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(54) **APPARATUS FOR CONTROLLING COMPRESSOR, CONTROL SYSTEM FOR COMPRESSOR AND METHOD FOR CONTROLLING COMPRESSOR**

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(57) **ABSTRACT**

The present disclosure relates to a compressor control apparatus, a compressor control system, and a compressor control method for controlling the switching operation of a plurality of switching modules according to a preset control criterion to discharge residual charge remaining in an electrolytic capacitor.

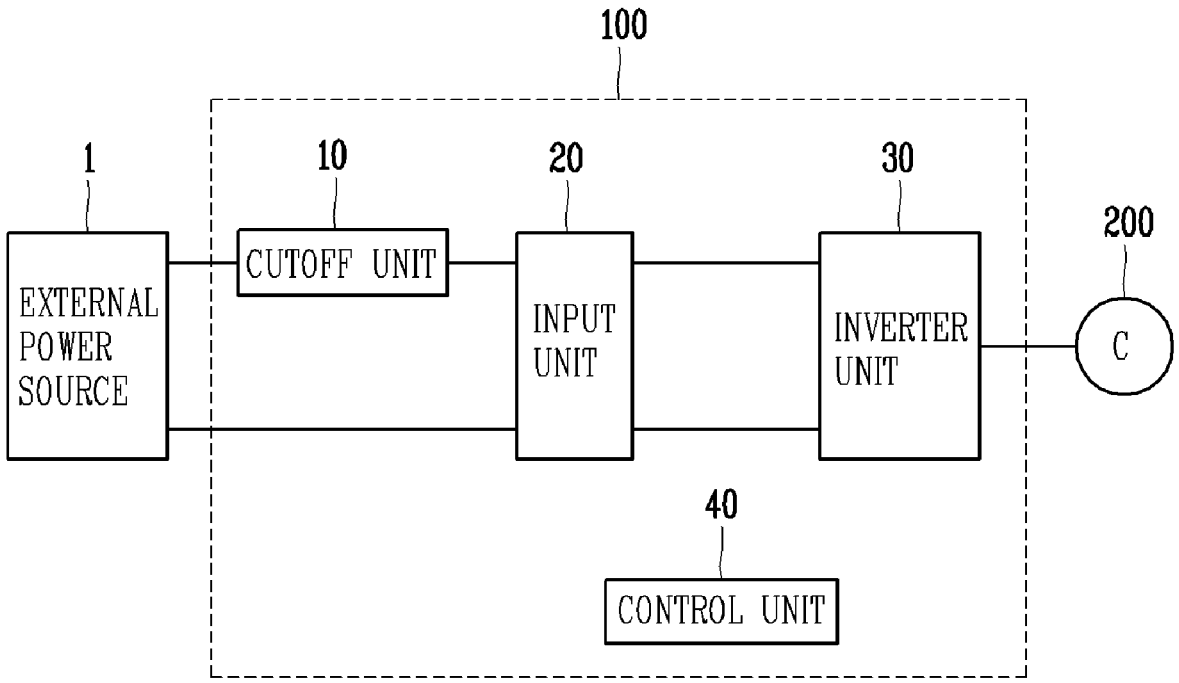


FIG. 1

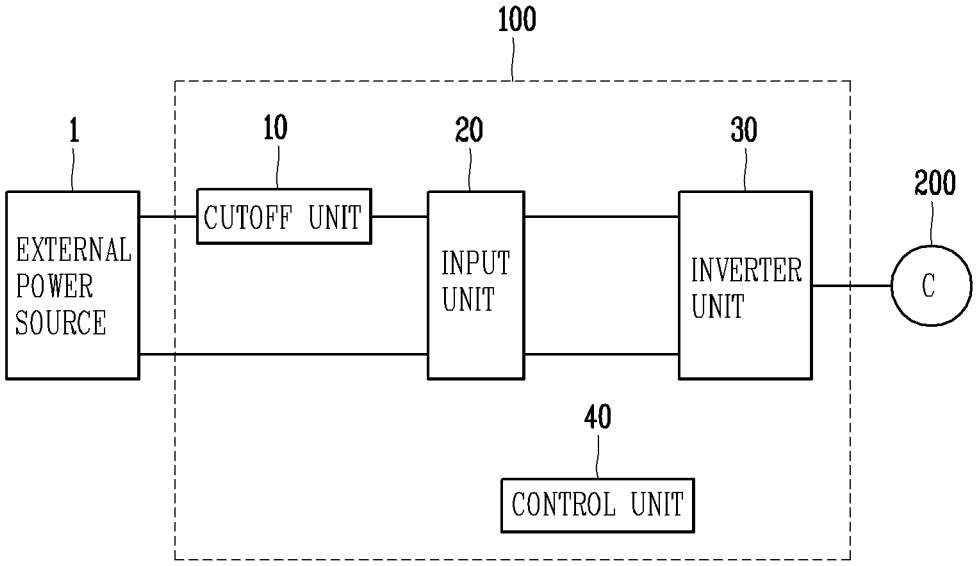

100
1
10
20
30
200
EXTERNAL POWER SOURCE
CUTOFF UNIT
INPUT UNIT
INVERTER UNIT
C
40
CONTROL UNIT

FIG. 2

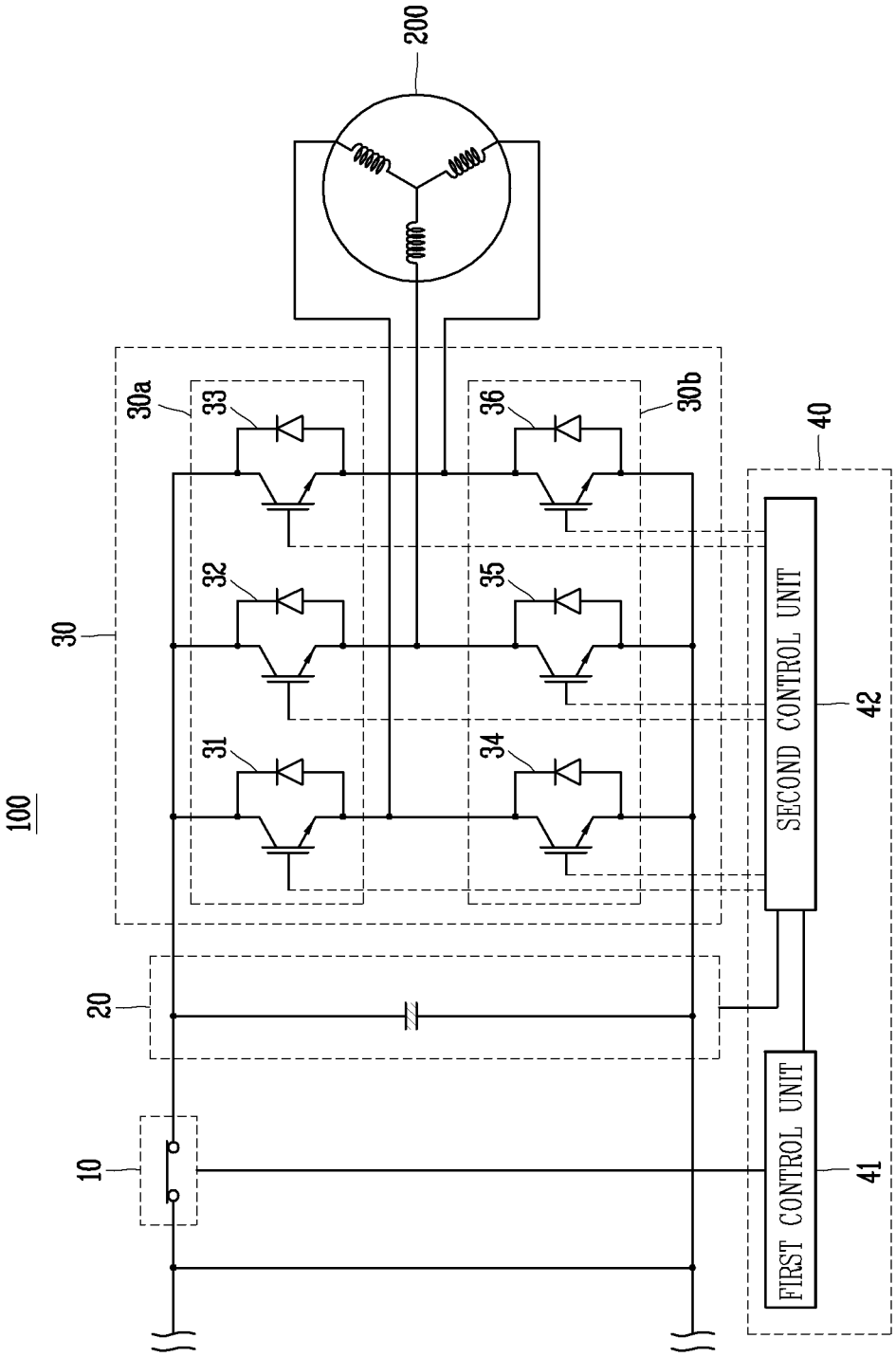

100
200
30
30a
30b
31
32
33
34
35
36
40
42
SECOND CONTROL UNIT
41
FIRST CONTROL UNIT
20
10

FIG. 3

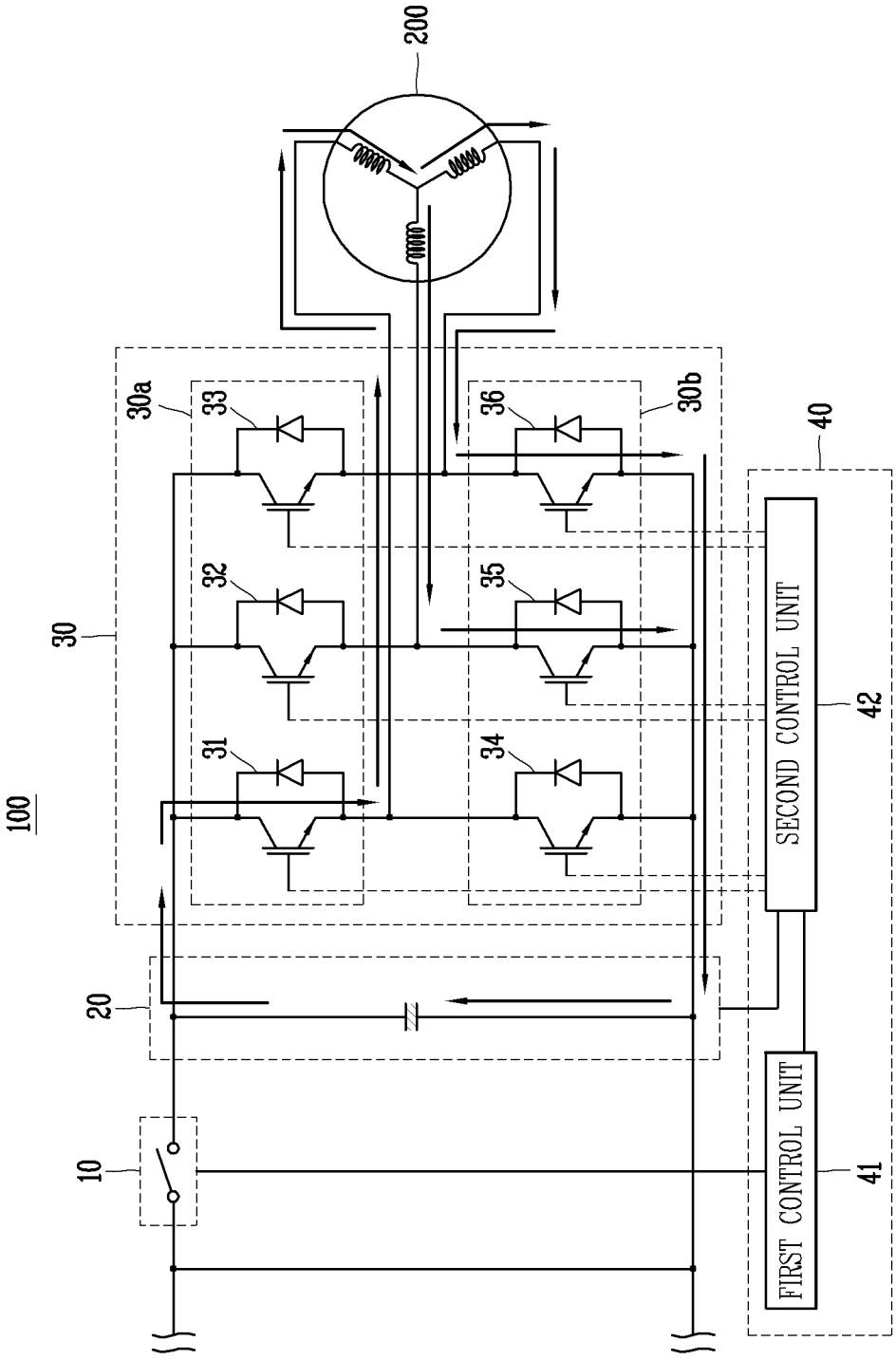

100
200
30
30a
30b
31
32
33
34
35
36
40
41
42
FIRST CONTROL UNIT
SECOND CONTROL UNIT
20
10

FIG. 4

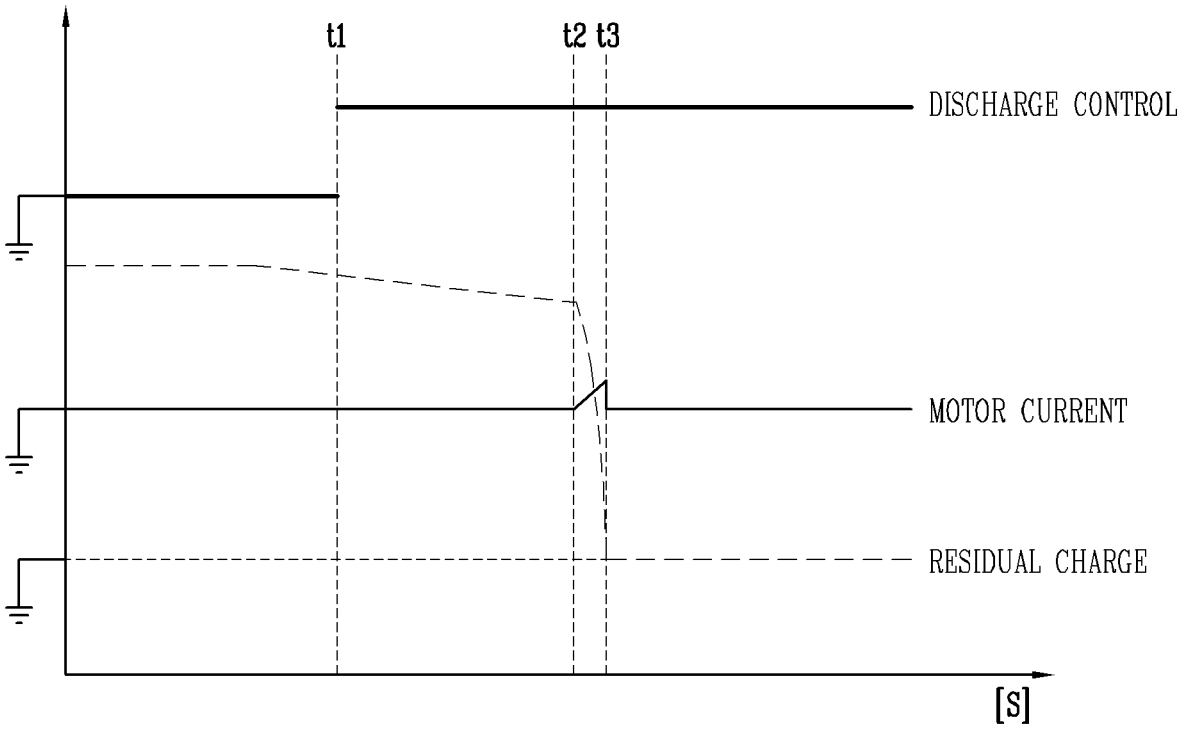


FIG. 5

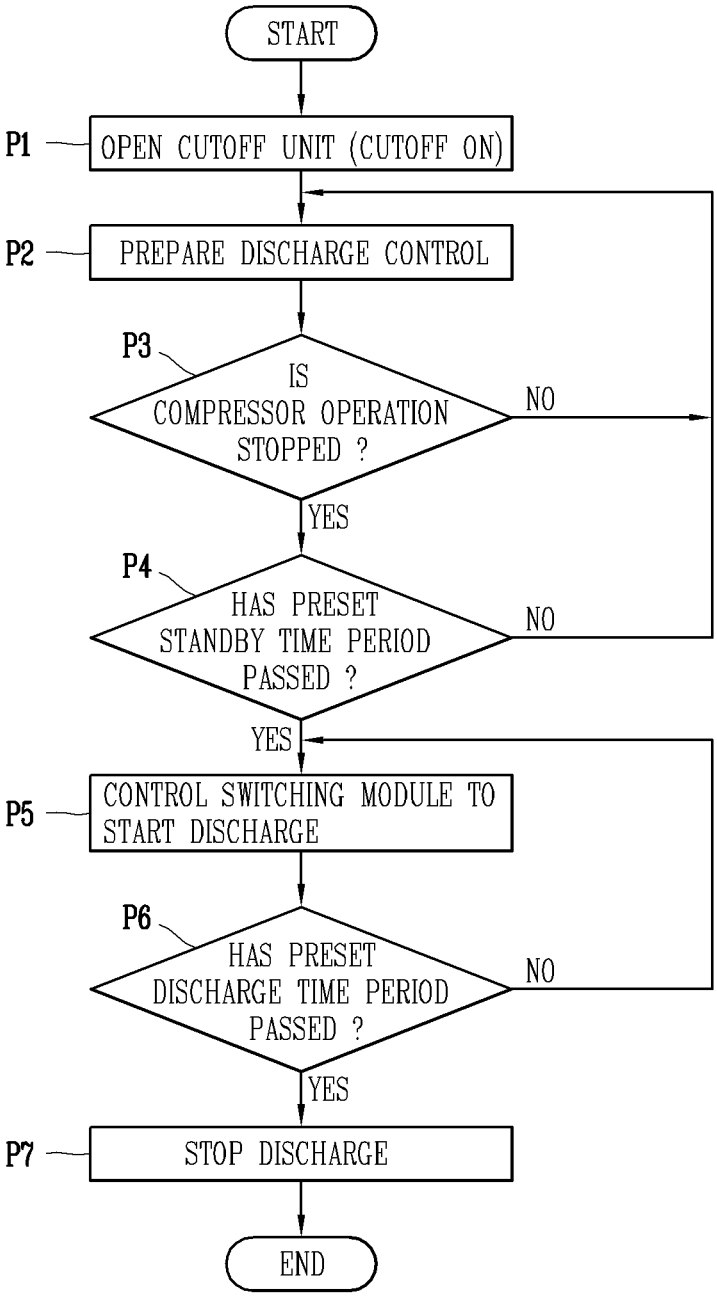

START
P1
OPEN CUTOFF UNIT (CUTOFF ON)
P2
PREPARE DISCHARGE CONTROL
P3
IS COMPRESSOR OPERATION STOPPED ?
NO
YES
P4
HAS PRESET STANDBY TIME PERIOD PASSED ?
NO
YES
P5
CONTROL SWITCHING MODULE TO START DISCHARGE
P6
HAS PRESET DISCHARGE TIME PERIOD PASSED ?
NO
YES
P7
STOP DISCHARGE
END

FIG. 6

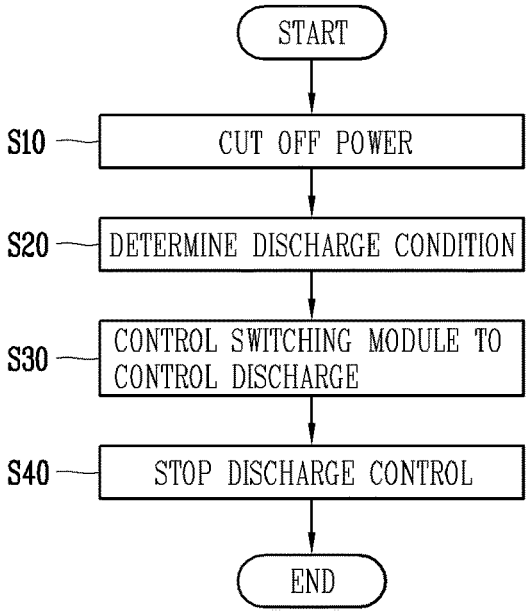
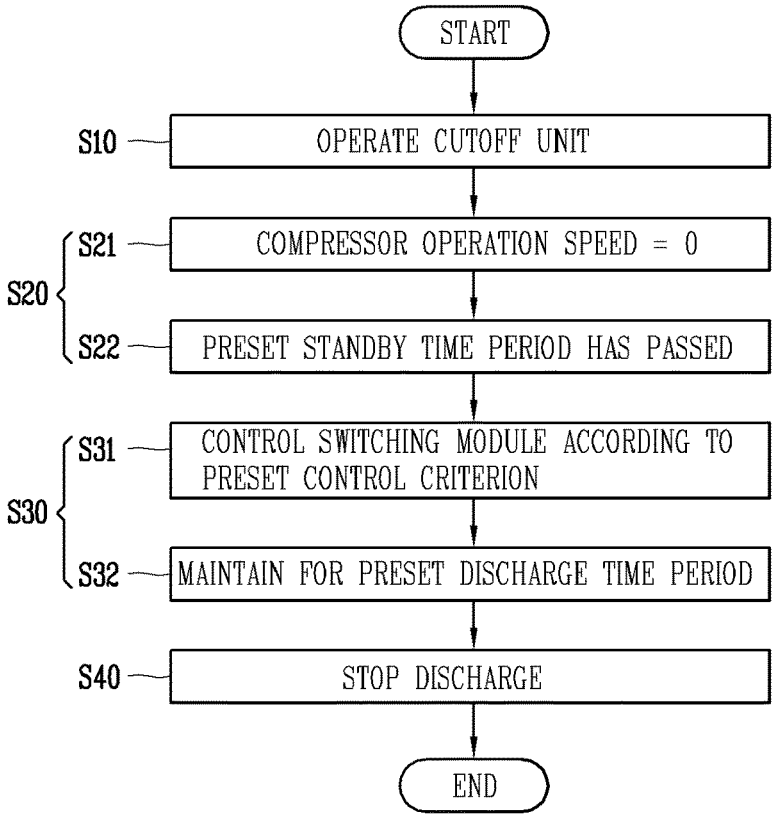

START
S10
CUT OFF POWER
S20
DETERMINE DISCHARGE CONDITION
S30
CONTROL SWITCHING MODULE TO CONTROL DISCHARGE
S40
STOP DISCHARGE CONTROL
END

FIG. 7


START
S10
OPERATE CUTOFF UNIT
S20
S21
COMPRESSOR OPERATION SPEED = 0
S22
PRESET STANDBY TIME PERIOD HAS PASSED
S30
S31
CONTROL SWITCHING MODULE ACCORDING TO PRESET CONTROL CRITERION
S32
MAINTAIN FOR PRESET DISCHARGE TIME PERIOD
S40
STOP DISCHARGE
END

# APPARATUS FOR CONTROLLING COMPRESSOR, CONTROL SYSTEM FOR COMPRESSOR AND METHOD FOR CONTROLLING COMPRESSOR

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** Pursuant to 35 U.S.C. § 119(a), this application claims the benefit of earlier filing date and right of priority to Korean Application No. 10-2018-0088123, filed on Jul. 27, 2018, the contents of which is incorporated by reference herein in its entirety.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

**[0002]** The present disclosure relates to a compressor control apparatus for controlling a motor of a compressor, a compressor control system, and a compressor control method.

### 2. Description of the Conventional Art

**[0003]** The technology underlying the present disclosure relates to a control apparatus (inverter) for controlling an electric compressor.

**[0004]** In an electric vehicle using an electric compressor, it is required to discharge residual charge remaining in the electric compressor in order to prevent electric shock on a human body due to high voltage when an accident or other emergency occurs.

**[0005]** In case of discharging residual charge in the control of the electric compressor controlling an inverter in the related art, a high voltage drawn into the electric compressor is cut off by a high voltage distribution unit (HPDU), however, in order to remove charge remaining in an electrolytic capacitor when the power of the electric motor is cut off by the HPDU, a power device is separately configured in a PCB to discharge the residual charge of the electrolytic capacitor. In other words, a separate discharge element for discharging the residual charge is provided, and when such a discharge element is provided, the cost of manufacturing and design increases, and design constraints also increase since the amount of space used increases. Even though the power device is pursued to be miniaturized, it has been required to minimize or eliminate the power device due to the characteristics of the inverter for an electric compressor having a large space limitation. In addition, due to the safety problem, the discharge of the residual charge must be performed in a state where the power supply is cut off. However, due to the above structural/design limitations, the discharge control itself may not be performed safely and accurately.

**[0006]** In other words, in the related art, in order to remove the residual charge remaining in the electrolytic capacitor when the power of the electric compressor is cut off, a power device is separately configured in a PCB to discharge the residual charge of the electrolytic capacitor. The provision of such a discharge element has structural/economic limitations, and has caused a problem that the safety/accuracy/reliability of the discharge control cannot be guaranteed.

## SUMMARY OF THE INVENTION

**[0007]** An aspect of the present disclosure is to overcome the limitations of the related art as described above.

**[0008]** In other words, the present disclosure provides a compressor control apparatus, a compressor control system, and a compressor control method capable of overcoming the limitations of the related art as described above.

**[0009]** Specifically, the present disclosure provides a compressor control apparatus, a compressor control system, and a compressor control method capable of discharging residual charge stored in a control apparatus for controlling a compressor after the operation of the compressor is stopped.

**[0010]** In addition, the present disclosure provides a compressor control apparatus, a compressor control system, and a compressor control method capable of appropriately and safely discharging the residual charge.

**[0011]** In order to solve the foregoing problems, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may have technical features in which the switching operation of a plurality of switching modules is controlled according to a preset control criterion to discharge residual charge remaining in an electrolytic capacitor.

**[0012]** Specifically, a discharge path may be formed through the switching operation of the plurality of switching modules, thereby discharging the residual charge through the discharge path.

**[0013]** In other words, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may form a discharge path between the electrolytic capacitor and the motor through the plurality of switching modules so as to discharge the residual charge through the formed discharge path as a solution.

**[0014]** Through the foregoing solution, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may discharge the residual charge through the discharge path so as to discharge the residual charge safely and appropriately without any additional discharge element, thereby solving the above-described problems.

**[0015]** The above technical features may be embodied in a compressor control apparatus, a compressor control system, and a compressor control method for controlling the operation of a compressor through an inverter unit that applies operating power to the motor through the switching operation of a plurality of switching modules, and the present disclosure may provide a compressor control apparatus, a compressor control system, and a compressor control method using the foregoing technical features as a solution to the problems.

**[0016]** In order to solve the foregoing problems with the above technical features, a compressor control apparatus according to an embodiment of the present disclosure may include a cutoff unit configured to interrupt power received from an external power source, an input unit configured to input power from the external power source through the cutoff unit, an inverter unit configured to convert the input power to operating power for operating a motor of a compressor through a plurality of switching modules to output the operating power to the motor, and a control unit configured to control the inverter unit to control the conversion and output of the operating power, wherein when the operation of the motor is stopped, the control unit controls the

switching operation of the plurality of switching modules according to a preset control criterion to discharge residual charge stored in the input unit.

**[0017]** Furthermore, in order to solve the foregoing problems with the above technical features, a compressor control system according to an embodiment of the present disclosure may include a motor driven compressor, and a control apparatus comprising a plurality of switching modules configured to convert power input from an external power source to operating power for operating the motor to output the operating power to the motor so as to control the switching operation of the plurality of switching modules to control the operation of the motor, wherein the control apparatus controls the switching operation of two or more specific switching modules among the plurality of switching modules after the operation of the motor is stopped to discharge residual charge stored in the control apparatus.

**[0018]** Moreover, in order to solve the foregoing problems with the above technical features, there is provided a method of controlling a compressor control apparatus including a cutoff unit configured to interrupt power received from an external power source, an input unit configured to input power from the external power source through the cutoff unit, an inverter unit configured to convert the input power to operating power for operating a motor of a compressor through a plurality of switching modules to output the operating power to the motor, and a control unit configured to control the inverter unit so as to control the conversion and output of the operating power, and the method may include cutting off power input from the external power source, determining a discharge condition based on an operation state of the motor, controlling the plurality of switching modules according to a preset control criterion to perform the discharge control of residual charge stored in the input unit, and stopping the discharge control.

**[0019]** The compressor control apparatus, the compressor control system, and the compressor control method according to the present disclosure as described above may be applied to and implemented on a compressor control apparatus provided in a compressor, for instance, an inverter apparatus for controlling a motor of a compressor, a compressor including the same, or a control method for the compressor. However, technologies disclosed herein are not limited thereto, and may also be applicable to all compressor control apparatuses, compressors, compressor control systems, and compressor control methods to which the technical concept of the present disclosure is applicable.

**[0020]** A compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may form a discharge path through the switching operation of a plurality of switching modules, thereby having an effect of discharging the residual charge through the discharge path.

**[0021]** In other words, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may discharge the residual charge through the discharge path, thereby having an effect of safely and appropriately discharging the residual charge without any additional discharge element.

**[0022]** Furthermore, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may safely and appropriately discharge the residual charge thereby having an effect preventing the internal burnout of a compressor and a control apparatus that controls the compressor due to the residual charge.

**[0023]** Moreover, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may discharge residual charge according to an input state of external power source, an operation state of a motor, and a discharge state of the residual charge, thereby having an effect of accurately performing the discharge of residual charge, and reducing loss due to an unnecessary switching operation.

**[0024]** As a result, a compressor control apparatus, a compressor control system, and a compressor control method according to the present disclosure may reliably and accurately discharge residual charge without any additional discharge element, thereby having an effect of improving the limitations of the related art as well as increasing stability, accuracy, ease of use, utility, usefulness and reliability of electric compressor control using an inverter.

## BRIEF DESCRIPTION OF THE DRAWING

**[0025]** The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

**[0026]** FIG. **1** is a configuration view showing a configuration of a compressor control apparatus according to the present disclosure.

**[0027]** FIG. **2** is a configuration view showing a specific circuit configuration of a compressor control apparatus according to the present disclosure.

**[0028]** FIG. **3** is a circuit configuration view showing current flow according to discharge control of a compressor control apparatus according to the present disclosure.

**[0029]** FIG. **4** is a graph showing a result of discharge control of a compressor control apparatus according to the present disclosure.

**[0030]** FIG. **5** is a flowchart showing a control process of a compressor control system according to the present disclosure.

**[0031]** FIG. **6** is a flowchart showing a flow of a compressor control apparatus according to the present disclosure.

**[0032]** FIG. **7** is a flowchart showing a specific flow of a compressor control apparatus according to the present disclosure.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0033]** The invention disclosed herein may be applicable to a compressor control apparatus, a compressor control system, a compressor control method, and a compressor to which such a technology is applied. However, the invention disclosed in this specification is not limited thereto, but may also applicable to all existing compressor control apparatuses, compressor control systems, compressors and compressor control methods, motor control apparatuses, motor operating apparatuses, inverter apparatuses of controlling a motor, control methods of a motor control apparatus, control methods of an inverter apparatus, control elements of controlling a motor control apparatus and control methods

thereof, control apparatuses of controlling an inverter apparatus, and control methods thereof, and the like, and more particularly, may be usefully applicable to a compressor control apparatus, a compressor control system, and a compressor control method of controlling an electric compressor.

**[0034]** It should be noted that technological terms used herein are merely used to describe a specific embodiment, but not to limit the concept of technologies disclosed herein. Furthermore, unless particularly defined otherwise, technological terms used herein should be construed as a meaning that is generally understood by those having ordinary skill in the art disclosed herein, and should not be construed too broadly or too narrowly. Furthermore, if technological terms used herein are wrong terms unable to correctly express the concept of technologies disclosed herein, then they should be replaced by technological terms that are properly understood by those skilled in the art. In addition, general terms used in the present specification should be construed based on the definition of dictionary, or the context, and should not be construed too broadly or too narrowly.

**[0035]** Furthermore, a singular representation used in the present specification may include a plural representation as far as it represents a definitely different meaning from the context. In the present specification, the terms "comprising" and "including" should not be construed to necessarily include all of the elements or steps disclosed herein, and should be construed not to include some of the elements or steps thereof, or should be construed to further include additional elements or steps.

**[0036]** In describing technologies disclosed herein, moreover, the detailed description will be omitted when specific description for publicly known technologies to which the invention pertains is judged to obscure the gist of the present invention. In addition, it should be noted that the accompanying drawings are merely illustrated to easily explain the technological concept disclosed herein, and therefore, they should not be construed to limit the technological concept by the accompanying drawings.

**[0037]** First, a compressor control apparatus (hereinafter, referred to as a control apparatus) according to the present disclosure will be described.

**[0038]** The control apparatus denotes a control apparatus for controlling the operation of the compressor.

**[0039]** The control apparatus may be a control apparatus for supplying operating power to the motor of the compressor and controlling the operation of the compressor.

**[0040]** The control apparatus may be an apparatus for controlling the driving of the compressor to control the operation of the compressor.

**[0041]** The control apparatus may be an apparatus for controlling the motor using an inverter method.

**[0042]** In other words, the control apparatus may be an inverter that controls the driving of the compressor, or an apparatus including the inverter.

**[0043]** The control apparatus may control the operation of the motor by controlling the switching operation of the inverter and controlling the operating power applied to the motor.

**[0044]** The control apparatus may control the operating power through the control of the switching operation to control the operation of the motor, thereby controlling the operation of the compressor.

**[0045]** As illustrated in FIG. **1**, a control apparatus **100** includes a cutoff unit **10** for interrupting power input from an external power source **1**, an input unit **20** for receiving power from the external power source **1** through the cutoff unit **10**, an inverter unit **30** for converting the received power into operating power for operating a motor **200** of a compressor (C) through a plurality of switching modules to output the operating power to the motor **200**, and a control unit **40** for controlling the inverter unit **30** to control the conversion and output of the operating power.

**[0046]** The control apparatus **100** controls the switching operation of the plurality of switching modules included in the inverter unit **30** by the control unit **40** to control the conversion and output of the operating power converted through the switching operation, thereby controlling the operation of the motor **200**.

**[0047]** In the control apparatus **100** including the cutoff unit **10**, the input unit **20**, the inverter unit **30** and the control unit **40** as described above, the control device **40** controls the switching operation of the plurality of switching modules according to a preset control criterion to discharge residual charge stored in the input unit **20** when the operation of the motor **200** is stopped.

**[0048]** In other words, when the operation of the motor **200** is stopped, the control apparatus **100** may control the switching operation of the plurality of switching modules according to the control criterion, thereby discharging the residual charge stored and remained in the input unit **200** during the operation of the motor **200**.

**[0049]** The specific configuration of the control apparatus **100** may be as shown in FIG. **2**.

**[0050]** The cutoff unit **10** may be a high voltage power distribution unit (HPDU) for distributing high voltage power.

**[0051]** The cutoff unit **10** is closed at normal times, and open when sensing a high voltage above a predetermined reference level to cut off power input from the external power source **1**.

**[0052]** For example, when an accident occurs in the external power source **1** to generate a high voltage above predetermined reference level, it is detected to open, thereby cutting off power input from the external power source **1** to the control apparatus **100**.

**[0053]** When a high voltage above the predetermined reference level is induced from the external power source **1** or a high voltage above the predetermined reference level is generated in the control apparatus **100**, the cutoff unit **10** is open to separate the control apparatus **100** from the external power source **1**.

**[0054]** The cutoff unit **10** may be controlled by the control unit **40** or a control element at an outside of the control apparatus **100**.

**[0055]** The input unit **20** may receive direct current (DC) power or alternating current (AC) power from the external power source **1** through the cutoff unit **10**.

**[0056]** When power input to the input unit **10** is the DC power, the external power source **1** may be a battery for storing the DC power or a power supply element for supplying the DC power.

**[0057]** When power input to the input unit **10** is the AC power, the external power source **1** may be power conversion element for converting the DC power to the AC power or a power supply element for supplying the AC power.

**[0058]** The input power may preferably be the DC power.

**[0059]** The input unit **20** may include a smoothing capacitor for smoothing the input power.

**[0060]** The smoothing capacitor may be a DC link capacitor that reduces the ripple of the input power to smooth it in the form of DC power.

**[0061]** The smoothing capacitor may be an electrolytic capacitor.

**[0062]** The input unit **20** may store and smooth the DC power input from the external power source **1** through the cutoff unit **10** in the smoothing capacitor formed of the electrolytic capacitor.

**[0063]** The input unit **20** is connected to the inverter unit **30** to transfer the DC power smoothed through the smoothing capacitor to the inverter unit **30**.

**[0064]** The inverter unit **30** is connected to the motor **200** to convert the DC power received through the input unit **20** to the operating power and output it to the motor **200**.

**[0065]** Here, the motor **200** may be a three-phase motor that drives the compressor (C), and the operating power may be in the form of three-phase AC power.

**[0066]** The inverter unit **30** may convert the DC power into the operating power in the form of the AC power and output it to the motor **200**.

**[0067]** The inverter unit **30** may convert the DC power into three-phase AC power through the switching operation of the plurality of switching modules **31** to **36**.

**[0068]** The plurality of switching modules **31** to **36** may be preferably insulated gate bipolar transistor (IGBT) modules.

**[0069]** The switching operation of the plurality of switching modules **31** to **36** may be controlled by the control unit **40**.

**[0070]** The plurality of switching modules **31** to **36** may receive a control signal for the switching operation from the control unit **40** to perform a switching operation and convert the DC power to the AC power according to the control signal.

**[0071]** The plurality of switching modules **31** to **36** may include three pairs of switching modules **31-34**, **32-35**, **33-36**, in which two switching modules are connected in series, as shown in FIG. **2**.

**[0072]** The plurality of switching modules **31** to **36** including the three pairs of switching modules **31-34**, **32-35**, **33-36** may include first through third upper arm switching modules **30***a* (**31** to **33**) connected to an anode end of the input unit **20**, and first through third lower arm switching modules **30***b* (**34** to **36**) connected in series to the upper arm switching modules **30***a* (**31** to **33**), respectively, and connected to a cathode end of the input unit **20**.

**[0073]** Here, each of the three pairs of switching modules **31-34**, **32-35**, **33-36** may constitute each phase of the three-phase power output to the motor **200**.

**[0074]** For instance, the first pair **31-34** may be a U-phase, the second pair **32-35** may be a V-phase, and the third pair **33-36** may be a W-phase.

**[0075]** The plurality of switching modules **31** to **36** in which the upper arm switching module **30***a* (**31** to **33**) and the lower arm switching module **30***b* (**34** to **36**) connected to each other in pairs, respectively, may be controlled by the control unit **40** to output the operating power to the motor **200**.

**[0076]** In other words, the inverter unit **30** including the plurality of switching modules (**31** to **36**) may be controlled by the control unit **40**.

**[0077]** In the inverter unit **30**, the switching operation is controlled by the control unit **40** to control and the operation of the motor **200**.

**[0078]** The inverter unit **30** may control the operating power output to the motor **200** and applied to the motor **200** through the control of the switching operation to control the operation speed of the motor **200**.

**[0079]** Here, the operation speed may denote a rotation speed of the motor **200**.

**[0080]** The operation speed may also be replaced with an operation frequency at which the motor **200** operates or the number of revolutions of the motor **200** associated with the operation speed.

**[0081]** Hereinafter, for convenience of explanation, the embodiment will be described around the operation speed, but the implementation of the present disclosure may be implemented in a manner of replacing the operation speed with the operation frequency or the rotation speed.

**[0082]** The control unit **40** for controlling the switching operation to control the operation of the motor **200** may detect the voltage and current of the motor **200**, and measure the operation speed of the motor **200** based on the detected motor voltage and the motor current to control the switching operation according to the measured operation speed.

**[0083]** The control unit **40** may detect the motor voltage and the motor current applied to the motor **200** according to the switching operation, and measure the operation speed based on the motor voltage and the motor current.

**[0084]** The control unit **40** may generate a control signal for controlling the switching operation according to the operation speed, and apply the control signal to the inverter **30** to control the switching operation.

**[0085]** The control unit **40** may determine at least one of a command voltage for the motor voltage, a command current for the motor current, a speed command for the operation speed, and a frequency command for the switching frequency according to the operation speed, and generate the control signal according to the determination result.

**[0086]** In other words, the control unit **40** may determine at least one the command voltage, the command current, the speed command, the speed command, and the frequency command based on at least one of the detection result of detecting the motor voltage and the motor current, and the measurement result of measuring the operation speed, and generate the control signal according to the determination result, thereby controlling at least one of the motor voltage, the motor current, the operation speed, and the switching frequency.

**[0087]** As described above, the control unit **40** may control at least one of the motor voltage, the motor current, the operation speed and the switching frequency through the control of the switching operation, thereby controlling the operation of the motor **200**.

**[0088]** The control unit **40** may include a first control unit **41** for controlling the cutoff unit **10** and a second control unit **42** for controlling the inverter unit **30**.

**[0089]** When the control unit **40** includes the first control unit **41** and the second control unit **42** as described above, the first control unit **41** may generate a control command for the control of the inverter unit **30** to transfer it to the second control unit **42**, and the second control unit **42** may generate the control signal according to the control command received from the first control unit **41**.

**[0090]** As described above, the control unit **40** that controls the switching operation of the inverter unit **30** to control the conversion and output of the operating power controls the switching operation of the plurality of switching modules **31** to **36** according the control criterion to discharge the residual charge stored in the input unit **20** when the operation of the motor **200** is stopped.

**[0091]** In other words, the control unit **40** controls the switching operation of the plurality of switching modules **31** to **36** to discharge the residual charge remaining in the input unit **20** when the operation of the motor **200** is stopped.

**[0092]** The control unit **40** may determine whether or not the operation of the motor **200** is stopped while the cutoff unit **10** is open, and controls the switching operation to discharge the residual charge when the operation of the motor is stopped.

**[0093]** In other words, only when the operation of the motor **200** is stopped in a state where the cutoff unit **10** is open and power input to the input unit **20** from the external power source **1** is cut off, the control unit **40** may control the switching operation to discharge the residual charge.

**[0094]** As described above, the switching operation may be controlled to discharge the residual charge in a state where the cutoff unit **10** is open, and the operation of the motor **200** is stopped, thereby preventing the residual charge from being discharged toward the external power source **1** and allowing power to be input from the external power source **1** to the input unit **20** to prevent the power from being stored in the input unit **20** in which the residual charge is being discharged.

**[0095]** In the control unit **40** that controls the switching operation to discharge the residual charge in a state where the cutoff unit **10** is open and the operation of the motor **200** is stopped as described above, the first control unit **41** may transfer information on the cutoff state of the cutoff unit **10** and the switching operation control to the second control unit **42** while the cutoff unit **10** is controlled to be open, and the second control unit **42** may control the switching operation based on the cutoff state and information on the switching operation control received from the first control unit **41**.

**[0096]** In other words, the second control unit **42** may determine whether the operation of the motor **200** is stopped to control the switching operation only when the information on the cutoff state of the cutoff unit **10** is received from the first control unit **41**.

**[0097]** The control unit **40** may control the switching operation to discharge the residual charge when the operation of the motor **200** is stopped for more than a preset standby time period.

**[0098]** In other words, the control unit **40** may control the switching operation to discharge the residual charge when the operation stop of the motor **200** has passed the standby time.

**[0099]** The standby time may be a period of time for which charge remaining in the motor **200** is discharged immediately after the operation of the motor **200** is stopped.

**[0100]** In other words, when the operation of the motor **200** is stopped for more than the standby time, the control unit **40** may determine that charge remaining in the motor **200** is discharged after the operation of the motor **200** is stopped so as to control the switching operation to discharge the residual charge.

**[0101]** The standby time may be a period of time for which the operation of the motor **200** is completely stopped.

**[0102]** For instance, it may be a period of time from the start of stopping the operation speed of the motor **200** to a time point when the operation speed is zero.

**[0103]** As described above, the control unit **40** may control the switching operation to discharge the residual charge after the operation of the motor **200** is completely stopped and charge remaining in the motor **200** is discharged, thereby safely and accurately discharging the residual charge remaining in the input unit **20**.

**[0104]** The control unit **40** for discharging residual charge after the cutoff unit **10** is open, and the operation of the motor **200** is completely stopped and the charge remaining in the motor **200** is discharged, may control the switching operation according to the control criterion to discharge the residual charge.

**[0105]** The control criterion may be a criterion for controlling two or more of the plurality of switching modules **31** to **36**.

**[0106]** In other words, the control unit **40** may control switching operations of two or more of the plurality of switching modules **31** to **36** when the switching operation is controlled to discharge the residual charge.

**[0107]** The control criterion may be a criterion for controlling the switching operation of two or more switching modules among the plurality of switching modules **31** to **36** to form a discharge path between the input unit **20** and the motor **200**.

**[0108]** In other words, the control unit **40** may control the switching operation of two or more of the plurality of switching modules **31** to **36** according to the control criterion to form the discharge path through which the residual charge is discharged.

**[0109]** The control unit **40** that controls the switching operation according to the control criterion may control the switching operation of any one upper arm switching module in the switching modules **30***a* connected to an anode end of the input unit **20**, and one or more lower arm switching modules excluding a switching module connected to the upper arm switching module in the switching modules **30***b* connected to a cathode end of the input unit **20** among the plurality of switching modules **31** to **36** to discharge the residual charge.

**[0110]** A specific example of controlling the switching operation according to the control criterion will be described below with reference to FIG. **3**.

**[0111]** According to a specific control example of the control unit **40**, as illustrated in FIG. **3**, it may be possible to control the switching operation of any one upper arm switching module connected to an anode end of the input unit **20** among the plurality of switching modules **31** to **36**, and one or more lower arm switching modules other than the switching module connected to the upper arm switching module among the switching modules **30***b* connected to a cathode end of the input unit **20**.

**[0112]** In other words, in this case, the control unit **40** may control the first upper arm switching module **31** among the upper arm switching modules **30***a*, and the second lower arm switching module **35** and the third lower arm switching module **36** excluding the first lower arm switching module **34** connected to the first upper arm switching module **31** among the lower arm switching modules **30***b*.

**[0113]** At this time, the control unit **40** may control the switching operation to turn on the first upper switching

module **31**, the second lower arm switching modules **35** and the third lower arm switching module **36**.

**[0114]** Furthermore, the control unit **40** may control the switching operation of the second upper arm switching module **32** among the upper arm switching modules **30***a*, the first lower arm switching module **34** and the third lower arm switching module **36** excluding the second lower arm switching module **35** connected to the second upper arm switching module **32** among the lower arm switching modules **30***b*, and may also control the switching operation of the third upper arm switching module **33** among the upper arm switching modules **30***a*, the first lower arm switching module **34** and the third lower arm switching module **35** excluding the third lower arm switching module **36** connected to the third upper arm switching module **33** among the lower arm switching modules **30***b*.

**[0115]** The control unit **40** that controls the switching operation may control the switching operation of the upper arm switching module **30***a* and the lower arm switching module **30***b* to form the discharge path between the input unit **20** and the motor **200** through the upper arm switching modules **30***a* and the lower arm switching modules **30***a*, thereby discharging the residual charge through the formed discharge path.

**[0116]** In other words, the control unit **40** that controls the switching operation may control the switching operation of any one upper arm switching module in the switching modules **30***a* connected to an anode end of the input unit **20**, and one or more lower arm switching modules excluding a switching module connected to the upper arm switching module in the switching modules **30***b* connected to a cathode end of the input unit **20**.

**[0117]** Describing the operation with reference to an example illustrated in FIG. **3**, the control unit **40** may control the switching operation of the first upper arm switching module **31** in the upper arm switching modules **30***a*, and the second lower arm switching module **35** and the third lower arm switching module **36** excluding the first lower arm switching module **34** connected to the upper arm switching module **31** in the lower arm switching modules **30***b* to be turned on to form the discharge path connected through [an anode end of the input unit **20**—the first upper arm switching module **31**—the motor **200**—the second lower arm switching module **35** and the third lower arm switching module **36**—a cathode end of the input unit **200**], thereby discharging the residual charge stored in the input unit **20** through a loop of [the anode end of the input unit **20**—the first upper arm switching module **31**—the motor **200**—the second lower arm switching module **35** and the third lower arm switching module **36**—the cathode end of the input unit **200**].

**[0118]** In other words, the control unit **40** may form the discharge path between the control apparatus **100** and the motor **200** through the turn-on control of at least two switching modules among the plurality of switching modules **31** to **36**, thereby discharging the residual charge through the discharge path.

**[0119]** As described above, the control unit **40** may control the switching modules among the plurality of switching modules **31** to **36** to be turned on according to the control criterion to form the discharge path between the control apparatus **100** and the motor **200**, thereby discharging the residual charge in the control apparatus **100** and the motor **200** without any additional discharging element.

**[0120]** In this manner, the control unit **40** that controls the switching operation according to the control criterion, may control the switching operation for a preset discharge time period to discharge the residual charge.

**[0121]** The discharge time period may be a period of time for which the residual charge is discharged through the discharge path.

**[0122]** In other words, the control unit **40** may control the switching operation to discharge the residual charge for the discharge time period.

**[0123]** The discharge time period may be one second, for example.

**[0124]** As described above, the discharge control result of the control unit **40** for controlling the discharge of the residual charge may be as shown in FIG. **4**.

**[0125]** As illustrated in FIG. **4**, when the cutoff unit **10** is open and the operation of the motor **200** is stopped (t**1**), the control unit **40** may start the discharge control of the residual charge, and control the turn-on of at least two switching modules among the plurality of switching modules **31** to **36** for the discharge time period (t**3**−t**2**) after the operation stop of the motor **200** has passed the standby time (t**2**) such that the residual charge flows through the discharge path formed through the switching operation in a direction of the motor **200** for the discharge time period (motor current), thereby discharging the residual charge through the discharge path for the discharge time period.

**[0126]** After the residual charge is completely discharged for the discharge time period (t**3**), the control unit **40** may stop the discharge control to prevent the unnecessary switching operation of the plurality of switching modules **31** to **36**.

**[0127]** In other words, when the discharge time period (t**3**) has passed to end the discharge of the residual charge, the control unit **40** may stop the control of the switching operation to prevent the loss and burnout of the plurality of switching modules **31** to **36** according to the switching operation.

**[0128]** Hereinafter, a compressor control system (hereinafter, referred to as a control system) according to the present disclosure will be described, and its redundant described above in the control apparatus **100** will be omitted as much as possible.

**[0129]** The control system denotes a system for controlling the operation of the compressor.

**[0130]** The control system may be a control system for supplying operating power to the motor of the compressor to control the operation of the compressor.

**[0131]** The control system may be a control system that controls the motor in an inverter manner.

**[0132]** The control system may control the switching operation of the inverter to control operating power applied to the motor, thereby controlling the operation of the motor.

**[0133]** The control system may control the operating power through the control of the switching operation to control the operation of the compressor, thereby controlling the driving of the compressor.

**[0134]** The control system may control the driving of the compressor including the control apparatus **100** described above.

**[0135]** As illustrated in FIG. **2**, the control system includes a control apparatus **100** including a compressor (C) operated by a motor **200**, and a plurality of switching modules **31** to **36** for converting power input from an external power source **1** to operating power for operating the motor **200** to

output the converted power to the motor **200** so as to control the switching operation of the plurality of switching modules **31** to **36** to control the operation of the motor **200**.

**[0136]** Here, the control apparatus **100** may be the control apparatus **100** described above.

**[0137]** In the control system, after the operation of the motor **200** is stopped, the control apparatus **100** controls the switching operation of at least two specific switching modules among the plurality of switching modules **31** to **36** to discharge residual charge stored in the control apparatus **100**.

**[0138]** In other words, the control system controls the switching operation to discharge the residual charge when the operation of the motor **200** is stopped.

**[0139]** As illustrated in FIG. **2**, the control apparatus **100** may include a cutoff unit **10** for interrupting power input from the external power source **1**, an input unit **20** for receiving power from the external power source **1** through the cutoff unit **10**, an inverter unit **30** for converting the received power into the operating power through the plurality of switching modules **31** to **36** to output the operating power to the motor **200**, and a control unit **40** for controlling the inverter unit **30** to control the conversion and output of the operating power.

**[0140]** The control apparatus **100** may also be a control element having a configuration different from that of the control apparatus **100** described above.

**[0141]** The control apparatus **100** for controlling the switching operation to control the operation of the motor **200** may detect the voltage and current of the motor **200**, and measure the operation speed of the motor **200** based on the detected motor voltage and the motor current to control the switching operation according to the measured operation speed.

**[0142]** The control apparatus **100** may detect the motor voltage and the motor current applied to the motor **200** according to the switching operation, and measure the operation speed based on the motor voltage and the motor current.

**[0143]** The control apparatus **100** may generate a control signal for controlling the switching operation according to the operation speed, and apply the control signal to the inverter unit **30** to control the switching operation.

**[0144]** The control apparatus **100** may determine at least one of a command voltage for the motor voltage, a command current for the motor current, a speed command for the operation speed, and a frequency command for the switching frequency according to the operation speed, and generate the control signal according to the determination result.

**[0145]** In other words, the control apparatus **100** may determine at least one the command voltage, the command current, the speed command, the speed command, and the frequency command based on at least one of the detection result of detecting the motor voltage and the motor current, and the measurement result of measuring the operation speed, and generate the control signal according to the determination result, thereby controlling at least one of the motor voltage, the motor current, the operation speed, and the switching frequency.

**[0146]** As described above, the control apparatus **100** may control at least one of the motor voltage, the motor current, the operation speed and the switching frequency through the control of the switching operation, thereby controlling the operation of the motor **200**.

**[0147]** As described above, the control apparatus **100** that controls the switching operation of the inverter unit **30** to control the conversion and output of the operating power controls the switching operation of the plurality of switching modules **31** to **36** according the control criterion to discharge the residual charge when the operation of the motor **200** is stopped.

**[0148]** Here, the residual charge may be charge in which power stored in the input unit **20** remains.

**[0149]** In other words, the control apparatus **100** controls the switching operation of the plurality of switching modules **31** to **36** to discharge the residual charge remaining in the input unit **20** after the operation of the motor **200** is stopped.

**[0150]** The control apparatus **100** may include the cutoff unit **10**, which is closed at normal times, and open when sensing a high voltage above a predetermined reference level to cut off power input from the external power source **1**, thereby controlling the switching operation to discharge the residual charge while the cutoff unit **10** is open.

**[0151]** In other words, only when the operation of the motor **200** is stopped in a state where the cutoff unit **10** is open and power input to the input unit **20** from the external power source **1** is cut off, the control apparatus **100** may control the switching operation to discharge the residual charge.

**[0152]** The control apparatus **100** may stop the operation of the motor **200**, and control the switching operation to discharge the residual charge after a preset standby time has passed.

**[0153]** In other words, the control apparatus **100** may control the switching operation to discharge the residual charge when the operation of the motor **200** is stopped for more than the standby time.

**[0154]** The control apparatus **100** may control the switching operation according to the control criterion to discharge the residual charge.

**[0155]** The control criterion may be a criterion for controlling two or more of the plurality of switching modules **31** to **36**.

**[0156]** In other words, the control apparatus **100** may control switching operations of two or more of the plurality of switching modules **31** to **36** when the switching operation is controlled to discharge the residual charge.

**[0157]** The control criterion may be a criterion for controlling the switching operation of two or more switching modules among the plurality of switching modules **31** to **36** to form a discharge path between the input unit **20** and the motor **200**.

**[0158]** In other words, the control apparatus **100** may control the switching operation of two or more of the plurality of switching modules **31** to **36** according to the control criterion to form the discharge path through which the residual charge is discharged.

**[0159]** The control unit **100** may control the switching operation of any one upper arm switching module in the switching modules **30***a* disposed at one side of the plurality of switching modules **31** to **36**, and one or more lower arm switching modules excluding a switching module connected to the upper arm switching module in the switching modules **30***b* disposed at the other side thereof to discharge the residual charge.

**[0160]** The control apparatus **100** may control the switching operation of any one upper arm switching module in the

switching modules **30***a* connected to an anode end of the input unit **20**, and one or more lower arm switching modules excluding a switching module connected to the upper arm switching module in the switching modules **30***b* connected to a cathode end of the input unit **20** among the plurality of switching modules **31** to **36** to discharge the residual charge.

**[0161]** As illustrated in FIG. **3**, the control apparatus **100** may be possible to control the switching operation of any one upper arm switching module connected to an anode end of the input unit **20** among the plurality of switching modules **31** to **36**, and one or more lower arm switching modules other than the switching module connected to the upper arm switching module among the switching modules **30***b* connected to a cathode end of the input unit **20**.

**[0162]** At this time, the control apparatus **100** may control the switching operation to turn on the first upper switching module **31**, the second lower arm switching modules **35**, and the third lower arm switching module **36**.

**[0163]** The control apparatus **100** that controls the switching operation may control the switching operation of the upper arm switching module **30***a* and the lower arm switching module **30***b* to form the discharge path between the input unit **20** and the motor **200** through the upper arm switching modules **30***a* and the lower arm switching modules **30***a*, thereby discharging the residual charge through the formed discharge path.

**[0164]** In other words, the control apparatus **100** that controls the switching operation may control the switching operation of any one upper arm switching module in the switching modules **30***a* connected to an anode end of the input unit **20**, and one or more lower arm switching modules excluding a switching module connected to the upper arm switching module in the switching modules **30***b* connected to a cathode end of the input unit **20**.

**[0165]** In this manner, the control apparatus **100** that controls the switching operation according to the control criterion, may control the switching operation for a preset discharge time period to discharge the residual charge.

**[0166]** The discharge time period may be a period of time for which the residual charge is discharged through the discharge path.

**[0167]** In other words, the control apparatus **100** may control the switching operation to discharge the residual charge for the discharge time period.

**[0168]** The control process of the control system of controlling the switching operation to discharge the residual charge as described above may be carried out in a sequence as shown in FIG. **5**.

**[0169]** The control system may control the operation of the motor **200** by the control apparatus **100** in a control process as shown in FIG. **5**.

**[0170]** Here, the control process as shown in FIG. **5** may be carried out by the control unit **40** of the control apparatus **100**, and may be applicable to the foregoing embodiment of the control unit **40** of the control apparatus **100**.

**[0171]** As illustrated in FIG. **5**, the control apparatus **100** may open (P**1**) the cutoff unit **10** to prepare (P**2**) discharge control for discharging the residual charge while cutting off power from being received from the external power source **1**.

**[0172]** Here, the preparation (P**2**) for discharge control may be a process of allowing the first control unit **41** that controls the opening of the cutoff unit **10** to transfer the cutoff state information of the cutoff unit **10** and a command for the execution of the discharge control to the second control unit **42** that controls the switching operation of the plurality of switching modules **31** to **36** so as to allow the second control unit **42** to prepare the switching operation.

**[0173]** Then, the control apparatus **100** may stop the operation of the motor **200** (P**3**), and then determine whether or not the operation stop time of the motor **200** has passed the standby time period (P**4**), thereby controlling the switching operation in accordance with the control criterion when the motor stops for more than the standby time period.

**[0174]** Here, when the operation of the motor **200** is not stopped or the standby time has not passed after the operation of the motor **200** is stopped, the preparation process of the discharge control (P**2**) may be repeated.

**[0175]** The control apparatus **100** may control the switching operation for the discharge time period to discharge the residual charge for the discharge time period after starting the discharge of the residual charge (P**5**) so as to stop the control of the switching operation after the discharge time period has passed (P**6**), thereby stopping the discharge of the residual charge (P**7**).

**[0176]** The control system for controlling the switching operation to discharge the residual charge as described above may also control the switching operation in a process other than the control process as shown in FIG. **5**.

**[0177]** Hereinafter, a compressor control method (hereinafter, referred to as a control method) according to the present disclosure will be described, and its redundant described above in the control apparatus **100** and the control system will be omitted as much as possible.

**[0178]** The control method may be a control method for controlling a compressor.

**[0179]** The control method may be a control method of a control apparatus for controlling the compressor.

**[0180]** The control method may be a control method of the control apparatus **100** or the control system.

**[0181]** As illustrated in FIG. **2**, the control method is a compressor control method of the compressor control apparatus **100** including a cutoff unit **10** for interrupting power input from an external power source **1**, an input unit **20** for receiving power from the external power source **1** through the cutoff unit **10**, an inverter unit **30** for converting the received power into operating power for operating a motor **200** of a compressor (C) through a plurality of switching modules **31** to **36** to output the operating power to the motor **200**, and a control unit **40** for controlling the inverter unit **30** to control the conversion and output of the operating power, and as illustrated in FIG. **6**, the control method includes cutting off power received from the external power source **1** (S**10**), determining a discharge condition based on the operation state of the motor **200** (S**20**), controlling the plurality of switching modules **31** to **36** based on a preset control criterion to perform the discharge control of the residual charge stored in the input unit **20** (S**30**), and stopping the discharge control (S**40**).

**[0182]** The control method as shown in FIG. **6** may be carried out in a sequence as shown in FIG. **7**.

**[0183]** In the step (S**10**) of cutting off input power, the cutoff unit **10** may be operated to be open so as to cut off power input from the external power source **1**.

**[0184]** The step (S**20**) of determining a discharge condition may determine the discharge condition after the cutoff unit **10** is open in the step S**10** of cutting off the input power.

**[0185]** The discharge condition may be a condition for performing the discharge control of the residual charge.

**[0186]** The discharge condition may be a condition for whether or not the operation of the motor **200** is stopped or an operation stop time period.

**[0187]** In other words, the step (S**20**) of determining the discharge condition (S**20**) may determine whether or not the operation is stopped or the operation stop time period.

**[0188]** The step (S**20**) of determining the discharge condition may include determining whether or not the operation is stopped (S**21**) and determining the operation stop time period (S**22**).

**[0189]** The step (S**21**) of determining whether or not the operation is stopped may determine whether or not the operation of the motor **200** is stopped.

**[0190]** The step (S**21**) of determining whether or not the operation is stopped may determine whether or not the operation speed of the motor **200** is zero to determine whether or not the operation is stopped.

**[0191]** The step (S**22**) of determining the operation stop time period may compare a time period for which the operation of the motor **200** is stopped with the standby time period when it is determined that the operation of the motor **200** is stopped in the step (S**21**) of determining whether or not the operation is stopped to determine whether or not the operation stop time period has passed the standby time period.

**[0192]** The step (S**22**) of determining the operation stop time period may determine that the operation of the motor **200** is completely stopped when the operation stop time period of the motor **200** has passed the standby time period.

**[0193]** The step (S**30**) of performing the discharge control may control the switching operation of the plurality of switching modules **31** to **36** to discharge the residual charge when the operation stop time period of the motor **200** has passed the standby time period in the step (S**20**) of determining the discharge condition.

**[0194]** The step (S**30**) of performing the discharge control may control the switching operation of any one upper arm switching module connected to an anode end of the input unit **20** among the plurality of switching modules **31** to **36**, and one or more lower arm switching modules other than the switching module connected to the upper arm switching module among the switching modules **30***b* connected to a cathode end of the input unit **20**.

**[0195]** The step (S**30**) of performing the discharge control may control the switching operation of the upper arm switching module **30***a* and the lower arm switching module **30***b* to form the discharge path between the input unit **20** and the motor **200** through the upper arm switching modules **30***a* and the lower arm switching modules **30***a*, thereby discharging the residual charge through the formed discharge path.

**[0196]** The step S**30** of performing the discharging control for discharging the residual charge as described above may include controlling the switching operation of the plurality of switching modules **31** to **36** according to the control criterion (S**31**) and maintaining the control of the switching operation for a preset discharge time period (S**32**).

**[0197]** The step (S**31**) of controlling the switching operation may control the switching operation of any one upper arm switching module in the switching modules **30***a* connected to an anode end of the input unit **20**, and one or more lower arm switching modules excluding a switching module connected to the upper arm switching module in the switching modules **30***b* connected to a cathode end of the input unit **20** as described above.

**[0198]** The step (S**32**) of maintaining the discharge time period may perform the step (S**31**) of controlling the switching operation for the discharge time period.

**[0199]** The step (S**40**) of stopping the discharge control may stop the discharge control after the execution of the step (S**30**) of performing the discharge control.

**[0200]** Though a specific embodiment according to the present disclosure has been described above, it will be apparent to those skilled in this art that various modification may be made without departing from the scope of the present invention. Therefore, the scope of the present disclosure should not be limited to the described embodiments, but should be determined by the scope of the appended claims and equivalents thereof.

**[0201]** Although the present disclosure has been described with respect to specific embodiments and drawings, the present disclosure is not limited to those embodiments, and it will be apparent to those skilled in the art that various changes and modifications can be made from the description disclosed herein. Consequently, the concept of the present disclosure should be construed in accordance with the appended claims, and all the same and equivalent changes will fall into the scope of the present disclosure.

What is claimed is:

**1**. A compressor control apparatus, comprising:

a cutoff unit configured to interrupt power input from an external power source;

an input unit configured to receive the power input from the external power source through the cutoff unit;

an inverter unit configured to convert an input power supplied from the input unit to an operating power for operating a motor of a compressor, the inverter unit comprising a plurality of switching modules configured to perform a switching operation to control an output of the operating power to the motor; and

a control unit configured to, by controlling the inverter unit, control a conversion of the input power to the operating power and the output of the operating power,

wherein the control unit is configured to, based on an operation of the motor being stopped, control the switching operation of the plurality of switching modules according to a preset control criterion to thereby discharge a residual charge stored in the input unit.

**2**. The compressor control apparatus of claim **1**, wherein the cutoff unit is configured to:

maintain a closed state to transmit the power input from the external power source to the input unit, and

change to an open state to cut off the power input from the external power source based on sensing a high voltage that is greater than a predetermined reference level.

**3**. The compressor control apparatus of claim **1**, wherein the plurality of switching modules comprise three pairs of switching modules, each pair of switching modules comprising two switching modules connected to each other electrically in series.

**4**. The compressor control apparatus of claim **1**, wherein the plurality of switching modules comprise:

a first upper arm switching module, a second upper arm switching module, and a third upper arm switching module that are connected to an anode end of the input unit; and

a first lower arm switching module, a second lower arm switching module, and a third lower arm switching module that are connected to a cathode end of the input unit,

wherein the first upper arm switching module and the first lower arm switching module are connected to each other electrically in series,

wherein the second upper arm switching module and the second lower arm switching module are connected to each other electrically in series, and

wherein the third upper arm switching module and the third lower arm switching module are connected to each other electrically in series.

**5**. The compressor control apparatus of claim **1**, wherein the control unit is configured to:

determine whether or not the operation of the motor is stopped based on the cutoff unit being opened to cut off the power input from the external power source; and

based on a determination that the operation of the motor is stopped, control the switching operation to discharge the residual charge.

**6**. The compressor control apparatus of claim **1**, wherein the control unit is configured to:

control the switching operation to discharge the residual charge based on the operation of the motor being stopped for a duration greater than a preset standby time period.

**7**. The compressor control apparatus of claim **2**, wherein the preset control criterion comprises an operation of at least two of the plurality of switching modules to control the switching operation.

**8**. The compressor control apparatus of claim **1**, wherein the plurality of switching modules comprise a plurality of upper arm switching modules connected to an anode end of the input unit and a plurality of lower arm switching modules connected to a cathode end of the input unit, and

wherein the control unit is configured to:

control the switching operation of one of the plurality of upper arm switching modules and one or more of the plurality of lower arm switching modules other than one lower arm switching module connected to the one of the plurality of upper arm switching modules to thereby discharge the residual charge.

**9**. The compressor control apparatus of claim **8**, wherein the control unit is configured to:

control the switching operation of the one of the plurality of upper arm switching modules and the one or more of the plurality of lower arm switching modules to define a discharge path between the input unit and the motor through the one of the plurality of upper arm switching modules and the one or more of the plurality of lower arm switching modules to thereby discharge the residual charge through the defined discharge path.

**10**. The compressor control apparatus of claim **1**, wherein the control unit is configured to control the switching operation for a preset discharge time period to discharge the residual charge.

**11**. A compressor control system, comprising:

a motor configured to drive a compressor; and

a control apparatus comprising a plurality of switching modules configured to convert a power input from an external power source to an operating power for operating the motor, the control apparatus being configured to output the operating power to the motor to control operation of the motor based on controlling a switching operation of the plurality of switching modules,

wherein the control apparatus is configured to, based on an operation of the motor being stopped, control the switching operation of two or more of the plurality of switching modules to thereby discharge a residual charge stored in the control apparatus.

**12**. The compressor control system of claim **11**, wherein the control apparatus is configured to:

maintain a closed state to transmit the power input from the external power source to the motor;

change to an open state to interrupt the power input from the external power source based on sensing a high voltage that is greater than a predetermined reference level; and

in the open state, control the switching operation to discharge the residual charge.

**13**. The compressor control system of claim **11**, wherein the control apparatus is configured to:

stop the operation of the motor; and

control the switching operation to discharge the residual charge based on an elapse of a preset standby time period after stopping the operation of the motor.

**14**. The compressor control system of claim **11**, wherein the plurality of switching modules comprise a plurality of upper arm switching modules disposed at a first side of the plurality of switching modules and a plurality of lower arm switching modules disposed at a second side of the plurality of switching modules, and

wherein the control apparatus is configured to:

control the switching operation of one of the plurality of upper arm switching modules and one or more of the plurality of lower arm switching modules other than one lower switching module connected to the one of the plurality of upper arm switching modules to thereby discharge the residual charge.

**15**. The compressor control system of claim **14**, wherein the control apparatus is configured to:

control the switching operation of the one of the plurality of upper arm switching modules and the one or more of the plurality of lower arm switching modules to define a discharge path between the control apparatus and the motor through the one of the plurality of upper arm switching modules and the one or more of the plurality of lower arm switching modules to thereby discharge the residual charge through the defined discharge path.

**16**. The compressor control system of claim **11**, wherein the control apparatus is configured to control the switching operation for a preset discharge time period to discharge the residual charge.

**17**. A method of controlling a compressor control apparatus that includes a cutoff unit configured to interrupt power input from an external power source, an input unit configured to receive the power input from the external power source through the cutoff unit, an inverter unit that is configured to convert an input power supplied from the input unit to an operating power for operating a motor of a compressor, the inverter unit including a plurality of switching modules configured to perform a switching operation to control an output of the operating power to the motor, and a control unit configured to, by controlling the inverter unit, control a conversion from the input power to the operating power and the output of the operating power, the method comprising:

cutting off the power input from the external power source;

determining a discharge condition based on an operation of the motor;

based on the discharge condition, performing a discharge control of a residual charge stored in the input unit by controlling the plurality of switching modules according to a preset control criterion; and

stopping the discharge control.

**18**. The method of claim **17**, wherein the discharge condition comprises whether or not the operation of the motor is stopped or an operation stop time period for which the operation of the motor has been stopped.

**19**. The method of claim **17**, wherein the plurality of switching modules comprise a plurality of upper arm switching modules connected to an anode end of the input unit and a plurality of lower arm switching modules connected to a cathode end of the input unit, and

wherein performing the discharge control comprises:

controlling the switching operation of one of the plurality of upper arm switching modules and one or more of the plurality of lower arm switching modules other than one lower arm switching module connected to the one of the plurality of upper arm switching modules.

**20**. The method of claim **17**, wherein performing the discharge control comprises performing the discharge control for a preset discharge time period.

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