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(12) **United States Patent**
Kim et al.

(10) **Patent No.: US 12,395,048 B2**
(45) **Date of Patent: *Aug. 19, 2025**

(54) **CONTROLLER AND MOTOR ASSEMBLY COMPRISING SAME**

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(73) Assignee: **LG INNOTEK CO., LTD.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 248 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **18/074,626**

(22) Filed: **Dec. 5, 2022**

(65) **Prior Publication Data**

US 2023/0098103 A1 Mar. 30, 2023

Related U.S. Application Data

(63) Continuation of application No. 16/647,813, filed as application No. PCT/KR2018/008514 on Jul. 27, 2018, now Pat. No. 11,545,878.

(30) **Foreign Application Priority Data**

Sep. 29, 2017 (KR) 10-2017-0128155
Oct. 16, 2017 (KR) 10-2017-0133853
Nov. 13, 2017 (KR) 10-2017-0150611

(51) **Int. Cl.**
H02K 11/33 (2016.01)
H02K 5/06 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H02K 11/33*** (2016.01); ***H02K 5/06*** (2013.01); ***H02K 5/225*** (2013.01); ***H05K 7/20854*** (2013.01); *H05K 2201/0999* (2013.01)

(58) **Field of Classification Search**
CPC .. H02K 5/00; H02K 5/06; H02K 5/22; H02K 5/225; H02K 11/00; H02K 11/02;
(Continued)

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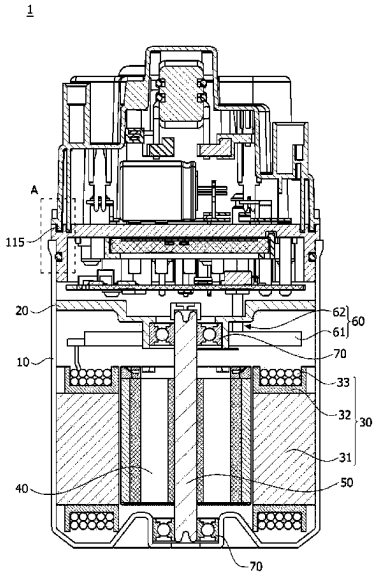
Primary Examiner — Tran N Nguyen
(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A controller including a first housing; a first cover disposed on an opening of the first housing; filter units disposed above the first cover; a power module unit disposed below the first cover; and a substrate disposed below the power module unit; wherein the power module unit includes a bracket; and a power module disposed between the bracket and the first cover, and wherein the power module includes a power module body; a plurality of first pins arranged to protrude downward from one side of the power module body; and five terminal pins arranged to protrude downward from the other side of the power module body, wherein an end portion of the first pin is coupled to the substrate.

20 Claims, 38 Drawing Sheets



(51) **Int. Cl.**
H02K 5/22 (2006.01)
H05K 7/20 (2006.01)

(58) **Field of Classification Search**
CPC . H02K 11/33; H02K 7/00; H02K 7/20; H02K 7/208; H02K 7/20854
See application file for complete search history.

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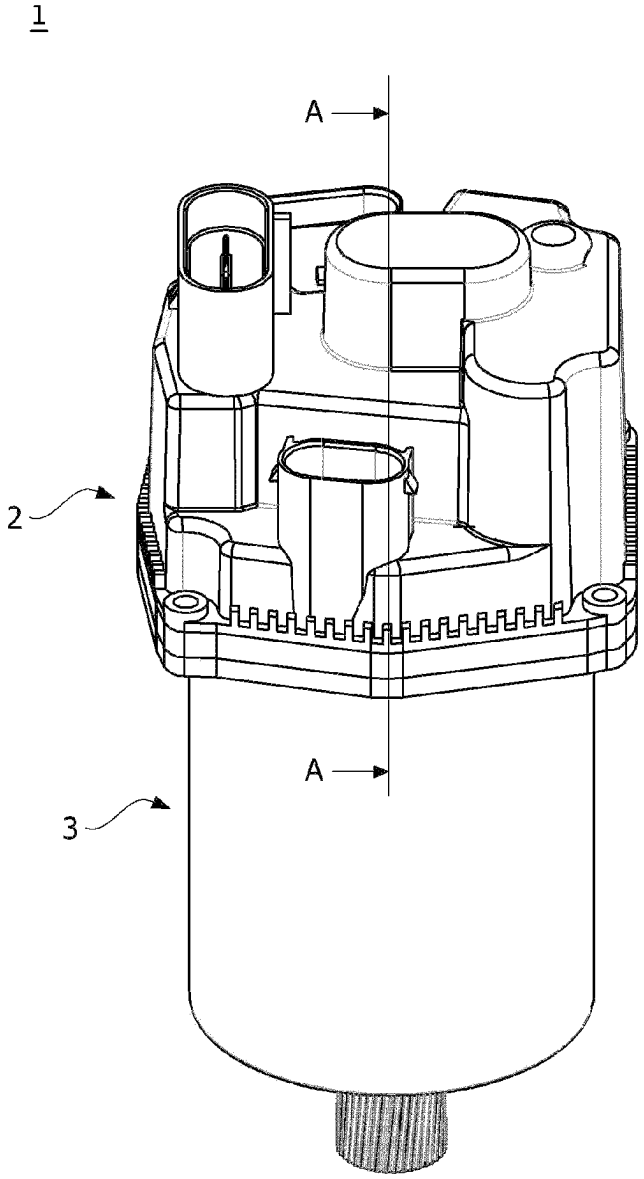
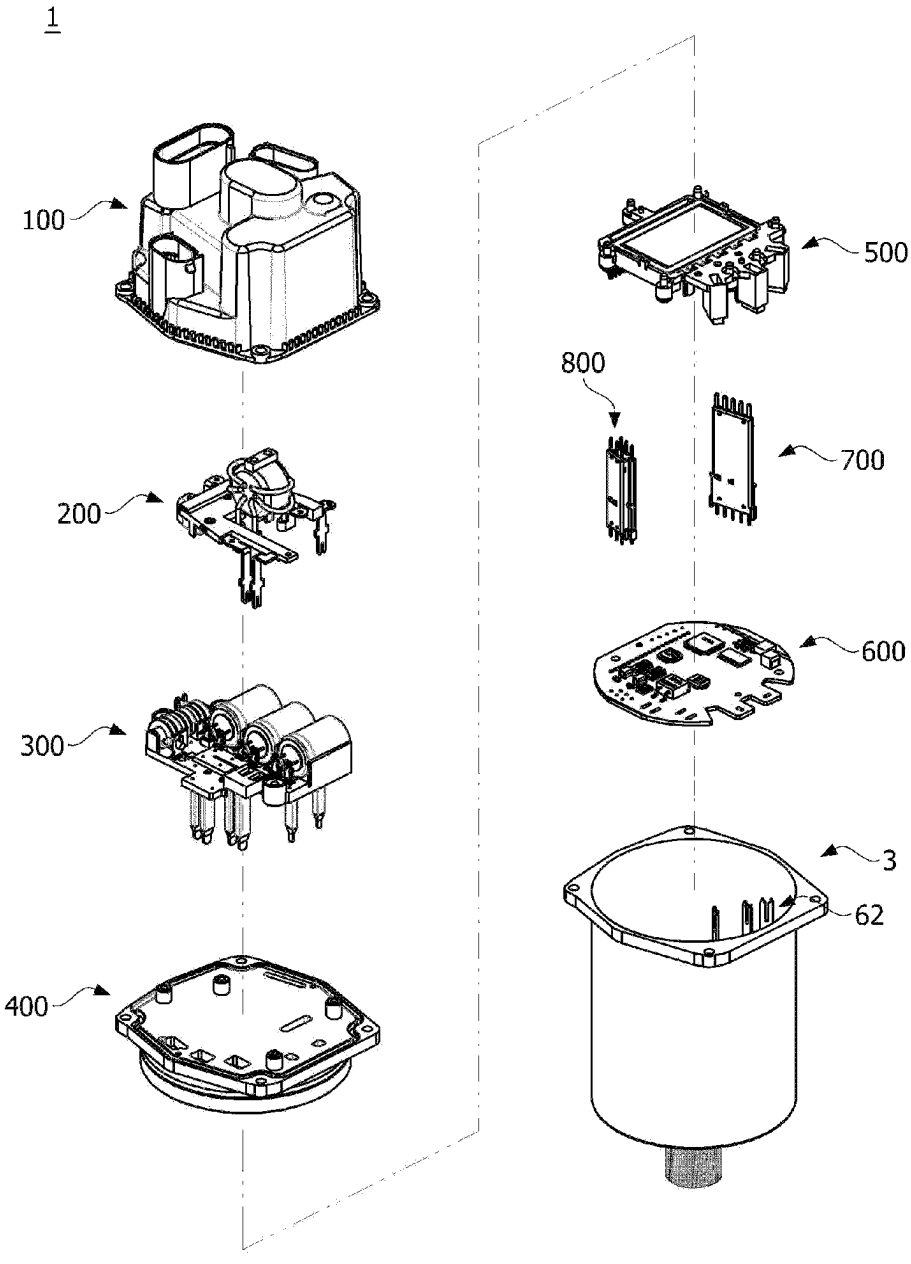
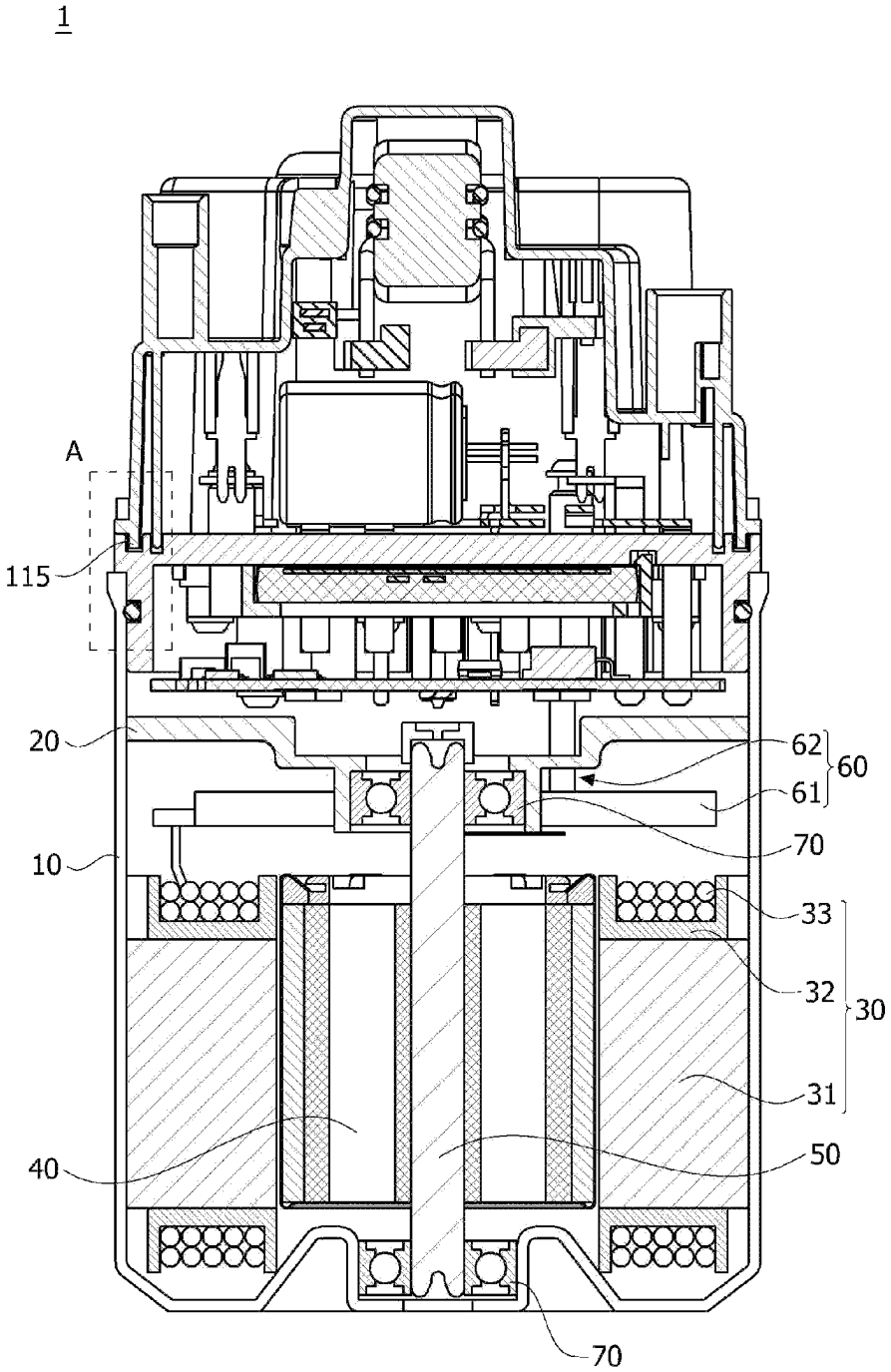
【FIG. 1】



【FIG. 2】



【FIG. 3】



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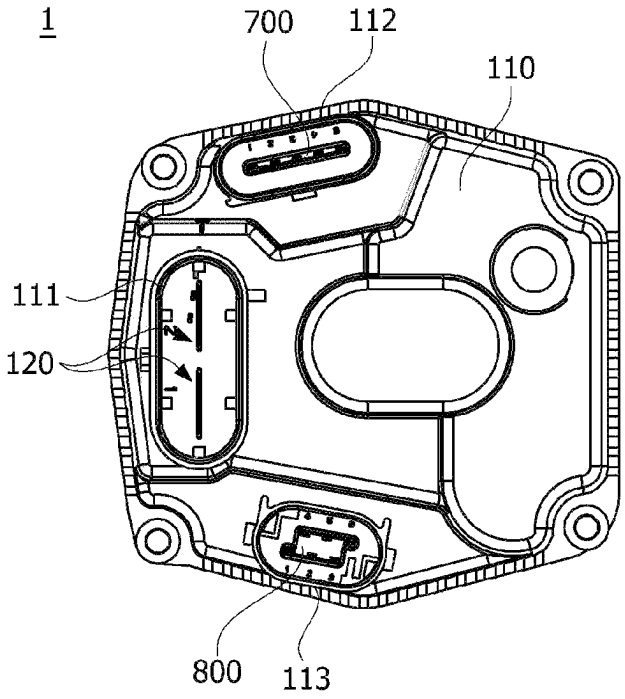
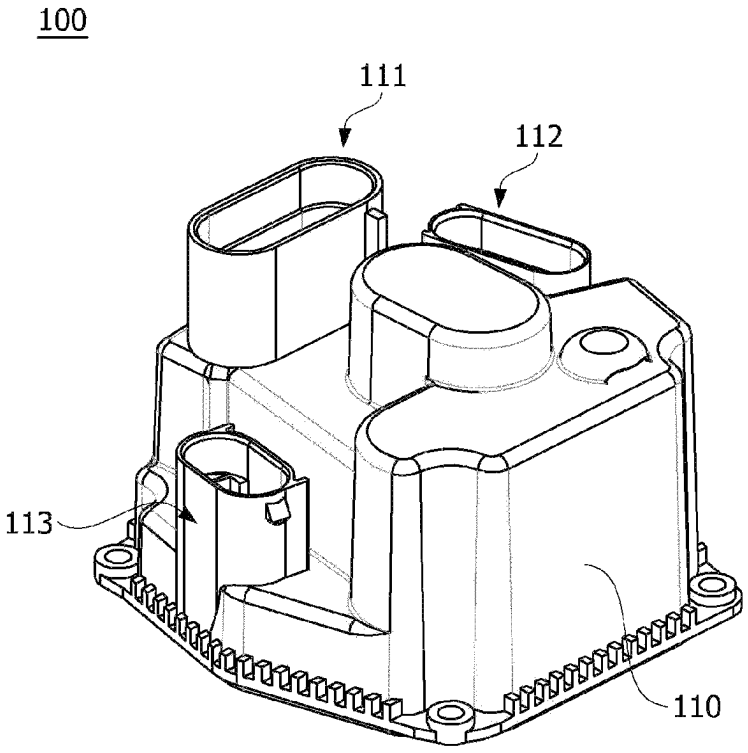


【FIG. 5】



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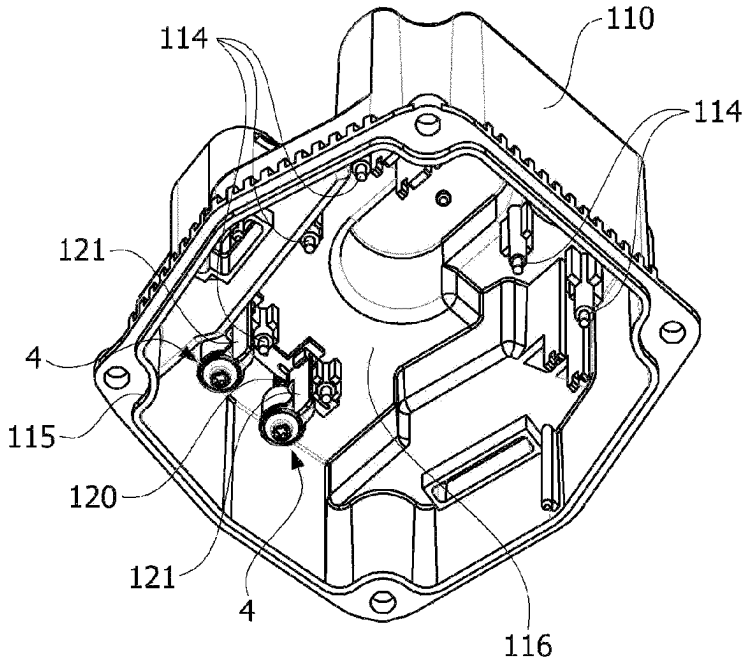
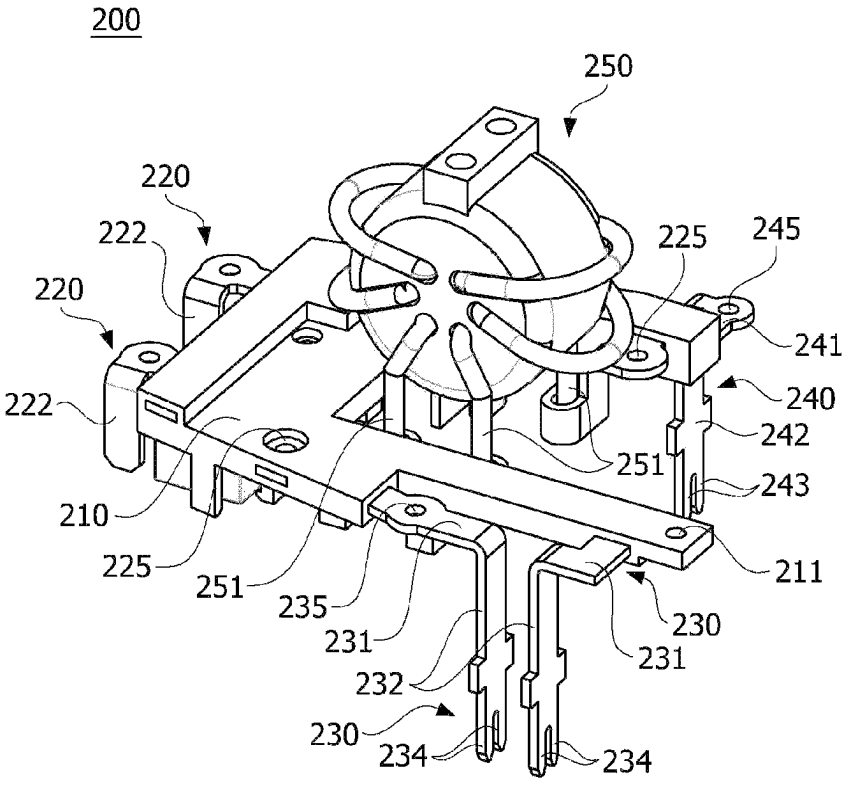


【FIG. 7】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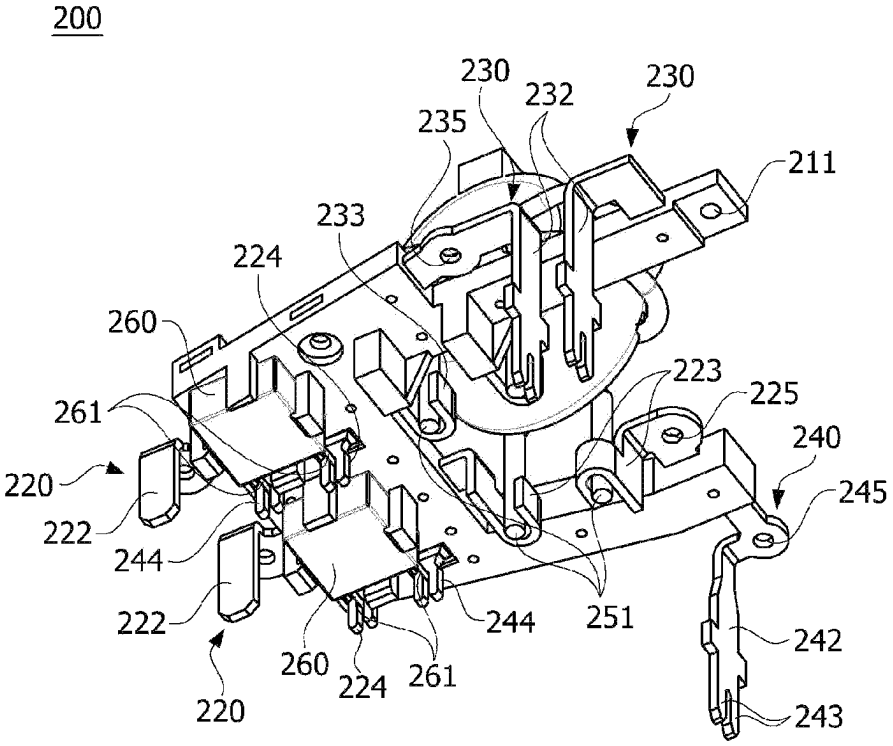
【FIG. 8】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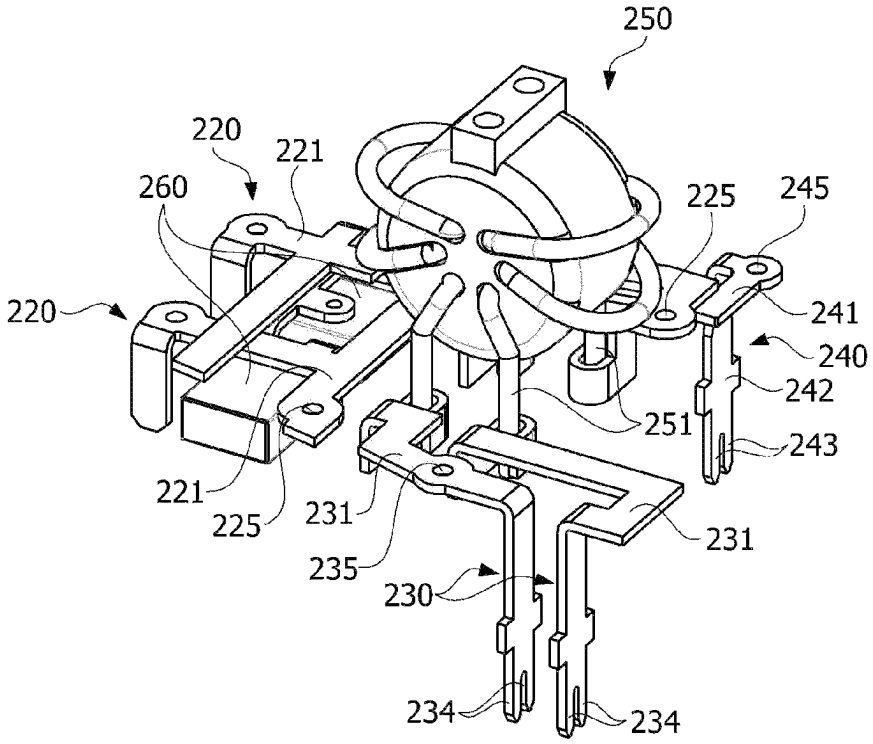
【FIG. 9】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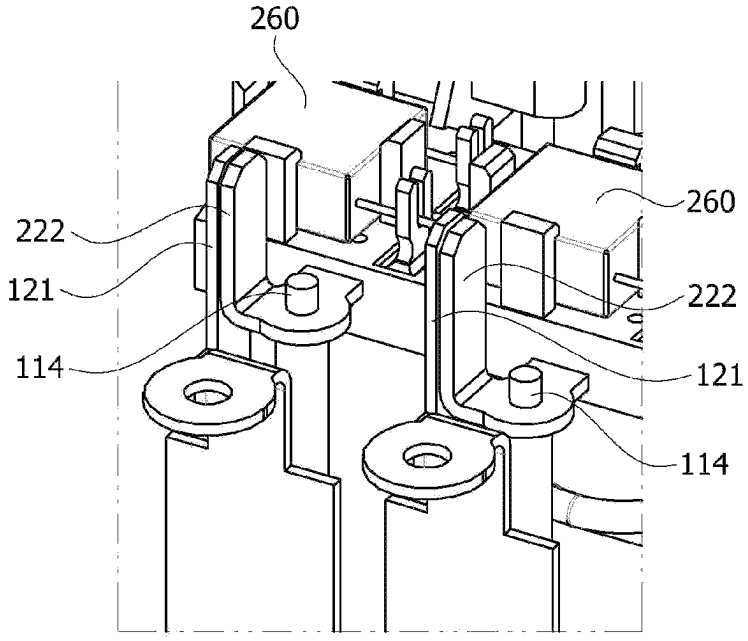
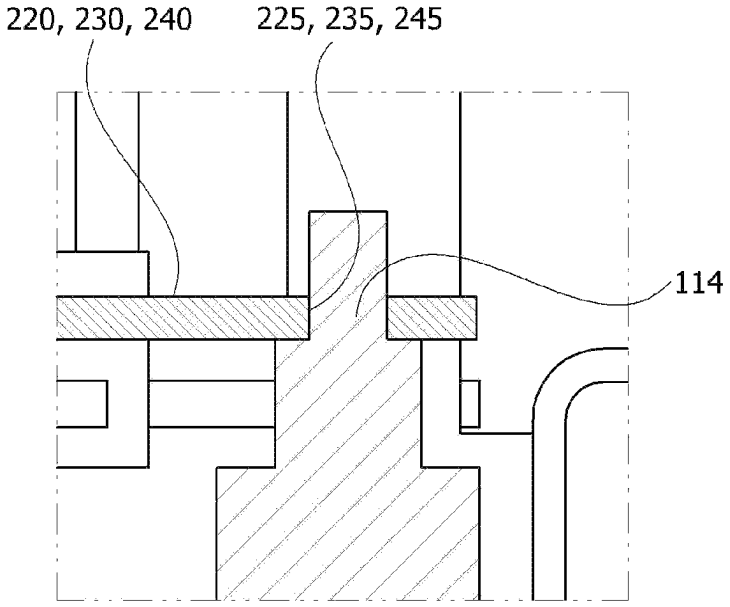
【FIG. 10】



【FIG. 11】



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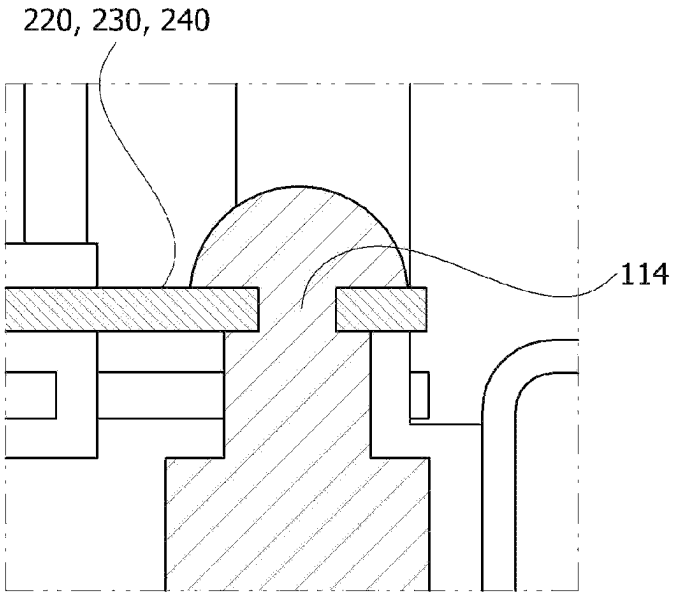
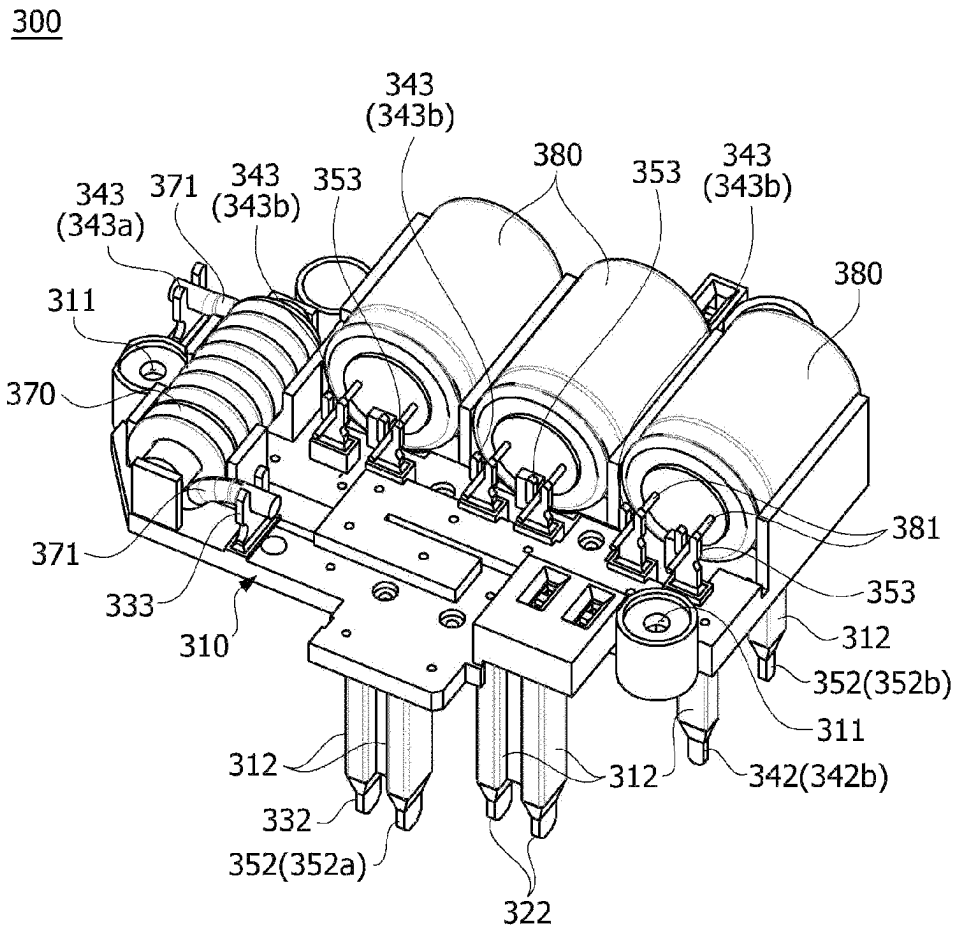


【FIG. 13】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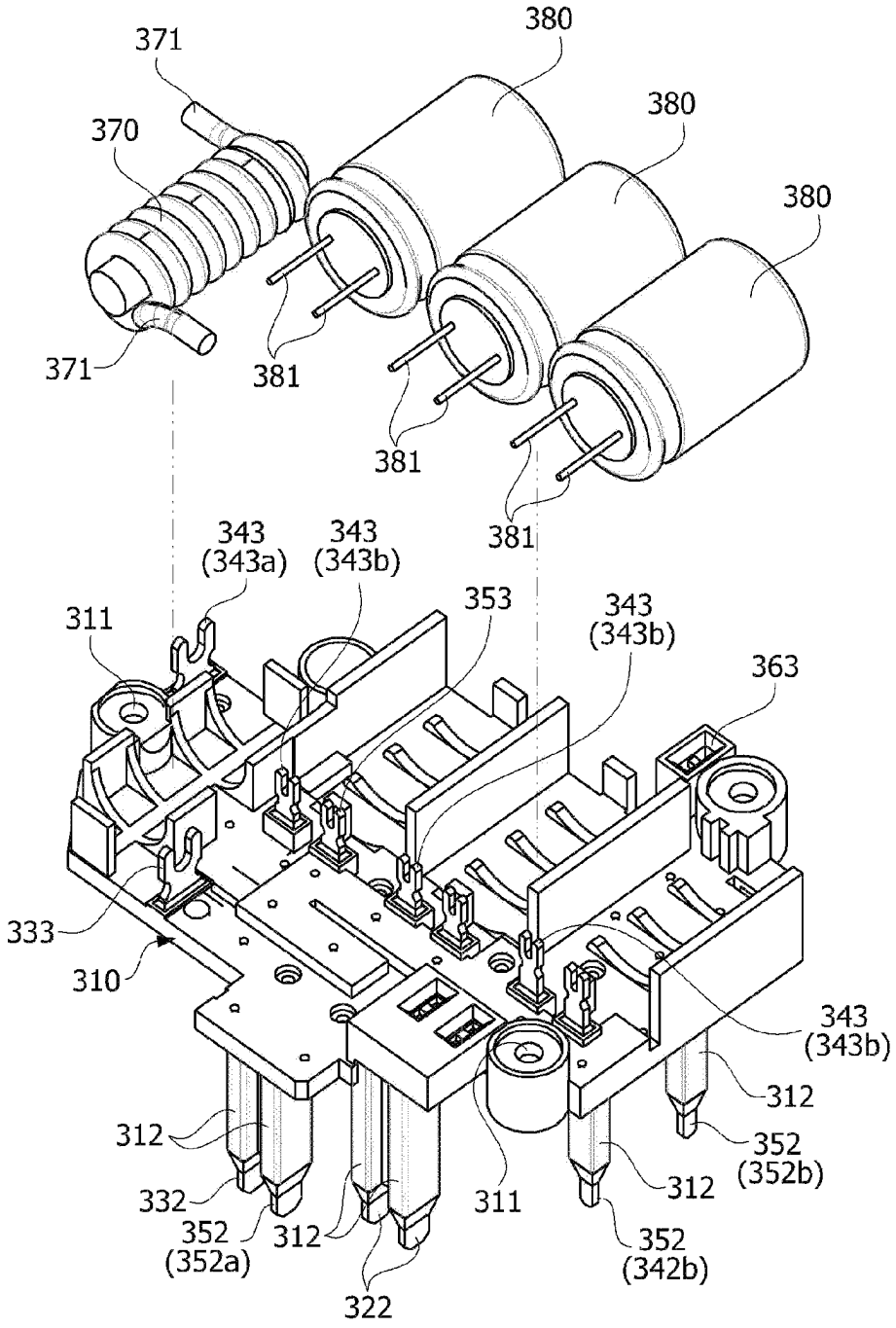
【FIG. 14】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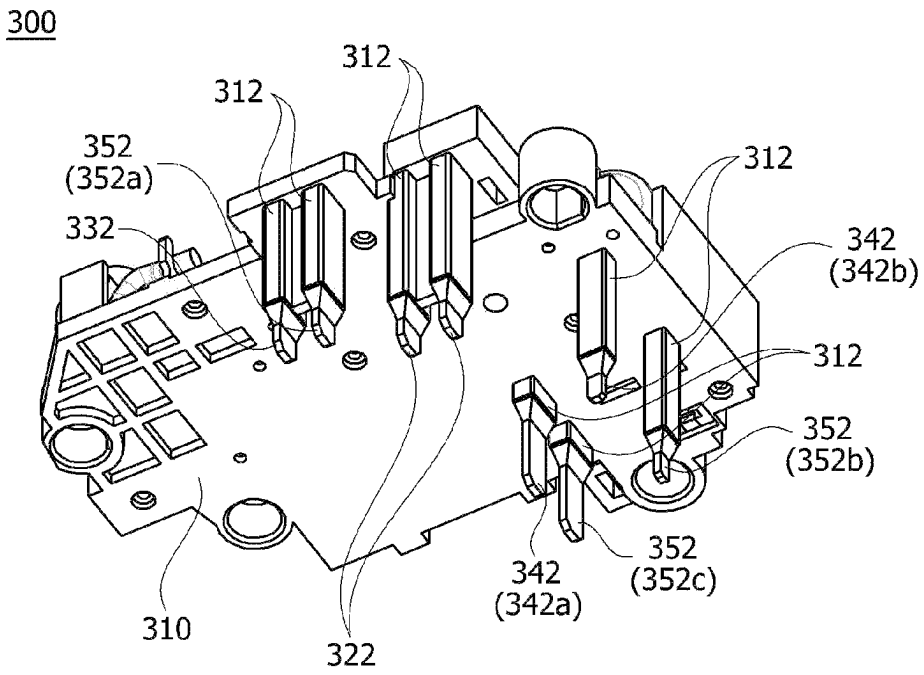
【FIG. 15】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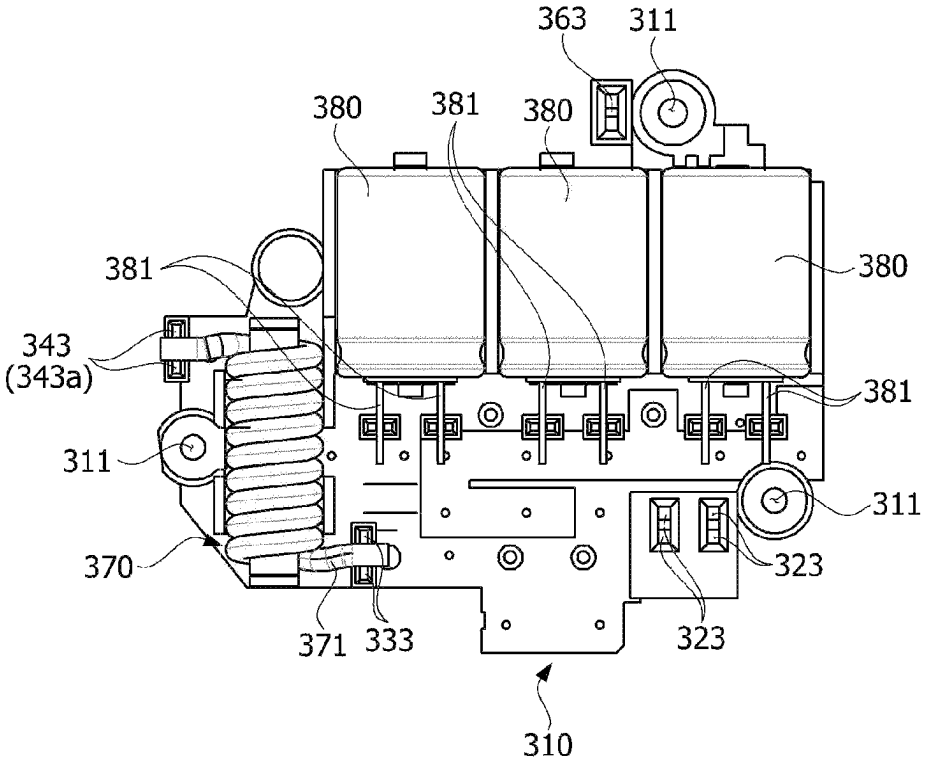
【FIG. 16】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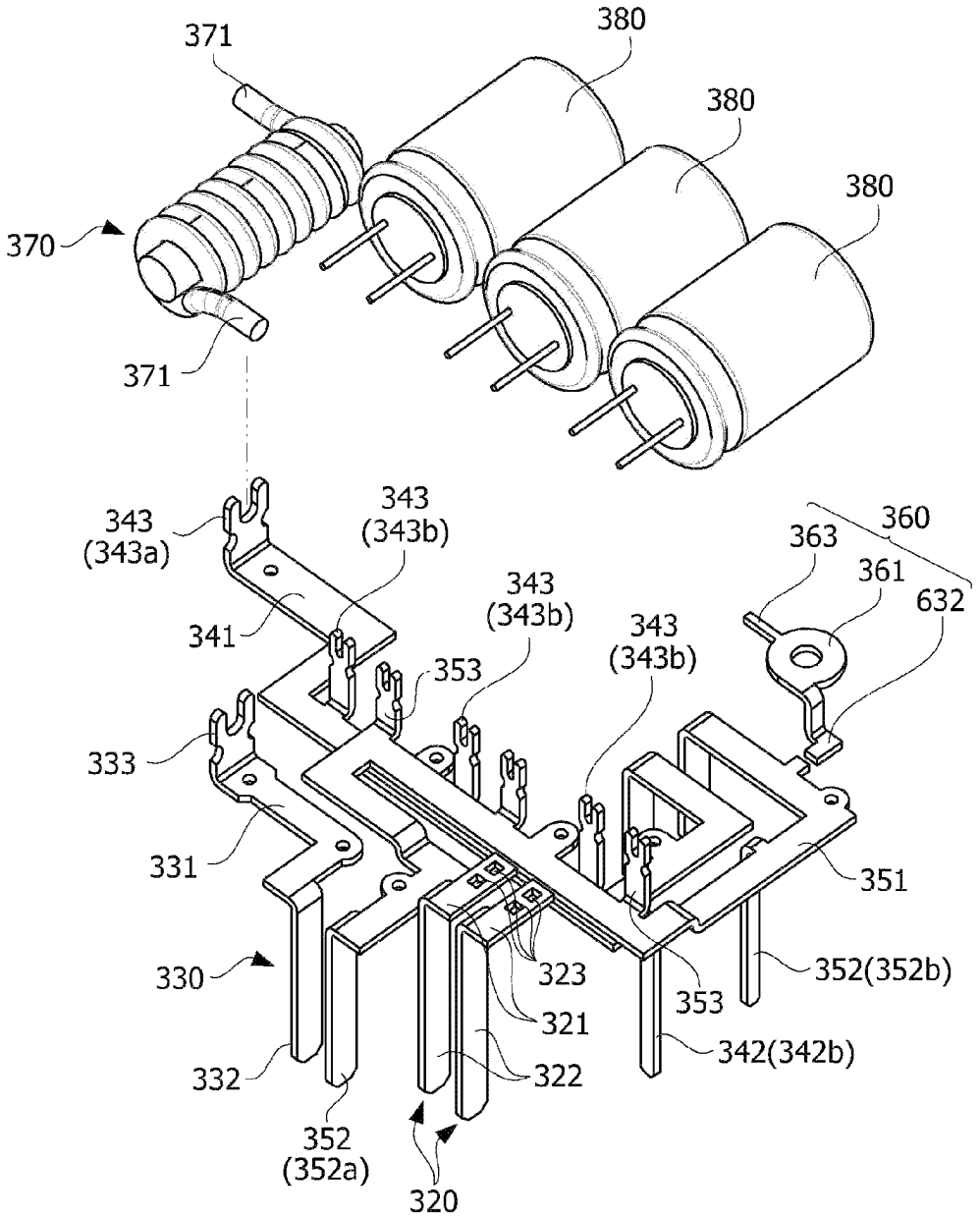
【FIG. 17】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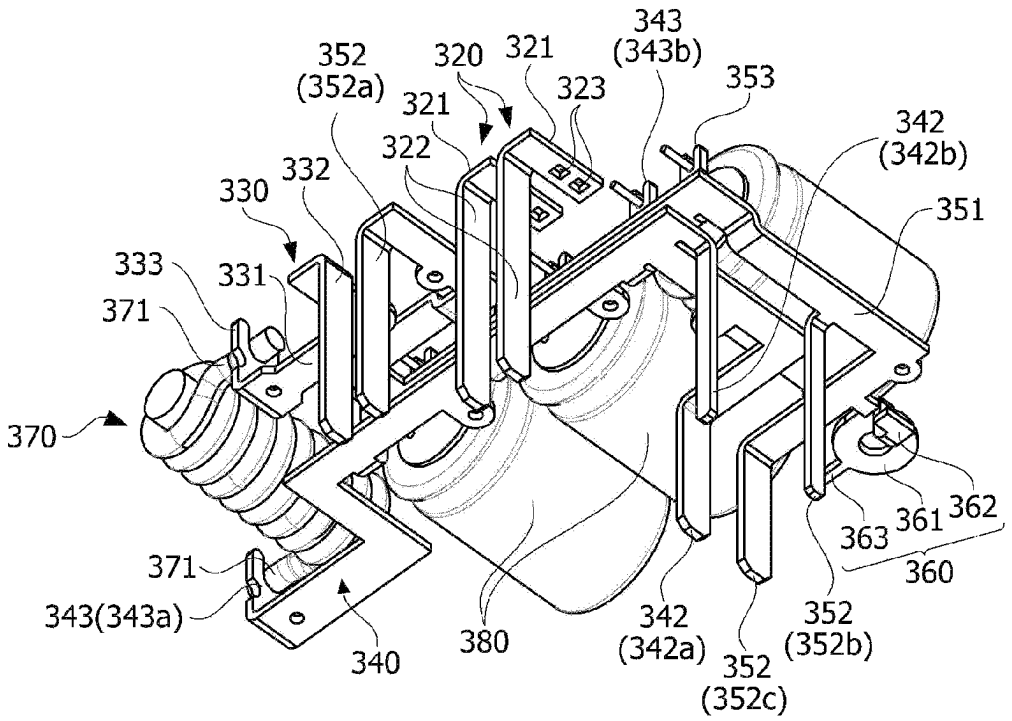
【FIG. 18】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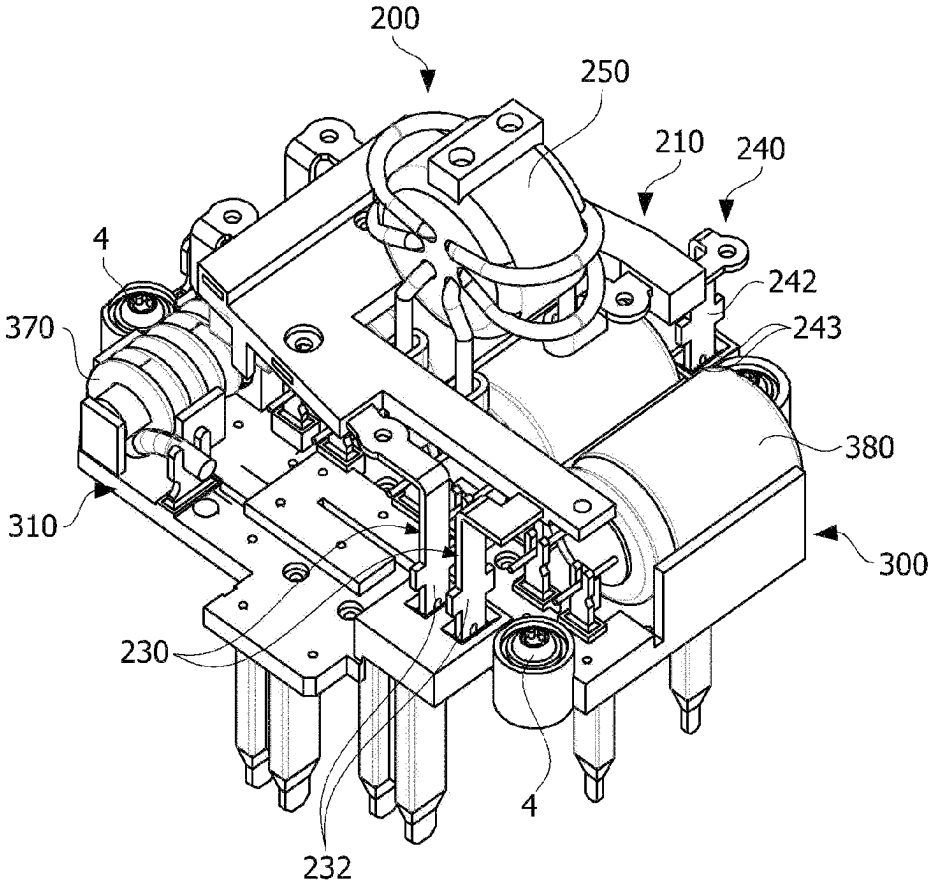
【FIG. 19】



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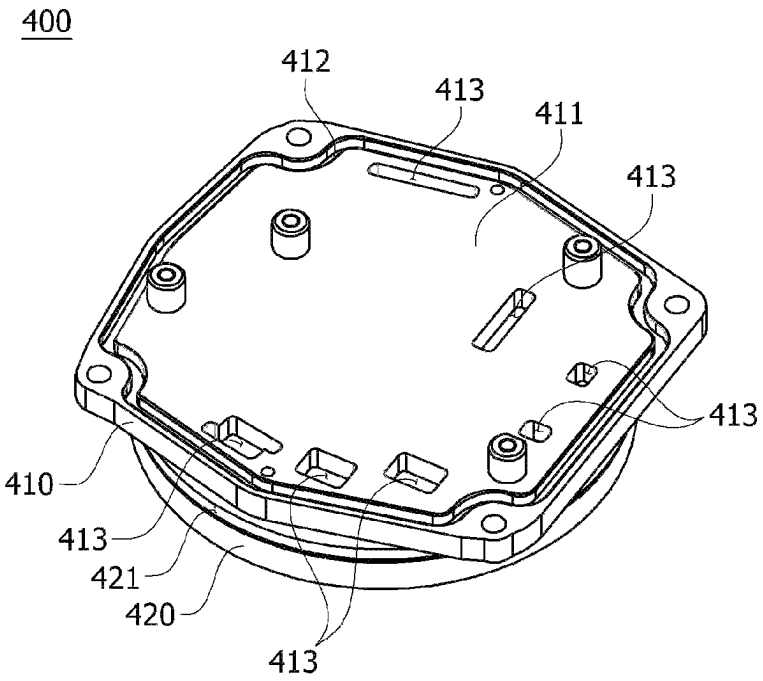
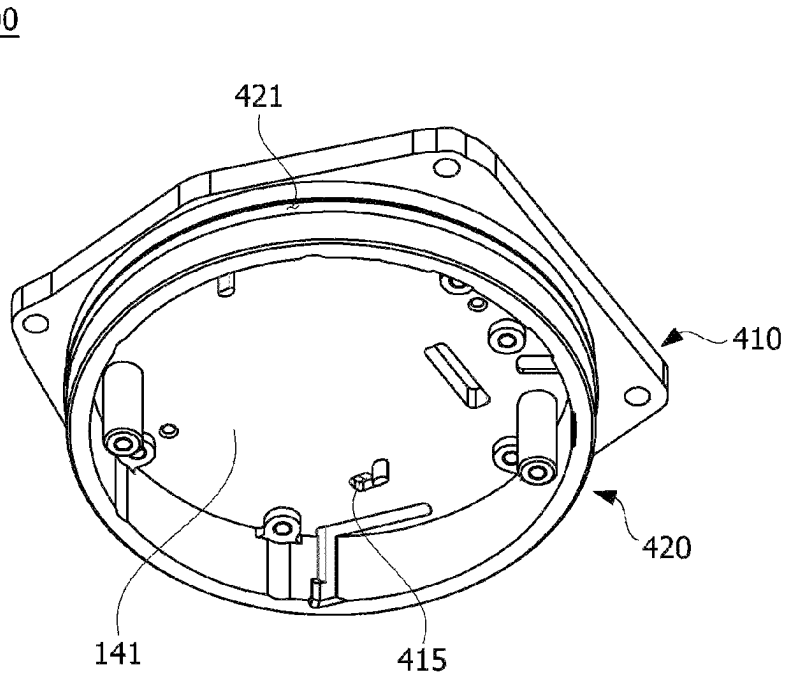
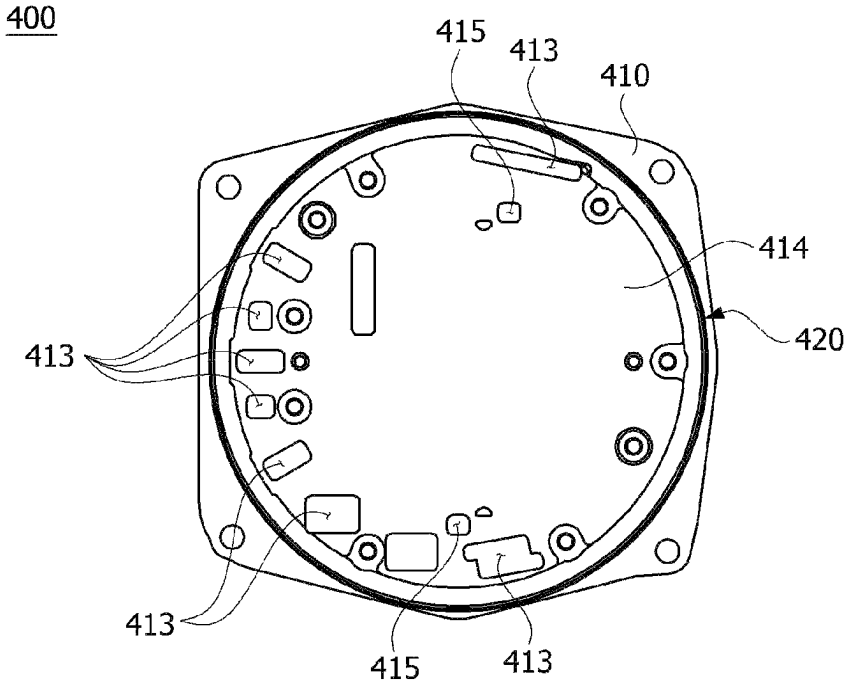


【FIG. 21】



【FIG. 22】



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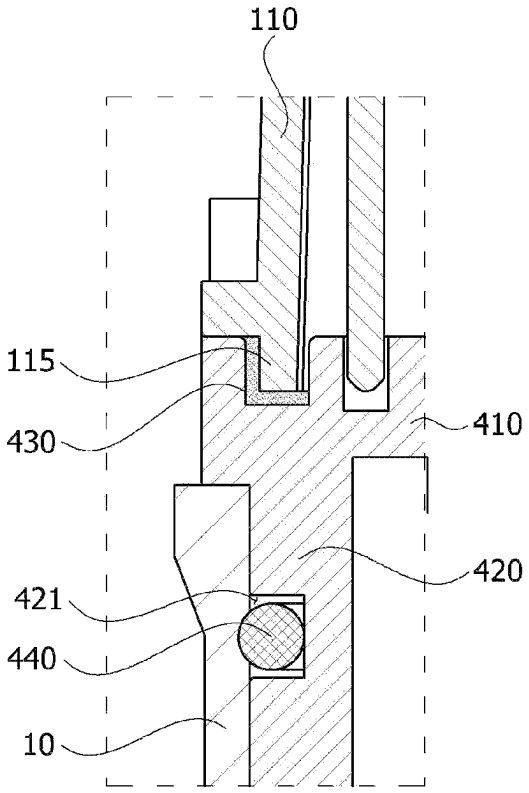

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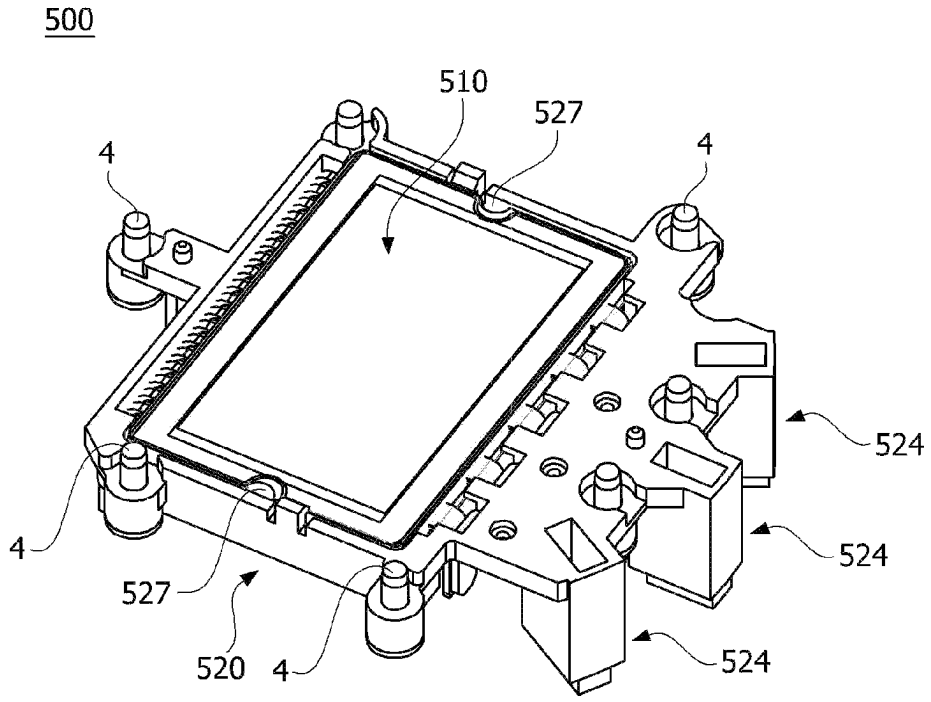
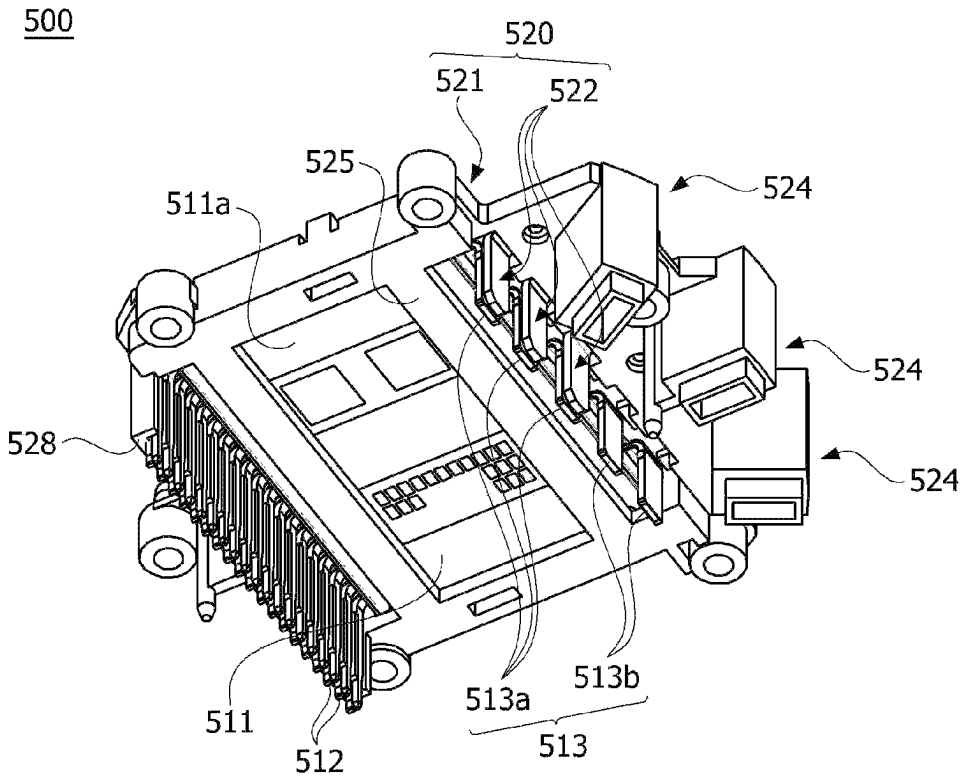


【FIG. 25】



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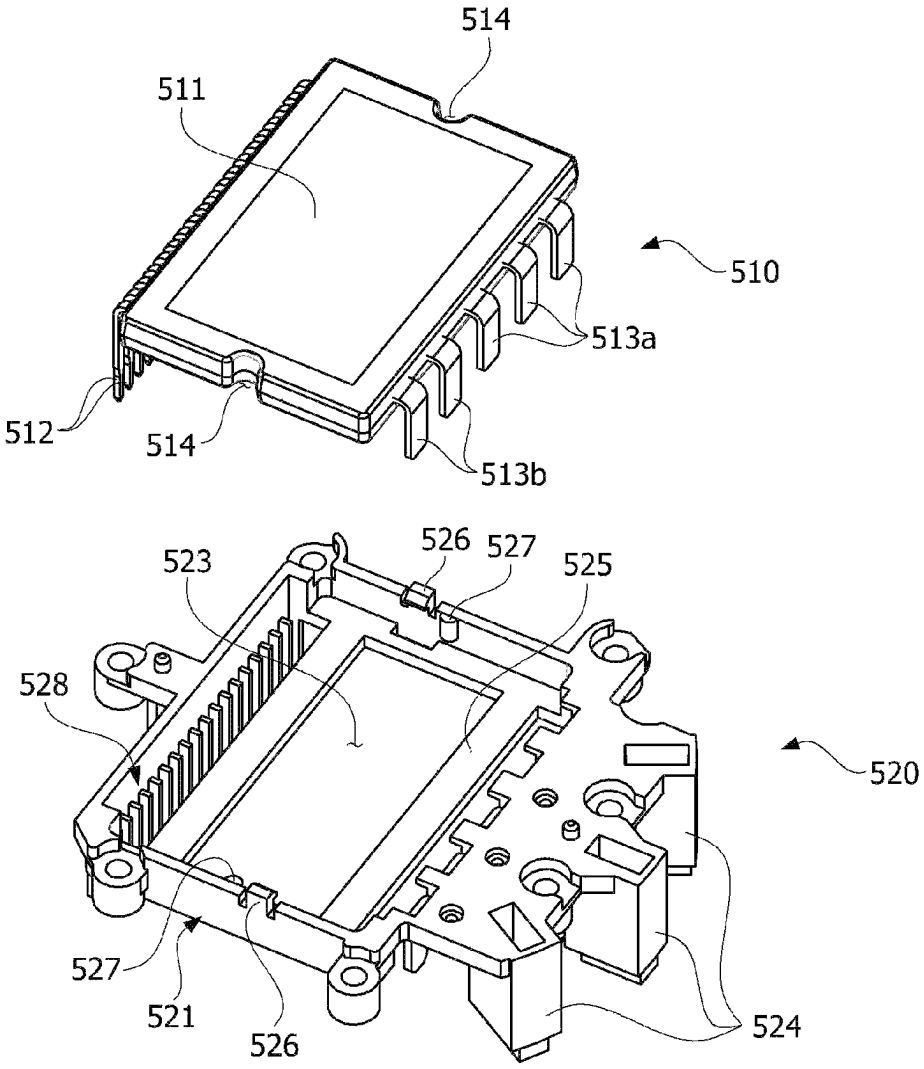
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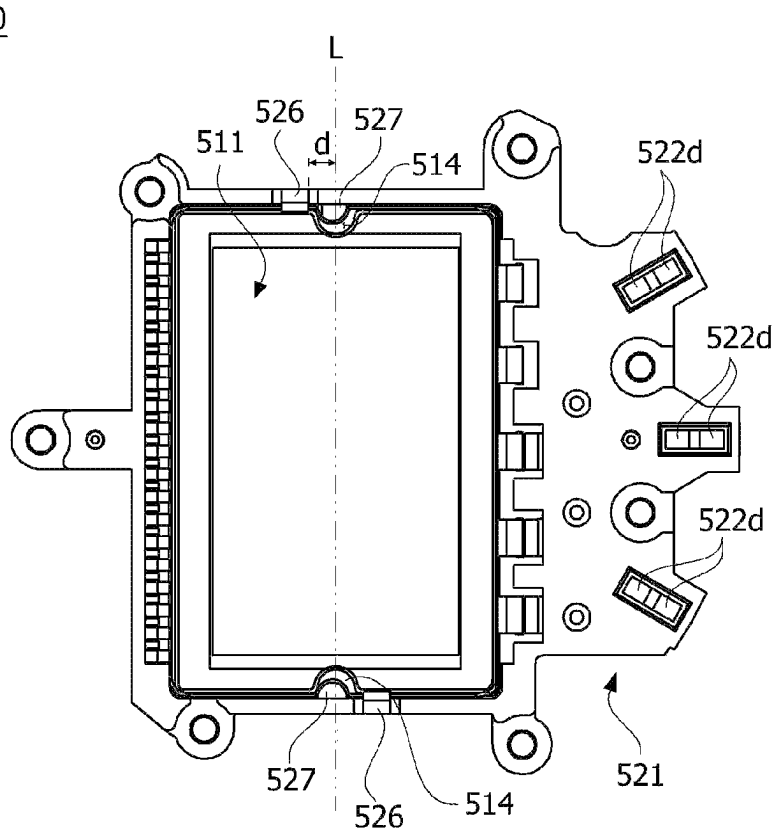
【FIG. 27】



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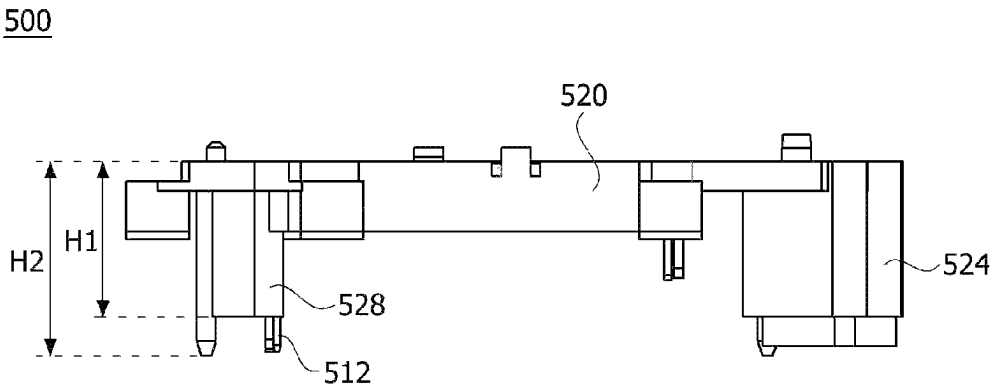

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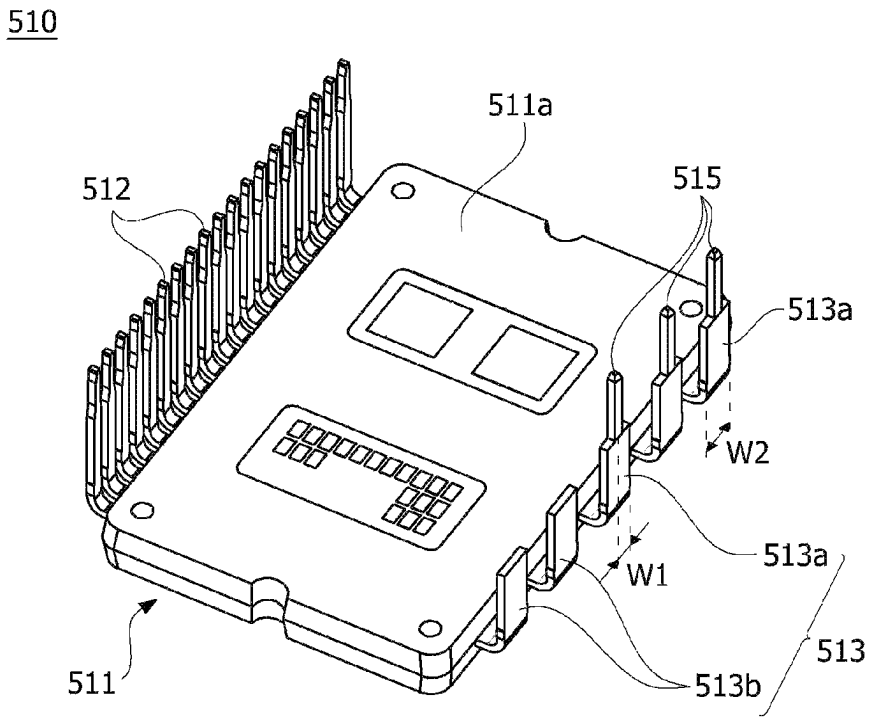

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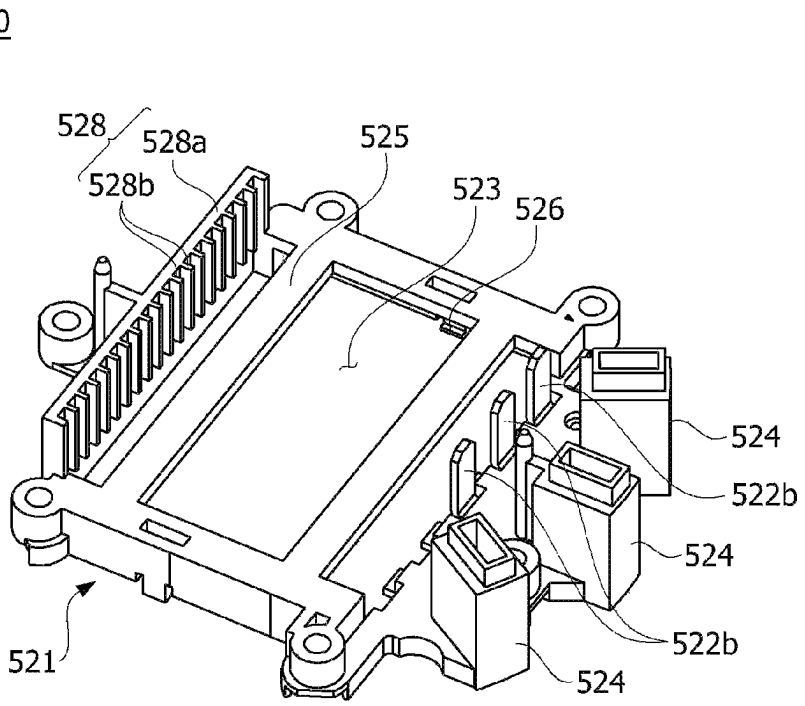

【FIG. 31】

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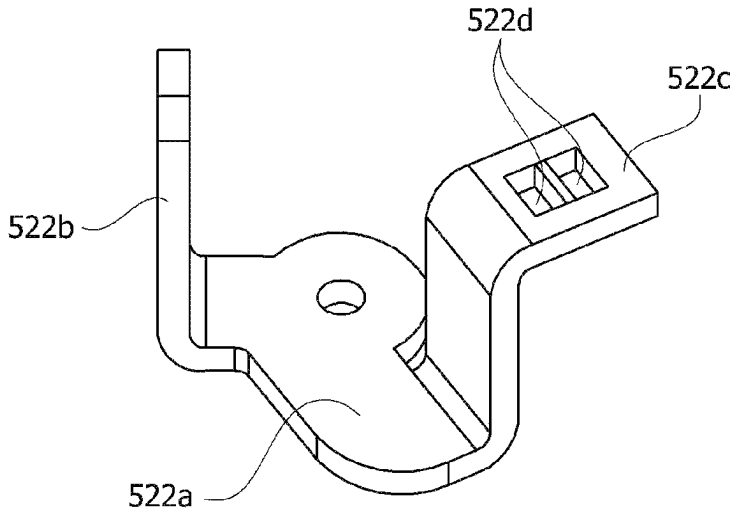

【FIG. 32】

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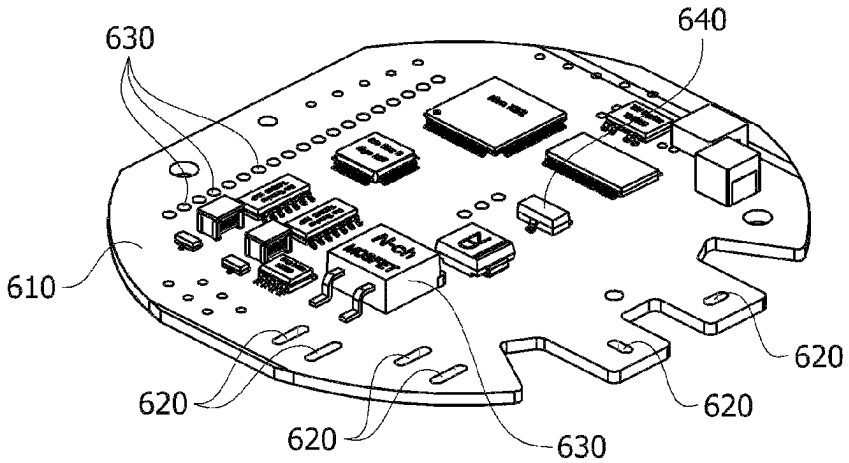
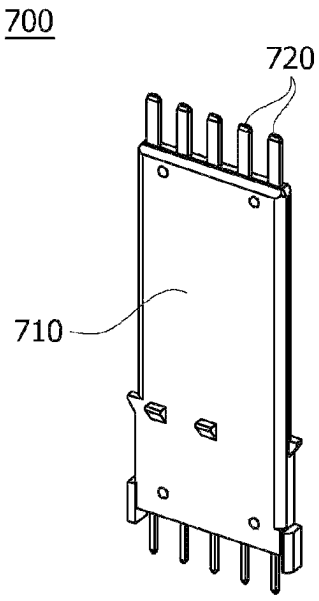
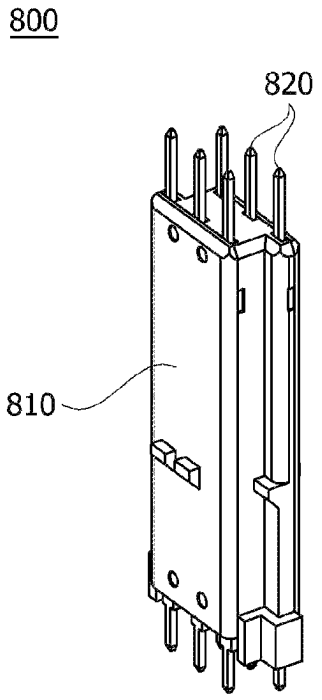


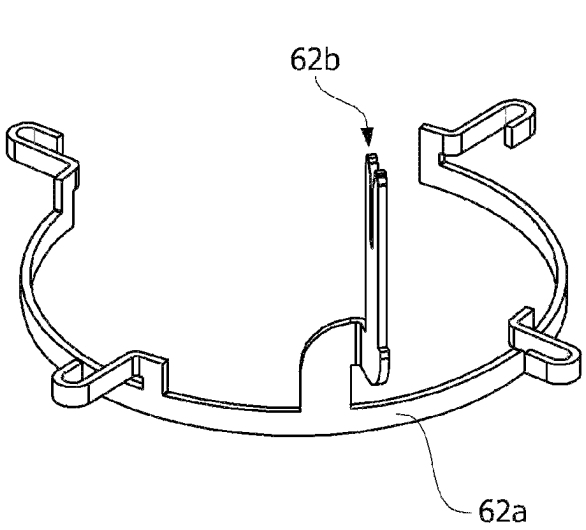
【FIG. 33】



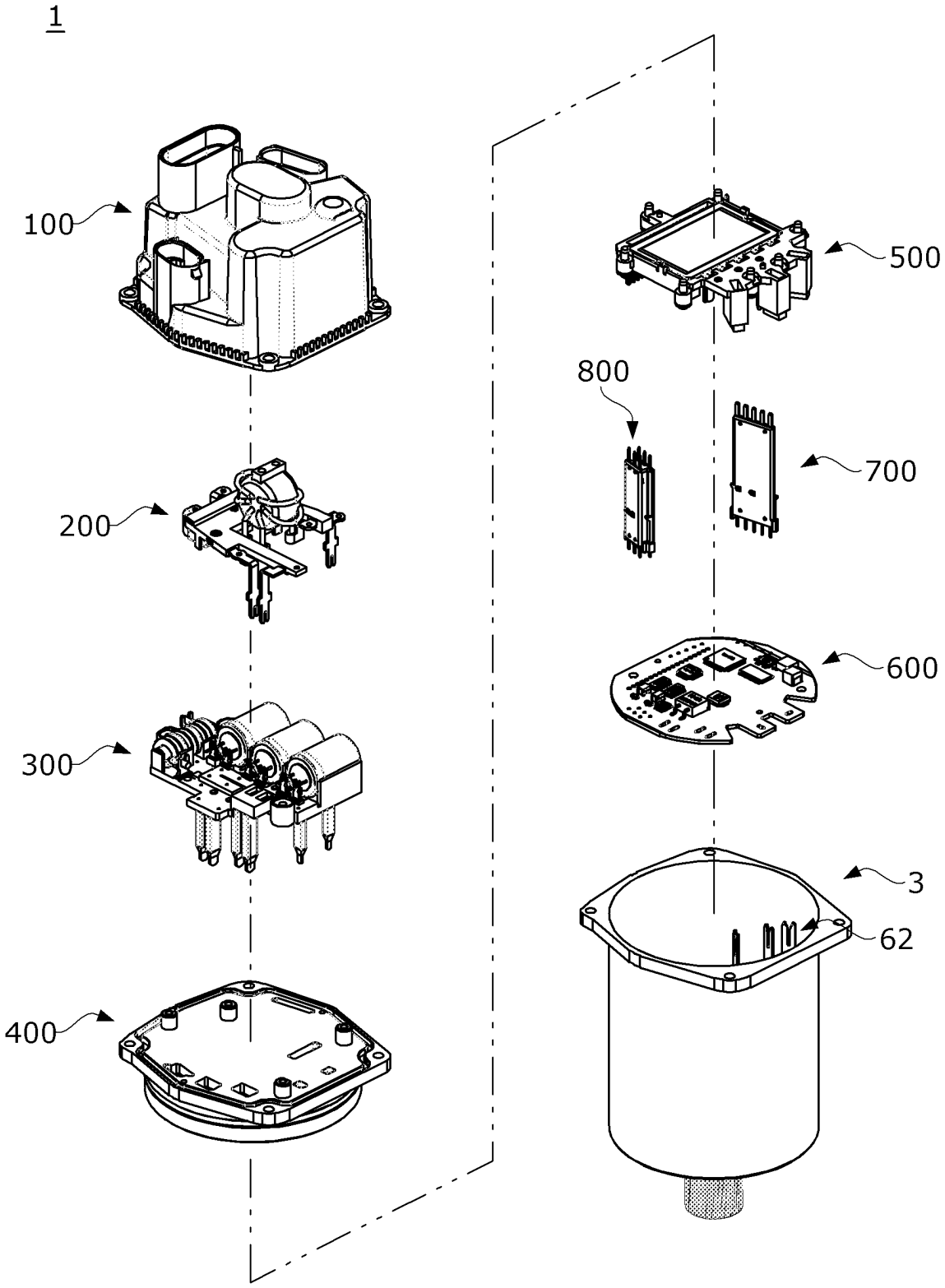
【FIG. 34】



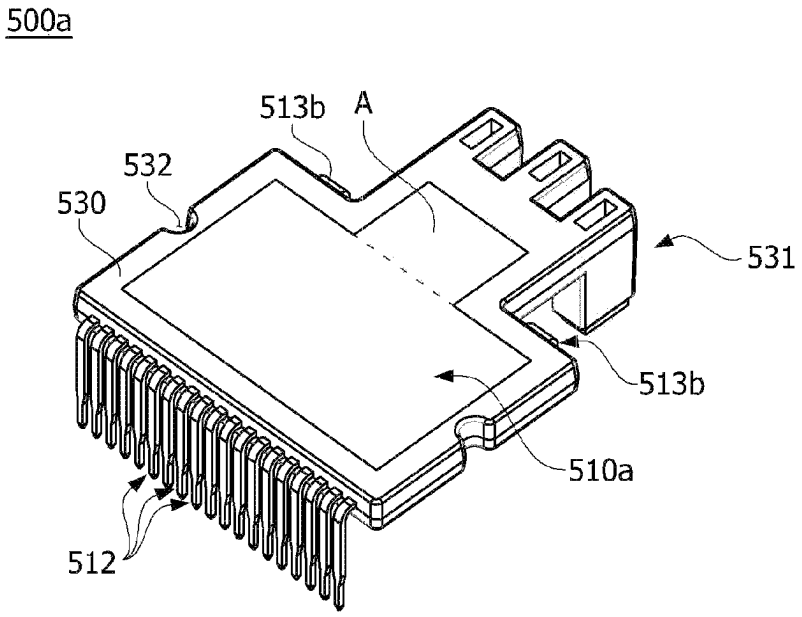
【FIG. 35】



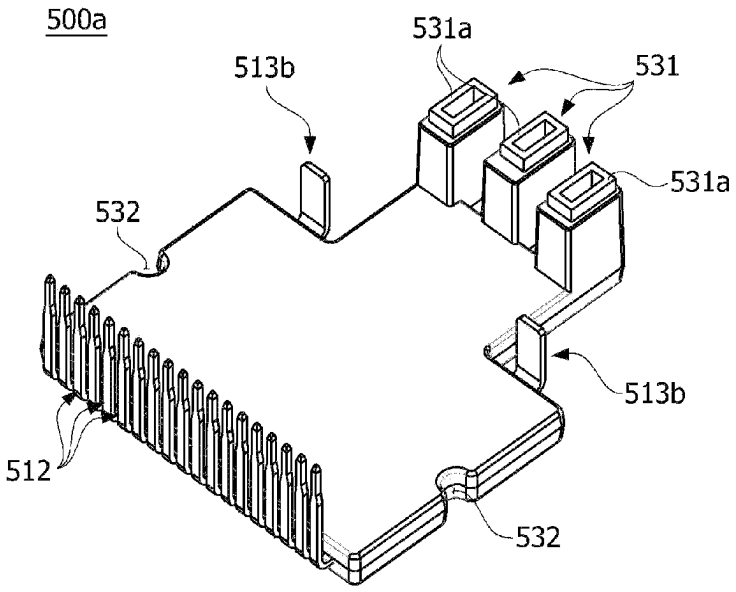
【FIG. 36】



【FIG. 37】



【FIG. 38】



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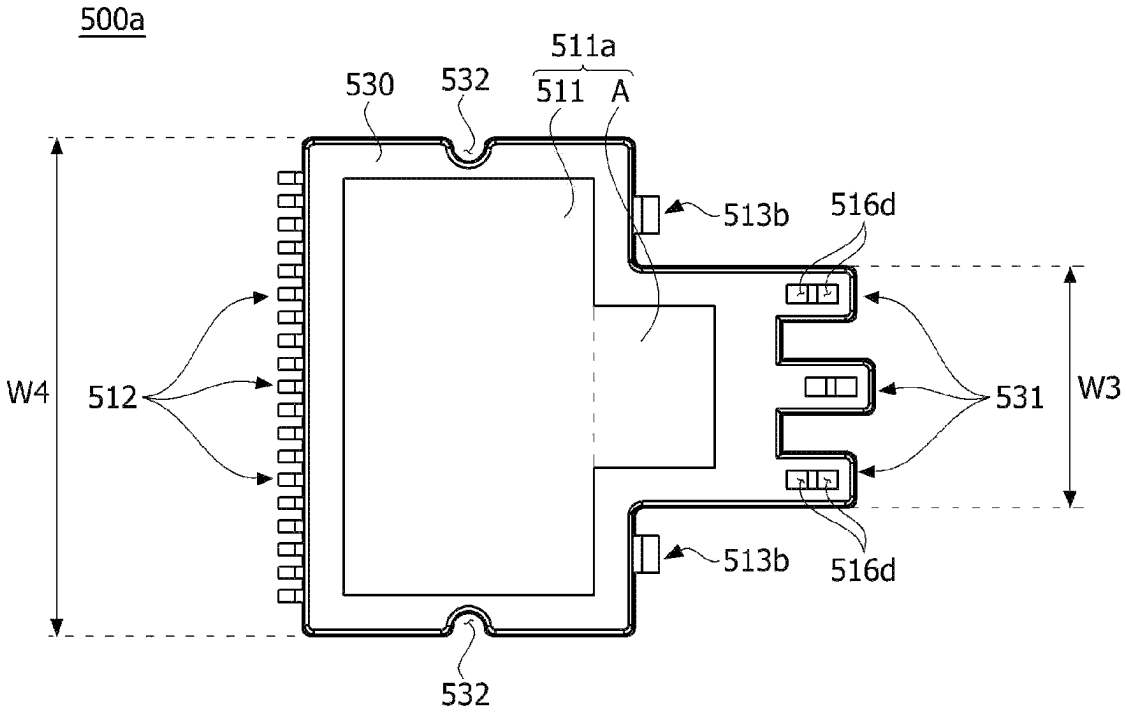
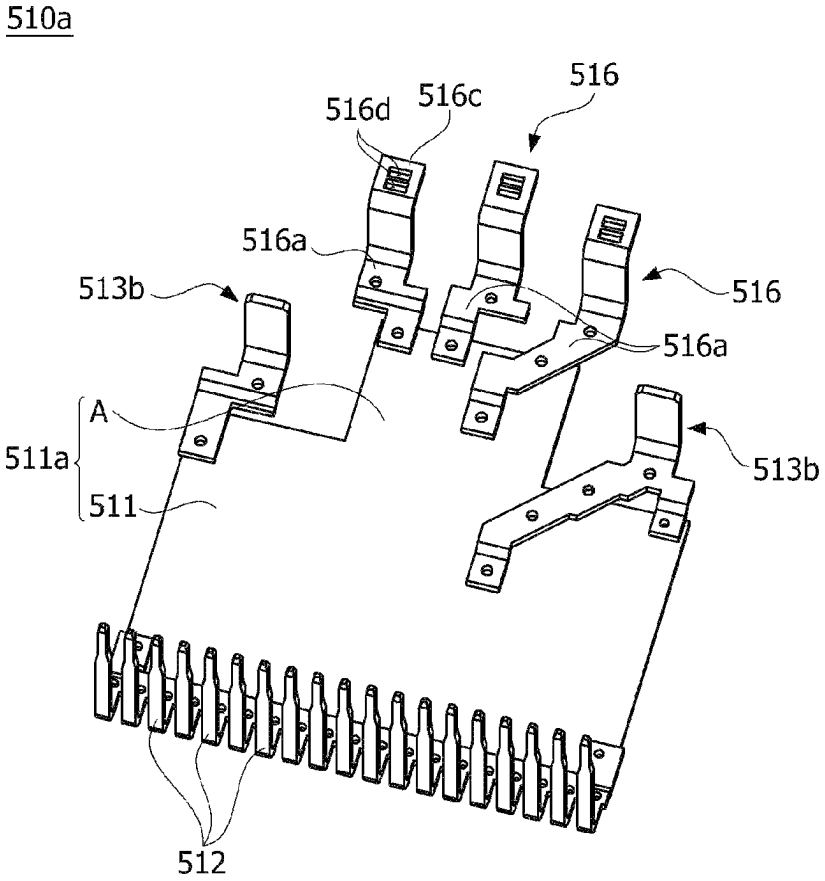


【FIG. 40】



CONTROLLER AND MOTOR ASSEMBLY COMPRISING SAME

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of U.S. application Ser. No. 16/647,813 filed on Mar. 16, 2020 (now U.S. Pat. No. 11,545,878 issued on Jan. 3, 2023), which is the National Phase of PCT International Application No. PCT/KR2018/008514, filed on Jul. 27, 2018, which claims priority under 35 U.S.C. § 119(a) to Patent Application Nos. 10-2017-0128155, filed in the Republic of Korea on Sep. 29, 2017, 10-2017-0133853, filed in the Republic of Korea on Oct. 16, 2017, and 10-2017-0150611, filed in the Republic of Korea on Nov. 13, 2017, all of which are hereby expressly incorporated by reference into the present application.

TECHNICAL FIELD

An embodiment relates to a controller and a motor assembly including the same.

BACKGROUND ART

Motors are devices that convert electric energy into rotational energy using a force applied to a conductor in a magnetic field. Recently, with the expansion of the use of the motors, the role of the motor has become important. In particular, as vehicle electrification progresses rapidly, demands for the motor applied to a steering system, a braking system, an interior system, and the like are greatly increasing.

In the case of such a motor for a vehicle, a motor assembly including a controller capable of controlling the motor may be provided in the vehicle.

Since a high current is used in the controller, a heat-generation problem is emerging. For example, in the case of a substrate used in the controller, a direct current (DC) power circuit, a control circuit, and an inverter circuit are disposed on the substrate. In addition, a heat-generation problem occurs in the substrate as the high current is applied thereto. When the size of the substrate is increased to solve such a heat-generation problem, it is difficult to reduce the size and weight of the motor assembly.

Accordingly, there is a need for a motor assembly that is compact and solves a heat-generation problem occurring in the substrate.

Further, since the size of a controller is limited due to the user's request, there is a need for a motor assembly in which placement of elements and assembly of the elements within a limited size may be simplified.

SUMMARY

An embodiment is directed to providing a controller and a motor assembly in which a heat-generation problem may be solved while miniaturization and lightweighting are implemented.

An embodiment is also directed to providing a controller and a motor assembly in which some components may be shared.

Objectives to be achieved by the embodiments of the present invention are not limited to the above-described objectives, and other objectives which are not described above may be clearly understood by those skilled in the art through the following specification.

One aspect of the present invention provides a controller including a controller housing, a controller cover disposed on an opening of the controller housing, a differential-mode (DM) filter unit disposed above the controller cover, a common-mode (CM) filter unit disposed above the DM filter unit, a power module unit disposed below the controller cover, a substrate disposed below the power module unit, and a first connector and a second connector each having one side disposed on the substrate through the controller cover, wherein the power module unit includes a bracket, and a power module disposed between the bracket and the controller cover, wherein one surface of the power module is pressed against the controller cover, which is made of a metal material, by the bracket.

The power module may include a power module body, a plurality of first pins arranged to protrude downward from one side of the power module body, and five terminal pins arranged to protrude downward from the other side of the power module body, wherein an end portion of the first pin may be coupled to the substrate.

The bracket may include a bracket body having a cavity in which the power module is disposed and three fourth bosses protruding downward formed therein and three fourth terminals each having one side disposed to be exposed inside each of the fourth bosses and the other side disposed on the bracket body to protrude downward.

The bracket may further include a plate disposed below the bracket body to cross the cavity.

The bracket may further include at least two hooks protruding from the bracket body, and the power module may be fixed to the bracket by the hooks.

The hooks may be disposed to be spaced apart from each other at predetermined intervals on the basis of a virtual line L passing through a center of the power module.

A second groove may be formed on a lower surface of the controller cover such that an end portion of each of the hooks is disposed therein.

The bracket may further include a fourth protruding part protruding downward from the bracket body, and the fourth protruding part may be disposed adjacent to the first pin.

A protruding height of the first pin may be greater than a protruding height of the fourth protruding part.

A heat transfer member may be further disposed between the power module body and the controller cover.

The fourth terminal may include a fourth body disposed horizontally, a fourth frame formed to protrude downward from an end portion of one side of the fourth body, and a fourth end portion bent at an end portion of the other side of the fourth body and disposed inside the fourth boss, wherein the fourth frame may be in contact with the terminal pin.

A sixth hole may be formed in the fourth end portion.

Another aspect of the present invention provides a motor assembly including a controller and a motor, wherein the controller includes a controller housing, a controller cover disposed on an opening of the controller housing, a differential-mode (DM) filter unit disposed above the controller cover, a common-mode (CM) filter unit disposed above the DM filter unit, a power module unit disposed below the controller cover, a substrate disposed below the power module unit, and a first connector and a second connector each having one side disposed on the substrate through the controller cover, wherein the power module unit includes a bracket and a power module disposed between the bracket and the controller cover, wherein one side of the power module is pressed against the controller cover, which is made of a metal material, by the bracket.

The motor may include a rotation shaft, a rotor disposed outside the rotation shaft, a stator disposed outside the rotor; a bus bar disposed above the stator, a motor housing accommodating the rotor, the stator, and the bus bar, and a motor cover disposed on an opening of the motor housing, wherein the bus bar may include a bus-bar body and a bus-bar terminal, the bracket may include a bracket body having a cavity in which the power module is disposed and three fourth bosses protruding downward formed therein and three fourth terminals each having one side disposed to be exposed inside each of the fourth bosses and the other side disposed on the bracket body to protrude downward, and one side of the bus-bar terminal may be coupled to a sixth hole of the fourth terminal.

Still another aspect of the present invention provides a controller including a controller housing, a controller cover disposed on an opening of the controller housing, a differential-mode (DM) filter unit disposed above the controller cover, a common-mode (CM) filter unit disposed above the DM filter unit, a power module unit disposed below the controller cover, a substrate disposed below the power module unit, and a first connector and a second connector each having one side disposed on the substrate through the controller cover, wherein the power module unit includes a bracket and a power module disposed between the bracket and the controller cover, wherein the power module includes a power module body, a plurality of first pins arranged to protrude downward from one side of the power module body, five terminal pins arranged to protrude downward from the other side of the power module body, and a third protrusion protruding from an end portion of each of three terminal pins among the terminal pins, wherein an end portion of the third protrusion is coupled to the substrate.

An end portion of the first pin may be coupled to the substrate.

One surface of the power module may be pressed against the controller cover, which is made of a metal material, by the bracket.

The bracket may include a bracket body having a cavity in which the power module is disposed and three fourth bosses protruding downward formed therein and a fourth terminal having one side disposed to be exposed inside each of the fourth bosses and the other side disposed on the bracket body to protrude downward.

The fourth terminal may be in contact with the terminal pin on which the third protrusion is formed.

The bracket may further include a plate disposed below the bracket body to cross the cavity.

The bracket may further include at least two hooks protruding from the bracket body, and the power module may be fixed to the bracket by the hooks.

The hooks may be disposed to be spaced apart from each other at predetermined intervals on the basis of a virtual line L passing through a center of the power module.

A second groove may be formed on a lower surface of the controller cover such that an end portion of the hook is disposed therein.

The bracket may further include a fourth protruding part protruding downward from the bracket body, and the fourth protruding part may be disposed adjacent to the first pin.

A protruding height of the first pin may be greater than a protruding height of the fourth protruding part.

The fourth terminal may include a fourth body disposed horizontally, a fourth frame formed to protrude downward from an end portion of one side of the fourth body, and a fourth end portion bent at an end portion of the other side of the fourth body and disposed inside the fourth boss, wherein the fourth frame may be in contact with the terminal pin.

A sixth hole may be formed in the fourth end portion.

A heat transfer member may be further disposed between the power module body and the controller cover.

A width of the third protrusion may be less than that of the terminal pin.

Yet another aspect of the present invention provides a motor assembly including a controller and a motor, wherein the controller includes a controller housing, a controller cover disposed on an opening of the controller housing, a differential-mode (DM) filter unit disposed above the controller cover, a common-mode (CM) filter unit disposed above the DM filter unit, a power module unit disposed below the controller cover, a substrate disposed below the power module unit, and a first connector and a second connector each having one side disposed on the substrate through the controller cover, wherein the power module unit includes a bracket and a power module disposed between the bracket and the controller cover, wherein the power module includes a power module body, a plurality of first pins arranged to protrude downward from one side of the power module body, five terminal pins arranged to protrude downward from the other side of the power module body, and a third protrusion protruding from an end portion of each of three terminal pins among the terminal pins, wherein an end portion of the third protrusion is coupled to the substrate.

A width of the third protrusion may be less than that of the terminal pin.

One surface of the power module may be pressed against the controller cover, which is made of a metal material, by the bracket.

The motor may include a rotation shaft, a rotor disposed outside the rotation shaft, a stator disposed outside the rotor; a bus bar disposed above the stator, a motor housing accommodating the rotor, the stator, and the bus bar, and a motor cover disposed on an opening of the motor housing, wherein the bus bar may include a bus-bar body and a bus-bar terminal, the bracket may include a bracket body having a cavity in which the power module is disposed and three fourth bosses protruding downward formed therein and three fourth terminals each having one side disposed to be exposed inside each of the fourth bosses and the other side disposed on the bracket body to protrude downward, and one side of the bus-bar terminal may be coupled to a sixth hole of the fourth terminal.

The fourth terminal may be in contact with the terminal pin on which the third protrusion is formed.

Yet another aspect of the present invention provides a motor controller including a substrate, a controller housing disposed on the substrate, a common-mode (CM) filter unit disposed between the substrate and the controller housing, a differential-mode (DM) filter unit disposed below the CM filter unit, a controller cover disposed between the substrate and the DM filter unit, a power module unit disposed between the substrate and the controller cover, and a connector unit coupled to the substrate, wherein the power module unit includes a power module and a mold unit surrounding the power module, wherein the mold unit includes a boss part protruding from one side thereof.

The power module may include a power module body, a first pin coupled to one side of the power module body, and a terminal part coupled to the other side of the power module body, wherein an end portion of the first pin may be coupled to the substrate.

The terminal part may include two first power module terminals protruding toward an outside of the mold unit from

the other side of the power module body and three second power module terminals each having one side connected to the other side of the power module body.

Each of the second power module terminals may include a body having one side end portion connected to the power module body, an end portion bent at the other side end portion of the body and disposed inside the boss part, and a hole formed in the end portion.

The boss part may be branched into three parts from the mold unit.

The boss part may protrude toward the substrate, and the other side of the second power module terminal may be disposed to be exposed inside the boss part.

A space may be formed at the inside of the boss part, and the space may be formed to pass through from a lower portion to an upper portion of the boss part.

A protruding part protruding downward may be further formed at a lower end of the boss part.

A width of one side of the mold unit on which the boss part is formed may be less than a width of the other side disposed to face the one side.

One side of the first power module terminal, which protrudes toward the outside of the mold unit, may be disposed to protrude downward.

The power module body may further include a protruding region protruding from one side thereof, and the protruding region may be disposed between the first power module terminals.

The other side of the first power module terminal may be connected to the protruding region.

The controller cover may be made of a metal material.

Yet another aspect of the present invention provides a motor assembly including a motor controller and a motor, wherein the motor controller includes a substrate, a controller housing disposed on the substrate, a common-mode (CM) filter unit disposed between the substrate and the controller housing, a differential-mode (DM) filter unit disposed below the CM filter unit, a controller cover disposed between the substrate and the DM filter unit, a power module unit disposed between the substrate and the controller cover, and a connector unit coupled to the substrate, wherein the power module unit includes a power module and a mold unit surrounding the power module, wherein the mold unit includes a boss part protruding from one side thereof.

The motor may include a rotation shaft, a rotor disposed outside the rotation shaft, a stator disposed outside the rotor; a bus bar disposed above the stator, a motor housing accommodating the rotor, the stator, and the bus bar, and a motor cover disposed on an opening of the motor housing, wherein the bus bar may include a bus-bar body and a bus-bar terminal, and the power module may include a power module body, a first pin coupled to one side of the power module body, two first power module terminals disposed to protrude downward from the other side of the power module body, and three second power module terminals each having one side connected to the other side of the power module body, wherein one side of the bus-bar terminal may be coupled to a hole of the second power module terminal.

The connector unit may include a first connector and a second connector, and each of the first connector and the second connector may pass through the controller cover.

One side of the first connector may be coupled to the substrate and the other side thereof may be disposed inside one boss of three bosses formed in the controller housing, and one side of the second connector may be coupled to the substrate and the other side thereof may be disposed inside another boss of the three bosses formed in the controller housing.

Advantageous Effects

A motor assembly including a controller according to an embodiment can solve a heat-generation problem by pressing a power module generating a great amount of heat against a controller cover made of a metal material.

Further, space can be utilized and material costs and mold costs can be reduced by placing a mold unit in a power module through an insert injection method.

Further, the size of a power module can be increased by placing a mold unit in a power module through an insert injection method, thereby improving a degree of the design freedom of the power module. Furthermore, in the power module having an increased size, the contact area with a controller cover can be increased to improve heat dissipation performance.

Further, a controller and a motor assembly can be implemented in a compact structure by vertically disposing an element having a large size.

Further, whenever the different types of motors are coupled to a controller, only a substrate can be replaced together with the motor so that some components of the controller can be shared.

Further, the reverse connection of power can be prevented by using a metal-oxide-semiconductor field-effect transistor (MOSFET) disposed on the substrate. Accordingly, the reliability of the stability of a motor assembly can be improved.

Various and beneficial advantages and effects of the embodiment are not limited to the above descriptions and will be more easily understood in a process of describing specific embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a motor assembly according to an embodiment.

FIG. **2** is an exploded perspective view of the motor assembly according to the embodiment in which a power module unit according to a first embodiment is disposed.

FIG. **3** is a cross-sectional view illustrating the motor assembly according to the embodiment.

FIG. **4** is a plan view of the motor assembly according to the embodiment.

FIG. **5** is a perspective view illustrating a controller housing of the motor assembly according to the embodiment.

FIG. **6** is a bottom perspective view illustrating the controller housing of the motor assembly according to the embodiment.

FIG. **7** is a perspective view illustrating a common-mode (CM) filter unit of the motor assembly according to the embodiment.

FIG. **8** is a bottom perspective view illustrating the CM filter unit of the motor assembly according to the embodiment.

FIG. **9** is a view illustrating a second terminal, a (2-1)th terminal, a (2-2)th terminal, a CM filter, and a first capacitor of the CM filter unit according to the embodiment.

FIG. **10** is a view illustrating an arrangement relationship between a first terminal of the controller housing and the second terminal of the CM filter unit of the motor assembly according to the embodiment.

FIG. **11** is a view illustrating an arrangement relationship between a first protrusion of the controller housing and a first hole of the CM filter unit in the motor assembly according to the embodiment.

FIG. **12** is a view illustrating a relationship in which a first protrusion of the controller housing of the motor assembly according to the embodiment is fused and fixed to a first hole.

FIG. **13** is a perspective view illustrating a differential-mode (DM) filter unit of the motor assembly according to the embodiment.

FIG. **14** is an exploded perspective view illustrating the DM filter unit of the motor assembly according to the embodiment.

FIG. **15** is a bottom perspective view illustrating the DM filter unit of the motor assembly according to the embodiment.

FIG. **16** is a plan view illustrating the DM filter unit of the motor assembly according to the embodiment.

FIG. **17** is a view illustrating a third terminal, a (3-1)th terminal, a (3-2)th terminal, a (3-3)th terminal, a DM filter, and a second capacitor of the DM filter unit according to the embodiment.

FIG. **18** is a bottom perspective view illustrating the third terminal, the (3-1)th terminal, the (3-2)th terminal, the (3-3)th terminal, the DM filter, and the second capacitor of the DM filter unit according to the embodiment.

FIG. **19** is a view illustrating a state in which the CM filter unit and the DM filter unit of the motor assembly according to the embodiment are coupled to each other.

FIG. **20** is a perspective view illustrating a controller cover of the motor assembly according to the embodiment.

FIG. **21** is a bottom perspective view illustrating the controller cover of the motor assembly according to the embodiment.

FIG. **22** is a bottom view illustrating the controller cover of the motor assembly according to the embodiment.

FIG. **23** is an enlarged view of region Ain FIG. **3**.

FIG. **24** is a perspective view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment.

FIG. **25** is a bottom perspective view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment.

FIG. **26** is an exploded perspective view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment.

FIG. **27** is a plan view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment.

FIG. **28** is a side view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment.

FIG. **29** is a view illustrating a power module of the power module unit according to the first embodiment.

FIG. **30** is a view illustrating a bracket of the power module unit according to the first embodiment.

FIG. **31** is a view illustrating a fourth terminal of the power module unit according to the first embodiment.

FIG. **32** is a view illustrating a substrate of the motor assembly according to the embodiment.

FIG. **33** is a view illustrating a first connector of the motor assembly according to the embodiment.

FIG. **34** is a view illustrating a second connector of the motor assembly according to the embodiment.

FIG. **35** is a view illustrating a bus-bar terminal of the motor assembly according to the embodiment.

FIG. **36** is an exploded perspective view illustrating a motor according to the embodiment in which a power module unit according to a second embodiment is disposed.

FIG. **37** is a perspective view illustrating the power module unit according to the second embodiment of the motor assembly according to the embodiment.

FIG. **38** is a bottom perspective view illustrating the power module unit according to the second embodiment of the motor assembly according to the embodiment.

FIG. **39** is a plan view illustrating the power module unit according to the second embodiment of the motor assembly according to the embodiment.

FIG. **40** is a view illustrating a power module of the power module unit according to the second embodiment.

DETAILED DESCRIPTION

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

However, the technical spirit of the present invention is not limited to some embodiments which will be described herein and may be realized using various other embodiments, and at least one element of the embodiments may be selectively coupled, substituted, and used to realize the technical spirit within the range of the technical spirit.

Further, unless clearly and specifically defined otherwise by context, all terms (including technical and scientific terms) used herein can be interpreted as having customary meanings to those skilled in the art, and meanings of generally used terms, such as those defined in commonly used dictionaries, will be interpreted by considering contextual meanings of the related technology.

Further, the terms used in the embodiments of the present invention are provided only to describe embodiments of the present invention and not for limiting the present invention.

In the present specification, the singular forms include the plural forms unless the context clearly indicates otherwise, and the phrase "at least one element (or one or more elements) of an element A, an element B, and an element C" should be understood as including the meaning of at least one of all combinations being obtained by combining the element A, the element B, and the element C.

Further, in describing elements of the embodiments of the present invention, the terms such as first, second, A, B, (a), (b), and the like may be used.

These terms are merely for distinguishing one element from other elements, and the essential, order, sequence, and the like of corresponding elements are not limited by the terms.

In addition, when an element is referred to as being "connected or coupled" to another element, such a description may include both a case in which the element is directly connected or coupled to another element, and a case in which the element is connected or coupled to another element with still another element disposed therebetween.

Further, when an element is described as being formed or disposed "on (above)" or "under (below)" another element, the term "on (above)" or "under (below)" includes a case in which two elements are in direct contact with each other and a case in which one or more elements are (indirectly) disposed between two elements. Also, being "above (on) or below (beneath)" may include not only an upward direction but also a downward direction on the basis of one element.

Hereinafter, the embodiments will be described in detail with reference to the accompanying drawings. However, equal or corresponding elements will be referred to as the

same reference numerals regardless of drawing signs, and a repetitive description thereof will be omitted.

FIG. **1** is a perspective view of a motor assembly according to an embodiment.

A motor assembly **1** according to the embodiment may include a controller **2** and a motor **3** according to the embodiment. Here, the controller **2** is a motor controller configured to control the motor **3**.

Here, the motor **3** may be detachably disposed at a lower portion of the controller **2**. Accordingly, various motors **3** may be connected to the controller **2** even when some components of the controller **2** are shared. Here, a substrate may be replaceably disposed between the controller **2** and the motor **3**. Thus, whenever the different types of motors **3** are coupled, only the substrate may be replaced together with the motor **3** so that some components of the controller **2** may be shared.

FIG. **2** is an exploded perspective view of the motor assembly according to the embodiment in which a power module unit according to a first embodiment is disposed, FIG. **3** is a cross-sectional view illustrating the motor assembly according to the embodiment, and FIG. **4** is a plan view of the motor assembly according to the embodiment. Here, FIG. **3** may be a cross-sectional view taken along line A-A in FIG. **1**.

Referring to FIGS. **1** to **3**, the controller **2** may include a controller housing **100**, a common-mode (CM) filter unit **200**, a differential-mode (DM) filter unit **300**, a controller cover **400**, a power module unit **500** according to the first embodiment, a substrate **600**, and a connector unit. Here, the connector unit may include a first connector **700** and a second connector **800**. Here, the controller housing **100** may be referred to as a first housing. In addition, the controller cover **400** may be referred to as a first cover unit.

The connector unit may pass through the controller cover **400**. Here, the connector unit may pass through the controller cover **400** to be spaced apart from an outer side of the power module unit **500**. For example, one side of each of the first connector **700** and the second connector **800** disposed through the controller cover **400** may be disposed on the substrate **600**. As illustrated in FIG. **4**, the other side of the first connector **700** may be disposed inside one boss of three bosses formed in the controller housing **100**, and the other side of the second connector **800** may be disposed inside another boss of the three bosses.

The controller **2** receives power through an external connector. In addition, the power is transferred to the substrate **600** through the CM filter unit **200** and the DM filter unit **300**. In addition, the power in which the reverse connection is prevented at the substrate **600** is transferred to the DM filter unit **300** and then supplied to the power module unit **500** and the substrate **600**.

The controller housing **100** and the controller cover **400** disposed on an opening of the controller housing **100** may form an outer shape of the controller **2**. Here, the controller housing **100** may be disposed on the substrate **600**.

An accommodation space may be formed therein by combining the controller housing **100** and the controller cover **400**. The CM filter unit **200** and the DM filter unit **300** may be disposed in the accommodation space.

FIG. **5** is a perspective view illustrating the controller housing of the motor assembly according to the embodiment, and FIG. **6** is a bottom perspective view illustrating the controller housing of the motor assembly according to the embodiment.

Referring to FIGS. **5** and **6**, the controller housing **100** may include a controller housing body **110** and a first terminal **120**. Here, the controller housing body **110** may be referred to as a first body. In addition, the first terminal **120** may be referred to as a controller housing terminal.

The controller housing body **110** may be formed in a cylindrical shape such that an accommodation space is formed therein. Openings may be formed in the controller housing body **110** for the arrangement of the CM filter unit **200** and the DM filter unit **300**.

A first boss **111**, a second boss **112**, a third boss **113**, a plurality of first protrusions **114**, and a first protruding part **115** may be formed in the controller housing body **110**. Here, the first boss **111**, the second boss **112**, the third boss **113**, the first protrusions **114**, and the first protruding part **115** may be integrally formed with the controller housing body **110**.

The first boss **111**, the second boss **112**, and the third boss **113** may be formed to protrude from an upper portion of the controller housing body **110**. Here, the first boss **111**, the second boss **112**, and the third boss **113** may be disposed to be spaced apart from each other.

A space may be formed in each of the first boss **111**, the second boss **112**, and the third boss **113**, and an external connector (not shown), through which power or signals from the outside may be transmitted and received, may be connected to each of the first boss **111**, the second boss **112**, and the third boss **113**. Accordingly, each of the first boss **111**, the second boss **112**, and the third boss **113** may be formed in various shapes depending on the shape of the external connector.

As illustrated in FIG. **6**, the plurality of first protrusions **114** may be formed to protrude downward from an inner surface **116** of a lower side of the controller housing body **110**. Thus, the CM filter unit **200** may be coupled to a lower portion of the controller housing **100** through the first protrusions **114**.

The first protruding part **115** may be formed to protrude downward from an end portion of the controller housing body **110**. In addition, the first protruding part **115** may be coupled to the controller cover **400**.

As illustrated in FIG. **4**, two first terminals **120** may be provided.

The first terminal **120** may be disposed in the controller housing body **110** through an insert injection method. As illustrated in FIG. **4**, the first terminal **120** may be disposed inside the first boss **111**. Here, the first terminal **120** may be made of a metal material. Accordingly, the first terminal **120** may be formed by press processing a sheet metal such as a copper plate.

Power may be applied to the first terminal **120** through the external connector coupled to the first boss **111**.

Referring to FIGS. **4** and **6**, one side of the first terminal **120** may be disposed inside the first boss **111**, and an end portion **121** of the other side of the first terminal **120** may be disposed to protrude downward from the inner surface **116** of the controller housing body **110**. As illustrated in FIG. **6**, the first terminal **120** may be fixed to an inside of the controller housing body **110** by a coupling member **4** such as a bolt or a screw.

Meanwhile, the controller housing body **110** in which the first boss **111**, the second boss **112**, and the third boss **113** are formed may be made of a synthetic resin material. Accordingly, the controller housing body **110** may be formed in various shapes according to a design thereof and enable lightweighting of the motor assembly **1**.

FIG. **7** is a perspective view illustrating the CM filter unit of the motor assembly according to the embodiment, FIG. **8** is a bottom perspective view illustrating the CM filter unit of the motor assembly according to the embodiment, FIG. **10**

is a view illustrating an arrangement relationship between the first terminal of the controller housing and a second terminal of the CM filter unit in the motor assembly according to the embodiment, FIG. **11** is a view illustrating an arrangement relationship between the first protrusion of the controller housing and a first hole of the CM filter unit in the motor assembly according to the embodiment, and FIG. **12** is a view illustrating a relationship in which the first protrusion of the controller housing of the motor assembly according to the embodiment is fused and fixed to the first hole.

The CM filter unit **200** may be disposed above the DM filter unit **300**. The CM filter unit **200** may be disposed between the controller housing **100** and the substrate **600**. Here, the CM filter unit **200** may be disposed below the inner surface **116** of the controller housing **100**.

Referring to FIGS. **7** to **9**, the CM filter unit **200** may include a CM filter unit body **210**, a second terminal **220**, a (2-1)th terminal **230**, a (2-2)th terminal **240**, a CM filter **250**, and two first capacitors **260**. First holes **225**, **235**, and **245** may be formed in the second terminal **220**, the (2-1)th terminal **230**, and the (2-2)th terminal **240**, respectively. Here, the CM filter unit body **210** may be referred to as a second body, and the first capacitors **260** may be referred to as CM filter unit capacitors. In addition, the first holes **225**, **235**, and **245** may be referred to as fixing holes.

The CM filter unit body **210** may be made of a synthetic resin material, and the second terminal **220**, the (2-1)th terminal **230**, and the (2-2)th terminal **240** may be made of a metal material. Accordingly, the second terminal **220**, the (2-1)th terminal **230**, and the (2-2)th terminal **240** may be disposed in the CM filter unit body **210** through an insert injection method. Here, the second terminal **220**, the (2-1)th terminal **230**, and the (2-2)th terminal **240** may be preferentially formed by press processing a sheet metal such as a copper plate.

The CM filter unit body **210** may be formed in a shape.

A second hole **211** may be formed in the CM filter unit body **210**. Here, the second hole **211** may be referred to as a guide hole.

The first protrusion **114** of the controller housing **100** may be disposed in the second hole **211**. Accordingly, since the CM filter unit body **210** may be disposed in the controller housing **100** in the manner of inserting the second hole **211** into the first protrusion **114**, the assembly position of the CM filter unit **200** is restricted. Further, the coupling of the first protrusion **114** and the second hole **211** prevents the movement of the CM filter unit **200** in a horizontal direction.

The second terminal **220** has one side in contact with the end portion **121** of the other side of the first terminal **120** and the other side in contact with the CM filter **250** to be electrically connected. Here, two second terminal **220** may be provided to correspond to the number of the first terminals **120**.

The second terminal **220** may include a second body **221** disposed horizontally, a second frame **222** protruding downward from an end portion of one side the second body **221**, a second bent portion **223** formed by bending an end portion of the other side of the second body **221**, a second end portion **224**, and a first hole **225**.

The second frame **222**, which is an end portion of one side of the second terminal **220** in contact with the first terminal **120**, may be formed by bending one side of the second body **221** downward. As illustrated in FIG. **10**, the end portion **121** of one side of the first terminal **120**, which is disposed to protrude downward from the inner surface **116**, is in contact with the second frame **222** of the second terminal **220**, which is bent downward. Here, the contact force between the end portion **121** of one side of the first terminal **120** and the second frame **222** of the second terminal **220** may be improved through a fusing process.

The second bent portion **223**, which is one of end portions of the other side of the second terminal **220**, is connected to a first wire **251** disposed in the CM filter **250**. To this end, the second bent portion **223** formed on the other side of the second body **221** may be formed in a hook shape, and the first wire **251** may be electrically connected to the other side of the second terminal **220** through a fusing process. Here, the first wire **251** may be referred to as a first CM filter wire.

The second end portion **224** branched from the other side of the second terminal **220** is electrically connected to a second wire **261** disposed on the first capacitor **260**. For example, the second end portion **224** may be formed in a shape in which two protrusions are disposed to be spaced apart from each other, and as illustrated in FIG. **8**, the second wire **261** may be disposed between the protrusions. Here, the second wire **261** may be electrically connected to the second end portion **224** of the second terminal **220** through a fusing process. Here, the second wire **261** may be referred to as a second CM filter wire.

Referring to FIGS. **7** to **9**, the first hole **225** may be formed in the second terminal **220**.

As illustrated in FIG. **11**, the first protrusion **114** of the controller housing **100** may be disposed in the first hole **225**. Accordingly, the first hole **225** may be coupled to the first protrusion **114** in the manner of inserting the first hole **225** into the first protrusion **114**.

Then, an end portion of the first protrusion **114** may be fused to the second terminal **220** by heating, as illustrated in FIG. **12**. Accordingly, the CM filter unit **200** may be fixed to the controller housing **100**. Here, since the first protrusion **114** is made of a synthetic resin material and the second terminal **220** is made of a metal material, thermal fusion is possible.

One side of the (2-1)th terminal **230** is bent toward the DM filter unit **300**, and the other side of the (2-1)th terminal **230** is electrically connected to the CM filter **250** by being in contact therewith. Here, two (2-1)th terminals **230** may be provided.

The (2-1)th terminal **230** may include a (2-1)th body **231** disposed horizontally, a (2-1)th frame **232** protruding downward from an end portion of one side of the (2-1)th body **231**, a (2-1)th bent portion **233** formed by bending an end portion of the other side of the (2-1)th body **231**, and a first hole **235**.

The (2-1)th frame **232** may be formed by bending the end portion of one side of the (2-1)th body **231** downward. The (2-1)th frame **232**, which is an end portion of one side of the (2-1)th terminal **230** bent downward, may be coupled to a third terminal **320** of the DM filter unit **300**. Here, two (2-1)th protrusions **234** may be disposed on the (2-1)th frame **232** to be spaced apart from each other. Accordingly, the coupling force and contact force between the (2-1)th protrusion **234** and the third terminal **320** may be improved.

The other side of the (2-1)th terminal **230** is connected to the first wire **251** disposed in the CM filter **250**. To this end, the (2-1)th bent portion **233** of the (2-1)th terminal **230** may be formed in a hook shape, and the first wire **251** may be electrically connected to the other side of the (2-1)th terminal **230** through a fusing process.

Referring to FIGS. **7** to **9**, the first hole **235** may be formed in the (2-1)th terminal **230**.

As illustrated in FIG. **11**, the first protrusion **114** of the controller housing **100** may be disposed in the first hole **235**.

Accordingly, the first hole **235** may be coupled to the first protrusion **114** in the manner of inserting the first hole **235** into the first protrusion **114**.

Then, an end portion of the first protrusion **114** may be fused to the (2-1)th terminal **230** by heating, as illustrated in FIG. **12**. Accordingly, the CM filter unit **200** may be fixed to the controller housing **100**.

The (2-2)th terminal **240** may perform a grounding function.

One side of the (2-2)th terminal **240** is bent toward the DM filter unit **300**, and the other side of the (2-2)th terminal **240** is electrically connected to the first capacitor **260** by being in contact therewith. Here, an end portion **242** of the other side of the (2-2)th terminal **240** may be branched to be connected to each of the two first capacitor **260**.

The (2-2)th terminal **240** may include a (2-2)th body **241** disposed horizontally, a (2-2)th frame **242** protruding downward from an end portion of one side of the (2-2)th body **241**, a (2-2)th end portion **244**, and a first hole **245**.

The (2-2)th frame **242** may be formed by bending one side of the (2-2)th body **241** downward. The (2-2)th frame **242**, which is an end portion of one side of the (2-2)th terminal **240** bent downward, may be coupled to a (3-3)th terminal **350** of the DM filter unit **300**. Here, two (2-2)th protrusions **243** may be further disposed on the (2-2)th frame **242** to be spaced apart from each other. Accordingly, the coupling force and contact force between the (2-2)th protrusion **243** and a (3-4)th terminal **360** may be improved.

The other side of the (2-2)th terminal **240** is electrically connected to the second wire **261** disposed in the first capacitor **260**. To this end, the (2-2)th end portion **244**, which is an end portion of the other side of the (2-2)th terminal **240**, may be formed in a shape in which two protrusions are disposed to be spaced apart from each other, and the second wire **261** may be disposed between the protrusions, as illustrated in FIG. **8**. Here, the second wire **261** may be electrically connected to the other side of the (2-2)th terminal **240** through a fusing process.

Referring to FIGS. **7** to **9**, the first hole **245** may be formed in the (2-2)th terminal **240**.

As illustrated in FIG. **11**, the first protrusion **114** of the controller housing **100** may be disposed in the first hole **245**. Accordingly, the first hole **245** may be coupled to the first protrusion **114** in the manner of inserting the first hole **245** into the first protrusion **114**.

Then, an end portion of the first protrusion **114** may be fused to the (2-2)th terminal **240** by heating as illustrated in FIG. **12**. Accordingly, the CM filter unit **200** may be fixed to the controller housing **100**.

The CM filter **250** may be disposed between the second terminal **220** and the (2-1)th terminal **230**. Here, the CM filter **250** may be disposed above the CM filter unit body **210** and may be disposed between two legs of the CM filter unit body **210** disposed horizontally to be spaced apart from each other.

The CM filter **250** may reduce a CM noise. For example, the second terminal **220** electrically connected to the first terminal **120** may be used as a power line, and the CM filter **250** may reduce the CM noise, which is caused by a CM current component, among conductive noises generated through the second terminal **220** being used as the power line.

As illustrated in FIG. **7**, a plurality of first wires **251** may be arranged in the CM filter **250**, and the first wires **251** may be electrically connected to the second terminals **220** and the (2-1)th terminal **230** at the space between the legs.

The first capacitor **260** may be disposed below the CM filter unit body **210**. Here, a plurality of second wires **261** arranged in the first capacitor **260** may be electrically connected to each of the second terminal **220** and the (2-2)th terminal **240**.

FIG. **13** is a perspective view illustrating the DM filter unit of the motor assembly according to the embodiment, FIG. **14** is an exploded perspective view illustrating the DM filter unit of the motor assembly according to the embodiment, FIG. **15** is a bottom perspective view illustrating the DM filter unit of the motor assembly according to the embodiment, FIG. **16** is a plan view illustrating the DM filter unit of the motor assembly according to the embodiment, FIG. **17** is a view illustrating a third terminal, a (3-1)th terminal, a (3-2)th terminal, a (3-3)th terminal, a DM filter, and a second capacitor of the DM filter unit according to the embodiment, FIG. **18** is a bottom perspective view illustrating the third terminal, the (3-1)th terminal, the (3-2)th terminal, the (3-3)th terminal, the DM filter, and the second capacitor of the DM filter unit according to the embodiment, and FIG. **19** is a view illustrating a state in which the CM filter unit and the DM filter unit of the motor assembly according to the embodiment are coupled to each other.

The DM filter unit **300** may be disposed above the controller cover **400**. Here, the DM filter unit **300** may be disposed below the CM filter unit **200**.

Referring to FIGS. **13** to **17**, the DM filter unit **300** may include a DM filter unit body **310**, the third terminal **320**, a (3-1)th terminal **330**, a (3-2)th terminal **340**, the (3-3)th terminal **350**, the (3-4)th terminal **360**, a DM filter **370**, and three second capacitors **380**. Here, the DM filter unit body **310** may be referred to as a third body, and the second capacitors **380** may be referred to as DM filter unit capacitors.

The DM filter unit body **310** may be made of a synthetic resin material, and the third terminal **320**, the (3-1)th terminal **330**, the (3-2)th terminal **340**, the (3-3)th terminal **350**, and the (3-4)th terminal **360** may be made of a metal material. Accordingly, the third terminal **320**, the (3-1)th terminal **330**, the (3-2)th terminal **340**, the (3-3)th terminal **350**, and the (3-4)th terminal **360** may be disposed in the DM filter unit body **310** through an insert injection method. Here, the third terminal **320**, the (3-1)th terminal **330**, the (3-2)th terminal **340**, the (3-3)th terminal **350**, and the (3-4)th terminal **360** may be preferentially formed by press processing a sheet metal such as a copper plate.

A fourth hole **311** and a plurality of second protruding parts **312** may be formed in the DM filter unit body **310**. Here, the fourth hole **311** may be referred to as a fastening hole.

The DM filter unit **300** may be fixed to the controller cover **400** by the coupling member **4** being disposed in the fourth hole **311**.

The second protruding part **312** may be formed to protrude downward from the DM filter unit body **310**. Here, the second protruding parts **312** may be integrally formed with the DM filter unit body **310**.

The second protruding parts **312** may be disposed to pass through the controller cover **400**. Accordingly, the third terminal **320**, the (3-1)th terminal **330**, the (3-2)th terminal **340**, and the (3-3)th terminal **350**, each having one region disposed inside the second protruding part **312**, may be insulated from the controller cover **400**.

The third terminal **320** electrically connects the (2-1)th terminal **230** to the substrate **600**. Here, two third terminals **320** may be provided. In addition, one region of the third

terminal **320** may pass through the controller cover **400**. To this end, a hole may be formed in the controller cover **400**.

The third terminal **320** may include a third body **321** disposed horizontally, a third frame **322** protruding downward from an end portion of one side of the third body **321**, and a third hole **323**.

The third hole **323** may be formed in each of the third bodies **321**. Here, the third hole **323** may be referred to as a coupling hole.

As illustrated in FIG. **19**, the (2-1)th frame **232**, which is an end portion of one side of the (2-1)th terminal **230**, may be coupled to the third hole **323**.

When two third hole **323** are formed, the (2-1)th protrusions **234** formed on the (2-1)th frame **232** may be coupled to the third holes **323**. Accordingly, the coupling force and contact force between the (2-1)th terminal **230** and the third terminal **320** may be improved.

One region of the third terminal **320** may be bent toward the substrate **600**. For example, the third frame **322**, which is a bent end portion of one side of the third terminal **320**, may be formed by being bent downward.

The third frame **322** of the third terminal **320** may be disposed to protrude from an end portion of the second protruding part **312**. Here, the second protruding part **312** is disposed to surround one region of the third frame **322** so that the third terminal **320** is insulated from the controller cover **400**.

In addition, an end portion of the third frame **322** exposed from the second protruding part **312** may be fixed to the substrate **600** through soldering.

One side of the (3-1)th terminal **330** is connected to the substrate **600**, and the other side thereof is connected to the DM filter **370**. Thus, the (3-1)th terminal **330** electrically connects the DM filter **370** to the substrate **600**. Here, one region of the (3-1)th terminal **330** may pass through the controller cover **400**. To this end, a hole may be formed in the controller cover **400**.

The (3-1)th terminal **330** may include a (3-1)th body **331** disposed horizontally, a (3-1)th frame **332** protruding downward from an end portion of one side of the (3-1)th body **331**, and a (3-1)th end portion **333** disposed at the other side of the (3-1)th body **331**.

One region of the (3-1)th body **331** may be bent toward the substrate **600**. For example, the (3-1)th frame **332**, which is a bent end portion of one side of the (3-1)th terminal **330**, may be formed by bending one side of the (3-1)th body **331** downward.

The (3-1)th frame **332**, which is an end portion of the (3-1)th terminal **330**, may be disposed to protrude from an end portion of the second protruding part **312**. Here, the second protruding part **312** is disposed to surround one region of the (3-1)th frame **332** so that the (3-1)th terminal **330** is insulated from the controller cover **400**.

In addition, an end portion of the (3-1)th frame **332** exposed from the second protruding part **312** may be fixed to the substrate **600** through soldering.

The (3-1)th end portion **333**, which is an end portion of the other side of the (3-1)th terminal **330**, is electrically connected to a third wire **371** disposed in the DM filter **370**. To this end, the (3-1)th end portion **333** may be formed in a shape in which two protrusions are disposed to be spaced apart from each other, and as illustrated in FIG. **13**, the third wire **371** may be disposed between the protrusions. Here, the third wire **371** may be electrically connected to the (3-1)th end portion **333** of the (3-1)th terminal **330** through a fusing process.

The (3-2)th terminal **340** allows the DM filter **370**, the second capacitor **380**, the power module unit **500**, and the substrate **600** to be electrically connected to each other.

The (3-2)th terminal **340** may include a (3-2)th body **341** disposed horizontally, a (3-2)th frame **342** protruding downward from the (3-2)th body **341**, and a (3-2)th end portion **343** protruding upward from the (3-2)th body **341**. Here, the (3-2)th frame **342** may include a (3-2-1)th frame **342***a* having an end portion coupled to the power module unit **500**, and a (3-2-2)th frame **342***b* having an end portion coupled to the substrate **600**. In addition, the (3-2)th end portion **343** may include a (3-2-1)th end portion **343***a* coupled to the DM filter **370** and a (3-2-2)th end portion **343***b* coupled to the second capacitor **380**.

One region of the (3-2)th body **341** may be bent downward. For example, the (3-2)th frame **342**, which is a bent end portion of one side of the (3-2)th terminal **340**, may be formed by bending one side of the (3-2)th body **341** downward.

Accordingly, the end portion of the (3-2-1)th frame **342***a* that is one portion of the (3-2)th frame **342** may be coupled to the power module unit **500**. In addition, the end portion of the (3-2-2)th frame **342***b* which is another portion of the (3-2)th frame **342** may be coupled to the substrate **600**. Here, a length of the (3-2-1)th frame **342***a* is less than a length of the (3-2-2)th frame **342***b*.

The (3-2)th frame **342** of the (3-2)th terminal **340** may pass through the controller cover **400**. To this end, a hole may be formed in the controller cover **400**.

Meanwhile, the (3-2)th frame **342** of the (3-2)th terminal **340** may be disposed to protrude from an end portion of the second protruding part **312**. Here, the second protruding part **312** is disposed to surround one region of the (3-2)th frame **342** so that the (3-2)th terminal **340** that is disposed to pass through the controller cover **400** is insulated from the controller cover **400**.

In addition, an end portion of the (3-2-2)th frame **342***b* exposed from the second protruding part **312** may be fixed to the substrate **600** through soldering.

The (3-2-1)th end portion **343***a*, which is one of end portions of the other side of the (3-2)th terminal **340**, is electrically connected to the third wire **371** disposed in the DM filter **370**. To this end, the (3-2-1)th end portion **343***a* may be formed in a shape in which two protrusions are disposed to be spaced apart from each other, and as illustrated in FIG. **13**, the third wire **371** may be disposed between the protrusions. Here, the third wire **371** may be electrically connected to the (3-2-1)th end portion **343***a* of the (3-1)th terminal **330** through a fusing process. Here, the third wire **371** may be referred to as a first DM filter wire.

The (3-2-2)th end portion **343***b*, which is another one of the end portions of the other side of the (3-2)th terminal **340**, is electrically connected to a fourth wire **381** disposed in the second capacitor **380**. For example, the (3-2-2)th end portion **343***b* may be formed in a shape in which two protrusions are disposed to be spaced apart from each other, and as illustrated in FIG. **13**, the fourth wire **381** may be disposed between the protrusions. Here, the fourth wire **381** may be electrically connected to the (3-2-2)th end portion **343***b* of the (3-1)th terminal **330** through a fusing process. Here, the fourth wire **381** may be referred to as a second DM filter wire.

The (3-3)th terminal **350** allows the second capacitor **380**, the power module unit **500**, and the substrate **600** to be electrically connected to each other.

The (3-3)th terminal **350** may include a (3-3)th body **351** disposed horizontally, a (3-3)th frame **352** protruding down-

ward from the (3-3)th body **351**, and a (3-3)th end portion **353** protruding upward from the (3-3)th body **351**.

One region of the (3-3)th body **351** may be bent downward. For example, the (3-3)th frame **352**, which is a bent end portion of one side of the (3-3)th terminal **350**, may be formed by bending one side of the (3-3)th body **351** downward.

Here, the (3-3)th frame **352** may include a (3-3-1)th frame **352***a* having an end portion coupled to the substrate **600** to receive power, a (3-3-2)th frame **352***b* having an end portion coupled to the substrate **600** to transmit the power, and a (3-3-3)th frame **352***c* having an end portion coupled to the power module unit **500** to transmit the power.

Here, a length of the (3-3-3)th frame **352***c* is less than a length of the (3-3-1)th frame **352***a*. In addition, the length of the (3-3-1)th frame **352***a* may be the same as a length of the (3-3-2)th frame **352***b*.

Further, the (3-3)th frame **352** of the (3-3)th terminal **350** may pass through the controller cover **400**. To this end, a hole may be formed in the controller cover **400**.

Further, the (3-3)th frame **352** of the (3-3)th terminal **350** may be disposed to protrude from an end portion of the second protruding part **312**. Here, the second protruding part **312** is disposed to surround one region of the (3-3)th frame **352** so that the (3-3)th terminal **350** that is disposed to pass through the controller cover **400** is insulated from the controller cover **400**.

In addition, an end portion of the (3-3)th frame **352** exposed from the second protruding part **312** may be fixed to the substrate **600** through soldering.

The (3-3)th end portion **353**, which is an end portion of the other side of the (3-3)th terminal **350**, is electrically connected to the fourth wire **381** disposed in the second capacitor **380**. For example, the (3-3)th end portion **353** may be formed in a shape in which two protrusions are disposed to be spaced apart from each other, and as illustrated in FIG. **13**, the fourth wire **381** may be disposed between the protrusions. Here, the fourth wire **381** may be electrically connected to the (3-3)th end portion **353** of the (3-1)th terminal **330** through a fusing process.

The (3-4)th terminal **360** may be electrically connected to the (2-2)th terminal **240** and the controller cover **400**.

One region of the (3-3)th terminal **350** may be cut to form the (3-4)th terminal **360**. For example, the (3-4)th terminal **360** may be formed by pressing and cutting one region of the (3-3)th terminal **350** when the (3-3)th terminal **350** is disposed in the DM filter unit body **310** through the insert injection method.

The (3-4)th terminal **360** may include a (3-4)th body **361** disposed horizontally, a (3-4)th frame **362** protruding downward from the (3-4)th body **361**, and a (3-4)th end portion **363** protruding horizontally from the (3-4)th body **361**.

One region of the (3-4)th body **361** may be bent downward. For example, the (3-4)th frame **362**, which is a bent end portion of one side of the (3-4)th terminal **360**, may be formed by bending one side of the (3-4)th body **361** downward. In addition, an end portion of the (3-4)th frame **362** may be brought into contact with the controller cover **400** by horizontally bending the end portion of the (3-4)th frame **362**. Accordingly, the (3-4)th frame **362** may perform grounding.

The (3-4)th end portion **363** may be provided as one protrusion, as illustrated in FIG. **18**. Accordingly, as illustrated in FIG. **19**, the (3-4)th end portion **363** may be coupled to the (2-2)th protrusion **243** of the (2-2)th frame **242**.

The DM filter **370** may be disposed between the (3-1)th terminal **330** and the (3-2)th terminal **340**.

The DM filter **370** may reduce a DM noise. For example, the (3-1)th terminal **330** and the (3-2)th terminal **340** may be used as power lines, and the DM filter **370** may reduce the CM noise, which is caused by a DM current component, among conductive noises generated through the (3-1)th terminal **330** and the (3-2)th terminal **340** being used as the power lines.

A plurality of third wires **371** may be arranged in the DM filter **370**, and the third wires **371** may be electrically connected to each of the (3-1)th terminal **330** and the (3-2)th terminal **340**.

The second capacitor **380** may be disposed above the DM filter unit body **310**.

Here, a plurality of fourth wires **381** arranged in the second capacitor **380** may be electrically connected to each of the (3-2)th terminal **340** and the (3-3)th terminal **350**.

FIG. **20** is a perspective view illustrating the controller cover of the motor assembly according to the embodiment, FIG. **21** is a bottom perspective view illustrating the controller cover of the motor assembly according to the embodiment, FIG. **22** is a bottom view illustrating the controller cover of the motor assembly according to the embodiment, and FIG. **23** is an enlarged view of region A in FIG. **3**.

The controller cover **400** may be disposed on the opening of the controller housing **100**. The controller cover **400** may be disposed between the DM filter unit **300** and the substrate **600**.

Referring to FIGS. **20** to **22**, the controller cover **400** may include a controller cover body **410** disposed on the opening of the controller housing **100** and a third protruding part **420** protruding downward from the controller cover body **410**. In addition, the controller cover **400** may further include a sealing member **430** and an O-ring **440**. Here, the controller cover body **410** may be referred to as a fourth body.

The controller cover body **410** and the third protruding part **420** may be integrally formed. Accordingly, the controller cover **400** may be made of a metal material. For example, the controller cover **400** may be made of an aluminum material having good thermal conductivity through a die-casting method.

The controller cover body **410** may be formed in a plate shape.

The end portion of the (3-4)th frame **362** may be in contact with an upper surface **411** of the controller cover body **410**. Accordingly, the controller cover body **410** made of a metal material may perform grounding. Here, the third protruding part **420** may be in contact with a motor housing **10** of the motor **3**.

A first groove **412** may be formed along an edge of the upper surface **411** of the controller cover body **410**. Here, the first groove **412** may be formed in a shape corresponding to the shape of the first protruding part **115** of the controller housing **100**. Accordingly, the first protruding part **115** may be coupled to the first groove **412**. Here, the first groove **412** may be referred to as a coupling groove.

Referring to FIG. **23**, two first grooves **412** may be formed. Accordingly, the coupling force and airtightness of the controller housing **100** and the controller cover **400** may be improved.

The sealing member **430** may be further disposed in the first groove **412**. As illustrated in FIG. **23**, the sealing member **430** is disposed between the first protruding part **115** and the first groove **412** to further improve the airtightness.

In addition, a plurality of fifth holes **413** are formed in the controller cover body **410**. The fifth holes **413** may be formed to vertically pass through the controller cover body **410**. Thus, the frames of the first connector **700**, the second connector **800**, and the third terminal **320** and the like may pass through the controller cover body **410** through the fifth holes **413**. Here, the fifth hole **413** may be referred to as a through hole.

A second groove **415** may be formed in a lower surface **414** of the controller cover body **410**. Here, the second groove **415** may be referred to as a placement groove.

Further, a protrusion protruding downward may be further disposed on the lower surface of the controller cover body **410**. In addition, the protrusion may be integrally formed with the controller cover body **410**. In addition, the protrusion may guide the placement of the power module unit **500**.

The third protruding part **420** may be formed to protrude downward from the controller cover body **410**. In addition, the third protruding part **420** may be formed in a cylindrical shape.

The third protruding part **420** may be disposed inside the motor housing **10** of the motor **3**. Here, an outer circumferential surface of the third protruding part **420** is in contact with an inner circumferential surface of the motor housing **10** to perform grounding. Here, the motor housing **10** may be referred to as a second housing.

A third groove **421** may be formed along the outer circumferential surface of the third protruding part **420**. The O-ring **440** may be disposed in the third groove **421**. Here, the third groove **421** may be referred to as an O-ring groove.

As illustrated in FIG. **23**, the O-ring **440** may improve airtightness between the inner circumferential surface of the motor housing **10** and the third protruding part **420**.

FIG. **24** is a perspective view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment, FIG. **25** is a bottom perspective view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment, FIG. **26** is an exploded perspective view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment, FIG. **27** is a plan view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment, FIG. **28** is a side view illustrating the power module unit according to the first embodiment of the motor assembly according to the embodiment, FIG. **29** is a view illustrating the power module of the power module unit according to the first embodiment, and FIG. **30** is a view illustrating a bracket of the power module unit according to the first embodiment.

The power module unit **500** according to the first embodiment may transmit a signal capable of controlling the motor **3**. The power module unit **500** may be disposed between the controller cover **400** and the substrate **600**.

Referring to FIGS. **24** to **27**, the power module unit **500** may include a power module **510** and a bracket **520**.

The power module **510** transmits a signal capable of controlling the motor **3**. Here, an automotive power module (APM) may be used as the power module **510**. Accordingly, the power module **510** generates a great amount of heat than other components of the controller **2**.

The power module **510** may include a power module body **511**, a plurality of first pins **512** protruding downward from one side of the power module body **511**, and five terminal pins **513** disposed to protrude downward from the other side of the power module body **511**. The power module **510** may further include a fourth groove **514**. Here, the power module body **511** may be referred to as a fifth body.

As illustrated in FIG. **28**, the first pin **512** and the terminal pin **513** may be spaced apart to face each other. In addition, an end portion of the first pin **512** is coupled to the substrate **600** to receive a signal from the substrate **600**. Here, the first pin **512** may be fixed to the substrate **600** through soldering. Here, the first pin **512** may be referred to as a power module pin. In addition, the terminal pin **513** may be referred to as a power module terminal.

Referring to FIG. **25**, the terminal pin **513** may include a first terminal pin **513***a* and a second terminal pin **513***b*.

Three first terminal pins **513***a* may be electrically connected to fourth terminals **522** of the bracket **520**. Accordingly, the power may be supplied to the motor **3** through the fourth terminal **522**. Here, the fourth terminal **522** may be referred to as a controller terminal.

Each of two second terminal pins **513***b* is electrically connected to each of the (3-2-1)th frame **342***a* of the (3-2)th terminal **340** and the (3-3-3)th frame **352***c* of the (3-3)th terminal **350** to receive the power.

When the power module **510** is disposed on the bracket **520**, the fourth groove **514**, which is concavely formed, guides the assembly of the power module **510**. Here, the fourth groove **514** may be referred to as a guide groove.

As illustrated in FIG. **27**, two fourth grooves **514** may be formed at both sides of the power module body **511**. In addition, the fourth grooves **514** may be disposed on a virtual line L passing through the power module body **511**.

Meanwhile, the power module **510** may further include a third protrusion **515**. Here, the third protrusion **515** may be referred to as a coupling protrusion.

Referring to FIG. **29**, the third protrusion **515** may be formed to protrude downward from an end portion of the first terminal pin **513***a*. For example, the third protrusion **515** may protrude in the same direction as a direction in which the first terminal pin **513***a* protrudes. Here, an end portion of the third protrusion **515** may be coupled to the substrate **600**.

The end portion of the third protrusion **515** may be fixed to the substrate **600** through soldering. Accordingly, a sensor disposed on the substrate **600** may confirm whether a signal is transmitted to the motor **3** through the third protrusion **515**. In addition, the substrate **600** may shut off the motor **3** by confirming the signal transmitted to the motor **3**.

As illustrated in FIG. **29**, a width W1 of the third protrusion **515** is less than a width W2 of the first terminal pin **513***a*. Accordingly, the third protrusion **515** may be easily disposed on and fixed to the substrate **600**. Here, the width W1 of the third protrusion **515** determines the occupied space and soldering amount of the substrate **600**.

The bracket **520** presses the power module **510** against the lower surface **414** of the controller cover **400**. Here, the coupling member **4** such as a bolt may be used. Accordingly, heat generated in the power module **510** is conducted to the controller cover **400**, and the conducted heat is discharged to the outside through the motor housing **10** of the motor **3**. That is, the heat dissipation effect of the controller **2** may be increased due to the controller cover **400** made of a metal material.

The bracket **520** may include a bracket body **521** and the fourth terminal **522**. Here, the bracket body **521** may be made of a synthetic resin material, and the fourth terminal **522** may be made of a metal material. Accordingly, the fourth terminal **522** may be disposed on the bracket body **521** through an insert injection method. Here, the bracket body **521** may be referred to as a sixth body.

The bracket body **521** may include a cavity **523** formed in the bracket body **521**, a fourth boss **524**, a plate **525**, hooks **526** disposed on the bracket body **521** to be spaced apart from each other, a fourth protrusion **527**, and a fourth protruding part **528**. Here, the fourth boss **524**, the plate **525**, the hook **526**, the fourth protrusion **527**, and the fourth protruding part **528** may be integrally formed with the bracket body **521**. Here, the fourth boss **524** may be referred to as a bracket boss or boss part. In addition, the plate **525** may be referred to as a support part.

As illustrated in FIG. **26**, the power module body **511** of the power module **510** may be disposed in the cavity **523**.

Three fourth bosses **524** may be formed to protrude downward from the bracket body **521**. Each of the fourth bosses **524** may have a space formed therein, and one side of the fourth terminal **522** may be disposed in the fourth boss **524**.

In addition, each of the fourth bosses **524** guides the motor **3** to couple to one region of a bus-bar terminal **62**. Accordingly, one region of the bus-bar terminal **62** may be coupled to one side of the fourth terminal **522** to receive one power of three-phase (U, V, and W) powers.

The plate **525** may be disposed below the bracket body **521** to cross the cavity **523**, as illustrated in FIG. **25**. Here, the plate **525** may be formed in a plate shape. Accordingly, the plate **525** is in contact with a lower surface **511***a* of the power module body **511** so that the power module **510** is pressed against the controller cover **400**.

The hooks **526** may be disposed on the bracket body **521** to be spaced apart from each other. Here, the hook **526** may be formed to protrude upward from the bracket body **521**.

When the power module **510** is disposed in the cavity **523**, the hook **526** fixes the power module body **511** to the bracket body **521**. Here, since the second groove **415** may be formed in the lower surface **414** of the controller cover body **410**, an end portion of the hook **526** may be disposed in the second groove **415** of the controller cover **400**. Accordingly, when the controller cover **400** is coupled to the power module unit **500**, interference due to the hook **526** is prevented.

As illustrated in FIG. **27**, the hook **526** may be disposed to be spaced apart from the virtual line L passing through a center of the power module body **511** at a predetermined distance d. Accordingly, when the controller cover **400** is coupled to the power module unit **500**, the power module unit **500** may be assembled at a preset position by the coupling of the second groove **415** and the hook **526**.

As illustrated in FIG. **30**, the fourth protrusion **527** may be formed to protrude toward an inner side of the cavity **523**. In addition, the fourth protrusion **527** is coupled to the fourth groove **514** of the power module **510**. Accordingly, when the power module **510** is coupled to the bracket **520**, the fourth protrusion **527** is disposed in the fourth groove **514** so that the fourth protrusion **527** guides the coupling of the power module **510**. Here, the fourth protrusion **527** may be referred to as a guide protrusion.

The fourth protruding part **528** may be formed to protrude downward from the bracket body **521**. Here, the fourth protruding part **528** may be disposed adjacent to the first pins **512**. Here, the term "adjacent to" refers to being in contact with or disposed to be spaced apart at predetermined intervals. Here, the fourth protruding part **528** may be referred to as a protection part.

Thus, the fourth protruding part **528** may protect the first pin **512**. For example, when the first pin **512** is coupled to the substrate **600**, the fourth protruding part **528** supports one region of the first pin **512** to prevent or minimize the phenomenon in which the first pin **512** is bent.

As illustrated in FIG. **30**, the fourth protruding part **528** may include a (4-1)th protruding part **528***a* and a plurality of (4-2)th protruding parts **528***b*.

The (4-1)th protruding part **528***a* may be formed in a plate shape. And, the (4-2)th protruding parts **528***b* may protrude toward the first pin **512** from one surface of the (4-1)th protruding part **528***a*. Accordingly, the first pin **512** may be disposed between the (4-2)th protruding parts **528***b*.

As illustrated in FIG. **28**, in order for the end portion of the first pin **512** and the substrate **600** to be coupled to each other, a protruding height H1 of the fourth protruding part **528** is less than a protruding height H2 of the first pin **512** on the basis of the lower surface **414** of the controller cover **400**. That is, the protruding height H2 of the first pin **512** is greater than the protruding height H1 of the fourth protruding part **528**. Here, the protruding height may be referred to as a protruding length.

The fourth terminal **522** electrically connects the first terminal pin **513***a* to the bus-bar terminal **62** of the motor **3**.

Referring to FIGS. **25** and **27**, an end portion of one side of the fourth terminal **522** is bent downward and exposed, and an end portion of the other side thereof may be disposed inside the fourth boss **524**.

FIG. **31** is a view illustrating the fourth terminal of the power module unit according to the first embodiment.

Referring to FIG. **31**, the fourth terminal **522** may include a fourth body **522***a* disposed horizontally, a fourth frame **522***b* formed to protrude downward from an end portion of one side of the fourth body **522***a*, and a fourth end portion **522***c* bent downward from an end portion of the other side of the fourth body **522***a* and then bent in the horizontal direction. Here, a sixth hole **522***d* may be formed in the fourth end portion **522***c*. Here, the fourth end portion **522***c* is disposed to be exposed inside the fourth boss **524**. Here, the sixth hole **522***d* may be referred to as an insertion hole or hole.

The fourth frame **522***b* may be disposed to be in contact with the first terminal pin **513***a*. Here, the contact force between the fourth frame **522***b* and the first terminal pin **513***a* may be improved through a fusing process.

An end portion of the bus-bar terminal **62** may be coupled to the sixth hole **522***d*. Here, two sixth holes **522***d* may be formed to improve the coupling force and contact force with the end portion of the bus-bar terminal **62**.

A heat transfer member (not shown) may be further disposed between the controller cover **400** and the power module **510** of the power module unit **500**. Accordingly, heat generated by the power module **510** is conducted to the controller cover **400** through the heat transfer member. Here, a thermal pad, a thermal grease, or the like may be used as the heat transfer member.

FIG. **32** is a view illustrating the substrate of the motor assembly according to the embodiment.

The substrate **600** may prevent the reverse connection of the power. Here, the term "reverse connection" means that a positive polarity and a negative polarity of power sources are applied differently from the preset polarities, and thus damage to the motor assembly **1** may occur due to the reverse connection. Thus, even when the positive and negative polarities of the power sources are applied differently from the preset polarities, the substrate **600** may prevent damage due to the reverse connection by using a metal-oxide-semiconductor field-effect transistor (MOSFET).

That is, the controller **2** receives power from the external connector coupled to the first boss **111**, removes noises using the CM filter unit **200** and the DM filter unit **300**, and then transmits the power to the substrate **600**. In addition, the

power in which the reverse connection is prevented at the substrate **600** is transferred to the DM filter unit **300** and then supplied to the power module unit **500** and the substrate **600**.

In addition, the substrate **600** may transmit and receive signals to and from the external connector through the first connector **700** and the second connector **800**. In addition, the substrate **600** may transmit and receive signals to and from the power module unit **500**.

Referring to FIG. **32**, the substrate **600** may include a substrate body **610** on which circuit wiring is disposed, a plurality of seventh holes **620**, a MOSFET **630**, and a sensor **640**. Here, the substrate body **610** may be referred to as a seventh body. In addition, the seventh holes **620** may be referred to as through holes.

The plurality of seventh holes **620** may be formed in the substrate body **610**. In addition, the end portion of the third frame **322**, the end portion of the (3-1)th frame **332**, the end portion of the (3-2-2)th frame **342***b*, the end portion of the (3-3)th frame **352**, the end portion of the first pin **512**, the end portion of the third protrusion **515**, and the like may be disposed in the seventh holes **620**. Further, each of the end portions may be soldered to be fixed to the substrate body **610**.

The MOSFET **630** may be disposed on the substrate body **610**.

The MOSFET **630** prevents the reverse connection of the power supplied to the substrate body **610** after the noises are removed by the CM filter unit **200** and the DM filter unit **300**.

The sensor **640** may be disposed on the substrate body **610**.

The sensor **640** senses whether a signal is properly transmitted to the motor **3** through the third protrusion **515**.

FIG. **33** is a view illustrating the first connector of the motor assembly according to the embodiment.

The first connector **700** electrically connects the external connector coupled to the second boss **112** to the substrate **600**. Here, one side of the first connector **700** is coupled to the substrate **600**.

Referring to FIG. **33**, the first connector **700** may include a first connector body **710** and a plurality of first connector pins **720**. Here, the first connector body **710** may be made of a synthetic resin material, and the first connector pin **720** may be made of a metal material. In addition, the first connector body **710** may be referred to as an eighth body. Also, the first connector pin **720** may be referred to as a second pin.

One side of the first connector pin **720** is connected to the external connector coupled to the second boss **112**, and the other side of the first connector pin **720** is electrically connected to the substrate **600**.

FIG. **34** is a view illustrating the second connector of the motor assembly according to the embodiment.

The second connector **800** electrically connects the external connector coupled to the third boss **113** to the substrate **600**. Here, one side of the second connector **800** is coupled to the substrate **600**.

Referring to FIG. **34**, the second connector **800** may include a second connector body **810** and a plurality of second connector pins **820**. Here, the second connector body **810** may be made of a synthetic resin material, and the second connector pin **820** may be made of a metal material. In addition, the second connector body **810** may be referred to as a ninth body. Further, the second connector pin **820** may be referred to as a third pin.

One side of the second connector pin **820** is connected to the external connector coupled to the third boss **113**, and the other side of the second connector pin **820** is electrically connected to the substrate **600**.

Referring to FIGS. **1** to **3**, the motor **3** according to the embodiment may include the motor housing **10** having an opening formed at one side thereof, a motor cover **20** covering the opening of the motor housing **10**, a stator **30** disposed inside the housing **10**, a rotor **40** rotatably disposed in the stator **30**, a rotation shaft **50** rotating together with the rotor **40**, and a bus bar **60**. Here, a bearing **70** may be disposed on an outer circumferential surface of the rotation shaft **50** for the rotation of the rotation shaft **50**. Here, the motor cover **20** may be referred to as a second cover part.

Here, the motor housing **10** and the motor cover **20** may form an outer shape of the motor **3**. In addition, an accommodation space may be formed by coupling the motor housing **10** to the motor cover **20**. Accordingly, as illustrated in FIG. **3**, the stator **30**, the rotor **40**, the rotation shaft **50**, and the bus bar **60** may be disposed in the accommodation space.

The motor housing **10** may be formed in a cylindrical shape such that the accommodation space is formed. The inner circumferential surface of the motor housing **10** may be coupled to the outer circumferential surface of the third protruding part **420**

Here, the motor housing **10** may be made of a metal material. Accordingly, heat transmitted through the controller cover **400** is emitted to the outside through the motor housing **10**. In addition, the motor housing **10** is in contact with the controller cover **400** and thus a grounding function may be performed.

The motor cover **20** is disposed in the opening of an upper side of the motor housing **10**. Here, the bearing **70** may be disposed inside the motor cover **20**.

The stator **30** may be disposed inside the motor housing **10**. In addition, the stator **30** causes electrical interaction with the rotor **40**.

Referring to FIG. **3**, the stator **30** may include a stator core **31** and a coil **33** wound around the stator core **31**. In addition, the stator **30** may further include an insulator **32** disposed between the stator core **31** and the coil **33**. The insulator **32** insulates the stator core **31** from the coil **33**.

The stator core **31** may be formed by stacking plates having a plate shape at a predetermined height.

The rotor **40** may be disposed inside the stator **30** and may be disposed on the outer circumferential surface of the rotation shaft **50**. Here, the rotor **40** may be rotatably disposed in the stator **30**.

The rotor **40** may be formed by stacking a plurality of disk-shaped core plates. Magnets disposed on the rotor **40** are disposed to face the stator **30**, and each of the magnets may be formed as an interior permanent magnet (IPM) type that is inserted into and coupled to the rotor **40** through a hole formed in the rotor **40**.

The rotor **40** may be configured as a type in which a magnet is disposed on an outer circumferential surface of a rotor core.

Accordingly, the rotor **40** is rotated by the electric interaction between the coil **33** and the magnet. In addition, the rotation shaft **50** rotates as the rotor **40** rotates to generate a driving force.

The rotation shaft **50** may be disposed to pass through a central portion of the rotor **40**. When a driving current is applied to the stator **30**, the rotor **40** is rotated by the electromagnetic interaction between the stator **30** and the rotor **40** so that the rotation shaft **50** rotates in conjunction with the rotation of the rotor **40**.

The bus bar **60** is disposed above the stator **30**.

The bus bar **60** may include a bus-bar body **61** and the bus-bar terminal **62** disposed inside the bus-bar body **61**.

Here, the bus-bar body **61** may be a molded product formed through injection molding.

The bus-bar terminal **62** may be a phase terminal connected to power sources of a U-phase, a V-phase, or a W-phase.

Connecting end portions of the bus-bar terminal **62** are disposed to be exposed from the bus-bar body **61**. Accordingly, the connecting end portion of the bus-bar terminal **62** may be connected to the coil **33** as illustrated in FIG. **3**.

FIG. **35** is a view illustrating the bus-bar terminal of the motor assembly according to the embodiment.

Referring to FIG. **35**, the bus-bar terminal **62** may include a bus-bar terminal body **62***a* and a fifth frame **62***b* protruding upward from the bus-bar terminal body **62***a*. Here, the fifth frame **62***b* may be referred to as a coupling end portion.

The fifth frame **62***b* may be disposed to protrude toward an upper side of the motor cover **20** through the motor cover **20**.

An end portion of the fifth frame **62***b* is guided by the fourth boss **524** and coupled to one side of the fourth terminal **522** disposed inside the fourth boss **524**. Here, two protrusions may be formed to be spaced apart from each other at the end portion of the fifth frame **62***b*, and the protrusions may be coupled to the sixth holes **522***d* of the fourth terminal **522**.

Meanwhile, a power module unit **500***a* according to a second embodiment may be disposed in the motor assembly **1** according to the embodiment instead of the power module unit **500** according to the first embodiment.

FIG. **36** is an exploded perspective view illustrating the motor according to the embodiment in which the power module unit **500***a* according to the second embodiment is disposed.

Referring to FIGS. **1** and **36**, the motor assembly **1** according to the embodiment may include the controller **2** and the motor **3**. In addition, the controller **2** may include the controller housing **100**, the CM filter unit **200**, the DM filter unit **300**, the controller cover **400**, the power module unit **500***a* according to the second embodiment, the substrate **600**, the first connector **700**, and the second connector **800**.

Hereinafter, in describing the motor assembly **1** according to the embodiment in which the power module unit **500***a* according to the second embodiment is disposed, the same components described in the motor assembly **1**, in which the power module unit **500** according to the first embodiment is disposed, are described with the same reference numerals, and thus detailed descriptions of the controller housing **100**, the CM filter unit **200**, the DM filter unit **300**, the controller cover **400**, the substrate **600**, the first connector **700**, and the second connector **800** will be omitted.

Power in which the reverse connection is prevented at the substrate **600** is transferred to the DM filter unit **300** and then supplied to the power module unit **500***a*.

In addition, the power module unit **500***a* transmits a signal capable of controlling the motor **3**. Here, the power module unit **500***a* is pressed against the lower surface **414** of the controller cover **400**.

FIG. **37** is a perspective view illustrating the power module unit according to the second embodiment of the motor assembly according to the embodiment, FIG. **38** is a bottom perspective view illustrating the power module unit according to the second embodiment of the motor assembly according to the embodiment, and FIG. **39** is a plan view illustrating the power module unit according to the second embodiment of the motor assembly according to the embodiment.

Referring to FIGS. **37** to **39**, the power module unit **500***a* may include a power module **510***a* and a mold unit **530** surrounding the power module **510***a*. At this point, the power module **510***a* may be disposed in the mold unit **530** through an injection method. Here, the mold unit **530** may be made of a synthetic resin material. Since the power module unit **500***a* is formed through the injection method, material costs and mold costs may be reduced and thus production costs may be reduced.

The power module **510***a* transmits a signal capable of controlling the motor **3**. Here, an APM may be used as the power module **510***a*.

FIG. **40** is a view illustrating the power module of the power module unit according to the second embodiment.

Referring to FIG. **40**, the power module **510***a* may include a power module body **511***a*, a plurality of power module pins **512** arranged to protrude downward from one side of the power module body **511**, and a terminal part.

The terminal part may include two first power module terminals **513***b* each having one region arranged to protrude downward from the other side of the power module body **511***a* and three second power module terminals **516** each having one side connected to the power module body **511***a*.

Here, the power module pin **512** is the same component as the first pin **512** of the power module unit **500** according to the first embodiment.

In addition, the first power module terminal **513***b* is the same component as the second terminal pin **513***b* of the power module unit **500** according to the first embodiment. In addition, the second power module terminal **516** is a component obtained by modifying the first terminal pin **513***a* and the fourth terminal **522** of the power module unit **500** according to the first embodiment to be integrated.

One side of the power module body **511***a* is disposed to be pressed against the lower surface **414** of the controller cover **400**. As illustrated in FIG. **37**, the power module body **511***a* may be formed to have a concave-convex shape in which a partial region thereof protrudes. That is, the power module body **511***a* may include the power module body **511** according to the first embodiment and a protruding region A protruding from one side of the power module body **511** according to the first embodiment.

Accordingly, when compared to the power module body **511** of the power module unit **500** according to the first embodiment, the power module body **511***a* has an increased contact area that is in contact with the controller cover **400** due to the protruding region A so that heat dissipation performance may be improved. In addition, since the size of the power module body **511***a* may be increased, a degree of design freedom may be increased.

The power module pin **512** and the first power module terminal **513***b* may be disposed to be spaced apart from each other to face each other. In addition, an end portion of the power module pin **512** is coupled to the substrate **600** to receive a signal from the substrate **600**. Here, the power module pin **512** may be fixed to the substrate **600** through soldering.

One side of the first power module terminal **513***b* is electrically connected to the power module body **511***a*, and the other side thereof may be bent downward.

As illustrated in FIG. **38**, one side of the first power module terminal **513***b* may be connected to the protruding region A of the power module body **511***a*, and the other side of the first power module terminal **513***b* may protrude

toward the outside of the mold unit **530**. Here, the power module pin **512** and one region of the first power module terminal **513***b* protruding downward may be disposed to be spaced apart from each other to face each other.

Each of two first power module terminals **513***b* is electrically connected to each of the (3-2-1)th frame **342***a* of the (3-2)th terminal **340** and the (3-3-3)th frame **352***c* of the (3-3)th terminal **350** to receive the power. Here, the first power module terminals **513***b* may be disposed with the protruding region A of the power module body **511** interposed therebetween.

Power is supplied to the motor **3** through the second power module terminal **516**. Here, the second power module terminal **516** may be made of a metal material.

An end portion of one side of the second power module terminal **516** may be connected to one side of the power module body **511***a*, and an end portion of the other side of the second power module terminal **516** may be disposed in a boss part **531**. As illustrated in FIG. **40**, the end portion of one side of the second power module terminal **516** may be disposed in the protruding region A of the power module body **511***a*.

Referring to FIG. **40**, the second power module terminal **516** may include a fourth body **516***a* that is horizontally disposed and has one side end portion connected to the protruding region A of the power module body **511***a*, and a fourth end portion **516***c* that is bent downward from the other side end portion of the fourth body **516***a* and then bent in a horizontal direction. Here, a sixth hole **516***d* may be formed at the fourth end portion **516***c*. Here, the fourth end portion **516***c* having the sixth hole **516***d* formed therein is disposed to be exposed inside the boss part **531**. Here, the fourth body **516***a* may be referred to as a power module terminal body. In addition, the sixth hole **516***d* may be referred to as an insertion hole or hole.

The end portion of the bus-bar terminal **62** may be coupled to the sixth hole **516***d*. Here, two sixth holes **516***d* may be formed to enhance the coupling force and contact force with the end portion of the bus-bar terminal **62**.

The mold unit **530** may be disposed to surround one region of the power module **510***a*. Here, the mold unit **530** may be divided into a first region surrounding the power module body **511** and a second region surrounding the protruding region A.

The boss part **531** and a groove **532** may be formed in the mold unit **530**. Here, the boss part **531** may be disposed in the second region. In addition, the groove **532** may be disposed in the first region.

Referring to FIG. **39**, a width W3 of one side of the mold unit **530** on which the boss part **531** is formed is less than a width W4 of the other side of the mold unit **530** disposed to face the one side. For example, the width W3 of the second region is less than the width W4 of the first region. Here, width W3:width W4 is 16:37.

Each of three boss parts **531** may be formed to protrude downward from one side of the mold unit **530**. At this point, the boss part **531** protrudes toward the substrate **600** and is branched into three parts from the mold unit **530**, as illustrated in FIG. **38**. Here, the boss part **531** may be disposed in the second region to be adjacent to the protruding region A.

A space may be formed in each of the boss parts **531**, and the fourth end portion **516***c* of the second power module terminal **516** may be disposed in the boss part **531**. Here, the space may be formed to pass through from a lower portion to an upper portion of the boss part **531**.

In addition, each of the boss parts **531** guides the motor **3** to couple to one region of the bus-bar terminal **62**. Accordingly, one region of the bus-bar terminal **62** may be coupled to the fourth end portion **516***c* of the second power module terminal **516** to receive one power of three-phase (U, V, and W) powers.

Meanwhile, a protruding part **531***a* may be further formed at a lower end of each of the boss parts **531**.

The protruding part **531***a* is formed to protrude downward from the lower end of the boss part **531**. Accordingly, the space of the boss part **531** extends downward due to the protruding part **531***a*. As illustrated in FIG. **38**, the protruding part **531***a* may be formed in a quadrangular shape in a plan view.

Two grooves **532** may be formed at both sides of the power module body **511**. In addition, the power module unit **500***a* is in close contact with and fixed to the lower surface **414** of the controller cover **400** by a fastening member (not shown) such as a bolt or screw passing through the groove **532**.

Although the above-described descriptions are described with reference to the embodiments of the present invention, it should be understood that those skilled in the art may be capable of variously modifying and changing the present invention within the spirit and the scope disclosed in the claims which will be described below. In addition, it should be interpreted that the differences related to the change and modification fall within the range of the present invention defined by the appended claims.

EXPLANATION OF REFERENCE NUMERALS

1: motor assembly, **10**: motor housing, **20**: motor cover, **60**: bus bar, **100**: controller housing, **200**: common-mode (CM) filter unit, **300**: differential-mode (DM) filter unit, **400**: controller cover, **500** or **500***a*: power module unit, **600**: substrate, **630**: metal-oxide-semiconductor field-effect transistor (MOSFET), **700**: first connector, **800**: second connector.

The invention claimed is:

1. A controller comprising:
a first housing;
a first cover disposed on an opening of the first housing;
filter units disposed above the first cover;
a power module unit disposed below the first cover; and
a substrate disposed below the power module unit,
wherein the power module unit includes:
a bracket; and
a power module disposed between the bracket and the first cover,
wherein the power module includes:
a power module body;
a plurality of first pins arranged to protrude downward from one side of the power module body; and
five terminal pins arranged to protrude downward from the other side of the power module body, and
wherein an end portion of the first pin is coupled to the substrate.

2. The controller of claim **1**, wherein a protrusion protrudes from an end portion of each of three terminal pins among the terminal pins, and
wherein an end portion of the protrusion is coupled to the substrate.

3. The controller of claim **2**, wherein one surface of the power module is pressed against the first cover, which is made of a metal material, by the bracket.

4. The controller of claim 2, wherein the bracket includes:
a bracket body having a structure of a cavity in which the power module is disposed and three bosses protrude downward; and
a terminal having one side disposed to be exposed inside each of the bosses and the other side disposed on the bracket body to protrude downward.

5. The controller of claim 4, wherein the terminal is in contact with the terminal pin on which the protrusion is formed.

6. The controller of claim 5, wherein the bracket further includes a plate disposed below the bracket body to traverse the cavity.

7. The controller of claim 6, wherein the bracket further includes at least two hooks protruding from the bracket body, and the power module is fixed to the bracket by the hooks.

8. The controller of claim 7, wherein the hooks are disposed to be spaced apart from each other at predetermined intervals with respect to a virtual line L passing through a center of the power module.

9. The controller of claim 8, wherein a groove is formed on a lower surface of the first cover such that an end portion of the hooks is disposed therein.

10. The controller of claim 9, wherein the bracket further includes a protruding part protruding downward from the bracket body, and the protruding part is disposed to be adjacent to the first pin.

11. The controller of claim 10, wherein a protruding height of the first pin is greater than a protruding height of the protruding part.

12. The controller of claim 10, wherein the terminal includes:
a body disposed horizontally,
a frame formed to protrude downward from an end portion of one side of the body, and
an end portion bent at an end portion of the other side of the body and disposed inside the boss, and
wherein the frame is in contact with the terminal pin.

13. The controller of claim 12, wherein a hole is formed in the end portion.

14. The controller of claim 1, further comprising:
a heat transfer member disposed between the power module body and the first cover.

15. The controller of claim 2, wherein a width of the protrusion is less than the width of the terminal pin.

16. A motor assembly comprising:
a motor controller; and
a motor,
wherein the motor controller includes:
a first housing;
a first cover disposed on an opening of the first housing;
filter units disposed above the first cover;
a power module unit disposed below the first cover; and
a substrate disposed below the power module unit,
wherein the power module unit includes:
a bracket; and
a power module disposed between the bracket and the first cover,
wherein the power module includes:
a power module body;
a plurality of first pins arranged to protrude downward from one side of the power module body;
five terminal pins arranged to protrude downward from the other side of the power module body; and
a protrusion protruding from an end portion of each of three terminal pins among the terminal pins, and
wherein an end portion of the protrusion is coupled to the substrate.

17. The motor assembly of claim 16, wherein a width of the protrusion is less than the width of the terminal pin.

18. The motor assembly of claim 16, wherein one surface of the power module is pressed against the first cover, which is made of a metal material, by the bracket.

19. The motor assembly of claim 16, wherein the motor includes a rotation shaft, a rotor disposed outside the rotation shaft, a stator disposed outside the rotor, a bus bar disposed above the stator, a second housing accommodating the rotor, the stator, and the bus bar, and a second cover disposed on an opening of the second housing,
wherein the bus bar includes a bus-bar body and a bus-bar terminal,
wherein the bracket includes:
a bracket body having a structure of a cavity in which the power module is disposed and three bosses protrude downward; and
a terminal having one side disposed to be exposed inside each of the bosses and the other side disposed on the bracket body to protrude downward, and
wherein one side of the bus-bar terminal is coupled to a hole of the terminal.

20. The motor assembly of claim 16, wherein the terminal is in contact with the terminal pin on which the protrusion is formed.

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