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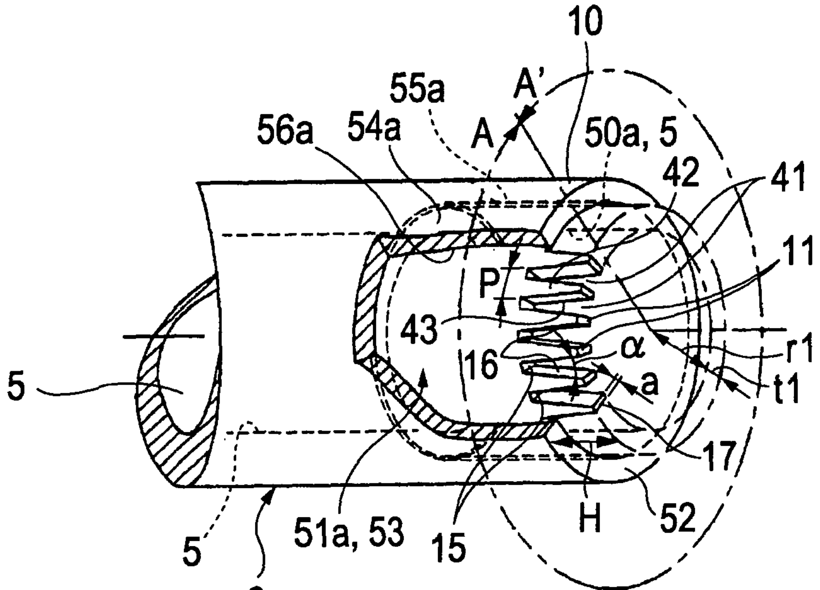
(54) **Weft insertion nozzle and weft-fall-out preventing component used in weft insertion nozzle**

(57) A tubular component (51a) having a through hole (50a) and a cylindrical section (55a) is fitted within or around a thread guide (3), the cylindrical section (55a) at least having a tubular shape at one end in an axial direction thereof. Of the tubular component (51a) and the thread guide (3), the one whose inner periphery surface substantially serves as a weft guiding path (5) has a downstream end in a weft-insertion direction that is provided with a plurality of projections (11) arranged in a circumferential direction, each projection (11) being tapered from a base end (15) towards a tip thereof.

FIG. 3A



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to weft insertion nozzles in fluid jet looms, and particularly, to a technology for preventing a weft yarn from falling out of a weft insertion nozzle (so-called weft fall-out) in response to repulsive force generated at the time of a weft cutting process.

2. Description of the Related Art

[0002] Japanese Unexamined Utility Model Registration Application Publication No. 51-124159 (which will be referred to as Patent Document 1 hereinafter) and Japanese Unexamined Patent Application Publication No. 11-200193 (which will be referred to as Patent Document 2 hereinafter) disclose a weft-fall-out preventing unit in a fluid jet loom, which is for preventing a weft yarn from falling out of a weft insertion nozzle after a beating process.

[0003] More specifically, Patent Document 1 discloses a technology in which a plurality of linear members such as nylon strings or metal wires are mounted to a downstream end of a weft insertion nozzle in a flow direction of compressed fluid, such that these linear members are arranged in a converged manner around an outlet of the weft insertion nozzle. This allows a weft yarn to be constantly in contact with the linear members. Consequently, when the weft yarn is cut and separated from a woven cloth after a beating process, the weft yarn can be caught by the linear members even if the weft yarn tries to move in the opposite direction to the weft-insertion direction in response to a repulsive force generated at the time of the weft cutting process. Accordingly, this prevents the weft yarn from moving backwards.

[0004] However, because the weft yarn is constantly in contact with the linear members, the technology disclosed in Patent Document 1 can lead to problems such as an unstable weft-insertion process or damages to the weft yarn.

[0005] On the other hand, Patent Document 2 discloses a technology in which a weft holding mechanism is disposed within a weft insertion nozzle at a position upstream of a thread guide and holds a weft yarn by means of an air jet. This weft holding mechanism is provided in a base body that connects a yarn guide and a nozzle body. Specifically, the weft holding mechanism has air jet holes located between the yarn guide and the nozzle body and facing each other across a weft traveling path, and a weft holding portion having a plurality of through holes extending through an inner wall of the base body. The weft holding mechanism emits air through the air jet holes at a predetermined timing so as to press and hold a weft yarn against the weft holding portion, thereby preventing the weft yarn from moving backwards at the time of a weft cutting process.

[0006] However, the technology disclosed in Patent Document 2 is problematic in that the structure thereof is complex due to requiring a mechanism for controlling the air jet, and that periodical cleaning is necessary to prevent the weft holding mechanism from becoming dysfunctional as a result of the through holes getting filled with lint.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the present invention to provide a weft insertion nozzle used in a fluid jet loom, which has a simple mechanism that can prevent a weft yarn from falling out of the nozzle at the time of a weft cutting process without lowering the stability of the weft-insertion process or impairing the quality of the weft yarn even if the weft yarn used has high elasticity.

[0008] In order to achieve the aforementioned object, the present invention provides a weft insertion nozzle (1) in a fluid jet loom, in which a tubular component (51a, 51b, 51c, 51d, 51e) having a through hole (50a, 50b, 50c, 50d, 50e) and a cylindrical section (55a, 55b, 55c, 55d, 55e) is fitted within or around a thread guide (3), the cylindrical section (55a, 55b, 55c, 55d, 55e) at least having a tubular shape at one end in an axial direction thereof. An inner periphery surface of one of the tubular component (51a, 51b, 51c, 51d, 51e) and the thread guide (3) substantially serves as a weft guiding path (5) in an area where the tubular component (51a, 51b, 51c, 51d, 51e) is disposed. The one of the tubular component (51a, 51b, 51c, 51d, 51e) and the thread guide (3) has a downstream end in a weft-insertion direction that is provided with a plurality of projections (11) arranged in a circumferential direction, each projection (11) being tapered from a base end (15) towards a tip thereof.

[0009] Accordingly, when a weft yarn (9) is cut after a beating process, the weft yarn (9) at the nozzle side can be properly caught in at least one of notches (41) defined by the plurality of projections (11) even if the cut weft yarn (9) tries to move backward towards the upstream side of the weft insertion nozzle (1) due to its own elasticity. Specifically, each notch (41) is defined by opposing sides (16) of an adjacent pair of the projections (11) and by the base end (15), and is tapered towards the base end (15). Accordingly, the weft yarn (9) can be prevented from moving further, thereby preventing the weft yarn (9) from falling out of the nozzle (1). In addition, unlike the technology disclosed in Patent Document 1 where the members for preventing a backward movement of a weft yarn are projected inward towards the weft traveling path so as to be constantly in contact with the yarn, the weft insertion nozzle (1) according to the present invention is configured to prevent such a backward movement of the weft yarn (9) by having the projections (11) projected towards one (axial) end of the thread guide (3). This means that, during a weft insertion process, no resistance force is generated against the weft yarn (9) being discharged by fluid jet, thereby preventing the weft yarn (9) from being damaged.

[0010] Specifically, in the weft insertion nozzle (1), the tubular component (51a, 51e) may be fitted within or around an end portion (10) of the thread guide (3) so that the end portion (10) of the thread guide (3) has a two-tiered structure in a radial direction thereof. The one that has the downstream end provided with the plurality of projections (11) arranged in the circumferential direction may be one of the end portion (10) of the thread guide (3) and the tubular component (51a, 51e) that is disposed at an internal side of the two-tiered structure.

[0011] Accordingly, when the weft yarn (9) is cut after a beating process, the moving weft yarn (9) cut and separated from a woven cloth can be properly caught by the projections (11) provided at one end of the thread guide (3) even if the weft yarn (9) starts to move backward towards the upstream side of the weft insertion nozzle (1) due to its own elasticity. Thus, the weft yarn (9) can be stopped from moving, thereby preventing the weft yarn (9) from falling out of the nozzle (1).

[0012] Furthermore, in the weft insertion nozzle (1), the other one of the end portion (10) of the thread guide (3) and the tubular component (51a, 51e) that is disposed at an external side of the two-tiered structure has a downstream end surface (52) in the weft-insertion direction. In this case, the base end (15) of each projection (11) may be positioned upstream relative to the downstream end surface (52).

[0013] Accordingly, this can reduce the degree of exposure of the notches (41) between the projections (11) with respect to an orifice flow channel (40). Therefore, the amount of fluid escaping into the weft guiding path (5) through the notches (41) can be minimized, whereby a stable fluid flow can be created in the weft-insertion direction. As a result, this allows for a favorable weft-insertion process and a stable operation of the loom. Accordingly, the weft conveying force of the weft insertion nozzle (1) can be prevented from deteriorating.

[0014] Furthermore, in the weft insertion nozzle (1), the end portion (10) of the thread guide (3) may have a step section (56a, 56e) serving as a thin-walled section. In this case, the tubular component (51a, 51e) may be fitted to the step section (56a, 56e).

[0015] Accordingly, the tubular component (51a, 51e) can be properly positioned in the axial direction with respect to the thread guide (3). This can prevent the axial position of tubular components (51a, 51e) from varying at the manufacturing stage of thread guides (3), thereby reducing the percent defective of weft insertion nozzles (1) and thus improving the yield rate.

[0016] Specifically, in the weft insertion nozzle (1), the tubular component (51b, 51c, 51d) may be fitted within the thread guide (3). In this case, the one having the downstream end provided with the plurality of projections (11) arranged in the circumferential direction may be the tubular component (51b, 51c, 51d).

[0017] Accordingly, when the weft yarn (9) is cut after a beating process, the moving weft yarn (9) cut and separated from a woven cloth can be properly caught by the projections (11) provided at one end of the thread guide (3) even if the weft yarn (9) starts to move backward towards the upstream side of the weft insertion nozzle (1) due to its own elasticity. Thus, the weft yarn (9) can be stopped from moving, thereby preventing the weft yarn (9) from falling out of the nozzle (1).

[0018] Furthermore, in the weft insertion nozzle (1), the tubular component (51a, 51b, 51c, 51d) may have a cylindrical shape such that the through hole (50a, 50b, 50c, 50d) thereof has a fixed inside diameter and that the tubular component (51a, 51b, 51c, 51d) has a fixed outside diameter over an entire length thereof in the axial direction.

[0019] Accordingly, this facilitates the machining process of the tubular component (51a, 51b, 51c, 51d) and is thus advantageous for mass production.

[0020] Furthermore, in the weft insertion nozzle (1), the tubular component (51c, 51d) may be provided with a flange (57c, 57d) located upstream of the cylindrical section (55c, 55d) in the weft-insertion direction and connected to the cylindrical section (55c, 55d). Moreover, the thread guide (3) may be provided with a base surface (54c, 54d) extending outward in a radial direction. In this case, the tubular component (51c, 51d) may be disposed such that a downstream-facing surface of the flange (57c, 57d) in the weft-insertion direction abuts on the base surface (54c, 54d).

[0021] Accordingly, the tubular component (51c, 51d) can be readily positioned at a predetermined location within the weft guiding path (5) of the thread guide (3). This can prevent the axial position of tubular components (51c, 51d) from varying at the manufacturing stage of thread guides (3), thereby reducing the percent defective of weft insertion nozzles (1) and thus improving the yield rate.

[0022] The present invention also provides a weft-fall-out preventing component (53) fitted within a thread guide (3) of a weft insertion nozzle (1) to prevent weft from falling out of the weft insertion nozzle (1). The weft-fall-out preventing component (53) includes a tubular component (51a, 51b, 51c, 51d). Specifically, the tubular component (51a, 51b, 51c, 51d) has a through hole (50a, 50b, 50c, 50d) extending in an axial direction and a cylindrical section (55a, 55b, 55c, 55d) whose at least one axial end has a fixed outside diameter in the axial direction, the cylindrical section (55a, 55b, 55c, 55d) having an end provided with a plurality of projections (11) arranged in a circumferential direction, each projection (11) being tapered from a base end (15) towards a tip thereof.

[0023] Accordingly, by attaching the weft-fall-out preventing component (53) to an existing thread guide (3), the existing thread guide (3) can be equipped with a function for preventing a weft yarn from falling out of a nozzle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 is a cross-sectional view of a weft insertion nozzle in an air jet loom and a peripheral area thereof;
Fig. 2 is an enlarged cross-sectional view of the weft insertion nozzle in the air jet loom and the peripheral area thereof;
Figs. 3A and 3B are a perspective view and a cross-sectional view of an end portion of a thread guide according to an exemplary embodiment of the present invention;
Fig. 4 is a development view along line A-A' in Fig. 3;
Fig. 5 is a development view showing a structure of projections according to a modified example;
Fig. 6 is a development view showing a structure of projections according to another modified example;
Fig. 7 is a development view showing a structure of projections according to another modified example;
Fig. 8 is a development view showing a structure of projections according to another modified example;
Figs. 9A to 9C are cross-sectional views showing examples of the end portion of the thread guide according to the exemplary embodiment of the present invention; and
Fig. 10 is an enlarged cross-sectional view of a weft insertion nozzle in an air jet loom and a peripheral area thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] A weft insertion nozzle 1 according to the present invention is used in a fluid jet loom. The weft insertion nozzle 1 according to the present invention can be roughly classified into two types depending on the attachment position of a tubular component serving as a weft-fall-out preventing component 53 for preventing a weft yarn from falling out of the nozzle, which is a characteristic component of the invention. Specifically, one type is such that a tubular component (51a, 51e) is attached to an end portion 10 of a thread guide 3, and another type is such that a tubular component (51b, 51c, 51d) is attached to an arbitrary position of a weft guiding path 5 within the thread guide 3. An example of the type in which the tubular component 51a or 51e is attached to the end portion 10 of the thread guide 3 will be described first with reference to Figs. 1 to 9, and another example of the type in which the tubular component 51b, 51c, or 51d is attached to an arbitrary position of the weft guiding path 5 within the thread guide 3 will be described afterwards with reference to Fig. 10.

[0026] Figs. 1 and 2 illustrate a weft insertion nozzle (main nozzle) of an air jet loom and a peripheral area thereof, the air jet loom being an example of a fluid jet loom to which the present invention can be applied.

[0027] The weft insertion nozzle 1 mainly includes a nozzle body 2 having an insertion hole 4, a thread guide 3 inserted in the insertion hole 4, an orifice member 12 that accelerates air serving as compressed fluid, and a pipe 13 having a hollow section where a weft yarn 9 and the air meet. The insertion hole 4 forms a through hole constituted by a first insertion hole 33 through which the orifice member 12 extends and a second insertion hole 34 in which the pipe 13 is fitted, the first insertion hole 33 and the second insertion hole 34 being coaxially aligned with each other. The first insertion hole 33 has an female screw portion 31 at the inner periphery near an open end thereof, which is provided for attaching the thread guide 3 thereto.

[0028] Although each of the components are composed of, for example, a metallic material, other materials that are resistant to abrasion, such as a ceramic material, may also be used. Moreover, the components may be fabricated by known methods such as cutting, electric discharge machining, and molding. In this example, the nozzle body 2 is composed of an aluminum material, and the thread guide 3, the orifice member 12, and the pipe 13 are composed of a stainless steel material.

[0029] The thread guide 3 has therein a weft guiding path 5 for the weft yarn 9, which extends in the axial direction of the thread guide 3. The weft guiding path 5 tapers from the entrance to a midsection of the thread guide 3 in the axial direction, and has a fixed inside diameter from the midsection onward. The outer periphery of the thread guide 3 includes a large-diameter section 6 extending in the axial direction from the entrance and having a male screw portion 32 engageable to the female screw portion 31 of the insertion hole 4, a small-diameter section 7 located downstream of the large-diameter section 6 in the weft-insertion direction, and a needle section 8 located downstream of the small-diameter section 7. The needle section 8 has a part where an outside diameter thereof tapers downstream and then extends to the downstream end of the thread guide 3. The small-diameter section 7 and the needle section 8 have disposed therebetween a plurality of rectifier fins 29 extending outward radially from the thread guide 3. Each adjacent pair of rectifier fins 29 has a rectifying flow channel 28 therebetween.

[0030] The thread guide 3 is inserted in the first insertion hole 33 of the nozzle body 2, and the male screw portion 32 of the thread guide 3 is engaged to the female screw portion 31 so that the thread guide 3 is attached to the nozzle body 2 in a hermetically sealed state. In this state, a space surrounded by the small-diameter section 7, the needle section 8, and the insertion hole 4 (first insertion hole 33) of the nozzle body 2 define an annular flow channel 27. The nozzle body 2 has a connector 26 attached thereto, which is connected to a duct 25, and is provided with a flow channel (not shown) extending from a compressed fluid source (not shown) to the duct 25 and the annular flow channel 27. The duct 25 is connected to an output port of an electromagnetic control valve (not shown) that controls the fluid supplied from the compressed fluid source (not shown). Specifically, at a predetermined weft-insertion timing, the electromagnetic control valve allows compressed air to flow from the duct 25 and into the annular flow channel 27 through the connector 26. Subsequently, the compressed air is rectified by the rectifier fins 29 in the rectifying flow channel 28 and is then accelerated by an orifice flow channel 40, so as to be emitted from an outlet 30. Specifically, the orifice flow channel 40 is defined by an outward-facing guide surface 8a of the needle section 8, the first insertion hole 33, and an inward-facing guide surface 12a of the orifice member 12.

[0031] On the other hand, the weft yarn 9 inserted into the weft guiding path 5 from a yarn guide 14 is pulled out from the thread guide 3 in response to negative pressure created as a result of the air emitted from the outlet 30. The weft yarn 9 then joins the air flowing through the hollow section of the pipe 13, so as to be discharged from the opening of the pipe 13 together with the air. The discharged weft yarn 9 is inserted into a shed 21 formed by warp yarns 20, is beaten by a reed 22, and is separated from a woven cloth 24 with a cutter 23. The yarn guide 14 provided at the entrance of the weft guiding path 5 of the thread guide 3 has a guide surface with a diameter smaller than the inside diameter of the entrance of the weft guiding path 5. The yarn guide 14 is formed of an abrasion-resistant material such as mail glass.

[0032] A downstream end portion 10 of the thread guide 3 is fitted with a tubular component 51a which is a characteristic component of the present invention. One end of the tubular component 51a is provided with a plurality of projections 11 arranged in the circumferential direction of the tubular component 51a. Fig. 2 shows an example where the tubular component 51a is fitted within the end portion 10 of the thread guide 3 such that the end portion 10 of the thread guide 3 has a two-tiered structure in the radial direction. Alternatively, as shown in Fig. 9C, a tubular component 51e may be fitted around the end portion 10 of the thread guide 3 to give the end portion 10 of the thread guide 3 a two-tiered structure in the radial direction. In either case, the projections 11 are arranged in the circumferential direction of the downstream end, as viewed in the weft-insertion direction, of the internally-disposed component of the tubular component 51a or 51e and the end portion 10 of the thread guide 3, namely, the downstream end of the component whose inner periphery surface substantially serves as the weft guiding path 5.

[0033] Figs. 3A and 3B show an example where the tubular component 51a is fitted within the end portion 10 of the thread guide 3, and the projections 11 are provided at one end of the tubular component 51a. The tubular component 51a has a through hole 50a having a fixed inside diameter over its entire length in the axial direction, and a cylindrical section 55a having a fixed outside diameter. The downstream end of the tubular component 51a in the weft-insertion direction has the projections 11 arranged in the circumferential direction. Each projection 11 is tapered from a base end 15 towards a tip thereof. The projections 11 are arranged at a fixed pitch in the circumferential direction based on conditions to be described hereinafter. The adjacent projections 11 have notches 41 therebetween. When the weft yarn 9 is pulled upstream at the time of a cutting process performed after a beating process, the weft yarn 9 can be caught in and held by at least one of these notches 41. The projections 11 are integrated with the tubular component 51a and can be formed by cutting out the downstream end of the tubular component 51a in the weft-insertion direction using a known method such as electric discharge machining.

[0034] On the other hand, the end portion 10 of the thread guide 3 has an inner step section 56a therein that defines a thin-walled section, such that the end portion 10 has a stepped structure with a base surface 54a facing downstream. The tubular component 51a is given an outside diameter that allows the tubular component 51a to be engageable to the inner periphery of the thin-walled section of the thread guide 3. The tubular component 51a has an upstream end surface in the weft-insertion direction that abuts on the base surface 54a, so as to be fitted within the inner step section 56a of the thread guide 3. The inside diameter of the through hole 50a in the tubular component 51a is preferably equal to the inside diameter of the weft guiding path 5 in the end portion 10 of the thread guide 3. This allows the inner periphery surfaces of the through hole 50a of the tubular component 51a and the end portion 10 of the thread guide 3 to be flush with each other, thereby preventing the inner periphery surfaces from being a hindrance when the weft yarn 9 is being pulled out. However, such a hindrance will not have a significant effect on the weft-insertion process as long as the step between the inner periphery surfaces is small. The inner periphery surface of the through hole 50a of the tubular component 51a communicates with the weft guiding path 5 of the thread guide 3 and substantially serves as the weft guiding path 5 at the end portion 10 of the thread guide 3.

[0035] The tubular component 51a is fitted within the thread guide 3 such that the base end 15 of each projection 11 is positioned upstream relative to a downstream end surface 52 of the end portion 10 of the thread guide 3. This can reduce the degree of exposure of the notches 41 with respect to the orifice flow channel 40. Consequently, of the air flow accelerated by the orifice flow channel 40, the amount of air escaping into the weft guiding path 5 through the notches 41 provided between the projections 11 can be minimized, whereby a stable air flow can be created in the weft-insertion direction. As a result, this allows for a stable weft-insertion process and prevents the weft conveying force of the weft insertion nozzle 1 from deteriorating.

[0036] The projections 11 will now be described in detail. The projections 11 are formed by cutting the downstream end of the tubular component 51a in the axial direction by a known method such as electric discharge machining, so that each projection 11 is given a length H from the tip thereof. In this case, if the base surfaces of the projections 11 provided in the circumferential direction are defined as the base ends 15, each projection 11 is formed so as to be tapered from the base end 15 to the tip and to have a length a in the circumferential direction at an apex 17 defining the tip of the projection 11. More specifically, each projection 11 has two sides 16 connected to the base end 15 serving as the base surface, the flat apex 17 connected to the two sides 16, an inner periphery surface 43 connected to the sides 16 and the apex 17 and continuing from the inner periphery surface of the through hole 50a extending from upstream in the weft-insertion direction, and an outer periphery surface 42 connected to the sides 16 and the apex 17 and continuing from the outer periphery surface of the cylindrical section 55a. The spaces defined by pairs of opposing sides 16 and the base ends 15 serve as the notches 41 that communicate with the weft guiding path 5. The number of projections 11 provided is 4 or more, and preferably, between 6 to 30 inclusive to give the projections 11 a structure most suitable for hooking a weft yarn 9. The projections 11 are arranged while being separated from each other by a certain distance in the circumferential direction. This distance between the tips of the adjacent projections 11 is set such that a weft yarn 9 can be inserted into each of the notches 41 provided between the adjacent projections 11.

[0037] In actuality, the downstream end of the tubular component 51a has an inside radius r1 of 1 to 2 mm, and preferably has an inside radius equal to that of the weft guiding path 5 of the thread guide 3. Moreover, the downstream end of the tubular component 51a has a wall thickness t1 that is smaller than or equal to that of the thread guide 3. In detail, the wall thickness t1 is between 0.2 mm to 0.5 mm. The number of projections 11, the pitch P of the projections 11, the length a of each projection 11 at the apex 17 in the circumferential direction, and the height H (distance between the apex 17 and the base end 15) of each projection 11 are set to values most suitable for hooking a weft yarn 9 on the basis of the inside radius r1 and the wall thickness t1 of the tubular component 51a, and the thickness of the weft yarn used. In order to satisfactorily achieve the effect of the present invention, the above values are set so as to satisfy the following conditions obtained from experience.

(1) The length a of each projection 11 in the circumferential direction is set smaller than or equal to the wall thickness t1 at the end of the tubular component 51a. Accordingly, when the weft yarn 9 is pulled upstream at the time of a cutting process after a beating process, the weft yarn 9 can properly be caught in at least one of the notches 41. This ensures that the weft yarn 9 is prevented from falling out of the nozzle. In addition, by further reducing the length a in the circumferential direction, the returning weft yarn 9 can be prevented from bouncing off the apexes 17.

(2) The height H of each projection 11 is set smaller than the inside radius r1 at the end of the tubular component 51a. In addition, the height H is preferably greater than the wall thickness t1 to ensure that the returning weft yarn 9 can properly be caught in at least one of the notches 41.

(3) From experience, it is preferable that the pitch P of the projections 11 be substantially the same as or greater than the wall thickness t1 at the end of the tubular component 51a to achieve the effect of the present invention.

[0038] As a result of determining the length a, the height H, and the pitch P by considering all of these conditions comprehensively, it was found that an appropriate number of projections 11 to be provided in the present invention is between 6 to 30 inclusive. If five or less projections 11 are provided, the gaps (i.e. the notches 41) between the projections 11 become too wide. In this case, the effect of the present invention cannot be satisfactorily achieved since the weft yarn 9 will easily slip out of the gaps. On the other hand, if 31 or more projections 11 are provided, the gaps between the projections 11 become too narrow. In that case, the effect of the present invention cannot be satisfactorily achieved because, with weft yarns used for weft insertion in current fluid jet looms, the narrow gaps will make it difficult for a weft yarn 9 to be hooked thereon. However, it is to be noted that the number of projections 11 can be changed to a certain extent depending on, for example, the type of weft used or the size of the thread guide 3.

[0039] Although the outer periphery surface 42 and the inner periphery surface 43 connected to the sides 16 of each projection 11 provide a fixed wall thickness therebetween from the base end 15 to the apex 17 in this example, the wall thickness may decrease towards the tip of the projection 11 to prevent air flow disturbance. Furthermore, although an angle α formed between the opposing sides 16 of each adjacent pair of projections 11 is determined on the basis of the type of weft yarn 9 used, the dimensions (r1, t1) of the end portion 10, and the above conditions (1) to (3), the angle α is generally set lower than or equal to 90°, and is preferably an acute angle of 45° or lower.

[0040] Fig. 4 is a development view showing the structure of the projections 11 as viewed along line A-A' in Fig. 3. Figs. 5 to 8 illustrate modified examples of the structure of the projections 11. Fig. 5 shows an example where each projection 11 has a triangular shape with a pointed end (a = 0), and the base end 15 (base surface) is made flat. Unlike the case where each of the apexes 17 is flat as in Fig. 4, this structure in Fig. 5 can prevent a returning weft yarn 9 from hitting against a flat portion of the apex 17, whereby the weft yarn 9 can be easily guided towards the base end 15. Fig. 6 shows an example that simply differs from that in Fig. 5 in that the base end 15 of each projection 11 is defined by a V-shaped notch (i.e. the base surface is linear). With this structure, a returning weft yarn 9 can be nipped and held in at least one of the V-shaped notches, thereby further preventing the weft yarn 9 from falling out of the nozzle. Fig. 7 shows an example where the projections 11 have a saw-tooth-like structure and have both the advantages of the structures shown in Figs. 5 and 6. Fig. 8 is an example where the projections 11 are sharp and are separated from each other by U-shaped notches arranged at a certain pitch.

[0041] Figs. 9A to 9C illustrate other examples of the present invention for fitting a tubular component to the end portion 10 of the thread guide 3. Fig. 9A shows an example where the end portion 10 of the thread guide 3 is given a straight tubular structure in which the tubular component 51a is fitted, instead of being given an inner stepped structure. In order to prevent a flying weft yarn 9 from being damaged, the end surface of the tubular component 51a facing upstream in the weft-insertion direction is preferably beveled.

[0042] Fig. 9B shows an example where the apexes 17 of the projections 11 provided at one end of the tubular component 51a are located upstream in the weft-insertion direction relative to the downstream end surface 52 of the thread guide 3. In this example, the externally-disposed component of the two-tiered structure (the thread guide 3 in this example) completely covers the projections 11 from the outside, such that the projections 11 (notches 41) are not exposed to the orifice flow channel 40. This can completely prevent air from escaping into the weft guiding path 5 through the notches 41, whereby a stable air flow can be created in the weft-insertion direction. As a result, this allows for a stable weft-insertion process and prevents the weft conveying force of the weft insertion nozzle 1 from deteriorating, thereby achieving a stable operation with less occurrence of weft stoppages. An offset amount t3 of the apexes 17 with respect to the downstream end surface 52 is several millimeters, and is preferably between 0.1 and 5.0 mm inclusive. It is expected that a similar advantage can be achieved by positioning the apexes 17 and the downstream end surface 52 on the same plane without displacing them from each other by an offset amount.

[0043] Fig. 9C shows an example where a tubular component 51e is fitted around the end portion 10 of the thread guide 3, such that the end portion 10 of the thread guide 3 is given a two-tiered structure in the radial direction thereof. In this example, the projections 11 are provided at the downstream end of the thread guide 3 serving as the internally-disposed component of the two-tiered structure. The end portion 10 of the thread guide 3 has an outer step section 56e that defines a thin-walled section. The tubular component 51e is given an inside diameter that allows the tubular component 51e to be engageable to the outer step section 56e. Furthermore, in view of achieving a stable weft-insertion process, the tubular component 51e preferably has an outside diameter that is substantially equal to the outside diameter of the thread guide 3 immediately upstream of the outer step section 56e, so that the tubular component 51e can substantially serve as the end portion 10 of the thread guide 3. Thus, even when the air flow accelerated by the orifice flow channel 40 located further upstream reaches the area where the tubular component 51e is provided, the air flow can be prevented from being disturbed. The tubular component 51e is disposed around the thread guide 3 such that the base end 15 of each projection 11 is positioned upstream relative the downstream end surface 52 of the tubular component 51e. Furthermore, in this example, it is expected that a similar advantage to that of the example shown in Fig. 9B can be achieved by positioning the apexes 17 of the projections 11 provided at one end of the thread guide 3 upstream relative to the downstream end surface 52 of the tubular component 51e in the weft-insertion direction or by positioning the apexes 17 of the projections 11 and the downstream end surface 52 of the tubular component 51e on the same plane.

[0044] The tubular component 51a or the tubular component 51e can be joined to the end portion 10 of the thread guide 3 by means of, for example, press-fitting, adhering, or screwing. For example, the tubular component 51a may be given a male screw portion and the end portion 10 of the thread guide 3 may be given a female screw portion so that the relative position between the tubular component 51a and the end portion 10 of the thread guide 3 can be made adjustable in the axial direction. In this manner, the axial position of the projections 11 can be adjusted in accordance with the yarn type or yarn shape.

[0045] The examples of how a tubular component can be attached to the end portion 10 of the thread guide 3 have been described above. Next, an example where a tubular component is attached to the interior of the thread guide 3 will be described.

[0046] Referring to Fig. 10, three types of tubular components 51b, 51c, and 51d are fitted within the thread guide 3. Downstream ends of the tubular components 51b, 51c, and 51d in the weft-insertion direction (namely, cylindrical sections 55b, 55c, and 55d) are each provided with a plurality of projections 11 arranged in the circumferential direction. Although Fig. 10 shows an example where the three types of tubular components are all attached to the thread guide 3, an alternative example is permissible where any one of the tubular components or a combination of two or more tubular components is attached to the thread guide 3. The tubular components are attached to arbitrary positions within an area where the weft guiding path 5 is provided. Similar to the above example where a tubular component is attached to the end portion 10 of the thread guide 3, the number of projections 11, the pitch P of the projections 11, the length a of each projection 11 at the apex 17 in the circumferential direction, and the height H (distance between the apex 17 and the base end 15) of each projection 11 are set to values most suitable for hooking a weft yarn 9 on the basis of the inside radius r1 and the wall thickness t1 of each tubular component 51b, 51c, 51d, and the thickness of the weft yarn used.

[0047] A tubular component 51b according to a first embodiment is fitted within the weft guiding path 5 of the thread guide 3 in an area where the small-diameter section 7 of the thread guide 3 is provided. The tubular component 51b has a cylindrical shape having a conical hole whose upstream side in the weft-insertion direction has a larger diameter, a through hole 50b located downstream of the conical hole and having a fixed inside diameter in the axial direction, and a cylindrical section 55b having a fixed outside diameter over the entire length in the axial direction.

[0048] On the other hand, the weft guiding path 5 in the area of the thread guide 3 where the small-diameter section 7 is provided has an inner periphery surface having a fixed inside diameter D2 in the axial direction, and a stepped section 56b continuing from the inner periphery surface and having a base surface 54b that faces the entrance side. The weft guiding path 5 downstream of the stepped section 56b has a substantially fixed inside diameter D1 which is smaller than the inside diameter D2. The tubular component 51b is positioned in the axial direction by having its downstream end surface (i.e. the apexes 17 of the projections 11) disposed in abutment with the base surface 54b. The tubular component 51b has a substantially cylindrical shape with an outside diameter that allows the tubular component 51b to be fitted in the inner periphery surface of the stepped section 56b having the inside diameter D2. On the other hand, the tubular component 51b also has the through hole 50b having an inside diameter d1 which is smaller than the inside diameter D1 of the weft guiding path 5. Moreover, the tubular component 51b has a tapered surface provided for guiding a weft yarn 9. The diameter of this tapered surface decreases gradually in the downstream direction from the entrance of the tubular component 51b until reaching the inside diameter d1. An end of the tapered surface continuously connects to the inner periphery surface (weft guiding path 5) having the inside diameter d1.

[0049] The tubular component 51b is provided with a plurality of projections 11 arranged in the circumferential direction and tapered from the base ends 15 toward the tips thereof. The inner periphery surface of the through hole 50b and the tapered surface in the tubular component 51b communicate with the weft guiding path 5 of the thread guide 3 and substantially serve as the weft guiding path 5 in a part of the small-diameter section 7 of the thread guide 3. The apexes of the projections 11 at the end of the tubular component 51b are exposed to the weft guiding path 5 in an area of the weft guiding path 5 having a smaller diameter than the inside diameter D1. Thus, a weft yarn 9 can be caught in at least one of the notches between the adjacent projections 11.

[0050] A tubular component 51c according to a second embodiment is fitted within the weft guiding path 5 of the thread guide 3 in an area where the large-diameter section 6 is provided. The tubular component 51c has a cylindrical shape having a conical hole whose upstream side in the weft-insertion direction has a larger diameter and which tapers downstream to an inside diameter d2, a through hole 50c located downstream of the conical hole and having a fixed inside diameter d2 in the axial direction, a cylindrical section 55c having a fixed outside diameter and having a plurality of projections 11 arranged in the circumferential direction and tapered from the base ends 15 toward the tips thereof, and a flange 57c located upstream of the cylindrical section 55c and having a diameter larger than that of the cylindrical section 55c. The flange 57c is connected to the cylindrical section 55c.

[0051] On the other hand, the weft guiding path 5 in the area of the thread guide 3 where the large-diameter section 6 is provided has a base surface 54c extending outward in the radial direction, and a stepped section 56c located upstream of the base surface 54c and having a fixed inside diameter from the entrance of the weft guiding path 5. The weft guiding path 5 tapers gradually downstream from the area with the base surface 54c and extends through an area with an inside diameter D2'. The flange 57c of the tubular component 51c is positioned in the axial direction by having its downstream end surface disposed in abutment with the base surface 54c. The through hole 50c of the tubular component 51c has an inner periphery surface that communicates with the weft guiding path 5 of the thread guide 3 and substantially serves as the weft guiding path 5 in a part of the large-diameter section 6 of the thread guide 3.

[0052] The cylindrical section 55c extending downstream from the flange 57c has a fixed outside diameter and a fixed inside diameter d2 in the downstream direction that are smaller than the inside diameter D2' of the weft guiding path 5. One end of the cylindrical section 55c is provided with a plurality of projections 11 arranged in the circumferential direction and tapered from the base ends 15 toward the tips thereof. Therefore, in view of the inside-diameter relationship, the plurality of projections 11, namely, the notches 41 formed between the adjacent projections 11, are disposed so as to be entirely exposed to the weft guiding path 5 in the circumferential direction, whereby a weft yarn 9 can be caught in at least one of the notches 41 between the projections 11 at the time of a weft cutting process.

[0053] A tubular component 51d according to a third embodiment is fitted in an upstream opening of the weft guiding path 5 of the thread guide 3. In this example, the tubular component 51d not only has a function for preventing a weft yarn from falling out of the nozzle, but also functions as a yarn guide 14 for guiding a weft yarn towards the center of the weft guiding path 5. The tubular component 51d has a fixed inside diameter in the axial direction. The tubular component 51d has a through hole 50d whose upstream opening has a rounded rim, a cylindrical section 55d having an outside diameter that allows the cylindrical section 55d to be fitted within an inner periphery surface of the thread guide 3 having an inside diameter D3, and a flange 57d located upstream of the cylindrical section 55d and connected to the cylindrical section 55d. Specifically, the cylindrical section 55d has a plurality of projections 11 arranged in the circumferential direction and tapered from the base ends 15 toward the tips thereof in the downstream direction.

[0054] On the other hand, an upstream end of the weft guiding path 5 of the thread guide 3 is provided with a stepped section having a base surface 54d that extends outward in the radial direction. The tubular component 51d is positioned in the axial direction by having the downstream-facing surface of the flange 57d in abutment with the base surface 54d. The through hole 50d of the tubular component 51d has an inner periphery surface with a fixed inside diameter d3 and communicates with the weft guiding path 5 of the thread guide 3. Thus, the through hole 50d substantially serves as the weft guiding path 5 at the opening of the large-diameter section 6 of the thread guide 3. The cylindrical section 55d of the tubular component 51d has an outside diameter that is smaller than the inside diameter D3 of the weft guiding path 5. Since the plurality of projections 11, namely, the notches 41 formed between the adjacent projections 11, are entirely exposed to the weft guiding path 5 in the circumferential direction, a weft yarn 9 can be caught in at least one of the notches 41 between the projections 11 at the time of a weft cutting process.

[0055] The inside diameters D1, D2', and D3 of the weft guiding path 5 immediately downstream of the areas where the tubular components 51b, 51c, and 51d are disposed are set larger than the inside diameters d1, d2, and d3 of the through holes 50b, 50c, and 50d in the tubular components 51b, 51c, and 51d, respectively. Based on these inside-diameter relationships (D1>d1, D2'>d2, D3>d3), since the projections 11 (the apexes 17 and the notches 41) of the tubular components 51b, 51c, and 51d are exposed to the weft guiding path 5, a weft yarn 9 moving upstream can properly be caught in at least one of the notches 41 between the adjacent projections 11, thereby ensuring that the weft yarn 9 is prevented from falling out of the nozzle.

[0056] Furthermore, setting the inside diameters d1 and d2 of the through holes 50b and 50c of the tubular components 51b and 51c as minimum inside diameters of the weft guiding path 5 of the thread guide 3 is advantageous in that the probability of a weft yarn 9 being caught by the projections 11 (notches 41) can be increased.

[0057] The present invention is not limited to a main nozzle that is integrally attached to a sley and that discharges a weft yarn into a warp shed, such as a weft insertion nozzle in an air jet loom. For example, the present invention is applicable to a subsidiary main nozzle that is located further upstream and that adds momentum to a weft yarn in the downstream direction. Furthermore, the present invention is also applicable to a weft insertion nozzle in a water jet loom.

Claims

1. A weft insertion nozzle (1) in a fluid jet loom, the weft insertion nozzle (1) including a nozzle body (2) having an insertion hole (4) and also including a thread guide (3) inserted in the insertion hole (4), the thread guide (3) having a weft guiding path (5) extending therethrough, the thread guide (3) having one end fitted to the insertion hole (4) and having a needle section (8) located downstream of the one end in a weft-insertion direction, the needle section (8) having an outside diameter that decreases downstream, the weft insertion nozzle (1) supplying compressed fluid into a space between the needle section (8) of the thread guide (3) and the insertion hole (4) of the nozzle body (2) so as to discharge a weft yarn (9) extending through the weft guiding path (5),
   wherein a tubular component (51a, 51b, 51c, 51d, 51e) having a through hole (50a, 50b, 50c, 50d, 50e) and a cylindrical section (55a, 55b, 55c, 55d, 55e) is fitted within or around the thread guide (3), the cylindrical section (55a, 55b, 55c, 55d, 55e) at least having a tubular shape at one end in an axial direction thereof, and
   wherein an inner periphery surface of one of the tubular component (51a, 51b, 51c, 51d, 51e) and the thread guide (3) substantially serves as the weft guiding path (5) in an area where the tubular component (51a, 51b, 51c, 51d, 51e) is disposed, said one having a downstream end in the weft-insertion direction that is provided with a plurality of projections (11) arranged in a circumferential direction, each projection (11) being tapered from a base end (15) towards a tip thereof.

2. The weft insertion nozzle (1) according to Claim 1, wherein the tubular component (51a, 51e) is fitted within or around an end portion (10) of the thread guide (3) so that the end portion (10) of the thread guide (3) has a two-tiered structure in a radial direction thereof, and wherein said one having the downstream end provided with the plurality of projections (11) arranged in the circumferential direction comprises one of the end portion (10) of the thread guide (3) and the tubular component (51a, 51e) that is disposed at an internal side of the two-tiered structure.

3. The weft insertion nozzle (1) according to Claim 2, wherein the other one of the end portion (10) of the thread guide (3) and the tubular component (51a, 51e) that is disposed at an external side of the two-tiered structure has a downstream end surface (52) in the weft-insertion direction, and wherein the base end (15) of each projection (11) is positioned upstream relative to the downstream end surface (52).

4. The weft insertion nozzle (1) according to one of Claims 2 and 3, wherein the end portion (10) of the

thread guide (3) has a step section (56a, 56e) serving as a thin-walled section, and wherein the tubular component (51a, 51e) is fitted to the step section (56a, 56e).

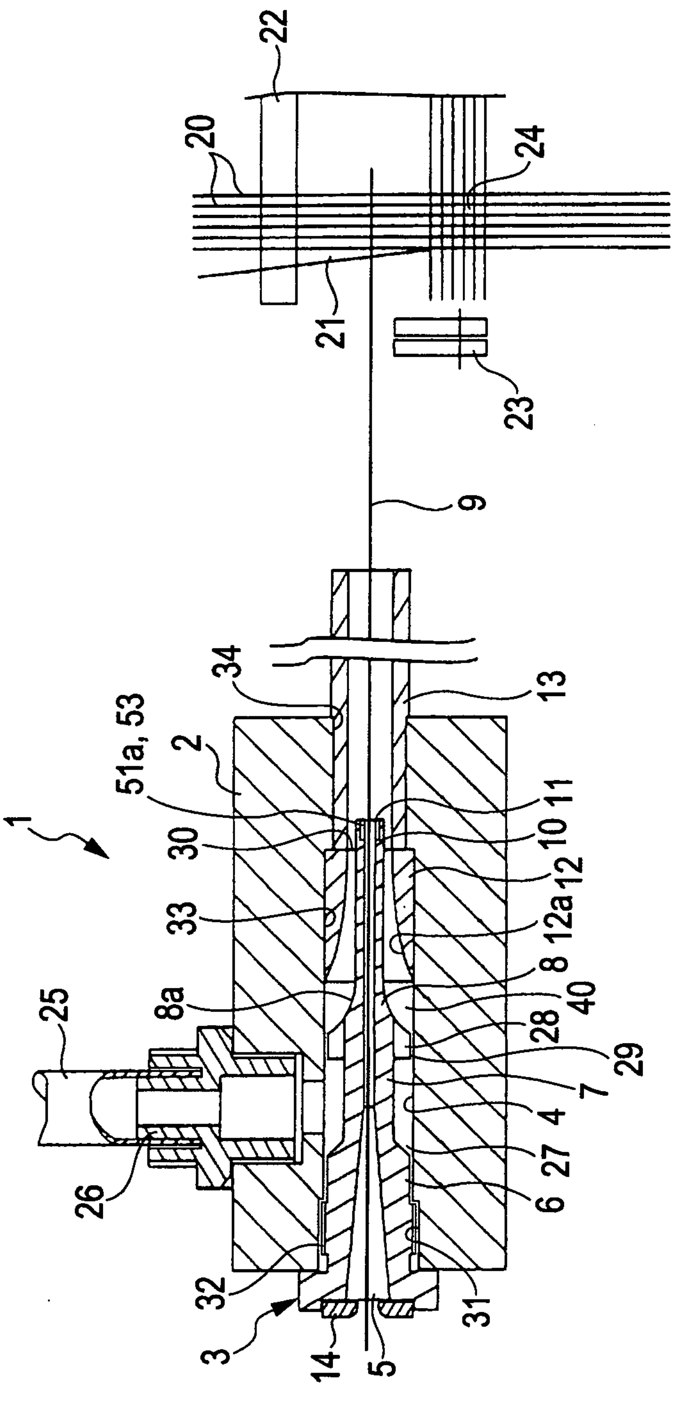
5. The weft insertion nozzle (1) according to Claim 1, wherein the tubular component (51b, 51c, 51d) is fitted within the thread guide (3), and wherein said one having the downstream end provided with the plurality of projections (11) arranged in the circumferential direction comprises the tubular component (51b, 51c, 51d).

6. The weft insertion nozzle (1) according to one of Claims 2 and 5, wherein the tubular component (51a, 51b, 51c, 51d) has a cylindrical shape such that the through hole (50a, 50b, 50c, 50d) thereof has a fixed inside diameter and that the tubular component (51a, 51b, 51c, 51d) has a fixed outside diameter over an entire length thereof in the axial direction, and wherein the tubular component (51a, 51b, 51c, 51d) is disposed within the thread guide (3).

7. The weft insertion nozzle (1) according to Claim 5, wherein the tubular component (51c, 51d) is provided with a flange (57c, 57d) located upstream of the cylindrical section (55c, 55d) in the weft-insertion direction and connected to the cylindrical section (55c, 55d), wherein the weft guiding path (5) of the thread guide (3) is provided with a base surface (54c, 54d) extending outward in a radial direction, and wherein the tubular component (51c, 51d) is disposed such that a downstream-facing surface of the flange (57c, 57d) in the weft-insertion direction abuts on the base surface (54c, 54d).

8. A weft-fall-out preventing component (53) equipped in a weft insertion nozzle (1) to prevent weft from falling out of the weft insertion nozzle (1), the weft-fall-out preventing component (53) comprising a tubular component (51a, 51b, 51c, 51d) fitted within a thread guide (3) of the weft insertion nozzle (1),
wherein the tubular component (51a, 51b, 51c, 51d) has a through hole (50a, 50b, 50c, 50d) extending in an axial direction and a cylindrical section (55a, 55b, 55c, 55d) whose at least one axial end has a fixed outside diameter in the axial direction, the cylindrical section (55a, 55b, 55c, 55d) having an end provided with a plurality of projections (11) arranged in a circumferential direction, each projection (11) being tapered from a base end (15) towards a tip thereof.

FIG. 1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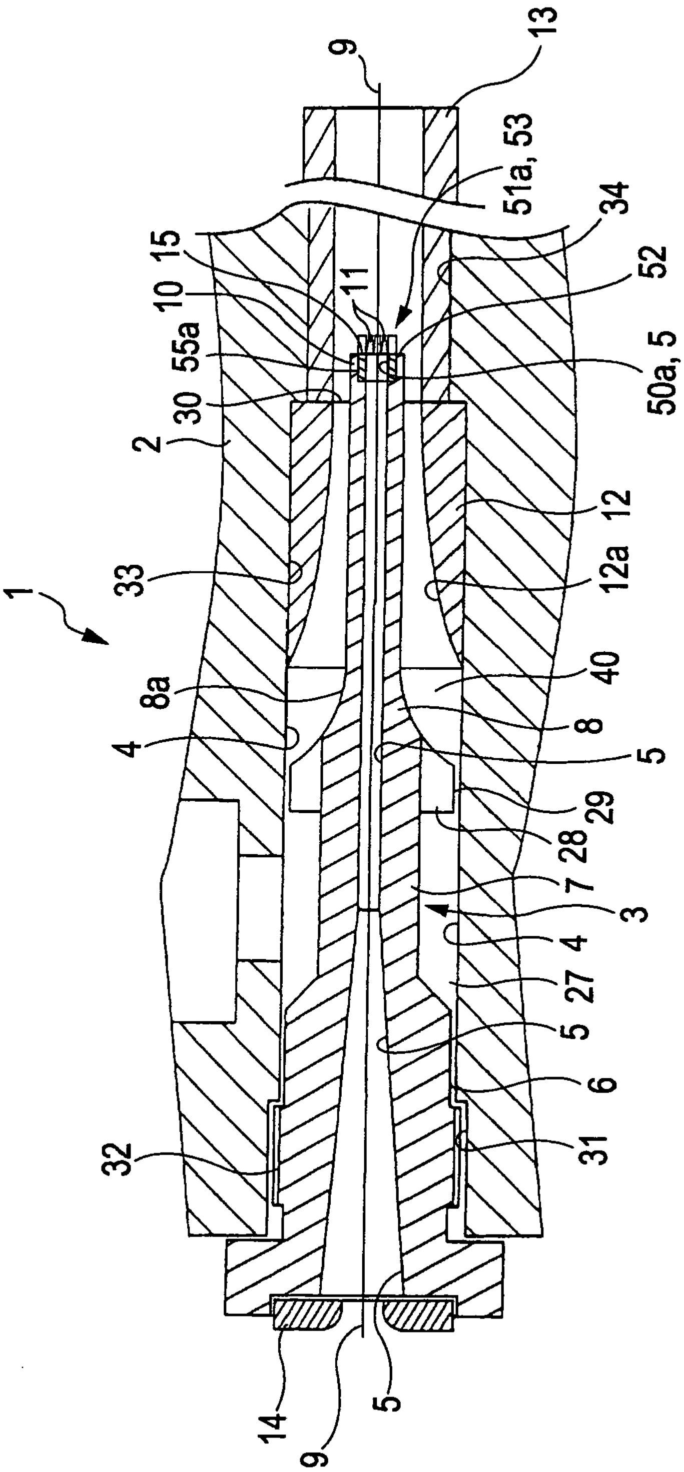
51a, 53

FIG. 2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50a, 5
51a, 53
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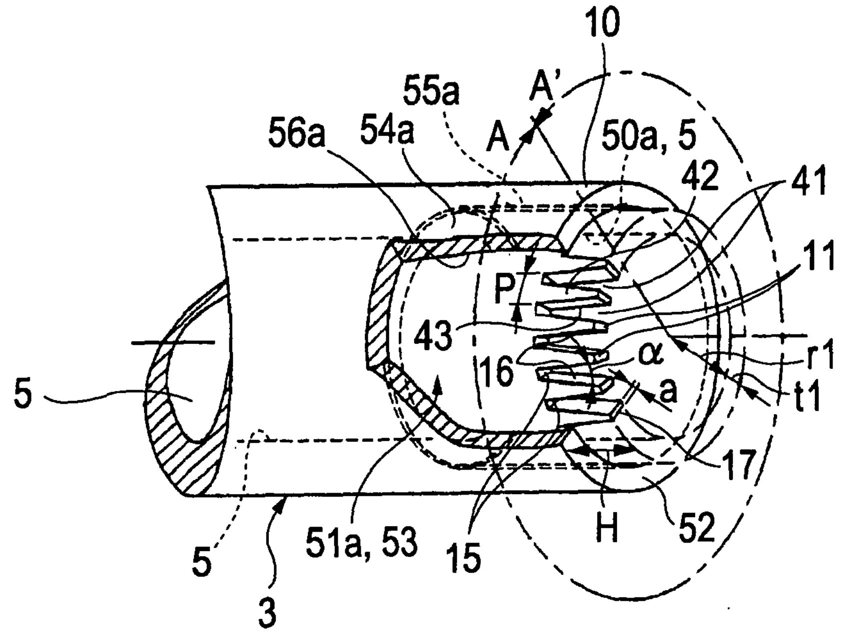
55a

FIG. 3A


10
A'
55a
A
56a
54a
50a, 5
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41
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P
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α
r1
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t1
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51a, 53
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5'
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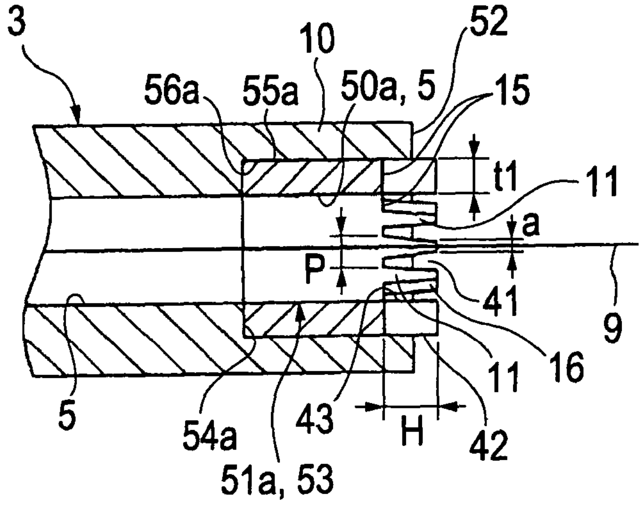
FIG. 3B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51a, 53

FIG. 4

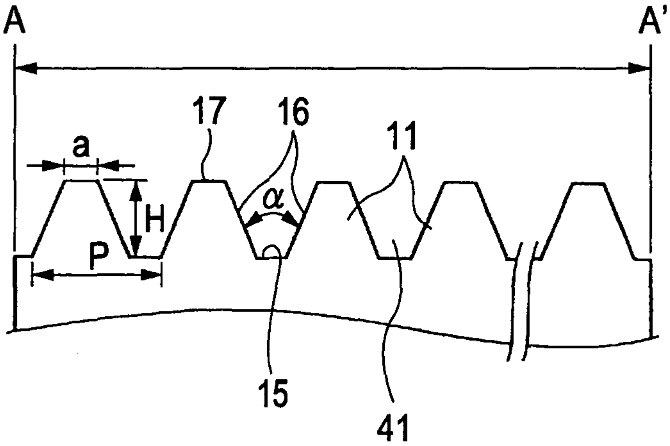


FIG. 5

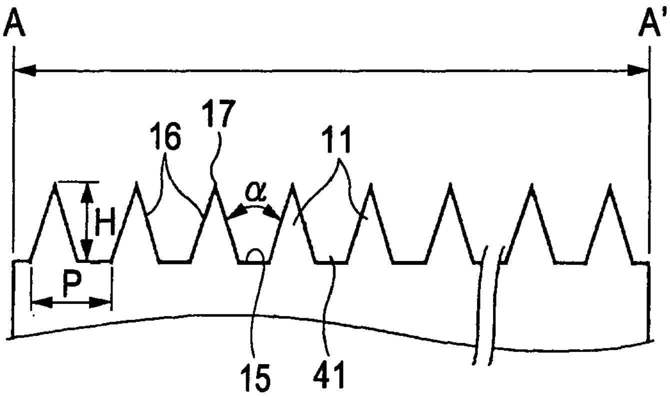


FIG. 6

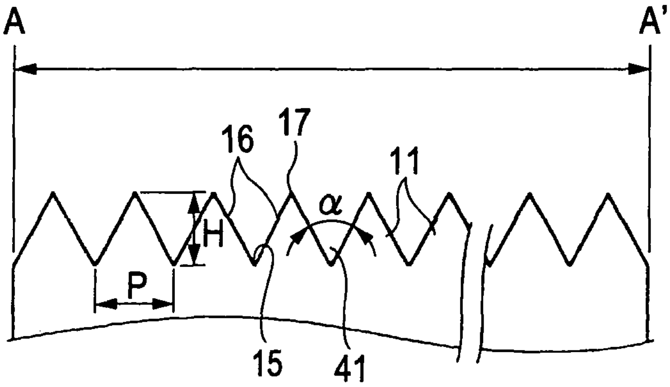


FIG. 7

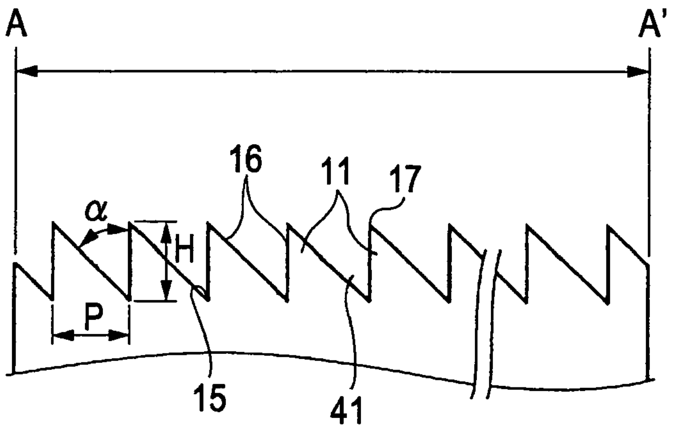


FIG. 8

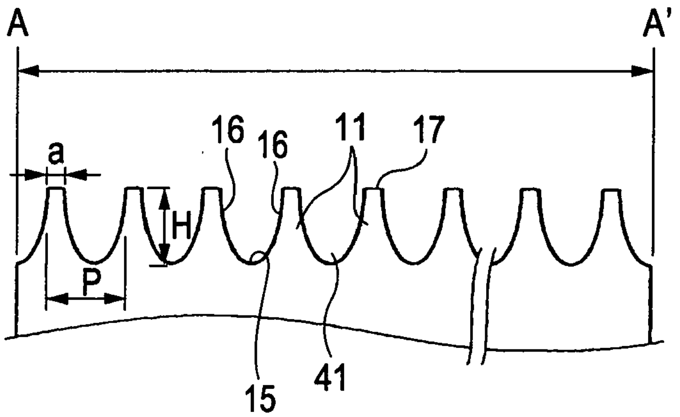


FIG. 9C

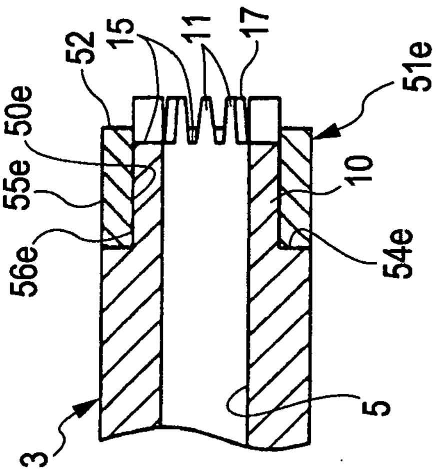


FIG. 9B

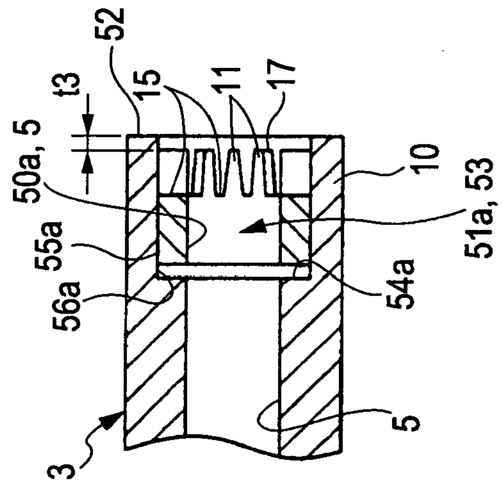


FIG. 9A

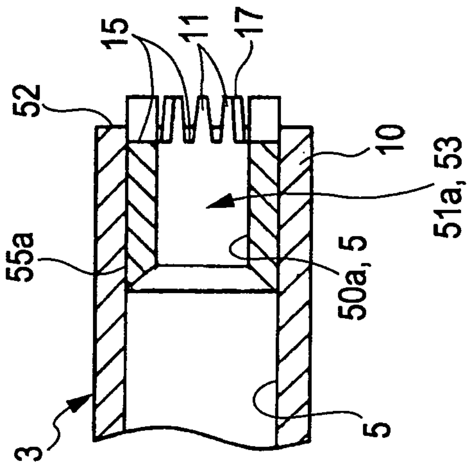
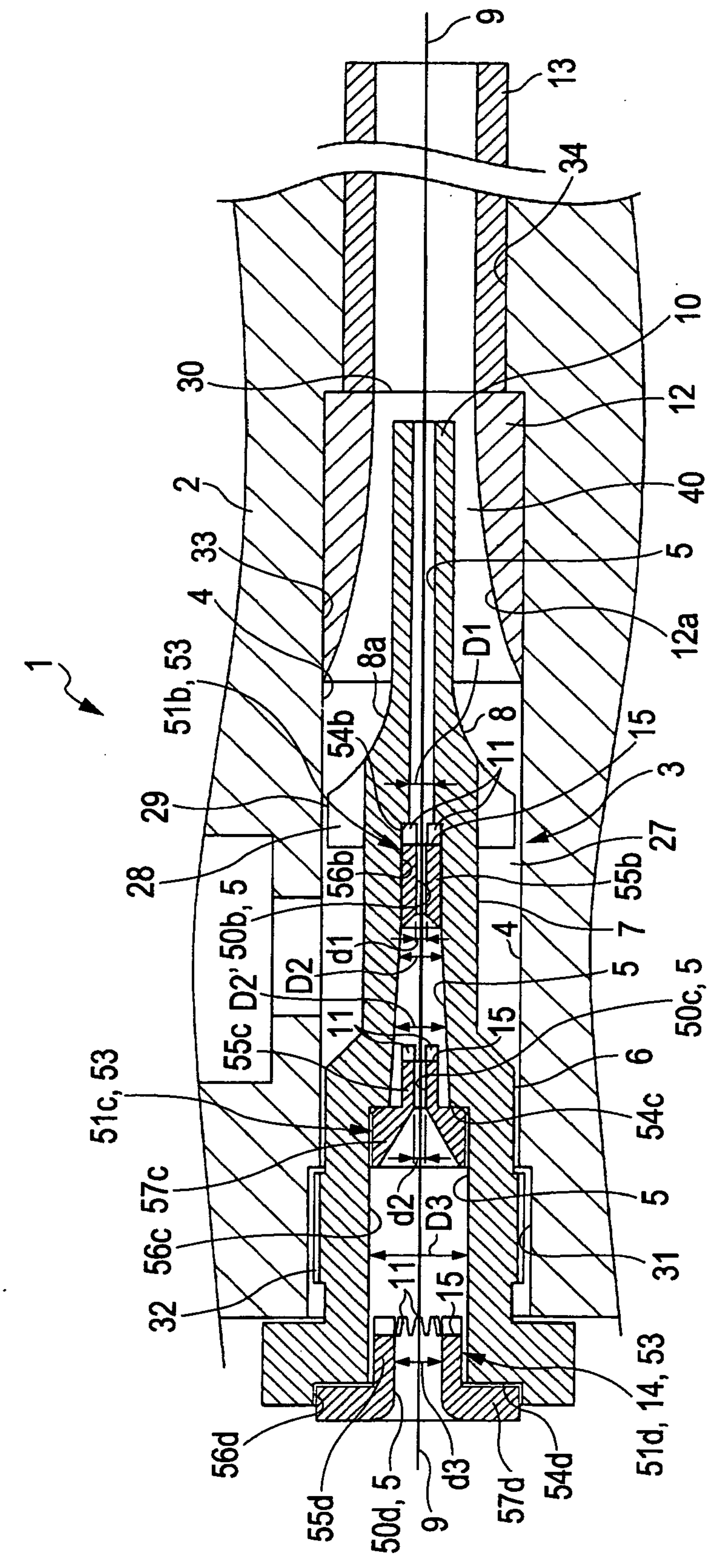


FIG. 10



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51c, 53
51d, 14, 53
54b
54c
54d
55b
55c
55d
56b
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56d
57c
57d
D1
D2
D2'
D3
d1
d2
d3

REFERENCES CITED IN THE DESCRIPTION

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- JP 11200193 A **[0002]**