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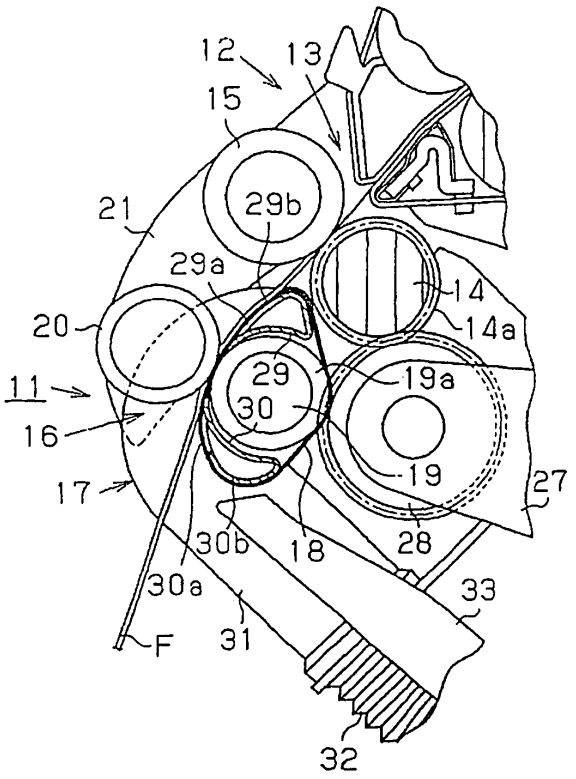
(54) Fibre condensing device for a spinning machine

(57) A fiber bundle collecting device (11) is provided on a downstream side of a final delivery roller pair (13) of a drafting device (12), and has a nip roller pair (16), a sucking portion (17) with guide surfaces (29b) and (30b) equipped with suction holes (29a) and (30a) in a moving direction of a fiber bundle (F), with a nipping point of the nip roller pair (16) therebetween, and a perforated belt (18) rotated while in slide contact with the guide surfaces (29b) and (30b). The perforated belt (18) is formed of a plain-woven fabric in a loop-like configuration, and a thermal fusion yarn (34) is used as a yarn forming the fabric, with the thermal fusion yarn (34) being fused at crossing portions (35). The thermal fusion yarn (34) has a core portion (34b) and a sheath portion (34a) which are both formed of polyamide.

FIG. 1A



EP 1 612 309 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a fiber bundle collecting device for a spinning machine, and more specifically to a fiber bundle collecting device arranged, for example, downstream of a drafting device (drafting part) of a fine spinning machine and adapted to collect a fiber bundle drafted by the drafting device.

Description of the Related Art

[0002] There have been proposed various fiber bundle collecting devices adapted to previously collect a drafted fiber bundle prior to twisting to thereby achieve an improvement in yarn quality, such as a reduction in fluff. To provide basic functions of collecting and transporting the fiber bundle, an endless perforated belt is used (see, for example, JP 2000-34631 A and JP 2003-113540 A). JP 2000-34631 A discloses a technique according to which the transport belt (endless perforated belt) is formed of a fabric using a polyamide multi-filament yarn with a diameter of less than 0.1 mm, whereby the suction airflow is made uniform to thereby enhance the suction efficiency. As the fabric, a plain-woven fabric is used. JP 2003-113540 A discloses a technique according to which the endless perforated belt (air-permeable apron) is formed of a woven fabric.

[0003] However, in the case where the endless perforated belt is formed of a fabric, when breakage of the yarn of the fabric forming the perforated belt or a fray of an end portion of the perforated belt occurs during spinning, the yarn end resulting from the breakage or the frayed yarn end gets entangled with the fiber bundle being spun, thus adversely affects the collecting of the fibers, which may lead to yarn breakage and a defective yarn quality. Further, when fraying starts to occur, there is a fear of the perforated belt being early brought into a state in which it can be no longer used. According to JP 2000-34631 A, the longitudinal edge of the transport belt (perforated belt) may be fused; however, the publication teaches nothing regarding the portions other than the end portion.

[0004] Further, in the case where the perforated belt is formed of a fabric, fibers of the fiber bundle being spun are likely to be caught by crossing portions of the yarn forming the fabric. When a fiber is caught by such a crossing portion, the fiber caught adversely affects the fiber bundle, thus can lead to yarn breakage or a defective yarn quality, so that it is necessary to clean the perforated belt frequently or replace the perforated belt with a new one. Further, when cleaning the perforated belt, the fibers caught in yarn crossing portions cannot be easily removed by a blast of compressed air or the like, and their removal takes time and effort.

SUMMARY OF THE INVENTION

[0005] The present invention has been made in view of the above problems in the prior art. It is an object of the present invention to provide a fiber bundle collecting device for a spinningmachine which prevents fibers being spun from being caught by and adhering to crossing portions of a yarn forming a perforated belt to thereby achieve an improvement in terms of spinning performance and which can facilitate the operation of removing the fibers adhering to the perforated belt, without involving a deterioration in the collecting/transporting function of the fiber bundle collecting device.

[0006] To achieve the above object, the present invention provides a fiber bundle collecting device for a spinning machine which collects a fiber bundle drafted by a drafting part. The fiber bundle collecting device is equipped with: a delivery portion provided on a downstream side of a final delivery roller pair of the drafting part and provided with a nip roller; a sucking portion having a guide surface provided with a suction hole, at least on an upstream side of a nipping point of the delivery portion with respect to a moving direction of the fiber bundle; and a perforated belt rotated so as to slide on the guide surface. The perforated belt is formed of a sheet-like material in which a yarn has crossing portions as in a woven fabric or a knitted fabric, and the yarn is fused at the crossing portions. Here, the term "sheet-like material" includes not only a plain-woven fabric, a twill fabric, and a knitted fabric, but also a fabric in which two yarn layers, each formed of yarn arranged in one direction, are stacked together, with the respective yarn arrangement directions of the yarn layers crossing each other and the yarn crossing portions being fused.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the accompanying drawings:

Fig. 1A is a schematic side view, partly in section, of a fiber bundle collecting device according to an embodiment of the present invention;
Fig. 1B is a schematic perspective view of a perforated belt;
Fig. 1C is a schematic diagram showing yarn crossing portions of the perforated belt;
Fig. 1D is a schematic diagram for illustrating an open area ratio;
Fig. 2 is a partial schematic view showing a relationship between a sucking portion and a bottom nip roller;
Fig. 3A is a schematic diagram showing a relationship between a warp and weft in a plain-woven fabric;
Fig. 3B is a schematic diagram showing a relationship between a warp and weft in a twill fabric;
Fig. 4 is a schematic diagram showing a construction of a sheet-like material forming the perforated belt according to another embodiment; and

Fig. 5 is a schematic side view of the fiber bundle collecting device according to another embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] In the following, a fiber bundle collecting device according to an embodiment of the present invention mounted in a fine spinning machine will be described with reference to Figs. 1A through 3B. Fig. 1A is a schematic side view, partly in section, of the fiber bundle collecting device, Fig. 1B is a schematic perspective view of a perforated belt, Fig. 1C is a schematic diagram showing yarn crossing portions of the perforated belt, and Fig. 1D is a schematic diagram for illustrating an open area ratio. Fig. 2 is a partial schematic view showing a relationship between a sucking portion and a bottom nip roller as seen from the obliquely upper left side in Fig. 1A, without a top roller side portion.

[0009] The fiber bundle collecting device is basically of the same construction as the fiber bundle collecting device as disclosed in JP 2003-113540 A, previously filed by the present applicant. As shown in Fig. 1A, a fiber bundle collecting device 11 is provided on a downstream side of a final delivery roller pair 13 of a drafting device 12 as a drafting part. The final delivery roller pair 13 is composed of a front bottom roller 14 and a front top roller 15.

[0010] The fiber bundle collecting device 11 is equipped with a nip roller pair 16 as a delivery portion, a sucking portion 17, and a perforated belt 18. The nip roller pair 16 is composed of a bottom nip roller 19a serving as a driving roller portion formed on a rotation shaft 19 arranged parallel to the front bottom roller 14, and a top nip roller 20 pressed against the bottom nip roller 19a through the intermediation of the perforated belt 18. Like the front top roller 15 of the drafting device 12, the top nip roller 20 is supported, for each two spindles, by a weighting arm (not shown) through a support member 21. The support member 21 is formed integrally with the support member of the front top roller 15.

[0011] As shown in Fig. 2, the bottom side portion of the fiber bundle collecting device 11 is formed by using half the number of the spindles arranged between roller stands 22 of the drafting device 12, which, in this embodiment, are four spindles as one unit. At an intermediate position of the roller stands 22 arranged at a predetermined interval in the longitudinal direction of the machine frame, there is arranged a support arm 23 in a state in which it is supported at the proximal end by a support beam (not shown) extending in the longitudinal direction of the machine frame on the rear side of a back bottom roller (not shown), with the rotation shaft 19 being supportedbetween the roller stand 22 and the support arm 23.

[0012] The rotation shaft 19 is formed in a predetermined length corresponding to a plurality of spindles (which, in this embodiment, are four spindles), and bearings (not shown) fixed to both ends thereof are fitted into end plugs 25. And, the end plugs 25 are supported at fit-engagement portions 25a by support portions 22a and 23a provided on the roller stands 22 and the support arms 23, whereby each of the rotation shafts 19 is rotatably supported between the roller stand 22 and the support arm 23. The support portions 22a and 23a are formed so as to be capable of supporting two end plugs 25, thus making it possible to support the end plugs 25 mounted to the ends of the rotation shafts 19 adjacent to each other.

[0013] At the longitudinal center of each rotation shaft 19, there is provided a gear 26 serving as a torque transmitting portion for transmitting a torque of a drive source. The gear 26 is formed integrally with the rotation shaft 19. In this embodiment, the front bottom roller 14 is used as the drive source for the rotation shaft 19. On the front bottom roller 14, there is formed a gear portion 14a (shown in Fig. 1A) at a position opposed to the gear 26. An intermediate gear 28 is rotatably supported by a support arm 27 whose proximal end is fixed to the support beam as in the case of the support arm 23, and the intermediate gear 28 is in mesh with the gear portion 14a and the gear 26. That is, the torque of the front bottom roller 14 is transmitted to the rotation shaft 19 through the gear portion 14a, the intermediate gear 28, and the gear 26.

[0014] A suction duct (not shown) is arranged in the fine spinning machine so as to extend in the longitudinal direction thereof (the direction perpendicular to the plane of Fig. 1A). The sucking portion 17 is equipped with suction pipes 29 and 30 extending parallel to the rotation shaft 19, and a connection tube 31 connected to the suction duct and adapted to apply negative pressure to the suction pipes 29 and 30. The connection tube 31 is arranged in front of the gear 26 so that a part of the connection tube 31 may serve as a cover of the gear 26 and the intermediate gear 28. At the same time, the connection tube 31 is, at the proximal end thereof, connected to the suction duct through a bellows-like connection tube 32. First ends of the suction pipes 29 and 30 are fitted into fitting holes formed on the right-hand and left-hand sides of the forward end portion of the connection tube 31, and second ends of the suction pipes 29 and 30 are fitted into the end plugs 25.

[0015] As shown in Figs. 1A and 2, each of the suction pipes 29 has a guide surface 29b in which there is formed a suction hole 29a extending upstream of the nipping point of the nip roller pair 16 with respect to a moving direction of a fiber bundle (fleece) F. Each of the suction pipes 30 has a guide surface 30b in which there is formed a suction hole 30a extending downstream. The suction pipe 29 is arranged so as to be situated on the upstream side, and the suction pipe 30 is arranged so as to be situated on the downstream side of the nipping point of the bottom nip roller 19a with respect to the moving direction of the fiber bundle F.

[0016] As shown in Fig. 1A, below and in the vicinity of the suction pipe 30, there are arranged the distal ends

of suction nozzles 33 of a single type pneumatic device adapted to suck the fiber bundle F delivered from the drafting device 12 at the time of yarn breakage. The proximal ends of the suction nozzles 33 are connected to a suction duct (not shown).

[0017] As shown in Fig. 1A, the perforated belt 18 is wrapped such that a part of the perforated belt 18 is in contact with the suction pipes 29 and 30, and that another part of the perforated belt 18 is in contact with the bottom nip roller 19a. The perforated belt 18 is adapted to run as the bottom nip roller 19a rotates while sliding on the guide surfaces 29b and 29b.

[0018] The perforated belt 18 is formed as a seamless loop of a plain-woven fabric. In this embodiment, it is obtained by cutting a cylindrically woven fabric in a predetermined width. As shown in Fig. 1C, a thermal fusion yarn 34 of a sheath-core structure is used as the yarn forming the fabric. At crossing portions 35 of the yarn forming the fabric, the sheath portions 34a of the thermal fusion yarn 34 are fused. In this embodiment, the core portion 34b and the sheath portion 34a of the thermal fusion yarn 34 are both formed of polyamide; the core portion 34b is formed of a polyamide whose melting point is 260°C, and the sheath portion 34a is formed of a polyamide whose melting point is 220°C. Further, in this embodiment, the core portion 34b consists of a mono-filament.

[0019] The fabric is woven with the thermal fusion yarn 34, whose diameter (thickness) is 0.05 to 0.15 mm. From the viewpoint of the sucking action on the fiber bundle F being spun, a thinner yarn is desirable; however, that would result in the strength of the perforated belt 18 being rather insufficient; thus, a thickness in the above-mentioned range is desirable. Further, the open area ratio ranges from 25 to 30%. Here, the term open area ratio is defined as: (A2/A1) x 100 (%), where, as shown in Fig. 1D, A1 is the area of the portion surrounded by the center lines (indicated by dashed lines) of two adjacent warp portions 36a and the center lines (indicated by dashed lines) of two adjacent weft portions 36b, and A2 is the area of the shaded portion (opening) surrounded by the two warp portions 36a and the two weft portions 36b.

[0020] The perforated belt 18 is endowed with an anti-static function. The anti-static function is imparted by applying an anti-static agent to the perforated belt 18. The anti-static agent suitably used is a well-known one, for example, a surface active agent, such as cation surface active agent or amphoteric surface active agent.

[0021] After forming a cylindrical plain-woven fabric of the thermal fusion yarn 34, it is cut in a predetermined width and maintained at a temperature at which solely the sheath portion 34a is melted, whereby it is possible to obtain the perforated belt 18 in which the crossing portions 35 of the warp and weft are fused. After being impregnated with a solution containing surface active agent, the perforated belt 18 is dried and subjected to charging prevention treatment.

[0022] Next, the operation of the fiber bundle collecting device 11, constructed as described above, will be illustrated.

[0023] When the fine spinning machine is operated, the fiber bundle F is drafted by the drafting device 12, and then guided from the final delivery roller pair 13 to the fiber bundle collecting device 11. The nip roller pair 16 are rotated at a velocity somewhat higher than the surface velocity of the final delivery roller pair 13, and the fiber bundle F passes the nipping point of the nip roller pair 16 under an appropriate tension before moving to the downstream side while being reversed and twisted.

[0024] Further, the sucking action of the duct is exerted on the suction pipes 29 and 30 through the connection tube 31, and the sucking action of the suction holes 29a and 30a formed on the guide surfaces 29b and 30b is exerted on the fiber bundle F through the perforated belt 18. The fiber bundle F then moves to positions corresponding to the suction holes 29a and 30a, while sucked and collected. Thus, as compared with a spinning machine equipped with no fiber bundle collecting device 11, it is possible to restrain generation of fluff and waste cotton and to achieve an improvement in terms of yarn quality.

[0025] In the case where the perforated belt 18 is formed of an ordinary fabric (a fabric whose yarn crossing portions 35 have undergone no treatment) as in the prior art, when the yarn forming the fabric breaks, the resultant yarn end gets entangled with the fiber bundle F being spun to thereby cause yarn breakage, a defect in yarn quality, etc., or fibers of the fiber bundle F being spun get caught in the yarn crossing portions 35 to thereby adversely affect the spinning. However, in the perforated belt 18 of this embodiment, the yarn (the thermal fusion yarn 34) forming the fabric is fused at the crossing portions 35, so, even if the yarn forming the fabric, etc. breaks, there is no fear of the resultant yarn end being entangled with the fiber bundle F being spun or of fibers of the fiber bundles F being spun being caught in the yarn crossing portions 35. Further, even if fibers adhere to mesh portions of the woven fabric, knitted fabric or the like, it is possible to easily remove them by a blast of compressed air or by the action of suction airflow.

[0026] The bottom nip roller 19a around which the perforated belt 18 is wrapped rotates at a rotating velocity which is approximately the same as that of the front bottom roller 14 of the drafting device 12 (200 to 300 rpm), so that static electricity is likely to be generated in the perforated belt 18, and the static electricity generated is likely to be charged. When the perforated belt 18 is left in a state in which charging with static electricity is likely to occur, fibers are likely to adhere to the perforated belt 18. However, since the perforated belt 18 is endowed with an anti-static function, fibers do not easily adhere to the perforated belt 18.

[0027] This embodiment provides the following effects:

(1) The perforated belt 18 running while in contact with the guide surfaces 29b and 30b of the suction

pipes 29 and 30, constituting the fiber bundle collecting device 11, is formed of a sheet-like fabric in which the material yarn (the thermal fusion yarn 34) is fused at the yarn crossing portions 35. Thus, even if the yarn forming the fabric breaks, there is no fear of the resultant yarn end being entangled with the fiber bundle F being spun, or fibers of the fiber bundle F being caught in the yarn crossing portions 35. As a result, it is possible to achieve an improvement in terms of spinning performance by preventing the fibers spun from being caught by or adhering to the crossing portions 35 of the yarn forming the perforated belt 18, and to facilitate the operation of removing fibers adhering to the perforated belt 18, without involving a deterioration in the function of collecting/transporting the fiber bundle F.

(2) As the yarn forming the fabric (the sheet-like material) constituting of the material of the perforated belt 18, the thermal fusion yarn 34 of a core-sheath structure is used. Thus, the yarn forming the fabric can be easily fused at the crossing portions 35.

(3) Both the core (the core portion 34b) and the sheath (the sheath portion 34a) of the thermal fusion yarn 34 are formed of polyamide. Thus, even if the thickness of the thermal fusion yarn 34 is reduced to approximately 0.1 mm in order to reduce the thickness of the perforated belt 18, it is possible to ensure the requisite strength. Further, polyamide and cotton are congenial to each other, so that it is possible to smoothly perform spinning of cotton yarn and a union yarn composed of cotton and other fibers.

(4) Since the perforated belt 18 is endowed with an anti-static function, fibers do not easily adhere to the perforated belt 18, so, in addition to the effect of preventing fibers from being caught due to the fusion of the yarn crossing portions 35, it is possible to achieve an improvement in terms of adhesion preventing effect.

(5) In the fabric constituting the material of the perforated belt 18, the thermal fusion yarn 34 is used for both the warp 36a and the weft 36b, so, as compared with the case in which the thermal fusion yarn 34 is used for only one of the warp and the weft, it is possible to effect fusion of the yarn crossing portions 35 more easily.

(6) Since the perforated belt 18 is woven in fine mesh with a thin yarn of approximately 0.1 mm, the sucking action is efficiently exerted on the fiber bundle F.

(7) Since the perforated belt 18 is formed as a seamless loop, the transport of the fiber bundle F is smoothly effected, and it is possible to prevent progress of fatigue, which is likely to be incurred at a seam portion.

(8) The fabric forming the perforated belt 18 is formed of filament yarn, so, it is possible to achieve an improvement in terms of strength and breathability in comparison with staple yarn of the same thickness.

[0028] The above-described embodiment should not be construed restrictively; for example, the following modifications are possible.

[0029] The perforated belt 18 is not restricted to a plain-woven fabric 37 (shown, for example, in Fig. 3A); it is also possible to use a fabric woven by some other weaving method, such as a twill fabric 38 (shown, for example, in Fig. 3B).

[0030] The perforated belt 18 is not restricted to one formed of a woven fabric; it may also be formed of a knitted fabric. In this case, due to the elasticity of the knitted fabric, it is possible for the perforated belt 18 to be rotated under an appropriate tension without any tension device provided.

[0031] The perforated belt 18 is not restricted to a woven fabric or a knitted fabric; as shown in Fig. 4, it is also possible to form the perforated belt 18 of a sheet-like material in which two layers 39 of yarn (thermal fusion yarn 34) each arranged in one direction are stacked together such that the respective arranging directions of the thermal fusion yarn 34 of the yarn layers 39 cross each other (so as to be, for example, perpendicular to each other) and yarn crossing portions 35 of each of the thermal fusion yarn 34 are fused.

[0032] The perforated belt 18 is not restricted to a seamless loop formed of an endless woven fabric or knitted fabric; it may also be a strip-like woven fabric, knitted fabric or the like in the form of a seamed loop with its ends firmly attached to each other.

[0033] It is not always necessary for the woven fabric forming the perforated belt 18 to be entirely formed of thermal fusion yarn; instead, it is also possible that solely either one of the warp or the weft is formed of thermal fusion yarn.

[0034] As the method of endowing the perforated belt 18 with an anti-static function, it is possible to use a conductive fiber (electrically conductive fiber) as the yarn forming the perforated belt 18. Examples of the conductive fiber include a fiber spun mixed with carbon black.

[0035] As the method of endowing the perforated belt 18 with an anti-static function, instead of the method in which an anti-static agent is applied after the formation of the perforated belt 18, it is possible to form the perforated belt 18 of a woven fabric or knitted fabric using yarn with an anti-static agent applied thereto.

[0036] The thermal fusion yarn 34 is not restricted to the one in which both the sheath portion 34a and the core portion 34b are formed of polyamide. For example, it is also possible to use one in which both the sheath portion 34a and the core portion 34b are formed of polyester, or one in which the sheath portion 34a is formed of polyester and in which the core portion 34b is formed of polyamide.

[0037] The arrangement of the rotation shaft 19 and the suction pipes 29 and 30 are not restricted to the one in which four spindles constitute one unit; it is also possible to adopt an arrangement in which the spindles between each pair of adjacent roller stands 22 (e.g., eight spindles) constitute one unit, or one in which two spindles

constitute one unit. Further, it is not always necessary for all the units to include the same number of spindles; it is also possible to arrange spindles in different numbers between the roller stands 22 (e.g., six spindles and two spindles) and to provide two kinds of units in correspondence therewith.

[0038] Instead of the construction in which the suction holes 29a and 30a are provided on the upstream side and the downstream side with respect to the nipping point for the fiber bundle F, it is also possible to adopt a construction in which the suction holes 29a are provided solely on the upstream side of the nipping point. In this case, instead of the suction pipes 30, pipes or bars of the same outer configuration as the suction pipes 30 but equipped with no suction holes 30a are used, whereby it is possible for the production method and assembly to be substantially the same as those of the above embodiment. Further, it is also possible to eliminate the suction pipes 30 and to wrap the perforated belt 18 between the suction pipes 29 and the bottom nip rollers 19a.

[0039] The delivery portion of the fiber bundle collecting device 11 is not restricted to the construction equipped with the nip roller pair 16. For example, as shown in Fig. 5, a suction pipe 40 with a substantially egg-shaped sectional configuration is provided, and a suction hole 40a is formed at a predetermined position of the suction pipe 40. Then, the perforated belt 18 is slidably wrapped around the outer periphery of the suction pipe 40 and the tension roller 41. Further, it is also possible to transmit the rotation of the front top roller 15 to the top nip roller 20 through a drive belt 42 and to drive the top nip roller 20 while keeping it in press contact with the perforated belt 18, thereby driving the perforated belt 18.

[0040] It is also possible to adopt a construction in which the rotation shaft 19 with the bottom nip roller 19a formed thereon is driven as a shaft common to all the spindles by a motor through a gear row provided at a gear end of the machine frame as in the case of the front bottom roller 14 of the drafting device 12.

[0041] It is also possible to provide the perforated belt 18 on the top side.

[0042] The present invention is applicable not only to the drafting device of a fine spinning machine but also to the drafting device of some other type of spinning machine.

[0043] The perforated belt may be endowed with an anti-static function by imparting conductivity to the yarn forming the perforated belt, and may be formed of a woven fabric or a knitted fabric with an anti-static agent applied thereto.

Claims

1. A fiber bundle collecting device (11) for a spinning machine which collects a fiber bundle (F) drafted by a drafting part (12), comprising:

   a delivery portion (16) provided on a downstream side of a final delivery roller pair (13) of the drafting part (12) and equipped with a nip roller;

   a sucking portion (17) having a guide surface (29b) equipped with a suction hole (29a) at least on an upstream side of a nipping point of the delivery portion (16) with respect to a moving direction of the fiber bundle (F); and

   a perforated belt (18) rotated while in slide contact with the guide surface (29b),

   characterized in that the perforated belt (18) is formed of a sheet-like material, such as a woven fabric or knitted fabric, including a yarn (34) with a crossing portion (35), with the yarn (34) being fused at the crossing portion (35).

2. A fiber bundle collecting device (11) for a spinning machine according to Claim 1, wherein a thermal fusion yarn (34) of a sheath/core structure is used as the yarn (34) forming the sheet-like material.

3. A fiber bundle collecting device (11) for a spinning machine according to one of Claims 1 and 2, wherein the thermal fusion yarn (34) has a core portion (34b) and a sheath portion (34a) which are both formed of polyamide.

4. A fiber bundle collecting device (11) for a spinning machine according to any one of Claims 1 through 3, wherein the perforated belt (18) is endowed with an anti-static function.

FIG. IA

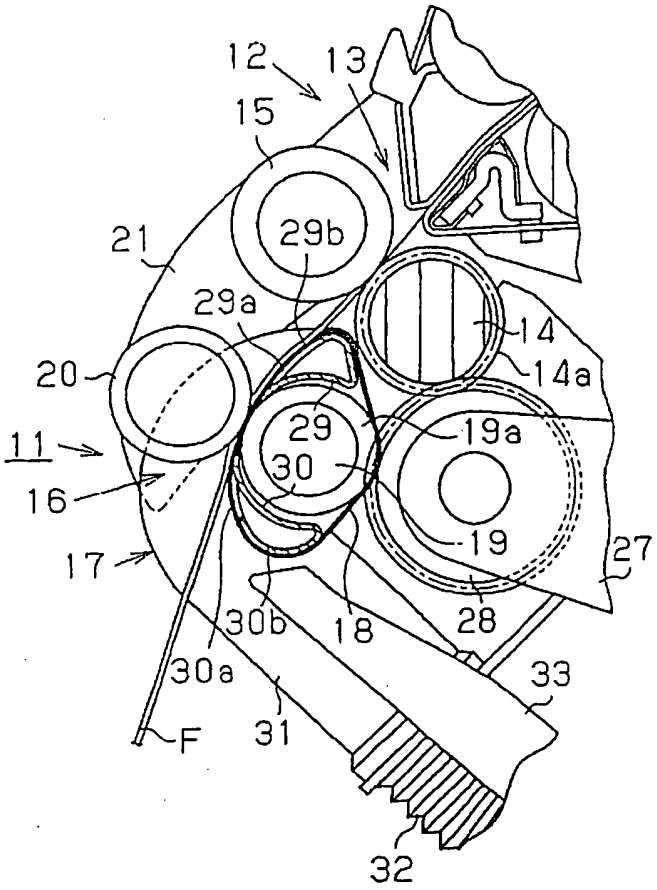


FIG. IB

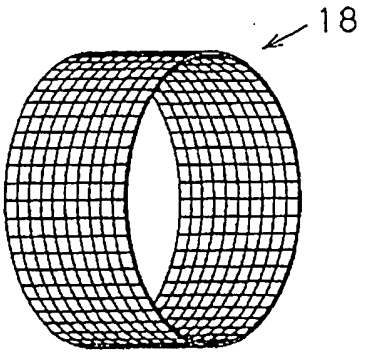
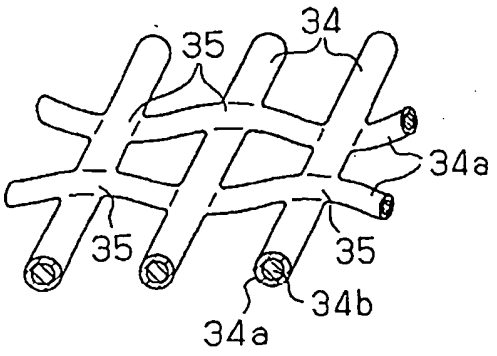


FIG. IC



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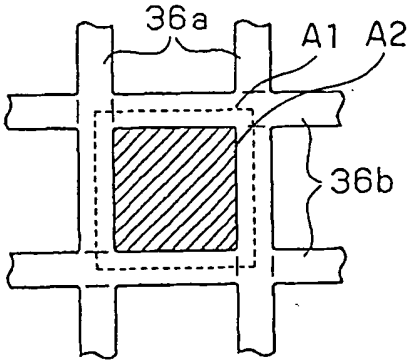

FIG. 2

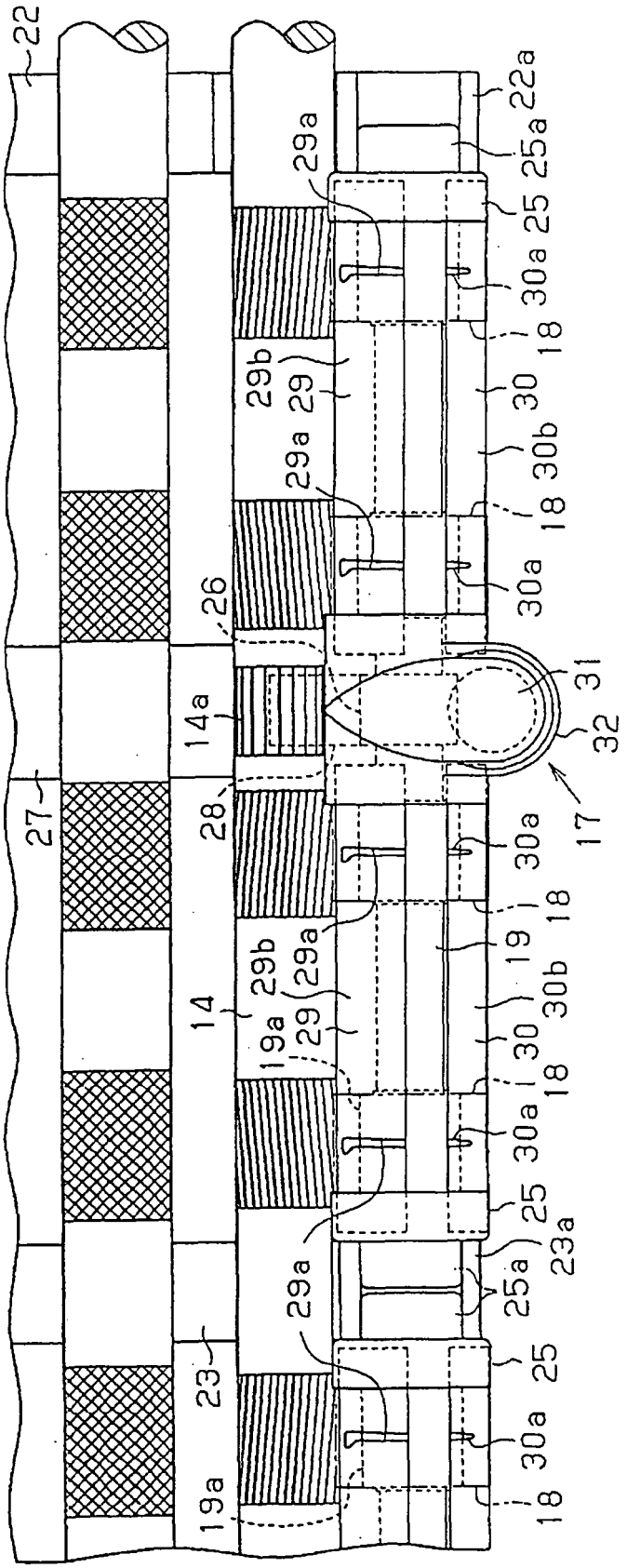
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FIG. 3A

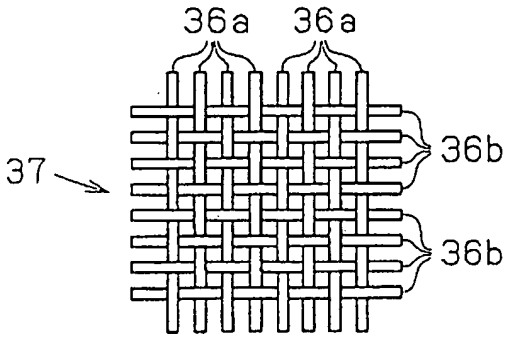

FIG. 3B

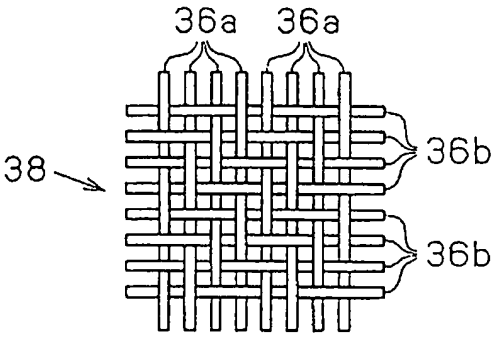

FIG. 4

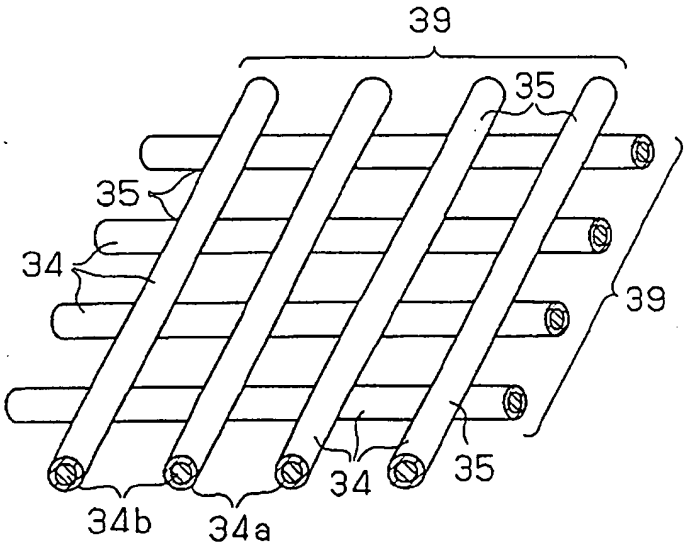

FIG. 5