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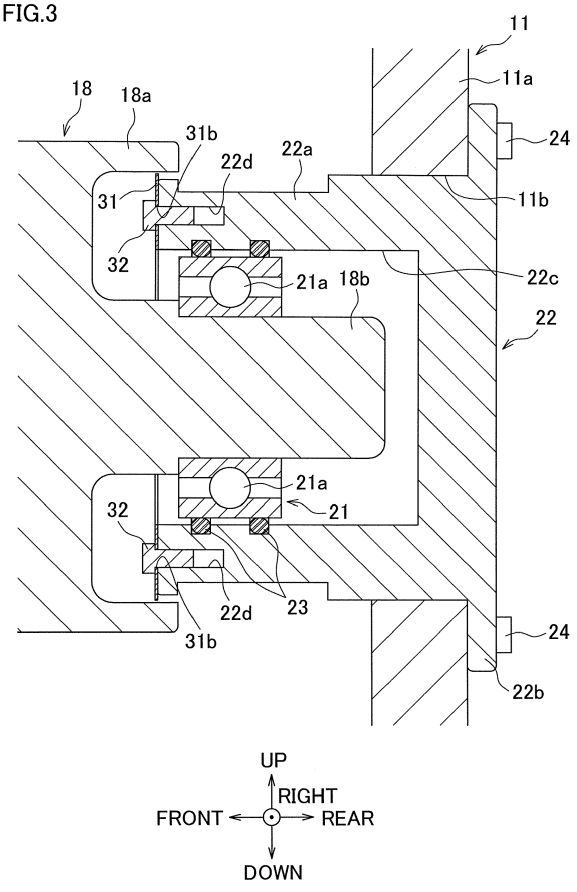
(54) YARN WINDING APPARATUS

(57) A problem, which occurs when a static electricity remover is disposed in the vicinity of the surface of a rotating body, is solved in a yarn winding apparatus including the rotating body which rotates while being in contact with the outer circumferential surface of a package. A yarn winding apparatus forming a package by winding a yarn onto a bobbin includes a rotating body 18 configured to rotate while being in contact with the outer circumferential surface of the package. In the yarn winding apparatus, a static electricity remover 31 for removing static electricity from the rotating body 18 is provided inside the rotating body 18 so as not to make contact with the rotating body 18.

FIG.3



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn winding apparatus configured to form a package by winding a yarn onto a bobbin.

[0002] For example, in a yarn winding apparatus provided in a spun yarn take-up apparatus disclosed by Patent Literature 1 (Japanese Unexamined Patent Publication No. 2013-213307), a package is formed in such a way that a yarn is wound onto a bobbin attached to a bobbin holder. In this yarn winding apparatus, a contact roller, which is made of metal, is provided to adjust the shape of a package. The contact roller rotates while being in contact with the outer circumferential surface of the package so as to apply a predetermined contact pressure to the package.

[0003] In this spun yarn take-up apparatus, because a fast-running yarn makes contact with a guide and the like, static electricity is charged to the yarn, with the result that the static electricity remains in a package. The core of the package, i.e., a bobbin is typically a take-up tube made of paper. Therefore, the static electricity in the package does not move to a bobbin holder, and moves solely to the contact roller. As a result, a large amount of static electricity is accumulated in the contact roller, and the accumulated static electricity may be discharged toward a member arranged in the vicinity of the contact roller.

SUMMARY OF THE INVENTION

[0004] To prevent the above described electric discharge, it is conceivable that a static electricity remover is arranged in the vicinity of the surface of the contact roller to discharge the static electricity accumulated in the contact roller. However, in the space where the yarn winding apparatus is provided, cotton flies, oil mist, and the like are scattered, and when these are attached to the static electricity remover, static electricity removing capability of this remover is reduced disadvantageously. In this regard, if electric discharge occurs from the contact roller to the static electricity remover, the surface of the contact roller may be damaged, with the result that deterioration in quality of yarns and yarn breakage may occur. Furthermore, the electric discharge can be seen from the outside, and this may unnecessarily cause an operator to feel anxiety.

[0005] An object of the present invention is to solve the problem which occurs in a yarn winding apparatus including a rotating body which rotates while being in contact with the outer circumferential surface of a package, when a static electricity remover is arranged in the vicinity of the surface of the rotating body.

[0006] The present invention relates to a yarn winding apparatus forming at least one package by winding at least one yarn onto at least one bobbin and includes a cylindrical rotating body configured to rotate while being in contact with the outer circumferential surface of the package. In the present invention, a static electricity remover configured to remove static electricity from the rotating body is provided inside the rotating body so as not to make contact with the rotating body.

[0007] In the present invention, because the static electricity remover is provided inside the cylindrical rotating body, the static electricity remover is covered by the static electricity remover. This restrains cotton flies, oil mist, and the like from being attached to the static electricity remover with the result that static electricity removing capability can be kept well for a long time. If the rotating body is damaged because of the electric discharge from the rotating body to the static electricity remover, damaged is the inner circumferential surface of the rotating body. Therefore, yarns, which make contact with the outer circumferential surface of the rotating body, are not affected adversely. Furthermore, because the rotating body is covered by the static electricity remover, the electric discharge can hardly be seen from the outside. Thanks to this, an operator does not feel anxiety unnecessarily. As described above, according to the present invention, a problem, which occurs when the static electricity remover is disposed in the vicinity of the surface of the rotating body, is solved.

[0008] In the present invention, a supporting member which supports the rotating body to be rotatable via a bearing, and which is partially inserted to the inside of the rotating body, may be further provided, and the static electricity remover may be provided at a part of the supporting member where the supporting member is inserted inside the rotating body.

[0009] Because the supporting member, which rotatably supports the rotating body, is a conventional member, no extensive changes are required to provide the static electricity remover if the static electricity remover is provided in the supporting member.

[0010] In the present invention, the static electricity remover may be independent from the supporting member.

[0011] Static electricity removing capability of the static electricity remover may be deteriorated disadvantageously when, for example, they are electrically corroded and deformed during use. Even in such a case, when the static electricity remover is an independent member, by replacing this member, static electricity removing capability can be recovered easily.

[0012] In the present invention, the static electricity remover may be integrated with the supporting member.

[0013] With this arrangement, there is no need to assemble the static electricity remover with the supporting member. Therefore, the distance between the rotating body and the static electricity remover is unchanged irrespective of the assembling accuracy of the static electricity remover. As a result, desired static electricity removing capability can be achieved.

[0014] In the present invention, the static electricity remover may have a protruding portion which protrudes

radially outward from the outer circumferential surface of the part of the supporting member where the supporting member is inserted inside rotating body.

[0015] In this case, to promote electric discharge from the inner circumferential surface of rotating body to the protruding portion, distance between the inner circumferential surface of rotating body and the leading end of the protruding portion is important. Therefore, it is necessary to accurately determine the position of the static electricity remover, in the radial direction. In this regard, to arrange accurately the shaft of the rotating body at the center of the rotating body, it is typical that the positions of the rotating body and the supporting member in the radial direction are accurately determined. As a consequence, the static electricity remover provided at the supporting member is accurately positioned in the radial direction, with the result that desired static electricity removing capability can be achieved.

[0016] In the present invention, the static electricity remover may have an annular shape, when viewed in the axial direction of the rotating body, and on the outer circumference of the static electricity remover, at least one triangular portion, which protrudes radially outward when viewed in the axial direction and has a triangular shape, may be formed as the protruding portion.

[0017] In this way, when the protruding portion is a triangular portion which is in triangular shape, the leading end is sharp. As a result, electric discharge from the rotating body to the triangular portion is promoted, and the static electricity removing capability is improved.

[0018] In the present invention, a plurality of the triangular portions may be formed across the whole outer circumference of the static electricity remover.

[0019] With this arrangement, electric discharge from the rotating body to the static electricity remover can be distributed to the plural triangular portions. As a result, the electric discharge is not concentrated in the specific parts, and the life of the static electricity remover can be prolonged.

[0020] In the present invention, the static electricity remover may be circular-arc-shaped, when viewed in the axial direction of the rotating body, and on the outer circumference of the static electricity remover, at least one triangular portion, which protrudes radially outward when viewed in the axial direction and has a triangular shape, may be formed as the protruding portion.

[0021] In this way, when the protruding portion is a triangular portion which is in triangular shape, the leading end is sharp. As a result, electric discharge from the rotating body to the triangular portion is promoted, and the static electricity removing capability is improved. Furthermore, when the static electricity remover is circular-arc-shaped, by adjusting the position of the static electricity remover in the circumferential direction, the electric discharge can hardly be seen from the outside.

[0022] In the present invention, the static electricity remover may be provided at the end face of the supporting member on the insertion side.

[0023] By providing the static electricity remover not at the outer circumferential surface but at the end face of the supporting member, even if the space between the inner circumferential surface of the rotating body and the outer circumferential surface of the supporting member is narrow, the static electricity remover can be easily provided at the supporting member.

[0024] In the present invention, the static electricity remover may have an annular shape, when viewed in the axial direction of the rotating body, and on at least part of the outer circumference of the static electricity remover, a tapered portion may be formed as the protruding portion so as to protrude radially outward to have a triangular shape, in a cross section orthogonal to the circumferential direction.

[0025] In this way, by providing as a protruding portion the tapered portion which is continuous in the circumferential direction, electric discharge from the rotating body to the static electricity remover can be distributed in the circumferential direction. As a result, the electric discharge is not concentrated in the specific parts, and the life of the static electricity remover can be prolonged.

[0026] In the present invention, the tapered portion may be formed across the whole outer circumference of the static electricity remover.

[0027] With this arrangement, electric discharge from the rotating body to the static electricity remover can be distributed more effectively. As a result, the life of the static electricity remover can be prolonged.

[0028] In the present invention, the static electricity remover may be provided at the end face of the supporting member on the insertion side.

[0029] By providing the static electricity remover not at the outer circumferential surface but at the end face of the supporting member, even if the space between the inner circumferential surface of the rotating body and the outer circumferential surface of the supporting member is narrow, the static electricity remover can be easily provided at the supporting member.

[0030] In the present invention, the static electricity remover may include a small diameter portion which is disposed between the tapered portion and the end face of the supporting member in the axial direction, and whose outer diameter is smaller than the diameter of the end face.

[0031] In this way, by providing the small diameter portion between the tapered portion and the end face of the supporting member, the small diameter portion forms a valley, with the result that the protruding portion of the tapered portion is emphasized. As a result, electric discharge from the rotating body to the tapered portion is promoted, and the static electricity removing capability is improved.

[0032] In the present invention, the static electricity remover may include a protruding portion which protrudes axially inward from the end face of the supporting member on the insertion side.

[0033] The rotating body vibrates in such a way as to

displace from the shaft center. Therefore, by arranging the protruding portion to protrude in the axial direction, it is easier to avoid contact between rotating body and the protruding portion due to the vibration of rotating body, than when the protruding portion protrudes in the radial direction. Furthermore, by arranging the protruding portion to protrude axially inward from the end face of the supporting member, the protruding portion is hidden by the supporting member, with the result that the electric discharge can be hardly seen from the outside.

[0034] In the present invention, the static electricity remover may be a static electricity removing string in which plural conductive fibers are exposed at the surface.

[0035] By using the static electricity removing string as the static electricity remover, electric discharge from the rotating body to the static electricity remover occurs at many parts where the conductive fibers are exposed. As a result, the electric discharge is not concentrated in the specific parts, and the life of the static electricity remover can be prolonged. Furthermore, when the static electricity remover is the static electricity removing string, even if the static electricity remover makes contact with the rotating body, the damage of the rotating body is restrained.

[0036] In the present invention, the static electricity removing string may be provided at least part of the supporting member in the circumferential direction.

[0037] As described above, by using the static electricity removing string as the static electricity remover, electric discharge from the rotating body to the static electricity remover occurs at many parts where the conductive fibers are exposed. Therefore, sufficient static electricity removing capability can be obtained even when the static electricity remover is provided only at least part in the circumferential direction. Furthermore, by providing the static electricity removing string at only part in the circumferential direction, the required length of the static electricity removing string can be shortened, leading to cost reduction.

[0038] In the present invention, the static electricity removing string may be provided across the whole circumferential direction of the supporting member.

[0039] With this arrangement, electric discharge from the rotating body to the static electricity removing string occurs on the whole circumference. As a result, the static electricity removing capability is improved.

[0040] In the present invention, an attaching member to attach the static electricity removing string may be further included, and the attaching member may be an annular member, when viewed in the axial direction of the rotating body, and be attached to the end face of the supporting member on the insertion side, and the attaching member may include a large diameter portion, and a small diameter portion which is disposed between the large diameter portion and the supporting member in the axial direction, and whose outer diameter is smaller than the diameters of the large diameter portion and the end face, and the static electricity removing string may be attached to the outer circumferential surface of the small diameter portion.

[0041] According to these arrangements, even when there is no space on the outer circumferential surface of the supporting member to attach the static electricity removing string, the static electricity removing string can be attached to the supporting member. Furthermore, because the static electricity removing string is sandwiched between the large diameter portion and the end face of the supporting member, the static electricity removing string does not drop off.

[0042] In the present invention, an attaching portion, in which an insertion hole which is to be inserted by the supporting member, may be further included, and the supporting member may include a flange portion whose diameter is larger than the diameter of the insertion hole, and the flange portion may be fixed to the attaching portion so as to be positioned on the opposite side of the rotating body across the attaching portion, while the supporting member is inserted into the insertion hole.

[0043] According to the above arrangement, detachment of the supporting member from the attaching portion is achieved only by releasing the fixing of the flange portion and the attaching portion and pulling out the supporting member from the insertion hole. In this way, it is possible to easily detach the supporting member from the attaching portion without making contact with the rotating body. Therefore, for example, maintenance of the static electricity remover, which is disposed at the supporting member, can be easily done.

[0044] In the present invention, a rubber-made ring member may be provided between the supporting member and the bearing.

[0045] With such a rubber-made ring member, the bearing is firmly attached to the supporting member. However, escape of static electricity from the rotating body to the supporting member via the bearing is obstructed, with the result that the accumulation of the static electricity in the rotating body is facilitated. Therefore, providing the static electricity remover is particularly effective.

[0046] In the present invention, the bearing may be a ball bearing with balls which are made of ceramic.

[0047] When the balls of the ball bearing are made of ceramic, electrolytic corrosion of the balls can be prevented. However, escape of static electricity from the rotating body to the supporting member via the bearing is obstructed, with the result that the accumulation of the static electricity in the rotating body is facilitated. Therefore, providing the static electricity remover is particularly effective.

[0048] In the present invention, a conductive member which is disposed in the vicinity of the outer circumferential surface of the rotating body may be further included, and the distance between the static electricity remover and the inner circumferential surface of the rotating body may be smaller than the distance between the conductive member and the outer circumferential surface of

the rotating body.

[0049] This arrangement promotes electric discharge from the rotating body to the static electricity remover, with the result that electric discharge from the rotating body to the conductive member can be certainly suppressed. As a result, problems such as electrolytic corrosion of the conductive member can be prevented.

[0050] In the present invention, a plurality of the bobbins may be attached to a bobbin holder supporting the bobbins, along the axial direction, and the rotating body may make contact with a plurality of the packages which are formed by winding a plurality of the yarns onto the bobbins.

[0051] When the rotating body makes contact with the packages, the amount of static electricity, which is accumulated in the rotating body, increases. The effect of the static electricity remover is therefore particularly conspicuous in this case.

[0052] In the present invention, the rotating body may be a contact roller which rotates with the package while applying a contact pressure to the package.

[0053] When static electricity is accumulated in the contact roller, winding and applying a contact pressure may not be properly done as the yarns are stuck onto the contact roller on account of the static electricity. However, with the static electricity remover, the winding and the application of a contact pressure can be properly done and hence the quality of the packages is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0054]

FIG. 1 is a front elevation of a spun yarn take-up apparatus of an embodiment of the present invention.

FIG. 2 is a profile of the spun yarn take-up apparatus of the embodiment.

FIG. 3 is an enlarged cross section of a supporting structure of a contact roller.

FIG. 4 is a profile schematically showing the flow of static electricity.

FIG. 5 is a front elevation showing an antistatic member.

FIGs. 6(a) and 6(b) are front elevations showing modifications of antistatic members.

FIG. 7 is a cross section showing the way of attaching an antistatic member of the Second Embodiment.

FIG. 8 is a perspective view showing the antistatic member of the Second Embodiment.

FIG. 9 is a cross section showing the way of attaching an antistatic member of the Third Embodiment.

FIG. 10 is a cross section when an antistatic member is integrated with a supporting component.

FIG. 11 shows the antistatic member viewed in the direction XI of FIG. 10.

FIG. 12 is a cross section showing a modification when an antistatic member is integrated with a supporting component.

FIG. 13 is a cross section when a protruding portion protrudes in the axial direction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0055] The following will describe an embodiment of the present invention with reference to figures. In the present embodiment, a yarn winder of the present invention is used in a spun yarn take-up apparatus.

(Spun Yarn Take-Up Apparatus)

[0056] FIG. 1 is a front elevation of a spun yarn take-up apparatus of an embodiment of the present invention, and FIG. 2 is a profile of the spun yarn take-up apparatus of the embodiment. Hereinafter, forward, rearward, leftward, rightward, upward, and downward directions shown in FIGs. 1 and 2 will be referred to as forward, rearward, leftward, rightward, upward, and downward directions of the spun yarn take-up apparatus.

[0057] A spun yarn take-up apparatus 1 is configured to take up yarns Y spun out from a spinning apparatus 2 and includes members such as godet rollers 3 and 4 and a yarn winder 5. The spinning apparatus 2 is provided above the spun yarn take-up apparatus 1 and is configured to spin out yarns Y made of synthetic fibers (e.g., fibers made of synthetic resin such as polyethylene terephthalate) through plural spinnerets (not illustrated). The godet rollers 3 and 4 are disposed below the spinning apparatus 2 so that the axis of each godet roller is substantially in parallel to the left-right direction. The godet roller 4 is provided obliquely above and behind the godet roller 3. The yarns Y spun out from the spinning apparatus 2 are wound onto the godet rollers 3 and 4 in this order. The godet rollers 3 and 4 are rotationally driven by an unillustrated drive motor. The yarns Y spun out from the spinning apparatus 2 are sent to the yarn winder 5 by the godet rollers 3 and 4.

[0058] The yarn winder 5 includes two yarn winding apparatuses 10 which are provided below the godet rollers 3 and 4. The two yarn winding apparatuses 10 are provided to oppose each other over a yarn path of the yarns Y which are sent from the godet rollers 3 and 4, so as to be substantially symmetrical in the left-right direction. The yarns Y spun out from the spinning apparatus 2 are sent to the two yarn winding apparatuses 10 in a divided manner. For example, when 32 yarns Y are sent from the spinning apparatus 2, a half of the yarns Y, i.e., 16 yarns are wound by the left yarn winding apparatus 10, whereas the remaining 16 yarns are wound by the right yarn winding apparatus 10. Note that the number of the yarns Y to be wound by each yarn winding apparatus 10 is not limited to this.

[0059] Each yarn winding apparatus 10 is constituted by members such as a supporting frame 11 and two bobbin holders 12. Each of the supporting frame 11 and the bobbin holders 12 is made of metal. The supporting frame

11 is cantilevered by a frame 13 to be substantially horizontal in posture. Each of the two bobbin holders 12 is a shaft member extending in the front-rear direction, and is cantilevered at its rear end portion by a turret 14. To the bobbin holder 12, plural (16 in the present embodiment) bobbins B are attachable along the axial direction. The bobbin holder 12 is rotated about the axis by an unillustrated motor. The turret 14 is a disc-shaped member and is attached to the frame 13 to be rotatable. As the turret 14 rotates, the positions of the two bobbin holders 12 supported by the turret 14 are switched.

[0060] Above the supporting frame 11, a guide supporter 15 is provided to extend in the front-rear direction. On the guide supporter 15, plural fulcrum guides 16 are provided along the front-rear direction to correspond to the respective bobbins B attached to the bobbin holder 12. On the supporting frame 11, plural traverse guides 17 are provided along the front-rear direction to correspond to the respective bobbins B attached to the bobbin holder 12. The traverse guides 17 are provided below the fulcrum guides 16.

[0061] In addition to the above, the yarn winding apparatus 10 includes a contact roller 18 which is made of metal and is supported by the supporting frame 11 to be rotatable. The contact roller 18 is provided below the supporting frame 11 and is able to make contact with the outer circumferential surfaces of packages P formed on the upper bobbin holder 12. The contact roller 18 adjusts the shape of each package P in such a way that the contact roller 18 is rotated with the package P while applying a predetermined contact pressure to the package P when the yarn Y is wound onto the bobbin B. While the yarn Y is wound onto the bobbin B and the diameter of the package P increases, the contact pressure is maintained to be constant as the position of the bobbin holder 12 is gradually lowered. Alternatively, the position of the contact roller 18 may be gradually moved upward.

[0062] In the yarn winding apparatus 10 structured as above, the yarns Y threaded onto the respective fulcrum guides 16 are traversed in the front-rear direction about the fulcrum guides 16 by the traverse guides 17. As the traversed yarns Y are wound onto the bobbins B attached to the upper bobbin holder 12, the packages P are formed. When the formation of the packages P on the upper bobbin holder 12 is completed, the turret 14 rotates to switch the two bobbin holders 12. In other words, the lower bobbin holder 12 is moved to the upper side, and the yarns Y are newly wound onto the bobbins B attached to this bobbin holder 12. The bobbin holder 12 on which the packages P are fully formed is moved to the lower side, and the fully-formed packages P are removed from the front side of the bobbin holder 12. The winding speed of winding the yarns Y in the present embodiment is considerably high, e.g., 4000 to 5000m/min.

(Supporting Structure of Contact Roller)

[0063] The following will detail the supporting structure of the contact roller 18. FIG. 3 is an enlarged cross section of the supporting structure of the contact roller 18. While FIG. 3 shows the supporting structure at a rear end portion of the contact roller 18, a front end portion has the same supporting structure.

[0064] The contact roller 18 is supported to be rotatable by a supporting member 22 via a bearing 21. The supporting member 22 is attached to an attachment 11a of the supporting frame 11. The supporting frame 11 is grounded via the frame 13 (see FIG. 2). The contact roller 18 includes a cylindrical portion 18a and a shaft end portion 18b. The cylindrical portion 18a has a cylindrical shape and the outer circumferential surface of the cylindrical portion 18a makes contact with the outer circumferential surfaces of the packages P. The shaft end portion 18b is smaller in diameter than the cylindrical portion 18a, and extends beyond the ends of the cylindrical portion 18a to the outside in the axial direction, and is supported by the bearing 21.

[0065] The supporting member 22 is a metal member having a bottomed cylindrical shape, and includes a cylindrical portion 22a and a flange portion 22b. The cylindrical portion 22a has a cylindrical shape, and forms a recess 22c opening to the front. The bearing 21 is provided in the recess 22c, and the shaft end portion 18b of the contact roller 18 is attached to the bearing 21. The bearing 21 is a ball bearing with balls 21a which are made of ceramic. Between the bearing 21 and the circumferential wall of the recess 22c, a rubber-made O-ring 23 is provided. While two O-rings 23 are provided in the present embodiment, the number of the O-rings 23 may be suitably changed.

[0066] The attaching portion 11a of the supporting frame 11 made of metal has an insertion hole 11b which penetrates the attaching portion 11a in the axial direction of the contact roller 18. The diameter of the insertion hole 11b is substantially same as the external diameter of the cylindrical portion 22a of the supporting member 22, and is smaller than the external diameter of the flange portion 22b. With the bearing 21 attached to the supporting member 22, the supporting member 22 is inserted into the insertion hole 11b from the rear of the attaching portion 11a, and then the shaft end portion 18b of the contact roller 18 is inserted into the bearing 21. By fixing the flange portion 22b to the attaching portion 11a by a bolt 24, the supporting member 22 is attached to the supporting frame 11. Conversely, by removing the bolt 24 and drawing the supporting member 22 to the rear, it is possible to detach the supporting member 22 from the contact roller 18 and the attaching portion 11a. When the contact roller 18 is assembled with the bearing 21, the front end portion of the cylindrical portion 22a of the supporting member 22 is inserted inside in the radial direction of the cylindrical portion 18a of the contact roller 18.

(Influence of Static Electricity at Contact Roller)

[0067] FIG. 4 is a profile schematically showing the

flow of static electricity. In the spun yarn take-up apparatus 1, because a fast-running yarn Y makes contact with members such as the fulcrum guide 16 and/or the traverse guide 17 (see FIG. 2), static electricity is generated. The bobbin B is a take-up tube made of paper and an insulator. Therefore, the static electricity does not move to the bobbin holder 12 from a package P via the bobbin B. That is, the static electricity does not move as indicated by the dotted arrow in FIG. 4. Therefore, the static electricity in the package P moves solely to the contact roller 18 which is in contact with the package P (see the solid arrow in FIG. 4)

[0068] As shown in FIG. 3, the contact roller 18 is supported by the bearing 21 including the balls 21a which are made of ceramic and are insulators. Furthermore, between the bearing 21 and the supporting member 22, the rubber-made O-ring 23, which is an insulator, is provided. Therefore, static electricity can not go anywhere from the contact roller 18, and when more than a predetermined quantity of the static electricity is accumulated in the contact roller 18, the static electricity is discharged to electrically conductive members around the contact roller 18.

[0069] Specifically, in the present embodiment, as shown in FIG. 4, a yarn detection member 19 made of metal is provided in the vicinity of the contact roller 18. This yarn detection member 19 is positioned such that a yarn Y wound onto the contact roller 18 makes contact with the yarn detection member 19. The yarn detection member 19 is connected to an unillustrated detector, and the detector is configured to detect a yarn Y being wound onto the contact roller 18 by detecting contact between the yarn detection member 19 and the yarn Y.

[0070] To achieve this object, the yarn detection member 19 is disposed as close as possible to the contact roller 18, and the distance between the yarn detection member 19 and the contact roller 18 is, for example, about 0.7 to 1.0 mm. As a result, when more than a predetermined quantity of static electricity is accumulated in the contact roller 18, and the static electricity is discharged to the yarn detection member 19, the yarn detection member 19 may be electrically corroded and the above detector may be activated in error.

[0071] In order to improve the efficiency in producing packages P, these days the number of bobbins B attached to the bobbin holder 12, i.e., the number (16 in the present embodiment) of packages P making contact with the contact roller 18 tends to be large. Furthermore, in order to improve the efficiency in producing packages P, the running speed of yarns Y, i.e., the rotation speed of the bobbin holder 12 tends to be high. Because of these tendencies, the amount of static electricity accumulated in the contact roller 18 gets larger and larger. Therefore, a static electricity countermeasure is essential.

(Antistatic Member)

[0072] As shown in FIG. 3, in the present embodiment, as an "static electricity remover" of the present invention to remove static electricity from the contact roller 18, an antistatic member 31 which is different from the supporting member 22 is provided. FIG. 5 is a front elevation showing the antistatic member 31. The antistatic member 31 is an annular and thin plate member made of metal. Across the whole outer circumference of the antistatic member 31, when viewed in the axial direction, a number of triangular portions 31a ("protruding portions" of the present invention), which protrude radially outward and are triangular in shape, are formed. The triangular portions 31a may be formed on only a part of the outer circumference of the antistatic member 31.

[0073] In the antistatic member 31, bolt holes 31b are formed in the circumferential direction. On the other hand, as shown in FIG. 3, in the front end surface of the cylindrical portion 22a of the supporting member 22, female screw portions 22d are formed to correspond to the bolt holes 31b of the antistatic member 31. When a bolt 32 is put through each of the bolt holes 31b of the antistatic member 31, and is fastened to each of the female screw portions 22d, the antistatic member 31 can be attached so as to be brought into contact with the front end surface of the supporting member 22. With this arrangement, the antistatic member 31 is disposed inside the cylindrical portion 18a of the contact roller 18 in the radial direction.

[0074] In FIG. 5, one-dot chain line shows the outer circumferential surface of the front end portion of the supporting member 22. As can be clearly seen from FIG. 5, the triangular portions 31a protrude radially outward from the outer circumferential surface of the front end portion of the supporting member 22. The distance between the leading end of each triangular portion 31a and the inner circumferential surface of the contact roller 18 is about 0.3 to 0.5 mm. This is shorter than the distance between the above described yarn detection member 19 and the outer circumferential surface of the contact roller 18. Therefore, static electricity accumulated in the contact roller 18 is discharged toward the triangular portions 31a from the inner circumferential surface of the contact roller 18, with the result that electric discharge from the contact roller 18 to the yarn detection member 19 can be suppressed.

(Modifications of Antistatic Member)

[0075] FIGs. 6(a) and 6(b) are front elevations showing modifications of antistatic members. Antistatic members 35 and 36 of the present modification are made of metal and are circular-arc-shaped thin plate members. In the same manner as the antistatic member 31 in FIG. 3, each of the antistatic members 35 and 36 is attached to the front end surface of the supporting member 22. In the antistatic member 35 shown in FIG. 6(a), three triangular

portions 35a are formed at a substantial center of the outer circumference. In the antistatic member 36 shown in FIG. 6(b), a single triangular portion 36a is formed at a substantial center of the outer circumference. Note that the number of the triangular portions and the positions of the triangular portions are not limited to these, and may be suitably changed.

[0076] When the antistatic member is a circular-arc-shaped member such as the antistatic members 35 and 36, the positions can be adjusted in the circumferential direction of the front end surface of the supporting member 22. In other words, each of the triangular portions 35a and 36a, in which electric discharge occur, can be disposed at a part in the circumferential direction, and the position can be adjusted, with the result that the electric discharge can hardly be seen from the outside. Only one antistatic member 35 or 36 may be provided in the circumferential direction, or plural antistatic members 35 or 36 may be provided.

(Advantageous Effects)

[0077] In the present embodiment, the antistatic members 31, 35, and 36 (static electricity removers) for removing static electricity from the contact roller 18 (rotating body) are provided inside the contact roller 18 so as not to make contact with the contact roller 18. With this arrangement, the antistatic members 31, 35, and 36 are covered by the contact roller 18. This restrains cotton flies, oil mist, and the like from being attached to the antistatic members 31, 35, and 36 with the result that static electricity removing capability can be kept well for a long time. If the contact roller 18 is damaged because of the electric discharge from the contact roller 18 to each of the antistatic members 31, 35, and 36, damaged is the inner circumferential surface of the contact roller 18. Therefore, yarns Y, which make contact with the outer circumferential surface of the contact roller 18, are not affected adversely. Furthermore, because each of the antistatic members 31, 35, and 36 is covered by the contact roller 18, the electric discharge can hardly be seen from the outside. Thanks to this, an operator does not feel anxiety unnecessarily. In this way, with the present embodiment, the problems, which occur when each of the antistatic members 31, 35, and 36 is disposed in the vicinity of the surface of the contact roller 18, can be solved.

[0078] In the present embodiment, the supporting member 22 which is partially inserted inside the contact roller 18 and rotatably supports the contact roller 18 via the bearing 21 is further provided, and each of the antistatic members 31, 35, and 36 is provided at the part of the supporting member 22 where the supporting member 22 is inserted inside the contact roller 18. Because the supporting member 22, which rotatably supports the contact roller 18, is a conventional member, no extensive changes are required to provide the antistatic members 31, 35, and 36 if the antistatic members 31, 35, and 36 are provided in the supporting member 22.

[0079] In the present embodiment, each of the antistatic members 31, 35, and 36 is a member independent from the supporting member 22. Static electricity removing capability of each of the antistatic members 31, 35, and 36 may be deteriorated disadvantageously when, for example, they are electrically corroded and deformed during use. Even in such a case, when each of the antistatic members 31, 35, and 36 is an independent member, by replacing each of the antistatic members 31, 35, and 36, static electricity removing capability can be recovered easily.

[0080] In the present embodiment, the antistatic members 31, 35, and 36 include the triangular portions 31a, 35a, and 36a (protruding portions) which protrude radially outward from the outer circumferential surface of the part of the supporting member 22 where the supporting member 22 is inserted inside the contact roller 18 (the front end portion of the supporting member 22). In this case, to promote electric discharge from the inner circumferential surface of the contact roller 18 to each of the triangular portions 31a, 35a, and 36a, distance between the inner circumferential surface of the contact roller 18 and the leading end of each of the triangular portions 31a, 35a, and 36a is important. Therefore, it is necessary to accurately determine the position of each of the antistatic members 31, 35, and 36, in the radial direction. In this regard, to arrange accurately the shaft of the contact roller 18 at the center of the contact roller 18, it is typical that the positions of the contact roller 18 and the supporting member 22 in the radial direction are accurately determined. Each of the antistatic members 31, 35, and 36 provided at the supporting member 22 is accurately positioned as a consequence, with the result that desired static electricity removing capability can be achieved.

[0081] In the present embodiment, when viewed in the axial direction of the contact roller 18, the antistatic member 31 has an annular shape, and on the outer circumference of the antistatic member 31, at least one triangular portion 31a, which protrudes radially outward when viewed in the axial direction and has a triangular shape, is formed as a protruding portion. In this way, when the protruding portion is a triangular portion 31a which is in triangular shape, the leading end is sharp. This arrangement promotes electric discharge from the contact roller 18 to the triangular portion 31a with the result that the static electricity removing capability is improved.

[0082] In the present embodiment, plural triangular portions 31a are formed across the whole outer circumference of the antistatic member 31. With this arrangement, electric discharge from the contact roller 18 to the antistatic member 31 can be distributed to the plural triangular portions 31a. As a result, the electric discharge is not concentrated on a specific part, and the life of the antistatic member 31 can be prolonged.

[0083] In a modification of the present embodiment, when viewed in the axial direction of the contact roller 18, the antistatic member 35 and 36 are in circular shape,

and on the outer circumference of the antistatic member 35 and 36, at least one triangular portion 35a or 36a, which protrude radially outward when viewed in the axial direction and are in triangular shape, is formed as a protruding portion. In this way, when the protruding portion is a triangular portion 35a or 36a which is in triangular shape, the leading end is sharp. This arrangement promotes electric discharge from the contact roller 18 to each of the triangular portions 35a and 36a with the result that the static electricity removing capability is improved. Furthermore, when each of the antistatic members 35 and 36 is in circular shape, by adjusting position of each of the antistatic members 35 and 36 in the circumferential direction, the electric discharge can hardly be seen from the outside.

[0084] In the present embodiment, each of the antistatic members 31, 35, and 36 is arranged at the end face on the insertion direction side of the supporting member 22 (the front end surface of the supporting member 22). By disposing each of the antistatic members 31, 35, and 36 not at the outer circumferential surface of the supporting member 22 but at the front end surface of the supporting member 22, even if the gap between the inner circumferential surface of the contact roller 18 and the outer circumferential surface of the supporting member 22 is narrow, each of the antistatic members 31, 35, and 36 can be easily disposed at the supporting member 22.

[0085] In the present embodiment, the attaching portion 11a in which the insertion hole 11b which is to be inserted by the supporting member 22 is formed is further provided. The supporting member 22 includes the flange portion 22b whose diameter is larger than the diameter of the insertion hole 11b, and the flange portion 22b is fixed to the attaching portion 11a so as to be positioned on the opposite side of the contact roller 18 across the attaching portion 11a, while the supporting member 22 is inserted into the insertion hole 11b. According to the above arrangement, detachment of the supporting member 22 from the attaching portion 11a is achieved only by releasing the fixing of the flange portion 22b and the attaching portion 11a and pulling out the supporting member 22 from the insertion hole 11b. In this way, it is possible to easily detach the supporting member 22 from the attaching portion 11a without making contact with the contact roller 18. Therefore, for example, maintenance and replacement of each of the antistatic members 31, 35, and 36, which is disposed at the supporting member 22, can be easily done.

[0086] In the present embodiment, between the supporting member 22 and the bearing 21, a rubber-made O-ring 23 (ring member) is provided. With such a rubber-made O-ring 23, the bearing 21 is firmly attached to the supporting member 22. However, escape of static electricity from the contact roller 18 to the supporting member 22 via the bearing 21 is obstructed, with the result that the accumulation of the static electricity in the contact roller 18 is facilitated. Therefore, providing each of the antistatic members 31, 35, and 36 is particularly effective.

[0087] In the present embodiment, the bearing 21 is a ball bearing with balls 21a which are made of ceramic. Provided that the balls 21a of the ball bearing 21 are made of ceramic, electrolytic corrosion of the balls 21a can be prevented. However, escape of static electricity from the contact roller 18 to the supporting member 22 via the bearing 21 is obstructed, with the result that the accumulation of the static electricity in the contact roller 18 is facilitated. Therefore, providing each of the antistatic members 31, 35, and 36 is particularly effective.

[0088] In the present embodiment, the yarn detection member 19 (conductive member) disposed in the vicinity of the outer circumferential surface of the contact roller 18 is further provided. The distance between each of the antistatic members 31, 35, and 36 and the inner circumferential surface of the contact roller 18 is shorter than the distance between the yarn detection member 19 and the outer circumferential surface of the contact roller 18. This arrangement promotes electric discharge from the contact roller 18 to each of the antistatic members 31, 35, 36, 41, and 51, with the result that electric discharge from the contact roller 18 to the yarn detection member 19 can be certainly suppressed. Therefore, electrolytic corrosion of the yarn detection member 19, malfunction of the detector, and the like can be prevented.

[0089] In the present embodiment, the bobbins B are attached along the axial direction of the bobbin holder 12 supporting the bobbins B, and the contact roller 18 makes contact with the packages P formed by winding the yarns Y into the bobbins B. When the contact roller 18 makes contact with the packages P, the amount of static electricity, which is accumulated in the contact roller 18, increases. The effect of the antistatic members 31, 35, and 36 is therefore particularly conspicuous in this case.

[0090] In the present embodiment, "rotating body" of the present invention is the contact roller 18 which rotates with the packages P and applies contact pressure to the packages P. When static electricity is accumulated in the contact roller 18, winding and applying contact pressure may not be properly done as the yarns Y are stuck onto the contact roller 18 on account of the static electricity. However, with each of the antistatic members 31, 35, and 36, the winding and the application of contact pressure can be properly done and hence the quality of the packages P is improved.

(Second Embodiment of Antistatic Member)

[0091] The following will describe the second embodiment of the antistatic member. It should be noted that the components having the same structures as those in the above-described embodiment are given the same reference numerals, and the arrangements and effects identical with those in the above-described embodiment are not repeated here.

[0092] FIG. 7 is a cross section showing in what manner an antistatic member 41 of the Second Embodiment is attached. FIG. 8 is a perspective view showing the

antistatic member 41 of the Second Embodiment. The antistatic member 41 is an annular member made of metal, and includes a tapered portion 41a ("protruding portion" of the present invention) formed on one side in the axial direction and a small diameter portion 41b formed on the other side.

[0093] As shown in FIG. 7, the tapered portion 41a protrudes radially outward to have a triangular shape in a cross section orthogonal to the circumferential direction, and the tapered portion 41a is formed across the whole outer circumference of the antistatic member 41. The maximum outer diameter of the tapered portion 41a is larger than the outer diameter of the outer circumferential surface of the front end portion of the supporting member 22. Therefore, the tapered portion 41a protrudes radially outward from the outer circumferential surface of the front end portion of the supporting member 22. The small diameter portion 41b has a cylindrical shape, and the outer diameter of the small diameter portion 41b is smaller than the outer diameter of the front end surface of the supporting member 22. In the circumferential direction of the antistatic member 41, bolt holes 41c are formed.

[0094] As shown in FIG. 7, the antistatic member 41 is attached to the front end surface of the supporting member 22 by bolts 42 so that the tapered portion 41a faces to the front and the small diameter portion 41b is brought into contact with the front end surface of the supporting member 22. In other words, in the axial direction, the small diameter portion 41b is disposed between the tapered portion 41a and the front end surface of the supporting member 22. Therefore, the small diameter portion 41b forms a valley, with the result that protruding portion of the tapered portion 41a is emphasized.

[0095] The distance between the leading end of the tapered portion 41a and the inner circumferential surface of the contact roller 18 is about 0.3 to 0.5 mm. This is shorter than the distance between the above described yarn detection member 19 and the outer circumferential surface of the contact roller 18. Therefore, static electricity accumulated in the contact roller 18 is discharged toward the tapered portion 41a from the inner circumferential surface of the contact roller 18 with the result that electric discharge from the contact roller 18 to the yarn detection member 19 can be suppressed. In the present embodiment, the tapered portion 41a may be disposed at only a part in the circumferential direction, and the small diameter portion 41b may be omitted.

[0096] In the present embodiment, when viewed in the axial direction of the contact roller 18, the antistatic member 41 has a circular shape, and on at least part of the outer circumference of the antistatic member 41, the tapered portion 41a is formed as a protruding portion so as to protrude radially outward to have a triangular shape, in a cross section orthogonal to the circumferential direction. In this way, by providing as a protruding portion the tapered portion 41a which is continuous in the circumferential direction, electric discharge from the contact roller 18 to the antistatic member 41 can be distributed in the circumferential direction. As a result, the electric discharge is not concentrated in the specific parts, and the life of the antistatic member 41 can be prolonged.

[0097] In the present embodiment, the tapered portion 41a is formed across the whole outer circumference of the antistatic member 41. With this arrangement, electric discharge from the contact roller 18 to the antistatic member 41 can be distributed more effectively. As a result, the life of the antistatic member 41 can be prolonged.

[0098] In the present embodiment, the antistatic member 41 is disposed at the end face of the supporting member 22 in the insertion direction (i.e., at the front end surface of the supporting member 22). By providing the antistatic member 41 not at the outer circumferential surface but at the front end surface of the supporting member 22, even if the space between the inner circumferential surface of the contact roller 18 and the outer circumferential surface of the supporting member 22 is narrow, the antistatic member 41 can be easily provided at the supporting member 22.

[0099] In the present embodiment, the antistatic member 41 includes the small diameter portion 41b whose outer diameter is smaller than the front end surface of the supporting member 22, and which is disposed between the tapered portion 41a and the front end surface of the supporting member 22 in the axial direction. In this way, by providing the small diameter portion 41b between the tapered portion 41a and the supporting member 22, the small diameter portion 41b forms a valley, with the result that protruding portion of the tapered portion 41a is emphasized. As a result, electric discharge from the contact roller 18 to the tapered portion 41a is promoted, and the static electricity removing capability is improved.

(Third Embodiment of Antistatic Member)

[0100] The following will describe the third embodiment of the antistatic member. It should be noted that the components having the same structures as those in the above-described embodiments are given the same reference numerals, and the arrangements and effects identical with those in the above-described embodiments are not repeated here.

[0101] FIG. 9 is a cross section showing in what manner an antistatic member 51 of the Third Embodiment is attached. The antistatic member 51 is a static electricity removing string in which plural conductive fibers are exposed at the surface. The static electricity removing string 51 is provided across the whole circumferential direction of the supporting member 22. A part of the static electricity removing string 51 protrudes radially outward from the outer circumferential surface of a later-described attachment member 52 (large diameter portion 52a) and the outer circumferential surface of the front end portion of the supporting member 22.

[0102] In the present embodiment, with the attachment member 52, the static electricity removing string 51 can

be attached to the front end surface of the supporting member 22. The attachment member 52 is an annular member made of metal, and includes a cylindrical large diameter portion 52a formed on one side in the axial direction and a small diameter portion 52b formed on the other side. The outer diameter of the small diameter portion 52b is smaller than the outer diameter of the large diameter portion 52a and the front end surface of the supporting member 22. In the attachment member 52, bolt holes 52c are formed in the circumferential direction.

[0103] The attachment member 52 is attached to the front end surface of the supporting member 22, while the static electricity removing string 51 is threaded onto the outer circumferential surface of the small diameter portion 52b. To be more specific, the attachment member 52 is attached to the front end surface of the supporting member 22 by bolts 53 so that the large diameter portion 52a faces to the front and the small diameter portion 52b is brought into contact with the front end surface of the supporting member 22. In other words, the static electricity removing string 51 is attached while the same is sandwiched between the large diameter portion 52a and the front end surface of the supporting member 22.

[0104] In the present embodiment, the antistatic member 51 is a static electricity removing string in which plural conductive fibers are exposed at the surface. By using a static electricity removing string as the antistatic member 51, electric discharge from the contact roller 18 to the antistatic member 51 occurs at many parts where the conductive fibers are exposed. As a result, the electric discharge is not concentrated in the specific parts, and the life of the antistatic member 51 can be prolonged. Furthermore, with a static electricity removing string, even if the string makes contact with the contact roller 18, the damage of the contact roller 18 is restrained.

[0105] In the present embodiment, the static electricity removing string 51 is provided across the whole circumferential direction of the supporting member 22. With this arrangement, electric discharge from the contact roller 18 to the static electricity removing string 51 occurs on the whole circumference. As a result, the static electricity removing capability is improved.

[0106] However, providing the static electricity removing string 51 across the whole circumferential direction of the supporting member 22 is not essential, and the string may be provided only at a part of the supporting member 22. By using the static electricity removing string 51 as an "static electricity remover" of the present invention, electric discharge from the contact roller 18 to the static electricity remover occurs at many parts where the conductive fibers are exposed. Therefore, sufficient static electricity removing capability can be obtained even when the static electricity remover is provided only at least part of the supporting member 22 in the circumferential direction. Furthermore, by providing the static electricity removing string 51 at only a part in the circumferential direction, the required length of the static electricity removing string 51 can be shortened, leading to cost reduction.

[0107] In the present embodiment, the annular attachment member 52 for attaching the static electricity removing string 51 is further provided. The attachment member 52 is an annular member, when viewed in the axial direction of the contact roller 18, and is attached to the end face of the supporting member 22 on the insertion side (front end surface of the supporting member 22). The attachment member 52 includes the large diameter portion 52a and the small diameter portion 52b which is disposed between the large diameter portion 52a and the front end surface of the supporting member 22 in the axial direction, and whose outer diameter is smaller than the diameters of the large diameter portion 52a and the front end surface of the supporting member 22. The static electricity removing string 51 is attached to the outer circumferential surface of the small diameter portion 52b. According to these arrangements, even when there is no space on the outer circumferential surface of the supporting member 22 to attach the static electricity removing string 51, the static electricity removing string 51 can be attached to the supporting member 22. Furthermore, because the static electricity removing string 51 is sandwiched between the large diameter portion 52a and the front end surface of the supporting member 22, the static electricity removing string 51 does not drop off.

(Other Modifications)

[0108] The following will describe modifications of each of the above-described embodiments.

(1) In each of the above-described embodiments, the static electricity removers of the present invention are the antistatic members 31, 35, 36, 41, and 51 which are members independent from the supporting member 22. However, the static electricity remover may be integrated with the supporting member 22. For example, a static electricity remover 61 shown in FIG. 10 is integrated with the front end portion of the supporting member 22. As shown in FIG. 11, in the static electricity remover 61, triangular portions 62, which protrude radially outward and are in triangular shape, are formed as a protruding portion across the whole circumferential direction of the supporting member 22. Note that providing the triangular portions 62 across the whole circumferential direction is not essential, and the triangular portions 62 may be provided only at a part in the circumferential direction.

[0109] A static electricity remover 71 shown in FIG. 12 is integrated with the front end portion of the supporting member 22. In the static electricity remover 71, in a cross section orthogonal to the circumferential direction, a tapered portion 72, which protrudes radially outward and is in triangular shape, is formed as a protruding portion across the whole circumferential direction of the support-

ing member 22. Note that providing the tapered portion 72 on the whole circumferential direction is not essential, and the tapered portion 72 may be provided only at a part in the circumferential direction.

[0110] In this way, by integrating the static electricity removers 61 and 71 with the supporting member 22, there is no need to assemble the static electricity removers 61 and 71 with the supporting member 22. Therefore, the distance between the contact roller 18 and the static electricity remover 61, 71 is unchanged irrespective of the assembling accuracy of the static electricity removers 61 and 71. As a result, desired static electricity removing capability can be achieved.

(2) In each of the above-described embodiments, as a protruding portion of the present invention, the triangular portions 31a, 35a, and 36a and the tapered portion 41a are formed. However, the shape of the protruding portion is not limited to triangular shape or tapered shape, and may be, e.g., needle shape.

(3) In each of the above-described embodiments, as a protruding portion of the present invention, the triangular portions 31a, 35a, and 36a and the tapered portion 41a protrude radially outward. However, the direction where the protruding portions protrude is not limited to the outward in the radial direction. For example, an antistatic member 81 in FIG. 13 includes a protruding portion 82 which protrudes inward in the axial direction, and is attached to the front end surface of the supporting member 22. The protruding portion 82 is tapered in cross section and protrudes inward in the axial direction, and is in triangular shape. The protruding portion 82 is formed across the whole circumferential direction. Note that the shape of the protruding portion 82 is not limited to this, the shape may be in crown shape in which plural triangular portions are formed at the leading end in the axial direction, or may be in needle shape. Furthermore, the protruding portions, which protrude inward in the axial direction, may be integrated with the supporting member 22.

[0111] The contact roller 18 vibrates in such a way as to displace from the shaft center. Therefore, by arranging the protruding portion 82 to protrude in the axial direction, it is easier to avoid contact between the contact roller 18 and the protruding portion 82 due to the vibration of the contact roller 18, than when the protruding portion protrudes in the radial direction. Furthermore, by arranging the protruding portion 82 to protrude axially inward from the front end surface of the supporting member 22, the protruding portion 82 is hidden by the supporting member 22, with the result that the electric discharge can be hardly seen from the outside.

(4) In each of the above-described embodiments, the antistatic members 31, 35, 36, 41, and 51 are attached to the front end surface of the supporting member 22. However, the antistatic members 31, 35, 36, 41, and 51 may be attached to the outer circumferential surface of the supporting member 22. Alternatively, if there is a suitable member other than the supporting member 22, the antistatic members 31, 35, 36, 41, and 51 may be attached to that member.

(5) In each of the above-described embodiments, the antistatic members 31, 35, 36, 41, and 51 are attached to the supporting member 22 by the bolts 32, 42, and 53. However, the way of attaching the antistatic members 31, 35, 36, 41, and 51 is not limited to this, and, for example, the members may be attached to the supporting member 22 by a conductive adhesive.

(6) In each of the above-described embodiments, the present invention is applied to the yarn winding apparatus 10 of the spun yarn take-up apparatus 1. Alternatively, the present invention may be applied to a yarn winding apparatus provided in a textile machine which is different from the spun yarn take-up apparatus.

(7) In each of the above-described embodiments, the rotating body of the present invention is the contact roller 18 which rotates with the package P while applying a contact pressure to the package P. In this regard, the rotating body of the present invention may not be rotationally driven with the rotation of the package P as shown in the above-described embodiments, in an indirect manner. The rotating body may be, for example, a winding drum which is directly rotated by a motor as disclosed in Japanese Unexamined Patent Publication No. 2014-15334.

Claims

1. A yarn winding apparatus (10) forming at least one package (P) by winding at least one yarn (Y) onto at least one bobbin (B), comprising:

   a cylindrical rotating body (18) configured to rotate while being in contact with an outer circumferential surface of the at least one package (P); and

   a static electricity remover (31, 35, 36, 41, 51, 61, 71, 81) configured to remove static electricity from the rotating body (18), which is provided inside the rotating body (18) without making contact with the rotating body (18) .

2. The yarn winding apparatus (10) according to claim 1 further comprising: a supporting member (22) which supports the rotating body (18) to be rotatable via a bearing (21), and which is partially inserted to the inside of the rotating body (18),

   the static electricity remover (31, 35, 36, 41, 51, 61, 71, 81) being provided at a part of the supporting

member (22) where the supporting member (22) is inserted inside the rotating body (18).

3. The yarn winding apparatus (10) according to claim 2, wherein, the static electricity remover (31, 35, 36, 41, 51, 81) is independent from the supporting member (22) .

4. The yarn winding apparatus (10) according to claim 2, wherein, the static electricity remover(61, 71) is integrated with the supporting member (22).

5. The yarn winding apparatus (10) according to any one of claims 2 to 4, wherein, the static electricity remover (31, 35, 36, 41) includes a protruding portion (31a, 35a, 36a, 41a) which protrudes radially outward from an outer circumferential surface of the part of the supporting member (22) where the supporting member (22) is inserted inside the rotating body (18).

6. The yarn winding apparatus (10) according to claim 5, wherein, the static electricity remover (31) has an annular shape, when viewed in an axial direction of the rotating body (18), and
on an outer circumference of the static electricity remover (31), at least one triangular portion (31a), which protrudes radially outward when viewed in the axial direction and has a triangular shape, is formed as the protruding portion.

7. The yarn winding apparatus (10) according to claim 5, wherein, the static electricity remover is circular-arc-shaped, when viewed in the axial direction of the rotating body (18), and
on the outer circumference of the static electricity remover (35, 36), at least one triangular portion (35a, 36a), which protrudes radially outward when viewed in the axial direction and has a triangular shape, is formed as the protruding portion.

8. The yarn winding apparatus (10) according to claim 5, wherein, the static electricity remover (41) has an annular shape, when viewed in the axial direction of the rotating body (18), and
on at least part of the outer circumference of the static electricity remover (41), a tapered portion (41a) is formed as the protruding portion so as to protrude radially outward to have a triangular shape, in a cross section orthogonal to a circumferential direction.

9. The yarn winding apparatus (10) according to claim 8, wherein, the tapered portion (41a) is formed across the whole outer circumference of the static electricity remover (41).

10. The yarn winding apparatus (10) according to any one of claims 6 to 9, wherein, the static electricity remover (41) is provided at an end face of the supporting member (22) on an insertion side.

11. The yarn winding apparatus (10) according to any one of claims 2 to 4, wherein, the static electricity remover (81) includes a protruding portion (82) which protrudes axially inward from an end face of the supporting member (22) on an insertion side.

12. The yarn winding apparatus (10) according to claim 3, wherein, the static electricity remover (51) is a static electricity removing string in which plural conductive fibers are exposed at the surface.

13. The yarn winding apparatus (10) according to claim 12, wherein, the static electricity removing string (51) is provided at least at part of the supporting member (22) in the circumferential direction.

14. The yarn winding apparatus (10) according to claims 12 or 13 further comprising an attaching member (52) to attach the static electricity removing string (51),
the attaching member (52) being an annular member, when viewed in the axial direction of the rotating body (18), and being attached to an end face of the supporting member (22) on an insertion side,
the attaching member (52) including: a large diameter portion (52a); and
a small diameter portion (52b) which is disposed between the large diameter portion (52a) and the end face of the supporting member (22) in the axial direction, and whose outer diameter is smaller than the diameters of the large diameter portion (52a) and the end face,
the static electricity removing string (51) being attached to the outer circumferential surface of the small diameter portion (52b).

15. The yarn winding apparatus (10) according to any one of claims 2 to 14 further comprising an attaching portion (11a) in which an insertion hole (11b) into which the supporting member (22) is inserted is formed,
the supporting member (22) including a flange portion (22b) whose diameter is larger than the diameter of the insertion hole (11b), and the flange portion (22b) being fixed to the attaching portion (11a) so as to be positioned on the opposite side of the rotating body (18) across the attaching portion (11a), while the supporting member (22) is inserted into the insertion hole (11b).

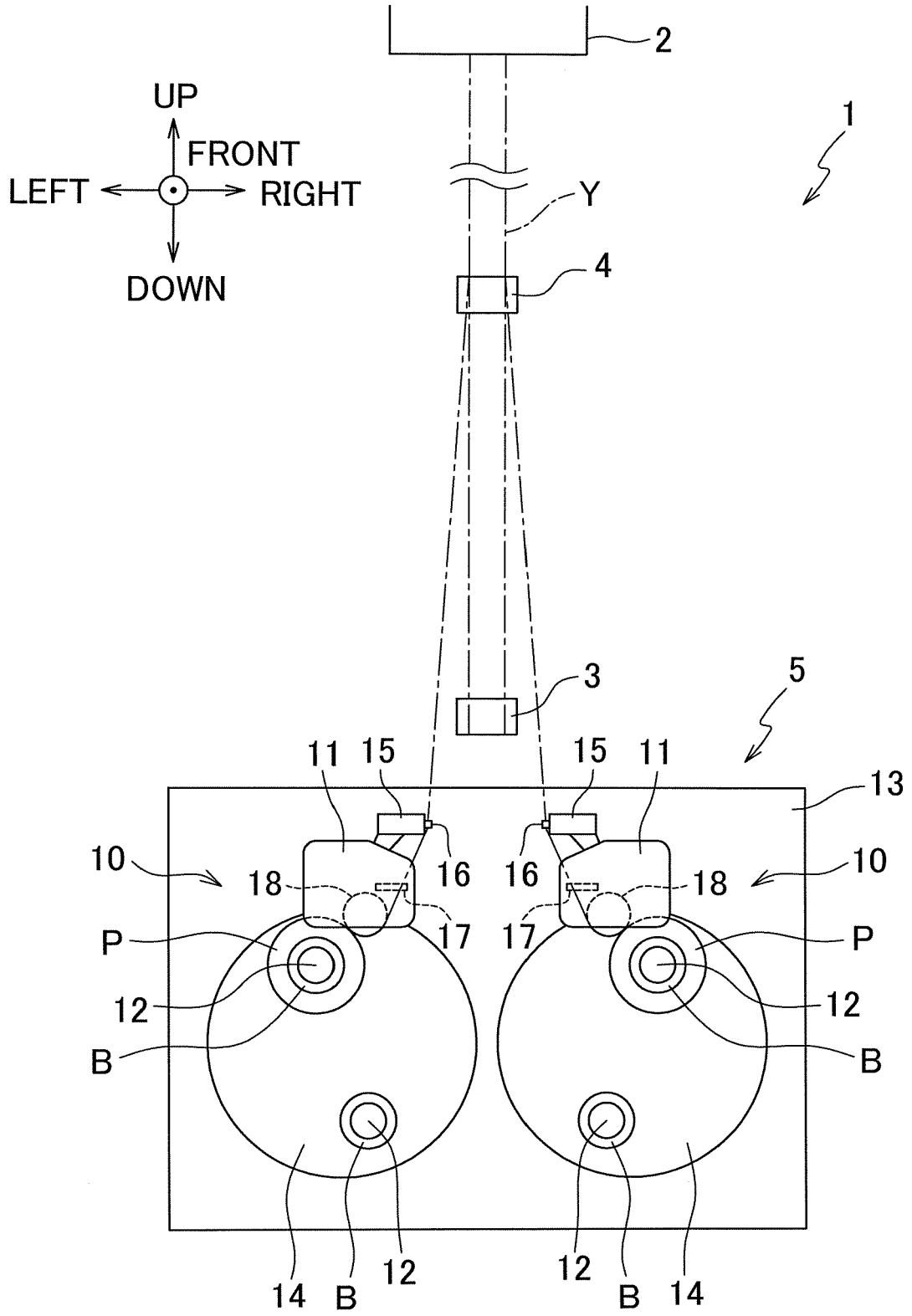
16. The yarn winding apparatus (10) according to any one of claims 1 to 15 further comprising a conductive member (19) which is disposed in the vicinity of the outer circumferential surface of the rotating body (18),
the distance between the static electricity remover

(31, 35, 36) and the inner circumferential surface of the rotating body (18) being smaller than the distance between the conductive member (19) and the outer circumferential surface of the rotating body (18).

17. The yarn winding apparatus (10) according to any one of claims 1 to 16, wherein, a plurality of the at least one bobbin (B) are attached to a bobbin holder (12) supporting the bobbins (B), along the axial direction,
the rotating body (18) making contact with a plurality of the at least one package (P) which are formed by winding the at least one yarn (Y) onto the bobbins (B).

18. The yarn winding apparatus (10) according to any one of claims 1 to 17, wherein, the rotating body (18) is a contact roller which rotates with the at least one package (P) while applying a contact pressure to the at least one package (P).

FIG.1


UP
FRONT
LEFT
RIGHT
DOWN
2
1
Y
4
3
5
11
15
15
11
13
10
18
16
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17
17
P
P
12
12
B
B
14
B
12
12
B
14

FIG.2

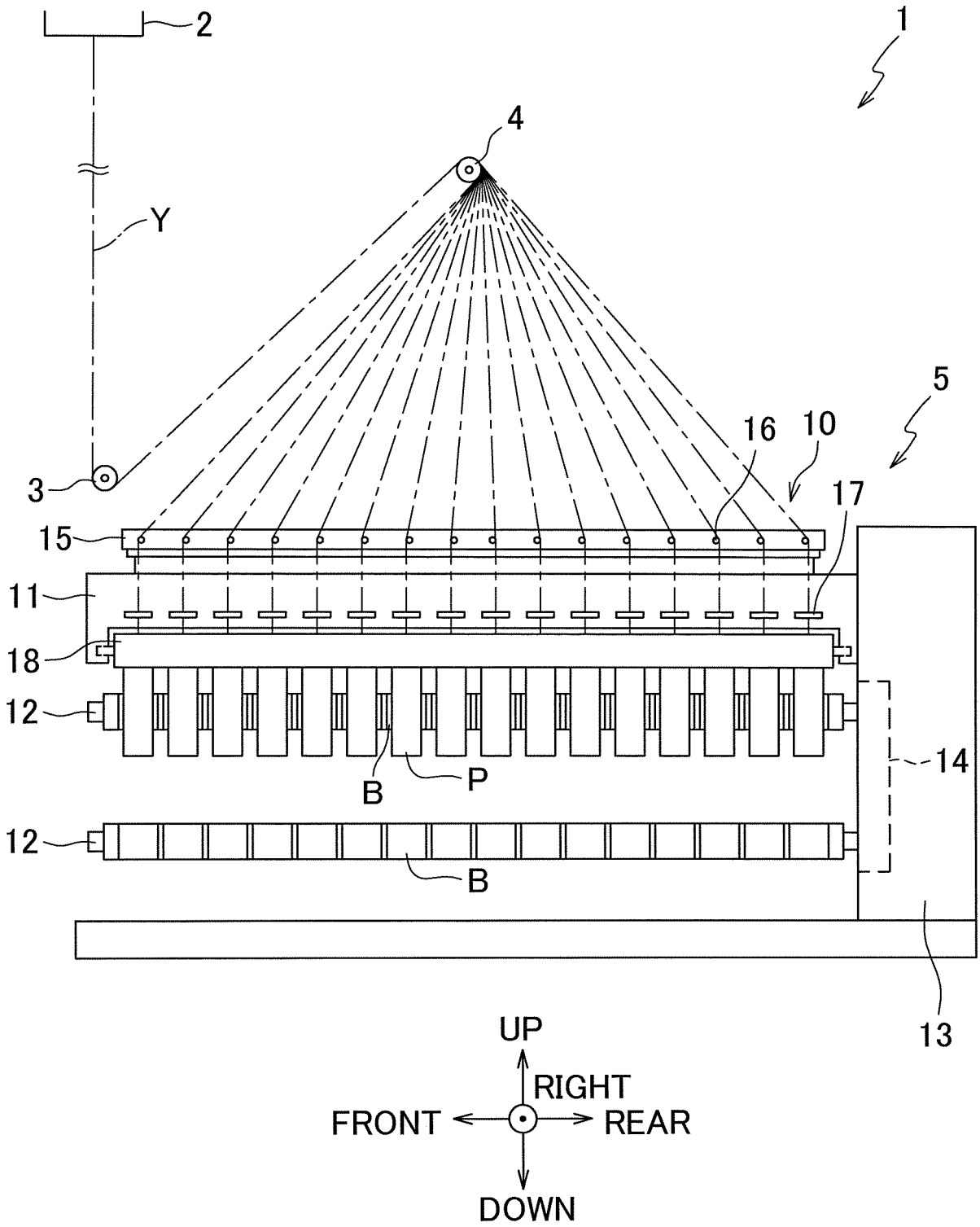


FIG.3

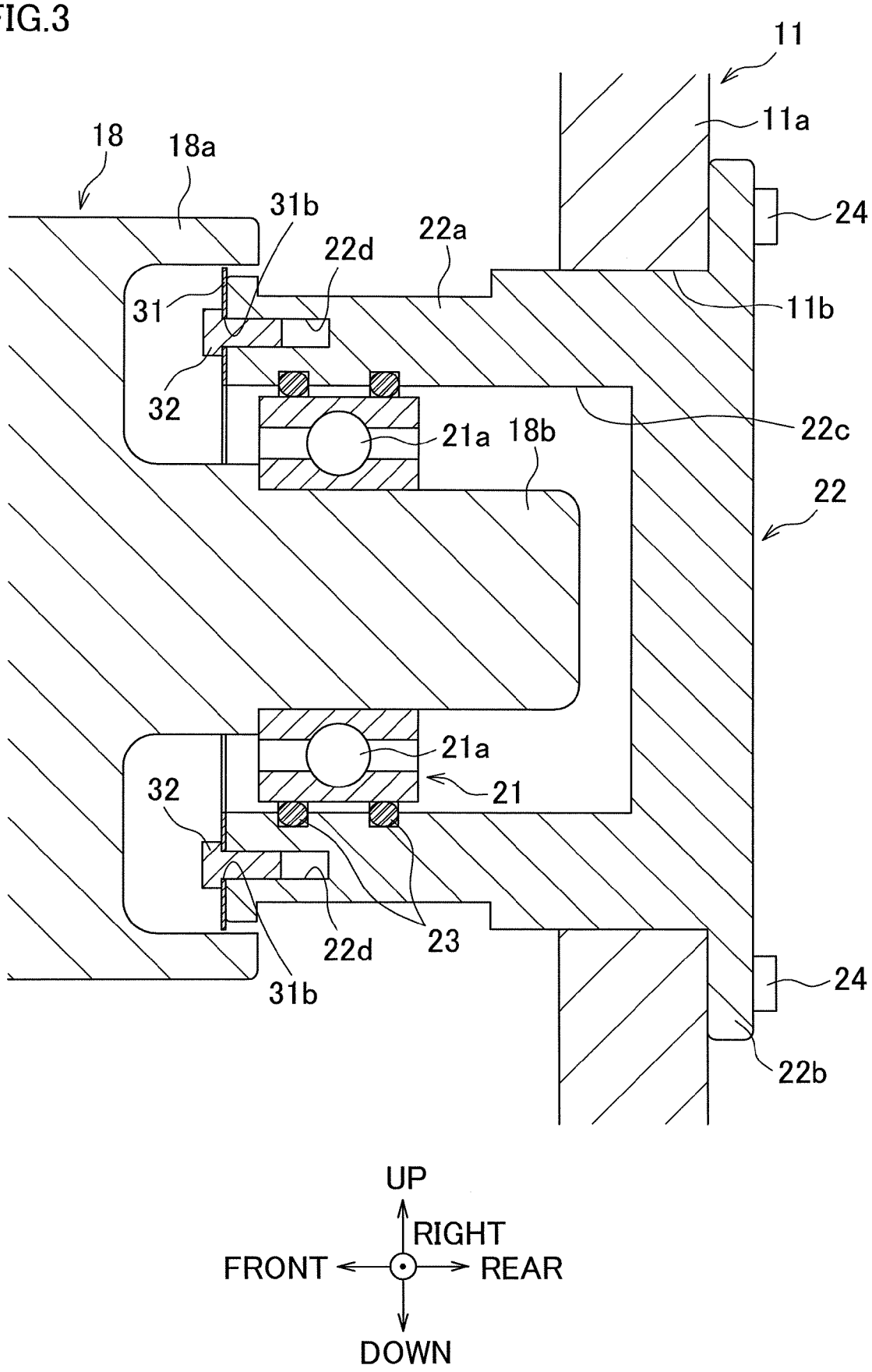
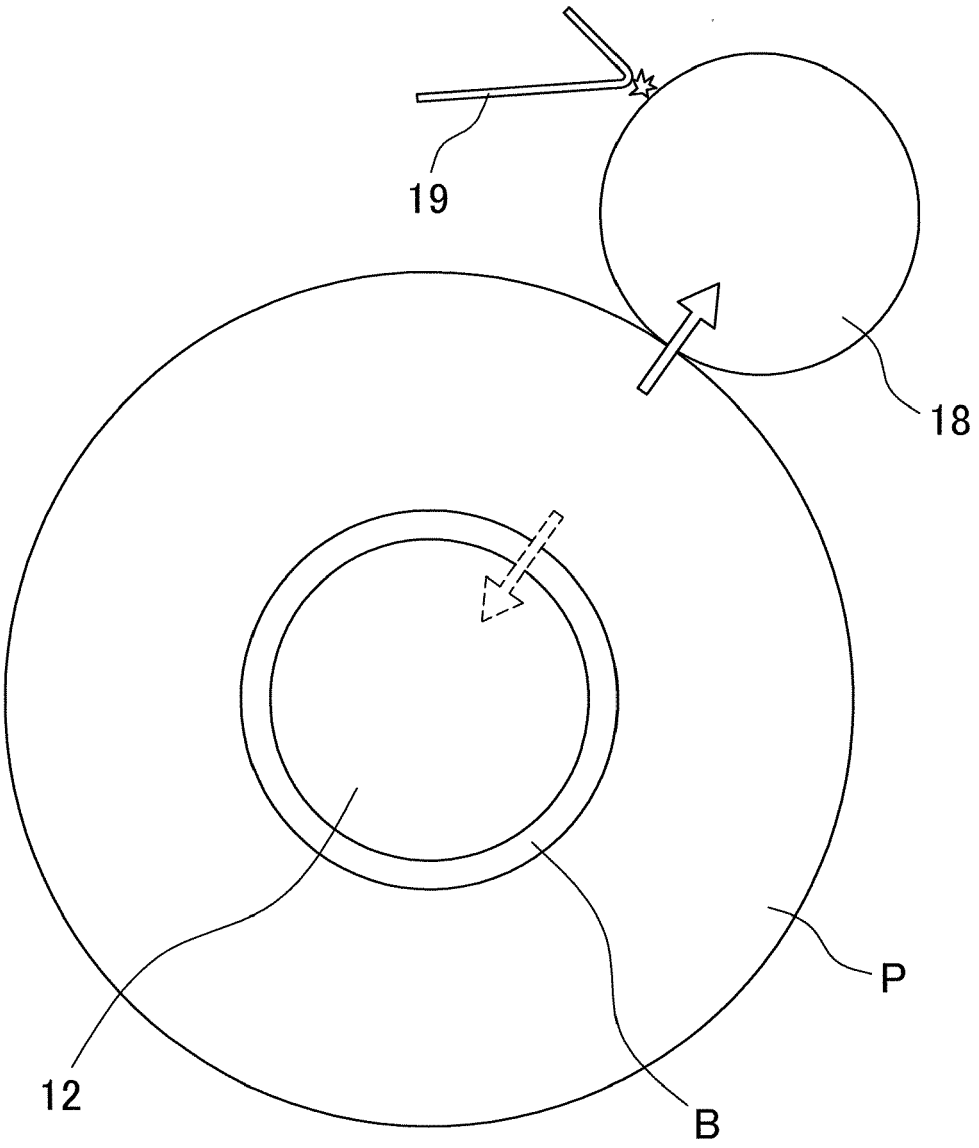

11
11a
18
18a
31b
22a
24
22d
31
11b
32
21a
18b
22c
22
21a
21
32
22d
23
31b
24
22b
UP
RIGHT
FRONT
REAR
DOWN

FIG.4



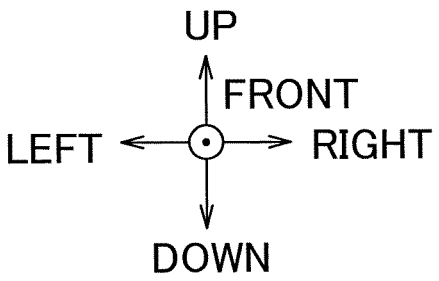


FIG.5

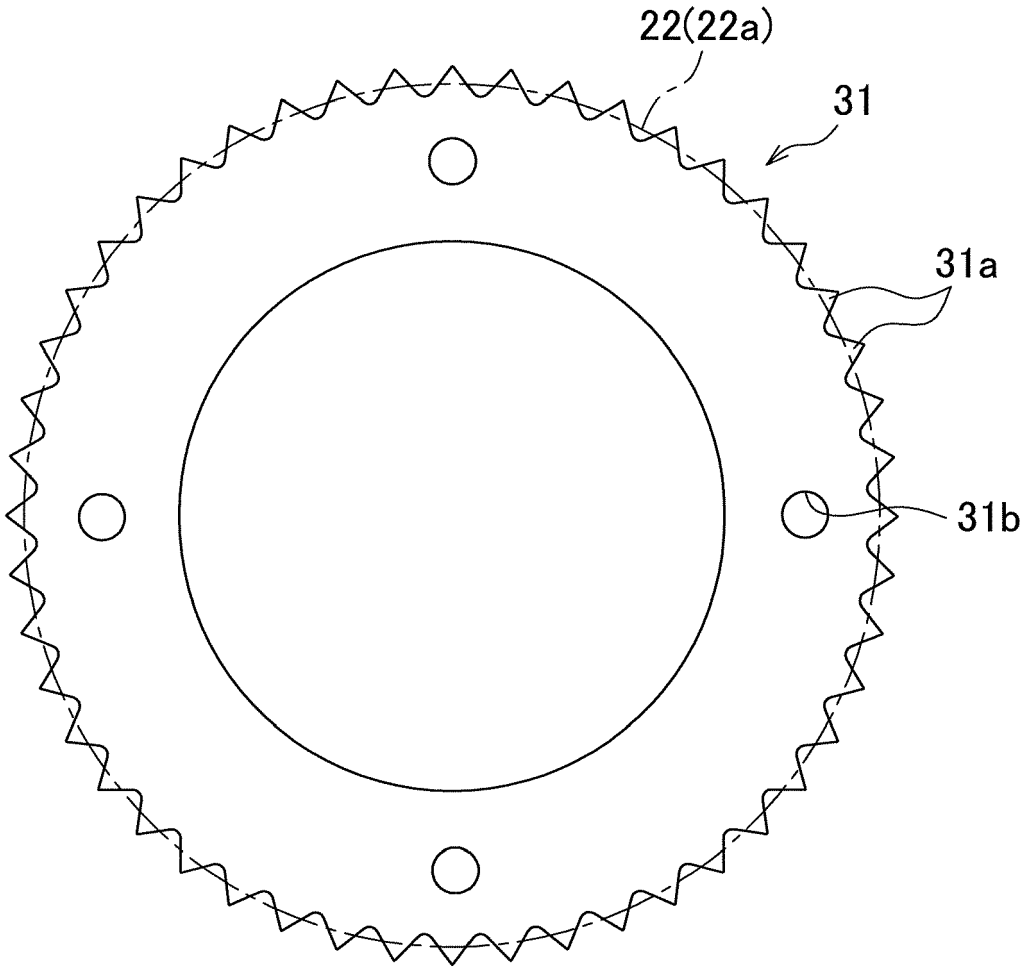
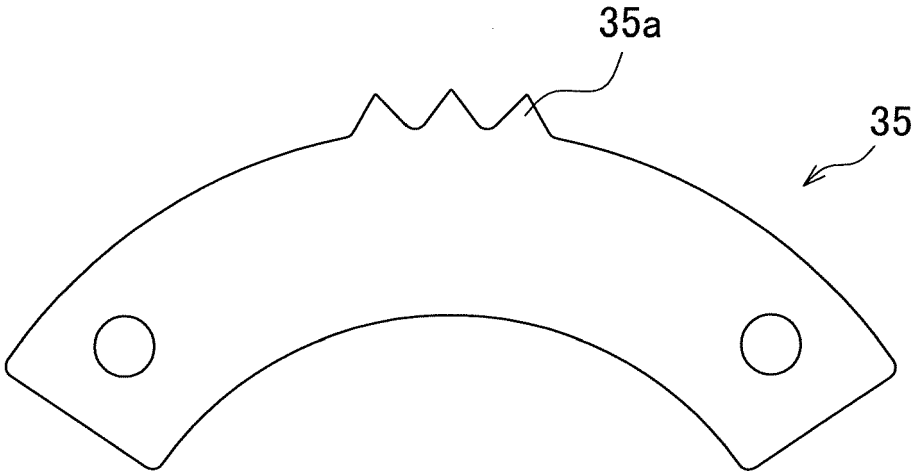


FIG.6

(a)



(b)

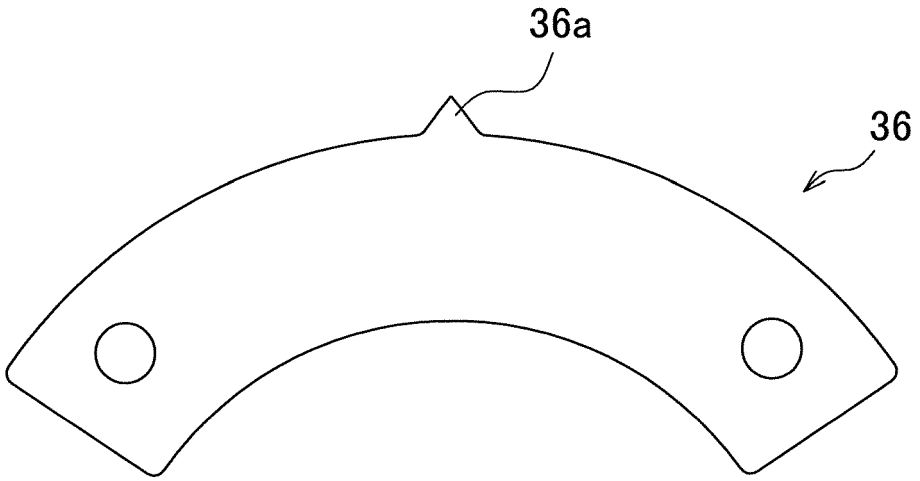
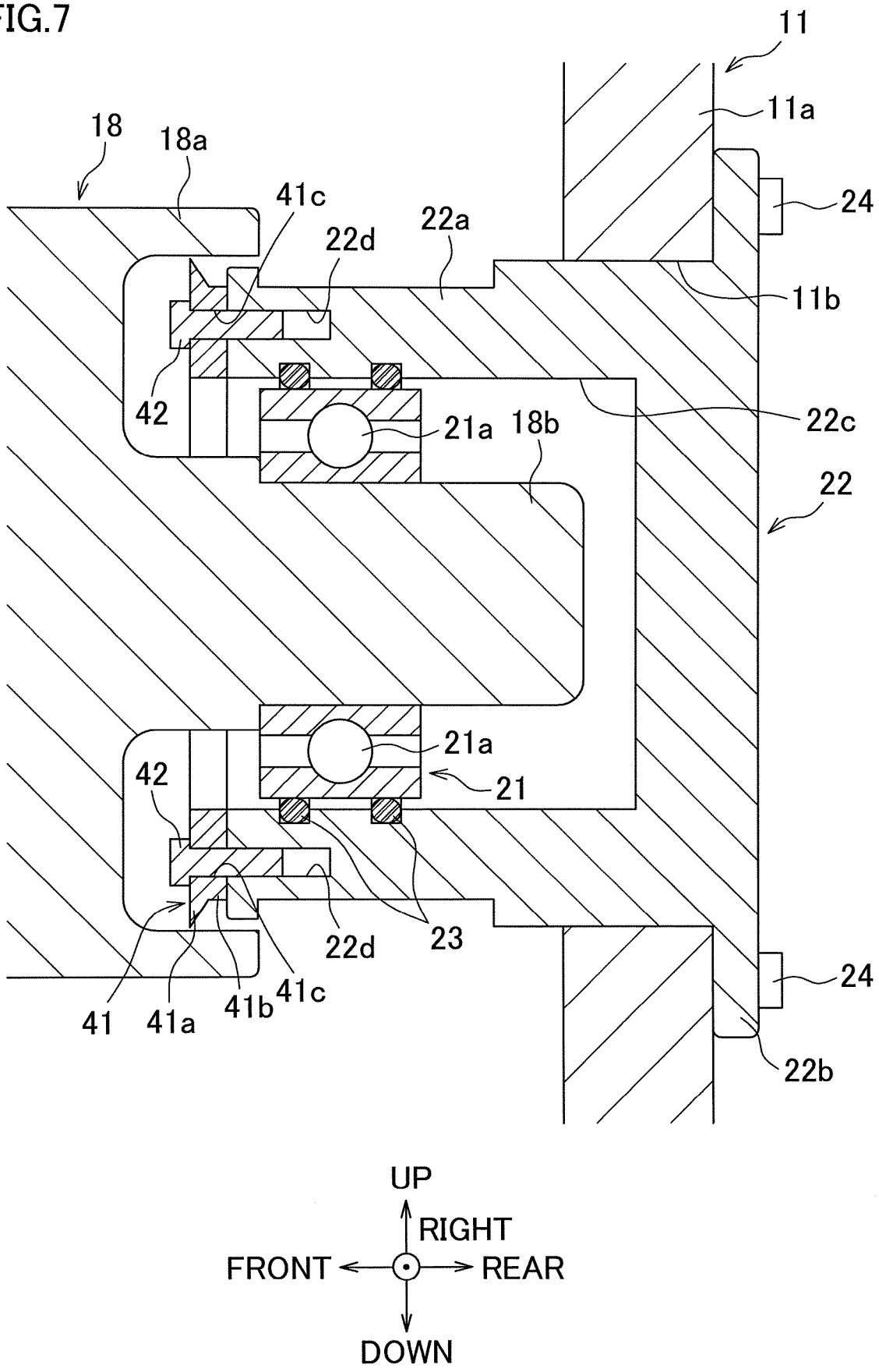


FIG.7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11a
18
18a
41c
22d
22a
24
11b
42
21a
18b
22c
22
21a
42
21
23
22d
41
41a
41b
41c
24
22b
UP
RIGHT
FRONT
REAR
DOWN

FIG.8

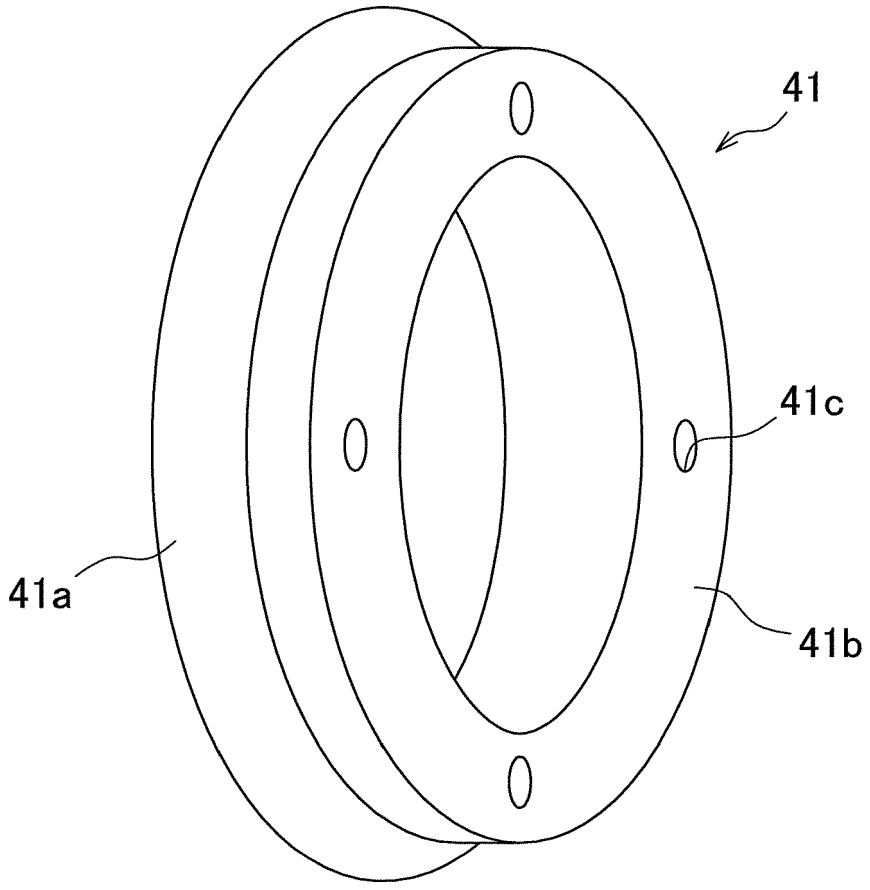
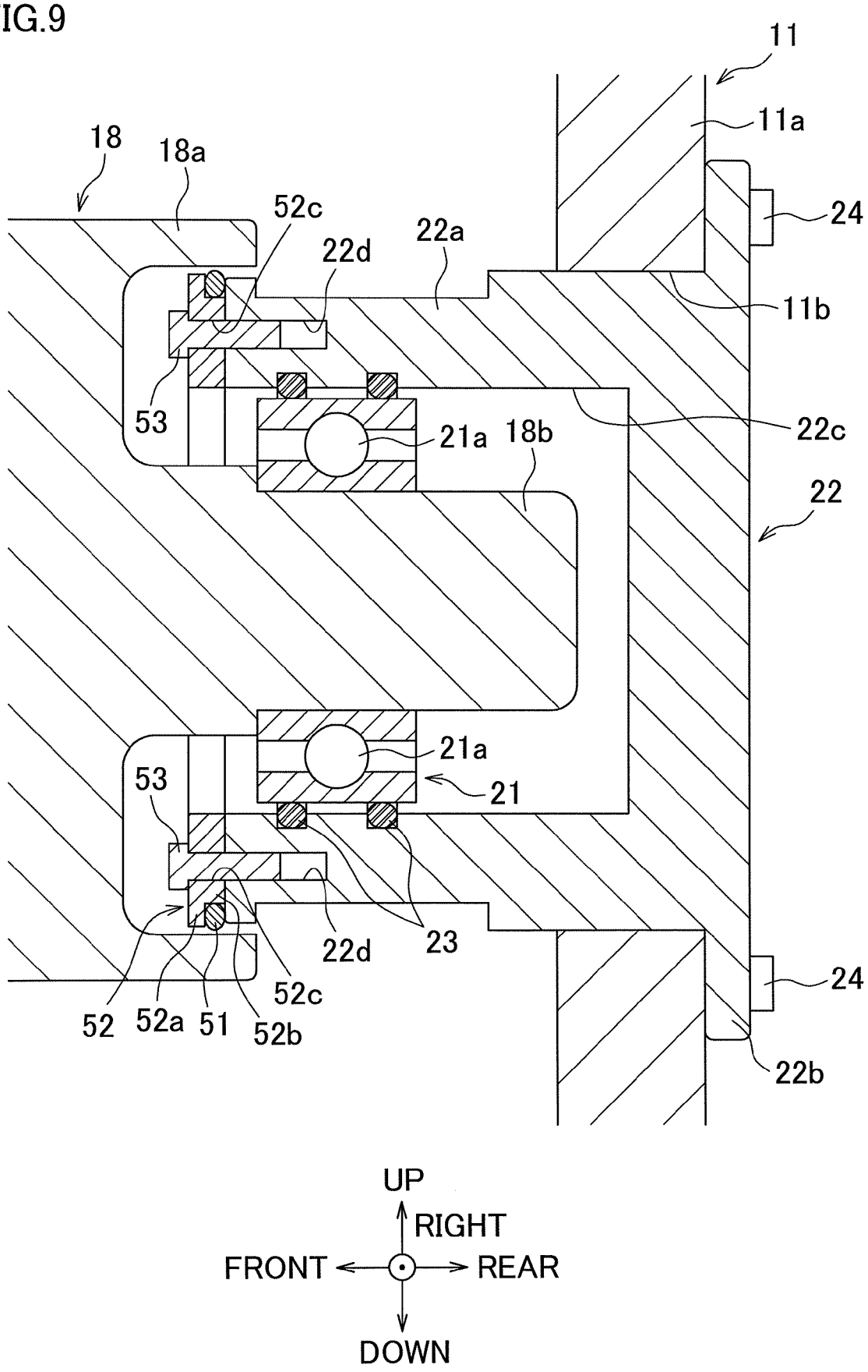


FIG.9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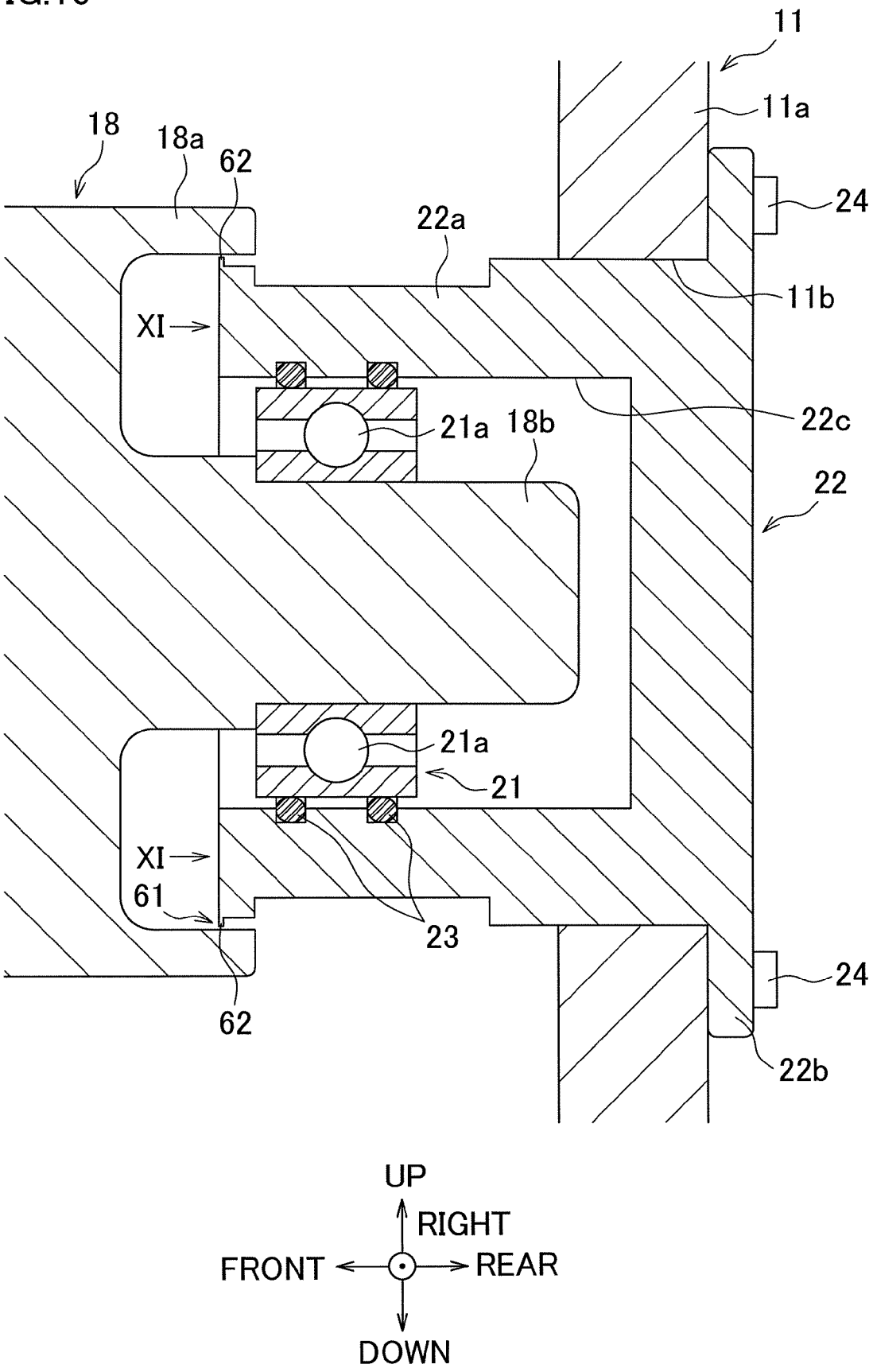
18a
24
52c
22d
22a
11b
53
21a
18b
22c
22
21a
21
53
23
22d
24
52
52a
51
52b
52c
22b
UP
RIGHT
FRONT
REAR
DOWN

FIG.10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11a
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18a
62
24
22a
11b
XI
21a
18b
22c
22
21a
21
XI
61
23
24
62
22b
UP
RIGHT
FRONT
REAR
DOWN

FIG.11

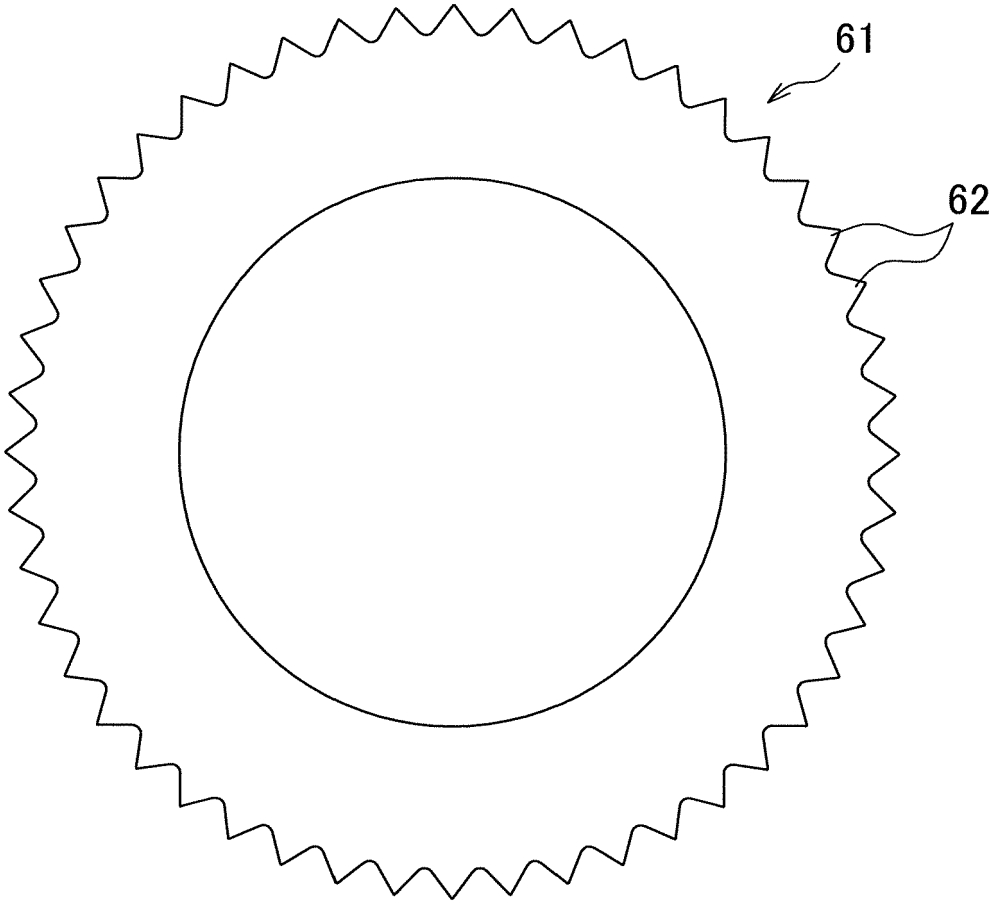
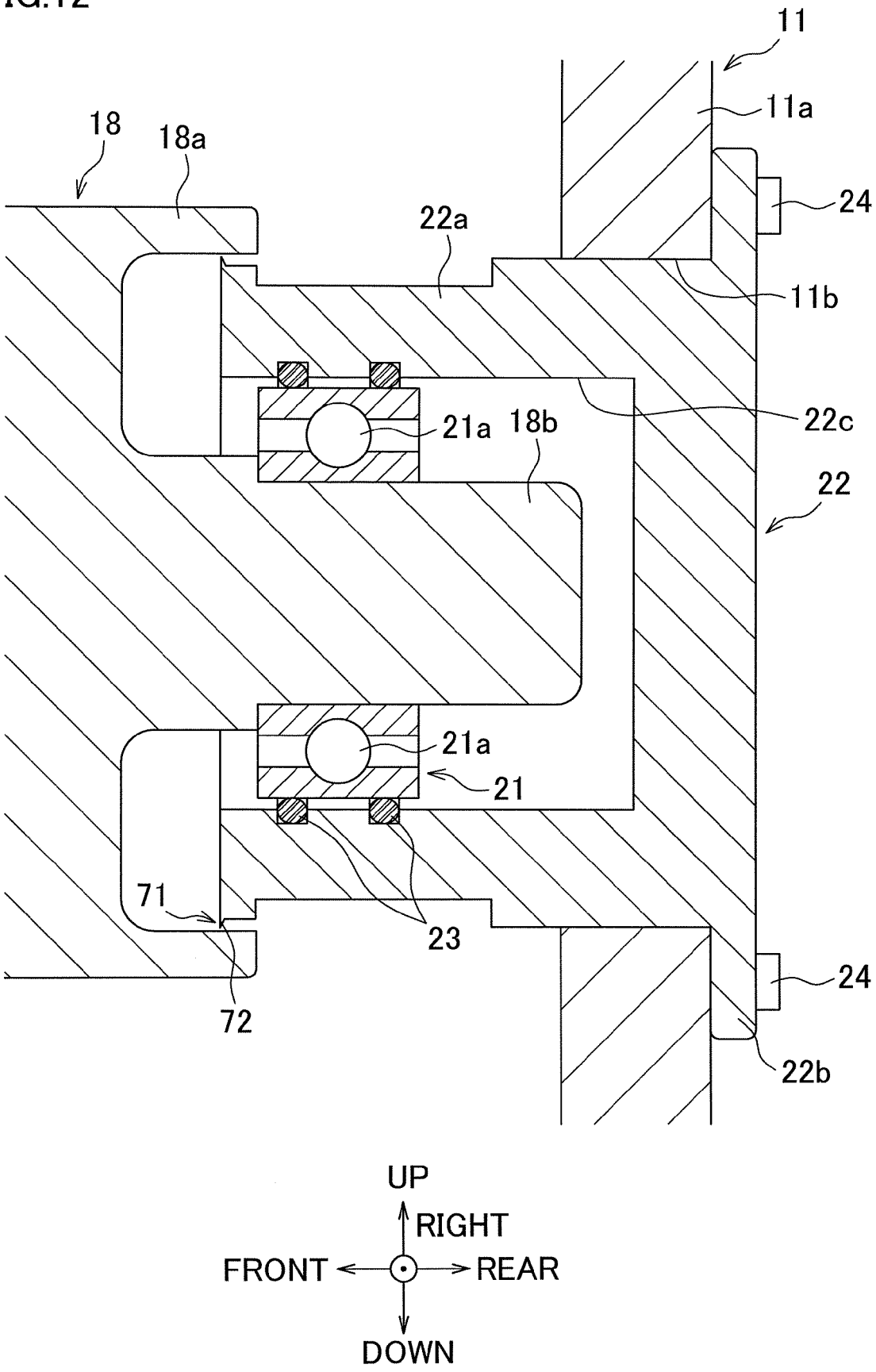


FIG.12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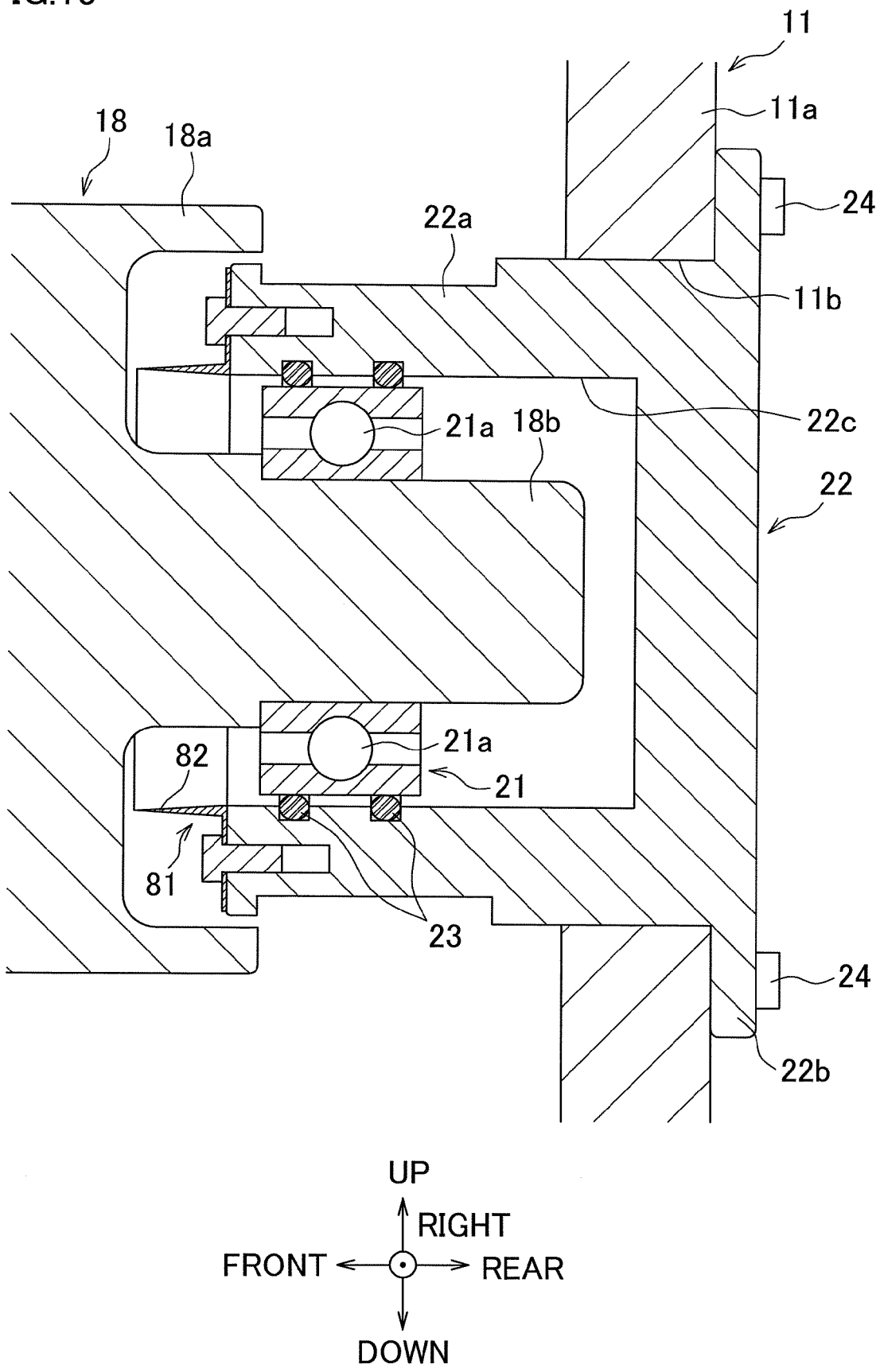
18
18a
24
22a
11b
22c
21a
18b
22
21a
21
71
23
72
24
22b
UP
RIGHT
FRONT
REAR
DOWN

FIG.13


11
11a
18
18a
24
22a
11b
22c
21a
18b
22
21a
82
21
81
23
24
22b
UP
RIGHT
FRONT
REAR
DOWN

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EUROPEAN SEARCH REPORT

Application Number
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A	DE 10 2012 104249 A1 (FREUDENBERG CARL KG [DE]; OERLIKON TEXTILE GMBH & CO KG [DE]) 21 November 2013 (2013-11-21) * paragraphs [0024], [0030]; claim 10; figures *	1-18	INV. B65H54/46 B65H54/72 B65H67/048
A	US 3 806 053 A (KINARIWALA N) 23 April 1974 (1974-04-23) * column 2, lines 22-26 * * column 4, line 44 - column 5, line 18; figures *	1-18	
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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	10 May 2019	Lemmen, René

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