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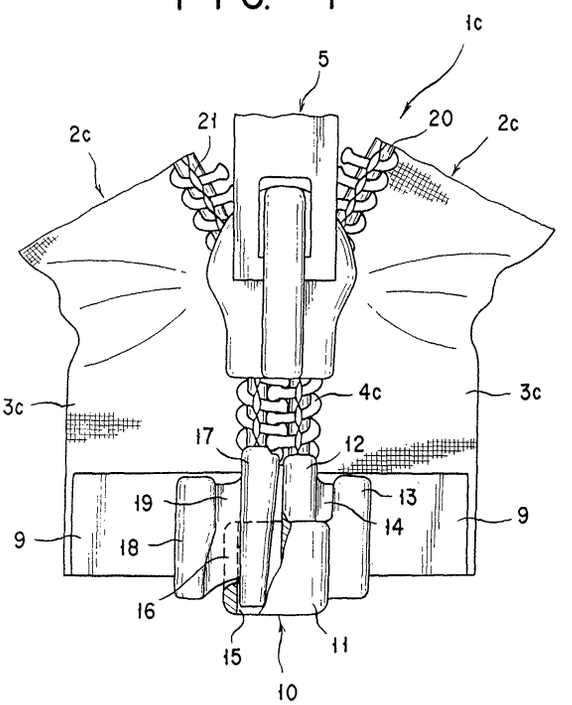
(54) Fastener product made of hydrolysis-resistent synthetic resin

(57) In a fastener product made of a synthetic resin such as a slide fastener, a separable fastener and a snap tape comprising an attachment part and an engagement part, at least the engagement part is made of a hydrolysis-resistant synthetic resin. Preferably, the hydrolysis-resistant synthetic resin is polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein. In a slide fastener (1-1c) having a pair of fastener tapes (3-3i) and coupling elements (4-4i) fixed to the longitudinal edges of the fastener tapes, they are made of a hydrolysis-resistant synthetic resin material. When the slide fastener further comprises upper and lower stop members (7, 8), a pin-and-box separator (10), a pair of reinforcing sheet-like members (9), sewing threads (21) and core cords (20), they are made of the hydrolysis-resistant synthetic resin material.

FIG. 4



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

[0001] This invention relates to a fastener product made of a synthetic resin, which product is excellent in resistance to moist heat and resistance to hydrolysis. More particularly, the present invention relates to recyclable fastener products of synthetic resin such as slide fasteners of synthetic resin, separable fasteners or surface fasteners of synthetic resin and snap tapes (tapes with snap buttons) of synthetic resin, which products are excellent in durability against wet heat and capable of maintaining the stable state of engagement without producing deterioration of strength even when repeatedly left under a high-temperature and high-humidity atmosphere.

2. Description of the Prior Art:

[0002] Most of the clothes such as working clothes heretofore used in a clean room of a pharmaceutical factory and those used in a hospital, medical service sites, nursing facilities, and the like are disposable. Since these clothes are disposed of by incineration as industrial waste after use, the desirability of reusing the clothes has come to find enthusiastic recognition year after year from the viewpoints of environmental pollution and saving of resources.

[0003] In order to reuse these products in the above-mentioned working places, the clothes must be washed and subjected to autoclaving (120-130°C x 30 minutes) with high-temperature and high-pressure steam as a sterilization treatment every day. Therefore, the products using the conventional polyester long fibers easily suffered hydrolysis by repeated processing and resulted in deterioration of strength.

[0004] In recent years, polyester fibers excelling in resistance to hydrolysis have been developed. As a result, the durability of the textile of a woven and/or knitted product against wet heat has been improved considerably, and under the present situation it is possible to provide the clothes which can be reused under the above conditions.

[0005] However, the above problems will also hold for the fastener products to be attached to the clothes. For example, a slide fastener made of a synthetic resin will be deteriorated by about 50 rounds of autoclaving due to hydrolysis and thus cannot be used any longer. Specifically, in the case of coupling elements of polyester, for example, the deterioration thereof due to hydrolysis with high-temperature steam proceeds during repeated use thereof for a relatively short period and autoclaving. Consequently, cracks, flaws, the fracturing phenomena into the shape of fiber and the like may occur in the engagement portions (heads) of the coupling elements, thereby causing deterioration of strength thereof. Eventually, the state of engagement of coupling elements will come off and the product will no longer function as a fastener. On the other hand, in the case of coupling elements made of nylon, although they have an advantage of hardly causing deterioration of the strength, they poses the problem of suffering discoloration in brown with the high temperature steam.

SUMMARY OF THE INVENTION

[0006] It is therefore a fundamental object of the present invention is to provide a fastener product made of a synthetic resin such as a slide fastener of synthetic resin, a separable fastener of synthetic resin and a snap tape (a tape with a snap button) of synthetic resin, which product exhibits excellent durability against wet heat and is capable of maintaining the stable state of engagement without producing deterioration of strength, discoloration, etc. even when repeatedly left under the high-temperature and high-humidity atmosphere.

[0007] A further object of the present invention is to provide a recyclable fastener product made of a synthetic resin such as a slide fastener of synthetic resin, a separable fastener of synthetic resin and a snap tape of synthetic resin, which product is excellent in both the resistance to moist heat and resistance to hydrolysis.

[0008] To accomplish the objects mentioned above, the fundamental mode of the present invention provides an engagement member made of a synthetic resin comprising an attachment part and an engagement part, which member is characterized by the fact that at least the engagement part mentioned above is made of a hydrolysis-resistant synthetic resin. The term "attachment part" as used herein refers to a part to which an engagement part is attached or a part to be utilized for attachment to the other products, such as a fastener tape of a slide fastener, a base portion or base fabric of a separable fastener or surface fastener, and a tape of a snap tape or snap fastener. And the term "engagement part" as used herein refers to such parts as coupling elements of a slide fastener, engagement elements like hooks and/or loops of a separable fastener, and male and/or female detachably fitting parts of a snap tape or snap fastener.

[0009] Preferably, the hydrolysis-resistant synthetic resin material mentioned above is polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein.

[0010] In accordance with a more concrete first embodiment of the present invention, there is provided a slide fastener made of a synthetic resin having a pair of fastener tapes and coupling elements fixed to the edges of the fastener tapes and characterized by the fact that the fastener tapes and the coupling elements mentioned above are made of a hydrolysis-resistant synthetic resin material.

[0011] When the slide fastener comprises sewing

threads for the fixation of the coupling elements to the fastener tapes and/or core cords extended as inserted through the individual coupling elements in the longitudinal direction thereof, the sewing threads and/or the core cords may be made of a hydrolysis-resistant synthetic resin material.

[0012] Further, in the slide fastener of the type having upper and lower stop members provided respectively at the upper and lower ends of the rows of coupling elements, the upper and lower stop members may be made of a hydrolysis-resistant synthetic resin material as in the case of the other component parts mentioned above.

[0013] In the open-link type slide fastener which has a pin-and-box separator and a pair of reinforcing sheet-like members formed integrally or not integrally with the pin-and-box separator (lacking a lower stop member), which have fixed to the lower end portions of the fastener tapes, the pin-and-box separator and the reinforcing sheet-like members mentioned above may be made of a hydrolysis-resistant synthetic resin material as in the case of the other component parts mentioned above.

[0014] In a preferred embodiment, in any of the cases mentioned above a slide fastener has substantially all the component parts thereof made of the same chemical type or system of material. Incidentally, the slider itself may be manufactured from a metallic material etc. and it has no problem in terms of resistance to hydrolysis. When the recycling use is taken into consideration, however, the slider may be made of the same chemical type of synthetic resin material as the other component parts mentioned above.

[0015] In accordance with a more concrete second embodiment of the present invention, there is provided a separable fastener made of a synthetic resin comprising a base part and an engagement part composed of a multiplicity of engaging elements formed on the obverse side of the base part and characterized by the fact that the base part and the engagement part mentioned above are made of a hydrolysis-resistant synthetic resin material.

[0016] In accordance with a more concrete third embodiment of the present invention, there is provided a snap tape or a snap fastener made of a synthetic resin comprising a tape and an engagement part composed of male and/or female detachably fitting parts formed on the tape and characterized by the fact that the tape and the engagement part mentioned above are made of a hydrolysis-resistant synthetic resin material.

[0017] Since the fastener products of synthetic resin of the present invention, such as a slide fastener of synthetic resin, a separable fastener of synthetic resin and a snap tape of synthetic resin, are made of a hydrolysis-resistant synthetic resin, particularly polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein, they exhibit excellent durability against wet heat and are capable of maintaining the stable state of engagement for a long period without producing deterioration of strength and degradation of the material due to hydrolysis, particularly change in the form of engagement part, and securing the stable state of the tape or base part to which the engagement part is attached, even when repeatedly left under the high-temperature and high-humidity atmosphere. Further, when the sewing threads are also manufactured from a hydrolysis-resistant synthetic resin material, it is possible to provide a fastener product of synthetic resin which hardly incurs breakage of the sewing threads. In the case of a slide fastener, when the core cords are also manufactured from a hydrolysis-resistant synthetic resin material, the attached state of coupling elements becomes more stable. Accordingly, they can be advantageously used as fastener products to be attached to clothes such as working clothes to be used in a clean room of a pharmaceutical factory and those used in a hospital, medical service sites, nursing facilities, and the like which are repeatedly subjected to a sterilization treatment with high-temperature and high-pressure steam.

[0018] When all the component parts of the fastener products are manufactured from an essentially identical hydrolysis-resistant synthetic resin material, they are recyclable and contribute greatly to the conservation of the earth's environment and the effective utilization of resources. Further, since the raw materials for the component parts are unified, it is relatively easy to recover the discarded fastener products and the discarded plastic materials.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Other objects, features, and advantages of the invention will become apparent from the following description taken together with the drawings, in which:

Fig. 1 is a plan view illustrating one basic form of a slide fastener made of a hydrolysis-resistant synthetic resin according to the present invention;

Fig. 2 is a plan view illustrating another form of the slide fastener made of a hydrolysis-resistant synthetic resin according to the present invention;

Fig. 3 is a plan view illustrating still another form of the slide fastener made of a hydrolysis-resistant synthetic resin according to the present invention;

Fig. 4 is a partially cutaway plan view illustrating another form of the slide fastener made of a hydrolysis-resistant synthetic resin according to the present invention;

Fig. 5 is a fragmentary plan view of a coiled coupling element provided with a core cord;

Fig. 6 is a fragmentary cross-sectional view illustrating one state of fixing the coiled coupling element provided with a core cord shown in Fig. 5 to a fastener tape;

Fig. 7 is a fragmentary cross-sectional view illustrating another state of fixing the coiled coupling element provided with a core cord shown in Fig. 5 to a

fastener tape;
Fig. 8 is a fragmentary plan view of a coiled coupling element devoid of a core cord;
Fig. 9 is a fragmentary cross-sectional view illustrating a state of fixing the coiled coupling element shown in Fig. 8 to a fastener tape;
Fig. 10 is a fragmentary plan view of a zigzag-like coupling element;
Fig. 11 is a fragmentary cross-sectional view illustrating a state of fixing the zigzag-like coupling element shown in Fig. 10 to a fastener tape;
Fig. 12 is a fragmentary plan view of coupling elements fixed by extrusion molding to connecting cords;
Fig. 13 is a fragmentary plan view illustrating the coupling elements shown in Fig. 12 as posed in a state bent in the shape of a letter U around the engaging portion thereof as the center;
Fig. 14 is a fragmentary cross-sectional view illustrating a state of fixation of the coupling elements shown in Fig. 12 and Fig. 13 to a fastener tape;
Fig. 15 is a fragmentary plan view illustrating a slide fastener having individual coupling elements of synthetic resin attached fast to the longitudinal edge of a fastener tape having a circularly swelled cross section;
Fig. 16 is a fragmentary cross-sectional view illustrating the slide fastener shown in Fig. 15;
Fig. 17 is a fragmentary perspective view illustrating one form of a male fastener member made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 18 is a fragmentary cross-sectional side view illustrating the state before engagement between a male fastener member and a female fastener member, both made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 19 is a fragmentary cross-sectional side view illustrating another form of the female fastener member made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 20 is a fragmentary cross-sectional side view illustrating another form of the male fastener member made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 21 is a fragmentary cross-sectional side view schematically illustrating still another form of the female fastener member made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 22 is a fragmentary plan view schematically illustrating yet another form of the female fastener member made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 23 is a fragmentary perspective view of one form of a snap tape made of a hydrolysis-resistant synthetic resin according to the present invention;
Fig. 24 is a graph showing the results of measurement of the lateral tensile strength of a fastener stringer of slide fasteners produced in the working example and the comparative example to be described hereinafter measured after repeated autoclaving (126°C x 30 minutes);
Fig. 25 is a graph showing the results of measurement of the sliding resistance during the opening motion of slide fasteners produced in the working example and the comparative example to be described hereinafter measured after repeated autoclaving (126°C x 30 minutes); and
Fig. 26 is a graph showing the results of measurement of the sliding resistance during the closing motion of slide fasteners produced in the working example and the comparative example to be described hereinafter measured after repeated autoclaving (126°C x 30 minutes).

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present inventors, after pursuing a diligent study on the use of the fastener products of synthetic resin such as a slide fastener of synthetic resin, a separable fastener of synthetic resin and a snap tape of synthetic resin under the high temperature and high humidity atmosphere, have found that the fastener products as mentioned above made of a hydrolysis-resistant synthetic resin, particularly a synthetic resin having a carbodiimide-based hydrolytic stabilizing agent incorporated therein exhibit excellent durability against wet heat, are capable of maintaining the stable state of engagement without producing such defects as deterioration of strength and discoloration even when repeatedly left under the high-temperature and high-humidity atmosphere, fulfill such characteristics as mechanical properties, resistance to wear and durability to withstand the friction due to the sliding motion which are expected of any fastener products for a long period, and are recyclable as well. The present invention has been perfected as a result.

[0021] To be specific, the fundamental technical idea of the present invention consists in manufacturing the component parts of fastener products with a synthetic resin material which exhibits excellent resistance to moist heat and to hydrolysis. It is provided, however, that there are times when the slider itself should be manufactured from other synthetic resin or a metal, depending on the function or construction which is expected from the slide fastener. In this case, the slider can be manufactured from the material which is so needed. In the case of the slide fastener using the slider of this description, it is relatively easy to recover the slider selectively from the discarded slide fastener and the discarded plastic materials emanating from the production line can be wholly reclaimed.

[0022] Since the fastener products of synthetic resin of the present invention exhibit excellent durability against wet heat, they are capable of maintaining the

stable state of engagement for a long period without producing degradation of the material due to hydrolysis, particularly change in the form of engagement parts such as coupling elements, snap buttons and engagement elements, and securing the stable state of the tape or base part to which the engagement parts such as coupling elements are attached, even when repeatedly subjected to washing and autoclaving.

[0023] When the individual component parts of the fastener product are manufactured from the same chemical type of synthetic resin material, it is possible to provide recyclable fastener products of synthetic resin. Further when the cloths of clothing on which the fastener products are fitted are manufactured from the same chemical type synthetic resins as those of the fastener products, it is made possible to recycle the whole clothing having the fastener products attached thereto.

[0024] The hydrolysis-resistant synthetic resin material used in the present invention means a synthetic resin having a hydrolytic stabilizing agent incorporated therein. As the synthetic resin, various synthetic resin materials such as polyester, polycarbonate, a polymer blend of polycarbonate/polyester, and nylon may be used. Since polyester is commonly used as the raw material for the hydrolysis-resistant cloths of clothing, polyester such as polyethylene terephthalate (PET) and polybutylene terephthalate (PBT) is more preferable in terms of recycle use and such characteristics as mechanical properties, durability to withstand the friction due to the sliding motion and resistance to wear which are expected of any fastener products.

[0025] As hydrolytic stabilizing agents, carbodiimides, preferably bis-carbodiimides represented by the formulas R-N=C=N-R and R-N=C=N-R' may be advantageously used. In the above formulas, R and R' represent C_4-C_{20} substituted or unsubstituted alkyl groups, substituted or unsubstituted aryl groups, wherein substitutions being halogen atom, nitro group, amino group, sulfonyl group, hydroxyl group, alkyl group, or alkoxy group, and wherein R and R' may or may not be the same. As concrete examples of such compounds, 2,2', 6,6'-tetraisopropyldiphenyl carbodiimide; a bis-carbodiimide produced by Rhein-Chemie GmbH of Germany and marketed under the trademark designation of STABAXOL, and aromatic polycarbodiimides such as 2,4-diisocyanate-1,3,5-tris(1-methylethyl) copolymer with 2,6-diisopropyldiisocyanate and benzene-2,4-diisocyanato-1,3,5-tris(1-methylethyl) homopolymer may be cited. Properly, a hydrolytic stabilizing agent may be added to the synthetic resin material in an amount of about 1 to 5% by weight, preferably 1.5 to 2.5% by weight.

[0026] The hydrolytic stabilizing agent mentioned above is generally produced as a masterbatch made of a career resin and a hydrolytic stabilizing agent. For instance, the masterbatch may comprise about 70 to 98% by weight of a career resin and about 2 to 30% by weight of a hydrolytic stabilizing agent. The most preferable proportion is 15% by weight of the hydrolytic stabilizing agent to 85% by weight of the career resin. The career resin is preferred to be the same chemical type as a synthetic resin material.

[0027] Monofilaments or multifilaments may be produced by kneading such hydrolytic stabilizing agent-containing masterbatch chips and synthetic resin pellets and melt-extruding the resultant blend. They are used for weaving and/or knitting a fastener tape of a slide fastener, manufacturing sewing threads and core cords, weaving and/or knitting a base fabric and engagement elements of a separable fastener and a tape of a snap tape according to the present invention. Coiled coupling elements of a slide fastener may be manufactured from the monofilament. Further, coupling elements, separable fasteners, snap buttons, etc. may be formed by injection molding.

[0028] Now, the modes of embodying the present invention in the component parts of the fastener products will be specifically described below with reference to various fastener products which are illustrated in the accompanying drawings.

[0029] Fig. 1 illustrates a slide fastener 1 which is used for opening and closing the opening in a garment or a bag and depicts the form of a product having the upper and lower ends of laterally paired fastener stringers 2 cut off. The fastener stringers 2 are composed of fastener tapes 3 made of hydrolysis-resistant synthetic resin and a row of coupling elements (coiled coupling elements) 4 made of hydrolysis-resistant synthetic resin attached fast to each of the opposed longitudinal edges of the fastener tapes 3. The fastener tapes 3 are formed by weaving and/or knitting hydrolysis-resistant synthetic resin fibers, manufactured from a non-woven fabric, or made of a sheet of hydrolysis-resistant synthetic resin. The coupling elements 4 are known in various forms such as, for example, those of the type obtained by injection molding the individual coupling elements and simultaneously attaching them fast to the edges of the fastener tapes, the continuous coupling elements such as the coiled coupling elements obtained by winding a monofilament of hydrolysis-resistant synthetic resin in the shape of a coil and the so-called zigzag coupling elements obtained by alternately connecting vertically in a zigzagging pattern in the longitudinal direction the portions bent in the shape of a letter U in the lateral direction in a plane, and the extrusion molded coupling elements obtained by attaching the opposite end portions of the individual coupling elements by means of extrusion molding to the two separate connecting cords (core cords) laid parallel to each other in the longitudinal direction thereby forming a composite resembling a ladder and bending the composite in the shape of a letter U around the longitudinal center line thereof. These examples of various coupling elements will be described afterward with reference to the relevant drawings. Then, the coiled coupling elements which include a core cord and a sewing thread among the component parts there-

of will be also described afterward with reference to the relevant drawings. The reference numeral 5 denotes a slider which is slidable along the opposed rows of coupling elements for making and breaking engagement of the coupling elements.

[0030] A slide fastener 1a illustrated in Fig. 2 is in a form having the upper ends of the two fastener stringers 2 cut off. It is different from the slide fastener illustrated in Fig. 1 in respect that a lower stopping part 6 is formed by fusing the prescribed lower portions of the engaged rows of coupling elements 4.

[0031] A slide fastener 1b illustrated in Fig. 3 is different from the slide fastener illustrated in Fig. 1 in respect that upper stop members 7 are attached respectively to the upper ends of the rows of coupling elements 4b attached fast to fastener tapes 3b of fastener stringers 2b and a lower stop member 8 is attached to the lower ends thereof. The upper and lower stop members mentioned above are manufactured from a hydrolysis-resistant synthetic resin material.

[0032] Fig. 4 illustrates an open-link type slide fastener 1c. To the lower end portions of fastener tapes 3c of fastener stringers 2c, reinforcing sheet-like members (taffeta) 9 made of hydrolysis-resistant synthetic resin are welded through the medium of an adhesive layer (not shown). A box member 11 of a pin-and-box separator 10 made of hydrolysis-resistant synthetic resin is attached to the inner edge of one of the opposed reinforcing sheet-like members 9 and a butterfly rod or pin 17 made of hydrolysis-resistant synthetic resin is attached to the inner edge of the other reinforcing sheet-like member 9. The box member 11 is formed integrally with a guide projecting part 13 adjoining the box member 11 and a box rod 12 and a groove 14 is formed as interposed between the box rod 12 and the guide projecting part 13 so as to admit therein the lower end part of the slider 5 by slippage. Similarly, a guide groove 19 is formed between the butterfly rod 17 and a guide ridge 18 formed integrally with the adjoining butterfly rod 17. A butterfly rod inserting hole 15 is formed as pierced in the vertical direction in the left side portion of the box member 11 and a lateral groove 16 is formed on the outer wall of the butterfly rod inserting hole 15. When the butterfly rod 17 is inserted into the butterfly rod inserting hole 15 of the box member 11, therefore, the insertion can be smoothly carried out because the inner side of the lower end of the guide ridge 18 slide on the edge of the lateral groove 16 of the box member 11 so as to guide the butterfly rod 17.

[0033] With reference to Fig. 4, the reference numeral 20 denotes a core cord which is inserted in the longitudinal direction through the empty space inside the spiral of the coiled coupling element 4c and the reference numeral 21 denotes a sewing thread sewing the core cord 20 and the coiled coupling element 4c along the longitudinal edge of the fastener tape 3c. Both of them are manufactured from a hydrolysis-resistant synthetic resin material.

[0034] The pin-and-box separator does not need to be limited to what is illustrated in Fig. 4. The so-called reverse open-link type using the same box member as in the construction of the slider 5 and enabling the slider fastener to effect junction and disjunction of the opposed rows of coupling elements at the lower end thereof, for example, has been known as one version thereof.

[0035] Further, the embodiment, as illustrated in the diagram, uses reinforcing sheet-like members which are formed separately of the pin-and-box separator and welded to the lower end portion of each of the fastener tapes. The reinforcing sheet-like members do not need to be limited to this particular construction. The reinforcing members can be integrally formed with the pin-and-box separator as found, for example, in a construction which has a sheet-like portion produced by injection molding a synthetic resin material integrally with a box member or a butterfly rod and fixed to the entire width of the fastener tape or a construction which has slits of an arbitrarily selected pattern inserted in a sheet-like portion thereby imparting flexibility thereto.

[0036] Fig. 5 through Fig. 9 illustrate examples of coupling elements which are formed by coiling a monofilament of hydrolysis-resistant synthetic resin. Fig. 6 illustrates an example of having sewn to the longitudinal edge of a fastener tape 3d with a sewing thread 21 of hydrolysis-resistant synthetic resin a coiled coupling element 4d having the core cord 20 inserted through the empty space within a spiral in the longitudinal direction as illustrated in Fig. 5. In contrast, Fig. 7 illustrates an example of having a coiled coupling element 4e attached to the longitudinal edge of a fastener tape 3e as encircled with the tape at the same time that the tape is woven. Fig. 9 illustrates an example of having sewn to the longitudinal edge of a fastener tape 3f with the sewing thread 21 a coiled coupling element 4f having no core cord inserted through the empty space within a spiral as illustrated in Fig. 8.

[0037] Fig. 10 illustrates a so-called zigzag coupling element 4g which is obtained by forming U-shaped bends of a monofilament of hydrolysis-resistant synthetic resin each lying laterally in a plane and alternately connecting the U-shaped bends vertically in the longitudinal direction. The vertically adjacent bends are sewn with the sewing thread 21 to the longitudinal edge of a fastener tape 3g nipped therebetween.

[0038] Fig. 12 through Fig. 14 illustrate an example of attaching the opposite end portions of regularly spaced individual coupling elements 4h by means of an extruder to two separate connecting cords (core cords) 20h laid parallel to each other in the longitudinal direction thereby forming a composite resembling a ladder as illustrated in Fig. 12, bending the composite in the shape of a letter U around an engaging portion 22 as a center as illustrated in Fig. 13, and sewing the bent composite to the longitudinal edge of a fastener tape 3h with the sewing thread 21 as illustrated in Fig. 14.

[0039] In contrast, Fig. 15 and Fig. 16 illustrate an ex-

ample of attaching a core cord 20i by weaving into the longitudinal edge of a fastener tape 3i at the same time that the tape is woven and attaching individual coupling elements 4i of hydrolysis-resistant synthetic resin by injection molding as regularly spaced to the longitudinal edge swelled into a circular cross section of the fastener tape 3i formed as described above. The sewing threads and core cords (connecting cords) mentioned above are also manufactured from a hydrolysis-resistant synthetic resin material.

[0040] The slide fastener of hydrolysis-resistant synthetic resin according to the present invention can be applied not only to the slide fasteners of the types illustrated in Fig. 1 through Fig. 16 but also to various fastener products. It can be applied, for example, to a railed fastener product, i.e. a fastener of the type having a groove formed along the edge of one of paired opposed sheet members of a container bag and a ridge matched to the groove and formed similarly on the other sheet member such that the bag is closed by bringing the groove and the ridge into mutual engagement. Likewise in this type of slide fastener, a slider adapted to slide along the opposed edges of the bag for the purpose of closure is utilized.

[0041] The selection of the type of slide fastener product for proper application of the material depends also on the kind of synthetic resin to be used for the product. Generally, nylon 6 and nylon 66 among other polyamide resins are suitable for such slide fasteners as are shown in Fig. 1 through Fig. 16 and nylon 11 and nylon 12 are suitable for the railed fastener product. The polyester resins are suitable for both the slide fasteners and the railed fasteners.

[0042] Then, some embodiments of applying the present invention to the separable fasteners will be specifically described below. Fig. 17 is a partial perspective view of a male fastener member illustrating a structural example of typical hook-like engaging elements of the molded (injected) type, and Fig. 18 is a partially cross-sectioned side view representing the state before engagement with loop-like engaging elements of the opposite female fastener member.

[0043] The component parts of these male fastener member 30 and female fastener member 40 are manufactured from the hydrolysis-resistant synthetic resin material mentioned above according to the present invention.

[0044] In the male fastener member 30 shown in Fig. 17, a hook-like engaging element 32 raised from a base part 31 has a stem 34 which has a rear surface 34a rising obliquely in a smooth curve from the base part 31 and a front surface 34b rising upwardly from the base part 31, and a hook-like engaging portion 33 extending forwardly and curving downwardly from a distal end of the stem 34. The stem 34 has on one side surface a first reinforcing rib 35 perpendicularly rising from the base part and on both sides thereof second reinforcing ribs 36 raised from the base part.

[0045] The first reinforcing rib 35 projects upwardly with respect to the rear surface of the hook-like engaging portion 33 to a predetermined extent and terminates in an arcuate upper end to assume an equilateral triangle. The height of the apex O_3 of the first reinforcing rib 35 is defined to be smaller than the height of an apex O_2 of the hook-like engaging portion 33. The apex O_3 of the first reinforcing rib 35 is set at the height above a tangent line which touches the hook-like engaging portion 33 at the lowest tip O_1 of hooked leading end and which is substantially parallel to the upper surface of the flat base part 31. In the illustrated example, the second reinforcing ribs 36 are set at the height lower than that of the first reinforcing rib 35 and has a mount-like shape with its arcuate top surface and skirt parts enlarging downwardly.

[0046] The function of the hook structure of the male fastener member 30 constructed as mentioned above will now be described with reference to Fig. 18. The presence of the reinforcing ribs 35, 36 prevents the hook-like engaging elements 32 from falling down. Further, when the hook-like engaging elements 32 are depressed by the base part 41 of the opposite female fastener member 40 having a multiplicity of loop-like engaging elements 42, although the hook-like engaging portion 33 is initially inclined slightly forwardly by the pressing force until the base part 41 comes into contact with the apex O_3 of the first reinforcing rib 35, the first reinforcing rib 35 bears the base part 41 to prevent the hook-like engaging portion 33 from further inclination, thereby maintaining the poses of the hook-like engaging elements 32 engaged with the loop-like engaging elements 42. Since the hook-like engaging portion 33 as slightly forwardly inclined becomes smaller in radius of curvature of the crooked shape, the loop-like engaging elements 42 once engaged with the hook-like engaging elements 32 will be retained more reliably than usual.

[0047] Fig. 19 and Fig. 20 illustrate an embodiment of applying the present invention to a woven separable fastener, i.e. a separable fastener which is manufactured by preparing monofilaments or multifilements of the hydrolysis-resistant synthetic resin according to the present invention and interweaving them.

[0048] In a female fastener member 50 shown in Fig. 19, pile yarns formed of hydrolysis-resistant synthetic resin filaments are interwoven in a pile pattern into a base part (base fabric) 51 produced by plain weaving hydrolysis-resistant synthetic resin filaments so as to give rise to pile loops (loop-like engaging elements) 52 which protrude from the obverse side of the base part. A male fastener member 60 shown in Fig. 20 is identical in structure with the female fastener member 50 mentioned above except that the pile loops protruding from the obverse side of the base part 61 are partially cut to form hook-like engaging elements 62. Incidentally, coating layers 53, 63 of synthetic rubber or synthetic resin are applied to the reverse sides of the base parts (base fabrics) 51, 61 respectively, for the purpose of prevent-

ing the loop-like and hook-like engaging elements 52, 62 from being left out and to impart the shape retention property to the bas parts.

[0049] Then, some embodiments of applying the present invention to the knitted separable fasteners will be described below with reference to the drawings.

[0050] Fig. 21 is a view schematically illustrating a warp-knitted base fabric 70 for a separable fastener which functions as a female fastener member to be attached to a breathable product. The warp-knitted base fabric 70 for a separable fastener is manufactured by knitting a base texture out of pile knitting yarns and ground yarns to form on wales 71 a multiplicity of pile loops (loop-like engaging elements) 72 serving as engagement elements of a separable fastener and passing insertion yarns in the wales direction and the course direction according to the marquisette texture so that a multiplicity of stitches 73 of the substantially rectangular shape serving as breather portions are formed between wales 71. The upper side parts of the pile loops 72 of this warp-knitted base fabric 70 for a separable fastener is cut to form hooks and the resultant fabric is used as a male fastener member. Incidentally, such a warp-knitted base fabric 70 for a separable fastener has pile knitting parts and the selvage parts on both sides thereof. Accordingly, it is possible to obtain simultaneously several warp-knitted tapes for separable fasteners by severing the base fabric along the center of this selvage by a slitter.

[0051] Fig. 22 illustrates an example of the texture of the pile knitted part of the warp-knitted base fabric 70 (strip tape before severing) for separable fasteners. The pile knitted part is composed of the pile formation threads 74 which forms the pile loops 72 and the two needle stitching threads 75 and lateral insertion threads 76 which form the ground. The pile formation thread 74 consists of a multifilament and is used for forming pile loops 72 by a sinker by overfeeding more positively than other threads. The pile formation thread 74 is used to form the pile loops 72 every other course while lapping with an adjoining knitting needle and, as shown by the structural diagram of the pile knitted part in Fig. 22, it is knitted so as to be arranged in the longitudinal direction in a zigzag pattern. Therefore, the pile loops 72 can be engaged with the hooks of the opposite male fastener member always with high engagement probability, no matter what direction the hooks are directed, and the performance of the separable fastener is greatly improved.

[0052] In case open stitches are formed in the warp-knitted base fabric 70 for separable fasteners as mentioned above, a coating material such as synthetic rubber and synthetic resin is applied to the reverse side of the base fabric to stabilize a ground texture and engaging elements. However, such coating is not necessary when closed stitches are formed in the pile loops which constitute engaging elements and the chain yarns which form the ground texture.

[0053] As the knitting yarns which form the pile loops mentioned above, monofilament threads or multi-filament threads are used when knitting the base fabric of a female fastener member, and monofilament threads are used when knitting the base fabric of a male fastener member. These knitting yarns and the threads which constitute the ground texture are manufactured from the hydrolysis-resistant synthetic resin according to the present invention.

[0054] Fig. 23 illustrates an example of application of the present invention to a snap tape, i.e. snap buttons integrally attached to a tape.

[0055] In the manufacture of this snap tape 80, a plurality of fitting holes 82 are formed in a long tape 81 at predetermined intervals in advance, this tape is fed into a metal mold for molding, and ring-like base materials 83 that are components member for forming female fitting parts 84 and/or male fitting parts 85 are integrally injection-molded with the tape on both the obverse and reverse sides thereof so as to nip the peripheral edges of the fitting holes 82 mentioned above. Then, a plurality of base materials 83 having the same form and integrally molded on one and the same tape 81 in the longitudinal direction thereof at predetermined intervals as mentioned above are alternately formed into female engaging parts (hole parts) 86 and male engaging parts (protruding parts) 87 to form a product having female fitting parts 84 and male fitting parts 85 alternately and integrally fixed to one and the same tape 81. The engagement is performed by snap-in fitting the male engaging part 87 into the female engaging part 86. Although in the embodiment shown in Fig. 23 the base materials 83 are alternately formed into the female engaging parts 86 and the male engaging parts 87 in the longitudinal direction of the tape 81 at predetermined intervals, the female engaging parts (hole parts) 86 may be formed in one tape and the male engaging parts (protruding parts) 87 may be formed in other tape.

[0056] The tape 81 and the engagement parts composed of female fitting parts 84 and/or male fitting parts 85 mentioned above are manufactured from a hydrolysis-resistant synthetic resin according to the present invention.

[0057] When the synthetic resin material is polyethylene terephthalate (PET), basically the PET can be used for all the component parts of fastener products. In the case of a slide fastener, however, preferably the slider which is required to possess high mechanical strength is made of polybutylene terephthalate (PBT) instead, with the PBT in the body portion of the slider reinforced with such reinforcing fibers as glass fibers. In recycling the slide fastener of polyester answering this description, it is preferable to remove the slider from the slide fastener discarded as no longer useful and utilize the remainder of the slide fastener exclusively for the sake of reclamation. When the used slide fastener is wholly recovered and put to reclamation, the material that is obtained at all is in the form of a PET/PBT polymer

blend. In the case of such an open-link type slide fastener as illustrated in Fig. 4, the pin-and-box separator is preferred to be made of PBT likewise on account of mechanical strength.

[0058] In any of the cases mentioned above, however, the component parts of the fastener products can be simultaneously dyed in the same hue by piece dyeing because the materials for the component parts are invariably polyester. Though various dyes are usable for the piece dyeing, a disperse dye is used preferably. The disperse dye that can be used herein is known in various types such as, for example, quinone type disperse dyes, azo type disperse dyes, and anthraquinone type disperse dyes. Various dyeing assistants in popular use such as leveling agents and dye fastness promotors can be additionally incorporated in a dye bath as is usually practiced. While various methods are available for the dyeing under discussion, the method of beam dyeing proves to be advantageous.

[0059] In setting the used polyester fastener products to the process of recycle, the reclaimed polyester may be used for manufacturing the fastener products such as slide fasteners, separable fasteners, and snap tapes again or for manufacturing other textile products and molded articles such as binding bands for packages and containers. When the reclaimed polyester is used as the raw material for other molded articles, it may incorporate therein a varying filler like such reinforcing fibers as glass fibers, carbon fibers, or aramid fibers or it may be blended with such other thermoplastic resin as PBT. In manufacturing a slide fastener by using reclaimed PET, the slider, pin-and-box separator, coupling elements, and sewing thread which require high mechanical strength are preferred to use virgin PET or a blend of virgin PET with reclaimed PET.

[0060] When the synthetic resin material is a polyamide, all the component parts of fastener products except a slider of a slide fastener, i.e. fastener tapes, coupling elements, a pin-and-box separator, reinforcing sheet-like members, upper and lower stop members, sewing threads, and core cords of a slide fastener, a base part and engaging elements of a separable fastener, and a tape and engagement parts of a snap tape can be made of the polyamide. The slider in a slide fastener can be made of the PBT mentioned above or a metal. When the slide fastener of polyamide answering this description is used in the recycling path, the slider is removed from the used slide fastener and the remainder of slide fastener is recycled. As concrete examples of the use found for the reclaimed polyamide, the component parts of a slide fastener excepting a slider, separable fasteners, snap tapes and other similar fastener products, textile products, and molded articles may be cited. In the case of the fastener products made of polyamide, similarly to the fastener products made of polyester mentioned above, the component parts made of polyamide can be simultaneously dyed in the same hue by piece dyeing. As concrete examples of the polyamide which is advantageously used herein, nylon 6, nylon 66, and copolymerized nylon may be cited.

[0061] When the cloths, such auxiliary materials as lining cloths, core cloths, and sewing threads, and such resinous accessories as buttons and snaps for garments on which the recyclable fastener product made of a synthetic resin according to the present invention is fitted are made of the same or homologous hydrolysis-resistant synthetic resin as that of the fastener product, it is made possible to recover the used products wholly and utilize them for reclamation without requiring the individual component parts thereof to be separated and selected.

[0062] The regeneration of the slide fastener from a discarded PET material is advantageously attained by granulating the recovered PET to strand-like chips, subjecting the chips to drying under a vacuum and, as occasion demands, to solid-phase polymerization, and extrusion molding the resultant polymer into a monofilament. Otherwise, the polymer may be molded into a sewing thread or multifilaments of a minute diameter. Alternatively, the polymer may be injection molded to form other component parts. In the case of a slide fastener, subsequently, the extrusion molded monofilament is drawn, formed in the shape of a coil, sewn to the edges of fastener tapes obtained by weaving and/or knitting PET fibers with the sewing thread, then heat set, and thereafter dyed to a desired color by piece dyeing. What is important in this operation is that the water content of the dry chips be repressed to the lowest possible extent and the decline of the intrinsic viscosity (I. V.) or limiting viscosity number before and after the work of monofilament extrusion be restrained for ensuring manufacture of fastener stringers of prescribed quality. The decline of the intrinsic viscosity before and after the work of monofilament extrusion is considered to originate in the hydrolysis of the resinous material caused by the water contained in the chips and is liable to induce breakage of the monofilament during the course of drawing. The water content of the dry chips, therefore, should be restrained 50 ppm (0.005%) and less, preferably 30 ppm and less, and more preferably 20 ppm and less. Particularly, in the manufacture of such products as sewing threads and multifilaments which have minute diameters, the water content should be kept 20 ppm and less, preferably 10 ppm and less, and more preferably 5 ppm and less in consideration of the possibility of breakage thereof.

[0063] Now, the present invention will be described specifically below with reference to working example.

Example

[0064] Monofilaments manufactured from a mixture of PET and masterbatch chips (STABAXOL® KE9291 of Rhein-Chemie GmbH, consisting of a carrier resin PET (containing 5% of PE) containing 15% by weight of aromatic polycarbodiimide (STABAXOL® P100)) in a

weight ratio of 7:1 were formed into coiled coupling elements. Fastener tapes were prepared by weaving PET high-tenacity yarn (BRABER® of Asahi Kasei Kogyo K. K., containing no hydrolytic stabilizing agent) and sewing threads and core cords were also manufactured from the same PET high-tenacity yarn. A slide fastener as shown in Fig. 1 was produced by using these component members.

Comparative Example

[0065] A slide fastener was produced by following the procedure of Example except that only PET was used as a raw material for coiled elements.

Test Example

[0066] Each of the slide fasteners prepared in Example and Comparative Example mentioned above was repeatedly subjected to autoclaving (126°C x 30 minutes) and then tested for lateral tensile strength of a fastener stringer and for resistance to sliding motion when opening and closing a slide fastener in accordance with the methods described in JIS (Japanese Industrial Standard) S 3015. The measurement results of the lateral tensile strength are shown in Fig. 24, the measurement results of the resistance to sliding motion when opening the slide fastener in Fig. 25, and the measurement results of the resistance to sliding motion when closing the slide fastener in Fig. 26.

[0067] The guarantee value specified as the lateral tensile strength of a fastener stringer is 60 kg and over. Although the slide fasteners prepared in Example and Comparative Example satisfied this requirement even after 50 rounds of autoclaving, the slide fastener prepared in Comparative Example by using coiled elements manufactured from PET only had poor strength so as to cause breakages of coupling elements and sewing threads used for sewing coupling elements.

[0068] The guarantee value specified as the resistance to sliding motion in opening (when opening the slide fastener with a slider) and closing (when closing the slide fastener with a slider) is 700 g and under, respectively. Although the slide fastener prepared in Example satisfied this requirement even after about 100 rounds of autoclaving, the slide fastener prepared in Comparative Example had a value far from this guarantee value and its coupling elements had coarse surfaces containing a plenty of cracks with hangnails.

[0069] Further, when fastener tapes, sewing threads and core cords all manufactured from hydrolytic stabilizing agent-containing polyester fibers were used to prepare a slide fastener, the durability of the slide fastener against autoclaving has been further improved.

[0070] While certain specific embodiments and working example have been disclosed herein, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The described embodiments and example are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

Claims

1. An engagement member made of a synthetic resin, comprising an attachment part and an engagement part, wherein at least said engagement part is made of a hydrolysis-resistant synthetic resin.

2. The engagement member according to claim 1, wherein said hydrolysis-resistant synthetic resin is polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein.

3. A slide fastener made of a synthetic resin, comprising a pair of fastener tapes and coupling elements fixed to edges of said fastener tapes, wherein said fastener tapes and said coupling elements are made of a hydrolysis-resistant synthetic resin material.

4. The slide fastener according to claim 3, which further comprises sewing threads for fixation of said coupling elements to said fastener tapes, said sewing threads being made of a hydrolysis-resistant synthetic resin material.

5. The slide fastener according to claim 3 or 4, which further comprises core cords extended as inserted through the individual coupling elements in the longitudinal direction of said elements, said core cords being made of a hydrolysis-resistant synthetic resin material.

6. The slide fastener according to any one of claims 3 to 5, which further comprises upper and lower stop members fitted respectively to upper and lower ends of said coupling elements, said upper and lower stop members being made of a hydrolysis-resistant synthetic resin material.

7. The slide fastener according to any one of claims 3 to 6, which is an open-link type slide fastener having a pin-and-box separator and a pair of reinforcing sheet-like members fixed respectively to lower end portions of said fastener tapes, but having no lower stop member, wherein said pin-and-box separator and reinforcing sheet-like members being made of a hydrolysis-resistant synthetic resin material.

8. The slide fastener according to claim 7, wherein

said reinforcing sheet-like members are integrated with said pin-and-box separator.

9. The slide fastener according to any one of claims 3 to 8, wherein all component parts are made of the same chemical type of synthetic resin material.

10. The slide fastener according to claim 9, wherein said synthetic resin material is polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein.

11. A separable fastener made of a synthetic resin, comprising a base part and an engagement part composed of a multiplicity of engaging elements formed on an obverse side of said base part, wherein said base part and said engagement part are made of a hydrolysis-resistant synthetic resin material.

12. The separable fastener according to claim 11, wherein said hydrolysis-resistant synthetic resin material is polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein.

13. A snap tape made of a synthetic resin, comprising a tape and an engagement part composed of male and/or female detachably fitting parts formed on said tape, wherein said tape and said engagement part are made of a hydrolysis-resistant synthetic resin material.

14. The snap tape according to claim 13, wherein said hydrolysis-resistant synthetic resin material is polyester having a carbodiimide-based hydrolytic stabilizing agent incorporated therein.

FIG. 1

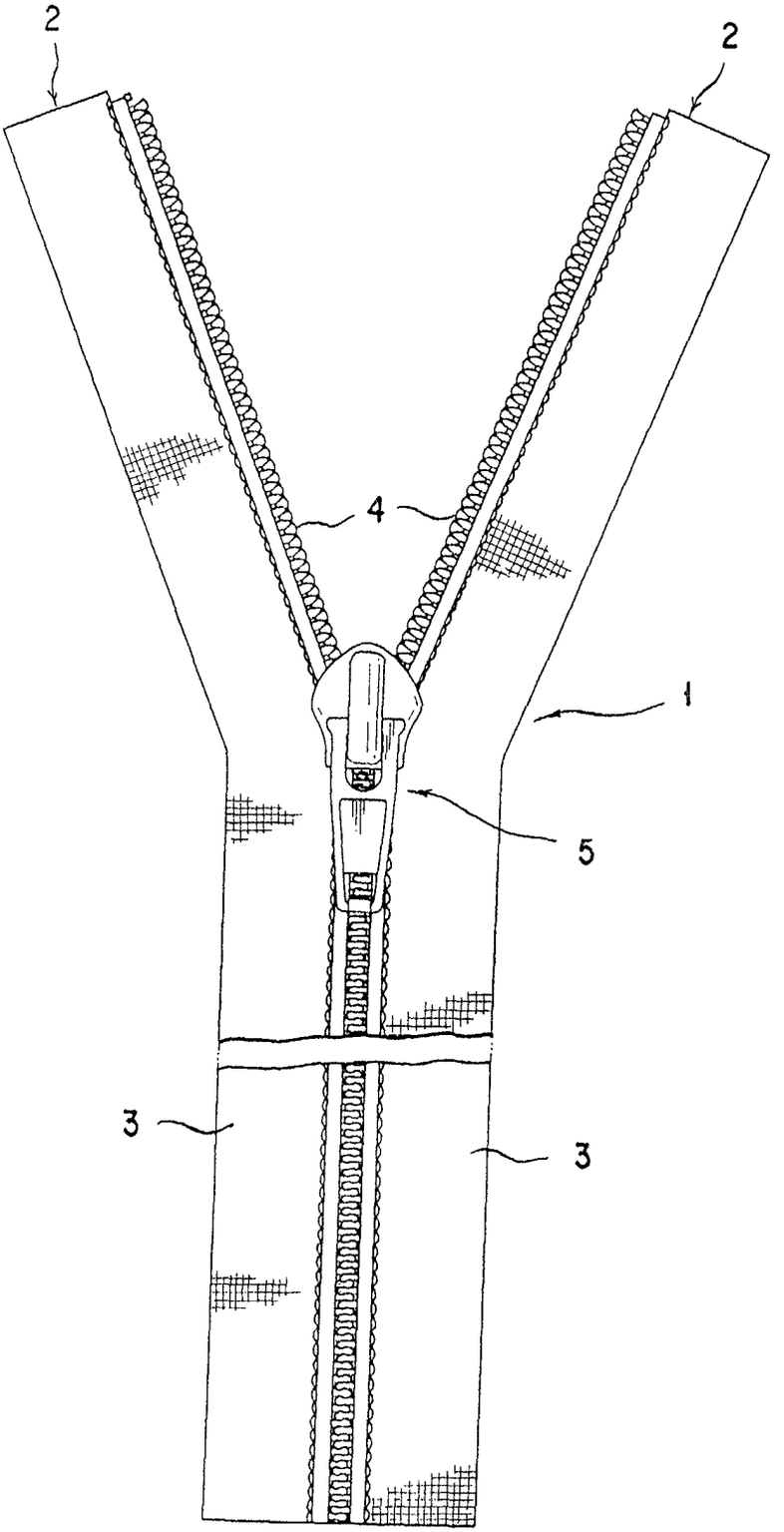


FIG. 2

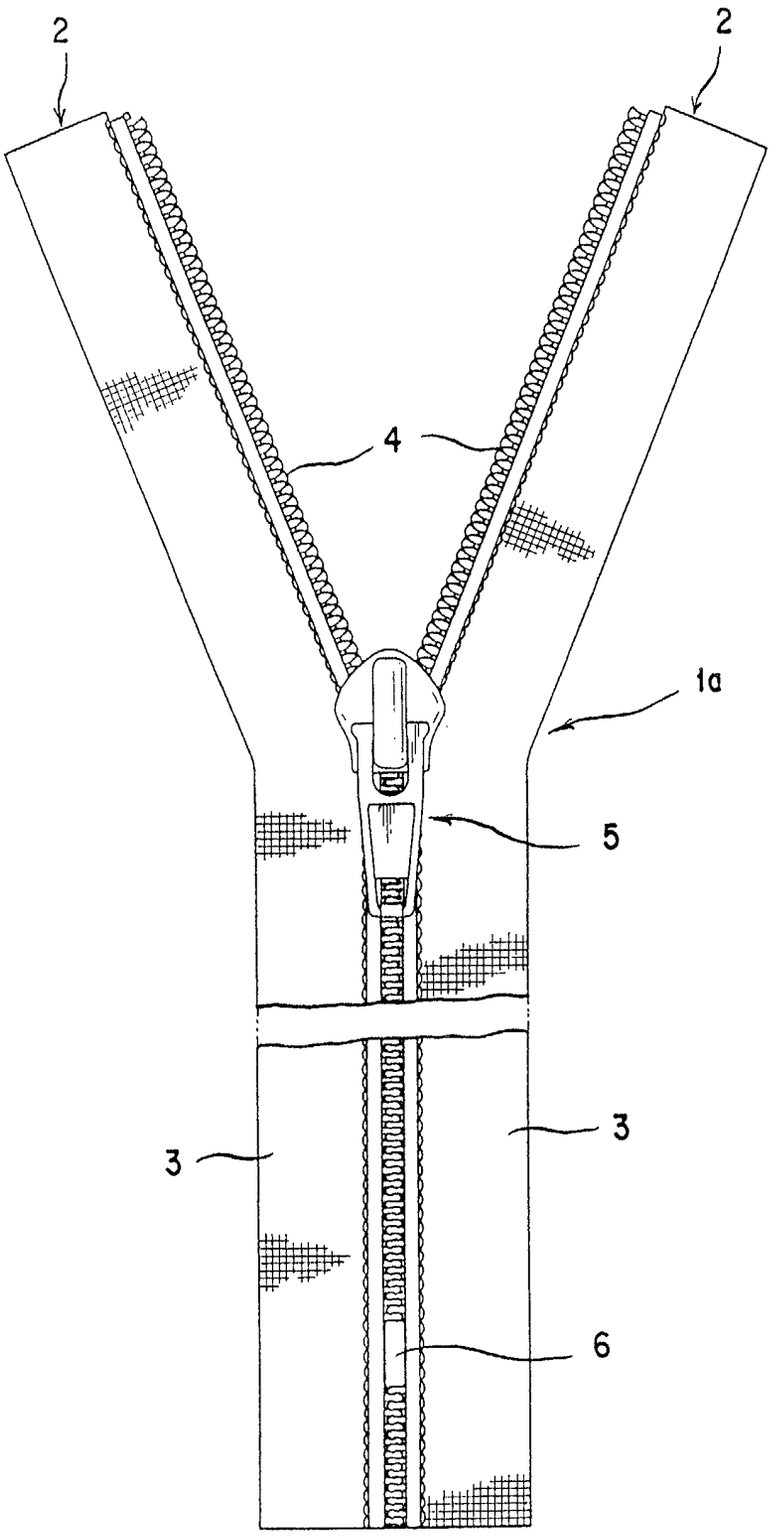


FIG. 3

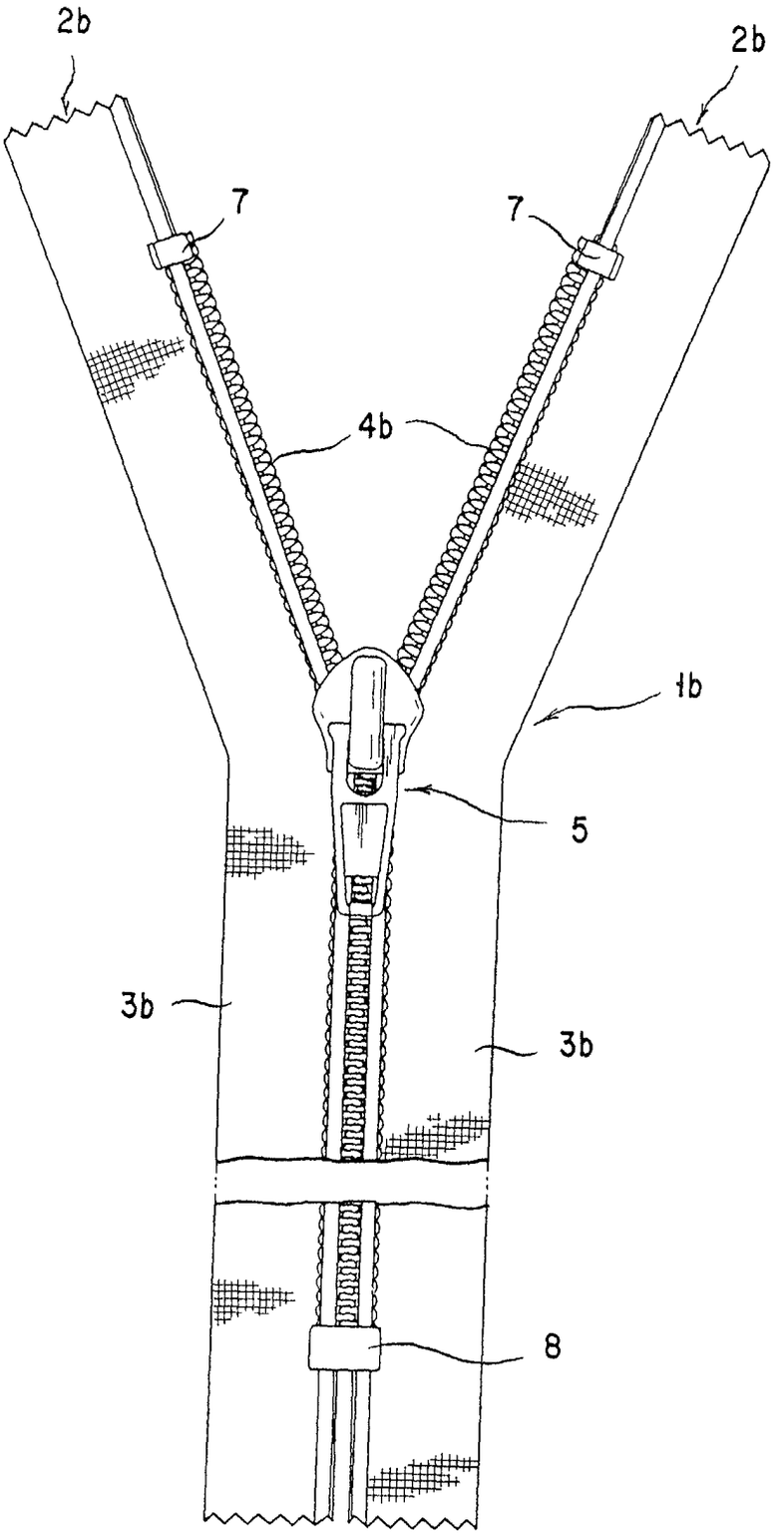


FIG. 4

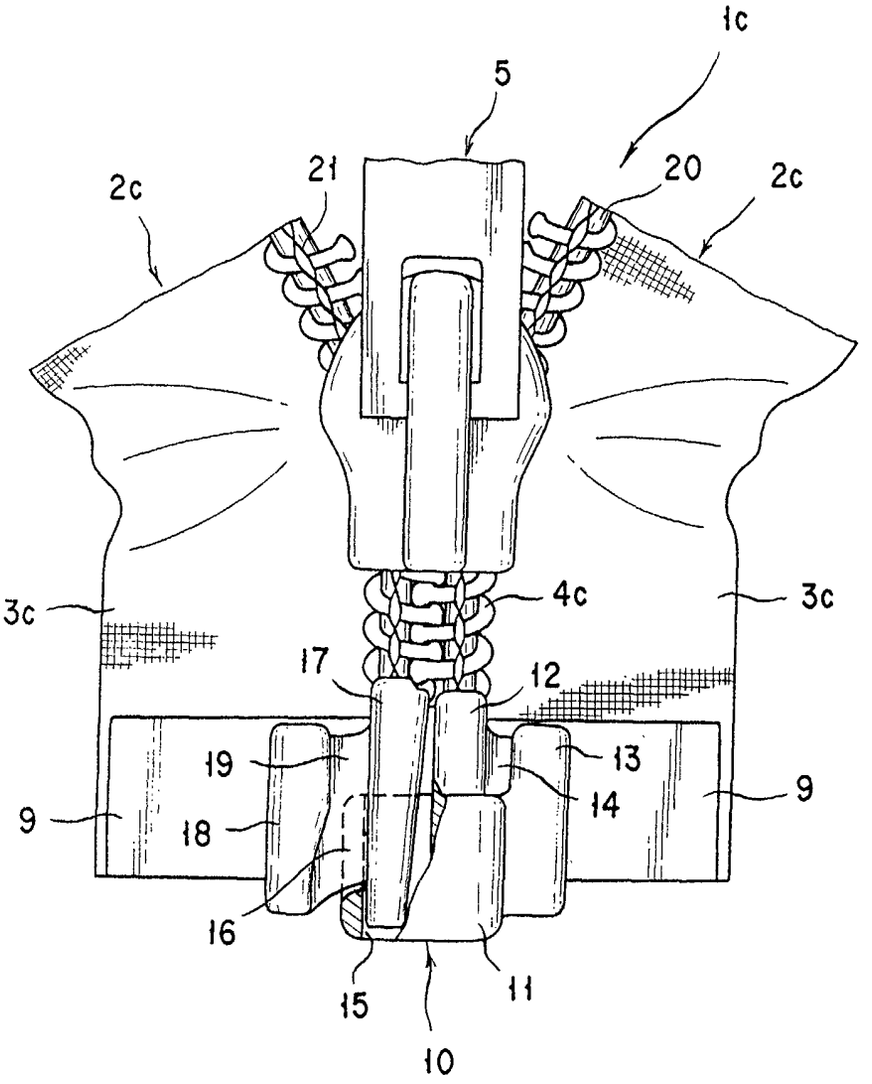


FIG. 5

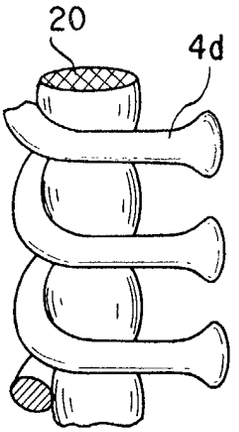


FIG. 6

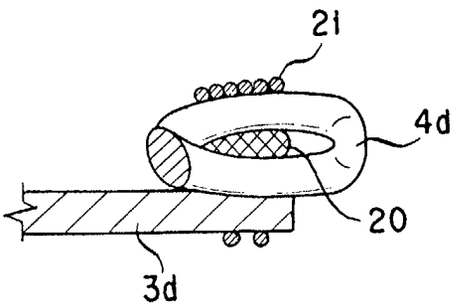


FIG. 7

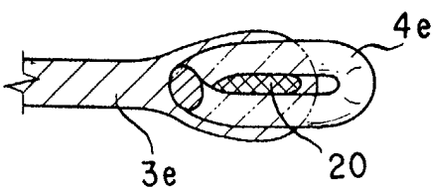


FIG. 8

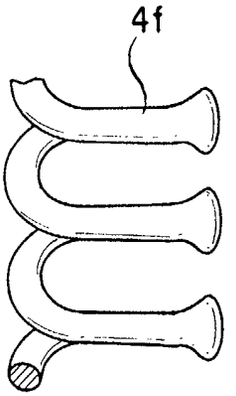


FIG. 9

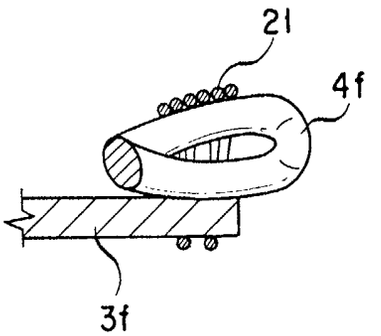


FIG. 10

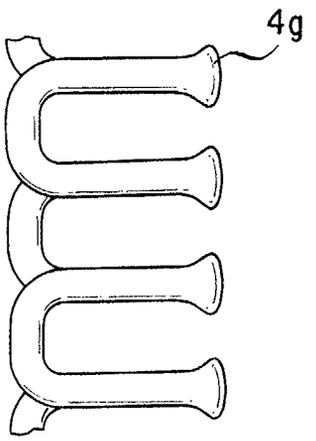


FIG. 11

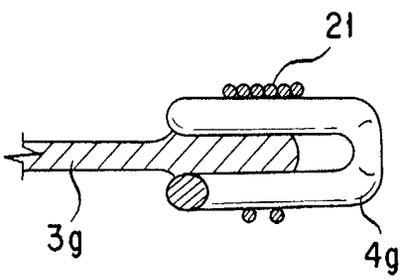


FIG. 12

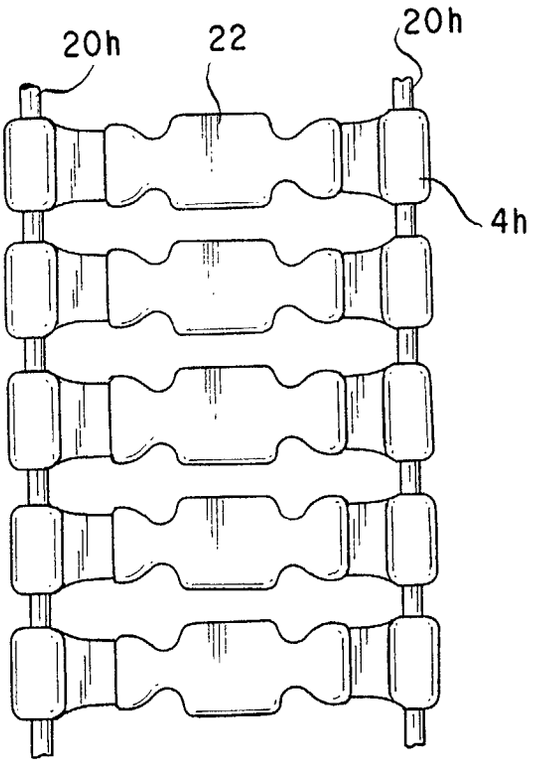


FIG. 13

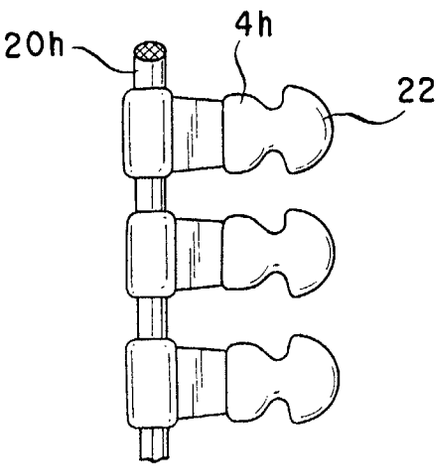


FIG. 14

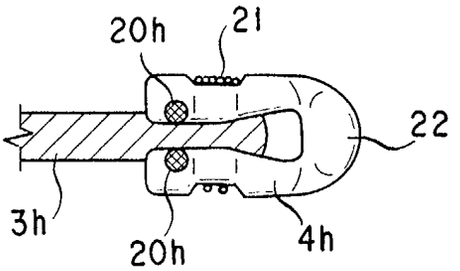


FIG. 15

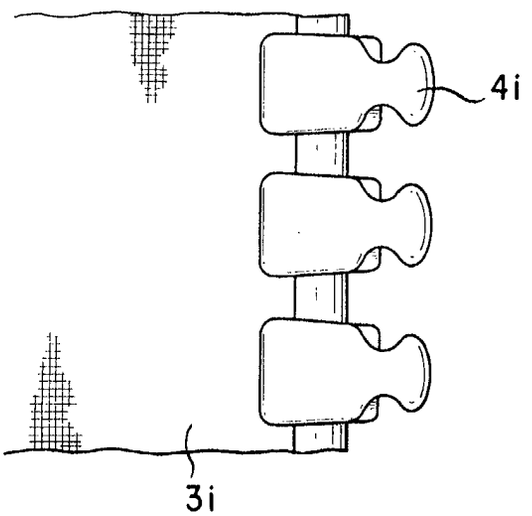


FIG. 16

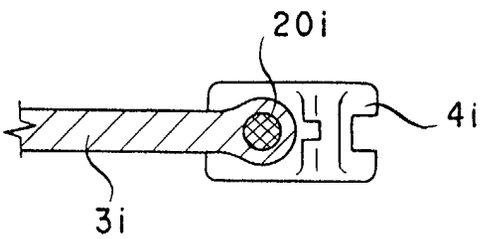


FIG. 17

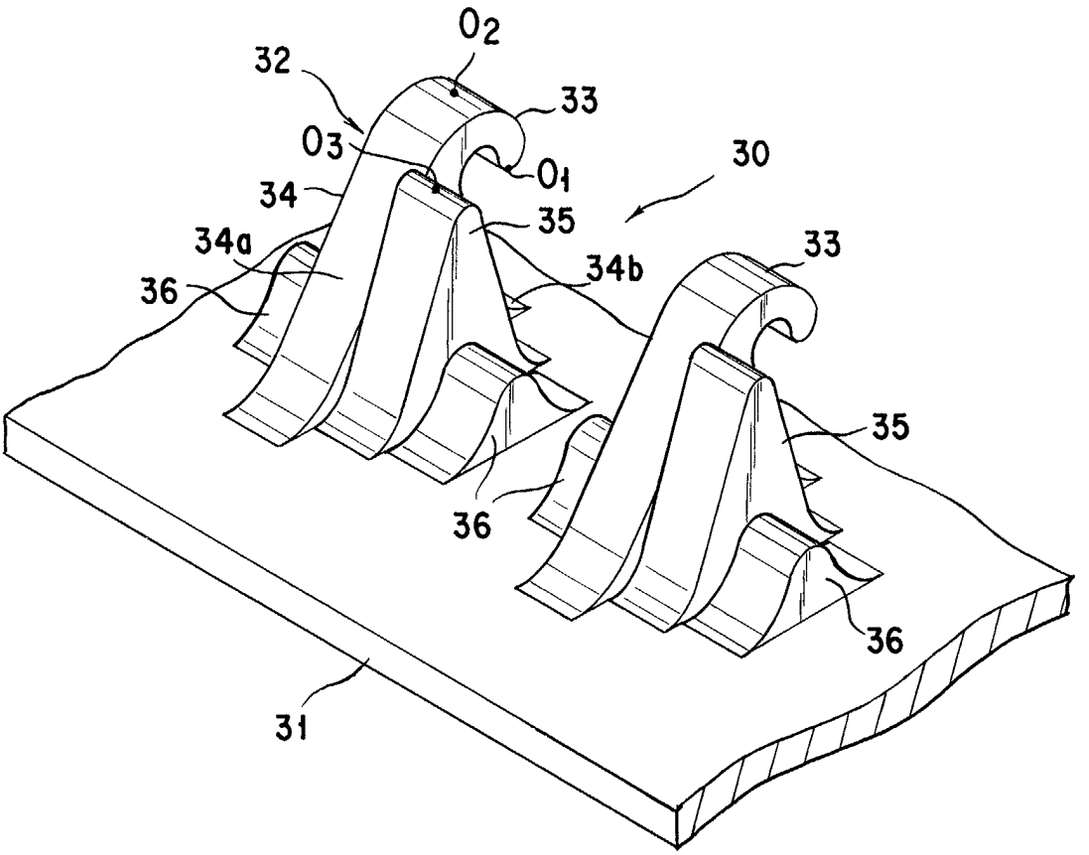


FIG. 18

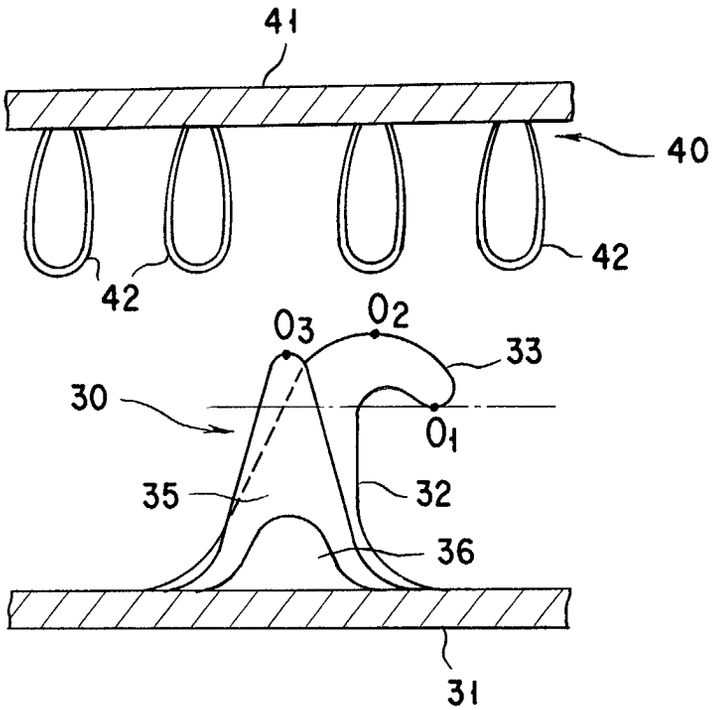


FIG. 19

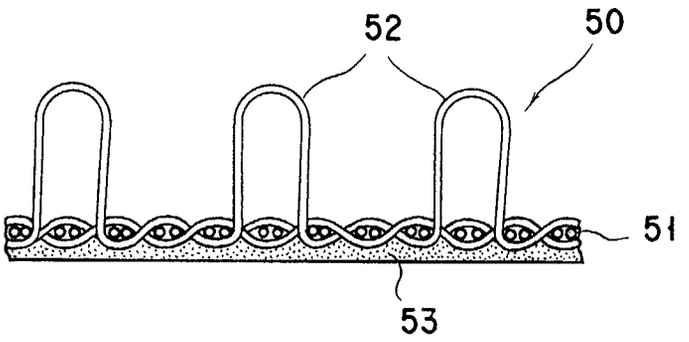


FIG. 20

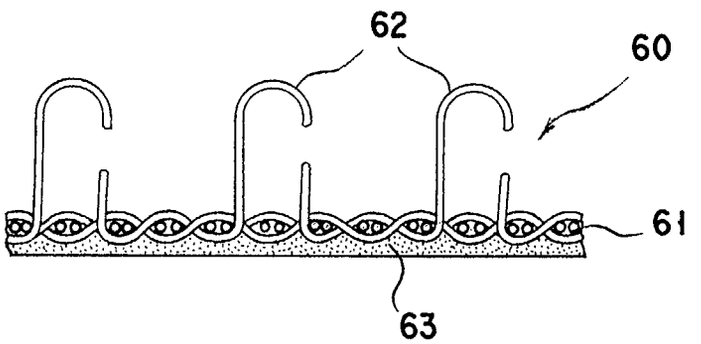


FIG. 21

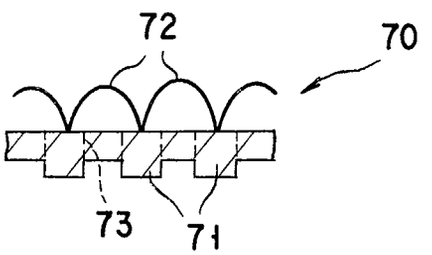


FIG. 22

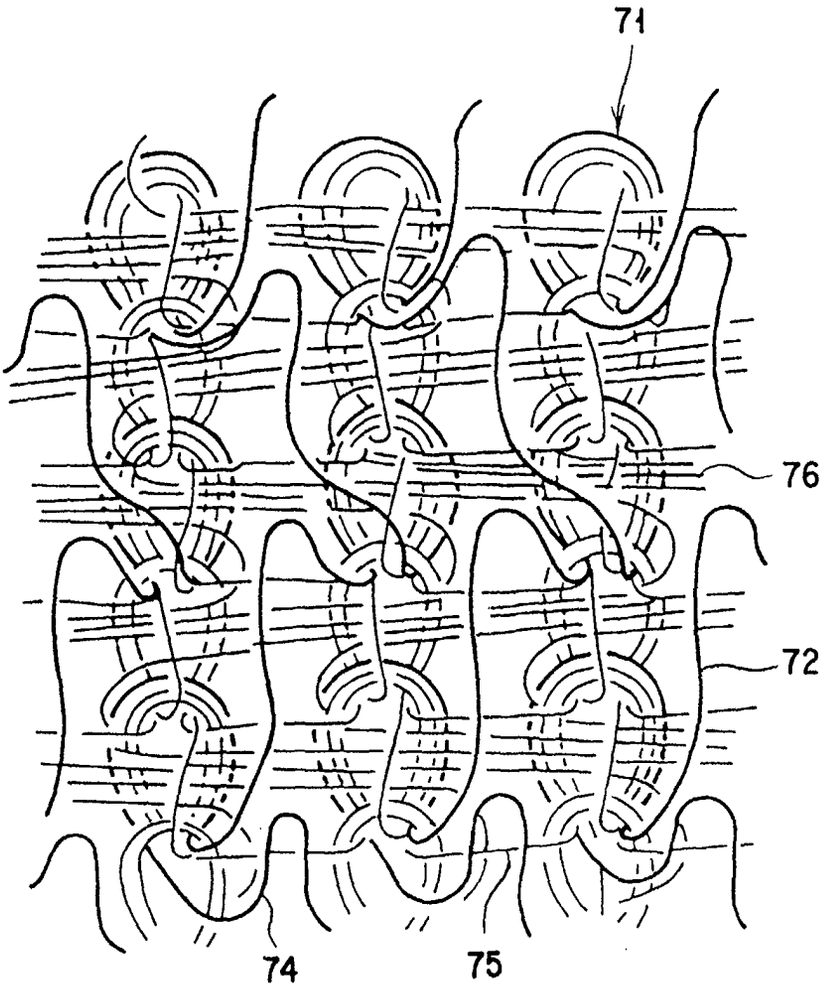


FIG. 23

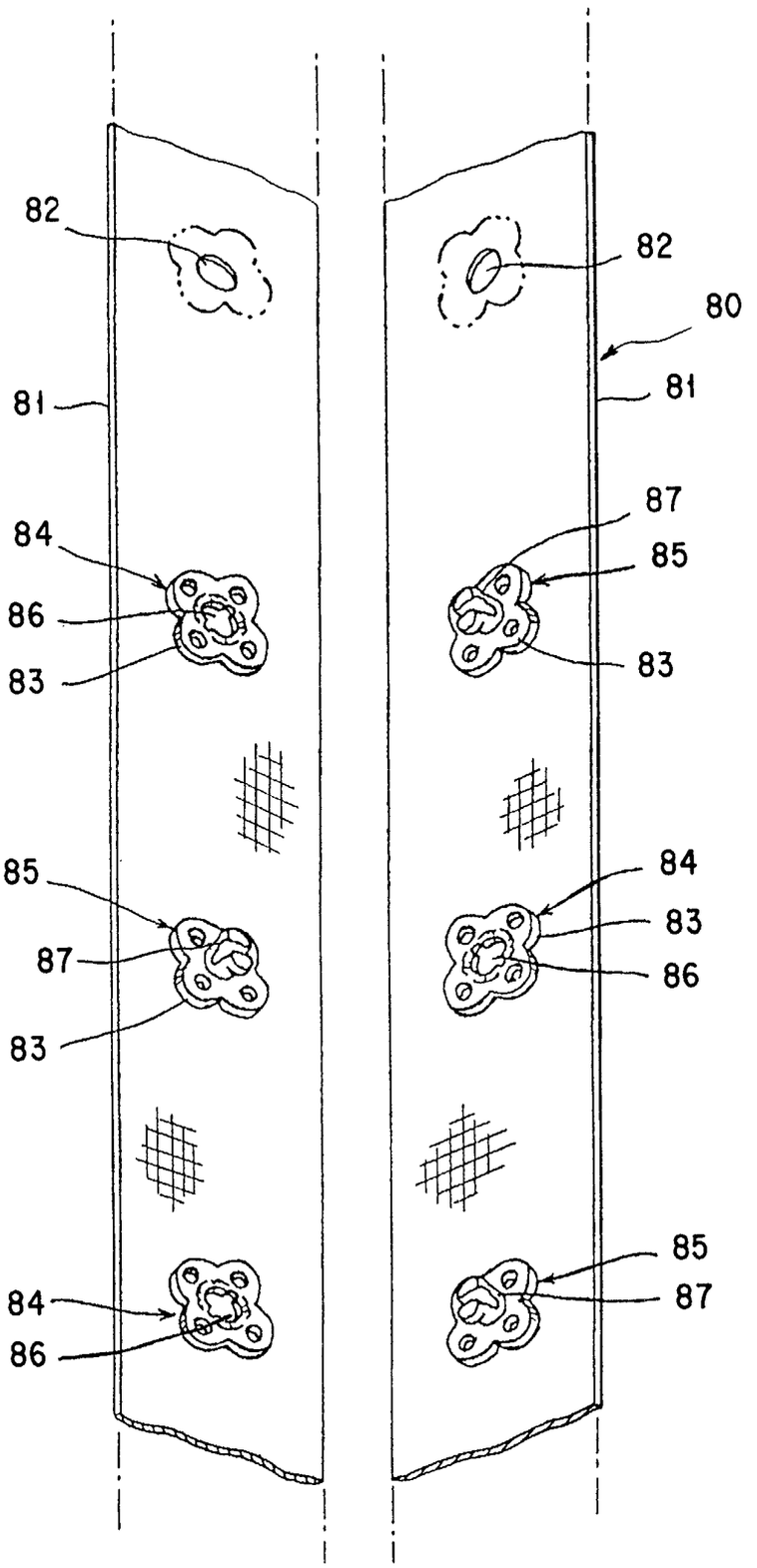


FIG. 24

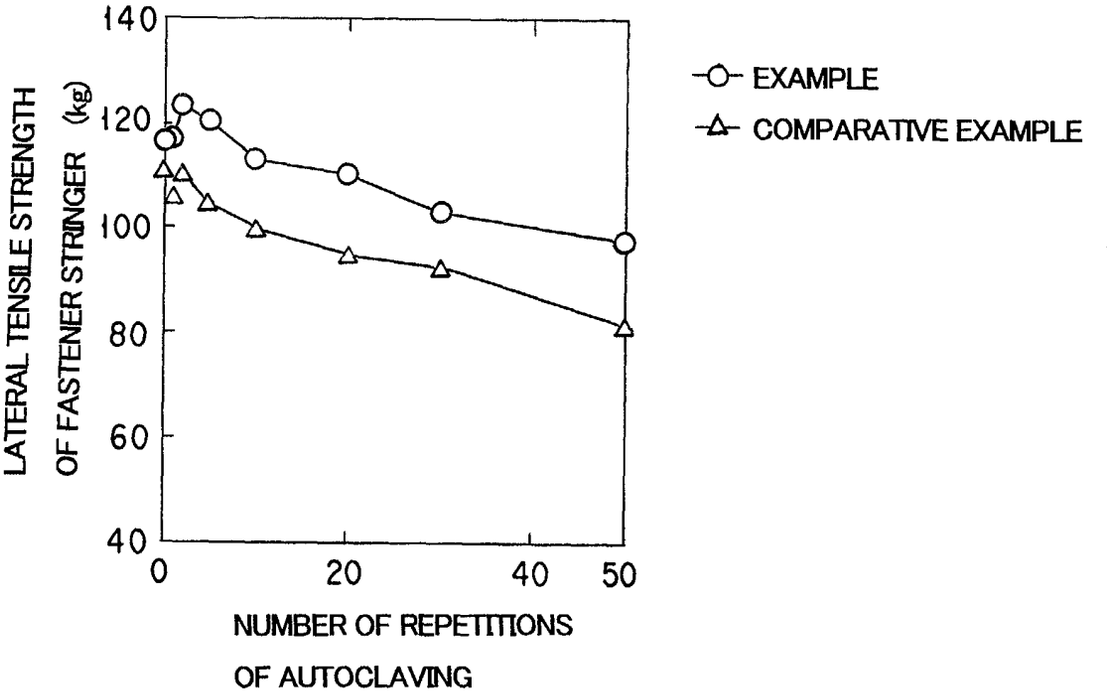

140
120
100
80
60
40
0
20
40
50
LATERAL TENSILE STRENGTH OF FASTENER STRINGER (kg)
NUMBER OF REPETITIONS OF AUTOCLAVING
EXAMPLE
COMPARATIVE EXAMPLE

FIG. 25

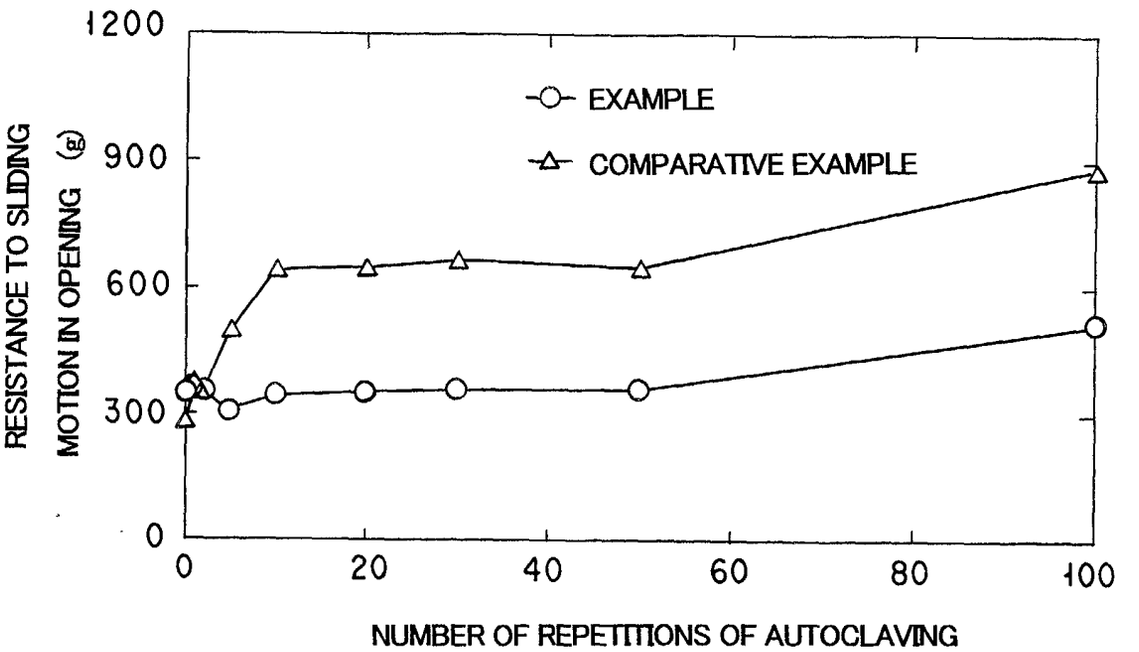
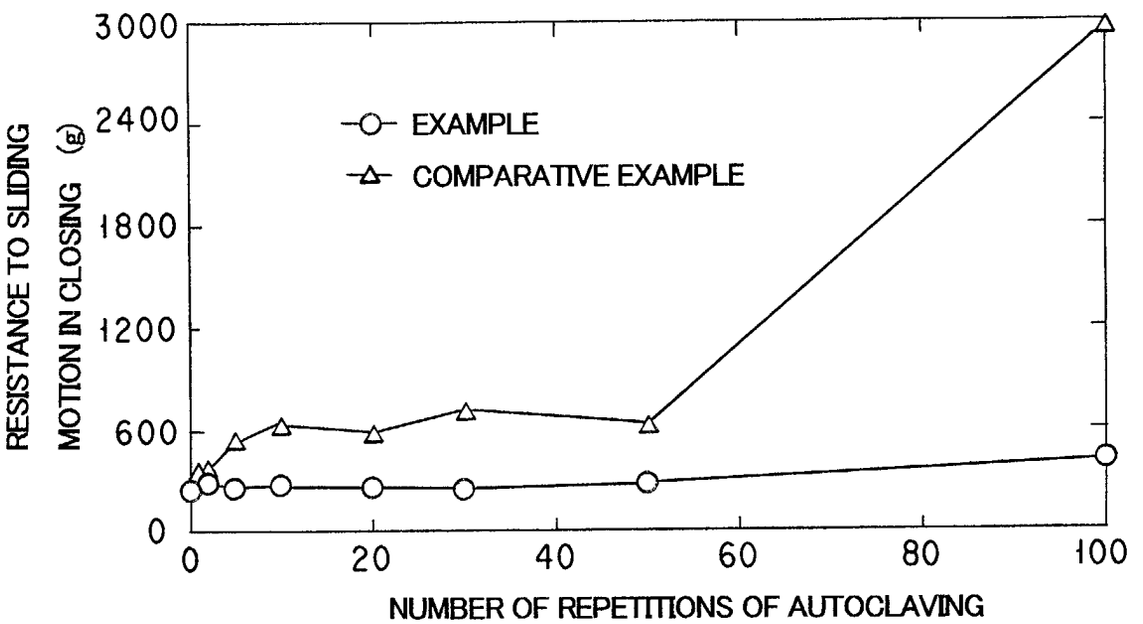

1200
900
600
300
0
0
20
40
60
80
100
RESISTANCE TO SLIDING MOTION IN OPENING (g)
NUMBER OF REPETITIONS OF AUTOCLAVING
EXAMPLE
COMPARATIVE EXAMPLE

FIG. 26


3000
2400
1800
1200
600
0
0
20
40
60
80
100
RESISTANCE TO SLIDING MOTION IN CLOSING (g)
NUMBER OF REPETITIONS OF AUTOCLAVING
EXAMPLE
COMPARATIVE EXAMPLE