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(72) Inventor: **Rocher, Jean-Emile**
45500 Gien (FR)

(74) Representative: **Schmitt-Nilson Schraud Waibel
Wohlfrom**
Patentanwälte Partnerschaft mbB
Pelkovenstraße 143
80992 München (DE)

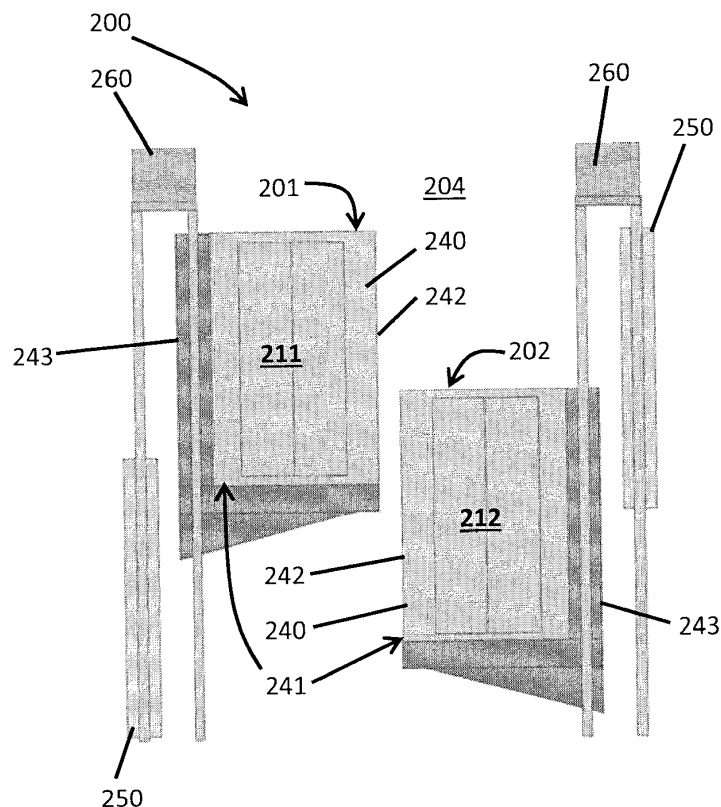
(71) Applicant: **Otis Elevator Company**
Farmington, Connecticut 06032 (US)

(54) **SCALABLE ELEVATOR CAR FRAME**

(57) A scalable elevator system is provided and includes a first elevator movable in a hoistway in upward and downward directions, a second elevator movable in the hoistway in the upward and downward directions and

a removable insert. The removable insert is securable to complementary sides of the first and second elevators such that the first and second elevators and the removable insert jointly define a combined interior.

FIG. 2



Description

[0001] The following description relates to elevator systems and, more specifically, to an elevator system with an elevator car that is scalable.

[0002] Elevator systems are typically deployed in multi-floor buildings to transport individuals, luggage and certain other types of loads from floor to floor. A given elevator system can include multiple elevators and, in some cases, one or more freight elevators. The multiple elevators and the freight elevator can each include an elevator car that moves upwardly and downwardly through a hoistway, a driving element that drives the movement of the elevator car and a control system that controls the driving element.

[0003] In conventional elevator systems, each of the elevators and each of the freight elevators is dedicated to a particular usage and has a predefined and fixed duty load and surface. That is, in a given elevator system with three elevators and one freight elevator, for example, the three elevators may have a maximum duty load and a bottom surface of a certain surface area while the freight elevator might have a slightly larger maximum duty load and a bottom surface with a slightly larger surface area. Thus, a load that is heavier than the maximum duty load of any of the elevators or the freight elevator might not be transportable by the elevator system. Similarly, a load that does not fit into any of the elevators or the freight elevator as a result of the load having a dimension which exceeds a corresponding dimension of the elevators and the freight elevator might also not be transportable by the elevator system.

[0004] According to an aspect of the disclosure, a scalable elevator system is provided and includes a first elevator movable in a hoistway in upward and downward directions, a second elevator movable in the hoistway in the upward and downward directions and a removable insert. The removable insert is securable to complementary sides of the first and second elevators such that the first and second elevators and the removable insert jointly define a combined interior.

[0005] In accordance with additional or alternative embodiments, each of the first and second elevators is individually configured as a cantilever elevator.

[0006] In accordance with additional or alternative embodiments, each of the first and second elevators includes an elevator car comprising a car frame with at least one first side proximate to and facing toward another elevator car and at least one second side which faces away from the another elevator car, a counterweight, which is coupled to the elevator car and disposed at the at least one second side of the car frame and a driving machine, which is configured to drive upward and downward movements of the elevator car in the hoistway against a weight of the counterweight.

[0007] In accordance with additional or alternative embodiments, the first and second elevators each include a removable and stowable car frame side.

[0008] In accordance with additional or alternative embodiments, the removable insert includes at least a floor which is securable at opposite sides thereof to respective floors of the first and second elevators and front and back sides which are respectively securable at respective opposite sides thereof to respective front and back sides of the first and second elevators.

[0009] In accordance with additional or alternative embodiments, the first and second elevators and the removable insert are configured to be arranged in at least one of side-to-side formations, back-to-back formations and side-to-back formations.

[0010] In accordance with additional or alternative embodiments, a control system is configured to control the respective upward and downward movements of the first and second elevator cars independently or dependently.

[0011] According to another aspect of the disclosure, a scalable elevator system is provided and includes first and second elevators respectively movable in a hoistway in upward and downward directions and a removable insert. The first and second elevators are operable in a normal mode characterized in that the first and second elevators are operated independently of one another and in a scaled mode characterized in that the first and second elevators are operated dependently. The first and second elevators are respectively configurable to independently define first and second separate and independent interiors adapted for the normal mode and to jointly define, with the removable insert removably inserted between respective proximal sides of the first and second elevators, a combined interior adapted for the scaled mode.

[0012] In accordance with additional or alternative embodiments, each of the first and second elevators is individually configured as a cantilever elevator.

[0013] In accordance with additional or alternative embodiments, wherein each of the first and second elevators includes an elevator car comprising a car frame with at least one first side proximate to and facing toward another elevator car and at least one second side which faces away from the another elevator car, a counterweight, which is coupled to the elevator car and disposed at the at least one second side of the car frame and a driving machine, which is configured to drive upward and downward movements of the elevator car in the hoistway against a weight of the counterweight.

[0014] In accordance with additional or alternative embodiments, the first and second elevators each include a removable and stowable car frame side.

[0015] In accordance with additional or alternative embodiments, the removable insert includes at least a floor which is securable at opposite sides thereof to respective floors of the first and second elevators and front and back sides which are respectively securable at respective opposite sides thereof to respective front and back sides of the first and second elevators.

[0016] In accordance with additional or alternative embodiments, the first and second elevators and the remov-

able insert are configured to be arranged in at least one of side-to-side formations, back-to-back formations and side-to-back formations.

[0017] In accordance with additional or alternative embodiments, a control system is configured to control the respective upward and downward movements of the first and second elevator cars independently when the normal mode is in effect and dependency when the scaled mode is in effect.

[0018] In accordance with additional or alternative embodiments, the control system is configured to at least one of confirm that the removable insert is secured to the first and second elevators when the scaled mode is initiated and prior to dependent operations and maintain synchronicity in the dependent control of the respective upward and downward movements of the first and second elevator cars when the scaled mode is in effect.

[0019] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

[0020] The subject matter, which is regarded as the disclosure, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features and advantages of the disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of an elevator system in accordance with embodiments;

FIG. 2 is a side view of adjacent cantilever elevators in an elevator system similar to that of FIG. 1 which are operating in a normal mode in accordance with embodiments;

FIG. 3 is a side view of adjacent cantilever elevators in an elevator system similar to that of FIG. 1 which are operating in a scaled mode in accordance with embodiments;

FIG. 4 is a schematic side view of an elevator with a removable and stowable elevator car side in accordance with embodiments;

FIG. 5 is a perspective view of a removable insert which is insertable between first and second elevators in accordance with embodiments;

FIG. 6 is a schematic top-down view of an elevator system that is operable in a scaled mode in accordance with embodiments;

FIG. 7 is a schematic top-down view of an elevator system that is operable in a scaled mode in accordance with embodiments;

FIG. 8 is a schematic top-down view of an elevator

system that is operable in a scaled mode in accordance with embodiments;

FIG. 9 is a schematic diagram illustrating components of a control system for controlling an elevator system in accordance with embodiments;

FIG. 10 is a flow diagram illustrating a method of operating an elevator system in accordance with embodiments; and

FIG. 11 is a schematic side view of a compliant insert in accordance with embodiments.

[0021] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

[0022] As will be described below, a scalable elevator system (or freight elevator system) is provided. The scalable elevator system is based on the use of two cantilever elevators in a same hoistway with counterweights (CWTs) on non-intervening sides. When in use, the two cantilever elevators can be modified such that no separator beam or car guide rail is positioned between them. In a first operational configuration (i.e., a normal mode), the two cantilever elevators work independently. Conversely, in a second operational mode (i.e., a scaled mode), the cantilever elevators are merged. The merge results in the two cantilever elevators essentially operating as a single large elevator and is achieved by the platforms and paneling of each of the two cantilever elevators being linked to close the gap between them and by their complementary paneling being suppressed or removed in order to obtain the one single, large-size elevator. This single, large-size elevator will have two entrances in front and paired drive and machine operations.

[0023] FIG. 1 is a perspective view of an elevator system 101 including an elevator car 103, a counterweight 105, a roping 107, a guide rail 109, a machine 111, a position encoder 113, and a controller 115. The elevator car 103 and counterweight 105 are connected to each other by the roping 107. The roping 107 may include or be configured as, for example, ropes, steel cables, and/or coated-steel belts. The counterweight 105 is configured to balance a load of the elevator car 103 and is configured to facilitate movement of the elevator car 103 concurrently and in an opposite direction with respect to the counterweight 105 within an elevator shaft 117 and along the guide rail 109.

[0024] The roping 107 engages the machine 111, which is part of an overhead structure of the elevator system 101. The machine 111 is configured to control movement between the elevator car 103 and the counterweight 105. The position encoder 113 may be mounted on an upper sheave of a speed-governor system 119 and may be configured to provide position signals related to a position of the elevator car 103 within the elevator shaft 117. In other embodiments, the position encoder

113 may be directly mounted to a moving component of the machine 111, or may be located in other positions and/or configurations as known in the art.

[0025] The controller 115 is located, as shown, in a controller room 121 of the elevator shaft 117 and is configured to control the operation of the elevator system 101, and particularly the elevator car 103. For example, the controller 115 may provide drive signals to the machine 111 to control the acceleration, deceleration, leveling, stopping, etc. of the elevator car 103. The controller 115 may also be configured to receive position signals from the position encoder 113. When moving up or down within the elevator shaft 117 along guide rail 109, the elevator car 103 may stop at one or more landings 125 as controlled by the controller 115. Although shown in a controller room 121, those of skill in the art will appreciate that the controller 115 can be located and/or configured in other locations or positions within the elevator system 101.

[0026] The machine 111 may include a motor or similar driving mechanism. In accordance with embodiments of the disclosure, the machine 111 is configured to include an electrically driven motor. The power supply for the motor may be any power source, including a power grid, which, in combination with other components, is supplied to the motor.

[0027] Although shown and described with a roping system, elevator systems that employ other methods and mechanisms of moving an elevator car within an elevator shaft, such as hydraulic and/or ropeless elevators, may employ embodiments of the present disclosure. FIG. 1 is merely a non-limiting example presented for illustrative and explanatory purposes.

[0028] With reference to FIGS. 2 and 3, a scalable elevator system 200 is provided. The scalable elevator system 200 is generally provided in a similar configuration as the elevator system 101 of FIG. 1 except that, where the elevator system 101 of FIG. 1 includes a single elevator, the scalable elevator system 200 of FIGS. 2 and 3 includes a first elevator 201, a second elevator 202 and a removable insert 203 (see FIG. 3).

[0029] The first elevator 201 and the second elevator 202 may each be individually configured as a cantilever elevator and they are respectively movable in a hoistway 204 in respective upward and downward directions. The first and second elevators 201 and 202 are operable in a normal mode and a scaled mode. In the normal mode, the first and second elevators 201 and 202 are operated independently of one another. In the scaled mode, the first and second elevators 201 and 202 are operated dependently. To these ends, the first and second elevators 201 and 202 are respectively configurable to independently define a first interior 211 and a second interior 212, which is separate and distinct from the first interior 211, where the first and second interiors 211 and 212 are adapted for use with the normal mode. Conversely, the first and second elevators 201 and 202 are respectively configurable to jointly define, with the removable insert

203 having been removably inserted between respective proximal sides 221 and 222 of the first and second elevators 201 and 202, a combined interior 213 where the combined interior 213 is adapted for the scaled mode.

[0030] As shown in FIGS. 2 and 3, each of the first and second elevators 201 and 202 includes an elevator car 240, a counterweight 250 and a driving machine 260. The elevator car 240 includes a car frame 241 with at least one first side 242 that is proximate to and facing toward another elevator car (i.e., at the respective proximal sides 221, 222) and at least one second side 243 which faces away from the another elevator car. The counterweight 250 is coupled to the elevator car 240 as described above in the text accompanying FIG. 1 and is disposed at the at least one second side 243 of the car frame 241. Thus, the counterweight 250 is not provided in an intervening position between the first and second elevators 201 and 202. The driving machine 260 may be provided as a single or separate driving machines and, in either case, is configured to drive upward and downward movements of the elevator car 240 in the hoistway 204 against a weight or load of the counterweight 250.

[0031] With reference to FIG. 4, the car frames 241 of the elevator cars 240 of each of the first and second elevators 201 and 202 include a removable and stowable car frame side 270. The removable and stowable car frame sides 270 may be provided initially at the at least one first sides 242 (see FIGS. 2 and 3) so that, when they are installed during the normal mode, they are proximate to one another and face in opposite directions. Conversely, when the removable and stowable car frame sides 270 are removed and eventually stowed during the scaled mode, the removable and stowable car frame sides 270 can be positioned in stowed locations (e.g., atop the car frames 241). As shown in FIG. 4, each removable and stowable car frame side 270 can be removed and stowed by a rotational and sliding movement thereof, which is illustrated by the arrow of FIG. 4 and which moves the removable and stowable car frame side 270 from the at least one first side 242, about and along an upper edge of the car frame 241 until the removable and stowable car frame side 270 sits atop the car frame 241.

[0032] With reference to FIGS. 3 and 5, the removable insert 203 includes at least a floor portion 280, a front portion 281 and a back portion 282. The floor portion 280 is securable at opposite sides thereof to respective floors of the first and second elevators 201 and 202. The front portion 281 is securable at opposite sides thereof to respective front sides of the first and second elevators 201 and 202. The back portion 282 is securable at opposite sides thereof to respective backs of the first and second elevators 201 and 202. The removable insert 203 may also include a ceiling portion (not shown) that is securable at opposite sides thereof to respective ceilings of the first and second elevators 201 and 202. Thus, while the first and second elevators 201 and 202 are formed to define the first and second interiors 211 and 212 with the re-

movable and stowable car frame sides 270 disposed at the least one first sides 242, the first and second elevators 201 and 202 and the removable insert 203 effectively define the combined interior 213 with the removable and stowable car frame sides 270 removed and stowed and with the removable insert 203 removably inserted between the respective proximal sides 221 and 222 of the first and second elevators 201 and 202.

[0033] With reference to FIGS. 6-8, the first and second elevators 201 and 202 and the removable inserts 203 may be arranged in various configurations including, but not limited to, at least one of side-to-side formations 601 (see FIG. 6), back-to-back formations 701 (see FIG. 7) and side-to-back formations 801 (see FIG. 8). In the side-to-side formations 601 of FIG. 6, the combined interiors 213 of the pairs of first and second elevators 201 and 202 and the removable inserts 203 have elongate widths that exceed the widths of the first and second elevators 201 and 202 alone. In the back-to-back formations 701 of FIG. 7, the combined interiors 213 of the pairs of first and second elevators 201 and 202 and the removable inserts 203 have elongate lengths that exceed the lengths of the first and second elevators 201 and 202 alone. In the side-to-back formations 801 of FIG. 8, the combined interior 213 of the second elevator 202 sandwiched between the first elevators 201 and the removable inserts 203 has an elongate width that is substantially elongate as compared to the widths of the second elevator 202 and the first elevators 201 alone.

[0034] It is to be understood that the various configurations of FIG. 6-8 are merely exemplary and that other configurations are possible. For example, additional removable inserts 203 can be removably inserted between the first elevators 201 in the back-to-back configuration of FIG. 7 to effectively redefine the combined interior 213 into a continuous squared shape. As another example, the side-to-back formations 801 of FIG. 8 can include multiple second elevators 202 with additional removable inserts 203 removably installed.

[0035] With reference to FIG. 9, the elevator system 200 of FIGS. 2 and 3 can include a control system 901 that is configured to control the respective upward and downward movements of the elevator cars 240 of the first and second elevators 201 and 202 independently when the normal mode is in effect and dependently when the scaled mode is in effect. The control system 901 is configured to confirm that the removable insert 203 is secured to the first and second elevators 201 and 202 when the scaled mode is initiated and prior to dependent operations and to maintain synchronicity in the dependent control of the respective upward and downward movements of the elevator cars 240 of the first and second elevators 201 and 202 when the scaled mode is in effect.

[0036] As shown in FIG. 9, the control system 901 includes a processing unit 910, a memory unit 920, a sensing unit 930 and a servo control unit 940 all of which are intercommunicative via a common bus 950. The sensing

unit 930 is disposed and configured to sense and determine whether the removable insert 203 is properly secured to the first and second elevators 201 and 202 and to sense and determine relative positioning, velocities and/or accelerations of the first and second elevators 201 and 202 during at least the scaled mode being in effect. The servo control unit 940 is disposed and configured to issue commands to the driving machine(s) 260 in accordance with instructions received from the processing unit 910. The memory unit 920 has executable instructions stored thereon, which are readable and executable by the processing unit 910. When the executable instructions are read and executed by the processing unit 910, the executable instructions cause the processing unit 910 to operate as described herein.

[0037] In particular, with reference to FIG. 10, when the executable instructions are read and executed by the processing unit 910, the executable instructions cause the processing unit 910 to execute a method of operating the scalable elevator system 200 of FIGS. 2 and 3. As shown in FIG. 10, the method includes determining whether a normal mode or a scaled mode is currently selected (1001). In an event the normal mode is currently selected, the method includes confirming that the first and second elevators are configured for normal mode operations (1002) and accordingly operating the first and second elevators independently (1003). In an event the scaled mode is currently selected, the method further includes confirming that the first and second elevators are configured for scaled mode operations with the removable insert secured to the complementary proximal sides of the first and second elevators (1004) and accordingly operating the first and second elevators dependently (1005). In accordance with embodiments, the dependent operating may include identifying an asynchronous condition between the first and second elevators from sensing results of the sensing unit (1006) and adjusting dependent operations of the first and second elevators to correct the asynchronous condition (1007). That is, if the sensing unit 930 senses that one of the first and second elevators is moving upwardly faster than the other during the dependent operations, the processing unit 910 will instruct the servo control unit 940 to cause the driving machine(s) to slow down the leading elevator or to speed up the lagging elevator so as to bring the first and second elevators into a more synchronous condition.

[0038] With reference to FIG. 11, to the extent that the first and second elevators 201 and 202 may be operated asynchronously for at least a moment during the dependent operations, the removable insert 203 may be provided with a compliant capability. The compliant capability can be embodied in a material of the removable insert 203 or in flexible connections 1101 and 1102 of the removable insert 203 with the first and second elevators 201 and 202.

[0039] Technical effects and benefits of the present disclosure are the merging or separating of contiguous elevators (two or more elevators) so that a customer can

adapt them according to need. For example, during construction of the building, the paired configuration can be rapidly merged and used to transport heavy and large materials. Then, during the regular usage of the building, the elevators can be unpaired to transport people.

[0040] While the disclosure is provided in detail in connection with only a limited number of embodiments, it should be readily understood that the disclosure is not limited to such disclosed embodiments. Rather, the disclosure can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the disclosure. Additionally, while various embodiments of the disclosure have been described, it is to be understood that the exemplary embodiment(s) may include only some of the described exemplary aspects. Accordingly, the disclosure is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

Claims

1. A scalable elevator system, comprising:

a first elevator movable in a hoistway in upward and downward directions;
a second elevator movable in the hoistway in the upward and downward directions; and
a removable insert, which is securable to complementary sides of the first and second elevators such that the first and second elevators and the removable insert jointly define a combined interior.

2. The scalable elevator system according to claim 1, wherein each of the first and second elevators is individually configured as a cantilever elevator.

3. The scalable elevator system according to either of claims 1 or 2, wherein each of the first and second elevators comprises:

an elevator car comprising a car frame with at least one first side proximate to and facing toward another elevator car and at least one second side which faces away from the another elevator car;
a counterweight, which is coupled to the elevator car and disposed at the at least one second side of the car frame; and
a driving machine, which is configured to drive upward and downward movements of the elevator car in the hoistway against a weight of the counterweight.

4. The scalable elevator system according to any of

claims 1-3, wherein the first and second elevators each comprise a removable and stowable car frame side.

5. The scalable elevator system according to any of claims 1-4, wherein the removable insert comprises at least:

a floor which is securable at opposite sides thereof to respective floors of the first and second elevators; and
front and back sides which are respectively securable at respective opposite sides thereof to respective front and back sides of the first and second elevators.

6. The scalable elevator system according to any of claims 1-5, wherein the first and second elevators and the removable insert are configured to be arranged in at least one of side-to-side formations, back-to-back formations and side-to-back formations.

7. The scalable elevator system according to any of claims 1-6, further comprising a control system configured to control the respective upward and downward movements of the first and second elevator cars independently or dependently.

8. A scalable elevator system, comprising:

first and second elevators respectively movable in a hoistway in upward and downward directions; and
a removable insert,
the first and second elevators being operable in a normal mode in which the first and second elevators are operated independently of one another and in a scaled mode in which the first and second elevators are operated dependently, and
the first and second elevators being respectively configurable to independently define first and second separate and independent interiors adapted for the normal mode and to jointly define, with the removable insert removably inserted between respective proximal sides of the first and second elevators, a combined interior adapted for the scaled mode.

9. The scalable elevator system according to claim 8, wherein each of the first and second elevators is individually configured as a cantilever elevator.

10. The scalable elevator system according to either of claims 8 or 9, wherein each of the first and second elevators comprises:

an elevator car comprising a car frame with at least one first side proximate to and facing toward another elevator car and at least one second side which faces away from the another elevator car; 5
 a counterweight, which is coupled to the elevator car and disposed at the at least one second side of the car frame; and
 a driving machine, which is configured to drive upward and downward movements of the elevator car in the hoistway against a weight of the counterweight. 10

11. The scalable elevator system according to any of claims 8-10, wherein the first and second elevators each comprise a removable and stowable car frame side. 15

12. The scalable elevator system according to any of claims 8-11, wherein the removable insert comprises at least: 20

a floor which is securable at opposite sides thereof to respective floors of the first and second elevators; and 25
 front and back sides which are respectively securable at respective opposite sides thereof to respective front and back sides of the first and second elevators. 30

13. The scalable elevator system according to any of claims 8-12, wherein the first and second elevators and the removable insert are configured to be arranged in at least one of side-to-side formations, back-to-back formations and side-to-back formations. 35

14. The scalable elevator system according to any of claims 8-13, further comprising a control system configured to control the respective upward and downward movements of the first and second elevator cars independently when the normal mode is in effect and dependently when the scaled mode is in effect. 40

15. The scalable elevator system according to any of claims 8-14, wherein the control system is configured to at least one of: 45

confirm that the removable insert is secured to the first and second elevators when the scaled mode is initiated and prior to dependent operations, and 50
 maintain synchronicity in the dependent control of the respective upward and downward movements of the first and second elevator cars when the scaled mode is in effect. 55

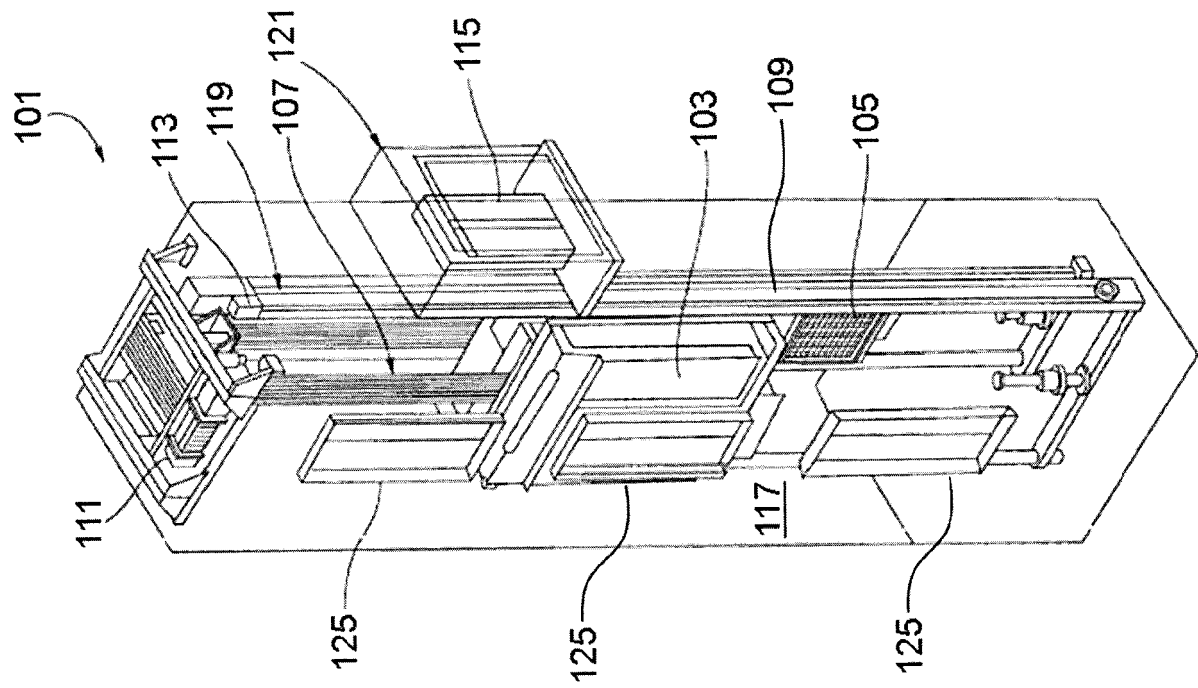


FIG. 1

FIG. 3

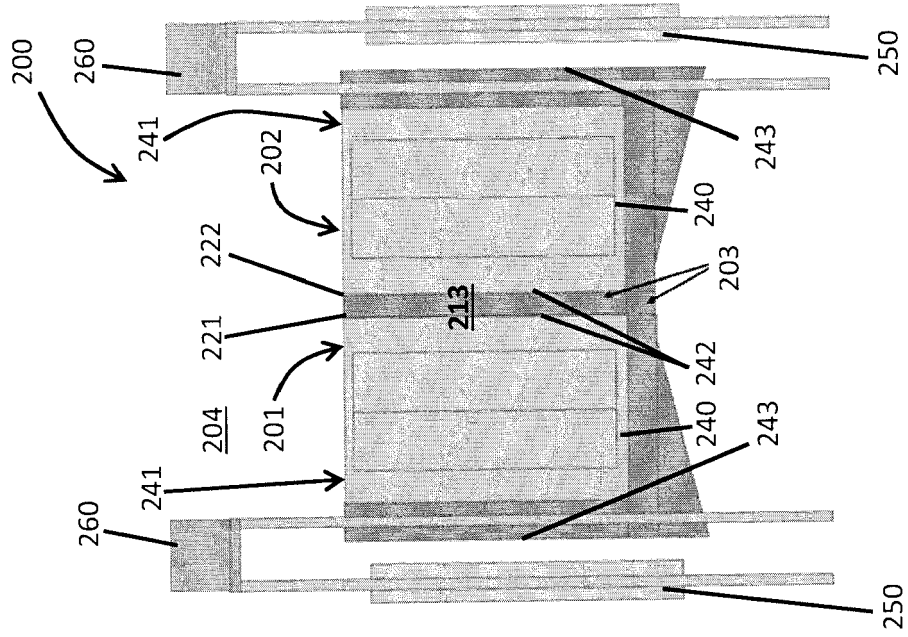


FIG. 2

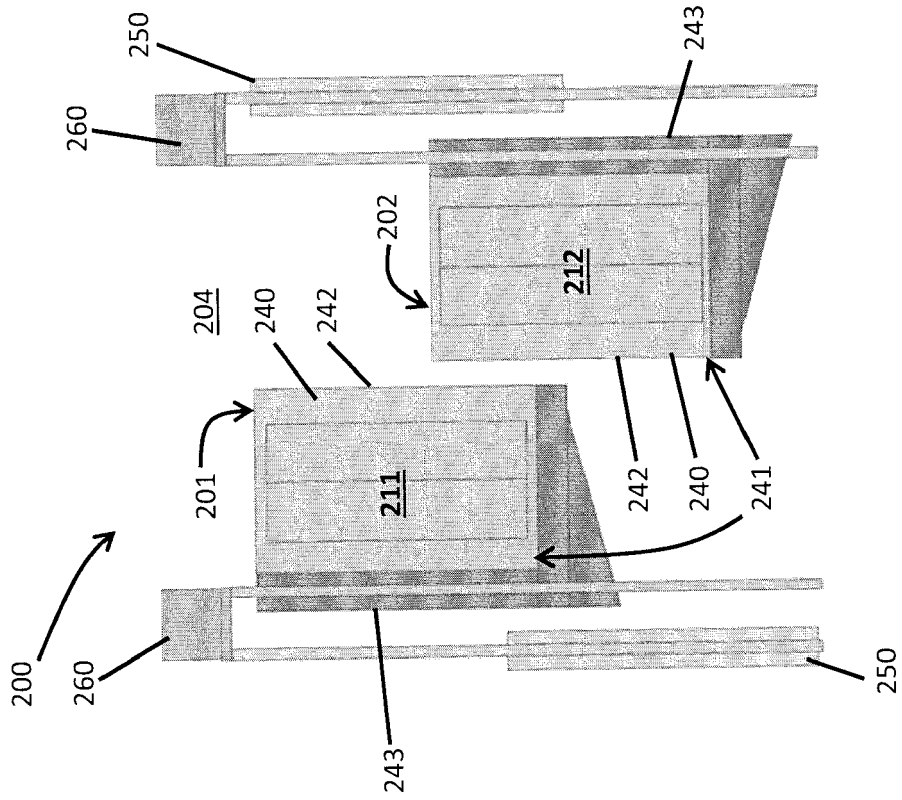


FIG. 5

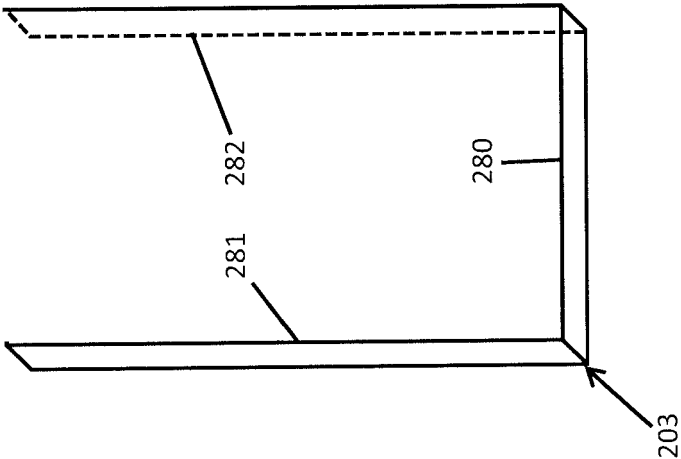


FIG. 4

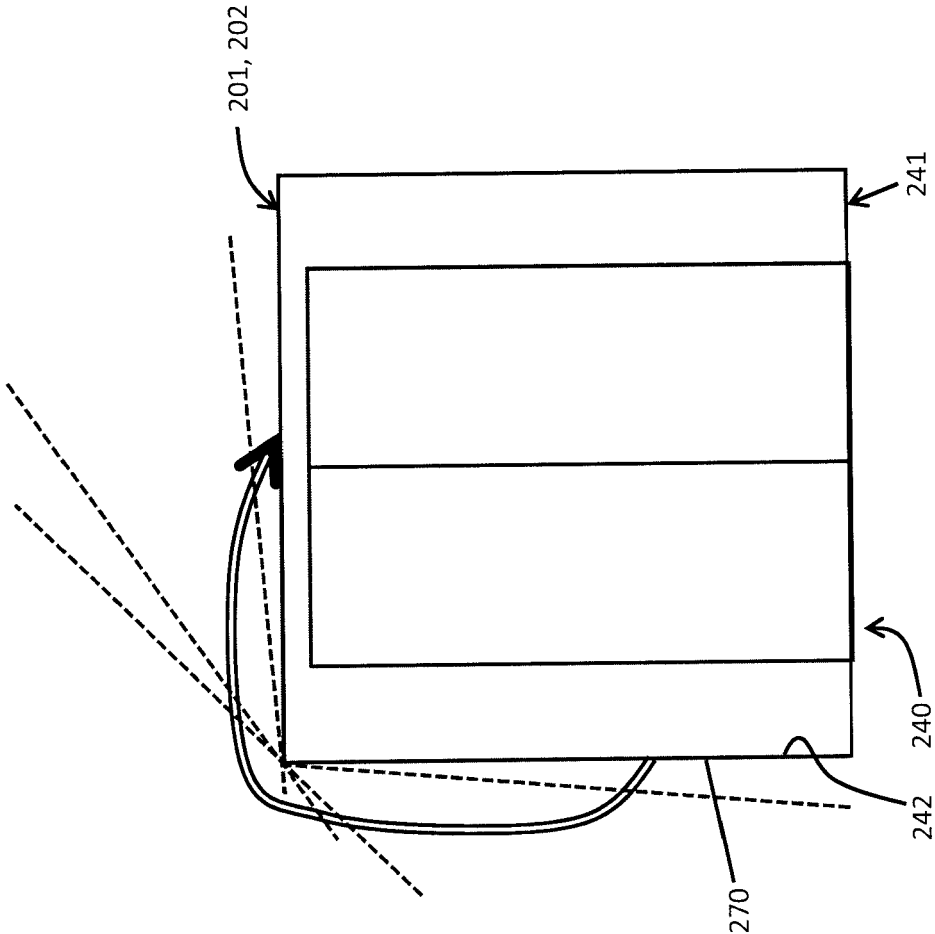


FIG. 6

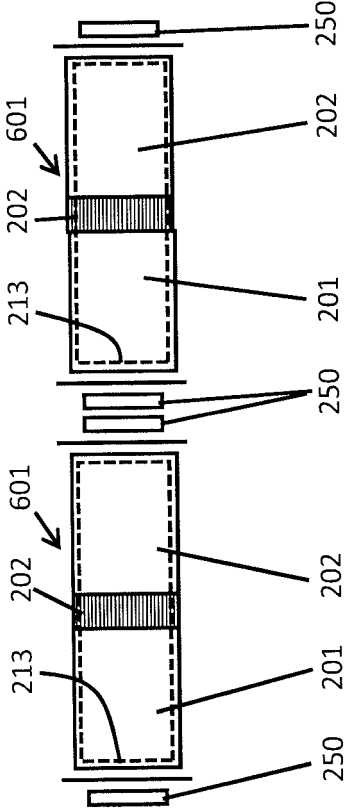


FIG. 7

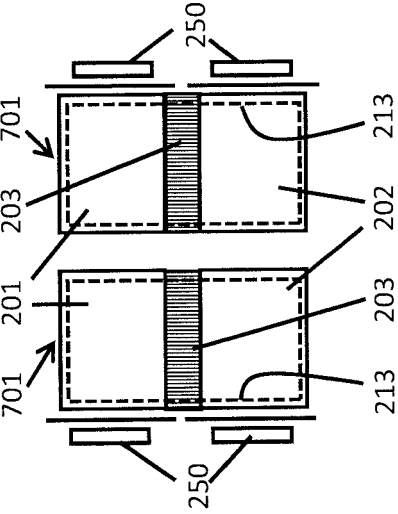


FIG. 8

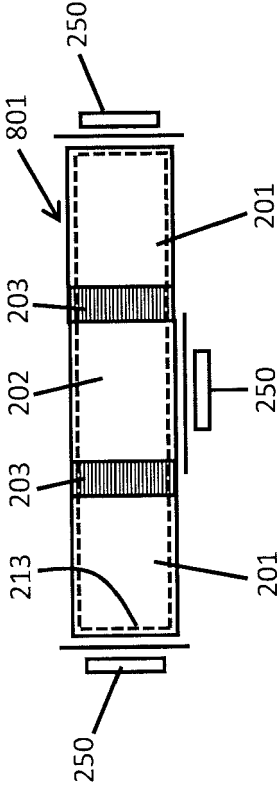


FIG. 9

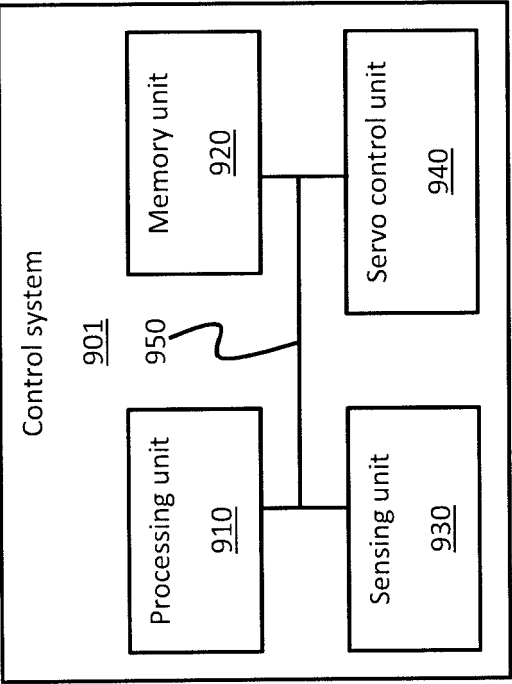


FIG. 10

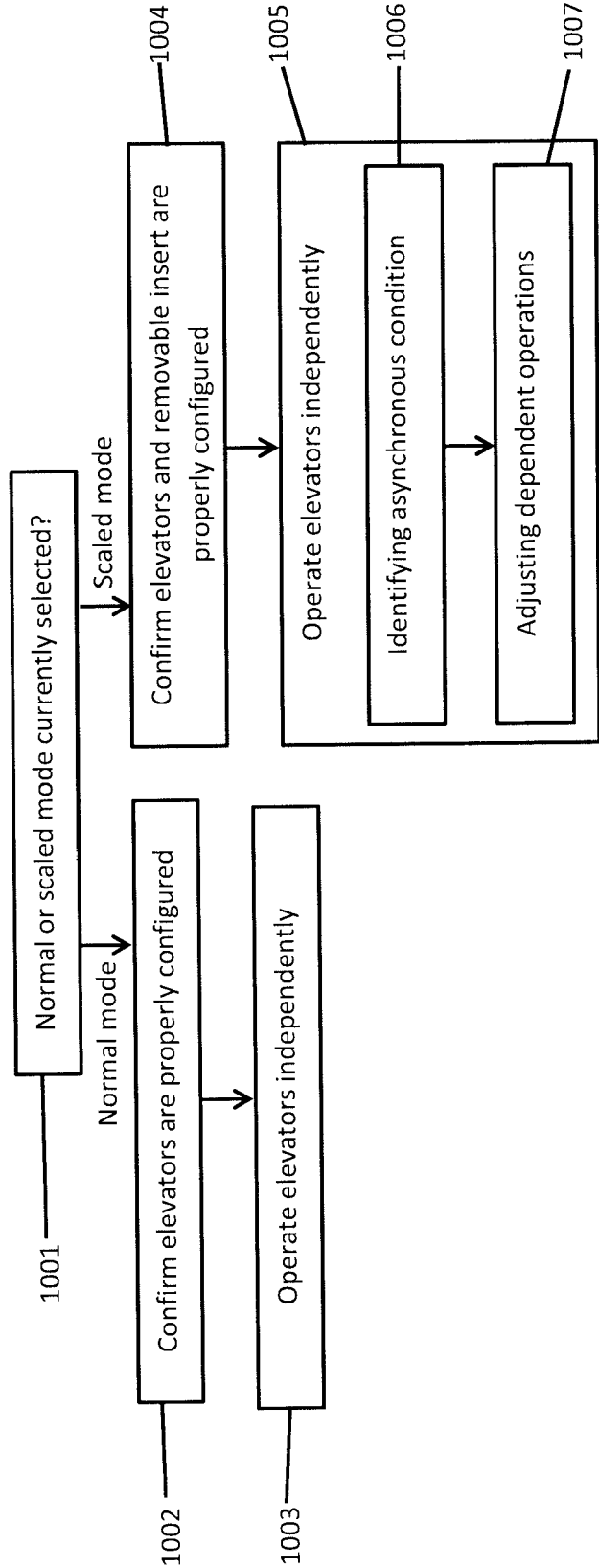
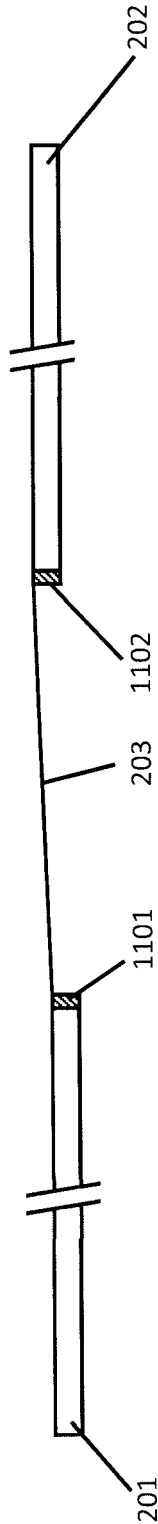


FIG. 11





EUROPEAN SEARCH REPORT

Application Number
EP 18 30 6077

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search The Hague		Date of completion of the search 8 February 2019	Examiner Miklos, Zoltan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 18 30 6077

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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08-02-2019

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