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(54) **A DIRECTION CHANGING ARRANGEMENT FOR A MULTI-MOTOR CONFIGURATION LINEAR MOTOR CONVEYOR SYSTEM, LINEAR MOTOR SYSTEM AND A CONVEYOR SYSTEM**

(57) A linear motor system, a conveyor system and a direction changing arrangement for a multi-motor configuration linear motor conveyor system, the arrangement comprising a first rotatable motor segment (204, 304) and a second rotatable motor segment (205, 305), a first rotator (202, 302) and a second rotator (203, 303) having axes of rotation in parallel with each other and/or along a line formed by the motor segments, e.g. at the center line of the motor segments. The first rotator (202, 302) and the second rotator (203, 303) are separated with a distance and the first rotator (202, 302) is coupled to the first motor segment (204, 304) and the second rotator (203, 303) is coupled to the second motor segment (205, 305) such that rotating of each rotator causes rotation of the respective motor segments to at least two predefined positions. The arrangement further comprises a turning means (201, 301) operatively connected to the first rotator (202, 302) and the second rotator (203, 303) and configured to rotate the first motor segment (204, 304) and the second motor segment (205, 305) by driving the first rotator (202, 302) and the second rotator (230, 303).

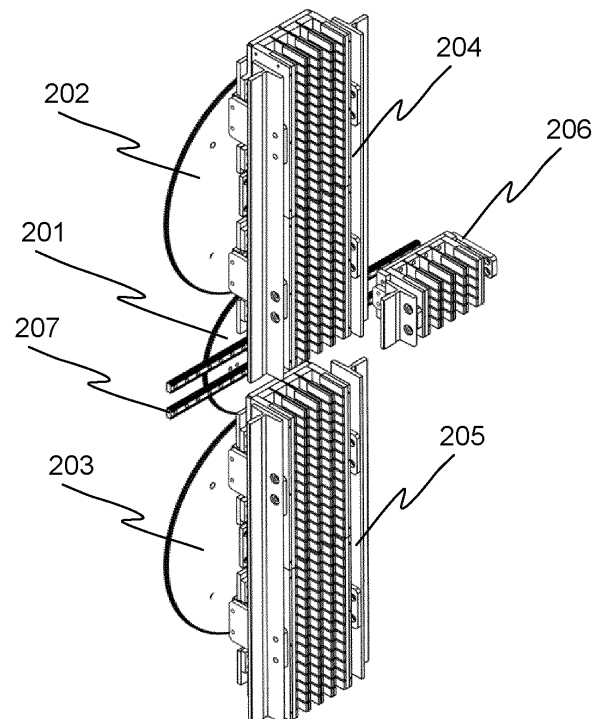


FIG. 2A

Description**Technical Field**

5 **[0001]** The invention concerns in general the technical field of linear motor systems and linear motor conveyor systems. Especially the invention concerns multi-motor configuration linear motor conveyor systems.

Background

10 **[0002]** At the present time, the elevators utilizing electric linear motor systems are being developed. These elevators can be used e.g. in multicar elevator system in which a plurality of elevator cars travel within the same elevator shafts. The movement of the elevator car in these kind of systems with linear motors is produced by the mover in electromagnetic engagement with the stator of the linear motor system. At least one of the movers and the stator comprises windings or coils for generating propulsion force to the mover and the elevator car. The stator is being arranged in fixed manner with respect to the elevator shaft. To increase propulsion force and/or supporting capabilities of the linear motor system, a multi-motor configuration has been introduced. In the multi-motor configuration plurality of movers (i.e. two or more) are coupled to the same elevator car. The plurality of movers are in electromagnetic engagement with one or more stators of the linear motor system.

15 **[0003]** The use of electric linear motors in elevators facilitate designing elevators having elevator cars moving in addition to vertical directions (up and down) also to horizontal directions or to any other direction, depending on the direction into which the stator of the electric linear motor has been arranged.

20 **[0004]** In conventional elevators having hoisting rope and elevator car configured to move only in vertical directions, there was no need to take into account the issue of changing the direction of the elevator car to any other direction. However, in elevators having electric linear motor systems and elevator cars configured to be moved in vertical and horizontal directions, there is a need to a solution for changing the direction of the elevator car, for example, from vertical direction to horizontal direction and vice versa. The problem with the known prior art solutions is that the direction changing apparatuses of the prior art are complex, large and expensive structures.

Summary

30 **[0005]** The following presents a simplified summary in order to provide basic understanding of some aspects of various invention embodiments. The summary is not an extensive overview of the invention. It is neither intended to identify key or critical elements of the invention nor to delineate the scope of the invention. The following summary merely presents some concepts of the invention in a simplified form as a prelude to a more detailed description of exemplifying embodiments of the invention.

35 **[0006]** An objective of the invention is to present a direction changing arrangement for a multi-motor configuration linear motor conveyor system, linear motor system and a conveyor system.

40 **[0007]** The objectives of the invention are reached by the direction changing arrangement for a multi-motor configuration linear motor conveyor system, linear motor system and a conveyor system by the respective independent claims.

45 **[0008]** According to a first aspect, the invention relates to a direction changing arrangement for a multi-motor configuration linear motor conveyor system, the arrangement comprising a first rotatable motor segment and a second rotatable motor segment, a first rotator and a second rotator having axes of rotation in parallel with each other and/or along a line formed by the motor segments, e.g. at the center line of the motor segments, and wherein the first rotator and the second rotator are separated with a distance. The first rotator is coupled to the first motor segment and the second rotator is coupled to the second motor segment such that rotating of each rotator causes rotation of the respective motor segments to at least two predefined positions. The arrangement further comprises a turning means operatively connected to the first rotator and the second rotator and configured to rotate the first motor segment and the second motor segment by driving the first rotator and the second rotator.

50 **[0009]** In one embodiment of the invention the turning means comprises an actuator, such as an electric motor, configured to rotate the turning means between at least two predefined positions.

55 **[0010]** In one embodiment of the invention the direction changing arrangement is configured in the first position of the at least two pre-defined positions of the motor segments to provide a route to first direction and in the second position of the at least two predefined positions of the motor segments to provide a route to second direction, wherein the first direction and the second direction are different directions, selected from the group of horizontal, inclined and vertical direction.

60 **[0011]** In one embodiment of the invention the first motor segment is a first stator segment and the second motor segment is a second stator segment of an electric linear motor system having multi-motor configuration, the stator segment comprising a linear stator part, e.g. stator beam, for receiving a mover of the linear motor conveyor system.

[0012] In one embodiment of the invention the ends of the linear stator parts are shaped, e.g. rounded, for facilitating the rotation and aligning of the linear stator parts with respect to each other and/or counterparts, such as other parts of the respective linear stator.

[0013] In one embodiment of the invention the arrangement is configured to rotate the first motor segment and the second motor segment when a first mover is positioned at the first motor segment and when a second mover is positioned at the second motor segment. In one embodiment the arrangement can comprise means to detect that the mover is in the motor segment and/or ready to be rotated.

[0014] In one embodiment of the invention the first motor segment and the second motor segment and the first mover positioned at the first motor segment and the second mover positioned at the second motor segment are configured to be rotated between the two predefined positions with respect to the axes of rotation of the first rotator and the second rotator.

[0015] In one embodiment of the invention the arrangement comprises four rotatable motor segments and four rotators coupled to said four motor segments, and wherein the turning means is configured to rotate the four motor segments by driving the four rotators.

[0016] In one embodiment of the invention the axes of rotation two of the rotatable motor segments are arranged along a line formed by two motor segments and the axes of rotation the other two of the rotatable motor segments are arranged along a line formed by the other two motor segments, e.g. at the center line of the motor segments.

[0017] In one embodiment of the invention the arrangement comprises a gear system, and wherein the turning means comprises a primary gear coupled to the turning means, and each of the rotators comprise a secondary gear coupled to the primary gear of the gear system.

[0018] In one embodiment of the invention the arrangement comprises a belt or chain drive system, and wherein the turning means comprises a primary sprocket coupled to the turning means, e.g. to a rotating axis of the actuator, and each of the rotators comprise a secondary sprocket connected to the primary sprocket via a belt or chain.

[0019] In one embodiment of the invention the arrangement comprises at least one movable extension segment arranged between the first and the second rotatable motor segments, and/or wherein the arrangement comprises linear moving means, e.g. a linear actuator, for displacing or moving the movable extension segment in such a way that a gap between the first motor segment and the second motor segment is covered in at least the one position of the first and second motor segments.

[0020] According to a second aspect the invention relates to a linear motor system comprising at least one direction changing arrangement according to the invention.

[0021] According to a third aspect the invention relates to a conveyor system comprising at least one a linear motor system according to the invention.

[0022] In one embodiment of the invention the conveyor system is an elevator system comprising an elevator shaft, an elevator car configured to move in the elevator shaft by the linear motor system comprising at least linear stator parts, such as stator beam parts, and two movers rotatably coupled to the elevator car.

[0023] In one embodiment of the invention the two rotatable linear stator parts are arranged such that the axes of rotation of the linear stator parts align with the axes of rotation of the movers when the movers are at corresponding positions with respect to the at least two linear stator parts for changing the direction of movement of the elevator car.

[0024] In one embodiment of the invention the elevator system is a multi-car elevator system comprising a plurality of elevator cars and an elevator control unit, wherein the elevator control unit is configured to control operation of the direction changing arrangement, e.g. the movement of the turning means and/or the linear moving means of the movable extension segment.

[0025] The above described direction changing apparatus provides advantages when compared to prior art solutions. The solution of the invention introduces a simple and compact structure for a direction changing apparatus in a linear motor system having a multi-motor configuration which is also cost effective to manufacture and install.

[0026] The expression "a number of" refers herein to any positive integer starting from one, e.g. to one, two, or three.

[0027] The expression "a plurality of" refers herein to any positive integer starting from two, e.g. to two, three, or four.

[0028] Various exemplifying and non-limiting embodiments of the invention both as to constructions and to methods of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific exemplifying and non-limiting embodiments when read in connection with the accompanying drawings.

[0029] The verbs "to comprise" and "to include" are used in this document as open limitations that neither exclude nor require the existence of unrecited features.

[0030] The features recited in dependent claims are mutually freely combinable unless otherwise explicitly stated. Furthermore, it is to be understood that the use of "a" or "an", i.e. a singular form, throughout this document does not exclude a plurality.

Brief description of the Figures

[0031] The embodiments of the invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings.

Figure 1 illustrates schematically an elevator system according to one embodiment of the present invention,

Figures 2A and 2B illustrate schematically an example embodiment of a direction changing apparatus according to one embodiment of the present invention, and

Figures 3A and 3B illustrate schematically an example embodiment of a direction changing apparatus according to one embodiment of the present invention.

Description of the exemplifying embodiments

[0032] The present invention relates to a multi-motor configuration linear motor conveyor system. The linear motor conveyor system can be an elevator system comprising an elevator shaft and an elevator car configured to move in the elevator shaft. An example of such system is presented in Figure 1 which illustrates schematically an elevator 100 according to an embodiment of the present invention in which the solution of the invention can be used. The elevator 100 may comprise at least one or a plurality of movable units 102, such as elevator cars or motor units, moving in the elevator shaft 101 or the elevator car pathway 101. The movable units 102 may comprise an electrical converter unit 107, e.g. comprising a frequency converter or an inverter, and/or a first energy storage 109 such as a battery or batteries. The electrical converter unit 107 may be utilized for operating a mover 106 arranged to the movable unit 102, such as an elevator car or a motor unit, for moving the unit 102 along the elevator shaft 101. There may also be other electrically operated equipment in the movable unit 102, such as lighting, doors, user interface, emergency rescue equipment, etc. The electrical converter unit 107 or a further electrical converter, such as an inverter or a rectifier, may be utilized for operating one or several of said other equipment of the movable unit 102. The first energy storage 109 may be electrically coupled to the electrical converter unit 107, for example, to the intermediate circuit of the converter therein, for providing electrical power to the electrical converter unit 107 and/or for storing electrical energy provided by the first electrical converter unit 107 or a further electrical converter or other electrical power source.

[0033] The movable unit according to the present invention may refer, for example, to a multi-motor configuration elevator car which is arranged to be moved by movers 106 of an electric linear motor of the elevator 100 in the elevator shaft 101. However, alternatively, the movable units 102 may refer to a motor unit. The motor unit may be, in some embodiments, the mover 106 of the electric linear motor which may be moved as such in the elevator shaft 101. The motor unit may also comprise electrical power providing means for providing electrical power to the mover 106, such as from an energy storage 109, for example, a battery or batteries. Furthermore, the motor unit may comprise a controller for controlling the movement. The elevator car, or specifically the "cage" into which the passengers enter, may then be removably coupled to the motor unit for moving the elevator car. However, in various embodiments, the motor unit may be arranged to be moved in the elevator shaft 101 and along the stator beam 104 independently of the elevator car.

[0034] According to an alternative embodiment, the electrical converter unit 107 may be arranged stationary in elevator shaft. Stator beam 104 may comprise windings, which may be energized by the electrical converter unit 107.

[0035] There are preferably at least two landing floors, having landing floor doors 103 or openings, comprised in the elevator 100. There may also be doors comprised in the movable units 102. Although shown in Fig. 1 that there are two horizontally separated sets, or "columns", of vertically aligned landing floors, there could as well be more than two, for example, three, or basically any number of vertical and/or horizontal, or having any other direction, shaft portions.

[0036] Regarding the elevator shaft 101, it may be such that it defines a substantially closed volume in which the movable unit 102, such as an elevator car, is adapted and configured to be moved. The walls may be, for example, of concrete, metal or at least partly of glass, or any combination thereof. The elevator shaft 101 herein refers basically to any structure or pathway along which the movable unit 102, such as an elevator car, is configured to be moved.

[0037] As can be seen in Fig. 1, the movable unit(s) 102 may be moved along the elevator shaft 101 vertically and/or horizontally depending on the direction of stator beams 104. According to embodiments similar to one in Fig. 1 in this respect, the movable unit(s) 102 may be configured to be moved along at least one vertical 104 and/or horizontal 104 stator beams, for example, two beams such as in Fig. 1 and in the example embodiment of Figures 3A and 3B. A one beam solution is displayed in the Figure 2A and 2B and also that solution can be used in the system of Figure 1 when the two stator beams are replaced with one beam or corresponding structure. The stator beams 104 are part of an electric linear motor of the elevator 100 utilized to move the movable unit 102 or units 102 in the elevator shaft 101. At least part of the stator beams 104 may be arranged in fixed manner, that is, stationary with respect to the elevator shaft 101, for example, to a wall of the shaft by fastening portions. The solution of the invention also comprises a direction

changing arrangement 130 for changing the direction of the movable unit 102.

[0038] The conveyor system according to the one embodiment of the invention may further comprise one or more reservation shafts into which one or more moving units, such as elevator cars, may be instructed. The one or more reservation shafts may be used for example to store one or more moving units which are not operating properly, i.e. there is a malfunction in the one or more moving units, for bypassing an elevator car not operating properly, to store extra, e.g. idle moving units, and/or to be able to move more moving units to serve in the other direction e.g. during a traffic peak. The reservation shaft may be vertical or a horizontal channel, for example. The direction changing arrangement of the invention can be used to direct moving units to and from the reservation shaft.

[0039] The elevator 100 may comprise a conveyor control unit 111, such as an elevator control unit, for controlling the operation of the elevator 100. The conveyor control unit 111 may be a separate device or may be comprised in the other components of the elevator 100 such as in or as a part of the electrical drive 107. The conveyor control unit 111 may also be implemented in a distributed manner so that, e.g., one portion of the conveyor control unit 111 may be comprised in the electrical drive 107 and another portion in the movable unit 102, such as in an elevator car. The conveyor control unit 111 may also be arranged in distributed manner at more than two locations or in more than two devices whereas the elevator 100 may comprise electrical and/or data connections between the control unit 111 and various other elements of the elevator 100, and/or connections between different portions of the conveyor control unit 111 for enabling controlling the operation of the elevator 100. The conveyor control unit can for example also control the operation of the direction changing arrangement 130 so that the direction of movement of the movable unit is changed at the direction changing arrangement when needed. In one embodiment of the invention the system can comprise a separate control unit which is configured to control the operation of the direction changing arrangement 130 and e.g. the movement of the turning means of the direction changing arrangement and/or the linear moving means of the movable extension segments of the direction changing arrangement.

[0040] The conveyor control unit or other control unit of the system may comprise a processing unit comprising one or more processors, a memory unit comprising one or more memories, a communication unit comprising one or more communication devices, and a user interface (UI). The mentioned elements of may be communicatively coupled to each other with e.g. an internal bus. The one or more processors of the processing unit may be any suitable processor for processing information and control the operation of the conveyor control unit, among other tasks. The memory unit may store portions of computer program code and any other data, and the processing unit may cause the conveyor control unit to operate as described by executing at least some portions of the computer program code stored in the memory unit. Furthermore, the one or more memories of the memory unit may be volatile or non-volatile. Moreover, the one or more memories are not limited to a certain type of memory only, but any memory type suitable for storing the described pieces of information may be applied in the context of the invention. The communication unit may be based on at least one known communication technologies, either wired or wireless, in order to exchange pieces of information as described earlier. The communication unit provides an interface for communication with any entities of the multicar elevator system or any external units, such as database and/or any external systems. The user interface may comprise input/output (I/O) devices, such as buttons, keyboard, touch screen, microphone, loudspeaker, display and so on, for receiving input and outputting information.

[0041] The processor of the conveyor control unit or other control unit of the system may be configured to implement at least various tasks of the conveyor system, such as an elevator, for example one or several of the method steps described hereinafter. The implementation of the tasks may be achieved by arranging the processor to execute at least some portion of computer program code stored in the memory causing the processor, and thus the conveyor control unit or other control unit of the system, to implement the tasks. The processor may thus be arranged to access the memory and retrieve and store any information therefrom and thereto. For sake of clarity, the processor herein refers to any unit suitable for processing information and control the operation of the conveyor control unit or other control unit of the system, among other tasks. The operations may also be implemented with a microcontroller solution with embedded software. Similarly, the memory is not limited to a certain type of memory only, but any memory type suitable for storing the described pieces of information may be applied in the context of the present invention.

[0042] The direction changing arrangement of the invention comprises a first rotatable motor segment and a second rotatable motor segment, a first rotator and a second rotator having axes of rotation in parallel with each other and/or along a line formed by the motor segments, e.g. at the center line of the motor segments. The first rotator and the second rotator are separated with a distance. The first rotator is coupled to the first motor segment and the second rotator is coupled to the second motor segment such that rotating of each rotator causes rotation of the respective motor segments to at least two predefined positions. The arrangement further comprises a turning means operatively connected to the first rotator and the second rotator and configured to rotate the first motor segment and the second motor segment by driving the first rotator and the second rotator.

[0043] In one embodiment of the invention the direction changing arrangement is configured in the first position of the at least two predefined positions of the motor segments to provide a route to first direction and in the second position of the at least two predefined positions of the motor segments to provide a route to second direction, wherein the first

direction and the second direction are different directions, selected from the group of horizontal, inclined and vertical direction.

[0044] In one embodiment of the invention the first motor segment is a first stator segment and the second motor segment is a second stator segment of an electric linear motor system having multi-motor configuration, the stator segment comprising a linear stator part, e.g. stator beam, for receiving a mover of the linear motor conveyor system.

[0045] If the conveyor system is an elevator system comprising an elevator shaft and an elevator car configured to move in the elevator shaft by the linear motor system, the motor segments can be linear stator parts, such as stator beam parts, and the system can comprise at least two movers rotatably coupled to the elevator car. In one embodiment of the invention the two rotatable linear stator parts are arranged such that the axes of rotation of the linear stator parts align with the axes of rotation of the movers when the movers are arranged at corresponding positions with respect to the at least two linear stator parts for changing the direction of movement of the elevator car.

[0046] In one embodiment of the invention the arrangement comprises a gear system, and the turning means comprises a primary gear coupled to the turning means, and each of the rotators comprise a secondary gear coupled to the primary gear of the gear system.

[0047] In one embodiment of the invention the arrangement comprises a belt drive system, and the turning means comprises a primary sprocket coupled to the turning means, e.g. to a rotating axis of the actuator, and each of the rotators comprise a secondary sprocket connected to the primary sprocket via a belt.

[0048] Example embodiments of direction changing apparatuses are presented in Figures 2A - 2B and 3A - 3B.

[0049] Figures 2A and 2B present an embodiment which comprises two rotatable motor segments 204, 205. The linear motor can be in this example embodiment for example an ironless linear motor. The arrangement of Fig. 2A and 2B comprises a first rotator 202 and a second rotator 203. The first rotator 202 is coupled to the first motor segment 204 and the second rotator 203 is coupled to the second motor segment 205 such that rotating of each rotator causes rotation of the respective motor segments to at least two predefined positions. The motor segments are in this example embodiment motor segments of an ironless linear motor but also other kind of motor segments suitable for a linear motor system can be used and work with the solution of the invention. The arrangement comprises a turning means 201 operatively connected to the first rotator 202 and the second rotator 203 configured to rotate the first motor segment 204 and the second motor segment 205 by driving the first rotator and the second rotator. The turning means 201 comprises a primary gear coupled to the turning means and the rotators 202, 203 comprise a secondary gear coupled to the primary gear of the gear system. The turning means can comprise an actuator, such as an electric motor, configured to rotate the turning means between at least two predefined positions. When the movers are at the motor segments and the motor segments rotate, also the movers rotate along with respective rotatable motor segments. In the embodiment of Figures 2A - 2B the first position is presented in Figure 2A and the second position is presented in Figure 2B.

[0050] When the moving unit is positioned at the direction changing arrangement and when the first mover is positioned at the first motor segment 204 and the second mover positioned at the second motor segment 205, the turning means 201 starts to rotate the motor segments and the movers at the motor segments from the first position to the second position. If the moving unit arrives to the direction changing arrangement from a direction below or above the arrangement the direction changing arrangement is in the position presented in the Figure 2A. If the moving unit should continue its travel to the same direction, the turning means and the motor segments are not rotated. If the traveling direction of the moving unit should be changed e.g. to horizontal direction, the arrangement rotates the turning means and the motor segments, e.g. to direction presented in Figure 2B.

[0051] The embodiment of the Figures 2A - 2B further comprises a one movable extension segment 206 arranged between the first and the second rotatable motor segments 204, 205. The arrangement comprises linear moving means, e.g. a linear actuator, for displacing or moving the movable extension segment in such a way that a gap between the first motor segment and the second motor segment is covered when a mover of a movable unit moves in the direction changing arrangement. The movable extension segment may be arranged to move along a bar or track segment as is presented in the example of Figures 2A and 2B. In the example of Figures 2A and 2B the extension segment has not been moved between the first motor segment and the second motor segment in which place it would cover the gap between the first motor segment and second motor segment, e.g. so the extension segment is aligned with the first motor segment and second motor segment.

[0052] The example embodiment of Figure 3A - 3B is otherwise similar as the example presented in Figures 2A - 2B but in this example embodiment the linear motor can be for example a levitating FSPM linear motor. The direction changing arrangement of this embodiment comprises four rotatable motor segments 304, 305, 314, 315 and four rotators 302, 303, 312, 313 coupled to said four motor segments. The motor segments are in this example embodiment motor segments of a levitating FSPM linear motor but also other kind of motor segments suitable for a linear motor system can be used and work with the solution of the invention. The turning means 301 is configured to rotate the four motor segments by driving the four rotators. The axes of rotation two of the rotatable motor segments are arranged along a line formed by two motor segments and the axes of rotation the other two of the rotatable motor segments are arranged along a line formed by the other two motor segments, e.g. at the center line of the motor segments. This example

arrangement comprises a gear system, and the turning means 301 comprises a primary gear coupled to the turning means, and each of the rotators 302, 303, 312, 313 comprise a secondary gear coupled to the primary gear of the gear system. Also, in this example embodiment the turning means can comprise an actuator, such as an electric motor, configured to rotate the turning means between at least two predefined positions. When the movers are at the motor segments and the motor segments rotate, also the movers rotate along with respective rotatable motor segments. In the embodiment of Figures 3A - 3B the first position is presented in Figure 3A and the second position is presented in Figure 3B.

[0053] When the moving unit is positioned at the direction changing arrangement and when the first mover is positioned at the first motor segment 304, the second mover is positioned at the second motor segment 305, the third mover is positioned at the third motor segment 314 and the fourth mover is positioned at the fourth motor segment 315, the turning means 301 starts to rotate the motor segments and the movers at the motor segments from the first position to the second position. If the moving unit arrives to the direction changing arrangement from a direction below or above the arrangement the direction changing arrangement is in the position presented in the Figure 3A. If the moving unit should continue its travel to the same direction, the turning means and the motor segments are not rotated. If the traveling direction of the moving unit should be changed e.g. to horizontal direction, the arrangement rotates the turning means and the motor segments, e.g. to direction presented in Figure 3B.

[0054] The embodiment of the Figures 3A - 3B further comprises four movable extension segments 307, 309, 317, 319 arrangeable between the motor segments in such a way that a gap between the motor segments is covered when a mover of a movable unit moves in the direction changing arrangement. In this example embodiment the first movable extension segment 307 can be moved between the first motor segment 304 and the second motor segment 305 when the segments are in the first position e.g. so the extension segment is aligned with the first motor segment 304 and the second motor segment 305. In corresponding fashion, the third movable extension segment 317 can be moved between the third motor segment 314 and the fourth motor segment 315 when the segments are in the first position. The second movable extension segment 309 can be moved between the first motor segment 304 and the third motor segment 314 when the segments are in the second position. In corresponding fashion, the fourth movable extension segment 319 can be moved between the second motor segment 315 and the fourth motor segment 315 when the segments are in the second position. The arrangement comprises linear moving means, e.g. linear actuators 308, 310, 318, 320 for displacing or moving the movable extension segments.

[0055] In one embodiment of the invention ends of the linear stator parts are shaped, for example. rounded, for facilitating the rotation and aligning of the linear stator parts with respect to each other and/or counterparts, such as other parts of the respective linear stator.

[0056] The specific examples provided in the description given above should not be construed as limiting the applicability and/or the interpretation of the appended claims. Lists and groups of examples provided in the description given above are not exhaustive unless otherwise explicitly stated.

Claims

1. A direction changing arrangement for a multi-motor configuration linear motor conveyor system, the arrangement comprising:

a first rotatable motor segment (204, 304) and a second rotatable motor segment (205, 305),
a first rotator (202, 302) and a second rotator (203, 303) having axes of rotation in parallel with each other and/or along a line formed by the motor segments, e.g. at the center line of the motor segments, and wherein the first rotator (202, 302) and the second rotator (203, 303) are separated with a distance, wherein the first rotator (202, 302) is coupled to the first motor segment (204, 304) and the second rotator (203, 303) is coupled to the second motor segment (205, 305) such that rotating of each rotator causes rotation of the respective motor segments to at least two predefined positions,

the arrangement further comprises a turning means (201, 301) operatively connected to the first rotator (202, 302) and the second rotator (203, 303) and configured to rotate the first motor segment (204, 304) and the second motor segment (205, 305) by driving the first rotator (202, 302) and the second rotator (230, 303).

2. An arrangement according to claim 1, wherein the turning means (201, 301) comprises an actuator, such as an electric motor, configured to rotate the turning means between at least two predefined positions.
3. An arrangement according to claim 1 or 2, wherein the direction changing arrangement is configured in the first position of the at least two pre-defined positions of the motor segments to provide a route to first direction and in the second position of the at least two predefined positions of the motor segments to provide a route to second

direction, wherein the first direction and the second direction are different directions, selected from the group of horizontal, inclined and vertical direction.

- 5 4. An arrangement according to any previous claim, wherein the first motor segment (204, 304) is a first stator segment and the second motor segment (205, 305) is a second stator segment of an electric linear motor system having multi-motor configuration, the stator segment comprising a linear stator part, e.g. stator beam, for receiving a mover of the linear motor conveyor system.
- 10 5. An arrangement according to any previous claim, wherein ends of the linear stator parts are shaped, e.g. rounded, for facilitating the rotation and aligning of the linear stator parts with respect to each other and/or counterparts, such as other parts of the respective linear stator.
- 15 6. An arrangement according to any previous claim, wherein the arrangement is configured to rotate the first motor segment (204, 304) and the second motor segment (205, 305) when a first mover is positioned at the first motor segment (204, 304) and when a second mover is positioned at the second motor segment (205, 305).
- 20 7. An arrangement according to any previous claim, wherein the first motor segment (204, 304) and the second motor segment (205, 305) and the first mover positioned at the first motor segment and the second mover positioned at the second motor segment are configured to be rotated between the two predefined positions with respect to the axes of rotation of the first rotator (202, 302) and the second rotator (203, 303).
- 25 8. An arrangement according to any previous claim, wherein the arrangement comprises four rotatable motor segments (304, 305, 314, 315) and four rotators (302, 303, 312, 313) coupled to said four motor segments, and wherein the turning means (301) is configured to rotate the four motor segments (304, 305, 314, 315) by driving the four rotators (302, 303, 312, 313).
- 30 9. An arrangement according to claim 8, wherein the axes of rotation two of the rotatable motor segments (304, 305) are arranged along a line formed by two motor segments (304, 305) and the axes of rotation the other two of the rotatable motor segments (314, 315) are arranged along a line formed by the other two motor segments (314, 315), e.g. at the center line of the motor segments.
- 35 10. An arrangement according to any previous claim, wherein the arrangement comprises a gear system, and wherein the turning means comprises a primary gear coupled to the turning means, and each of the rotators comprise a secondary gear coupled to the primary gear of the gear system.
- 40 11. An arrangement according to any previous claim, wherein the arrangement comprises a belt drive system, and wherein the turning means comprises a primary sprocket coupled to the turning means, e.g. to a rotating axis of the actuator, and each of the rotators comprise a secondary sprocket connected to the primary sprocket via a belt.
- 45 12. An arrangement according to any previous claim, wherein the arrangement comprises at least one movable extension segment (206, 308) arranged between the first and the second rotatable motor segments (204, 205, 304, 305), and/or wherein the arrangement comprises linear moving means, e.g. a linear actuator (308), for displacing or moving the movable extension segment (206, 308) in such a way that a gap between the first motor segment (204, 304) and the second motor segment (205, 305) is covered in at least the one position of the first and second motor segments.
- 50 13. A linear motor system **characterized in that** the system comprises at least one direction changing arrangement (130) according to any claim 1 - 12.
- 55 14. A conveyor system **characterized in that** the system comprises at least one a linear motor system according to claim 13.
15. A conveyor system according to claim 14, wherein the conveyor system is an elevator system comprising an elevator shaft (101), an elevator car configured to move in the elevator shaft by the linear motor system comprising at least linear stator parts, such as stator beam parts, and two movers (106) rotatably coupled to the elevator car.
16. A conveyor system according to claim 15, wherein the two rotatable linear stator parts are arranged such that the axes of rotation of the linear stator parts align with the axes of rotation of the movers when the movers (106) are

arranged at corresponding positions with respect to the at least two linear stator parts for changing the direction of movement of the elevator car.

- 5 17. A conveyor system according to claim 16, wherein the elevator system is a multi-car elevator system comprising a plurality of elevator cars and an elevator control unit (111), wherein the elevator control unit (111) is configured to control operation of the direction changing arrangement, e.g. the movement of the turning means and/or the linear moving means of the movable extension segment.

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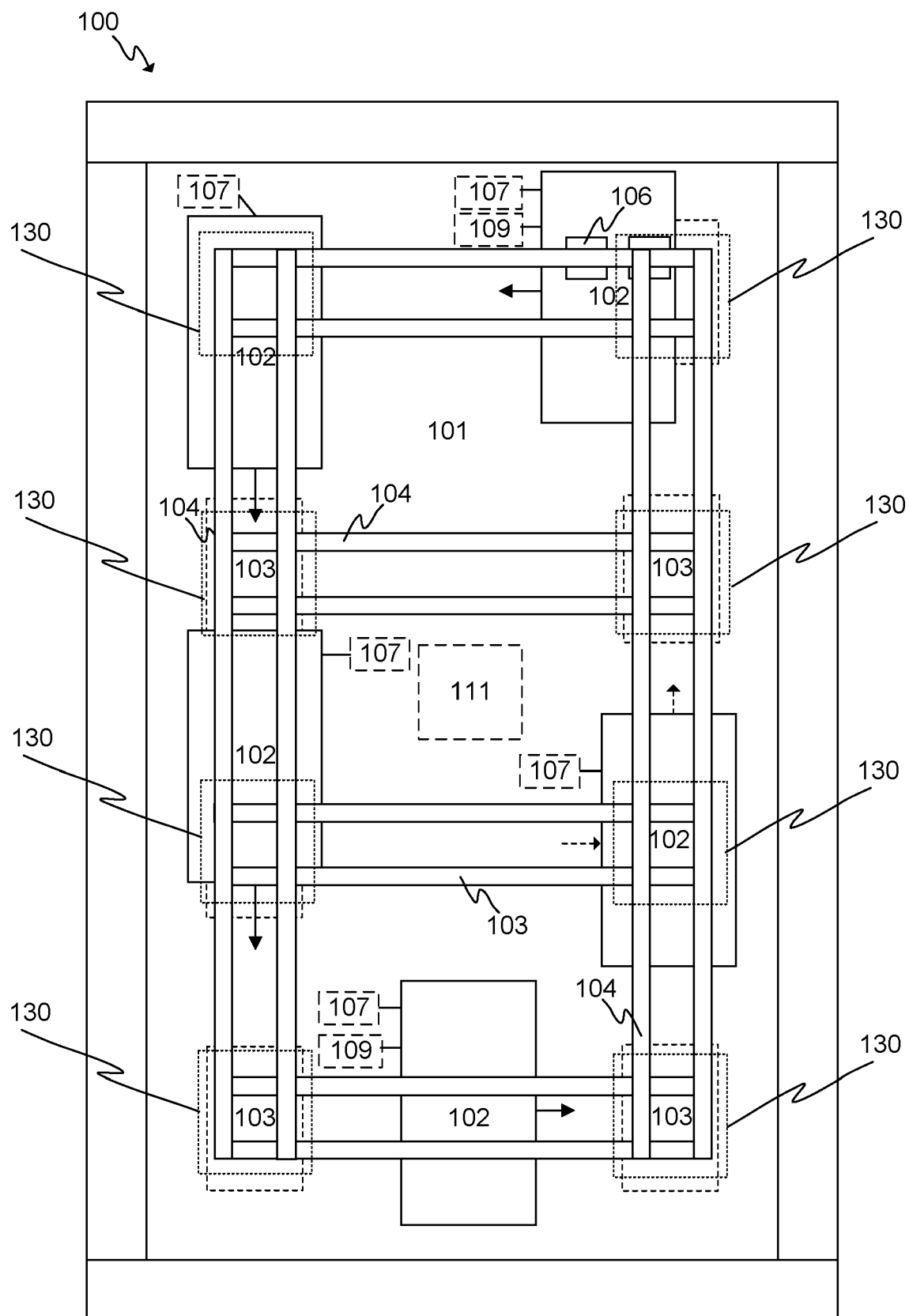


FIG. 1

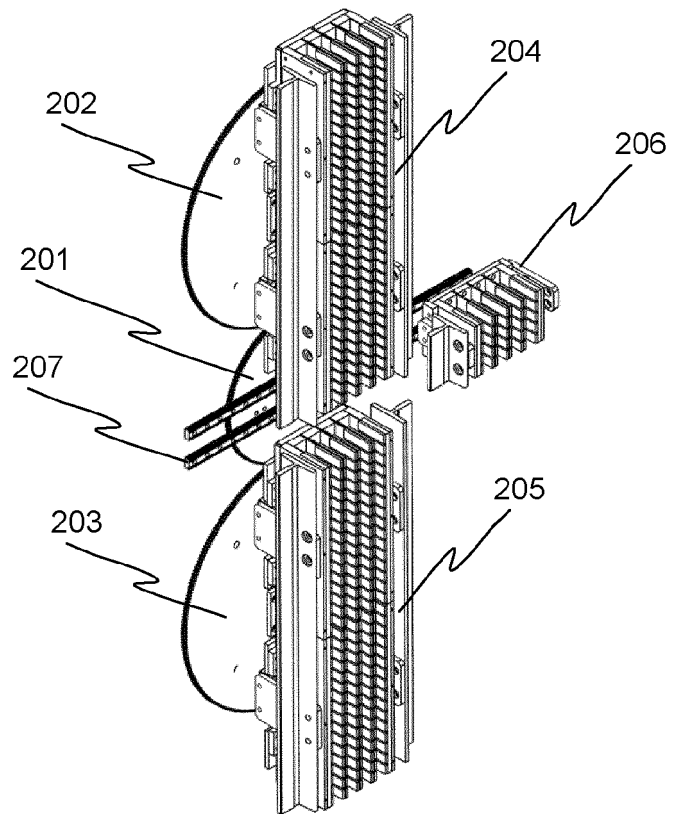


FIG. 2A

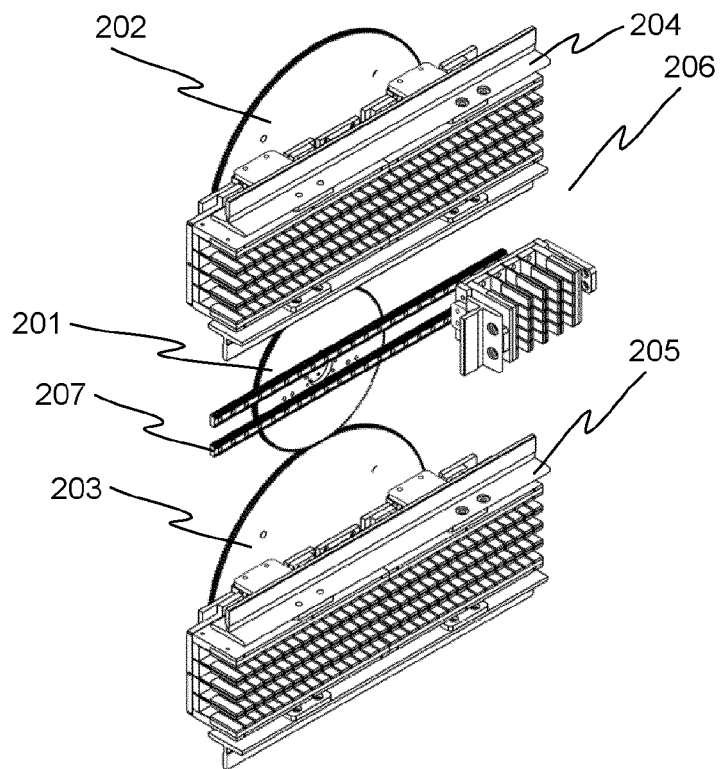


FIG. 2B

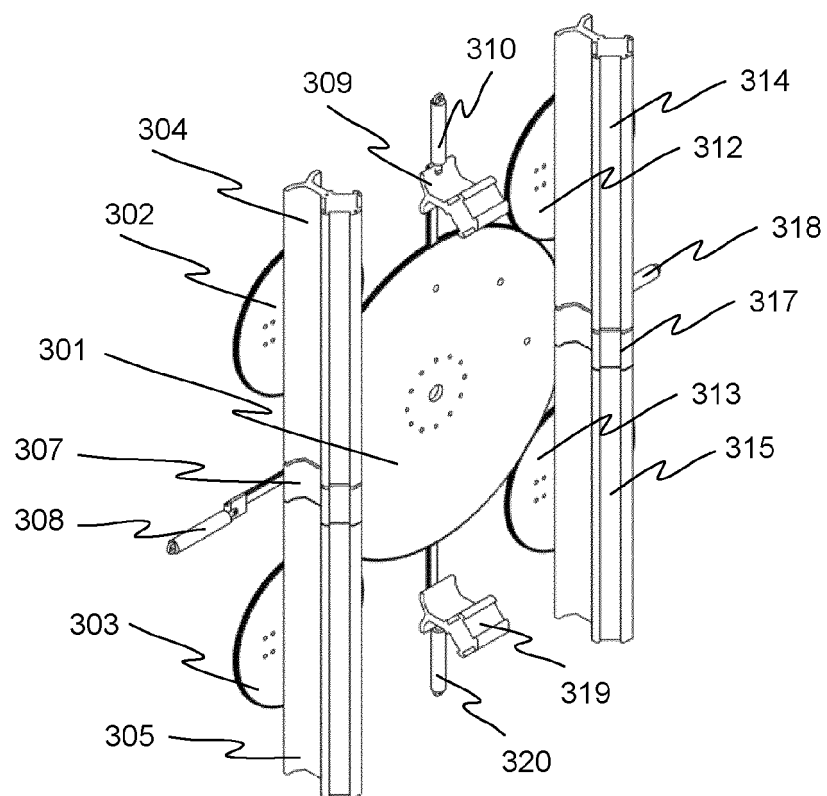


FIG. 3A

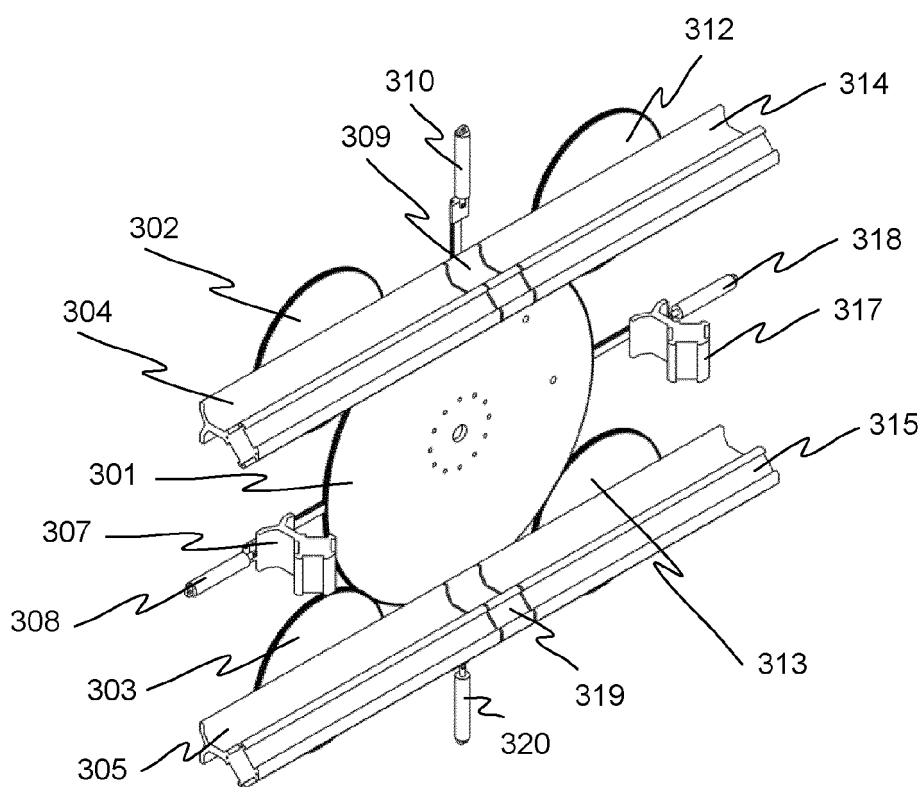


FIG. 3B



EUROPEAN SEARCH REPORT

Application Number
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			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 March 2021	Examiner Severens, Gert
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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