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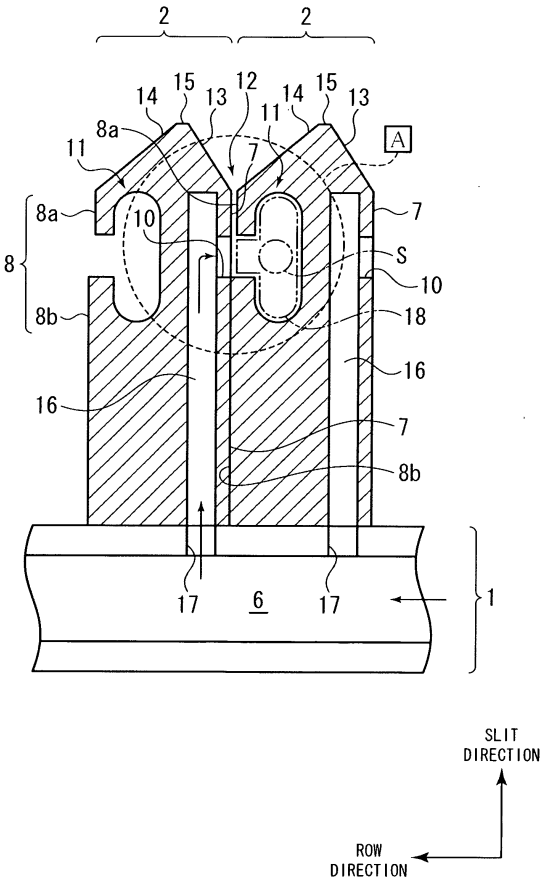
(54) Interlacing device

(57) The present invention provides an interlacing device (100) including a first interlacing piece (2) having a first surface (7) and a fluid ejecting hole (10) formed in the first surface (7) so that fluid is ejected through the fluid ejecting hole (10), and a second interlacing piece (2) having a second surface (8) and a yarn traveling groove (11) formed in the second surface (8). The first surface (7) and the second surface (8) are arranged opposite each other so as to combine the yarn traveling groove (11) and the first surface (7) together to form a yarn traveling space (18) as a space through which the multifilament yarn Y to be interlaced travels so that the yarn traveling space (18) communicates with the fluid ejecting hole (10) and to form a slit (12) as a gap through which the multifilament yarn Y can be inserted into the yarn traveling space (18) in a direction perpendicular to a yarn traveling direction of the multifilament yarn Y. The yarn traveling groove (11) extends inward in a direction perpendicular to the second surface (8).

FIGURE 3



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Description

Field of the Invention

[0001] The present invention relates to a device that interlaces a multifilament yarn.

Background of the Invention

[0002] As a technique of this kind, the Japanese Patent No. 3034649 discloses a crimping device that entangles multifilament yarns with each other. The crimping device comprises a nozzle body portion 1 and a baffle body portion 2. A yarn passage 6 is formed to extend linearly through the nozzle body portion 1 and the baffle body portion 2. The yarn passage 6 communicates with a blow nozzle 7 provided in the nozzle body portion 1 and with an insertion slit 8. The insertion slit 8 is positioned between a flat surface of the nozzle body portion 1 and a flat surface of the baffle body portion 2. The yarn passage 6 is formed of a groove formed in the nozzle body portion 1 and comprising a first recessed wall surface 11 and a groove formed in the baffle body portion 2 and comprising a second recessed wall surface 12. See p. 3, 5th column, 11. 47 to 48 and 6th column, 11. 2 to 13, and Figure 4 in the Japanese Patent No. 3034649.

[0003] However, in the configuration disclosed in the Japanese Patent No. 3034649, the insertion slit 8 is positioned close to the center of a cross section of the yarn passage 6. This is expected to pose various problems. That is, first, the yarn traveling close to the center of the cross section of the yarn passage 6 is likely to jump out through the insertion slit 8. Second, a fluid injected against the yarn through the blow nozzle 7 is likely to be blown out through the insertion slit 8.

Summary of the Invention

[0004] The present invention has been made in view of the above-described problems. A main object of the present invention is to provide an interlacing device that can solve various problems resulting from a slit through which a yarn is inserted into a yarn traveling space.

[0005] The problems to be solved by the present invention have been described above. Now, means for solving the problems and the effects thereof will be described.

[0006] A first aspect of the present invention provides an interlacing device configured as follows. That is, the interlacing device comprises a first member having a first surface and a fluid injecting hole formed in the first surface so that a fluid is injected through the fluid injecting hole, and a second member having a second surface. The first surface and the second surface are arranged opposite each other to form a yarn traveling space as a space through which a yarn to be interlaced travels so that the yarn traveling space communicates with the fluid injecting hole and to form a yarn inserting gap as a gap through which the yarn can be inserted into the yarn traveling space in a direction perpendicular to a traveling direction of the yarn. A groove is formed in the second surface, and the groove and the first surface are combined together to form the yarn traveling space. The groove extends inward in a direction perpendicular to the second surface. In the above-described configuration, the gap is located upstream of the fluid injected toward a groove bottom of the groove and away from the groove bottom of the groove. Thus, effects (1) to (3) described below are exerted.

(1) The yarn is unlikely to jump out through the gap.
(2) An area in which the fluid injected into the yarn traveling space is mostly present or mostly flows may have a cross section that is line-symmetric with respect to a direction in which the fluid injecting hole is drilled.
(3) The fluid is inhibited from being blown out through the gap. Since the groove is formed to extend inward, the effects (1) and (3) are more appropriately exerted. The availability of the sectional shape described in (2) enables the symmetric flow of the fluid in the area, which is expected to be useful for interlacing performance. Since the yarn traveling space is made up of the combination of the groove and the surface, the interlacing device can be very easily manufactured.

[0007] A second aspect of the present invention provides an interlacing device configured as follows. That is, the interlacing device comprises a first member having a first surface and a fluid injecting hole formed in the first surface so that a fluid is injected through the fluid injecting hole, and a second member having a second surface and a groove formed in the second surface. The first surface and the second surface are arranged opposite each other so as to combine the groove and the first surface together to form a yarn traveling space as a space through which a yarn to be interlaced travels so that the yarn traveling space communicates with the fluid injecting hole and to form a yarn inserting gap as a gap through which the yarn can be inserted into the yarn traveling space in a direction perpendicular to a traveling direction of the yarn. The groove extends inward in a direction perpendicular to the second surface. In the above-described configuration, the gap is located upstream of the fluid injected toward a groove bottom of the groove and away from the groove bottom of the groove. Thus, effects (1) to (3) described below are exerted.

(1) The yarn is unlikely to jump out through the gap.
(2) An area in which the fluid injected into the yarn traveling space is mostly present or mostly flows may have a cross section that is line-symmetric with respect to a direction in which the fluid injecting hole is drilled.
(3) The fluid is inhibited from being blown out through

the gap. Since the groove is formed to extend inward, the effects (1) and (3) are more appropriately exerted. The availability of the sectional shape described in (2) enables the symmetric flow of the fluid in the area, which is expected to be useful for interlacing performance. Since the yarn traveling space is made up of the combination of the groove and the surface, the interlacing device can be very easily manufactured.

[0008] A third aspect of the present invention provides an interlacing device configured as follows. That is, interlacing pieces each having a first surface and a second surface are provided in a row so that the first surface and second surface are arranged opposite each other. A fluid injecting hole is formed in the first surface of each of the interlacing pieces. A groove is formed in the second surface of each of the interlacing pieces. The first surface and the second surface are arranged opposite each other so as to combine the groove and the first surface together to form a yarn traveling space as a space through which a yarn to be interlaced travels so that the yarn traveling space communicates with the fluid injecting hole and to form a yarn inserting gap as a gap through which the yarn can be inserted into the yarn traveling space in a direction perpendicular to a traveling direction of the yarn. The groove extends inward in a direction perpendicular to the second surface. In the above-described configuration, the gap is located upstream of the fluid injected toward a groove bottom of the groove and away from the groove bottom of the groove. Thus, effects (1) to (3) described below are exerted.

(1) The yarn is unlikely to jump out through the gap.
(2) An area in which the fluid injected into the yarn traveling space is mostly present or mostly flows may have a cross section that is line-symmetric with respect to a direction in which the fluid injecting hole is drilled.
(3) The fluid is inhibited from being blown out through the gap. Since the groove is formed to extend inward, the effects (1) and (3) are more appropriately exerted. The availability of the sectional shape described in (2) enables the symmetric flow of the fluid in the area, which is expected to be useful for interlacing performance. Since the yarn traveling space is made up of the combination of the groove and the surface, the interlacing device can be very easily manufactured.

[0009] The above-described interlacing device is further configured as follows. The area in which the fluid injected into the yarn traveling space is mostly present or mostly flows is formed line-symmetrically with respect to the direction in which the fluid injecting hole is drilled. This arrangement enables the symmetric flow of the fluid in the area, which is expected to be useful for interlacing performance.

[0010] The above-described interlacing device is further configured as follows. The fluid injecting hole is formed to have a cross section that is flat along the traveling direction of the yarn. This arrangement allows the fluid to be injected against the yarn traveling through the yarn traveling space, for a long time. This improves the interlacing performance.

[0011] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

Brief Description of the Drawings

[0012]

Figure 1 is a perspective view of an interlacing device according to an embodiment of the present invention.
Figure 2 is a partly enlarged view of the interlacing device in Figure 1.
Figure 3 is a sectional view taken along line 3-3 in Figure 2.
Figure 4 is an enlarged view of a part A in Figure 3.
Figure 5 is a diagram similar to Figure 3.
Figure 6 is a diagram similar to Figure 3.
Figure 7 is a diagram similar to Figure 3.
Figure 8 is a diagram similar to Figure 3.
Figure 9 is a diagram which is similar to Figure 2 and which illustrates a second embodiment of the present invention.
Figure 10 is a diagram which is similar to Figure 3 and which is taken along line 10-10 in Figure 9.
Figure 11 is an enlarged view of a part A in Figure 10, which is similar to Figure 4.
Figure 12 is a graph showing results of tests for checking an interlacing device according to a second embodiment for technical effects.
Figure 13 is a diagram which is similar to Figure 2 and which illustrates a third embodiment of the present invention.

Detailed Description of the Preferred Embodiments

[0013] A first embodiment of the present invention will be described below with reference to the drawings. Figure 1 is a perspective view of an interlacing device according to the first embodiment of the present invention.

[0014] An interlacing device 100 shown in Figure 1 is used to simultaneously interlace plural groups of a multifilament yarn Y. The interlacing device 100 is composed of a plurality of interlacing pieces 2 provided on a base 1 in a row, mounting bars 3 that fixes the interlacing pieces 2 to the base 1, and first yarn guides 4 and second yarn guides 5 which appropriately guide the multifilament yarn Y to the respective interlacing pieces 2. The mounting bars 3 are provided in pairs, and the interlacing pieces

2 are fixed to the base 1 via the pair of mounting bars 3. Arrow D shows a direction in which the multifilament yarn Y travels. Each of the first yarn guides 4 is located upstream of the corresponding multifilament yarn Y inserted through the corresponding interlacing piece 2. Each of the second yarn guides 5 is located downstream of the corresponding multifilament yarn Y inserted through the corresponding interlacing piece 2. The first yarn guides 4 and the second yarn guides 5 are supported on the base 1 by a method not shown in the drawings. A "yarn traveling direction" shown in Figure 1 indicates the direction in which the multifilament yarn Y travels. Similarly, a "row direction" indicates a direction in which the plurality of interlacing pieces 2 are provided. A "slit direction" indicates a direction orthogonal to both the "yarn traveling direction" and the "row direction".

[0015] Now, the configuration of the base 1 and the interlacing piece 2 will be described in detail. See Figure 2. Figure 2 is a partly enlarged view of the interlacing device in Figure 1. For convenience of description, Figure 2 illustrates only a part of the base 1 and a pair of the adjacent interlacing pieces 2.

[0016] As shown in Figure 2, a fluid channel 6 extending in the row direction is formed inside the base 1.

[0017] The interlacing piece 2 has a first surface 7 and a second surface 8. The plurality of interlacing pieces 2 are provided in a row so that the first surface 7 and the second surface 8 are arranged opposite each other so as to abut partly against each other. Paired notches 9 in which the mounting bars 3 are partly accommodated are formed at a base end of the interlacing piece 2. The mounting bars 3 are inserted through the notches 9 and pushed toward the base 1 to fix the interlacing pieces 2 to the base 1. A fluid injecting hole 10 is formed in the first surface 7 of the interlacing piece 2 so that the fluid can be injected through the fluid injecting hole 10. A groove (hereinafter referred to as a yarn traveling groove 11) is formed in the second surface 8 of the interlacing piece 2. A first inclined surface 13 and a second inclined surface 14 are formed at a leading end of the interlacing piece 2 so as to guide the multifilament yarn Y into a slit 12 (yarn traveling gap). The first inclined surface 13 is inclined from the top 15 of the interlacing piece 2 toward the first surface 7. The second inclined surface 14 is inclined from the top 15 of the interlacing piece 2 toward the second surface 8.

[0018] Figure 3 is a sectional view taken along line 3-3 in Figure 2. As shown in Figure 3, the fluid injecting hole 10 is formed inside the interlacing piece 2 and communicates with a fluid supply path 16 that is open toward the base end. A fluid supply port 17 is open in the base 1 and communicates with the fluid supply path 16. Each of the interlacing pieces 2 is fixed to the base 1 so that the fluid supply port 16 and the fluid supply port 17 communicate with each other. In this configuration, when a fluid supply device (not shown in the drawings) supplies a fluid to the fluid channel 6, the fluid is injected at a predetermined pressure and a predetermined flow rate through the fluid injecting hole 10 via the fluid supply port 17 and the fluid supply port 16 in this order. In the present embodiment, the fluid injecting hole 10 has a circular cross section as shown in Figure 2.

[0019] As shown in Figures 1 to 3, the yarn traveling groove 11 is formed to extend inward in a direction perpendicular to the second surface 8. That is, the yarn traveling groove 11 is formed to extend inward in the row direction. The yarn traveling groove 11 is linearly formed along the yarn traveling direction so as to penetrate the interlacing piece 2. In other words, the yarn traveling groove 11 is formed along a yarn path of the multifilament yarn Y. As shown in Figure 3, the first surface 7 and the second surface 8 are arranged opposite each other so as to combine the yarn traveling groove 11 and the first surface 7 together to form a yarn traveling space 18 such that the multifilament yarn Y to be interlaced travels through the yarn traveling space 18. In Figure 3, the yarn traveling space 18 is schematically shown by an alternate long and two short dashes line. The yarn traveling space 18 communicates with the fluid injecting hole 10 in the adjacent interlacing piece 2. In Figure 3, the yarn path of the multifilament yarn Y is set to lie inside a circular area shown by reference character S. In other words, mounting positions of the first yarn guide 4 and the second yarn guide 5, shown in Figure 1, are adjusted such that the yarn path of the multifilament yarn Y lies roughly inside the circular area S. Additionally, the yarn traveling space 18 includes the circular area S, which is positioned inside the yarn traveling groove 11.

[0020] As shown in Figure 3, the second surface 8 is divided into two parts by the yarn traveling groove 11, described above. That is, the second surface 8 is composed of a second surface leading end portion 8a located closer to the leading end of the interlacing piece 2 than the yarn traveling groove 11 and a second surface base end portion 8b located closer to the base end of the interlacing piece 2 than the yarn traveling groove 11. The second surface leading end portion 8a and the second surface base end portion 8b are parallel to each other but are not present in the same plane and are slightly displaced from each other in the row direction. As described above, the plurality of interlacing pieces 2 are arranged in a row so that the first surface 7 and the second surface 8 are arranged opposite each other so as to abut partly against each other. Specifically, with the plurality of interlacing pieces 2 provided on the base 1 in a row, the first surface 7 abuts against the second surface base end portion 8b but not against the second surface leading end surface 8a. With the first surface 7 and the second surface 8 thus arranged opposite each other, a slit 12 of thickness about 0.1 mm is formed between the first surface 7 and the second surface leading end portion 8a. The presence of the slit 12 allows the multifilament yarn Y to be inserted into the yarn traveling space 18 in a direction perpendicular to the yarn traveling direction.

[0021] Figure 4 is an enlarged view of a part A in Figure 3. As shown in Figure 4, the yarn traveling space 18 is

composed of an opening 18a formed in the second surface 8 and an inner portion 18b formed inside the opening 18a. In a cross section shown in Figure 4, the yarn traveling space 18 is formed such that the inner portion 18b is thicker than the opening 18a in the slit direction. In this sense, the yarn traveling space 18 is said to extend inward. The contour of a cross section of the inner portion 18b of the yarn traveling space 18 is an oval composed of paired semicircles 19 and paired straight lines 20 joining the paired semicircles. The paired straight lines 20 extend in the slit direction. The paired semicircles 19 are located opposite each other in the slit direction. The inner portion 18b communicates with the opening 18a in the center of the inner portion 18b in the slit direction. In the present embodiment, the radius of the fluid injecting hole 10 is equal to a width defined by contours 18c, 18d of the opening 18 and which appear along the row direction in Figure 4. The slit 12, connected to the yarn traveling space 18, is not connected directly to the inner portion 18b. The slit 12 is connected to the inner portion 18b via the opening 18a. The slit 12 is connected to the yarn traveling space 18 at a position located farthest from the inner portion 18b. The slit 12 is connected to the yarn traveling space 18 at the boundary between the fluid injecting hole 10 and the opening 18a. The inner portion 18b is line-symmetric with respect to a line C. The line C is parallel to the flow of a fluid passing through the fluid injecting hole 10 and overlaps the center of the circular area S.

[0022] In the above-described configuration, interlacing of the multifilament yarn Y is started. First, a fluid is supplied to the fluid channel 16 in the base 1, shown in Figure 2. For example, compressed air is used as the fluid. Then, the traveling multifilament yarn Y is inserted into the slit 12 utilizing the first inclined surface 13 and the second inclined surface 14, shown in Figure 3. Thus, the multifilament yarn Y traverses the opening 18a of the yarn traveling space 18 and is placed in the inner portion 18b of the yarn traveling space 18 (as shown in Figure 4). Specifically, the multifilament yarn Y is guided by the appropriately positionally adjusted first yarn guide 4 and second yarn guide 5 so as to penetrate the circular area S.

[0023] The fluid supplied to the fluid channel 6 in the base 1 is injected through the liquid injecting hole 10 via the liquid supply path 16 and the like. The fluid then traverses the opening 18a and is introduced into the inner portion 18b. The fluid introduced into the inner portion 18b collides against a groove bottom P of the yarn traveling groove 11, the contour of which is shown by the straight lines 20 in Figure 4. The fluid then diverges toward side surfaces of the yarn traveling groove 11, the contour of which is shown by the paired semicircles 19. Then, the side surfaces of the yarn traveling groove 11 interfere with the diverged fluid, which thus flows slightly spirally, while being discharged from the opposite ends of the yarn traveling groove 11 along the yarn path. In short, the fluid introduced into the inner portion 18b is diverged twice along the slit direction and along the yarn traveling direction. The fluid injected into the yarn traveling space 18 is expected to be mostly present in the inner portion 18b and to flow mostly in the inner portion 18b.

[0024] The above-described specific flow of the fluid allows the multifilament yarn Y traveling through the yarn traveling space 18 to be interlaced at predetermined intervals.

[0025] As described above, the interlacing device 100 in the above-described embodiment is configured as follows. The interlacing pieces 2 each having the first surface 7 and the second surface 8 are provided in a row so that the first surface 7 and the second surface 8 are arranged opposite each other. The fluid injecting hole 10 is formed in the first surface 7 of each of the interlacing pieces 2 so that the fluid is injected through the fluid injecting hole 10. The yarn traveling groove 11 is formed in the second surface 8 of the interlacing piece 2. The first surface 7 and the second surface 8 are arranged opposite each other so as to combine the yarn traveling groove 11 and the first surface 7 together to form the yarn traveling space 18 as a space through which the multifilament yarn Y to be interlaced travels so that the yarn traveling space 18 communicates with the fluid injecting hole 10 and to form the slit 12 as a gap through which the multifilament yarn Y can be inserted into the yarn traveling space 18 in the direction perpendicular to the yarn traveling direction of the multifilament yarn Y. The yarn traveling groove 11 extends inward in the direction perpendicular to the second surface 8. In this configuration, the slit 12 is located upstream of the fluid injected toward the groove bottom P of the yarn traveling groove 11 and away from the groove bottom P of the yarn traveling groove 11. Thus, effects (1) to (3) described below are exerted.

(1) The multifilament yarn Y is unlikely to jump out through the slit 12.

(2) The area in which the fluid injected into the yarn traveling space 18 is mostly present or mostly flows may have a cross section that is line-symmetric with respect to the direction in which the fluid injecting hole 10 is drilled. In other words, the area may have a cross section that is line-symmetric with respect to the line C in the inner portion 18b.

(3) The fluid is inhibited from being blown out through the slit 12. Since the yarn traveling groove 11 is formed to extend inward, the effects (1) and (3) are more appropriately exerted.

[0026] The availability of the sectional shape described in (2) enables the symmetric flow of the fluid in the area (inner portion 18b), which is expected to be useful for interlacing performance. Since the slit 12 is composed of the combination of the groove and the surface, the interlacing device 100 can be very easily manufactured.

[0027] Of special note is that the inner portion 18b is

formed line-symmetrically with respect to the line C. Thus, the flow of the fluid in the yarn traveling space 18 is expected to be formed line-symmetrically with respect to the line C. The present inventors expect that the fluid flow in the yarn traveling space 18 formed line-symmetrically with respect to the line C is technically significant. Additionally, such a line-symmetric sectional shape cannot be obtained by adopting the configuration in Japanese Patent No. 3034649, described above.

[0028] The preferred embodiment of the present invention has been described. However, the above-described embodiment can be varied as described below.

<First Variation>

[0029] In the above-described first embodiment, the interlacing device 100 is configured such that the large number of interlacing pieces 2 are provided in a row so as to allow the large number of multifilament yarns Y to be simultaneously interlaced. Alternatively, the interlacing device 100 may be configured so as to allow only the single multifilament yarn Y to be simultaneously interlaced. That is, the interlacing device 100 may be configured as described below.

[0030] The interlacing device 100 comprises the interlacing piece 2 (first member) having the first surface 7 and the fluid injecting hole 10 formed in the first surface 7 so that the fluid is injected through the fluid injecting hole 10, and the interlacing piece 2 (second member) having the second surface 8 and the yarn traveling groove 11 formed in the second surface 8. The first surface 7 and the second surface 8 are arranged opposite each other so as to combine the yarn traveling groove 11 and the first surface 7 together to form the yarn traveling space 18 as a space through which the multifilament yarn Y to be interlaced travels so that the yarn traveling space 18 communicates with the fluid injecting hole 10 and to form the slit 12 as a gap through which the multifilament yarn Y can be inserted into the yarn traveling space 18 in the direction perpendicular to the yarn traveling direction of the multifilament yarn Y. The yarn traveling groove 11 extends inward in the direction perpendicular to the second surface 8. This configuration allows only the single multifilament yarn Y to be simultaneously interlaced, but can exert the above-described various effects.

[0031] In the first variation, the interlacing piece 2 (first member) having the first surface 7 in which the fluid injecting hole 10 is formed need not have the second surface 8, described above. Similarly, the interlacing piece 2 (second member) having the second surface 8 in which the yarn traveling groove 11 is formed need not have the first surface 7, described above.

<Second Variation>

[0032] In the above-described first embodiment, the number of interlacing pieces 2 provided on the base 1 in a row can be increased or reduced without limitation. For example, the number may be two, three, four, or more.

[0033] Figure 5 is similar to Figure 3. As shown in Figure 5, the sectional shape of the inner portion 18b of the yarn traveling space 18 may be a circle that is line-symmetric with respect to the line C, instead of the shape according to the first embodiment, that is, the oval that is line-symmetric with respect to the line C.

<Fourth Variation>

[0034] Figure 6 is similar to Figure 3. As shown in Figure 6, the sectional shape of the inner portion 18b of the yarn traveling space 18 may be a trapezoid that is line-symmetric with respect to the line C, instead of the shape according to the first embodiment, that is, an oval that is line-symmetric with respect to the line C. The inner portion 18b shown in Figure 6 is shaped to be narrower toward the adjacent opening 18a. However, alternatively, the inner portion 18b may be shaped to be narrower away from the opening 18a.

<Fifth Variation>

[0035] Figure 7 is similar to Figure 3. As shown in Figure 7, the inner portion 18b of the yarn traveling space 18 may have a sectional shape according to a fourth variation, that is, the sectional shape may be a trapezoid which is line-symmetric with respect to the line C and which has rounded sides.

<Sixth Variation>

[0036] Figure 8 is similar to Figure 3. As shown in Figure 8, the sectional shape of the inner portion 18b of the yarn traveling space 18 may be a combination of a trapezoid that is line-symmetric with respect to the line C and a rectangle that is line-symmetric with respect to the line C, instead of the shape according to the first embodiment, that is, the oval that is line-symmetric with respect to the line C. In the inner portion 18b shown in Figure 8, the trapezoid that is narrower toward the opening 18a is connected to the opening 18a, and the rectangle is positioned opposite the opening 18a across the trapezoid. Of course, alternatively, the inner portion 18b may be such that the rectangle is connected to the opening 18a and such that the trapezoid is positioned opposite the opening 18a across the rectangle.

[0037] Now, a second embodiment of the present invention will be described. Figure 9 is similar to Figure 2 and illustrates the second embodiment of the present invention. Duplicate descriptions of the first embodiment are appropriately omitted.

[0038] In the first embodiment, the fluid injecting hole 10 has the circular cross section as shown in Figure 2. In contrast, in the present embodiment, the fluid injecting hole 10 has a cross section that is flat along the yarn traveling direction as shown in Figure 9. Specifically,

compared to the fluid injecting hole 10 according to the first embodiment, the fluid injecting hole 10 according to the second embodiment is thick in the yarn traveling direction and thin in the slit direction. The opposite ends of the fluid injecting hole 10 in the yarn traveling direction are slightly rounded. That is, the fluid injecting hole 10 according to the present embodiment has an oval cross section.

[0039] Figure 10 is a sectional view which is similar to Figure 3 and which is taken along line 10-10 in Figure 9. In the slit direction in Figure 10, the width h1 of the fluid injecting hole 10 is smaller than the width h2 of the opening 18a of the yarn traveling space 18.

[0040] Figure 11 is an enlarged view of a part A in Figure 10 and is similar to Figure 4. As shown in Figure 11, a fluid injected through the fluid injecting hole 10 collides against the groove bottom P of the yarn traveling groove 11 while maintaining the small width in the slit direction.

[0041] As described above, in the above-described embodiment, the interlacing device 100 is further configured as described below. That is, the fluid injecting hole 10 is formed to be flat along the traveling direction of the multifilament yarn Y. The above-described configuration allows the fluid to be injected against the multifilament yarn Y traveling through the yarn traveling space 18, over a long time.

[0042] Now, tests for checking the interlacing device 100 according to the second embodiment for technical effects will be described. Figure 12 is a graph showing the results of the tests for checking the interlacing device 100 according to the second embodiment for technical effects. The check tests are intended to verify the technical significance of the second embodiment compared to the first embodiment. The check tests focus particularly on the interlacing performance.

[0043] First, test conditions will be described. A model 1 shows the interlacing device 100 according to the first embodiment. Models 2 and 3 are the interlacing devices 100 according to the second embodiment. The fluid injecting hole 10 in the model 1 had a circular cross section as described above; the circle had a diameter of 1.3 mm. The fluid injecting hole 10 in the model 2 had an oval cross section as described above; the paired semicircles constituting the oval each had a radius of 0.4 mm, and straight lines connecting the paired semicircles together each had a length of 1.0 mm. Similarly, the fluid injecting hole 10 in the model 3 had an oval cross section as described above; the paired semicircles constituting the oval each had a radius of 0.3 mm, and straight lines connecting the paired semicircles together each had a length of 1.7 mm. In short, the models 1, 2, and 3 were set to have the same sectional area so as to allow easy comparison of the technical effects.

[0044] The types of multifilament yarns Y to be interlaced were PET, 83dtex, and 36 filaments. Yarn speed was set to 4,700 m/min. In Figure 12, the axis of ordinate shows an interlace count as the number of interlaced portions formed on the multifilament yarn Y per unit meter. The axis of abscissa shows the flow rate of the fluid injected through the fluid injecting hole 10. Compressed air was adopted as the fluid. In the specification, the interlacing performance is defined as (interface count/flow rate).

[0045] Figure 12 shows that adoption of the models 2 according to the second embodiment allows a high interlace count to be achieved at the same flow rate and also allows the same interlace count to be achieved at a lower flow rate. That is, the models 2 and 3 exhibit a high interlacing performance. In general, with the interlacing device 100 shown in Figure 1, about 10,000 interlacing devices 100 are simultaneously used in one factory. Thus, as is understood from the test results, the second modes 2 and 3 are very useful in terms of the performance of compressors that supply air to the interlacing devices 100.

[0046] Now, a third embodiment of the present invention will be described with reference to the drawings. Figure 13 is similar to Figure 2 and illustrates the third embodiment of the present invention. Duplicate descriptions of the first embodiment are appropriately omitted.

[0047] As shown in Figure 3, in the first embodiment, the second surface leading end portion 8a and the second surface base end portion 8b, constituting the second surface 8, are parallel to each other but are not present in the same plane. In contrast, as shown in Figure 13, in the present embodiment, the second surface leading end portion 8a and the second surface base end portion 8b, constituting the second surface 8, are parallel to each other and are present in the same plane. In other words, the second surface 8 is entirely present in one plane. Thus, in the present embodiment, the yarn traveling space 18 shown in Figure 4 is not partly but entirely line-symmetric with respect to the line C.

[0048] Furthermore, as shown in Figure 2, in the present embodiment, the slit 12 is formed between the first surface 7 and the second surface 8, arranged opposite each other. Furthermore, the first surface 7 and the second surface 8 abut partly against each other. In contrast, as shown in Figure 13, in the present embodiment, a small gap (g) is created between the first surface 7 and the second surface 8 so as to form the slit 12. The small gap (g) has a width of, for example, 0.1 mm. The gap (g) is formed, for example, as follows. That is, when the plurality of interlacing pieces 2 are provided on the base 1 in a row, an appropriate thin piece 21 is interposed between the adjacent interlacing pieces 2. In other words, the interlacing pieces 2 and the thin pieces 21 are alternately juxtaposed on the base 1.

[0049] As described above, in the present embodiment, the interlacing device 100 is configured as follows. That is, the slit 12 is formed by disposing the adjacent interlacing pieces 2 with the gap (g) created between the interlacing pieces 2. This configuration enables the following features to be simultaneously achieved: (a) the first surface 7 is present in one plane, (b) the second

surface 8 is present in one plane, and (c) the slit 12 is formed between the first surface 7 and the second surface 8. Moreover, when focus is placed on the point that the features (a) and (b) are simultaneously achieved, the present embodiment is effective for reducing manufacturing costs compared to the first embodiment, in which the second surface 8 is separately present in a plane different from that in which the first surface 7 is present.

[0050] While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intented by the appended claims to cover all modifications of the present invention that fall within the true spirit and scope of the invention.

Claims

1. An interlacing device comprising a first member having a first surface and a fluid injecting hole formed in the first surface so that a fluid is injected through the fluid injecting hole, and a second member having a second surface, the first surface and the second surface being arranged opposite each other to form a yarn traveling space as a space through which a yarn to be interlaced travels so that the yarn traveling space communicates with the fluid injecting hole and to form a yarn inserting gap as a gap through which the yarn can be inserted into the yarn traveling space in a direction perpendicular to a traveling direction of the yarn, the device being **characterized in that:**

   a groove is formed in the second surface, and the groove and the first surface are combined to form the yarn traveling space, and
   the groove extends inward in a direction perpendicular to the second surface.

2. An interlacing device **characterized by** comprising:

   a first member having a first surface and a fluid injecting hole formed in the first surface so that a fluid is injected through the fluid injecting hole; and
   a second member having a second surface and a groove formed in the second surface,
   the first surface and the second surface being arranged opposite each other so as to combine the groove and the first surface together to form a yarn traveling space as a space through which a yarn to be interlaced travels so that the yarn traveling space communicates with the fluid injecting hole and to form a yarn inserting gap as a gap through which the yarn can be inserted into the yarn traveling space in a direction perpendicular to a traveling direction of the yarn, and
   the groove extending inward in a direction perpendicular to the second surface.

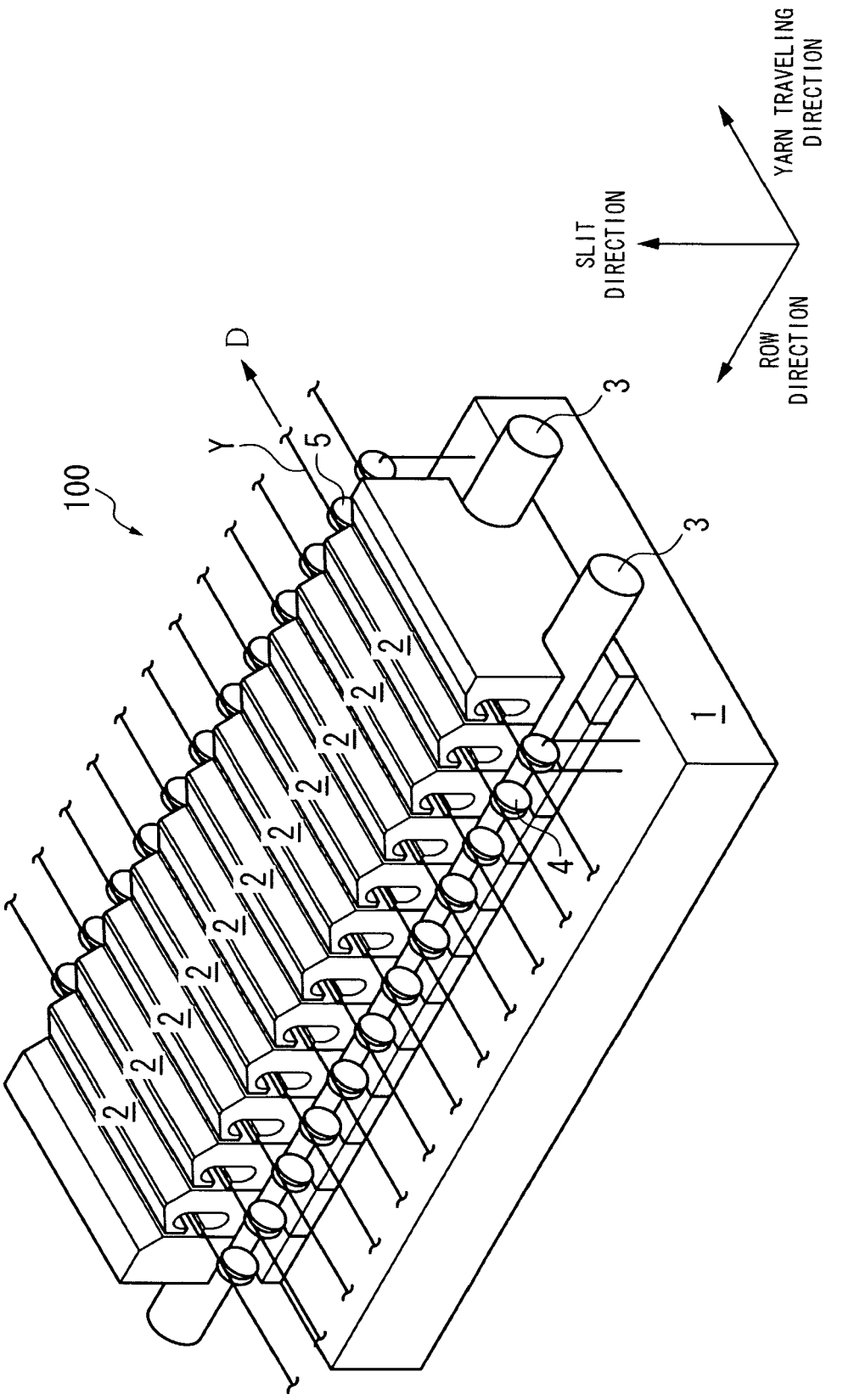
3. An interlacing device **characterized in that:**

   interlacing pieces each having a first surface and a second surface are provided in a row so that the first surface and the second surface are arranged opposite each other,
   a fluid injecting hole is formed in the first surface of each of the interlacing pieces,
   a groove is formed in the second surface of each of the interlacing pieces,
   the first surface and the second surface are arranged opposite each other so as to combine the groove and the first surface together to form a yarn traveling space as a space through which a yarn to be interlaced travels so that the yarn traveling space communicates with the fluid injecting hole and to form a yarn inserting gap as a gap through which the yarn can be inserted into the yarn traveling space in a direction perpendicular to a traveling direction of the yarn, and
   the groove extends inward in a direction perpendicular to the second surface.

4. An interlacing device according to any one of Claim I to Claim 3, **characterized in that** an area in which the fluid injected into the yarn traveling space is mostly present or mostly flows is formed line-symmetrically with respect to a direction in which the fluid injecting hole is drilled.

5. An interlacing device according to any one of Claim 1 to Claim 4, **characterized in that** the fluid injecting hole is formed to have a cross section that is flat along the traveling direction of the yarn.

FIGURE 1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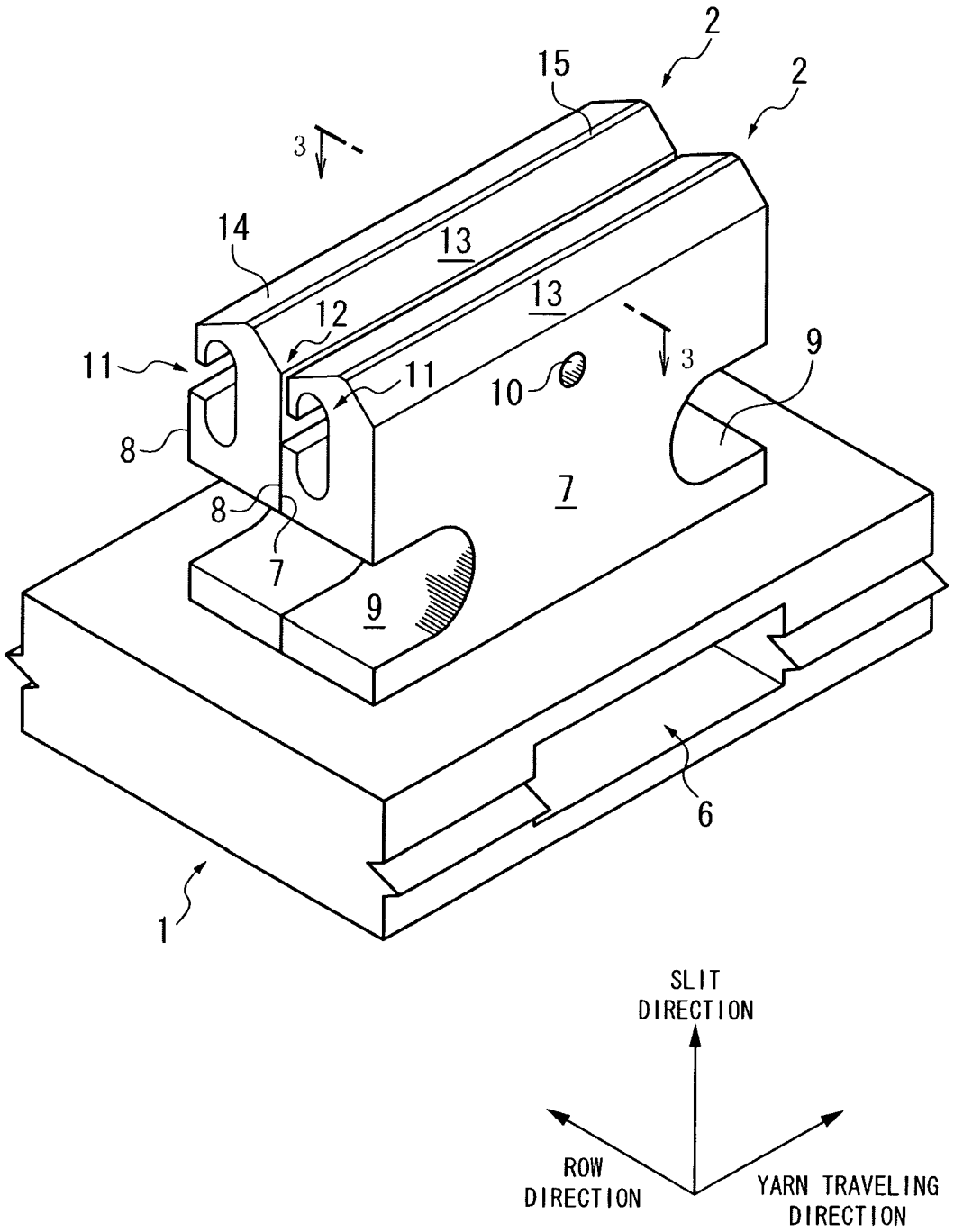
SLIT DIRECTION
YARN TRAVELING DIRECTION
ROW DIRECTION

FIGURE 2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6
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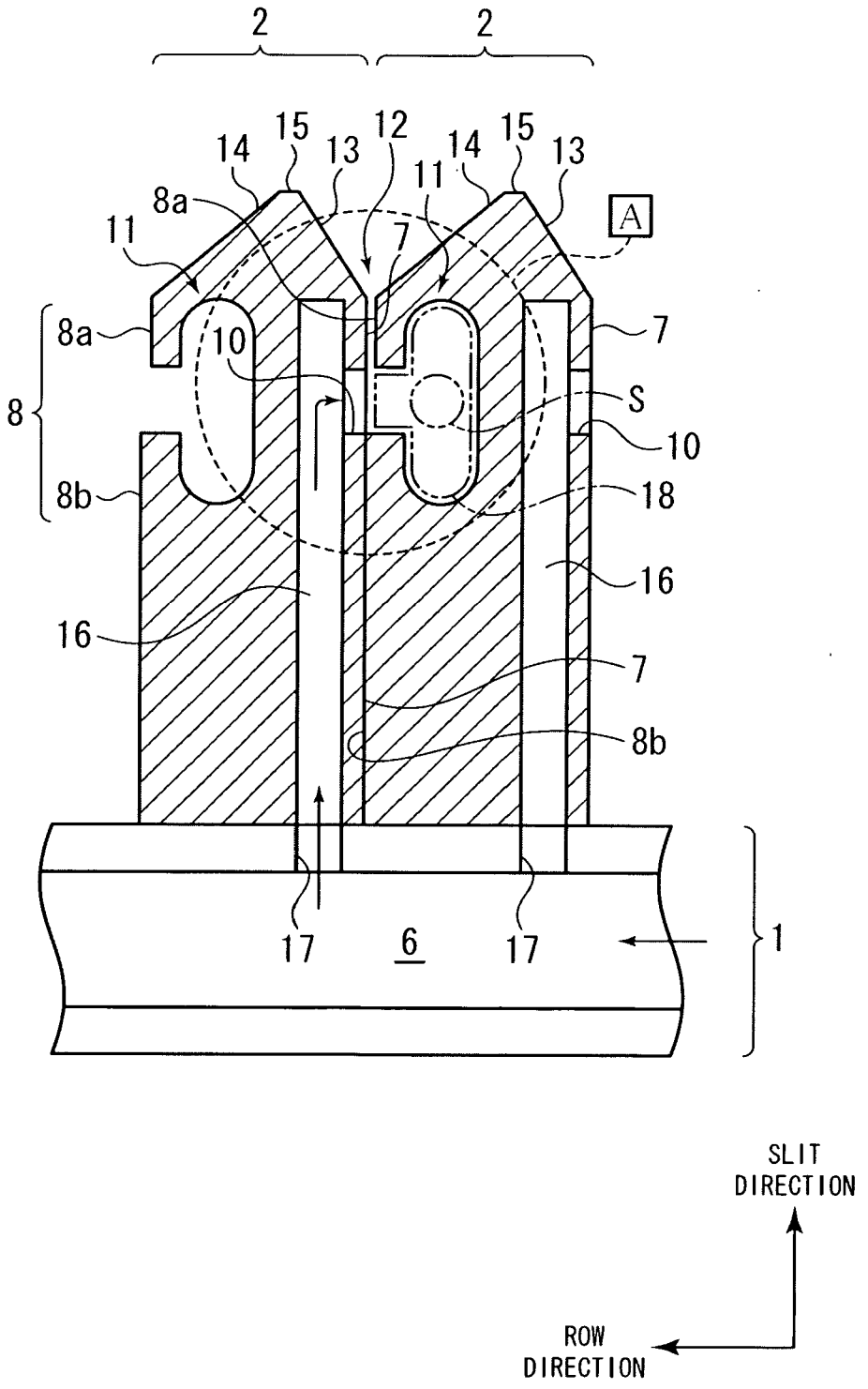
SLIT DIRECTION
ROW DIRECTION
YARN TRAVELING DIRECTION

FIGURE 3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7
8b
17
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17
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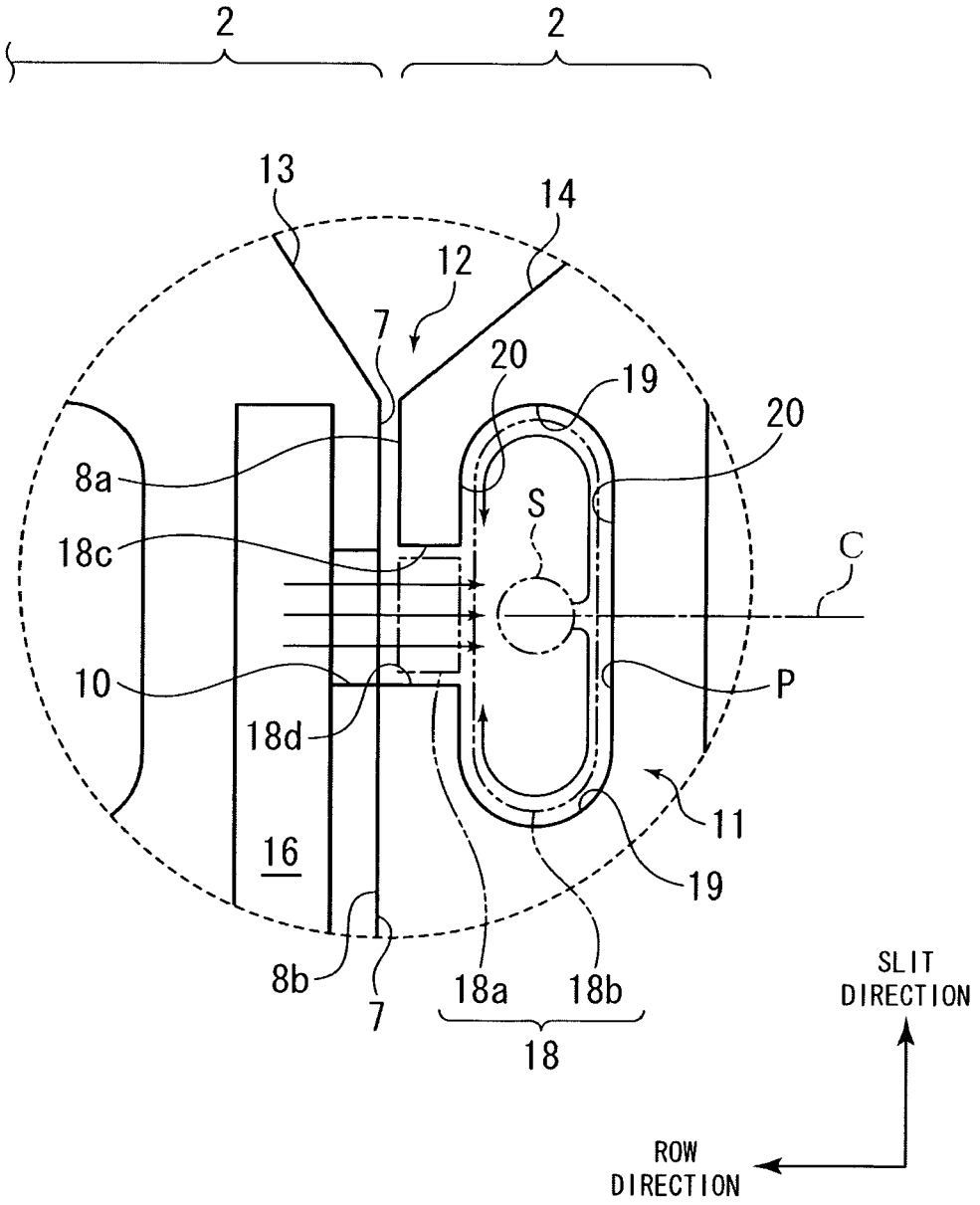
SLIT
DIRECTION
ROW
DIRECTION

FIGURE 4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8a
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18c
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18d
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8b
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18a
18b
18
SLIT DIRECTION
ROW DIRECTION

FIGURE 5

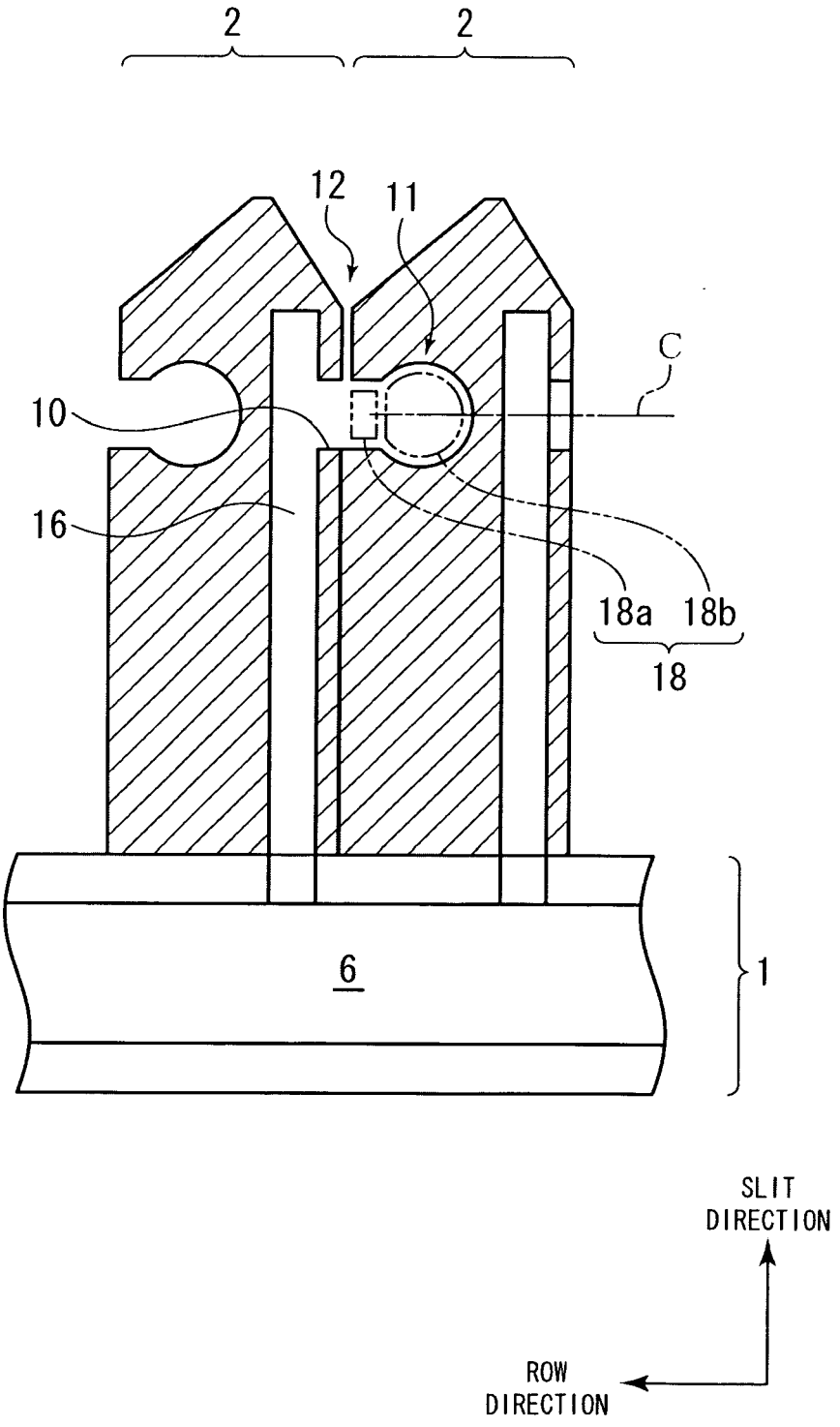


FIGURE 6

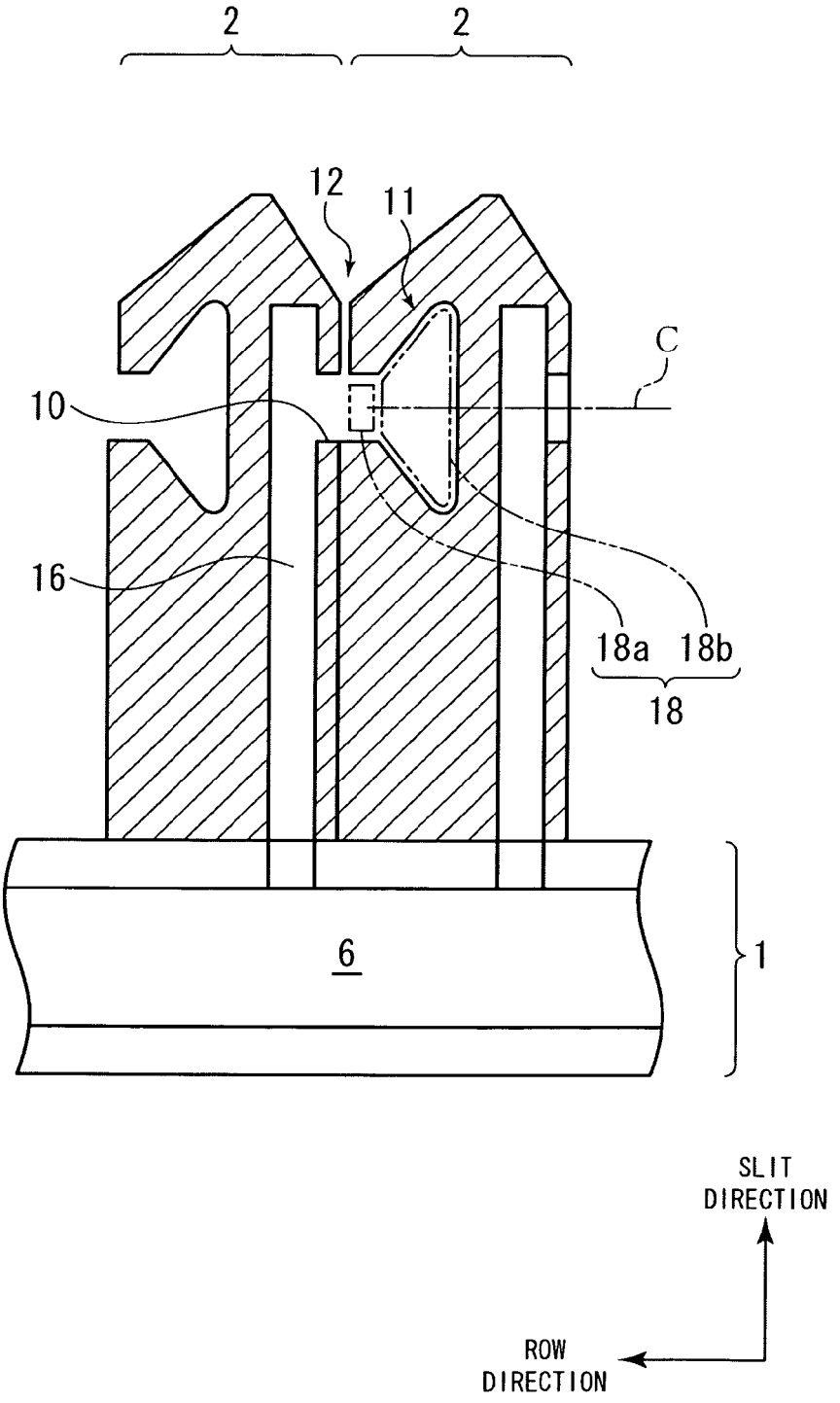


FIGURE 7

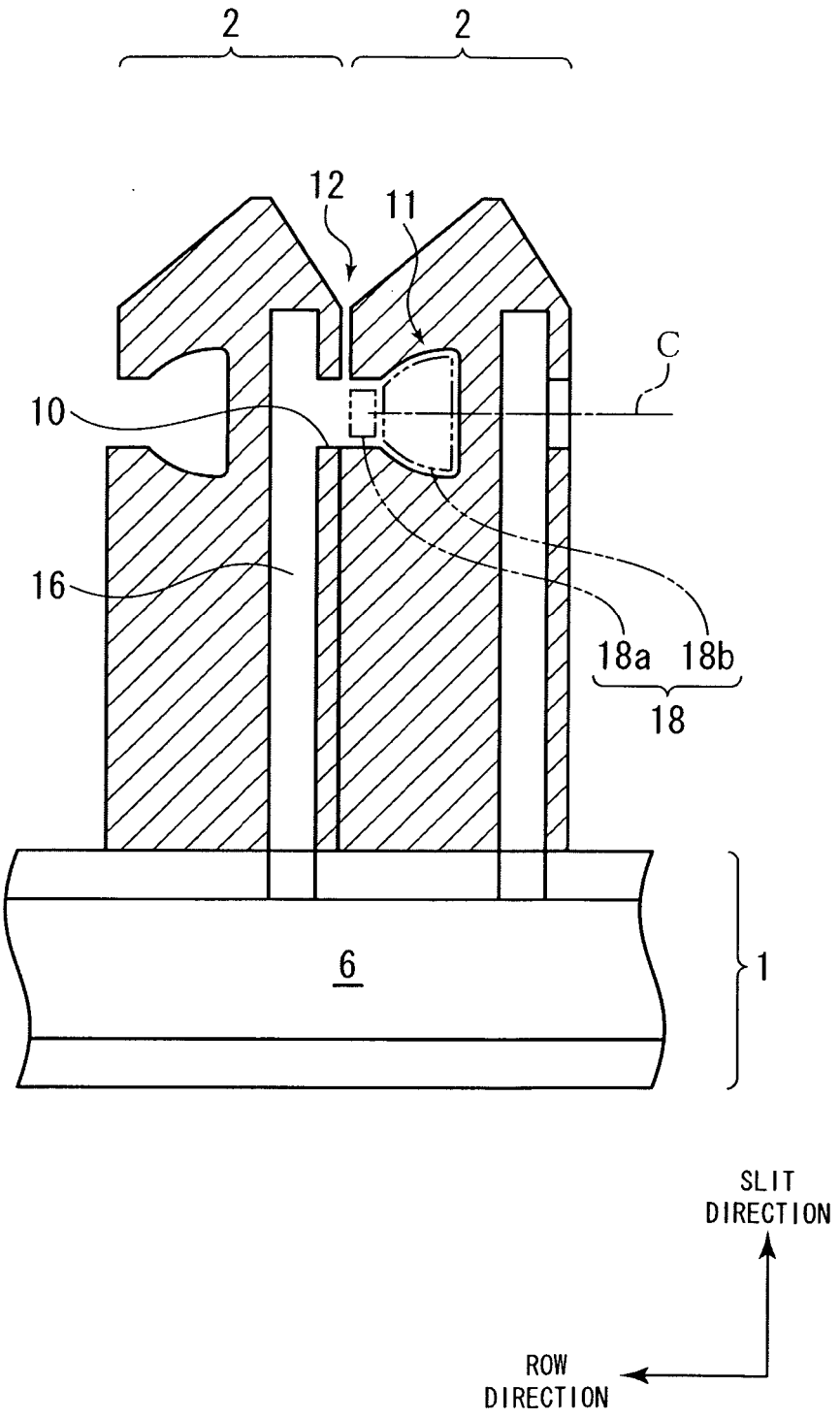


FIGURE 8

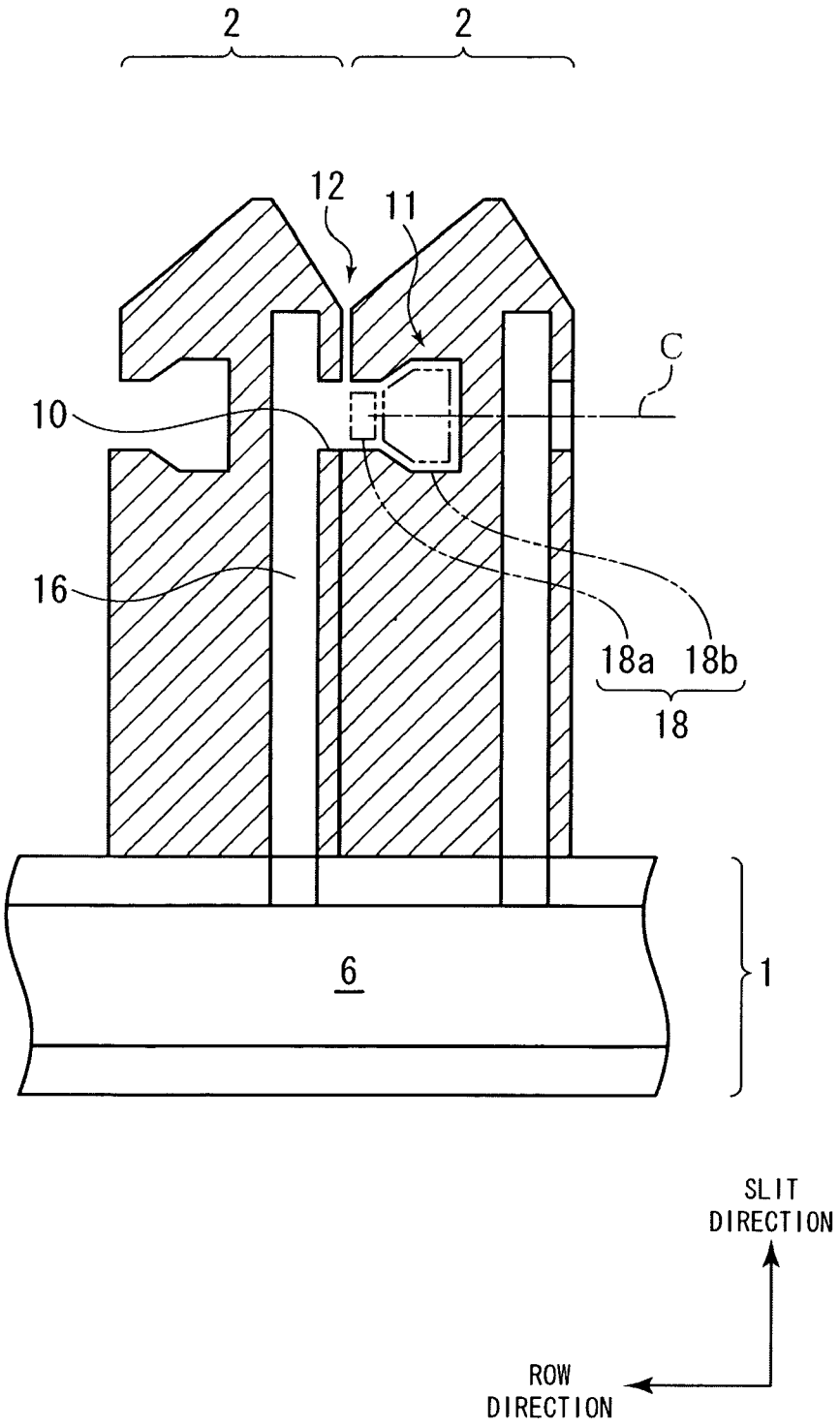
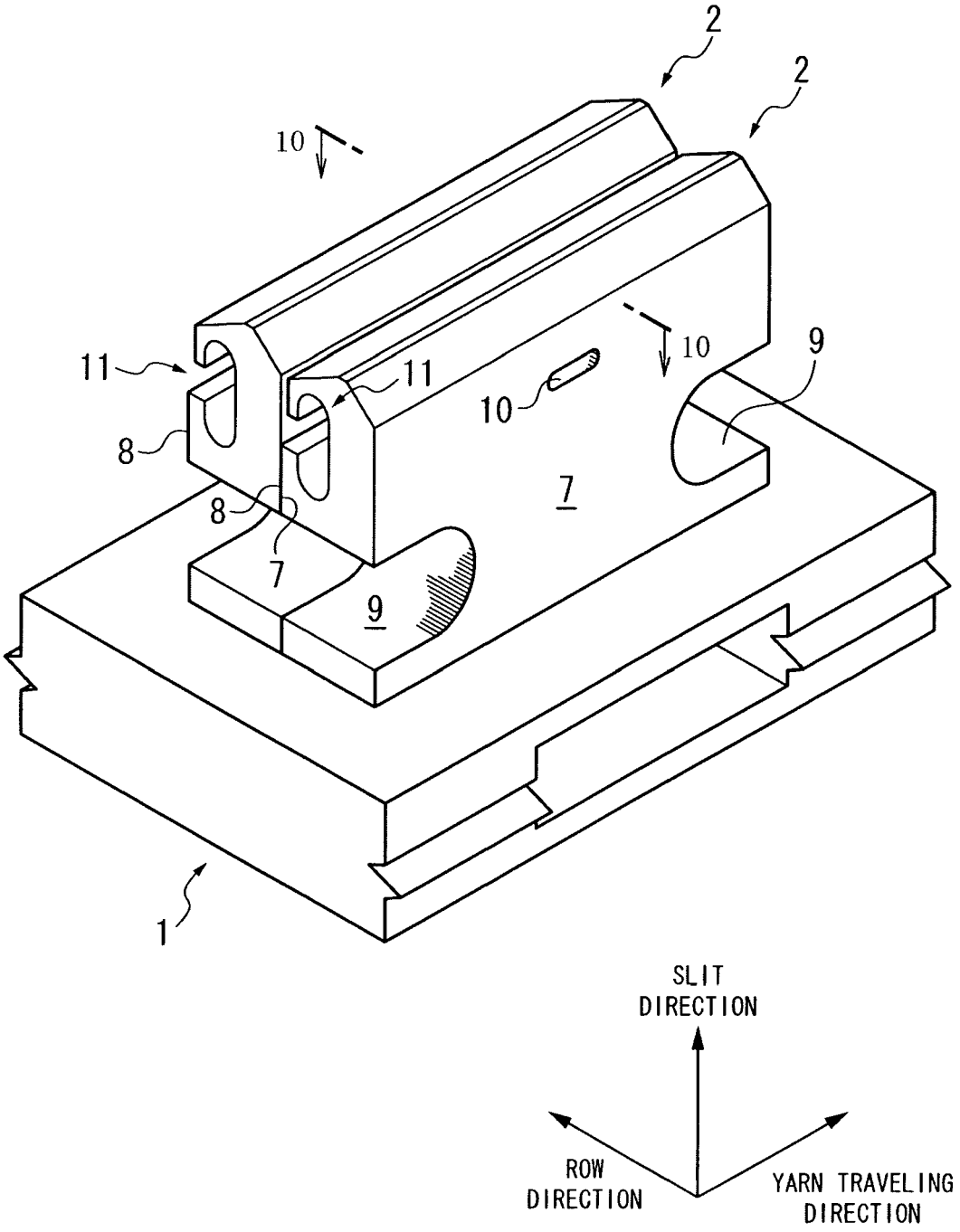


FIGURE 9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SLIT DIRECTION
ROW DIRECTION
YARN TRAVELING DIRECTION

FIGURE 10

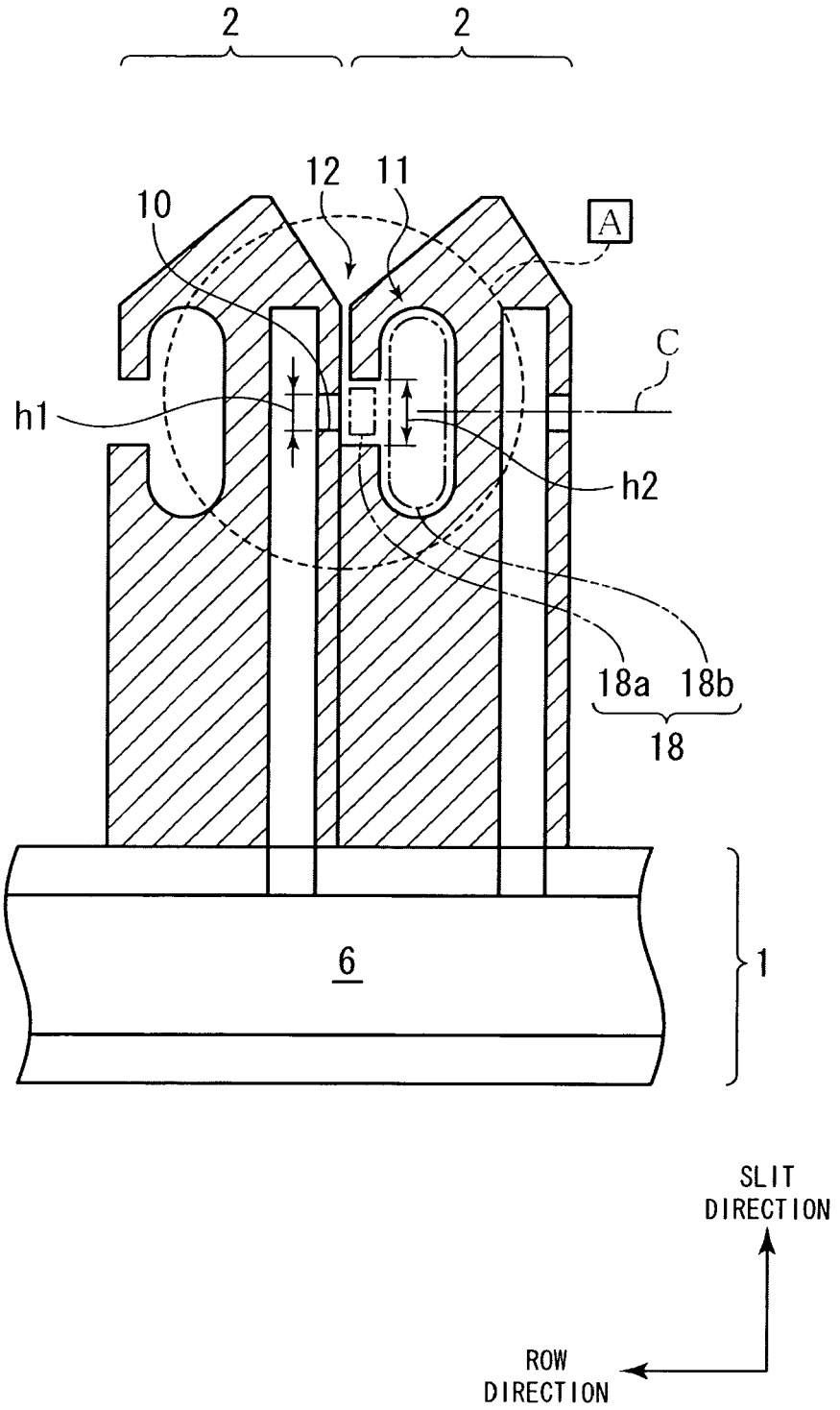


FIGURE 11

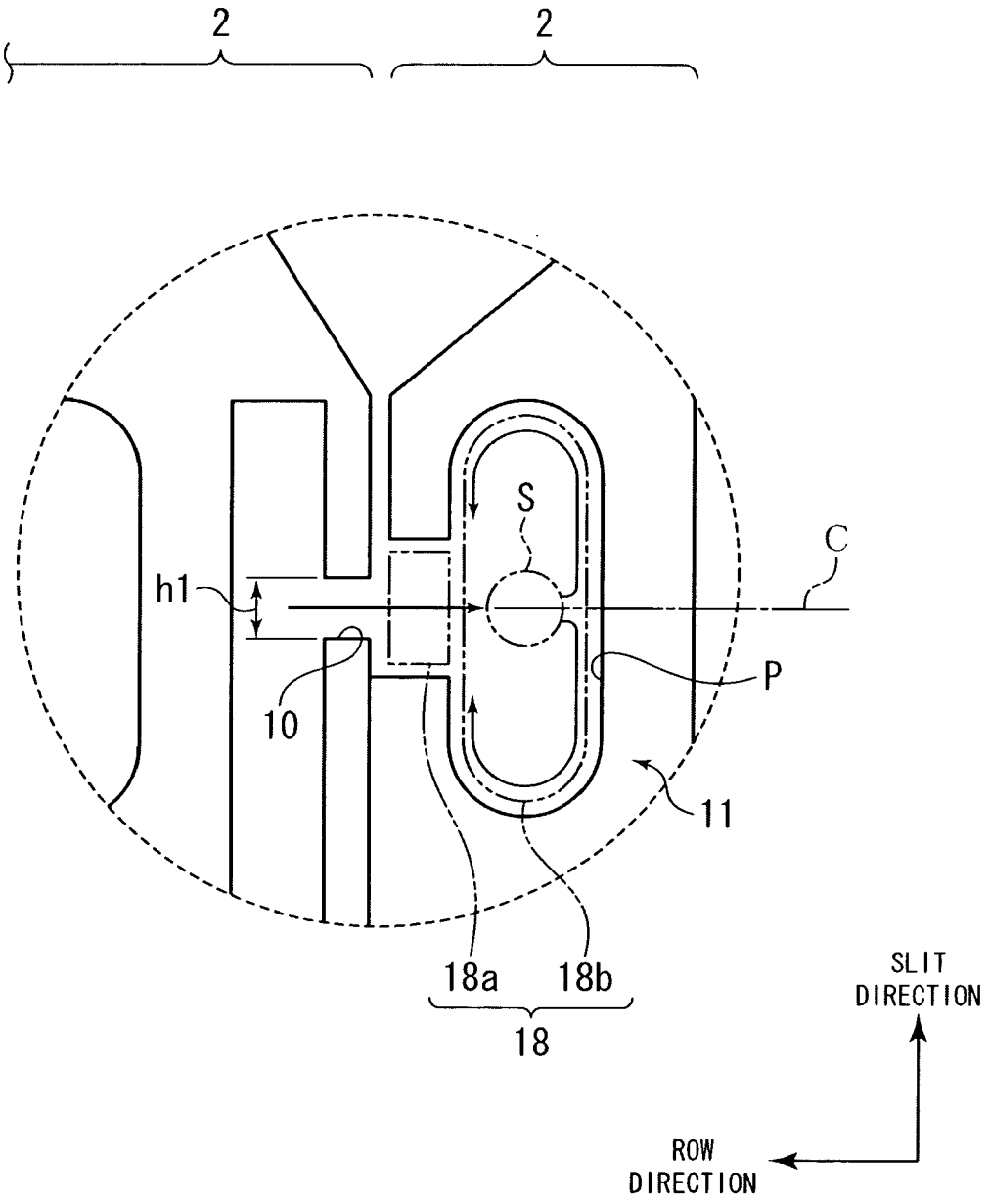
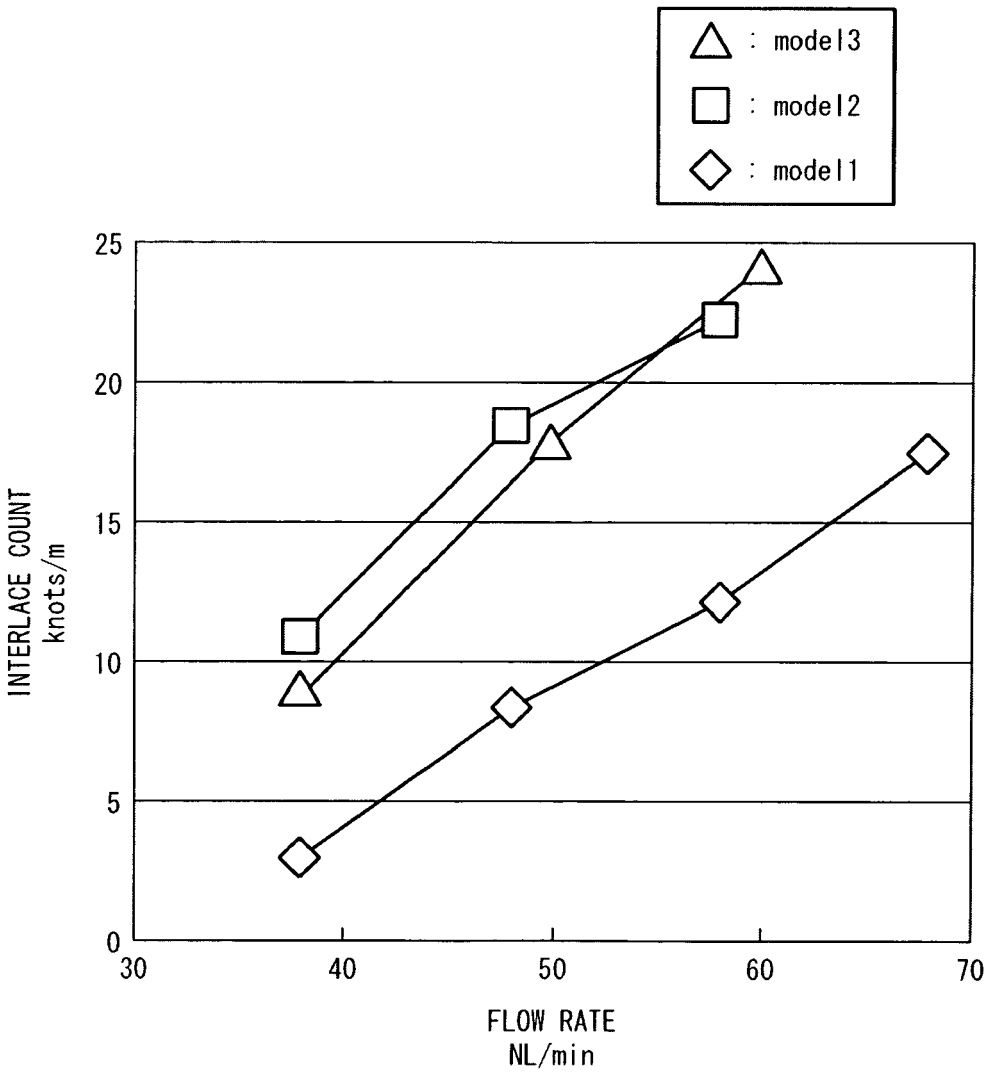


FIGURE 12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: model2
: model1
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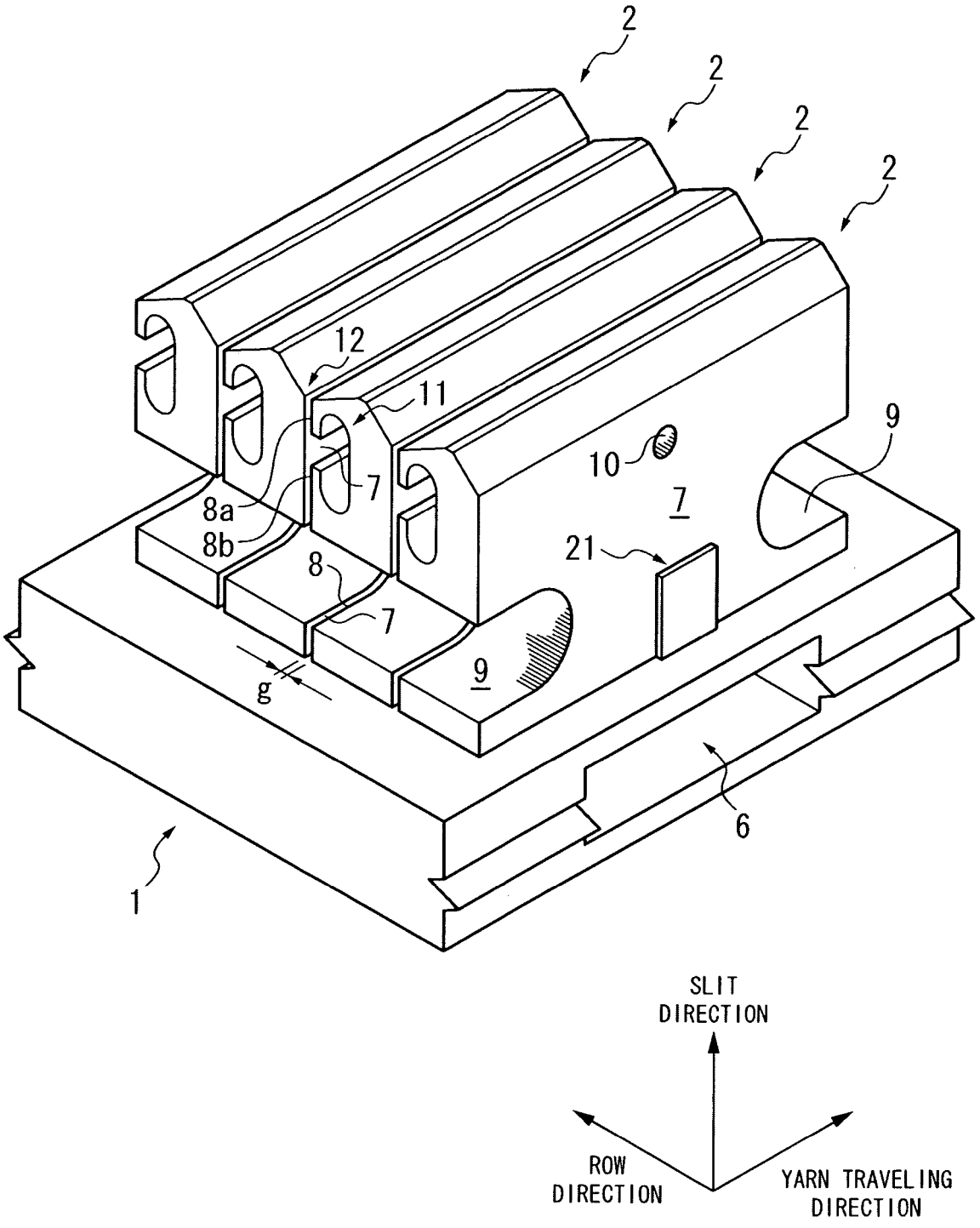
20
15
10
5
0
30
40
50
60
70
FLOW RATE
NL/min

FIGURE 13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6
SLIT DIRECTION
ROW DIRECTION
YARN TRAVELING DIRECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 3759

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X	WO 2006/002562 A (HEBERLEIN FIBERTECHNOLOGY INC [CH]; BUCHMUELLER PATRICK [CH]) 12 January 2006 (2006-01-12) * page 11, line 25 - page 13, line 4; figures 1-3 *	1-4	INV. D02J1/08
X	JP 2005 213692 A (TORAY INDUSTRIES) 11 August 2005 (2005-08-11) * paragraph [0046] - paragraph [0047]; figures 10,11 *	1-4	
X	JP 09 250043 A (TORAY INDUSTRIES) 22 September 1997 (1997-09-22) * abstract; figures 1-5 *	1-4	
X	DE 39 04 815 A1 (BARMAG BARMER MASCHF [DE]) 7 September 1989 (1989-09-07) * column 3, line 6 - column 5, line 12; figures 1,2 *	1,2,4	
X,D	EP 0 465 407 A (HEBERLEIN & CO AG [CH]) 8 January 1992 (1992-01-08) * page 2 - page 3; figures 1-3 *	1,2,4	TECHNICAL FIELDS SEARCHED (IPC) D02J D02G
X	JP 58 065029 A (TORAY INDUSTRIES) 18 April 1983 (1983-04-18) * figure 4 *	1,2,4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 February 2009	Pollet, Didier

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18-02-2009

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