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

(11) **EP 2 915 911 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.09.2015 Bulletin 2015/37

(21) Application number: **15152593.8**

(22) Date of filing: **27.01.2015**

(51) Int Cl.:
D03D 47/25 *(2006.01)* ***D03D 47/30*** *(2006.01)*
D03D 49/42 *(2006.01)* ***D03J 1/04*** *(2006.01)*
D03J 5/06 *(2006.01)*

(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

(30) Priority: **13.02.2014 JP 2014025478**

(71) Applicant: **KABUSHIKI KAISHA TOYOTA JIDOSHOKKI**
Kariya-shi, Aichi 448-8671 (JP)

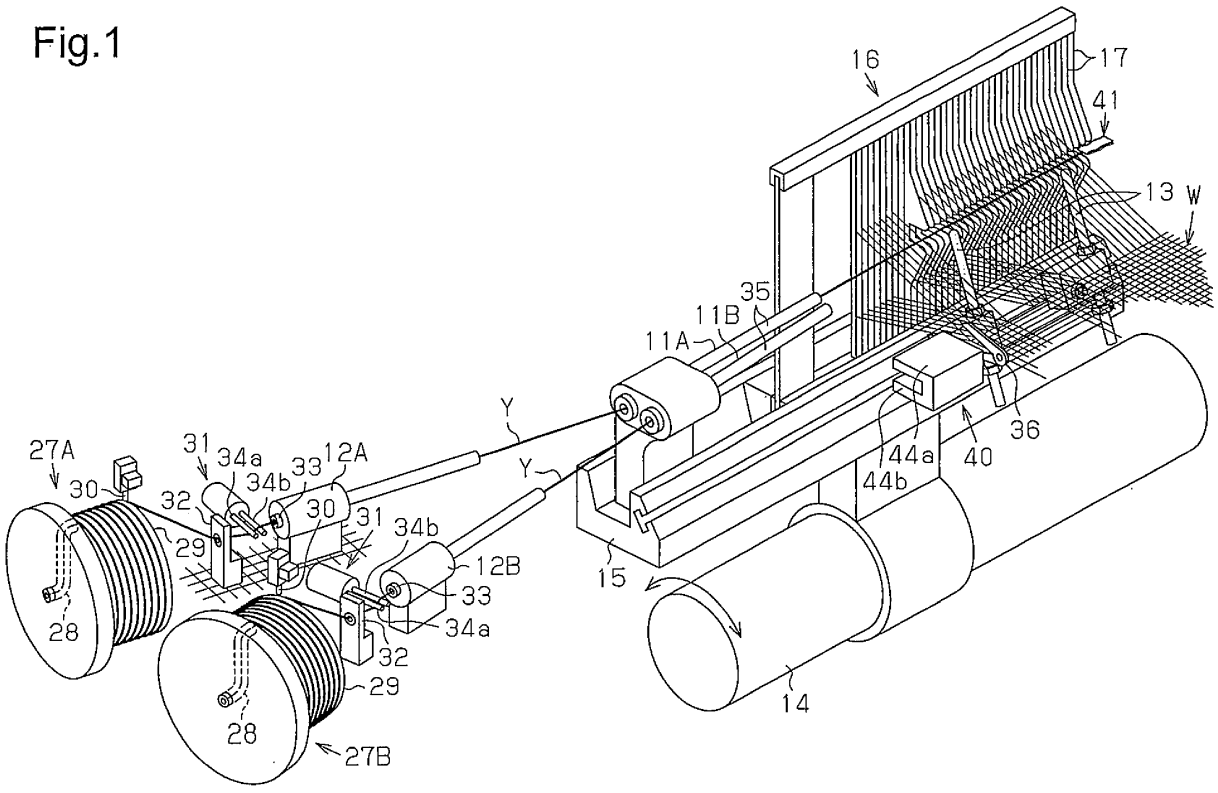
(72) Inventors:
- **Makino, Yoichi**
  Kariya-shi,, Aichi 448-8671 (JP)
- **Takagi, Shinji**
  Kariya-shi,, Aichi 448-8671 (JP)
- **Suzuki, Fujio**
  Nagakute-shi,, Aichi 480-1192 (JP)
- **Yachi, Hiroshi**
  Nagakute-shi,, Aichi 480-1192 (JP)

(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(54) **Weft insertion method for air jet loom and flight promotor attaching device**

(57) A weft insertion method in an air jet loom includes: attaching a flight promoter (41) that has a greater surface area per unit weight than a weft yarn (Y) to a distal end portion of the weft yarn (Y) before weft insertion; and performing insertion of the weft yarn (Y) to which the flight promoter (41) is attached.

Fig.1



EP 2 915 911 A2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a weft insertion method for an air jet loom and a flight promotor attaching device.

[0002] In recent years, air jet looms have been increasingly used to improve the speed and efficiency of weaving.

[0003] An air jet loom performs weft insertion by transporting weft yarns with high-pressure jet flow discharged from nozzles. When a weft yarn of an air jet loom is a yarn with a significantly small air friction resistance, such as a monofilament yarn and metal fiber, the weft yarn may not be able to fly over the fabric width in the reed passage, disrupting the weaving. When the weft yarn of an air jet loom is a multifilament yarn having a smaller air friction resistance than a spun yarn, which is formed by twisting fine short fibers, such as a flat yarn and a hard twist yarn, or a yarn having a high fiber stiffness, such as a hemp yarn, the weft yarn may not fly at a sufficient velocity. This may stop the operation of the loom or significantly increase the air consumption.

[0004] To avoid such problems, Japanese Laid-Open Patent Publications No. 51-92352 and No. 58-163758, for example, disclose a weft insertion system and a weft insertion method. The '352 publication discloses a weft insertion system that bonds a spherical solid object to a weft yarn. The solid object is several tens of times the diameter of the weft yarn. The weft yarn is inserted by directing a jet of fluid (air or water) to the weft yarn. The '758 publication discloses a weft insertion method in a loom in which a jet of fluid carries a weft yarn in weft insertion. In this method, the distal end region of a weft yarn is deformed by bending, for example, before weft insertion, so that the propelling force the weft yarn receives from the jet of fluid is increased. The length of the deformed distal end region does not exceed the length of the weft selvage to be discarded.

[0005] When a spherical solid object that is tens of times the diameter of the weft yarn is bonded like the system of the '352 publication, the section to which the spherical solid object is bonded has a greater weight per length than the other section of the weft yarn to be inserted. This hinders the weft yarn from flying straight. When the distal end region of a weft yarn is deformed like the method of the '758 publication, the yarn propelling force during flight of the weft yarn is increased compared to a straight weft yarn. However, when a yarn with a significantly small air friction resistance, such as a monofilament yarn and metal fiber, or a yarn having a smaller air friction resistance than a spun yarn, such as a flat yarn and hard twist yarn, is used, it is difficult to reduce the air consumption required to maintain the yarn propelling force during flight of the weft yarn.

SUMMARY OF THE INVENTION

[0006] It is an objective of the present invention to provide a weft insertion method for an air jet loom and a flight promotor attaching device that allows weaving to be performed even when the weft yarn is a monofilament yarn or metal fiber and allows weaving to be performed with less air consumption even when the weft yarn is a flat yarn, hard twist yarn, or hemp yarn.

[0007] To achieve the foregoing objective and in accordance with one aspect of the present invention, a weft insertion method in an air jet loom is provided that includes: attaching a flight promoter that has a greater surface area per unit weight than a weft yarn to a distal end portion of the weft yarn before weft insertion; and performing insertion of the weft yarn to which the flight promoter is attached.

[0008] In accordance with another aspect of the present invention, a flight promotor attaching device in an air jet loom is provided, in which a flight promoter that has a greater surface area per unit weight than a weft yarn is attached to a distal end portion of the weft yarn before weft insertion.

[0009] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a schematic perspective view showing an air jet loom of a first embodiment;
Fig. 2 is a cross-sectional side view showing the positional relationship between a reed dent and a sub-nozzle in the air jet loom of Fig. 1;
Fig. 3 is a schematic view showing supply paths of compressed air to nozzles in the air jet loom of Fig. 1;
Fig. 4 is a schematic view showing a weft yarn to which a flight promoter is attached at the distal end portion;
Fig. 5 is a partially cutaway front view schematically showing the structure of an attaching device of the air jet loom of Fig. 1;

Fig. 6 is a partially cutaway front view showing an operation of the attaching device of Fig. 5;
Fig. 7 is a partially cutaway front view showing an operation of the attaching device of Fig. 5;
Fig. 8 is a front view showing a weft yarn and a flight promoter at the beginning of weft insertion;
Fig. 9 is a schematic perspective view showing an attaching device of a second embodiment;
Fig. 10 is a schematic view showing the attaching device of Fig. 9;
Fig. 11 is a schematic view showing a weft yarn to which a flight promoter is fused at the distal end portion by the attaching device of Fig. 9;
Fig. 12 is a diagram showing the relationship between the surface area of the flight promoter and the weft yarn propelling force achieved by sub-nozzles in the profile reed channel;
Fig. 13 is a diagram showing the relationship between the weight of the flight promoter and the flying ability of the weft yarn; and
Fig. 14 is a schematic perspective view showing a attaching device of a third embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

[0011] A first embodiment of the present invention will now be described with reference to Figs. 1 to 8.

[0012] As shown in Fig. 1, an air jet loom includes a weft insertion system that includes two main nozzles 11 A and 11 B for weft insertion, tandem nozzles 12A and 12B, which are arranged on the upstream sides of the main nozzles 11 A and 11 B, respectively, and a plurality of sub-nozzles 13 for weft insertion that is arranged on the downstream side of the main nozzles 11 A and 11 B. The tandem nozzles 12A and 12B are fixed by brackets or the like that are attached to a frame of the air jet loom or the floor surface.

[0013] The main nozzles 11A and 11 B and the sub-nozzles 13 are arranged on a sley 15 that is fixed to a pivot shaft 14 and pivots forward and backward in the front-rear direction of the air jet loom. A profile reed 16 is fixed on the sley 15. The profile reed 16 includes a plurality of dents 17 arranged in the weft insertion direction. As shown in Fig. 2, guide recesses 17a of the dents 17 form a reed channel 18 that functions as the insertion path of weft yarns Y. The sub-nozzles 13 are spaced apart from one another along the weft insertion path such that the ends of the sub-nozzles 13 face the reed channel 18. In Fig. 1, the dents 17 are partially removed.

[0014] As shown in Fig. 3, a main nozzle switching valve 19A is connected to the main nozzle 11 A, a main nozzle switching valve 19B is connected to the main nozzle 11 B, a tandem nozzle switching valve 20A is connected to the tandem nozzle 12A, and a tandem nozzle switching valve 20B is connected to the tandem nozzle 12B by separate pipes 21. A common pipe 22 connects the switching valves 19A, 19B, 20A and 20B to a main tank 23. A controller (not shown) controls the switching valves 19A, 19B, 20A and 20B to control discharge timing of compressed air from each of the main nozzles 11 A and 11 B and the tandem nozzles 12A and 12B. In the first embodiment, the switching valves 19A, 19B, 20A and 20B are controlled such that weft insertion by the main nozzle 11A and the tandem nozzle 12A and weft insertion by the main nozzle 11 B and the tandem nozzle 12B alternate.

[0015] The weft insertion system includes a plurality of sets of three sub-nozzles 13. In addition, the weft insertion system includes sub-nozzle switching valves 24, each of which is associated with one of the sets of the sub-nozzles 13. The three sub-nozzles 13 in each set are connected to the associated sub-nozzle switching valve 24 by separate pipes 25a. A common pipe 25b connects the switching valves 24 to a sub-tank 26. A controller (not shown) controls the switching valves 24 to open and close in sequence from the upstream side at a predetermined timing during weft insertion. Accordingly, the sub-nozzles 13 discharge jets of compressed air in a relaying manner.

[0016] As shown in Fig. 1, drum-type weft accumulators 27A and 27B are arranged on the upstream sides of the tandem nozzles 12A and 12B, respectively. Each of the weft accumulators 27A and 27B includes a weft winding tube 28. The weft yarn Y that is supplied from a yarn supply portion (not shown) to each weft winding tube 28 is wound around a length measurement drum 29 and stored. Each of the weft accumulators 27A and 27B includes an engagement pin 30 that is movable toward and away from the associated length measurement drum 29. To start releasing the weft yarn Y, each engagement pin 30 is moved out of engagement with the associated length measurement drum 29 and separated from the drum 29. When one insertion length of the weft yarn Y is released from the length measurement drum 29, the engagement pin 30 that is separated from the length measurement drum 29 engages the length measurement drum 29 to stop releasing of the weft yarn Y.

[0017] A weft brake 31 is arranged between the tandem nozzle 12A and the weft accumulator 27A and between the tandem nozzle 12B and the weft accumulator 27B. Each weft brake 31 includes a weft guide 32 that guides the weft yarn Y supplied from the associated one of the weft accumulators 27A and 27B to the associated one of the tandem nozzles 12A and 12B. Each weft brake 31 includes a pair of engagement bars 34a and 34b that is engageable with the weft yarn Y between the weft guide 32 and a weft inlet 33 of the associated one of the tandem nozzles 12A and 12B. Each pair of the engagement bars 34a and 34b is movable between a movement permission position that permits

movement of the weft yarn Y supplied from the associated one of the weft accumulator 27A and 27B and a restriction position that restricts movement of the weft yarn Y.

[0018] A weft cutter 36 is arranged on the insertion side of the air jet loom beside the fabric fell. The weft cutter 36 cuts the weft yarn Y that is inserted and beat up by the profile reed 16 between a woven fabric W and the main nozzles 11 A and 11 B. A flight promotor attaching device 40 is arranged between the main nozzles 11 A and 11 B and the weft cutter 36. The attaching device 40 attaches a flight promoter 41 to the distal end portion of the weft yarn Y. The flight promoter 41 has a larger surface area per unit weight than the weft yarn Y.

[0019] As shown in Fig. 4, the flight promoter 41 of the first embodiment is shaped like tape and formed from flat yarns 42 that are non-woven fabric having minute projections and depressions on the surface, for example. The phrase "shaped like tape" refers to a flat shape in which the width is several tens of times or the thickness or greater. The flight promoter 41 is formed from two flat yarns 42 and includes an end region (proximal end region) that forms a fused section 43. The two flat yarns 42 sandwich the weft yarn Y, and the fused section 43 is thermally fused to the distal end portion of the weft yarn Y. In other words, the flight promoter 41 is thermally fused to the distal end portion of the weft yarn Y in a manner wrapping the weft yarn Y. The flat yarns 42 are formed from thermosetting resin that melts at a relatively low temperature.

[0020] As shown in Fig. 5, the attaching device 40 includes guide members 44a and 44b that face each other in the vertical direction and sandwich the flight path of the weft yarns Y that are inserted by the main nozzles 11A and 11 B. The distance between the guide members 44a and 44b is substantially equal to the outer diameter of acceleration tubes 35 of the main nozzles 11 A and 11 B. As shown in Fig. 1, the guide members 44a and 44b are part of a component of the attaching device 40 that has a U-shaped cross section.

[0021] A flat yarn supply portion 45a, a guide base 46a, and a feed roller 47a are arranged above the upper guide member 44a. The guide base 46a and the feed roller 47a guide the flat yarn 42 supplied from the flat yarn supply portion 45a to the guide member 44a. The section of the guide member 44a that is closer to the weft cutter 36 includes a guide groove 48a that guides the flat yarn 42 supplied from the flat yarn supply portion 45a to the clearance between the guide members 44a and 44b.

[0022] A flat yarn supply portion 45b, a guide base 46b, and a feed roller 47b are arranged below the lower guide member 44b. The guide base 46b and the feed roller 47b guide the flat yarn 42 supplied from the flat yarn supply portion 45b to the guide member 44b. Each of the flat yarn supply portions 45a and 45b includes a reel around which the flat yarn 42 is wound. The section of the guide member 44b that is closer to the weft cutter 36 includes a guide groove 48b that guides the flat yarn 42 supplied from the flat yarn supply portion 45b to the clearance between the guide members 44a and 44b.

[0023] A cutter 49a is arranged near the upper surface of the guide member 44a. The cutter 49a thermally cuts the flat yarn 42 that is guided by the guide groove 48a. A cutter 49b is arranged near the lower surface of the guide member 44b. The cutter 49b thermally cuts the flat yarn 42 that is guided by the guide groove 48b.

[0024] A heater 50 is arranged on the side of the lower guide member 44b that is opposite to the weft cutter 36. A portion of the heater 50 is exposed on the upper surface of the guide member 44b. The section of the upper guide member 44a that faces the heater 50 is cut out. An air cylinder 51 extends vertically above the guide member 44a. The air cylinder 51 is arranged such that the distal end surface of a piston rod 51 a presses the upper surface of the heater 50 when the piston rod 51 a projects. The distal end surface of the piston rod 51 a is shaped to press the flat yarns 42 over that entire width when the flat yarns 42 are arranged between the distal end surface and the upper surface of the heater 50 and sandwich the weft yarn Y.

[0025] Operation of the attaching device 40 and the weft insertion of the air jet loom will now be described.

[0026] The flat yarns 42 supplied from the respective flat yarn supply portions 45a and 45b are held in standby positions where the ends of the flat yarns 42 face the ends of the respective guide grooves 48a and 48b. When the weft yarn Y is not located between the guide members 44a and 44b, the attaching device 40 supplies the flat yarns 42 from the flat yarn supply portions 45a and 45b by driving the feed rollers 47a and 47b. As shown in Fig. 5, the distal ends of the flat yarns 42 pass through the respective guide grooves 48a and 48b and are placed at the ends of the guide members 44a and 44b that are opposite to the weft cutter 36. That is, the distal ends of the flat yarns 42 are aligned with the heater 50. A suction device (not shown) keeps the end of the flat yarn 42 that is guided by the upper guide member 44a from drooping.

[0027] When the previous weft insertion is completed under the situation described above, the main nozzle 11A and the profile reed 16 pivot with the sley 15 to the beat up position. This places the weft yarn Y between the two flat yarns 42 between the guide members 44a and 44b as shown in Fig. 5. Then, as shown in Fig. 6, the air cylinder 51 is driven to lower the piston rod 51 a. This fuses together the proximal end portions of the two upper and lower flat yarns 42 with the weft yarn Y sandwiched between the flat yarns 42. The two flat yarns 42, or the flight promoter 41, are attached to the distal end portion of the weft yarn Y through thermal fusion and enclose the weft yarn Y. In addition, the heated cutters 49a and 49b are moved into contact with the respective flat yarns 42 near the inlets of the guide grooves 48a and 48b of the respective guide members 44a and 44b. The cutters 49a and 49b melt and cut the flat yarns 42 to a

predetermine length.

[0028] Then, the air cylinder 51 is driven to return the piston rod 51a to the standby position as shown in Fig. 7. In addition, the weft brake 31 located on the upstream side of the tandem nozzle 12A pulls back the weft yarn Y to which the flight promoter 41 is attached at the distal end portion. This temporarily places the flight promoter 41 in the acceleration tube 35 of the main nozzle 11 A. The main nozzle 11A and the tandem nozzle 12A stay in this position until the next weft insertion.

[0029] When one set of weft insertion and attachment of a flight promoter 41 to the weft yarn Y by the nozzles 11 A and 12A is completed, the nozzles 11 B and 12B perform weft insertion and attachment of a flight promoter 41 to the weft yarn Y in the same manner. During weft insertion of the main nozzle 11 B and the tandem nozzle 12B, the weft accumulator 27A for the main nozzle 11 A and the tandem nozzle 12A stores the weft yarn Y by the length needed for the next weft insertion.

[0030] At the start of the next weft insertion, the engagement pin 30 of the weft accumulator 27A is moved out of engagement with the length measurement drum 29 and separated from the drum 29. In addition, the weft brake 31 moves to a position that permits movement of the weft yarn Y. At the same time, the main nozzle 11A and the tandem nozzle 12A discharge jets of compressed air. As shown in Fig. 8, the air jets carry the weft yarn Y to which the flight promoter 41 is attached at the distal end portion into the reed channel 18 in the profile reed 16. The sub-nozzles 13 discharge jets of compressed air in a relaying manner to transfer the weft yarn Y to the end of the woven fabric W on the side opposite to the insertion side. Then, the portion of the weft yarn Y to which the flight promoter 41 is attached is cut away from the woven fabric W as discarded selvage.

[0031] The nozzles 11 B and 12B perform weft insertion in the similar manner as the nozzles 11 A and 12A. After the flight promoter 41 is attached to the distal end portion of the weft yarn Y, the weft yarn Y is pulled back by the associated weft brake 31 so that the flight promoter 41 is temporarily placed in the acceleration tube 35 of the main nozzle 11 B.

[0032] In the same manner, weft insertion and attachment of a flight promoter 41 to the weft yarn Y by the nozzles 11 A and 12A and weft insertion and attachment of a flight promoter 41 to the weft yarn Y by the nozzles 11 B and 12B are repeated in alternation. This forms the woven fabric W.

[0033] Before starting operation of the air jet loom, an operator attaches a flight promoter 41 to each of the distal end portion of the weft yarn Y that is to be inserted by the nozzle 11A and 12A and the distal end portion of the weft yarn Y that is to be inserted by the nozzles 11 B and 12B.

[0034] The first embodiment has the following advantages.

(1) The weft insertion method of the present embodiment inserts the weft yarn Y to which a flight promoter 41 is attached at the distal end portion. The flight promoter 41 has a greater surface area per unit weight than the weft yarn Y. The flight promoter 41 increases the yarn propelling force acting on the weft yarn Y. This enables weaving even when the weft yarn Y is a monofilament yarn, metal fiber, or the like. In addition, the air consumption in weaving is reduced even when the weft yarn Y is a flat yarn, hard twist yarn, or hemp yarn.

(2) The attaching device 40 attaches the flight promoter 41, which has a greater surface area per unit weight than the weft yarn Y, to the distal end portion of the weft yarn Y before insertion of the weft yarn Y. The flight promoter 41 increases the flight propelling force in insertion of the weft yarn Y. This enables weaving even when the weft yarn Y is a monofilament yarn, metal fiber, or the like. In addition, the air consumption in weaving is reduced even when the weft yarn Y is a flat yarn, hard twist yarn, or hemp yarn.

(3) The flight promoter 41 is shaped like tape. This facilitates the preparation of the flight promoter 41 that has a greater surface area per unit weight than the weft yarn Y. Further, the flight promoter 41, which is wound around a reel, is intermittently released from the reel and cut to the predetermined length. This facilitates the storage and handling of the flight promoter 41.

(4) The flight promoter 41 is attached to the distal end portion of the weft yarn Y through thermal fusion in a manner wrapping the weft yarn Y. In this structure, unlike a structure in which a single flat yarn 42 is thermally fused to one side of the weft yarn Y, the two flat yarns 42 that form the flight promoter 41 are fused together and entangled with the weft yarn Y. This prevents separation of the flight promoter 41 from the weft yarn Y during insertion, allowing for a stable weft insertion.

(5) The attaching device 40 includes the flat yarn supply portions 45a and 45b that include the reels around which the flat yarns 42 are wound. The flat yarns 42 are intermittently released from the reels and cut to the predetermined length by the respective cutters 49a and 49b. This facilitates the storage and handling of the flight promoter 41.

(6) The attaching device 40 attaches the flight promoter 41 to the weft yarn Y between the main nozzles 11A and 11 B and the weft cutter 36 of the air jet loom. This reduces the length of the selvage of the weft yarn Y to be discarded compared to a structure in which the attachment of the flight promoter 41 to the weft yarn Y is performed before the weft yarn Y is supplied to the main nozzle 11 A or 11 B.

(7) The cutters 49a and 49b thermally cut the associated flat yarns 42. This ensures quick cutting of the flat yarns 42 with a simple structure compared to when the flat yarns 42 are cut by blades.

(8) After the flight promoters 41 are attached to the distal end portions of the weft yarns Y, the weft brakes 31 pulls the weft yarns Y backward. The flight promoters 41 are temporarily placed in the acceleration tubes 35 of the respective main nozzles 11 A and 11 B. This significantly increases the weft propelling force when discharging jets of compressed air from the main nozzles 11A and 11 B on the same principle as pop guns, enabling a high-speed weft insertion and reduction of the compressed air consumption.

Second Embodiment

[0035] Referring to Figs. 9 to 13, a second embodiment will now described. The second embodiment differs from the first embodiment in that a flight promoter 141 is used that is formed by fibrillating a multifilament textured yarn. Naturally, the structure of the attaching device 40 that attaches the flight promoter 141 to the weft yarn Y differs from that of the attaching device 40 in the first embodiment. Like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment. Such components will not be described in detail.

[0036] Referring to Fig. 9, the attaching device 40 includes two sets of a yarn bobbin 56 and an electrostatic fibrillation device 57 (only one set is shown in Fig. 9). A multifilament textured yarn 55 is wound around each yarn bobbin 56, and the associated electrostatic fibrillation device 57 fibrillates the textured yarn 55 supplied from the yarn bobbin 56. The two sets of the yarn bobbin 56 and the electrostatic fibrillation device 57 are arranged on the upper and lower sides of the flight path of the weft yarns Y to be inserted by the main nozzles 11 A and 11B and sandwich the flight path. In Fig. 9, the set of the yarn bobbin 56 and the electrostatic fibrillation device 57 on the upper side of the flight path of the weft yarns Y is not shown.

[0037] A block element 58 is arranged below the flight path of the weft yarn Y between the main nozzles 11 A and 11 B and the weft cutter 36. The block element 58 includes a heater 50 that is exposed on the surface of the block element 58. A guide base 60b and a feed roller 61b are arranged between the lower electrostatic fibrillation device 57 and the block element 58. The guide base 60b and the feed roller 61 b guide a fibrillated yarn 59, which is fibrillated by the lower electrostatic fibrillation device 57, to the upper surface of the block element 58. The distance between the portion in which the heater 50 is exposed on the upper surface of the block element 58 and the end of the block element 58 that faces the guide base 60b is longer than the distance between the exposed portion and the end of the block element 58 that is farther from the guide base 60b. In other words, the exposed portion of the heater 50 is deviated from the center on the upper surface of the block element 58 toward the downstream side in the feeding direction of the fibrillated yarn 59. The fibrillated yarn 59 having a length required to form one flight promoter 141 can be placed on the upper surface of the block element 58. The block element 58, the lower guide base 60b, the feed roller 61 b and the electrostatic fibrillation device 57 are arranged such that the fibrillated yarn 59 extends diagonally to the weft yarn Y. In addition, to prevent interfering between the yarn bobbin 56 and the woven fabric W, the yarn bobbin 56 supplies the textured yarn 55 to the electrostatic fibrillation device 57 in a direction diagonal to the direction in which the fibrillated yarn 59 extends.

[0038] An electromagnetic solenoid 62 is arranged above the block element 58. The electromagnetic solenoid 62 includes a push rod 62a that extends in the vertical direction and has a distal end surface that presses the upper surface of the heater 50 when the push rod 62a projects. The distal end surface of the push rod 62a is shaped to press the distal end regions of the fibrillated yarns 59 over the entire width when the fibrillated yarns 59 are placed between the distal end surface and the upper surface of the heater 50 and sandwich the weft yarn Y.

[0039] A support member 63 fixes a fibrillated yarn cutter 64 to the push rod 62a. When the push rod 62a presses the fibrillated yarns 59, which sandwich the weft yarn Y on the block element 58, against the block element 58, the fibrillated yarn cutter 64 thermally cuts the fibrillated yarns 59 between the block element 58 and the guide base 60b.

[0040] A guide base 60a and a feed roller 61 a are arranged between the upper electrostatic fibrillation device 57 and the block element 58. The guide base 60a and the feed roller 61 a guide the fibrillated yarn 59 fibrillated by the electrostatic fibrillation device 57 to the upper side of the block element 58. As shown in Fig. 10, the upper guide base 60a and the feed roller 61 a are parallel to the lower guide base 60b and the feed roller 61 b. The upper guide base 60a includes a guide member 65 that guides the upper fibrillated yarn 59 such that the upper and lower fibrillated yarns 59 cooperate to hold the weft yarn Y.

[0041] In the second embodiment, the attaching device 40 fibrillates the textured yarn 55 supplied from each yarn bobbin 56 with the associated electrostatic fibrillation device 57 through the action of static electricity. This creates the fibrillated yarns 59 that include many layers of air and are expanded like fluffy cotton. The feed rollers 61 a and 61 b place the respective fibrillated yarns 59 on the block element 58. The distal ends of the fibrillated yarns 59 are aligned with the end of the exposed portion of the heater 50 that is farther from the guide bases 60a and 60b. A suction device (not shown) keeps the distal end of the upper fibrillated yarn 59 from drooping.

[0042] When the main nozzle 11 A and the profile reed 16 pivot with the sley 15 to the beat up position after the previous weft insertion is completed, the weft yarn Y is sandwiched between the two fibrillated yarns 59 as shown in Fig. 10. Then, the electromagnetic solenoid 62 is driven to lower the push rod 62a and the fibrillated yarn cutter 64. Accordingly, the heater 50 thermally fuses the distal end portions of the two fibrillated yarns 59 with the weft yarn Y

sandwiched between the upper and lower fibrillated yarns 59. In addition, the fibrillated yarn cutter 64 thermally cuts the fibrillated yarns 59 between the block element 58 and the guide base 60b to the predetermined length. Accordingly, as shown in Fig. 11, the flight promoter 141 is attached to the distal end portion of the weft yarn Y through thermal fusion in a manner wrapping the weft yarn Y.

[0043] Then, the push rod 62a and the fibrillated yarn cutter 64 return to the standby position. The weft yarn Y to which the flight promoter 141 is attached at the distal end portion is pulled back by the weft brake 31 on the upstream side of the tandem nozzle 12A. This temporary places the flight promoter 141 in the acceleration tube 35 of the main nozzle 11 A. The fibrillated yarns 59 extend diagonally to the longitudinal direction of the weft yarn Y when fused to the weft yarn Y. However, when placed in the acceleration tube 35 of the main nozzle 11A, the flight promoter 141 extends in the weft movement direction so that the end of the flight promoter 141 opposite to the fused section 43 is placed along the distal end side of the weft yarn Y since the fibrillated yarns 59 have a low fiber stiffness.

[0044] At the start of the next weft insertion, the engagement pin 30 of the weft accumulator 27A is moved out of engagement with the length measurement drum 29 and separated from the drum 29. In addition, the weft brake 31 moves to a position that permits movement of the weft yarn Y. At the same time, the main nozzle 11A and the tandem nozzle 12A discharge jets of compressed air. Then, the air jets carry the weft yarn Y to which the flight promoter 141 is attached at the distal end portion into the yarn flight channel in the profile reed 16. The sub-nozzles 13 discharge jets of compressed air in a relaying manner to transfer the weft yarn Y to the end of the woven fabric W on the side opposite to the insertion side.

[0045] The nozzles 11 B and 12B perform weft insertion and attachment of the flight promoter 141 to the weft yarn Y in the same manner as described above. The nozzles 11 A and 12A and the nozzles 11B and 12B alternately repeat attachment of the flight promoter 141 to the weft yarn Y and weft insertion in the same manner. This forms the woven fabric W.

Examples

[0046] The flight promoters 41 and 141 of the embodiments that vary in shape and material were attached to various types of weft yarns for evaluation. Fig. 12 shows the relationship between the surface area and the propelling force applied by the sub-nozzles 13 in the reed channel 18. Fig. 13 shows the relationship between the weight of the flight promoter and the flying ability of weft yarn in the profile reed channel.

[0047] Table 1 shows the shape, material, weight, surface area, and surface area per unit weight of the evaluated flight promoters. Table 2 shows the type (i.e., material and thickness), weight for 1800 mm length, surface area, surface area per weight, and nominal diameter of the evaluated weft yarns.

Table 1

	Shape	Material Size or thickness	Weight W (mg)	Surface area A (mm^2)	A/W (mm^2/mg)
First Example	Tape-shape (non-woven fabric)	Polyester 5 × 100 mm	11.4	1000	88
Second Example	Fibrillated yarn	Polyester 900 denier	10.4	1934	186
First comparative example	Bullet shaped	Urethane foam ϕ3 8 mm	9.8	89.5	9
Second comparative example	Spherical	Urethane foam ϕ3.5	6.8	38.5	6

Table 2

Type Thickness	Weight W (mg)	Surface area A (mm^2)	A/W (mm^2/mg)	Nominal diameter (mm)
Polyester/cotton Count 45	23.0	797	35	0.141
Cotton Count 6	175.7	2205	13	0.390
Hard twist yarn, polyester 75 denier	16.7	679	41	0.120

(continued)

Type Thickness	Weight W (mg)	Surface area A (mm^2)	A/W (mm^2/mg)	Nominal diameter (mm)
Carbon 1758 denier	356.0	3138	9	0.555
Monofilament Nylon ϕ0.33	186.3	1866	10	0.330

[0048] As shown in Fig. 12, the propelling force acting on the weft yarns Y increases in proportion to the surface areas A of the flight promoters 41 and 141. The test demonstrated that it is desirable for the flight promoters 41 and 141 to have a surface area of 100 mm^2 or more. If the flight promoters 41 and 141 have a surface area of less than 100 mm^2, the enhancement of the yarn propelling force decreases, degrading the weaving performance. In addition, the reduction of the air consumption decreases.

[0049] As shown in Fig. 13, the lighter flight promoter 41 increases the flying ability of the weft yarn Y. Further, the test demonstrated that it is desirable for the flight promoters 41 and 141 to have a weight of 20 mg or less. If the flight promoters 41 and 141 have a weight of more than 20 mg, the distal end portion of the weft yarn Y becomes too heavy. Thus, the flight velocity of the distal end portion of the weft yarn Y may be less than the flight velocity of the portion of the weft yarn Y on the rear side of the distal end portion. This hinders the effects achieved by attaching the flight promoters 41 and 141.

[0050] In addition to the advantages (1), (2) and (4) to (8) of the first embodiment, the second embodiment provides the following advantage.

[0051] (9) The flight promoter 141 is the fibrillated yarns 59 that are formed by fibrillating the textured yarns 55. In this structure, the surface area per unit weight is greater than that of the tape-shaped flight promoter. Thus, the yarn propelling force required for flight of the weft yarn Y is achieved with less consumption of air.

Third Embodiment

[0052] Referring to Fig. 14, a third embodiment will now be described. The third embodiment differs from the first embodiment in that attachment of the flight promoter 41 to the weft yarn Y is performed between the tandem nozzle 12A and the main nozzle 11A and between the tandem nozzle 12B and the main nozzle 11 B. Like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment. Such components will not be described in detail.

[0053] As shown in Fig. 14, the attaching device 40 is arranged at the distal end portion of each of the tandem nozzles 12A and 12B. The acceleration tubes 35 are shortened so that the main nozzles 11A and 11 B have a shorter total length than the first embodiment. The inner diameter of thread guides 37 is increased so as not to block the flight of the flight promoter 41.

[0054] In addition to the advantages (1) to (5), (7), and (8) of the first embodiment, the third embodiment provides the following advantage.

[0055] (10) Attachment of the flight promoter 41 to the distal end portion of the weft yarn Y is performed between the tandem nozzle 12A and the main nozzle 11 A and between the tandem nozzle 12B and the main nozzle 11 B. In this structure, compared to a structure in which attachment of the flight promoter 41 to the distal end portion of the weft yarn Y is performed between the distal ends of the main nozzles 11A and 11 B and the weft cutter 36, swinging of the distal end portion of the weft yarn Y is reduced when the flight promoter 41 is attached to the distal end portion of the weft yarn Y, and the distal end portion of the weft yarn Y stops for a longer period. Thus, more time can be used to attach the flight promoter 41 to the distal end portion of the weft yarn Y during single pivoting of the loom, and the speed of the loom can be increased.

[0056] The first to third embodiments are not limited to the above described configurations, but may be embodied as follows, for example.

[0057] In the first and second embodiments, after the flight promoters 41 and 141 are attached to the distal end portions of the weft yarns Y, the main nozzles 11A and 11 B may discharge jets of compressed air without pulling the respective weft yarns Y backward to place the flight promoters 41 and 141 in the acceleration tubes 35 of the main nozzles 11A and 11 B.

[0058] Instead of alternately inserting the same type of weft yarns Y, the set of the nozzles 11 A and 12A and the set of the nozzles 11 B and 12B may alternately insert different types of weft yarns Y. Alternatively, weft yarns Y of the same type or of different types may be randomly inserted.

[0059] Instead of including the main nozzles 11 A and 11 B and the tandem nozzles 12A and 12B, the air jet loom may include only one set of main nozzle 11 A and the tandem nozzle 12A.

[0060] The cutters 49a and 49b and the fibrillated yarn cutter 64 thermally cut the flat yarns 42 or the fibrillated yarns 59. However, the present invention is not limited to such a structure, and the cutting may be achieved by blades.

[0061] In the second embodiment, the multifilament textured yarn 55 is fibrillated by electrostatic force with the electrostatic fibrillation device 57. The fibrillated yarn 59 thus fibrillated is attached to the weft yarn Y. Alternatively, a fibrillated yarn 59 that is formed in advance by fibrillating the textured yarn 55 may be used. In this case, the attaching device 40 does not require the electrostatic fibrillation device 57.

[0062] In the above embodiment, the flat yarn 42 and the textured yarn 55 have the length of a plurality of flight promoters 41 and a plurality of flight promoters 141 of the predetermined length, respectively. The flat yarn 42 and the textured yarn 55 are cut to the predetermined length after the flight promoters 41 and 141 are attached to the distal end portions of the weft yarns Y. However, a flight promoter that is cut to the predetermined length in advance may be used. In this case, the cutters 49a and 49b and the fibrillated yarn cutter 64 are unnecessary.

[0063] The flight promoter may be formed by combining the flat yarn 42 and the fibrillated yarn 59. That is, the flat yarn 42 and the fibrillated yarn 59 may be fused to the distal end portion of the weft yarn Y to sandwich the distal end portion of the weft yarn Y.

[0064] The method for attaching the flight promoter 41 to the distal end portion of the weft yarn Y is not limited to thermal fusion. Attachment methods such as a mechanical method may be used if necessary.

[0065] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

[0066] A weft insertion method in an air jet loom includes: attaching a flight promoter that has a greater surface area per unit weight than a weft yarn to a distal end portion of the weft yarn before weft insertion; and performing insertion of the weft yarn to which the flight promoter is attached.

Claims

1. A weft insertion method in an air jet loom, the method being **characterized by**:

   attaching a flight promoter (41) that has a greater surface area per unit weight than a weft yarn (Y) to a distal end portion of the weft yarn (Y) before weft insertion; and
   performing insertion of the weft yarn (Y) to which the flight promoter (41) is attached.

2. A flight promotor attaching device in an air jet loom, being **characterized in that** a flight promoter (41) that has a greater surface area per unit weight than a weft yarn (Y) is attached to a distal end portion of the weft yarn (Y) before weft insertion.

3. The attaching device according to claim 2, wherein the flight promoter (41) is shaped like tape.

4. The attaching device according to claim 2, wherein the flight promoter (41) is a fibrillated yarn.

5. The attaching device according to any one of claims 2 to 4, wherein the flight promoter (41) is attached to the distal end portion of the weft yarn (Y) through thermal fusion in a manner wrapping the weft yarn (Y).

6. The attaching device according to any one of claims 2 to 5, wherein the attachment of the flight promoter (41) to the weft yarn (Y) is performed between a main nozzle (11 A) and a weft cutter (36) of the air jet loom.

7. The attaching device according to any one of claims 2 to 5, wherein the attachment of the flight promoter (41) to the weft yarn (Y) is performed between a tandem nozzle (12A) and a main nozzle (11 A) of the air jet loom.

Fig.1

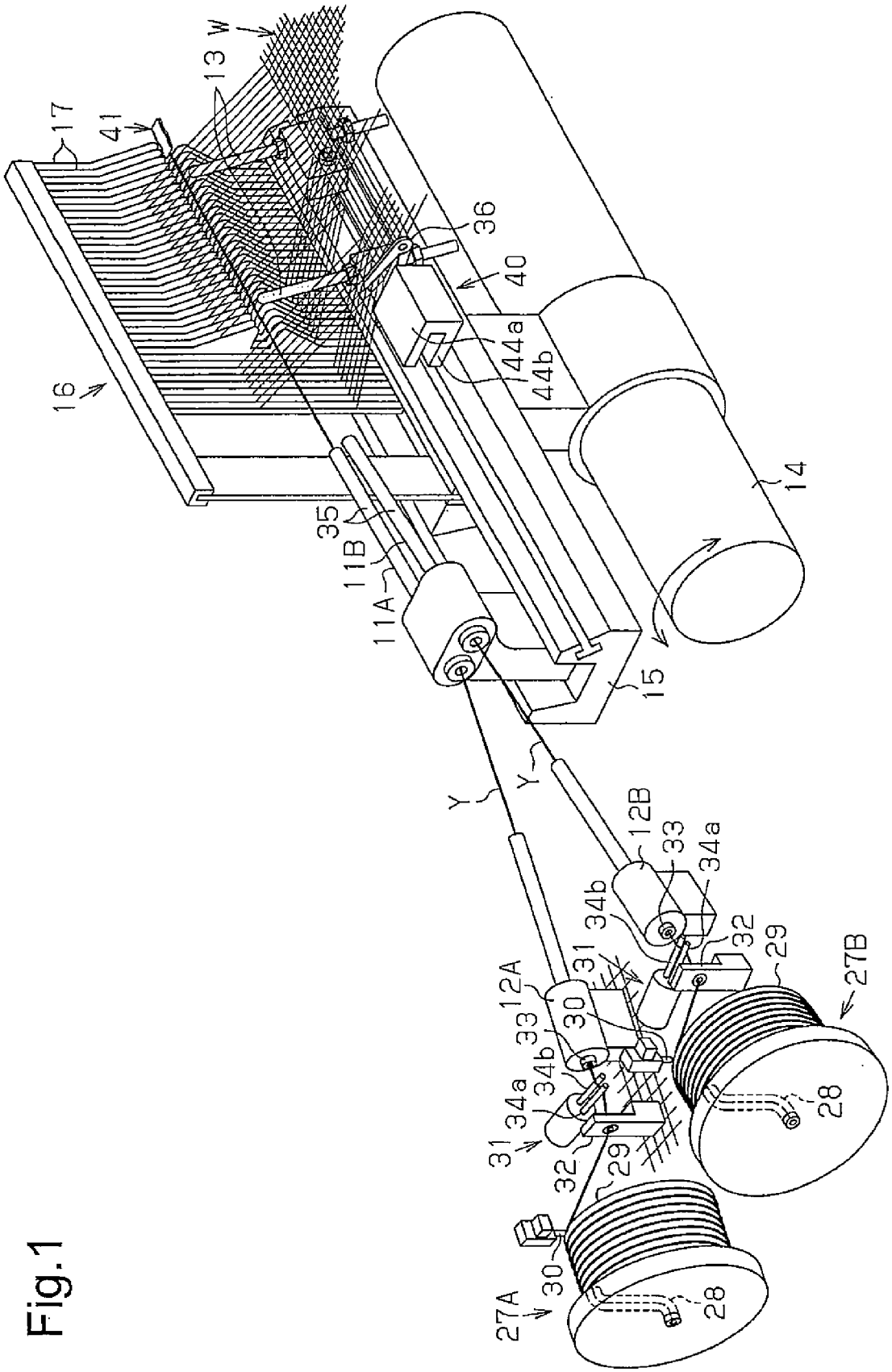

W
13
17
41
36
40
44a
44b
16
14
35
11B
11A
15
Y
Y
12B
33
34a
34b
32
31
29
27B
12A
30
33
34b
34a
31
32
29
28
30
27A
28

Fig.2

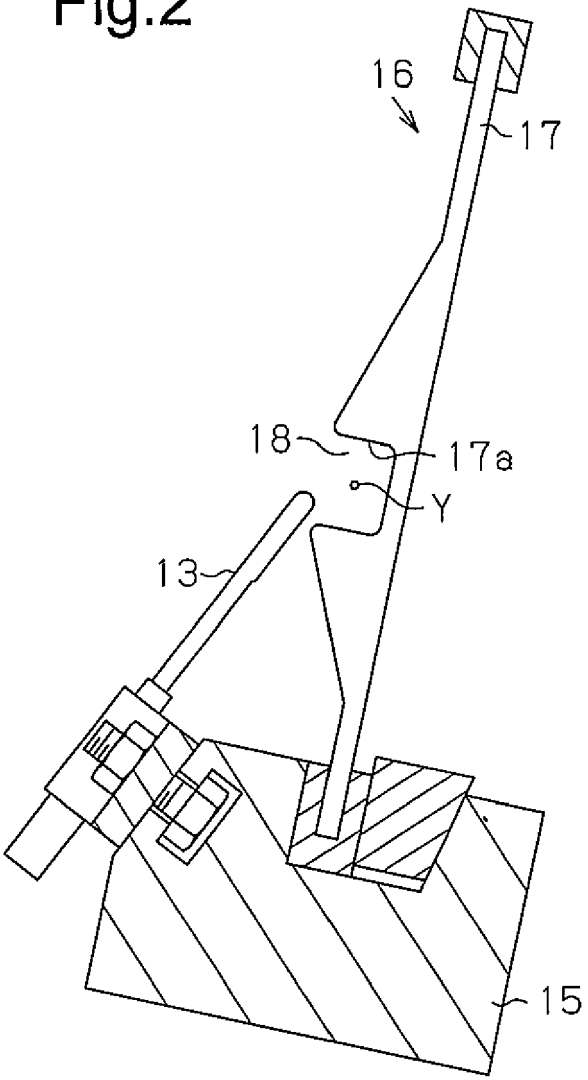


Fig.3

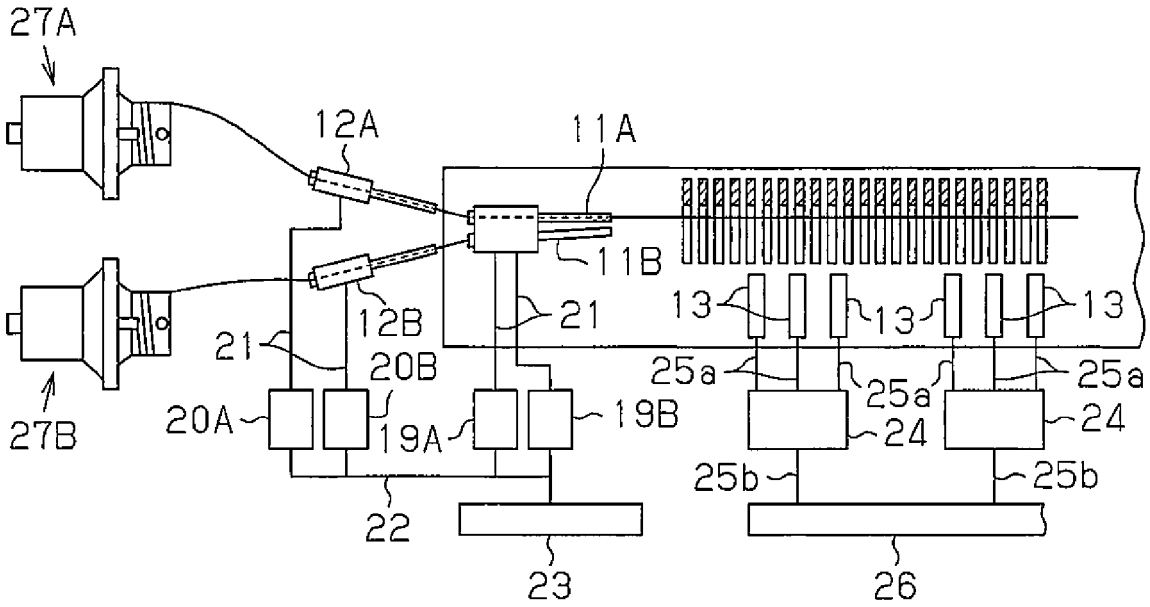

27A
12A
11A
11B
12B
21
13
13
13
21
20B
25a
25a
25a
27B
20A
19A
19B
24
24
25b
25b
22
23
26

Fig.4

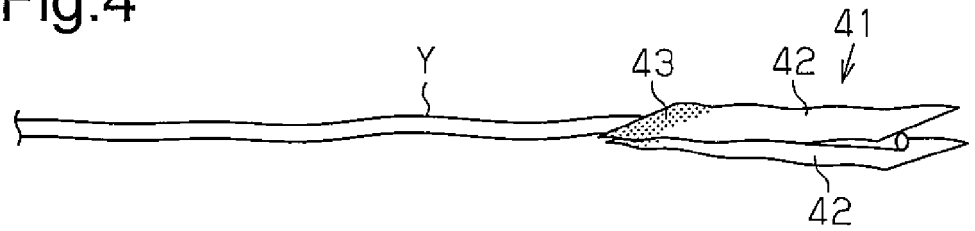

41
Y
43
42
42

Fig.6

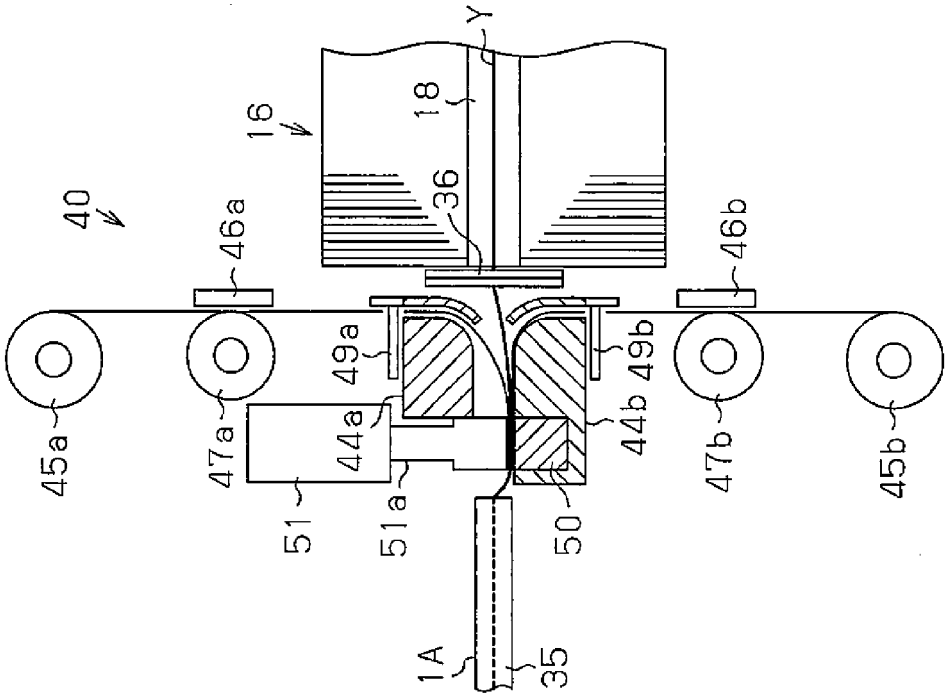

Y
18
16
40
36
46a
46b
49a
49b
45a
47a
44a
44b
47b
45b
51
51a
50
11A
35

Fig.5

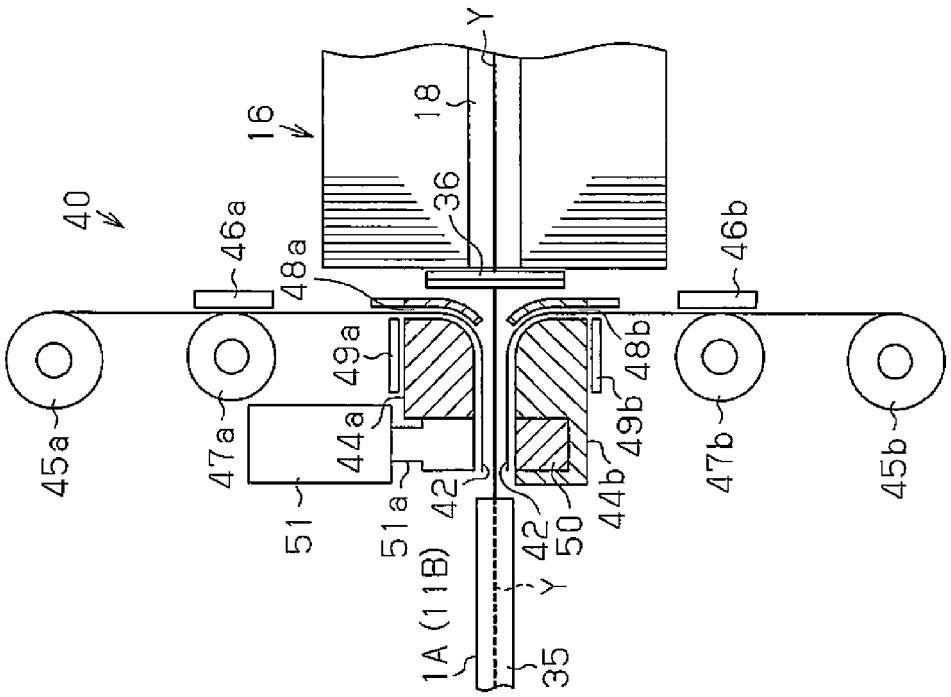

Y
18
16
40
36
46a
48a
46b
49a
48b
45a
47a
44a
49b
44b
47b
45b
51
51a
42
42
50
11A (11B)
Y
35

Fig.8

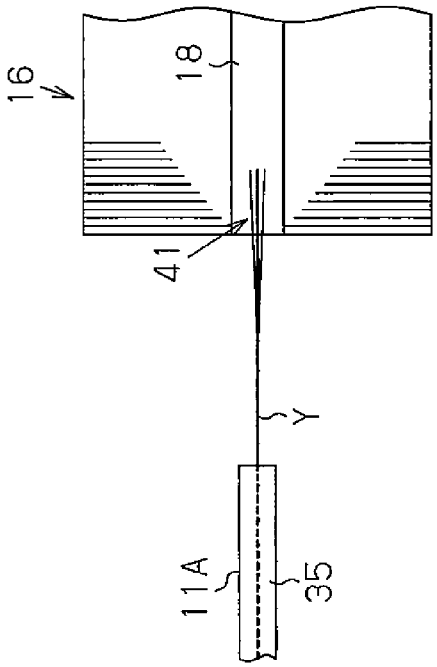

16
18
41
Y
11A
35

Fig.7

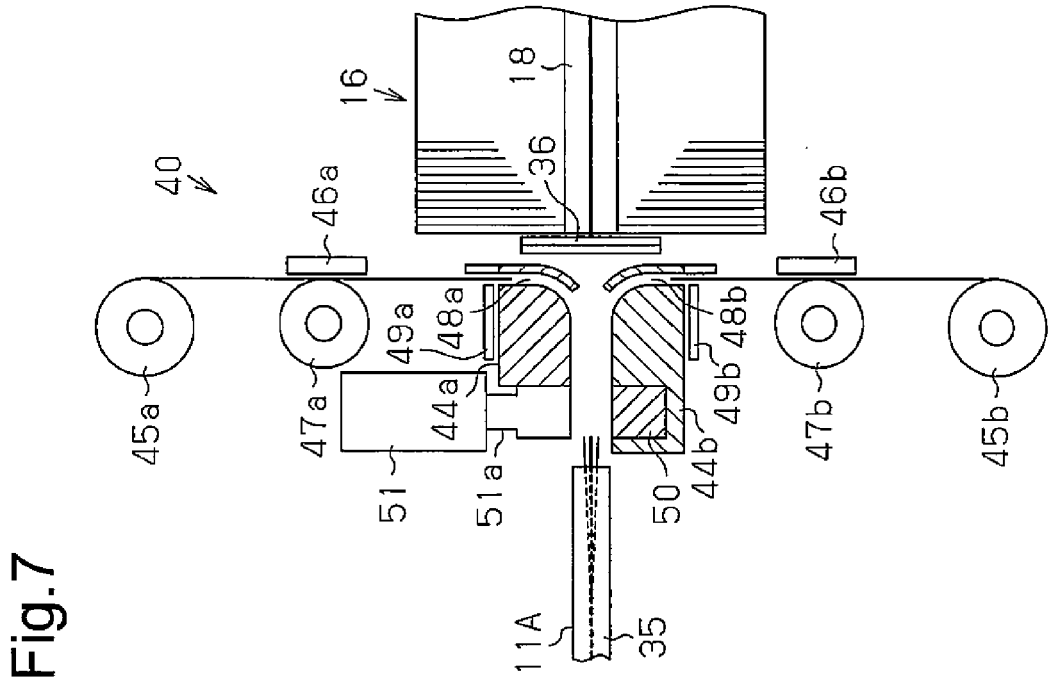

40
16
18
36
46a
46b
45a
47a
49a
48a
44a
51
51a
50
44b
49b
48b
47b
45b
11A
35

Fig.9

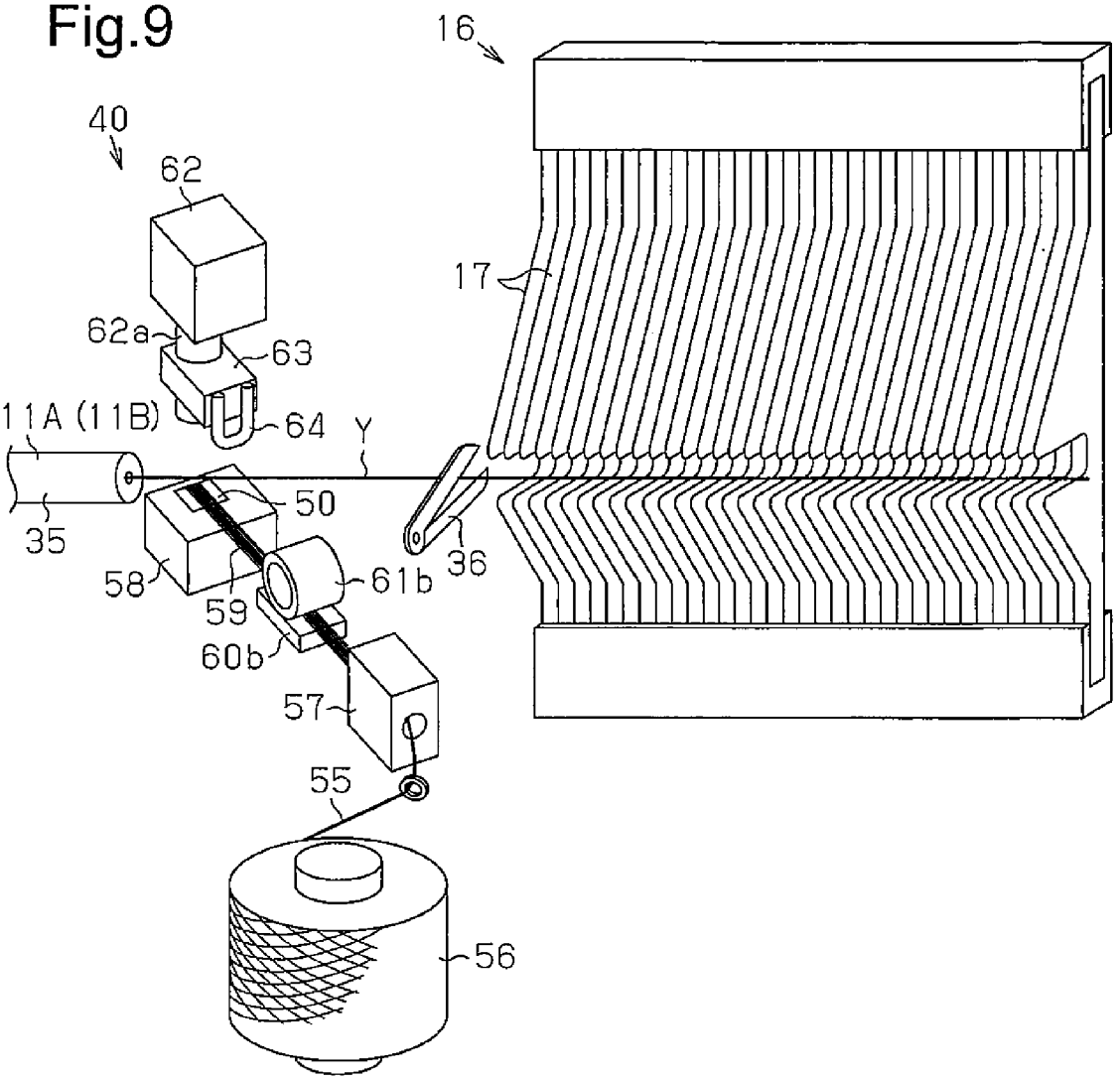

16
40
62
17
62a
63
11A (11B)
64
Y
50
35
36
58
61b
59
60b
57
55
56

Fig.10

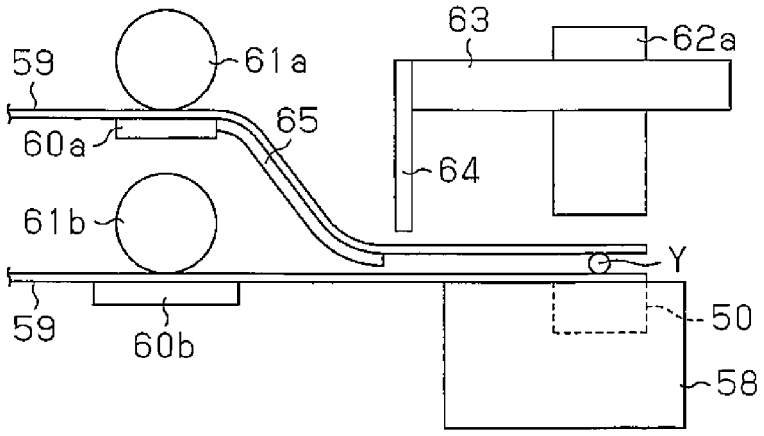

63
62a
59
61a
65
60a
64
61b
Y
59
60b
50
58

Fig.11

Fig.12

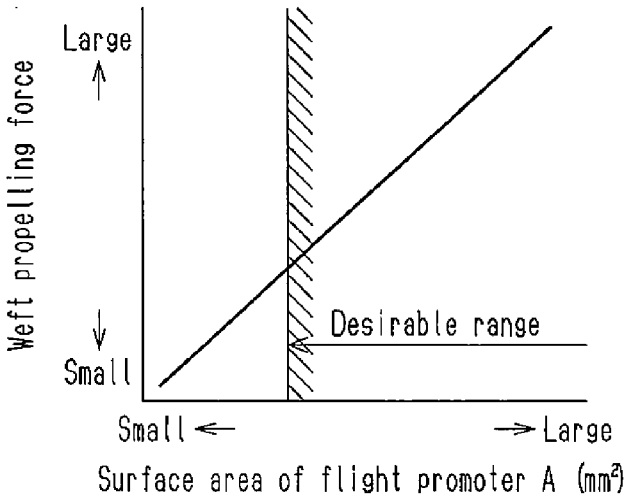


Fig.13

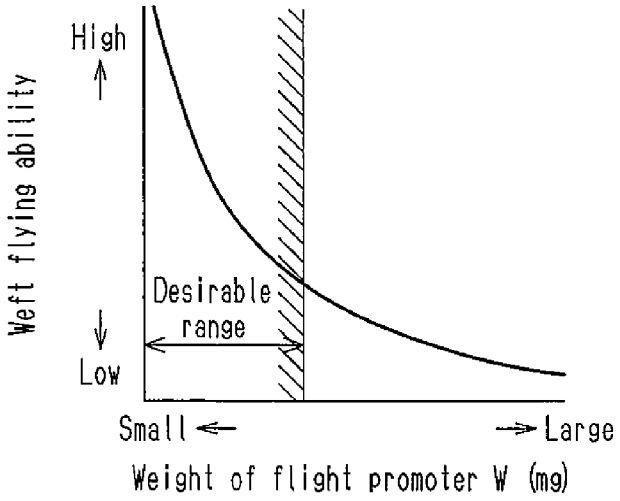
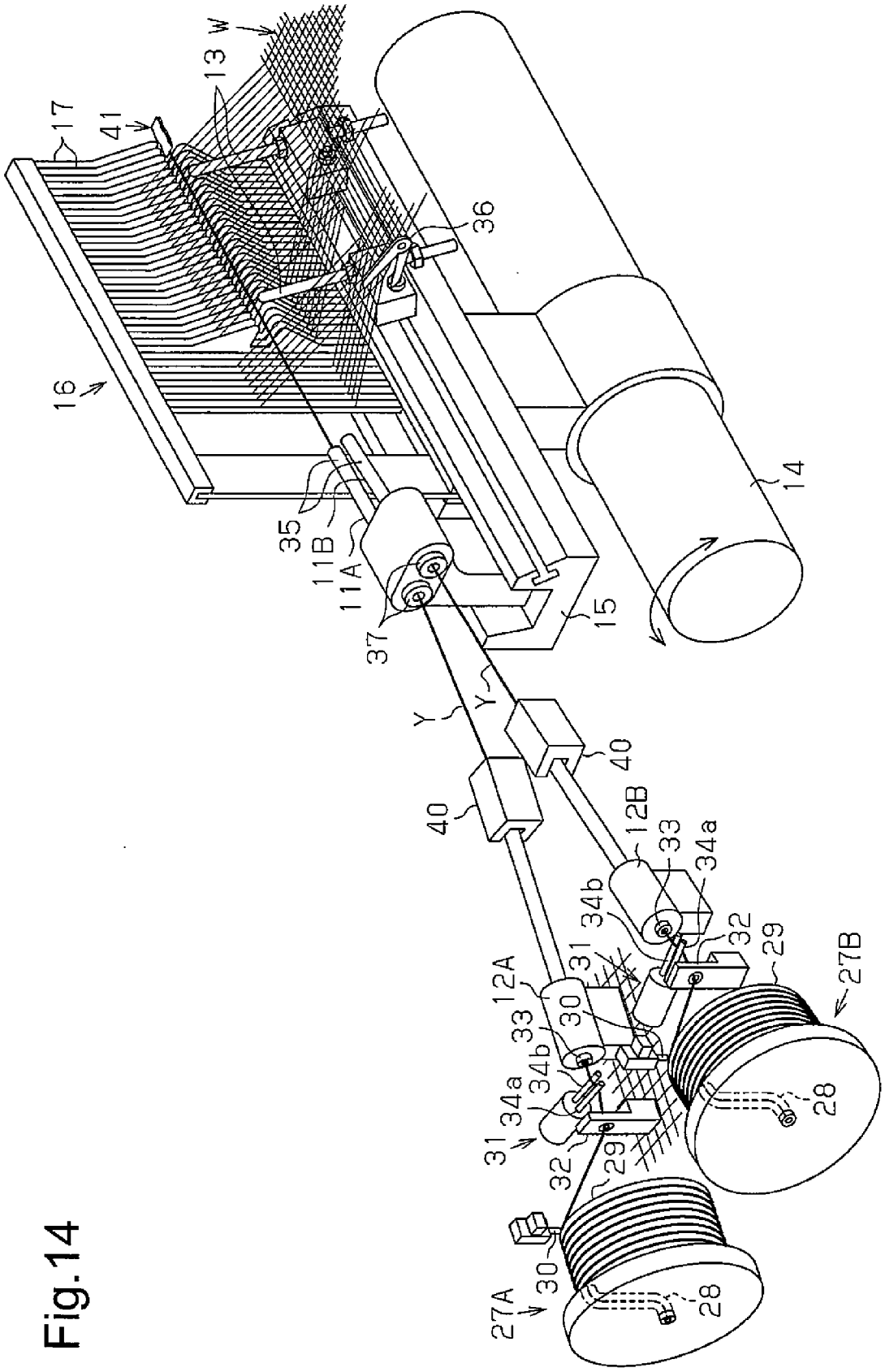


Fig.14


W
13
17
41
36
16
14
35
11B
11A
37
15
Y
Y
40
40
12B
33
34a
34b
32
29
27B
12A
31
30
33
34b
34a
31
32
29
28
27A
30
28

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 51092352 A **[0004]**
- JP 58163758 A **[0004]**