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(19) **United States**(12) **Patent Application Publication**  
**Hahizume et al.**(10) **Pub. No.: US 2016/0324273 A1**(43) **Pub. Date: Nov. 10, 2016**(54) **SLIDE FASTENER**(52) **U.S. Cl.**(71) Applicant: **YKK CORPORATION**, Tokyo (JP)CPC ..... *A44B 19/08* (2013.01); *A44B 19/26*  
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**Takata**, Toyama (JP)(57) **ABSTRACT**(21) Appl. No.: **15/104,267**(22) PCT Filed: **Dec. 8, 2014**(86) PCT No.: **PCT/JP2014/082465**

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(2006.01)

There is provided a slide fastener including a fastener chain and a slider. The slider includes upper and lower blades, a front end wall having a first front mouth and a second front mouth provided below the first front mouth, and one rear mouth. The slider is movable in a first direction to engage a pair of element rows, and in a second direction to disengage the pair of element rows. Each element has a base portion fixed to respective fastener tapes and a head portion configured to be engaged with the opposing elements. The head portion has a first head portion arranged at a side of upper surfaces of the tapes and a second head portion arranged at a side of lower surfaces of the tapes. The first head portion is formed to be offset from the second head portion in the first direction.

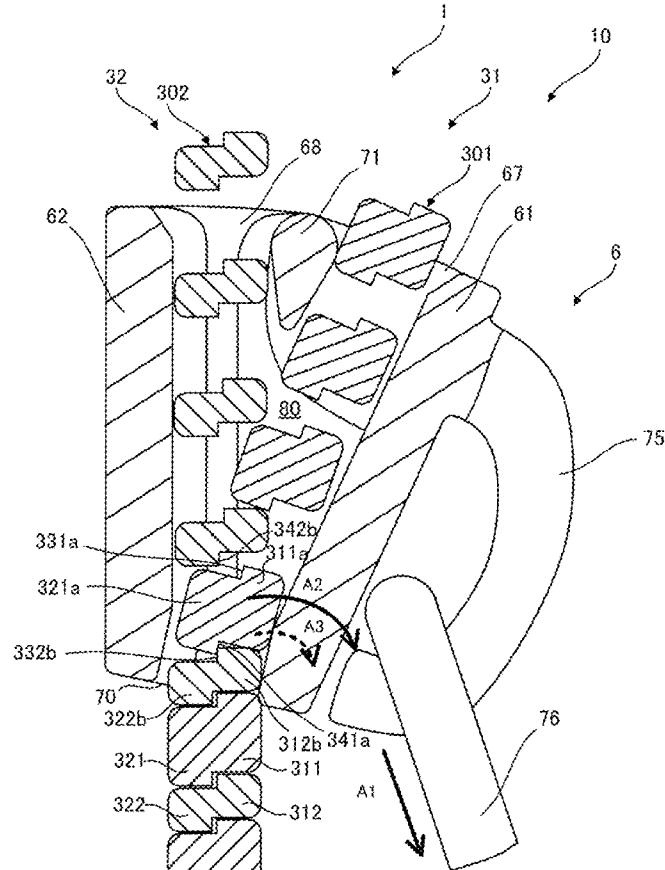


FIG. 1

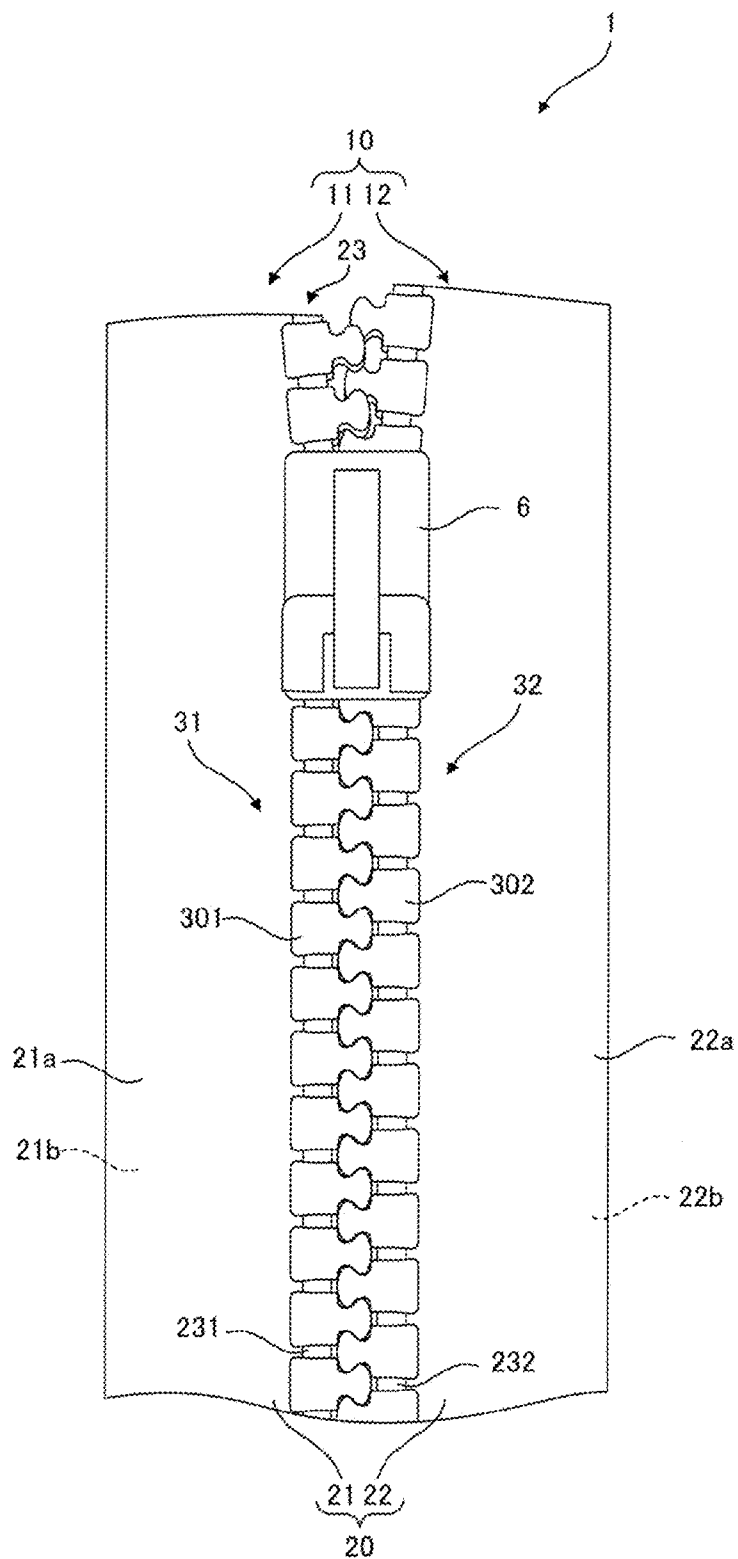
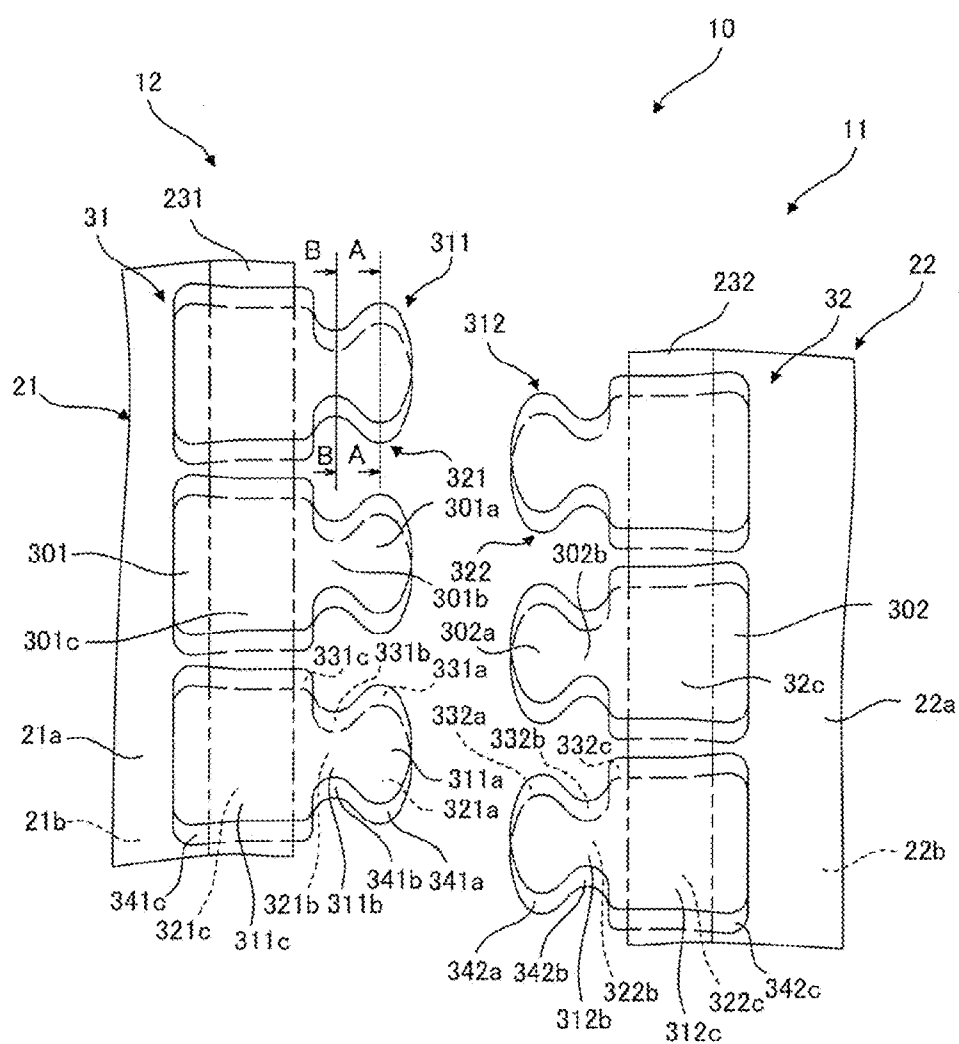
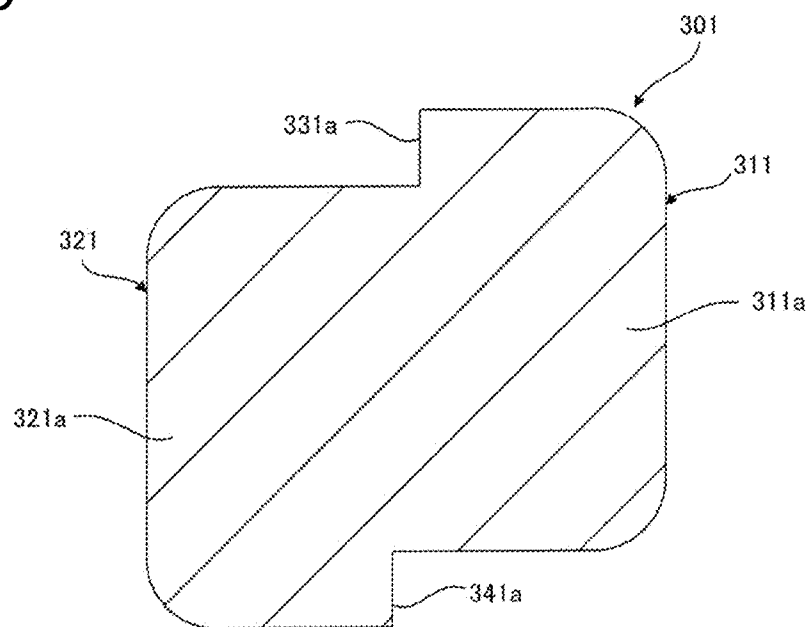


FIG. 2



**FIG.3**



**FIG.4**

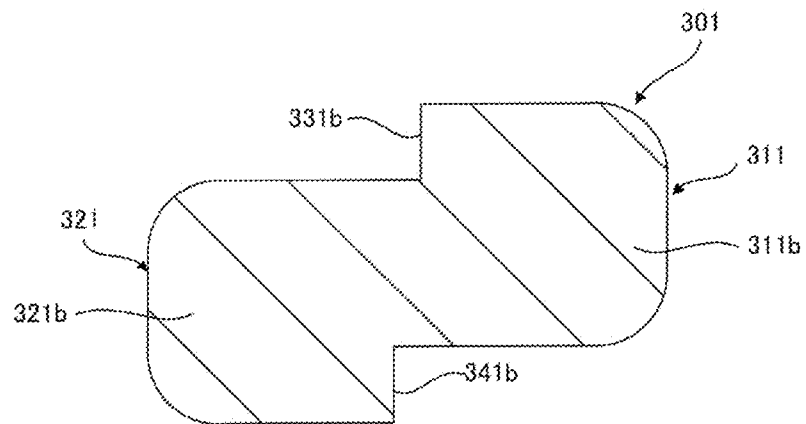


FIG. 5

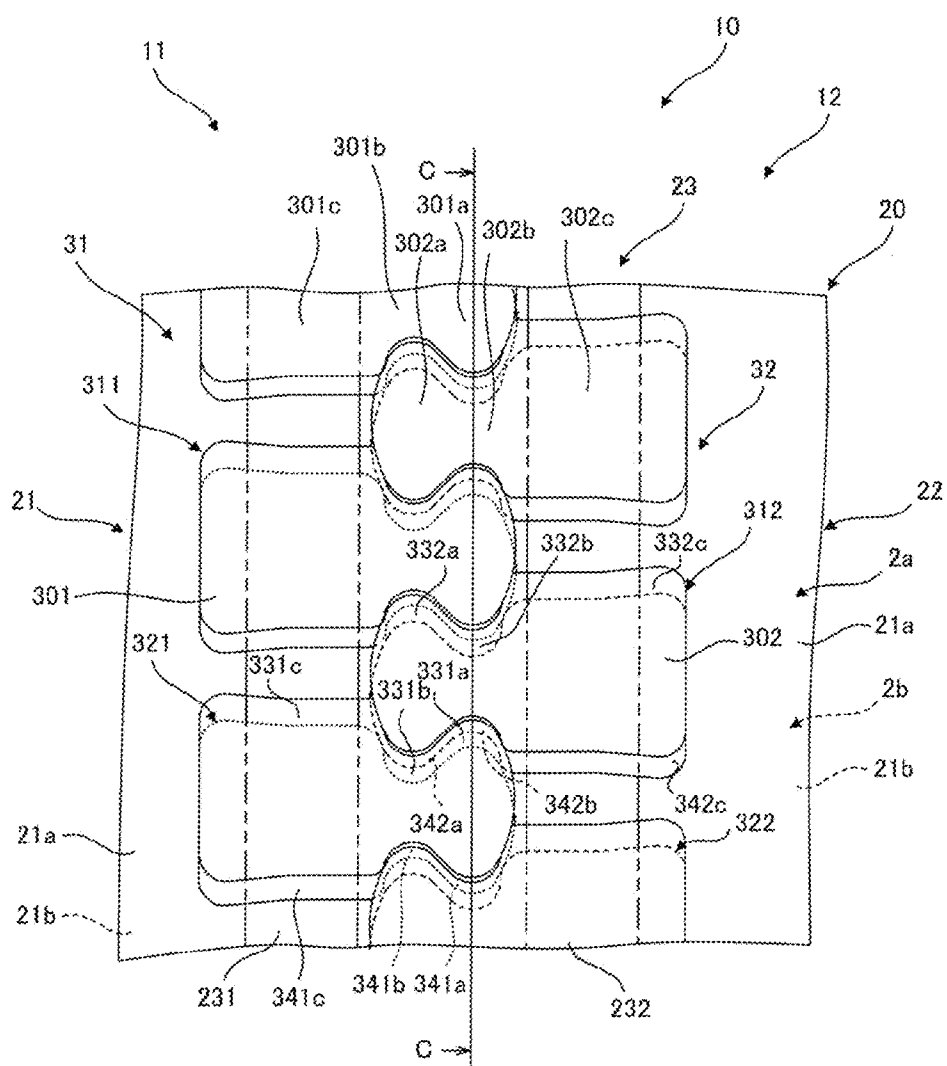


FIG. 6

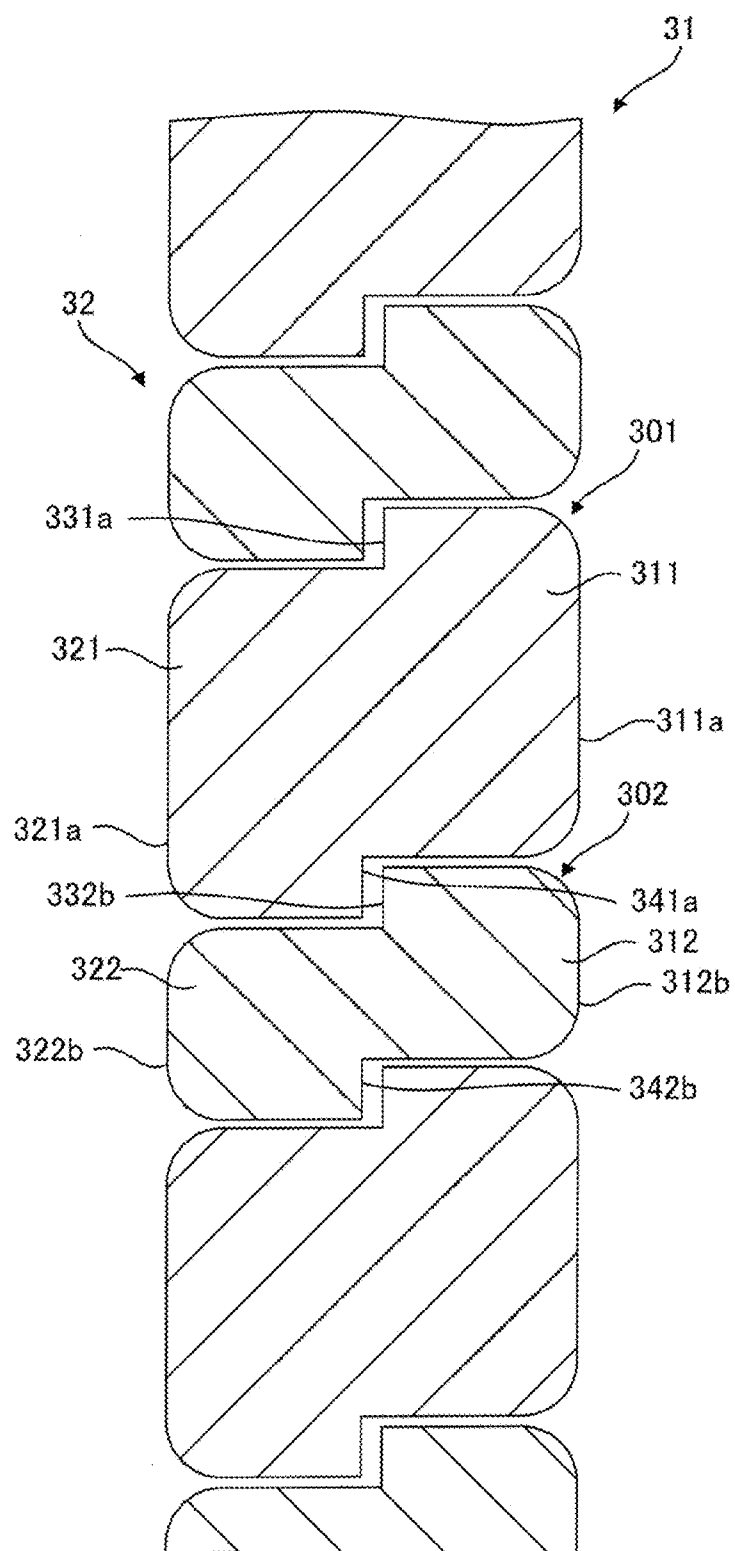


FIG. 7

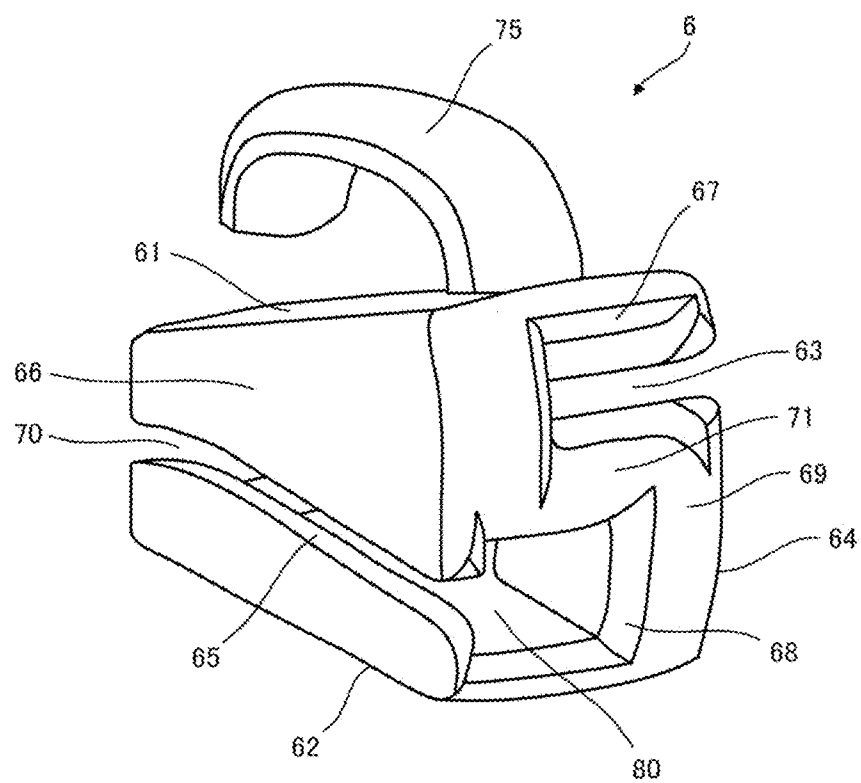


FIG. 8

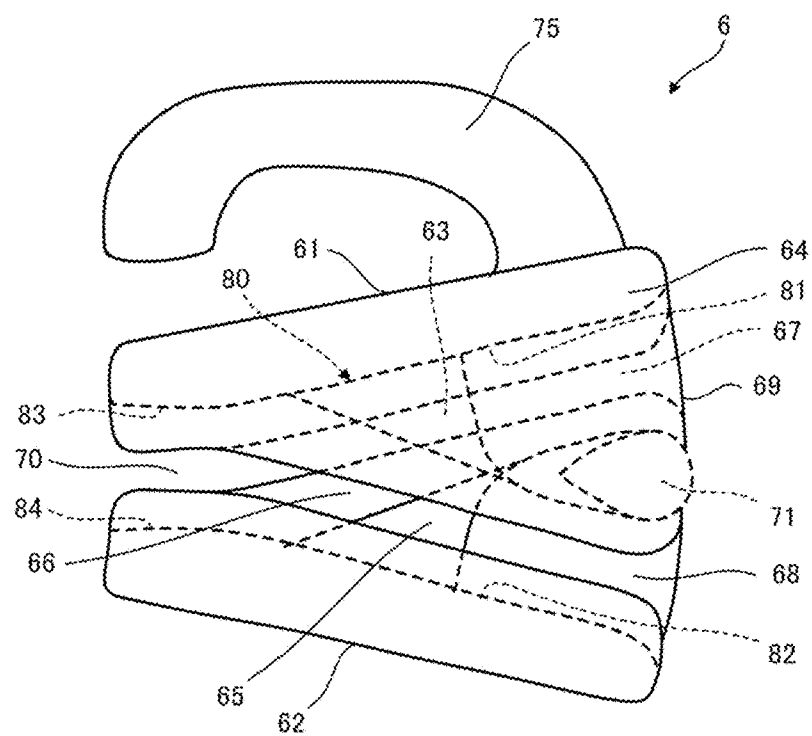


FIG. 9

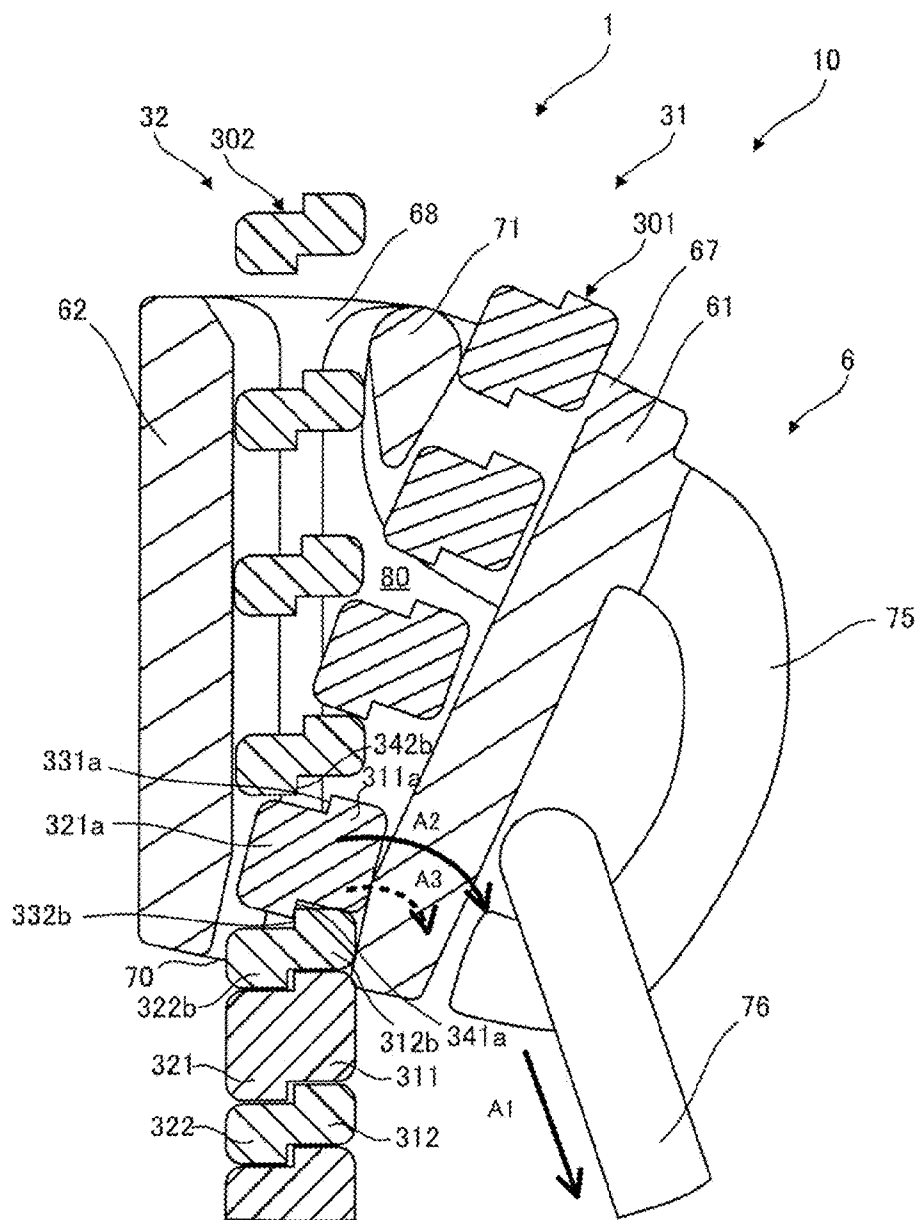


FIG. 10

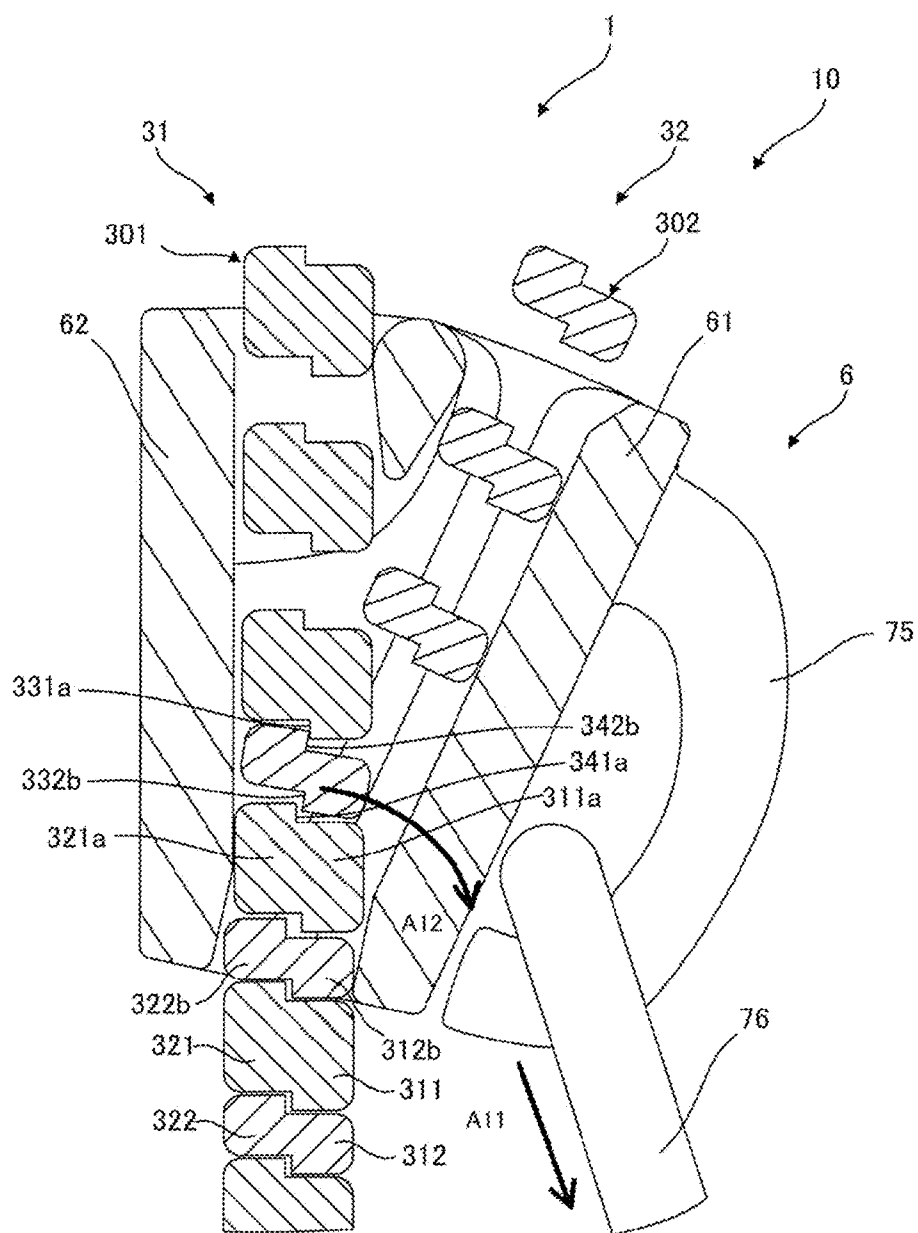




FIG. 12

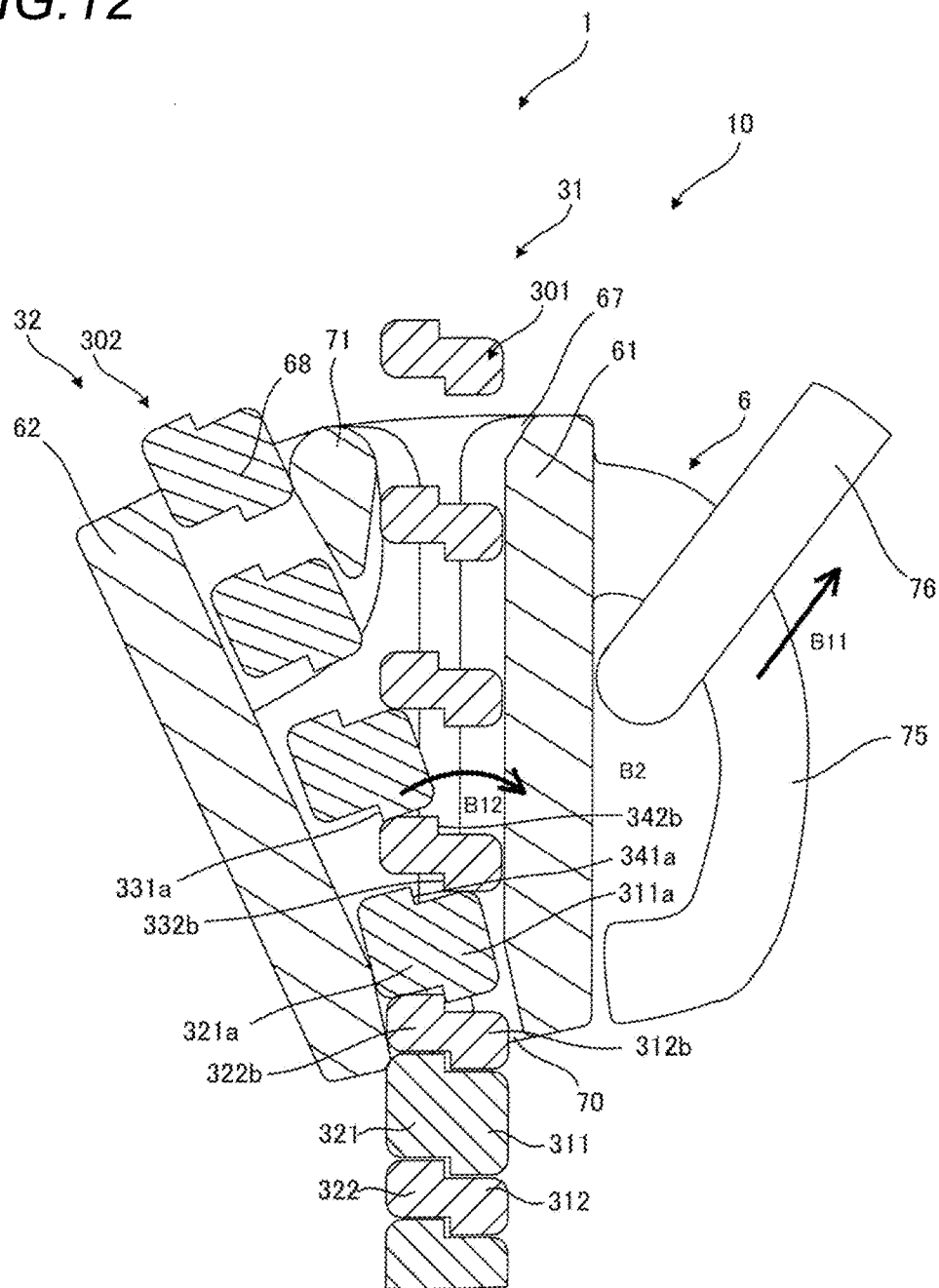


FIG. 13

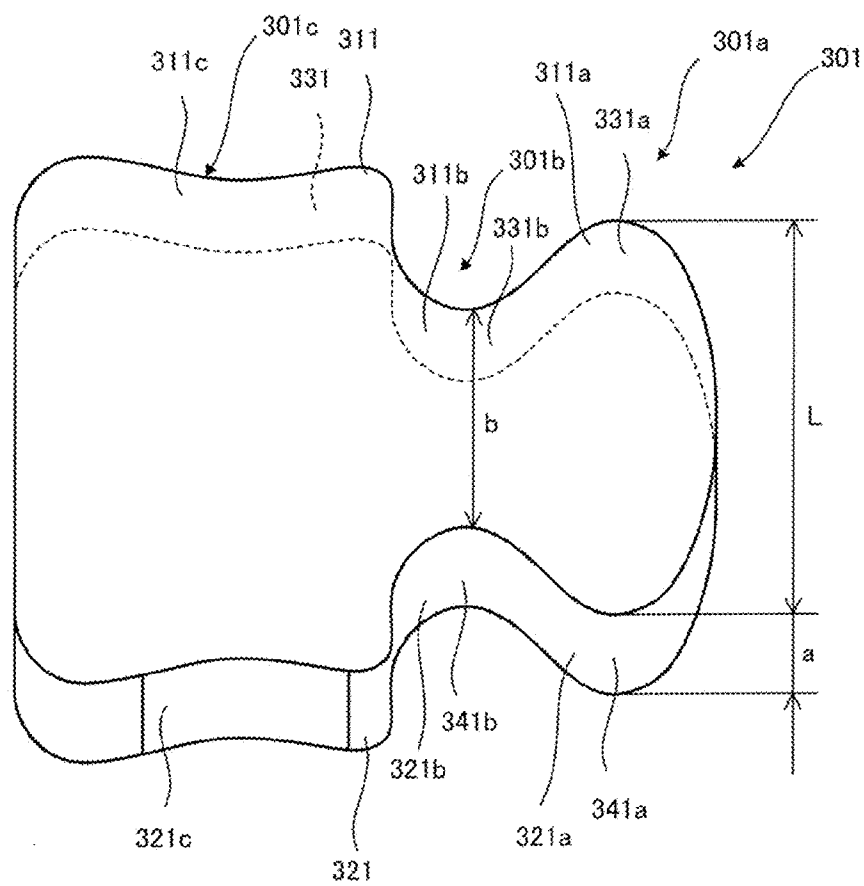


FIG. 14

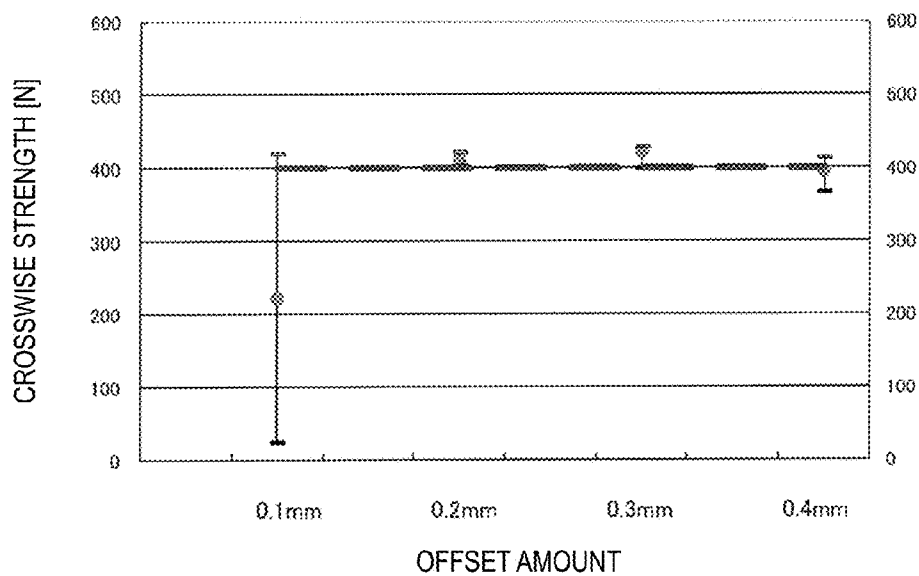
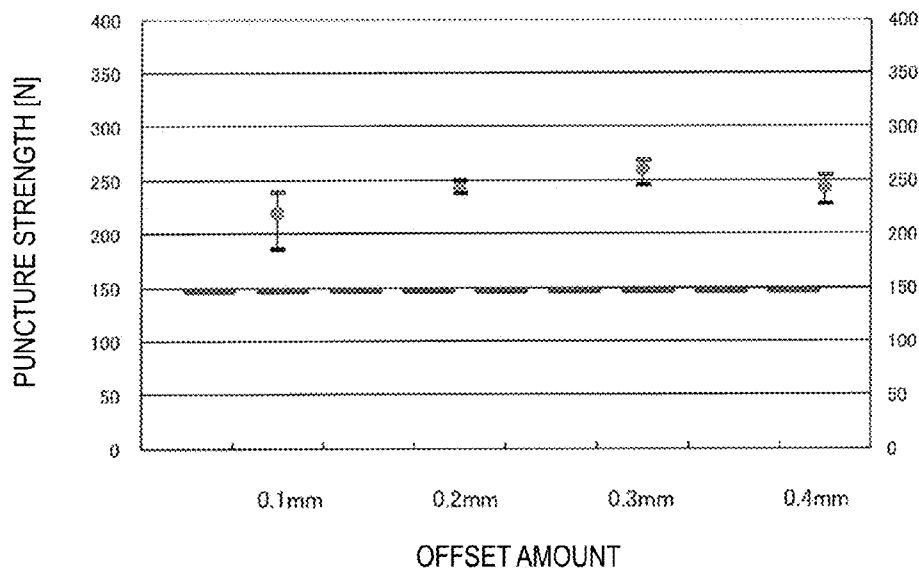
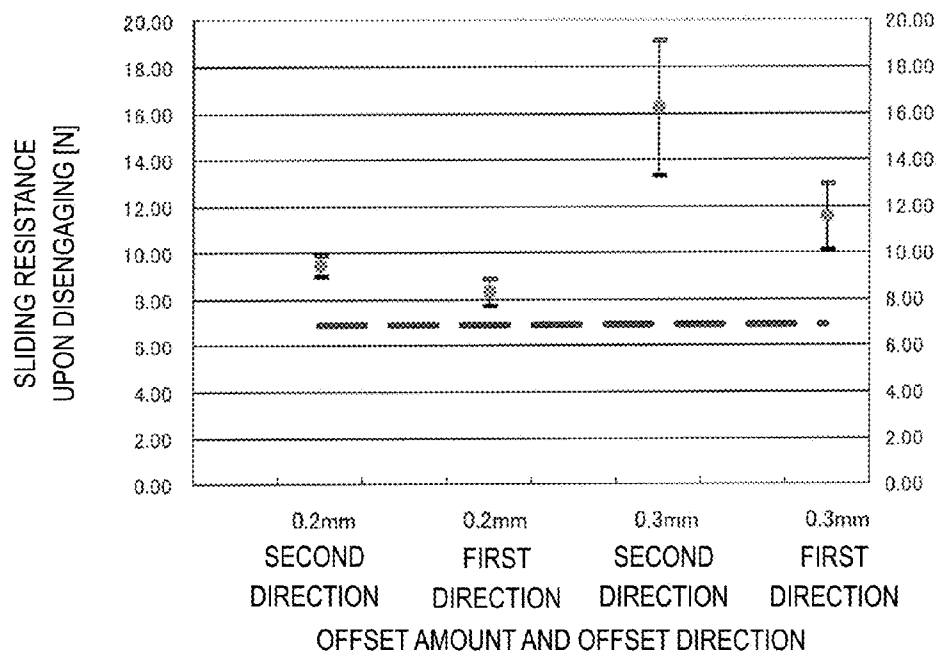


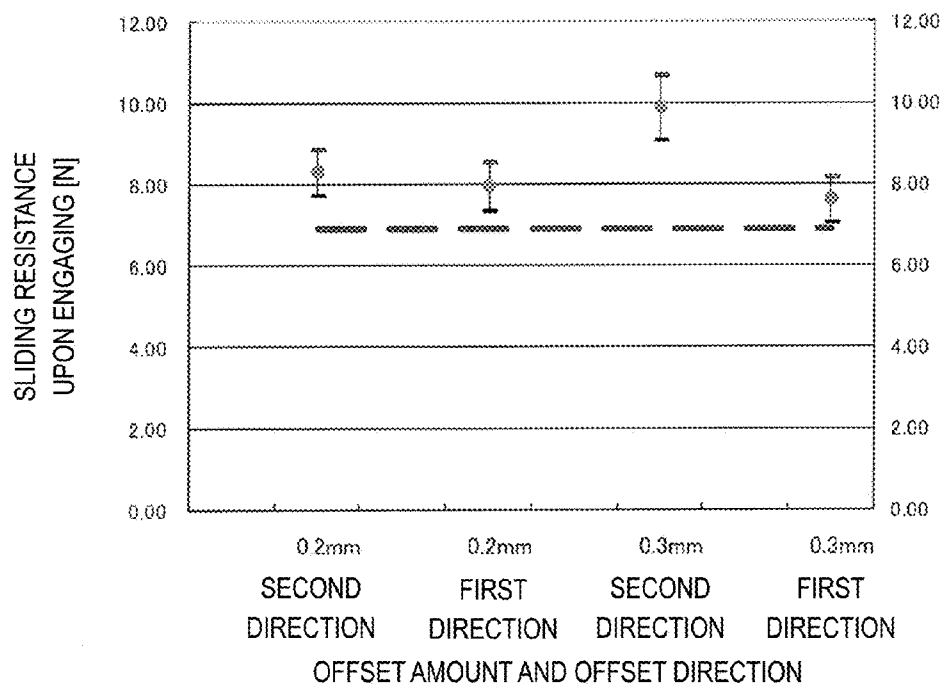
FIG. 15



**FIG. 16**



**FIG. 17**



**SLIDE FASTENER****TECHNICAL FIELD**

[0001] The present invention relates to a slide fastener in which a fastener chain has continuous element rows fixed to fastener tapes and is configured to be engaged and disengaged by a slider of a type, which causes engagement to be occurred in an upward and downward direction.

**BACKGROUND ART**

[0002] From WO 2010/082291 (Patent Document 1), a slide fastener is disclosed, in which an element guide passage of a slider has right and left shoulder mouths stepwise arranged in a front and back direction and configured, respectively, to allow a first element row and a second element row in a disengaged state to enter and exit therethrough, and a rear mouth configured to allow the first and second element rows in an engaged state to enter and exit therethrough, and an extension length of a front latch portion in the first element row is set to be shorter than an extension length of a front latch portion of the second element row.

[0003] According to the invention described in Patent Document 1, when right and left element rows are engaged with each other, the first element row having a shorter extension length and the second element row having a longer extension length are introduced from the front side in such a manner that the rows are stepped relative to each other in the front and rear direction, and then the right and left element rows are obliquely merged with each other in the front and back direction and the right and left direction, thereby allowing the element rows to be easily engaged with each other. Also, when the right and left element rows in the engaged state are disengaged from each other, the element rows are obliquely separated from each other in the front and back direction and the right and left direction, thereby allowing the element rows to be easily disengaged from each other.

**PRIOR ART DOCUMENT****Patent Document**

[0004] Patent Document 1: WO 2010/082291

**SUMMARY OF INVENTION****Problems to be Solved by Invention**

[0005] An object of the present invention is to provide a slide fastener, in which continuous element rows can be easily engaged with and disengaged from each other by a slider of a type, which causes engagement to be occurred in an upward and downward direction.

**Means for Solving Problems**

[0006] A slide fastener according to one embodiment of the present invention includes:

[0007] a fastener chain including a pair of fastener stringers having a pair of fastener tapes respectively having upper surfaces and lower surfaces opposite to the upper surfaces and element rows respectively constituted of a plurality of elements fixed to respective edge portions of the pair of

fastener tapes at a predetermined pitch, the fastener chain in which the element rows are arranged so as to oppose each other; and

[0008] a slider movable to engage and disengage the element rows with and from each other and including an upper blade arranged at a side of upper surfaces, a lower blade arranged at a side of the lower surfaces, a front end wall connecting the upper blade with the lower blade and having a first front mouth for allowing the first element row to enter and exit therethrough and a second front mouth stepwise provided at the side of the lower surfaces relative to the first front mouth, for allowing the second element row to enter and exit therethrough, and one rear mouth for allowing the pair of element rows in an engaged state to enter and exit therethrough,

[0009] wherein each of the elements has a base portion fixed to the respective fastener tapes and a head portion protruding from the base portion and configured to be engaged with the opposing elements,

[0010] wherein the head portion of each of the elements has a first head portion arranged at the side of the upper surfaces and a second head portion arranged at the side of the lower surfaces of the fastener tapes, and

[0011] wherein the first head portion is formed to be offset from the second head portion in the first direction.

[0012] In the slide fastener according to one embodiment of the present invention,

[0013] each of the elements has a neck portion located between the base portion and the head portion and having a width smaller than those of the base portion and the head portion,

[0014] the neck portion of each of the elements has a first neck portion arranged at the side of the upper surfaces and a second neck portion arranged at the side of the lower surfaces of the fastener tapes, and

[0015] the first neck portion is formed to be offset from the second neck portion in the first direction.

[0016] In the slide fastener according to one embodiment of the present invention,

[0017] each of the elements includes:

[0018] a first protrusion portion formed on the first head portion, which is located toward the respective lower surfaces and at a side of the first direction;

[0019] a first recess portion formed on the first neck portion, which is located toward the respective lower surfaces and at a side of the first direction;

[0020] a second protrusion portion formed on the second head portion, which is located toward the respective upper surfaces and at a side of a second direction opposite to the first direction; and

[0021] a second recess portion formed on the second neck portion, which is located toward the respective upper surfaces and at a side of the second direction opposite to the first direction,

[0022] upon engaging of the pair of fastener stringers, the first protrusion portion of the elements located at one side is engaged with the second recess portion of the opposing elements, and

[0023] the first recess portion of the elements located at the one side is engaged with the second protrusion portion of the opposing elements.

[0024] An offset amount by which the first head portion is offset from the second head portion is 0.2 mm or greater and 0.3 mm or smaller, and

[0025] a ratio of the offset amount with respect to a dimension of the head portion of the elements along the first direction is 9% or greater and 15% or smaller.

#### Advantageous Effects of Invention

[0026] According to the present invention, a slide fastener, in which continuous element rows can be easily engaged with and disengaged from each other by a slider of a type, which causes engagement to be occurred in an upward and downward direction, can be provided.

#### BRIEF DESCRIPTION OF DRAWINGS

[0027] FIG. 1 is a front view showing a slide fastener constructed using a fastener chain according to one embodiment of the present invention.

[0028] FIG. 2 is a view showing a disengaged state of the fastener chain according to one embodiment of the present invention.

[0029] FIG. 3 is a sectional view taken along a line A-A in FIG. 2.

[0030] FIG. 4 is a sectional view taken along a line B-B in FIG. 2.

[0031] FIG. 5 is a view showing an engaged state of elements of the fastener chain according to one embodiment of the present invention.

[0032] FIG. 6 is a sectional view taken along a line C-C in FIG. 5.

[0033] FIG. 7 is a perspective view of a slider of a slide fastener according to one embodiment of the present invention.

[0034] FIG. 8 is a side view of a slider of the slide fastener according to one embodiment of the present invention.

[0035] FIG. 9 is a views showing a state where the slide fastener of the present embodiment is being disengaged by the slider.

[0036] FIG. 10 is a view showing a state of a reference example where a slide fastener, which is reversed front to back and thus is different from the present embodiment, is being disengaged by a slider.

[0037] FIG. 11 is a view showing a state where the slide fastener of the present embodiment is being engaged by the slider.

[0038] FIG. 12 is a view showing a state of a reference example where a slide fastener, which is reversed front to back and thus is different from the present embodiment, is being engaged by a slider.

[0039] FIG. 13 is a view showing dimensions of an element 30 of the present embodiment.

[0040] FIG. 14 is a graph showing crosswise strength against offset amount in Table 1.

[0041] FIG. 15 is a graph showing puncture strength against offset amount in Table 1.

[0042] FIG. 16 is a graph showing sliding resistance upon disengaging against offset amount in Table 2.

[0043] FIG. 17 is a graph showing sliding resistance upon engaging against offset amount in Table 3.

#### EMBODIMENTS OF INVENTION

[0044] Hereinafter, a fastener chain 10 and a slide fastener 1 according to embodiments of the present invention will be described in detail on the basis of the accompanying drawings.

[0045] FIG. 1 is a front view showing a slide fastener constructed using a fastener chain according to one embodiment of the present invention.

[0046] The slide fastener 1 as explained in the present embodiment has a pair of right and left fastener chains 10 including a first fastener stringer 11, in which a first element row 31 constituted of a plurality of first elements 301 is attached to a first fastener tape 21, and a second fastener stringer 12, in which a second element row 32 constituted of a plurality of second elements 302 is attached to a second fastener tape 22, and a slider 6 configured to be slid along the right and left continuous element rows 31 and 32 and thus to engage and disengage the elements 301 and 302 of the continuous element rows 31 and 32 with and from each other.

[0047] Also, in the following description, a direction in which the continuous element rows are provided along a longitudinal direction of the fastener chain 10 is referred to as a front and rear direction, a direction in which the slider 6 is slid to engage the right and left continuous element rows 31 and 32 with each other is referred to as a front direction, and a direction in which the slider 6 is slide to disengage the element rows from each other is referred to as a rear direction. Also, a right and left direction refers to a direction horizontal to a plane of the fastener chain 10 and perpendicular to the front and rear direction. A direction perpendicular to a plane defined by the front and rear direction and the right and left direction is referred to as a front and back direction, a side of the fastener chain 6 on which a pull tab of the slider 6 exists is referred to as a front surface, and a side opposite thereto is referred to as a back surface. The front and back direction can be also referred to as an upward and downward direction, and correspondingly, the front surface can be also referred to as an upper surface and the back surface can be also referred to as a lower surface.

[0048] Further, the front direction and the rear direction may be interchangeably referred to as a first direction and a second direction, respectively. The second direction is a direction opposite to the first direction. In addition, the front surface and the back surface may be interchangeably referred to as a first surface and a second surface, respectively.

[0049] The fastener chain 10 is constituted of a pair of fastener stringers 11 and 12. The fastener stringers 11 and 12 have a pair of fastener tapes 20 each having an upper surface 21a and a lower surface 21b opposite to the upper surface 21a, and element rows 31 and 32 respectively constituted of a plurality of elements 301 and 302 fixed to respective edge portions 23 of the pair of fastener tapes 20 at a predetermined pitch. The element rows 31 and 32 are arranged to oppose each other.

[0050] Also, a top stop, not shown, is fixed to an upper end of each of continuous element rows 31 and 32 and one bottom stop, not shown, is fixed to lower ends of the continuous element rows 31 and 32. Thus, it can be prevented that the slider 6 is pulled out from the upper and lower ends of the continuous element rows 31 and 32. Alternatively, in the present embodiment, instead of the bottom stop, an opener, such as a separable pin and a retainer pin, may be fixed.

[0051] FIG. 2 is a view showing a disengaged state of the fastener chain according to one embodiment of the present

invention. FIG. 3 is a sectional view taken along a line A-A in FIG. 2. FIG. 4 is a sectional view taken along a line B-B in FIG. 2.

[0052] The first elements 301 have a head portion 301a located at the most outward side remotest from a first edge portion 231 of the first fastener tape 21 in the right and left direction of the fastener chain 10, a neck portion 301b located inward relative to the head portion 301a (close to the first edge portion 231) but outward relative to the first edge portion 231, and a base portion 301c located inward relative to the neck portion 301b and sandwiching the first edge portion 231. Also, the first elements 301 have a first half portion 311 arranged at a side of the upper surface 21a of the first fastener tape 21 and a second half portion 321 arranged at a side of the lower surface 21b of the first fastener tape 21. The first half portion 311 and the second half portion 321 are integrally formed with each other to sandwich the first fastener tape 21 from upper and lower sides thereof.

[0053] The first half portion 311 has a first base portion 311c in contact with the upper surface 21a of the first fastener tape 21, a first neck portion 311b protruding from the first base portion 311c and extending toward the outside of the first fastener tape 21, and a first head portion 311a formed on a distal end of the first neck portion 311b. The second half portion 321 has a second base portion 321c in contact with the lower surface 21b of the first fastener tape 21, a second neck portion 321b protruding from the second base portion 321c and extending toward the outside of the first fastener tape 21, and a second head portion 321a formed on a distal end of the second neck portion 321b. The first base portion 311c and the second base portion 321c sandwich the first edge portion 231 from the upward and downward directions.

[0054] The first elements 301 of the present embodiment are formed in a state where the first half portion 311 is offset relative to the second half portion 321 in the front direction or a state where the second half portion 321 is offset relative to the first half portion 311 in the rear direction. A first protrusion portion 331a is formed in front of the first head portion 311a of the first half portion 311, a first recess portion 331b is formed in front of the first neck portion 311b, and a first stepped portion 331c is formed in front of the first base portion 311c. A second protrusion portion 341a is formed in the rear of the second head portion 321a of the second half portion 321, a second recess portion 341b is formed in the rear of the second neck portion 321b, and a second stepped portion 341c is formed in the rear of the second base portion 321c.

[0055] The second fastener stringer 12 of the present embodiment is formed to be symmetric to the first fastener stringer 11 in the right and left direction, and components thereof are the same as those of the first fastener stringer 11. The second elements 302 have a head portion 302a located at the most outward side remotest from a second edge portion 232 of the second fastener tape 22 in the right and left direction of the fastener chain 10, a neck portion 302b located inward relative to the head portion 302a (close to the second edge portion 232) but outward relative to the second edge portion 232, and a base portion 302c located inward relative to the neck portion 302b and sandwiching the second edge portion 231. Also, the second elements 302 have a first half portion 312 arranged at the side of the upper surface 21a of the second fastener tape 22 and a second half portion 322 arranged at the side of the lower surface 21b of

the second fastener tape 22. The first half portion 312 and the second half portion 322 are integrally formed with each other to sandwich the second fastener tape 22 from upper and lower sides thereof.

[0056] The first half portion 312 has a first base portion 312c in contact with the upper surface 21a of the second fastener tape 22, a first neck portion 312b protruding from the first base portion 312c and extending toward the outside of the second fastener tape 22, and a first head portion 312a formed on a distal end of the second neck portion 312b. The second half portion 322 has a second base portion 322c in contact with the lower surface 21b of the second fastener tape 22, a second neck portion 322b protruding from the second base portion 322c and extending toward the outside of the second fastener tape 22, and a second head portion 322a formed on a distal end of the second neck portion 322b. The first base portion 312c and the second base portion 322c sandwich the second edge portion 232 from the upward and downward directions.

[0057] The second elements 302 of the present embodiment are formed in a state where the first half portion 312 is offset in the front direction or a state where the second half portion 322 is offset in the rear direction. A first protrusion portion 332a is formed in front of a side of the first half portion 312 opposite to the first head portion 312a, a first recess portion 332b is formed in front of a side thereof opposite to the first neck portion 312b, and a first stepped portion 332c is formed in front of a side thereof opposite to the first base portion 312c. A second protrusion portion 342a is formed in the rear of a side of the second half portion 322 opposite to the second head portion 322a, a second recess portion 342b is formed in the rear of a side thereof opposite to the second neck portion 322b, and a second stepped portion 342c is formed in the rear of a side thereof opposite to the second base portion 322c.

[0058] FIG. 5 is a view showing an engaged state of the fastener chain according to one embodiment of the present invention. FIG. 6 is a sectional view taken along a line C-C in FIG. 5.

[0059] In the engaged state of the fastener chain 10 of the present embodiment, as shown in FIG. 5, the head portion 301a of the first element row 31 and the neck portion 302b of the second element row 32, which are adjacent to each other in the front and rear direction, are engaged with each other, and the neck portion 301b of the first element row 31 and the head portion 302a of the second element row 32, which are adjacent to each other in the front and rear direction, are engaged with each other.

[0060] Also, as shown in FIG. 6, the first protrusion portion 331a of the first element 301 opposes to the second recess portion 342b of the second element 302 and the second protrusion portion 341a of the first element 301 opposes the first recess portion 332b of the second element 302, and although not shown, the first recess portion 331b of the first element 301 opposes the second protrusion portion 342a of the second element 302 and the second recess portion 341b of the first element 301 opposes the first protrusion portion 332a of the second element 302.

[0061] Accordingly, the first element row 31 and the second element row 32 opposing each other can be exactly engaged with each other.

[0062] Next, the slider 6 of the fastener chain 10 of the present embodiment will be described.

[0063] FIG. 7 is a perspective view of a slider of a slide fastener according to one embodiment of the present invention. FIG. 8 is a side view of the slider of the slide fastener according to one embodiment of the present invention.

[0064] Referring to FIGS. 7 and 8, the slider 6 according to the present embodiment includes, as a basis structure, an upper blade 61, a lower blade 62, a first side wall 64 having a first guide groove 63 for guiding the first fastener tape 21 shown in FIG. 1, a second side wall 66 having a second guide groove 65 for guiding the second fastener tape 2, a front end wall 69 connecting the upper blade 61 with the lower blade 62 and provided with a first front mouth 67 for allowing the first element row 31 in the disengaged state shown in FIG. 2 to enter and exit therethrough and a second front mouth 68 located below the first front mouth 67 for allowing the second element row 32 to enter and exit therethrough, and one rear mouth 70 for allowing the pair of element rows 31 and 32 in the engaged state shown in FIG. 1 to enter and exit therethrough.

[0065] A pull tab attaching portion 75 is provided on an upper surface of the upper blade 61. Although in the present embodiment, the pull tab attaching portion 75 has a gate shape of extending in a sliding direction in a cantilever shape with one end thereof fixed, the invention is not limited to such a configuration, and thus a pull tab attaching portion having any other shapes as known to those skilled in the art may be employed. Also, a pull tab having an annular portion at one end thereof may be prepared and then the pull tab may be pivotally attached to the pull tab attaching portion 75 via the annular portion. Further, a distal end of the pull tab attaching portion 75 may be crimped downward (i.e., a direction of approaching the distal end to the upper blade), thereby preventing a pull tab, not shown, from being easily separated from the pull tab attaching portion 75.

[0066] Referring to FIG. 8, two front mouths 67 and 68 and one rear mouth 70 are connected by a generally Y-shaped element guide passage 80 formed inside the slider to be furcated in the upward and downward direction along the guide grooves 63 and 65, respectively. The element guide passage 80 is defined by an inner surface of the upper blade 61, an inner surface of the lower blade 62, inner surfaces of right and left side walls 64 and 66, and an element guide post 71.

[0067] The inner surface of the upper blade 61 defining the element guide passage 80 has an inclined surface 81 inclined downward from the first front mouth 67 on the front surface side and a horizontal surface 83 connected to the inclined surface 81 and configured to cause the element rows to be engaged with each other. Also, the inner surface of the lower blade 62 has an inclined surface 82 inclined upward from the second front mouth 68 on the back surface side and a horizontal surface 84 connected to the inclined surface 82 and configured to cause the element rows to be engaged with each other. A rear end of each of horizontal surfaces 83 and 84 is connected to the rear mouth 70. Each of connection portions between the inclined surfaces 81 and 82 and the horizontal surfaces 83 and 84 is preferably formed in a curved line shape in order to allow a smooth movement of the element rows.

[0068] The guide grooves 63 and 65 have an inclined portion and a horizontal portion corresponding to shapes of the inner surface of the upper blade 61 and the inner surface of the lower blade 62, and connection portions therebetween are preferably formed in a curved line shape in order to

allow a smooth movement of the fastener tapes. Specifically, the first guide groove 63 formed in the first side wall 64 has a front end connected to the first front mouth 67 on the front surface side, an inclined portion connected to the front end and inclined downward, a horizontal portion connected to the inclined portion and configured to cause the element rows to be engaged with each other and a rear end connected to the horizontal portion and also connected to the rear mouth 70, and the inclined portion and the horizontal portion are formed to be parallel to the inner surface of the upper blade 61. The second guide groove 65 formed in the second side wall 66 has a front end connected to the second front mouth 68 on the back surface side, an inclined portion connected to the front end and inclined forward, a horizontal portion connected to the inclined portion and configured to cause the element rows to be engaged with each other and a rear end connected to the horizontal portion and also connected to the rear mouth 70, and the inclined portion and the horizontal portion are formed to be parallel to the inner surface of the lower blade 62.

[0069] Next, operations when elements of the fastener chain 10 of the present embodiment are disengaged by the slider 6 will be described.

[0070] FIG. 9 is a views showing a state where the slide fastener of the present embodiment is being disengaged by the slider.

[0071] When the slider 6 is moved in a direction of an arrow A1, a pair of element rows engaged with each other enters the slider 6 through the rear mouth 70. The element rows, which are initially engaged with each other, are disengaged by the element guide post 71 formed in the element guide passage 80.

[0072] In the slider 6 according to the present embodiment, each of two front mouths 67 and 68 exists to straddle the center line in the right and left direction, and thus the two front mouths 67 and 68 create an overlapped portion in the right and left direction. Accordingly, the element rows 31 and 32 are disengaged from each other in the front and back direction.

[0073] Upon disengaging, the first elements 301 directed toward the first front mount 67 on the front surface side are pulled in a direction of an arrow A2 as shown in FIG. 9. Then, the second protrusion portion 341a of the first element 301 and the first recess portion 332b of the second element 302 come in contact with each other, and the second recess portion 341b of the first element 301 and the first protrusion portion 332a of the second element 302, not shown, come in contact with each other. The first protrusion portion 332a of the first element 301 and the second recess portion 342b of the second element 302 are spaced from each other, and the first recess portion 331b of the first element 301 and the second protrusion portion 342a of the second element 302, not shown, are spaced from each other.

[0074] In order to cause the first element 301 to be spaced from the second element 302, a movement thereof in a direction of an arrow A3 is required. In a case of the present embodiment, the first element 301 is pulled in the direction of the arrow A2 after the second protrusion portion 341a and the second recess portion 341b of the first element 301 come in contact with the first recess portion 332b and the first protrusion portion 332a of the second element 302, respectively. Then, the first element 301 is inclined in the direction of the arrow A3 to have an angle allowing the first element 301 to be easily slide relative to the second element 302.

[0075] A force along the arrow A2 exerted on the first element 301 and a movement thereof in the direction of the arrow A3 shown in FIG. 9 have the same rotating direction, and accordingly the first element 301 can be easily moved in the direction of the arrow A3 by a force in the direction A1 of pulling the slider 6. Thus, as the slider 6 is further moved, the first elements 301 and the second elements 302 can be easily spaced from each other.

[0076] FIG. 10 is a view showing a state of a reference example where a slide fastener, which is reversed front to back and thus is different from the present embodiment, is being disengaged by a slider.

[0077] In a case of the example in which orientation of the elements is different from that of the present embodiment as shown in FIG. 10, if upon disengaging, a slider 6 is pulled in a direction of an arrow A11 to be moved rearward, second elements 302 directed toward a first front mouth 67 on the front surface side are moved in a direction of an arrow A12. Then, a first protrusion portion 331a of a first element 301 and a second recess portion 342b of a second element 302 come in contact with each other, and a first recess portion 331b of the first element 301 and the second protrusion portion 342a of the second element 302, not shown, come in contact with each other. Then, a force causing rotation thereof about such contact points is occurred on the second element 302, and thus the second protrusion portion 341a of the first element 301 and the second recess portion 342b of the second element 302 come in contact with each other and the second recess portion 341b of the first element 301 and the second protrusion portion 342a of the second element 302, not shown, also come in contact with each other.

[0078] In this case, because the first protrusion portion 331a of the first element 301 and the second recess portion 342b of the second element 302 come in contact with each other and the first recess portion 331b of the first element 301 and the second protrusion portion 342a of the second element 302, not shown, come in contact with each other, it is difficult to space the first element 301 and the second element 302 from each other.

[0079] Next, operations when elements of the fastener chain 10 of the present embodiment are engaged by the slider 6 will be described.

[0080] FIG. 11 is a view showing a state where the slide fastener of the present embodiment is being engaged by the slider.

[0081] When the slider 6 is moved in a direction of an arrow B1, the first elements 301 in the disengaged state enter through the first front mouth 67 on the front surface side and the second elements 302 enter through the second front mouth 68 on the back surface side. As the first elements 301 and the second elements 302 are guided by the element guide passage 80, the first elements 301 and the second elements 302 are engaged in front of the rear mouth 70 and then are discharged through the rear mouth 70.

[0082] Upon engaging, the second elements 302, which have entered through the second front mouth 68 on the back surface side and then passed over the element guide post 71, are pulled in a direction of an arrow B2 as shown in FIG. 11. Then, the first protrusion portion 331a of the first element 301 and the second recess portion 342b of the second element 302 come in contact with each other and the first recess portion 331b of the first element 301 and the second protrusion portion 342a of the second element 302, not

shown, come in contact with each other, thereby causing the second element 302 to be moved in a direction of an arrow B3.

[0083] A force along the arrow B2 exerted on the second element 302 and a movement thereof in the direction of the arrow B3 shown in FIG. 11 have the same rotating direction, and accordingly the second element 302 can be easily moved in the direction of the arrow B3 by a force in the direction B1 of pulling the slider 6. Thus, as the slider 6 is further moved, the first elements 301 and the second elements 302 can be easily engaged with each other.

[0084] FIG. 12 is a view showing a state of a reference example where a slide fastener, which is reversed front to back and thus is different from the present embodiment, is being engaged by a slider.

[0085] In a case of the example in which orientation of the elements is different from that of the present embodiment as shown in FIG. 12, if upon engaging, a slider 6 is pulled and moved in a direction of an arrow B11, a first element 301, which has passed over the element guide post 71, of the first elements 301 directed toward a rear mouth 70, is moved in a direction of an arrow

[0086] B12.

[0087] Then, a surface of a first head portion 311a of the first element 301 comes in contact with a second recess portion 332b of a second element 302, and thus there is a possibility that engagement of the first element 301 with the second element 302 is interfered.

[0088] Next, an offset dimension (also referred to as an offset amount) between the first half portion 311 and the second half portion 322 of each element of the present embodiment will be described. Meanwhile, the offset amount means a dimension by which the first head portion 311a is offset from the second head portion 321a, and also a dimension by which the first neck portion (311b) is offset from the second neck portion (321b).

[0089] FIG. 13 is a view showing dimensions of an element 30 of the present embodiment. Meanwhile, in the following, dimensions of the first element 301 will be described by way of example, but the same can be also applied to the second element 302.

[0090] As shown in FIG. 13, the largest dimension of the head portion 301a of the first element 301 in the front and rear direction is indicated as L, the offset amount is indicated as a, and the smallest dimension of the neck portion 301b in the front and rear direction is indicated as b. Meanwhile, the dimension L in the front and rear direction can be interchangeably referred to as a dimension along a first direction or a dimension along a second direction. Herein, the first head portion 311a of the first half portion 311 and the second head portion 321a of the second half portion 321 have the same dimensions. Also, the first neck portion 311b and the second neck portion 321b have the same dimensions.

[0091] The offset amount a between the first half portion 311 and the second half portion 321 of the first element 301 is a dimension of the first protrusion portion 331a and the second protrusion portion 341a of the first element 301 in the front and rear direction, if stated in another way. Meanwhile, the offset amount a is the same as a dimension of the first recess portion 331b and the second recess portion 341b.

[0092] In order to measure the offset amount a, a dimension from a front end edge of the first head portion 311a of the first half portion 311 to a front end edge of the second head portion 321a of the second half portion 321, or a

dimension from a rear end edge of the second head portion **321a** of the second half portion **321** to a rear end edge of the first head portion **311a** of the first half portion **311** is measured. Alternatively, the offset amount  $a$  may be obtained by measuring a dimension from a front end edge of the first neck portion **311b** of the first half portion **311** to a front end edge of the second neck portion **321b** of the second half portion **321**, or measuring a dimension from a rear end edge of the second neck portion **321b** of the second half portion **321** to a rear end edge of the first neck portion **311b** of the first half portion **311**.

**[0093]** Table 1 shows results of strength tests of the chain performed with regard to two items, i.e., crosswise strength and puncture strength. Also, FIG. 14 is a graph showing crosswise strength against offset amount in Table 1. FIG. 15 is a graph showing puncture strength against offset amount in Table 1. Herein, the crosswise strength means a magnitude of resistance when right and left fastener tapes are pulled at a predetermined speed in right and left directions opposite to each other in a state where the fastener chain is engaged. Also, the puncture strength means a magnitude of resistance when elements are vertically pushed up relative to the tape surface in a state where the fastener chain is engaged. The units are [N]. Five fastener chains for each of crosswise strength and puncture strength are prepared, and a magnitude of resistance for each is recorded and a maximum value (max), a minimum value (min) and an average (Ave) are shown.

TABLE 1

|     | Crosswise Strength (N) |        |        |        | Puncture Strength (N) |        |        |        |
|-----|------------------------|--------|--------|--------|-----------------------|--------|--------|--------|
|     | 0.1 mm                 | 0.2 mm | 0.3 mm | 0.4 mm | 0.1 mm                | 0.2 mm | 0.3 mm | 0.4 mm |
| Ave | 221                    | 411    | 421    | 395    | 219                   | 242    | 260    | 243    |
| max | 420                    | 422    | 429    | 414    | 239                   | 250    | 269    | 255    |
| min | 24                     | 403    | 400    | 367    | 186                   | 238    | 246    | 228    |

**[0094]** As shown in FIG. 14, the fastener chains have an average of crosswise strength below a predetermined reference value of 400 N in cases where the offset amount is 0.1 mm and 0.4 mm. This cannot be said that the fastener chains has a sufficient strength, and accordingly, it is preferable that the offset amount  $a$  of the fastener chain satisfy the following equation (1).

$$0.2 \leq a \leq 0.3 \quad (1)$$

**[0095]** Also, a ratio of the offset amount  $a$  with respect to the dimension  $L$  of the head portion **301a** of the first element **301** may be prescribed. In this case, it is preferable that the ratio satisfy the following equation (2)

$$9\% \leq a/L \leq 15\% \quad (2)$$

**[0096]** More preferably, the ratio may satisfy  $9.6\% \leq a/L \leq 14.4\%$ .

**[0097]** According to this equation, if the ratio is smaller than 9%, a sufficient crosswise strength or puncture strength cannot be obtained, and if the ratio is greater than 15%, a sliding resistance upon engaging and disengaging is increased. Herein, a cause of increasing the sliding resistance is that for example, in case where right and left elements are disengaged from each other inside the slider, the right and left elements are disengaged from the engaged state in a posture where the elements are inclined so that

front mouths of the slider are separated from each other in the upward and downward direction. Thus, if  $a/L$  is greater, in order to disengage the elements from each other, the elements have to be inclined by largely changing the posture thereof, thereby increasing the sliding resistance. Upon engaging, the right and left elements in the disengaged state are changed in posture to become from the inclined state to a horizontal state, thereby increasing the sliding resistance, like upon disengaging.

**[0098]** In the present embodiment, preferably,  $L=2.1$  mm. Meanwhile, as a reference, a dimension (width)  $b$  of the neck portion of the present embodiment in the front and rear direction is set to 1.2 mm.

**[0099]** Table 2 shows sliding resistances upon disengaging of slide fasteners. Table 3 shows sliding resistances upon engaging of slide fasteners. FIG. 16 is a graph showing sliding resistance upon disengaging against offset amount in Table 2. FIG. 17 is a graph showing sliding resistance upon engaging against offset amount in Table 3. Herein, the sliding resistance upon engaging is a magnitude of resistance when a pull tab of a slider of a slide fastener is pulled and moved in a direction of engaging the slide fastener, and the sliding resistance upon disengaging is a magnitude of resistance when the pull tab of the slider of the slide fastener is pulled and moved in a direction of disengaging the slide fastener.

**[0100]** In Tables, “0.2 mm Second direction” is a case where an offset amount  $a$  of elements is 0.2 mm and a first half portion **311** is offset from a second half portion **321** in the rear direction (second direction), and “0.2 mm First direction” is a case where an offset amount  $a$  of elements is 0.2 mm and a first half portion **311** is offset from a second half portion **321** in the front direction (first direction). Also, “0.3 mm Second direction” is a case where an offset amount  $a$  of elements is 0.3 mm and a first half portion **311** is offset from a second half portion **321** in the rear direction (second direction), and “0.3 mm First direction” is a case where an offset amount  $a$  of elements is 0.3 mm and a first half portion **311** is offset from a second half portion **321** in the front direction (first direction). The unit is [N].

**[0101]** Table 2 shows a magnitude of resistance of a slider when a slide fastener in an engaged state is disengaged by the slider. Five slide fasteners are prepared, and a magnitude of resistance when the slider is slid is recorded and a maximum value (max), a minimum value (min) and an average (Ave) are shown.

TABLE 2

| Offset Amount<br>a of Element<br>Offset Direction | 0.2 mm<br>Second<br>Direction | 0.2 mm<br>First<br>Direction | 0.3 mm<br>Second<br>Direction | 0.3 mm<br>First<br>Direction |
|---------------------------------------------------|-------------------------------|------------------------------|-------------------------------|------------------------------|
| Ave                                               | 9.48                          | 8.34                         | 16.24                         | 11.56                        |
| max                                               | 9.93                          | 8.92                         | 19.14                         | 12.97                        |
| min                                               | 9.02                          | 7.75                         | 13.34                         | 10.14                        |

**[0102]** Table 3 shows a magnitude of resistance of a slider when a slide fastener in a disengaged state is engaged by the slider. Five slide fasteners are prepared, and a magnitude of resistance when the slider is slid is recorded and a maximum value (max), a minimum value (min) and an average (Ave) are shown.

TABLE 3

| Offset Amount<br>a of Element<br>Offset Direction | 0.2 mm<br>Second<br>direction | 0.2 mm<br>First<br>direction | 0.3 mm<br>Second<br>direction | 0.3 mm<br>First direction |
|---------------------------------------------------|-------------------------------|------------------------------|-------------------------------|---------------------------|
| Ave                                               | 8.30                          | 7.96                         | 9.89                          | 7.63                      |
| Max                                               | 8.86                          | 8.55                         | 10.69                         | 8.18                      |
| Min                                               | 7.74                          | 7.36                         | 9.09                          | 7.07                      |

[0103] As shown in FIGS. 16 and 17, in each case of having the same offset amount of 0.2 mm or 0.3 mm, a sliding resistance of slide fasteners in which a first half portion 311 of a first element 301 is offset from a second half portion 321 in the front direction (first direction) as shown in FIG. 13 is smaller than a sliding resistance of slide fasteners in which a first half portion 311 of a first element 301 is offset from a second half portion 321 in the rear direction (second direction). In other words, if offset amounts are the same, slide fasteners in which the first half portion 311 of the first element 301 is offset from the second half portion 321 in the front direction (first direction) can be slid more smoothly than slide fasteners in which the first half portion 311 of the first element 301 is offset from the second half portion 321 in the rear direction (second direction). Meanwhile, as described above, the same results are also obtained for the second element 302.

[0104] As described above, the slide fastener 1 of the present embodiment includes a fastener chain 10 including a pair of fastener stringers 11 and 12 having a pair of fastener tapes 21 and 22 respectively having upper surfaces 21a and 22a and lower surfaces 21b and 22b opposite to the upper surfaces 21a and 22a and element rows respectively constituted of a plurality of elements 301 and 302 fixed to respective edge portions 23 of the pair of fastener tapes 21 and 22 at a predetermined pitch, in which the element rows 31 and 32 are arranged so as to oppose each other; and a slider 6 movable to engage and disengage the element rows 31 and 32 with and from each other and including an upper blade 61 arranged at a side of the upper surfaces 21a and 22a and configured to allow a pull tab 76 to be attached thereon, a lower blade 62 arranged at a side of the lower surfaces 21b and 22b, a front end wall 69 connecting the upper blade 61 with the lower blade 62 and having a first front mouth 67 for allowing the first element row 31 to enter and exit therethrough and a second front mouth 68 provided at the side of the lower surfaces relative to the first front mouth 67, for allowing the second element row 32 to enter and exit therethrough, and one rear mouth 70 for allowing the pair of element rows 31 and 32 in an engaged state to enter and exit therethrough. In the front end wall, the second front mouth 68 is provided to be stepped relative to the first front mouth 67 in the upward and downward and to be positioned below the first front mouth 67.

[0105] Each of the elements 301 and 302 has a base portion 301c and 302c fixed to the respective fastener tapes 2 and a head portion 301a and 302a protruding from the base portion 301c and 302c and configured to be engaged with opposing elements 301 and 302, and the head portion 301a and 302a of each of the elements 301 and 302 has a first head portion 311a and 312a arranged at the side of the upper surfaces 21a and 22a, and a second head portion 321a and 321b arranged at the side of the respective lower surfaces 21b and 22b of the fastener tapes 21 and 22. The first head portion 311a and 312a is formed to be offset from the second

head portion 321a and 322a in a first direction along which the slider 6 is moved when engaging the element rows 31 and 32 with each other. A slide fastener, in which continuous element rows 31 and 32 can be easily engaged with and disengaged from each other by a slider 6 of a type, which causes engagement to be occurred in the upward and downward direction, can be provided.

[0106] Also, according to the slide fastener 1 of the present embodiment, each of the elements 301 and 302 has a neck portion 301b and 302b located between the base portion 301c and 302c and the head portion 301a and 302a and having a width as a dimension in the front and rear direction smaller than those of the base portion 301c and 302c and the head portion 301a and 302a, and the neck portion 301a and 302a of each of the elements 301 and 302 has a first neck portion 311b and 312b arranged at the side of the lower surfaces 21a and 22a and a second neck portion 321b and 322b arranged at the side of the lower surfaces 21b and 22b of the fastener tapes 20. Also, the first neck portion 311b and 312b is formed to be offset from the second neck portion 321b and 322b in the first direction when the element rows 31 and 32 are engaged with each other. Accordingly, a slide fastener which can be more easily and stably engaged and disengaged can be provided.

[0107] Further, according to the slide fastener 1 of the present embodiment, each of the elements 301 and 302 has a first protrusion portion 331a and 332a formed on a side of the first head portion 311a and 312a, which is located toward the respective lower surfaces 21b and 22b and faces the first direction, a first recess portion 331b and 332b formed on a side of the first neck portion 311b and 312b, which is located toward the respective lower surfaces 21b and 22b and faces the first direction, a second protrusion portion 341a and 342a formed on a side of the second head portion 321a and 322a, which is located toward the respective upper surfaces 21a and 22a and faces a second direction opposite to the first direction, and a second recess portion 341b and 342b formed on a side of the second neck portion 321b and 322b, which is located toward the respective upper surfaces 21a and 22a and faces the second direction opposite to the first direction. Also, upon engaging of the pair of fastener stringers, the first protrusion portion 331a and 332a of the elements 301 and 302 located on one side is engaged with the second recess portion 341b and 342b of the opposing elements 301 and 302, and the first recess portion 331b and 332b of the elements 301 and 302 located on the one side is engaged with the second protrusion portion 341a and 342a of the opposing elements 301 and 302. Accordingly, a slide fastener which can be stably engaged and disengaged can be provided.

[0108] Further, according to the slide fastener 1 of the present embodiment, an offset amount a by which the first head portion 311a and 312a is offset from the second head portion 321a and 322a is 0.2 mm or greater and 0.3 mm or smaller and a ratio a/L of the offset amount a with respect to a dimension L of the head portion 301a and 302a of the elements 301 and 302 along the first direction is 9% or greater and 15% or smaller. Accordingly, a slide fastener 1 which strengths required for the fastener are sufficient and a sliding resistance is small can be obtained. If the ratio is smaller than 9%, sufficient strengths cannot be obtained, and if the ratio is greater than 15%, the sliding resistance is increased.

[0109] Although various embodiments of the present invention have been described in the foregoing, the present invention is not limited to the foregoing embodiments, and accordingly, any other embodiments constructed by appropriately combining configurations of the foregoing embodiments are intended to be encompassed by the scope of the invention.

#### DESCRIPTION OF REFERENCE NUMERALS

|        |                  |                           |
|--------|------------------|---------------------------|
| [0110] | 301 . . .        | First Element             |
| [0111] | 302 . . .        | Second Element            |
| [0112] | 301a, 302a . . . | Head Portion              |
| [0113] | 301b, 302b . . . | Neck Portion              |
| [0114] | 301c, 302c . . . | Base Portion              |
| [0115] | 311, 312 . . .   | First Half Portion        |
| [0116] | 311a, 312a . . . | First Head Portion        |
| [0117] | 311b, 312b . . . | First Neck Portion        |
| [0118] | 311c, 312c . . . | First Base Portion        |
| [0119] | 321, 322 . . .   | Second Half Portion       |
| [0120] | 321a, 322a . . . | Second Head Portion       |
| [0121] | 321b, 322b . . . | Second Neck Portion       |
| [0122] | 321c, 322c . . . | Second Base Portion       |
| [0123] | 331a, 332a . . . | First Protrusion Portion  |
| [0124] | 331b, 332b . . . | First Recess Portion      |
| [0125] | 331c, 332c . . . | First Stepped Portion     |
| [0126] | 341a, 342a . . . | Second Protrusion Portion |
| [0127] | 341b, 342b . . . | Second Recess Portion     |
| [0128] | 341c, 342c . . . | Second Stepped Portion    |
| [0129] | 6 . . .          | Slider                    |
| [0130] | 1 . . .          | Slide Fastener            |

#### 1. A slide fastener, comprising:

a fastener chain comprising a pair of fastener stringers having a pair of fastener tapes respectively having upper surfaces and lower surfaces opposite to the upper surfaces and element rows respectively constituted of a plurality of elements fixed to respective edge portions of the pair of fastener tapes at a predetermined pitch, the fastener chain in which the element rows are arranged so as to oppose each other; and

a slider including an upper blade arranged at a side of the upper surfaces, a lower blade arranged at a side of the lower surfaces, a front end wall connecting the upper blade with the lower blade and having a first front mouth for allowing the first element row to enter and exit therethrough and a second front mouth provided at the side of the lower surfaces relative to the first front mouth, for allowing the second element row to enter and exit therethrough, and one rear mouth for allowing the pair of element rows in an engaged state to enter and exit therethrough,

wherein the slider is movable in a first direction, along which the slider is moved to engage the element rows with each other, and in a second direction opposite to the first direction, along which the slider is moved to disengage the element rows from each other,

wherein each of the elements has a base portion fixed to the respective fastener tapes and a head portion protruding from the base portion and configured to be engaged with the opposing elements;

wherein the head portion of each of the elements has a first head portion arranged at the side of the upper surfaces and a second head portion arranged at the side of the lower surfaces of the fastener tapes,

wherein the first head portion is formed to be offset from the second head portion in the first direction.

#### 2. The slide fastener according to claim 1,

wherein each of the elements has a neck portion located between the base portion and the head portion and having a width smaller than those of the base portion and the head portion,

wherein the neck portion of each of the elements has a first neck portion arranged at the side of the upper surfaces and a second neck portion arranged at the side of the lower surfaces of the fastener tapes,

wherein the first neck portion is formed to be offset from the second neck portion in the first direction.

#### 3. The slide fastener according to claim 2,

wherein each of the elements comprises:

a first protrusion portion formed on the first head portion at a side of the first direction;

a first recess portion formed on the first neck portion at a side of the first direction;

a second protrusion portion formed on the second head portion at a side of the second direction; and

a second recess portion formed on the second neck portion at a side of the second direction,

wherein upon engaging of the pair of fastener stringers, the first protrusion portion of the elements located at one side is engaged with the second recess portion of the opposing elements, and

wherein the first recess portion of the elements located at the one side is engaged with the second protrusion portion of the opposing elements.

#### 4. The slide fastener according to claim 1,

wherein an offset amount of the first head portion from the second head portion is 0.2 mm or greater and 0.3 mm or smaller, and

wherein a ratio of the offset amount with respect to a dimension of the head portion of the elements along the first direction is 9% or greater and 15% or smaller.

\* \* \* \* \*