



(11)

EP 3 147 392 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.03.2017 Bulletin 2017/13

(51) Int Cl.:
D01D 5/088 (2006.01)

(21) Application number: **16188502.5**

(22) Date of filing: **13.09.2016**

(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

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(30) Priority: **16.09.2015 JP 2015183344**

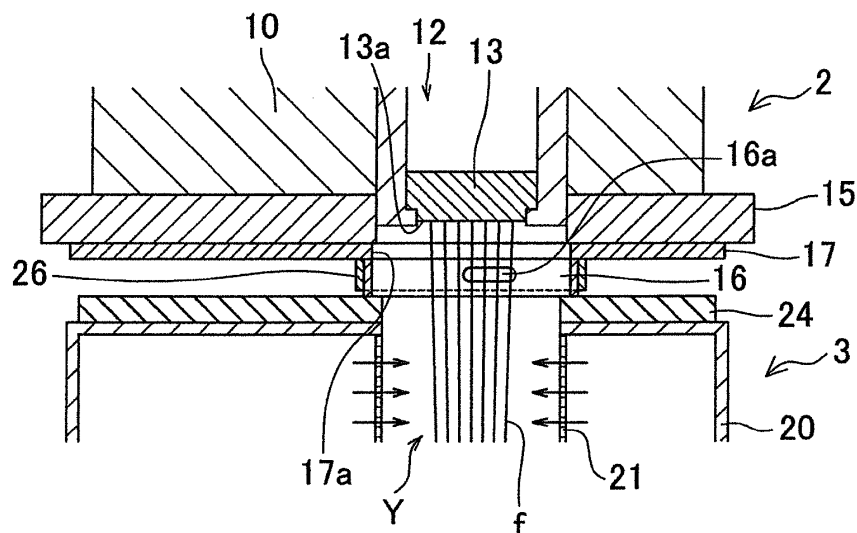
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(54) **MELT SPINNING DEVICE**

(57) A melt spinning device in which the aperture area between a spinneret and a cooler is adjustable by a simple operation is provided. A melt spinning device includes a spinning unit 2 to which a spinning pack 12 having a spinneret 13 is attached, and a cooling cylinder 21 provided below the spinning unit 2 to cool a yarn Y (filaments f) spun out from the spinneret 13. The melt spin-

ning device further includes an exhaust ring 16 provided between the spinning unit 2 and the cooling cylinder 21 and in which openings 16a are formed at intervals in the circumferential direction, and an adjustment ring 26 attached to be movable relative to the exhaust ring 16 and adjusting the aperture area of each of the openings 16a.

FIG.2



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a melt spinning device configured to spin out yarns.

[0002] A melt spinning device configured to spin out molten polymer such as polyester from a spinneret has been known. For example, a melt spinning device of Patent Literature 1 (Japanese Utility Model Publication No. 62-60264 (FIGs. 1 and 2)) includes a heating body to which a spinneret spinning out polymer is attached and a tubular cooler (tubular cooling wind blowing device) provided below the heating body. In the cooler, yarns are cooled by applying cooling wind to the yarns spun out from the spinneret from around the yarns.

[0003] The cooler described above has a problem such that gas including a sublimable material generated in spinning stagnates at a position immediately below the spinneret. In particular, this stagnation of the gas tends to occur in a tubular cooler in which the space immediately below the spinneret is surrounded over the entire circumference. When such stagnation of gas continues, the sublimable material included in the gas is adhered to a polymer discharging surface of the spinneret, with the result that yarn breakage may occur.

[0004] In consideration of the problem above, a known melt spinning device is provided with a measure for exhaust of the gas stagnating at around the polymer discharging surface of the spinneret. For example, in the apparatus of Patent Literature 1 above, to begin with, a gap is formed between the heating body and the cooler. In addition to this, a tubular dam is provided at an upper part of the cooler to protrude upward toward the spinneret. According to the literature, the gas immediately below the spinneret is smoothly exhausted. In addition to the above, Patent Literature 1 discloses an arrangement such that an exhaust amount adjusting pipe in which holes are evenly formed in the circumferential direction is attached around the dam above.

SUMMARY OF THE INVENTION

[0005] When there is a gap between the spinneret and the cooler, the polymer discharging surface of the spinneret is easily cooled, with the result that yarn breakage may frequently occur in a certain spinning condition. For example, when a yarn formed of thick filaments is produced, the cooling of the spinneret to some extent is not so problematic. In the meanwhile, when a yarn formed of thin filaments is produced, the cooling of the polymer discharging surface is seriously problematic and yarn breakage tends to occur. In view of this, the aperture area between the spinneret and the cooler is preferably changed in accordance with yarn production conditions.

[0006] In this regard, Patent Literature 1 recites an arrangement such that an exhaust amount adjusting pipe having holes is attached around the tubular dam. This

arrangement, however, is disadvantageous in that the burden on an operator is heavy because the exhaust amount adjusting pipe must be detached and attached each time the exhaust amount is adjusted. Furthermore, when the exhaust amount is adjusted in steps, exhaust amount adjusting pipes of plural types must be prepared in advance and an exhaust amount adjusting pipe is replaced with another exhaust amount adjusting pipe in accordance with a yarn spinning condition. As such, fine adjustment of the exhaust amount is difficult.

[0007] An object of the present invention is to provide a melt spinning device in which the aperture area between a spinneret and a cooler is adjustable by a simple operation.

[0008] According to the first aspect of the invention, a melt spinning device includes: a spinning unit to which a spinning pack having a spinneret is attached and which is configured to spin out a yarn through the spinneret; and a cooling cylinder provided below the spinning unit to cool the yarn spun out from the spinneret, the melt spinning device further including: an opening formation member provided between the spinning unit and the cooling cylinder, first openings being formed in the opening formation member at intervals in a circumferential direction; and an adjusting member attached inside or outside of the opening formation member to be movable relative to the opening formation member, the adjusting member adjusting an aperture area of each of the first openings.

[0009] According to the present invention, the aperture area of each of the first openings is adjustable by a simple operation of moving the adjusting member relative to the opening formation member. It is therefore easy to change the aperture area of each first opening in accordance with the yarn spinning condition.

[0010] According to the second aspect of the invention, the melt spinning device of the first aspect is arranged such that the number of the first openings formed in the opening formation member is three or more.

[0011] Because three or more first openings are provided in the circumferential direction, the airflow in the cooling cylinder is less likely to be disturbed and hence the yarn is evenly cooled.

[0012] According to the third aspect of the invention, the melt spinning device of the first or second aspects is arranged such that the first openings are provided at equal intervals in the circumferential direction.

[0013] Because the first openings are provided at equal intervals in the circumferential direction, the airflow in the cooling cylinder is less likely to be disturbed. In addition to the above, because the gas including the sublimable material generated during spinning is evenly ejected through the first openings which are provided at equal intervals, local stagnation of the gas is prevented.

[0014] According to the fourth aspect of the invention, the melt spinning device of any one of the first to third aspects is arranged such that the adjusting member is ring-shaped, and in the adjusting member, second openings are formed to be communicable with the first open-

ings of the opening formation member, respectively.

[0015] In the ring-shaped adjusting member, the second openings are formed to correspond to the first openings of the opening formation member. As the adjusting member is moved relative to the opening formation member, the degrees of overlap between the first openings and the second openings are changed at once. In this way, the aperture areas of the first openings are adjusted at once for the same amount of change. This prevents the aperture areas of the first openings from becoming different from one another.

[0016] According to the fifth aspect of the invention, the melt spinning device of any one of the first to fourth aspects is arranged such that the adjusting member is movable in the circumferential direction relative to the opening formation member.

[0017] According to the present invention, the aperture area of each of the first openings is adjustable by moving the adjusting member in the circumferential direction relative to the opening formation member.

[0018] According to the sixth aspect of the invention, the melt spinning device of any one of the first to fifth aspects is arranged such that each of the first openings is shaped to be a long hole which is long in the circumferential direction.

[0019] Because the first opening is long in the circumferential direction, gas generated during the spinning is exhausted to the outside through a wide range in the circumferential direction, and hence the gas is less likely to stagnate. When each first opening is not very long in the circumferential direction, the aperture area is significantly changed even if the adjusting member is only slightly slid in the circumferential direction, and hence fine adjustment of the aperture area is difficult. In this regard, because in the present invention the first opening is a long hole which is long in the circumferential direction, the adjustment of the aperture area by the adjusting member is easily done.

[0020] According to the seventh aspect of the invention, the melt spinning device of the first aspect is arranged such that the adjusting member is movable in an up-down direction relative to the opening formation member.

[0021] According to the present invention, the aperture area of each of the first openings is adjustable by moving the adjusting member in the up-down direction relative to the opening formation member.

[0022] According to the eighth aspect of the invention, the melt spinning device of the first aspect is arranged such that the adjusting member is movable in the circumferential direction and an up-down direction relative to the opening formation member.

[0023] According to the present invention, the aperture area of each of the first openings is adjustable by moving the adjusting member in the circumferential direction and the up-down direction relative to the opening formation member.

[0024] According to the ninth aspect of the invention,

the melt spinning device of any one of the first to eighth aspects is arranged such that, in the opening formation member and the adjusting member, a notch mechanism is provided to adjust the aperture area stepwise.

[0025] According to the present invention, because the aperture area of each first opening is adjustable stepwise by the notch mechanism, an operator can easily adjust the aperture area.

[0026] In any one of the first to ninth aspects of the invention, preferably, the adjusting member is able to adjust, within a range of 0 to 14%, a ratio of a total aperture area of the first openings to an area of a polymer discharging surface of the spinneret (tenth aspect).

15 BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a cross section of a melt spinning device of an embodiment.

FIG. 2 is a partial enlarged view of FIG. 1.

FIG. 3 (a) is a bottom view of a spinneret having nozzle holes each of which is circular in cross section and FIG. 3(b) is a bottom view of a spinneret having nozzle holes each of which is non-circular in cross section.

FIG. 4 is a cross section taken at the IV-IV line in FIG. 1.

FIG. 5 is viewed in the V-V line in FIG. 1.

FIG. 6(a) and FIG. 6(b) are a perspective view and a cross section showing an exhaust ring and an adjustment ring.

FIG. 7 is a table of yarn spinning conditions and the numbers of times of yarn breakage in each of an example and a comparative example of the present invention.

FIG. 8 is a partial enlarged cross section of an exhaust ring and an adjustment ring having a notch mechanism of a modification.

FIG. 9 is a perspective view of an exhaust ring and an adjustment ring of another modification.

FIG. 10 is a perspective view of an exhaust ring and an adjustment ring of another modification.

FIG. 11 is a cross section of an exhaust ring and an adjusting member of a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] The following will describe an embodiment of the present invention. FIG. 1 is a cross section of a melt spinning device of the present embodiment. FIG. 2 is a partial enlarged view of FIG. 1. The descriptions below assume that the up-down direction and the front-back direction in FIG. 1 are the up-down direction and the front-back direction of the melt spinning device of the present embodiment.

[0029] The melt spinning device 1 of the present embodiment includes members such as a spinning unit 2,

a cooling unit 3, and an oil guide 4. The spinning unit 2 includes a spinning beam 10 and pack housings 11 attached to the spinning beam 10. To the pack housings 11, spinning packs 12 are attached, respectively. The pack housings 11 (spinning packs 12) are staggered to form two lines along the direction orthogonal to the plane of FIG. 1. To the spinning pack 12 attached to each pack housing 11, molten polymer is supplied from an unillustrated pipe or the like in the spinning beam 10.

[0030] Each spinning pack 12 has, at its lower end portion, a spinneret 13 in which nozzle holes 14 are formed. FIG. 3 is a bottom view of the spinneret 13. The spinneret 13 may be a spinneret in which each nozzle hole 14 is circular in cross section as shown in FIG. 3 (a) or a spinneret in which each nozzle hole 14 is non-circular in cross section as shown in FIG. 3(b).

[0031] The spinning pack 12 spins out the supplied molten polymer through each nozzle hole 14 of the spinneret 13. The polymer spun out from the nozzle holes 14 is cooled at the later-described cooling unit 3 and becomes filaments f. To put it differently, one multi-filament yarn Y formed of plural filaments f is spun out from one spinneret 13. As shown in FIG. 3(a), when each nozzle hole 14 is circular in cross section, each spun-out filament f is circular in cross section, too. In the meanwhile, when each nozzle hole 14 is non-circular in cross section as shown in FIG. 3(b), each spun-out filament f is non-circular in accordance with the cross section of each nozzle hole 14. The spinneret 13 shown in FIG. 3(b) is used for producing filaments f which are non-circular in cross section.

[0032] As shown in FIG. 1 and FIG. 2, in the present embodiment, the spinneret 13 is provided to slightly protrude downward as compared to the lower surface of the spinning beam 10, and the lower surface (polymer discharging surface 13a) of the spinneret 13 where the nozzle holes 14 are formed is provided below the lower surface of the spinning beam 10. With this structure, the polymer discharging surface 13a of the spinneret 13 is easily cooled. In the present embodiment, to restrain the cooling of the polymer discharging surface 13a, a metal plate-shaped heater 15 is fixed to a lower end portion of the spinning beam 10. At a part of this heater 15 which part is directly below the spinning pack 12, a through hole is formed. The yarn Y spun out from the spinneret 13 passes through the through hole of the heater 15 and heads toward the cooling unit 3.

[0033] To the lower surface of the heater 15, an exhaust ring 16 is attached through the intermediary of an attaching plate 17. The details of the structure of the exhaust ring 16 will be given later.

[0034] FIG. 4 is a cross section taken at the IV-IV line in FIG. 1. The cooling unit 3 is provided below the spinning unit 2 to cool and solidify the molten polymer spun out from the spinning packs 12. The cooling unit 3 is arranged to be movable in the up-down direction by an unillustrated cylinder. As the cooling unit 3 is moved downward away from the spinning unit 2, the replacement of the spinning

pack 12 and the cleaning of the polymer discharging surface 13a of the spinneret 13 become possible. As shown in FIG. 1, FIG. 2, and FIG. 4, the cooling unit 3 includes a cooling wind supplying box 20, cooling cylinders 21 housed in the cooling wind supplying box 20, and partitioning cylinders 22.

[0035] On the top surface of the cooling wind supplying box 20, a packing 24 is provided. As the cooling unit 3 is moved up by the cylinder, the lower end of the exhaust ring 16 on the spinning unit 2 side is pressed onto the packing 24, with the result that a gap between the lower surface of the exhaust ring 16 and the upper surface of the cooling unit 3 is sealed.

[0036] The internal space of the cooling wind supplying box 20 is partitioned into upper and lower spaces by a horizontal flow adjustment plate 23 made of a material having flow adjustment capability such as punching metal. In the upper space of the cooling wind supplying box 20, the cooling cylinders 21 are provided directly below the spinning packs 12. To put it differently, the cooling cylinders 21 are staggered in accordance with the arrangement of the spinning packs 12, as shown in FIG. 4. The wall of each cooling cylinder 21 is, in a manner similar to the flow adjustment plate 23, made of a material having flow adjustment capability such as punching metal. In the meanwhile, in the lower space of the cooling wind supplying box 20, the partitioning cylinders 22 are provided directly below the cooling cylinders 21. Being different from the cooling cylinder 21, the wall of each partitioning cylinder 22 is made of an air-impermeable material.

[0037] The yarn Y spun out from the spinning pack 12 and made of the filaments f passes through the internal space of the cooling cylinder 21 directly below the spinning pack 12 and the internal space of the partitioning cylinder 22 in order. In the meanwhile, as shown in FIG. 1, the lower space of the cooling wind supplying box 20 is connected with a duct 25, and cooling wind is supplied to the lower space through the duct 25. The cooling wind having flown into the lower space of the cooling wind supplying box 20 is adjusted upward while passing through the horizontal flow adjustment plate 23, and reaches the upper space of the cooling wind supplying box 20. In this regard, because the wall of each partitioning cylinder 22 is air-impermeable, the cooling wind does not directly flows from the lower space of the cooling wind supplying box 20 into the partitioning cylinders 22. The cooling wind having flown into the upper space of the cooling wind supplying box 20 is adjusted when passing through the wall of the cooling cylinder 21, and flows into the inside of the cooling cylinder 21. In the cooling cylinder 21, cooling wind is applied to the yarn Y made of the filaments f from the entire outer circumference of the cooling cylinder 21, with the result that the yarn Y is cooled.

[0038] The oil guide 4 is provided below the cooling cylinder 21 and the partitioning cylinder 22. With this oil guide 4, the yarn Y having been cooled at the cooling cylinder 21 makes contact. In so doing, the oil guide 4

discharges oil to the yarn Y so that the oil is applied to the yarn Y. The yarn Y to which the oil has been applied by the oil guide 4 is taken up by a take-up roller (not illustrated) provided below the oil guide 4. The yarn Y is then sent to a winding device (not illustrated) and is wound onto a bobbin (not illustrated) at the winding device.

[0039] Now, the exhaust ring 16 (equivalent to an opening formation member of the present invention) will be described. FIG. 5 is viewed the V-V line in FIG. 1. FIG. 6 (a) and FIG. 6(b) are a perspective view and a cross section showing the exhaust ring 16 and the adjustment ring 26. As shown in FIG. 2, the metal attaching plate 17 is fixed to the heater 15. As shown in FIG. 2, FIG. 5, and FIG. 6, in the attaching plate 17, through holes 17a are formed to correspond to the spinning packs 12, respectively. On the lower surface of the attaching plate 17, metal exhaust rings 16 are attached to communicate with the respective through holes 17a.

[0040] As shown in FIG. 6, in the exhaust ring 16, three openings 16a (equivalent to first openings of the present invention) are formed at intervals in the circumferential direction. The three openings 16a are formed at trisection positions in the circumferential direction of the exhaust ring 16. In other words, the openings 16a neighboring each other in the circumferential direction form an angle of 120 degrees. Each opening 16a is formed to be a long hole which is long in the circumferential direction.

[0041] Outside the exhaust ring 16, the adjustment ring 26 (equivalent to the adjusting member of the present invention) is mounted. The adjustment ring 26 is attached to be slidable in the circumferential direction relative to the exhaust ring 16. The adjustment ring 26 can be fixed not to be slidable relative to the exhaust ring 16, by means of a suitable stopper 27 such as a setscrew or a bolt.

[0042] In the adjustment ring 26, three openings 26a (equivalent to second openings of the present invention) are formed to correspond to the three openings 16a of the exhaust ring 16, respectively. The three openings 26a are formed at trisection positions in the circumferential direction of the adjustment ring 26. Each opening 26a is substantially identical in shape with the opening 16a of the exhaust ring 16 and is formed to be a long hole which is long in the circumferential direction.

[0043] As the adjustment ring 26 is rotated relative to the exhaust ring 16 and the positions of the openings 16a of the exhaust ring 16 are aligned with the positions of the openings 26a of the adjustment ring 26, the three openings 16a communicate with the three openings 26a, with the result that the space directly below the spinneret 13 communicates with the outside air. With this, gas including a sublimable material generated during spinning is immediately exhausted through the openings 16a, and hence adherence of the sublimable material to the polymer discharging surface 13a of the spinneret 13 is restrained. The occurrence of yarn breakage is therefore restrained and the cleaning of the polymer discharging surface 13a of the spinneret 13 is less frequently re-

quired.

[0044] When the spinneret 13 having the nozzle holes 14 which are non-circular shown in FIG. 3(b) is used, the filament f immediately after the spun out from the nozzle hole 14 is non-circular in cross section in accordance with the shape of the nozzle hole 14. At this stage, however, the polymer is still highly fluid, and hence the cross sectional shape of the filament f is, due to the surface tension, changed from the cross sectional shape of the nozzle hole 14 to a cross sectional shape close to the circular shape as the filament f is cooled and solidified. It is therefore difficult to obtain a filament f having a desired shape which is close to the cross sectional shape of the nozzle hole 14. To arrange the cross sectional shape of the filament f to be close to the nozzle hole shape as much as possible, it is preferable that the filament f is cooled and solidified immediately after being spun out. In this regard, in the present embodiment, because the three openings 16a are formed in the exhaust ring 16 between the spinning unit 2 and the cooling cylinder 21, the effect of cooling the filament f at a position directly below the spinneret 13 is enhanced. This makes it possible to arrange the cross sectional shape of the filament f to be close to the desired shape.

[0045] In the meanwhile, when the openings 16a are open, the polymer discharging surface 13a of the spinneret 13 is easily cooled. On this account, depending on the yarn spinning condition, it is at times preferable to reduce the exhaust volume by reducing the aperture area of each opening 16a in order to restrain the cooling of the polymer discharging surface 13a. For example, when the aperture of the nozzle hole 14 is small and the filament f to be spun out is narrow, the influence of the cooling of the spinneret 13 is significant and yarn breakage tends to occur. In this regard, in the present embodiment, the aperture area of each opening 16a can be adjusted by sliding the adjustment ring 26 in the circumferential direction according to the yarn spinning condition to block at least a part of the opening 16a by the adjustment ring 26.

[0046] Now, the ratio R (%) of the total area (effective aperture area) of parts of the three openings 16a of the exhaust ring 16, which are open and not closed by the adjustment ring 26, to the area of the polymer discharging surface 13a of the spinneret 13 is defined as below. $R(\%) = (\text{total of effective aperture areas of three openings 16a}) / (\text{area of polymer discharging surface 13a}) \times 100$. The aperture ratio R is at the maximum when the openings 16a of the exhaust ring 16 overlap the openings 26a of the adjustment ring 26. In the present embodiment, the maximum value R_{max} of the aperture ratio R is 14%. The aperture ratio R is at the minimum when the three openings 16a of the exhaust ring 16 are completely closed by the adjustment ring 26. The minimum value R_{min} of the aperture ratio is 0%. In other words, in the present embodiment, the aperture ratio R is adjustable within the range of $0 \leq R \leq 14$ by the adjustment ring 26.

[0047] The adjustment of the aperture area of the ex-

haust ring 16 is performed for all exhaust rings 16 provided for the respective spinning packs 12. In so doing, when the spinning packs 12 are identical in the yarn spinning condition (e.g., yarn brand), the angle of each adjustment ring 26 is adjusted so that the aperture areas of the openings 16a are identical between the exhaust rings 16.

[0048] As described above, according to the present embodiment, the aperture area of each of the three openings 16a is adjustable by simply moving the adjustment ring 26 in the circumferential direction relative to the exhaust ring 16. It is therefore easy to change the aperture area of each opening 16a in accordance with the yarn spinning condition.

[0049] Because the three openings 16a are provided at equal intervals in the circumferential direction in the exhaust ring 16, the airflow in the cooling cylinder 21 is less likely to be disturbed, and hence the yarn Y is evenly cooled. In addition to the above, because the gas including the sublimable material directly below the spinneret 13 is evenly ejected through the three openings 16a which are provided at equal intervals, local stagnation of the gas is prevented.

[0050] Because each opening 16a of the exhaust ring 16 is long in the circumferential direction, gas generated during the spinning is exhausted to the outside through a wide range in the circumferential direction, and hence the gas is less likely to stagnate. When each opening 16a is not very long in the circumferential direction, the aperture area is significantly changed even if the adjustment ring 26 is only slightly slid in the circumferential direction, and hence fine adjustment of the aperture area is difficult. In this regard, because in the present embodiment each opening 16a is a long hole which is long in the circumferential direction, the adjustment of the aperture area by the adjustment ring 26 is easily done.

[0051] In the present embodiment, in the adjustment ring 26, three openings 26a are formed to correspond to the three openings 16a of the exhaust ring 16, respectively. On this account, when the adjustment ring 26 is slid in the circumferential direction, the degrees of overlap between the three openings 16a and the three openings 26a are changed at once. In this way, the aperture areas of the three openings 16a are adjusted at once for the same amount of change. This prevents the aperture areas of the three openings 16a from becoming different from one another.

(Example)

[0052] Now, an example showing an effect of the openings 16a of the exhaust ring 16 will be specifically described in comparison with a comparative example in which no opening 16a is formed. FIG. 7 is a table of yarn spinning conditions and the numbers of times of yarn breakage in each of the example and the comparative example.

[0053] In the comparative example with no opening

16a, as shown in FIG. 7, the aperture area of the exhaust ring was 0mm^2 (i.e., the aperture ratio R was 0%). In this case, the number of time of yarn breakage per 1 ton of discharged polymer was two. In the meanwhile, in the example with the openings 16a, provided that the effective aperture area of the exhaust ring 16 was 283.9mm^2 and the aperture ratio R was 5.0%, the number of times of yarn breakage per 1 ton was 0.6. As such, the frequency of the yarn breakage was significantly decreased.

[0054] Now, modifications of the embodiment above will be described. The members identical with those in the embodiment above will be denoted by the same reference numerals and the explanations thereof are not repeated.

[0055] 1] The number of the openings 16a formed in the exhaust ring 16 is not limited to three. For example, four or more openings 16a may be formed in the exhaust ring 16. Alternatively, the number of the openings 16a of the exhaust ring 16 may be two. Furthermore, in the exhaust ring 16, a lot of (e.g., 10 or more) small openings 16a may be lined up in the circumferential direction.

[0056] 2] While in the embodiment above the adjustment ring 26 is provided outside the exhaust ring 16, the adjustment ring 26 may be provided inside the exhaust ring 16.

[0057] 3] While in FIG. 1 of the embodiment above the heater 15 is provided below the spinning unit 2, the heater 15 may be omitted when the polymer discharging surface 13a is structurally less likely to be cooled because, for example, the polymer discharging surface 13a of the spinneret 13 is provided at an upper part as compared to FIG. 1.

[0058] 4] As mentioned in the embodiment above, the aperture areas of the exhaust rings 16 are required to be identical when the spinning packs 12 are identical in the yarn spinning condition (e.g., yarn type). However, it may not be easy by means of manual adjustment by an operator to arrange the positions (rotation angles) of the adjustment rings 26 to be identical for all exhaust rings 16. Therefore an arrangement for assisting the adjustment of the aperture area of the adjustment ring 26 is preferably provided.

[0059] For example, a notch mechanism 30 for adjusting the aperture area stepwise may be provided in the exhaust ring 16 and the adjustment ring 26. FIG. 8 is a partial enlarged cross section of the exhaust ring 16 and the adjustment ring 26 having the notch mechanism of a modification. In FIG. 8, plural concave notches 31 (indentations) are formed on the outer circumferential surface of the exhaust ring 16. In the meanwhile, in the adjustment ring 26, a ball 32 and a spring 33 biasing the ball 32 inward in the radial direction are provided. The ball 32 biased by the spring 33 is engaged with the concave notch 31, with the result that the exhaust ring 16 and the adjustment ring 26 are aligned. As the adjustment ring 26 is rotated with a little more power, the ball 32 is pushed up against the biasing force of the spring 33 and goes out from the notch 31, and as the adjustment ring

26 is further rotated, the ball 32 is engaged with the neighboring notch 31. According to this arrangement, because the notch mechanism 30 allows the aperture area of the exhaust ring 16 to be adjusted by stepwise rotation of the adjustment ring 26, it becomes easy to correctly set the position (angle) of each adjustment ring 26 in order to obtain a predetermined aperture area. The aperture areas of all exhaust rings 16 are therefore easily arranged to be identical.

[0060] In addition to the above, a scale may be provided on the exhaust ring 16 or the adjustment ring 26 to allow an operator to visually understand the rotation angle of the adjustment ring 26. Alternatively, openings 26a of plural types, which are different from one another in the length in the circumferential direction, may be formed in the adjustment ring 26 for one opening 16a of the exhaust ring 16, and one of these openings 26a of the different types may be selected and matched with the opening 16a of the exhaust ring 16.

[0061] 5] While in the embodiment above the adjustment ring 26 is movable in the circumferential direction relative to the exhaust ring 16, the adjustment ring may be movable in the up-down direction. For example, in FIG. 9, an opening 40a is formed in an upper half of an exhaust ring 40. Outside this exhaust ring 40, an adjustment ring 41 is attached. Although not shown in FIG. 9, the outer circumference of the exhaust ring 40 and the inner circumference of the adjustment ring 41 are both threaded, and as the adjustment ring 41 is rotated, the adjustment ring 41 moves up or down relative to the exhaust ring 40. As the adjustment ring 41 moves up or down relative to the exhaust ring 40, the area of the opening 40a of the exhaust ring 40 which area is covered with the adjustment ring 41 is changed, with the result that the aperture area of the exhaust ring 40 is adjusted. The position of the adjustment ring 41 after the adjustment may be fixed by means of a setscrew 42.

[0062] According to this arrangement, when the distance between the attaching plate 17 and the upper end of the adjustment ring 41 is determined, the effective aperture area of the opening 40a is determined based on the determined distance and the fixed values such as the sizes of the exhaust ring 40 and the adjustment ring 41. In this connection, for example, the aperture area of the exhaust ring 40 is easily adjusted to a desired area as the up-down position of the adjustment ring 41 is adjusted by inserting a tool for gap adjustment into the gap between the attaching plate 17 and the adjustment ring 41. The aperture areas of all exhaust rings 40 are therefore easily arranged to be identical.

[0063] When the resistance of the screw mechanism between the exhaust ring 40 and the adjustment ring 41 is high, the setscrew 42 for fixing the position of the adjustment ring 41 may be omitted. In addition to the above, the screw mechanism between the exhaust ring 40 and the adjustment ring 41 is not prerequisite. The adjustment ring 41 may be slid in the up-down direction while frictionally making contact with the exhaust ring 40. In this

case, the adjustment ring 41 is preferably fixed firmly by a setscrew 42 or the like in order to prevent the adjustment ring 41 to move in the up-down direction relative to the exhaust ring 40.

[0064] 6] An adjustment ring 51 may be movable in the circumferential direction and the up-down direction relative to the exhaust ring 50. For example, in FIG. 10, openings 50a are formed in the exhaust ring 50 in the circumferential direction at intervals. Furthermore, at a part of the exhaust ring 50 which part is between neighboring openings 50a, a long hole 50b which is long in the up-down direction is formed. In the meanwhile, in an upper half of the adjustment ring 51, openings 51a are formed to correspond to the openings 50a of the exhaust ring 50. Each opening 51a is a notch cut off from the upper end side. Furthermore, at a part of the adjustment ring 51 which part is between neighboring openings 51a, a long hole 51b which is long in the circumferential direction is formed. The long hole 50b of the exhaust ring 50 is partially overlapped with the long hole 51b of the adjustment ring 51, and a bolt 52 is inserted at the overlapped part.

[0065] Because the long hole 51b extending in the circumferential direction is formed in the adjustment ring 51, the adjustment ring 51 is movable in the circumferential direction relative to the exhaust ring 50, when the bolt 52 is loosened. Furthermore, because the exhaust ring 50 has the long hole 50b extending in the up-down direction, the adjustment ring 51 is movable in the up-down direction relative to the exhaust ring 50. As the adjustment ring 51 is moved in the circumferential direction and the up-down direction, the overlapped area between the opening 50a of the exhaust ring 50 and the opening 51a of the adjustment ring 51 is changed, with the result that the aperture area of the exhaust ring 50 is adjusted.

[0066] When the aperture area is adjustable by moving the adjustment ring 51 in the circumferential direction and the up-down direction as shown in FIG. 10, an adjustment method such that the two moving directions of the adjustment ring 51 are arranged to correspond to different yarn spinning conditions and the position of the adjustment ring 51 is adjusted is possible. For example, the adjustment ring 51 is moved in the up-down direction to adjust the aperture area for the fineness of the yarn Y whereas the adjustment ring 51 is moved in the circumferential direction to adjust the aperture area for the fineness of the filament f.

[0067] 7] The member for adjusting the aperture area of the exhaust ring may not be ring-shaped. For example, in FIG. 11, three adjusting members 60 each of which is circulararc-shaped are provided outside the exhaust ring 16 to correspond to the three openings 16a, respectively. Outside the three adjusting members 60, a ring member 61 is attached to prevent the adjusting members 60 from dropping off. The three adjusting members 60 are movable in the circumferential direction between the exhaust ring 16 and the ring member 61. As each adjusting mem-

ber 60 is moved in the circumferential direction, the area of the opening 16a of the exhaust ring 16 is adjustable. Each adjusting member 60 is positionally fixed by a fixing tool 62 such as a bolt provided in the ring member 61.

[0068] In FIG. 11, the three adjusting members 60 are separated from one another and are moved one by one when the adjustment is carried out. In this regard, the three adjusting members 60 may be connected with one another by suitable connection members, so that the three adjusting members 60 are moved together.

[0069] 8] In the embodiment above, the adjustment ring (adjusting member) is movable relative to the exhaust ring (opening formation member). On the contrary, the adjusting member may be fixed and the opening formation member may be movable relative to the adjusting member.

Claims

1. A melt spinning device comprising: a spinning unit to which a spinning pack having a spinneret is attached and which is configured to spin out a yarn through the spinneret; and a cooling cylinder provided below the spinning unit to cool the yarn spun out from the spinneret, the melt spinning device further comprising:

an opening formation member provided between the spinning unit and the cooling cylinder, first openings being formed in the opening formation member at intervals in a circumferential direction; and

an adjusting member attached inside or outside of the opening formation member to be movable relative to the opening formation member, the adjusting member adjusting an aperture area of each of the first openings.

2. The melt spinning device according to claim 1, wherein, the number of the first openings formed in the opening formation member is three or more.
3. The melt spinning device according to claim 1 or 2, wherein, the first openings are provided at regular intervals in the circumferential direction.
4. The melt spinning device according to any one of claims 1 to 3, wherein, the adjusting member is ring-shaped, and in the adjusting member, second openings are formed to be communicable with the first openings of the opening formation member, respectively.
5. The melt spinning device according to any one of claims 1 to 4, wherein,

the adjusting member is movable in the circumferential direction relative to the opening formation member.

6. The melt spinning device according to any one of claims 1 to 5, wherein, each of the first openings is shaped to be a long hole which is long in the circumferential direction.
7. The melt spinning device according to claim 1, wherein, the adjusting member is movable in an up-down direction relative to the opening formation member.
8. The melt spinning device according to claim 1, wherein, the adjusting member is movable in the circumferential direction and an up-down direction relative to the opening formation member.
9. The melt spinning device according to any one of the claims 1 to 8, wherein, in the opening formation member and the adjusting member, a notch mechanism is provided to adjust the aperture area stepwise.
10. The melt spinning device according to any one of the claims 1 to 9, wherein, the adjusting member is able to adjust, within a range of 0 to 14%, a ratio of a total aperture area of the first openings to an area of a polymer discharging surface of the spinneret.

FIG.1

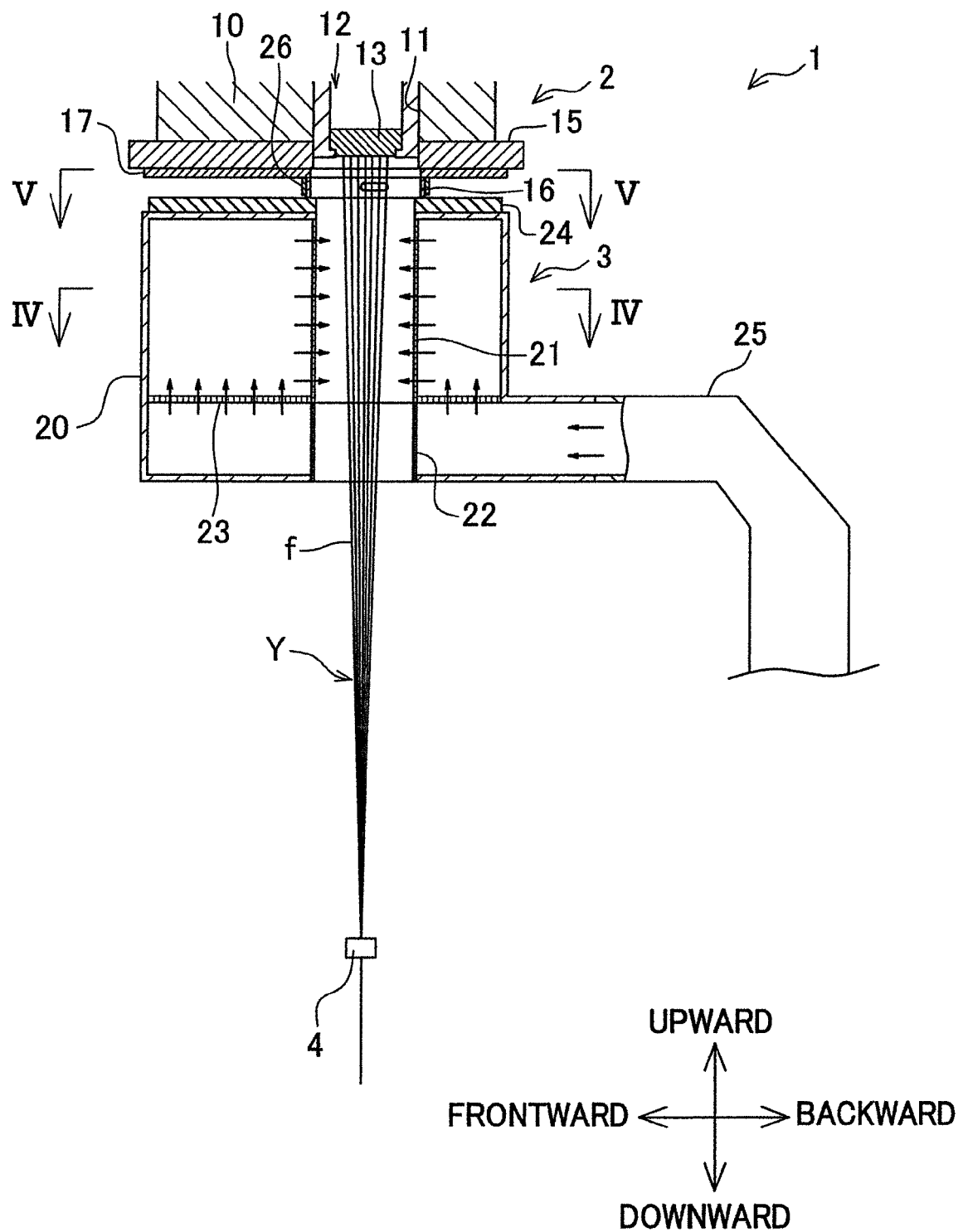


FIG.2

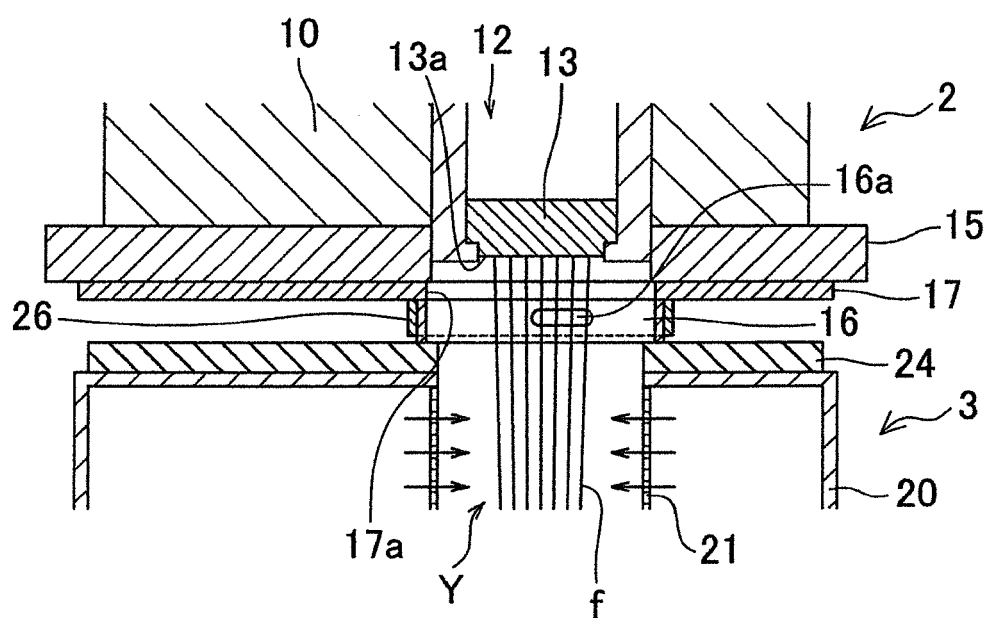


FIG.3

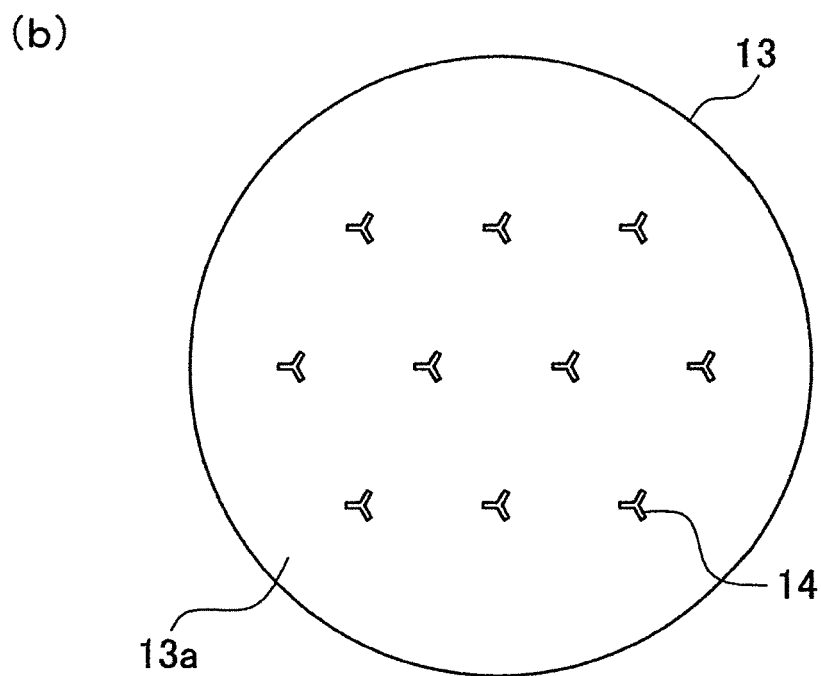
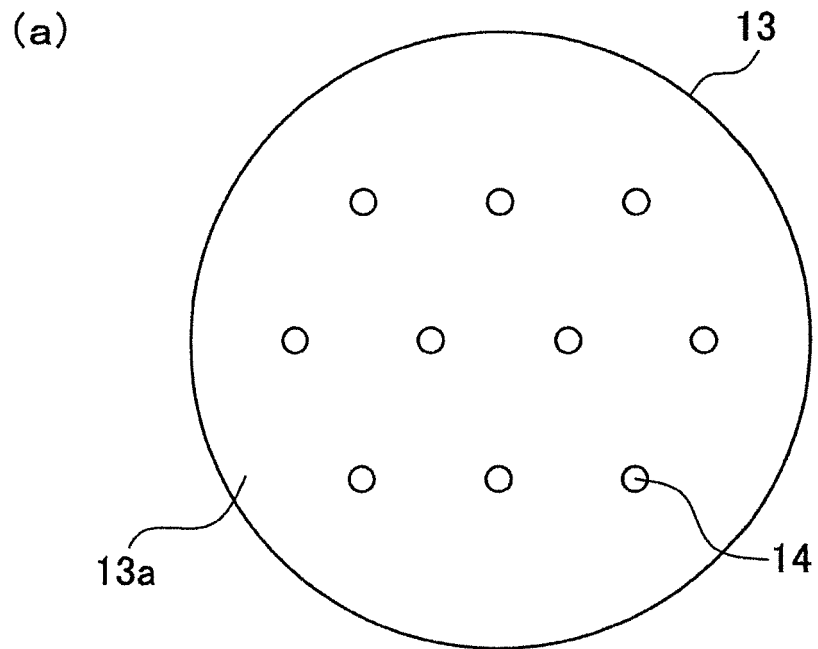


FIG.4

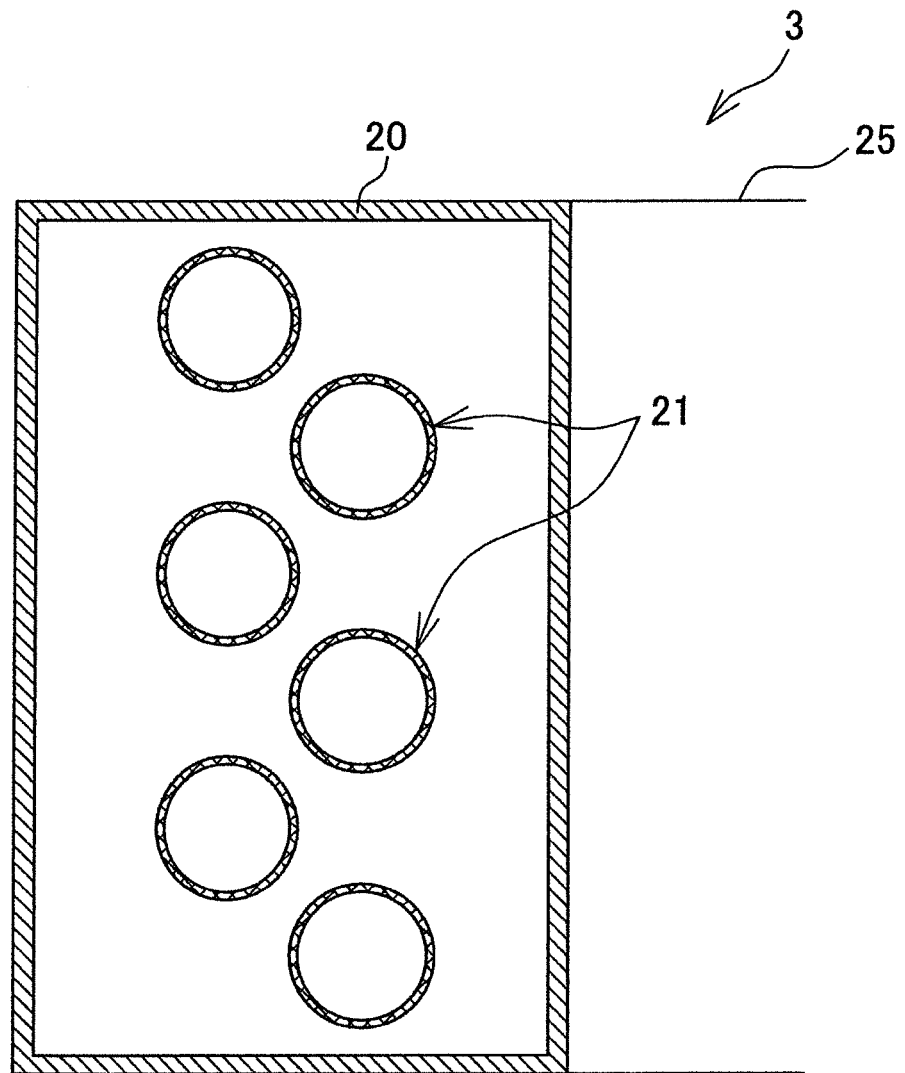


FIG.5

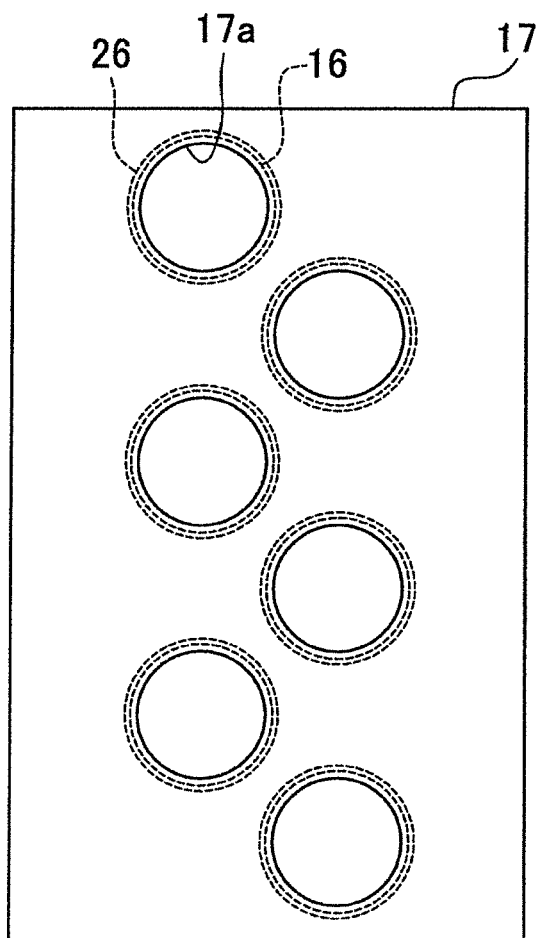


FIG.6

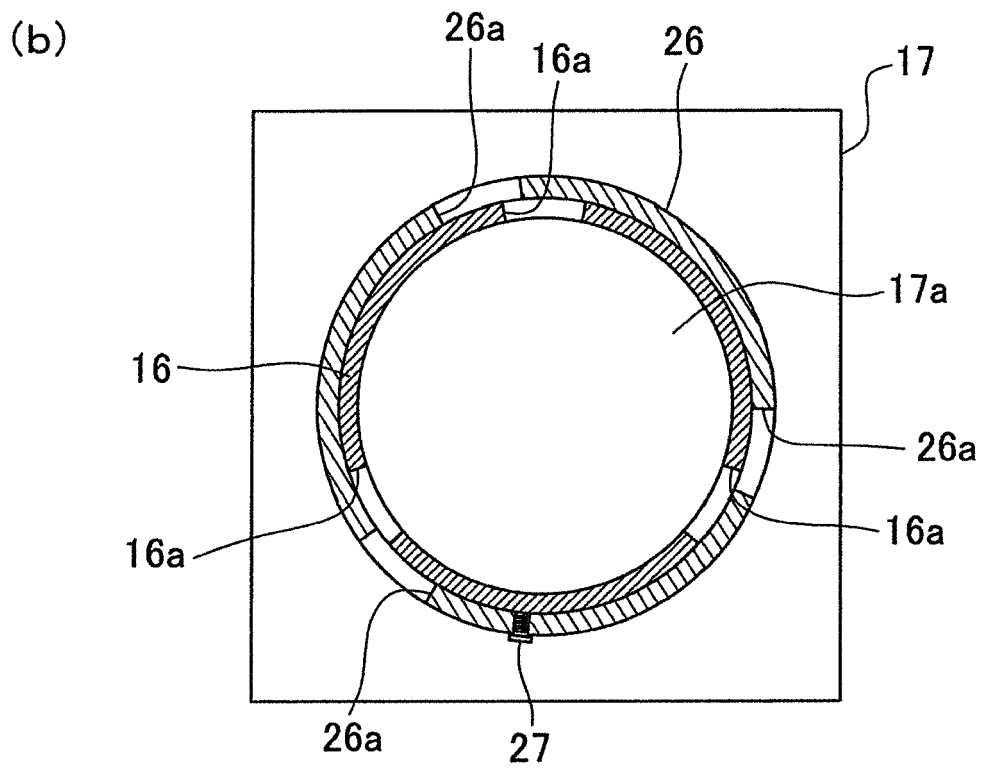
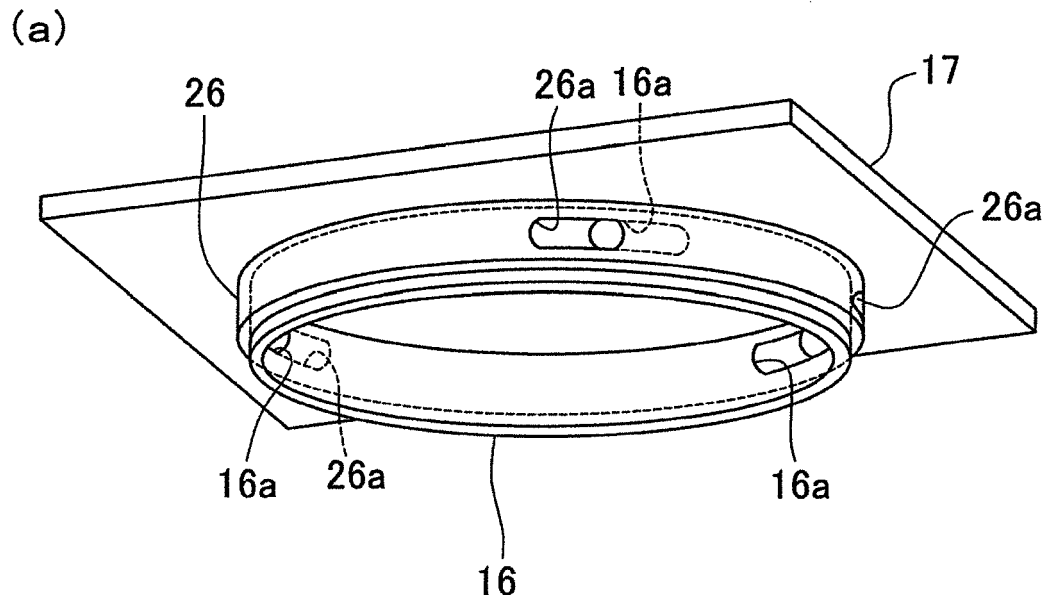


FIG.7

		EXAMPLE	COMPARATIVE EXAMPLE
SPINNERET DIAMETER		ϕ 85	ϕ 85
TOTAL OF EFFECTIVE APERTURE AREAS(mm ²)		283.9	0
APERTURE RATIO R		5	0
YARN BRAND	(dtex/f)	82/36	82/36
HEATER TEMPERATURE	(°C)	295	290
WINDING SPEED	(m/min)	4805	4810
NUMBER OF TIMES OF YARN BREAKAGE		0.6 TIME/ton	TWICE/ton

FIG.8

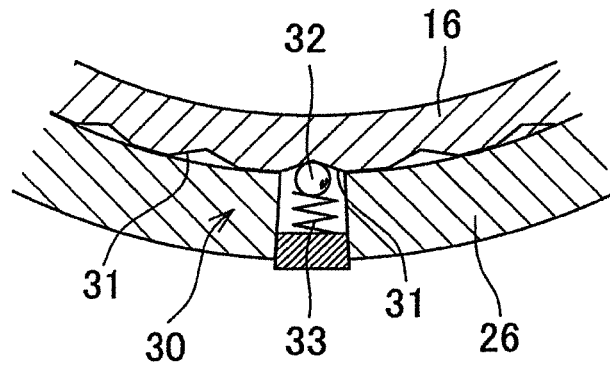


FIG.9

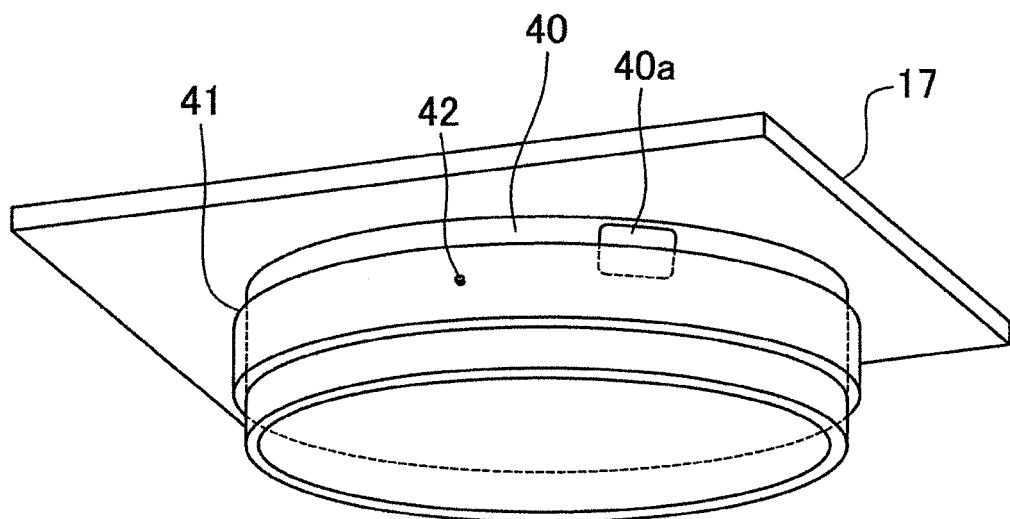


FIG.10

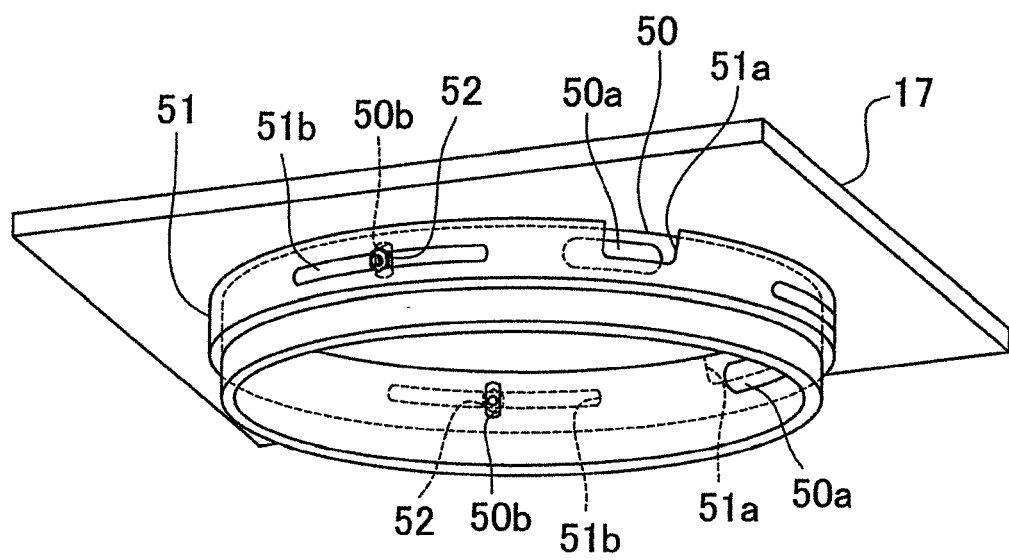
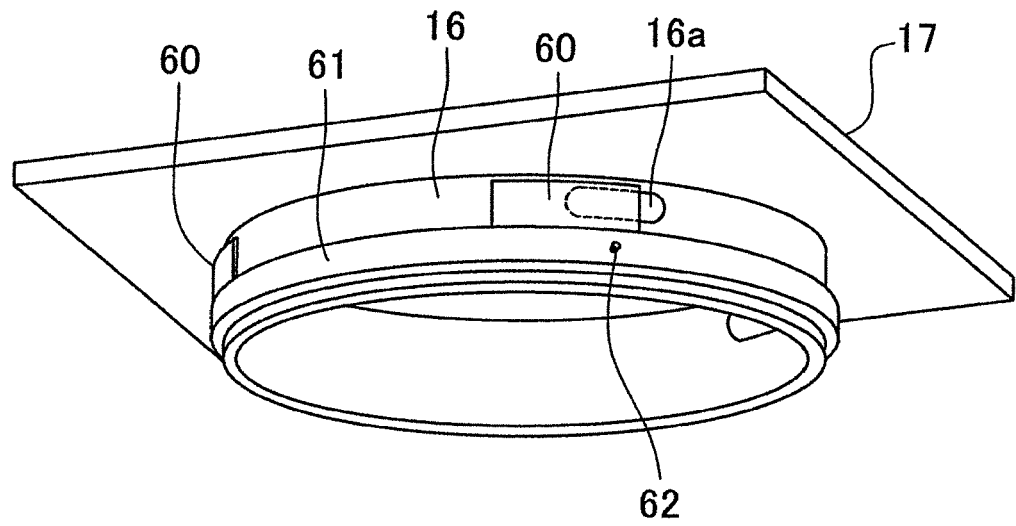
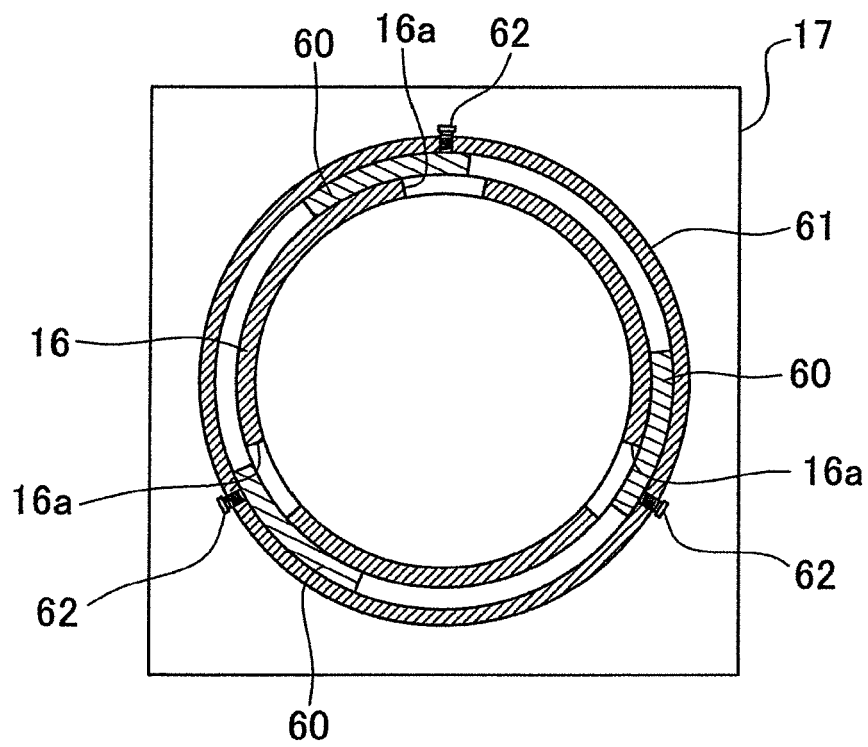


FIG.11

(a)



(b)





EUROPEAN SEARCH REPORT

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A	----- CN 202 401 170 U (BEIJING CHONGLEE MACHINERY ENG) 29 August 2012 (2012-08-29) * figure 1 * * paragraphs [0022], [0025] *	1-10	
A	----- US 2006/145385 A1 (FUJII TAKASHI [JP] ET AL) 6 July 2006 (2006-07-06) * figure 19 * * paragraphs [0134] - [0140] *	1-10	
A	----- WO 2008/071658 A2 (OERLIKON TEXTILE GMBH & CO KG [DE]; HARRIS WILEY SCOTT [US]; LU FUMIN) 19 June 2008 (2008-06-19) * figures 1-4 * * page 5, line 20 - page 6, line 3 * * page 16, lines 21-30 *	1-10	TECHNICAL FIELDS SEARCHED (IPC) D01D D04H
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Place of search The Hague		Date of completion of the search 2 February 2017	Examiner Verschuren, Jo
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The members are as contained in the European Patent Office EDP file on
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