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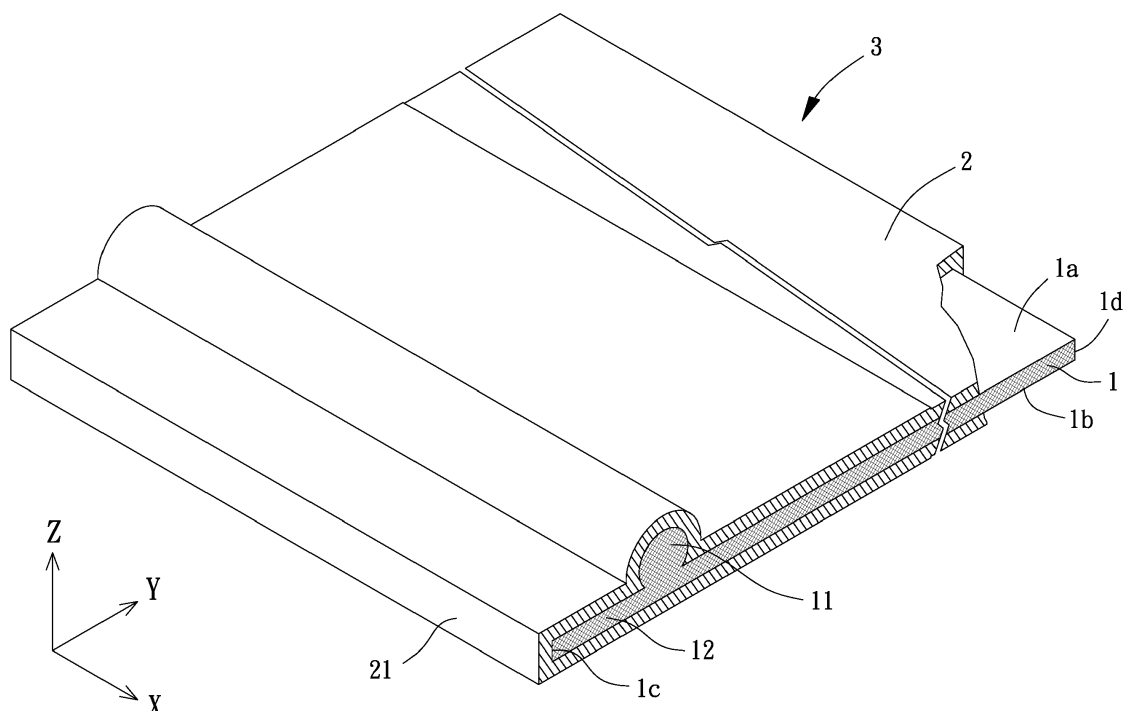
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(54) **WATERPROOF FASTENER TAPE AND WATERTIGHT SLIDE FASTENER INCLUDING THE SAME**

(57) A waterproof fastener tape of a watertight slide fastener includes a fabric tape (1) and a waterproof layer (2). The fabric tape (1) includes a first surface (1a), a second surface (1b), a first edge, a second edge, a cord portion (11), and an extension portion (12). The cord portion (11) protrudes from the first surface (1a). The first and second edges are connected between the first and

second surfaces (1a, 1b). The cord portion (11) is spaced from the first edge at a smaller distance than from the second edge. The extension portion (12) extends between the first edge and the cord portion (11). The second surface (1b) is planar. The waterproof layer (2) covers the first surface (1a), the second surface (1b), the cord portion (11), the first edge and the second edge.

**FIG. 5****EP 3 440 954 A1**

## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention generally relates to a waterproof fastener tape and a watertight slide fastener using the waterproof fastener tape and, more particularly, to a waterproof fastener tape that is formed by a tape having a cord in which the tape is provided with a waterproof layer and includes a plurality of scoops (teeth) that can be conveniently and precisely attached thereto, as well as a watertight slide fastener including the waterproof fastener tape.

#### 2. Description of the Related Art

**[0002]** A weaved or knitted fabric tape can be provided with a waterproof function by coating an elastomeric material therewith (such as rubber), as it has been adopted by the manufacturers for decades. FIG. 1 shows a waterproof slide fastener 7 including a pair of belt-like core material 71 made by weaving or knitting. Each core material 71 is coated with a waterproof layer 72 formed by an elastomeric material to produce a waterproof tape. The waterproof tape includes a scoop engagement portion adjacent to an engagement edge thereof. A plurality of through-holes is formed in the scoop engagement portion. Molten resin can flow into the through-holes to form a plurality of scoops 73. Thus, the upper and lower parts of the scoops 73 can be formed along the engagement edge of the waterproof tape while the scoops 73 are located on both the top and bottom faces of the waterproof tape. One example of such a waterproof slide fastener can be seen in U.S. Patent No. 7,337,506 entitled "Waterproof Slide Fastener and Apparatus for Manufacturing the Same."

**[0003]** The scoops 73 are formed by injection. The waterproof tape does not include a cord, therefore it is difficult to properly position the waterproof tape. In addition, it is impossible to visually observe whether the edge of the waterproof tape in a mold cavity of a mold is in complete contact with the mold before formation of the scoops. Due to these reasons, when the waterproof tape is placed in the mold cavity of the mold to form the scoops 73, the waterproof tape cannot be properly positioned in the mold cavity. The installation of the scoops 73 is difficult, and the scoops 73 cannot be accurately aligned with each other along the scoop engagement portion. As a result, the scoops 73 will be misaligned with each other which means they cannot be located on the same line.

**[0004]** FIG. 2 shows a fastener stringer 8 as disclosed in Japan Patent No. 63-13687. The fastener stringer 8 includes two tapes. Each tape includes a fabric tape 81, a cord portion 82 and an extension portion 83. Both the surfaces of the fabric tape 81 are coated with an elastomeric material to form a waterproof layer 84. The water-

proof layer 84 covers the fabric tape 81, the cord portion 82 and the extension portion 83 to form a waterproof tape. The waterproof layer 84 extends beyond the extension portion 83 to form a wing 85. A plurality of through-holes 86 is formed in the waterproof tape along a length direction of the waterproof tape. Based on this, the waterproof tape is placed into a mold cavity of a mold to form a plurality of scoops 87. The upper and lower parts of the scoops 87 are unevenly misaligned with each other in regular intervals. Since the fastener stringer 8 includes the wing 85, when the waterproof tape is being coated with the molten elastomeric material, the cord portion 82 and the wing 85 of the fastener stringer 8 will deform. The wing 85 deforms because it is thin and long. As mentioned above, the upper parts of the scoops 87 are misaligned with the lower parts of the scoops 87. Thus, when the scoops 87 are unevenly deviated from the through-holes 86, the fastener stringer 8 will not be able to provide a waterproof effect.

**[0005]** FIGS. 3 and 4 show a liquid-tight slide fastener 9 as disclosed by U.S. Patent No. 9,015,908. The liquid-tight slide fastener 9 includes a pair of tapes 91. A cord portion 92 is formed on each tape 91. One face of the tape 91 is provided with a waterproof layer 93 which is formed by adhering a film thereto or by coating the face of the tape 91 with a molten resin. Then, a synthetic resin is disposed on the tape 91 by injection molding to form a row of scoops 94. The cord portion 92, the waterproof layer 93 and the scoops 94 are smeared with a water repellent agent or an oil repellent agent to provide a liquid-tight effect for the slide fastener 9.

**[0006]** The mold that is used to form the scoops 94 includes a row of spaced scoop cavities. The mold cavity of the mold includes a groove corresponding to the cord portion 92. Thus, the tape 91, the cord portion 92 and the waterproof layer 93 are placed in the mold cavity, and a synthetic resin is injected to form the scoops 94 to provide a secure engagement effect between the scoops 94 and the tape 91. As mentioned above, the waterproof layer 93 is formed by simply adhering the film to the tape 91 or by coating the tape 91 with the molten resin. Moreover, the cord portion 92 is not coated with the molten resin and there are gaps between the scoops 94. Due to the above reasons, after the liquid-tight slide fastener 9 has been used for a period of time, although the tape 91 has the water repellent or the oil repellent agent, water will still permeate through the liquid-tight slide fastener 9 from the outside via the gaps between the engaged scoops 94. Thus, the liquid-tight slide fastener 9 can only prevent the permeation of the water in a small rain or can only form a water-diverting effect. The conventional liquid-tight slide fastener 9 cannot provide a proper liquid-tight effect.

**[0007]** Therefore, it is necessary to improve the conventional waterproof fastener tape and its manufacturing method by providing a way to form a waterproof layer on the waterproof fastener tape and to prevent deformation of the waterproof fastener tape so that the scoops can

be conveniently formed and accurately positioned on the waterproof fastener tape.

#### SUMMARY OF THE INVENTION

**[0008]** It is therefore the objective of this invention to provide a waterproof fastener tape including a cord portion and a fabric tape portion that are coated with a waterproof layer to provide an improved function in preventing the permeation of the water.

**[0009]** It is another objective of the invention to provide a waterproof fastener tape that does not deform, permitting the scoops to be conveniently formed and accurately positioned on the waterproof fastener tape.

**[0010]** It is a further objective of the invention to provide a waterproof fastener tape where the scoops are securely formed on the waterproof fastener tape.

**[0011]** In the invention, the tape longitudinally extends in a length direction which is defined as an "X" direction. The two sides of the tape extending in the length direction are long sides. The tape also includes two short sides extending between the long sides in a "Y" direction. The tape also includes a thickness extending in a "Z" direction. The "X", "Y" and "Z" directions are perpendicular to each other. When two of the tapes are combined together, each tape includes an inner edge adjacent to the other tape, as well as an outer edge distant to the other tape.

**[0012]** In an aspect, a waterproof fastener tape of a watertight slide fastener includes a fabric tape and a waterproof layer. The fabric tape includes a first surface, a second surface, a first edge, a second edge, a cord portion, and an extension portion. The cord portion protrudes from the first surface. The first and second edges are connected between the first and second surfaces. The cord portion is spaced from the first edge at a smaller distance than from the second edge. The extension portion extends between the first edge and the cord portion. The second surface is planar. The waterproof layer covers the first surface, the second surface, the cord portion, the first edge and the second edge.

**[0013]** Based on this, since the waterproof fastener tape according to the invention includes the cord portion, during the placement of the fabric tape and the cord portion into the extrusion mold, the cord portion can be used to guide the fabric tape into the cavity of the extrusion mold easily. Besides, when the molten high polymer material is coated around the surface of the fabric tape, the waterproof layer is even. Thus, the waterproof fastener tape is formed.

**[0014]** In an example, a plurality of through-holes extends through the waterproof fastener tape and a portion of the cord portion in regular intervals. This permits the scoops to be securely coupled with the waterproof tape.

**[0015]** In the example, each of the plurality of through-holes extends through a half or slightly smaller than a half portion of the cord portion. This permits the scoops to be securely coupled with the waterproof tape.

**[0016]** In the example, the cord portion is partially ex-

posed via the first surface. Thus, the cord portion can be used to guide the fabric tape into the cavity of the extrusion mold easily.

**[0017]** In the example, each of the through-holes is formed with a scoop by extrusion molding, and the scoop includes an upper portion and a lower portion that are symmetric with each other. Thus, the through-hole can be accurately located in the center of the scoop, such that a watertight slide fastener using the waterproof fastener tape can have an improved watertight effect.

**[0018]** In another aspect, a watertight slide fastener according to the invention includes two waterproof fastener tapes and a slider. Each of the two waterproof fastener tapes includes an inner edge. A row of scoops is located adjacent to the inner edge of each waterproof fastener tape. The slider is adapted to engage the rows of scoops of the two waterproof fastener tapes with each other or to disengage said rows of scoops from each other. Therefore, the watertight slide fastener according to the invention provides an improved watertight effect. Furthermore, the scoops can be more securely coupled with the two waterproof fastener tapes, significantly improving the product yield rate and utility.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** The present invention will become more fully understood from the detailed description given hereinafter and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

FIG. 1 is a cross-sectional view of a first type of conventional waterproof fastener tape whose scoops are engaged with each other.

FIG. 2 is a top plan view of a second type of conventional waterproof fastener tape whose scoops are engaged with each other.

FIG. 3 is a perspective view of a third type of conventional waterproof fastener tape.

FIG. 4 is a cross-sectional view of the third type of the conventional waterproof fastener tape where the scoops are engaged with each other.

FIG. 5 is a partly-cutaway, perspective view of a waterproof fastener tape according to a first embodiment of the invention.

FIG. 6 is a cross-sectional view of the waterproof fastener tape of the first embodiment of the invention taken in a lateral direction.

FIG. 7 shows the waterproof fastener tape in FIG. 6 with an inclusion of a plurality of through-holes.

FIG. 8 shows the waterproof fastener tape in FIG. 7 with an inclusion of a plurality of scoops.

FIG. 9 is a top plan view of a watertight slide fastener including two waterproof fastener tapes of the first embodiment of the invention.

FIG. 10 is a cross-sectional view of the watertight slide fastener in FIG. 9 taken along a line 10-10.

FIG. 11 is a perspective view of a waterproof fastener tape according to a second embodiment of the invention.

**[0020]** In the various figures of the drawings, the same numerals designate the same or similar parts. Furthermore, when the terms "first", "second", "inner", "outer", "top", "bottom" and similar terms are used hereinafter, it should be understood that these terms have reference only to the structure shown in the drawings as it would appear to a person viewing the drawings, and are utilized only to facilitate describing the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0021]** FIGS. 5 and 6 show a waterproof fastener tape of a watertight slide fastener according to a first embodiment of the invention. The waterproof fastener tape includes a fabric tape 1 and a waterproof layer 2. The surfaces of the fabric tape 1 are covered by the waterproof layer 2.

**[0022]** The fabric tape 1 is a tape formed by weaving or knitting fibers. The fabric tape 1 includes a first surface 1a and a second surface 1b. A cord portion 11 protrudes from the first surface 1a of the cord portion 11. The cord portion 11 is relatively adjacent to an inner edge 1c of the fabric tape 1. An extension portion 12 is formed between the cord portion 11 and the inner edge 1c. The second surface 1b is planar.

**[0023]** The waterproof layer 2 is formed by an elastomeric resin material. The first surface 1a, the second surface 1b, the cord portion 11, and the inner edge 1c and an outer edge 1d that are connected between the first surface 1a and the second surface 1b, are coated with the elastomeric resin material. Thus, the fabric tape 1 has a complete waterproof effect.

**[0024]** Referring to FIG. 6, since the fabric tape 1 includes the cord portion 11, when the fabric tape 1 is to be coated with the elastomeric resin material, the cord portion 11 can be used to guide the fabric tape 1 into a cavity of an extrusion mold easily. However, in a non-limiting example, the waterproof fastener tape 3 may be formed by extrusion. In other words, the molten elastomeric material can be continuously extruded on the first surface 1a, the second surface 1b, the inner edge 1c and the outer edge 1d of the fabric tape 1.

**[0025]** Based on the above structure, referring to FIGS. 7 and 8, when a plurality of scoops 4 is to be formed in the waterproof fastener tape 3, a plurality of through-holes 31 can be formed on the waterproof fastener tape 3 at regular intervals. Each of the through-holes 31 extends through the waterproof fastener tape 3 and at least one portion of the cord portion 11. In an example, each of the through-holes 31 extends through a half or slightly smaller than a half portion of the cord portion 11. In this manner, during the formation of the scoops 4, the molten resin material can flow through and completely fill the through-holes 31. As a result, the upper portions of the

scoops 4 can be connected to the lower portions of the scoops 4 through the through-holes 31. The upper portions of the scoops 4 and the lower portions of the scoops 4 are symmetric with each other. Thus, each of the through-holes 31 can be accurately located in the center of the corresponding scoop 4 without asymmetry between the upper and lower portions of the scoop 4. Accordingly, a better positioning effect is attained. Moreover, the fabric tape 1 and the cord portion 11 are placed into a lower mold while the cord portion 11 is received in a cord-shaped groove of the mold, thus forming the scoops 4. Furthermore, since each of the through-holes 31 extends through the waterproof fastener tape 3 and at least one portion of the cord portion 11, the portion of the molten resin material that is connected between the upper and lower portions of the scoop 4 is adjacent to the inner side of the scoop 4 than to the outer side of the scoop 4. As a result, the scoops 4 can be more securely coupled with the waterproof fastener tape 3.

**[0026]** FIG. 9 shows two waterproof fastener tapes 3 that are connected to each other by a plurality of scoops 4 thereof. A slider 32 is connected to the two waterproof fastener tapes 3 to engage the scoops 4 with each other or to disengage the scoops 4 from each other, forming an open or closed watertight slide fastener.

**[0027]** Referring to FIG. 10, each waterproof layer 2 includes an abutting protrusion 21. Thus, when the scoops 4 are engaged with each other, the abutting protrusions 21 of the two waterproof layers 2 can press against each other to prevent the liquid from passing between the engaged scoops 4. Furthermore, since the fabric tape 1 is completely covered by the waterproof layer 2 and since the upper and lower portions of each scoop 4 are symmetrically positioned with respect to each other, the through-hole 31 is precisely located at the center of the scoop 4 without asymmetry between the upper and lower portions of the scoop 4. In addition, the scoops 4 can securely couple with the waterproof fastener tapes 3 to provide an improved watertight effect. Furthermore, since the through-holes 31 extend through the waterproof fastener tape 3 and at least one portion of the cord portion 11, the portion of the molten resin material that is connected between the upper and lower portions of the scoop 4 is relatively adjacent to the inner side of the scoop 4. As a result, the scoops 4 can be more securely coupled with the waterproof fastener tape 3.

**[0028]** FIG. 11 shows a waterproof fastener tape of a watertight slide fastener according to a second embodiment of the invention. The first surface 1a is provided with a first cord portion 11, and the second surface 1b may be provided with a second cord portion 11. The first and second cord portions 11 are aligned with each other. One of the first and second cord portions 11 can be placed in a cord-shaped groove of a lower mold that is used to form the scoops 4. Furthermore, since the through-holes 31 also extend through the waterproof fastener tape 3 and at least one portion of the first cord portion 11 and since the upper and lower portions of the scoops 4 are

symmetrically positioned with respect to each other, each of the through-holes 31 is precisely located at the center of a corresponding scoop 4 without asymmetry between the upper and lower portions of the corresponding scoop 4. Advantageously, an improved waterproof effect is attained. Furthermore, since each of the through-holes 31 extends through the waterproof fastener tape 3 and at least one portion of the first cord portion 11, the portion of the molten resin material that is connected between the upper and lower portions of each scoop 4 is adjacent to the inner side of the scoop 4 than to the outer side of the scoop 4. As a result, the scoops 4 can be more securely coupled with the waterproof fastener tape 3.

**[0029]** In conclusion, in the waterproof fastener tape and the watertight slide fastener including the same according to the invention, since the waterproof fastener tape includes the cord portion, the cord portion can be used to guide the fabric tape easily into the cavity of the extrusion mold while placing the fabric tape into the mold. Thus, a waterproof fastener tape can be formed. Moreover, the cord portion of the waterproof fastener tape is placed into the cord-shaped groove of the lower mold for precise positioning. Since the upper and lower portions of the scoops are symmetrically positioned with respect to each other, each of the through-holes can be precisely located at the center of a corresponding scoop to provide an improved waterproof effect. Furthermore, since the through-holes extend through at least one portion of the cord portion, the portion of the molten resin material that is connected between the upper and lower portions of the scoop is relatively adjacent to the inner side of the scoop than to the outer side of the scoop. As a result, the scoops can be more securely coupled with the waterproof fastener tape, significantly improving the product yield rate and utility.

## Claims

1. A waterproof fastener tape of a watertight slide fastener, **characterized in** comprising:

a fabric tape (1) including a first surface (1a), a second surface (1b), a first edge, a second edge, a cord portion (11) protruding from the first surface (1a), and an extension portion (12), wherein the first and second edges are connected between the first and second surfaces (1a, 1b), wherein a spacing between the cord portion (11) and the first edge is smaller than a spacing between the cord portion (11) and the second edge, wherein the extension portion (12) extends between the first edge and the cord portion (11), and wherein the second surface (1b) is planar; and

a waterproof layer (2) covering the first surface (1a), the second surface (1b), the cord portion (11), the first edge and the second edge.

2. The waterproof fastener tape of the watertight slide fastener as claimed in claim 1, **characterized in that** a plurality of through-holes (31) extends through the waterproof fastener tape and a portion of the cord portion (11) at regular intervals.
3. The waterproof fastener tape of the watertight slide fastener as claimed in claim 2, **characterized in that** each of the plurality of through-holes (31) extends through a half or slightly smaller than a half portion of the cord portion (11).
4. The waterproof fastener tape of the watertight slide fastener as claimed in claim 1, **characterized in that** the cord portion (11) is partially exposed via the first surface (1a).
5. The waterproof fastener tape of the watertight slide fastener as claimed in any of claims 1-4, **characterized in that** each of the plurality of through-holes (31) is formed with a scoop (4) by injection molding, and wherein each of the scoops (4) includes an upper portion and a lower portion that are symmetric with each other.

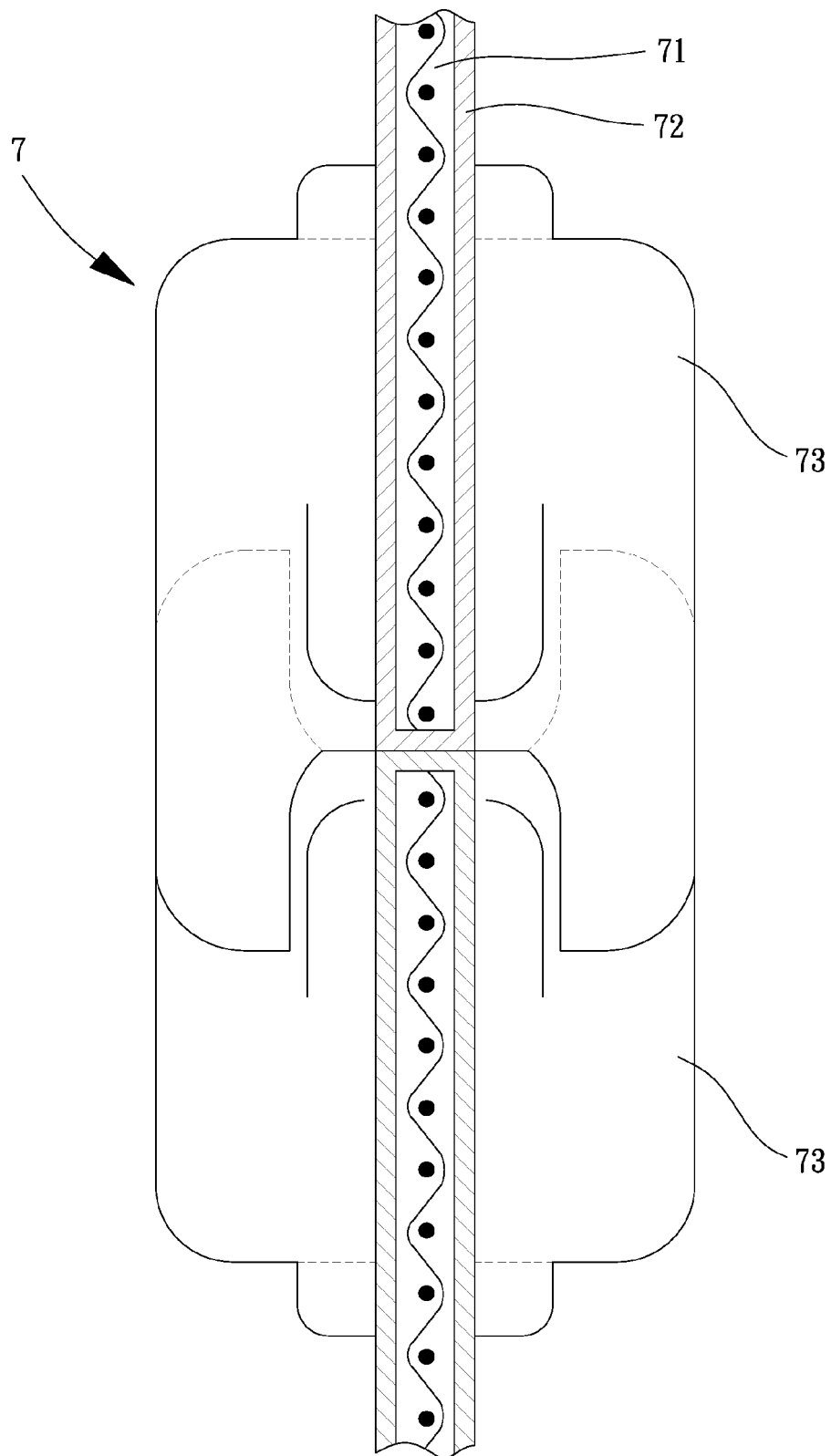


FIG. 1  
PRIOR ART

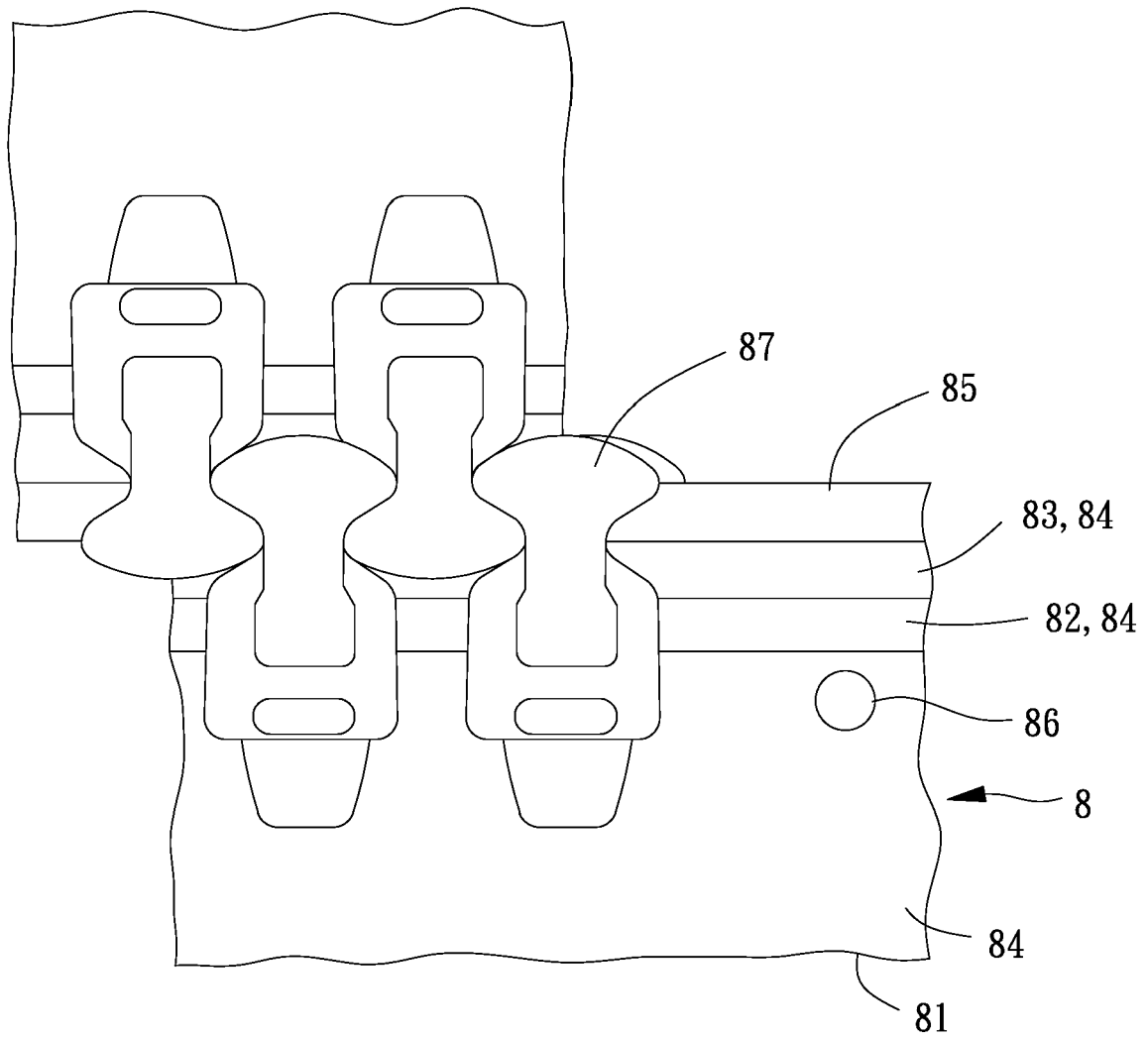


FIG. 2  
PRIOR ART

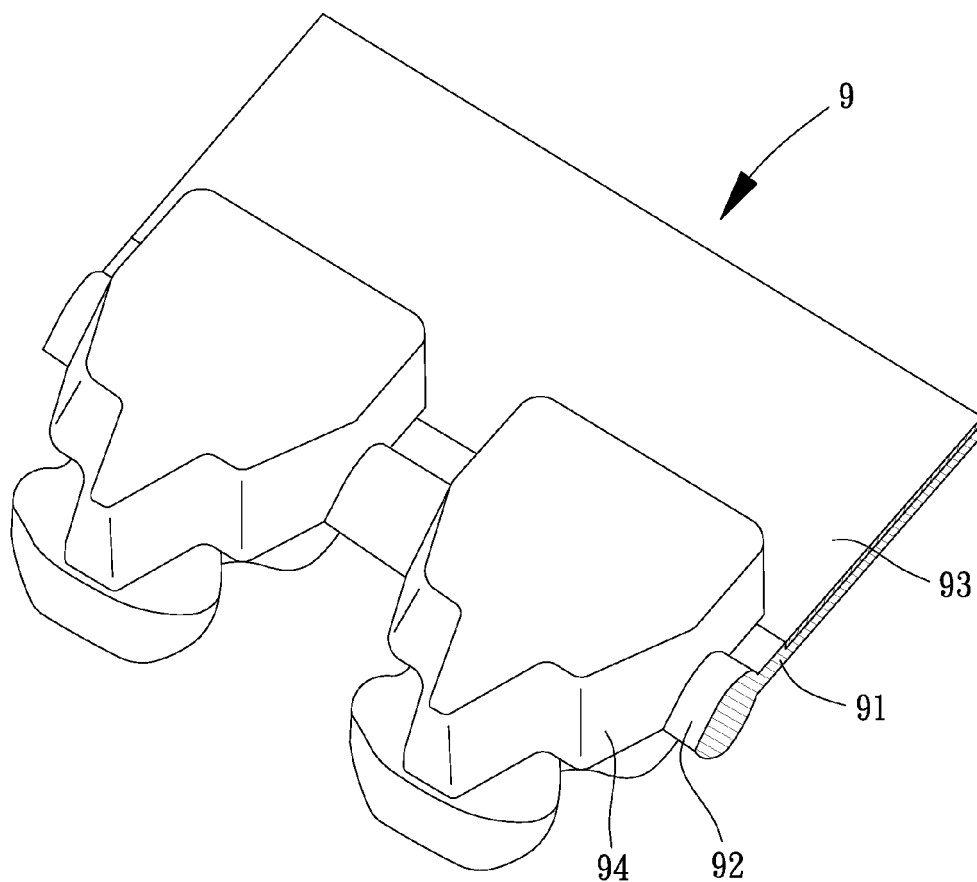


FIG. 3  
PRIOR ART

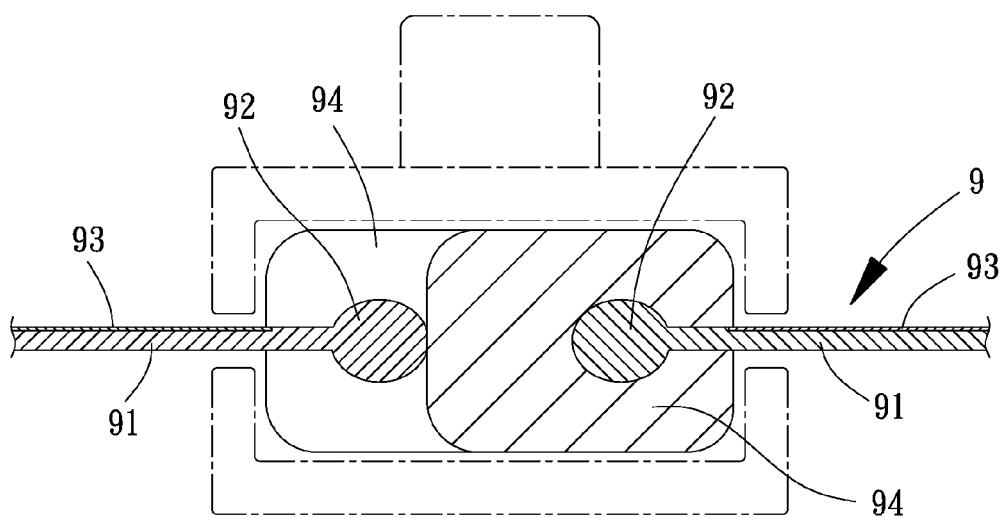


FIG. 4  
PRIOR ART

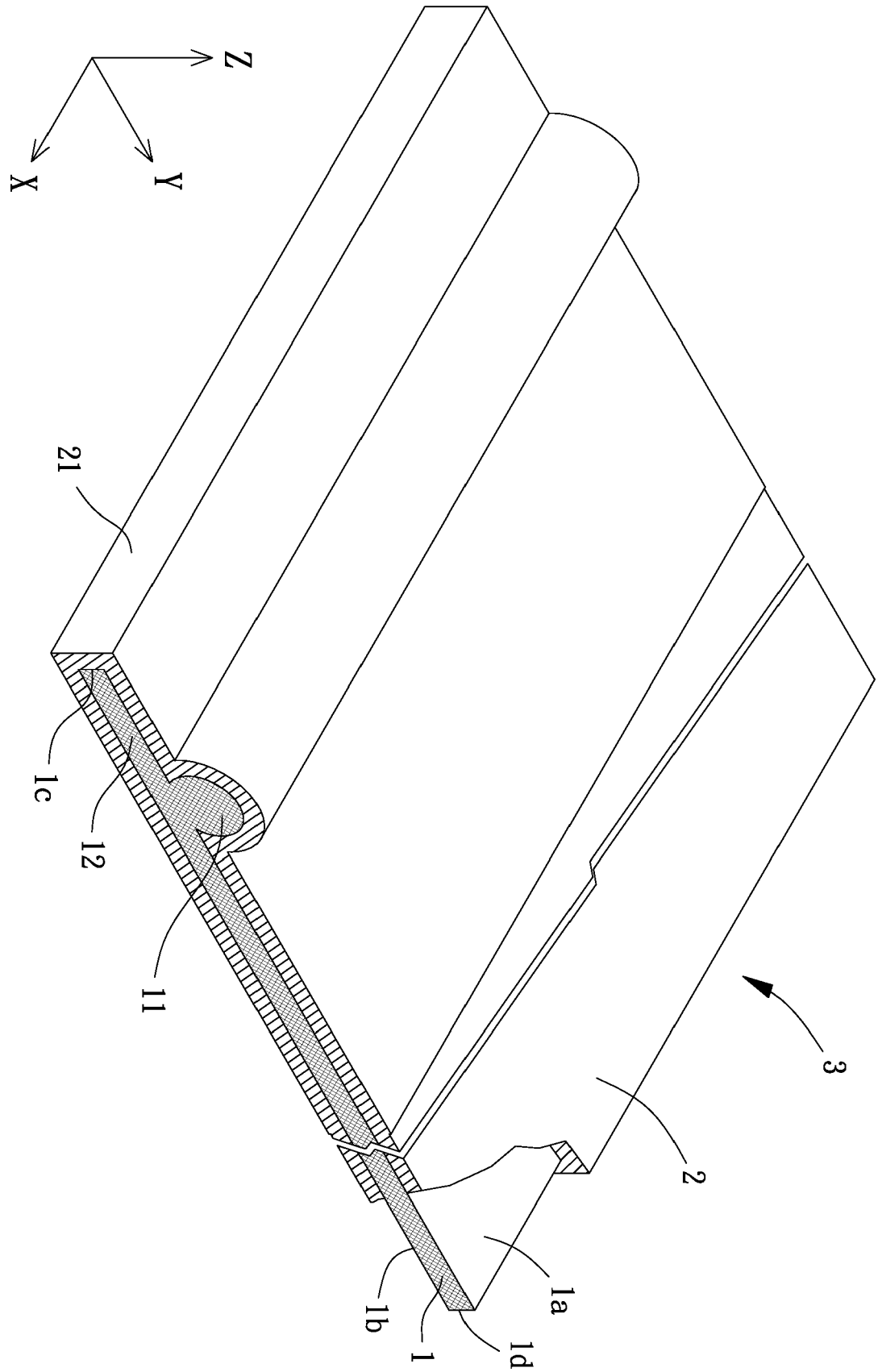


FIG. 5

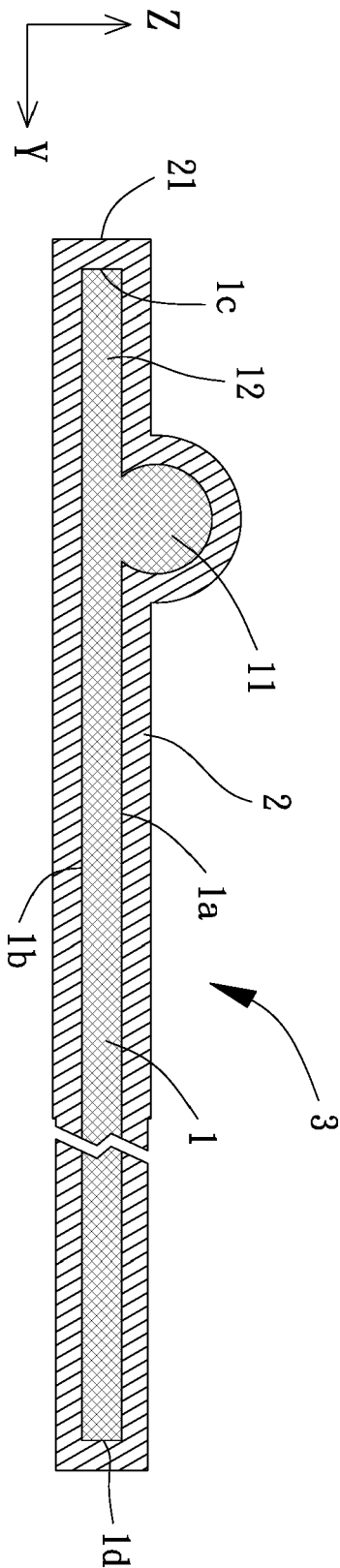


FIG. 6

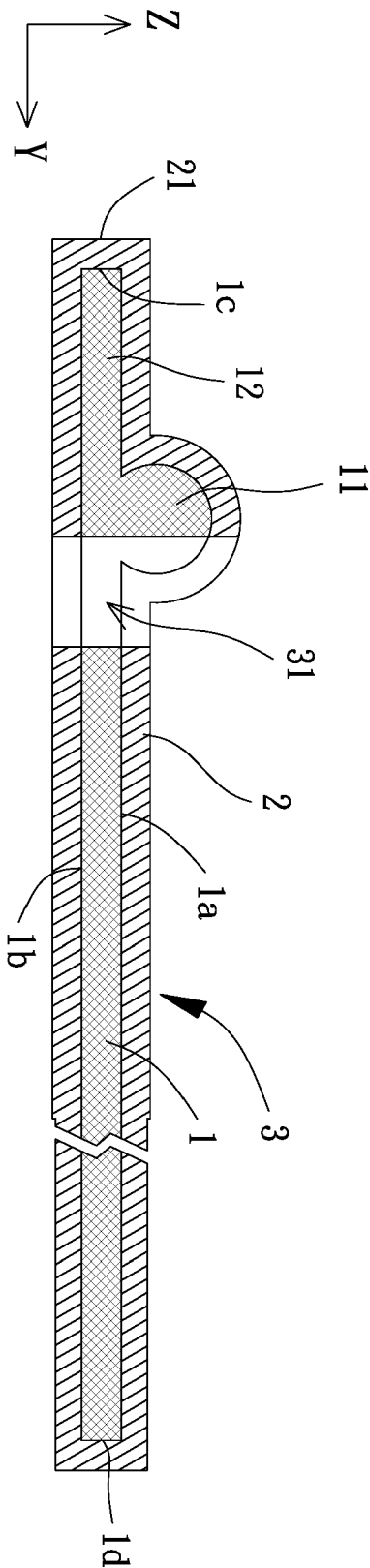


FIG. 7

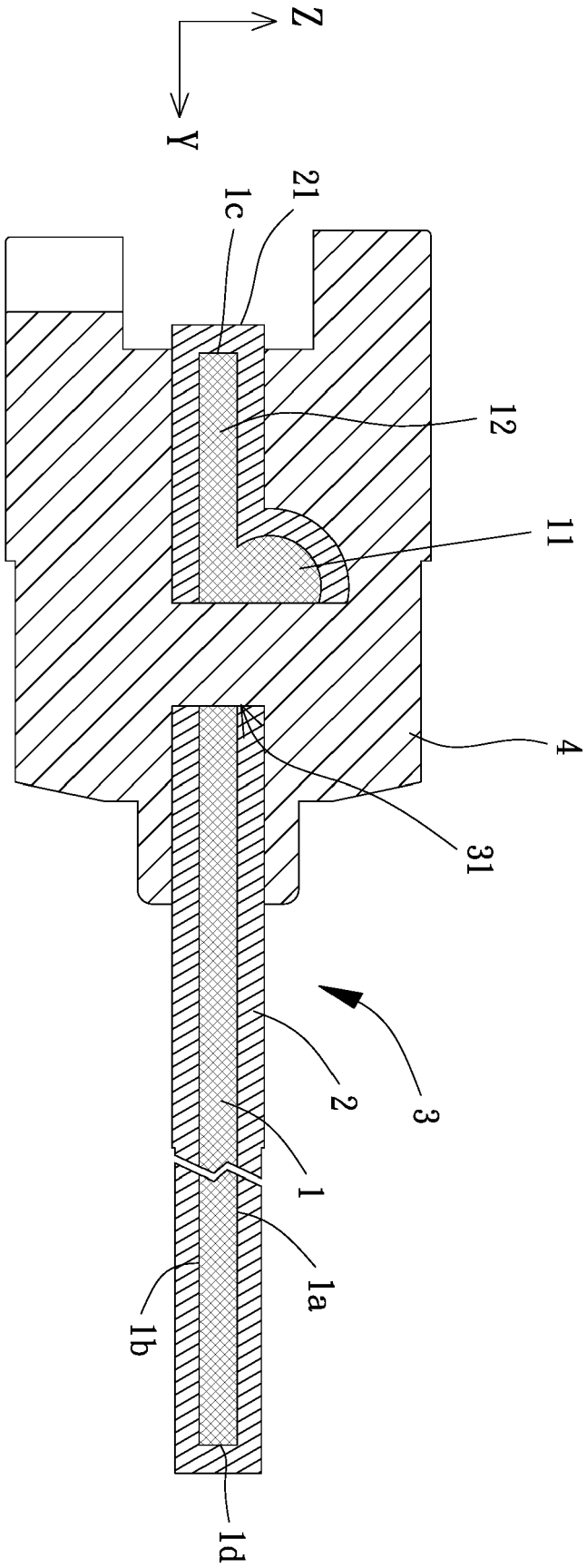


FIG. 8

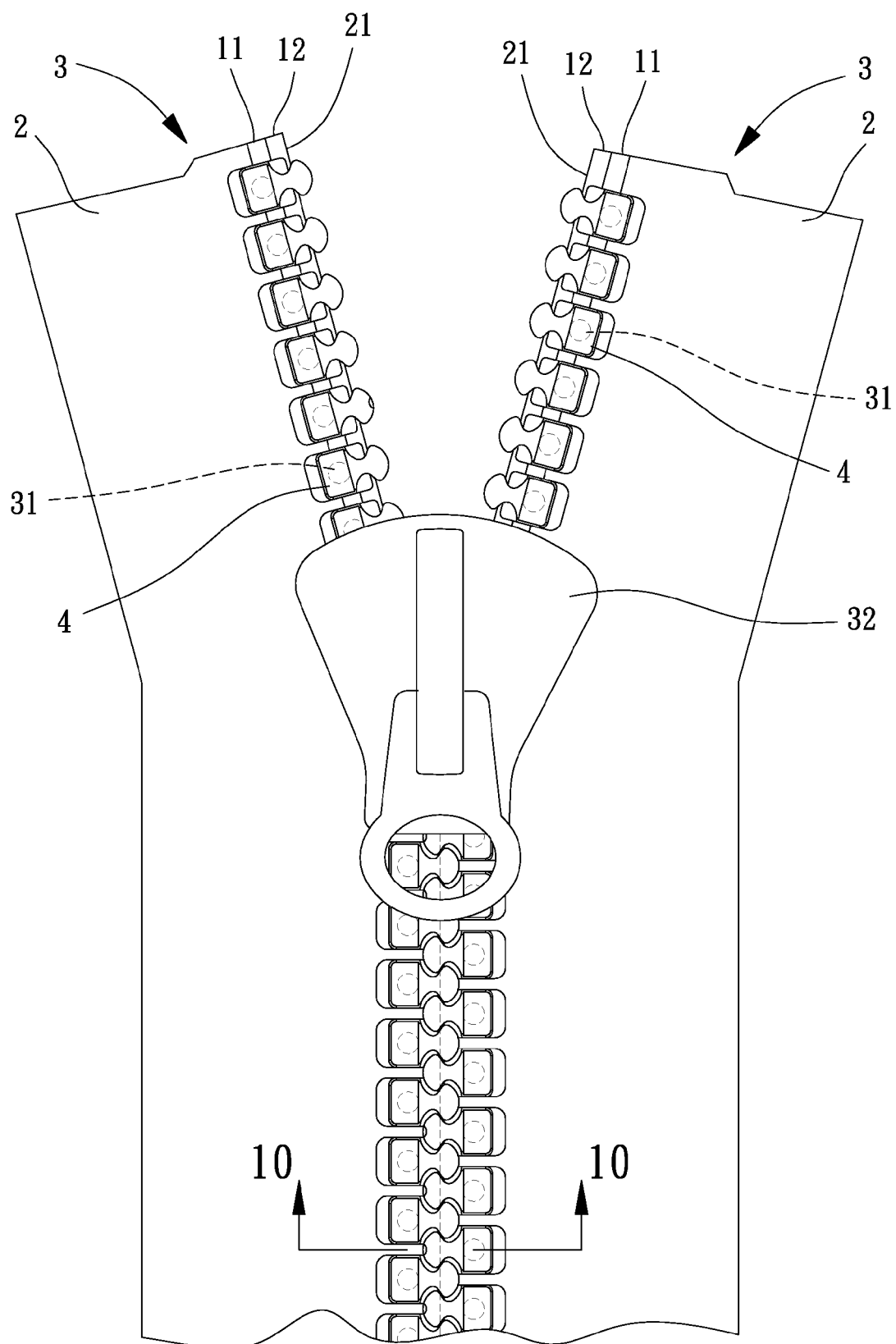


FIG. 9

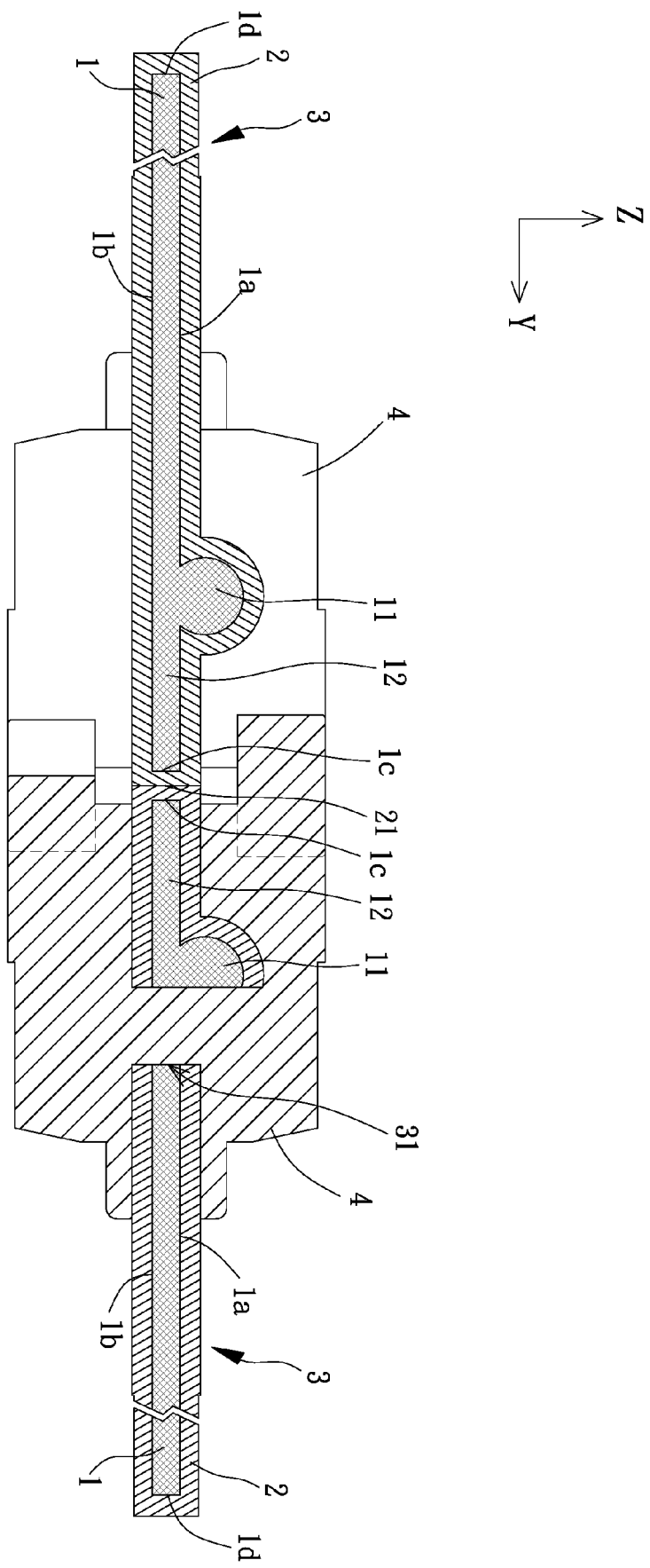


FIG. 10

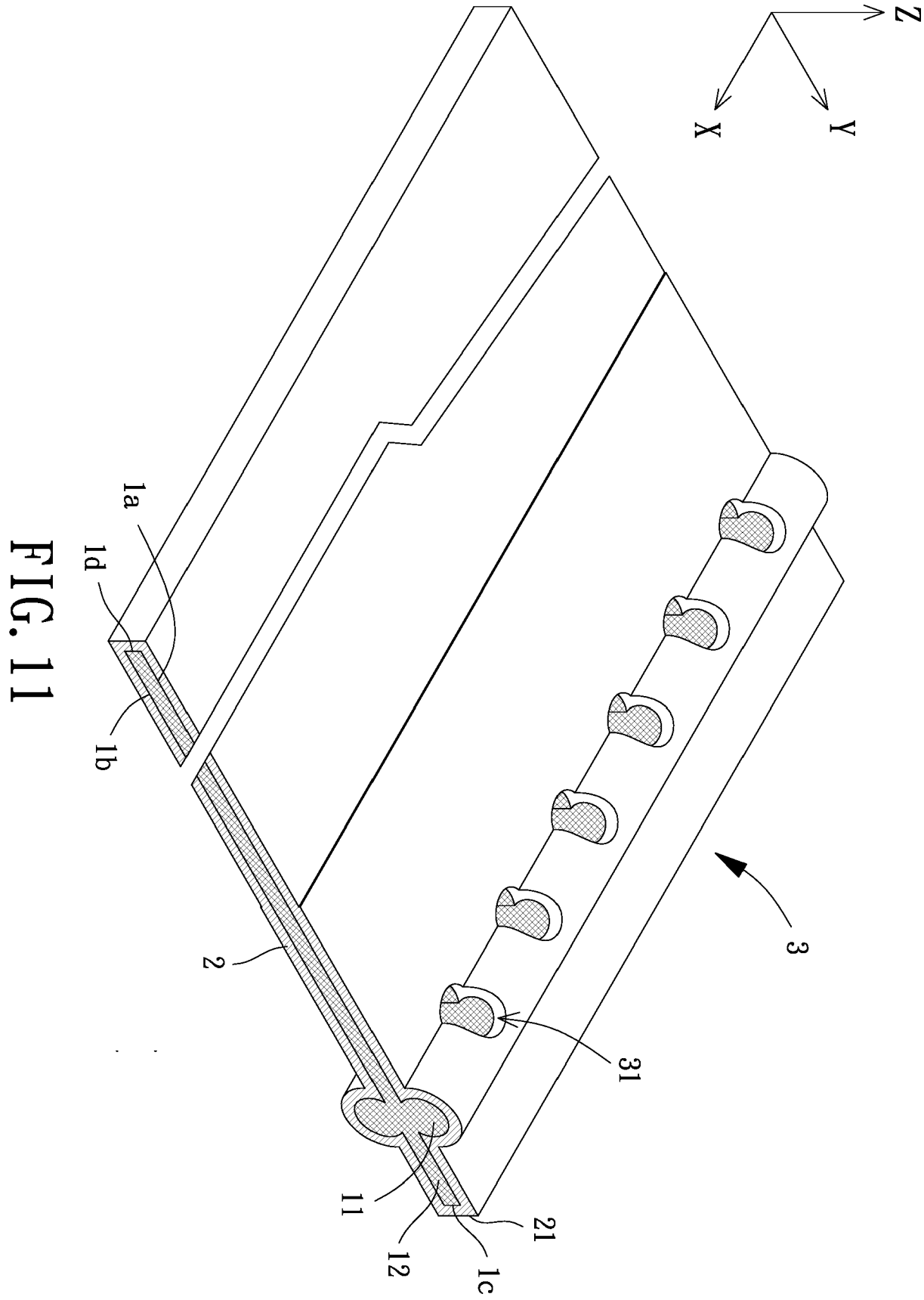


FIG. 11



## EUROPEAN SEARCH REPORT

Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                        |                                                             |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                          | Relevant to claim                                           | CLASSIFICATION OF THE APPLICATION (IPC) |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2006/207069 A1 (CHENG JUNG-YUAN [TW])<br>21 September 2006 (2006-09-21)<br>* paragraphs [0038], [0039]; figure 13 * | 1-5                                                         | INV.<br>A44B19/34                       |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 3 165 120 A1 (UNITECH ZIPPER & MACHINERY CO LTD [TW])<br>10 May 2017 (2017-05-10)<br>* figures 2,4 *                | 1-5                                                         | ADD.<br>A44B19/32                       |
| X,P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | TW I 619 445 B (UNITECH ZIPPER & MACHINERY CO LTD [TW]) 1 April 2018 (2018-04-01)<br>* figures 1-11 *                  | 1-5                                                         |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                        |                                                             | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                        |                                                             | A44B                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                                                             |                                         |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                        | Date of completion of the search<br><b>26 November 2018</b> | Examiner<br><b>van Voorst, Frank</b>    |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                        |                                                             |                                         |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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26-11-2018

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| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|----|---------------------|----------------------------|---------------------|
| US 2006207069                             | A1 | 21-09-2006          | NONE                       |                     |
| -----                                     |    |                     |                            |                     |
| EP 3165120                                | A1 | 10-05-2017          | NONE                       |                     |
| -----                                     |    |                     |                            |                     |
| TW 1619445                                | B  | 01-04-2018          | -----                      |                     |
| -----                                     |    |                     |                            |                     |

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 7337506 B [0002]
- JP 63013687 A [0004]
- US 9015908 B [0005]