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(54) **Auxiliary nozzle of air jet loom**

Hilfsdüse einer Luftdüsen-Webmaschine

Buse auxiliaire de métier à tisser à jet d'air

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an auxiliary nozzle of an air jet loom.

[0002] In an air jet loom, weft insertion is accomplished by an air jet injected by a main nozzle into a weft yarn guide passage provided in a shed of warp yarns and also by air jets injected by auxiliary nozzles for assisting the weft yarn in flying through the shed. The entry of the auxiliary nozzle into a shed of warp yarns should be minimized so as to reduce interference of the nozzles with the warp yarns as much as possible. Due to the structure of a weft insertion device in an air jet loom, a predetermined distance is unavoidably required between the flying path of an inserted weft yarn and the entry position of the auxiliary nozzle in the shed of warp yarns. Therefore, a high directivity is required for the air jet that is injected from the auxiliary nozzle toward the flying path of the weft yarn.

[0003] Japanese Patent Application Publication 8-60492 discloses an auxiliary nozzle that can be disposed parallel to warp yarns so as to restrict the diffusion of air injected from the auxiliary nozzle and also to reduce the interference with the warp yarns.

[0004] The auxiliary nozzle of the above Publication is formed into a flattened hollow tube whose front wall and rear wall are disposed substantially parallel to each other when the auxiliary nozzle is mounted in place in the air jet loom. The auxiliary nozzle is formed by deep drawing process so as to taper toward the upper end thereof and close at the upper end. A nozzle hole is formed through the front wall of the auxiliary nozzle at a position adjacent to the upper end thereof. The center of the nozzle hole is offset from the center of the auxiliary nozzle in such a width direction thereof that the nozzle hole is located at a position that is adjacent to the reed of the loom when the auxiliary nozzle is fixed in place to the slay of the air jet loom. The nozzle hole is also formed so that the axis thereof is directed obliquely upward. That is, the nozzle hole is machined so that the axis thereof is directed upward and also in a direction toward the reed. Additionally, the nozzle hole is tapered at a constant rate outwardly in the air flowing direction through the hole.

[0005] Due to the above-described structure of the auxiliary nozzle, compressed air in the nozzle hole is converged by the inner peripheral wall surface thereof, so that the diffusion of the air is prevented when the air is injected from the auxiliary nozzle. Additionally, though the flattened hollow tube of the auxiliary nozzle is disposed parallel to warp yarns, the nozzle hole is located on the side of the auxiliary nozzle adjacent to the reed and the axis of the nozzle hole is directed toward the reed side, so that air jet from the nozzle acts effectively on a weft yarn flying in the weft yarn flying path.

[0006] However, in the auxiliary nozzle of the above Publication, attention is given only to the disposition of the nozzle hole adjacent to the weft yarn flying path, but the auxiliary nozzle has a problem in that the injection pressure of air injected from the nozzle hole is decreased. The auxiliary nozzle is formed into a flattened hollow tube and closed at the upper end and compressed air is supplied into the auxiliary nozzle from the lower end thereof. Generally, in the flow of compressed air in such a hollow tube, pressure loss occurs in the region adjacent to the inner wall of the tube, so that the pressure of compressed air flowing around the center of the tube becomes highest.

[0007] In the auxiliary nozzle of the above Publication, however, the center of the nozzle hole, i.e. the axis thereof, is offset from the center of the auxiliary nozzle in the width direction thereof. Therefore, most of the compressed air flowing adjacent to the center of the auxiliary nozzle in the width direction thereof and having the highest pressure is not introduced into the nozzle hole smoothly, but impinges on inner surface of the upper end of the auxiliary nozzle. The impinging air turns around, flows downward toward the nozzle hole along inner surface of the front wall and introduced into the nozzle hole. Therefore, the compressed air flowing adjacent to the center of the auxiliary nozzle in the width and the thickness directions thereof incurs pressure loss due to the impingement on the inner surface of the upper end of the auxiliary nozzle and also the friction between the compressed air and the inner surface of the front wall. Thus, the air having its pressure reduced will be injected through the nozzle hole of the auxiliary nozzle. In order to produce an air jet with the desired level of velocity to allow a weft yarn to be conveyed through a shed of warp yarns stably by the subsidiary nozzle of the above Publication, compressed air with a higher pressure needs to be supplied to the auxiliary nozzle. However, increasing the pressure of the compressed air merely increases power consumption of the air jet loom.

[0008] **Furthermore, an auxiliary nozzle according to the preamble of claim 1 is know from** CH 688 284 A5**.**

[0009] **It is the object of t**he present invention to provid**e** an auxiliary nozzle of an air jet loom that can increase the injection pressure and improve the directivity of the air jet.

[0010] **According to the present invention, the above object is solved with an auxiliary nozzle having the features of claim 1.**

SUMMARY OF THE INVENTION

[0011] **An** auxiliary nozzle **for** an air jet loom includes a nozzle hole formed through a front wall of the auxiliary nozzle and having an inner opening opening to inside of the auxiliary nozzle and an outer opening opening to outside of the auxiliary nozzle. An axis extending in longitudinal direction of the auxiliary nozzle through axial center of the auxiliary nozzle is defined as center axis. An axis intersecting with the center axis and extending in a di-

rection perpendicular to the front wall is defined as weft insertion axis. An axis extending through center of the inner opening and center of the outer opening is defined as nozzle hole axis. The nozzle hole axis is angularly spaced horizontally from the weft insertion axis. Weft insertion is accomplished by compressed air injected from the nozzle hole. The center of the inner opening is positioned on the weft insertion axis.

[0012] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. 1 is a schematic block diagram showing an air jet loom having an auxiliary nozzle according to a preferred embodiment of the present invention;
FIG. 2 is a cross-sectional view showing a fixing structure for the auxiliary nozzle of the air jet loom of FIG. 1;
FIG. 3 is an enlarged fragmentary front view of the auxiliary nozzle of FIG. 2;
FIG. 4 is a cross-sectional view taken along the line A-A in FIG. 3;
FIG. 5 is a fragmentary longitudinal cross-sectional view of the auxiliary nozzle of FIG. 2; and
FIG. 6 is an enlarged fragmentary schematic front view of the auxiliary nozzle of FIG. 2 describing the flow of compressed air in the auxiliary nozzle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] The following will describe the auxiliary nozzle of an air jet loom according to the preferred embodiment of the present invention with reference to FIGS. 1 through 6. The air jet loom and a weft insertion device used for the air jet loom are generally designated by numerals 1 and 2 in FIG. 1, respectively. The weft insertion device 2 includes a main nozzle 3, a tandem nozzle 4 provided upstream of the main nozzle 3 and a plurality of auxiliary nozzles 5 provided downstream of the main nozzle 3. The main nozzle 3 and the auxiliary nozzles 5 are fixedly mounted on a slay 6 (refer to FIG. 2) of the air jet loom 1 and swingable reciprocally back and forth of the air jet loom 1 together with the slay 6. The tandem nozzle 4 is fixed to a frame (not shown) of the air jet loom 1 or to a bracket (not shown) that is fixed to the floor (not shown). The weft insertion device 2 further includes a weft supply 7 and a weft measurement and storage device 9 that are both provided upstream of the tandem nozzle 4. Using a weft yarn stop pin (not shown), the weft measurement and storage device 9 stores and measures a predetermined length of weft yarn 8 that is drawn out from the weft supply 7 and corresponds to the weaving width.

[0015] A main valve 10 is connected to the main nozzle 3 through a tube 11 for controllably supplying compressed air to the main nozzle 3. Similarly, a tandem valve 12 is connected to the tandem nozzle 4 through a tube 13 for controllably supplying compressed air to the tandem nozzle 4. The main valve 10 and the tandem valve 12 are connected to a common air tank 16 through tubes 14, 15, respectively. The air tank 16 is connected through a main regulator 17, a pressure gauge 18 and a filter 19 to a common air supply source (not shown) that is composed of, e.g., a compressor installed in a weaving mill. The air tank 16 stores therein compressed air that is supplied from the air supply source and adjusted to a set pressure by the main regulator 17.

[0016] The auxiliary nozzles 5 are divided into a plurality of groups (only two groups being shown in FIG. 1) and the auxiliary nozzles 5 of each group are connected through a tube 21 to an auxiliary valve 20 (only two auxiliary valves 20 being shown in FIG. 1) which are fixed to the frame (not shown) of the air jet loom 1. The auxiliary valves 20 of the respective groups are connected to a common auxiliary air tank 23 through tubes 22. The auxiliary air tank 23 is connected through an auxiliary regulator 25 and tubes 24 to a tube 26 connecting the main regulator 17 and the pressure gauge 18. The auxiliary air tank 23 stores compressed air that is supplied from the air supply source (not shown) and adjusted to a set pressure by the auxiliary regulator 25. The auxiliary valves 20 are operable to open in a relay manner at controlled timings during the weft inserting operation of the loom for allowing the auxiliary nozzles 5 of the respective groups to inject air jets in a relay manner.

[0017] The main valve 10, the tandem valve 12, the auxiliary valves 20 and the pressure gauge 18 are electrically connected to a control device 27 of the air jet loom 1 through wirings 28 through 32. The control device 27 transmits control signals to activate the main valve 10, the tandem valve 12 and the auxiliary valves 20 at a predetermined crank angle of the loom for weft insertion into a shed of warp yarns.

[0018] Referring to FIG. 2, the auxiliary nozzle 5 and a reed 33 are fixed to the slay 6. The reed 33 includes an upper frame 35, a lower frame 36 and a large number of dents 34 which are connected at opposite ends thereof to the upper frame 35 and the lower frame 36, respectively. The lower frame 36 is fixed to the slay 6. Each dent 34 has an upper jaw 37, a lower jaw 38 and a U-shaped weft guide opening formed between the upper jaw 37 and the lower jaw 38. A plurality of such weft guide openings cooperate to form a weft guide passage 39. Meanwhile, each auxiliary nozzle 5 is fixed to the slay 6. Specifically, an auxiliary nozzle holder 40 supporting the

auxiliary nozzles 5 is fastened to the slay 6 by means of bolts 42 provided in a groove 41 of the slay 6 and nuts 43 (only one pair of bolt and nut being shown in the drawing). Each auxiliary nozzle 5 has formed therethrough a nozzle hole 45 at upper end 44 thereof and a tube 21 (FIG. 1) is connected to the lower end 46 of the auxiliary nozzle 5.

[0019] The following will describe the auxiliary nozzle 5 in detail with reference to FIGS. 3 through 5. The auxiliary nozzle 5 includes a flattened hollow tube having the closed upper end 44, a front wall 47 and a rear wall 48 (FIG. 4). The flattened hollow tube of the auxiliary nozzle 5 may be formed by deep drawing process. The auxiliary nozzle 5 has a width H (FIGS. 3 and 4) and has formed therein a hollow space that serves as an air passage 49. With the auxiliary nozzle 5 fixed to the slay 6 as shown in FIG. 2, the flat front wall 47 and the flat rear wall 48 are disposed parallel to warp yarns so as to reduce the interference between the auxiliary nozzle 5 and the warp yarns.

[0020] The nozzle hole 45 is formed through the front wall 47 at a position adjacent to the upper end 44 of the auxiliary nozzle 5. The nozzle hole 45 may be formed by electrical discharge or mechanical machining process. The nozzle hole 45 is formed into a tapered passage that has a circular inner opening 50 opening to the air passage 49 and having a center 50A and a circular outer opening 51 opening to the outside of the auxiliary nozzle 5 and having a center 51A. Referring to FIGS. 3 and 4, the axis extending in longitudinal direction of the auxiliary nozzle 5 at the axial center thereof in the width H and the thickness directions of the auxiliary nozzle 5 is indicated by X and referred to as the center axis, the axis intersecting with the center axis X and extending in a direction that is perpendicular to the front wall 47 of the auxiliary nozzle 5 (or perpendicular to the longitudinal direction of the auxiliary nozzle 5) is indicated by Y and referred to as the weft insertion axis and the axis extending through the center 50A of the inner opening 50 and the center 51A of the outer opening 51 is indicated by Z and referred to as the nozzle hole axis.

[0021] The nozzle hole 45 is formed so that the center 50A of the inner opening 50 is positioned on the weft insertion axis Y (refer to FIGS. 4 and 5) and the nozzle hole axis Z is angularly spaced horizontally toward the reed 33 side at an angle of α degrees from the weft insertion axis Y, as shown in FIG. 4. Therefore, the center 51A of the outer opening 51 is spaced away from the weft insertion axis Y in the width direction of the auxiliary nozzle 5. In other words, with the auxiliary nozzle 5 fixed to the slay 6 as shown in FIG. 2, the center 51A of the outer opening 51 is spaced from the weft insertion axis Y toward the reed 33 side of the loom 1. With the front wall 47 and the rear wall 48 of the auxiliary nozzle 5 disposed parallel to the warp yarns (not shown), air can be injected from the outer opening 51 toward the weft guide passage 39 formed by the weft guide openings of the respective dents 34.

[0022] It is to be noted that, according to the present invention, the nozzle hole 45 may be formed within a general permissible range of tolerance that permits the center 50A of the inner opening 50 to be positioned slightly away from the weft insertion axis Y

[0023] The nozzle hole 45 is also formed so that the nozzle hole axis Z is angularly spaced vertically toward the upper end 44 of the auxiliary nozzle 5 at an angle of ß degrees from the weft insertion axis Y, as shown in FIG. 5. In other words, with the auxiliary nozzle 5 fixed to the slay 6, the nozzle hole axis Z is directed toward the deep upper corner of the weft guide passage 39, as shown in FIG. 2, so that the force due to air jet can be applied to the weft yarn 8 effectively for allowing the weft yarn 8 to fly through a shed efficiently.

[0024] The nozzle hole 45 is also formed so that the area of the outer opening 51 is smaller than that of the inner opening 50. The nozzle hole 45 is tapered toward the outer opening 51 at a constant taper rate (refer to FIGS. 4 and 5). Air that flows out through the nozzle hole 45 is converged along the nozzle hole axis Z by the tapered inner peripheral wall surface 52, so that the injection directivity of air jet can be improved.

[0025] Various flowing directions of compressed air in the air passage 49 of the auxiliary nozzle 5 are schematically shown by dotted arrows in FIG. 6. Compressed air supplied into the auxiliary nozzle 5 flows toward the upper end 44 of the auxiliary nozzle 5 in the air passage 49 with the highest pressure of compressed air maintained about the center axis X. In the auxiliary nozzle 5 wherein the center 50A of the inner opening 50 lies on the weft insertion axis Y and, therefore, the center 50A is also projected on the center axis X in the front view of the auxiliary nozzle 5 as shown in FIG. 6, with the result that most of the high-pressure compressed air can be introduced toward the nozzle hole 45.

[0026] The compressed air introduced toward the nozzle hole 45 is converged along the nozzle hole axis Z by the tapered inner peripheral wall surface 52 and injected at high pressure from the outer opening 51 in the injection direction T indicated by bold arrow in FIG. 6. Angularly spacing the injection direction T horizontally from the weft insertion axis Y at an angle of α and also vertically from the same axis Y at an angle of ß as previously described can improve the directivity of the injection direction T of air jet toward a weft yarn 8 that has been inserted by the main nozzle 3 into the weft guide passage 39.

[0027] The present invention is not limited to the preferred embodiment, but may be practiced in various ways as exemplified below.

(1) The inner peripheral wall surface 52 of the nozzle hole 45 of the auxiliary nozzle 5 may not necessarily extend straight continuously as seen in a traverse section of the auxiliary nozzle 5 (FIG. 4), but may be curved or bent in any way as seen in the same section of the auxiliary nozzle 5, as long as the nozzle hole 45 is tapered outwardly.

(2) The nozzle hole 45 may not necessarily be tapered at a constant taper rate, but the nozzle hole 45 may be divided into a plurality of regions in the tapering direction which have different taper rates.
(3) The inner peripheral wall surface 52 of the nozzle hole 45 of the auxiliary nozzle 5 may be formed parallel to the nozzle hole axis Z.
(4) The cross-section of the nozzle hole 45 of the auxiliary nozzle 5 taken perpendicularly to the nozzle hole axis Z is not limited to be circular in shape, but it may be of any other shape such as ellipsoidal, square or star-shaped.
(5) The flat front wall 47 and the flat rear wall 48 of the auxiliary nozzle 5 may not necessarily be formed parallel to warp yarns, but they may be disposed so as to be inclined relative to the warp yarns at an angle.

Claims

1. An auxiliary nozzle (5) for an air jet loom comprising:

   a nozzle hole (45) formed through a front wall (47) of the auxiliary nozzle (5) and having an inner opening (50) opening to inside of the auxiliary nozzle (5) and an outer opening (51) opening to outside of the auxiliary nozzle (5), wherein an axis extending in longitudinal direction of the auxiliary nozzle (5) through axial center of the auxiliary nozzle (5) is defined as center axis (X), wherein an axis intersecting with the center axis (X) and extending in a direction perpendicular to the front wall (47) is defined as weft insertion axis (Y), wherein an axis extending through center (50A) of the inner opening (50) and center (51A) of the outer opening (51) is defined as nozzle hole axis (Z), wherein the nozzle hole axis (Z) is angularly spaced horizontally from the weft insertion axis (Y), wherein weft insertion is accomplished by compressed air injected from the nozzle hole (45), **characterized in that** the center (50A) of the inner opening (50) is positioned on the weft insertion axis (Y).

2. The auxiliary nozzle (5) for an air jet loom according to claim 1, **characterized in that** the nozzle hole axis (Z) is angularly spaced vertically toward upper end (44) of the auxiliary nozzle (5) from the weft insertion axis (Y).

3. The auxiliary nozzle (5) for an air jet loom according to any one of claims 1 and 2, **characterized in that** the area of the outer opening (51) is smaller than that of the inner opening (50).

4. The auxiliary nozzle (5) for an air jet loom according to claim 3, **characterized in that** the nozzle hole (5) is tapered toward the outer opening (51) at a constant taper rate.

5. The auxiliary nozzle (5) for an air jet loom according to any one of claims 1 through 4, **characterized in that** the cross-section of the nozzle hole (45) taken perpendicularly to the nozzle hole axis (Z) is circular in shape.

Patentansprüche

1. Hilfsdüse (5) für eine Luftstrahlwebmaschine mit:

   einem Düsenloch (45), das durch eine Vorderwand (47) der Hilfsdüse (5) ausgebildet ist und eine innere Öffnung (50), die sich zu der Innenseite der Hilfsdüse (5) öffnet, und eine äußere Öffnung (51), die sich zu der Außenseite der Hilfsdüse (5) öffnet, hat, wobei eine sich in Längsrichtung der Hilfsdüse (5) durch eine axiale Mitte der Hilfsdüse (5) erstreckende Achse als eine Mittelachse (X) definiert ist, wobei eine die Mittelachse (X) schneidende und sich in einer Richtung senkrecht zu der Vorderwand (47) erstreckende Achse als eine Schusseintragsachse (Y) definiert ist, wobei eine sich durch die Mitte (50A) der inneren Öffnung (50) und die Mitte (51A) der äußeren Öffnung (51) erstreckende Achse als eine Düsenlochachse (Z) definiert ist, wobei die Düsenlochachse (Z) von der Schusseintragsachse (Y) in Horizontalrichtung winkelmäßig beabstandet ist, wobei der Schusseintrag durch von dem Düsenloch (45) eingestrahlter Druckluft bewerkstelligt wird, **dadurch gekennzeichnet, dass** die Mitte (50A) der inneren Öffnung (50) an der Schusseintragsachse (Y) positioniert ist.

2. Hilfsdüse (5) für eine Luftstrahlwebmaschine gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Düsenlochachse (Z) in Vertikalrichtung schräg zu dem oberen Ende (44) der Hilfsdüse (5) von der Schusseintragsachse (Y) beabstandet ist.

3. Hilfsdüse (5) für eine Luftstrahlwebmaschine gemäß einem der Ansprüche 1 und 2, **dadurch gekennzeichnet, dass** die Fläche der äußeren Öffnung (51) kleiner als jene der inneren Öffnung (50) ist.

4. Hilfsdüse (5) für eine Luftstrahlwebmaschine gemäß Anspruch 3, **dadurch gekennzeichnet, dass** das Düsenloch (5) mit einer konstanten Konizität in Richtung der äußeren Öffnung (51) konisch verläuft.

5. Hilfsdüse (5) für eine Luftstrahlwebmaschine gemäß einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Querschnitt des Düsenlochs

(45), der senkrecht zu der Düsenlochachse (Z) verläuft, kreisförmig ist.

Revendications

1. Buse auxiliaire (5) pour un métier à tisser du type à jet d'air, comprenant :

   un trou d'injection (45) pratiqué à travers une paroi frontale (47) de la buse auxiliare (5) et possédant une ouverture interne (50) qui s'ouvre sur l'intérieur de la buse auxiliaire (5) et une ouverture externe (51) qui s'ouvre sur l'extérieur de la buse auxiliaire (5), dans laquelle un axe s'étendant dans la direction longitudinale de la buse (5) en passant par le centre axial de la buse auxiliaire (5) est défini comme centre axial (X), dans laquelle un axe coupant l'axe central (X) et s'étendant dans une direction perpendiculaire à la paroi frontale (47) est défini comme axe d'insertion de fil de trame (Y), dans laquelle un axe qui s'étend en passant par le centre (50A) de l'ouverture interne (50) et par le centre (51 A) de l'ouverture externe (51) est défini comme axe de trou d'injection (Z), dans laquelle l'axe (Z) est espacé en formant un angle à l'horizontale par rapport à l'axe d'insertion de fil de trame (Y), dans laquelle l'insertion du fil de trame est mise en oeuvre via de l'air comprimé injecté à partir du trou d'injection (45), **caractérisée en ce que** le centre (50A) de l'ouverture interne (50) est disposé sur l'axe d'insertion de fil de trame (Y).

2. Buse auxiliaire (5) pour un métier à tisser du type à jet d'air selon la revendication 1, **caractérisée en ce que** l'axe (Z) du trou d'injection est espacé en formant un angle à la verticale en direction de l'extrémité supérieure (44) de la buse auxiliaire par rapport à l'axe d'insertion de fil de trame (Y).

3. Buse auxiliaire (5) pour un métier à tisser du type à jet d'air selon l'une quelconque des revendications 1 et 2, **caractérisée en ce que** la, surface de l'ouverture externe (51) est inféneure à celle de l'ouverture interne (50).

4. Buse auxiliaire (5) pour un métier à tisser du type à jet d'air selon la revendication 3, **caractérisée en ce que** le trou injection (5) prend une configuration tronconique en direction de l'ouverture externe (51) à un taux de conicité constant.

5. Buse auxiliaire (5) pour un métier à tisser du type à jet d'air selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que** la section transversale du trou d'injection (45), prise perpendiculairement à l'axe (Z) du trou d'injection est de configuration circulaire.

FIG. 1

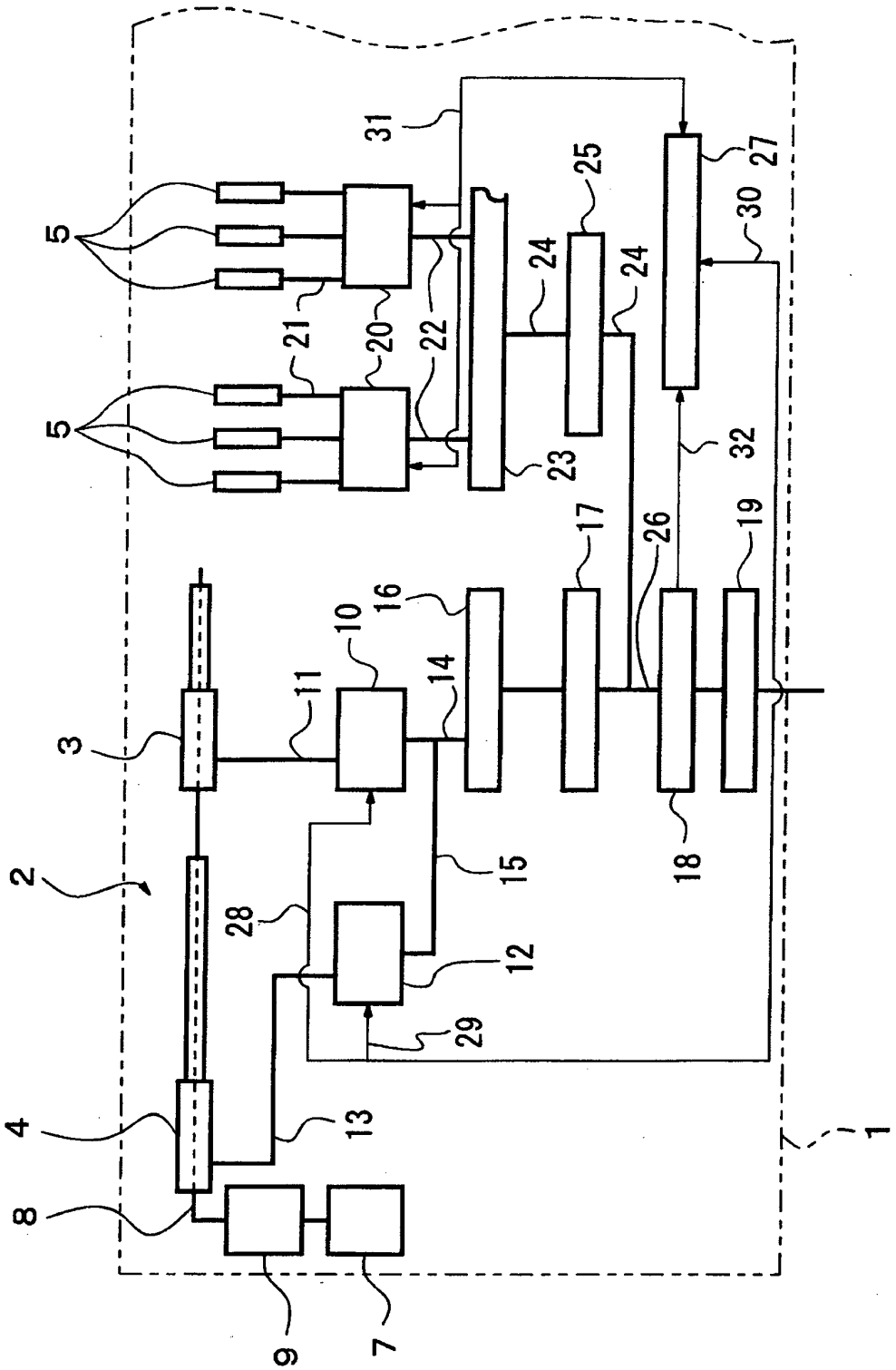

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FIG. 2

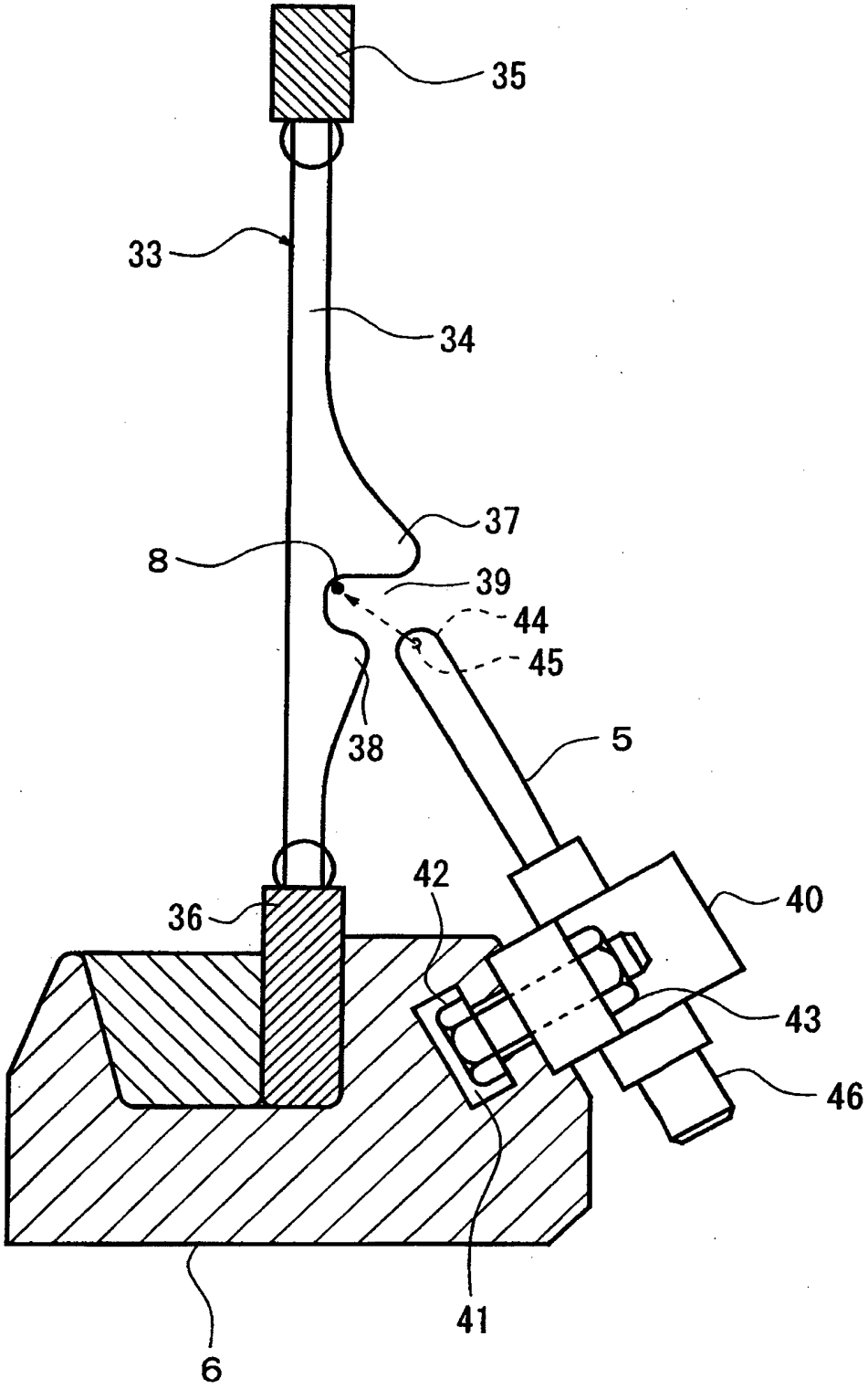


FIG. 3

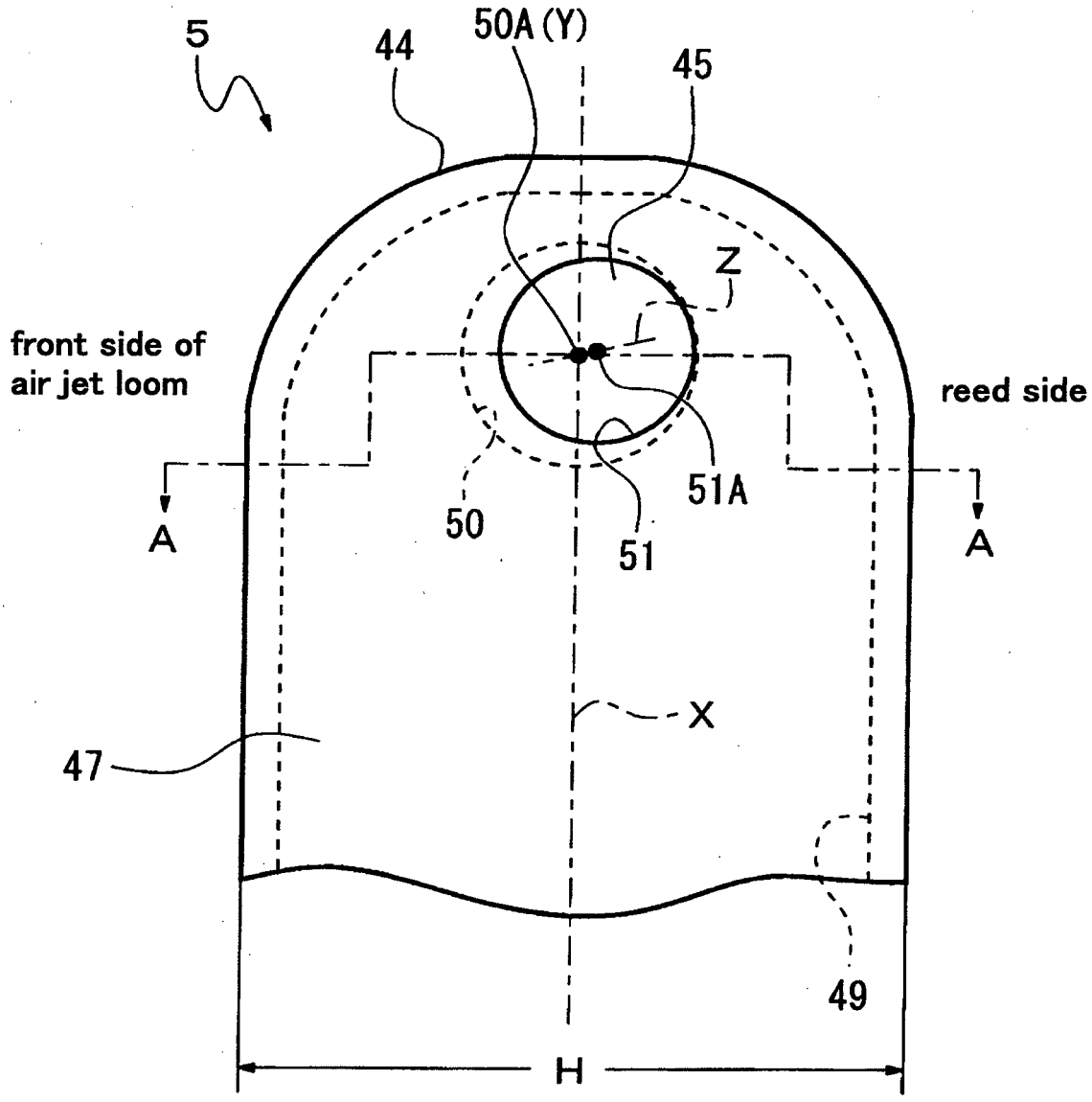

5
44
50A (Y)
45
Z
front side of
air jet loom
reed side
A
A
50
51
51A
47
X
49
H

FIG. 4

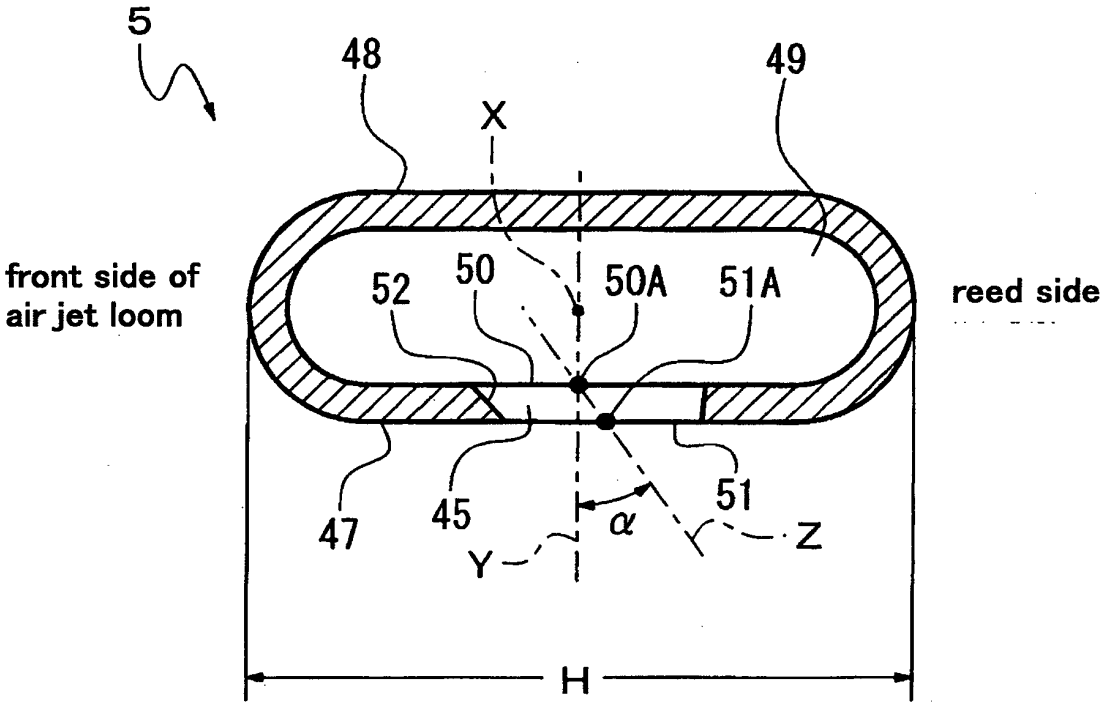

5
48
49
X
front side of
air jet loom
52
50
50A
51A
reed side
47
45
α
51
Y
Z
H

FIG. 5

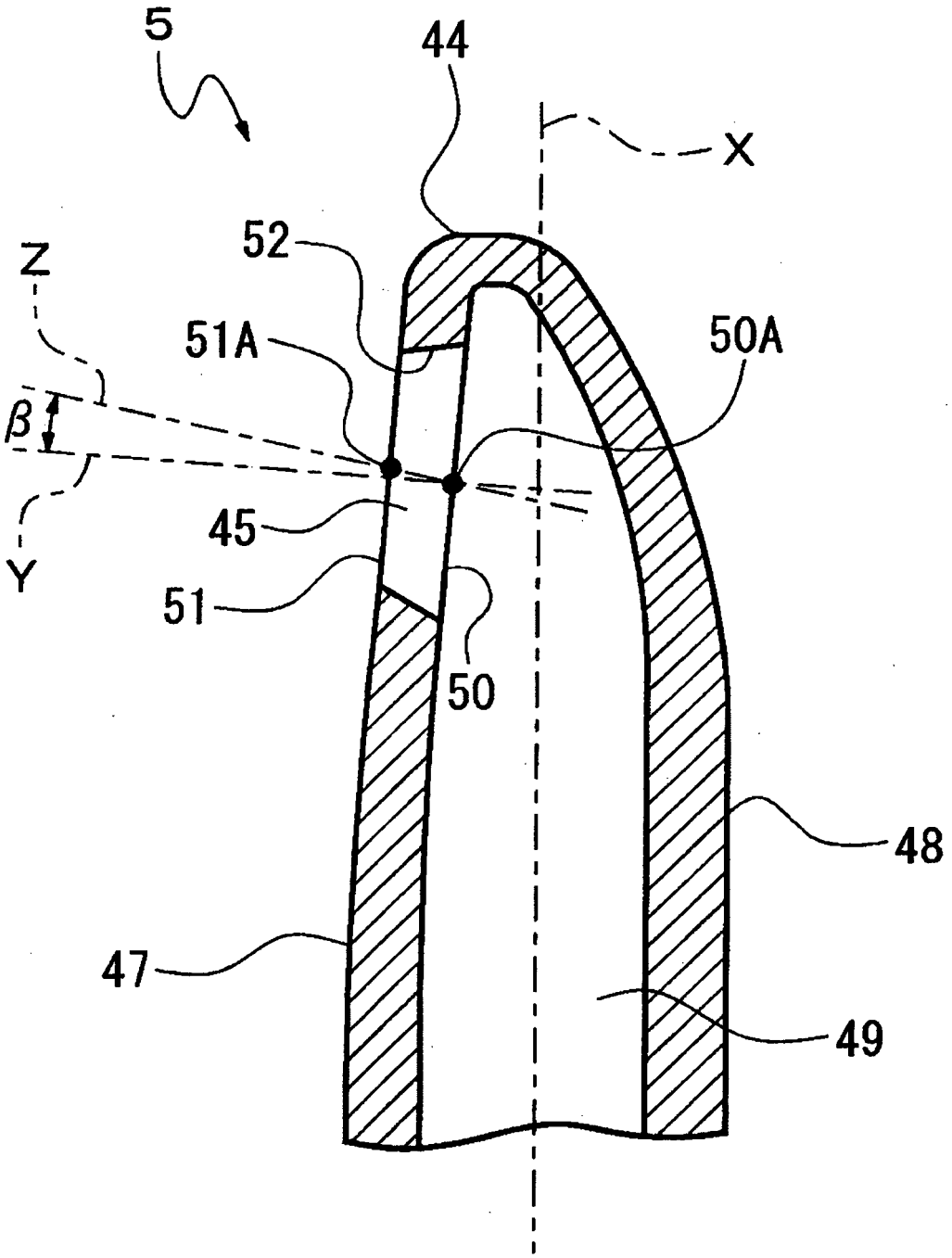
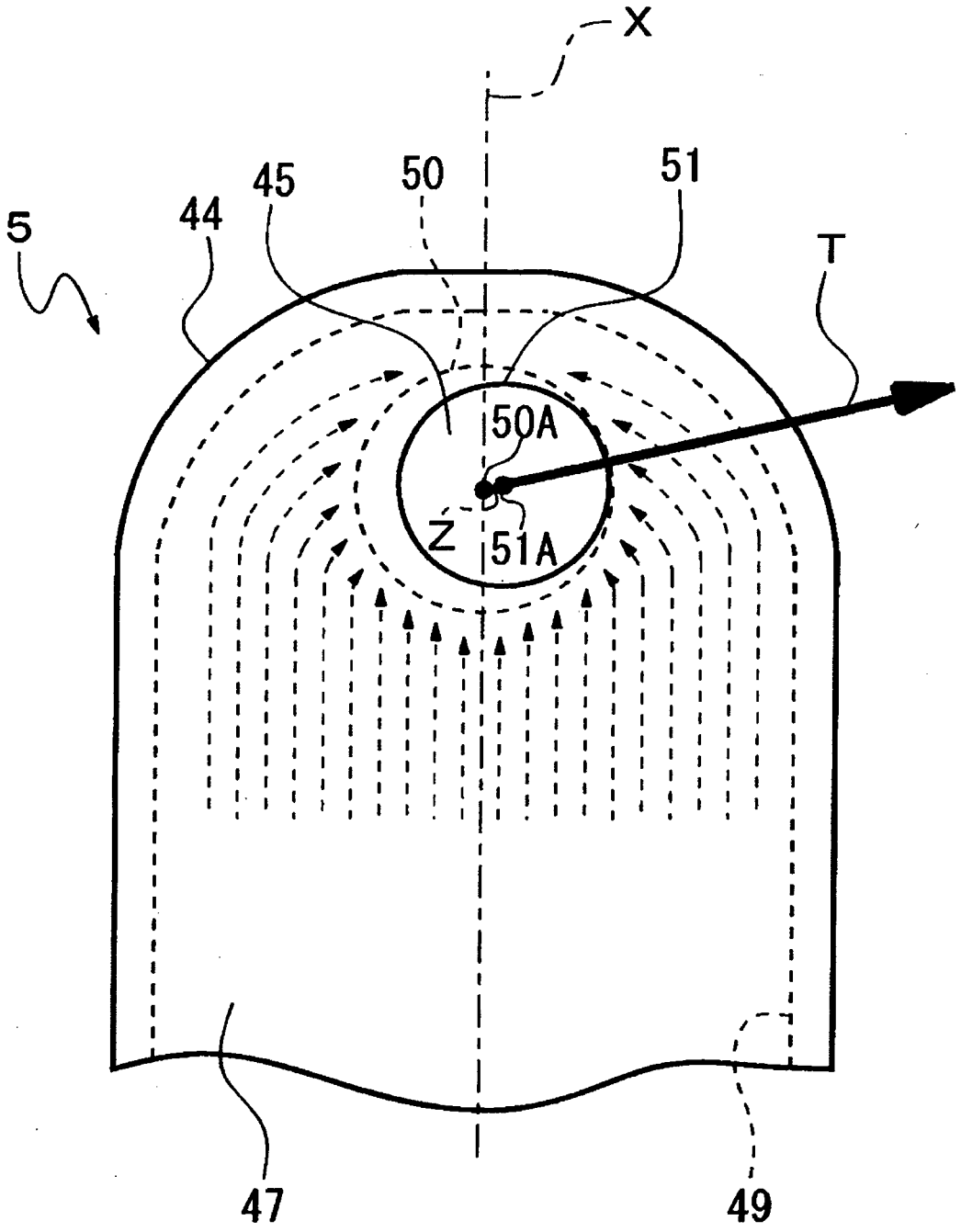


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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