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(71) Applicant: **TMT Machinery, Inc.**
Osaka-shi, Osaka 541-0041 (JP)

(72) Inventors:
- **YASUKAWA, Riku**
  Kyoto-shi, Kyoto, 612-8686 (JP)
- **HASHIMOTO, Kinzo**
  Kyoto-shi, Kyoto, 612-8686 (JP)
- **OKADA, Keisuke**
  Kyoto-shi, Kyoto, 612-8686 (JP)

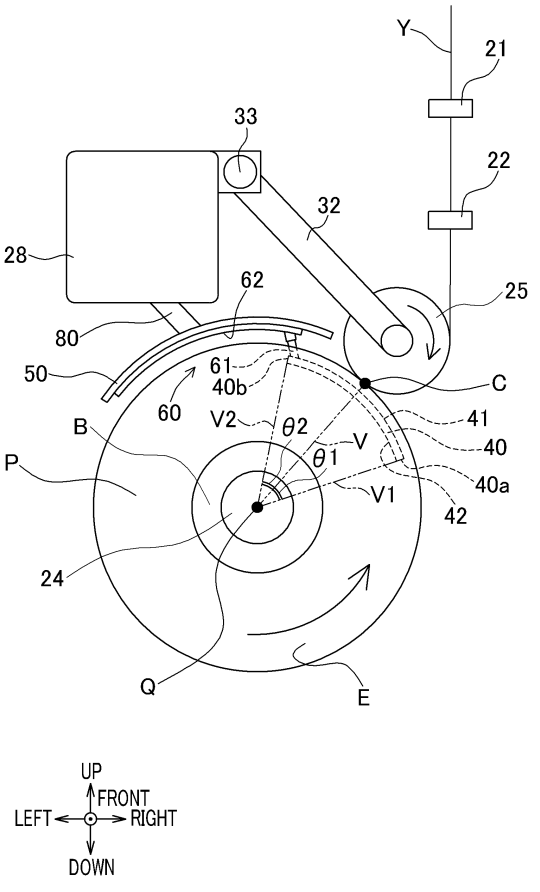
(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) YARN WINDER

(57) An object of the present invention is to improve the reduction effect of power consumption by effectively suppressing air resistance applied to an end face of a package at a time of yarn winding.

A yarn winder 4 includes: bobbin holders 24 to which bobbins B, onto which yarns Y are respectively wound, are attached; a contact roller 25 configured to make contact with outer circumferential surfaces of packages P which are formed by winding the yarns Y onto the respective bobbins B; and end-face gap covers 40 provided at the respective spaces 70 formed between end faces of the packages P that are adjacent in a front-rear direction. Each end-face gap cover 40 includes a contact roller surface 41 which faces the contact roller 25 side when viewed in the front-rear direction. The contact roller surface 41 is provided on the center Q side of a package P as compared to the outer circumferential surface of the package P in a radial direction of the package P. When viewed in the front-rear direction, at least part of the contact roller surface 41 is provided within an angular range of 30 degrees on the upstream side from the virtual line segment V connecting a contact C to a center Q of the package P and an angular range of 30 degrees on the downstream side from the virtual line segment V in a rotational direction of the package P.

FIG.4



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn winder configured to wind yarns.

[0002] Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2021-123458) discloses a yarn winder configured to wind yarns. The yarn winder includes a bobbin holder extending in a predetermined axial direction and a contact roller extending in parallel to the bobbin holder. To the bobbin holder, cylindrical bobbins onto which yarns are respectively wound are attached to be aligned in the axial direction. The contact roller makes contact with outer circumferential surfaces of cylindrical packages formed by winding the yarns onto the bobbins, so as to apply a contact pressure to each package. The yarn winder is configured to rotate the bobbin holder so as to form each package by winding a yarn onto a bobbin attached to the bobbin holder. In such a yarn winder, as the packages rotating together with the bobbin holder receive air resistance, the rotational load on the bobbin holder is increased and thus the power consumption of the yarn winder is disadvantageously increased.

[0003] A yarn winder of Patent Literature 1 is provided with a cover (a first cover member of Patent Literature 1) extending along an outer circumferential surface of a package, in order to suppress the air resistance on the package. Because the cover is provided, air (hereinafter, this will be referred to as an outer circumferential surface accompanied flow) flowing along the outer circumferential surface of the package is guided to an inner surface of the cover so that the air is suppressed from flowing away from the outer circumferential surface of the package. The decrease in density of the air is therefore suppressed in an area (hereinafter, this will be referred to as an outer circumferential surface area) extending along the outer circumferential surface of the package, with the result that an airflow from the space around the package is suppressed from flowing into the outer circumferential surface area. Consequently, the air resistance on the outer circumferential surface of the package is suppressed so as to reduce power consumption.

SUMMARY OF THE INVENTION

[0004] There are gaps between end faces of the adjacent packages attached to the bobbin holder in the axial direction. In this regard, end faces of each package are circular surfaces at both ends of each cylindrical package. The end faces of each package receive the air resistance from the air provided at a gap (hereinafter, this well be referred to as a package end-face gap) between end faces of each two adjacent packages. That is, the air resistance on each package includes not only that on the outer circumferential surface of each package but also that on the end faces of each package. However, the yarn winder of Patent Literature 1 cannot sufficiently suppress the air resistance on the end faces of each package. The following will describe the details.

[0005] In such a yarn winder described in Patent Literature 1, the outer circumferential surface of the package is in contact with a contact roller so that the outer circumferential surface accompanied flow collides with and is blocked by the contact roller. With this, the density of the outer circumferential surface accompanied flow is decreased by an amount of the blocked air in an area, which is provided immediately downstream of the contact roller in a rotational direction of the package, among the outer circumferential surface area. Then, the air around the package flows into the area where the density of the air is decreased. Subsequently, a part of the air flowing into the area from the surroundings of the package flows into the package end-face gap so that the air provided at the package end-face gap is disturbed. As a result, the air provided at the package end-face gap flows in a direction which is significantly different from the rotational direction of the end faces of the package. This increases the air resistance on the end faces of each package.

[0006] Furthermore, a part of the air blocked by the contact roller flows into the package end-face gap in an area, which is provided immediately upstream of the contact roller in the rotational direction of the package, among the outer circumferential surface area. With this, the air flowing into the package end-face gap disturbs a flow of the air provided at the package end-face gap similarly as described above, and the air resistance on the end faces of each package is increased.

[0007] As described above, the yarn winder of Patent Literature 1 cannot sufficiently suppress the increase in the air resistance on the end faces of each package because of the collision between the outer circumferential surface accompanied flow and the contact roller. On this account, the arrangement of Patent Literature 1 may not effectively reduce the power consumption of the yarn winder.

[0008] An object of the present invention is to improve the reduction effect of power consumption by effectively suppressing air resistance applied to an end face of a package at a time of yarn winding.

[0009] A yarn winder of the present invention comprises: at least one bobbin holder which extends in a predetermined axial direction and to which bobbins are attached to be aligned in the axial direction, yarns being respectively wound onto the bobbins; a contact roller which extends along the axial direction and which is configured to make contact with outer circumferential surfaces of packages formed by winding the yarns onto the respective bobbins; and an end-face gap cover provided at one or more of spaces formed between end faces of the packages that are adjacent in the axial direction. In this regard, when viewed in the axial direction, the end-face gap cover includes a contact roller surface facing the contact roller side. Furthermore, when viewed in the axial direction, at least part of the contact roller surface is provided on the center side of the

packages as compared to the outer circumferential surfaces of the packages in a radial direction of the packages. Furthermore, when viewed in the axial direction, the at least a part of the contact roller surface is provided within an angular range of 30 degrees on the upstream side from a virtual line segment and an angular range of 30 degrees on the downstream side from the virtual line segment in a rotational direction of the packages. In this regard, the virtual line segment connects a contact between the packages and the contact roller to a center of each of the packages.

[0010] According to this arrangement, the at least part of the contact roller surface of the end-face gap cover located between the end faces of the adjacent packages (hereinafter, this will be referred to as a package end-face gap) is provided on the center side of the packages as compared to the outer circumferential surfaces of the packages in the radial direction thereof. In other words, the at least part of the contact roller surface of the end-face gap cover is provided inside the outer circumferential surfaces of the packages in the radial direction thereof. This makes it possible to suppress air from entering the inside of the end-face gap cover from the outside thereof in the radial direction of the packages, and to effectively suppress the air from entering the package end-face gap. The at least part of the contact roller surface is provided within an angular range of 30 degrees on the upstream side and an angular range of 30 degrees on the downstream side from the virtual line segment in the rotational direction of the packages. In other words, the end-face gap cover is provided in the vicinity of the contact between the packages and the contact roller. This makes it possible to suppress the air flowing along the outer circumferential surfaces of the packages (hereinafter, this will be referred to as an outer circumferential surface accompanied flow) from colliding with the contact roller and flowing into the package end-face gap in the vicinity of the contact. It is therefore possible to suppress the disturbance of an airflow at the package end-face gap. As a result, air resistance applied to the end faces of the packages is effectively reduced so that the reduction effect of power consumption is effectively improved.

[0011] In the yarn winder of the present invention, when viewed in the axial direction, at least part of the end-face gap cover is preferably provided upstream of the virtual line segment in the rotational direction of the packages.

[0012] According to this arrangement, part of the air blocked by the contact roller is suppressed from flowing into the package end-face gap on the upstream side of the contact in the rotational direction of the packages. It is therefore possible to suppress the disturbance of the airflow at the package end-face gap, and to effectively suppress the air resistance applied to the end faces of the packages.

[0013] In the yarn winder of the present invention, when viewed in the axial direction, the at least part of the end-face gap cover is preferably provided downstream of the virtual line segment in the rotational direction of the packages.

[0014] According to this arrangement, the air is suppressed from flowing into the package end-face gap in an area on the downstream side of the contact in the rotational direction of the packages. This area is an area where the outer circumferential surface accompanied flow collides with the contact roller and is blocked so that the density of air is decreased. It is therefore possible to suppress the disturbance of the airflow at the package end-face gap, and to effectively suppress the air resistance applied to the end faces of the packages.

[0015] In the yarn winder of the present invention, the end-face gap cover preferably includes a bobbin surface which faces the center side of the packages when the bobbin surface is viewed in the axial direction, and the bobbin surface viewed in the axial direction is preferably a curved surface extending along the rotational direction of the packages.

[0016] According to this arrangement, the air at the package end-face gap flows along the bobbin surface of the end-face gap cover. Because the bobbin surface is curved along the rotational direction of the packages, the air flowing along the bobbin surface easily flows in the same direction as the rotational direction of the end faces of the packages. It is therefore possible to suppress the increase in air resistance which is applied to the end faces of the packages because of the air flowing through the package end-face gap.

[0017] In the yarn winder of the present invention, preferably, when viewed in the axial direction, (i) the end-face gap cover is continuously formed across an angular range of 25 degrees or more in the rotational direction of the packages and (ii) the at least part of the end-face gap cover is continuously formed across an angular range of 20 degrees on the upstream side from the virtual line segment and an angular range of 5 degrees on the downstream side from the virtual line segment in the rotational direction of the packages.

[0018] According to this arrangement, the air is suppressed from flowing into the package end-face gap in both of areas provided immediately upstream and downstream of the contact in the rotational direction of the packages.

[0019] Another yarn winder of the present invention comprises: at least one bobbin holder which extends in a predetermined axial direction and to which bobbins are attached to be aligned in the axial direction, yarns being respectively wound onto the bobbins; a contact roller which extends along the axial direction and which is configured to make contact with outer circumferential surfaces of packages formed by winding the yarns onto the respective bobbins; and an end-face gap cover provided at one or more of spaces formed between end faces of the packages that are adjacent in the axial direction. In this regard, when viewed in the axial direction, the end-face gap cover includes a contact roller surface facing the contact roller side. Furthermore, when viewed in the axial direction, at least part of the contact

roller surface is provided on the center side of the packages as compared to the outer circumferential surfaces of the packages in a radial direction of the packages. Furthermore, this yarn winder further comprises a movement mechanism configured to move the end-face gap cover between an end-face gap position where at least part of the end-face gap cover is provided at the at least one of the spaces formed between the end faces of the adjacent packages and a retracted position provided outside the end-face gap position in the radial direction of the packages. In this regard, the end-face gap position is closer to a contact between the packages and the contact roller than the retracted position in a circumferential direction of the packages.

[0020] According to this arrangement, the at least part of the end-face gap cover located at the end-face gap position is provided between the end faces of the adjacent packages (hereinafter, those will be referred to as a package end-face gap). The at least part of the contact roller surface of the end-face gap cover located at the package end-face gap is provided on the center side of the packages as compared to the outer circumferential surfaces of the packages in the radial direction thereof. In other words, the at least part of the contact roller surface of the end-face gap cover is provided inside the outer circumferential surfaces of the packages in the radial direction thereof. This makes it possible to suppress air from entering the inside of the end-face gap cover from the outside thereof in the radial direction of the packages, and to effectively suppress the air from entering the package end-face gap. The end-face gap position is closer to the contact between the packages and the contact roller than the retracted position. In other words, the end-face gap cover is provided in the vicinity of the contact. This makes it possible to suppress the air flowing along the outer circumferential surfaces of the packages (hereinafter, this will be referred to as an outer circumferential surface accompanied flow) from colliding with the contact roller and flowing into the package end-face gap in the vicinity of the contact. It is therefore possible to suppress the disturbance of an airflow at the package end-face gap. As a result, air resistance applied to the end faces of the packages is effectively reduced so that the reduction effect of power consumption is effectively improved.

[0021] The present invention brings the following effects. Because the diameter of the packages is significantly small immediately after the start of winding of the yarns, the contact roller is close to the bobbins in the radial direction of the packages. Accordingly, the positional relationship between the end-face gap cover and the contact roller may cause the interference between the end-face gap cover and the bobbins immediately after the start of winding of the yarns. In the present invention, the interference between the end-face gap cover and the bobbins is reliably avoided by moving the end-face gap cover to the retracted position immediately after the start of winding of the yarns. When the winding of a yarn onto each bobbin advances so that (i) the diameter of each package increases and (ii) the distance between the contact roller and the bobbin becomes sufficiently long, the end-face gap cover is moved to the end-face gap position. This makes it possible to avoid the interference between the end-face gap cover and the bobbins, and to suppress the air from flowing into the package end-face gap.

[0022] The yarn winder of the present invention preferably further comprises a movement mechanism configured to move the end-face gap cover between an end-face gap position where the at least part of the end-face gap cover is provided at the one or more of the spaces formed between the end faces of the adjacent packages and a retracted position provided outside the end-face gap position in the radial direction of the packages.

[0023] Because the diameter of the packages is significantly small immediately after the start of winding of the yarns, the contact roller is close to the bobbins in the radial direction of the packages. Accordingly, the positional relationship between the end-face gap cover and the contact roller may cause the interference between the end-face gap cover and the bobbins immediately after the start of winding of the yarns. In the present invention, the interference between the end-face gap cover and the bobbins is reliably avoided by moving the end-face gap cover to the retracted position immediately after the start of winding of the yarns. When the winding of a yarn onto each bobbin advances so that (i) the diameter of each package increases and (ii) the distance between the contact roller and the bobbin becomes sufficiently long, the end-face gap cover is moved to the end-face gap position. This makes it possible to avoid the interference between the end-face gap cover and the bobbins, and to suppress the air from flowing into the package end-face gap.

[0024] The yarn winder of the present invention preferably further comprises: a sensor configured to detect information regarding the size in diameter of the packages; and a controller configured to drive the movement mechanism. In this regard, the controller is configured to calculate the size in diameter of the packages based on the information regarding the size in diameter of the packages. Furthermore, when the diameter of the packages reaches a predetermined size, the controller controls the movement mechanism to move the end-face gap cover from the retracted position to the end-face gap position.

[0025] According to this arrangement, when the diameter of the packages reaches a predetermined size so that the distance between the contact roller and the bobbins becomes sufficient, the end-face gap cover is moved to the end-face gap position. It is therefore possible to further reliably avoid the interference between the end-face gap cover and the bobbins.

[0026] The yarn winder of the present invention preferably further comprises a controller configured to drive the movement mechanism, and the controller is prefer-

ably configured to control the movement mechanism to move the end-face gap cover from the retracted position to the end-face gap position at a predetermined timing calculated based on winding elapse time elapsed from the start of winding of the yarns onto the bobbins.

[0027] According to this arrangement, the end-face gap cover is moved to the end-face gap position at a predetermined timing at which the diameter of the packages reaches a size so that the distance between the contact roller and the bobbins becomes sufficient. It is therefore possible to further reliably avoid the interference between the end-face gap cover and the bobbins.

[0028] In the yarn winder of the present invention, the end-face gap cover is preferably provided at each of the spaces.

[0029] This makes it possible to effectively suppress the air from flowing into all package end-face gaps. This also makes it possible to suppress the disturbance of airflows at all package end-face gaps. It is therefore possible to effectively reduce the air resistance applied to the end faces of each package.

[0030] In the yarn winder of the present invention, the size of a gap between the end-face gap cover and the each of the packages in the axial direction is preferably 3 to 5 mm.

[0031] According to this arrangement, the end-face gap cover is provided as close to the end-faces of the packages as possible, as long as the end-face gap cover can avoid the contact with the end-faces of the packages. It is therefore possible to further effectively suppress the air radially outside the packages from flowing into the package end-face gap.

[0032] In the yarn winder of the present invention, when viewed in the axial direction, the distance between the contact roller surface and the contact is preferably 5 to 10 mm.

[0033] According to this arrangement, the contact roller surface is provided as close to the contact as possible, as long as the end-face gap cover can avoid the contact with the contact roller. This allows the end-face gap cover to suppress, as much as possible, the outer circumferential surface accompanied flow from colliding with the contact roller and causing the air to flow into the package end-face gap in the vicinity of the contact. It is therefore possible to further effectively suppress the increase in air resistance applied to the end faces of the packages.

[0034] In the yarn winder of the present invention, when viewed in the axial direction, the end-face gap cover is preferably and continuously formed across an angular range of 25 degrees or more in the rotational direction of the packages.

[0035] This makes it possible to suppress the air from flowing into the package end-face gap, in a wide area of the packages in the rotational direction thereof.

[0036] The yarn winder of the present invention preferably further comprises a circumferential surface cover provided to surround parts of the outer circumferential surfaces of the packages in the circumferential direction of the packages.

[0037] This makes it possible to suppress the outer circumferential surface accompanied flow from being separated from the outer circumferential surfaces of the packages. This also makes it possible to suppress the air from flowing from a space provided around the packages into an area (hereinafter, this will be referred to as an outer circumferential surface area) provided along the outer circumferential surfaces of the packages.

[0038] In the yarn winder of the present invention, the circumferential surface cover is preferably provided downstream of the contact in the rotational direction of the packages.

[0039] According to this arrangement, the air is suppressed from flowing into the outer circumferential surface area in an area on the downstream side of the contact in the rotational direction of the packages. This area is an area where the outer circumferential surface accompanied flow collides with the contact roller and is blocked so that the density of air is decreased. The air is also suppressed from flowing from the outer circumferential surface area into the package end-face gap. It is therefore possible to suppress the air resistance applied to the packages.

[0040] The yarn winder of the present invention preferably further comprises a supporting member which supports the contact roller, and the circumferential surface cover is directly or indirectly attached to the supporting member.

[0041] It is therefore unnecessary to additionally provide a member for supporting the circumferential surface cover.

[0042] In the yarn winder of the present invention, preferably, the end-face gap cover is directly or indirectly attached to the circumferential surface cover.

[0043] It is therefore unnecessary to additionally provide a member for supporting the end-face gap cover.

[0044] In the yarn winder of the present invention, preferably, the movement mechanism includes a connecting member configured to move along a direction in which the circumferential surface cover viewed in the axial direction extends, the connecting member is connected to the circumferential surface cover and the end-face gap cover, and the movement mechanism is configured to move the end-face gap cover between the end-face gap position and the retracted position by moving the connecting member along the direction in which the circumferential surface cover extends.

[0045] According to this arrangement, the end-face gap cover is moved between the end-face gap position and the retracted position by moving the connecting member from the circumferential surface cover. It is therefore unnecessary to provide a member different from the circumferential surface cover, as a member from which the connecting member is moved. This reduces the number of members.

[0046] In the yarn winder of the present invention, the connecting member is preferably extendable and con-

tractable in the radial direction of the packages.

[0047] According to this arrangement, when the end-face gap cover is located at the retracted position, the end-face gap cover is moved away from the bobbins as far as possible by moving the end-face gap cover so as to be close to the circumferential surface cover. It is therefore possible to reduce the risk of interference between the end-face gap cover and the bobbins. Furthermore, when the end-face gap cover is located at the end-face gap position, the end-face gap cover can be elongated in the radial direction of the packages. It is therefore possible to provide the end-face gap cover at a position where the air is most effectively suppressed from flowing into the package end-face gap.

[0048] The yarn winder of the present invention further comprises: two bobbin holders; and a turret which is rotatable and which supports each of the two bobbin holders, and the each of the two bobbin holders is rotatable between a winding position where the winding of the yarns onto the bobbins is performed and a standby position different from the winding position as the turret rotates. Furthermore, when viewed in the axial direction, the circumferential surface cover is provided on the outside of orbits of the packages rotating together with the two bobbin holders.

[0049] According to this arrangement, the contact between the circumferential surface cover and the packages which rotate as the turret rotates is avoided in the case where the two bobbin holders are provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0050]

FIG. 1 is a schematic side view of a spun yarn take-up apparatus of an embodiment.

FIG. 2 is a front view of a yarn winder.

FIG. 3 is a perspective view of a part of the yarn winder, and shows a front end of a bobbin holder at a winding position and its surroundings.

FIG. 4 is a front view of the part of the yarn winder, and shows the bobbin holder at the winding position and its surroundings.

FIG. 5 is a side view of a part of the yarn winder viewed from the right side.

FIG. 6 is a front view of a part of the yarn winder, and shows an end-face gap cover at a retracted position.

FIG. 7 is a front view of a part of the yarn winder, and shows the end-face gap cover moved to an end-face gap position.

FIG. 8 is a block diagram showing an electric configuration of the yarn winder.

FIG. 9 is a table showing an effect of suppression of air resistance on a yarn winder of an Example.

FIG. 10 is a front view of a yarn winder of a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Spun Yarn Take-Up Apparatus 1)

[0051] The following will describe a preferred embodiment of the present invention with reference to figures. FIG. 1 is a schematic side view of a spun yarn take-up apparatus 1 including a yarn winder 4 of an embodiment. An up-down direction on the sheet of FIG. 1 will be referred to as an up-down direction in which the gravity acts, and a left-right direction on the sheet thereof will be referred to as a front-rear direction. Furthermore, a direction orthogonal to the sheet of FIG. 1 will be referred to as a left-right direction. In the left-right direction, a direction toward the viewer will be referred to as a right direction while a direction away from the viewer will be referred to as a left direction. These directions will be suitably used hereinbelow. FIG. 1 does not show an end-face gap cover 40 and a circumferential surface cover 50 which are described later.

[0052] The spun yarn take-up apparatus 1 includes a first godet roller 8, second godet roller 9, and yarn regulating guide 7 for taking up yarns Y spun out from a spinning apparatus 3, and a yarn winder 4 for forming plural packages P by winding the taken-up yarns Y onto bobbins B.

[0053] The first godet roller 8 is a roller which has an axis substantially in parallel to the left-right direction and which is provided above a front end portion of the yarn winder 4. The first godet roller 8 is rotationally driven by an unillustrated motor. The second godet roller 9 is a roller which has an axis substantially in parallel to the left-right direction and which is provided above and behind the first godet roller 8. The second godet roller 9 is rotationally driven by an unillustrated motor.

[0054] The yarn regulating guide 7 is provided above the first godet roller 8. The yarn regulating guide 7 is, e.g., a known yarn guide with a comb teeth shape. When the yarns Y are threaded thereto, the yarn regulating guide 7 regulates an interval between adjacent yarns Y to a predetermined value.

(Yarn Winder 4)

[0055] The following will describe the yarn winder 4 with reference to FIG. 1 to FIG. 2. FIG. 2 is a front view of the yarn winder 4. As shown in FIG. 1 and FIG. 2, the yarn winder 4 includes members such as a base 20, fulcrum guides 21, traverse guides 22, a turret 23, two bobbin holders 24, a contact roller 25, and a controller 26.

[0056] As shown in FIG. 1, the base 20 includes a base main body 27 which stands up from a rear portion of the yarn winder 4, and a frame 28 (a supporting member of the present invention) which is fixed to an upper portion of the base main body 27 and which extends forward. The base main body 27 supports the turret 23, etc. The frame 28 supports the contact roller 25 extending along the

front-rear direction.

[0057] The fulcrum guides 21 are provided for the respective yarns Y, and are aligned in the front-rear direction. The fulcrum guides 21 are attached to a guide supporting member 29 supported by the frame 28. As the yarns Y are threaded, the fulcrum guides 21 function as fulcrums when the yarns Y are traversed.

[0058] The traverse guides 22 are provided for the respective yarns Y, and are aligned in the front-rear direction. The traverse guides 22 are driven by a traverse motor 35 (see FIG. 8), and reciprocate in the front-rear direction. With this, the yarns Y threaded to the traverse guides 22 are traversed about the fulcrum guides 21.

[0059] The turret 23 is a disc-shaped member which has an axis substantially in parallel to the front-rear direction and which is rotatably supported by the base main body 27. The turret 23 is rotationally driven by a turret motor 36 (see FIG. 8). The turret 23 cantilevers the two bobbin holders 24, and is configured to rotate about the rotational axis substantially in parallel to the front-rear direction so as to move the two bobbin holders 24. With this, the following positions can be switched from one another in the yarn winder 4: the position of the bobbin holder 24 located at a winding position (an upper position in FIG. 1) where winding of the yarns Y onto the bobbins B is performed; and the position of the bobbin holder 24 located at a standby position (a lower position in FIG. 1) where the winding of the yarns Y is not performed. While the yarns Y are wound onto the bobbins B attached to the bobbin holder 24 located at the yarn winding position, the replacement of the bobbins B can be performed for the bobbin holder 24 located at the standby position. The turret 23 is rotatable in accordance with the increase in the amount of the yarns Y wound onto the bobbins B in the winding of the yarns Y. To be more specific, as the amount of the yarns Y wound onto the bobbins B increases, the turret 23 rotates counterclockwise.

[0060] To each of the two bobbin holders 24, the bobbins B are attached. Each of the two bobbin holders 24 is rotatably supported by the turret 23 supported by the base main body 27, and protrudes forward from the turret 23. To be more specific, as shown in FIG. 2, each of the two bobbin holders 24 viewed in the front-rear direction is supported by the turret 23 so that the two bobbin holders 24 are point symmetric with respect to the rotation center of the turret 23. The axes of the two bobbin holders 24 are substantially in parallel to the front-rear direction. A leading end side (a front portion) of the bobbin holder 24 is typically a working side where operations such as attachment of the bobbins B to the bobbin holder 24 are performed.

[0061] The bobbins B are provided for the respective yarns Y, aligned in the front-rear direction, and attached to each bobbin holder 24. The number of the bobbins B attached to one bobbin holder 24 is, e.g., 16. The two bobbin holders 24 are rotationally driven by their respective winding motors 37 and 38 (see FIG. 8). In the present embodiment, the rotational direction of the bobbin holder 24 viewed from the front side is a counterclockwise direction shown in FIG. 2 (as shown by a solid arrow in FIG. 2).

[0062] As shown in FIG. 1, the contact roller 25 extends along the front-rear direction. As shown in FIG. 1 and FIG. 2, the contact roller 25 is a roller which has an axis substantially in parallel to the front-rear direction and which is provided immediately above the upper bobbin holder 24 located at the winding position. The contact roller 25 is configured to make contact with the outer circumferential surfaces of the packages P which are formed by winding the yarns Y onto the respective bobbins B attached to the bobbin holder 24 located at the winding position, so as to apply a contact pressure to the outer circumferential surfaces of the unfinished packages P to adjust the shape of each package P.

[0063] In the present embodiment, the contact roller 25 is swingably supported by the frame 28 via a roller supporting member 30. As shown in FIG. 1 and FIG. 2, the roller supporting member 30 includes, e.g., a supporting portion 31, an arm portion 32, and a swing axis 33. The supporting portion 31 rotatably supports the contact roller 25 at the respective end portions of the contact roller 25 in the front-rear direction. The arm portion 32 has one end portion connected to the supporting portion 31, and extends toward the frame 28 in the direction orthogonal to the front-rear direction. The swing axis 33 is connected to the other end portion of the arm portion 32, extends along the front-rear direction, and is swingably supported by the frame 28. The arm portion 32 is swingable about the swing axis 33 (as shown by a dotted arrow in FIG. 2).

[0064] The controller 26 includes members such as a CPU, a ROM, and a RAM. The controller 26 is configured to control members by the CPU, based on a program stored in the ROM. To be more specific, the controller 26 is configured to control members such as the traverse motor 35, the turret motor 36, the winding motors 37 and 38, a movement mechanism motor 63 described later, and a sensor 90 described later.

[0065] In the yarn winder 4 structured as described above, when the bobbin holder 24 located at the winding position is rotationally driven, the yarns Y traversed by the traverse guides 22 are wound onto the bobbins B so that the packages P are formed. At this stage, the packages P rotate together with the rotating bobbin holder 24. That is, the rotational direction of the packages P is the same as that of the bobbin holder 24, i.e., a counterclockwise direction shown in FIG. 2 (as indicated by a solid arrow in FIG. 2). While the packages P are being formed, the contact roller 25 makes contact with the outer circumferential surfaces of the packages P and applies a contact pressure thereto so that the shape of each package P is adjusted. The contact roller 25 rotates in a direction opposite to the rotational direction of the bobbin holder 24, i.e., in a clockwise direction shown in FIG. 2 (as indicated by a solid arrow in FIG. 2). In the present embodiment, when the yarns Y are wound onto the

bobbins B, the yarns Y making contact with a right part of the contact roller 25 are sent downstream in the rotational direction of the contact roller 25 and along the circumferential direction of the contact roller 25. The yarns Y then pass over a contact C between the packages P (or the bobbins B immediately after the start of winding of the yarns Y onto the bobbins B) and the contact roller 25, and are sent downstream in the rotational direction of the packages P and along the circumferential direction of the packages P.

[0066] The yarn winder 4 of the present embodiment further includes end-face gap covers 40 and a circumferential surface cover 50. The following will describe the end-face gap covers 40 and the circumferential surface cover 50 with reference to FIG. 2 to FIG. 5. FIG. 3 is a perspective view of a part of the yarn winder 4, and shows a front end of the bobbin holder 24 located at the winding position and its surroundings. FIG. 4 is a front view of the part of the yarn winder 4, and shows the bobbin holder 24 located at the winding position and its surroundings. FIG. 5 is a side view of a part of the yarn winder 4 viewed from the right side.

(End-Face Gap Cover 40)

[0067] As shown in FIG. 3, the end-face gap covers 40 are provided at the respective spaces 70 formed between end faces E of the packages P that are adjacent in the front-rear direction (hereinafter, those will be referred to as package end-face gaps). To be more specific, in the present embodiment, the yarns Y are respectively wound onto sixteen bobbins B attached to the bobbin holder 24 located at the winding position, with the result that sixteen packages P are formed. At package end-face gaps between the sixteen packages P, fifteen spaces 70 are formed. Each end-face gap cover 40 is provided at each of the fifteen spaces 70. In the present embodiment, while the spaces 70 are formed between the end faces E of the adjacent packages P, spaces are not formed between end faces of the adjacent bobbins B. That is, the adjacent bobbins B are in contact with each other without gaps (see FIG. 1 and FIG. 5).

[0068] As shown in FIG. 4, each end-face gap cover 40 includes a contact roller surface 41 and a bobbin surface 42. The contact roller surface 41 faces the contact roller 25 side when viewed in the front-rear direction. In other words, the contact roller surface 41 is oriented radially outward of a package P. The bobbin surface 42 faces the center Q side of the package P when viewed in the front-rear direction. In other words, the bobbin surface 42 is oriented radially inward of the package P. That is, the bobbin surface 42 is oriented to the center side of a bobbin B when viewed in the front-rear direction. When viewed in the front-rear direction, the center of the bobbin B coincides with the center Q of the package P.

[0069] As shown in FIG. 4, the contact roller surface 41 is provided on the center Q side of the package P as compared to the outer circumferential surface of the package P in a radial direction of the package P. In other words, the contact roller surface 41 is provided on the center Q side of the package P as compared to the contact C in the radial direction of the package P. In the present embodiment, when the diameter of the package P reaches a predetermined size, the contact roller surface 41 is provided on the center Q side of the package P in the radial direction of the package P as compared to the contact C between the contact roller 25 and the package P. In this regard, the diameter of a package with a predetermined size is larger than the diameter of a package (e.g., 120 mm) immediately after the start of winding of the yarn Y onto the bobbin B and is smaller than the diameter of a package (i.e., the diameter of a fully-formed package: e.g., 380 mm) at the end of winding of the yarn Y onto the bobbin B. The diameter of a package with a predetermined size is, e.g., 200 mm.

[0070] When viewed in the front-rear direction, the distance between the contact roller surface 41 and the contact C is preferably 5 to 10 mm. The term "distance" in this case indicates the shortest distance between the contact roller surface 41 and the contact C. In the present embodiment, when viewed in the front-rear direction, the distance between the contact roller surface 41 and the contact C is, e.g., 5 mm.

[0071] As shown in FIG. 4, when viewed in the front-rear direction, the bobbin surface 42 is a curved surface extending along the rotational direction of the package P. To be more specific, when viewed in the front-rear direction, the bobbin surface 42 is an arc-shaped surface extending along the rotational direction of the package P. In this regard, the rotational direction of the package P is that of the end faces E of the package P. In the present embodiment, when viewed in the front-rear direction, the contact roller surface 41 is also an arc-shaped surface extending along the rotational direction of the package P.

[0072] As shown in FIG. 4, when viewed in the front-rear direction, at least a part of the contact roller surface 41 is provided within an angular range of 30 degrees on the upstream side from a virtual line segment V connecting the contact C to the center Q of the package P and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P. The upstream side in the rotational direction of the package P viewed from the front side indicates an angular range of 180 degrees clockwise from the reference, i.e., the virtual line segment V in an end face E of the package P. The downstream side in the rotational direction of the package P viewed from the front side indicates an angular range of 180 degrees counterclockwise from the reference, i.e., the virtual line segment V in the end face E of the package P.

[0073] Furthermore, as shown in FIG. 4, one part of the end-face gap cover 40 viewed in the front-rear direction is provided upstream of the virtual line segment V in the rotational direction of the package P. When viewed in the front-rear direction, another part of the end-face gap cover 40 is provided downstream of the virtual line seg-

ment V in the rotational direction of the package P.

[0074] When viewed in the front-rear direction, the end-face gap cover 40 is continuously formed across an angular range of 25 degrees or more in the rotational direction of the package P. To be more specific, when viewed in the front-rear direction, a part of the end-face gap cover 40 is continuously formed across an angular range of 20 degrees on the upstream side from the virtual line segment V and an angular range of 5 degrees on the downstream side from the virtual line segment in the rotational direction of the package P. In other words, when viewed in the front-rear direction, an angle $\theta 1$(see FIG. 4) between the following line segments is 20 degrees or more: a line segment V1 connecting the center Q of the package P to an upstream end 40a of the end-face gap cover 40 on the upstream side of the virtual line segment V in the rotational direction of the package P; and the virtual line segment V. When viewed in the front-rear direction, an angle $\theta 2$ (see FIG. 4) between the following line segments is 5 degrees or more: a line segment V2 connecting the center Q of the package P to a downstream end 40b of the end-face gap cover 40 on the downstream side of the virtual line segment V in the rotational direction of the package P; and the virtual line segment V. When viewed in the front-rear direction, the end-face gap cover 40 is formed continuously (i.e., formed without gaps) from the upstream end 40a to downstream end 40b of the end-face gap cover 40. In the present embodiment, for example, when viewed in the front-rear direction, the end-face gap cover 40 is preferably formed continuously across an angular range of 30 degrees on the upstream side from the virtual line segment V and an angular range of 15 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P. That is, the angle $\theta 1$ is preferably 30 degrees, and the angle $\theta 2$ is preferably 15 degrees. However, the end-face gap cover 40 may be arranged differently.

[0075] As shown in FIG. 5, the size S of a gap between an end face E of the package P and the end-face gap cover 40 is preferably 3 to 5 mm in the front-rear direction. The term "gap" in this case indicates the shortest distance between the end face E of the package P and the end-face gap cover 40. In the present embodiment, the size S of the gap between the end face E of the package P and the end-face gap cover 40 is, e.g., 5 mm in the front-rear direction.

(Circumferential Surface Cover 50)

[0076] As shown in FIG. 4, the circumferential surface cover 50 is provided so as to cover parts of the outer circumferential surfaces of the packages P in the circumferential direction of the packages P. To be more specific, the circumferential surface cover 50 is provided along the circumferential direction of, e.g., the fully-formed packages P. The circumferential surface cover 50 is provided downstream of the contact C in the rotational direction of the packages P. When the circumferential surface cover 50 is provided downstream of the contact C in the rotational direction of the packages P, the circumferential surface cover 50 is provided above a straight line (i.e., above the extension of the virtual line segment V) connecting the contact C to the center Q of the packages P.

[0077] When viewed in the front-rear direction, the circumferential surface cover 50 is provided on the outside of orbits of the packages P which rotate together with each bobbin holder 24 as the turret 23 rotates. An orbit M of each bobbin holder 24 which rotates as the turret 23 rotates is indicated by a two-dot chain line in FIG. 2. In the present embodiment, the distance between the center Q of a package P and the circumferential surface cover 50 is longer than that between the center Q of the package P and each end-face gap cover 40 in the radial direction of the package P (see FIG. 4). In other words, the circumferential surface cover 50 is provided outside each end-face gap cover 40 in the radial direction of the package P.

[0078] In the present embodiment, the shortest distance between the contact C and the circumferential surface cover 50 is preferably as short as possible as long as the circumferential surface cover 50 does not make contact with the contact roller 25. The shortest distance between the contact C and the circumferential surface cover 50 is, e.g., 25 mm. The circumferential surface cover 50 is preferably formed continuously across an angular range of 45 degrees or more along the circumferential direction of the package P. In the present embodiment, the circumferential surface cover 50 is formed continuously across an angular range of 60 degrees along the circumferential direction of the package P. In the present embodiment, a part of the circumferential surface cover 50 overlaps a part of each end-face gap cover 40 in the circumferential direction of the package P (see FIG. 4).

[0079] As shown in FIG. 3, the circumferential surface cover 50 extends in the front-rear direction. The length of the circumferential surface cover 50 is substantially the same as that of each bobbin holder 24 in the front-rear direction.

[0080] As shown in FIG. 4, the circumferential surface cover 50 is attached to the frame 28 via a connection member 80. In other words, the circumferential surface cover 50 is indirectly attached to the frame 28. One end of the connection member 80 is connected to the frame 28, and the other end of the connection member 80 is connected to the circumferential surface cover 50. One end of the connection member 80 is provided above and to the left of the other end of the connection member 80. The connection member 80 may extend in, e.g., the front-rear direction. However, the connection member 80 may be arranged differently.

[0081] As shown in FIG. 3 and FIG. 4, the circumferential surface cover 50 is connected to each end-face gap cover 40 via each of rod members 61. In other words, the end-face gap covers 40 are attached to the circumfer-

ential surface cover 50 via the respective rod members 61. That is, each end-face gap cover 40 is indirectly attached to the circumferential surface cover 50. As shown in FIG. 4, one end of each rod member 61 is connected to the circumferential surface cover 50, and the other end of each rod member 61 is connected to a bobbin surface 42 of an end-face gap cover 40. In the present embodiment, the other end of each rod member 61 is connected to a bobbin surface 42 of an end-face gap cover 40 in the vicinity of a downstream end 40b thereof. However, the disclosure is not limited to this. As shown in FIG. 3, the rod members 61 connected to the respective end-face gap covers 40 are connected to the circumferential surface cover 50.

(Movement Mechanism 60)

[0082] The yarn winder 4 of the present embodiment includes a movement mechanism 60 for moving the end-face gap covers 40. The following will detail the movement mechanism 60 with reference to FIG. 3, FIG. 4, FIG. 6, and FIG. 7.

[0083] The movement mechanism 60 is configured to move the end-face gap covers 40 between end-face gap positions (a position shown in FIG. 3, FIG. 4, and FIG. 7) and retracted positions (a position shown in FIG. 6). Each end-face gap position is a position where at least a part of each end-face gap cover 40 is provided at a corresponding space 70 of the package end-face gap. In the present embodiment, each end-face gap position is a position where each end-face gap cover 40 is entirely provided at a corresponding space 70. Furthermore, each end-face gap position of the present embodiment is a position of each end-face gap cover 40 when at least a part of the contact roller surface 41 is provided within an angular range of 30 degrees on the upstream side from the virtual line segment V and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of the packages P. The retracted positions are provided outside the end-face gap positions in the radial direction of the packages P. Furthermore, each retracted position is a position where each end-face gap cover 40 is provided outside the orbits of the bobbins B which rotate together with each bobbin holder 24 as the turret 23 rotates.

[0084] As shown in FIG. 3 and FIG. 4, the movement mechanism 60 includes the above-described rod members 61 and rails 62. Each rail 62 extends along the left-right direction, and is formed along an inner surface of the circumferential surface cover 50. The inner surface of the circumferential surface cover 50 faces inward in the radial direction of the packages P. In other words, the inner surface of the circumferential surface cover 50 faces the center Q side of each package P. Each rail 62 slidably supports one end of a rod member 61. In other words, one end of each rod member 61 is connected to the circumferential surface cover 50 via a rail 62.

[0085] As described above, the other end of each rod member 61 is connected to an end-face gap cover 40. With this arrangement, each end-face gap cover 40 connected to the other end of each rod member 61 is movable between an end-face gap position and a retracted position as the rod member 61 slides along a corresponding rail 62. Each rod member 61 is equivalent to a connecting member of the present invention. The sliding of each rod member 61 along a corresponding rail 62 is performed by, e.g., a movement mechanism motor 63 (see FIG. 8). The driving of the movement mechanism motor 63 is controlled by the controller 26. In the present embodiment, the sliding of the rod members 61 is controlled collectively.

(Sensor 90)

[0086] The yarn winder 4 of the present embodiment includes a sensor 90 (see FIG. 1) configured to detect information regarding the size in diameter of the packages P attached to the bobbin holder 24 located at the winding position. For example, the sensor 90 is configured to detect an inclination of an axis of the bobbin holder 24 with respect to the front-rear direction. The inclination of the bobbin holder 24 depends on the weight of the packages P which increases as the diameter of each package P increases. That is, the inclination of the bobbin holder 24 is equivalent to "information regarding the size in diameter of the packages P" of the present invention. Information regarding the inclination of the bobbin holder 24 is detected by the sensor 90 and sent to the controller 26.

[0087] The controller 26 is configured to calculate the diameter of the packages P based on the inclination of the bobbin holder 24. When the diameter of the packages P reaches a predetermined size, the controller 26 controls the movement mechanism 60 so that each end-face gap cover 40 is moved from the retracted position to the end-face gap position. The diameter of a package with a predetermined size is, e.g., 200 mm. In this regard, "information regarding the size in diameter of the packages P" may not be the above-described inclination of the bobbin holder 24. For example, when the sensor 90 is an optical sensor and is configured to detect a coordinate position of the outer circumferential surface of each package P, "information regarding the size in diameter of the packages P" is the coordinate position of the outer circumferential surface of each package P.

(Winding of Yarns)

[0088] The following will describe the winding of the yarns Y by means of the yarn winder 4. To begin with, as shown in FIG. 6, the bobbins B attached to the bobbin holder 24 located at the winding position are in contact with the contact roller 25 at the start of winding of the yarns Y onto the bobbins B. At this time, each end-face gap cover 40 is located at the retracted position. Each end-face gap cover 40 located at the retracted position is

provided inside the circumferential surface cover 50 in the radial direction of a package P. At the start of winding of the yarns Y onto the bobbins B, the contact roller 25 has slightly swung clockwise about the swing axis 33 from the position shown in FIG. 4 (as indicated by a full-line arrow in FIG. 6).

[0089] As (i) the winding of the yarns Y onto the bobbins B advances and (ii) the diameter of the packages P increases, the contact roller 25 moves to a position shown in FIG. 4. That is, the contact roller 25 slightly swings counterclockwise about the swing axis 33. As (i) the amount of the yarns Y wound onto the bobbins B increases and (ii) the diameter of the packages P increases, the turret 23 is gradually rotated counterclockwise (as indicated by a full-line arrow in FIG. 2). Because of this, as the diameter of the packages P increases, the bobbin holder 24 gradually moves leftward and downward. As a result, even when the diameter of the packages P has increased, a coordinate position of the contact C between each package P and the contact roller 25 viewed in the front-rear direction is scarcely changed.

[0090] During the winding of the yarns Y, the controller 26 calculates the size in diameter of the package P always or at regular intervals based on the inclination of the bobbin holder 24 detected by the sensor 90. When the diameter of the packages P reaches a predetermined size (e.g., 200 mm), the controller 26 controls the movement mechanism 60 so that each end-face gap cover 40 is moved from the retracted position to the end-face gap position (as indicated by a full-line arrow in FIG. 7). Then, the winding of the yarns Y is continued in the state of FIG. 7 until the packages P are fully formed.

(Reduction Effect of Air Resistance of Yarn Winders of Examples)

[0091] The following will describe the reduction effects of air resistance of yarn winders in Examples 1 and 2, with reference to FIG. 9. A yarn winder of Example 1 includes end-face gap covers 40, and does not include a circumferential surface cover 50. A yarn winder of Example 2 includes end-face gap covers 40 and a circumferential surface cover 50 (in the same manner as the yarn winder 4 of the embodiment above). Each of the yarn winders of Examples 1 and 2 includes a movement mechanism 60 for moving the end-face gap covers 40. The end-face gap covers 40, the circumferential surface cover 50, and the movement mechanism 60 are structured in the same manner as the embodiment above.

[0092] FIG. 9 shows reduction rates (%) of air resistance which was reduced by the yarn winders of Examples 1 and 2 as compared to a yarn winder of Comparative Example. The yarn winder of Comparative Example does not include end-face gap covers 40 and a circumferential surface cover 50. FIG. 9 shows simulated values (%) of the reduction rates of the air resistance in the yarn winders of Examples 1 and 2 as compared to the air resistance in the yarn winder of Comparative Example. The reduction rates of air resistance shown in FIG. 9 include: a reduction rate (shown in an upper part of FIG. 9) of air resistance applied to the outer circumferential surface of each package P; a reduction rate (shown in a middle part of FIG. 9) of air resistance applied to end faces E of each package P; and a reduction rate (shown in a lower part of FIG. 9) of air resistance applied to each entire package P (i.e., a total of air resistance applied to the outer circumferential surface and end faces E of each package P). Each type of air resistance indicates air resistance applied from the start to end of winding of the yarns Y onto the bobbins B. A package diameter (i.e., the diameter of each package P) at the start of winding of the yarns Y is set in 120 mm, and the package diameter at the end of the winding (i.e., the diameter of each fully-wound package P) is set in 380 mm.

[0093] The air resistance applied to the outer circumferential surface of each package P indicates a total value of air resistance applied to the outer circumferential surfaces of sixteen packages P attached to the bobbin holder 24 located at the winding position. The air resistance applied to the outer circumferential surface of each package P is calculated based on a speed difference between the speed of air (hereinafter, this will be referred to an outer circumferential surface accompanied flow) flowing along the outer circumferential surface of each package P and the rotation speed (circumferential speed) of each package P. The air resistance applied to the end faces E of each package P indicates a total value of air resistance applied to thirty-two end faces E of sixteen packages P attached to the bobbin holder 24 located at the winding position. The air resistance applied to the end faces E of each package P is calculated based on a speed difference between the speed of air in contact with the end faces E of each package P and the rotation speed of the end faces E thereof. The air resistance applied to each entire package P indicates a total value of the air resistance applied to the outer circumferential surface of each package P and the air resistance applied to the end faces E thereof.

[0094] As shown in FIG. 9, in the entire yarn winder of each of Examples 1 and 2, the reduction of air resistance is achieved as compared to the yarn winder of Comparative Example. In the yarn winder of Example 1 in which (i) the end-face gap covers 40 were provided and (ii) the circumferential surface cover 50 was not provided, the air resistance applied to the end faces E of each package P was reduced by 22% as compared to Comparative Example. As a result, in the entire yarn winder of Example 1, the air resistance was reduced by 10% as compared to Comparative Example. In the yarn winder of Example 2 in which the end-face gap covers 40 and the circumferential surface cover 50 are provided, the air resistance applied to the outer circumferential surface of each package P was reduced as compared to Comparative Example. In the yarn winder of Example 2, the air resistance applied to the end faces E of each package P is further reduced as compared to Example 1. As a result, in the entire yarn

winder of Example 2, the air resistance was reduced by 21% as compared to Comparative Example.

[0095] From these results, it is presumed that the provision of the end-face gap covers 40 reduces the air resistance applied to the yarn winder so that the reduction effect of power consumption is sufficiently obtained. Furthermore, the air resistance applied to the yarn winder is further effectively reduced by providing the circumferential surface cover 50 in addition to the end-face gap covers 40, with the result that the reduction effect of power consumption is further effectively obtained.

(Effects)

[0096] The yarn winder 4 of the present embodiment includes: the bobbin holders 24 to which the bobbins B, onto which the yarns Y are respectively wound, are attached; the contact roller 25 configured to make contact with the outer circumferential surfaces of the packages P which are formed by winding the yarns Y onto the respective bobbins B; and the end-face gap covers 40 provided at the respective spaces 70 formed between the end faces of the packages P that are adjacent in the front-rear direction. Each end-face gap cover 40 includes the contact roller surface 41 which faces the contact roller 25 side when viewed in the front-rear direction. The contact roller surface 41 is provided on the center Q side of the package P as compared to the outer circumferential surface of the package P in a radial direction of the package P. When viewed in the front-rear direction, at least a part of the contact roller surface 41 is provided within an angular range of 30 degrees on the upstream side from the virtual line segment V connecting the contact C to the center Q of the package P and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P.

[0097] In the present embodiment, at least a part of the contact roller surface 41 of each end-face gap cover 40 provided at the package end-face gap is provided on the center Q side of the package P as compared to the contact C in the radial direction of the package P. In other words, at least a part of the contact roller surface 41 of the end-face gap cover 40 is provided inside the outer circumferential surface of the package P in the radial direction of the package P. This makes it possible to suppress air from entering the inside of the end-face gap cover 40 from the outside thereof in the radial direction of the package P, and to effectively suppress the air from entering the package end-face gap. At least a part of the end-face gap cover 40 is provided within an angular range of 30 degrees on the upstream side from the virtual line segment V and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P. In other words, the end-face gap cover 40 is provided in the vicinity of the contact C. This makes it possible to suppress the air flowing along the outer circumferential surface of the package P (hereinafter, this will be referred to as an outer circumferential surface accompanied flow) from colliding with the contact roller 25 and flowing into the package end-face gap in the vicinity of the contact C. It is therefore possible to suppress the disturbance of an airflow at the package end-face gap between rotating packages P. As a result, the air resistance applied to the end faces E of each package P is effectively reduced so that the reduction effect of power consumption is effectively improved.

[0098] In the yarn winder 4 of the present embodiment, the end-face gap covers 40 are provided at the respective spaces 70. This makes it possible to effectively suppress the air from flowing into all package end-face gaps. This also makes it possible to suppress the disturbance of airflows at all package end-face gaps. It is therefore possible to effectively reduce the air resistance applied to the end faces E of each package P.

[0099] In the yarn winder 4 of the present embodiment, when viewed in the front-rear direction, a part of each end-face gap cover 40 is provided upstream of the virtual line segment V in the rotational direction of the package P. With this arrangement, a part of the air blocked by the contact roller 25 is suppressed from flowing into the package end-face gap on the upstream side of the contact C in the rotational direction of the package P. It is therefore possible to suppress the disturbance of an airflow at the package end-face gap, and to effectively suppress the air resistance applied to the end faces E of each package P.

[0100] In the yarn winder 4 of the present embodiment, when viewed in the front-rear direction, a part of each end-face gap cover 40 is provided downstream of the virtual line segment V in the rotational direction of the package P. With this arrangement, the air is suppressed from flowing into the package end-face gap in an area provided downstream of the contact C in the rotational direction of the package P. This area is an area where the outer circumferential surface accompanied flow collides with the contact roller 25 and is blocked so that the density of air is decreased. It is therefore possible to suppress the disturbance of an airflow at the package end-face gap, and to effectively suppress the air resistance applied to the end faces E of each package P.

[0101] In the yarn winder 4 of the present embodiment, each end-face gap cover 40 includes the bobbin surface 42 which faces the center Q side of the package P when viewed in the front-rear direction. When viewed in the front-rear direction, the bobbin surface 42 is a curved surface extending along the rotational direction of the package P. With this arrangement, the air at the package end-face gap flows along the bobbin surface 42 of the end-face gap cover 40. Because the bobbin surface 42 is curved along the rotational direction of the package P, the air flowing along the bobbin surface 42 easily flows in the same direction as the rotational direction of the end faces E of the package P. That is, a speed difference between the speed of air flowing along the bobbin surface 42 and

the rotation speed of the end faces E of the package P becomes small. It is therefore possible to suppress the increase in air resistance which is applied to the end faces E of the package P because of the air flowing through the package end-face gap.

[0102] In the yarn winder 4 of the present embodiment, the size of the gap S between the end-face gap cover 40 and the package P is 3 to 5 mm in the front-rear direction. With this arrangement, the end-face gap cover 40 is provided as close to the end-faces E of the package P as possible, as long as the end-face gap cover 40 can avoid the contact with the end-faces E of the package P. It is therefore possible to further effectively suppress the air radially outside the package P from flowing into the package end-face gap.

[0103] In the yarn winder 4 of the present embodiment, when viewed in the front-rear direction, the distance between the contact roller surface 41 and the contact C is 5 to 10 mm. With this arrangement, the contact roller surface 41 is provided as close to the contact C as possible, as long as the end-face gap cover 40 can avoid the contact with the contact roller 25. This allows the end-face gap cover 40 to suppress, as much as possible, the outer circumferential surface accompanied flow from colliding with the contact roller 25 and causing the air to flow into the package end-face gap in the vicinity of the contact C. It is therefore possible to further effectively suppress the increase in air resistance applied to the end faces E of each package P.

[0104] In the yarn winder 4 of the present embodiment, when viewed in the front-rear direction, the end-face gap cover 40 is continuously formed across an angular range of 25 degrees or more in the rotational direction of the package P. This makes it possible to suppress the air from flowing in the package end-face gap, in a wide area of the package P in the rotational direction thereof.

[0105] In the yarn winder 4 of the present embodiment, when viewed in the front-rear direction, a part of the end-face gap cover 40 is continuously formed across an angular range of 20 degrees on the upstream side from the virtual line segment and an angular range of 5 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P. This makes it possible to suppress the air from flowing into the package end-face gap, in both of areas provided immediately upstream and downstream of the contact C in the rotational direction of the package P.

[0106] The yarn winder 4 of the present embodiment includes the movement mechanism 60 configured to move the end-face gap covers 40 between the end-face gap positions where at least parts of the end-face gap covers 40 are provided at the respective spaces 70 formed between the end faces E of the adjacent packages P and the retracted positions provided outside the end-face gap positions in the radial direction of the packages P. Because the diameter of the packages P is significantly small immediately after the start of winding of the yarns Y, the contact roller 25 is close to the bobbins B in the radial direction of the packages P. Accordingly, the positional relationship between the end-face gap covers 40 and the contact roller 25 may cause the interference between the end-face gap covers 40 and the bobbins B immediately after the start of winding of the yarns Y. Especially, when the adjacent bobbins B are in contact with each other without gaps (i.e., spaces are not formed between the end faces of the adjacent bobbins B) as in the present embodiment, the end-face gap covers 40 are more likely to interfere with the bobbins B. This is because installation spaces (e.g., spaces between the end faces of the adjacent bobbins B) of the end-face gap covers 40 may not be sufficient and the interference between the end-face gap covers 40 and the bobbins B may not be avoided.

[0107] In this regard, immediately after the start of winding of the yarns Y, the interference between the end-face gap covers 40 and the bobbins B is reliably avoided by moving the end-face gap covers 40 to the retracted positions in the present embodiment. When the winding of a yarn Y onto each bobbin B advances so that (i) the diameter of each package P increases and (ii) the distance between the contact roller 25 and the bobbin B becomes sufficiently long, each end-face gap cover 40 is moved to an end-face gap position. This makes it possible to avoid the interference between the end-face gap cover 40 and the bobbin B, and to suppress the air from flowing into the package end-face gap.

[0108] The yarn winder 4 of the present embodiment includes the sensor 90 configured to detect information regarding the size in diameter of the packages P and the controller 26 configured to control the driving of the movement mechanism 60. When (i) the controller 26 calculates the size in diameter of the packages P based on information regarding the size in diameter of the packages P and (ii) it is shown that the diameter of the packages P reaches a predetermined size, the controller 26 controls the movement mechanism 60 so that each end-face gap cover 40 is moved from the retracted position to the end-face gap position. Because of this, when the diameter of each package P reaches a predetermined size so that the distance between the contact roller 25 and each bobbin B becomes sufficient, the end-face gap cover 40 is moved to the end-face gap position. It is therefore possible to further reliably avoid the interference between the end-face gap cover 40 and the bobbin B.

[0109] The yarn winder 4 of the present embodiment includes the circumferential surface cover 50 provided to surround parts of the outer circumferential surfaces of the packages P in the circumferential direction thereof. This makes it possible to suppress the outer circumferential surface accompanied flow from being separated from the outer circumferential surfaces of the packages P. This also makes it possible to suppress the air from flowing from a space provided around the packages P into an area (hereinafter, this will be referred to as an outer circumferential surface area) provided along the outer circumferential surfaces of the packages P.

[0110] In the yarn winder 4 of the present embodiment, the circumferential surface cover 50 is provided downstream of the contact C in the rotational direction of each package P. With this arrangement, the air is suppressed from flowing into the outer circumferential surface area among an area provided downstream of the contact C in the rotational direction of the package P. This area is an area where the outer circumferential surface accompanied flow collides with the contact roller 25 and is blocked so that the density of air is decreased. The air is also suppressed from flowing from the outer circumferential surface area into the package end-face gap. It is therefore possible to suppress the air resistance applied to the package P.

[0111] The yarn winder 4 of the present embodiment further includes the frame 28 supporting the contact roller 25. The circumferential surface cover 50 is indirectly attached to the frame 28. It is therefore unnecessary to additionally provide a member for supporting the circumferential surface cover 50.

[0112] In the yarn winder 4 of the present embodiment, each end-face gap cover 40 is indirectly attached to the circumferential surface cover 50. It is therefore unnecessary to additionally provide a member for supporting the end-face gap cover 40.

[0113] In the yarn winder 4 of the present embodiment, the movement mechanism 60 includes the rod members 61 configured to move along a direction in which the circumferential surface cover 50 viewed in the front-rear direction extends. The rod members 61 are connected to the circumferential surface cover 50 and the respective end-face gap covers 40. The movement mechanism 60 is configured to move the end-face gap covers 40 between the end-face gap positions and the retracted positions by moving the rod members 61 along the direction in which the circumferential surface cover 50 extends. With this arrangement, the end-face gap covers 40 are moved between the end-face gap positions and the retracted positions by moving the rod members 61 from the circumferential surface cover 50. It is therefore unnecessary to provide a member different from the circumferential surface cover 50, as a member from which the rod members 61 are moved. This reduces the number of members. Furthermore, because provision of this member is unnecessary, it is unnecessary to secure a space for providing this member. As a result, the increase in size of the device because of provision of this member is avoided.

[0114] The yarn winder 4 of the present embodiment further includes the two bobbin holders 24 and the turret 23 which is rotatable and which supports each bobbin holder 24. Each bobbin holder 24 is rotatable between the winding position where the yarns Y are wound onto the bobbins B and the standby position different from the winding position, as the turret 23 rotates. When viewed in the front-rear direction, the circumferential surface cover 50 is provided outside the orbits of the packages P which rotate together with each bobbin holder 24. With this arrangement, the contact between the circumferential surface cover 50 and the packages P which rotate as the turret 23 rotates is avoided in the case where the two bobbin holders 24 are provided.

(Modifications)

[0115] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference signs and the explanations thereof may not be repeated.

(First Modification)

[0116] The following will describe a yarn winder of a first modification different from the embodiment above. Similarly to the yarn winder 4 of the embodiment above, the yarn winder of the first modification includes members such as: a base 20; fulcrum guides 21; traverse guides 22; a turret 23; two bobbin holders 24; a contact roller 25; and a controller 26. These constituent features are not explained.

[0117] The yarn winder of the first modification includes end-face gap covers 40 and a movement mechanism 60 in the same manner as the embodiment above. The movement mechanism 60 is configured to move the end-face gap covers 40 between end-face gap positions where at least parts of the end-face gap covers 40 are provided at the respective spaces 70 formed between end faces of the adjacent packages P and retracted positions provided outside the end-face gap positions in the radial direction of the packages P. In the first modification, the end-face gap positions are closer to the contact C than the retracted positions are in the circumferential direction of the packages P. That is, in the yarn winder of the first modification, the end-face gap covers 40 located at the end-face gap positions are closer to the contact C than the end-face gap covers 40 located at the retracted positions are in the circumferential direction of the packages P.

[0118] With this arrangement, at least parts of the end-face gap covers 40 located at the end-face gap positions are provided between the end faces of the adjacent packages P (hereinafter, those will be referred to as package end-face gaps). At least parts of contact roller surfaces 41 of the end-face gap covers 40 located at the package end-face gaps are provided on the center Q side of the packages P as compared to the outer circumferential surfaces of the packages P in the radial direction of the packages P. In other words, at least parts of the contact roller surfaces 41 of the end-face gap covers 40 are provided inside the outer circumferential surfaces of the packages P in the radial direction thereof. This makes it possible to suppress air from entering the inside of the end-face gap covers 40 from the outside thereof in the radial direction of the packages P, and to effectively suppress the air from entering the package end-face

gaps. The end-face gap positions are closer to the contact C than the retracted positions are in the circumferential direction of the packages P. In other words, the end-face gap covers 40 are provided in the vicinity of the contact C. This makes it possible to suppress the air flowing along the outer circumferential surfaces of the packages P (hereinafter, this will be referred to as an outer circumferential surface accompanied flow) from colliding with the contact roller 25 and flowing into the package end-face gaps in the vicinity of the contact C. It is therefore possible to suppress the disturbance of an airflow at the package end-face gaps. As a result, air resistance applied to the end faces of the packages P is effectively reduced so that the reduction effect of power consumption is effectively improved.

[0119] The structure of the first modification brings the following effects. Because the diameter of the packages P is significantly small immediately after the start of winding of yarns Y, the contact roller 25 is close to bobbins B in the radial direction of the packages P. Accordingly, the positional relationship between the end-face gap covers 40 and the contact roller 25 may cause the interference between the end-face gap covers 40 and the bobbins B immediately after the start of winding of the yarns Y. In this regard, immediately after the start of winding of the yarns Y, the interference between the end-face gap covers 40 and the bobbins B is reliably avoided by moving the end-face gap covers 40 to the retracted positions in the first modification. When the winding of a yarn Y onto each bobbin B advances so that (i) the diameter of each package P increases and (ii) the distance between the contact roller 25 and the bobbin B becomes sufficiently long, each end-face gap cover 40 is moved to the end-face gap position. This makes it possible to avoid the interference between the end-face gap covers 40 and the bobbins B, and to suppress the air from flowing into the package end-face gaps.

[0120] In the first modification, the number of the end-face gap covers 40 may be one. That is, a single end-face gap cover 40 may be provided at only one of the spaces 70.

[0121] In the above-described first modification, for example, each end-face gap position is preferably provided on the contact C side as compared to an orthogonal straight line (not illustrated) which is a straight line passing the center Q of a package P and which is orthogonal to a virtual line segment V. In the above-described first modification, each end-face gap position is preferably closer to the contact C than to the center Q of the package P when viewed in an axial direction. In the above-described first modification, when viewed in the axial direction, a part of each end-face gap cover 40 located at the end-face gap position preferably overlaps the virtual line segment V connecting the contact C to the center Q of the package P.

[0122] In the above-described first modification, a circumferential surface cover 50 is preferably provided. The definition of the circumferential surface cover 50 is the same as in the embodiment above.

(Other Modifications)

[0123] In the embodiment above, the end-face gap covers 40 are provided at the respective spaces 70 formed between the end faces of the packages P that are adjacent in the front-rear direction. However, an end-face gap cover 40 may be provided at one or more of the spaces 70 formed between the end faces of the packages P that are adjacent in the front-rear direction. For example, an end-face gap cover 40 may be provided at only one of the spaces 70 formed between the end faces of the packages P that are adjacent in the front-rear direction. For example, when the end-face gap cover 40 is provided at only one space 70, the movement mechanism 60 moves the one end-face gap cover 40 between the end-face gap position and the retracted position. When the end-face gap cover 40 is provided at only one space 70, the number of rod members 61 connected to the end-face gap cover 40 is one.

[0124] In the embodiment above, one end-face gap cover 40 is provided per space 70 formed at the package end-face gap. However, two or more end-face gap covers 40 may be provided per space 70. For example, when two end-face gap covers 40 are provided per space 70, thirty end-face gap covers 40 are provided in total for fifteen spaces 70. In this case, when viewed in the front-rear direction, at least a part of each end-face gap cover 40 is provided within an angular range of 30 degrees on the upstream side from the virtual line segment V connecting the contact C to the center Q of the package P and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of a package P. Furthermore, at least a part of a contact roller surface 41 of each end-face gap cover 40 is provided on the center Q side of the package P as compared to the contact C in the radial direction of the package P.

[0125] In the embodiment above, the entire contact roller surface 41 is provided on the center Q side of the package P as compared to the contact C in the radial direction of the package P. However, only a part of the contact roller surface 41 may be provided on the center Q side of the package P as compared to the contact C in the radial direction of the package P.

[0126] In the present embodiment, spaces are not formed between the end faces of the adjacent bobbins B. However, the spaces may be formed between the end faces of the adjacent bobbins B.

[0127] In the embodiment above, the entire end-face gap cover 40 is provided within an angular range of 30 degrees on the upstream side from the virtual line segment V connecting the contact C to the center Q of the package P and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of a package P. However, only a part of the end-face gap cover 40 may be provided within an angular range of 30 degrees on the upstream side from

the virtual line segment V connecting the contact C to the center Q of the package P and an angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P. In this case, the remaining part of the end-face gap cover 40 may be provided outside the angular range of 30 degrees on the upstream side from the virtual line segment V connecting the contact C to the center Q of the package P and the angular range of 30 degrees on the downstream side from the virtual line segment V in the rotational direction of the package P.

[0128] In the embodiment above, when viewed in the front-rear direction, the bobbin surface 42 is a curved surface extending along the rotational direction of the package P. However, when viewed in the front-rear direction, the bobbin surface 42 may extend along, e.g., a straight line. Alternatively, when viewed in the front-rear direction, the bobbin surface 42 may extend along, e.g., a straight line at least one part of which is bent.

[0129] In the embodiment above, when viewed in the front-rear direction, a part of each end-face gap cover 40 is provided upstream of the virtual line segment V in the rotational direction of the package P. However, the entire end-face gap cover 40 may be provided upstream of the virtual line segment V in the rotational direction of the package P. In the embodiment above, when viewed in the front-rear direction, a part of each end-face gap cover 40 is provided downstream of the virtual line segment V in the rotational direction of the package P. However, the entire end-face gap cover 40 may be provided downstream of the virtual line segment V in the rotational direction of the package P.

[0130] In the embodiment above, when viewed in the front-rear direction, the end-face gap cover 40 is continuously formed across an angular range of 25 degrees or more in the rotational direction of the package P. However, when viewed in the front-rear direction, the end-face gap cover 40 may be continuously formed across an angular range of less than 25 degrees in the rotational direction of the package P.

[0131] In the embodiment above, each rod member 61 may be extendable and contractible in the radial direction of the package P. In this regard, each end-face gap cover 40 located at the retracted position is provided inside the circumferential surface cover 50 in the radial direction of the package P (see FIG. 6). With this arrangement, when the end-face gap cover 40 is located at the retracted position, the end-face gap cover 40 is moved away from the bobbin B as far as possible by contracting the rod member 61 and moving the end-face gap cover 40 so as to be close to the circumferential surface cover 50. It is therefore possible to reduce the risk of interference between the end-face gap cover 40 and the bobbin B. Furthermore, when the end-face gap cover 40 is located at the end-face gap position, the end-face gap cover 40 can be elongated in the radial direction of the package P. It is therefore possible to provide the end-face gap cover 40 at a position where the air is most effectively suppressed from flowing into the package end-face gap in the radial direction of the package P.

[0132] In the embodiment above, the controller 26 is configured to calculate the diameter of the packages P based on information regarding the size in diameter of the packages P which is detected by the sensor 90. When the diameter of the packages P reaches a predetermined size, the controller 26 controls the movement mechanism 60 so that each end-face gap cover 40 is moved from the retracted position to the end-face gap position. However, the controller 26 may control the movement mechanism 60 so that each end-face gap cover 40 is moved from the retracted position to the end-face gap position at a predetermined timing calculated based on winding elapse time elapsed from the start of winding of the yarn Y onto the bobbin B. Because of this, the end-face gap cover 40 is moved to the end-face gap position at a predetermined timing at which the diameter of each package P reaches a size so that the distance between the contact roller 25 and each bobbin B becomes sufficient. It is therefore possible to further reliably avoid the interference between the end-face gap cover 40 and the bobbin B.

[0133] In the embodiment above, the controller 26 may be configured to determine a timing of moving each end-face gap cover 40 from the retracted position to the end-face gap position based on a signal input by an operator. To be more specific, for example, an unillustrated operation unit is provided in the yarn winder 4. As the operator operates the operation unit at a timing of moving each end-face gap cover 40 from the retracted position to the end-face gap position, an operation signal is sent to the controller 26. The controller 26 moves each end-face gap cover 40 from the retracted position to the end-face gap position based on the operation signal sent from the operation unit.

[0134] The yarn winder 4 of the embodiment above includes the movement mechanism 60 configured to move the end-face gap covers 40 from the end-face gap positions and the retracted positions. However, the yarn winder 4 may not include the movement mechanism 60. In this case, each end-face gap cover 40 is fixedly provided at the end-face gap position. Furthermore, a space is preferably formed between end faces of each adjacent bobbins B. With this arrangement, at least a part of each end-face gap cover 40 may be provided at the space formed between the end faces of each adjacent bobbins B.

[0135] In the yarn winder 4 of the embodiment above, the end-face gap covers 40 and the circumferential surface cover 50 are provided. However, the circumferential surface cover 50 may not be provided in the yarn winder 4 of the present invention.

[0136] In the embodiment above, the circumferential surface cover 50 is provided downstream of the contact C in the rotational direction of the packages P. However, the circumferential surface cover 50 may be provided upstream of the contact C in the rotational direction of the packages P.

[0137] In the embodiment above, the circumferential surface cover 50 is provided along the circumferential direction of the fully-formed packages P. However, the circumferential surface cover 50 may be differently arranged as long as it is provided so as to cover parts of the outer circumferential surfaces of the packages P in the circumferential direction of the packages P. For example, when viewed in the front-rear direction, the circumferential surface cover 50 may extend along, e.g., a straight line or a curved line. Alternatively, when viewed in the front-rear direction, the circumferential surface cover 50 may extend along, e.g., a straight line at least one part of which is bent. In this regard, when the circumferential surface cover 50 is provided so as to cover parts of the outer circumferential surfaces of the packages P in the circumferential direction of the packages P, the outer circumferential surfaces of the packages P are provided inside the outer circumferential surface cover 50 in the radial direction of the packages P.

[0138] In the embodiment above, the circumferential surface cover 50 is attached to the frame 28 via the connection member 80. However, the circumferential surface cover 50 may be attached to the roller supporting member 30 via the connection member 80. To be more specific, for example, the circumferential surface cover 50 may be attached to the arm portion 32 of the roller supporting member 30 via the connection member 80. In this case, the roller supporting member 30 is equivalent to the supporting member of the present invention. The circumferential surface cover 50 may be directly attached to the frame 28 or the arm portion 32. The circumferential surface cover 50 may be attached to a portion different from the frame 28 and the arm portion 32.

[0139] In the embodiment above, the end-face gap covers 40 are attached to the circumferential surface cover 50 via the respective rod members 61. However, the end-face gap covers 40 are attached to the circumferential surface cover 50 via the respective members different from the rod members 61.

[0140] In the embodiment above, each end-face gap cover 40 is indirectly attached to the circumferential surface cover 50. However, each end-face gap cover 40 may be directly attached to the circumferential surface cover 50. Each end-face gap cover 40 may be attached to a member different from the circumferential surface cover 50. As shown in FIG. 10, for example, each end-face gap cover 40 may be directly or indirectly attached to a wall member 92 extending upward from a floor surface in the front-rear direction. In FIG. 10, each end-face gap cover 40 is attached to an upper end of the wall member 92 via an arm member 93. Each end-face gap cover 40 may be directly or indirectly attached to the frame 28 or the arm portion 32.

[0141] In the embodiment above, the sliding of each rod member 61 along a corresponding rail 62 is performed by the movement mechanism motor 63. However, the sliding of each rod member 61 along a corresponding rail 62 may be performed by an air cylinder.

[0142] In the embodiment above, the movement mechanism 60 includes the rod members 61 and the rails 62. In this regard, the movement mechanism 60 may be arranged differently. For example, as shown in FIG. 10, a movement mechanism 100 may be provided instead of the movement mechanism 60. The movement mechanism 100 includes the wall member 92 and arm portions 93 extending from the upper end of the wall member 92 in a direction orthogonal to the front-rear direction. A base end portion of each arm portion 93 is rotatably supported by the upper end of the wall member 92 via a swing axis 94. A leading end portion of each arm portion 93 is connected to an end-face gap cover 40 via a rotational axis 95. The movement mechanism 100 is able to move each end-face gap cover 40 between an end-face gap position and a retracted position (as indicated by two-dot chain lines in FIG. 10) by swinging each arm portion 93 about the swing axis 94 and rotating each end-face gap cover 40 about the rotational axis 95. To be more specific, the movement mechanism 100 swings the arm portion 93 counterclockwise about the swing axis 94 at first (as indicated by full-line arrows in FIG. 10). The movement mechanism 100 then rotates the end-face gap cover 40 counterclockwise about the rotational axis 95 (as indicated by full-line arrows in FIG. 10). Because of this, the end-face gap cover 40 is moved from the end-face gap position to the retracted position. The swing of the arm portion 93 and the rotation of the end-face gap cover 40 are performed by, e.g., an unillustrated motor.

[0143] In the embodiment above, the movement mechanism 60 is driven by the controller 26. That is, the movement mechanism 60 is automatically controlled. However, the movement mechanism 60 may be manually driven by an operator.

[0144] In the embodiment above, the yarn winder 4 includes the two bobbin holders 24. However, the yarn winder 4 may include only one bobbin holder 24. When the yarn winder 4 includes only one bobbin holder 24, the yarn winder 4 may be structured so that, e.g., the contact roller 25 is moved and separated from the packages P at the time of replacement of the bobbins B in the bobbin holder 24. Alternatively, the yarn winder 4 may be structured so that the one bobbin holder 24 is moved for separating the packages P attached to the bobbin holder 24 from the contact roller 25.

Claims

1. A yarn winder (4) comprising:

at least one bobbin holder (24) which extends in a predetermined axial direction and to which bobbins (B) are attached to be aligned in the axial direction, yarns (Y) being respectively wound onto the bobbins (B);

a contact roller (25) which extends along the axial direction and which is configured to make

contact with outer circumferential surfaces of packages (P) formed by winding the yarns (Y) onto the respective bobbins (B); and
an end-face gap cover (40) provided at one or more of spaces (70) formed between end faces (E) of the packages (P) that are adjacent in the axial direction,
when viewed in the axial direction, the end-face gap cover (40) including a contact roller surface (41) facing the contact roller (25) side,
when viewed in the axial direction, at least part of the contact roller surface (41) being provided on the center (Q) side of the packages (P) as compared to the outer circumferential surfaces of the packages (P) in a radial direction of the packages (P),
when viewed in the axial direction, the at least part of the contact roller surface (41) being provided within an angular range of 30 degrees on the upstream side from a virtual line segment (V) and an angular range of 30 degrees on the downstream side from the virtual line segment (V) in a rotational direction of the packages (P), and the virtual line segment (V) connecting a contact (C) between the packages (P) and the contact roller (25) to a center (Q) of each of the packages (P).

2. The yarn winder (4) according to claim 1, wherein, when viewed in the axial direction, at least part of the end-face gap cover (40) is provided upstream of the virtual line segment (V) in the rotational direction of the packages (P) .

3. The yarn winder (4) according to claim 1 or 2, wherein, when viewed in the axial direction, the at least part of the end-face gap cover (40) is provided downstream of the virtual line segment (V) in the rotational direction of the packages (P).

4. The yarn winder (4) according to any one of claims 1 to 3, wherein, the end-face gap cover (40) includes a bobbin surface (42) which faces the center (Q) side of the packages (P) when the bobbin surface (42) is viewed in the axial direction, and
the bobbin surface (42) viewed in the axial direction is a curved surface extending along the rotational direction of the packages (P).

5. The yarn winder (4) according to any one of claims 1 to 4, wherein, when viewed in the axial direction, (i) the end-face gap cover (40) is continuously formed across an angular range of 25 degrees or more in the rotational direction of the packages (P) and (ii) the at least part of the end-face gap cover (40) is continuously formed across an angular range of 20 degrees on the upstream side from the virtual line segment (V) and an angular range of 5 degrees on the downstream side from the virtual line segment (V) in the rotational direction of the packages (P).

6. A yarn winder (4) comprising:

at least one bobbin holder (24) which extends in a predetermined axial direction and to which bobbins (B) are attached to be aligned in the axial direction, yarns (Y) being respectively wound onto the bobbins (B);
a contact roller (25) which extends along the axial direction and which is configured to make contact with outer circumferential surfaces of packages (P) formed by winding the yarns (Y) onto the respective bobbins (B); and
an end-face gap cover (40) provided at one or more of spaces (70) formed between end faces (E) of the adjacent packages (P) that are adjacent in the axial direction,
when viewed in the axial direction, the end-face gap cover (40) including a contact roller surface (41) facing the contact roller (25) side,
when viewed in the axial direction, at least part of the contact roller surface (41) being provided on the center (Q) side of the packages (P) as compared to the outer circumferential surfaces of the packages (P) in a radial direction of the packages (P),
the yarn winder (4) further comprising a movement mechanism (60) configured to move the end-face gap cover (40) between an end-face gap position where at least part of the end-face gap cover (40) is provided at the one or more of the spaces (70) formed between the end faces (E) of the adjacent packages (P) and a retracted position provided outside the end-face gap position in the radial direction of the packages (P), and
the end-face gap position being closer to a contact (C) between the packages (P) and the contact roller (25) than the retracted position in a circumferential direction of the packages (P).

7. The yarn winder (4) according to any one of claims 1 to 5, further comprising a movement mechanism (60) configured to move the end-face gap cover (40) between an end-face gap position where the at least part of the end-face gap cover (40) is provided at the one or more of the spaces (70) formed between the end faces (E) of the adjacent packages (P) and a retracted position provided outside the end-face gap position in the radial direction of the packages (P).

8. The yarn winder (4) according to claim 6 or 7, further comprising:

a sensor (90) configured to detect information regarding the size in diameter of the packages

(P); and
a controller (26) configured to drive the movement mechanism (60), wherein,
the controller (26) is configured to calculate the size in diameter of the packages (P) based on the information regarding the size in diameter of the packages (P), and
when the diameter of the packages (P) reaches a predetermined size, the controller (26) controls the movement mechanism (60) to move the end-face gap cover (40) from the retracted position to the end-face gap position.

9. The yarn winder (4) according to claim 6 or 7, further comprising a controller (26) configured to drive the movement mechanism (60), and
the controller (26) is configured to control the movement mechanism (60) to move the end-face gap cover (40) from the retracted position to the end-face gap position at a predetermined timing calculated based on winding elapse time elapsed from the start of winding of the yarns (Y) onto the bobbins (B).

10. The yarn winder (4) according to any one of claims 1 to 9, wherein, the end-face gap cover (40) is provided at each of the spaces (70).

11. The yarn winder (4) according to any one of claims 1 to 10, wherein, the size of a gap (S) between the end-face gap cover (40) and the each of the packages (P) in the axial direction is 3 to 5 mm.

12. The yarn winder (4) according to any one of claims 1 to 11, wherein, when viewed in the axial direction, the distance between the contact roller surface (41) and the contact (C) is 5 to 10 mm.

13. The yarn winder (4) according to any one of claims 1 to 12, wherein, when viewed in the axial direction, the end-face gap cover (40) is continuously formed across an angular range of 25 degrees or more in the rotational direction of the packages (P).

14. The yarn winder (4) according to any one of claims 1 to 13, further comprising a circumferential surface cover (50) provided to surround parts of the outer circumferential surfaces of the packages (P) in the circumferential direction of the packages (P).

15. The yarn winder (4) according to claim 14, wherein, the circumferential surface cover (50) is provided downstream of the contact (C) in the rotational direction of the packages (P).

16. The yarn winder (4) according to claim 14 or 15, further comprising a supporting member (28) which supports the contact roller (25), wherein,
the circumferential surface cover (50) is directly or indirectly attached to the supporting member (28).

17. The yarn winder (4) according to claim 16, wherein, the end-face gap cover (40) is directly or indirectly attached to the circumferential surface cover (50).

18. The yarn winder (4) according to claim 17, further comprising the movement mechanism (60) configured to move the end-face gap cover (40) between the end-face gap position where the at least part of the end-face gap cover (40) is provided at the one or more of the spaces (70) formed between the end faces (E) of the adjacent packages (P) and the retracted position provided outside the end-face gap position in the radial direction of the packages (P), wherein,

the movement mechanism (60) includes a connecting member (61) configured to move along a direction in which the circumferential surface cover (50) viewed in the axial direction extends,
the connecting member (61) is connected to the circumferential surface cover (50) and the end-face gap cover (40), and
the movement mechanism (60) is configured to move the end-face gap cover (40) between the end-face gap position and the retracted position by moving the connecting member (61) along the direction in which the circumferential surface cover (50) extends.

19. The yarn winder (4) according to claim 18, wherein, the connecting member (61) is extendable and contractable in the radial direction of the packages (P).

20. The yarn winder (4) according to any one of claims 14 to 19, further comprising:

two bobbin holders (24); and
a turret (23) which is rotatable and which supports each of the two bobbin holders (24), wherein,
the each of the two bobbin holders (24) is rotatable between a winding position where the winding of the yarns (Y) onto the bobbins (B) is performed and a standby position different from the winding position as the turret (23) rotates, and
when viewed in the axial direction, the circumferential surface cover (50) is provided on the outside of orbits of the packages (P) rotating together with the two bobbin holders (24).

FIG.1

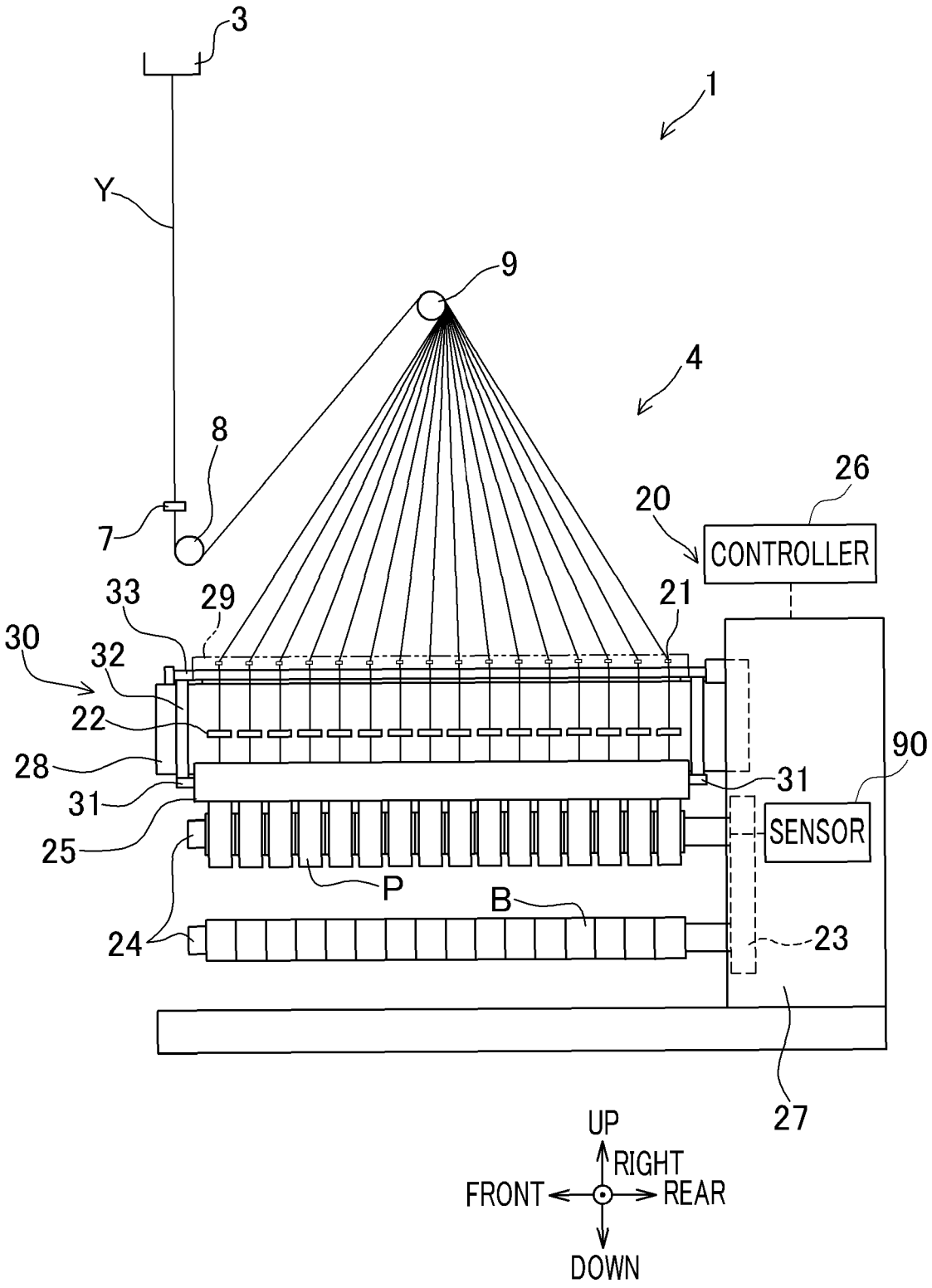
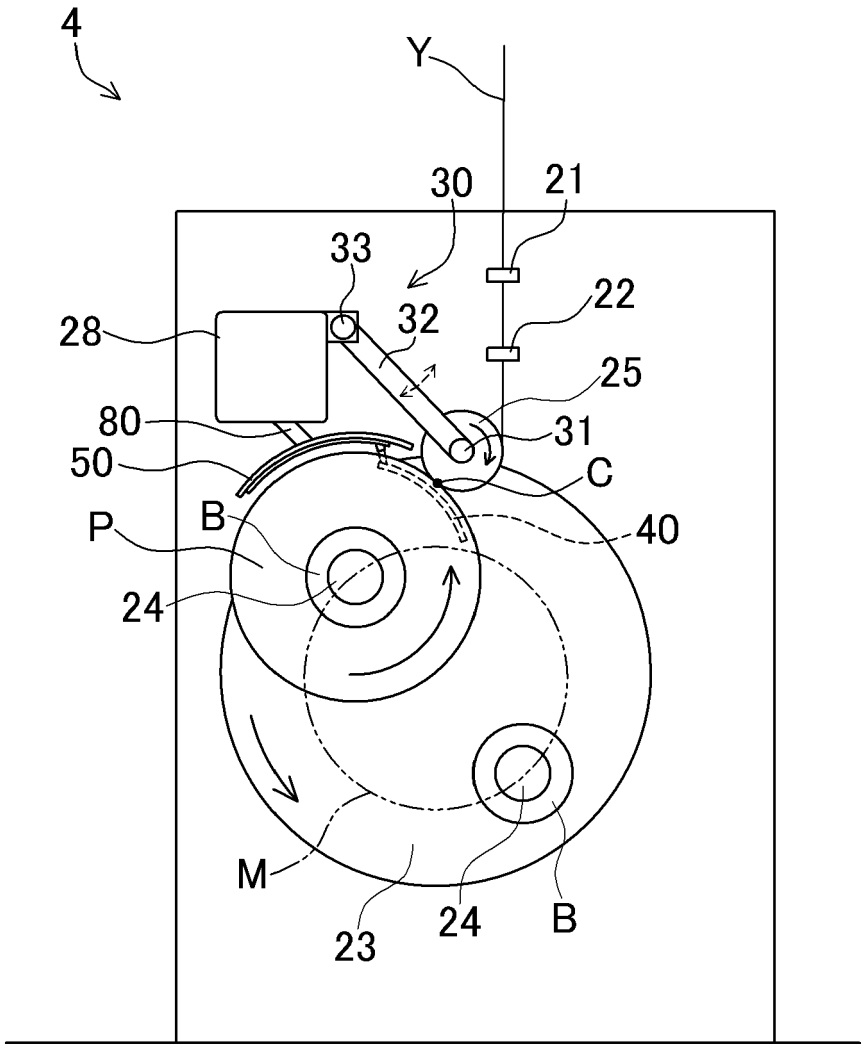

3
1
Y
9
4
8
26
20
CONTROLLER
7
33
29
21
30
32
22
28
31
90
31
SENSOR
25
P
B
24
23
27
UP
RIGHT
FRONT
REAR
DOWN

FIG.2


4
Y
30
21
33
22
28
32
25
80
31
50
C
B
P
40
24
M
23
24
B

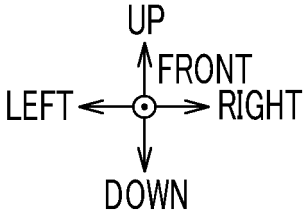
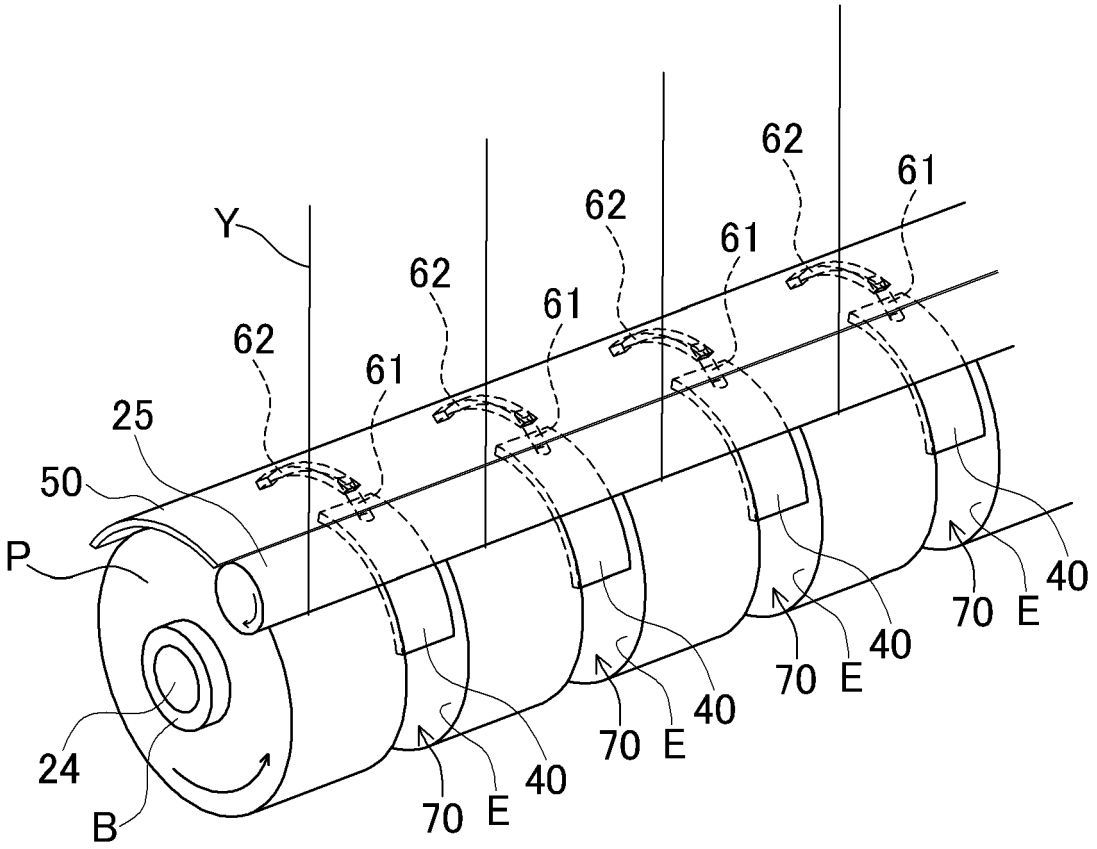

UP
FRONT
LEFT
RIGHT
DOWN

FIG.3


Y
62
61
62
61
62
61
62
61
25
50
P
24
B
70
E
40
70
E
40
70
E
40
70
E
40
70
E
40

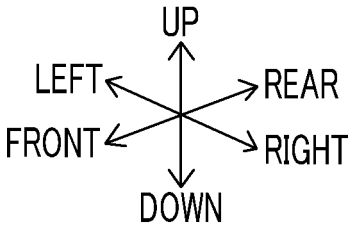

UP
LEFT
REAR
FRONT
RIGHT
DOWN

FIG.4

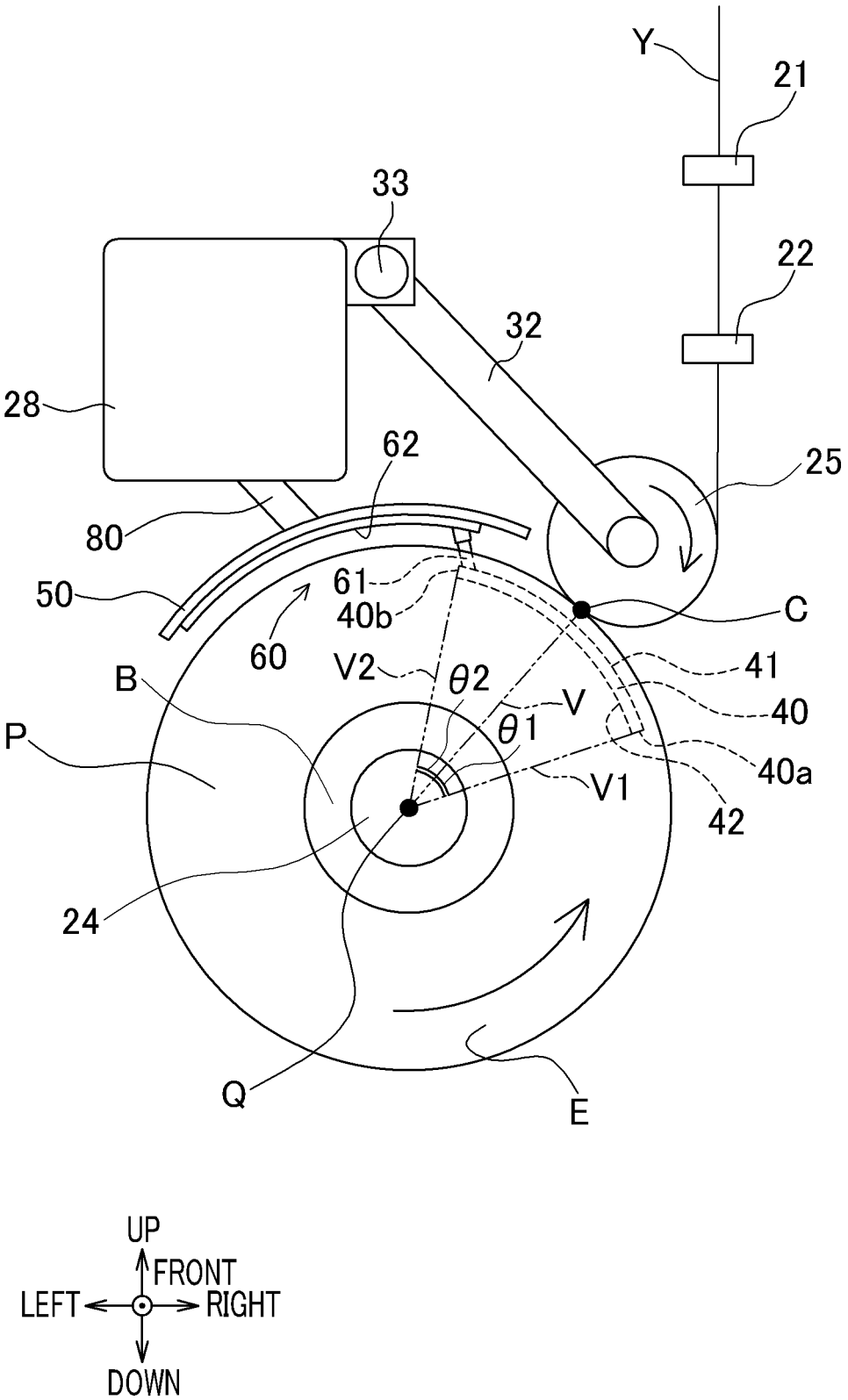

Y
21
33
22
32
28
62
25
80
50
61
40b
C
60
V2
θ2
41
B
V
40
θ1
P
40a
V1
42
24
Q
E
UP
FRONT
LEFT
RIGHT
DOWN

FIG.5

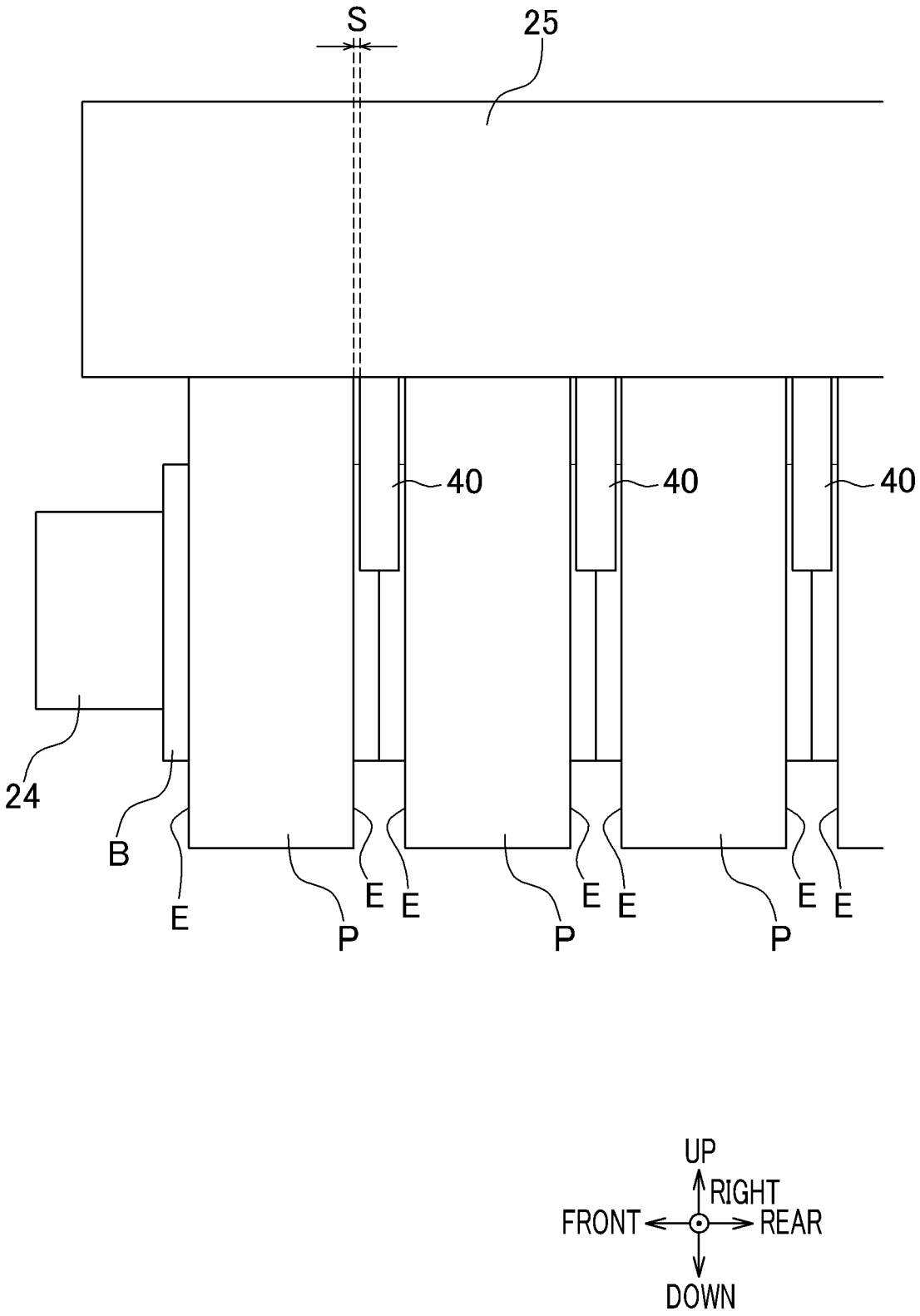
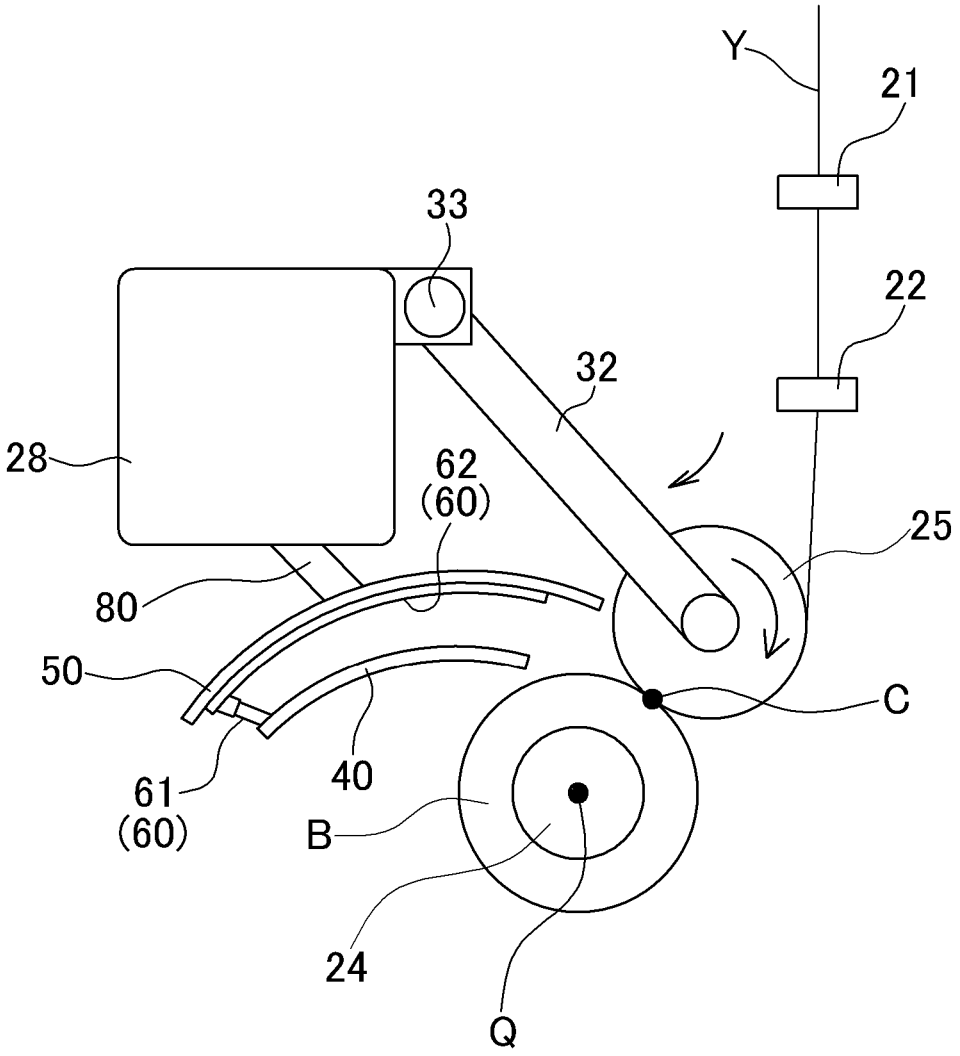


FIG.6


Y
21
33
22
32
28
62
(60)
25
80
50
C
61
(60)
40
B
24
Q

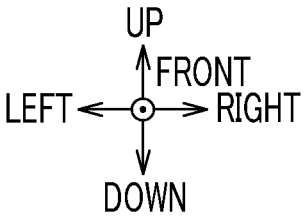

UP
FRONT
LEFT
RIGHT
DOWN

FIG.7

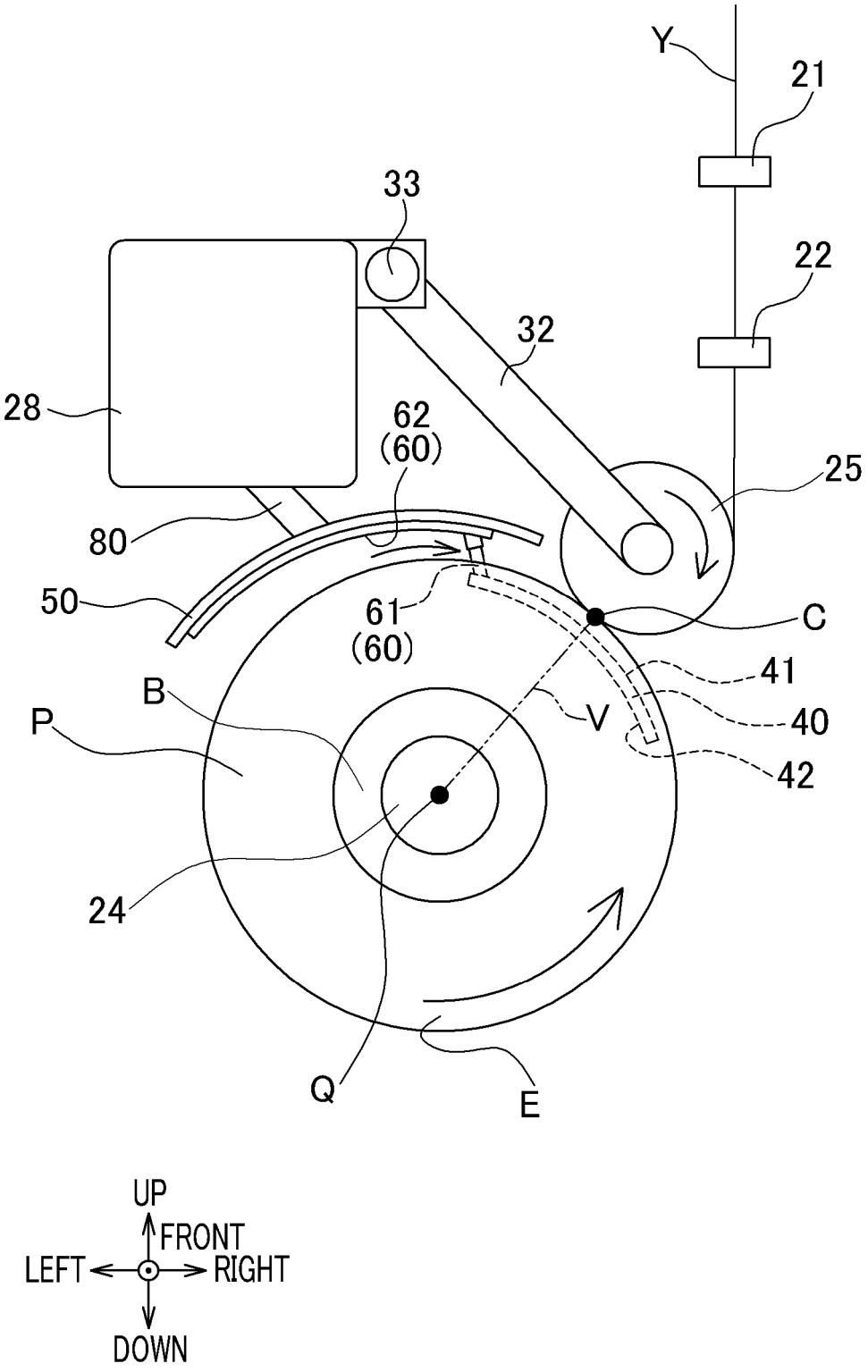

Y
21
33
22
32
28
62
(60)
25
80
50
61
(60)
C
41
B
V
40
P
42
24
Q
E
UP
FRONT
LEFT
RIGHT
DOWN

FIG.8

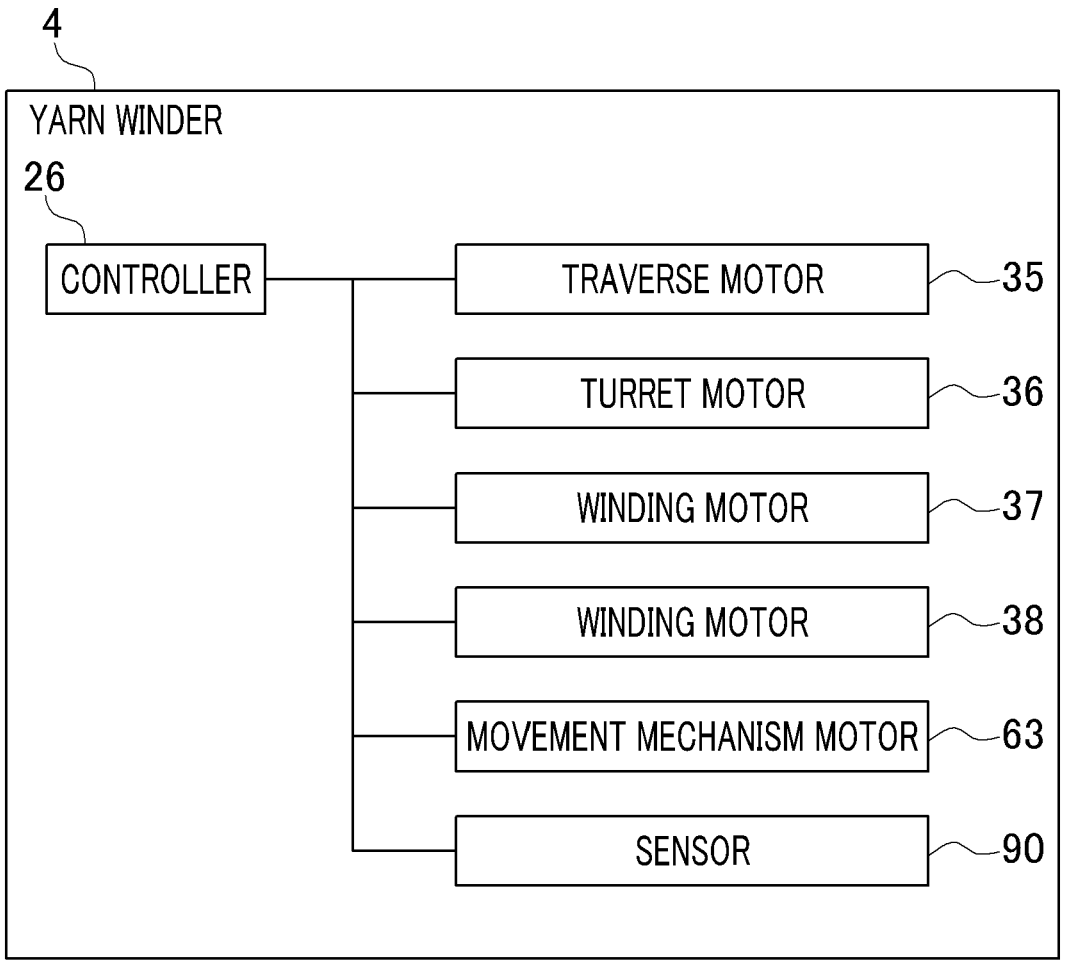
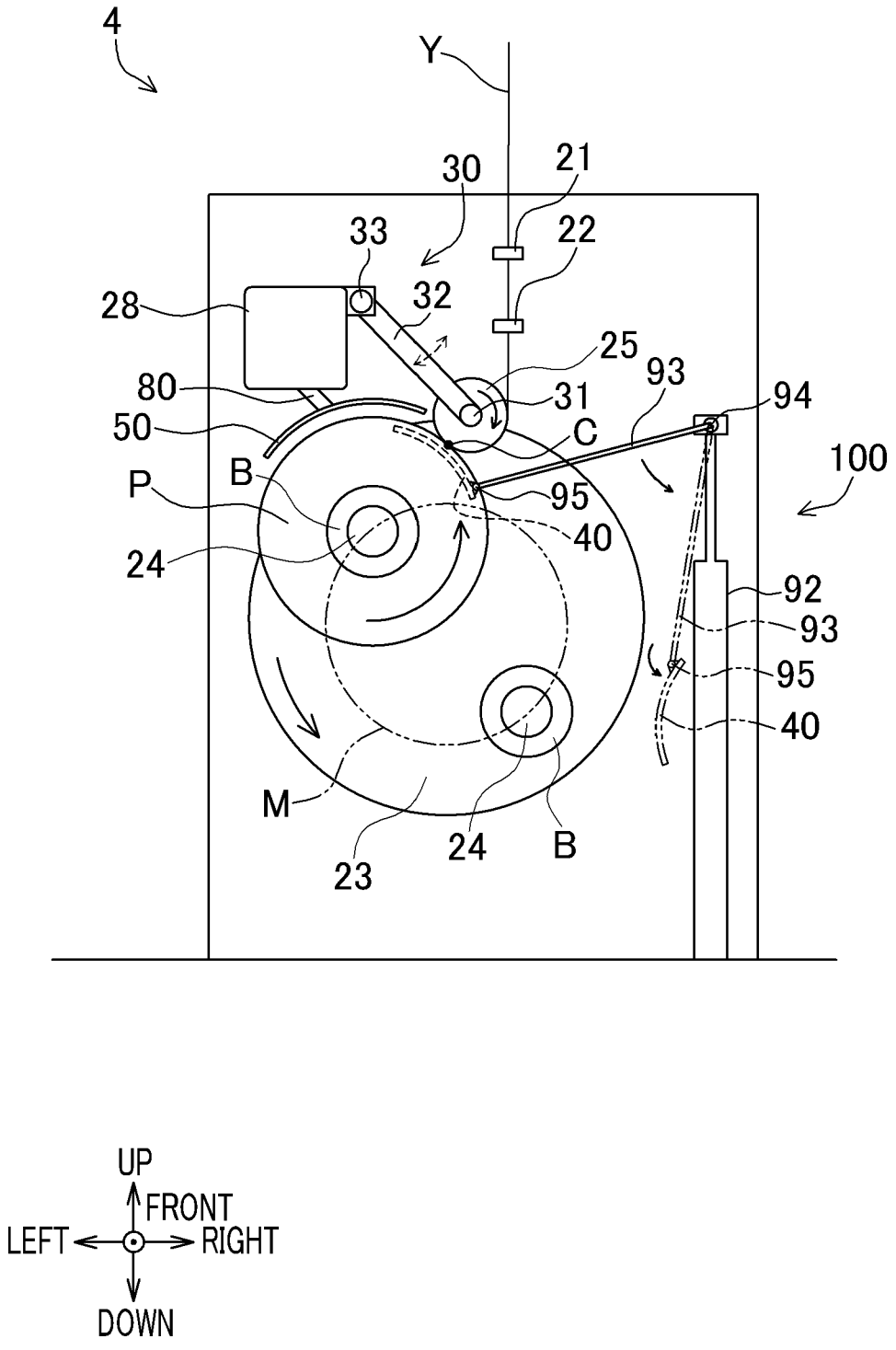

4
YARN WINDER
26
CONTROLLER
TRAVERSE MOTOR
35
TURRET MOTOR
36
WINDING MOTOR
37
WINDING MOTOR
38
MOVEMENT MECHANISM MOTOR
63
SENSOR
90

FIG.9

	COMPARATIVE EXAMPLE	EXAMPLE 1	EXAMPLE 2
AIR RESISTANCE APPLIED TO OUTER CIRCUMFERENTIAL SURFACE	0	0	−9%
AIR RESISTANCE APPLIED TO END FACE	0	−22%	−33%
TOTAL AIR RESISTANCE	0	−10%	−21%

FIG.10


4
Y
30
21
33
22
28
32
25
80
31
93
94
50
C
100
B
P
95
40
24
92
93
95
40
M
24
B
23
UP
FRONT
LEFT
RIGHT
DOWN

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EUROPEAN SEARCH REPORT

Application Number
EP 24 20 9801

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2021 123458 A (TMT MACHINERY INC) 30 August 2021 (2021-08-30) * the whole document *	1-20	INV. B65H54/72 B65H67/048
A	& EP 3 862 305 A1 (TMT MACHINERY INC [JP]) 11 August 2021 (2021-08-11) * paragraph [0007] - paragraph [0036] * * figures 1-9 *	1-20	
A	US 3 556 755 A (DENT JOSEPH B JR) 19 January 1971 (1971-01-19) * column 2, line 57 - line 72 * * figures 1,2 *	1-20	
A	DE 198 18 715 A1 (BARMAG BARMER MASCHF [DE]) 12 November 1998 (1998-11-12) * column 4, line 16 - line 53 * * figures 1,2 *	1-20	
A	US 4 613 090 A (SUGIOKA TAKAMI [JP]) 23 September 1986 (1986-09-23) * the whole document *	1-20	TECHNICAL FIELDS SEARCHED (IPC)
A	DE 10 2016 014977 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 17 August 2017 (2017-08-17) * paragraph [0029] - paragraph [0033] * * figures 1-4 *	1-20	B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 April 2025	Guisan, Thierry

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11-04-2025

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2021123458 A	30-08-2021	CN 113213257 A	06-08-2021
		EP 3862305 A1	11-08-2021
		JP 7401333 B2	19-12-2023
		JP 2021123458 A	30-08-2021
US 3556755 A	19-01-1971	NONE	
DE 19818715 A1	12-11-1998	NONE	
US 4613090 A	23-09-1986	JP H0117564 Y2	22-05-1989
		JP S60145153 U	26-09-1985
		US 4613090 A	23-09-1986
DE 102016014977 A1	17-08-2017	NONE	

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Patent documents cited in the description

- JP 2021123458 A **[0002]**