(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 553 009 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.10.2019 Bulletin 2019/42

(51) Int Cl.:
B65H 69/06 *(2006.01)*

(21) Application number: **19167770.7**

(22) Date of filing: **08.04.2019**

(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:
KH MA MD TN

(30) Priority: **12.04.2018 JP 2018076685**
12.04.2018 JP 2018076686
12.04.2018 JP 2018076688
30.05.2018 JP 2018103798

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

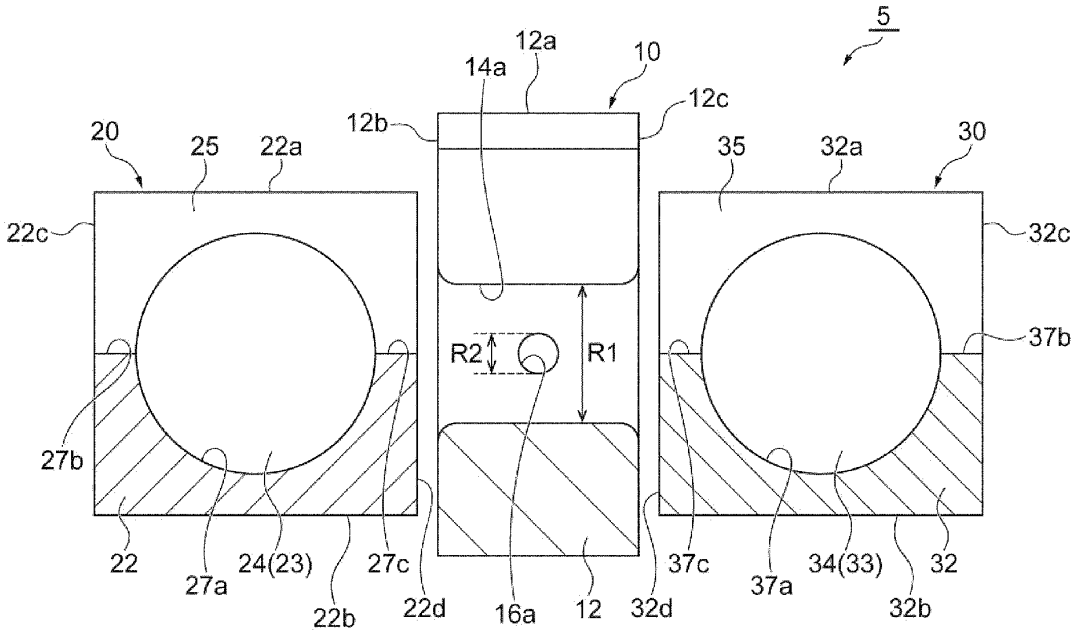
(72) Inventor: **HAYASHI, Yasushi**
Kyoto-shi, Kyoto 612-8686 (JP)

(74) Representative: **Grünecker Patent- und Rechtsanwälte**
PartG mbB
Leopoldstraße 4
80802 München (DE)

(54) SYNTHETIC YARN SPLICER

(57) A synthetic yarn splicer 1 includes: a yarn splicing portion 10 that includes a chamber 14 which forms a space through which a first yarn Y1 and a second yarn Y2 are insertable and an injection hole 16a which opens to the chamber 14 and injects a fluid; and a first clamping mechanism 20 and a second clamping mechanism 30 that are provided at a position interposing the chamber 14 of the yarn splicing portion 10 and clamp each of the first yarn Y1 and the second yarn Y2 inserted through the space, in which the injection hole 16a has a circular shape, and in which a diameter R2 of the injection hole 16a is equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm.

Fig.5



EP 3 553 009 A1

Description

TECHNICAL FIELD

[0001] The invention relates to a synthetic yarn splicer.

BACKGROUND

[0002] As a conventional synthetic yarn splicer, for example, one described in Patent Literature 1 (Japanese Unexamined Patent Publication No. H10-17214) is known. In the synthetic yarn splicer described in Patent Literature 1, a starting end and a terminating end of two synthetic yarns are aligned in the opposite directions to be drawn into an air nozzle, both side portions outside the air nozzle of the drawn yarn end are pressed down, the pressed both side portions are moved into the air nozzle, the aligned yarn end is loosened inside the air nozzle, and the yarns are spliced by an air flow inside the air nozzle.

SUMMARY

[0003] The synthetic yarn splicer is used to splice a terminating end of a yarn of one supply bobbin and a starting end of a yarn of the other supply bobbin in, for example, a yarn winding machine for winding synthetic fibers. In the yarn winding machine, the yarn is wound around a bobbin while applying a tension to the yarn to form a package. For that reason, an entangled portion obtained by splicing the yarns by the synthetic yarn splicer is pulled while a tension is applied thereto. In the yarn winding machine, when the entangled portion is unwound during the winding operation, the winding operation must be temporarily stopped and hence the production efficiency is lowered. For that reason, there is a demand for forming an entangled portion having a tensile elongation capable of withstanding a winding tension in the synthetic yarn splicer.

[0004] In the conventional synthetic yarn splicer, there is a possibility that the entangled portion cannot be appropriately formed according to the type of yarn. In particular, since it is difficult to entangle the synthetic yarn of which the thickness is thin and the number of filaments is small, an entangled portion is not formed or even an entangled portion is unraveled. For that reason, in the case of the synthetic yarn of which the thickness is thin and the number of filaments is small, a splicing operation is manually performed by an operator. However, since there is a change in quality of the entangled portion in the case of the entangled portion which is manually formed by the operator according to a skill or the like of the operator, it is not possible to stably form the entangled portion having a tensile elongation capable of withstanding a winding tension. Further, since the yarn is connected at one position in the case of the entangled portion which is manually formed by the operator, the yarn can be easily broken. Thus, in the synthetic yarn splicer, there has been a demand for forming an entangled portion having a tensile elongation capable of withstanding a winding tension even in a yarn of which the thickness is thin and the number of filaments is small.

[0005] An aspect of the invention is to provide a synthetic yarn splicer capable of suppressing a decrease in tensile elongation of an entangled portion.

[0006] A synthetic yarn splicer according to an aspect of the invention is a synthetic yarn splicer that splices one yarn and the other yarn formed of synthetic fibers, including: a yarn splicing portion that includes a passage which forms a space through which the one yarn and the other yarn are insertable and an injection hole which opens to the passage and injects a fluid; and a pair of clamping mechanisms that is provided at a position interposing the passage of the yarn splicing portion and clamps each of the one yarn and the other yarn inserted through the space, in which the injection hole has a circular shape, and in which a diameter of the injection hole is equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm.

[0007] In the synthetic yarn splicer according to an aspect of the invention, one yarn and the other yarn clamped by the pair of clamping mechanisms are swayed inside the passage by using a position clamped by the clamping mechanism as a fixed point to form an entangled portion. When the diameter of the injection hole is smaller than ϕ0.8 mm, a force of a fluid injected into the passage is small. For this reason, since the fluid does not appropriately act on one yarn and the other yarn and one yarn and the other yarn are not appropriately swayed inside the passage, it is difficult to form the entangled portion. When the diameter of the injection hole is larger than ϕ1.3 mm, there is a concern that the fluid excessively acts on one yarn and the other yarn and hence it is difficult to appropriately form the entangled portion. In the synthetic yarn splicer of the invention, the diameter of the injection hole is equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm. Accordingly, in the synthetic yarn splicer, since the fluid can be appropriately act on one yarn and the other yarn and one yarn and the other yarn are appropriately swayed inside the passage, the entangled portion can be appropriately formed. Thus, in the synthetic yarn splicer, the entangled portion of the yarn can be formed and a decrease in tensile elongation of the entangled portion can be suppressed.

[0008] In one embodiment, a diameter of the injection hole may be equal to or larger than ϕ1.0 mm and equal to or smaller than ϕ1.3 mm. In this configuration, the entangled portion can be more appropriately formed.

[0009] In one embodiment, the passage may have a circular shape when viewed from a penetration direction of the passage and a diameter of the passage may be equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm. When the diameter of the passage is smaller than ϕ3.0 mm, one yarn and the other yarn swayed inside the passage easily contact the inner peripheral surface of the passage and hence it is difficult

for the yarn to be turned inside the passage. For that reason, there is a concern that the entangled portion is not appropriately formed. When the diameter of the passage is larger than ϕ4.0 mm, the fluid injected from the injection hole can be dispersed inside the passage. Accordingly, since the fluid do not appropriately act on one yarn and the other yarn, it is difficult to form the entangled portion. In the synthetic yarn splicer, since the diameter of the passage is equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm, it is possible to suppress an influence due to the contact with the inner peripheral surface of the passage and to effectively apply the fluid to one yarn and the other yarn. Thus, in the synthetic yarn splicer, the entangled portion of the yarn can be more reliably formed and a decrease in tensile elongation of the entangled portion can be further suppressed.

[0010] In one embodiment, the one yarn and the other yarn of which the thickness is 55 dtex or less and the number of filaments is 10f or less may be spliced. It is difficult to form the entangled portion in the yarn of which the thickness is 55 dtex or less and the number of filaments is 10f or less. Since the synthetic yarn splicer has the above-described configuration, it is possible to form the entangled portion also in the yarn of which the thickness of 55 dtex or less and the number of filaments is 10f or less, that is, the number of filaments is small.

[0011] According to an aspect of the invention, it is possible to suppress a decrease in tensile elongation of an entangled portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a perspective view illustrating a synthetic yarn splicer according to an embodiment.
FIG. 2 is a view illustrating a yarn splicing mechanism when viewed from above.
FIG. 3 is a side view of the yarn splicing mechanism.
FIG. 4 is a cross-sectional view of a yarn splicing portion.
FIG. 5 is a cross-sectional view taken along a line V-V of FIG. 2.
FIG. 6A is a diagram illustrating an operation of the yarn splicing mechanism.
FIG. 6B is a diagram illustrating an operation of the yarn splicing mechanism.
FIG. 7A is a diagram showing a measurement result.
FIG. 7B is a diagram showing a measurement result.
FIG. 8A is a diagram showing a measurement result.
FIG. 8B is a diagram showing a measurement result.
FIG. 9A is a diagram showing a measurement result.
FIG. 9B is a diagram showing a measurement result.

DETAILED DESCRIPTION

[0013] Hereinafter, preferred embodiments of the invention will be described in detail with reference to the accompanying drawings. Furthermore, in the description of the drawings, the same reference numerals will be given to the same or equivalent components and the repetitive description will be omitted.

[0014] A synthetic yarn splicer 1 illustrated in FIG. 1 is a device which performs a splicing operation between a yarn end of a first yarn (one yarn) Y1 (see FIG. 6A) formed of synthetic fibers and a yarn end of a second yarn (the other yarn) Y2 (see FIG. 6A) formed of synthetic fibers. In the embodiment, the synthetic yarn splicer 1 splices a first yarn Y1 and a second yarn Y2 of which the thickness is 55 dtex or less and the number of filaments is 10f or less. The synthetic yarn splicer 1 is used to perform a splicing operation between a terminating end of a yarn of one supply bobbin and a starting end of a yarn of the other supply bobbin, for example, in a yarn winding machine that winds a yarn from a supply bobbin to form a package. In the embodiment, the synthetic yarn splicer 1 is a so-called hand splicer.

[0015] The synthetic yarn splicer 1 includes a main body 3 and a yarn splicing mechanism 5. The main body 3 is a casing which accommodates the yarn splicing mechanism 5. The main body 3 includes a first main body portion 3a and a second main body portion 3b. The main body 3 is formed in, for example, a substantially L shape in the side view.

[0016] The first main body portion 3a is a portion which is gripped by an operator when the synthetic yarn splicer 1 is used. The first main body portion 3a has, for example, a substantially rectangular parallelepiped shape. The first main body portion 3a is provided with an operation portion 7. The operation portion 7 is a button which is operated when performing a splicing operation in the synthetic yarn splicer 1. In the embodiment, the operation portion 7 is provided at a portion which is located within an operation range of an index finger when the first main body portion 3a is gripped by the operator at the side of one end portion (the side of the second main body portion 3b) of the first main body portion 3a in the longitudinal direction.

[0017] The lower end portion of the first main body portion 3a (the other end portion of the longitudinal direction) is provided with a connection portion 9. A tube (not illustrated) supplying compressed air (fluid) (hereinafter, simply referred to as "air") is connected to the connection portion 9. The first main body portion 3a may accommodate a switch which is operated in synchronization with the operation of the operation portion 7 and components branching compressed air supplied through the connection portion 9.

[0018] The second main body portion 3b is provided with the yarn splicing mechanism 5. The second main body portion 3b has, for example, a substantially rectangular parallelepiped shape. The second main body portion 3b is provided at one end portion of the first main body portion 3a. Specifically, the second main body portion 3b is integrally formed with the first main body portion

3a so that a predetermined angle (for example, 90° or less) is formed between the longitudinal direction of the second main body portion 3b and the longitudinal direction of the first main body portion 3a. The second main body portion 3b exposes the yarn splicing mechanism 5. The second main body portion 3b accommodates a driving portion or the like (for example, a cylinder or the like) which drives a first clamping mechanism 20 and a second clamping mechanism 30 to be described later.

[0019] As illustrated in FIG. 2 or 3, the yarn splicing mechanism 5 includes a yarn splicing portion 10, the first clamping mechanism 20, and the second clamping mechanism 30. The first clamping mechanism 20 and the second clamping mechanism 30 are provided at a position that interposes a chamber 14 of the yarn splicing portion 10.

[0020] As illustrated in FIG. 4, the yarn splicing portion 10 includes a yarn splicing nozzle 12, a slit 13, a chamber (a passage) 14, and an air flow passage 16.

[0021] The yarn splicing nozzle 12 is a block body which is formed of metal or ceramic. The yarn splicing nozzle 12 includes an upper surface 12a and a pair of side surfaces 12b and 12c. The slit 13 is provided in the yarn splicing nozzle 12. The slit 13 is a portion which communicates with the chamber 14 and introduces a yarn into the chamber 14. The slit 13 is provided over the upper surface 12a of the yarn splicing nozzle 12 and the chamber 14. The width of the slit 13 is, for example, 0.4 mm. An upper portion of the slit 13 is provided with an inclined surface 15. The inclined surface 15 guides a yarn to the slit 13. The inclined surface 15 has a tapered shape which is narrowed from an upper surface 12a of the yarn splicing nozzle 12 toward the slit 13.

[0022] The chamber 14 is a passage through which a first yarn Y1 and a second yarn Y2 are inserted. As illustrated in FIG. 5, the chamber 14 penetrates one side surface 12b and the other side surface 12c of the yarn splicing nozzle 12. That is, the penetration direction of the chamber 14 is a facing direction of the pair of side surfaces 12b and 12c and is orthogonal to the insertion direction of the first yarn Y1 and the second yarn Y2 with respect to the slit 13. The chamber 14 forms a space through which the first yarn Y1 and the second yarn Y2 are insertable. As illustrated in FIG. 4, the chamber 14 has a circular shape when viewed from the side surfaces 12b and 12c. In the embodiment, the chamber 14 has a true circular shape. The diameter R1 of the chamber 14 is equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm.

[0023] The air flow path 16 circulates air to be supplied to the chamber 14. The air flow path 16 includes an injection hole 16a which opens to the chamber 14. The injection hole 16a communicates the air flow path 16 with the chamber 14. Air is injected from the injection hole 16a to the chamber 14. The injection hole 16a has a circular shape. In the embodiment, the injection hole 16a has a true circular shape. The diameter of the injection hole 16a is desirably equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm and more desirably equal to or larger than ϕ1.0 mm and equal to or smaller than ϕ1.3 mm. In the embodiment, the injection hole 16a is disposed on a line passing through the center of the chamber 14 and orthogonal to the insertion direction of the first yarn Y1 and the second yarn Y2 with respect to the slit 13. A connection portion 18 is provided at the upstream side of the air flow passage 16 (the side opposite to the injection hole 16a). A supply pipe or the like supplying air is connected to the connection portion 18.

[0024] As illustrated in FIGS. 2 and 3, the first clamping mechanism 20 includes a support portion 22 and a clamping portion 23. The first clamping mechanism 20 clamps a yarn inserted through the chamber 14 of the yarn splicing portion 10.

[0025] The support portion 22 has a rectangular parallelepiped shape (prismatic shape). As illustrated in FIG. 5, the support portion 22 includes a pair of facing main surfaces 22a and 22b and a pair of facing side surfaces 22c and 22d. The side surface 22d is a surface which faces the side surface 12b in the yarn splicing nozzle 12.

[0026] The support portion 22 holds the clamping portion 23. The support portion 22 is provided to be swingable. Specifically, as illustrated in FIG. 2, a base end portion of the support portion 22 (one end portion of the longitudinal direction) is provided with a shaft 21. The shaft 21 is fixed to a frame (not illustrated) or the like. The support portion 22 swings about the shaft 21. The support portion 22 moves between a second position P2 (see FIG. 6B) in which a front end portion (the other end portion of the longitudinal direction) moves close to the yarn splicing portion 10 and a first position P1 (see FIG. 6A) in which the front end portion moves away from the yarn splicing portion 10 in relation to the second position P2. That is, the first clamping mechanism 20 moves between the first position P1 and the second position P2. The support portion 22 moves by the driving of, for example, a driving portion (not illustrated) such as a cylinder. In the embodiment, as described above, one end portion of the longitudinal direction provided with the shaft 21 in the support portion 22 will be referred to as a base end portion and the other end portion of the longitudinal direction opposite to the one end portion will be referred to as a front end portion.

[0027] The support portion 22 is provided with a concave portion 25. The concave portion 25 is provided at the side of the front end portion of the support portion 22. The concave portion 25 opens to the main surface 22a and the pair of side surfaces 22c and 22d of the support portion 22. The concave portion 25 exposes a part of the clamping portion 23. As illustrated in FIG. 2, the concave portion 25 has a rectangular shape when viewed from the main surface 22a of the support portion 22. As illustrated in FIG. 3, the concave portion 25 has a rectangular shape when viewed from the side surface 22c of the support portion 22.

[0028] As illustrated in FIG. 5, the support portion 22 includes a support surface 27a which slidably supports

a second clamping member 26 (a first clamping member 24) to be described later in the clamping portion 23. The support surface 27a is provided at a center portion in the facing direction of the pair of side surfaces 22c and 22d of the support portion 22. The support surface 27a has a shape (a semi-circular shape) which is curved in a convex shape downward in response to the shape of the outer peripheral surface of the second clamping member 26 (the first clamping member 24). The support surface 27a extends in the longitudinal direction of the support portion 22.

[0029] The support portion 22 includes a first contact surface 27b and a second contact surface 27c at a position interposing the support surface 27a in the facing direction of the pair of side surfaces 22c and 22d (the facing direction of the first clamping mechanism 20 and the second clamping mechanism 30). The first contact surface 27b and the second contact surface 27c constitute a bottom surface of the concave portion 25. The first contact surface 27b is a surface which is able to contact the first yarn Y1 and the second yarn Y2 clamped by the clamping portion 23. A contactable state includes a case in which the first contact surface 27b contacts the first yarn Y1 and the second yarn Y2 clamped by the clamping portion 23 and a case in which the first contact surface 27b does not contact the first yarn Y1 and the second yarn Y2. The second contact surface 27c is a surface which contacts the first yarn Y1 and the second yarn Y2 clamped by the clamping portion 23. As illustrated in FIG. 2, the first contact surface 27b and the second contact surface 27c are provided at a position in which at least the first clamping member 24 and the second clamping member 26 contact.

[0030] As illustrated in FIG. 5, the first contact surface 27b is a flat surface which is continuous to one end of the support surface 27a (an end at the side of the side surface 22c). The second contact surface 27c is a flat surface which is continuous to the other end of the support surface 27a (an end at the side of the side surface 22d). That is, respective surfaces are provided in order of the second contact surface 27c, the support surface 27a, and the first contact surface 27b from the yarn splicing portion 10 when viewed from the facing direction of the pair of main surfaces 22a and 22b of the support portion 22. That is, the second contact surface 27c is disposed between the yarn splicing portion 10 and the clamping portion 23. The second contact surface 27c is located at the inside of the facing direction of the first clamping mechanism 20 and the second clamping mechanism 30 facing each other with the yarn splicing portion 10 interposed therebetween and the first contact surface 27b is located at the outside of the facing direction.

[0031] The first contact surface 27b is substantially parallel to the main surfaces 22a and 22b. The first contact surface 27b is provided over the support surface 27a and the side surface 22c. The second contact surface 27c is substantially parallel to the main surfaces 22a and 22b. The second contact surface 27c is provided over the support surface 27a and the side surface 22d. The first contact surface 27b and the second contact surface 27c are located at the same height position in the facing direction of the pair of main surfaces 22a and 22b of the support portion 22.

[0032] An angle of about 90° is formed between the second contact surface 27c and the side surface 22d. It is desirable to polish a surface of a top of a corner between the second contact surface 27c and the side surface 22d. In this configuration, it is possible to suppress the damage of the first yarn Y1 and the second yarn Y2 when the first yarn Y1 and the second yarn Y2 are separated from the top.

[0033] As illustrated in FIG. 2, the clamping portion 23 includes the first clamping member 24 and the second clamping member 26. Each of the first clamping member 24 and the second clamping member 26 is formed in a columnar shape. Each of the first clamping member 24 and the second clamping member 26 is formed of, for example, metal such as SUS having abrasion resistance. The diameter of each of the first clamping member 24 and the second clamping member 26 may be appropriately set.

[0034] The first clamping member 24 and the second clamping member 26 are disposed at the support portion 22 so that respective end surfaces face each other. Specifically, the first clamping member 24 is disposed at the side of the front end portion of the support portion 22 and the second clamping member 26 is disposed at the side of the base end portion of the support portion 22 in relation to the first clamping member 24. The first clamping mechanism 20 holds a yarn by clamping the yarn between the end surface of the first clamping member 24 and the end surface of the second clamping member 26 in the clamping portion 23.

[0035] A part of the first clamping member 24 is accommodated in the support portion 22 and a part of the first clamping member 24 is exposed in the concave portion 25 of the support portion 22. The first clamping member 24 may be fixed to the support portion 22 and may be provided to be movable (slidable on the support surface 27a) in the facing direction of the first clamping member 24 and the second clamping member 26 (hereinafter, simply referred to as the "facing direction").

[0036] A part of the second clamping member 26 is accommodated in the support portion 22 and a part of the second clamping member 26 is exposed in the concave portion 25 of the support portion 22. The second clamping member 26 is movably provided in the support portion 22. The second clamping member 26 moves in the facing direction. The second clamping member 26 is biased toward the first clamping member 24 by a biasing member (not illustrated) such as a spring. That is, the end surfaces of the second clamping member 26 and the first clamping member 24 are in contact with each other by a biasing force of a biasing member in a state in which a force other than the biasing member is not applied to the second clamping member 26.

[0037] The second clamping member 26 moves in synchronization with the movement of the support portion 22. The second clamping member 26 moves in a direction moving away from the first clamping member 24 by the movement of the support portion 22 from the second position P2 (see FIG. 6B) to the first position P1 (see FIG. 6A). Specifically, the second clamping member 26 can be pressed down in a direction opposite to the biasing direction of the biasing member by a cam mechanism (not illustrated) or the like when the support portion 22 moves from the second position P2 to the first position P1. Accordingly, a gap (space) is formed between the first clamping member 24 and the second clamping member 26 in the clamping portion 23. Furthermore, the movement of the second clamping member 26 may not be synchronized with the movement of the support portion 22.

[0038] As illustrated in FIGS. 2 and 3, the second clamping mechanism 30 includes a support portion 32 and a clamping portion 33. The second clamping mechanism 30 clamps a yarn inserted through the chamber 14 of the yarn splicing portion 10.

[0039] The support portion 32 has a rectangular parallelepiped shape (prismatic shape). As illustrated in FIG. 5, the support portion 32 includes a pair of facing main surfaces 32a and 32b and a pair of facing side surfaces 32c and 32d. The side surface 32d is a surface which faces the side surface 12c of the yarn splicing nozzle 12.

[0040] The support portion 32 holds the clamping portion 33. The support portion 32 is provided to be swingable. Specifically, as illustrated in FIG. 2, a base end portion of the support portion 32 (one end portion of the longitudinal direction) is provided with a shaft 31. The shaft 31 is fixed to a frame (not illustrated) or the like. The support portion 32 swings about the shaft 31. The support portion 32 moves between a second position P2 (see FIG. 6B) in which a front end portion (the other end portion of the longitudinal direction) moves close to the yarn splicing portion 10 and a first position P1 (see FIG. 6A) in which the front end portion moves away from the yarn splicing portion 10 in relation to the second position P2. That is, the first clamping mechanism 20 moves between the first position P1 and the second position P2. The support portion 32 moves by the driving of, for example, a driving portion (not illustrated) such as a cylinder. The driving portion may be the same as the driving portion that drives the support portion 22 or may be separately provided. In the embodiment, as described above, one end portion of the longitudinal direction provided with the shaft 31 in the support portion 32 will be referred to as a base end portion and the other end portion of the longitudinal direction opposite to the one end portion will be referred to as a front end portion.

[0041] The support portion 32 is provided with a concave portion 35. The concave portion 35 is provided at the side of the front end portion of the support portion 32. The concave portion 35 opens to the main surface 32a and the pair of side surfaces 32c and 32d of the support portion 32. The concave portion 35 exposes a part of the clamping portion 33. As illustrated in FIG. 2, the concave portion 35 has a rectangular shape when viewed from the main surface 32a of the support portion 32. The concave portion 35 has a rectangular shape when viewed from the side surfaces 32c and 32d of the support portion 32.

[0042] As illustrated in FIG. 5, the support portion 32 includes a support surface 37a which slidably supports the second clamping member 36 (the first clamping member 34) to be described later in the clamping portion 33. The support surface 37a is provided at a center portion of the facing direction of the pair of side surfaces 32c and 32d of the support portion 32. The support surface 37a has a shape (a semi-circular shape) which is curved in a convex shape downward in response to the shape of the outer peripheral surface of the second clamping member 36 (the first clamping member 34). The support surface 37a extends in the longitudinal direction of the support portion 32.

[0043] The support portion 32 includes a first contact surface 37b and a second contact surface 37c at a position interposing the support surface 37a in the facing direction of the pair of side surfaces 32c and 32d. The first contact surface 37b and the second contact surface 37c constitute a bottom surface of the concave portion 35. The first contact surface 37b is a surface which is able to contact the first yarn Y1 and the second yarn Y2 clamped by the clamping portion 33. The second contact surface 37c is a surface which contacts the first yarn Y1 and the second yarn Y2 clamped by the clamping portion 33. As illustrated in FIG. 2, the first contact surface 37b and the second contact surface 37c are provided at a position in which at least the first clamping member 34 and the second clamping member 36 contact.

[0044] As illustrated in FIG 5, the first contact surface 37b is a flat surface which is continuous to one end of the support surface 37a (an end at the side of the side surface 32c). The second contact surface 37c is a flat surface which is continuous to the other end of the support surface 37a (an end at the side of the side surface 32d). That is, respective surfaces are provided in order of the second contact surface 37c, the support surface 37a, and the first contact surface 37b from the yarn splicing portion 10 when viewed from the facing direction of the pair of main surfaces 32a and 32b of the support portion 32. That is, the second contact surface 37c is disposed between the yarn splicing portion 10 and the clamping portion 33. The second contact surface 37c is located at the inside of the facing direction of the first clamping mechanism 20 and the second clamping mechanism 30 facing each other with the yarn splicing portion 10 interposed therebetween and the first contact surface 37b is located at the outside of the facing direction.

[0045] The first contact surface 37b is substantially parallel to the main surfaces 32a and 32b. The first contact surface 37b is provided over the support surface 37a and the side surface 32c. The second contact surface

37c is substantially parallel to the main surfaces 32a and 32b. The second contact surface 37c is provided over the support surface 37a and the side surface 32d. The first contact surface 37b and the second contact surface 37c are located at the same height position in the facing direction of the pair of main surfaces 32a and 32b of the support portion 32.

[0046] An angle of about 90° is formed between the second contact surface 37c and the side surface 32d. It is desirable to polish a surface of a top of a corner formed by the second contact surface 37c and the side surface 32d.

[0047] As illustrated in FIG. 2, the clamping portion 33 includes the first clamping member 34 and the second clamping member 36. Each of the first clamping member 34 and the second clamping member 36 is formed in a columnar shape. Each of the first clamping member 34 and the second clamping member 36 is formed of, for example, metal such as SUS having abrasion resistance. The diameter of each of the first clamping member 34 and the second clamping member 36 may be appropriately set.

[0048] The first clamping member 34 and the second clamping member 36 are disposed at the support portion 32 so that respective end surfaces face each other. Specifically, the first clamping member 34 is disposed at the side of the front end portion of the support portion 32 and the second clamping member 36 is disposed at the side of the base end portion of the support portion 32 in relation to the first clamping member 34. The second clamping mechanism 30 holds a yarn by clamping the yarn between the end surface of the first clamping member 34 and the end surface of the second clamping member 36 in the clamping portion 33.

[0049] A part of the first clamping member 34 is accommodated in the support portion 32 and a part of the first clamping member 34 is exposed in the concave portion 35 of the support portion 32. The first clamping member 34 may be fixed to the support portion 32 and may be provided to be movable in the facing direction of the first clamping member 34 and the second clamping member 36 (to be slidable on the support surface 37a).

[0050] A part of the second clamping member 36 is accommodated in the support portion 32 and a part of the second clamping member 36 is exposed in the concave portion 35 of the support portion 32. The second clamping member 36 is movably provided in the support portion 32. The second clamping member 36 moves in the facing direction. The second clamping member 36 is biased toward the first clamping member 34 by a biasing member (not illustrated) such as a spring. That is, the end surfaces of the second clamping member 36 and the first clamping member 34 contact each other by a biasing force of a biasing member in a state in which a force other than the biasing member is not applied to the second clamping member 36.

[0051] The second clamping member 36 moves in synchronization with the movement of the support portion 32. The second clamping member 36 moves in a direction moving away from the first clamping member 34 by the movement of the support portion 32 from a second position P2 (see FIG. 6B) to a first position P1 (see FIG. 6A). Specifically, the second clamping member 36 is pressed down in a direction opposite to the biasing direction of the biasing member by a cam mechanism (not illustrated) or the like when the support portion 32 moves from the second position P2 to the first position P1. Accordingly, a gap (space) is formed between the first clamping member 34 and the second clamping member 36 in the clamping portion 33. Furthermore, the movement of the second clamping member 36 may not be synchronized with the movement of the support portion 32.

[0052] Subsequently, a method of forming an entangled portion using the synthetic yarn splicer 1 (a splicing method) will be described.

[0053] First, as illustrated in FIG. 6A, the first yarn Y1 and the second yarn Y2 are set on the synthetic yarn splicer 1. Specifically, the first yarn Y1 and the second yarn Y2 are located in the chamber 14 through the slit 13 of the yarn splicing portion 10 and are disposed on the first clamping mechanism 20 and the second clamping mechanism 30 located at the first position P1. More specifically, the first yarn Y1 and the second yarn Y2 are disposed between the first clamping member 24 and the second clamping member 26 of the first clamping mechanism 20 and are disposed between the first clamping member 34 and the second clamping member 36 of the second clamping mechanism 30. Accordingly, the first yarn Y1 and the second yarn Y2 are placed on the first contact surface 27b and the second contact surface 27c of the first clamping mechanism 20 and are placed on the first contact surface 37b and the second contact surface 37c of the second clamping mechanism 30.

[0054] When the first yarn Y1 and the second yarn Y2 are set on the synthetic yarn splicer 1, the operation portion 7 is operated (pressed down). Accordingly, in the synthetic yarn splicer 1, the driving portion is operated so that the first clamping mechanism 20 and the second clamping mechanism 30 are operated.

[0055] Specifically, the first yarn Y1 and the second yarn Y2 are clamped by the first clamping member 24 and the second clamping member 26 of the first clamping mechanism 20. Further, the first yarn Y1 and the second yarn Y2 are clamped by the first clamping member 34 and the second clamping member 36 of the second clamping mechanism 30. Then, as illustrated in FIG. 6B, the first clamping mechanism 20 and the second clamping mechanism 30 move from the first position P1 to the second position P2. Accordingly, as illustrated in FIG. 7, the first yarn Y1 and the second yarn Y2 are held between the clamping portion 23 and the clamping portion 33 in a loosened state. Further, the first yarn Y1 and the second yarn Y2 are held while contacting at least the second contact surface 27c and the second contact surface 37c.

[0056] Further, when the operation portion 7 is oper-

ated, air is injected from the injection hole 16a to the chamber 14 through the air flow path 16. Accordingly, the first yarn Y1 and the second yarn Y2 located inside the chamber 14 are spliced by the action of air to form an entangled portion.

[0057] Subsequently, the operation of the operation portion 7 is cancelled. Accordingly, in the synthetic yarn splicer 1, the injection of air from the injection hole 16a to the chamber 14 is stopped and the first clamping mechanism 20 and the second clamping mechanism 30 are operated.

[0058] Specifically, as illustrated in FIG. 6A, the first clamping mechanism 20 and the second clamping mechanism 30 move from the second position P2 to the first position P1. In accordance with this operation, the second clamping member 26 of the first clamping mechanism 20 moves in a direction moving away from the first clamping member 24 and the clamping of the first yarn Y1 and the second yarn Y2 by the first clamping member 24 and the second clamping member 26 is cancelled. Also similarly to the second clamping mechanism 30, the second clamping member 36 moves in a direction moving away from the first clamping member 34 and the clamping of the first yarn Y1 and the second yarn Y2 by the first clamping member 34 and the second clamping member 36 is cancelled. Furthermore, the clamping of the first yarn Y1 and the second yarn Y2 by the first clamping member 24 and the second clamping member 26 may be cancelled after the first clamping mechanism 20 moves from the second position P2 to the first position P1. Similarly, the clamping of the first yarn Y1 and the second yarn Y2 by the first clamping member 34 and the second clamping member 36 may be cancelled after the second clamping mechanism 30 moves from the second position P2 to the first position P1. With the above-described configuration, the splicing of the first yarn Y1 and the second yarn Y2 by the synthetic yarn splicer 1 is completed. Accordingly, the first yarn Y1 and the second yarn Y2 become one yarn.

[0059] As described above, in the synthetic yarn splicer 1 according to the embodiment, the first yarn Y1 and the second yarn Y2 held by the first clamping mechanism 20 and the second clamping mechanism 30 are swayed inside the chamber 14 by using the clamping positions of the first clamping mechanism 20 and the second clamping mechanism 30 as fixed points to form the entangled portion. When the diameter R2 of the injection hole 16a is smaller than ϕ0.8 mm, air does not effectively act on the first yarn Y1 and the second yarn Y2 since a force of air injected into the chamber 14 is small and it is difficult to form the entangled portion since the first yarn Y1 and the second yarn Y2 are not appropriately swayed inside the chamber 14. When the diameter R2 of the injection hole 16a becomes larger than ϕ1.3 mm, there is concern that air excessively acts on the first yarn Y1 and the second yarn Y2 in the case of the yarn of which the thickness is thin and the number of filaments is small. Accordingly, it is difficult to appropriately form the entangled portion.

[0060] In the synthetic yarn splicer 1 according to the embodiment, the diameter R2 of the injection hole 16a is equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm. Accordingly, in the synthetic yarn splicer 1, since air can effectively act on the first yarn Y1 and the second yarn Y2 even in the case of the yarn of which the thickness is thin and the number of filaments is small, the first yarn Y1 and the second yarn Y2 are appropriately swayed inside the chamber 14 and hence the entangled portion can be appropriately formed. Thus, in the synthetic yarn splicer 1, it is possible to form the entangled portion and to suppress a decrease in tensile elongation of the entangled portion in the case of the yarn of which the thickness is thin and the number of filaments is small.

[0061] In the synthetic yarn splicer 1 according to the embodiment, the chamber 14 has a circular shape when viewed from the penetration direction of the chamber 14. The diameter R1 of the chamber 14 is equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm. When the diameter R1 of the chamber 14 is smaller than ϕ3.0 mm, the yarn easily contacts the inner peripheral surface of the chamber 14 and it is difficult for the yarns to turn inside the chamber 14 when the first yarn Y1 and the second yarn Y2 are swayed inside the chamber 14. For that reason, there is concern that the entangled portion is not appropriately formed. When the diameter R1 of the chamber 14 is larger than ϕ4.0 mm, air injected from the injection hole 16a can be injected into the chamber 14. Accordingly, since air cannot appropriately act on the first yarn Y1 and the second yarn Y2, it is difficult to form the entangled portion. In the synthetic yarn splicer 1, since the diameter R1 of the chamber 14 is equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm, it is possible to suppress an influence due to the contact with the inner peripheral surface of the chamber 14 and to appropriately apply air to the first yarn Y1 and the second yarn Y2. Thus, in the synthetic yarn splicer 1, it is possible to more reliably form the entangled portion and to further suppress a decrease in tensile elongation of the entangled portion in the case of the yarn of which the thickness is thin and the number of filaments is small.

[0062] The synthetic yarn splicer 1 according to the embodiment splices the first yarn Y1 and the second yarn Y2 of which the thickness is 55 dtex or less and the number of filaments is 10f or less. It is difficult to form the entangled portion in the yarn of which the thickness is 55 dtex or less and the number of filaments is 10f or less. Since the synthetic yarn splicer 1 has the above-described configuration, it is possible to form the entangled portion also in the yarn of which the thickness is 55 dtex or less and the number of filaments is 10f or less.

[0063] FIGS. 7A and 8A are diagrams showing a tensile elongation measurement result of an entangled portion when the entangled portion is formed by changing a combination of the diameter R1 of the chamber 14 and the diameter R2 of the injection hole 16a in the synthetic yarn splicer 1 according to the embodiment. The measurement result shown in FIGS. 7A and 8A corresponds

to an average value obtained from seven measurement results in which the dropout of the yarn of the entangled portion does not occur after a tensile test is performed on the entangled portion. Furthermore, when the dropout of the yarn was found three times, the measurement ended at that time point. For that reason, the measurement result in which the dropout of the yarn occurred three times corresponds to one measurement result or an average value of plural measurement results.

[0064] In the measurement of the tensile elongation, TENSORAPID4 (trade name) manufactured by USTER was used. FIGS. 7A and 8A show a result in a case in which the pressure of air injected from the injection hole 16a is set to 7 kgf/cm^2. The yarn is a pre-oriented yarn (POY). In the result shown in FIGS. 7A and 8A, "×" indicates a state in which the entangled portion is not formed.

[0065] The yarn corresponding to a measurement target in FIG. 7A is 40dtex-10f. The tensile elongation of the yarn (original yarn) without the entangled portion used for the measurement in FIG. 7A was 64.6 (%) (hereinafter, referred to as the "original yarn elongation A"). The yarn corresponding to the measurement target in FIG. 8A is 20dtex-5f. The tensile elongation of the yarn without the entangled portion used for the measurement in FIG. 8A was 68.6 (%) (hereinafter, referred to as the "original yarn elongation B").

[0066] As shown in FIGS. 7A and 8A, when the diameter R2 of the injection hole 16a was ϕ0.8 mm, ϕ1.0 mm, and ϕ1.3 mm, it was found that the tensile elongation decrease amount (%) for each of the original yarn elongations A and B was relatively small as compared a case in which the diameter R2 of the injection hole 16a was ϕ0.6 mm, ϕ1.6 mm, and ϕ1.8 mm.

[0067] When the diameter R1 of the chamber 14 was ϕ2.5 mm, the entangled portion was not formed regardless of the first yarn Y1 and the second yarn Y2. When the diameter R1 of the chamber 14 was ϕ3.0 mm, ϕ3.5 mm, and ϕ4.0 mm and the diameter R1 was ϕ4.5 mm, ϕ5.5 mm, and ϕ6.0 mm, no big difference was found in the tensile elongation decrease amount (%) for each of the original yarn elongations A and B when the diameter R2 of the injection hole 16a was ϕ0.8 mm, ϕ1.0 mm, and ϕ1.3 mm. When the diameter R2 of the injection hole 16a was ϕ1.0 mm and the diameter R1 of the chamber 14 was ϕ3.5 mm, it was found that the tensile elongation decrease amount (%) for each of the original yarn elongations A and B was clearly small.

[0068] FIGS. 9A and 9B show a CV value (a value obtained by dividing a standard deviation calculated based on a plurality of measurement results of tensile elongation by the average value of tensile elongation) in a predetermined combination of the diameter R1 of the chamber 14 and the diameter R2 of the injection hole 16a. FIG. 9A shows a result of a yarn of 40dtex-10f. FIG. 9B shows a result of a yarn of 20dtex-5f.

[0069] As shown in FIG. 9A, the original yarn elongation A is 64.6 (%) and the CV value of the original yarn is 3.4 %. When the diameter R1 of the chamber 14 is ϕ3.5 mm and the diameter R2 of the injection hole 16a is ϕ1.0 mm, the average value of the tensile elongation is 59.7 (%) and the CV value is 4.5 (%). When the diameter R1 of the chamber 14 is ϕ4.0 mm and the diameter R2 of the injection hole 16a is ϕ1.3 mm, the average value of the tensile elongation is 58.2 (%) and the CV value is 5.7 (%).

[0070] When the diameter R1 of the chamber 14 is ϕ6.0 mm and the diameter R2 of the injection hole 16a is ϕ0.8 mm, the average value of the tensile elongation is 58.2 (%) and the CV value is 15.7 (%). When the diameter R1 of the chamber 14 is ϕ6.0 mm and the diameter R2 of the injection hole 16a is ϕ1.3 mm, the average value of the tensile elongation is 58.9 (%) and the CV value is 10.5 (%). In this way, when the diameter R1 of the chamber 14 is ϕ3.5 mm, ϕ4.0 mm, and ϕ6.0 mm, the average value of the tensile elongation is not largely different, but the CV value is largely different. When the diameter R1 of the chamber 14 is ϕ3.5 mm and ϕ4.0 mm, the CV value is small in any case as compared with a case in which the diameter R1 of the chamber 14 is ϕ6.0 mm. That is, a change in tensile elongation decrease amount (%) is small in any case. For that reason, when the diameter R2 of the injection hole 16a was equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm and the diameter R1 of the chamber 14 was equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm, it was found that the tensile elongation decrease amount (%) with respect to the original yarn elongation was low and a change in tensile elongation decrease amount (%) could be suppressed. Thus, in the synthetic yarn splicer 1, it was found that the entangled portion could be stably formed in the yarn of 40dtex-10f.

[0071] As shown in FIG. 9B, the original yarn elongation B was 68.6 (%) and the CV value of the original yarn was 2.5%. When the diameter R1 of the chamber 14 is ϕ3.5 mm and the diameter R2 of the injection hole 16a is ϕ1.0 mm, the average value of the tensile elongation is 57.9 (%) and the CV value is 6.8 (%). When the diameter R1 of the chamber 14 is ϕ4.0 mm and the diameter R2 of the injection hole 16a is ϕ1.3 mm, the average value of the tensile elongation is 50.8 (%) and the CV value is 11.0 (%).

[0072] When the diameter R1 of the chamber 14 is ϕ6.0 mm and the diameter R2 of the injection hole 16a is ϕ0.8 mm, the average value of the tensile elongation is 56.9 (%) and the CV value is 11.3 (%). When the diameter R1 of the chamber 14 is ϕ6.0 mm and the diameter R2 of the injection hole 16a is ϕ1.3 mm, the average value of the tensile elongation is 57.7 (%) and the CV value is 13.6 (%). In this way, when the diameter R1 of the chamber 14 is ϕ3.5 mm, ϕ4.0 mm, and ϕ6.0 mm, the average value of the tensile elongation is not largely different, but the CV value is different. When the diameter R1 of the chamber 14 is ϕ3.5 mm and ϕ4.0 mm, the CV value is small in any case as compared with a case in which the diameter R1 of the chamber 14 is ϕ6.0 mm. That is, a

change in tensile elongation decrease amount (%) is small in any case. Thus, in the synthetic yarn splicer 1, it was found that the entangled portion could be stably formed in the yarn of 20dtex-5f.

[0073] FIGS. 7B and 8B show the number of times of the dropout of the yarn due to a tensile test. In the tensile test, an entangled portion is formed in the first yarn Y1 and the second yarn Y2 by using the synthetic yarn splicer 1 and then the entangled portion is pulled from both sides by a predetermined force. When a tensile force is applied to the first yarn Y1 and the second yarn Y2 so that the entangled portion is unraveled and the coupling of the first yarn Y1 and the second yarn Y2 cannot be maintained, the dropout of the yarn occurs.

[0074] As shown in FIG. 7B, the dropout of the yarn did not occur in the yarn of 40dtex-10f. For that reason, even when the diameter R2 of the injection hole 16a was equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm and the diameter R1 of the chamber 14 was equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm, it was found that the entangled portion can be stably formed in the case of the yarn of 40dtex-10f.

[0075] As shown in FIG. 8B, when the diameter R2 of the injection hole 16a is ϕ0.6 mm, ϕ1.6 mm, and ϕ1.8 mm, the dropout of the yarn relatively occurs. Even when the diameter R1 of the chamber 14 is ϕ3.5 mm and the diameter R2 of the injection hole 16a is ϕ0.8 mm and ϕ1.3 mm, the dropout of the yarn occurs once. In contrast, the filament changes in an unraveled direction in accordance with a temperature and a humidity. For that reason, the reason why the dropout of the yarn occurs once is because there is an influence of an environment at the time of forming the entangled portion. As described above, when the diameter R2 of the injection hole 16a was equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm, it was found that the dropout of the yarn was relatively small.

[0076] When the diameter R2 of the injection hole 16a is equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm and the diameter R1 of the chamber 14 is equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm, the number of times of the dropout of the yarn is relatively small and the CV value is small as compared with the other combinations. For that reason, when the diameter R2 of the injection hole 16a was equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm and the diameter R1 of the chamber 14 was equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm, it was found that the entangled portion could be stably formed in the yarn of 20dtex-5f. When the diameter R2 of the injection hole 16a was Φ1.0 mm and the diameter R1 of the chamber 14 was ϕ3.5 mm, the dropout of the yarn was not found. For that reason, when the diameter R2 of the injection hole 16a was ϕ1.0 mm and the diameter R1 of the chamber 14 was ϕ3.5 mm, it was found that the entangled portion could be stably formed in the yarn of 20dtex-5f.

[0077] Although the embodiment of the invention has been described, the invention is not essentially limited to the above-described embodiment and can be modified into various forms without departing from the gist thereof.

[0078] In the above-described embodiment, a shape illustrated in FIG. 1 has been described as the shape of the main body 3. However, the shape of the main body 3 is not limited to the shape illustrated in FIG. 1.

[0079] In the above-described embodiment, an example of an embodiment in which the first clamping members 24 and 34 and the second clamping members 26 and 36 are formed in a columnar shape, that is, the cross-sections of the first clamping members 24 and 34 and the second clamping members 26 and 36 are formed in a circular shape has been described. However, the first clamping member and the second clamping member are not limited to the columnar shape as long as the yarn can be clamped, but may be formed in various shapes (for example, prismatic shapes or the like).

[0080] In the above-described embodiment, an example of an embodiment in which the support portions 22 and 32 swing about the shafts 21 and 31 to move to the first position P1 and the second position P2 has been described. However, the support portions 22 and 32 may move in a direction moving close to each other and moving away from each other, for example, in a substantially parallel state.

[0081] In the above-described embodiment, an example of an embodiment in which the first yarn Y1 and the second yarn Y2 are disposed on the first clamping mechanism 20 and the second clamping mechanism 30 located at the first position P1, the first clamping mechanism 20 and the second clamping mechanism 30 are moved from the first position P1 to the second position P2, and air is injected from the injection hole 16a to the chamber 14 to form an entangled portion has been described. However, a method of forming the entangled portion by using the synthetic yarn splicer 1 is not limited thereto.

[0082] For example, the first yarn Y1 and the second yarn Y2 are disposed on the first clamping mechanism 20 and the second clamping mechanism 30 located at the second position P2, the first clamping mechanism 20 and the second clamping mechanism 30 are moved from the second position P2 to the first position P1, the first clamping mechanism 20 and the second clamping mechanism 30 are moved from the first position P1 to the second position P2, and air is injected from the injection hole 16a to the chamber 14 to form an entangled portion.

[0083] In the above-described embodiment, an example of an embodiment in which the synthetic yarn splicer 1 is a hand splicer used while being gripped by an operator has been described. However, the synthetic yarn splicer may be provided in an apparatus or the like.

REFERENCE SIGNS LIST

[0084] 1...SYNTHETIC YARN SPLICER, 10...YARN SPLICING PORTION, 14...CHAMBER (PASSEGE),

16a...INJECTION HOLE, 20...FIRST CLAMPING MECHANISM, 30...SECOND CLAMPING MECHANISM, R1...DIAMETER, R2...DIAMETER, Y1...FIRST YARN (ONE YARN), Y2...SECOND YARN (OTHER YARN).

Claims

1. A synthetic yarn splicer (1) that splices one yarn (Y1) and the other yarn (Y2) formed of synthetic fibers, comprising:

   a yarn splicing portion (10) that includes a passage (14) which forms a space through which the one yarn (Y1) and the other yarn (Y2) are insertable and an injection hole (16a) which opens to the passage (14) and injects a fluid; and a pair of clamping mechanisms (20,30) that is provided at a position interposing the passage (14) of the yarn splicing portion (10) and clamps each of the one yarn (Y1) and the other yarn (Y2) inserted through the space,
   wherein the injection hole (16a) has a circular shape, and
   wherein a diameter (R2) of the injection hole (16a) is equal to or larger than ϕ0.8 mm and equal to or smaller than ϕ1.3 mm.

2. The synthetic yarn splicer (1) according to claim 1, wherein a diameter (R2) of the injection hole (16a) is equal to or larger than ϕ1.0 mm and equal to or smaller than ϕ1.3 mm.

3. The synthetic yarn splicer (1) according to claim 1 or 2,
   wherein the passage (14) has a circular shape when viewed from a penetration direction of the passage (14), and
   wherein a diameter (R1) of the passage (14) is equal to or larger than ϕ3.0 mm and equal to or smaller than ϕ4.0 mm.

4. The synthetic yarn splicer (1) according to any one of claims 1 to 3,
   wherein the one yarn (Y1) and the other yarn (Y2) of which the thickness is 55 dtex or less and the number of filaments is 10f or less are spliced.

Fig.1

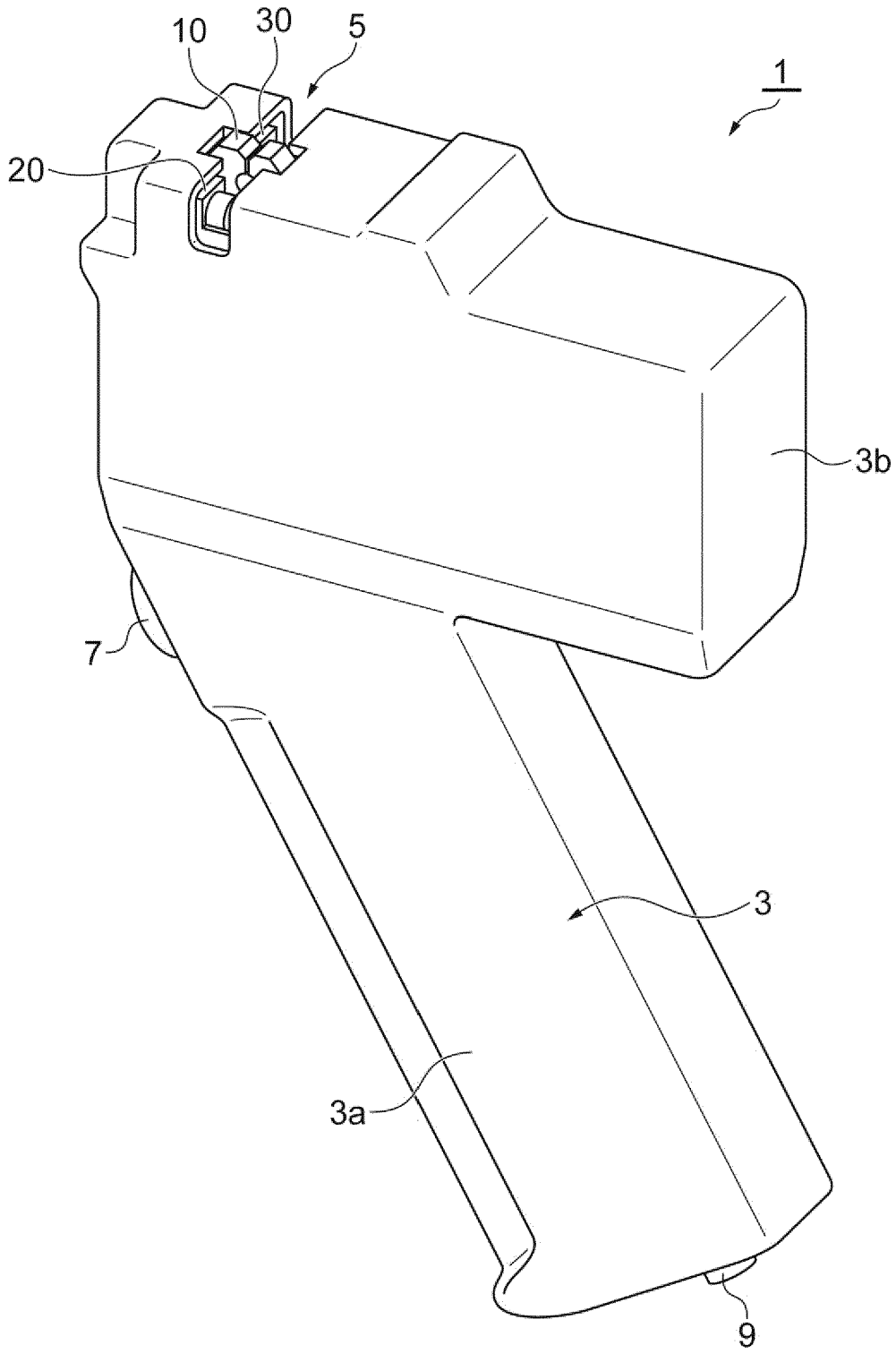


Fig.2

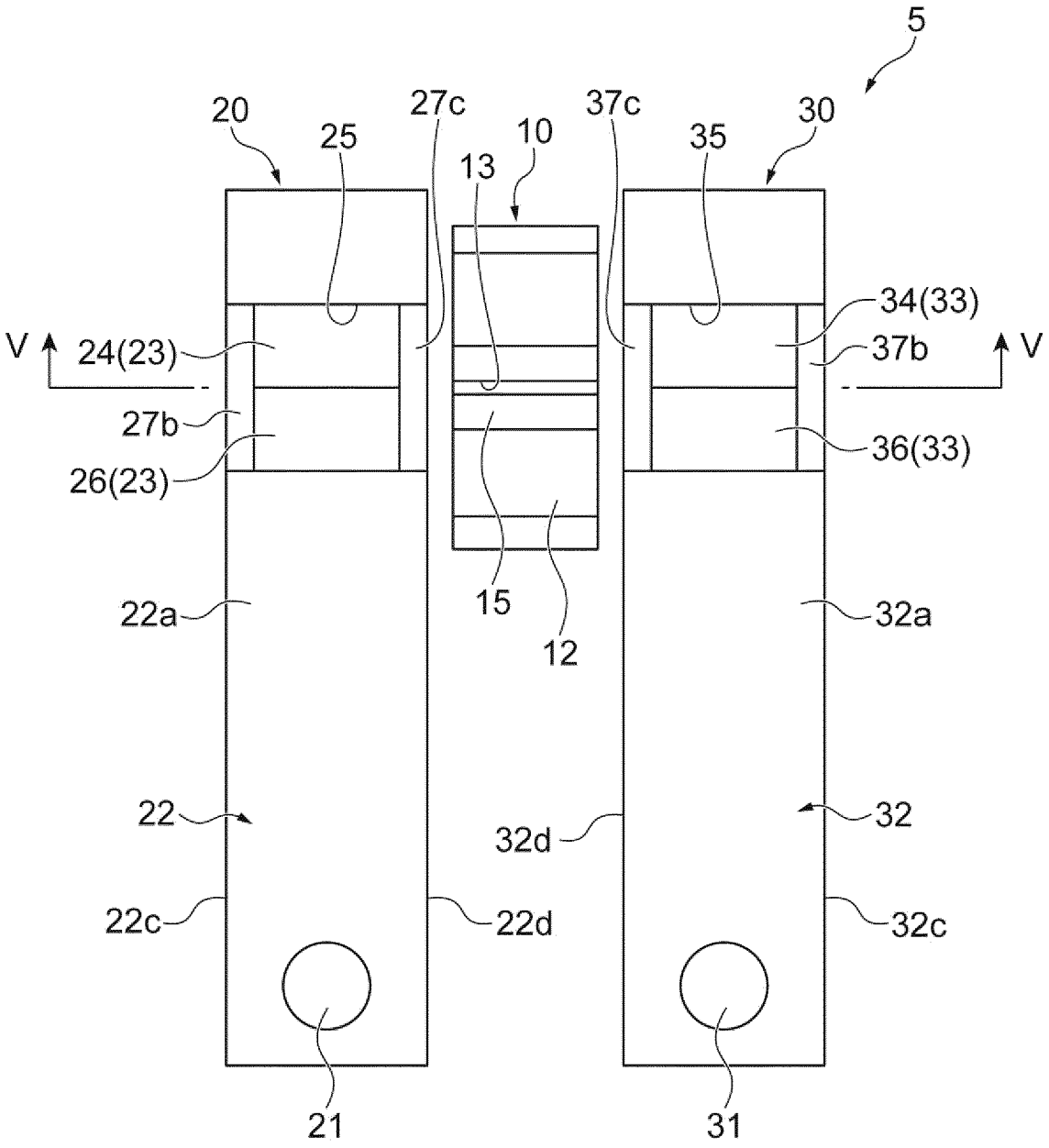

5
20
25
27c
10
13
37c
35
30
34(33)
V
24(23)
37b
V
27b
36(33)
26(23)
22a
15
12
32a
22
32d
32
22c
22d
32c
21
31

Fig.3

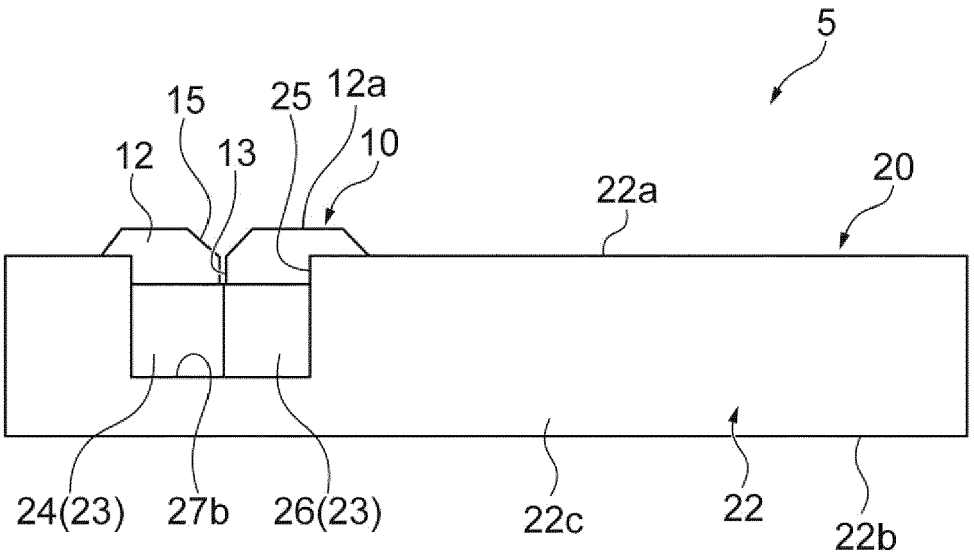


Fig.4

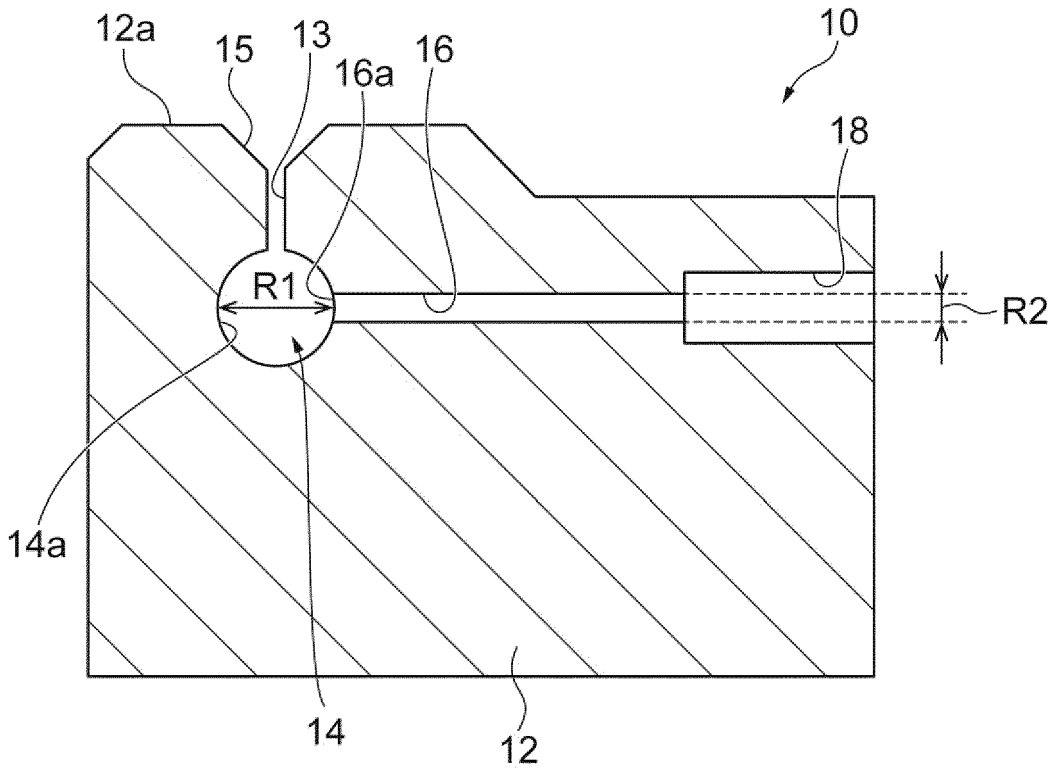


Fig.5

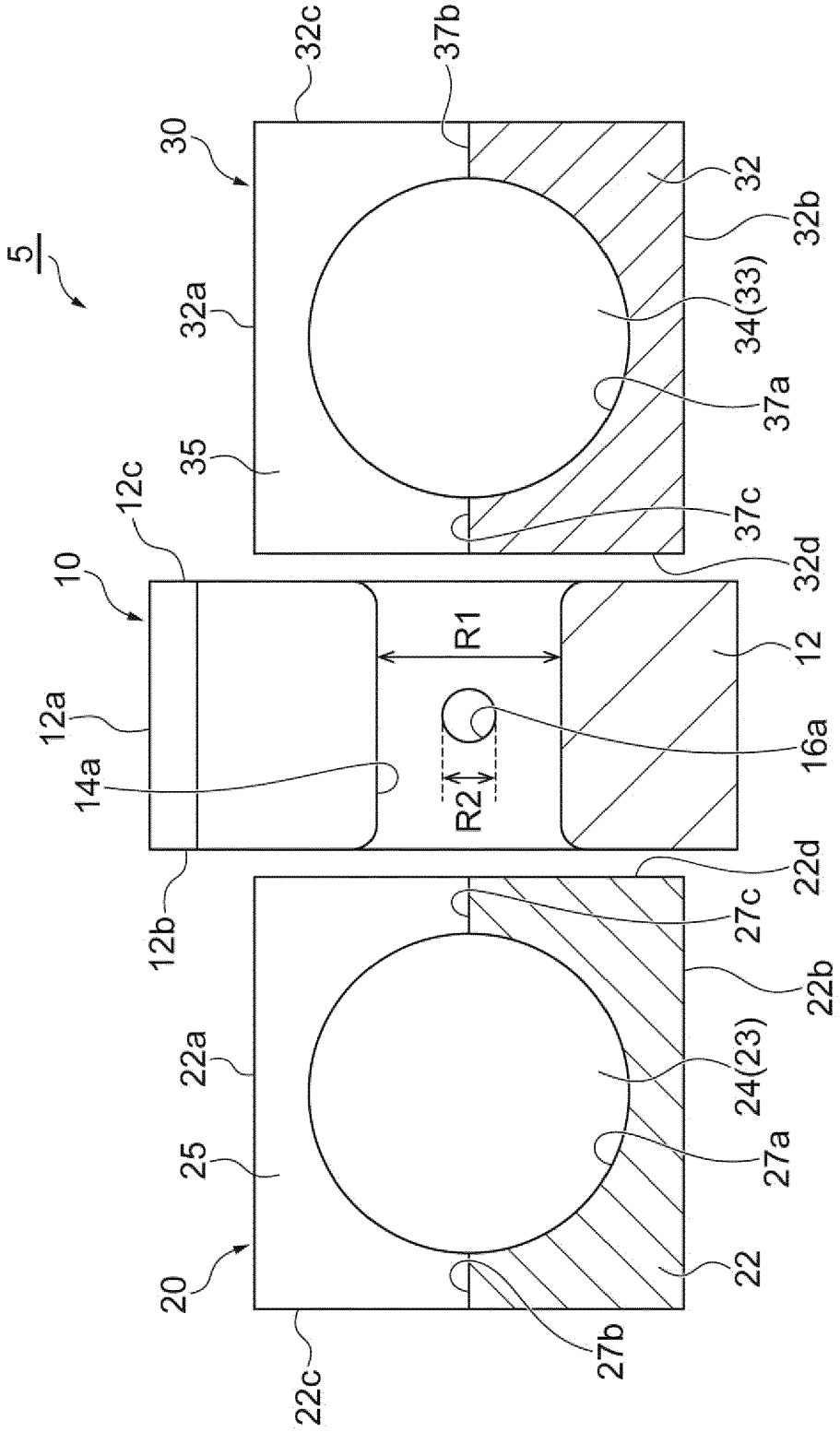

5
30
32c
37b
32
32b
32a
34(33)
37a
35
37c
32d
12c
10
R1
12
12a
16a
14a
R2
22d
12b
27c
22b
22a
24(23)
25
27a
20
22
22c
27b

Fig.6B

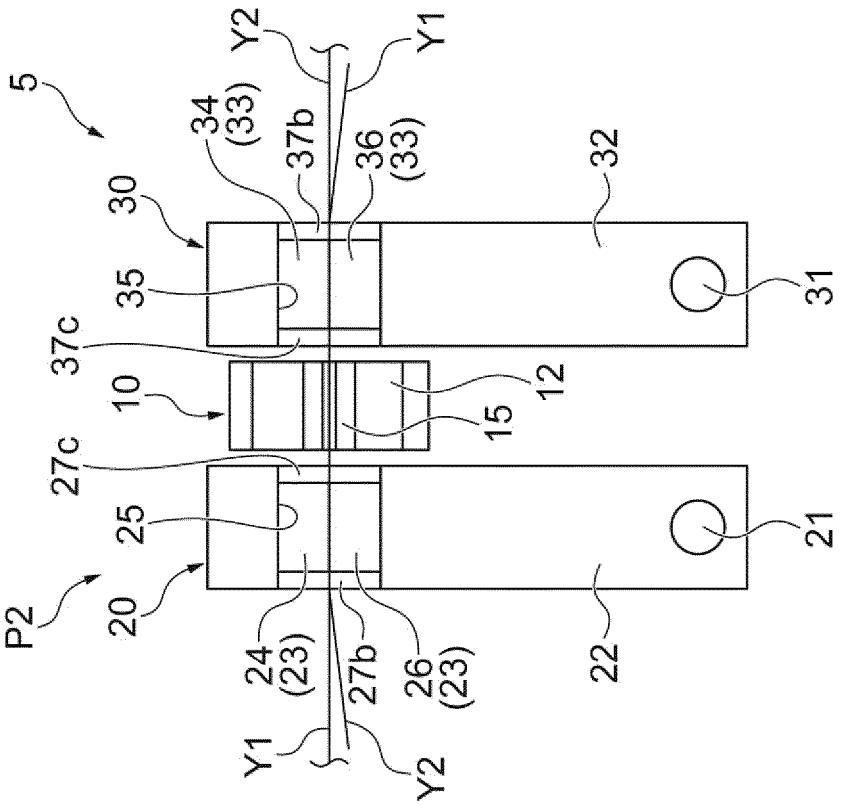

5
Y2
Y1
34
(33)
37b
36
(33)
32
30
35
31
37c
10
12
15
27c
25
21
P2
20
24
(23)
27b
26
(23)
22
Y1
Y2

Fig.6A

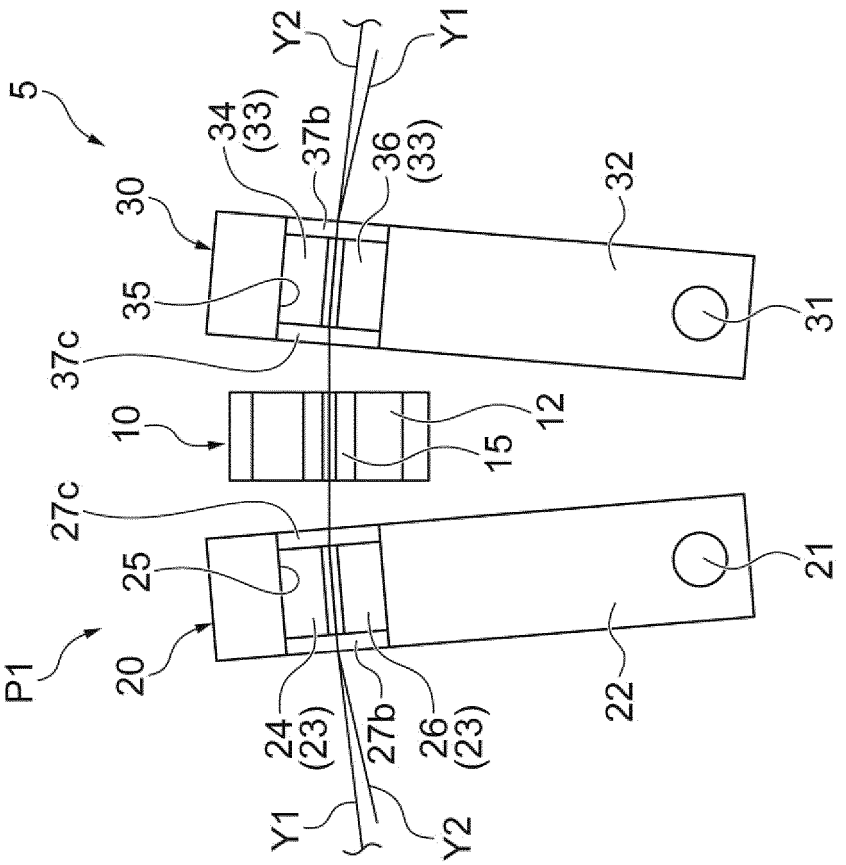

5
Y2
Y1
34
(33)
37b
36
(33)
32
30
35
31
37c
10
12
15
27c
25
21
P1
20
24
(23)
27b
26
(23)
22
Y1
Y2

Fig.7A

TENSILE ELONGATION [%]

		CHAMBER DIAMETER R1 [mm]						
		ϕ2.5	ϕ3.0	ϕ3.5	ϕ4.0	ϕ4.5	ϕ5.5	ϕ6.0
INJECTION HOLE DIAMETER R2 [mm]	ϕ0.6	×	—	54.9%	—	—	—	49.3%
	ϕ0.8	×	55.7%	45.6%	50.1%	—	—	58.2%
	ϕ1.0	×	57.7%	59.7%	58.2%	—	—	52.8%
	ϕ1.3	—	52.8%	55.4%	58.2%	54.3%	59.1%	58.9%
	ϕ1.6	—	—	55.5%	50.8%	—	29.7%	48.3%
	ϕ1.8	—	—	—	39.6%	—	—	39.9%

Fig.7B

NUMBER OF TIMES OF DROPOUT [TIME]

		CHAMBER DIAMETER R1 [mm]						
		ϕ2.5	ϕ3.0	ϕ3.5	ϕ4.0	ϕ4.5	ϕ5.5	ϕ6.0
INJECTION HOLE DIAMETER R2 [mm]	ϕ0.6	×	—	0 TIMES	—	—	—	0 TIMES
	ϕ0.8	×	0 TIMES	0 TIMES	0 TIMES	—	—	0 TIMES
	ϕ1.0	×	0 TIMES	0 TIMES	0 TIMES	—	—	0 TIMES
	ϕ1.3	—	0 TIMES	0 TIMES	0 TIMES	0 TIMES	0 TIMES	0 TIMES
	ϕ1.6	—	—	0 TIMES	0 TIMES	—	0 TIMES	0 TIMES
	ϕ1.8	—	—	—	0 TIMES	—	—	0 TIMES

Fig.8A

TENSILE ELONGATION [%]

		CHAMBER DIAMETER R1 [mm]						
		ϕ2.5	ϕ3.0	ϕ3.5	ϕ4.0	ϕ4.5	ϕ5.5	ϕ6.0
INJECTION HOLE DIAMETER R2 [mm]	ϕ0.6	×	—	36.1%	—	—	—	×
	ϕ0.8	×	43.8%	47.4%	47.1%	—	—	56.9%
	ϕ1.0	×	56.0%	57.9%	—	—	—	43.3%
	ϕ1.3	—	49.2%	44.5%	50.8%	53.4%	57.4%	57.7%
	ϕ1.6	—	—	55.1%	44.4%	—	33.5%	55.9%
	ϕ1.8	—	—	—	50.4%	—	—	45.0%

Fig.8B

NUMBER OF TIMES OF DROPOUT [TIME]

		CHAMBER DIAMETER R1 [mm]						
		ϕ2.5	ϕ3.0	ϕ3.5	ϕ4.0	ϕ4.5	ϕ5.5	ϕ6.0
INJECTION HOLE DIAMETER R2 [mm]	ϕ0.6	×	—	1 TIME	—	—	—	×
	ϕ0.8	×	0 TIMES	1 TIME	0 TIMES	—	—	1 TIME
	ϕ1.0	×	0 TIMES	0 TIMES	—	—	—	1 TIME
	ϕ1.3	—	0 TIMES	1 TIME	0 TIMES	0 TIMES	0 TIMES	1 TIME
	ϕ1.6	—	—	1 TIME	1 TIME	—	3 TIMES	0 TIMES
	ϕ1.8	—	—	—	0 TIMES	—	—	2 TIMES

Fig.9A

40dtex-10f

CHAMBER DIAMETER R1 [mm]	ϕ3.5	ϕ4.0	ϕ6.0	ϕ6.0	ORIGINAL YARN
INJECTION HOLE DIAMETER R2 [mm]	ϕ1.0	ϕ1.3	ϕ0.8	ϕ1.3	
TENSILE ELONGATION	59.7%	58.2%	58.2%	58.9%	64.6%
CV VALUE	4.5%	5.7%	15.7%	10.5%	3.4%

Fig.9B

20dtex-5f

CHAMBER DIAMETER R1 [mm]	ϕ3.5	ϕ4.0	ϕ6.0	ϕ6.0	ORIGINAL YARN
INJECTION HOLE DIAMETER R2 [mm]	ϕ1.0	ϕ1.3	ϕ0.8	ϕ1.3	
TENSILE ELONGATION	57.9%	50.8%	56.9%	57.7%	68.6%
CV VALUE	6.8%	11.0%	11.3%	13.6%	2.5%

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 16 7770

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	US 5 280 698 A (GERSTNER-STEVENS DITMAR [DE] ET AL) 25 January 1994 (1994-01-25) * column 4, lines 22-29; figure 3 * -----	1-4	INV. B65H69/06
X	EP 1 420 091 A1 (MITSUBISHI RAYON CO [JP]) 19 May 2004 (2004-05-19) * paragraph [0020]; figure 1 * -----	1,2	
X	JP 2002 302342 A (MITSUBISHI RAYON CO) 18 October 2002 (2002-10-18) * abstract; figures 1,3 * -----	1,2	
A	US 4 693 067 A (LOCATELLI LORENZO [IT]) 15 September 1987 (1987-09-15) * column 5, lines 29-33 * -----	1-3	
			TECHNICAL FIELDS SEARCHED (IPC) B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 August 2019	Pussemier, Bart

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 19 16 7770

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.

23-08-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5280698 A	25-01-1994	BE 1004782 A3	26-01-1993
		DE 4032512 C1	16-01-1992
		IT 1250318 B	07-04-1995
		US 5280698 A	25-01-1994
EP 1420091 A1	19-05-2004	EP 1420091 A1	19-05-2004
		JP 3833654 B2	18-10-2006
		JP WO2002101129 A1	24-09-2004
		US 2004168425 A1	02-09-2004
		WO 02101129 A1	19-12-2002
JP 2002302342 A	18-10-2002	JP 4592208 B2	01-12-2010
		JP 2002302342 A	18-10-2002
US 4693067 A	15-09-1987	DE 3626374 A1	12-03-1987
		IT 206161 Z2	03-07-1987
		JP H0780633 B2	30-08-1995
		JP S62111878 A	22-05-1987
		US 4693067 A	15-09-1987

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 H1017214 B **[0002]**