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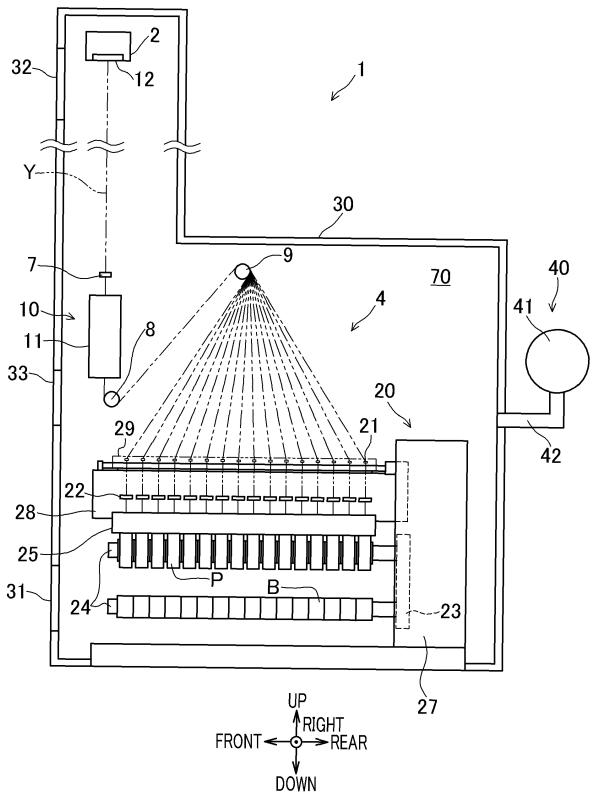
(54) SPUN YARN TAKE-UP APPARATUS

(57) An effect of reducing power consumption is improved by effectively suppressing air resistance on a package, when a yarn is wound. A spun yarn take-up apparatus 1 includes: a spinning apparatus 2 having a spinneret 12 through which yarns Y are spun out downward; a yarn winder 4 having bobbin holders 24 to which bobbins B are attached, the yarns Y spun out from the spinneret 12 being wound onto the bobbins B; a housing 30 which houses the yarns Y spun out from the spinneret 12 and running toward the yarn winder 4 and packages P formed by winding the yarns Y onto the respective bobbins B; and a decompression mechanism 40 capable of decompressing the inside of the housing 30. The housing 30 is provided with the discharge opening portion 31 which is provided to discharge the packages P and is openable and closable. The packages P can be discharged from the inside of the housing 30 when the discharge opening portion 31 is open. The internal space 70 of the housing 30 is in a sealed state when the discharge opening portion 31 is closed.

FIG.1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a spun yarn take-up apparatus including a yarn winder configured to wind a yarn spun out from a spinning apparatus.

[0002] Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2021-123458) discloses a spun yarn take-up apparatus (take-up apparatus of Patent Literature 1) including a yarn winder configured to wind a yarn spun out from a spinning apparatus. The yarn winder includes a bobbin holder extending in a horizontal direction, bobbins attached to the bobbin holder to be aligned in the axial direction of the bobbin holder, and a contact roller configured to apply a contact pressure to packages formed by winding yarns onto the bobbins. The yarn winder is configured to rotate the bobbin holder so as to form a package by winding a yarn onto a bobbin attached to the bobbin holder. In such a yarn winder, as the package rotating together with the bobbin holder receives air resistance, the rotational load on the bobbin holder is increased and hence the power consumption of the yarn winder is increased.

[0003] Under this circumstance, in the yarn winder of Patent Literature 1, a cover member (first cover member of Patent Literature 1) is provided to extend along the circumferential direction of the package, in order to suppress the air resistance on the package. Because the cover member is provided, air flowing along the outer circumferential surface of the package is guided to the inner surface of the cover member, with the result that the air is suppressed from flowing away from the outer circumferential surface of the package. Due to this, decrease in density of the air is suppressed in a region extending along the outer circumferential surface of the package, and an airflow from the space around the package to the region along the outer circumferential surface of the package is suppressed. Consequently, the air resistance applied to the package is suppressed, and hence the power consumption is successfully reduced.

SUMMARY OF THE INVENTION

[0004] In Patent Literature 1, contact between the outer circumferential surface of the package and the cover member must be avoided in order not to deteriorate the quality of the package. In particular, in consideration of increase in diameter of the package in accordance with the progress of yarn winding and disadvantageous swinging of the rotating bobbin holder in yarn winding, a sufficient gap is required between the outer circumferential surface of the package and the cover member in order to reliably avoid the contact between them. However, when the gap between the outer circumferential surface of the package and the cover member is wide, the effect of suppressing the air resistance on the package is limited.

[0005] In addition to the above, in Patent Literature 1, the contact between the cover member and the contact roller must be avoided to properly wind the yarn. Due to this, the cover member cannot be provided at around a part where the contact roller is in contact with the outer circumferential surface of the package. To put it differently, the cover member covers the outer circumferential surface of the package only partially, and cannot cover the outer circumferential surface of the package entirely. On this account, the arrangement of Patent Literature 1 may not effectively suppress the air resistance on the package.

[0006] An object of the present invention is to improve an effect of reducing power consumption by effectively suppressing air resistance on a package, when a yarn is wound.

[0007] A spun yarn take-up apparatus of the present invention includes: a spinning apparatus which has a spinneret from which yarns are spun out downward; a yarn winder which includes a bobbin holder to which bobbins are attached, the yarns spun out from the spinneret being wound onto the respective bobbins; a housing which houses the yarns spun out from the spinneret and running toward the yarn winder and packages formed by winding the yarns onto the bobbins; and a decompression mechanism which is able to decompress inside of the housing, wherein, the housing is provided with a discharge opening portion which is provided to discharge the packages and is openable and closable, and discharge of the packages from the inside of the housing is possible when the discharge opening portion is open, and an internal space of the housing is in a sealed state when the discharge opening portion is closed.

[0008] According to the present invention, when the package is formed by winding the yarn spun out from the spinning apparatus onto the bobbin, the discharge opening portion can be closed to cause the internal space of the housing to be in the sealed state. As the decompression mechanism is driven in this state, the inside of the housing is decompressed. As a result, the air around the package is decreased, and hence the air resistance on the package is effectively suppressed. On this account, the load at the time of rotating the bobbin holder is significantly decreased, and hence the effect of reducing the power consumption of the yarn winder in winding the yarn is improved.

[0009] The spun yarn take-up apparatus of the present invention is preferably arranged so that the housing is provided with a first opening portion which is for accessing the spinneret from outside of the housing and is openable and closable, and access to the spinneret from the outside of the housing is possible when the discharge opening portion is open, and the internal space of the housing is in the sealed state when the first opening portion is closed.

[0010] In the present invention, the operator is allowed to easily access the spinneret through the first opening

portion that is provided in addition to the discharge opening portion, when, for example, maintenance of the spinneret is performed.

[0011] The spun yarn take-up apparatus of the present invention is preferably arranged so that the decompression mechanism includes a pump provided outside the housing and a connection passage connecting the housing with the pump, and the connection passage is connected to the housing at a position that is closer to the yarn winder than the spinneret.

[0012] According to the present invention, the connection passage is connected to the housing at a position that is closer to the yarn winder than the spinneret. On this account, most of the air sucked by the pump flows from the spinneret toward the yarn winder, and flows into the connection passage. As a result, the direction in which most of the air sucked by the pump flows is more or less identical with the direction in which air flows along the yarns running from the spinneret toward the yarn winder. Due to this, it is possible to suppress the collision between the air sucked by the pump and the air flowing along the running yarns, with the result that yarn swing due to the disturbance of an airflow caused by air collision is suppressed.

[0013] The spun yarn take-up apparatus of the present invention is preferably arranged so that, on the upstream of the yarn winder in a yarn running direction, a godet roller is provided to feed the yarns spun out from the spinneret to the yarn winder, the housing is provided with a second opening portion that is openable and closable, access to the godet roller from the outside of the housing is possible when the second discharge opening portion is open, and the internal space of the housing is in the sealed state when the second opening portion is closed.

[0014] According to the present invention, the operator is allowed to easily access the godet roller through the second opening portion that is provided in addition to the discharge opening portion, with the result that yarn placement onto the godet roller can be easily done.

[0015] The spun yarn take-up apparatus of the present invention is preferably arranged so that a heat generating member configured to generate heat when the yarn winder is driven is provided in the housing, and a heat radiation mechanism is provided to radiate the heat generated by the heat generating member to the outside of the housing.

[0016] When the pressure in the housing is decreased in winding of the yarn onto the bobbin, the heat radiation efficiency of the heat generating member is deteriorated because the amount of air mediating the heat radiation from the heat generating member is decreased. Consequently, the temperature in the housing is disadvantageously increased, and this may cause a malfunction of the yarn winder. In the present invention, because the heat generated by the heat generating member is radiated to the outside of the housing by the heat radiation mechanism, the heat radiation efficiency is sufficient even when the pressure in the housing is decreased.

[0017] The spun yarn take-up apparatus of the present invention is preferably arranged so that the heat radiation mechanism includes: a heat radiation member which is provided outside the housing and is exposed to atmospheric air; a circulation passage which is in contact with the heat radiation member and the heat generating member, and in which fluid circulates; and a circulation pump which is configured to circulate the fluid in the circulation passage.

[0018] According to the present invention, heat exchange is performed between the heat generated by the heat generating member and the fluid flowing in the circulation passage. The fluid which becomes hot due to the heat exchange with the heat generating member circulates to the heat radiation member side, and radiates heat on account of the exposure to the atmospheric air through the heat radiation member. The fluid having radiated heat circulates back to the heat generating member side, and the above-described heat exchange is performed. In this way, the heat generated by the heat generating member is continuously radiated to the outside of the housing.

[0019] The spun yarn take-up apparatus of the present invention is preferably arranged so that the heat radiation mechanism includes a cooling member that is provided in the housing and is arranged to cool the fluid flowing in the circulation passage.

[0020] According to the present invention, the fluid flowing in the circulation passage member is further cooled by the cooling member. The fluid sent to the heat generating member is further lowed in temperature, and hence the heat exchange between the heat generating member and the fluid is further efficiently performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

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 schematic side view of the yarn winder and a heat radiation mechanism.
FIG. 4 is a graph showing an output required to rotationally drive a bobbin holder when the pressure inside a housing is changed.
FIG. 5 is a table showing conditions in yarn winding.
FIG. 6 is a table showing power consumption of the yarn winder at each air pressure inside the housing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Spun Yarn Take-Up Apparatus 1)

[0022] 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 of the present embodiment. In this description, a left-right direction on the sheet of FIG. 1 is defined as a front-rear direction, and a direction away from the viewer of the sheet of the figure is defined as a left-right direction (the viewer of the sheet is on the right side in the direction). Furthermore, a direction orthogonal to both the front-rear direction and the left-right direction is defined as an up-down direction in which the gravity acts.

[0023] As shown in FIG. 1, the spun yarn take-up apparatus 1 includes a spinning apparatus 2, a yarn regulating guide 7, a spun yarn drawing device 10, a first godet roller 8, a second godet roller 9, a yarn winder 4, a housing 30, a decompression mechanism 40, and a heat radiation mechanism 50 (see FIG. 3) . The spinning apparatus 2 has a spinneret 12 in which nozzles (not illustrated) are formed to spin out yarns Y downward. The spinning apparatus 2 is provided on an upper floor of a facility in which the spun yarn take-up apparatus 1 is provided. The yarn regulating guide 7, the spun yarn drawing device 10, the first godet roller 8, the second godet roller 9, the yarn winder 4, the decompression mechanism 40, and the heat radiation mechanism 50 are provided on a lower floor of the facility. The housing 30 is provided across the upper floor and the lower floor. It is noted that the heat radiation mechanism 50 is not shown in FIG. 1.

[0024] The first godet roller 8 and the second godet roller 9 are rollers used for taking up yarns Y spun out from the spinneret 12. As shown in FIG. 1, 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. In other words, the first godet roller 8 is provided on the upstream side of the yarn winder 4 in a yarn running direction of the yarns Y. 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 rearward of the first godet roller 8. The second godet roller 9 is rotationally driven by an unillustrated motor. In the present embodiment, when the yarns Y are placed onto the first godet roller 8 and the second godet roller 9, the second godet roller 9 is moved to a position close to the first godet roller 8.

[0025] The yarn regulating guide 7 is provided above the first godet roller 8. The yarn regulating guide 7 is, for example, a known yarn guide with a comb teeth shape. When the yarns Y are threaded thereto, the yarn regulating guide 7 regulates the interval between neighboring yarns Y to a predetermined value.

[0026] The spun yarn drawing device 10 is configured to heat and draw the yarns Y, and provided below the spinning apparatus 2. The spun yarn drawing device 10 includes plural (e.g., five) godet rollers (not illustrated) housed in a thermal insulation box 11.

(Yarn Winder 4)

[0027] The following will describe the yarn winder 4 with reference to FIG. 1 and FIG. 2. FIG. 2 is a front view of the yarn winder 4. The yarn winder 4 includes members such as: a base 20; fulcrum guides 21; traverse guides 22; a turret 23; two bobbin holders 24; and a contact roller 25.

[0028] 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 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 or the like. The frame 28 supports the contact roller 25 which extends along the front-rear direction.

[0029] 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.

[0030] The traverse guides 22 are provided for the yarns Y, respectively, and are aligned in the front-rear direction. The traverse guides 22 are driven by a traverse motor 81 (see FIG. 3) 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. For example, plural traverse motors 81 are provided for the respective traverse guides 22.

[0031] The turret 23 is a disc-shaped member having an axis substantially in parallel to the front-rear direction, and is rotatably supported by the base main body 27. The turret 23 is rotationally driven by a turret motor 82 (see FIG. 3). The turret 23 cantilevers two bobbin holders 24, and rotates about a rotation shaft substantially in parallel to the front-rear direction so as to move the two bobbin holders 24. Because of this, in the yarn winder 4, the position of the bobbin holder 24 located at a yarn winding position (upper position shown in FIG. 1 and FIG. 2) where winding of yarns Y is performed and the position of the bobbin holder 24 located at a standby position (lower position shown in FIG. 1 and FIG. 2) where the winding of yarns Y is not performed are switchable. 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 bobbins B can be performed for the bobbin holder 24 located at the standby position.

[0032] To each of the two bobbin holders 24, plural bobbins B are attached. The two bobbin holders 24 are rotatably supported at an upper end portion and a lower end portion of the turret 23 supported by the base main body 27, respectively, and protrude forward from the turret 23. To put it differently, the two bobbin holders 24 are cantilevered by the base main body 27 which is provided on the rear side. The axes of the two bobbin holders 24 are substantially in parallel to the front-rear direction. The leading end side (front side) of the bobbin holder 24 is typically a working side where operations

such as attaching the bobbins B to the bobbin holder 24 are performed.

[0033] The bobbins B are attached to each bobbin holder 24. The bobbins B are respectively provided for the yarns Y, and lined up in the front-rear direction. The number of the bobbins B attached to one bobbin holder 24 is, for example, 16. The two bobbin holders 24 are rotationally driven by their respective winding motors 83 (see FIG. 3).

[0034] 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. 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 bobbins B attached to the upper bobbin holder 24. With this, the contact roller 25 applies a contact pressure to the surfaces of the unfinished packages P, to adjust the shape of each package P.

[0035] In the yarn winder 4 structured as described above, when the upper bobbin holder 24 is rotationally driven, the yarns Y traversed by the traverse guides 22 are wound onto the bobbins B. As a result, the packages P are formed.

(Housing 30)

[0036] The housing 30 houses the yarns Y spun out from the spinneret 12 and running toward the yarn winder 4 and the packages P formed by winding the yarns Y onto the bobbins B. As shown in FIG. 1, in the present embodiment, the housing 30 houses the spinning apparatus 2, the yarn regulating guide 7, the spun yarn drawing device 10, the first godet roller 8, the second godet roller 9, and the yarn winder 4.

[0037] As shown in FIG. 1, the housing 30 has a discharge opening portion 31, a first opening portion 32, and a second opening portion 33. Each of the discharge opening portion 31, the first opening portion 32, and the second opening portion 33 is arranged to be openable and closable. The opening/closing structure of each opening portion may be of any type, e.g., a slide door or a hinged door. The discharge opening portion 31, the first opening portion 32, and the second opening portion 33 are provided in the front surface of the housing 30.

[0038] The discharge opening portion 31 is an opening portion used for discharging the packages P to the outside of the housing 30. The discharge opening portion 31 is provided at a lower part of the front surface of the housing 30. To be more specific, in the front surface of the housing 30, the discharge opening portion 31 is positioned to be substantially as high as the bobbin holder 24 at the standby position. The discharge opening portion 31 is sized to be sufficient to discharge the packages P attached to the bobbin holder 24 at the standby position. The packages P can be discharged from the inside of the housing 30 when the discharge opening portion 31 is open. The internal space 70 of the housing 30 is in a sealed state when the discharge opening portion 31 is closed.

[0039] The first opening portion 32 is an opening portion for accessing the spinneret 12 from the outside of the housing 30. The first opening portion 32 is provided at an upper portion of the front surface of the housing 30. To be more specific, in the front surface of the housing 30, the first opening portion 32 is positioned to be substantially as high as the spinneret 12 or to be slightly below the spinneret 12. The first opening portion 32 is sized to allow a hand of an operator or an arm of an operational robot to enter the inside. The spinneret 12 is accessible from the outside of the housing 30 when the first opening portion 32 is open. The internal space 70 of the housing 30 is in the sealed state when the first opening portion 32 is closed. Although not illustrated in the present embodiment, members such as a cooler for cooling the yarns Y and an oil nozzle for applying oil to the yarns Y are provided below the spinning apparatus 2. The members such as the cooler and the oil nozzles are accessible from the outside of the housing 30 through the first opening portion 32 when the portion is open.

[0040] The second opening portion 33 is an opening portion for accessing the first godet roller 8 and the second godet roller 9. The second opening portion 33 is provided above the discharge opening portion 31 in the front surface of the housing 30. To be more specific, in the front surface of the housing 30, the second opening portion 33 is positioned to be substantially as high as the first godet roller 8. The second opening portion 33 is sized to allow a hand of an operator and an arm of an operational robot to enter the inside. The first godet roller 8 and the second godet roller 9 having been moved to a position close to the first godet roller 8 are accessible from the outside of the housing 30 when the second opening portion 33 is open. The internal space 70 of the housing 30 is in the sealed state when the second opening portion 33 is closed. In the present embodiment, the spun yarn drawing device 10 is also accessible from the outside of the housing 30 through the second opening portion 33 when the portion is open.

[0041] As described above, in the present embodiment, the internal space 70 of the housing 30 is in the sealed state when all of the discharge opening portion 31, the first opening portion 32, and the second opening portion 33 are closed.

(Decompression Mechanism 40)

[0042] The decompression mechanism 40 is capable of decompressing the inside of the housing 30. To be more specific, the decompression mechanism 40 is capable of decompressing the inside of the housing 30 in which the internal space 70 is in the sealed state. As shown in FIG. 1, the decompression mechanism 40 includes a pump 41 provided outside the housing 30 and a connection passage 42 connecting the housing 30 with the pump 41. The pump 41 is driven by a pump

motor (not illustrated). As the pump 41 is driven, the air in the housing 30 is sucked by the pump 41 through the connection passage 42. As shown in FIG. 1, the connection passage 42 is connected to the housing 30 at a position that is closer to the yarn winder 4 than the spinneret 12.

(Heat Radiation Mechanism 50)

[0043] The following will describe the heat radiation mechanism 50 with reference to FIG. 3. It is noted that FIG. 3 does not show the yarns Y for convenience. The heat radiation mechanism 50 is provided to radiate heat generated by heat generating members 80 in the housing 30 to the outside of the housing 30. The heat generating members are members generating heat when the yarn winder 4 is driven. For example, the heat generating members 80 include the traverse motor 81, the turret motor 82, and the winding motor 83 of the present embodiment. The heat generating members may include a controller configured to perform drive control of the members such as the above-described motors.

[0044] As shown in FIG. 3, the heat radiation mechanism 50 includes a heat radiation member 51, a circulation passage 52, a circulation pump 53, and cooling plates 54 and 55 (cooling member of the present invention). The heat radiation member 51 is provided outside the housing 30 and is exposed to the atmospheric air. The heat radiation member 51 is, for example, a radiator. The circulation passage 52 is in contact with the heat radiation member 51 and the heat generating member 80, and fluid circulates in the circulation passage 52. The fluid circulating in the passage is, for example, water or oil. The circulation pump 53 is configured to circulate the fluid in the circulation passage 52. As the circulation pump 53 is driven, the fluid in the circulation passage 52 is sucked by the circulation pump and flows in directions indicated by solid arrows in FIG. 3.

[0045] The fluid circulating in the circulation passage 52 radiates heat as the circulation passage 52 is exposed to the atmospheric air through the heat radiation member 51 at a part in contact with the heat radiation member 51. On this account, in the direction in which the fluid flows, the fluid flowing in a region on the downstream side of the heat radiation member 51 in the circulation passage 52 is low in temperature. This low-temperature fluid further flows in the circulation passage 52 and reaches a part in contact with each heat generating member 80. Heat exchange therefore occurs between the fluid flowing in the circulation passage 52 and the heat generated by the heat generating member 80. The fluid which becomes hot due to the heat exchange with the heat generating member 80 circulates back to the heat radiation member 51 side, and radiates heat on account of the exposure to the atmospheric air through the heat radiation member 51. In this way, the heat radiation mechanism 50 radiates heat generated by the heat generating member 80 to the outside of the housing 30.

[0046] When the distance between the heat radiation member 51 and the heat generating member 80 is long, the temperature of the fluid may be disadvantageously increased before the low-temperature fluid reaches the part in contact with the heat generating member 80 in the circulation passage 52. Due to this, the efficiency in heat exchange between the fluid and the heat generated by the heat generating member 80 is deteriorated. For example, in the present embodiment, as shown in FIG. 3, the distance between the traverse motors 81 and the heat radiation member 51 is long. On this account, the efficiency in heat exchange between the fluid flowing in the circulation passage 52 and the heat generated by each traverse motor 81 is deteriorated in comparison with the efficiency in heat exchange between the fluid and heat generated by another heat generating member 80 (such as the turret motor 82 and the winding motor 83).

[0047] In consideration of the above, in the present embodiment, the heat radiation mechanism 50 has the cooling plates 54 and 55 for cooling the fluid flowing in the circulation passage 52. The cooling plates 54 and 55 are provided in the housing 30 and in contact with the circulation passage 52. To be more specific, in the direction in which the fluid flows, the cooling plate 54 is in contact with the circulation passage 52 at a part upstream of parts in contact with the traverse motors 81 in the circulation passage 52. Furthermore, in the direction in which the fluid flows, the cooling plate 55 is in contact with the circulation passage 52 at a part downstream of the parts in contact with the traverse motors 81 in the circulation passage 52. Due to this, heat exchange is also performed between the heat generated by each traverse motor 81 and the fluid which is cooled by the cooling plates 54 and 55 and kept at a low temperature. In the present embodiment, the cooling plate 54 is supported by the base main body 27, for example. The cooling plate 55 is supported by the frame 28, for example.

(Output When Bobbin Holder Is Rotationally Driven)

[0048] The following will describe the relationship between an output [kW] required for rotationally driving the bobbin holder 24 when winding the yarns Y onto the respective bobbins B and the pressure inside the housing 30, with reference to FIG. 4 and FIG. 5.

[0049] FIG. 4 is a graph showing an output [kW] required to rotationally drive the bobbin holder 24 when the pressure inside the housing 30 is changed by the decompression mechanism 40. This output [kW] required to rotationally drive the bobbin holder 24 increases as the diameter of the package P increases. On this account, in FIG. 4, the output [kW] required to rotationally drive the bobbin holder 24 is calculated for each varying diameter of the package P. It is noted that the values of the output [kW] shown in FIG. 4 are simulated values. FIG. 5 is a table showing conditions in winding the yarns Y. The simulated values shown in FIG. 4 are calculated under the conditions shown in FIG. 5.

[0050] As shown in FIG. 5, the number of ends of the yarn winder 4 (i.e., the number of the bobbins B attached to one bobbin holder 24) is 12. The width of the yarn Y wound on the bobbin B is 122 mm, and the winding density is 0.95g/cm^3. The tension of the yarn Y wound on the bobbin B is 50 gram. The diameter of the fully-wound package P is 440 mm. The length of the bobbin holder 24 in the front-rear direction (axial direction) is 1.8 meter. Although not shown in FIG. 5, the diameter of the package P at the start of the winding of the yarn Y is 120 mm. The circumferential speed of the package P while the yarn Y is being wound is more or less constant from the start to the end of the winding of the yarn Y on the bobbin B.

[0051] The vertical axis of FIG. 4 indicates the output value [kW]. The horizontal axis of FIG. 4 indicates five patterns of pressure in the housing 30. The five patterns of the air pressures are 0.01 atm (a in FIG. 4), 0.5 atm (b in FIG. 4), 0.7 atm (c in FIG. 4), 0.9 atm (d in FIG. 4), and 1.0 atm (e in FIG. 4). The horizontal axis of FIG. 4 further indicates the varying diameters of the package P in 10 stages. The diameters of the package P shown in FIG. 4 are 124 mm, 150 mm, 200 mm, 250 mm, 300 mm, 350 mm, 380 mm, 400 mm, 430 mm, and 440 mm. The horizontal axis of FIG. 4 indicates five patterns of pressure in the housing 30, which correspond to each of 10 stages of the diameter [mm] of the package P. In summary, FIG. 4 shows the value of the output [kW] required to rotate the bobbin holder 24 when the pressure in the housing 30 is at each of the five patterns, in the form of a bar corresponding to each of 10 stages of the varying diameter of the package P.

[0052] A cross-hatched part of the bar in FIG. 4 indicates a part of the output required for rotating the bobbin holder 24, which is necessitated by a tension loss of the yarn Y. The tension loss of the yarn Y indicates the load on the bobbin holder 24 caused by the tension of each of the yarns Y threaded to the bobbins B. A blank part of the bar in FIG. 4 indicates a part of the output required for rotating the bobbin holder 24, which is necessitated by shaft damage. The shaft damage indicates the load on the bobbin holder 24 in accordance with the rotation of the bobbin holder 24. A hatched part of the bar in FIG. 4 indicates a part of the output required for rotating the bobbin holder 24, which is necessitated by a windage loss of the yarn Y. The windage loss of the yarn Y indicates the load on the bobbin holder 24 due to the air resistance on the package P.

[0053] As shown in FIG. 4, in the output required for rotating the bobbin holder 24, a partial output (cross-hatched) that is necessitated by a tension loss of the yarn Y is substantially identical even if the diameter of the package P varies or even if the pressure in the housing 30 varies. To put it differently, it is considered that the partial output necessitated by the tension loss of the yarn Y is scarcely influenced by the diameter of the package P and the pressure in the housing 30.

[0054] As shown in FIG. 4, a partial output (blank) necessitated by shaft damage among the output required for rotating the bobbin holder 24 is substantially identical even if the pressure in the housing 30 varies. To put it differently, it is considered that the partial output necessitated by the shaft damage is scarcely influenced by the pressure in the housing 30. On the other hand, the partial output (blank) necessitated by the shaft damage decreases as the diameter of the package P increases. This may be due to the following reason. When the circumferential speed of the package P is arranged to be constant from the start to the end of the winding of the yarn Y on the bobbin B, the rotation speed of the bobbin holder 24 must be decreased in accordance with the increase in diameter of the package P. The shaft damage increases as the rotation speed of the bobbin holder 24 increases. On this account, if the rotation speed of the bobbin holder 24 is decreased in accordance with the increase in diameter of the package P, the shaft damage is decreased and the output necessitated by the shaft damage is decreased. However, as shown in FIG. 4, the partial output necessitated by shaft damage accounts for a very small part of the entire output required for rotating the bobbin holder 24. Due to this, an influence of a variation of the output necessitated by the shaft damage on the output required for rotating the bobbin holder 24 is very small.

[0055] As shown in FIG. 4, a partial output (hatched) necessitated by a windage loss among the output required for rotating the bobbin holder 24 decreases in accordance with the decrease in pressure in the housing 30. Furthermore, as shown in FIG. 4, the partial output necessitated by the windage loss accounts for a large part of the entire output required for rotating the bobbin holder 24 (see, e.g., the bar corresponding to the pressure e in FIG. 4). Due to this, as the inside of the housing 30 is decompressed by the decompression mechanism 40, the partial output necessitated by the windage loss is suppressed, with the result that the entire output required for rotating the bobbin holder 24 is suppressed.

[0056] As shown in FIG. 4, the partial output (hatched) necessitated by the windage loss increases as the diameter of the package P increases. However, in accordance with the decrease in pressure in the housing 30, the degree of decrease in the partial output necessitated by the windage loss increases as the diameter of the package P increases. To put it differently, as the diameter of the package P increases, the effect of suppressing the output on account of the decompression inside the housing 30 is improved.

[0057] As described above, as the inside of the housing 30 is decompressed by the decompression mechanism 40, the output required for rotationally driving the bobbin holder 24 is effectively suppressed.

[0058] In regard to the above, the power consumption of a typical yarn winder (e.g., a yarn winder not including the decompression mechanism 40) encompasses, in addition to (1) an output required for rotationally driving the bobbin holder 24 (hereinafter, this may be simply

referred to as an output (1)), (2) an output required for performing reciprocal movement of the traverse guides 22 (hereinafter, this may be simply referred to as an output (2)) and (3) an output required by the controller to drive a member such as each motor (hereinafter, this may be simply referred to as an output (3)). On the other hand, the power consumption of the yarn winder 4 of the present embodiment further encompasses, in addition to the outputs (1) to (3), (4) an output required for driving the decompression mechanism 40 (hereinafter, this may be simply referred to as an output (4)) and (5) an output required to drive the heat radiation mechanism 50 (hereinafter, this may be simply referred to as an output (5)). However, the outputs (2) to (5) are significantly smaller than the output (1). The suppression of the power consumption of the entire yarn winder is therefore mainly achieved by suppressing the output (1) . With reference to FIG. 6, the following will describe why the yarn winder 4 of the present embodiment is able to achieve reduction in power consumption of the entire yarn winder, as compared to a known yarn winder.

(Power Consumption of Yarn Winder)

[0059] FIG. 6 shows a total power [kW·h] that is an integrated value of the output (1) in the power consumption of the yarn winder 4 from the start to the end of the winding of the yarn Y onto the bobbin B, when the air pressure in the housing 30 is varied. In FIG. 6, the air pressure in the housing 30 is 1.0 atm, 0.5 atm, 0.3 atm, 0.1 atm, 0.05 atm, 0.01 atm, or 0.005 atm. When the air pressure is 1.0 atm, the inside of the housing 30 is not decompressed. In other words, a known yarn winder not having the decompression mechanism 40 is virtually reproduced. In addition, FIG. 6 shows a suppressed power [kW·h] in comparison with the total power, when the air pressure is 1.0 atm.

[0060] As shown in FIG. 6, as compared to a case where the air pressure in the housing 30 was 1.0 atm, the total power was suppressed in all cases where the air pressure in the housing 30 was decompressed. In particular, when the air pressure in the housing 30 was in a range of 0.05 atm to 0.3 atm, the total power was effectively suppressed. When the air pressure in the housing 30 was 0.1 atm, the total power was further effectively suppressed.

[0061] In this way, in the yarn winder 4 of the present embodiment having the decompression mechanism 40, the output (1) was effectively suppressed as compared to the known yarn winder not having the decompression mechanism 40. In addition to the above, it was found that the air pressure inside the housing 30 was decompressed by the decompression mechanism 40 preferably to a range of 0.05 atm to 0.3 atm, and more preferably to 0.1 atm. As a supplement, it has been found that, when the inside of the housing 30 is decompressed, the outputs (2) and (3) slightly decrease (the data is not illustrated). As described above, in the first place, the outputs (2) and (5) are significantly smaller than the output (1). On this account, it is considered that, when the inside of the housing 30 is decompressed, not only the output (1) but also the power consumption of the entire yarn winder can be decreased.

(Effects)

[0062] The spun yarn take-up apparatus 1 of the present embodiment includes: the spinning apparatus 2 having the spinneret 12 through which the yarns Y are spun out downward; the yarn winder 4 having the bobbin holders 24 to which the bobbins B are attached, the yarns Y spun out from the spinneret 12 being wound onto the bobbins B; the housing 30 which houses the yarns Y spun out from the spinneret 12 and running toward the yarn winder 4 and the packages P formed by winding the yarns Y onto the respective bobbins B; and the decompression mechanism 40 capable of decompressing the inside of the housing 30. The housing 30 is provided with the discharge opening portion 31 which is provided to discharge the packages P and is openable and closable. The packages P can be discharged from the inside of the housing 30 when the discharge opening portion 31 is open. The internal space 70 of the housing 30 is in a sealed state when the discharge opening portion 31 is closed.

[0063] According to the present embodiment, when the package P is formed by winding the yarn Y spun out from the spinning apparatus 2 onto the bobbin B, the discharge opening portion 31 can be closed to cause the internal space 70 of the housing 30 to be in the sealed state. As the decompression mechanism 40 is driven in this state, the inside of the housing 30 is decompressed. As a result, the air around the package P is decreased, and hence the air resistance on the package P is effectively suppressed. On this account, the load at the time of rotating the bobbin holder 24 is significantly decreased, and hence the effect of reducing the power consumption of the yarn winder 4 in winding the yarn Y is improved.

[0064] In the spun yarn take-up apparatus 1 of the present embodiment, the housing 30 is provided with the first opening portion 32 which is for accessing the spinneret 12 from the outside of the housing 30 and is openable and closable. The spinneret 12 is accessible from the outside of the housing 30 when the first opening portion 32 is open. The internal space 70 of the housing 30 is in the sealed state when the first opening portion 32 is closed. In the present embodiment, the operator is allowed to easily access the spinneret 12 through the first opening portion 32 that is provided in addition to the discharge opening portion 31, when, for example, maintenance of the spinneret 12 is performed.

[0065] In the spun yarn take-up apparatus 1 of the present embodiment, the decompression mechanism 40 includes the pump 41 provided outside the housing 30 and the connection passage 42 connecting the housing 30 with the pump 41. The connection passage 42 is

connected to the housing 30 at a position that is closer to the yarn winder 4 than the spinneret 12. According to the present embodiment, most of the air sucked by the pump 41 flows from the spinneret 12 toward the yarn winder 4, and flows into the connection passage 42. As a result, the direction in which most of the air sucked by the pump 41 flows is more or less identical with the direction in which air flows along the yarns Y running from the spinneret 12 toward the yarn winder 4. Due to this, it is possible to suppress the collision between the air sucked by the pump 41 and the air flowing along the running yarns Y, with the result that yarn swing due to the disturbance of an airflow caused by air collision is suppressed.

[0066] In the spun yarn take-up apparatus 1 of the present embodiment, on the upstream of the yarn winder 4 in the yarn running direction, the first godet roller 8 and the second godet roller 9 are provided to feed the yarns Y spun out from the spinneret 12 to the yarn winder 4. The housing 30 is provided with the second opening portion 33 that is openable and closable. The first godet roller 8 and the second godet roller 9 are accessible from the outside of the housing 30 when the second opening portion 33 is open. The internal space 70 of the housing 30 is in the sealed state when the second opening portion 33 is closed. In the present embodiment, the operator is allowed to easily access the first godet roller 8 and the second godet roller 9 through the second opening portion 33 that is provided in addition to the discharge opening portion 31, with the result that yarn placement onto each godet roller can be easily done.

[0067] In the spun yarn take-up apparatus 1 of the present embodiment, the heat generating member 80 which generates heat when the yarn winder 4 is driven is provided in the housing 30, and the heat radiation mechanism 50 is provided to radiate the heat generated by the heat generating member 80 to the outside of the housing 30. When the pressure in the housing 30 is decreased in winding of the yarn Y onto the bobbin B, the heat radiation efficiency of the heat generating member 80 is deteriorated because the amount of air mediating the heat radiation from the heat generating member 80 is decreased. Consequently, the temperature in the housing 30 is disadvantageously increased, and this may cause a malfunction of the yarn winder 4. In the present embodiment, because the heat generated by the heat generating member 80 is radiated to the outside of the housing 30 by the heat radiation mechanism 50, the heat radiation efficiency is sufficient even when the pressure in the housing 30 is decreased.

[0068] In the spun yarn take-up apparatus 1 of the present embodiment, the heat radiation mechanism 50 includes the heat radiation member 51 provided outside the housing 30 and exposed to the atmospheric air, the circulation passage 52 in contact with the heat radiation member 51 and the heat generating member 80 and allowing the fluid to circulate therein, and the circulation pump 53 circulating the fluid in the circulation passage 52. According to the present embodiment, heat exchange is performed between the heat generated by the heat generating member 80 and the fluid flowing in the circulation passage 52. The fluid which becomes hot due to the heat exchange with the heat generating member 80 circulates to the heat radiation member 51 side, and radiates heat on account of the exposure to the atmospheric air through the heat radiation member 51. The fluid having radiated heat circulates back to the heat generating member 80 side, and the above-described heat exchange is performed. In this way, the heat generated by the heat generating member 80 is continuously radiated to the outside of the housing 30.

[0069] In the spun yarn take-up apparatus 1 of the present embodiment, the heat radiation mechanism 50 includes the cooling plates 54 and 55 that are provided in the housing 30 and are arranged to cool the fluid flowing in the circulation passage 52. According to the present embodiment, the fluid flowing in the circulation passage 52 is further cooled by the cooling plates 54 and 55. The fluid sent to the heat generating member 80 is further lowed in temperature, and hence the heat exchange between the heat generating member 80 and the fluid is further efficiently performed.

(Modifications)

[0070] 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.

[0071] In the embodiment above, the housing 30 houses the spinning apparatus 2, the yarn regulating guide 7, the spun yarn drawing device 10, the first godet roller 8, the second godet roller 9, and the yarn winder 4. However, as long as the housing 30 houses the yarns Y spun out from the spinneret 12 and running toward the yarn winder 4 and the packages P formed by winding the yarns Y onto the bobbins B, the disclosure is not limited to the arrangement described in the embodiment above. For example, the housing 30 may house part of the spinning apparatus 2 including the entire spinneret 12, the yarn regulating guide 7, the spun yarn drawing device 10, the first godet roller 8, the second godet roller 9, and part of the yarn winder 4 including all of the packages P.

[0072] In the embodiment above, the housing 30 has the discharge opening portion 31, the first opening portion 32, and the second opening portion 33. In this connection, the first opening portion 32 and the second opening portion 33 may not be provided. When the first opening portion 32 is not provided, for example, a robotic arm may be provided in the housing 30 for the purpose of performing maintenance of the spinneret 12. When the second opening portion 33 is not provided, for example, access to each godet roller may be done through the discharge opening portion 31. Alternatively, a large-sized opening portion may be provided to function as both the discharge opening portion 31 and the second opening

portion 33.

[0073] In the embodiment above, the connection passage 42 is connected to the housing 30 at a position that is closer to the yarn winder 4 than the spinneret 12. In this regard, the connection passage 42 may be connected to any position of the housing 30.

[0074] In the embodiment above, the decompression mechanism 40 includes the pump 41 and the connection passage 42. The decompression mechanism 40 may be differently structured as long as it can decompress the inside of the housing 30.

[0075] In the embodiment above, the heat radiation mechanism 50 has the two cooling plates 54 and 55. In this regard, only one cooling plate may be provided, or no cooling plate may be provided. While the heat radiation mechanism 50 of the embodiment above includes the heat radiation member 51, the circulation passage 52, and the circulation pump 53, the disclosure is not limited to this arrangement. Furthermore, the heat radiation mechanism 50 may not be provided.

Claims

1. A spun yarn take-up apparatus (1) comprising:

a spinning apparatus (2) which has a spinneret (12) from which yarns (Y) are spun out downward;
a yarn winder (4) which includes a bobbin holder (24) to which bobbins (B) are attached, the yarns (Y) spun out from the spinneret (12) being wound onto the respective bobbins (B);
a housing (30) which houses the yarns (Y) spun out from the spinneret (12) and running toward the yarn winder (4) and packages (P) formed by winding the yarns (Y) onto the bobbins (B); and
a decompression mechanism (40) which is able to decompress inside of the housing (30), wherein,
the housing (30) is provided with a discharge opening portion (31) which is provided to discharge the packages (P) and is openable and closable, and
discharge of the packages (P) from the inside of the housing (30) is possible when the discharge opening portion (31) is open, and an internal space (70) of the housing (30) is in a sealed state when the discharge opening portion (31) is closed.

2. The spun yarn take-up apparatus (1) according to claim 1, wherein,

the housing (30) is provided with a first opening portion (32) which is for accessing the spinneret (12) from outside of the housing (30) and is openable and closable, and
access to the spinneret (12) from the outside of the housing (30) is possible when the discharge opening portion (32) is open, and the internal space (70) of the housing (30) is in the sealed state when the first opening portion (32) is closed.

3. The spun yarn take-up apparatus (1) according to claim 1 or 2, wherein,

the decompression mechanism (40) includes a pump (41) provided outside the housing (30) and a connection passage (42) connecting the housing (30) with the pump (41), and
the connection passage (42) is connected to the housing (30) at a position that is closer to the yarn winder (4) than the spinneret (12).

4. The spun yarn take-up apparatus (1) according to any one of claims 1 to 3, wherein,

on the upstream of the yarn winder (4) in a yarn running direction, a godet roller (8) is provided to feed the yarns (Y) spun out from the spinneret (12) to the yarn winder (4),
the housing (30) is provided with a second opening portion (33) that is openable and closable,
access to the godet roller (8) from the outside of the housing (30) is possible when the second discharge opening portion (33) is open, and the internal space (70) of the housing (30) is in the sealed state when the second opening portion (33) is closed.

5. The spun yarn take-up apparatus (1) according to any one of claims 1 to 4, wherein,

a heat generating member (80) configured to generate heat when the yarn winder (4) is driven is provided in the housing (30), and
a heat radiation mechanism (50) is provided to radiate the heat generated by the heat generating member (80) to the outside of the housing (30).

6. The spun yarn take-up apparatus (1) according to claim 5, wherein,

the heat radiation mechanism (50) includes:
a heat radiation member (51) which is provided outside the housing (30) and is exposed to atmospheric air;
a circulation passage (52) which is in contact with the heat radiation member (51) and the heat generating member (80), and in which fluid circulates; and
a circulation pump (53) which is configured to circulate the fluid in the circulation passage (52).

7. The spun yarn take-up apparatus (1) according to claim 6, wherein, the heat radiation mechanism (50) includes a cooling member (54,55) that is provided in the housing (30) and is arranged to cool the fluid flowing in the circulation passage (52).

FIG.1

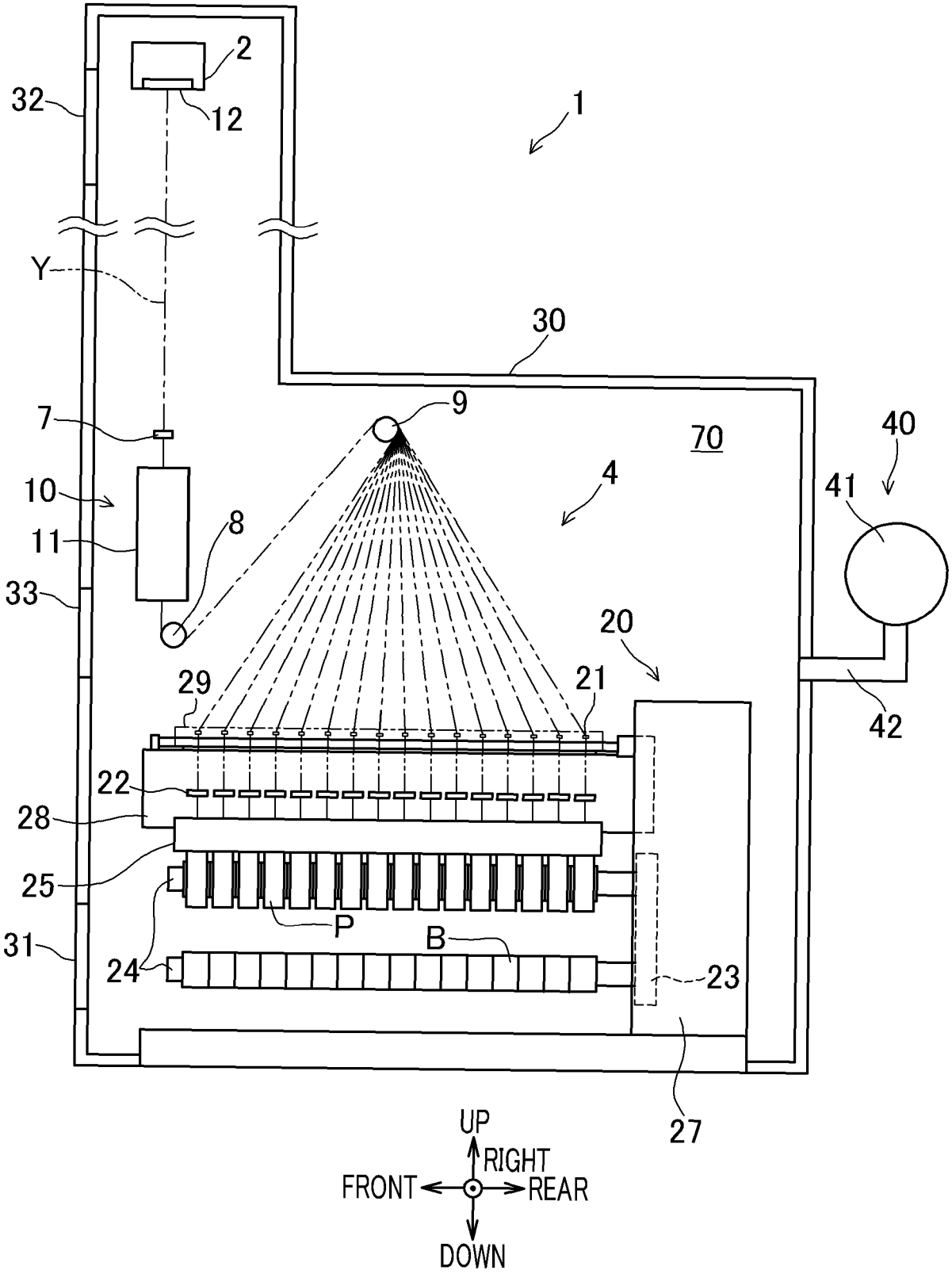
2
32
12
1
Y
30
7
9
70
40
10
4
41
11
8
33
20
29
21
42
22
28
25
P
B
31
24
23
27
UP
RIGHT
FRONT
REAR
DOWN

FIG.2

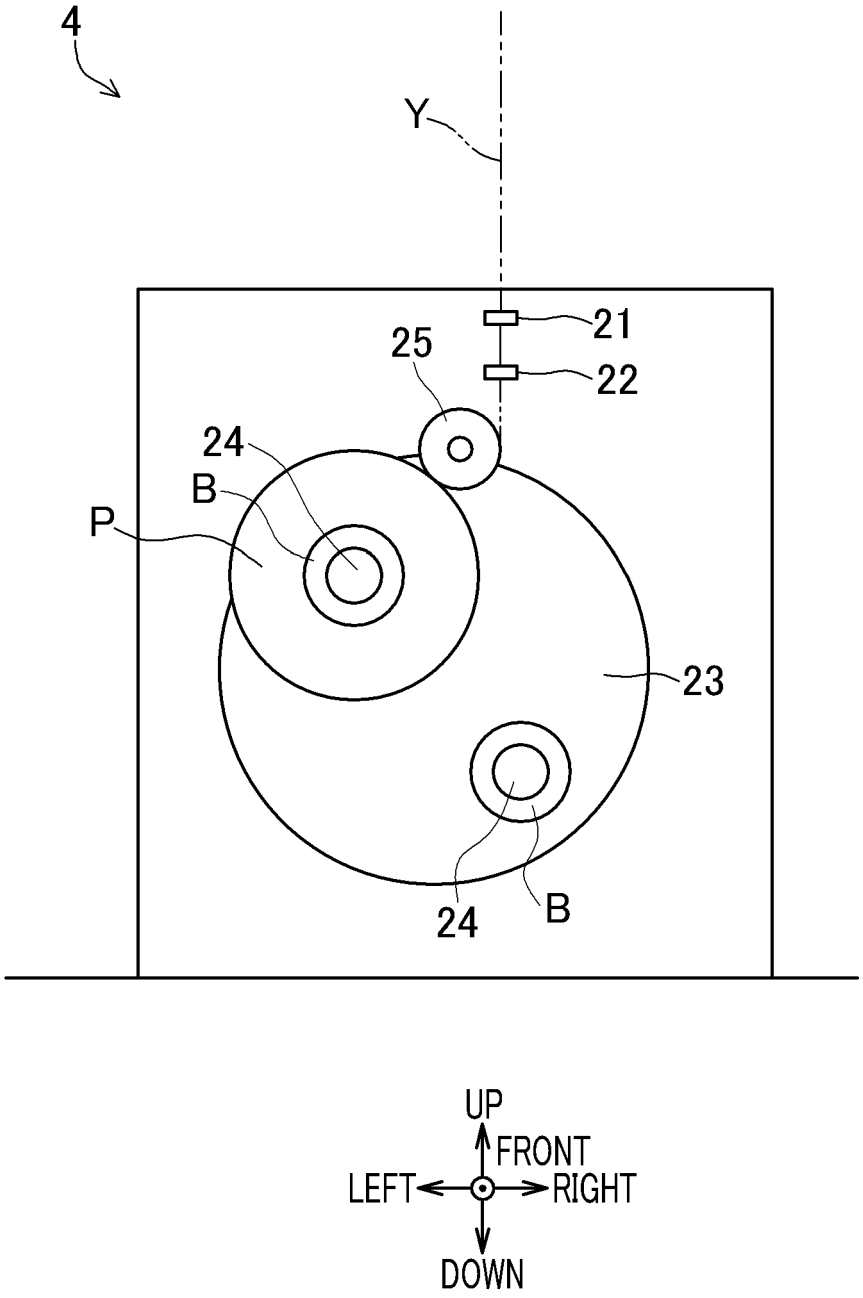

FIG.3

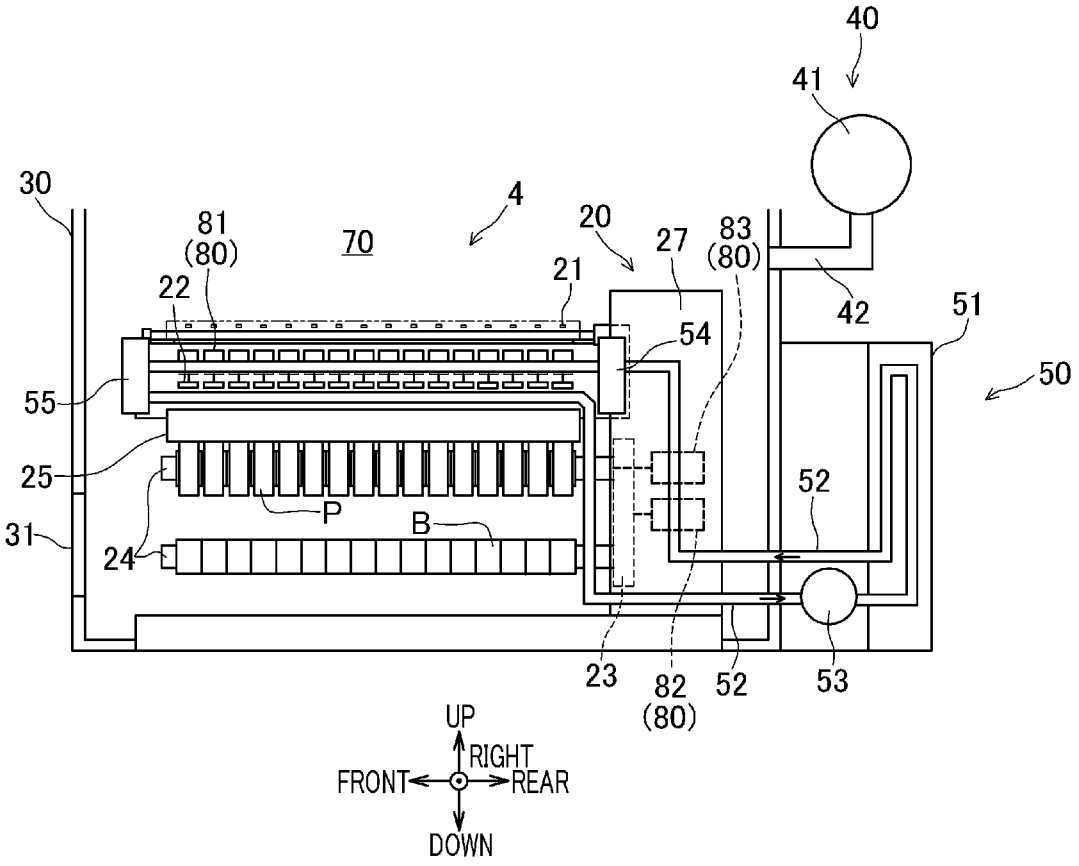
40
41
30
81
(80)
70
4
20
27
83
(80)
21
22
42
51
54
50
55
25
52
P
B
31
24
23
82
(80)
52
53
UP
RIGHT
FRONT
REAR
DOWN

FIG.4

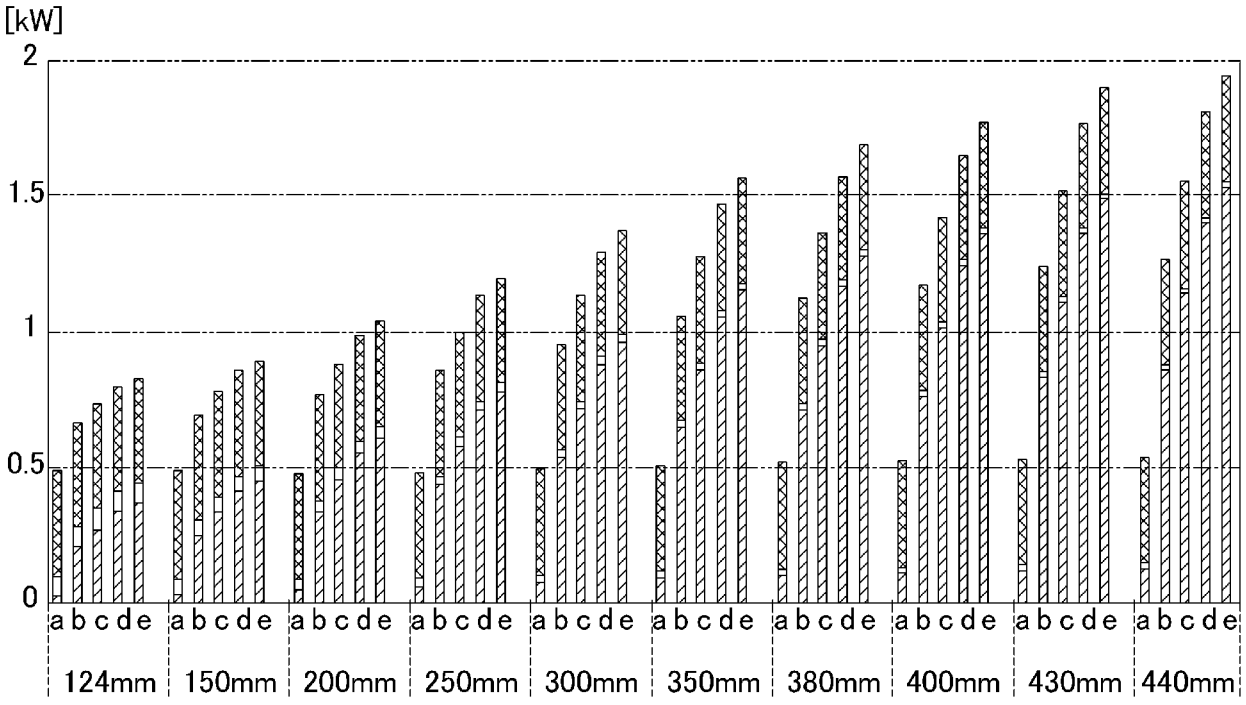
[kW]
2
1.5
1
0.5
0
a b c d e
124mm
150mm
200mm
250mm
300mm
350mm
380mm
400mm
430mm
440mm

FIG.5

NUMBER OF ENDS	12
WOUND WIDTH [mm]	122
WINDING DENSITY [g/cm^3]	0.95
YARN TENSION [g]	50
DIAMETER OF FULLY-WOUND PACKAGE [mm]	440
LENGTH OF BOBBIN HOLDER [m]	1.8

FIG.6

	AIR PRESSURE IS 1.0 atm	AIR PRESSURE IS 0.5 atm	AIR PRESSURE IS 0.3 atm	AIR PRESSURE IS 0.1 atm	AIR PRESSURE IS 0.05 atm	AIR PRESSURE IS 0.01 atm	AIR PRESSURE IS 0.005 atm
TOTAL POWER [kW·h]	5.154	3.914	3.408	3.169	3.454	3.876	4.168
SUPPRESSED POWER [kW·h]	0	1.240	1.746	1.985	1.699	1.278	0.986

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EUROPEAN SEARCH REPORT

Application Number
EP 24 20 5243

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 February 2025	Guisan, Thierry

CATEGORY OF CITED DOCUMENTS

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28-02-2025

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