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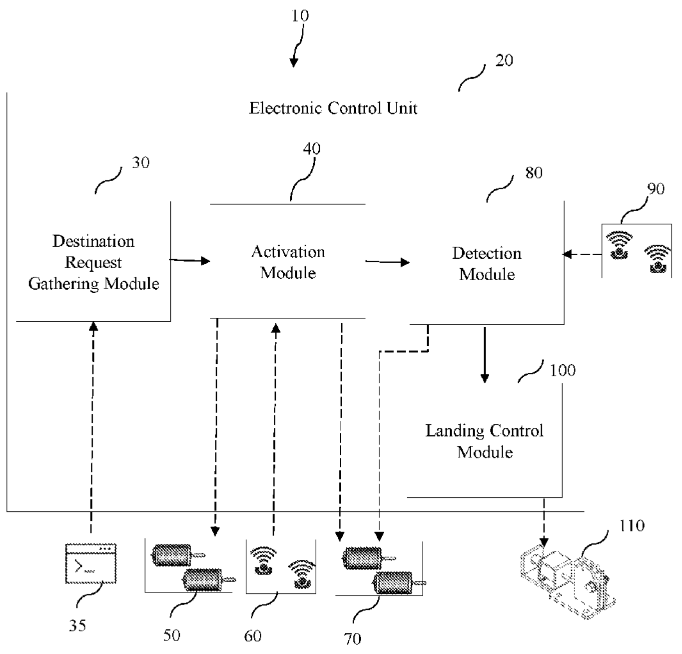

FIG. 1

(57) Abstract: A system to operate a pneumatic vacuum elevator is disclosed. The system includes an electronic control unit including a destination request gathering module to receive a destination request command from a cabin operating panel. The electronic control unit includes an activation module to provide a first activation signal to a first set of motors. The activation module detects movement of the elevator cabin towards a requested destination using a first set of sensors. The activation module provides a second activation command to a second set of motors to control motion of the elevator cabin. The electronic control unit includes a detection module to detect presence of the elevator cabin at the requested destination using a second set of sensors. The electronic control unit includes a landing control module to provide a deactivation signal to the motors and activates a landing lever assembly to lock the elevator cabin at the requested destination.

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SYSTEM AND METHOD TO OPERATE A PNEUMATIC VACUUM ELEVATOR

This International Application claims priority from a Complete patent application filed in India having Patent Application No. 202041029732, filed on July 13, 2020, and titled "SYSTEM AND METHOD TO OPERATE A PNEUMATIC VACUUM ELEVATOR".

BACKGROUND

Embodiments of the present disclosure relate to pneumatic vacuum elevators and more particularly to a system and a method to operate a pneumatic vacuum elevator.

The architectural development of high-level structure results in the development of elevators for transporting personnel or goods lifting. For the control of elevators, the existing controllers does not consider whether cabin is fully loaded or not. Fully loaded cabin may slow down usual operation related to the elevator. The existing apparatus for controlling elevator does not temporarily address this problem and has unnecessary stop situation under full load conditions. In addition, the unnecessary braking of elevator and speed-raising also increases the extra mechanical wear of elevator, thereby have reduced the service life of elevator.

Conventional automatic elevators utilize relay logic controllers to control the speed, position and door operation of an elevator or bank of elevators. However, such control system had size and power consumption constraint, where the number of relays required increases almost exponentially with the number of floors. Also, such control system has many moving parts which require more maintenance.

Furthermore, with advancement in technology, the elevators utilize microcontroller-based control system which interacts with a series of sensors, controllers, sequences of operation, real-time calculations or algorithms that balance passenger demand and cabin availability. The elevator sensors provide data on cabin positions, cabin moving direction, loads, door status, cabin calls, number of runs per cabin, alarms, etc. However, each microprocessor-based control system has inherent limitations in terms of its input/output capabilities, processing capability and speed. In any control system for an elevator, it is undesirable to have delays in processing and transmitting critical information, such as slowdown and stop signals, door control signals, and safety information.

Hence, there is a need for an improved system and method to operate the pneumatic vacuum elevator to address the aforementioned issue(s).

BRIEF DESCRIPTION

In accordance with an embodiment of the present disclosure, a system to operate a pneumatic vacuum elevator is provided. The system includes an electronic control unit located on an external cylinder assembly of the pneumatic vacuum elevator. The electronic control unit includes a destination request gathering module configured to receive a destination request command from a cabin operating panel inside an elevator cabin. The electronic control unit also includes an activation module configured to provide a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module. The activation module is also configured to detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors. The activation module is further configured to provide a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin. The electronic control unit further includes a detection module operatively coupled to the activation module. The detection module is configured to detect presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors. The electronic control unit further includes a landing control module operatively coupled to the detection module. The landing control module is configured to provide a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination. The landing control module is configured to activate a landing lever assembly to lock the elevator cabin at the requested destination upon receiving a signal from the second set of sensors.

In accordance with another embodiment of the present disclosure, a method to operate the pneumatic vacuum elevator is provided. The method includes receiving, by a destination request gathering module, a destination request command from a cabin operating panel inside an elevator cabin. The method also includes providing, by an activation module, a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module. The method further includes detecting, by the activation module, movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors. The method further includes providing, by the activation module, a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin. The method further includes detecting, by a detection module, presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors. The method further includes providing, by a landing control module, a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination. The method further includes activating, by the landing control module, a landing lever assembly to lock the elevator cabin the requested destination upon receiving a signal from the second set of sensors.

In accordance with yet another embodiment of the present disclosure, a pneumatic vacuum is provided. The elevator includes an external cylinder assembly comprising an elevator cabin inserted therein. The elevator also includes an electronic control unit located on top of the external cylinder assembly. The electronic control unit includes a destination request gathering module configured to receive a destination request command from a cabin operating panel inside an elevator cabin. The electronic control unit also includes an activation module configured to provide a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module. The activation module is also configured to detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors. The activation module is further configured to provide a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin. The electronic control unit further includes a detection module operatively coupled to the activation module. The detection module is configured to detect presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors. The electronic control unit further includes a landing control module operatively coupled to the detection module. The landing control module is configured to provide a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination. The landing control module is configured to activate a landing lever assembly to lock the elevator cabin at the requested destination upon receiving a signal from the second set of sensors.

To further clarify the advantages and features of the present disclosure, a more particular description of the disclosure will follow by reference to specific embodiments thereof, which are illustrated in the appended figures. It is to be appreciated that these figures depict only typical embodiments of the disclosure and are therefore not to be considered limiting in scope. The disclosure will be described and explained with additional specificity and detail with the appended figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure will be described and explained with additional specificity and detail with the accompanying figures in which:

FIG. 1 is a block diagram representation of a system to operate a pneumatic vacuum elevator in accordance with an embodiment of the present disclosure;

FIG. 2 is a block diagram representation of one embodiment of the system of FIG. 1 in accordance with an embodiment of the present disclosure;

FIG. 3 is a schematic representation of pneumatic vacuum elevator in accordance with an embodiment of the present disclosure;

FIG. 3(a) is a schematic representation of one embodiment of FIG. 3, depicting seal assembly in accordance with an embodiment of the present disclosure;

FIG. 3(b) is a schematic representation of one embodiment of FIG. 3, depicting integrated noise suppression apparatus in accordance with an embodiment of the present disclosure;

FIG. 3(c) is a schematic representation of one embodiment of FIG. 3, depicting split noise suppression apparatus in accordance with an embodiment of the present disclosure; and

FIG. 4 is a flow chart representing the steps involved in a method to operate the pneumatic vacuum elevator in accordance with an embodiment of the present disclosure.

Further, those skilled in the art will appreciate that elements in the figures are illustrated for simplicity and may not have necessarily been drawn to scale. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the figures by conventional symbols, and the figures may show only those specific details that are pertinent to understanding the embodiments of the present disclosure so as not to obscure the figures with details that will be readily apparent to those skilled in the art having the benefit of the description herein.

DETAILED DESCRIPTION

For the purpose of promoting an understanding of the principles of the disclosure, reference will now be made to the embodiment illustrated in the figures and specific language will be used to describe them. It will nevertheless be understood that no limitation of the scope of the disclosure is thereby intended. Such alterations and further modifications in the illustrated system, and such further applications of the principles of the disclosure as would normally occur to those skilled in the art are to be construed as being within the scope of the present disclosure.

The terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a process or method that comprises a list of steps does not include only those steps but may include other steps not expressly listed or inherent to such a process or method. Similarly, one or more devices or sub-systems or elements or structures or components preceded by "comprises... a" does not, without more constraints, preclude the existence of other devices, sub-systems, elements, structures, components, additional devices, additional sub-systems, additional elements, additional structures or additional components. Appearances of the phrase "in an embodiment", "in another embodiment" and similar language throughout this specification may, but not necessarily do, all refer to the same embodiment.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by those skilled in the art to which this disclosure belongs. The system, methods, and examples provided herein are only illustrative and not intended to be limiting.

In the following specification and the claims, reference will be made to a number of terms, which shall be defined to have the following meanings. The singular forms “a”, “an”, and “the” include plural references unless the context clearly dictates otherwise.

Embodiments of the present disclosure relate to a system and a method to operate a pneumatic vacuum elevator. The system includes an electronic control unit located on an external cylinder assembly of the pneumatic vacuum elevator. The electronic control unit includes a destination request gathering module configured to receive a destination request command from a cabin operating panel inside an elevator cabin. The electronic control unit also includes an activation module configured to provide a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module. The activation module is also configured to detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors. The activation module is further configured to provide a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin. The electronic control unit further includes a detection module operatively coupled to the activation module. The detection module is configured to detect presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors. The electronic control unit further includes a landing control module operatively coupled to the detection module. The landing control module is configured to provide a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination. The landing control module is configured to activate a landing lever assembly to lock the elevator cabin at the requested destination upon receiving a signal from the second set of sensors.

FIG. 1 is a block diagram representation of a system (10) to operate a pneumatic vacuum elevator in accordance with an embodiment of the present disclosure. The system (10) includes an electronic control unit (20) located on an external cylinder assembly of the pneumatic vacuum elevator. In a specific embodiment, the electronic control unit (20) may be located on top of the external cylinder assembly. The electronic control unit (20) includes a destination request gathering module (30) which receives a destination request command from a cabin operating panel (35) inside an elevator cabin. In detail, the cabin operating panel (35) includes multiple buttons corresponding to each floor in the structure where the elevator is placed and the various other functional operations. In such embodiment, the buttons related to various other functional operations may include button for call operation, button to operate fan, button to operate illumination source, emergency button or the like. When a user presses a button corresponding to desired destination, the destination request gathering module (30) receives the destination request from the cabin operating panel (35).

Further, the electronic control unit (20) includes an activation module (40) which provides a first activation signal to a first set of motors (50) based on the destination request command received from the destination request gathering module (30). In one embodiment, the first set of motors (50) may include traction motors. Upon receiving the destination request command, the activation module (40) activates the first set of motors (50) which are installed on hoist-way top, for extracting the air in the space, produce vacuum and start driving the elevator cabin. The activation module (40) further detects the movement of the elevator cabin in a direction towards a requested destination using the first set of sensors (60). In one embodiment, the first set of sensors (60) may include, but not limited to, a pressure sensor, a force sensor, a position sensor, a tension sensor and the like. The first set of sensors (60) may be located on top floor and inside the elevator assembly. In a specific embodiment, the direction towards the requested destination may be an ascending direction of the elevator cabin or a descending direction of the elevator cabin.

Moreover, the activation module (40) activates the second set of motors (70) upon detection of movement of the elevator cabin to control the motion of the elevator cabin. More specifically, when the first set of sensors (60) detects that the elevator cabin start travelling towards the requested direction, the activation module (40) send an activation command to the second of set of motors (70) to pull the elevator cabin ad increase the speed of the elevator cabin. In a specific embodiment, the second set of motors (70) may include traction motors.

Subsequently, the electronic control unit (20) includes a detection module (80) operatively coupled to the activation module (40). The detection module (80) detects presence of the elevator cabin at the requested destination using a second set of sensors (90) upon activation of the second set of motors (70). In one embodiment, the second set of sensors (90) may include a magnetic sensor and an acceleration sensor. In detail, each of the sensor from the second set of sensors (90) is positioned at each landing position at each floor. Specifically, one sensor is placed slightly above a floor and one sensor is placed slightly below the floor to detect the presence of the elevator cabin landing on the requested destination.

In addition, the electronic control unit (20) includes a landing control module (100) operatively coupled to the detection module (80). The landing control module (10) provides a deactivation signal to the first set of motors (50) and the second set of motors (70) upon detecting the presence of the elevator cabin at the requested destination. Further, upon deactivation of the motors (50, 70), the landing control module (100) activates a landing lever assembly (110) to lock the elevator cabin at the requested destination upon receiving a signal from the second set of sensors (90). The second set of sensors (90) activates a guide pin of the landing lever assembly (110) with further actuates a locking plate and lock the locking plate with guide rail of the elevator and stop the elevator cabin of the requested destination.

FIG. 2 is a block diagram representation of one embodiment of the system (10) of FIG. 1 in accordance with an embodiment of the present disclosure. The electronic control unit (20) of the system of FIG. 1 includes a destination request gathering module (30), an activation module (40), a detection module (80) and a landing control module (100). In one embodiment, the electronic control unit (20) of the system (10) may include a load detection module (120) operatively coupled to the activation module (40). The load detection module (120) receives load inside the elevator cabin detected by the one or more weight sensors and an overload valve. The load detection module (120) also compares the load received from the one or more sensors with a predefined threshold limit of the permissible load. As used herein, the overload valve is situated at top of the external cylinder along with motors. The overload valve is designed by a spring actuation device through electric signal to ensure the maximum permissible limit of pay load in the elevator cabin. The main function of the overload valve is to allow within the permissible limit of load capacity in the elevator cabin. If exceeding the permissible limit of loading capacity in the cabin assembly, the overload valve reacts through spring tension due to insufficient air pressure on the top seal of the elevator cabin and continuity of power is disconnected to the electric motor. Hence, the elevator cabin does not move within the external cylinder assembly. In another case where the load is within the permissible limits, the second set of motors are activated to control the motion of the elevator cabin in the requested direction.

In one embodiment, the electronic control unit (20) of the system (10) may also include a lock detection module (130) which is operatively coupled to the activation module (40). The lock detection module (130) detects a locking position of an elevator cabin door using one or more locks and one or more door sensors. The door locks are the electromechanical locks which sense the locking or unlocking condition of the elevator cabin door and send the corresponding signals to the activation module. Similarly, the door sensors such as switches and solenoid valve intimate the activation module (40) about the current position of the door when the control unit (20) receives the destination request command.

In a specific embodiment, the electronic control unit (20) of the system (10) may include an air flow control module (140) operatively coupled to the activation module (40). The air flow control module (140) controls the flow of air to and from one or more chambers in-order to move the elevator cabin in a tubular pathway. The air flow control module (140) allows air flow from the motor unit to inside of cylinder using an air valve in such a way that the air valve releases the vacuum pressure from the inside of the cylinder allowing the cabin to descend. The air volume that enters determines the rate in which the cabin will descend. The air valve has an orifice opening that lets the airflow between the outside atmosphere and diaphragm working unit.

In one embodiment, the electronic control unit (20) of the system (10) may include a brake control module (150) which is operatively coupled to the landing control module (100). The brake control module (100) activates a brake assembly to control the movement of the elevator cabin in at least one mode based on the movement of at least one spring. Specifically, the brake assembly includes a support plate mechanically coupled to a brake wheel coupled to a support plate, where the support plate rotates based on movement of the brake wheel. The at least one spring is coupled to a seal assembly, wherein the at least one spring is actuated based on the movement of the seal assembly. The brake assembly also includes a plurality of brake shoes coupled to the support plate, where the plurality of brake shoes controls the movement of the elevator cabin via a guide rail based on the movement of the at least one spring and the brake wheel. The brake assembly also includes an emergency braking system including a brake handle, a brake lever, a push button, a switch, an overpaid governor or any triggering device. The emergency braking system stops the movement of the elevator cabin in a running condition in case it is required to suddenly stop the cabin.

In operation, consider an example where a user presses a second-floor button on the operating control panel (35) of the elevator. Upon receiving the such command, the control unit (20) activates the one or more door locks and the one or more door sensors which sense the locking or unlocking condition of the elevator cabin door and intimate the same to the control unit (20). The control unit (20), upon receiving the command corresponding to the door locking condition, activates the first set of motors (50). The first set of motors (50) allows the air flow inside of cylinder using an air valve. Once the air flow is maintained inside the cylinder, the elevator cabin starts moving in the upward direction. The control unit (20) further activates the one or more weight sensors. The weight sensor using the overload valve provides the overall load present inside the elevator cabin. The control unit (20) compares the calculated load with the predefined threshold limit of the load. In case if the load inside the elevator cabin is less than the predefined threshold limit, the control unit (20) may active the second set of motors (70) to increase the speed of the elevator cabin towards the second floor. When the elevator cabin reaches to the second-floor, the second set of sensors (90) sense the landing position of the elevator cabin and activates the brake assembly and the landing lever assembly (110) to stop and lock the elevator cabin at the second floor.

FIG. 3 is a schematic representation of pneumatic vacuum elevator (200) in accordance with an embodiment of the present disclosure. The elevator (200) includes an external cylinder assembly (210) including an elevator cabin (220) inserted therein.

The elevator cabin (220) carries one or more users between one or more levels of a structure. In one embodiment, the structure may include building, vessel or the like. The external cylinder assembly (210) comprises a plurality of cylinders coupled using a base ring assembly (211) and a band ring assembly (212). The base ring assembly (211) provides a supporting layer between other external cylinder assemblies which are connected above or below the top surface and the bottom surface of the external cylinder assembly (210) coupled with the base ring and as a result enables the extension of height pneumatic vacuum elevator based on the requirement. The base ring (211) act as a connecting device for coupling one or more components of the pneumatic vacuum elevator such as the vertical guide rail fitment and the external cylinder assembly for the formation of a compact integrated structure of the pneumatic vacuum elevator. Further, the external cylinder assembly has a band (outer) ring (212) that is used to intact both top and bottom side of the base ring. The band ring (212) is the maximum diameter part in the pneumatic vacuum elevator.

Furthermore, the pneumatic vacuum elevator (200) includes a guide rail pillar (213) mechanically coupled to the elevator cabin. The guide rail pillar is disposed at the external cylinder assembly. The guide rail pillar (213) is configured to guide an actuation of the elevator cabin. The guide rail pillar (213) guides support of the cabin movement in upper and lower side without causing friction and thus reduces anxiety of the passenger within the elevator. The guide rail pillar (213) connects the base ring and provides more strength and rigidity to shaft of the pneumatic vacuum elevator. In addition, the pneumatic vacuum elevator (200) includes a polycarbonate sheet (214) configured to cover the external cylinder assembly (210). The polycarbonate sheet (214) and the external cylinder assembly is coupled using a first locking device and a second locking device. The first locking device is configured to lock an air gap between the polycarbonate sheet, the base ring assembly and the external cylinder assembly. The first locking device (not shown in FIG. 3) acts as tight lock or a hindrance between the base ring and the top and bottom surface of the vertical pillar, so that the vertical pillar is constant at its respective position for providing vertical support for smooth functioning of the pneumatic vacuum elevator and moreover reduces the air gap so that any abnormality or distortion during the operation of the pneumatic vacuum elevator is avoided.

The second locking device (not shown in FIG. 3) is configured to lock air gap between the polycarbonate sheet and the guide rail pillar. The second locking device helps in providing the locking mechanism to the guide rail by avoiding formation of the air gap which not only keeps the guide rail in an intact position but also does not affect smooth functioning of the guide rail in guiding the actuation of the cabin of the pneumatic vacuum elevator for transiting. Further, the pneumatic vacuum elevator (200) includes a seal assembly (215) adapted to fit over a top portion of the elevator cabin. The seal assembly (215) is configured to seal the elevator cabin to reduce vibrations during upward and downward movement of the elevator cabin. One embodiment of the seal assembly is shown in FIG. 3(a). The seal assembly (215) includes a depressurizing system (217) configured to prevent the elevator cabin from coming into force contact with the external cylinder assembly (210) during upward movement and contribute to safety of an elevator operation.

The elevator (200) also includes an electronic control unit (20) located on an external cylinder assembly (210) of the pneumatic vacuum elevator (200). The electronic control unit (20) includes a destination request gathering module (30) configured to receive a destination request command from a cabin operating panel inside an elevator cabin. The electronic control unit (20) also includes an activation module (40) configured to provide a first activation signal to a first set of motors (50) based on the destination request command received from the destination request gathering module (30).

The activation module (40) is also configured to detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors (60) upon activation of the first set of motors (50). The activation module (40) is further configured to provide a second activation command to a second set of motors (70) upon detection of movement of the elevator cabin to control motion of the elevator cabin. The electronic control unit (20) further includes a detection module (80) operatively coupled to the activation module (40). The detection module (80) is configured to detect presence of the elevator cabin at the requested destination using a second set of sensors (90) upon activation of the second set of motors (70). The electronic control unit (20) further includes a landing control module (100) operatively coupled to the detection module (80). The landing control module (110) provides a deactivation signal to the first set of motors (50) and the second set of motors (70) upon detecting the presence of the elevator cabin at the requested destination. The landing control module (100) also activates a landing lever assembly (110) to lock the elevator cabin at the requested destination upon receiving a signal from the second set of sensors (90).

The electronic control unit (20) also includes a load detection module configured to receive load inside the elevator cabin from one or more weight sensors using an overload valve. The load detection module (120) is also configured to compare the load received from the one or more weight sensors with a predefined threshold using an overload valve to activate the second set of motors for movement of the elevator cabin. The overload valve provides an automatic over-weight detection system for an elevator cabin. The overload valve by help of a spring actuation device and electric signal ensures the maximum permissible limit of pay load in the elevator cabin. Further, the electronic control unit (20) includes a lock detection module (130) configured to detect a locking position of the elevator cabin door using one or more door locks and one or more door sensors.

Subsequently, the electronic control unit (20) includes an air flow control module (140) configured to control flow of air to and from one or more chambers in-order to move the elevator cabin in a tubular pathway. The air flow control module reduces vibration or jerk movement due to sudden stop or halt of the elevator cabin of the pneumatic vacuum elevator while landing at the one or more positions. As a result, the air flow control module benefits the passenger in the elevator cabin by providing smooth riding experience in the one or more landing positions. The air flow control module enables the elevator cabin to descend always without power consumption by the motors and the emergency descent due to power failure during travel. Further, the electronic control unit includes a brake control module (150) configured to activate a brake assembly (not shown in FIG. 3) to control the movement of the elevator cabin in at least one mode based on the movement of at least one spring. The brake assembly also includes an emergency braking system which stops the movement of the elevator cabin in a running condition in case it is required to suddenly stop the cabin.

Moreover, the electronic control unit (20) includes a noise suppression module operatively coupled to an integrated noise suppression apparatus (221), wherein a command from the noise suppression module is sent to the integrated noise suppression apparatus (221) to absorb noise generated during operation of the pneumatic vacuum elevator upon air being circulated sequentially from a plurality of layers of a silencer unit. One embodiment of the integrated noise suppression apparatus (221) is shown in FIG. 3(b). The integrated noise suppression apparatus enables the integration of the noise suppression unit along with the one or more one or more elevator cylinders within the available space of the building. The structure of the layers used in the apparatus helps in reduction of noise while the pneumatic vacuum elevator is being operated. The noise suppression module is also operatively coupled to a split noise suppression apparatus (222), wherein a command from the noise suppression module is sent to the split noise suppression apparatus (222) to absorb noise developed upon air circulation using a noise absorption material and reduce vibration of a split unit during the operation of the pneumatic vacuum elevator using a plurality of anti-vibration pads. On embodiment of the split noise suppression apparatus (222) is shown in FIG. 3(c).

FIG. 4 is a flow chart representing the steps involved in a method (300) to operate the pneumatic vacuum elevator in accordance with an embodiment of the present disclosure. The method (300) includes receiving a destination request command from a cabin operating panel inside an elevator cabin in step 310. In one embodiment, receiving a destination request command may include receiving a destination request command by a destination request gathering module. the cabin operating panel includes multiple buttons corresponding to each floor in the structure where the elevator is placed and the various other functional operations. In such embodiment, the buttons related to various other functional operations may include button for call operation, button to operate fan, button to operate illumination source, emergency button or the like.

The method (300) also includes providing a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module in step 320. In one embodiment, providing a first activation signal to a first set of motors ma include providing a first activation signal to a first set of motors by an activation module. In one embodiment, the first set of motors may include traction motors. Upon receiving the destination request command, the activation module activates the first set of motors which are installed on hoist-way top, for extracting the air in the space, produce vacuum and start driving the elevator cabin.

The method (300) further includes detecting movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors in step 330. In one embodiment, detecting movement of the elevator cabin in a direction towards a requested destination may include detecting movement of the elevator cabin in a direction towards a requested destination by the activation module. In a specific embodiment, the first set of sensors may include, but not limited to, a pressure sensor, a force sensor, a position sensor, a tension sensor and the like. The first set of sensors may be located on top floor and inside the elevator assembly. In some embodiments, the direction towards the requested destination may be an ascending direction of the elevator cabin or a descending direction of the elevator cabin.

The method (300) further includes providing a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin in step 340. In one embodiment, providing a second activation command to a second set of motors may include providing a second activation command to a second set of motors by the activation module. In a specific embodiment, the second set of motors may include traction motors.

The method (300) further includes detecting presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors in step 350. In one embodiment, detecting presence of the elevator cabin at the requested destination may include detecting presence of the elevator cabin at the requested destination by a detection module. In one embodiment, the second set of sensors may include a magnetic sensor and an acceleration sensor. In detail, each of the sensor from the second set of sensors is positioned at each landing position at each floor. Specifically, one sensor is placed slightly above a floor and one sensor is placed slightly below the floor to detect the presence of the elevator cabin landing on the requested destination.

The method (300) further includes providing a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination in step 360. In one embodiment, providing a deactivation signal to the first set of motors and the second set of motors may include providing a deactivation signal to the first set of motors and the second set of motors by a landing control module. The method (300) further includes activating a landing lever assembly to lock the elevator cabin the requested destination upon receiving a signal from the second set of sensors in step 370. In one embodiment, activating a landing lever assembly may include activating a landing lever assembly by the landing control module. The second set of sensors activates a guide pin of the landing lever assembly with further actuates a locking plate and lock the locking plate with guide rail of the elevator and stop the elevator cabin of the requested destination.

In one embodiment, the method (300) may include receiving load inside the elevator cabin from one or more weight sensors using an overload valve. In such an embodiment, the method (300) may also include comparing the load received from the one or more weight sensors with a predefined threshold to activate the second set of motors for movement of the elevator cabin. In one embodiment, the method (300) may include detecting a locking position of an elevator cabin door using one or more door locks and one or more door sensors. In a specific embodiment, the method (300) may include controlling the flow of air to and from one or more chambers in-order to move the elevator cabin in a tubular pathway. In some embodiment, the method (300) may also include activating a brake assembly to control the movement of the elevator cabin in at least one mode based on the movement of at least one spring

Various embodiments of the system and method to operate the pneumatic vacuum elevator described above enable simple system which may be incorporated into the controls of the elevator systems to provide a simple and expeditious means for permitting passengers to leave an elevator, safely and without any appreciable time delay in an event of a power failure or other malfunction occur.

The system includes weight sensors and speech prompting device, which may guarantee that the elevator will not be overweight. The management and control center is alarmed automatically so that staff can find failure in time and can repair.

The system has intelligence, efficient, energy-saving advantages which result in significant economic benefit and social benefit. The control unit stabilizes the pneumatic elevator and controls on the architecture basis. The control unit also provides high stability and strong anti-interference ability.

Furthermore, there is no intention to be bound by any expressed or implied theory presented in the preceding technical field, background, brief summary or the detailed description. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the specification, are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise.

While specific language has been used to describe the disclosure, any limitations arising on account of the same are not intended. As would be apparent to a person skilled in the art, various working modifications may be made to the method (250) in order to implement the inventive concept as taught herein.

The figures and the foregoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment. For example, order of processes described herein may be changed and are not limited to the manner described herein. Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all of the acts need to be necessarily performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples.

WE CLAIM:

1. A system (10) to operate a pneumatic vacuum elevator (200) comprising:

an electronic control unit (20) located on an external cylinder assembly (210) of the pneumatic vacuum elevator (200), wherein the electronic control unit (20) comprises:

a destination request gathering module (30) configured to receive a destination request command from a cabin operating panel (35) inside an elevator cabin;

an activation module (40) configured to:

provide a first activation signal to a first set of motors (50) based on the destination request command received from the destination request gathering module (30);

detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors (60) upon activation of the first set of motors (50); and

provide a second activation command to a second set of motors (70) upon detection of movement of the elevator cabin to control motion of the elevator cabin;

a detection module (80) operatively coupled to the activation module (40), wherein the detection module (80) is configured to detect presence of the elevator cabin at the requested destination using a second set of sensors (90) upon activation of the second set of motors (70); and

a landing control module (100) operatively coupled to the detection module (80), wherein the landing control module (100) is configured to:

provide a deactivation signal to the first set of motors (50) and the second set of motors (70) upon detecting the presence of the elevator cabin at the requested destination; and activate a landing lever assembly (110) to lock the elevator cabin on a guide rail at the requested destination upon receiving a signal from the second set of sensors (90).

2. The system (10) as claimed in claim 1, wherein the first set of sensors (50) comprises a pressure sensor, a force sensor, a position sensor and a tension sensor.

3. The system (10) as claimed in claim 1, wherein the second set of sensors (90) comprises a magnetic sensor and an acceleration sensor.

4. The system (10) as claimed in claim 1, wherein the electronic control unit (20) comprises a load detection module (120) configured to:

receive load inside the elevator cabin from one or more weight sensors using an overload valve; and

compare the load received from the one or more weight sensors with a predefined threshold using an overload valve to activate the second set of motors for movement of the elevator cabin.

5. The system (10) as claimed in claim 1, wherein the electronic control unit (20) comprises a lock detection module (130) configured to detect a locking position of an elevator cabin door using one or more door locks and one or more door sensors.

6. The system (10) as claimed in claim 1, wherein the electronic control unit (20) comprises an air flow control module (140) configured to control flow of air to and from one or more chambers in-order to move the elevator cabin in a tubular pathway.

7. The system (10) as claimed in claim 1, wherein the electronic control unit (20) comprises a brake control module (150) configured to activate a brake assembly to control the movement of the elevator cabin in at least one mode based on the movement of at least one spring.

8. A method (300) comprising:

receiving, by a destination request gathering module, a destination request command from a cabin operating panel inside an elevator cabin; (310)

providing, by an activation module, a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module; (320)

detecting, by the activation module, movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors; (330)

providing, by the activation module, a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin; (340)

detecting, by a detection module, presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors; (350)

providing, by a landing control module, a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination; (360) and

activating, by the landing control module, a landing lever assembly to lock the elevator cabin the requested destination upon receiving a signal from the second set of sensors. (370)

9. A pneumatic vacuum elevator (200) comprising:

an external cylinder assembly (210) comprising an elevator cabin (220) inserted therein, wherein the external cylinder assembly (210) comprises a plurality of cylinders coupled using a base ring assembly (211) and a band ring assembly (212);

a guide rail pillar (213) mechanically coupled to the elevator cabin (220), wherein the guide rail pillar (213) is disposed at the external cylinder assembly

(210), wherein the guide rail pillar (213) is configured to guide an actuation of the elevator cabin (220);

a polycarbonate sheet (214) configured to cover the external cylinder assembly (210), wherein the polycarbonate sheet (214) and the external cylinder assembly (210) is coupled using a first locking device and a second locking device, wherein the first locking device is configured to lock an air gap between the polycarbonate sheet (214), the base ring assembly (211) and the external cylinder assembly (210) and the second locking device is configured to lock air gap between the polycarbonate sheet (214) and the guide rail pillar (213);

a seal assembly (215) adapted to fit over a top portion of the elevator cabin (220), wherein the seal assembly (215) is configured to seal the elevator cabin (220) to reduce vibrations during upward and downward movement of the elevator cabin (220),

wherein the seal assembly (215) comprises a depressurizing system configured to prevent the elevator cabin from coming into force contact with the external cylinder assembly during upward movement and contribute to safety of an elevator operation; and

an electronic control unit (20) located on top of the external cylinder assembly (210), wherein the electronic control unit (20) comprises:

a destination request gathering module (30) configured to receive a destination request command from a cabin operating panel (35) inside an elevator cabin;

an activation module (40) configured to:

provide a first activation signal to a first set of motors (50) based on the destination request command received from the destination request gathering module (30);

detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors (60) upon activation of the first set of motors (50); and provide a second activation command to a second set of motors (70) upon detection of movement of the elevator cabin to control motion of the elevator cabin;

a detection module (80) operatively coupled to the activation module (40), wherein the detection module (80) is configured to detect presence of the elevator cabin at the requested destination using a second set of sensors (90) upon activation of the second set of motors (70); and

a landing control module (100) operatively coupled to the detection module (80), wherein the landing control module (100) is configured to:

provide a deactivation signal to the first set of motors (50) and the second set of motors (70) upon detecting the presence of the elevator cabin at the requested destination; and

activate a landing lever assembly (110) to lock the elevator cabin on a guide rail at the requested destination upon receiving a signal from the second set of sensors (90).

10. The elevator as claimed in claim 9, wherein the electronic control unit (20) comprises a noise suppression module operatively coupled to:

an integrated noise suppression apparatus (221) configured to absorb noise generated during operation of the pneumatic vacuum elevator upon air being circulated sequentially from a plurality of layers of a silencer unit; and

a split noise suppression apparatus (222) configured to absorb noise developed upon air circulation using a noise absorption material and reduce vibration of a split unit during the operation of the pneumatic vacuum elevator using a plurality of anti-vibration pads.

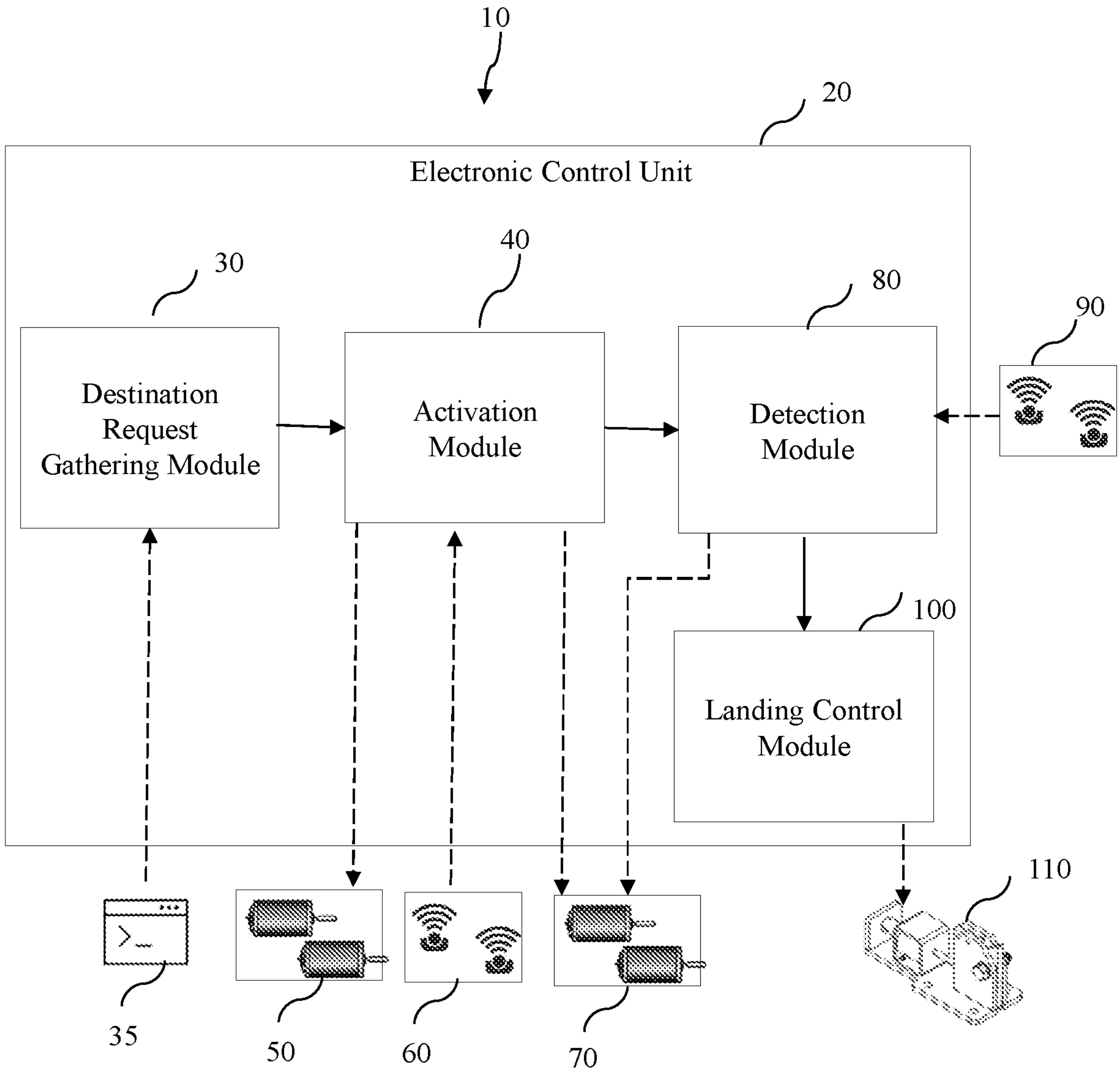
10
20
Electronic Control Unit
30
Destination Request Gathering Module
40
Activation Module
80
Detection Module
90
100
Landing Control Module
110
35
50
60
70

FIG. 1

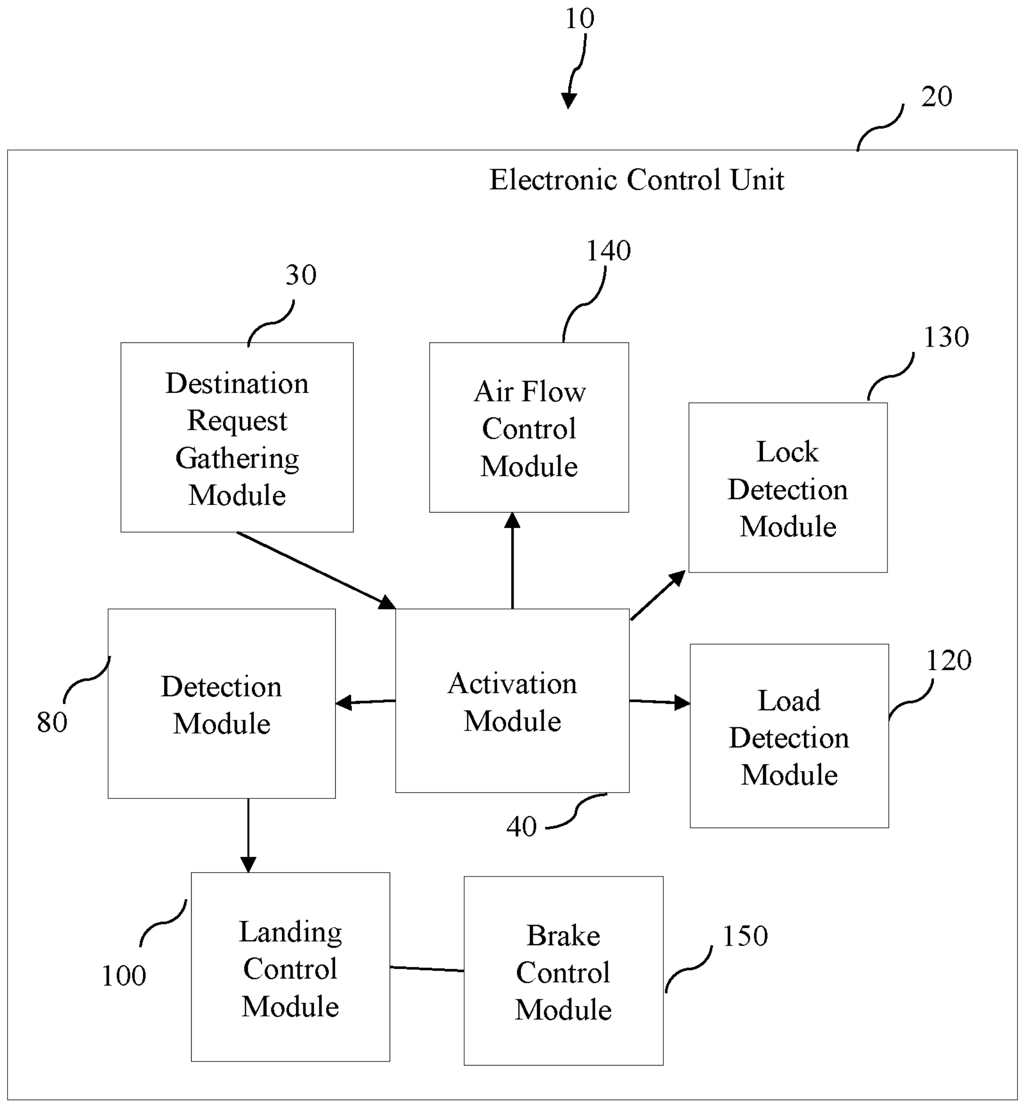
10
20
Electronic Control Unit
30
Destination Request Gathering Module
140
Air Flow Control Module
130
Lock Detection Module
Detection Module
80
Activation Module
40
Load Detection Module
120
Landing Control Module
100
Brake Control Module
150

FIG. 2

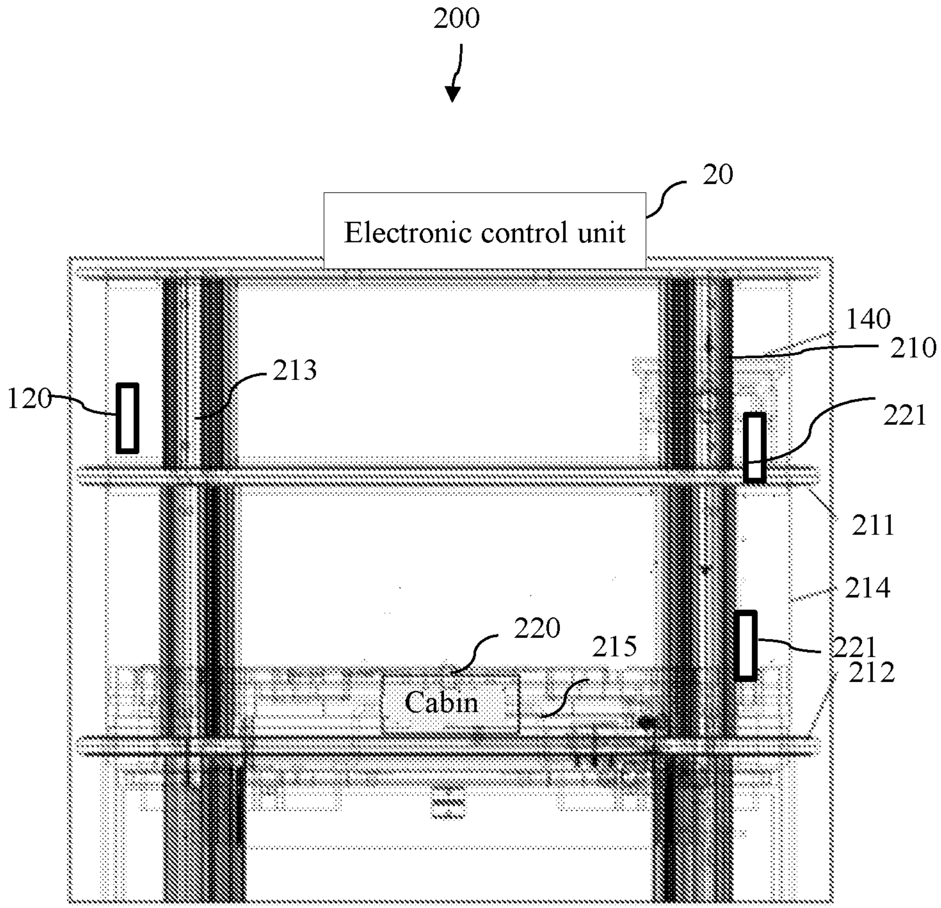
200
20
Electronic control unit
140
210
213
120
221
211
214
220
215
221
212
Cabin

FIG. 3

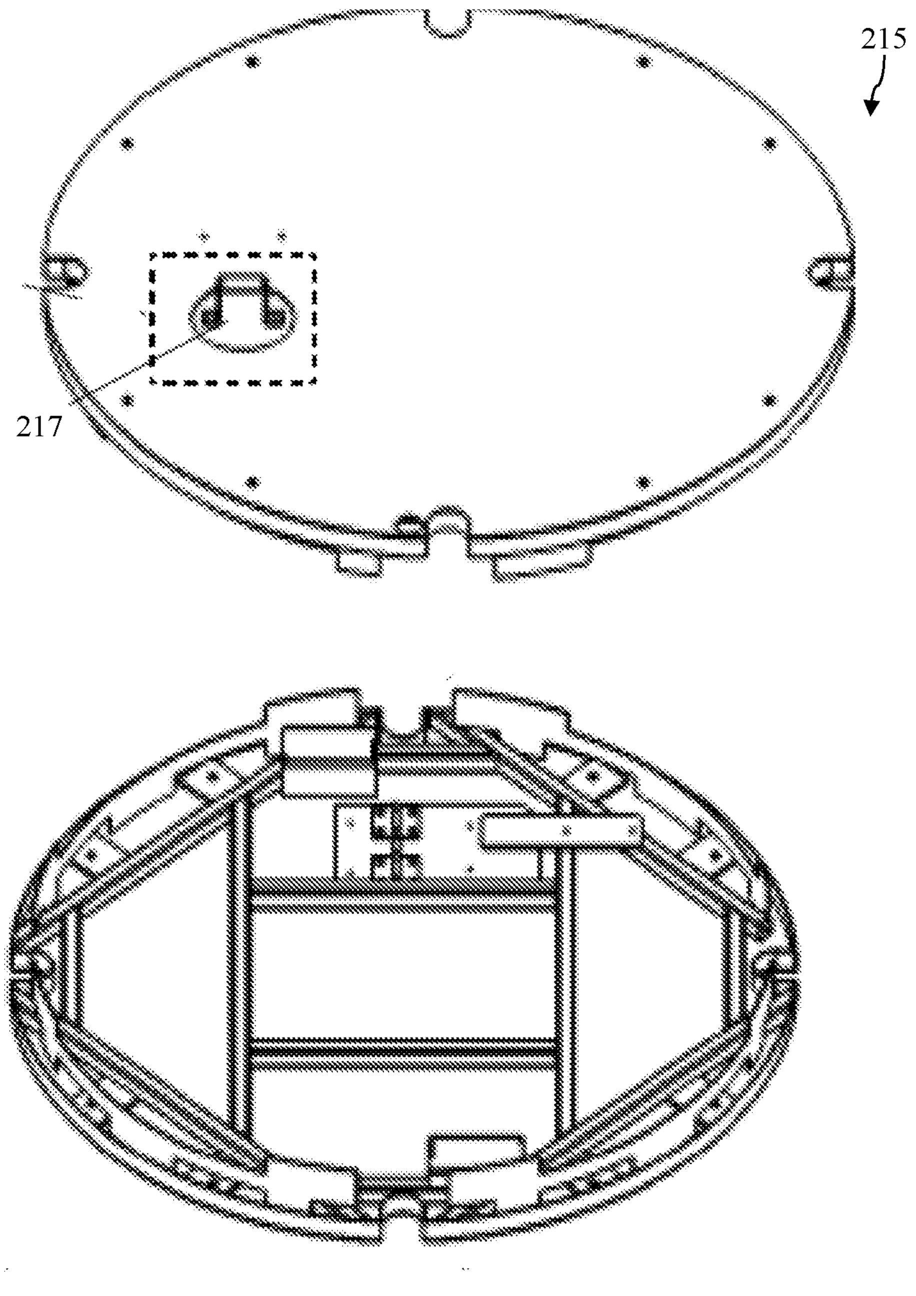

FIG. 3(a)

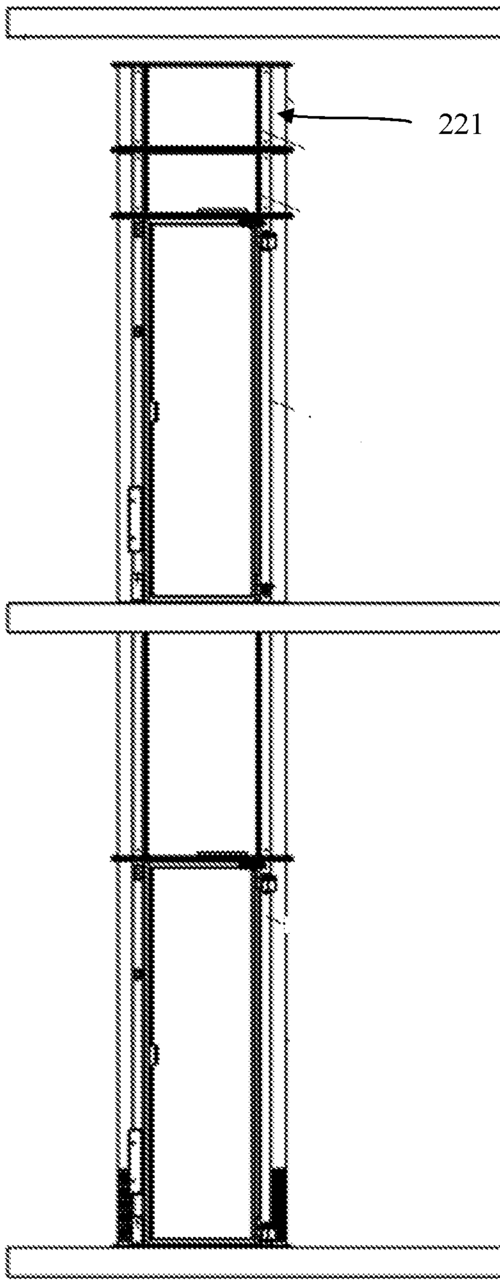

FIG. 3(b)

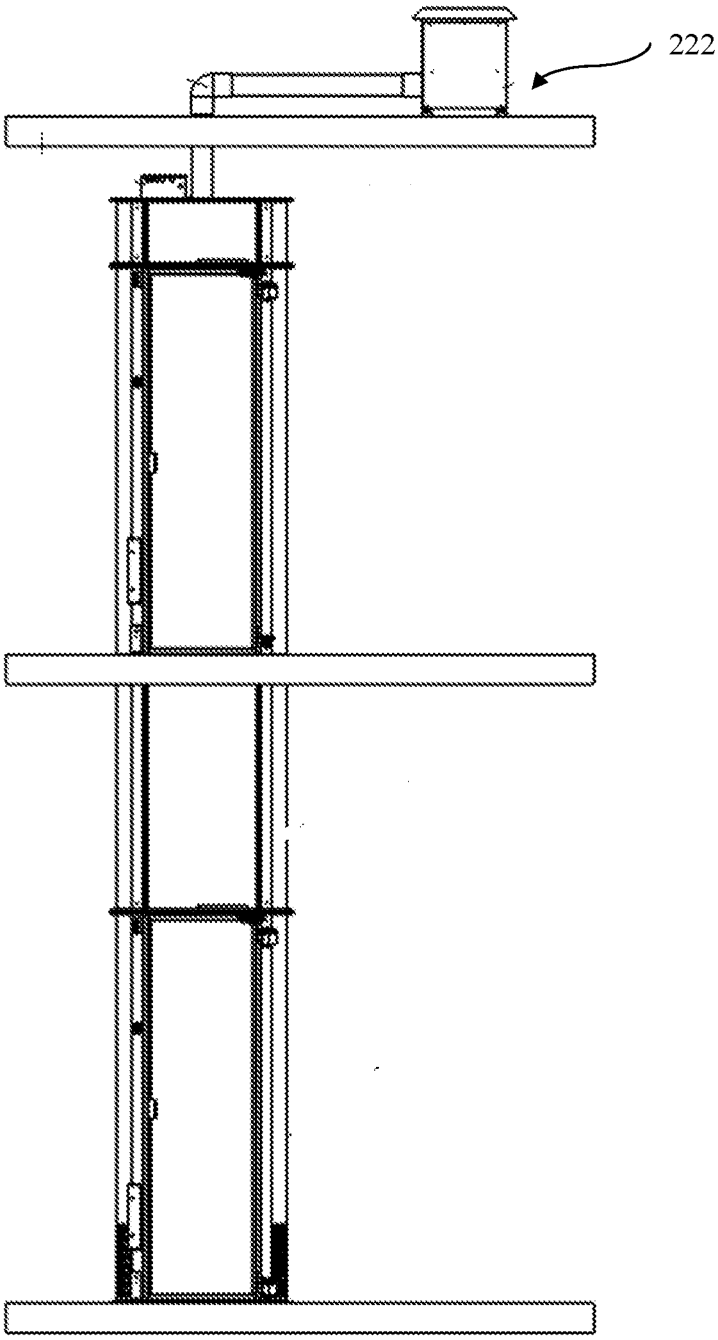

FIG. 3(c)

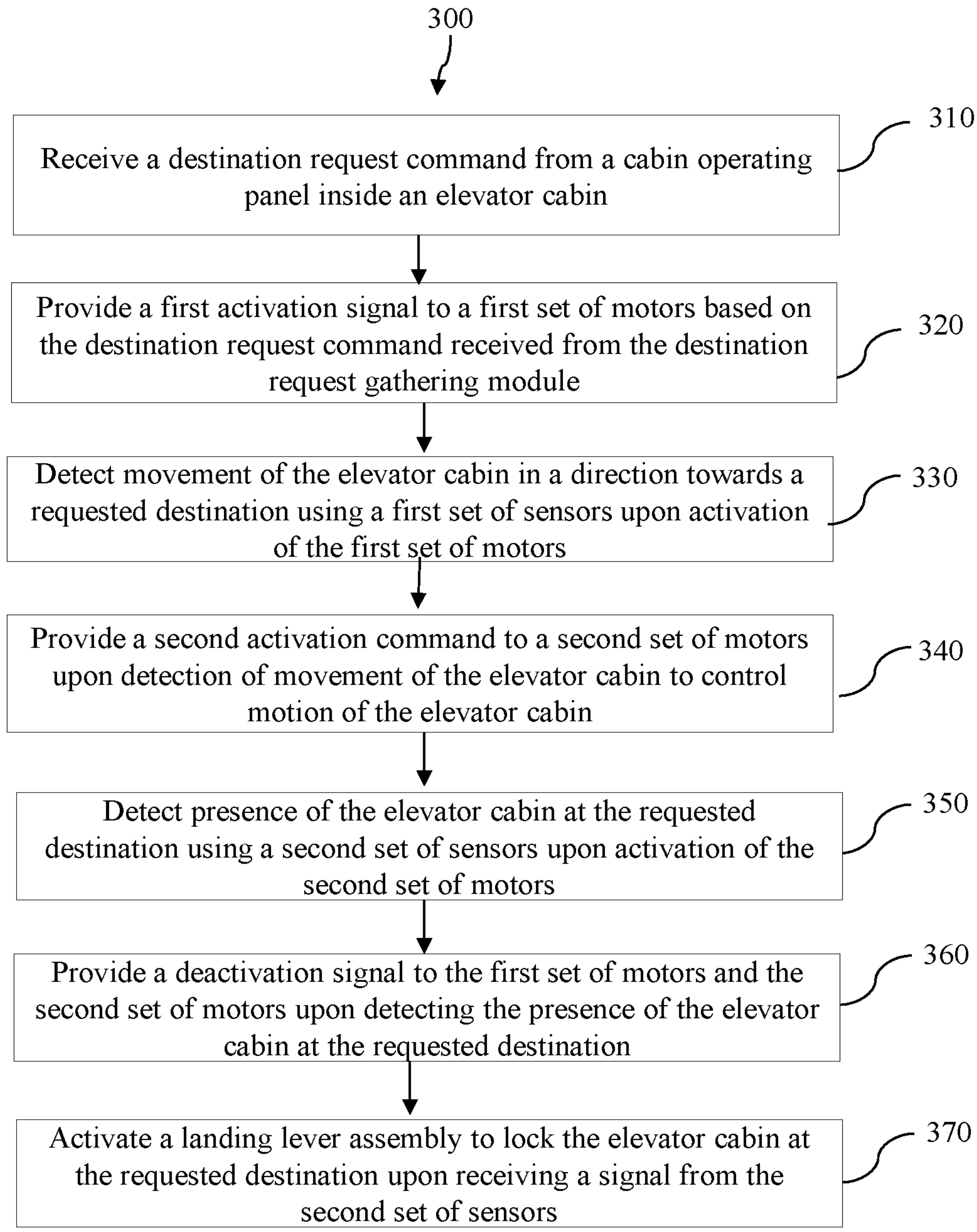
300
Receive a destination request command from a cabin operating panel inside an elevator cabin
310
Provide a first activation signal to a first set of motors based on the destination request command received from the destination request gathering module
320
Detect movement of the elevator cabin in a direction towards a requested destination using a first set of sensors upon activation of the first set of motors
330
Provide a second activation command to a second set of motors upon detection of movement of the elevator cabin to control motion of the elevator cabin
340
Detect presence of the elevator cabin at the requested destination using a second set of sensors upon activation of the second set of motors
350
Provide a deactivation signal to the first set of motors and the second set of motors upon detecting the presence of the elevator cabin at the requested destination
360
Activate a landing lever assembly to lock the elevator cabin at the requested destination upon receiving a signal from the second set of sensors
370

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2020/058416

A. CLASSIFICATION OF SUBJECT MATTER
B66B9/04,B66B1/28 Version=2020.01

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B66B

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

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

TotalPatent One, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN104803263A (KUNSHAN KOYO ELEVATOR CO LTD ; 29 Jul 2015) the entire document (as per Google Patent translation)	1-8
Y	CN104803263A (KUNSHAN KOYO ELEVATOR CO LTD ; 29 Jul 2015) the entire document (as per Google Patent translation)	9-10
Y	IN202041023104A (KILLAKATHU RAMANATHAN BABU ; 12 Jun 2020) abstract; para [0022] - [0023]; figures	9-10
Y	IN202041023097A (KILLAKATHU RAMANATHAN BABU ; 12 Jun 2020) abstract; para [0029]; figures	9-10
Y	IN202041023098A (KILLAKATHU RAMANATHAN BABU ; 12 Jun 2020) abstract	10
Y	IN202041023095A (KILLAKATHU RAMANATHAN BABU ; 12 Jun 2020) abstract	10

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23-11-2020	23-11-2020

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Krishan Kumar Telephone No. +91-1125300200