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(54) **HOUSING CORE INDUCTOR AND MOTOR ASSEMBLY USING THE SAME**

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USPC ..... **310/72**

(57) **ABSTRACT**

Disclosed herein are a housing core inductor and a motor assembly using the same. The housing core inductor includes: a housing core formed by stacking a plurality of plate bodies on a lower surface of a housing body of a housing of a motor assembly, each of the plurality of plate bodies including a central portion provided with a through-hole through which a shaft penetrates and a plurality of arms extended from the central portion in a radial direction to form a plurality of space parts; and a coil wound around the plurality of arms of the housing core.

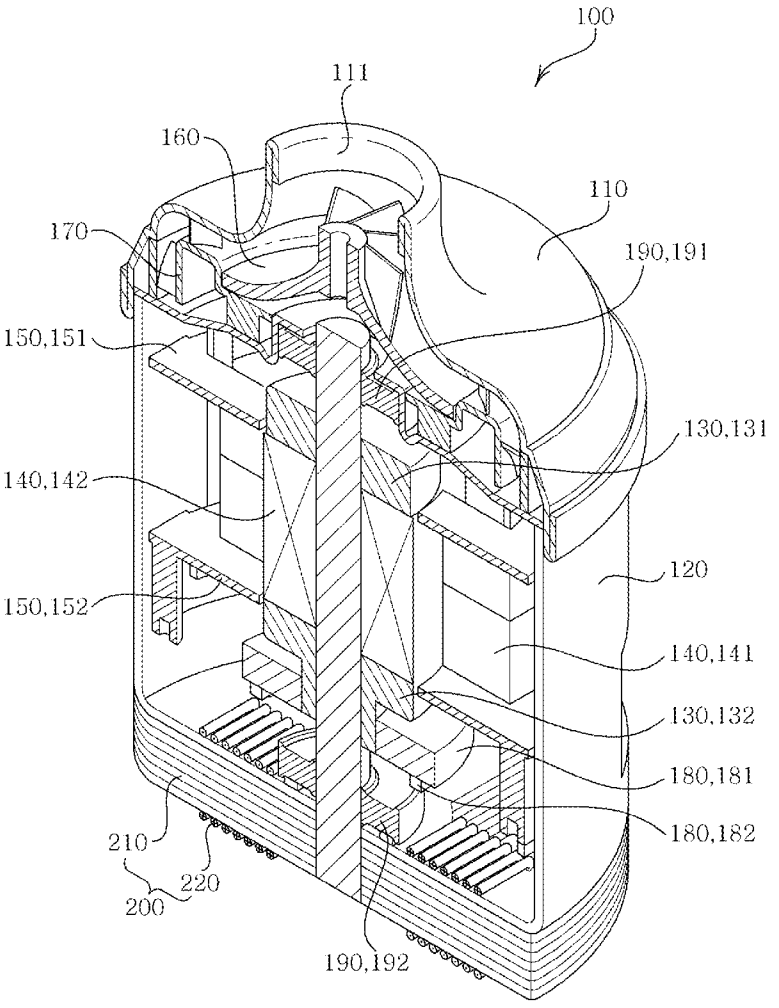


FIG.1

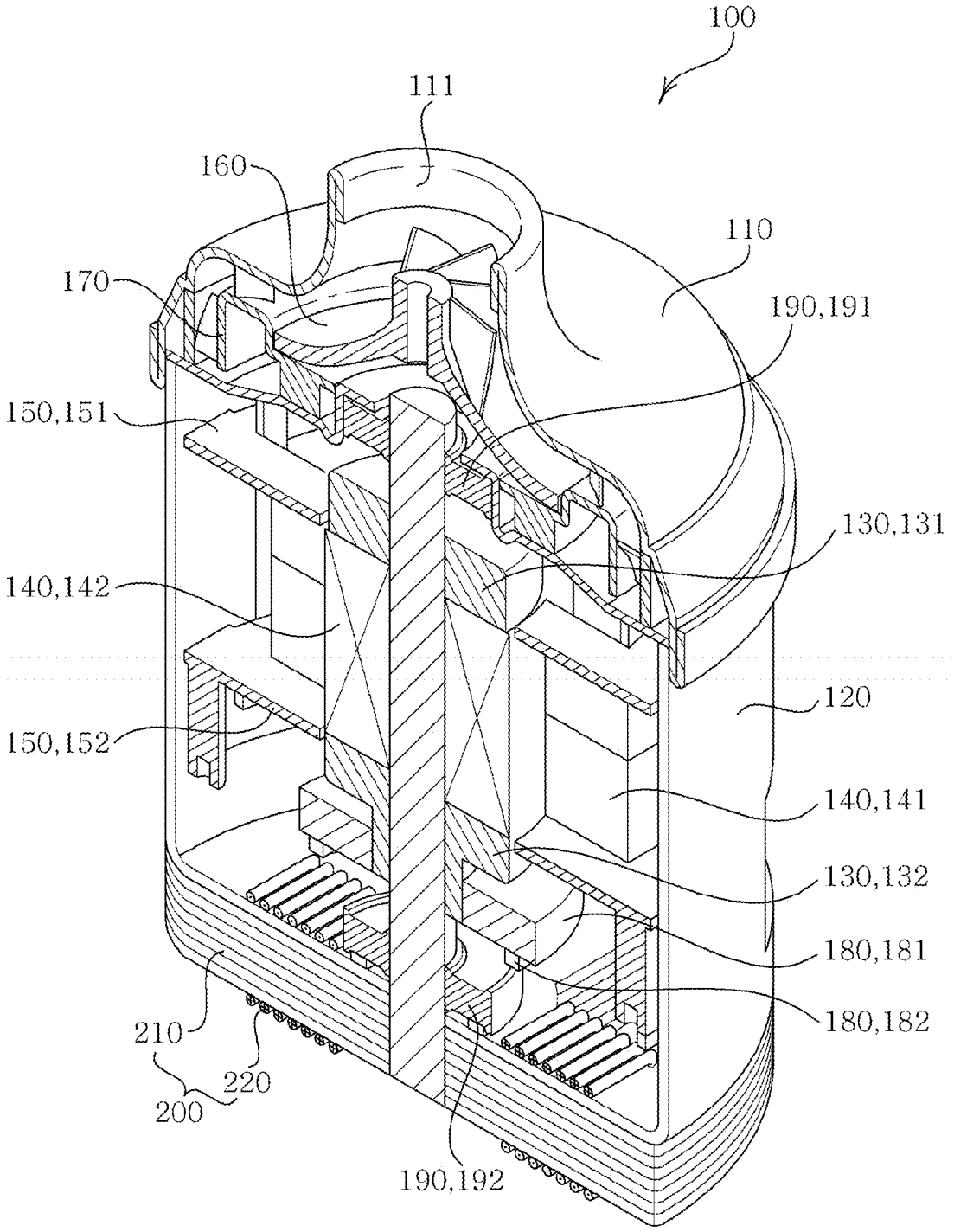

100
111
160
110
170
190,191
150,151
130,131
140,142
120
150,152
140,141
130,132
180,181
180,182
210
220
200
190,192

FIG.2

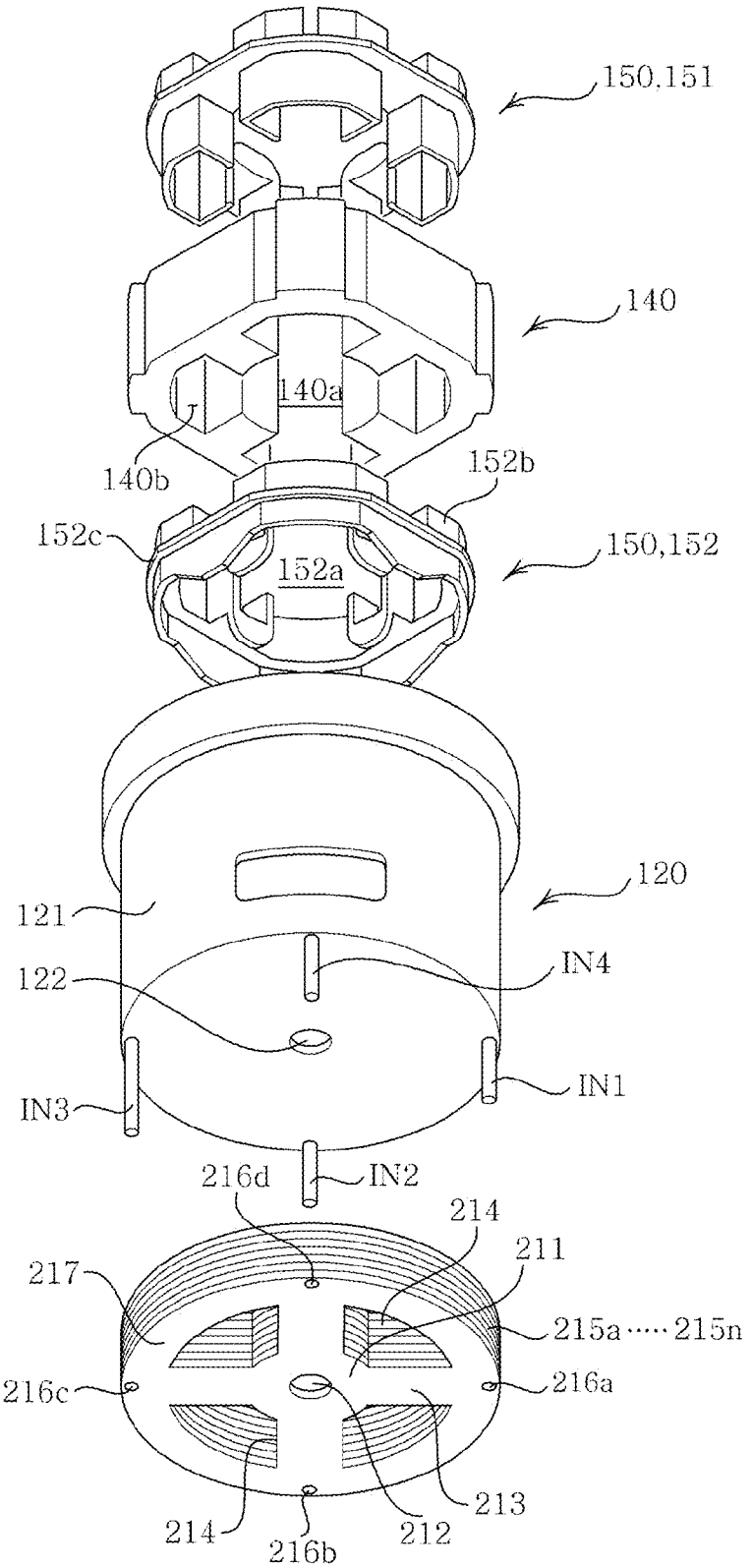

150,151
140
140a
140b
152b
152c
150,152
152a
120
121
122
IN4
IN3
IN1
216d
IN2
214
211
217
215a ····· 215n
216c
216a
213
214
212
216b

FIG. 3

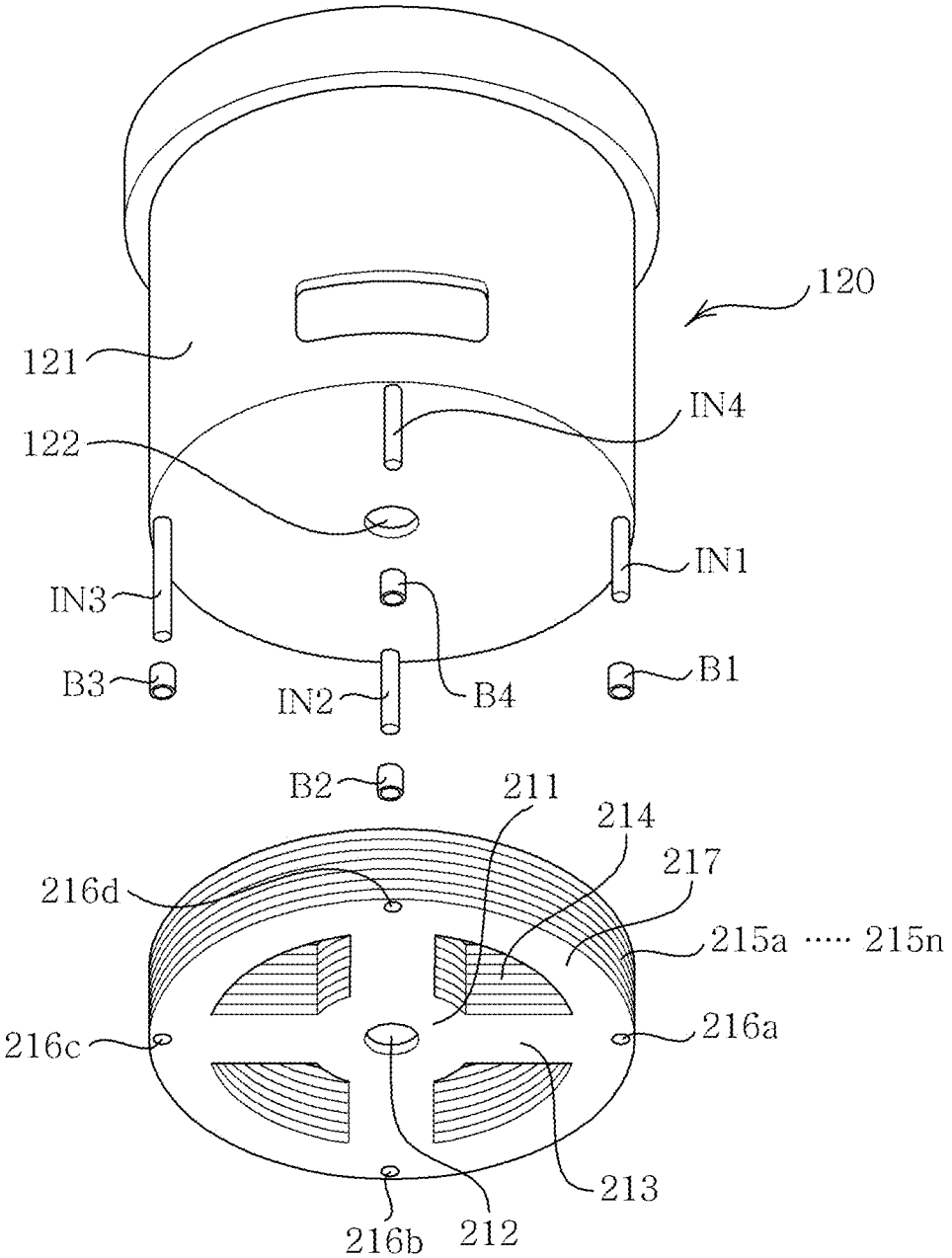

120
121
122
IN4
IN1
IN3
B3
B1
IN2
B4
B2
211
214
217
216d
215a ····· 215n
216c
216a
213
216b
212

FIG. 4

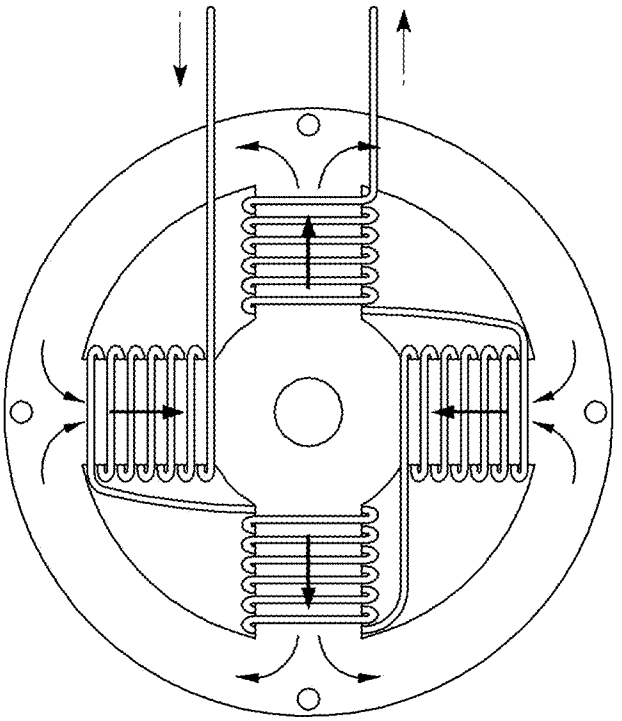


FIG. 5

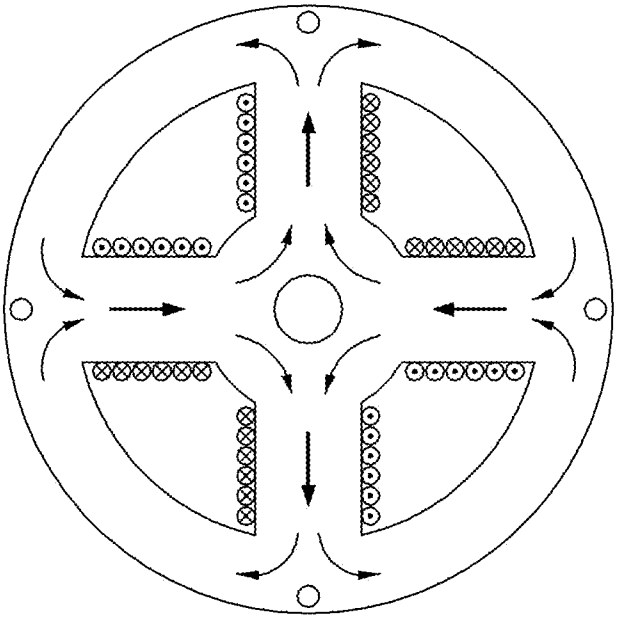


FIG. 6

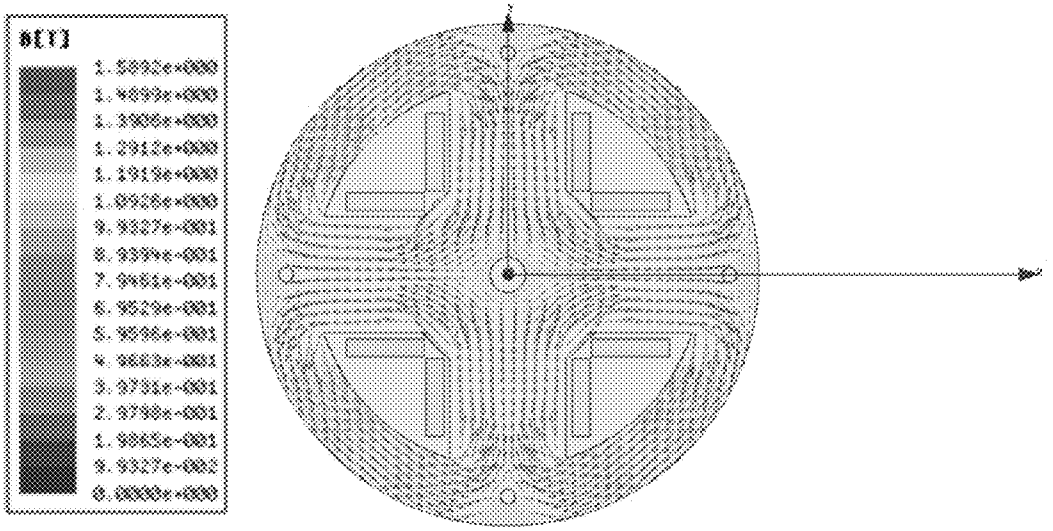
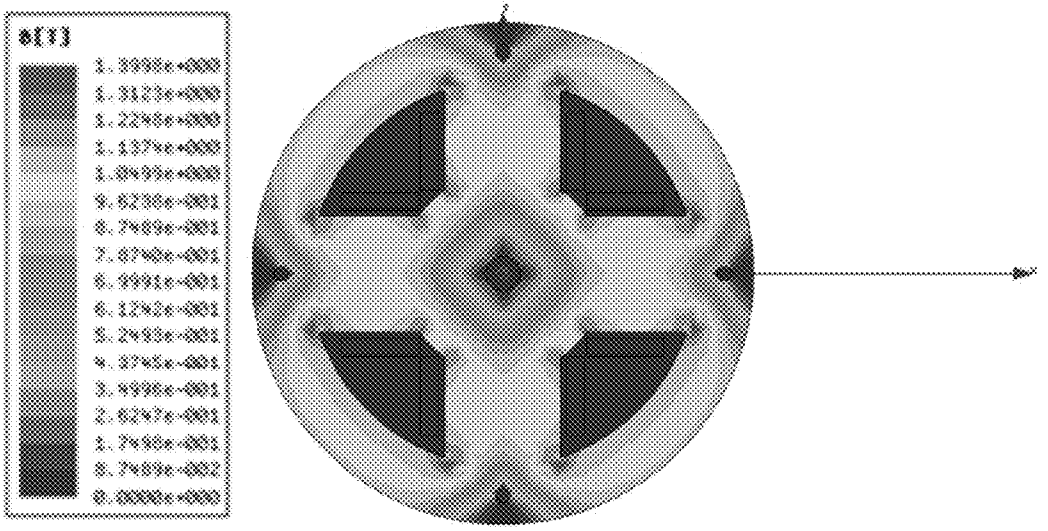



FIG. 7



# HOUSING CORE INDUCTOR AND MOTOR ASSEMBLY USING THE SAME

## CROSS REFERENCE TO RELATED APPLICATION

**[0001]** This application claims the benefit of Korean Patent Application No. 10-2012-0157095, filed on Dec. 28, 2012, entitled "Housing Core Inductor and Motor Assembly", which is hereby incorporated by reference in its entirety into this application.

## BACKGROUND OF THE INVENTION

**[0002]** 1. Technical Field

**[0003]** The present invention relates to a housing core inductor and a motor assembly using the same.

**[0004]** 2. Description of the Related Art

**[0005]** A switched reluctance motor (SRM) is one of the old motors that have been used over 150 years. This traditional type of reluctance motor has been known as the switched reluctance motor in order to satisfy a condition of a variable drive in accordance with the development of a power semiconductor.

**[0006]** "Switched Reluctance" was named by S.A. Nasar and has described two main features of the SRM.

**[0007]** First, 'Switched' means that a motor should always be operated in a continuous switching mode. This term has been used after applying a new type of power semiconductor in accordance with development and advance of the new type of power semiconductor.

**[0008]** Second, 'Reluctance' means a double salient pole type structure in which a rotor and a stator are operated by varying a reluctance magnetic circuit.

**[0009]** Scholars such as Nasar, French, Koch, and Lawrenson have devised a continuous mode control using a power semiconductor unlike a structurally similar stepping motor, in the 1960s.

**[0010]** At that time, since only a power thyristor semiconductor has a function of controlling a relatively high voltage and current, it has been used to control the switched reluctance motor.

**[0011]** At the present time, a power transistor, a gate turn-off thyristor (GTO), an insulated gate bipolar mode transistor IGBT, a power metal oxide semiconductor field effect transistor (MOSFET), and the like, have been developed and variously used in a rated power range for controlling the SRM.

**[0012]** The SRM has a very simple structure. The SRM does not include a permanent magnet, a brush, and a commutator. In this SRM, a stator includes salient poles and has a structure in which steel sheets are stacked, and windings around which coils connected in series with each other are wound are independently connected to the respective phases and enclose stator poles.

**[0013]** A rotor does not include a winding, has a structure in which steel sheets are stacked, and includes salient poles, similar to the stator. Therefore, since both of the stator and the rotor have the salient pole structure, the SRM may be considered as having a double salient pole type structure.

**[0014]** Due to this simple structure, reliability is increased and a production cost is decreased, such that it is likely that the SRM will substitute for a variable speed drive.

**[0015]** The SRM having the above-mentioned advantage has been currently used in various fields. Particularly, the SRM has been commercialized in a vacuum cleaner.

**[0016]** Meanwhile, several organizations have recently demanded to necessarily add a power factor compensating and electromagnetic interference (EMI)/electromagnetic capability (EMC) protecting circuit in all home appliances as well as a cleaner all over the world.

**[0017]** However, an inductor, which is one of the components configuring the power factor compensating and EMI/EMC protecting circuit, has a large volume and requires an additional component for heat radiation, which are problematic.

**[0018]** [Prior Art Document]

**[0019]** [Patent Document]

**[0020]** (Patent Document 1) Japanese Patent Laid-Open Publication No. 1995-87712

## SUMMARY OF THE INVENTION

**[0021]** The present invention has been made in an effort to provide a housing core inductor capable of having a decreased volume and facilitating heat radiation by being manufactured using a motor housing, and a motor assembly using the same.

**[0022]** According to a preferred embodiment of the present invention, there is provided a housing core inductor including: a housing core formed by stacking a plurality of plate bodies on a lower surface of a housing body of a housing of a motor assembly, each of the plurality of plate bodies including a central portion provided with a through-hole through which a shaft penetrates and a plurality of arms extended from the central portion in a radial direction to form a plurality of space parts; and a coil wound around the plurality of arms of the housing core.

**[0023]** The plate body of the housing core may be formed in a cross shape by the plurality of arms extended in the central portion in the radial direction.

**[0024]** The plate body of the housing core may further include a plurality of connection rings connecting outer sides of the plurality of arms extended from the central portion in the radial direction to each other.

**[0025]** The housing may include fixing parts extended in a via shape from one side thereof toward the housing core, and the housing core may include fixing holes formed at one side thereof and having the fixing parts inserted thereinto.

**[0026]** A plurality of fixing parts may be formed, and one of the plurality of fixing parts may be formed to have a length longer than those of the others thereof.

**[0027]** The housing may further include dampers mounted on the fixing parts, absorbing impact, and made of an elastic material.

**[0028]** As the housing core, any one of a dust core, a laminated core, and a ferrite core may be used.

**[0029]** The coil may be wound from an outer side of the aim toward the central portion.

**[0030]** According to another preferred embodiment of the present invention, there is provided a motor assembly including: a shaft forming the center of rotation of a motor; a motor unit including a rotor and a stator so as to rotate the shaft; an impeller coupled to an upper portion of the shaft so as to suck air through a sucking port formed in a cover; a diffuser guiding the air sucked by the impeller to an inner portion of the motor; a housing including the motor unit and formed to enclose an outer circumference of the shaft; and a housing

core inductor including a housing core formed by stacking a plurality of plate bodies on a lower surface of a housing body of the housing of the motor assembly, each of the plurality of plate bodies including a central portion provided with a through-hole through which the shaft penetrates and a plurality of arms extended from the central portion in a radial direction to form a plurality of space parts, and a coil wound around the plurality of arms of the housing core.

**[0031]** The motor assembly may further include: an upper insulator installed on an upper surface of the motor unit; and a lower insulator installed on a lower surface of the motor unit.

**[0032]** The plate body of the housing core may be formed in a cross shape by the plurality of arms extended in the central portion in the radial direction.

**[0033]** The plate body of the housing core may further include a plurality of connection rings connecting outer sides of the plurality of arms extended from the central portion in the radial direction to each other.

**[0034]** The housing may include fixing parts extended in a via shape from one side thereof toward the housing core, and the housing core may include fixing holes formed at one side thereof and having the fixing parts inserted thereinto.

**[0035]** A plurality of fixing parts may be formed, and one of the plurality of fixing parts may be formed to have a length longer than those of the others thereof.

**[0036]** The housing may further include dampers mounted on the fixing parts, absorbing impact, and made of an elastic material.

**[0037]** As the housing core, any one of a dust core, a laminated core, and a ferrite core may be used.

**[0038]** The coil may be wound from an outer side of the arm toward the central portion.

**[0039]** The motor assembly may further include: a sensor magnet installed on a lower surface of a lower balancing member of the motor unit; and a hall sensor installed on a lower surface of the sensor magnet.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0040]** The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

**[0041]** The above and other objects, features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

**[0042]** FIG. **1** is a cross-sectional perspective view of a switched reluctance motor assembly according to a preferred embodiment of the present invention;

**[0043]** FIG. **2** is an exploded perspective view showing that a motor housing inductor according to the preferred embodiment of the present invention is installed at a motor unit;

**[0044]** FIG. **3** is a partial exploded perspective view showing that a damper is installed on a fixing part of a housing;

**[0045]** FIG. **4** is a plan view of the motor housing inductor;

**[0046]** FIG. **5** is a view showing a magnetic flux flow of the motor housing inductor; and

**[0047]** FIGS. **6** and **7** are simulation diagrams of the motor housing inductor.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0048]** The objects, features and advantages of the present invention will be more clearly understood from the following detailed description of the preferred embodiments taken in conjunction with the accompanying drawings. Throughout the accompanying drawings, the same reference numerals are used to designate the same or similar components, and redundant descriptions thereof are omitted. Further, in the following description, the terms "Tint", "second", "one side", "the other side" and the like are used to differentiate a certain component from other components, but the configuration of such components should not be construed to be limited by the terms. Further, in the description of the present invention, when it is determined that the detailed description of the related art would obscure the gist of the present invention, the description thereof will be omitted.

**[0049]** Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the attached drawings.

**[0050]** FIG. **1** is a cross-sectional perspective view of a switched reluctance motor assembly according to a preferred embodiment of the present invention.

**[0051]** As shown in FIG. **1**, the switched reluctance motor assembly **100** according to the preferred embodiment of the present invention is configured to include an impeller **160** and a diffuser **170** sucking air through a sucking port **111** formed in a cover and transferring the sucked air; a housing **120** having a motor unit mounted therein, the motor unit **140** rotating a shaft S operating together with the impeller **160**; an insulator **150** installed on and beneath the motor unit **140**; and a motor housing inductor **200** including an inductor core **210** installed on a bottom surface of the housing **120** and a coil **220** wound around the inductor core **210**.

**[0052]** Here, the impeller **160** is installed at an inner side of the cover **110** having the sucking port **111** formed at an upper end thereof and is installed at an inner side of the housing **120** connected to a lower end of the cover **110** so as to be rotated by the shaft S.

**[0053]** In addition, the diffuser **170** is disposed between the impeller **160** and the motor unit **140** and transfers air discharged through an outlet part of the impeller **160**.

**[0054]** Here, the impeller **160** and the diffuser **170** are installed while having a predetermined interval therebetween so that the air is sucked through the sucking port **111** by rotation of the impeller **160**, passes through the impeller **160**, and is then transferred by the diffuser **170**, such that pressure thereof is increased.

**[0055]** The housing **120** is installed at the lower end of the cover **110** in which the sucking port **111** is formed.

**[0056]** Meanwhile, the housing **120** may include a housing body **121** having a cylindrical shape and having a through-hole **122** formed at the center thereof, the through-hole **122** having the shaft S penetrating therethrough; and fixing parts IN extended in a via shape from one side of the housing body **121** toward the motor housing inductor **200**, as shown in FIG. **2**.

**[0057]** The motor housing inductor **200** includes a housing core **210** formed by stacking a plurality of plate bodies **215***a* to **215***n* including a central portion **211** provided with a through-hole **212** through which the shaft S penetrates and a plurality of anus **213** extended from the central portion in a

radial direction to form a plurality of space parts **214** in which the coil **220** is wound; and the coil **220** wound around the housing core **210**.

**[0058]** As the housing core **210**, a dust core formed by compressing and molding ferromagnetic powders such as iron, a laminated core formed by laminating steel plates such as silicon steel, or a ferrite core is used

**[0059]** In addition, the plate body **215** of the housing core **210** is formed in a cross shape by the plurality of arms **213** extended in the central portion **211** in the radial direction. The housing core **210** may include fixing holes **216** formed at one side thereof and having the fixing parts IN inserted thereinto.

**[0060]** That is, the fixing parts IN extended from the housing **120** in a downward direction (toward the motor inductor core) in FIG. **2** are inserted into the fixing holes **216**, such that the housing **120** and the housing core **210** may be fixed to each other.

**[0061]** Here, the fixing parts IN may include four fixing parts IN**1**, IN**2**, IN**3**, and IN**4**, and the fixing holes **216** may also include four fixing holes **216***a*, **216***b*, **216***c*, and **216***d* corresponding thereto.

**[0062]** Meanwhile, as shown in FIG. **2**, a plurality of fixing parts IN may be formed, and one of the plurality of fixing parts IN may be formed to have a length longer than those of the others thereof. This is to easily assemble the housing **120** and the housing core **210** to each other by adjusting a height of a step at the time of assembling them to each other. When the fixing part having the long length is first inserted into the fixing hole **216**, positions of the other fixing parts are adjusted so that the other fixing parts may be automatically inserted into the other fixing holes **216**, thereby further facilitating the assembling. For example, after the fixing part IN**3** positioned at a lower end of the left in FIG. **2** is formed to have a length longer than those of the other fixing parts IN**1**, IN**2**, and IN**4** and is inserted into the fixing hole **216**, the other fixing parts IN**1**, IN**2**, and IN**4** are inserted into and fixed to the other fixing holes.

**[0063]** Meanwhile, as shown in FIG. **3**, the housing **120** may further include dampers B mounted on the fixing parts IN, absorbing impact, and made of an elastic material. That is, as shown in FIG. **3**, the dampers B**1**, B**2**, B**3**, and B**4** may be installed on the four fixing parts IN, respectively, to absorb impact or vibration generated inside or outside the housing **120**. As a material of the to damper B, any material having elasticity, such as rubber, or the like, may be used Here, the damper B has a hollow shape, such that the fixing part IN may penetrate therethrough. Further, in the damper B, a surface (an upper surface in FIG. **3**) into which the fixing part IN is inserted is opened, and a lower surface is not opened, such that the fixing part IN may be inserted into and received in the damper B.

**[0064]** In addition, the housing core **210** further includes a plurality of connection rings **217** connecting outer sides of the plurality of arms **213** extended from the central portion **211** in the radial direction to each other.

**[0065]** The coil **220** is wound around the arm of the housing core **210** in a direction from the outside toward the central portion **211**, such that it passes through the shortest distance when it is wound around a neighboring arm.

**[0066]** That is, referring to FIG. **4**, which is a plan view of the housing core inductor **200**, the coil is wound from the outside of the housing core **210** toward the central portion **211** so that magnetic fluxes flow inwardly in two anus facing each other and flow outwardly in the other two anus facing each other as shown in a view showing a magnetic flux flow of FIG. **5**, thereby making it possible to obtain a smooth magnetic flux flow.

**[0067]** Meanwhile, the insulator **150** for insulation from the coil wound around the stator **141** may be installed on and beneath of the motor unit **140**.

**[0068]** The insulator **150** may include an upper insulator **151** installed on an upper surface of the motor unit **140** and a lower insulator **152** installed on a lower surface of the motor unit **140**.

**[0069]** That is, the insulator **150** may be installed on the upper and lower surfaces of the motor unit **140**, respectively, in order to stably secure insulation performance of the motor unit **140**. Meanwhile, the lower insulator **152** may have a plate body shape as shown in FIG. **2** and include a lower insulator body **152***c* having a through-hole **152***a* formed at the center thereof, the through-hole **152***a* having the shaft S penetrating therethrough.

**[0070]** In addition, the lower insulator **152** may include insertion protrusions **152***b* protruding upwardly from the lower insulator body **152***c* and inserted into space parts **141***b* of the stator **141**, as shown in FIG. **2**. The insertion protrusion parts **152***b* may have a wall body shape, be formed to be spaced apart from each other, and be inserted into four space parts **141***b*, respectively, as shown in FIG. **2**.

**[0071]** The space part **141***b* of the stator **141** is an empty space between the winding coils (not shown) wound around neighboring stator parts as well known. Therefore, a detailed description thereof will be omitted.

**[0072]** As shown in FIG. **1**, the switched reluctance motor assembly **100** may also include a rotor electrode sensing device **180** including a sensor magnet **181** installed on a lower surface of a lower balancing member **132** of the motor unit **140** and a hall sensor **182** installed on the sensor magnet **181**. As well known, it is required to sense electrodes of a rotor **142** in order to control the switched reluctance motor. To this end, the switched reluctance motor assembly includes the sensor magnet **181** and the hall sensor **182** as described above.

**[0073]** An operation of sucking air by the switched reluctance motor assembly **100** according to the preferred embodiment of the present invention as described above will be described with reference to FIG. **1**.

**[0074]** First, as described above, the shaft S is rotated by the motor unit **140**, and the impeller **160** is rotated by the rotated shaft S. The air is sucked through the sucking port **111** by the rotated impeller **160** and is transferred by the diffuser **170**. Here, the shaft S may be supported by bearings **190**: **191** and **192** installed in a vertical direction as shown in FIG. **1**. Meanwhile, balancing members **130**: **131** and **132** may be installed on or beneath the motor unit **140**.

**[0075]** The motor unit **140** is controlled by a controller (not shown). In this case, the controller performs a control so that a rotation speed of the impeller **160** arrives at an optimal state. The control of the controller is performed by controlling an inverter driving the motor. In this case, as power required for the inverter, power converted into direct current (DC) power by an alternating current (AC) to DC rectifier, stored in the motor housing inductor **200**, and supplied from the motor housing inductor **200** is used.

**[0076]** Here, the motor housing inductor **200** is installed at a lower end of the housing **120** and is cooled by the air discharged by the impeller.

**[0077]** As set forth above, according to the preferred embodiment of the present invention, the inductor is manu-

factured using the motor housing, thereby making it possible to decrease a volume of the motor.

**[0078]** In addition, according to the preferred embodiment of the present invention, the air discharged from the motor directly passes through the coil and the core, thereby making it possible to obtain a sufficient heat radiation effect without requiring an additional heat radiation device.

**[0079]** FIGS. **6** and **7** are magnetic simulation diagrams of the motor housing inductor. As shown in FIGS. **6** and **7**, magnetic fluxes smoothly flow through the arms of the motor housing inductor, such that desired inductor characteristics may be obtained.

**[0080]** Although the embodiments of the present invention have been disclosed for illustrative purposes, it will be appreciated that the present invention is not limited thereto, and those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention.

**[0081]** Accordingly, any and all modifications, variations or equivalent arrangements should be considered to be within the scope of the invention, and the detailed scope of the invention will be disclosed by the accompanying claims.

What is claimed is:

**1**. A housing core inductor comprising:

a housing core formed by stacking a plurality of plate bodies on a lower surface of a housing body of a housing of a motor assembly, each of the plurality of plate bodies including a central portion provided with a through-hole through which a shaft penetrates and a plurality of arms extended from the central portion in a radial direction to form a plurality of space parts; and

a coil wound around the plurality of arms of the housing core.

**2**. The housing core inductor as set forth in claim **1**, wherein the plate body of the housing core is formed in a cross shape by the plurality of arms extended in the central portion in the radial direction.

**3**. The housing core inductor as set forth in claim **2**, wherein the plate body of the housing core further includes a plurality of connection rings connecting outer sides of the plurality of arms extended from the central portion in the radial direction to each other.

**4**. The housing core inductor as set forth in claim **1**, wherein the housing includes fixing parts extended in a via shape from one side thereof toward the housing core, and the housing core includes fixing holes formed at one side thereof and having the fixing parts inserted thereinto.

**5**. The housing core inductor as set forth in claim **4**, wherein a plurality of fixing parts are formed, and one of the plurality of fixing parts is formed to have a length longer than those of the others thereof

**6**. The housing core inductor as set forth in claim **4**, wherein the housing further includes dampers mounted on the fixing parts, absorbing impact, and made of an elastic material.

**7**. The housing core inductor as set forth in claim **1**, wherein as the housing core, any one of a dust core, a laminated core, and a ferrite core is used.

**8**. The housing core inductor as set forth in claim **1**, wherein the coil is wound from an outer side of the arm toward the central portion.

**9**. A motor assembly comprising:

a shaft forming the center of rotation of a motor;

a motor unit including a rotor and a stator so as to rotate the shaft;

an impeller coupled to an upper portion of the shaft so as to suck air through a sucking port formed in a cover;

a diffuser guiding the air sucked by the impeller to an inner portion of the motor;

a housing including the motor unit and formed to enclose an outer circumference of the shaft; and

a housing core inductor including a housing core formed by stacking a plurality of plate bodies on a lower surface of a housing body of the housing of the motor assembly, each of the plurality of plate bodies including a central portion provided with a through-hole through which the shaft penetrates and a plurality of arms extended from the central portion in a radial direction to form a plurality of space parts, and a coil wound around the plurality of arms of the housing core.

**10**. The motor assembly as set forth in claim **9**, further comprising:

an upper insulator installed on an upper surface of the motor unit; and

a lower insulator installed on a lower surface of the motor unit.

**11**. The motor assembly as set forth in claim **9**, wherein the plate body of the housing core is formed in a cross shape by the plurality of arms extended in the central portion in the radial direction.

**12**. The motor assembly as set forth in claim **11**, wherein the plate body of the housing core further includes a plurality of connection rings connecting outer sides of the plurality of arms extended from the central portion in the radial direction to each other.

**13**. The motor assembly as set forth in claim **9**, wherein the housing includes fixing parts extended in a via shape from one side thereof toward the housing core, and

the housing core includes fixing holes formed at one side thereof and having the fixing parts inserted thereinto.

**14**. The motor assembly as set forth in claim **13**, wherein plurality of fixing parts are formed, and one of the plurality of fixing parts is formed to have a length longer than those of the others thereof

**15**. The motor assembly as set forth in claim **13**, wherein the housing further includes dampers mounted on the fixing parts, absorbing impact, and made of an elastic material.

**16**. The motor assembly as set forth in claim **9**, wherein as the housing core, any one of a dust core, a laminated core, and a ferrite core is used.

**17**. The motor assembly as set forth in claim **9**, wherein the coil is wound from an outer side of the arm toward the central portion.

**18**. The motor assembly as set forth in claim **9**, further comprising:

a sensor magnet installed on a lower surface of a lower balancing member of the motor unit; and

a hall sensor installed on a lower surface of the sensor magnet.

* * * * *