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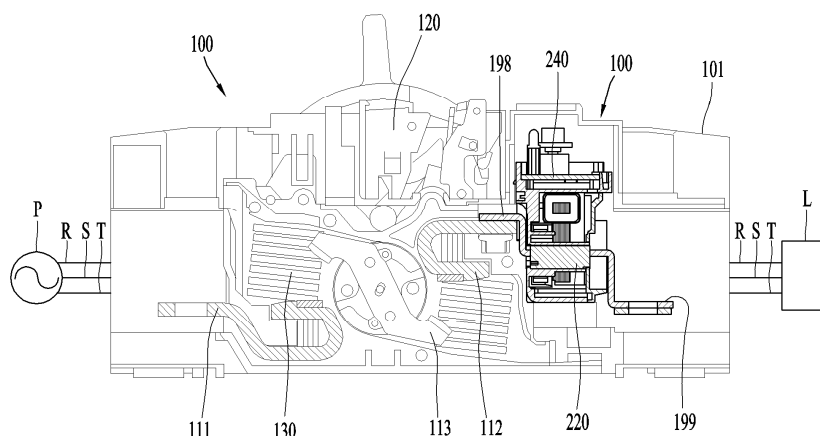
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(54) **ELECTRONIC TRIP UNIT OF MOLDED CASE CIRCUIT BREAKER**

(57) The present invention relates to an electronic trip unit of a molded case circuit breaker and, more specifically, to an electronic trip unit of a molded case circuit breaker in which the electronic trip unit has an inter-phase interference prevention function. According

to an electronic trip unit of a molded case circuit breaker according to one embodiment of the present invention, a magnetic field absorber surrounding a Rogowski coil is provided in a current detection unit and prevents a magnetic field from spreading to an adjacent phase.

FIG. 8



Description

Technical Field

[0001] The disclosure relates to an electronic trip unit of a molded case circuit breaker, and more particularly, to an electronic trip unit of a molded case circuit breaker having an inter-phase interference prevention function.

Background Art

[0002] In general, a molded case circuit breaker (MCCB) is an electric device that automatically breaks a circuit during an electrical overload condition or a short-circuit accident to protect the circuit and a load. The molded case circuit breaker generally includes a terminal unit connected to a power source or a load, a contact unit including a fixed contact and a movable contact, and an opening/closing mechanism unit that provides a driving force such that the movable contact can be in mechanical contact with the fixed contact, a trip unit that senses an overcurrent or a short-circuit current, occurring in the circuit, to induce a trip operation of the opening/closing mechanism unit, an arc-extinguishing unit for extinguishing an arc generated when an abnormal current is interrupted, and the like.

[0003] A longitudinal sectional view of a molded case circuit breaker according to a conventional art is shown in FIG. 1. The molded case circuit breaker according to the conventional art includes fixed contacts 2a and 2c and a movable contact 2b, which constitute a contact unit provided inside an enclosure 1 made of an insulating material to connect or disconnect a circuit through which power is transferred from a power source to a load, an opening/closing mechanism unit 3 that provides power capable of rotating the movable contact 2b, an arc-extinguishing unit 4 provided to extinguish an arc generated when a fault current is interrupted, a detection mechanism unit that detects an abnormal current, and the like. Here, the detection mechanism unit may be configured as an electronic trip unit 5.

[0004] A perspective view of the electronic trip unit 5 according to the conventional art is shown in FIG. 2. The electronic trip unit 5 includes a trip unit stator 6 that applies current to a current transformer (CT) 7 from the load-side fixed contact 2c, the current transformer 7 that transforms the applied current into low current, a current transformer accommodating unit 8, a control unit (PCB) 9 that drives the circuit with the current transformed by the current transformer 7, thereby operating a trip coil (not shown) when an abnormal current occurs, and the like.

[0005] When the abnormal current occurs in a circuit 10, the electronic trip unit receives a control signal of the control unit 9 to allow the trip coil to operate the opening/closing mechanism unit 3, thereby breaking the circuit. As a breaking operation of the circuit breaker is performed, an arc is extinguished in the arc-extinguishing unit 4.

[0006] A block diagram of a fault current interruption mechanism is shown in FIG. 3.

[0007] A part mainly related to a current detection function in the electronic trip unit 5 includes a current detection unit (signal CT) 7a, a power generation unit (power CT) 7b, and the control unit 9.

[0008] The control unit 9 operates by being supplied with power from the power generation unit 7b. The control unit 9 determines occurrence of an accident by receiving the magnitude and phase of current through the current detection unit 7a, and breaks the circuit by operating the opening/closing mechanism unit 3 through an operation of the trip coil. Accordingly, the control unit 9 performs a function of separating and interrupting a fault section from a healthy section in the circuit.

[0009] Here, the control unit 9 measures an amount of electricity, using the current detection unit 7a and a voltage generation unit 7c of the electronic trip unit 5, and then performs fault current determination, and the like, based on the measured amount of electricity. Such data requires high measurement accuracy so as to be able to replace a weighting device or a measuring device of a power system.

[0010] However, an error may occur in current measurement due to inter-phase interference in the current transformer 7.

[0011] The current transformer 7 will be described in more detail.

[0012] Each of the current detection unit 7a and the power generation unit 7b has a structure in which a circuit line (any one of phases R, S, and T) of the circuit 10 passes therethrough.

[0013] The current detection unit 7a uses a Rogowskii coil having no saturation characteristic with a small size as shown in FIG. 4.

[0014] In contrast, the power generation unit 7b uses a CT using an iron core having a saturation characteristic as shown in FIG. 5. In order to effectively use a small size of the molded case circuit breaker, the current detection unit 7a and the power generation unit 7b are generally configured, as shown in FIGS. 6A and 6B, at a same position at which the circuit line can pass therethrough, to be arranged as shown in FIG. 7, corresponding to a number of poles (three in the case of three phases) of the molded case circuit breaker.

[0015] Magnitude and phases of currents of different phases are distorted by the current flowing in each phase within the small size of the molded case circuit breaker. This is referred to as an inter-phase interference phenomenon, and should be eliminated so as to improve measurement accuracy.

[0016] In order to reduce the inter-phase interference phenomenon, several items, such as uninform winding management of the Rogowskii coil, management of start and end points of winding of the Rogowskii coil, and spacing of lead wires, were managed in the conventional art. However, this had a problem that a period for manufacturing a current transformer was lengthened and

facilities were complicated, and also had a problem that the effect of reducing the inter-phase interference phenomenon was not so much.

[0017] 'Molded case circuit breaker' disclosed in Korean Registered Utility Model No. 20-0487464 may be referred to as a prior technical document related to the disclosure.

Disclosure of Invention

Technical Problem

[0018] Therefore, to obviate those problems, an aspect of the detailed description is to provide an electronic trip unit of a molded case circuit breaker, which reduces inter-phase interference caused by magnetic fields of adjacent phases, thereby minimizing an error of measuring current.

Solution to Problem

[0019] To achieve these and other advantages and in accordance with the purpose of the disclosure, as embodied and broadly described herein, there is provided an electronic trip unit of a molded case circuit breaker, in which a circuit is connected from a power source to a load, and an alternating current having a plurality of phases flows in the circuit, the electronic trip unit including a current transformer provided in each of the plurality of phases to measure the alternating current, wherein the current transformer includes a current detection unit that measures current of any one phase in which the current transformer is installed, and wherein a magnetic absorber is provided in the current detection unit.

[0020] Here, the current transformer may further include a power generation unit in which a voltage is generated by an induced electromotive force generated in the one phase.

[0021] In addition, the electronic trip unit may further include a control unit operated by power provided from the power generation unit and breaking the circuit when it is determined that a current signal transmitted from the current detection unit is a fault current.

[0022] In addition, a current transformer accommodation portion having the current transformer accommodated therein may be provided in a trip unit case constituting an enclosure of the electronic trip unit.

[0023] In addition, a connection conductor insertion portion in which a connection conductor connected to the circuit is installed may be provided in the current transformer accommodation portion.

[0024] In addition, the current detection unit may include a Rogowskii coil having a through-hole, and the magnetic absorber may include a first magnetic absorber surrounding the Rogowskii coil.

[0025] In addition, the current detection unit may further include a first magnetic absorber fixing member fixedly installed in the current transformer accommoda-

tion portion to accommodate the Rogowskii coil therein and having the first magnetic absorber installed on an outside thereof.

[0026] In addition, a current transformer mounting unit may be formed to protrude in the current transformer accommodation portion, and a central hole fitted and coupled to the current transformer mounting unit may be formed in the first magnetic absorber fixing member.

[0027] In addition, the first magnetic absorber fixing member may have a front portion and a side portion, and the side portion may have a curved portion and a flat portion.

[0028] In addition, an inner diameter of the central hole may be formed smaller than an inner diameter of the Rogowskii coil.

[0029] In addition, a width of the side portion of the first magnetic absorber fixing member may be formed larger than a width of a side portion of the Rogowskii coil.

[0030] In addition, the Rogowskii coil, the first magnetic absorber fixing member, and the first magnetic absorber may be coupled to each other by a molding method.

[0031] In addition, the power generation unit may include an iron core and a coil, and the magnetic absorber may include a second magnetic absorber surrounding the iron core and the coil.

[0032] In addition, the magnetic absorber may be made of a material having a high permeability.

[0033] In addition, the magnetic absorber may be made of permalloy or nano-crystalline.

Advantageous Effects of Invention

[0034] According to the electronic trip unit of the molded case circuit breaker according to the disclosure, the magnetic absorber surrounding the Rogowskii coil is provided in the current detection unit, to prevent a magnetic field from spreading to an adjacent phase.

[0035] In addition, the magnetic absorber surrounding the iron core and the coil is provided in the power generation unit, to prevent a magnetic field from spreading to an adjacent phase.

[0036] Accordingly, a current measurement error due to the inter-phase interference is minimized when an abnormal current occurs in the circuit.

[0037] In addition, since the inter-phase interference is prevented, the creepage distance can be decreased, so that the entire size can be reduced.

Brief Description of Drawings

[0038]

FIG. 1 is a longitudinal sectional view of a molded case circuit breaker according to a conventional art. FIG. 2 is a perspective view of an electronic trip unit applied to the molded case circuit breaker according to the conventional art.

FIG. 3 is a block diagram of the electronic trip unit

according to the conventional art.

FIG. 4 shows a current detection unit of the electronic trip unit according to the conventional art.

FIGS. 5A and 5B show a power generation unit of the electronic trip unit according to the conventional art. FIGS. 6A and 6B show a current transformer of the electronic trip unit according to the conventional art. FIG. 7 shows a state in which the current transformer is assembled and inter-phase interference occurs in the electronic trip unit according to the conventional art.

FIG. 8 is a longitudinal sectional view of a molded case circuit breaker according to an embodiment of the disclosure.

FIGS. 9 and 10 are perspective views of an electronic trip unit applied to the molded case circuit breaker according to the embodiment of the disclosure.

FIG. 11 is an exploded perspective view of FIG. 10.

FIG. 12 is a rear view of the electronic trip unit, and shows a state in which a cover of the electronic trip unit is removed.

FIG. 13 is a perspective view of a current transformer applied to the electronic trip unit of the disclosure.

FIG. 14 is an exploded perspective view of a current detection unit in FIG. 13.

FIG. 15 is an exploded perspective view of a power generation unit in FIG. 13.

Mode for the Invention

[0039] Hereinafter, preferred embodiments of the disclosure will be described with reference to the accompanying drawings. However, this is intended to describe the disclosure in detail to allow a person skilled in the art to easily carry out the invention, but not to mean that the technical concept and scope of the disclosure are limited thereto.

[0040] The terms "members" or "portions" used herein to refer to components are not used for any limiting purpose and may be omitted.

[0041] An electronic trip unit of a molded case circuit breaker according to each embodiment of the disclosure will be described in detail with reference to the drawings. FIG. 8 is a longitudinal sectional view of a molded case circuit breaker according to an embodiment of the disclosure, FIGS. 9 and 10 are perspective views of an electronic trip unit applied to the molded case circuit breaker according to the embodiment of the disclosure, and FIG. 11 is an exploded perspective view of FIG. 10.

[0042] The electronic trip unit of the molded case circuit breaker according to the embodiment of the disclosure is applied to the molded case circuit breaker in which an alternating current having a plurality of phases R, S, and T flows to a power source P to a load L, and may include a current transformer 300 that measures the alternating current. The current transformer 300 includes a current detection unit 310 that senses a current of any one phase in which the current transformer 300 is installed among

the plurality of phases R, S, and T; and a power generation unit 350 that generates a voltage by means of an induced electromotive force generated in the one phase. Magnetic absorbers 330 and 370 that absorb a magnetic field generated in the one phase to allow the magnetic field not to spread to another phase may be provided in the current detection unit 310 or the power generation unit 350.

[0043] A longitudinal sectional view of a molded case circuit breaker 100 according to an embodiment of the disclosure is shown in FIG. 8.

[0044] A basic configuration of the molded case circuit breaker according to the disclosure follows a general molded case circuit breaker.

[0045] The molded case circuit breaker includes an enclosure 101 made of an insulating material. The enclosure 101 accommodates and support components therein.

[0046] A contact unit is provided inside the enclosure 101 to connect or disconnect a circuit through which power is transferred from a power source to a load. The contact unit includes fixed contacts 111 and 112 and a movable contact 113 in contact with or separated from the fixed contacts 111 and 112.

[0047] An opening/closing mechanism unit 120 provided above the contact unit provides power capable of rotating the movable contact 113.

[0048] An arc-extinguishing unit 130 is provided to extinguish an arc generated when a fault current is interrupted.

[0049] A detection and trip unit that detects an abnormal current is provided. The detection and trip unit may be configured as an electronic trip unit 200.

[0050] Here, the trip unit 200 includes a trip unit stator 198 and a connection conductor 220, which are connected to the fixed contact 112, the current transformer 300 that transforms current flowing in the connection conductor 220, and a control unit 240 operated by the current applied from the current transformer 300 to operate the opening/closing mechanism unit 120.

[0051] A perspective view of the electronic trip unit is shown in FIGS. 9 and 10. FIG. 9 shows the electronic trip unit such that a rear portion thereof appears, and FIG. 10 shows the electronic trip unit such that a front portion thereof appears. Meanwhile, an exploded perspective view of the electronic trip unit is shown in FIG. 11.

[0052] A trip unit case 201 may be made of an injection molding material. That is, the trip unit case 201 may be configured as a mold housing.

[0053] A control unit housing 202 is provided in an upper portion of the trip unit case 201, and a current transformer housing 203 is provided in a lower portion of the trip unit case 201. Here, the control unit housing 202 and the current transformer housing 203 may be integrally formed. Meanwhile, a current transformer housing cover 210 is provided in a rear portion of the trip unit case 201.

[0054] The control unit 240 is installed in the control

unit housing 202. The control unit 240 may be configured as a circuit board (PCB). The control unit 240 receives a current signal from the current transformer 300.

[0055] A current transformer accommodation portion 205 having the current transformer 300 inserted therein is formed in the current transformer housing 203. The current transformer accommodation portion 205 occupies most of the space of the current transformer housing 203. The current transformer housing cover 210 covers the current transformer accommodation portion 205. The current transformer 300 is inserted and installed in the current transformer accommodation portion 205. The current transformer accommodation portion 205 is provided for each phase in the current transformer housing 203. For example, in the case of a circuit of three phases R, S, and T, three current transformer accommodation portions 205 of phases R, S, and T are provided in the current transformer housing 203.

[0056] The current transformer 300 is provided to transform current flowing in the circuit into current having a magnitude, which can be applied to a current meter (not shown) of the control unit 240, or the like.

[0057] Each of the current transformer 300 and the current transformer accommodation portion 205 is provided in a number corresponding to that of phases. For example, when the alternating current flowing in the circuit has three phases, i.e., phases R, S, and T, three current transformers 300 and three current transformer accommodation portion 205 may be provided.

[0058] Isolation grooves 204 may be provided between the respective phases in a front portion of the trip unit case 201. The isolation groove 204 increases a creepage distance, thereby improving inter-phase insulation performance.

[0059] A voltage sensor insertion groove 215 is formed in the front portion of the trip unit case 201. A voltage sensor (not shown) is installed in the voltage sensor insertion groove 215. The voltage sensor senses a voltage generated in the connection conductor 220 and transfers the voltage to the control unit 240.

[0060] FIG. 12 will be additionally described. A rear view of the electronic trip unit is shown in FIG. 12. Here, the electronic trip unit is in a state in which the current transformer housing cover 210 is removed. Also, the electronic trip unit is in a state in which the power generation unit 350 of the current transformer 300 is removed in the phase S. The electronic trip unit is in a state in which the connection conductor 220 and the current transformer 300 are removed in the phase T.

[0061] The connection conductor 220 is provided in a center of the current transformer 300. The connection conductor 220 connects the trip unit stator 198 connected to the power source and a load-side terminal 199 connected to the load. The current transformer 300 reduces current flowing in the connection conductor 220 to transfer the current to the control unit 240.

[0062] A connection conductor insertion portion 207 is formed to protrude in the current transformer housing

203. The connection conductor insertion portion 207 is formed to extend forward and backward in a central portion of the current transformer accommodation portion 205. The connection conductor insertion portion 207 is formed in a tubular shape to have a connection conductor insertion groove 208 formed therein. The connection conductor 220 is inserted and installed in the connection conductor insertion groove 208. The current transformer 300 is installed at a periphery of the connection conductor insertion portion 207.

[0063] The connection conductor insertion portion 207 is made of an insulating material. The connection conductor insertion portion 207 may be integrally formed with the current transformer housing 203, using a same material as the current transformer housing 203. The current transformer 300 and the connection conductor 220 are insulated from each other by the connection conductor insertion portion 207.

[0064] The connection conductor 220 is installed in the trip unit 200 to electrically connect the power source and the load. The current flowing in the connection conductor 220 is measured by the current transformer to allow a trip operation to be performed when an abnormal current occurs.

[0065] A coupling groove 222 for coupling the trip unit stator 198 or the load-side terminal 199 to the connection conductor 220 is formed in each of both side surfaces of the connection conductor 220.

[0066] The trip unit stator 198 is coupled to one end of the connection conductor 220. The trip unit stator 193 connects a load-side fixed contact 112 and the load-side terminal 199 through the connection conductor 220.

[0067] A current transformer mounting unit 230 capable of fixing the current transformer 300 to the periphery of the connection conductor insertion portion 207 is formed in the current transformer housing 203. The current transformer mounting unit 230 is formed to protrude on a bottom surface of the current transformer accommodation portion 205. The current transformer mounting unit 230 is entirely formed in a circular shape.

[0068] FIG. 13 is a perspective view of the current transformer applied to the electronic trip unit of the disclosure, FIG. 14 is an exploded perspective view of the current detection unit in FIG. 13, and FIG. 15 is an exploded perspective view of the power generation unit in FIG. 13.

[0069] The current transformer 300 includes the current detection unit 310 and the power generation unit 350.

[0070] The current detection unit 310 (or signal generation unit) includes a Rogowski coil 311, a first magnetic absorber fixing member 320, and a first magnetic absorber 330. The current detection unit 310 outputs a current signal to the control unit 240.

[0071] The Rogowski coil 311 is formed in the shape of a donut. The Rogowski coil 311 has a form in which a coil is wound along an outer circumferential surface of the donut. Alternatively, the Rogowski coil 311 may be formed by bending long coils standing in straight lines

in a circular shape. Therefore, the Rogowskii coil 311 is also referred to as an air-core coil. The Rogowskii coil 311 has a small size and has no saturation characteristic, which is advantageous.

[0072] The Rogowskii coil 311 has a central portion formed as a hole. The connection conductor 220 is inserted into a through-hole 313 of the Rogowskii coil 311. The Rogowskii coil 311 senses the current flowing in the connection conductor 220.

[0073] The first magnetic absorber fixing member 320 is provided to support the first magnetic absorber 330. The first magnetic absorber fixing member 320 allows the first magnetic absorber 320 to be installed while being spaced apart from the Rogowskii coil 311 at a predetermined interval. The first magnetic absorber fixing member 320 mechanically support the first magnetic absorber 330 not to be deformed.

[0074] The first magnetic absorber fixing member 320 is formed to have a size with which the first magnetic absorber fixing member 320 can surround a periphery of the Rogowskii coil 311. The first magnetic absorber fixing member 320 is formed larger than a diameter of a front portion or a width of a side portion of the Rogowskii coil 311. Therefore, a space is formed between the Rogowskii coil 311 and the first magnetic absorber fixing member 320.

[0075] The first magnetic absorber fixing member 320 is entirely formed in a flat cylindrical shape.

[0076] The first magnetic absorber fixing member 320 has a front portion 321 and has a side portion 322 including a curved portion 323 and a flat portion 324.

[0077] A central hole 325 is formed in a central portion of the front portion 321 of the first magnetic absorber fixing member 320. The central hole 325 occupies most of the region of the front portion 321. Here, the central hole 325 is fitted and coupled to the current transformer mounting unit 230.

[0078] A width of the front portion 321 of the first magnetic absorber fixing member 320 except the central hole 325 is formed larger than a thickness of the Rogowskii coil 311, and a width of the side portion 322 of the first magnetic absorber fixing member 320 is formed larger than the width of the side portion of the Rogowskii coil 311. Therefore, the first magnetic absorber fixing member 320 completely covers the Rogowskii coil 311 at the front and side thereof.

[0079] An inner diameter of the central hole 325 of the first magnetic absorber fixing member 320 is formed smaller than an inner diameter of the Rogowskii coil 311. Therefore, when the central hole 325 of the first magnetic absorber fixing member 320 is fitted to the current transformer mounting unit 230 of the current transformer accommodation portion 205, the Rogowskii coil 311 is arranged in the current transformer accommodation unit 205 while being spaced apart from the central hole 325 at a predetermined interval.

[0080] An opening groove 326 is formed in the flat portion 234 of the side portion 322. The opening groove

326 is provided to prevent interference with peripheral components.

[0081] A working groove 327 formed to be inclined in an inner circumferential surface of the curved portion 323 of the side portion 322 is provided in a portion of the curved portion 323. A worker may adjust a position of the Rogowskii coil 311 through the working groove 327 in a state in which components of the current detection unit 310 are temporarily assembled while being accommodated in the current transformer accommodation portion 205.

[0082] The first magnetic absorber fixing member 320 has an open rear surface, to accommodate the Rogowskii coil 311.

[0083] The first magnetic absorber 330 has open front and rear surfaces. Therefore, the first magnetic absorber 330 is formed in the shape of a tube having a short length. The first magnetic absorber 330 has a curved portion 333 and a flat portion 334, which correspond to the shape of the side portion 322 of the first magnetic absorber fixing member 320. The first magnetic absorber 330 covers the side portion of the Rogowskii coil 311.

[0084] The first magnetic absorber 330 is formed to surround the first magnetic absorber fixing member 320. Since the Rogowskii coil 311 is inserted into the first magnetic absorber fixing member 320, the first magnetic absorber 330 absorbs a magnetic field generated in the Rogowskii coil 311 by surrounding the Rogowskii coil 311.

[0085] The magnetic absorbers 330 and 370 use a material having a high permeability. That is, a material capable of absorbing well a magnetic field generated at the periphery of the Rogowskii coil 311 is used as the material of the magnetic absorbers. In electromagnetics, the permeability is a value indicating how much a medium is magnetized in a given magnetic field. The general symbol of the permeability is Greek letter μ , and the international unit is henry per meter (H/m).

[0086] That a material having a high permeability is used as the material of the magnetic absorbers 330 and 370 means as follows.

[0087] First, this means that the magnetic absorbers 330 and 370 are easily magnetized. That is, this means that magnetic induction is well generated and magnetic flux density is high.

[0088] Second, this means that much magnetic energy is stored. That is, this means that magnetic energy storage capacity is large.

[0089] Third, this means that magnetic flux flows well. That is, the magnetic field flows well in the magnetic absorbers.

[0090] By such effects, the magnetic field generated in the Rogowskii coil 311 is absorbed by the first magnetic absorber 330 not to spread to the outside. Accordingly, the magnetic field has no influence on an adjacent phase.

[0091] Permalloy or nano-crystalline may be used as the material having a high permeability. The permalloy is an alloy composed of about 80% nickel and 20% iron, and

is a magnetic material having very high permeability and low loss of magnetic hysteresis. The nano-crystalline has an excellent permeability as compared with the permalloy but is easily fragile, which requires caution in the use of the nano-crystalline.

[0092] The current detection unit 310 includes the Rogowskii coil 311, the first magnetic absorber fixing member 320, and the first magnetic absorber 330, which is as described above. The Rogowskii coil 311, the first magnetic absorber fixing member 320, and the first magnetic absorber 330 is coupled to each other by a molding method. For example, the Rogowskii coil 311, the first magnetic absorber fixing member 320, and the first magnetic absorber 330 are solidified by injecting a molding liquid such as epoxy resin in a state in which the Rogowskii coil 311, the first magnetic absorber fixing member 320, and the first magnetic absorber 330 are inserted into the current transformer accommodation portion 205 and are temporarily assembled.

[0093] A portion of the central hole 325 of the first magnetic absorber fixing member 320 is fitted and coupled to the current transformer mounting unit 230 in the current transformer accommodation portion 205.

[0094] The first magnetic absorber 330 is fitted to an outer circumferential surface of the first magnetic absorber fixing member 320, and the Rogowskii coil 311 is inserted into the first magnetic absorber fixing member 320.

[0095] The power generation unit 350 allows current to be generated by an induced electromotive force of an iron core 351, and the control unit 240 is driven by power using the current. Also, the power generation unit 350 normally allows current to be generated by the induced electromotive force, and the generated current serves as a power source that enables the control unit 240 to be normally driven.

[0096] The power generation unit 350 includes the iron core 351, a coil 360, and a second magnetic absorber 370.

[0097] A cold rolled oriented silicon steel sheet may be used as a material of the iron core 351. A plurality of silicon steel sheets are assembled as a plurality of layers, using a lap bonding method. The assembled steel sheets are wound by an insulation tape having excellent thermal and mechanical characteristics, and anticorrosive coating processing for iron core surface protection is performed on the steel sheets.

[0098] A hollow portion 352 is formed in a central portion of the iron core 351 such that the connection conductor 220 and the connection conductor insertion portion 207 are inserted therein.

[0099] The coil 360 is formed on a portion of the iron core 351. Current is generated in the coil 360 by electromagnetic induction.

[0100] When a rated current (hundreds of amperes) flows in a small size of the molded case circuit breaker, a magnetic field is generated at a periphery of the circuit line of each phase, and the output of the current detection

unit 310 of another phase is distorted.

[0101] The inter-phase interference that distorts a signal of another phase due to the magnetic field as described above has bad influence on measurement accuracy of the molded case circuit breaker. Therefore, when a high-accuracy measurement function is implemented in the molded case circuit breaker, it is required to minimize the inter-phase interference.

[0102] The second magnetic absorber 370 is provided such that influence caused by the magnetic field generated at a periphery of the power generation unit 350 has no influence on an adjacent phase.

[0103] The second magnetic absorber 370 is formed in a shape capable of surrounding side portions of the iron core 351 and the coil 360.

[0104] The second magnetic absorber 370 follows the features and configuration of the first magnetic absorber 330. The second magnetic absorber 370 may be made of a same material as the first magnetic absorber 330.

[0105] The control unit 240 is operated by power provided from the power generation unit 350. The control unit 240 breaks the circuit by operating the trip coil (not shown) when it is determined that current transferred from the current detection unit 310 is an abnormal current.

[0106] According to the electronic trip unit of the molded case circuit breaker according to the embodiment of the disclosure, the magnetic absorber surrounding the Rogowskii coil is provided in the current detection unit, to prevent a magnetic field from spreading to an adjacent phase.

[0107] In addition, the magnetic absorber surrounding the iron core and the coil is provided in the power generation unit, to prevent a magnetic field from spreading to an adjacent phase.

[0108] Accordingly, a current measurement error due to the inter-phase interference is minimized when an abnormal current occurs in the circuit.

[0109] In addition, since the inter-phase interference is prevented, the creepage distance can be decreased, so that the entire size can be reduced.

[0110] The embodiments described above are embodiments implementing the disclosure, and it will be apparent to those skilled in this art that various changes and modifications may be made thereto without departing from the gist of the disclosure. Accordingly, it should be noted that the embodiments disclosed in the disclosure are only illustrative and not limitative to the concept of the disclosure, and the scope of the concept of the invention is not limited by those embodiments. In other words, the scope protected by the disclosure should be construed by the accompanying claims, and all the technical concept in the equivalent scope of the invention should be construed to be included in the scope of the right of the disclosure.

[Explanation of Symbols]

[0111]

100: semiconductor circuit breaker
 200: electronic trip unit
 205: current transformer accommodation portion
 220: connection conductor
 240: control unit
 300: current transformer
 310: current detection unit
 311: Rogowskii coil
 320: first magnetic absorber fixing member
 330: first magnetic absorber
 350: power generation unit
 351: iron core
 360: coil
 370: second magnetic absorber

Claims

1. An electronic trip unit of a molded case circuit breaker, in which a circuit is connected from a power source to a load, and an alternating current having a plurality of phases flows in the circuit, the electronic trip unit comprising:

a current transformer provided in each of the plurality of phases to measure the alternating current,
 wherein the current transformer comprises a current detection unit that measures current of any one phase in which the current transformer is installed, and
 wherein a magnetic absorber is provided in the current detection unit.

2. The electronic trip unit of claim 1, wherein the current transformer further comprises a power generation unit in which a voltage is generated by an induced electromotive force generated in the one phase.
3. The electronic trip unit of claim 2, further comprising a control unit operated by power provided from the power generation unit and breaking the circuit when it is determined that a current signal transmitted from the current detection unit is a fault current.
4. The electronic trip unit of claim 1, wherein a current transformer accommodation portion having the current transformer accommodated therein is provided in a trip unit case constituting an enclosure of the electronic trip unit.
5. The electronic trip unit of claim 4, wherein a connection conductor insertion portion in which a connection conductor connected to the circuit is installed is provided in the current transformer accommodation portion.
6. The electronic trip unit of claim 4, wherein the current

detection unit comprises a Rogowskii coil having a through-hole, and
 wherein the magnetic absorber comprises a first magnetic absorber surrounding the Rogowskii coil.

7. The electronic trip unit of claim 6, wherein the current detection unit further comprises a first magnetic absorber fixing member fixedly installed in the current transformer accommodation portion to accommodate the Rogowskii coil therein and having the first magnetic absorber installed on an outside thereof.
8. The electronic trip unit of claim 7, wherein a current transformer mounting unit is formed to protrude in the current transformer accommodation portion, and a central hole fitted and coupled to the current transformer mounting unit is formed in the first magnetic absorber fixing member.
9. The electronic trip unit of claim 7, wherein the first magnetic absorber fixing member has a front portion and a side portion, and the side portion has a curved portion and a flat portion.
10. The electronic trip unit of claim 8, wherein an inner diameter of the central hole is formed smaller than an inner diameter of the Rogowskii coil.
11. The electronic trip unit of claim 9, wherein a width of the side portion of the first magnetic absorber fixing member is formed larger than a width of a side portion of the Rogowskii coil.
12. The electronic trip unit of claim 7, wherein the Rogowskii coil, the first magnetic absorber fixing member, and the first magnetic absorber are coupled to each other by a molding method.
13. The electronic trip unit of claim 2, wherein the power generation unit comprises an iron core and a coil, and
 wherein the magnetic absorber comprises a second magnetic absorber surrounding the iron core and the coil.
14. The electronic trip unit of claim 1, wherein the magnetic absorber is made of a material having a high permeability.
15. The electronic trip unit of claim 14, wherein the magnetic absorber is made of permalloy or nanocrystalline.

FIG. 1

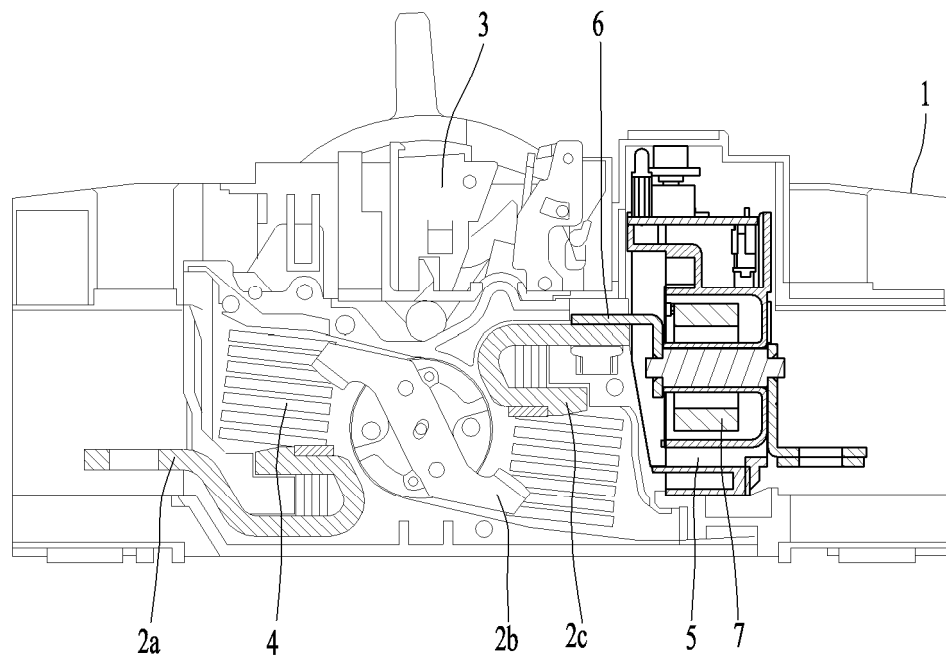


FIG. 2

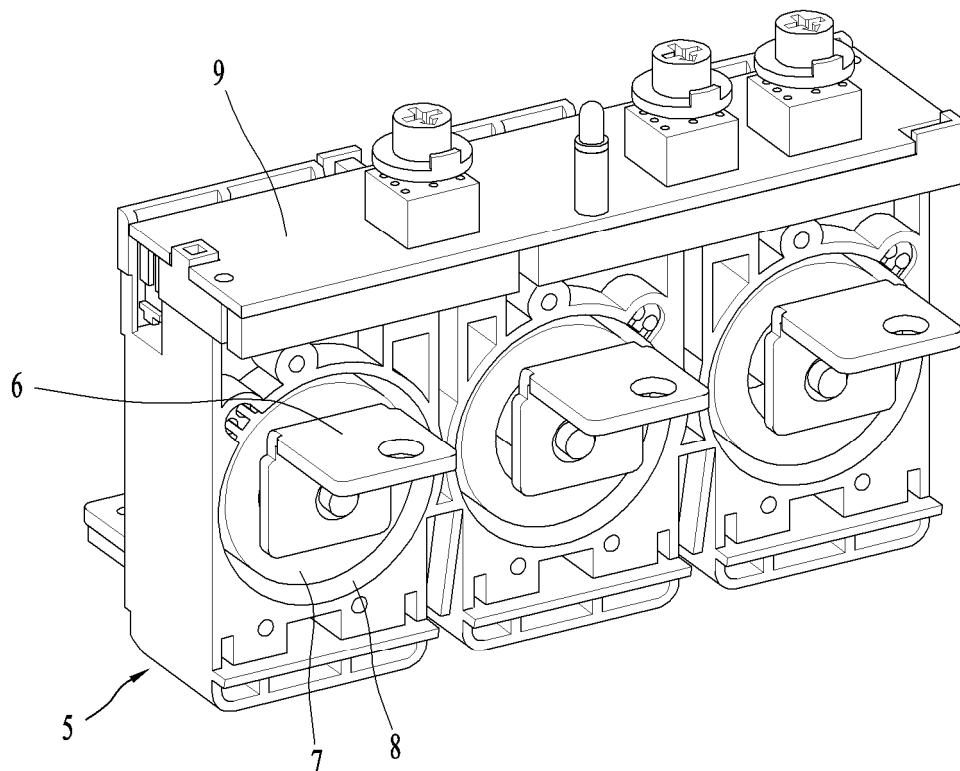


FIG. 3

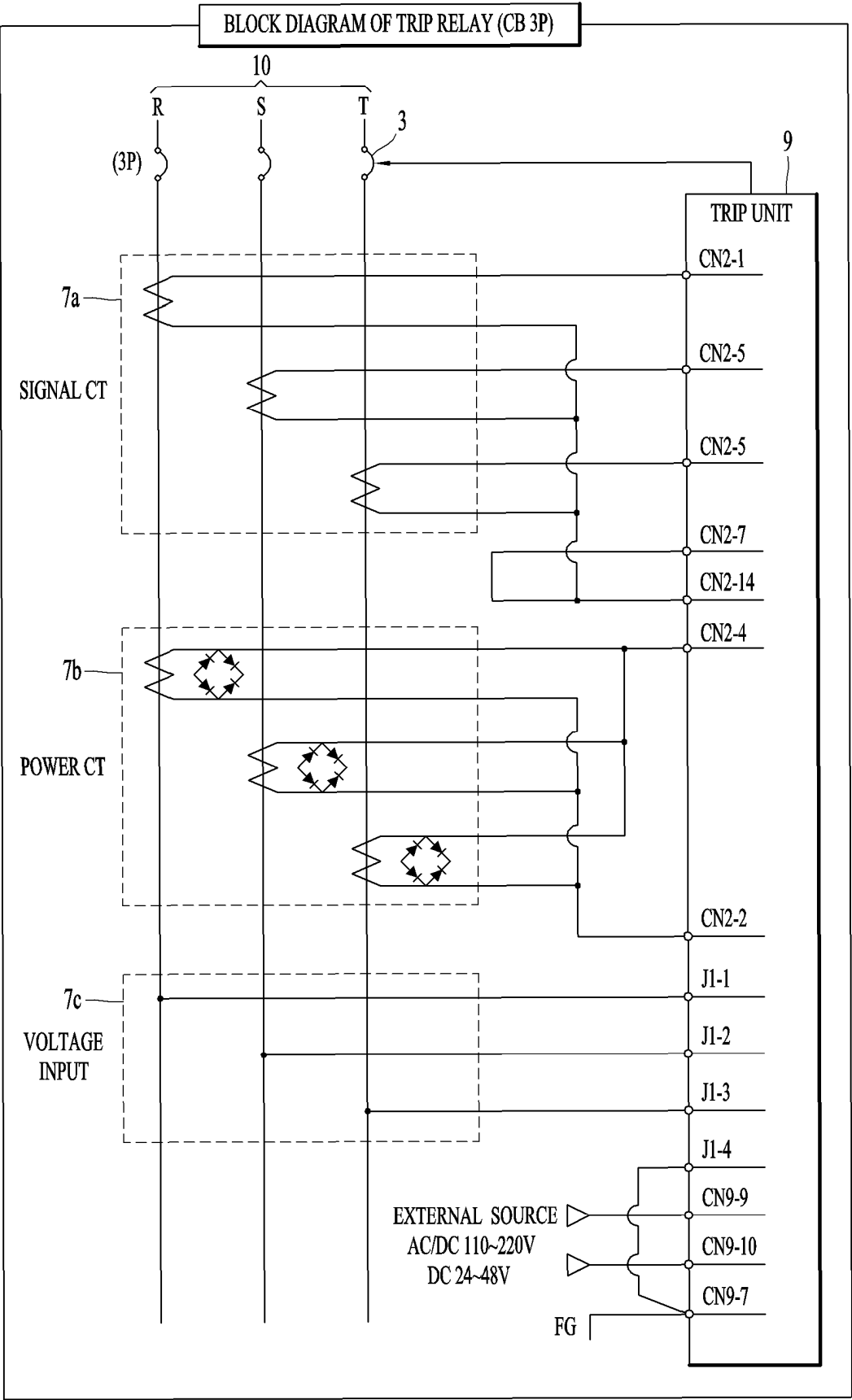


FIG. 4

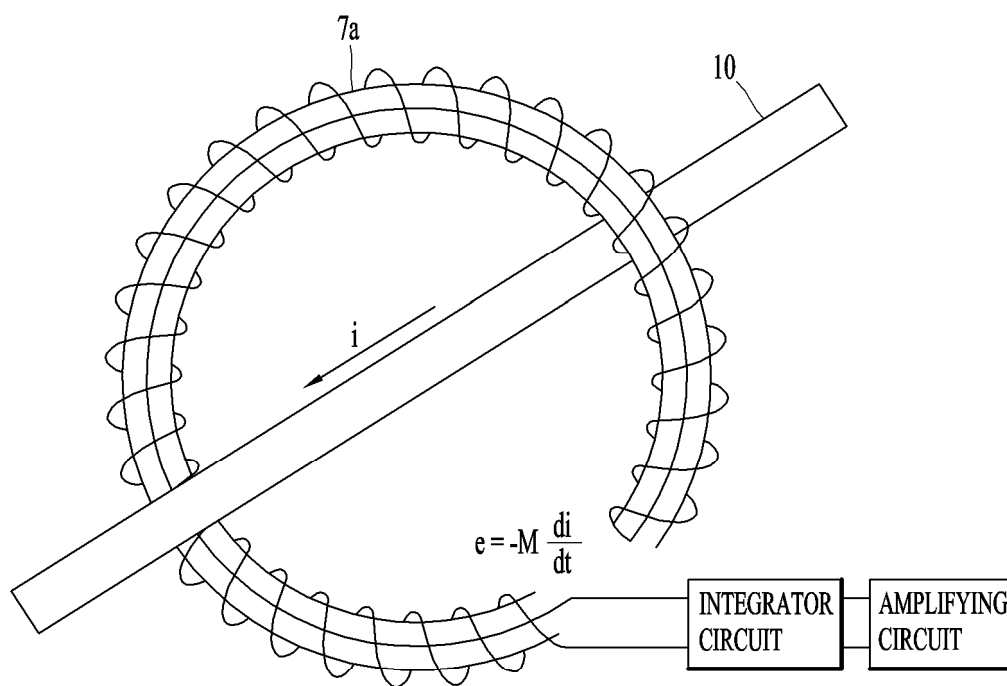


FIG. 5A

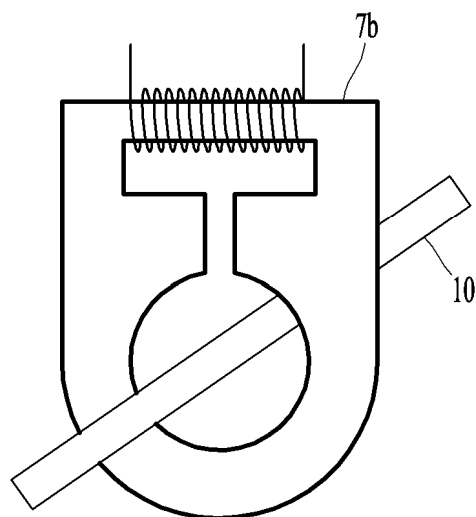


FIG. 5B

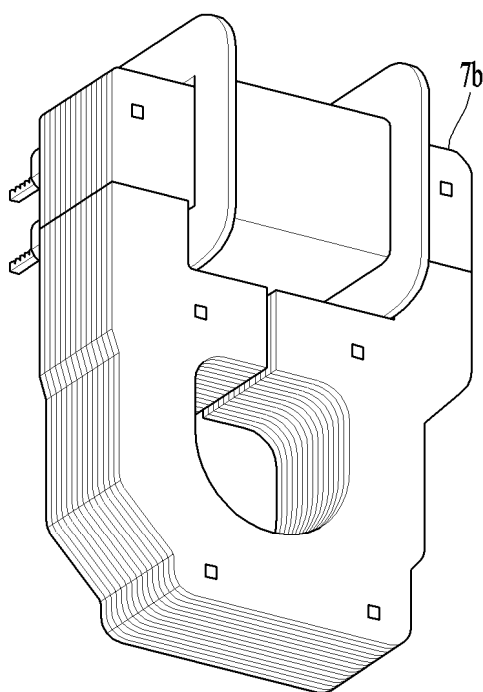


FIG. 6A

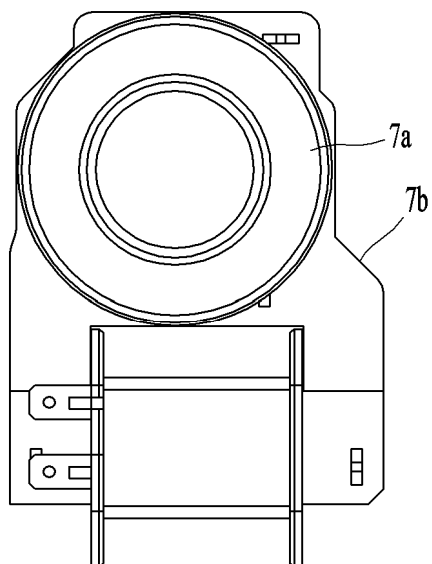


FIG. 6B

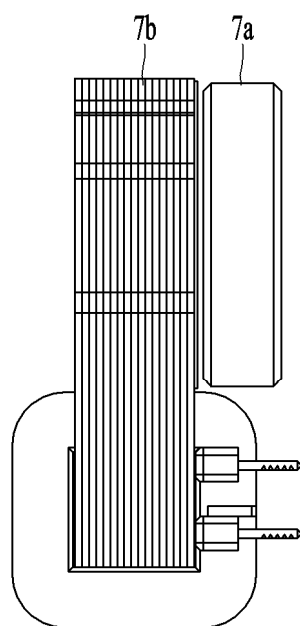


FIG. 7

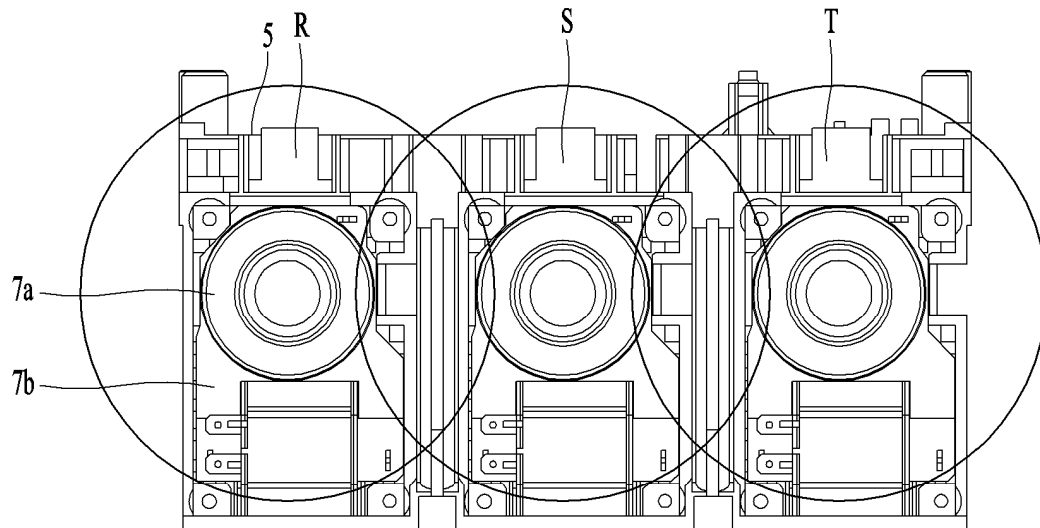


FIG. 8

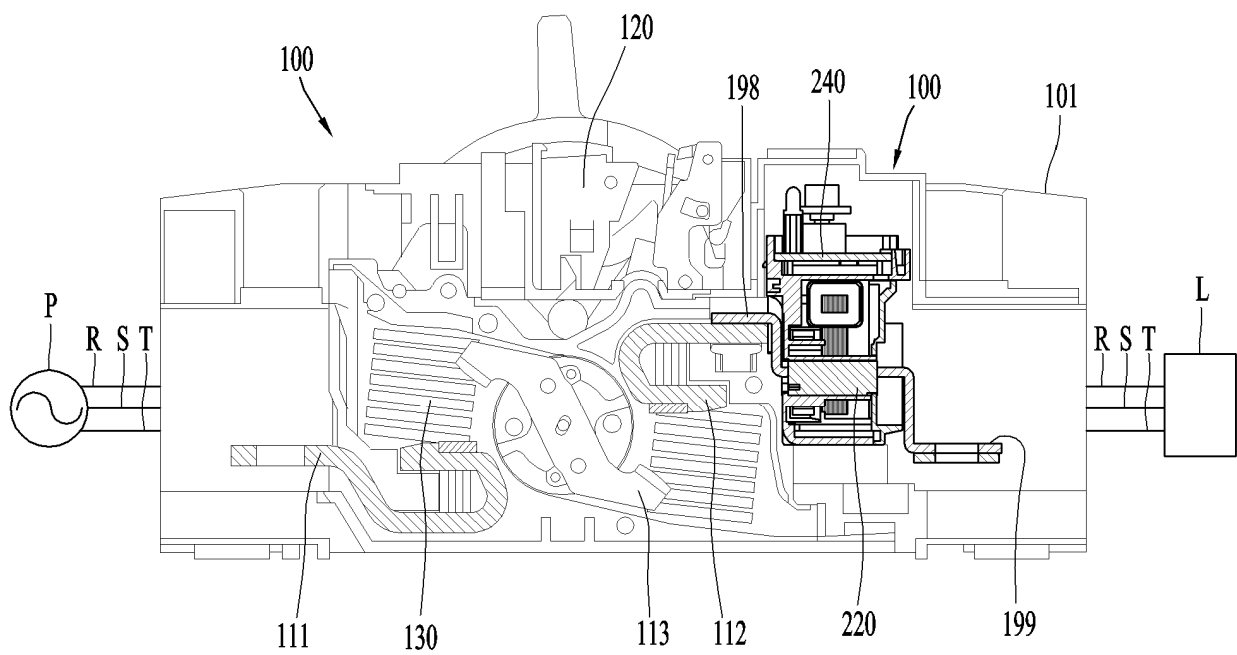


FIG. 9

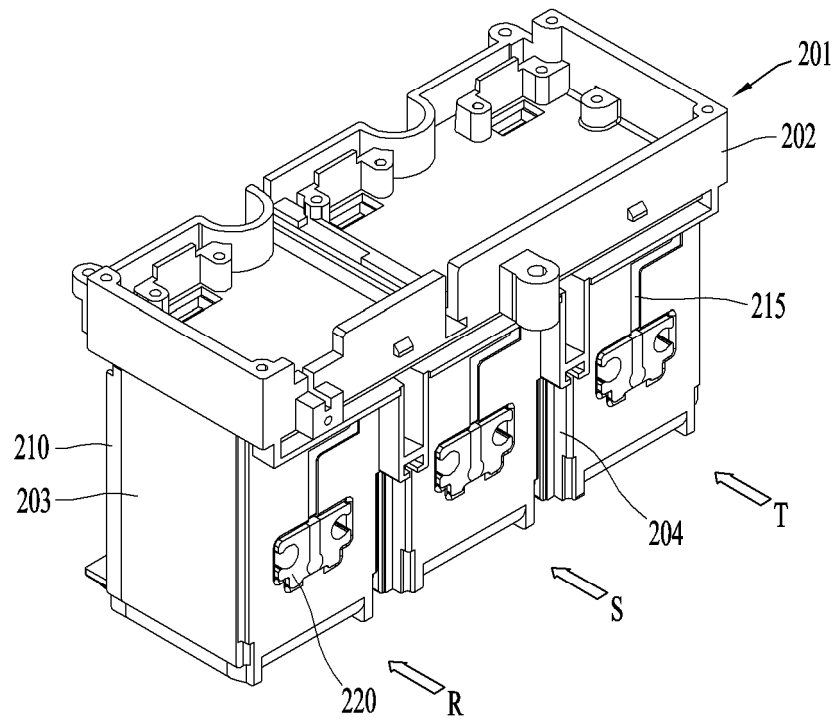


FIG. 10

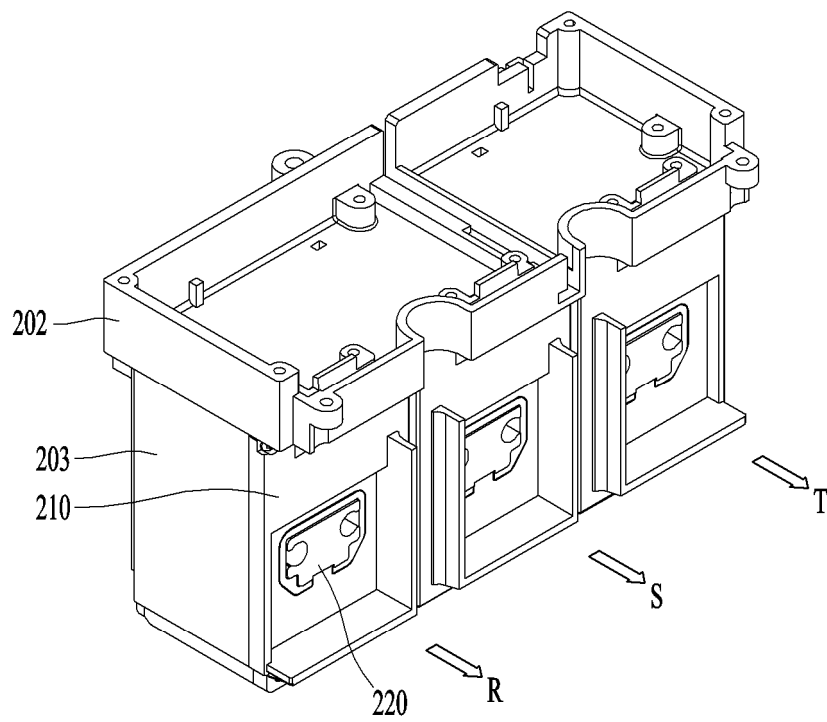


FIG. 11

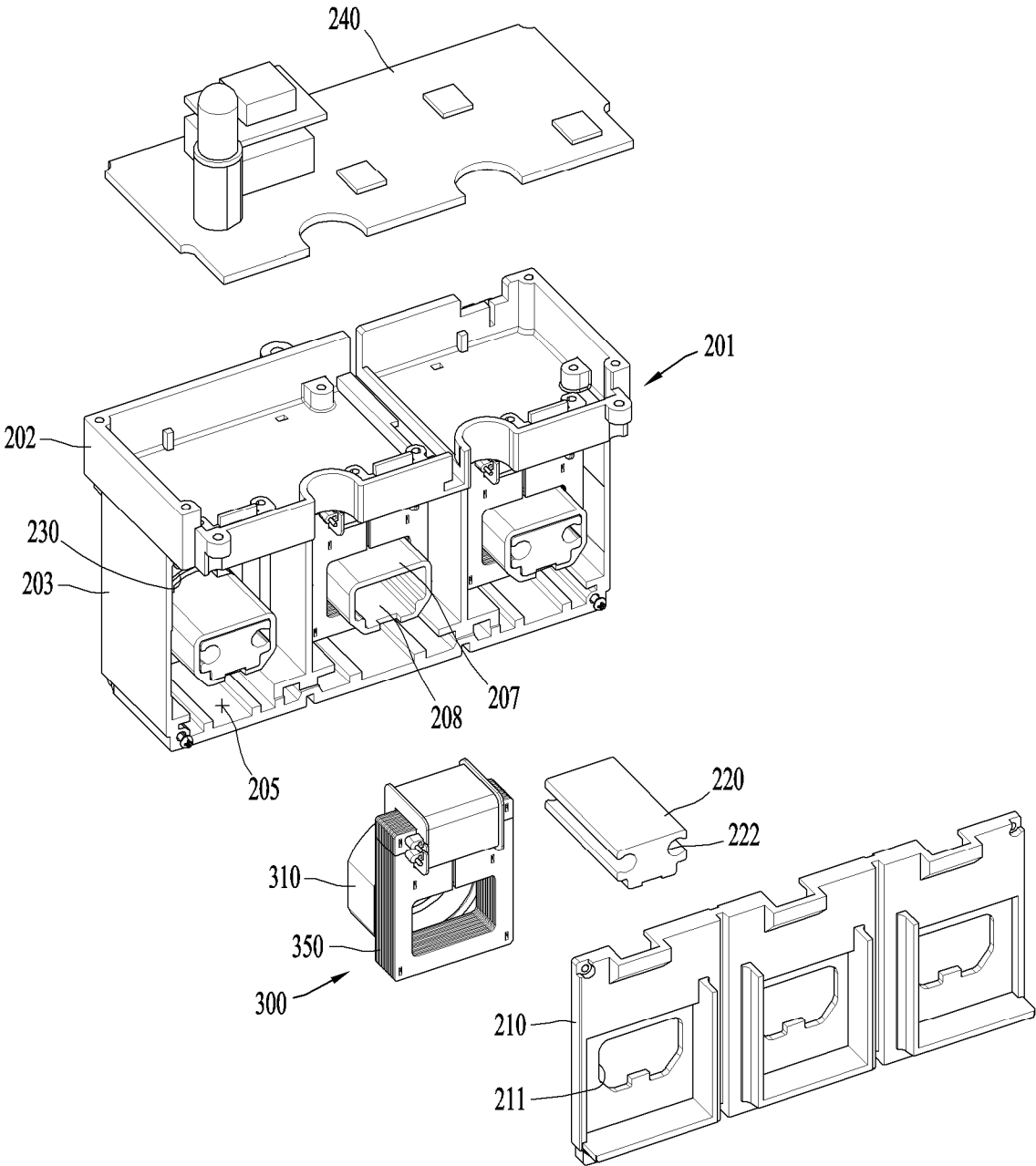


FIG. 12

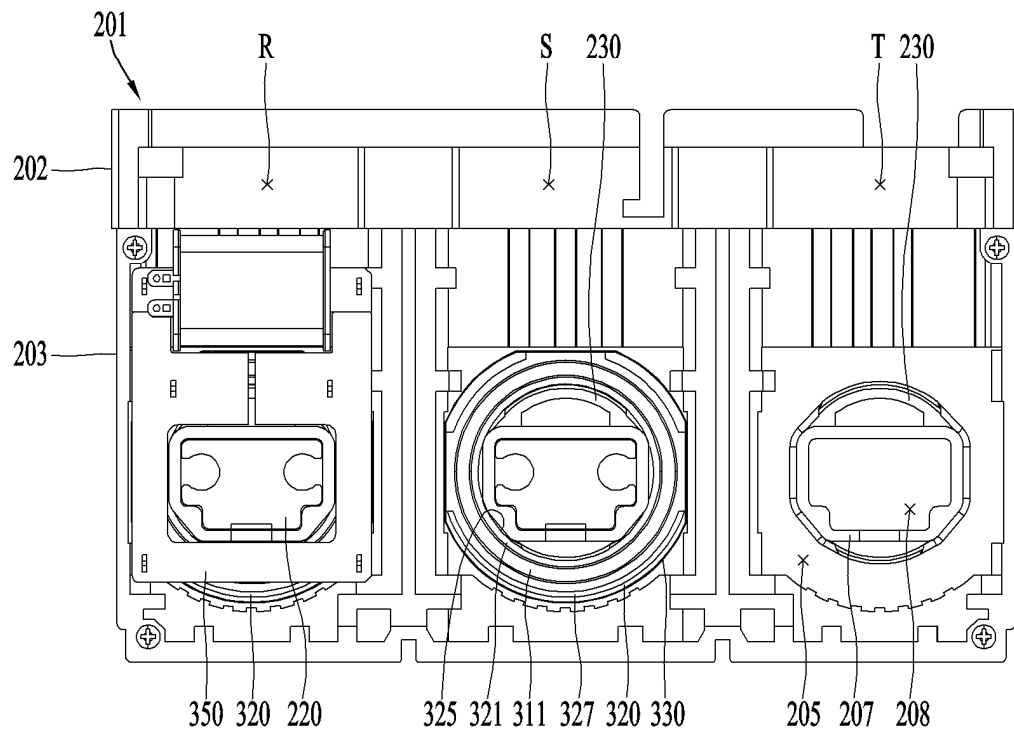


FIG. 13

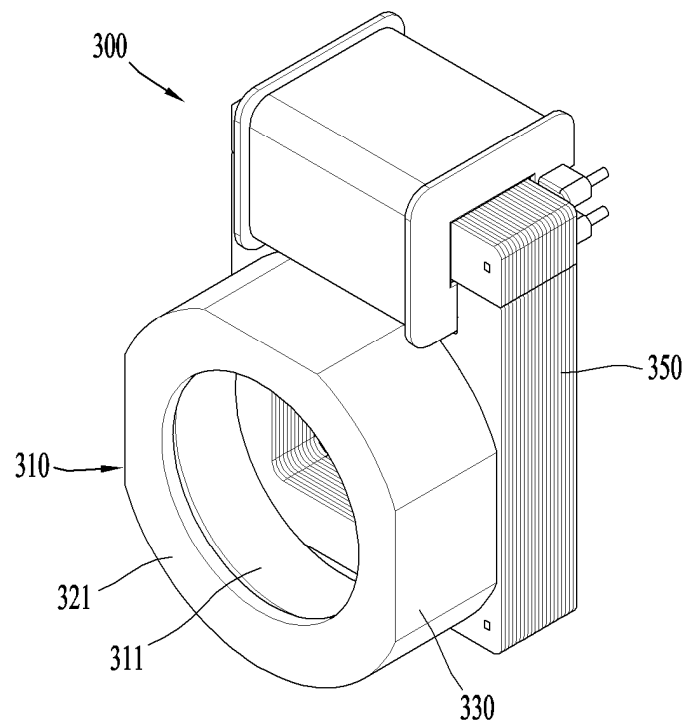


FIG. 14

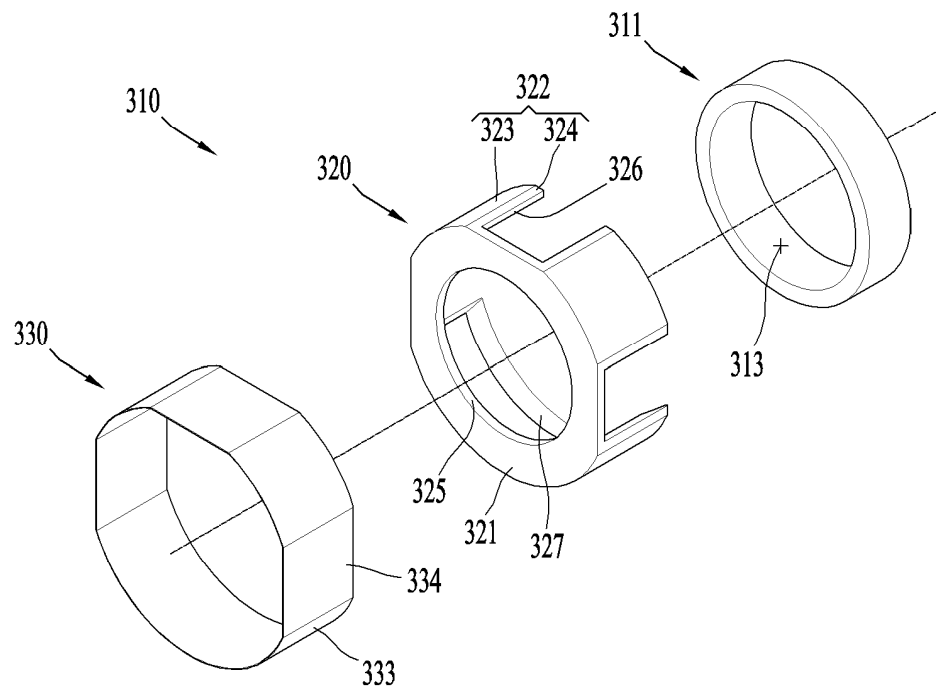
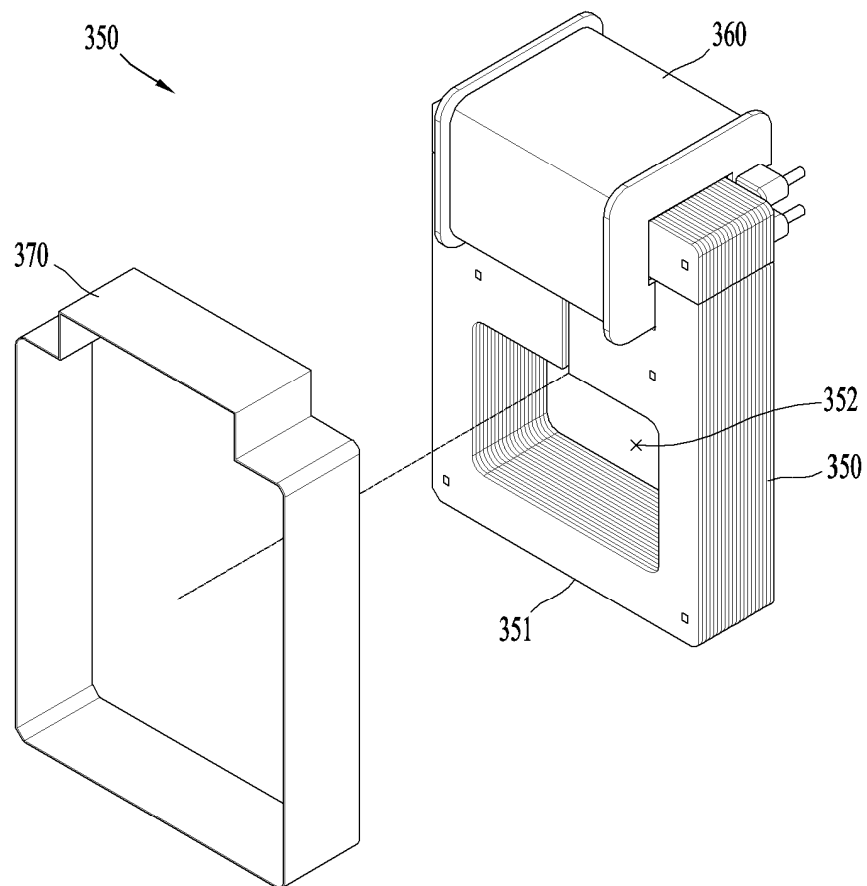


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/009301

A. CLASSIFICATION OF SUBJECT MATTER**H01H 73/36**(2006.01)i; **H01H 71/12**(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H 73/36(2006.01); H01F 27/00(2006.01); H01F 27/02(2006.01); H01F 27/36(2006.01); H01H 71/00(2006.01);
H01H 73/00(2006.01); H01H 73/06(2006.01); H01H 83/02(2006.01); H02J 50/10(2016.01); H02J 7/02(2006.01)

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

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 배전용 차단기(molded case circuit breaker), 전자식 트립부(electronic trip unit), 변류기(current transformer), 자계 흡수재(magnetic field absorber)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2004-0110265 A (LG IND. SYSTEMS CO., LTD.) 31 December 2004 (2004-12-31) See paragraphs [0044]-[0053] and claim 1.	1-15
Y	KR 10-2017-0069712 A (AMOGREENTECH CO., LTD.) 21 June 2017 (2017-06-21) See paragraphs [0003]-[0055], claim 1 and figure 2.	1-15
Y	KR 10-2020-0030385 A (AMOSENSE CO., LTD.) 20 March 2020 (2020-03-20) See paragraphs [0020]-[0033].	2-3,13
DY	KR 20-0487464 Y1 (LSIS CO., LTD.) 20 September 2018 (2018-09-20) See paragraphs [0027]-[0035] and figures 4-5.	4-12
A	JP 2008-262935 A (FUJI ELECTRIC FA COMPONENTS & SYSTEMS CO., LTD.) 30 October 2008 (2008-10-30) See claims 1-3.	1-15

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

* Special categories of cited documents:

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

“&” document member of the same patent family

Date of the actual completion of the international search

17 October 2024

Date of mailing of the international search report

17 October 2024

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2024/009301

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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2004-0110265 A	31 December 2004	KR 10-0509584 B1	22 August 2005
KR 10-2017-0069712 A	21 June 2017	CN 108369857 A	03 August 2018
		CN 114171301 A	11 March 2022
		CN 114171301 B	21 November 2023
		EP 3389061 A1	17 October 2018
		JP 2019-505090 A	21 February 2019
		JP 2020-191466 A	26 November 2020
		JP 7090928 B2	27 June 2022
		KR 10-1966749 B1	08 April 2019
		US 10600563 B2	24 March 2020
		US 2018-0366265 A1	20 December 2018
		WO 2017-099502 A1	15 June 2017
KR 10-2020-0030385 A	20 March 2020	CN 112703658 A	23 April 2021
		JP 2022-500988 A	04 January 2022
		JP 7181650 B2	01 December 2022
		KR 10-2218147 B1	23 February 2021
		US 11936195 B2	19 March 2024
		US 2022-0037922 A1	03 February 2022
		WO 2020-055050 A1	19 March 2020
KR 20-0487464 Y1	20 September 2018	KR 20-2018-0002564 U	27 August 2018
JP 2008-262935 A	30 October 2008	None	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 200487464 [0017]