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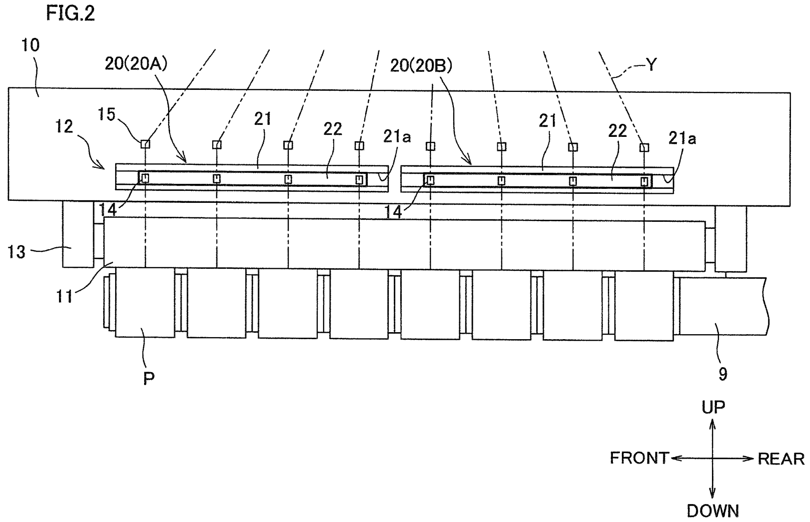
(54) TRAVERSE UNIT AND YARN WINDING DEVICE

(57) Vibration at the time of turnaround of traversed yarns is reduced. A traverse unit 12 configured to traverse yarns Y in a traverse direction includes: traverse guides 14 provided for the yarns Y respectively, and configured to reciprocate in the traverse direction while holding the yarns Y; one or more drivers 20 each including a movable portion 22 to which corresponding one or more of the traverse guides 14 are attached, the movable portion 22 being configured to reciprocate in the traverse direction; and a controller configured to control operation of the drivers 20. The number of the drivers 20 provided is two or more; and the controller is configured to control the plurality of drivers 20 so that at a same time when the movable portion(s) 22 of one or some of the plurality of drivers 20 turn around to move in one of opposite directions, the movable portion 22 of at least one driver 20 of a remainder of the plurality of drivers 20 turns around to move in the remaining one of the opposite directions.

FIG.2



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a traverse unit configured to traverse yarns, and a yarn winding device including the traverse unit.

[0002] There are traverse units configured to traverse yarns when winding the yarns onto bobbins to form packages. For example, Patent Literature 1 (Japanese Unexamined Patent Publication No. 2016-108073) discloses such a traverse unit, in which traverse guides are attached to an endless belt. In this traverse unit, pulleys around which the endless belt is wound are configured to rotate in forward and reverse directions repeatedly, and this allows a portion of the endless belt to which the traverse guides are attached to reciprocate in a traverse direction. As a result, the yarns held by the traverse guides are traversed.

SUMMARY OF THE INVENTION

[0003] In such an arrangement in which a movable portion (in Patent Literature 1, the portion of the endless belt) to which the traverse guides are attached reciprocates in the traverse direction to traverse the yarns, as described above, vibration occurs due to the inertia of the movable portion at the time of turnaround of the yarns, i.e., at the time of turnaround of the movable portion. Recently, in order to improve the production efficiency of packages, the winding speed of yarns has been increased. Along with this, the traversal speed has also been increased. Due to this, the inertia of the movable portion at the time of turnaround becomes larger than before, and this creates a situation in which the above-mentioned vibration cannot be ignored.

[0004] In view of the above, an object of the present invention is to provide a traverse unit capable of reducing vibration occurring at the time of turnaround of traversed yarns.

[0005] According to an embodiment of the present invention, a traverse unit configured to traverse yarns in a traverse direction includes: traverse guides provided for the yarns respectively, and configured to reciprocate in the traverse direction while holding the yarns; one or more drivers each including a movable portion to which corresponding one or more of the traverse guides are attached, the movable portion being configured to reciprocate in the traverse direction; and a controller configured to control operation of the drivers. The number of the drivers provided to the traverse unit is two or more; and the controller is configured to control the plurality of drivers so that at a same time when the movable portion or movable portions of one or some of the plurality of drivers turn around to move in one of opposite directions, the movable portion of at least one driver of a remainder of the plurality of drivers turns around to move in a remaining one of the opposite directions.

[0006] In the above aspect of the present invention, there are provided the plurality of drivers each including the movable portion to which corresponding one or more of the traverse guides are attached. When the movable portion(s) of one or some of the plurality of drivers turns around to move in a first direction, the movable portion of at least one driver of the remainder turns around to move in a second direction opposite to the first direction. As a result, an impact caused by the inertia at the time of turnaround of the movable portion(s) of the one or some of the drivers is cancelled out by an impact caused by the inertia at the time of turnaround of the movable portion(s) of the remaining driver(s). Consequently, vibration occurring at the time of turnaround of the yarns is reduced.

[0007] Furthermore, in the above aspect of the present invention, it is preferable that the number of the at least one driver of the remainder having the movable portion turning around to move in the remaining one of the opposite directions at the same time when the movable portion or movable portions of the one or some of the plurality of drivers turn around to move in the one of the opposite directions is equal to the number of the one or some of the plurality of drivers.

[0008] In the above arrangement, the above-mentioned impacts caused by the inertia at the time of turnaround of the movable portions are cancelled out by each other more effectively, leading to further reduction of the vibration occurring at the time of turnaround of the yarns.

[0009] Furthermore, in the above aspect of the present invention, it is preferable that the number of the traverse guides attached to each movable portion is two or more.

[0010] This arrangement allows a single driver to drive a plurality of traverse guides. This makes it possible to reduce the number of drivers, leading to cost reduction.

[0011] Furthermore, in the above aspect of the present invention, it is preferable that a predetermined equal number of traverse guides are attached to the movable portion of each of the plurality of drivers.

[0012] The above arrangement in which a predetermined equal number of traverse guides are attached to the movable portion of each driver ensures that impacts caused by the inertia of the traverse guides are also cancelled out by each other at the time of turnaround of the movable portions. Due to this, vibration occurring at the time of turnaround of the yarns is reduced more effectively.

[0013] Furthermore, in the above aspect of the present invention, it is preferable that: an even number of traverse guides are provided to the traverse unit; and the plurality of drivers include a first driver and a second driver, the first driver including the movable portion to which a half of the even number of traverse guides is attached, the second driver including the movable portion to which a remaining half of the even number of traverse guides is attached.

[0014] In the above arrangement in which the number of drivers is two, the number of the drivers is at a minimum, and this reduces the cost effectively. In addition, the number of traverse guides attached to the movable portion of the first driver is equal to the number of traverse guides attached to the movable portion of the second driver. Due to this, vibration occurring at the time of turnaround of the yarns is reduced more effectively.

[0015] Furthermore, in the above aspect of the present invention, it is preferable that the plurality of drivers are aligned in a line in the traverse direction.

[0016] In the above arrangement in which the drivers are aligned in a line, it is possible to prevent a moment from being applied to the traverse unit when the movable portions turn around to move in opposite directions. Due to this, vibration occurring at the time of turnaround of the yarns is reduced more effectively.

[0017] Furthermore, in the above aspect of the present invention, it is preferable that each of the drivers is a linear motor, and the movable portion is a slider of the linear motor.

[0018] For example, reference is made to a traverse unit in which traverse guides are attached to a belt, which is an elastic member. In such a traverse unit, strictly, the behavior of the belt does not match the behavior of the traverse guides, correspondingly to the deformation of the elastic member. Because of this, there has been a limitation on the improvement of the precision in the traverse control. In this regard, however, with the use of the linear motors, the behavior of each slider matches the behavior of the traverse guides provided thereon, and this makes it possible to improve the precision in the traverse control.

[0019] Furthermore, in the above aspect of the present invention, it is preferable that a traversal speed at which the yarns are traversed is 8 m/min or higher.

[0020] In the traverse unit configured to traverse yarns at such a relatively high speed, vibration at the time of turnaround of the movable portions tends to be large, and therefore the present invention is particularly effective.

[0021] According to an embodiment of the present invention, a yarn winding device is configured to wind yarns traversed by the traverse unit arranged as any of the above, to form packages.

[0022] In this yarn winding device, the reduction of the vibration in the traverse unit makes it possible to improve the quality of the packages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a schematic diagram illustrating a spun yarn take-up apparatus in an embodiment of the present invention.

FIG. 2 is an enlarged view illustrating details of a traverse unit.

FIG. 3 is a graph schematically showing the positional control of sliders.

FIG. 4(a) to FIG. 4(d) are a series of schematic diagrams showing the movement of the sliders.

FIG. 5 is a schematic diagram showing the structure of a traverse unit in another embodiment.

FIG. 6(a) and FIG. 6(b) each is a graph schematically showing the positional control of sliders of the other embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Spun Yarn Take-Up Apparatus)

[0024] The following will describe an example of embodiments of the present invention. FIG. 1 is a schematic diagram illustrating a spun yarn take-up apparatus in the present embodiment. A spun yarn take-up apparatus 1 is configured to wind synthetic fiber yarns Y spun out from a spinning apparatus 100 onto bobbins B, respectively, to form packages P. Hereinafter, upward, downward, forward, and rearward directions shown in FIG. 1 will be referred to as upward, downward, forward, and rearward directions of the spun yarn take-up apparatus 1.

[0025] The spun yarn take-up apparatus 1 includes godet rollers 3 and 4, a yarn winding device 5, and the like. In the spinning apparatus 100, polymer is extruded downward through a spinneret (not illustrated). Polymer is supplied by a polymer supplier (not illustrated) formed by a gear pump or the like. Yarns Y spun out from the spinning apparatus 100 are lined up in the direction perpendicular to the sheet of FIG. 1. While being arranged with a proper pitch by an unillustrated yarn path guide, the yarns Y run along a yarn path passing on the godet rollers 3 and 4. The yarns Y are distributed in the front-rear direction from the godet roller 4, and are then wound onto the bobbins B in the yarn winding device 5.

[0026] The yarn winding device 5 includes members such as a base 7, a turret 8, two bobbin holders 9, a supporting frame 10, a contact roller 11, a traverse unit 12, and a controller 16. The yarn winding device 5 winds the yarns Y sent from the godet roller 4 onto the bobbins B simultaneously by rotating the bobbin holder 9, so as to form packages P.

[0027] The disc-shaped turret 8 is attached to the base 7. The turret 8 is driven and rotated by a motor (not illustrated) about a rotation axis which is in parallel to the front-rear direction. The two long cylindrical bobbin holders 9 cantilever from the turret 8 in a rotatable manner so as to extend in the front-rear direction. To each bobbin holder 9, the bobbins B are attached to be lined up along the front-rear direction. As the turret 8 rotates, the positions of the two bobbin holders 9 are switched with each other, between an upper position and a lower position. The yarns Y are wound onto the bobbins B attached to the bobbin holder 9 at the upper position. After the yarns Y are fully wound onto the bobbins B attached to the bobbin holder 9 at the upper position and thereby packages P are formed, the upper and lower positions of the two bobbin holders 9 are switched with each other. Then, the yarns Y are wound onto the bobbins B attached to the bobbin holder 9 which has just brought into the upper position.

[0028] The supporting frame 10 is a frame-shaped member which is long in the front-rear direction. This supporting frame 10 is fixed to the base 7. A roller supporting member 13 is attached to a lower part of the supporting frame 10 so as to be vertically movable relative to the supporting frame 10. The roller supporting member 13 supports both ends of the contact roller 11 in a rotatable manner. The contact roller 11 extends in the axial direction of the bobbin holders 9. The contact roller 11 is configured to contact the packages P supported by the bobbin holder 9 at the upper position, while the yarns Y are wound. With this, a predetermined contact pressure is applied to the packages P, to adjust the shape of the packages P.

[0029] The traverse unit 12 is attached to the supporting frame 10 so as to be provided immediately above the contact roller 11. The traverse unit 12 includes traverse guides 14 which are lined up in the front-rear direction. The yarns Y are respectively threaded onto the traverse guides 14. As each traverse guide 14 holding the corresponding yarn Y reciprocates in a traverse direction (the front-rear direction), the yarn Y is traversed in the front-rear direction about a corresponding fulcrum guide 15. The yarn Y is wound onto the corresponding bobbin B while being traversed. Note that the details of the traverse unit 12 will be described later.

[0030] The controller 16 is configured to control the operation of components of the yarn winding device 5. Specifically, the controller 16 is configured to control the operation of the turret 8, the bobbin holders 9, the traverse unit 12, and the like.

[0031] In the present embodiment, the yarn winding device 5 is configured to wind eight yarns Y. Correspondingly to this, eight traverse guides 14 and eight fulcrum guides 15 are provided. It should be noted that the number of the above elements is changeable correspondingly to the number of yarns to be wound.

(Traverse Unit)

[0032] FIG. 2 is an enlarged view showing the details of the traverse unit 12. As shown in FIG. 2, the traverse unit 12 of the present embodiment includes two linear motors 20 functioning as drivers configured to drive the traverse guides 14. The two linear motors 20 are aligned in a line in the traverse direction (front-rear direction). Each linear motor 20 includes: a stator 21 fixed to the supporting frame 10; and a slider 22 (indicated with a bold line) which is movable in the front-rear direction relative to the stator 21. A track 21a extending in the front-rear direction is provided on the stator 21. The slider 22 moves in the front-rear direction along the track 21a.

[0033] The stator 21 includes a coil (not illustrated), and the energization state of the coil is controlled by the controller 16. The slider 22 includes a magnet (not illustrated). As a result of the control of the energization state of the coil of the stator 21 by the controller 16, electromagnetic induction occurs between the coil of the stator 21 and the magnet of the slider 22, and this allows the slider 22 to reciprocate along the track 21a of the stator 21 in the front-rear direction. The structure of each linear motor 20 is not limited to the above. The linear motor 20 may have a different structure. For example, it may be arranged so that the stator 21 includes a magnet and the slider 22 includes a coil. In the following description, one of the linear motors 20, which is provided in front of the other one, may be referred to as a linear motor 20A, while the other one of the linear motors 20, which is provided behind the one of the motors, may be referred to as a linear motor 20B, as needed.

[0034] Four traverse guides 14 lined up in the front-rear direction are attached to the slider 22 of each linear motor 20A, 20B. Specifically, four traverse guides 14 at the front side are attached to the slider 22 of the front linear motor 20A, and are moved by the linear motor 20A so as to reciprocate in the traverse direction. Meanwhile, four traverse guides 14 at the rear side are attached to the slider 22 of the rear linear motor 20B, and are moved by the linear motor 20B so as to reciprocate in the traverse direction.

[0035] It may be conceivable to attach all the eight traverse guides 14 to the slider of a single linear motor so that all the eight traverse guides 14 are driven by the single linear motor. However, this arrangement is disadvantageous in that large vibration occurs due to the inertial force of the slider having a large mass (generally, sliders are made of metal) when the slider of the linear motor turns around at each end portion of its movement area. To deal with such a problem, the plurality of linear motors 20 are provided to drive the traverse guides 14 in the present embodiment. The following will describe its details.

[0036] FIG. 3 is a graph schematically showing the positional control of the sliders 22. FIG. 4(a) to FIG. 4(d) are a series of schematic diagrams showing the movement of the sliders 22. As shown in FIG. 3, the controller 16 controls the linear motors 20 so that the slider 22 of the linear motor 20A and the slider 22 of the linear motor 20B reciprocate in opposite phases to each other with respect to the traverse direction (front-rear direction). Under such control, at Time t1 and t3, the slider 22 of each linear motor 20A, 20B is at the center of its movement area with respect to the traverse direction so that each traverse guide 14 is at the center of its traverse area, as shown in FIG. 4(a) and FIG. 4(c).

[0037] Meanwhile, at Time t2 and t4, as shown in FIG. 4(b) and FIG. 4(d), each traverse guide 14 attached to the slider 22 of the linear motor 20A turns around at one of the end portions of the traverse area in the traverse direction, and each traverse guide 14 attached to the slider 22 of the linear motor 20B turns around at an opposite end portion of the traverse area in the traverse direction (for example, when each traverse guide 14 on the linear motor 20A turns around at a front end portion, each traverse guides 14 on the linear motor 20B turns around at a rear end portion). That is, the slider 22 of the linear motor 20A and the slider 22 of the linear motor 20B turn around at the same time to move in opposite directions with respect to the traverse direction. As a result, an impact caused by the inertia at the time of turnaround of the slider 22 of the linear motor 20A and an impact caused by the inertia at the time of turnaround of the slider 22 of the linear motor 20B are cancelled out by each other, so that the vibration occurring at the time of turnaround of the sliders 22 is reduced.

[0038] In the present embodiment, the traversal speed at which the yarns Y are traversed by the traverse unit 12 is set to 8 m/min (133 mm/sec) or higher, which is relatively high. In the traverse unit 12 configured to traverse the yarns at such a relatively high speed, vibration occurring at the time of turnaround of the sliders 22 tends to be relatively large. For this reason, a significant effect will be provided by adopting the configuration of the present embodiment. However, it is a matter of course that the configuration of the present embodiment is effective to reduce the vibration also in cases where the traversal speed is less than 8 m/min.

(Advantageous Effects)

[0039] As described above, in the traverse unit 12 of the present embodiment, there are provided a plurality of drivers (linear motors 20) each including a movable portion (slider 22) to which corresponding one or more of the traverse guides 14 are attached. When the movable portion(s) 22 of one or some of the plurality of drivers 20 turns around to move in a first direction, the movable portion 22 of at least one driver 20 of the remainder turns around to move in a second direction opposite to the first direction. As a result, an impact caused by the inertia at the time of turnaround of the movable portion(s) 22 of the one or some of the drivers 20 is cancelled out by an impact caused by the inertia at the time of turnaround of the movable portion(s) 22 of the remaining driver(s) 20. Consequently, vibration occurring at the time of turnaround of the yarns Y is reduced.

[0040] Furthermore, in the present embodiment, the number of the at least one driver 20 of the remainder having the movable portion 22 turning around to move in the remaining one of the opposite directions (second direction) at the same time when the movable portion(s) 22 of the one or some of the plurality of drivers 20 turn around to move in the one of the opposite directions (first direction) is equal to the number of the one or some of the plurality of drivers 20. In the above arrangement, the above-mentioned impacts caused by the inertia at the time of turnaround of the movable portions 22 are cancelled out by each other more effectively, leading to further reduction of the vibration occurring at the time of turnaround of the yarns Y.

[0041] Furthermore, in the present embodiment, the plurality of traverse guides 14 are attached to each movable portion 22. This arrangement allows a single driver 20 to drive a plurality of traverse guides 14. This makes it possible to reduce the number of drivers 20, leading to cost reduction.

[0042] Furthermore, in the present embodiment, a predetermined equal number of traverse guides 14 are attached to the movable portion 22 of each of the plurality of drivers 20. The above arrangement in which a predetermined equal number of traverse guides 14 are attached to the movable portion 22 of each driver 20 ensures that impacts caused by the inertia of the traverse guides 14 are also cancelled out by each other at the time of turnaround of the movable portions 22. Due to this, vibration occurring at the time of turnaround of the yarns Y is reduced more effectively.

[0043] Furthermore, in the present embodiment, an even number of (eight) traverse guides 14 are provided to the traverse unit; and the plurality of drivers 20 include a first driver 20A and a second driver 20B, the first driver 20A including the movable portion 22 to which a half of the even number of traverse guides 14 is attached, the second driver 20B including the movable portion 22 to which a remaining half of the even number of traverse guides 14 is attached. In the above arrangement in which the number of drivers 20 is two, the number of the drivers 20 is at a minimum, and this reduces the cost effectively. In addition, the number of traverse guides 14 attached to the movable portion 22 of the first driver 20A is equal to the number of traverse guides 14 attached to the movable portion 22 of the second driver 20B. Due to this, vibration occurring at the time of turnaround of the yarns Y is reduced more effectively.

[0044] Furthermore, in the present embodiment, the plurality of drivers 20 are aligned in a line in the traverse direction. In the above arrangement, it is possible to prevent a moment from being applied to the traverse unit 12 when the movable portions 22 turn around to move in opposite directions. Due to this, vibration occurring at the time of turnaround of the yarns Y is reduced more effectively.

[0045] Furthermore, in the present embodiment, each of the drivers is the linear motor 20, and the movable portion is the slider 22 of the linear motor 20. For example, reference is made to a traverse unit in which traverse guides are attached to a belt, which is an elastic member. In such a traverse unit, strictly, the behavior of the belt does not match the behavior of the traverse guides, correspondingly to the deformation of the elastic member. Because of this, there has been a limitation on the improvement of the precision in the traverse control. In this regard, however, with the use of the linear motors 20, the behavior of each slider 22 matches the behavior of the traverse guides 14 provided thereon, and this makes it possible to improve the precision in the traverse control. Generally, the slider 22 of each linear motor 20 is made of metal or the like and has a large mass, and therefore the inertial force of the slider 22 tends to be large. For this reason, the present invention is particularly effective in cases where the linear motors 20 function as the drivers.

[0046] Furthermore, in the present embodiment, the traversal speed at which the yarns Y are traversed is 8 m/min or higher. In the traverse unit 12 configured to traverse the yarns Y at such a relatively high speed, vibration at the time of turnaround of the movable portions 22 tends to be large, and therefore the present invention is particularly effective.

[0047] In the yarn winding device 5 including the traverse unit 12 of the present embodiment, the reduction of the vibration in the traverse unit 12 makes it possible to improve the quality of the packages P.

(Other Embodiments)

[0048] While an embodiment of the present invention has been described, the present invention is not limited to the above-mentioned embodiment and can be suitably changed within the scope and sprit of the present invention.

[0049] In the embodiment described above, the two linear motors 20 are provided, and at the same time when the slider 22 of the single linear motor 20A turns around to move in one of opposite directions, the slider 22 of the single linear motor 20B turns around to move in the remaining one of the opposite directions. However, the number of linear motors 20 is not limited to two. Furthermore, the number of the sliders 22 turning around to move in one of the opposite directions does not have to be equal to the number of the sliders 22 turning around to move in the remaining one of the opposite directions at the same time. For example, consideration is given to cases where the total number of linear motors 20 is three or more. In such a case, it is only required that, when the sliders 22 of two of the three or more linear motors 20 turn around to move in one of the opposite directions, the slider 22 of at least one of the remaining linear motor(s) 20 turns around to move in the remaining one of the opposite directions. With this, at least the impact caused by the inertia corresponding to one slider 22 is cancelled out, and therefore the effect of reducing the vibration is provided. However, in order to enhance the effect of reducing the vibration, the following arrangement is preferable: an even number of linear motors 20 are provided; and at the same time when the slider(s) 22 of a predetermined number of linear motor(s) 20 turn around to move in one of the opposite directions, the slider(s) 22 of the same number of other linear motor(s) 20 (the same number as the predetermined number) turn around to move in the remaining one of the opposite directions.

[0050] An arrangement in which four linear motors 30 are provided will be described with reference to FIG. 5 and FIG. 6. In a traverse unit 112 shown in FIG. 5, four linear motors 30 are provided, and two traverse guides 14 are attached to the slider 22 of each linear motor 30. In such a case where the four linear motors 30 (30A to 30D) are provided, a plurality of patterns are conceivable to control the linear motors 30.

[0051] For example, as shown in FIG. 6(a), the following control is possible: the linear motors 30A and 30C are controlled in the same phase (in a first pattern); the linear motors 30B and 30D are controlled in the same phase (in a second pattern); the first pattern for the linear motors 30A and 30C and the second pattern for the linear motors 30B and 30D are opposite to each other (are shifted 180 degrees from each other). This control reduces the vibration. Note that, in the above control, the combinations of the linear motors 30 controlled in the same phase are not limited to those mentioned above.

[0052] Alternatively, as shown in FIG. 6(b), the following control is also possible: the phase for the linear motor 30A and the phase for the linear motor 30B are opposite to each other; and the phase for the linear motor 30C and the phase for the linear motor 30D are opposite to each other (the combinations of the motors are changeable as needed). In FIG. 6(b), the phase difference between the phase for the linear motor 30A (or the linear motor 30B) and the linear motor 30C (or the linear motor 30D) is 90 degrees. In this regard, the phase difference does not have to be 90 degrees. Under the above control in which the number of sliders 22 turning around at the same time is two, the total mass of the sliders 22 turning around at one time is smaller, and therefore it is possible to reduce the vibration more effectively.

[0053] Furthermore, while in the embodiment described above, the predetermined equal number of traverse guides 14 are attached to the slider 22 of each linear motor 20, there may be a slight difference in the number of traverse guides 14 attached, among the sliders 22.

[0054] While in the embodiment described above, the plurality of traverse guides 14 are attached to the slider 22 of each linear motor 20, only one traverse guide 14 may be attached to the slider 22 of each linear motor 20.

[0055] While in the embodiment described above, the plurality of linear motors 20 are aligned in a line in the traverse direction, this arrangement is not essential. For example, a plurality of linear motors 20 may be arranged in a staggered manner along the traverse direction.

[0056] While in the embodiment above, the linear motors 20 are used as drivers of the present invention, any other structures or devices other than linear motors may function as the drivers. For example, as each driver, a structure using an endless belt may be used as described in Patent Literature 1, or a structure using a ball screw may be used.

[0057] The following numbered paragraphs describe embodiments of the invention.

1. A traverse unit configured to traverse yarns in a traverse direction, the traverse unit comprising:

    traverse guides provided for the yarns respec-

tively, and configured to reciprocate in the traverse direction while holding the yarns;
one or more drivers each including a movable portion to which corresponding one or more of the traverse guides are attached, the movable portion being configured to reciprocate in the traverse direction; and
a controller configured to control operation of the drivers, wherein:

the number of the drivers provided to the traverse unit is two or more; and
the controller is configured to control the plurality of drivers so that at a same time when the movable portion or movable portions of one or some of the plurality of drivers turn around to move in one of opposite directions, the movable portion of at least one driver of a remainder of the plurality of drivers turns around to move in a remaining one of the opposite directions.

2. The traverse unit according to 1, wherein the number of the at least one driver of the remainder having the movable portion turning around to move in the remaining one of the opposite directions at the same time when the movable portion or movable portions of the one or some of the plurality of drivers turn around to move in the one of the opposite directions is equal to the number of the one or some of the plurality of drivers.

3. The traverse unit according to 1 or 2, wherein the number of the traverse guides attached to each movable portion is two or more.

4. The traverse unit according to any one of 1 to 3, wherein a predetermined equal number of traverse guides are attached to the movable portion of each of the plurality of drivers.

5. The traverse unit according to 4, wherein:

an even number of traverse guides are provided to the traverse unit; and
the plurality of drivers include a first driver and a second driver, the first driver including the movable portion to which a half of the even number of traverse guides is attached, the second driver including the movable portion to which a remaining half of the even number of traverse guides is attached.

6. The traverse unit according to any one of 1 to 5, wherein the plurality of drivers are aligned in a line in the traverse direction.

7. The traverse unit according to any one of 1 to 6, wherein each of the drivers is a linear motor, and the movable portion is a slider of the linear motor.

8. The traverse unit any one of 1 to 7, wherein a traversal speed at which the yarns are traversed is 8 m/min or higher.

9. A yarn winding device comprising the traverse unit recited in any one of 1 to 8, wherein
the yarn winding device is configured to wind the yarns traversed by the traverse unit to form packages.

Claims

1. A traverse unit (12) configured to traverse yarns (Y) in a traverse direction, the traverse unit (12) comprising:

traverse guides (14) provided for the yarns (Y) respectively, and configured to reciprocate in the traverse direction while holding the yarns (Y);
two or more drivers (20) each including a movable portion (22) to which corresponding one or more of the traverse guides (14) are attached, the movable portion (22) being configured to reciprocate in the traverse direction; and
a controller (16) configured to control operation of the drivers (20), wherein:

the controller (16) is configured to control the plurality of drivers (20) so that at a same time when the movable portion (22) or movable portions (22) of one or some of the plurality of drivers (20) turn around to move in one of opposite directions, the movable portion (22) of at least one driver of a remainder of the plurality of drivers (20) turns around to move in a remaining one of the opposite directions,
characterized in that:

the plurality of drivers (20) are aligned in a line in the traverse direction, and
each of the drivers (20) includes a ball screw.

2. The traverse unit (12) according to claim 1, wherein the number of the at least one driver of the remainder having the movable portion (22) turning around to move in the remaining one of the opposite directions at the same time when the movable portion (22) or movable portions (22) of the one or some of the plurality of drivers (20) turn around to move in the one of the opposite directions is equal to the number of the one or some of the plurality of drivers (20).

3. The traverse unit (12) according to claim 1 or 2, wherein the number of the traverse guides (14) attached to each movable portion (22) is two or more.

4. The traverse unit (12) according to any one of claims 1 to 3, wherein a predetermined equal number of traverse guides (14) are attached to the movable portion (22) of each of the plurality of drivers (20).

5. The traverse unit (12) according to claim 4, wherein:

an even number of traverse guides (14) are provided to the traverse unit (12); and
the plurality of drivers (20) include a first driver (20A) and a second driver (20B), the first driver (20A) including the movable portion (22) to which a half of the even number of traverse guides (14) is attached, the second driver (20B) including the movable portion (22) to which a remaining half of the even number of traverse guides (14) is attached.

6. The traverse unit (12) any one of claims 1 to 5, wherein a traversal speed at which the yarns (Y) are traversed is 8 m/min or higher.

7. A yarn winding device comprising the traverse unit (12) recited in any one of claims 1 to 6, wherein
the yarn winding device is configured to wind the yarns (Y) traversed by the traverse unit (12) to form packages.

FIG.1

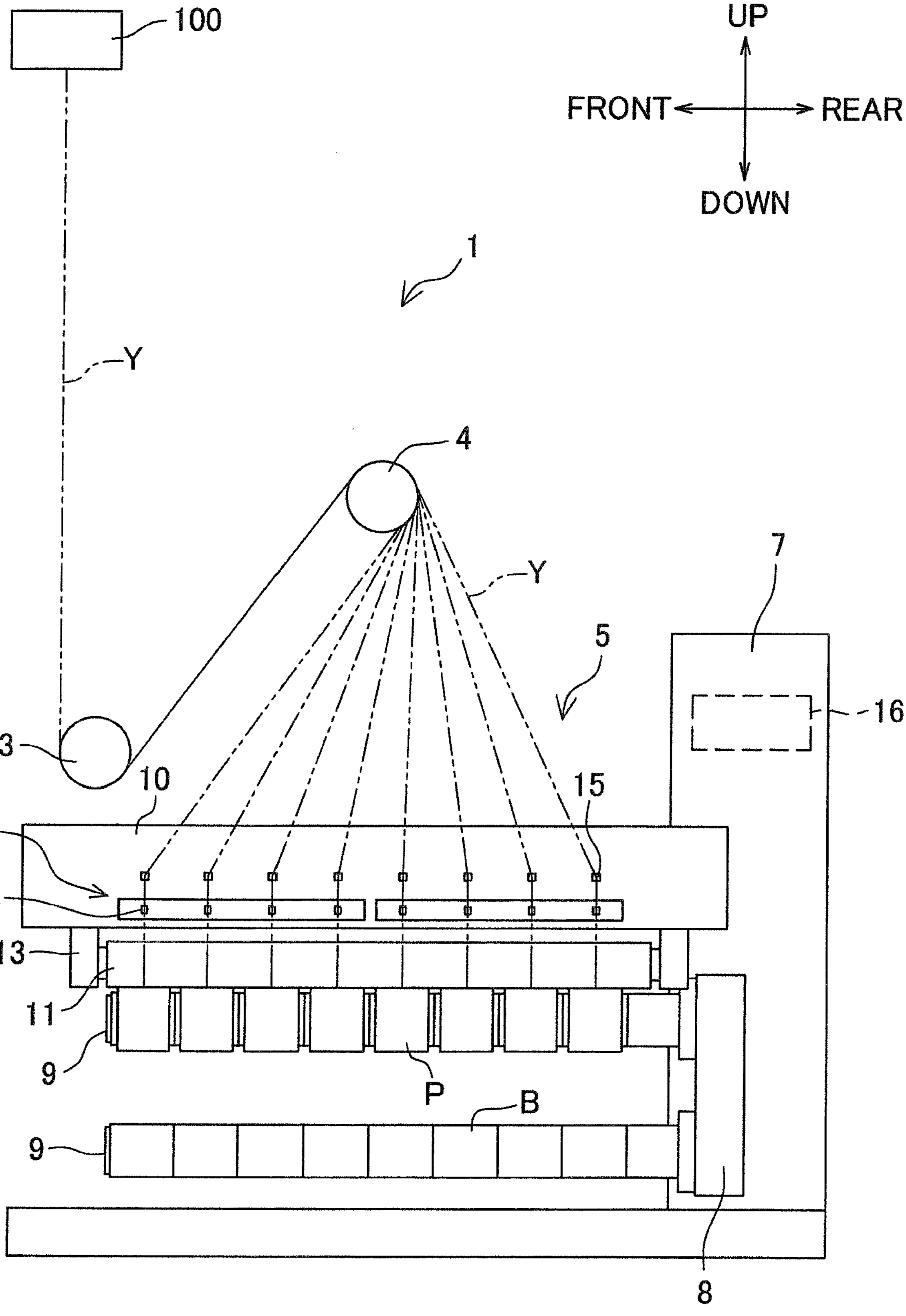


FIG.2

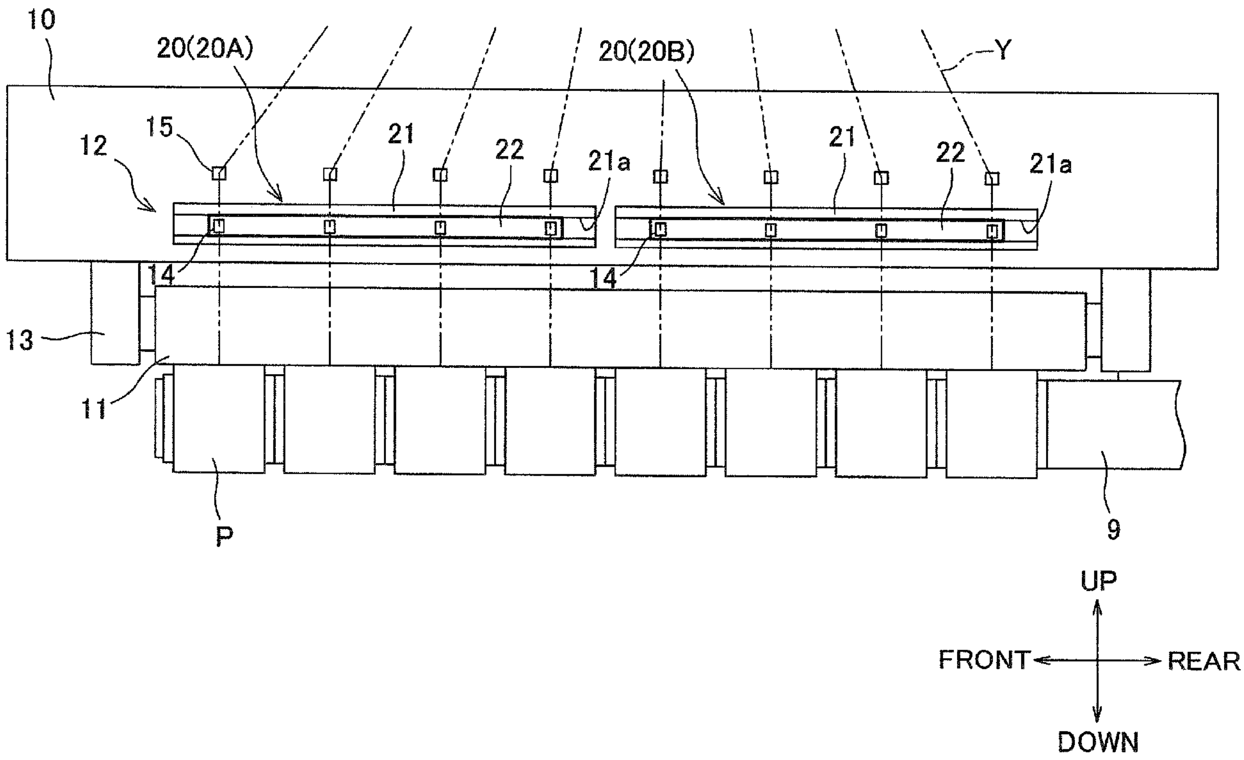

10
20(20A)
20(20B)
Y
15
12
21
22
21a
21
22
21a
14
14
13
11
P
9
UP
FRONT
REAR
DOWN

FIG.3

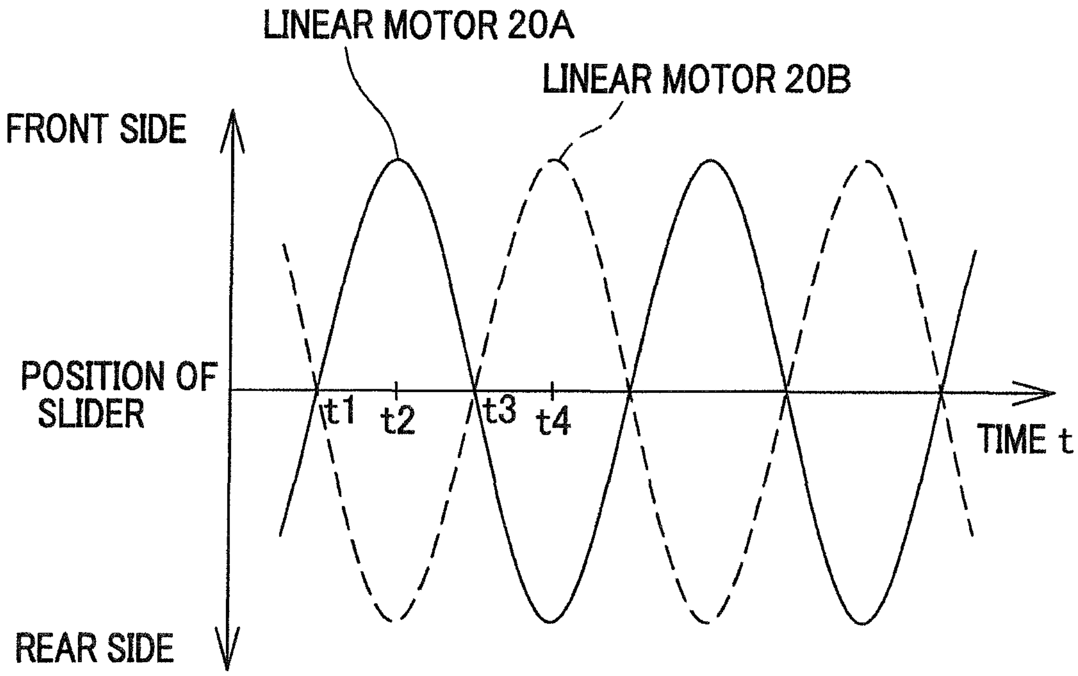

LINEAR MOTOR 20A
LINEAR MOTOR 20B
FRONT SIDE
POSITION OF SLIDER
t1
t2
t3
t4
TIME t
REAR SIDE

FIG.4

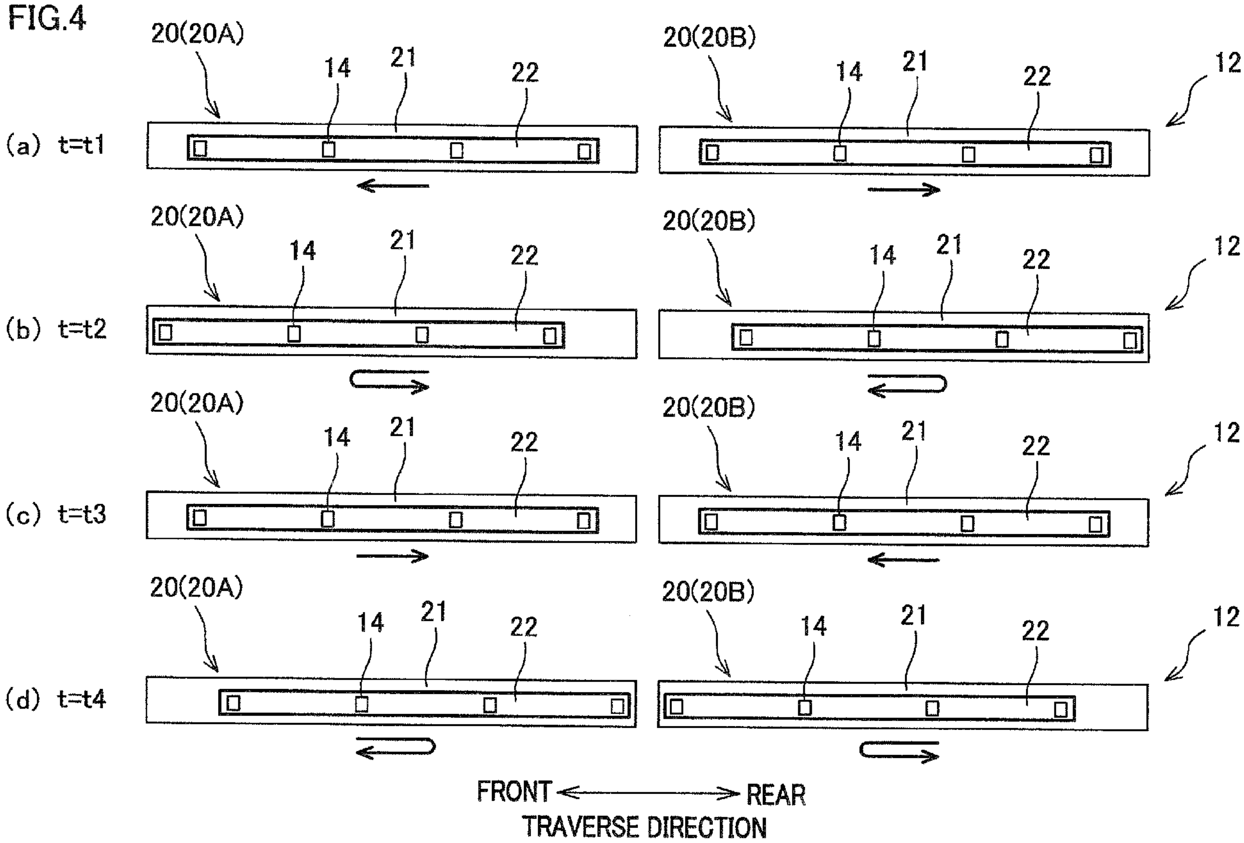

20(20A)
14
21
22
20(20B)
12
(a) t=t1
(b) t=t2
(c) t=t3
(d) t=t4
FRONT
REAR
TRAVERSE DIRECTION

FIG.5

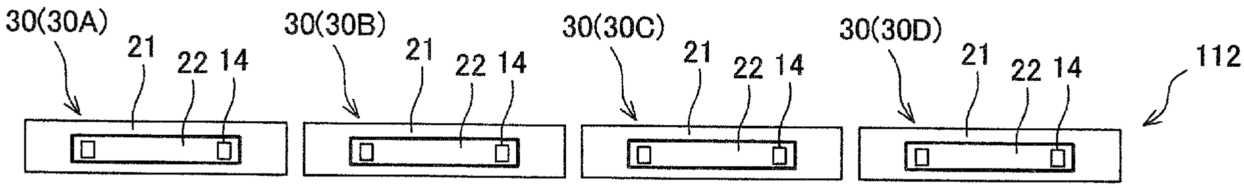
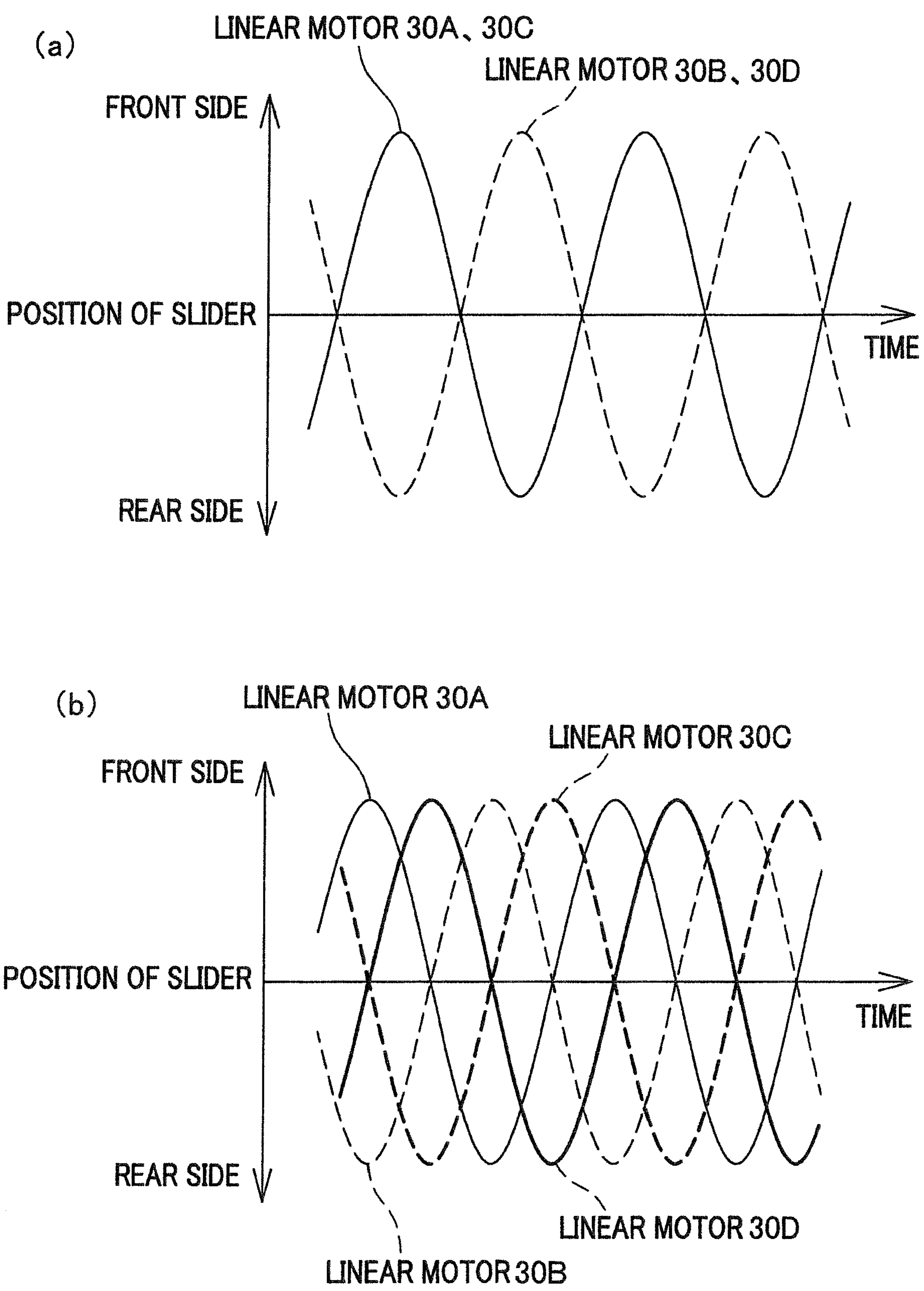


FIG.6


(a)
LINEAR MOTOR 30A、30C
LINEAR MOTOR 30B、30D
FRONT SIDE
POSITION OF SLIDER
TIME
REAR SIDE
(b)
LINEAR MOTOR 30A
LINEAR MOTOR 30C
FRONT SIDE
POSITION OF SLIDER
TIME
REAR SIDE
LINEAR MOTOR 30D
LINEAR MOTOR 30B

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EUROPEAN SEARCH REPORT

Application Number
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A	US 6 405 966 B1 (LIEBER REINHARD [DE] ET AL) 18 June 2002 (2002-06-18) * column 2, line 32 - line 43 * * column 7, line 20 - line 42 * * column 7, line 48 - column 8, line 15 * * column 8, line 43 - line 61 * * figure 5 *	1-7	
A	US 2015/034756 A1 (VOSS RAINALD [DE] ET AL) 5 February 2015 (2015-02-05) * paragraph [0004] * * paragraph [0009] * * paragraph [0012] - paragraph [0014] * * paragraph [0032] * * figure 2 *	1-7	TECHNICAL FIELDS SEARCHED (IPC)
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Place of search	Date of completion of the search	Examiner
The Hague	12 September 2019	Guisan, Thierry

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