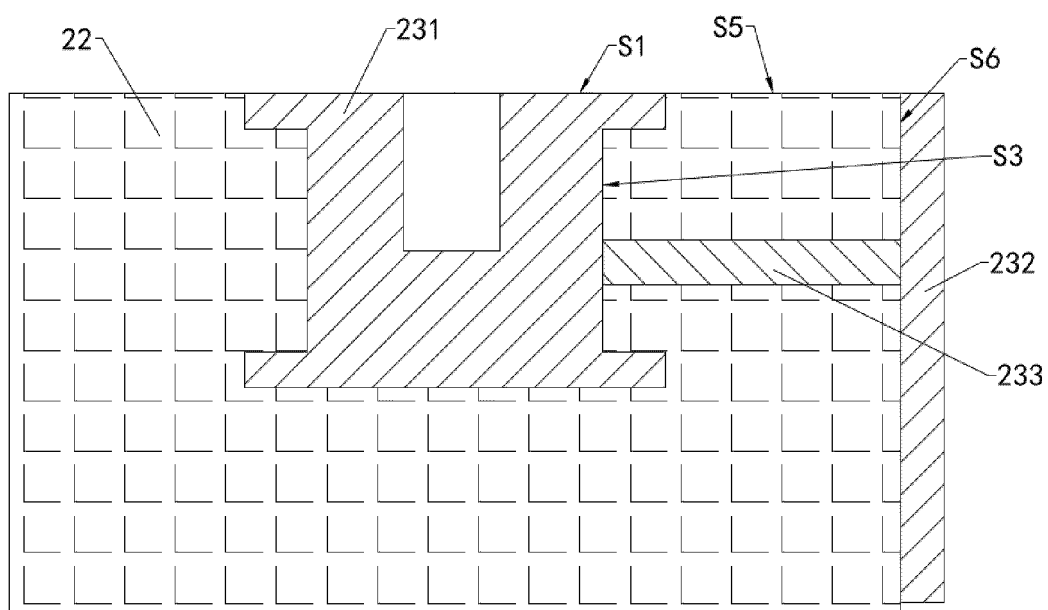


FIG. 10

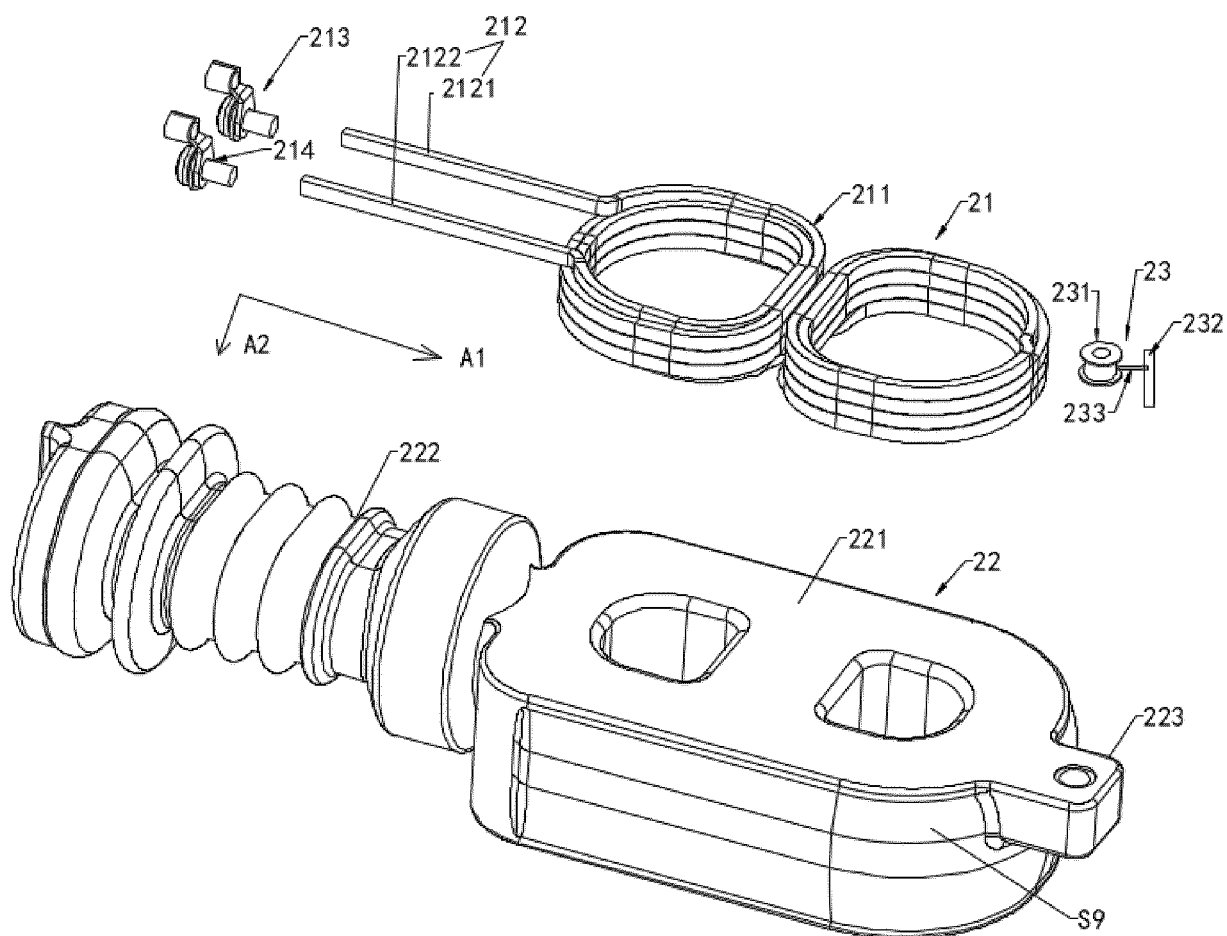


FIG. 11

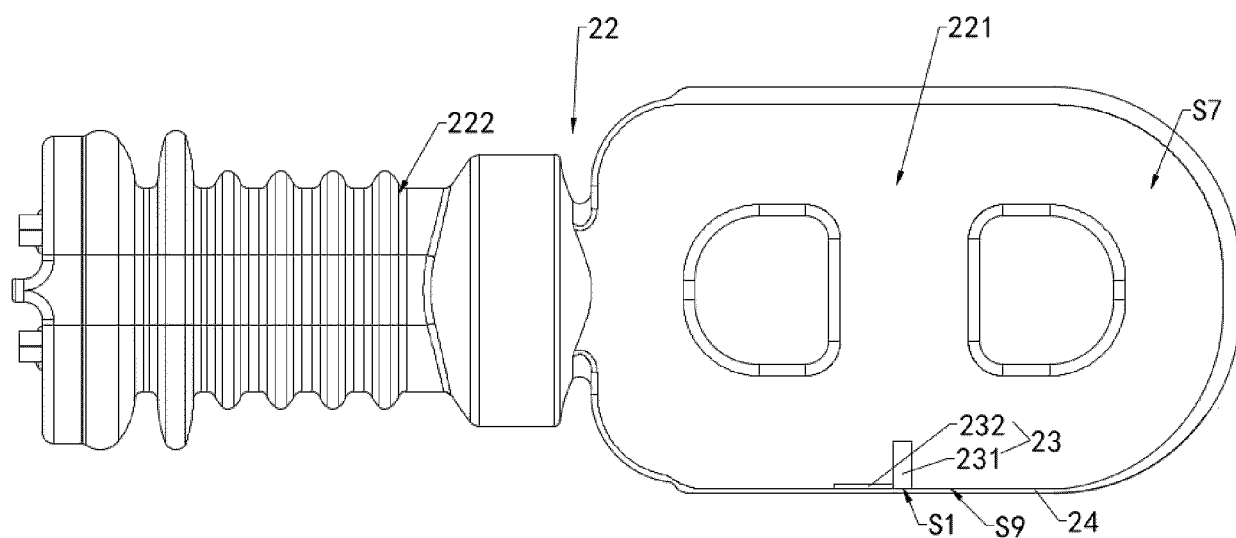


FIG. 12

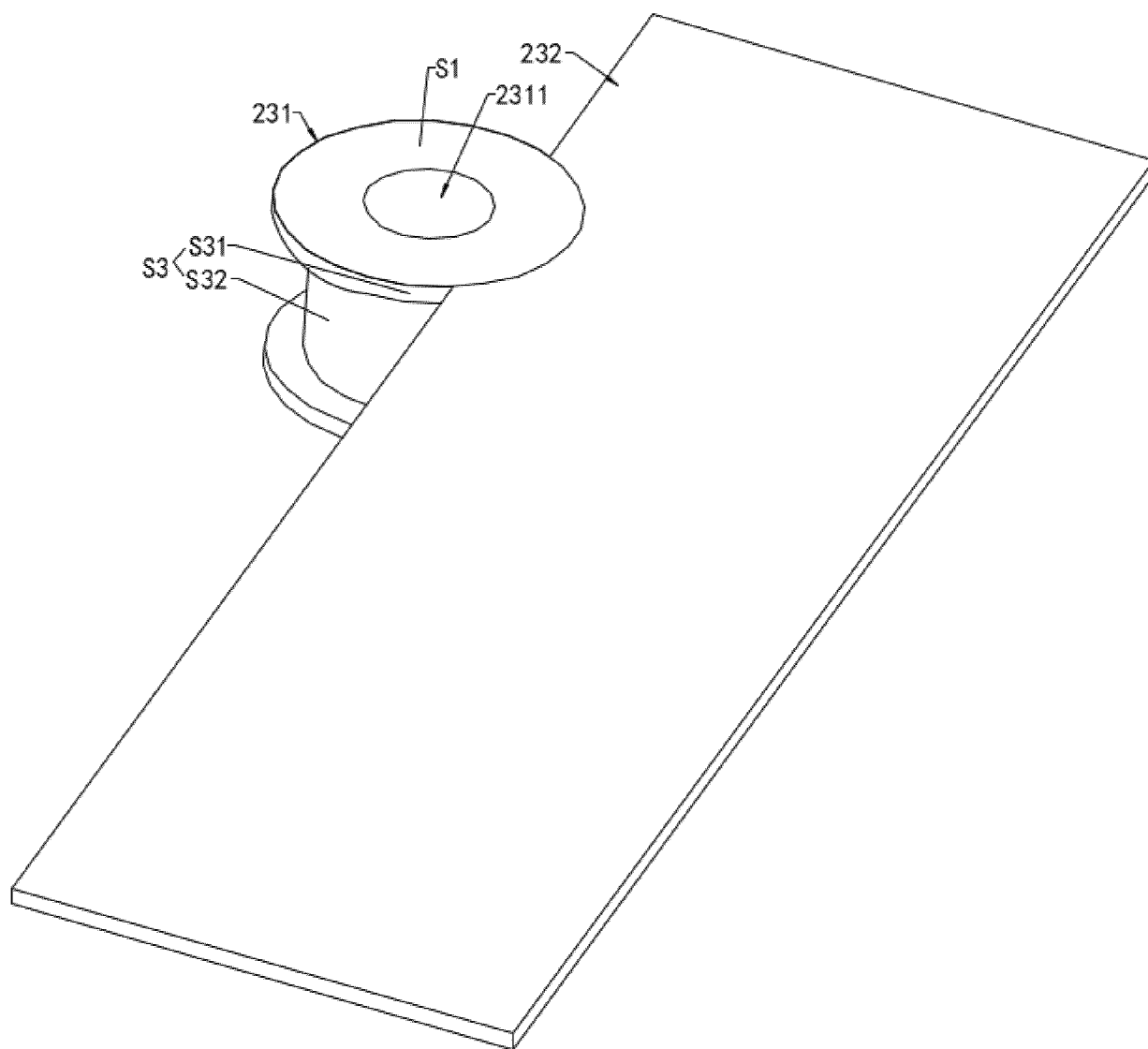


FIG. 13

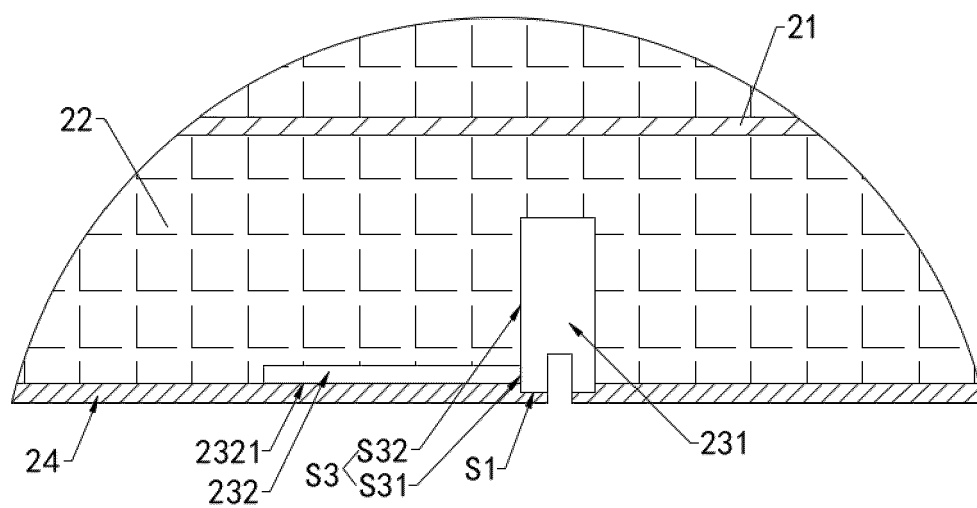


FIG. 14

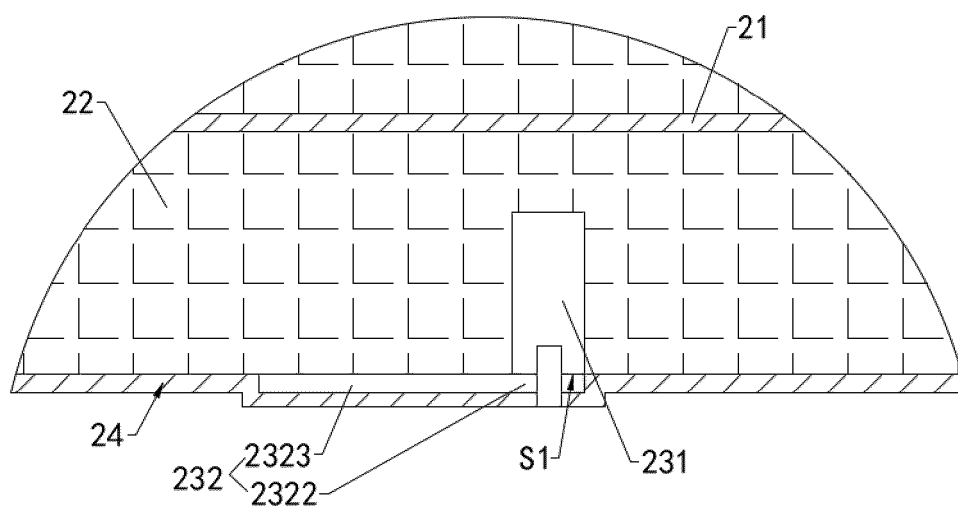


FIG. 15

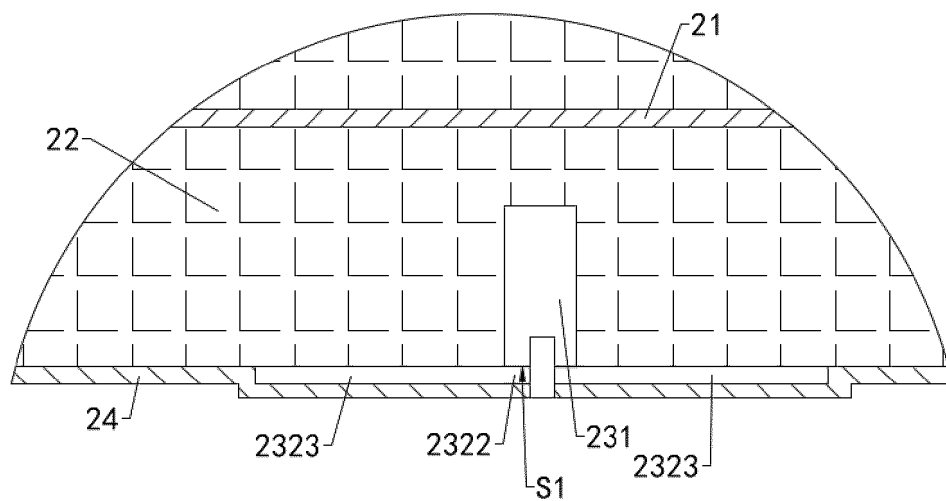


FIG. 16

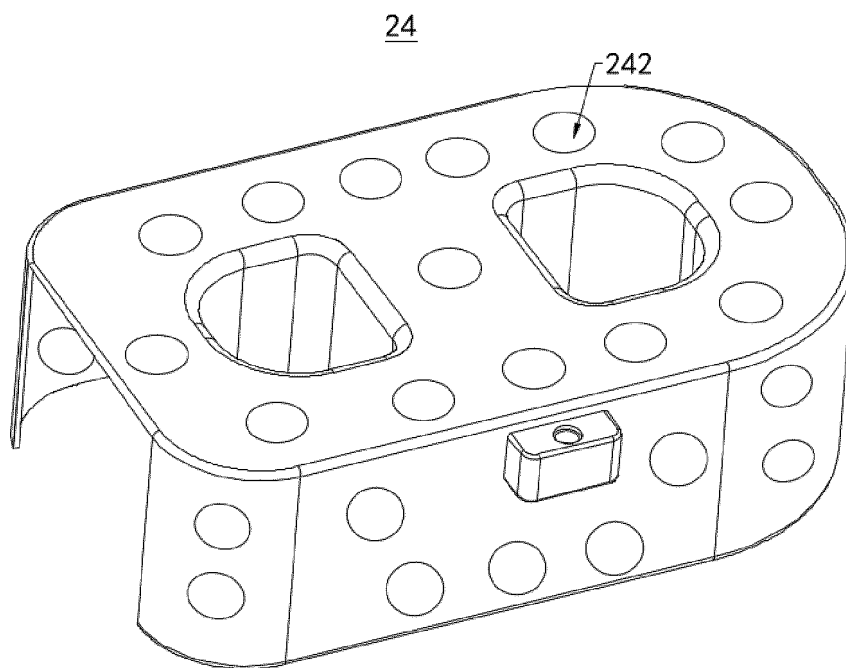


FIG. 17

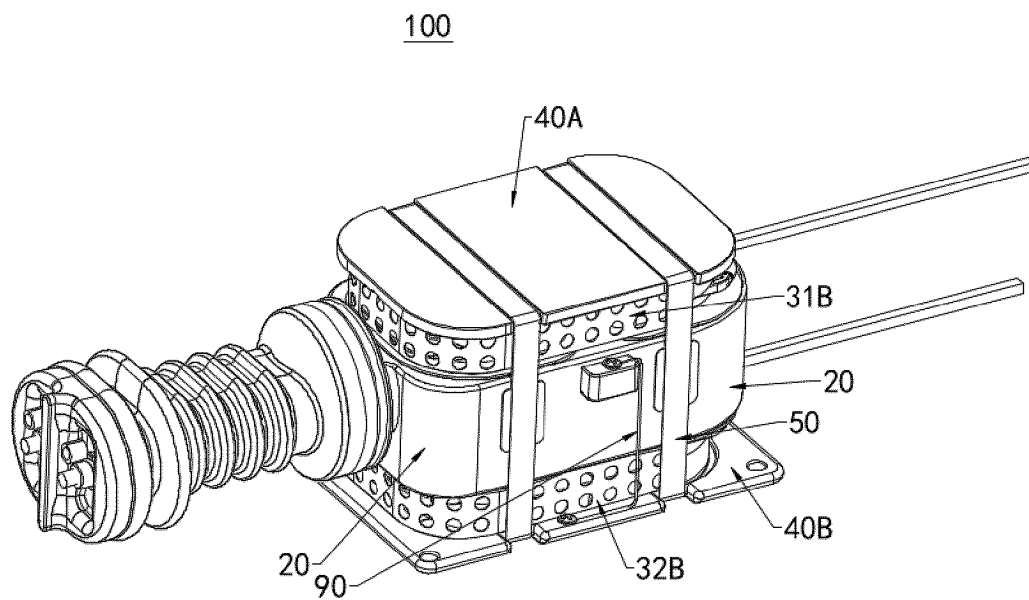


FIG. 18

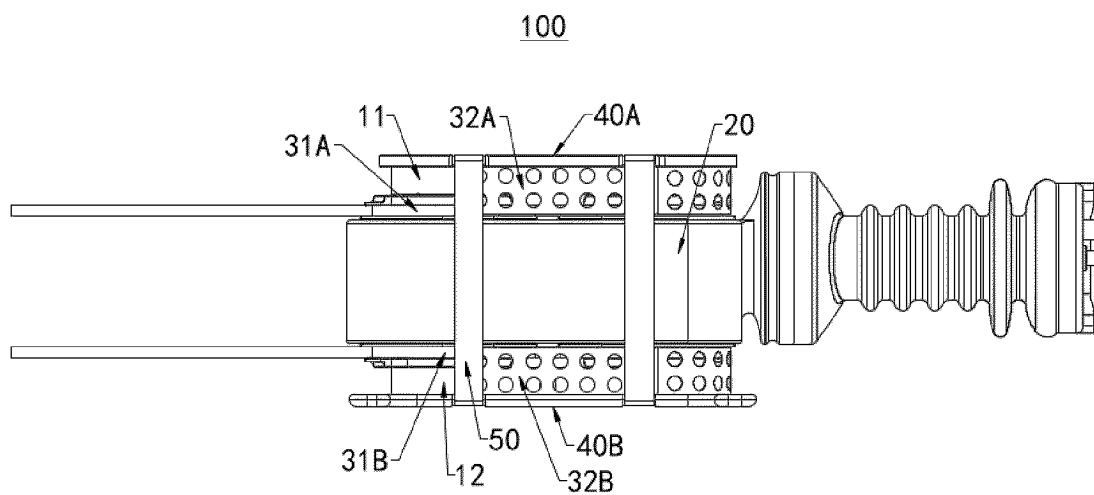


FIG. 19

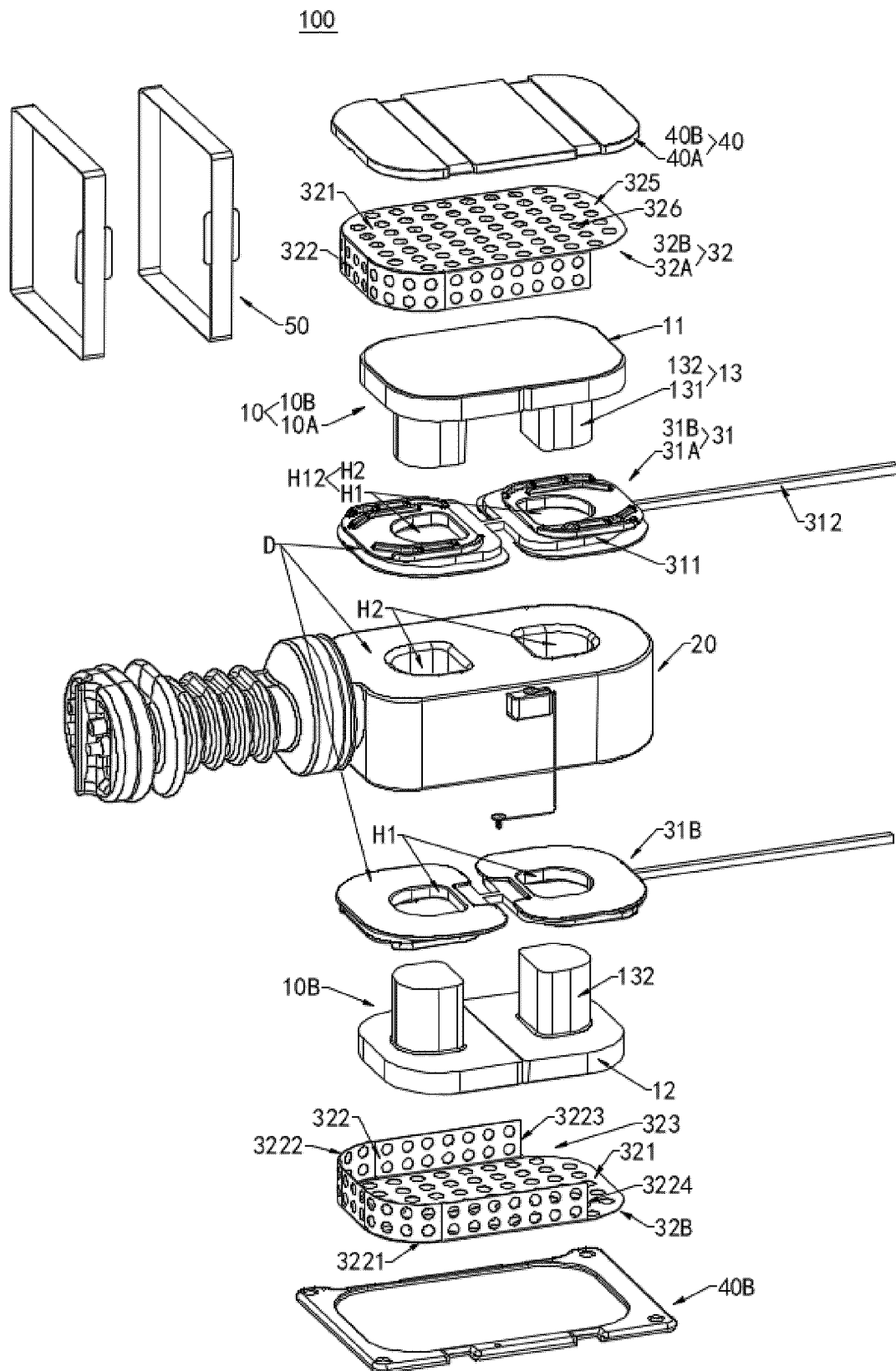


FIG. 20

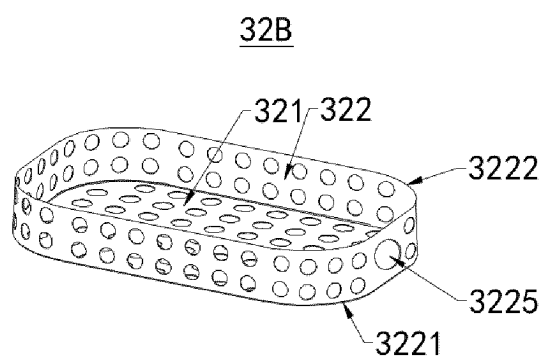


FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/077915

A. CLASSIFICATION OF SUBJECT MATTER

H01F27/30(2006.01)i; H01F27/36(2006.01)i; H01F27/32(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:H01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT, ENTXT, ENTXTC, DWPI, CNKI: 变压器, 高压, 接地, 绝缘层, 绝缘件, 屏蔽, 连接件, 导电板, transformer, high-voltage, grounding, insulating layer, insulator, shielding, connector, conductor board

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 114743778 A (HUAWEI DIGITAL POWER TECHNOLOGIES CO., LTD.) 12 July 2022 (2022-07-12) claims 1-28, and description, paragraphs [0003]-[0034], and figures 1-21	1-28
A	CN 113056800 A (SIEMENS ENERGY BRASIL LTDA. et al.) 29 June 2021 (2021-06-29) description, paragraphs [0027]-[0047], and figures 1-3	1-28
A	CN 205828113 U (ABB SCHWEIZ AG) 21 December 2016 (2016-12-21) entire document	1-28
A	CN 206460860 U (DELTA ELECTRONIC ENTERPRISE MANAGEMENT (SHANGHAI) CO., LTD.) 01 September 2017 (2017-09-01) entire document	1-28
A	US 2015109090 A1 (HAMMOND POWER SOLUTIONS, INC.) 23 April 2015 (2015-04-23) entire document	1-28

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

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

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“O” document referring to an oral disclosure, use, exhibition or other means

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

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

29 May 2023

Date of mailing of the international search report

31 May 2023

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
China No. 6, Xitucheng Road, Jimenqiao, Haidian District,
Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2023/077915

Patent document cited in search report				Publication date (day/month/year)		Patent family member(s)		Publication date (day/month/year)	
CN 114743778 A				12 July 2022		None			
CN 113056800 A				29 June 2021		CA	3102648 A1	12 December 2019	
						WO	2019232763 A1	12 December 2019	
						EP	3791413 A1	17 March 2021	
						BR	112020024709 A2	30 March 2021	
						US	2021151246 A1	20 May 2021	
						IN	202017056672 A	22 October 2021	
						EP	3791413 A4	05 January 2022	
						IN	399529 B	24 June 2022	
						BR	112020024709 A8	10 January 2023	
CN 205828113 U				21 December 2016		None			
CN 206460860 U				01 September 2017		US	2019096567 A1	28 March 2019	
						US	2020243253 A1	30 July 2020	
						US	2020251278 A1	06 August 2020	
						US	11250990 B2	15 February 2022	
						US	11417456 B2	16 August 2022	
						US	11515080 B2	29 November 2022	
						US	2018211761 A1	26 July 2018	
						US	10886054 B2	05 January 2021	
US 2015109090 A1				23 April 2015		WO	2015058298 A1	30 April 2015	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202210227744 [0001]