



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.07.2009 Bulletin 2009/30

(51) Int Cl.:
F24F 13/00 (2006.01)

(21) Application number: **08253424.9**

(22) Date of filing: **22.10.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(72) Inventor: **Jeong, Chang Hoon**
Changwon City, Gyoungsangnam-do 641-711 (KR)

(74) Representative: **Palmer, Jonathan R.**
Boult Wade Tennant
Verulam Gardens
70 Gray's Inn Road
London WC1X 8BT (GB)

(30) Priority: **21.01.2008 KR 20080006190**

(71) Applicant: **LG Electronics Inc.**
Seoul (KR)

Remarks:

(54) **Indoor unit of air conditioner and method for controlling the same**

(57) Provided are an indoor unit of a ceiling cassette air conditioner provided with a grill elevating unit (600),

and a method for controlling a grill elevating unit. A user can thus lower an intake grill to a suitable height to easily perform filter cleaning/replacement.

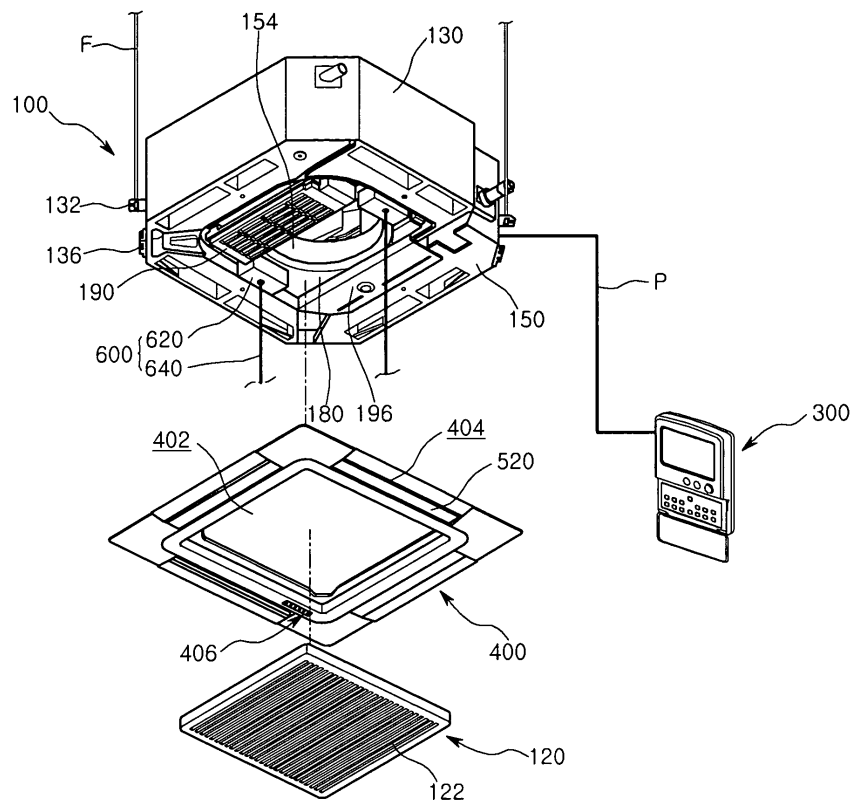


FIG. 2

Description

BACKGROUND

[0001] The present disclosure relates to an indoor unit of a ceiling cassette air conditioner provided with a grill elevating unit, and to a method for controlling a grill elevating unit.

[0002] In general, an air conditioner is a cooling/heating system that suctions indoor air and discharges the suctioned air back into the indoor environment after subjecting the air to heat exchange with refrigerant, and is an apparatus that forms a refrigerant cycle with a compressor-condenser-expansion valve-evaporator.

[0003] In particular, an air conditioner is partitioned into an outdoor unit installed outdoors, and an indoor unit installed inside a building. Specifically, a condenser and a compressor are installed in the outdoor unit, and an expansion device is installed in the indoor unit.

[0004] As is common knowledge, air conditioners can largely be categorized into split system air conditioners having the outdoor unit and indoor unit separately installed, and integrated air conditioners having the outdoor unit and indoor unit integrally installed.

[0005] Recently, multi unit air conditioners, having one outdoor unit connected to a plurality of indoor units, where the indoor units are installed in different indoor spaces, respectively, are being widely used.

[0006] FIG. 1 is an exploded perspective view of an indoor unit for a ceiling cassette air conditioner according to the

related art.

[0007] Referring to FIG. 1, an indoor unit 1 for a ceiling cassette air conditioner according to the related art is installed so that its main body is inserted in and fixed to a ceiling, and an outlet and inlet portion is exposed to the indoor environment.

[0008] In detail, the indoor unit 1 includes a cabinet 30 constituting the exterior shape thereof, a front panel 10 defining a lower surface portion of the cabinet 30, an intake grill 20 provided at the center of the front panel 10 to suction indoor air, and a base 40 sealing the top surface of the cabinet 30 and simultaneously enabling the indoor unit 1 to be fixed to the ceiling.

[0009] Specifically, outlets 12 are defined at the four edges of the front panel 10. Indoor air suctioned through the intake grill 20 undergoes heat exchange after which it is discharged back into the indoor environment through the outlets 12. An air guide 90 is provided above the front panel 10 to guide the flow of air that undergoes heat exchange. Also, louvers 14 may be formed on the outlets 12 to control the direction in which air is discharged into the indoor environment. An air filter 50 is provided above the intake grill 20. The air filter 50 filters impurities from suctioned indoor air.

[0010] A drain pan 60 is mounted above the front panel

10 described above to collect condensate that condenses on the surface of an indoor heat exchanger 70. Also, a through-hole is defined at the center of the drain pan 60, and an orifice 66 is inserted in the through-hole. The orifice 66 guides suctioned indoor air to flow toward a central portion of an indoor fan 80. The indoor fan 80 is rotated by a fan motor assembly 82 that generates rotational force when power is applied.

[0011] However, the following limitations are inherent in the above-configured related art.

[0012] Specifically, because the indoor unit 1 of the air conditioner according to the related art is installed in the ceiling, in order to remove impurities from the air filter 50, a user must employ a ladder to open the intake grill 20, after which the air filter 50 must be disassembled.

[0013] Accordingly, cleaning and replacement of the air filter 50 is not easy.

[0014] Also, when the intake grill 20 is opened, accidents often occur, where the air filter 50 falls onto a user.

SUMMARY

[0015] Embodiments provide an indoor unit of an air conditioner capable of raising and lowering an intake grill to facilitate cleaning and replacement of an air filter.

[0016] Embodiments also provide an indoor unit of an air conditioner with a modularized and downscaled grill elevating unit, to enable mounting of the grill elevating unit on existing indoor units without the use of separate installing blocks.

[0017] Embodiments further provide an indoor unit of an air conditioner that enables a user to selectively install a grill elevating unit at the lowest position possible, to facilitate replacement and cleaning of an air filter.

[0018] Embodiments still further provide a method for controlling an indoor unit of an air conditioner that performs controlling to automatically stop lowering of an intake grill if an obstacle exists in the lowering path, to increase user convenience and safety.

[0019] In one embodiment, an indoor unit of an air conditioner, includes: a main body including a heat exchanger and an indoor fan; an intake grill movably coupled to a bottom surface of the main body; a filter mounted on a top surface of the intake grill; an orifice provided in the main body to guide a flow of indoor air that is introduced; a front panel provided below the orifice, the intake grill closely contacting an inside of the front panel; a plurality of close-contact detecting units for detecting if the intake grill closely contacts the front panel; and a plurality of grill elevating units provided between the orifice and the front panel to allow the intake grill to be raised or lowered, wherein the elevating unit includes: an elevating kit generating rotational force; and a wire having a first end connected to the intake grill and a second end connected to the elevating kit.

[0020] In another embodiment, a method for controlling an indoor unit of an air conditioner, the method including: inputting a lowering command of an intake grill;

lowering the intake grill in accordance with the lowering command; stopping the intake grill at a location; setting an automatic lowering length of the intake grill by an elapse of a predetermined time, or a setting signal input to a controller.

[0021] In a further embodiment, a method for controlling an indoor unit of an air conditioner, the method including: inputting a filter cleaning/replacing command; lowering an intake grill; stopping the intake grill at an automatic stop location; inputting an intake grill raising command to raising the intake grill; and determining if the intake grill is returned to a normal state.

[0022] In an indoor unit of an air conditioner configured as above according to the present disclosure, the following effects can be realized.

[0023] By providing a modularized and compact grill elevating unit capable of raising and lowering an intake grill, the dimensions of an indoor unit can be minimized, and user convenience can be increased.

[0024] Also, because a user is afforded the ability to set a maximum lowered distance for a grill elevating unit, restrictions are not imposed from a user's height or from the installed height, and filter replacement or cleaning can be effectively performed at an optimal height.

[0025] Further, if there is an obstacle present in the travelling path of an intake grill while the grill is being lowered, the lowering is automatically stopped to improve safety.

[0026] Moreover, user convenience can be increased with the inclusion of a unit for sensing whether an intake grill is sealed, and the inclusion of a unit for sensing the tension of wires connected to the intake grill. That is, because it is possible to simultaneously sense whether the intake grill has been accurately inserted, whether the intake grill is loose, and whether there is interference between the intake grill and obstructions, user convenience is increased and malfunctioning of the indoor unit can be obviated.

[0027] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

FIG. 1 is an exploded perspective view of an indoor unit for a ceiling cassette air conditioner according to the related art.

FIG. 2 is an exploded perspective view of an installed indoor unit provided with a grill elevating unit according to embodiments of the present disclosure.

FIG. 3 is an exploded perspective view of an air conditioner provided with a grill elevating unit according to embodiments of the present disclosure.

FIG. 4 is a partial perspective view showing an elevating kit configuring a grill elevating unit that is

mounted to a front panel, according to embodiments of the present disclosure.

FIG. 5 is an exploded perspective view showing the elevating kit in detail.

FIG. 6 is a sectional view showing an intake grill separated from a front panel through operation of a grill elevating unit according to embodiments of the present disclosure.

FIG. 7 is a sectional view showing the intake grill sealed against the front panel.

FIG. 8 is a flowchart showing a controlling method for setting the lowered position of a grill elevating unit of an air conditioner indoor unit, according to embodiments of the present disclosure.

FIG. 9 is a flowchart describing a fine adjustment process for setting the lowered position of an intake grill, according to embodiments of the present disclosure.

FIG. 10 is a flowchart showing a process for cleaning/replacing a filter of an air conditioner indoor unit, according to embodiments of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0029] Reference will now be made in detail to an indoor unit of an air conditioner and a method for controlling the same, according to embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

[0030] FIG. 2 is an exploded perspective view of an installed indoor unit provided with a grill elevating unit according to embodiments of the present disclosure, and FIG. 3 is an exploded perspective view of an air conditioner provided with a grill elevating unit according to embodiments of the present disclosure.

[0031] Referring to FIGs. 2 and 3, an indoor unit 100 according to embodiments of the present disclosure has an upper portion that is inserted in and fixed to the inside of a ceiling and a lower surface that is exposed to an indoor space.

[0032] In detail, the indoor unit 100 includes a front panel 400 constituting the exterior lower surface thereof, an intake grill 120 installed at the center of the front panel 400 to suction indoor air from an indoor space into the indoor unit 100, a cabinet 130 constituting the upper exterior of the indoor unit 100 and having a plurality of components built-in, and a base 140 (in FIG. 3) that seals the top surface of the cabinet 130 and simultaneously supports the plurality of components mounted within the indoor unit 100.

[0033] A mounting hole 402 is provided in the central portion of the front panel 400. The mounting hole 402 has the intake grill 120 mounted therein, and indoor air flows in through the intake grill 120. Also, an air filter (not shown) may be mounted on the top surface of the intake grill 120 to filter impurities from air.

[0034] In detail, the intake grill 120 performs the function of guiding indoor air into the indoor unit 100, and has

intake holes 122 defined therein for this purpose.

[0035] Also, a rectangular outlet 404 is respectively formed at the front/rear and left/right of the front panel 400. The outlets 404 are for guiding indoor air that was suctioned into indoor unit 100 through the intake grill 120 back into the indoor space.

[0036] Also, an operating switch 406 is provided on one side of the front panel 400. The operating switch 406 allows a user to directly control the indoor unit 100, should the indoor unit 100 become uncontrollable with a remote control 300. Specifically, the operating switch 406 has a plurality of buttons including not only an on/off function for the operation of the indoor unit 100, but that also enable forced raising and lowering of the grill elevating unit 600.

[0037] An alerting unit may be provided separately from the operating switch 406. The alerting unit allows a user to check the operating state of the indoor unit, and may be embodied as a lamp that emits various colors or a buzzer.

[0038] A louver 520 may be pivotably mounted on the outlet 404 to control the direction in which air is discharged into the indoor space.

[0039] A drain pan 150 is provided above the front panel 400. The drain pan 150 is provided to collect condensate that is generated on the surface of the indoor heat exchanger 160 by means of a temperature difference arising from heat exchange between refrigerant flowing through the inside of the indoor heat exchanger 160 and indoor air. Specifically, a condensate space 152 is formed recessed in the top surface of the drain pan 150, for collecting condensate.

[0040] A through-hole 154 is defined in the central portion of the drain pan 150. Thus, suctioned indoor air rises up through the intake grill 120 and the through-hole 154.

[0041] Also, the cabinet 130 is formed of a plurality of plates that are coupled together, to constitute the exterior side surfaces of the indoor unit 100 and seal the inside of the indoor unit 100.

[0042] An installing bracket 132 coupled to the lower portion of an installing member (F) projects from the edge of the cabinet 130. Also, a panel bracket 136 projects from below the installing bracket 132. A fastening hole 137 is defined through the panel bracket 136 to insert a screw or other fastening member therein. The lower end of the cabinet 130 is coupled to the front panel 400, and the upper portion is coupled to the lower surface of the base 140.

[0043] An orifice 180 is provided inside the drain pan 150. The orifice 180 guides indoor air into the indoor unit, and defines a guide hole 182 within.

[0044] A plasma filter 190 may be mounted at a side of the lower surface of the orifice 180. Specifically, the plasma filter 190 generates plasma to which contaminant in air adhere.

[0045] A control box 196 is provided at the right, lower surface of the orifice 180 to control the operation of the indoor unit 100.

[0046] Also, a grill elevating unit 600 is provided below the orifice 180. Specifically, the grill elevating unit 600 is configured to selectively raise or lower the intake grill 120, which will be described in detail below.

[0047] A remote control 300 may be provided on a wall of the indoor space in which the indoor unit 100 is installed. The remote control 300 may be connected by an electric line (L) to the control box 196 or may transmit/receive wireless signals. In detail, if the remote control 300 is connected via an electric line (L), the electric line (L) may be buried in a wall of the indoor space and connected to the inside of the remote control 300.

[0048] As described above, the indoor heat exchanger 160 is installed above the drain pan 150. The indoor heat exchanger 160 is for performing heat exchange on indoor air that has been filtered by an air filter, and a refrigerant that exchanges heat with indoor air flows within the indoor heat exchanger 160.

[0049] Also, the indoor heat exchanger 160 is bent a plurality of times to form an approximately square shape when viewed from above. Thus, indoor air that passes upward through the through-hole 154 is diffused upward and exchanges heat with the indoor heat exchanger 160.

[0050] Also, an air guide 142 is provided to the outside of the indoor heat exchanger 160. The air guide 142 encloses the outer surface of the indoor heat exchanger 160, so that air that has exchanged heat with refrigerant does not leak from the outside of the cabinet 130.

[0051] Also, an indoor fan 170 is installed at the inner center of the cabinet 130. The indoor fan 170 is driven by a fan motor 172 that generates rotational force when power is applied thereto. The indoor fan 170 may be a centrifugal fan that suctions air in an axial direction and discharges air radially, and may be a turbo fan in one embodiment. That is, air rising upward through the through-hole 154 is discharged horizontally by the indoor fan 170 to pass through the indoor heat exchanger 160.

[0052] The grill elevating unit 600, for selectively raising/lowering the intake grill 120, is installed on the undersurface of the orifice 180 or the top surface of the front panel 400. Also, a wire 640 included in the grill elevating unit 600 is connected to the edge portions of the intake grill 120. Through winding or unwinding the wire 640, the intake grill 120 is raised or lowered. By connecting the end of the wire 640 to four corners of the intake grill 120, respectively, the intake grill 120 may be lowered and raised while retaining a horizontal disposition. Here, components apart from the intake grill 120 and the driving unit that drives the intake grill 120 can be said to be parts of the main body.

[0053] Below, a detailed description of the configuration of the grill elevating unit will be provided with reference to FIGs. 4 and 5.

[0054] FIG. 4 is a partial perspective view showing an elevating kit configuring a grill elevating unit that is mounted to a front panel, according to embodiments of the present disclosure, and FIG. 5 is an exploded perspective view showing the elevating kit in detail.

[0055] Referring to FIGs. 4 and 5, the grill elevating unit 600 is disposed between the front panel 400 and the orifice 180. That is, an elevating kit 620 forming the grill elevating unit 600 may be fixed to an inner edge portion on the upper surface of the front panel 400. Of course, it may alternatively be fixed and mounted to the under-

surface of the orifice 180. Below embodiments will describe the elevating kit 620 as being fixed to the inner edge portion of the front panel 400.

[0056] In detail, the grill elevating unit 600 includes the wire 640, an elevating kit 620 for selectively winding the wire 640, and a kit bracket 660 for fixing the elevating kit 620 to the orifice 180 or the front panel 400.

[0057] The wire 640 may be configured with a diameter of 0.60, and a tensile strength to withstand at least 3 kgf for 1 minute. This is assuming that the intake grill 120 on which the air filter is mounted has a weight of 2 kg, and the wire 640 may be varied according to the weight of the intake grill 120.

[0058] The kit bracket 660 is provided at the edge portion of the elevating kit 620. The kit bracket 660 is configured to fix the elevating kit 620 to the undersurface of the orifice 180 or the top surface of the front panel 400. Accordingly, the installed position of the kit bracket 660 is determined according to which of the orifice 180 and the front panel 400 the elevating kit 620 is installed on. That is, the kit bracket 660 may be installed on a side at the upper portion of the elevating kit 620 or at a side at the lower portion thereof.

[0059] An inserting hole 662 is defined in plurality in the kit bracket 660 to insert a fastening member.

[0060] A tension detecting unit 670, detecting whether there is tension applied to the wire 640 on the surface of the front panel, is disposed at the opposite side of the elevating kit 620. The tension detecting unit 670 may be a micro switch, and a micro switch pressing portion 671 is installed perpendicularly to and in contact with the wire 640.

[0061] Accordingly, when the wire 640 is stretched, the pressing portion 671 of the tension detecting unit 670 is switched on, and the tension detecting unit 670 applies power to the elevating kit 620 to operate the grill elevating unit 600.

[0062] Conversely, when the intake grill 120 or air filter is removed from the wire 640 or an obstacle causes the intake grill 120 to be raised so that the wire 640 becomes slack, the pressing portion 671 of the tension detecting unit 670 is switched off, and the grill elevating unit 600 is not operated.

[0063] Also, the grill elevating unit 600 is configured such that the intake grill 120 is completely pressed into the inlet 402, and the indoor unit 100 can be operated.

[0064] For this end, a contact detecting unit 680 may be provided on the undersurface of the front panel 400, or on the surface opposite to that on which the elevating kit 600 is mounted. Specifically, the contact detecting unit 680, like the tension detecting unit 670, may be a micro switch, and a pressing portion of the contact detecting

unit 680 is disposed toward the intake grill 120.

[0065] Also, the contact detecting unit 680 may be provided in plurality, fixed respectively to corners on the top surface of the front panel 400. In other words, four contact detecting units may be respectively mounted to the top surface of the front panel 400.

[0066] Accordingly, when the intake grill 120 is raised, the contact detecting unit 680 detects whether there is contact with the corners of the intake grill 120, so that it can be determined if the intake grill 120 has been correctly pressed into the inlet 402.

[0067] Here, when even one of the plurality of contact detecting units 680 cannot detect contact with the intake grill 120, it is determined that the intake grill 120 has not been horizontally inserted, and the indoor unit 100 is not operated. The operations of the tension detecting unit 670 and the contact detecting unit 680 are shown in detail in FIGS. 6 and 7.

[0068] As shown in FIG. 5, the wire 640 is stored in a wound state inside the elevating kit 620. Also, when the elevating kit 620 unwinds the wire 640, the intake grill 120 is lowered from the front panel 400.

[0069] The elevating kit 620 has its exterior defined by a hexahedral kit box 622, and a plurality of fastening holes 626 are defined in the outer surface of the kit box 622 to fasten the kit bracket 660.

[0070] A driving unit 632 generating rotational force, and a roller unit 634 connected to the driving unit 632 for winding the wire 640, are housed inside the kit box 622. An elevating controller 628 is provided on one of the pair of elevating kits 620 to control the operation of the driving unit 632 respectively provided in the elevating kits 620. That is, one elevating controller 628 controls the plurality of driving units 632 housed respectively in the kit boxes 622.

[0071] In detail, when the remote control 300 is manipulated during operation of the indoor unit 100, the elevating controller 628 controls the driving units 632 to not operate. Also, when the rotation of the indoor fan 170 exceeds 150 rpm, the elevating controller 628 may be configured to restrain operation of the driving units 632. Accordingly, when the driving units 632 are operating, the rotation of the indoor fan 170 is restrained. This is to obviate damage to the indoor unit 100 and provide safety to a user.

[0072] Also, when a user manipulates the remote control 300 with the intake grill 120 open, the elevating controller 628 allows a test operation of the indoor unit 100 to be performed. This is to allow the operation inside the indoor unit 100 to be checked during servicing of the indoor unit 100 with the intake grill 120 lowered.

[0073] The driving unit 632 may be a motor that generates rotational force when it is supplied with power, and the roller unit 634 is axially coupled to the driving unit 632 at the front of the driving unit 632. Thus, the wire 640 is wound around the outer periphery of the roller unit 634.

[0074] The front end of the roller unit 634 may be provided with a length detecting unit 636. Specifically, the

length detecting unit 636 detects the unwound length of the wire 640 corresponding to the number of turns of the roller unit 634. For this, the length detecting unit 636 may include a length unit body 637 of a cylindrical shape with corrugations 638 formed around the outer periphery thereof, and a detecting body 639 providing the elevating controller 628 with information on the number of corrugations 638 that have been contacted when the length unit body 637 selectively contacts the corrugations 638 while rotating. Also, the length detecting unit 636 may be integrally connected to the roller unit 634. Further, by having the detecting body 639 generate bias in the rotating center direction of the length unit body 637, it can be maintained in a state contacting the surfaces of the corrugations 638.

[0075] Moreover, the driving unit 632 and the roller unit 634 are built into the above-described kit box 622. The kit box 622 includes a box body 623, and a box cover 624 covering the open top surface of the box body 623. Accordingly, the driving unit 632, the rolling unit 634, and the elevating controller 628 are not exposed to the outside on account of the kit box 622.

[0076] A through-hole 629 is defined in the center of the kit box 622 for the wire 640 to pass through.

[0077] The elevating controller 628 controls the operation of the driving unit 632, and is installed separated from an inner wall of the kit box 622. In one embodiment, the elevating controller 628 may be installed separated 8 mm from an inner wall of the kit box 622. This is to obviate electrocution from current that is applied to the elevating controller 628 through leaking from the kit box 622, and prevent damage to other components. Also, the elevating controller 628 may be installed to be connected via wire or wirelessly to the remote control 300, as described above.

[0078] The elevating controller 628 may be configured to be linked to an operating switch 406 used selectively when operating commands input through the remote control 300 to operate the indoor unit 100 cannot be carried out.

[0079] The remote control 300 may be provided separately to control the operation of the grill elevating unit 600, or the remote control 300 for controlling the indoor unit 100 may be provided with buttons for controlling the grill elevating unit 600 as well.

[0080] FIG. 6 is a sectional view showing an intake grill separated from a front panel through operation of a grill elevating unit according to embodiments of the present disclosure, and FIG. 7 is a sectional view showing the intake grill sealed against the front panel.

[0081] Referring to FIGs. 6 and 7, with the wires 640 forming the grill elevating unit 600 tautly extended, the pressing portion formed at the side of the tension detecting unit 670 maintains a pressed state. With the intake grill 120 separated from the front panel 400, the pressing portion of the contact detecting unit 680 is spread (refer to FIG. 6). Conversely, when the intake grill 120 is completely contacted with the front panel 400, the pressing

portion of the contact detecting unit 680 is pressed (refer to FIG. 7).

[0082] Below, detailed descriptions of methods for controlling a grill elevating unit will be provided with reference to the flowcharts.

[0083] FIG. 8 is a flowchart showing a controlling method for setting the lowered position of a grill elevating unit of an air conditioner indoor unit, according to embodiments of the present disclosure.

[0084] Referring to FIG. 8, when an indoor unit of an air conditioner is manufactured, the lowering length of the intake grill for cleaning the filter is preset. That is, the product is manufactured with the extending length of the wire 640 forming the grill elevating unit 600 set to a reference value.

[0085] In this case, there is a need to readjust a lowering length of the intake grill 120 in accordance with a height of a ceiling on which the indoor unit 100 is installed and a user's height. The following will describe a method for adjusting a lowering length (a length between the ceiling and the air intake grills) of the intake grill 120.

[0086] First, the user inputs an operation command (referred to as an intake grill setting menu) for setting the lowering length of the air intake grill using a menu button provided on the remote control 300. Here, the remote control 300 may be provided with a separate menu button used for setting the lowering distance of the intake grill 120 to replace or clean the filter. Alternatively, the user may set the lowering length of the intake grill using a lowering/raising button of the intake grill 120.

[0087] Once the lowering length setting command is input or the intake grill lowering button is pressed, the driving unit 632 operates to lower the intake grill 120 at a predetermined speed (S120). At this point, the controller determines if a command for stopping the intake grill 120 is input (S130).

[0088] In more detail, when the stop command is input in the course of lowering the intake grill 120, the intake grill stops being lowered (S140). Here, it is determined if not only the stop command is input but also the intake grill 120 encounters an obstacle and the intake grill 120 reaches a lowering distance (approximately 4.5m) that is preset when the product is manufactured. In more detail, the meeting of the intake grill 120 with the obstacle is detected by an 'off' of a switch provided on the tension detecting unit 670. That is, since the driving unit 632 keeps operating even when the intake grill 120 encounters the obstacle, the wire is loosened to turn off the switch of the tension detecting unit 670.

[0089] When the intake grill 120 encounters the obstacle or reaches the initially set lowering length, the intake grill 120 stops being lowered (S220). At this point, when the intake grill 120 encounters the obstacle in the course of lowering, the intake grill 120 stops at that location or the driving unit 632 inversely rotates by the elevating controller 628. For example, the intake grill 120 may rise again by a predetermined length for several seconds by the reverse rotation of the elevating controller 628 and

subsequently stop rising.

[0090] When the intake grill 120 stops being lowered, the user performs a fine adjustment process for setting an automatic stop location of the intake grill 120 (S150).

[0091] In more detail, in the fine adjustment process, the user adjusts the intake grill 120 to an optimal location by repeatedly performing a raising/stopping/lowering process for the intake grill 120. The fine adjustment process will be described in more detail later.

[0092] After the fine adjustment process is finished, the user finally inputs a setting signal (S160). The input of the setting signal is to set the lowering length of the intake grill 120 by inputting a command in a state where the intake grill 120 is located at the optical height. For example, the setting signal may be input by the user pressing a stop button for several seconds or pressing the stop button several times within a predetermined time. Alternatively, the setting signal may be input by the user pressing a separate button provided on the remote control 300. The method for inputting the setting signal may be variously provided without limitation. When the setting signal is not input, the fine adjustment process is repeatedly performed.

[0093] On the other hand, when the fine adjustment process is not performed by the user even after the intake grill 120 stops being lowered and a predetermined time has elapsed (S190), the controller sets the current location of the intake grill 120 as a stop location of the intake grill that is being lowered.

[0094] When the lowering length setting of the intake grill 120 is finalized by the manipulation of the user and the predetermined time passes (S170), the process is finished. Accordingly, when it is intended to clean/replace the filter, the intake grill 120 stops after being lowered by the setting length. Then, the user separates and cleans or replaces the filter mounted on the intake grill 120.

[0095] The process goes to the fine adjustment process S150 even when the intake grill 120 encounters the obstacles or stops after being lowered by the initial setting lowering length. Here, an extending length of the wire 640 is calculated by the operation of a length unit body 637 and a detecting body 639 that constitute the length detecting unit 636.

[0096] FIG. 9 is a flowchart describing a fine adjustment process for setting the lowered position of an intake grill, according to embodiments of the present disclosure.

[0097] Referring to Fig. 9, when the intake grill 120 stops due to any one of the three reasons described with reference to Fig. 8, the user can lower the intake grill to an optical height through the fine adjustment process.

[0098] In more detail, the user can perform the fine adjustment process through an input of a raising/lowering command of the intake grill 120 in a state where the intake grill 120 stops. The raising and lowering commands of the intake grill 120 may be input by the user pressing the separate raising/lowering button provided on the remote control.

[0099] First, it is determined if the user inputs the rais-

ing or lowering command of the intake grill. In this embodiment, it is first determined if the user inputs the raise command.

[0100] That is, the controller determines if the user inputs the raise command of the intake grill (S151). When it is determined that the user inputs the raise command, the intake grill is raised (S152). It is determined if a stop command is input in the course of raising the intake grill 120 (S153). When the stop command is input, the intake grill stops rising (S154), and it is determined if a setting signal is input (S160). When the setting signal is input, the location of the intake grill 120 at that time is set as the automatic stop location. On the other hand, when no setting signal is input, the fine adjustment process, i.e., a process for standing by the input of the raising or lowering command, is repeatedly performed. Subsequently, when the setting signal is input, the current location is set as the automatic stop location of the intake grill 120 that is being lowered. Therefore, when the user inputs the filter cleaning/replacing command later, the intake grill 120 is automatically lowered to the stop location.

[0101] When no raise command is input, it is determined if the lowering command is input (S155). When the lowering command is input, the intake grill is lowered again, in the course of which, when the stop command is input (S157), the intake grill stops being lowered at the current location and this current location is set as the automatic stop location.

[0102] Further, when a predetermined time has elapsed in a state where the raising and lowering commands are not input, the current location may be automatically set as the automatic lowering location (S180).

[0103] In addition, when the length to the automatic lowering location, which is set by the user, is less than a length that is preset when the product is manufactured, the preset length may be set as the automatic lowering length. On the other hand, when the length to the automatic lowering location, which is set by the user, is greater than the preset length, the length set by the user can be set as the automatic lowering length.

[0104] FIG. 10 is a flowchart showing a process for cleaning/replacing a filter of an air conditioner indoor unit, according to embodiments of the present disclosure.

[0105] Referring to Fig. 10, when the user inputs a filter cleaning/replacing command (S210) after the automatic lowering length is set through the process that is described with reference to Figs. 8 and 9, the intake grill is automatically lowered by the automatic lowering length (i.e., to the automatic stop location) (S220). The intake grill stops at the automatic stop location (S230). In this state, the filter is cleaned or replaced. When the intake grill 120 encounters an obstacle in the course of being lowered, as described with reference to Fig. 8, the intake grill 120 stops. For example, the intake grill 120 may collide with a user's head in the course of being lowered. In this case, the intake grill 120 stops being lowered.

[0106] Here, when the indoor unit is being driven or the RPM of the indoor fan 170 is higher than a setting

RPM at a point where the user inputs the filter cleaning/replacing command, an alarm signal may be generated by the elevating controller 628 or the indoor unit controller. On the other hand, when the grill elevating unit 600 is operating, the operation of the indoor fan 170 is restrained. However, for a test run, the indoor fan 170 may operate in a state where the grill elevating unit 600 stops after being lowered.

[0107] The alarm signal may be beep or light. As described above, by restricting the filter cleaning/replacing work in a state where the indoor fan 170 is rotating at an RPM higher than the setting RPM, safety-related accidents can be prevented and clean air can be discharged from the air conditioner.

[0108] The user performs the filter cleaning/replacing work in a state where the intake grill 120 is lowered to the automatic stop location. Further, when the filter cleaning/replacing work is finished, the user inputs the grill raise command.

[0109] In more detail, the controller (one of the indoor unit controller or the elevating controller 628) determines if the intake grill raise command is input (S240). At this point, a value of a parameter n for counting the performance number of the processes for inducing the intake grill 120 to the normal state is reset to "0" as a method for determining if the intake grill 120 is returned to the normal state. Subsequently, the intake grill 120 is raised (S260).

[0110] Here, when the intake grill raise command is input, the tension detecting unit 670 detects the tension applied to the wire 640 so that it can be determined if the filter or intake grill 120 is separated from the wire 640. In more detail, when the filter and/or intake grill 120 is separated from the wire 640 and thus it is determined that the tension applied to the wire 640 is less than the preset tension, the elevating controller 638 or the indoor unit controller cuts off the power to the driving unit 632 and generates the alarm signal.

[0111] When the filter and intake grill 120 are mounted on the wire 640 and thus it is determined that there is no variation in the tension, the intake grill is raised at a preset speed (S560) and the controller determines if the intake grill is returned to the normal state (S270).

[0112] In more detail, the returning of the intake grill to the normal state is determined depending on whether the close-contact detecting units 680 are turned on. That is, when the intake grill 120 is horizontally raised to normally closely contact the front panel 400, the micro switches provided on the close-contact unit 680 are all turned on. When the intake grill 120 does not closely contact the front panel 400, at least one of the closely contacted detecting units 680 maintains an off-state. By this method, the returning of the intake grill 120 to the normal state is determined. When it is determined that the intake grill 120 is returned to the normal state, the intake grill 120 stops being raised and maintains a standby state for operating the indoor unit.

[0113] On the other hand, when it is determined that the intake grill 120 is not returned to the normal state as

at least one of the closely contact detecting units 680 maintains the off-state, a process for inducing the intake grill 120 to the normal state is performed.

[0114] In more detail, the process for inducing the intake grill 120 to the normal state is a process for allowing the intake grill 120 to horizontally closely contact the indoor unit by alternately performing the raising and lowering processes for a predetermined time.

[0115] For example, a process (L>K) for raising the intake grill 120 for a predetermined time and subsequently lowering the intake grill for a predetermined time may be performed (S280). Whenever the lowering and raising processes of the intake grill are performed one time, the value of the performance number (n) of the processes for inducing the intake grill to the normal state is accumulated (290). Subsequently, it is determined again if the intake grill 120 is returned to the normal state (S300). When it is determined that the intake grill 120 is returned to the normal state, the process is finished. When it is determined that the intake grill 120 is not returned to the normal state, it is determined if the performance number reaches a predetermined number (S310). When it is determined that the performance number does not reach the predetermined number, the inducing process S280 is performed again.

[0116] When it is determined that the intake grill is not returned to the normal state even when the inducing process S280 is performed by the predetermined number, an error signal is generated by the controller (S320).

[0117] Then, the user can safely perform the filter cleaning/replacing work through the above-described process.

[0118] Any reference in this specification to "one embodiment," "an embodiment," "exemplary embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to affect such feature, structure, or characteristic in connection with others of the embodiments.

[0119] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. An indoor unit of an air conditioner, comprising:

a main body comprising a heat exchanger and an indoor fan;
 an intake grill movably coupled to a bottom surface of the main body;
 a filter mounted on a top surface of the intake grill;
 an orifice provided in the main body to guide a flow of indoor air that is introduced;
 a front panel provided below the orifice, the intake grill closely contacting an inside of the front panel,

characterized in that the indoor unit further comprises:

a plurality of close-contact detecting units for detecting if the intake grill closely contacts the front panel;
 a plurality of grill elevating units provided between the orifice and the front panel to allow the intake grill to be raised or lowered: and
 a controller for controlling driving of the grill elevating unit,

wherein the elevating unit comprises:

an elevating kit generating rotational force; and
 a wire having a first end connected to the intake grill and a second end connected to the elevating kit.

2. The indoor unit according to claim 1, wherein operation of one of the grill elevating unit and the indoor fan is restricted when the other is operating, and wherein when an RPM of the indoor fan is higher than a predetermined value, operation of the grill elevating unit is restricted.
3. The indoor unit according to claim 1, wherein the grill elevating unit is mounted on an undersurface of the orifice or a top surface of the front panel.
4. The indoor unit according to claim 1, further comprising a tension detecting unit that is provided on a side of the front panel to determine whether the intake grill is separated or whether the intake grill encounters an obstacle by detecting a tension variation of the wire.
5. The indoor unit according to claim 4, wherein at least one of the close-contact detecting unit and the tension detecting unit comprises a micro switch.
6. The indoor unit according to claim 1, wherein the

elevating kit comprises:

a kit box;
 a driving unit received in the kit box and generating rotational force;
 a roller unit connected to the driving unit and winding or releasing the wire; and
 a length detecting unit for measuring a released length of the wire.

7. The indoor unit according to claim 6, wherein the length detecting unit comprises:

a length unit body that integrally rotates together with the roller unit and is provided at an outer circumference thereof with a plurality of protrusions and grooves; and
 a detecting body for calculating an RPM of the length unit body by detecting the protrusions and grooves.

8. The indoor unit according to claim 1, wherein the controller is one of a controller for controlling an operation of the indoor unit and an elevating controller provided in the grill elevating unit.

9. A method for controlling an indoor unit of an air conditioner, the method comprising:

inputting a lowering command of an intake grill;
 lowering the intake grill in accordance with the lowering command;
 stopping the intake grill at a location;
 setting an automatic lowering length of the intake grill by an elapse of a predetermined time, or a setting signal input to a controller.

10. The method according to claim 9, wherein the inputting of the lowering command is performed by manipulating a menu button or a lowering button.

11. The method according to claim 9, wherein the intake grill stops being lowered by one of a case where a stop command is input by the user, a case where the intake grill encounters an obstacle, and a case where the intake grill is lowered to a preset lowering length.

12. The method according to claim 9, wherein the stopping of the intake grill comprises performing a fine adjustment process for setting an automatic lowering length of the intake grill, and wherein the fine adjustment process is performed by a combination of the intake grill raising command, stop command, and lowering command.

13. The method according to claim 9, wherein the predetermined time is a time that elapses without the

input of an operational command in a state where the intake grill is lowered and stops.

14. The method according to claim 9, wherein the setting signal input is performed by inputting stop command signals as many as a preset number, or by continuously inputting a stop command signal within a preset time duration. 5
15. A method for controlling an indoor unit of an air conditioner, the method comprising: 10
 - inputting a filter cleaning/replacing command;
 - lowering an intake grill;
 - stopping the intake grill at an automatic stop location; 15
 - inputting an intake grill raising command to raising the intake grill; and
 - determining if the intake grill is returned to a normal state. 20
16. The method according to claim 15, wherein, when an indoor fan is being driven or rotating at an RPM higher than a predetermined value, the lowering of the intake grill is restricted. 25
17. The method according to claim 15, wherein, while the intake grill is being lowered, the intake grill stops being lowered when encountering an obstacle. 30
18. The method according to claim 15, wherein, in a state that the intake grill is stopped at the automatic stop location, an indoor fan is controlled to be capable of being driven for a test running of the indoor unit. 35
19. The method according to claim 15, further comprising determining if a filter or the intake grill is separated from a wire, after inputting of the intake grill raising command,. 40
20. The method according to claim 19, wherein, when the filter or the intake grill is separated from the wire, an alarm signal is generated.
21. The method according to claim 15, wherein the determining if the intake grill is returned comprises determining that the intake grill is returned to a normal state when all of close-contact detecting units mounted on the indoor unit are turned on; 45
 - determining that the intake grill is not returned to a normal state when any one of close-contact detecting units mounted on the indoor unit is turned off; and 50
 - performing a process for inducing the intake grill to the normal state.. 55
22. The method according to claim 21, wherein the process for inducing to the normal state is performed by lowering the intake grill for a first predetermined time

K and subsequently raising the intake grill for a second predetermined time $L(L > K)$.

23. The method according to claim 22, wherein the determining if the intake grill is returned to the normal state is performed each time the process for inducing to the normal state is performed, and wherein when it is determined that the intake grill is not returned to the normal state even after the process for inducing is performed as many as a predetermined number of times, an error signal is generated.

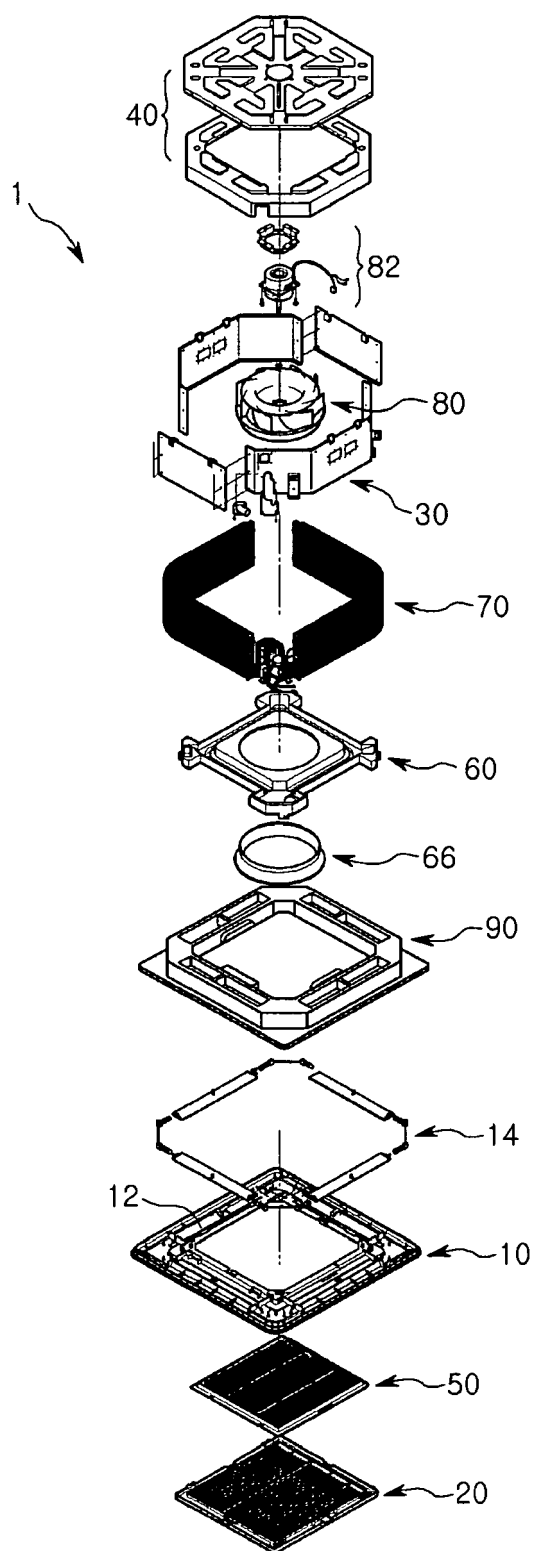


FIG. 1

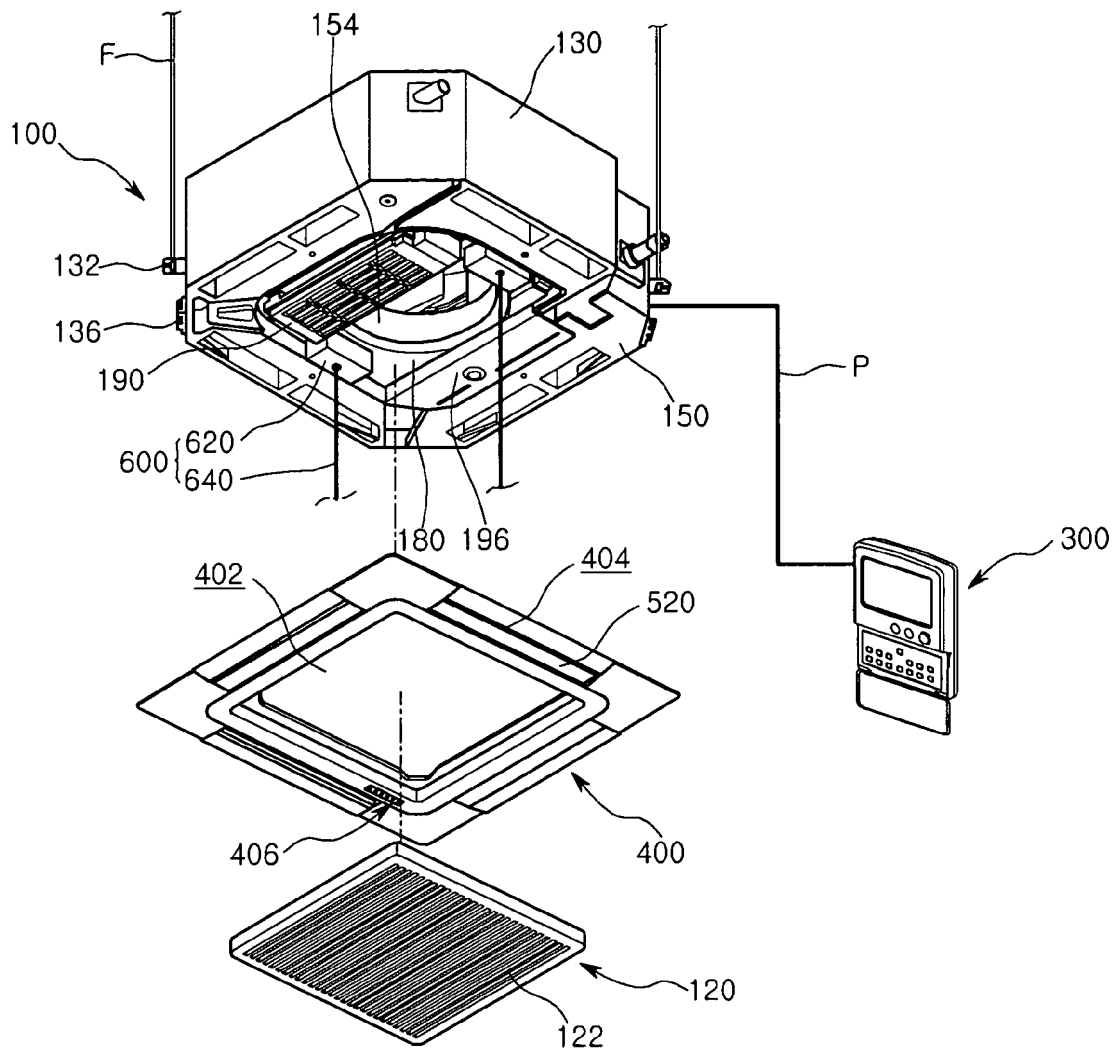


FIG.2

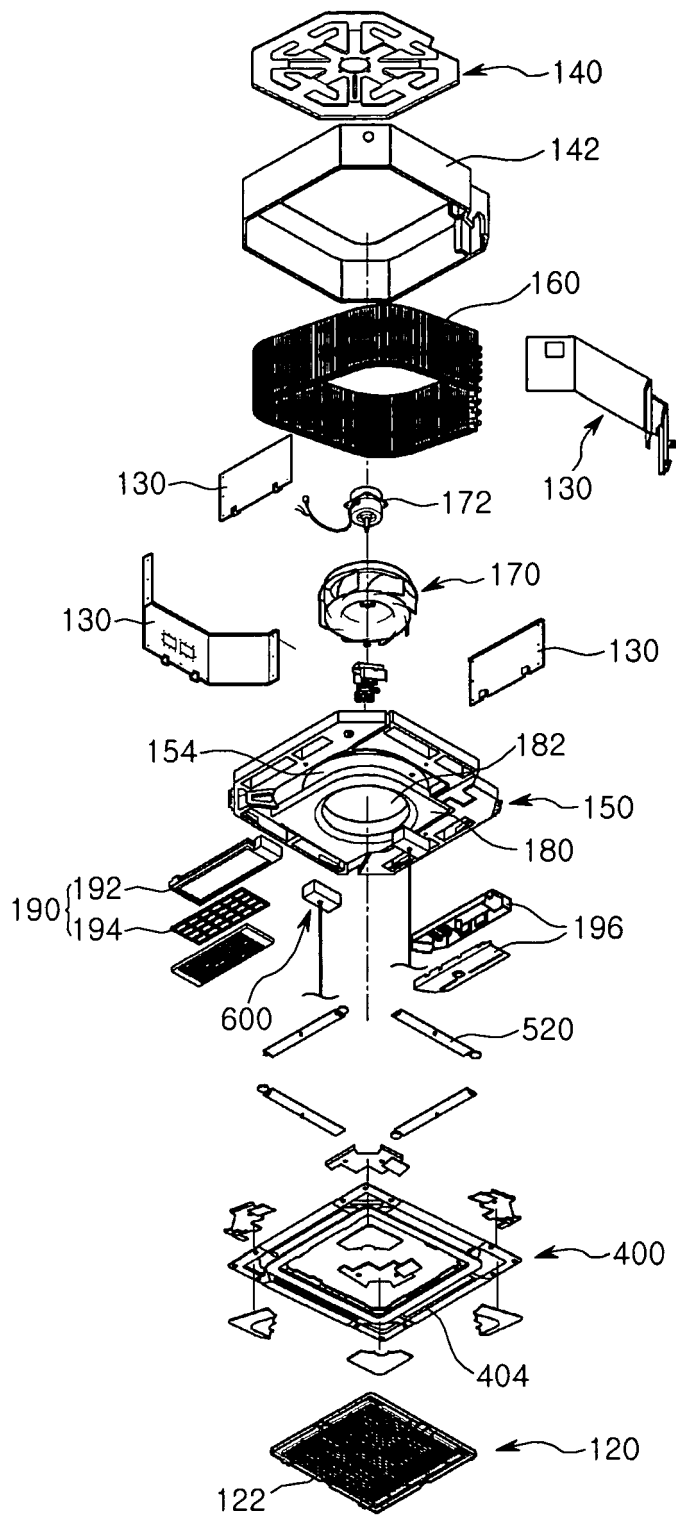


FIG.3

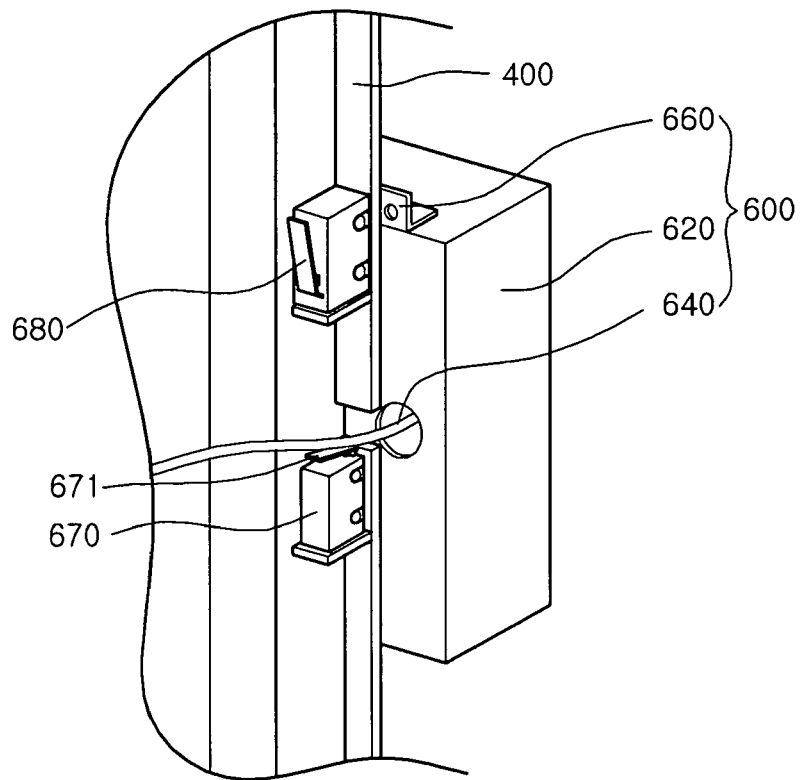


FIG. 4

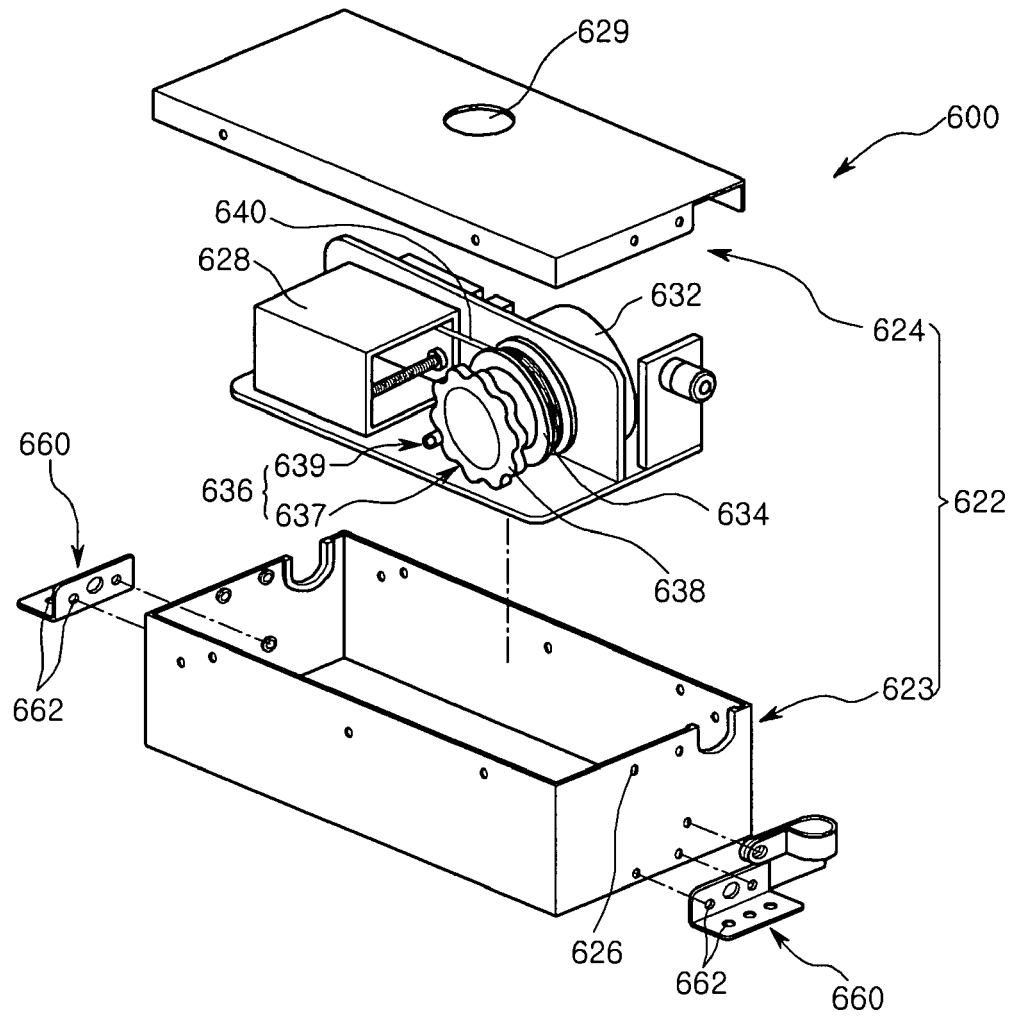


FIG. 5

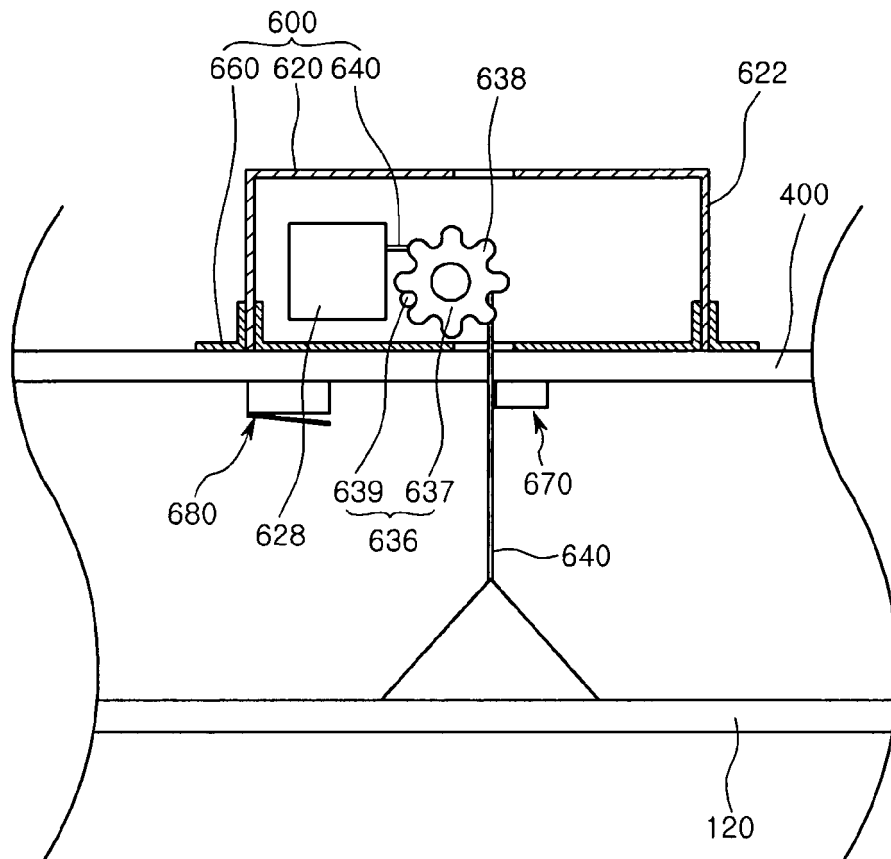


FIG. 6

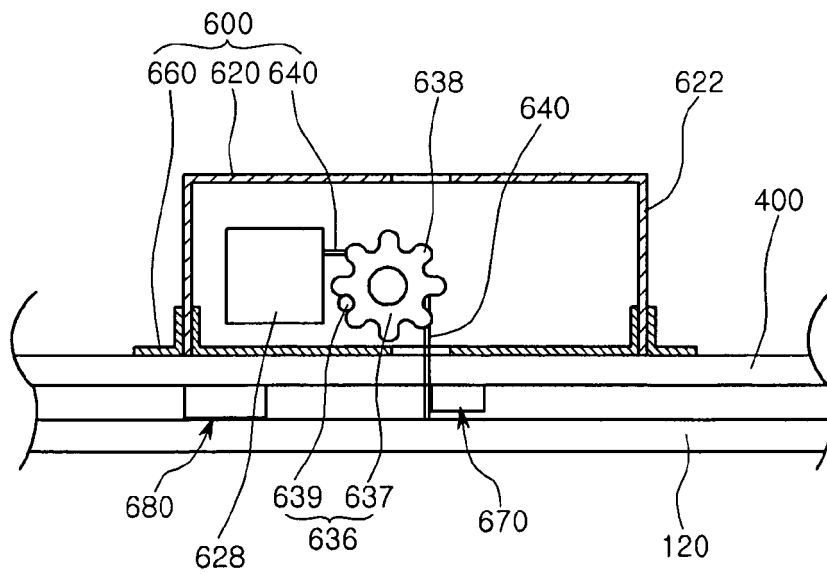


FIG. 7

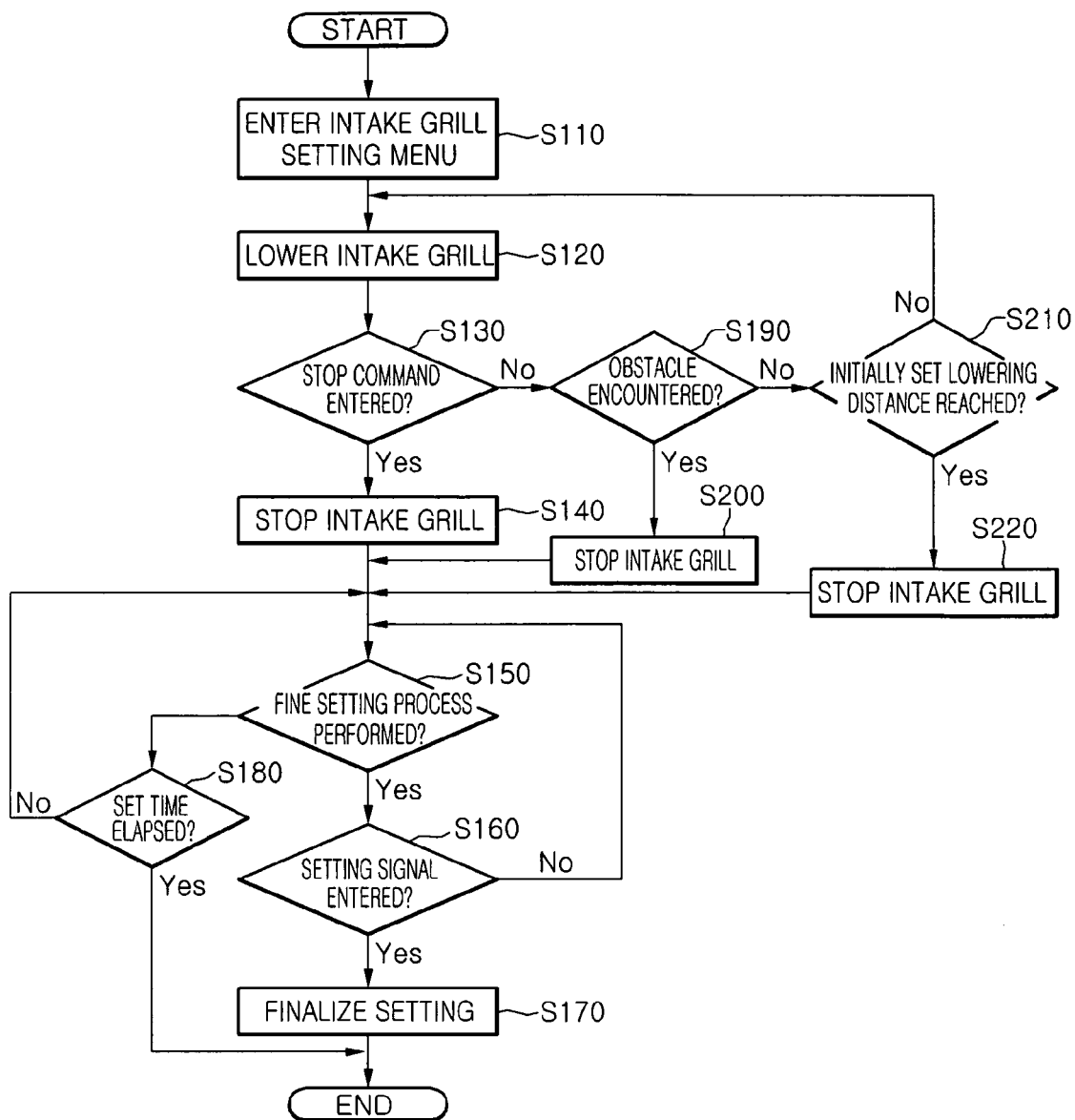


FIG.8

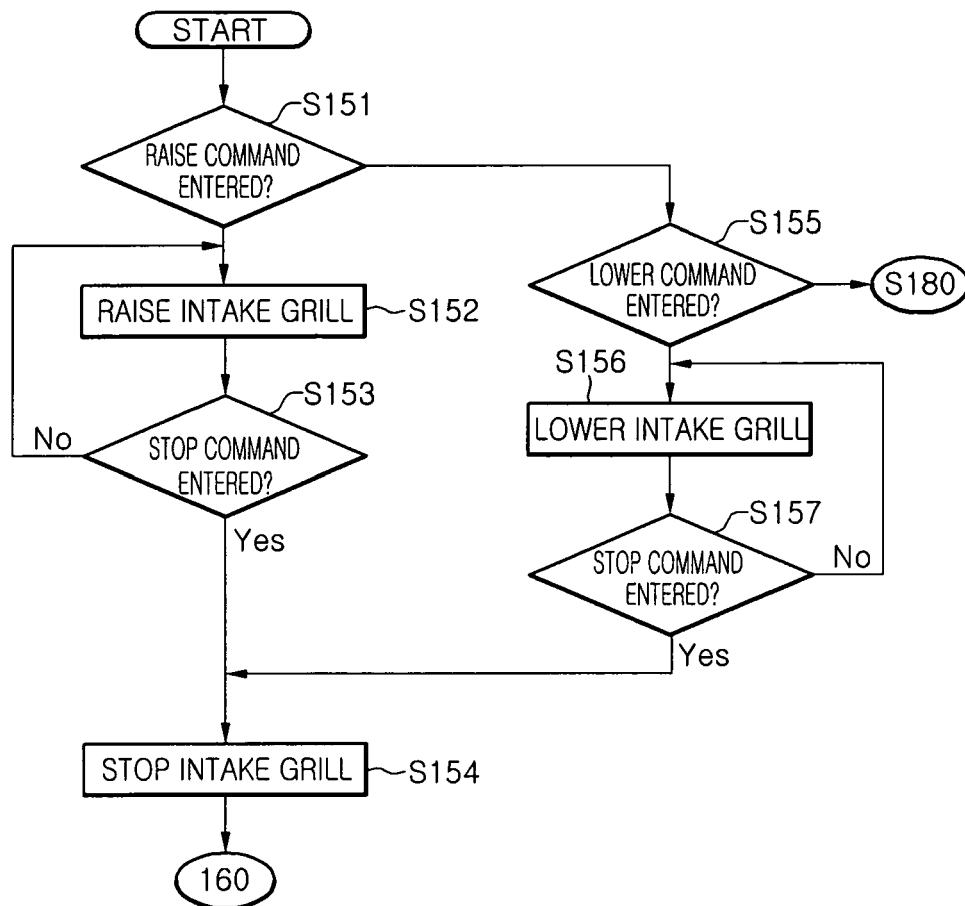


FIG. 9

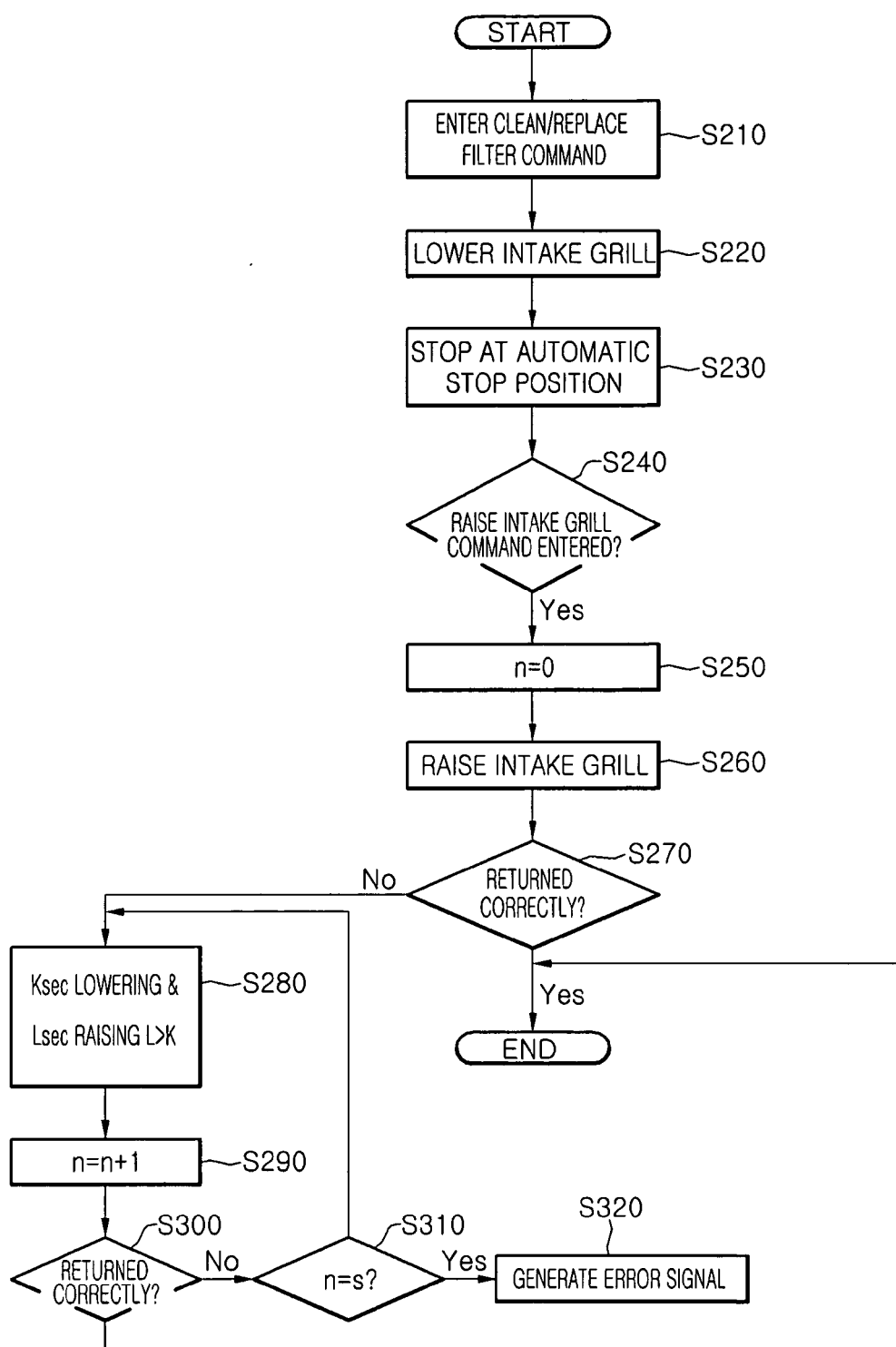


FIG. 10