

(19)



(11)

EP 3 098 336 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.11.2016 Bulletin 2016/48

(51) Int Cl.:
D01D 10/02 ^(2006.01) **D02J 13/00** ^(2006.01)
D02J 1/22 ^(2006.01) **D01D 5/16** ^(2006.01)

(21) Application number: **16171018.1**

(22) Date of filing: **24.05.2016**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(72) Inventors:
• **Sugiyama, Kenji**
Kyoto, 612-8686 (JP)
• **Hashimoto, Kinzo**
Kyoto, 612-8686 (JP)

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

(30) Priority: **25.05.2015 JP 2015105343**

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

(54) **YARN HEATER**

(57) The acceleration by a roller of an accompanied flow running from a yarn inlet to a yarn outlet of a thermal insulation box along the running direction of a yarn is restrained, and heat energy loss due to the discharge of hot air through the yarn outlet is restrained as much as possible. A heating-drawing unit 7 includes a thermal insulation box 16 having a yarn inlet 16a and a yarn outlet 16b and five godet rollers 11a to 11e which are yarn heat-

ing rollers. A yarn Y introduced into the thermal insulation box 16 through the yarn inlet 16a is wound onto each of the five godet rollers 11a to 11e at a winding angle of less than 270 degrees. For each of the five godet rollers 11a to 11e, a flow blocking plate 30 is provided to extend from the outside of the roller 11 toward a yarn separation position P1 on the outer circumference of the roller 11.

EP 3 098 336 A1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn heater configured to heat yarns.

[0002] Patent Literature 1 (Japanese Unexamined Patent Publication No. 2014-173212) recites an apparatus for drawing and thermally treating yarns spun out from a spinning apparatus. This apparatus includes five godet rollers each of which is a yarn heating roller and a thermal insulation box housing the five godet rollers.

[0003] In the thermal insulation box, a slit (yarn inlet) through which the yarns from the spinning apparatus are introduced into the thermal insulation box and a slit (yarn outlet) through which the yarns having been drawn and thermally treated in the thermal insulation box are taken out are formed. The yarns introduced into the thermal insulation box through the yarn inlet are wound onto each of the five godet rollers in the thermal insulation box at a winding angle of less than 270 degrees (so-called partial winding). The yarns introduced through the yarn inlet are serially fed by the five godet rollers, and are taken out through the yarn outlet after going through a process below.

[0004] Among the five godet rollers, two rollers on the downstream (yarn outlet side) in the yarn running direction are higher in heating temperature than three rollers on the upstream (yarn inlet side). Furthermore, the two rollers on the downstream are higher in yarn feeding speed than the three rollers on the upstream. The yarns introduced into the thermal insulation box through the yarn inlet are, to begin with, preliminarily heated to a predetermined glass transition temperature by the three rollers on the upstream. Subsequently, the preliminarily-heated yarns are drawn by the yarn feeding speed difference between the upstream roller and the downstream roller. The yarns after drawn are heated to a higher temperature by the two downstream rollers and the drawn state is thermally set, and then the yarns are taken out through the yarn outlet.

SUMMARY OF THE INVENTION

[0005] In the apparatus recited in Patent Literature 1, the yarns introduced into the thermal insulation box through the yarn inlet are heated by the five godet rollers and taken out from the thermal insulation box through the yarn outlet. In this regard, in the vicinity of the outer circumference of each roller, an accompanied flow is generated as the air around the roller flows in the circumferential direction in accordance with the rotation of the roller. Furthermore, an accompanied flow generated by a roller flows to a neighboring roller along the running yarns, and the speed of the accompanied flow is accelerated by the rotation of the neighboring roller. For this reason, as the yarns are fed serially by the five rollers, the speed of the flow accompanied with the yarns in-

creases toward the yarn outlet (see FIG. 3 which is explained in an embodiment). As a result, a lot of hot air is discharged from the yarn outlet, and hence the loss of heat energy is significant.

[0006] An object of the present invention is to restrain an accompanied flow, which runs along the running direction of yarns from a yarn inlet to a yarn outlet of a thermal insulation box, from being accelerated by rollers, and to minimize heat energy loss due to the discharge of hot air through the yarn outlet.

[0007] According to the first aspect of the invention, a yarn heater includes: a thermal insulation box provided with a yarn inlet through which a yarn is introduced and a yarn outlet through which the yarn is taken out; and rollers which are housed in the thermal insulation box, include a yarn heating roller configured to heat the yarn, and are configured to feed the yarn from the yarn inlet to the yarn outlet, the yarn introduced into the thermal insulation box through the yarn inlet being wound onto each of the rollers at a winding angle of less than 270 degrees, the yarn heater further comprising a first flow blocker which is provided for at least one of the rollers and extends from the outside of the at least one of the rollers toward a part of a wound region of the outer circumference of the at least one of the rollers, the wound region being a region where the yarn is wound and the part being a downstream part in a yarn running direction.

[0008] In the present invention, the yarn is wound onto each of the rollers housed in the thermal insulation box at a winding angle of less than 270 degrees, and the yarn is serially fed by the rollers. According to this arrangement, an accompanied flow generated by the rotation of a roller flows to the next roller in accordance with the running of the yarn, and the flow rate may be increased by the rotation of the next roller.

[0009] In this regard, according to the present invention, first of all, for at least one of the rollers housed in the thermal insulation box, the first flow blocker extending toward the outer circumference of the roller is provided. The acceleration of the accompanied flow running along the running direction of the yarn occurs at a part of each roller where the yarn is wound. For this reason, according to the present invention, the first flow blocker extends from the outside of the roller toward a downstream part in the yarn running direction of the yarn wound region on the outer circumference of the roller. With this arrangement, an accompanied flow is blocked by the first flow blocker in a region where the accompanied flow is accelerated by the rotation of the roller, and hence a high-speed accompanied flow is restrained from running from that roller toward the downstream in the running direction of the yarn. The speed of the accompanied flow running toward the yarn outlet is therefore reduced, with the result that heat energy loss is restrained.

[0010] According to the second aspect of the invention, the yarn heater of the first aspect is arranged such that the first flow blocker extends toward a part of the wound region of the outer circumference of the at least one of

the rollers, which part is between a yarn separation position where the yarn is separated from the at least one of the rollers and a position which is on the upstream in the yarn running direction of the yarn separation position by 60 degrees.

[0011] To certainly restrain the accompanied flow accelerated by the rotation of the roller from running toward the downstream in the yarn running direction of the roller, the accompanied flow is preferably blocked at a part of the wound region of the roller which part is as close to the most downstream part as possible. In the present invention, the first flow blocker extends toward a part of the wound region on the outer circumference of the roller, which part is between the yarn separation position and a position on the upstream of the yarn separation position by 60 degrees. This ensures that a high-speed accompanied flow is restrained from running from the roller toward the downstream in the running direction of the yarn.

[0012] According to the third aspect of the invention, the yarn heater of the first or second aspect is arranged such that the first flow blocker extends toward the yarn separation position in the wound region on the outer circumference of the at least one of the rollers.

[0013] In the present invention, the first flow blocker extends toward the yarn separation position (i.e., the end of the wound region of the yarn). On this account, the accompanied flow is blocked by the first flow blocker at the position where the acceleration of the accompanied flow by the rotation of the roller is completed, and hence a high-speed accompanied flow is restrained from running from the roller toward the downstream in the running direction of the yarn.

[0014] According to the fourth aspect of the invention, the yarn heater of any one of the first to third aspects is arranged such that the first flow blocker is provided at a last roller which is the most downstream roller in the yarn running direction among the rollers.

[0015] The yarn sent out from the last roller is taken out of the thermal insulation box through the yarn outlet. On this account, heat energy loss is large if the accompanied flow at the last roller directly runs downstream. In the present invention, to restrain a high-speed accompanied flow from running from the last roller toward the downstream, the first flow blocker is provided at least for the last roller.

[0016] According to the fifth aspect of the invention, the yarn heater of the fourth aspect is arranged such that the first flow blocker is provided for each of the last roller and at least one of the rollers on the upstream in the yarn running direction of the last roller.

[0017] When the first flow blocker is provided only for the last roller and no first flow blocker is provided for the rollers on the upstream of the last roller, the accompanied flow is accelerated until reaching the last roller, and hence the speed of the accompanied flow at the last roller is significantly high. When such a high-speed accompanied flow is blocked by the first flow blocker provided at the last roller, a part of the accompanied flow may flow back-

ward toward the rollers on the upstream of the last roller. For this reason, in the present invention, the first flow blocker is provided not only for the last roller but also for at least one of the rollers on the upstream of the last roller. In this arrangement, the acceleration of the accompanied flow running along the yarn is restrained at a roller on the upstream of the last roller, before reaching the last roller. With this, the speed of the accompanied flow at the last roller is restrained to be low, and hence backward flow due to the collision of the accompanied flow with the first flow blocker is restrained.

[0018] According to the sixth aspect of the invention, the yarn heater of any one of the first to third aspects is arranged such that the rollers include a first roller and a second roller which is on the downstream in the yarn running direction of the first roller and is higher in yarn feeding speed than the first roller, and the first flow blocker is provided at least for the second roller.

[0019] The higher the yarn feeding speed of a roller is, the more the accompanied flow is accelerated. In the present invention, to effectively restrain the speed of the accompanied flow, the first flow blocker is provided for at least the second roller which is high in the yarn feeding speed.

[0020] According to the seventh aspect of the invention, the yarn heater of any one of the first to sixth aspects is arranged such that the first flow blocker is provided for each of the all rollers.

[0021] In the present invention, because the acceleration of the accompanied flow is restrained at each of the rollers, the speed of the accompanied flow discharged through the yarn outlet is certainly restrained.

[0022] According to the eighth aspect of the invention, the yarn heater of any one of the first to seventh aspects further includes a second flow blocker which is provided for at least one of the rollers and extends from the outside of the at least one of the rollers toward a part of the wound region of the outer circumference of the at least one of the rollers, the part being an upstream part in the yarn running direction.

[0023] In the present invention, in the wound region of the roller, the second flow blocker is provided on the upstream in the yarn running direction in addition to the first flow blocker provided on the downstream in the yarn running direction. As such, on the outer circumference of the roller, the flow blockers are provided on the start side and the end side of the section where the accompanied flow is accelerated and the yarn is wound, respectively, and hence the acceleration of the accompanied flow by the rotation of the roller is further certainly restrained.

[0024] According to the ninth aspect of the invention, the yarn heater of any one of the first to eighth aspects is arranged such that the first flow blocker is movable between a near position which is close to the outer circumference of a corresponding roller and a retracted position which is farther from the outer circumference of the roller than the near position is.

[0025] To restrain the accompanied flow accelerated

by the rotation of the roller from running toward the downstream, the first flow blocker preferably extends to be as close to the outer circumference of the roller as possible. However, when the first flow blocker is provided in the vicinity of the outer circumference of the roller, yarn placement onto the roller is difficult. In this regard, in the present invention, the first flow blocker is movable between the near position and the retracted position. Because the first flow blocker is moved to the retracted position at the time of yarn placement to temporarily separate the first flow blocker from the roller, the yarn placement onto the roller is easily done.

[0026] According to the tenth aspect of the invention, the yarn heater of the ninth aspect further includes a biasing member configured to bias the first flow blocker toward the near position.

[0027] At the time of yarn placement onto the roller, an operator pushes up the first flow blocker at the near position against the biasing member to move the first flow blocker to the retracted position, and then performs the yarn placement onto the roller. When the yarn placement onto the roller is finished and the first flow blocker is no longer pushed up, the first flow blocker naturally returns from the retracted position to the near position thanks to biasing force of the biasing member. This prevents erroneous yarn processing performed when the first flow blocker is still at the retracted position as the operator forgets to return the first flow blocker from the retracted position to the near position after the yarn placement.

[0028] According to the eleventh aspect of the invention, the yarn heater of any one of the first to tenth aspects is arranged such that the distance between the first flow blocker and the outer circumference of a corresponding roller is 10mm or shorter.

[0029] To restrain the accompanied flow running along the outer circumference of the roller, the first flow blocker is preferably positioned to be as close to the outer circumference of the roller as possible. To be more specific, the distance between the first flow blocker and the outer circumference of the roller is preferably 10mm or shorter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

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

FIG. 2 is a cross section of a heating-drawing unit.

FIG. 3 explains how an accompanied flow runs in a thermal insulation box.

FIG. 4 is an enlarged view of the last godet roller in FIG. 2 and its surroundings.

FIG. 5 is an enlarged view of the last godet roller of a modification and its surroundings.

FIG. 6 is an enlarged view of the last godet roller of another modification and its surroundings.

FIG. 7 is a cross section of a heating-drawing unit of a further modification.

FIG. 8 is a cross section of a heating-drawing unit of a further modification.

FIG. 9 is a cross section of a heating-drawing unit of a further modification.

FIG. 10 is an enlarged view of the last godet roller of a further modification and its surroundings.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] The following will describe an embodiment of the present invention. FIG. 1 is a schematic diagram of a spun yarn take-up apparatus of the present embodiment. As shown in FIG. 1, the spun yarn take-up apparatus 1 includes a spun yarn drawing apparatus 3 and a take-up winder 4.

[0032] A molten fibrous material such as polyester, which is serially spun out from spinnerets of a spinning apparatus 2, is solidified by cooling wind blown thereon at a cooling cylinder 5, and becomes yarns Y. The spun yarn drawing apparatus 3 is provided below the cooling cylinder 5 to draw the yarns Y sent out downward from the cooling cylinder 5. The spun yarn drawing apparatus 3 includes an oil guide 6 and a heating-drawing unit 7 (a yarn heater of the present invention).

[0033] The oil guide 6 is configured to apply oil to the yarns Y spun out from the spinning apparatus 2. The yarns Y to which the oil has been applied by the oil guide 6 are fed to a heating-drawing unit 7 including five godet rollers 11a to 11e, via a guide roller 17.

[0034] FIG. 2 is a cross section of the heating-drawing unit 7. As shown in FIG. 1 and FIG. 2, the heating-drawing unit 7 includes a thermal insulation box 16 and the five godet rollers 11a to 11e housed in the thermal insulation box 16. The thermal insulation box 16 is a box formed of a heat insulating material. In one side wall member (a right side wall member in FIG. 1 and FIG. 2) of the thermal insulation box 16, a yarn inlet 16a for introducing the yarns Y into the thermal insulation box 16 and a yarn outlet 16b for taking the yarns Y out from the thermal insulation box 16 are formed. The yarn inlet 16a is formed at a lower end portion of the side wall member of the thermal insulation box 16, whereas the yarn outlet 16b is formed at an upper end portion of the side wall member of the thermal insulation box 16. In the thermal insulation box 16, five partition plates 21 to 25 are provided to form spaces in which the five godet rollers 11a to 11e are housed, respectively.

[0035] Among the five godet rollers 11a to 11e, the godet roller 11a is provided in the vicinity of a bottom portion of the thermal insulation box 16. Above this godet roller 11, the other four godet rollers 11b to 11e are provided to be staggered in the left-right direction in the figure. The yarns Y introduced into the thermal insulation box 16 through the yarn inlet 16a are wound onto the five godet rollers 11a to 11e one by one from the lowest godet roller 11. The yarns Y are wound onto each of the five godet rollers 11a to 11e at a winding angle θ of less than 270 degrees. In other words, the yarns Y are wound onto

each of the godet rollers 11a to 11e once or less than once. The yarns Y serially fed by the five godet rollers 11a to 11e therefore run from the yarn inlet 16a to the yarn outlet 16b along a meandering yarn path which does not cross itself on a plane in parallel to the plane of FIG. 2.

[0036] The five godet rollers 11a to 11e are rotationally driven by unillustrated motors, respectively. Each of the five godet rollers 11a to 11e is a yarn heating roller which includes a heater and heats the yarns while feeding them.

[0037] Among the five godet rollers 11, lower three godet rollers 11a to 11c (first rollers of the present invention) on the upstream in the yarn running direction are yarn heating rollers for heating the yarns Y to a drawable temperature. In cases of yarns made of polyester fibers, the glass transition temperature of the yarns Y is about 80 degrees centigrade, and the heating temperature (roller surface temperature) of the three godet rollers 11a to 11c is arranged to be slightly higher than this glass transition temperature (e.g., 80 to 95 degrees centigrade). In the meanwhile, the upper two godet rollers 11d and 11e (second rollers of the present invention) on the downstream in the yarn running direction are yarn heating rollers for thermally setting the drawn yarns Y. The heating temperature (roller surface temperature) of the two godet rollers 11d and 11e is arranged to be higher than the heating temperature of the lower three godet rollers 11a to 11c (e.g., 120 to 150 degrees centigrade). Furthermore, the yarn feeding speeds of the upper two godet rollers 11d and 11e are higher than those of the lower three godet rollers 11a to 11c. For each of the five godet rollers 11a to 11e, the temperature of the heater 20 (heating of the yarns Y) and the rotation of a motor (yarn feeding speed) are controlled by a controller 8.

[0038] As shown in FIG. 2, outside each of the five godet rollers 11a to 11e, a flow blocking plate 30 (a first flow blocker of the present invention) is provided. The details of this flow blocking plate 30 and effects thereof will be given later.

[0039] The yarns Y introduced into the thermal insulation box 16 are, to begin with, preliminarily heated to a drawable temperature, i.e., the glass transition temperature, while being fed by the lower three godet rollers 11a to 11c. Subsequently, the yarns Y having been preliminarily heated to the glass transition temperature are drawn on account of the difference in the yarn feeding speed between the two godet rollers 11c and 11d. Furthermore, the yarns Y are heated to higher temperatures while being fed by the upper two godet rollers 11d and 11e, with the result that the drawn state of the yarns Y is thermally set. The yarns Y drawn as above are taken out from the thermal insulation box 16 through the yarn outlet 16b and fed to the yarn winding device 4 by the guide roller 18.

[0040] The yarn winding device 4 is provided below the spun yarn drawing apparatus 3. This yarn winding device 4 includes members such as a bobbin holder 27 and a contact roller 28. The bobbin holder 27 is shaped to be long in the direction orthogonal to the plane of FIG.

1 and is rotationally driven by an unillustrated motor. To this bobbin holder 27, a plurality of bobbins 29 are attached side by side along the axial direction of the bobbin holder 27. The yarn winding device 4 rotates the bobbin holder 27 to simultaneously wind the yarns Y onto the bobbins 29, so as to form wound packages 9. The contact roller 28 makes contact with the surfaces of the wound packages 9 and applies a predetermined contact pressure thereto, in order to adjust the shape of each wound package 9.

[0041] Now, the flow blocking plates 30 provided in the thermal insulation box 16 will be described. FIG. 3 explains how the accompanied flow runs in the thermal insulation box 16. As discussed earlier, the yarns Y introduced into the thermal insulation box 16 through the yarn inlet 16a is wound on each of the five godet rollers 11a to 11e at a winding angle of less than 270 degrees. On this account, as shown in FIG. 2 and FIG. 3, the yarns Y run from the yarn inlet 16a to the yarn outlet 16b along a meandering yarn path which does not cross itself on a plane in parallel to the plane of the figure. In this regard, as indicated by arrows in FIG. 3, in the vicinity of the outer circumference of each roller 11, the air around the roller flows in the circumferential direction in accordance with the rotation of the roller 11, with the result that an accompanied flow 40 is generated. To begin with, the accompanied flow 40 generated at the godet roller 11a which is close to the yarn inlet 16a flows to the next godet roller 11b along the yarn path, and the accompanied flow 40 is accelerated by the rotation of this godet roller 11b. As this acceleration of the accompanied flow 40 is repeated, the speed of the accompanied flow 40 increases toward the yarn outlet 16b as the yarns Y are serially fed by the five godet rollers 11a to 11e.

[0042] On this account, at, in particular, the godet roller 11e (a last roller in the present invention) which is the most downstream roller in the yarn running direction, the speed of the accompanied flow 40 is significantly high. As the hot air in the thermal insulation box 16 is discharged through the yarn outlet 16b by the accompanied flow 40 together with the yarns Y, heat energy loss is great. In the present embodiment, to restrain the accompanied flow 40 running together with the yarns Y from being accelerated by the rotation of each of the godet rollers 11a to 11e, the flow blocking plate 30 is provided for each of the godet rollers 11a to 11e to block the accompanied flow 40 running along the outer circumference of each roller.

[0043] FIG. 4 is an enlarged view of the last godet roller 11e shown in FIG. 2 and its surroundings. As shown in FIG. 2 and FIG. 4, each flow blocking plate 30 is attached to the inner wall surface of the thermal insulation box 16 or to each of the partition plates 22 to 25 with a mounting member 31 therebetween. The flow blocking plate 30 is connected with the mounting member 31 to be rotatable by a hinge 32. With this arrangement, the leading end of the flow blocking plate 30 is movable between a near position (indicated by full lines) where the leading end is

close to the outer circumference of the corresponding godet roller 11 (11a to 11e) and a retracted position (indicated by two-dot chain lines) where the leading end is far from the near position. The flow blocking plate 30 is biased toward the near position by a torsion spring 33 (a biasing member of the present invention) provided on the hinge 32.

[0044] The acceleration of the accompanied flow 40 running along the yarn running direction is generated at a wound region (section a in FIG. 4) where the yarns Y are wound onto the outer circumference of each of the five godet rollers 11a to 11e. In consideration of this, the flow blocking plate 30 extends from the outer side of the corresponding godet roller 11 toward a downstream part in the yarn running direction of the wound region (section a). To certainly restrain the accompanied flow accelerated by the rotation of the godet roller 11 from running toward the downstream in the yarn running direction of the roller 11, the accompanied flow is preferably blocked at a part of the wound region of the roller 11 which part is as close to the most downstream part as possible. In this regard, in the present embodiment, the flow blocking plate 30 extends toward the end of the section a, i.e., toward a yarn separation position P1 where the yarns Y wound onto the godet roller 11 leave the godet roller 11.

[0045] With this arrangement, an accompanied flow is blocked by the flow blocking plate 30 in a region where the accompanied flow is accelerated by the rotation of the godet roller 11, and hence a high-speed accompanied flow is restrained from running from that roller 11 toward the downstream in the running direction of the yarns Y. In particular, in the present embodiment, the flow blocking plate 30 extends toward the yarn separation position P1 (i.e., the end of the wound region of the yarns Y). On this account, the accompanied flow 40a is blocked by the flow blocking plate 30 at the position where the acceleration of the accompanied flow by the rotation of the roller 11 is completed, and hence a high-speed accompanied flow is restrained from running from the roller 11 toward the downstream in the running direction of the yarns Y. With this, the speed of the accompanied flow 40b running from the last godet roller 11e toward the yarn outlet 16b is reduced, with the result that heat energy loss is restrained.

[0046] A result of study on the suppression of the accompanied flow by the flow blocking plate 30 is as below. In FIG. 4, when the yarn feeding speed (V_f) of the yarns Y fed by the godet roller 11 was 4500m/min, the speed (V_{1a}) of the accompanied flow on the upstream in the yarn running direction of the flow blocking plate 30 was 16.4m/s. In the meanwhile, the speed (V_{1b}) of the accompanied flow on the downstream in the yarn running direction of the flow blocking plate 30 was decreased to 3.12m/s.

[0047] In addition to the above, in the present embodiment, the flow blocking plates 30 are provided for all of the five godet rollers 11a to 11e. Because the acceleration of the accompanied flow 40 is restrained at each of

the five godet rollers 11a to 11e, the speed of the accompanied flow 40 discharged from the thermal insulation box 16 through the yarn outlet 16b is certainly restrained.

[0048] To restrain the accompanied flow accelerated by the rotation of each godet roller 11 from running toward the downstream, the flow blocking plate 30 is preferably positioned to be as close to the outer circumference of each godet roller 11 as possible. For example, the distance d between the leading end of the flow blocking plate 30 and the outer circumference of the godet roller 11 is preferably 10mm or shorter.

[0049] In regard to the above, when the flow blocking plate 30 is provided in the vicinity of the outer circumference of the godet roller 11, yarn placement onto the godet roller 11 is difficult. In particular, when an operator performs yarn placement onto each roller 11 by inserting a suction gun sucking and retaining yarns into a space between the godet rollers 11, such yarn placement is difficult when the flow blocking plate 30 is provided in the vicinity of the outer circumference of the godet roller 11.

[0050] In this connection, the flow blocking plate 30 is arranged to be movable between the near position and the retracted position. Because the flow blocking plate 30 can be temporarily moved away from the godet roller 11 by moving the flow blocking plate 30 to the retracted position at the time of the yarn placement, the yarn placement onto each godet roller 11 is easily done.

[0051] In addition to the above, the flow blocking plate 30 is biased toward the near position by the torsion spring 33. At the time of the yarn placement onto the godet roller 11, the operator pushes up the flow blocking plate 30 at the near position against the biasing force of the torsion spring to move the flow blocking plate to the retracted position, and then performs the yarn placement onto the roller 11. When the yarn placement onto the godet roller 11 is finished and the flow blocking plate 30 is no longer pushed up, the flow blocking plate 30 naturally returns from the retracted position to the near position thanks to the biasing force of the torsion spring 33. This prevents erroneous yarn processing performed when the flow blocking plate 30 is still at the retracted position as the operator forgets to return the flow blocking plate 30 from the retracted position to the near position after the yarn placement.

[0052] In addition to the above, in the present embodiment, as shown in FIG. 2, each flow blocking plate 30 rotates to retract from the near position along the rotational direction (yarn running direction) of the corresponding godet roller 11. For example, in case of the godet roller 11a, the flow blocking plate 30 is rotatable rightward in the figure from the near position, and in case of the godet roller 11b, the flow blocking plate 30 is rotatable leftward in the figure from the near position. This arrangement is particularly useful when the yarn placement is performed while the suction gun retaining the yarns Y is inserted into a gap between the godet rollers 11. That is to say, the operator performs the yarn placement while moving the suction gun in his/her hands in the rotational

direction of the five godet rollers 11a to 11e. In doing so, the operator puts the suction gun on the flow blocking plate 30 and moves the suction gun along the rotational direction of the godet roller 11 relative to the godet roller 11 while pushing the flow blocking plate 30 away from the roller 11. In this way, the operator places the yarns Y onto each godet roller 11.

[0053] Now, modifications of the embodiment above will be described. The members identical with those in the embodiment will be denoted by the same reference numerals and the explanations thereof are not repeated.

1] While in the embodiment above the flow blocking plate 30 extends toward the yarn separation position in the wound region of the godet roller 11, the flow blocking plate 30 may extend toward a position which is on the upstream in the yarn running direction of the yarn separation position P1. For example, as shown in FIG. 5, the flow blocking plate 30 may extend toward a part of the wound region (section a) of the godet roller 11, which part is in a section (section b) between the yarn separation position P1 and a position P3 which is on the upstream in the yarn running direction of the yarn separation position P1 by an angle α ($\alpha=60$ degrees). Alternatively, as shown in FIG. 6, the flow blocking plate 30 may extend toward a part of the wound region of the godet roller 11, which part is in a section (section c) between the yarn separation position P1 and a midpoint P4 of the wound region (section a).

2] While in the embodiment above the flow blocking plates 30 are provided for all of the five godet rollers 11, the flow blocking plates 30 may not be provided for all rollers 11. The flow blocking plate 30 may be provided for only one of the godet rollers 11 for reasons such as spatial restriction in the thermal insulation box 16. The following will describe examples of arrangements in which the flow blocking plate 30 is provided not for all godet rollers 11.

(a) The yarns Y sent out from the last godet roller 11e is taken out of the thermal insulation box 16 through the yarn outlet 16b. On this account, heat energy loss is large if the accompanied flow at the last godet roller 11e directly runs downstream. To restrain the high-speed accompanied flow 40 from running downstream from the last godet roller 11e and being discharged through the yarn outlet 16b, as shown in FIG. 7, preferably the flow blocking plate 30 is provided particularly at the last godet roller 11e (the last roller of the present invention).

(b) As shown in FIG. 7, when the flow blocking plate 30 is provided only for the last godet roller 11e and no flow blocking plate 30 is provided for the rollers 11 on the upstream of the last godet roller 11e, the accompanied flow 40 is accelerated until reaching the last godet roller 11e,

and hence the speed of the accompanied flow 40 at the last godet roller 11e is significantly high. When such a high-speed accompanied flow 40 is blocked by the flow blocking plate 30 provided at the last godet roller 11e, a part of the accompanied flow 40 colliding with the flow blocking plate 30 may flow backward toward the rollers 11 on the upstream of the last godet roller 11e. In this connection, soot is generated when the yarns Y to which oil has been applied are fed by a hot godet roller 11. When a part of the accompanied flow 40 including soot flows back toward the cool godet rollers 11a to 11e on the upstream, oil may adhere to the cool godet rollers 11a to 11c, with the result that the quality of the yarns Y may deteriorated.

For the reason above, the flow blocking plate 30 is preferably provided not only for the last godet roller 11e but also for at least one roller 11 on the upstream of the last godet roller 11e. For example, in FIG. 8, the flow blocking plate 30 is provided for the godet roller 11c, in addition to the last godet roller 11e. In this arrangement, the acceleration of the accompanied flow 40 running along the yarn path is restrained by the flow blocking plate 30 provided for the intermediate roller 11c, before the accompanied flow 40 reaches the last godet roller 11e. As such, the speed of the accompanied flow 40 at the last godet roller 11e is restrained to be low, and hence backward flow due to the collision with the flow blocking plate 30 is restrained.

(c) The higher the yarn feeding speed of a godet roller 11 is, the more the accompanied flow 40 is accelerated at that roller 11. In the embodiment above, the two godet rollers 11d and 11e on the downstream in the yarn running direction are higher in the yarn feeding speed than the three godet rollers 11a to 11c on the upstream, among the five godet rollers 11a to 11e, and the yarns Y are drawn between the godet roller 11c and the godet roller 11d. For this reason, as shown in FIG. 9, the flow blocking plates 30 may be provided respectively for the two godet rollers 11d and 11e on the downstream, which are high in the yarn feeding speed.

3] As discussed earlier, the accompanied flow 40 is accelerated particular at the section a of the godet roller 11, where the yarns Y are placed. To effectively restrain the speed of the accompanied flow 40 in this section a, a flow blocking plate may be provided at a position different from those described in the embodiment above.

For example, in FIG. 10, a flow blocking plate 50 (a second flow blocker of the present invention) is provided at the start side (upstream in the yarn running direction) of the section a where the yarns Y are

wound, in addition to the end side of the section a (downstream in the yarn running direction), on the outer circumference of the godet roller 11. In particular, in FIG. 10, the flow blocking plate 50 extends toward a yarn contact position P2 where the yarns make contact with the roller 11. Because the flow blocking plates 30 and 50 are provided on the start side and the end side of the section a, respectively, the acceleration of the accompanied flow 40 due to the rotation of the godet roller 11 is further certainly restrained. While in FIG. 10 the flow blocking plate 50 on the yarn contact position P2 side is identical in structure with the flow blocking plate 30 on the yarn separation position P1, these plates may be different from each other in structure.

A result of suppression of the accompanied flow by the flow blocking plates 30 and 50 in the arrangement shown in FIG. 10 is as below. In FIG. 10, when the yarn feeding speed (V_f) of the yarns Y by a godet roller 11 was 4500m/min, the flow rate (V_{2a}) of the accompanied flow on the upstream in the yarn running direction of the flow blocking plate 50 was 3.12m/s, whereas the speed (V_{1a}) of the accompanied flow on the upstream in the yarn running direction of the flow blocking plate 30 was 11.4m/s. In the meanwhile, the speed (V_{1b}) of the accompanied flow on the downstream in the yarn running direction of the flow blocking plate 30 was 1.63m/s.

4] While in the embodiment above the three godet rollers 11a to 11c on the upstream are yarn heating rollers for preliminarily heating the yarns Y before drawn whereas the two godet rollers 11d and 11e on the downstream are yarn heating rollers for thermally setting the yarns Y after drawn, the number of the preliminary heating godet rollers and the number of the heat-setting godet rollers may be suitably changed.

[0054] In addition to the above, all of the godet rollers 11 in the thermal insulation box 16 may not be yarn heating rollers. For example, when the yarns are made of nylon having a lower glass transition temperature than polyester, the yarns are often not required to be heated before drawn. In such cases, a godet roller 11 feeding the yarns Y before drawn may be a non-heating roller.

Claims

1. A yarn heater comprising:

a thermal insulation box provided with a yarn inlet through which a yarn is introduced and a yarn outlet through which the yarn is taken out; and
rollers which are housed in the thermal insulation box, include a yarn heating roller configured to heat the yarn, and are configured to feed the

yarn from the yarn inlet to the yarn outlet, the yarn introduced into the thermal insulation box through the yarn inlet being wound onto each of the rollers at a winding angle of less than 270 degrees,

the yarn heater further comprising a first flow blocker which is provided for at least one of the rollers and extends from the outside of the at least one of the rollers toward a part of a wound region of the outer circumference of the at least one of the rollers, the wound region being a region where the yarn is wound and the part being a downstream part in a yarn running direction.

2. The yarn heater according to claim 1, wherein, the first flow blocker extends toward a part of the wound region of the outer circumference of the at least one of the rollers, which part is between a yarn separation position where the yarn is separated from the at least one of the rollers and a position which is on the upstream in the yarn running direction of the yarn separation position by 60 degrees.
3. The yarn heater according to claim 2, wherein, the first flow blocker extends toward the yarn separation position in the wound region on the outer circumference of the at least one of the rollers.
4. The yarn heater according to any one of claims 1 to 3, wherein, the first flow blocker is provided at a last roller which is the most downstream roller in the yarn running direction among the rollers.
5. The yarn heater according to claim 4, wherein, the first flow blocker is provided for each of the last roller and at least one of the rollers on the upstream in the yarn running direction of the last roller.
6. The yarn heater according to any one of claims 1 to 3, wherein, the rollers include a first roller and a second roller which is on the downstream in the yarn running direction of the first roller and is higher in yarn feeding speed than the first roller, and the first flow blocker is provided at least for the second roller.
7. The yarn heater according to any one of claims 1 to 6, wherein, the first flow blocker is provided for each of the all rollers.
8. The yarn heater according to any one of claims 1 to 7, further comprising a second flow blocker which is provided for at least one of the rollers and extends from the outside of the at least one of the rollers toward a part of the

wound region of the outer circumference of the at least one of the rollers, the part being an upstream part in the yarn running direction.

9. The yarn heater according to any one of claims 1 to 8, wherein,
the first flow blocker is movable between a near position which is close to the outer circumference of a corresponding roller and a retracted position which is farther from the outer circumference of the roller than the near position is. 5 10
10. The yarn heater according to claim 9, further comprising
a biasing member configured to bias the first flow blocker toward the near position. 15
11. The yarn heater according to any one of claims 1 to 9, wherein,
the distance between the first flow blocker and the outer circumference of a corresponding roller is 10mm or shorter. 20

25

30

35

40

45

50

55

FIG.1

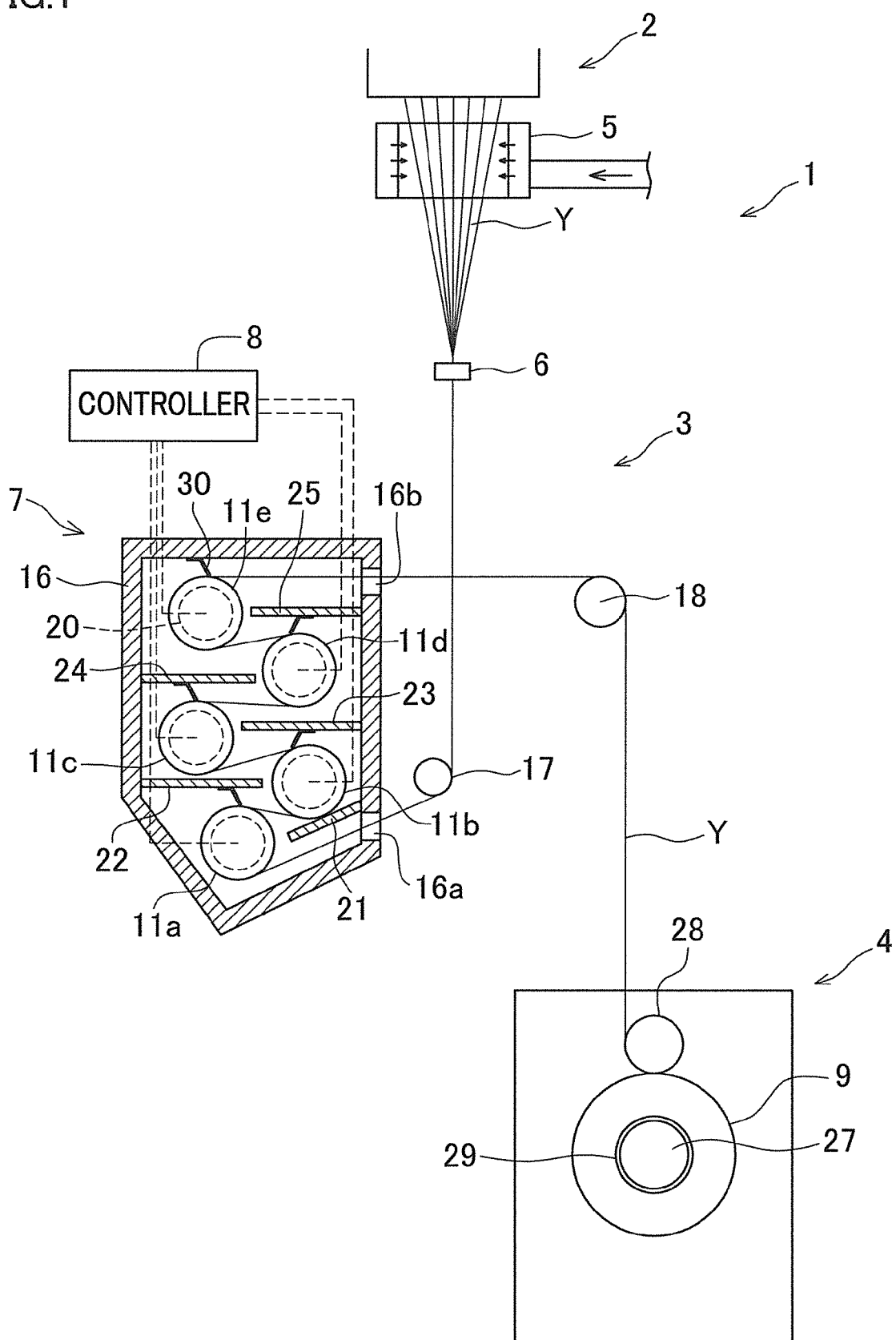


FIG.2

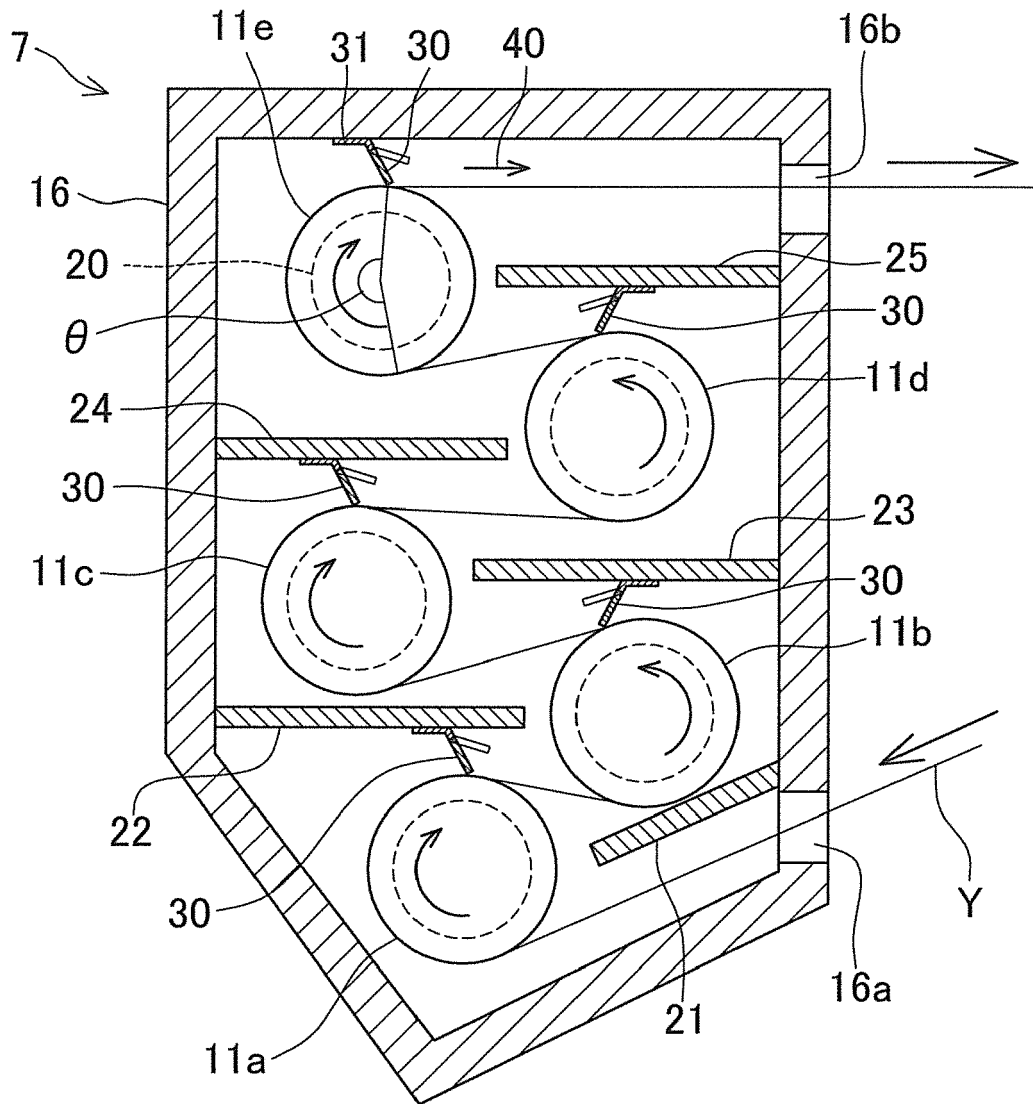


FIG.3

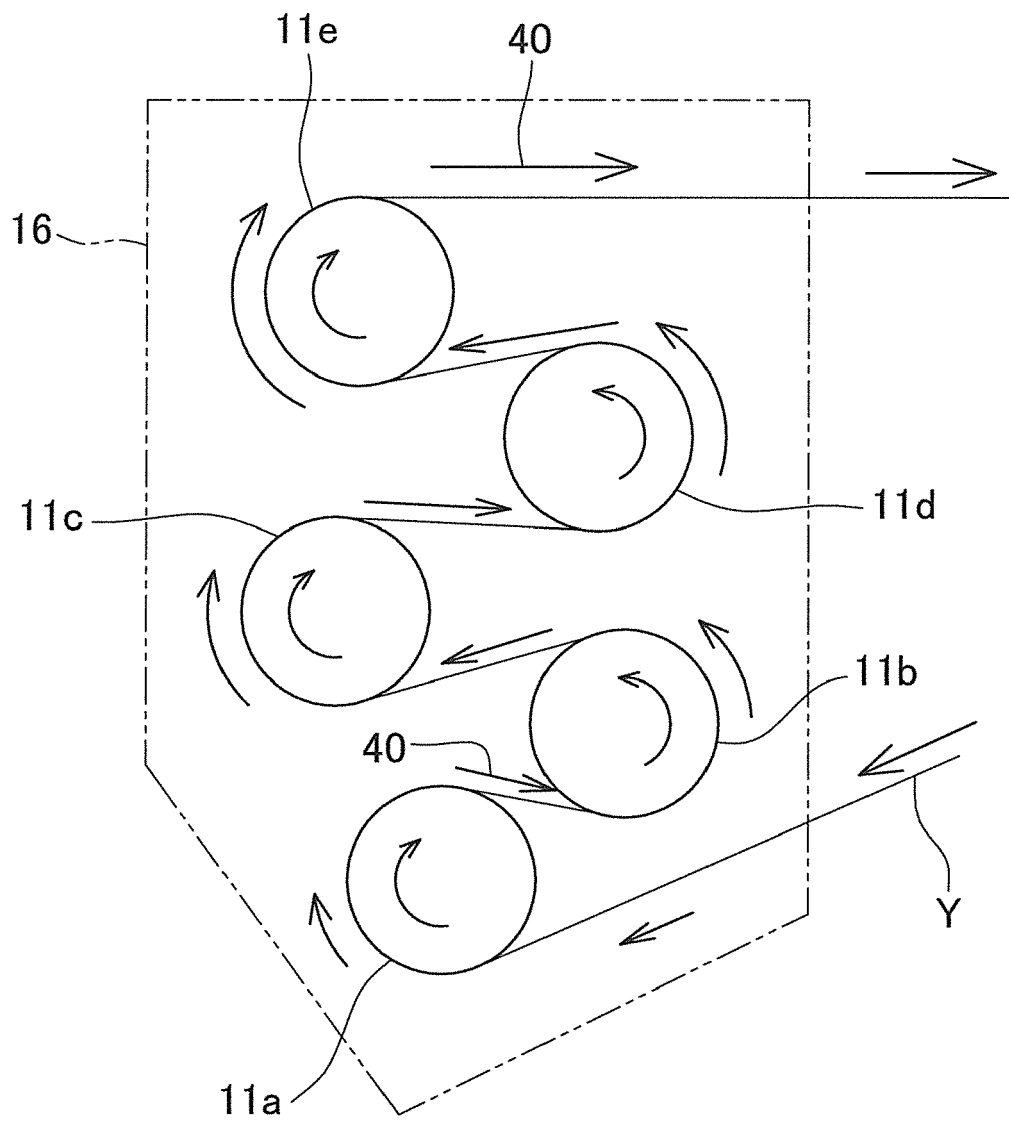


FIG.4

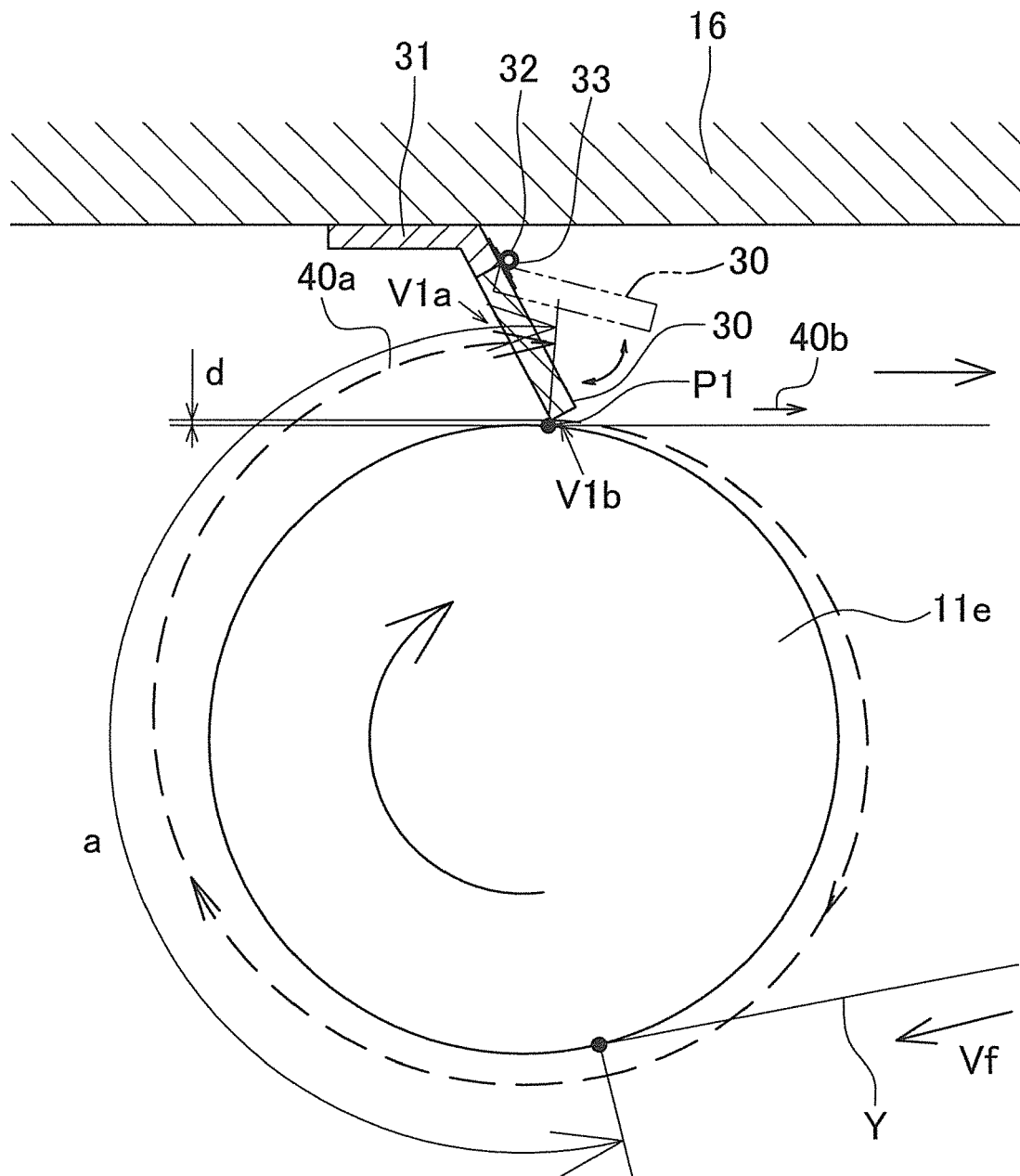


FIG.5

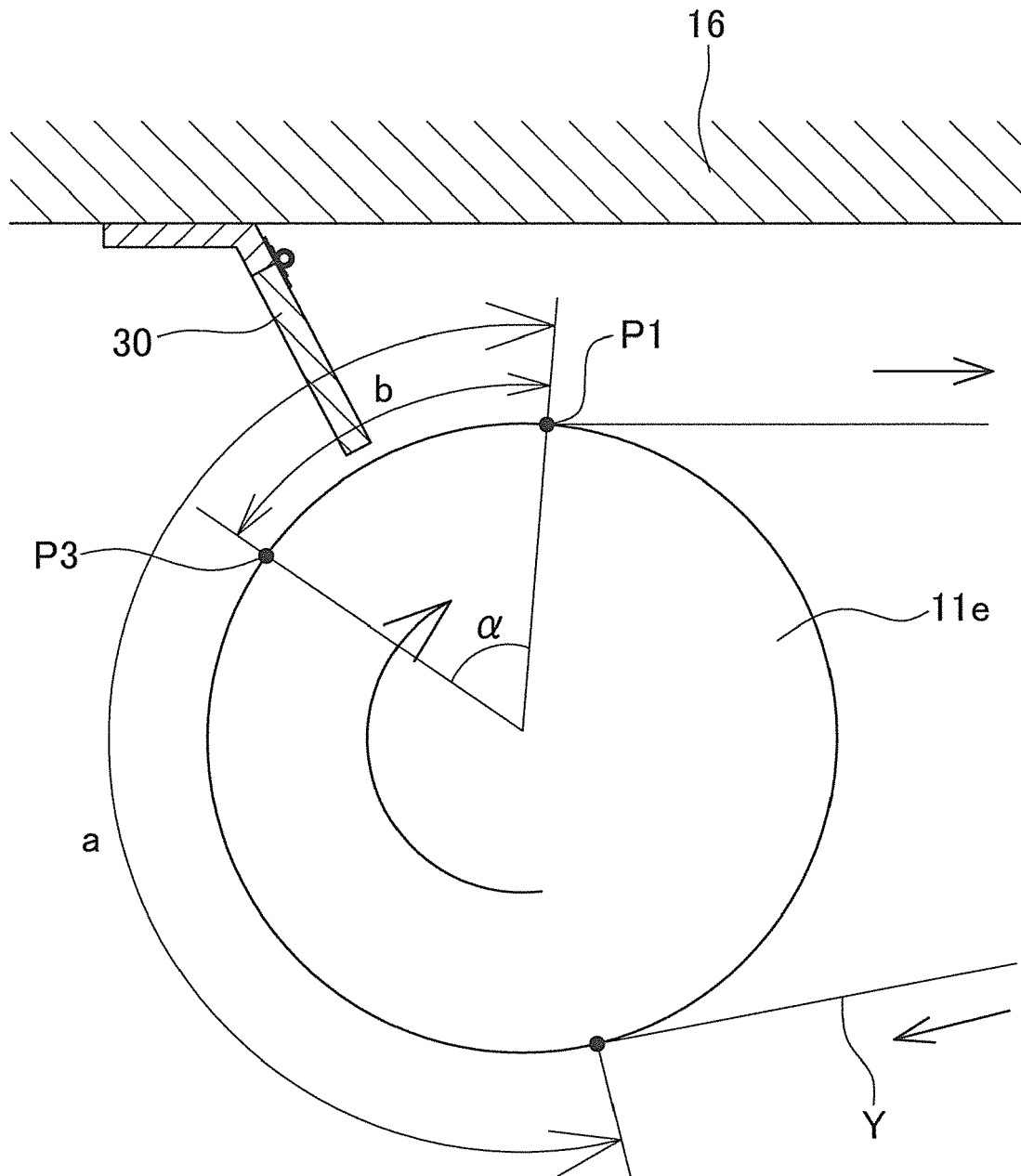


FIG.6

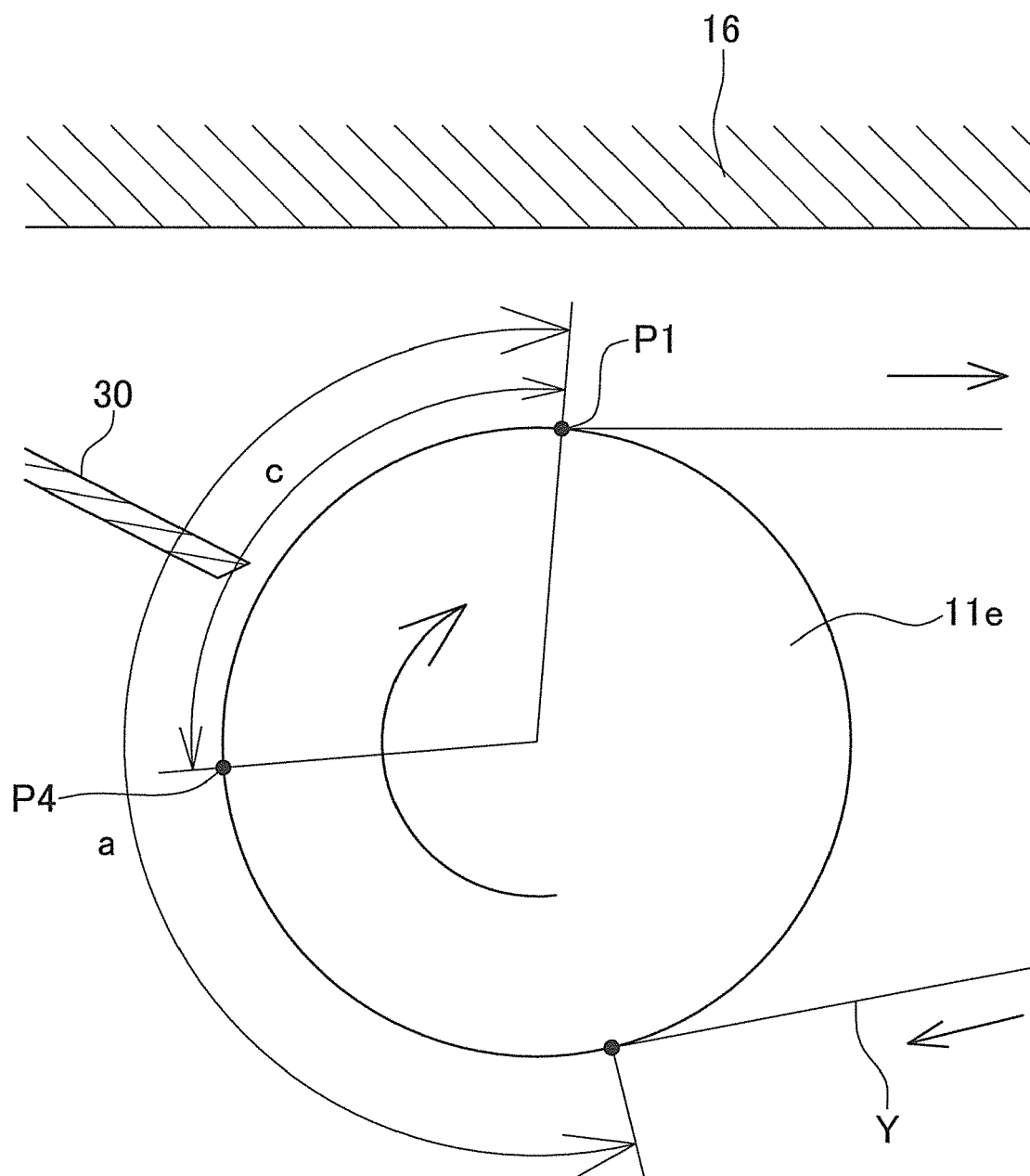


FIG.7

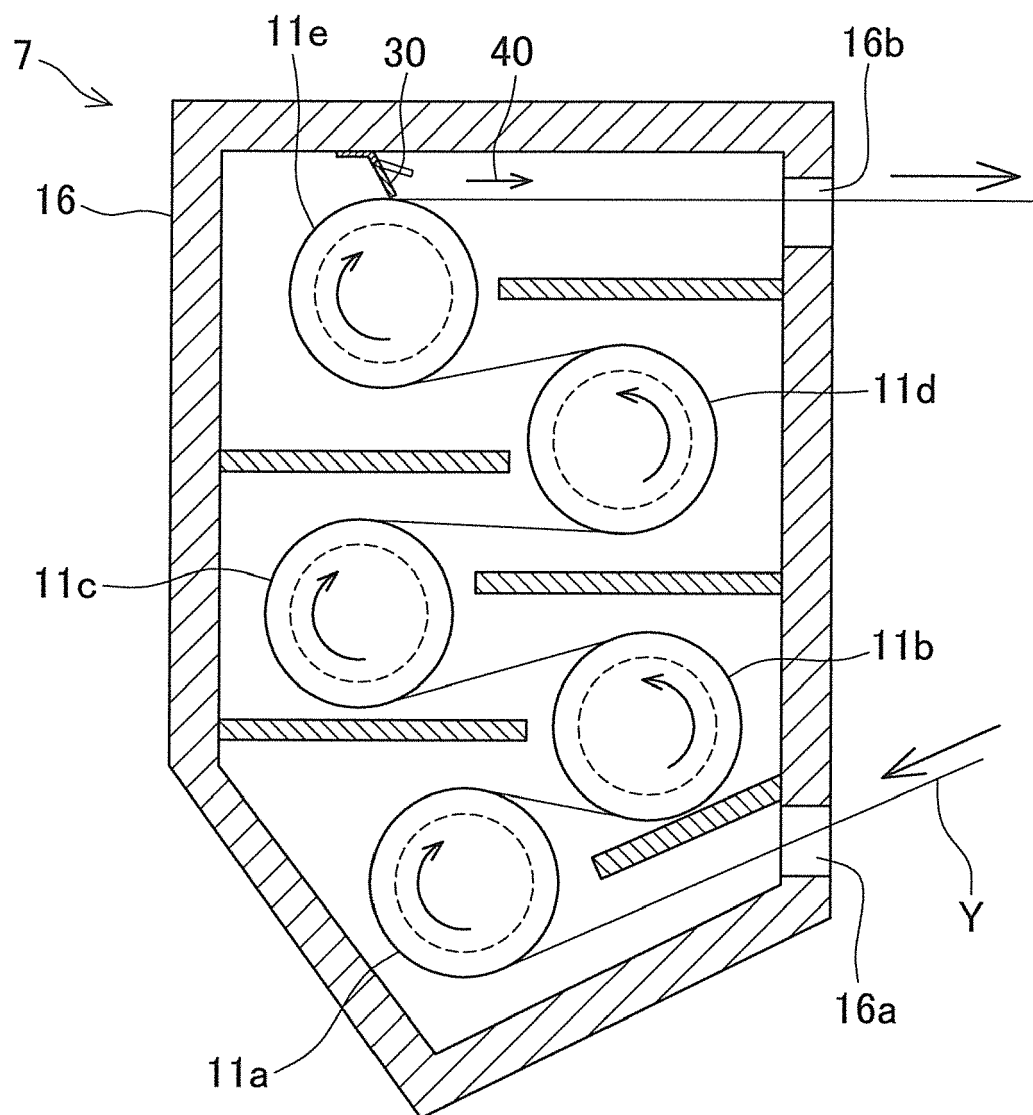


FIG.8

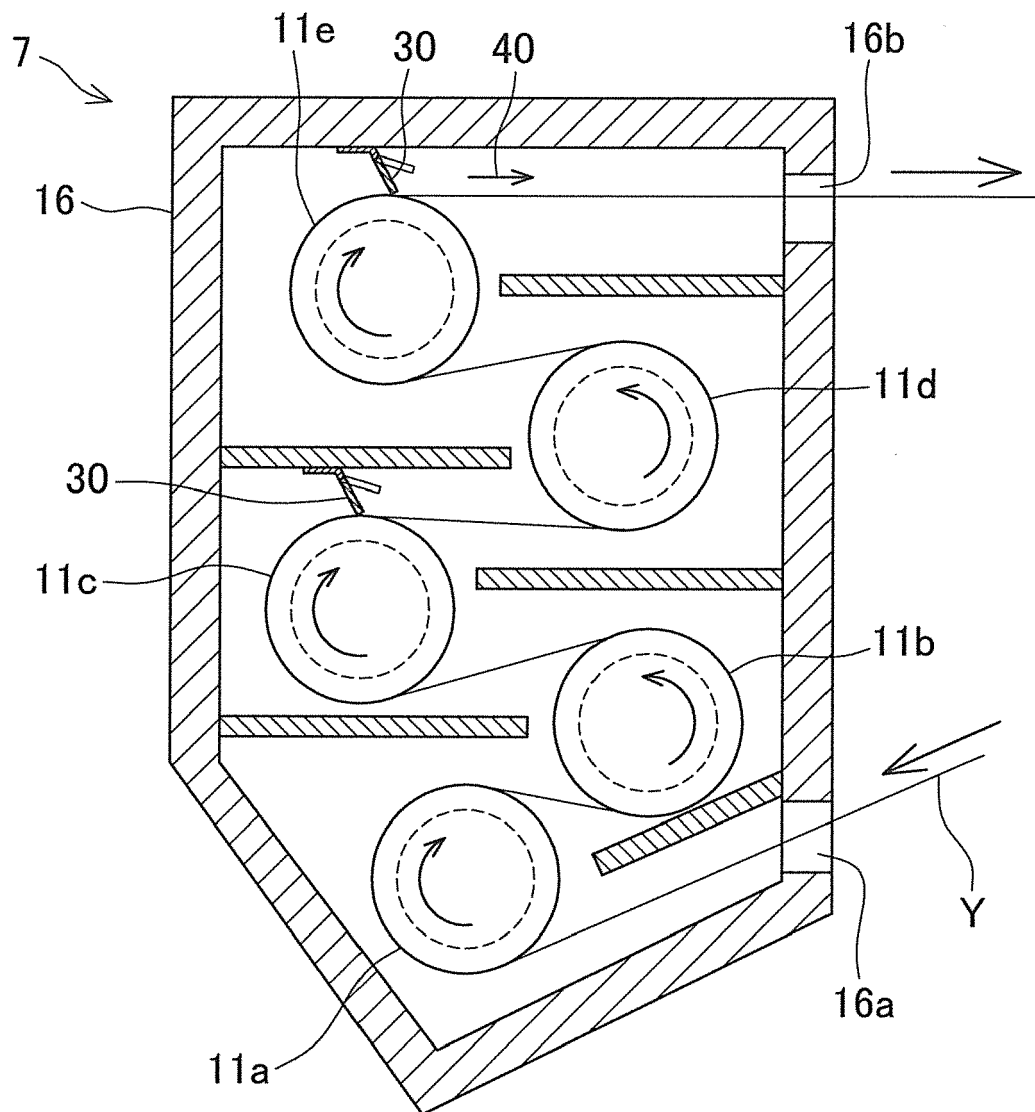


FIG.9

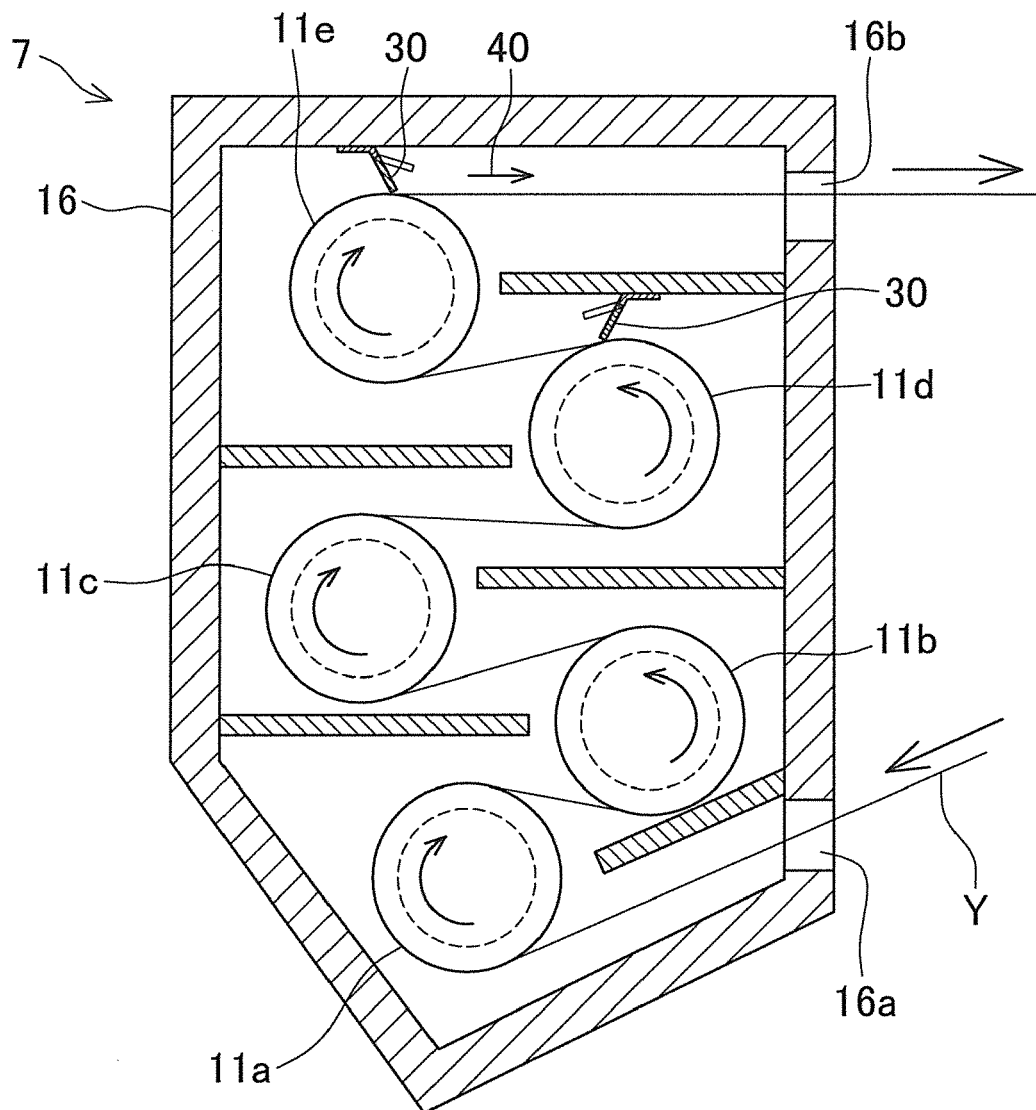
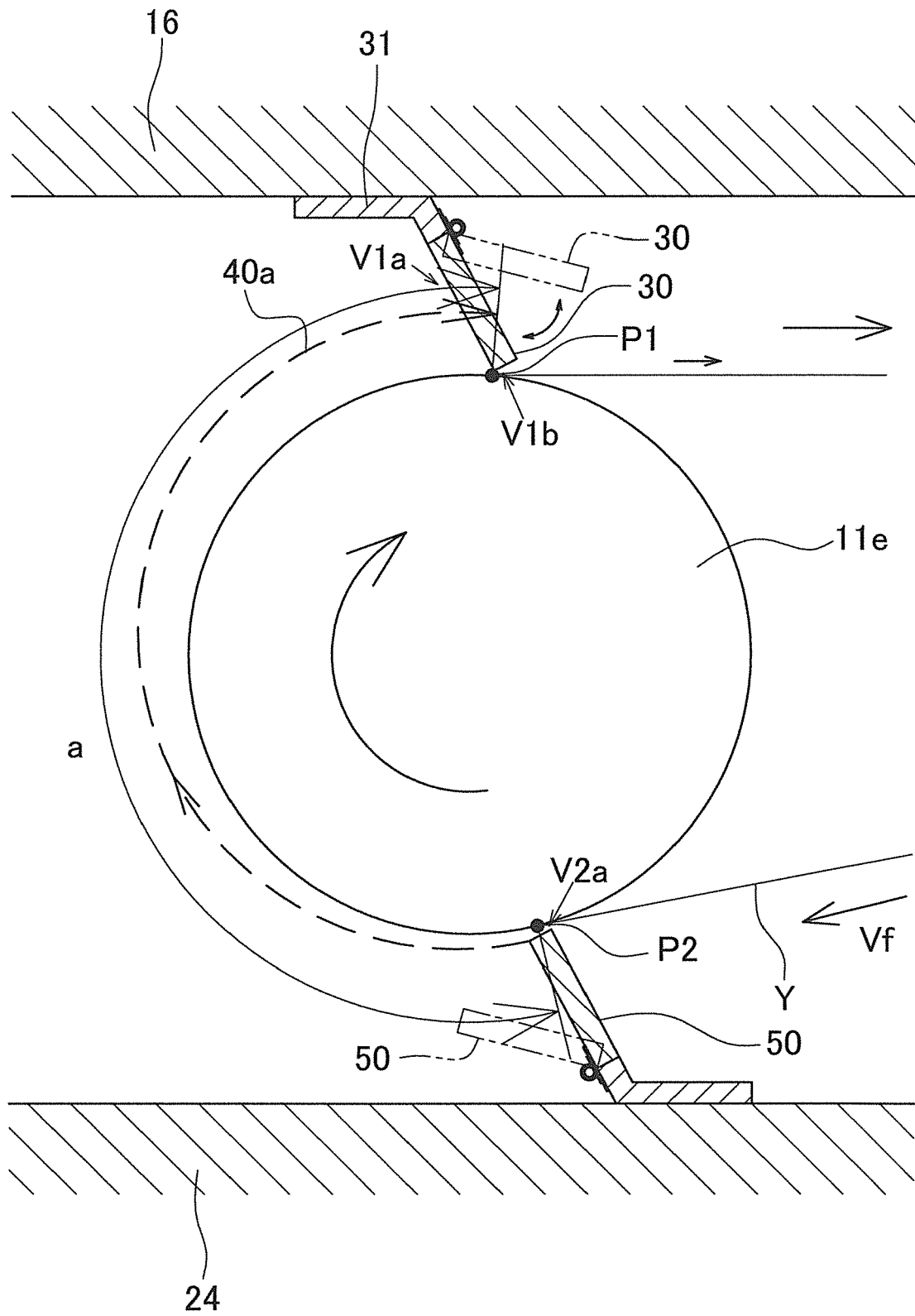


FIG.10





EUROPEAN SEARCH REPORT

Application Number
EP 16 17 1018

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2002 371429 A (TEIJIN LTD) 26 December 2002 (2002-12-26)	1-11	INV. D01D10/02 D02J13/00 D02J1/22 D01D5/16
Y	* paragraphs [0007], [0018], [0020], [0021], [0022], [0028], [0041] *	1-11	
Y	JP 2014 173212 A (TMT MACHINERY INC) 22 September 2014 (2014-09-22) * paragraphs [0012], [0023]; figures 1-4 *	1-11	
A	JP S63 21915 A (ASAHI CHEMICAL IND) 29 January 1988 (1988-01-29) * abstract *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			D01D D02J
Place of search		Date of completion of the search	Examiner
The Hague		8 July 2016	Van Beurden-Hopkins
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 17 1018

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-07-2016

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2002371429 A	26-12-2002	JP 4429549 B2 JP 2002371429 A	10-03-2010 26-12-2002
JP 2014173212 A	22-09-2014	NONE	
JP S6321915 A	29-01-1988	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2014173212 A [0002]