July 22, 1969 H. HEIMBERGER 3,456,306

SLIDE FASTENER WITH CONTINUOUS COUPLING ELEMENT

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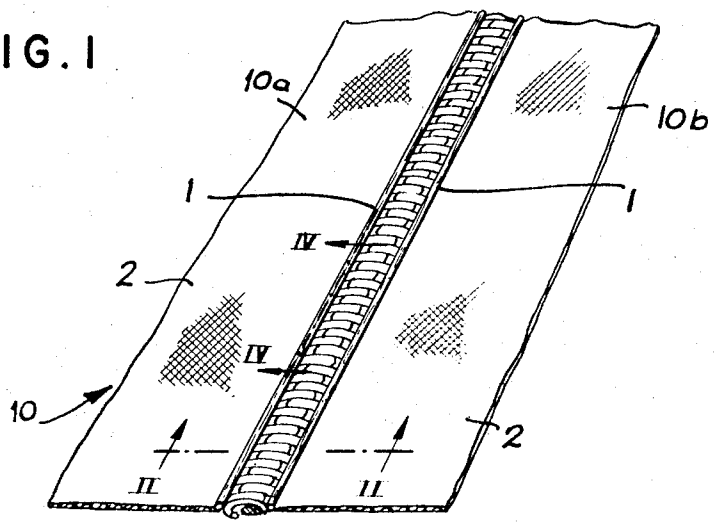
FIG. 1



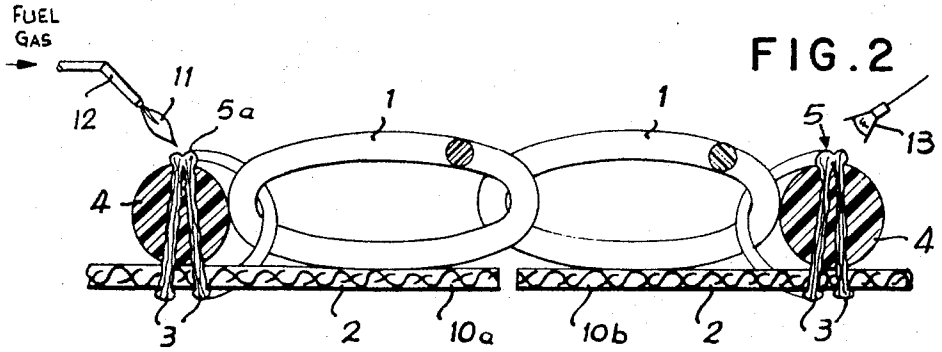


FIG. 2

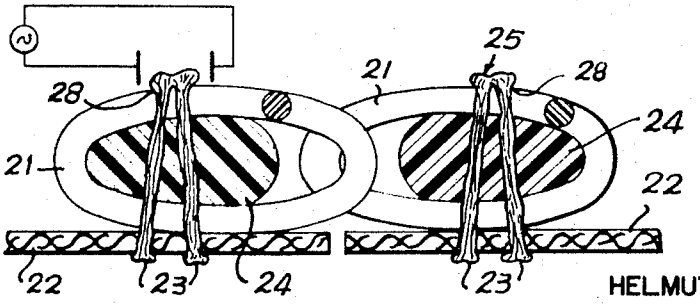


FIG. 3

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FIG. 4

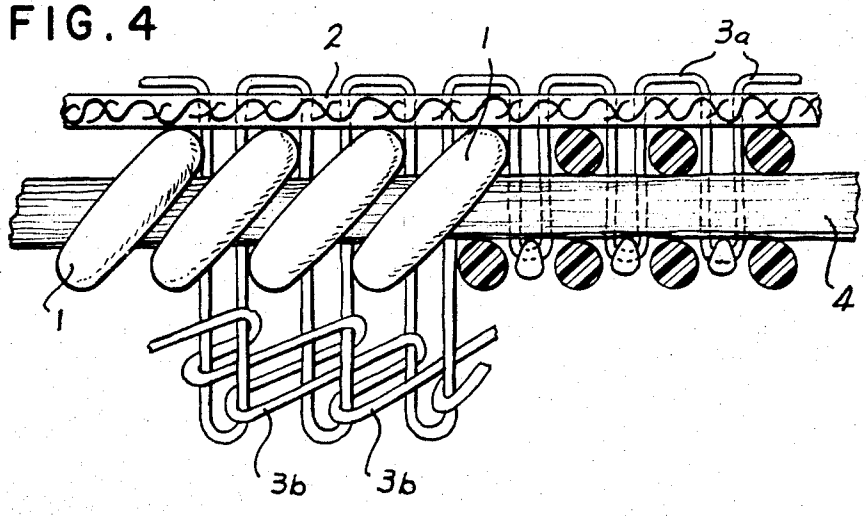

FIG. 7

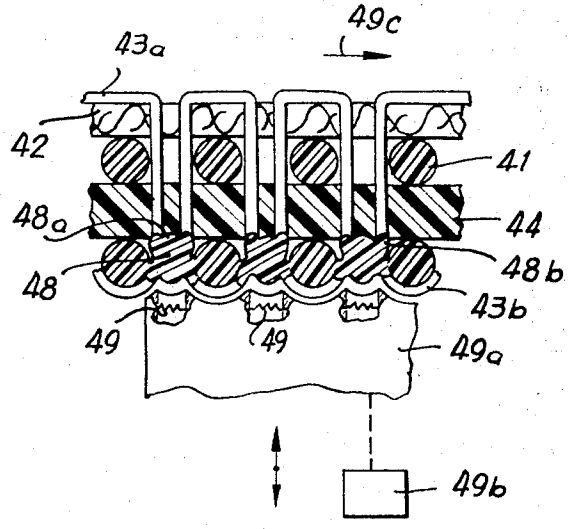

FIG. 8

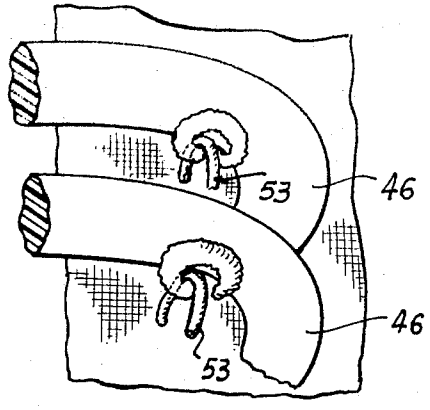

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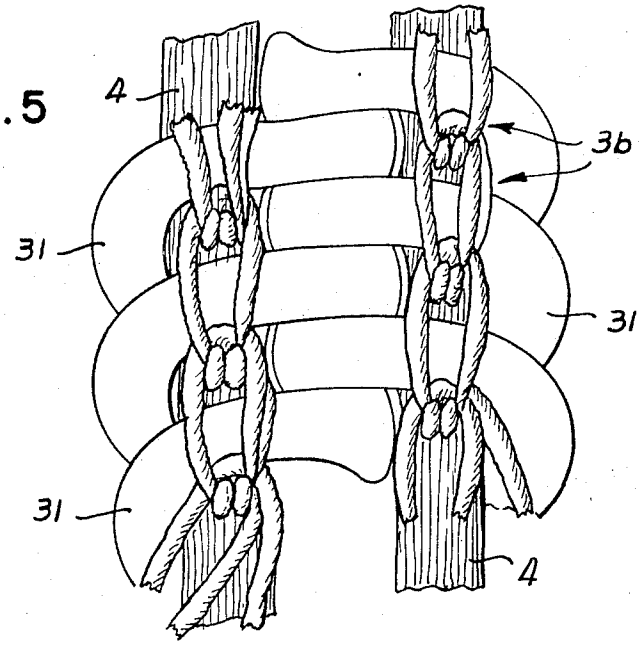
FIG.5



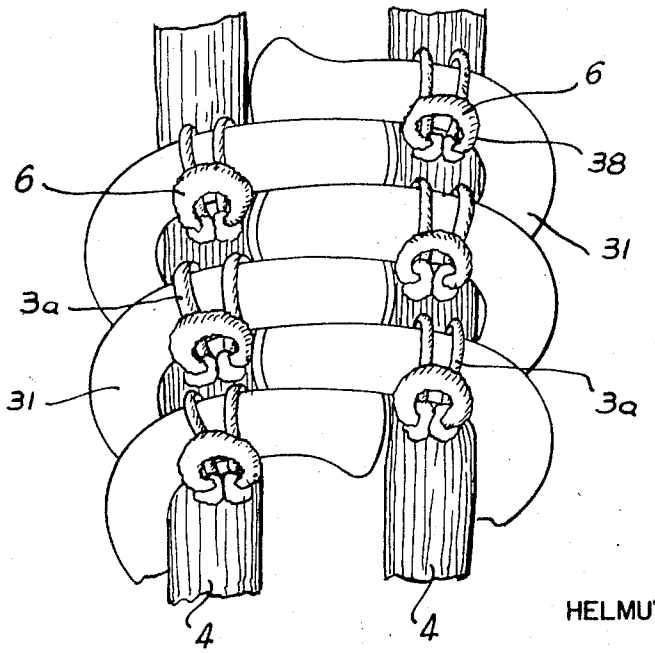


FIG.6

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SLIDE FASTENER WITH CONTINUOUS COUPLING ELEMENT

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Claims priority, application Germany, Oct. 15, 1966, O 12,025
Int. Cl. A44b 19/24
U.S. Cl. 24—205.16 8 Claims

ABSTRACT OF THE DISCLOSURE

A slide-fastener structure wherein a thermoplastic helicoidal or meandering coupling element is attached to a stringer tape with the aid of a fillet cord flanking the coupling element and/or a core cord extending through the coupling element and with thermoplastic threads (e.g. in a chain stitch) extending along the coupling element and thermally fused to bond a plurality of loops together, to bond the loops to the coupling element and/or to bond the loops to the cords.

My present invention relates to improved slide-fastener structures and, more particularly, to a slide-fastener structure wherein a pair of stringers, support tapes or bands are formed along their confronting edges with matingly interengageable continuous coupling elements having complementarily spaced heads which interengage upon movement of a slider along these coupling elements; more particularly, this invention relates to slide-fastener assemblies using so-called meandering or helicoidal coupling elements.

It has been found that continuous coupling elements of the meandering or helicoidal type permit improved, snagfree, washable, drycleanable and pressable fasteners to be produced without difficulties which have hitherto been encountered with coupling elements consisting of spaced-apart members individually fastened to an edge of a stringer tape. The continuous coupling elements are generally formed of molecularly oriented filamentary synthetic resin material of a thermosetting or thermoplastic type in which the heads of the coupling elements are formed by thermal deformation with a predetermined spacing along the continuous filament. The term "helicoidal" is used herein to refer to coupling elements in which the filament, usually a nylon-type polyamide, is coiled in a multiplicity of generally similar turns, such coupling elements being usually formed on a mandrel and being thermally deformed by pressing devices or the like after having been wound on this mandrel. The cross-section of the elongated coupling element may be eliptical, circular or any oval configuration and the turns may include mutually parallel and coplanar shanks connected by the coupling head, with the shanks of each head being connected with the adjacent shanks by bight portions bridging the turns. In systems of this type, the heads are provided with lateral protuberances which engage below the corresponding protuberances of the mating heads and interfit with the turns of the opposing coupling element.

Meandering coupling elements can be described as continuous elements of filamentary thermoplastic or other synthetic resin (usually nylon-type polyamides), of the molecularly oriented kind, which have been deformed into a multiplicity of similar undulations which may be disposed on one side of the stringer tape, may pass alternately back and forth from one side of the tape to the other, or may simultaneously bridge the opposite surfaces of the stringer. Again, the undulations usually have

bight portions which connect the heads and are secured to the stringer tape. Typical helicoidal slide fasteners are described in U.S. Patents No. 3,267,514 and 3,243,489, as well as in my commonly assigned copending application Ser. No. 544,487. Meandering coupling elements are illustrated and described in Patent No. 3,255,504.

Slide fasteners using meandering or helicoidal elements have been proposed in a number of configurations and, indeed, it has been suggested to cement coupling elements to the respective stringer tapes, to attach the coupling elements to stringerfoils by thermal welding, to enclose the coupling elements in woven sleeves of the stringer tapes and to sitch them to the latter. In the systems involving stitching of the coupling element to a stringer tape, two approaches may be described, namely, the stitching technique wherein the individual turns or undulations of the coupling element are secured to a fabric or other stringer tape by thread loops applied by a sewing machine, or the technique whereby a cord, core of other filler body extends along the coupling element and therewithin for assisting in joining the coupling element to the stringer tape. It has been suggested, moreover, to assign to the threads and filler cord functions beyond that of securing the coupling element to the stringer tape. In one arrangement, for example, the means for securing the coupling element to the stringer simultaneously acts as protection for the bight portion of the coupling element which otherwise might be subjected to wear from the slider or devices for treating the fabric or the like. Conventional techniques of this character have not been fully satisfactory because of breakage of the stretches and/or core, because of the high frictional obstructions to the slider introduced by such fastening means, the variability in the character of the fastening device with washing and the like.

It is, therefore, the principal object of the present invention to provide an improved slide-fastener assembly in which continuous coupling elements are attached to the stringer tapes by stitching.

Another object of my invention is to provide a slide fastener assembly in which the means for affixing the coupling element to the stringer tape of each slide fastener half is capable of withstanding the stresses to which it is subjected to a greater extent than heretofore.

I have now found that it is possible to attach coupling elements of a thermoplastic material to a fabric or foil stringer tape with threads extending along the coupling element and interweaved with the coupling element and/or stringer tape or stitched thereto (e.g. as chain stitches) wherein the threads are composed of thermoplastic synthetic resin (e.g. of polyamide or polyester) which threads are thermally fused in formfitting relationship to increase the ability of the attaching means to with stand stress. When the terms "thermal fusion" and "formfitting relationship" or expressions of similar import are used generally hereinafter, they are to be understood to refer to systems in which the attaching threads are in surface contact with one another, with a continuous cord or filler bead of thermoplastic material running through or along the coupling elements in a conventional manner and composed of a thermally weldable synthetic resin according to the present improvement, and/or with the helicoidal or meandering coupling elements which are composed of continuous filamentary thermoplastic material; the threads are bonded along the surface in such contact with one another, to the slider-guide bead or fillet, to the core running through the coupling element and/or to the coupling element itself in the region in which these threads engage the shanks. Furthermore, at the locations in which thermal welding is to take place, the expression "formfitting" is intended to include the concept of integrating the ma-

terial of the thread with the material of the body to which the thread is thermally bonded (i.e. another thread of the stitching, another convolution, loop or stretch of the same thread, the bead or fillet, the core and/or the coupling element), the integration forming substantially a monolithic structure at the thermal weld of the type characterizable as a flowing together of the thermally welded materials, an interdiffusion or interpenetration thereof and the like. All of these conditions are intended when the expression "thermal welding" is used hereinafter in conjunction with expressions relating to integration of the thread materials with the body to which they are bonded.

The assembly produced by, for example, thermally welding the threads constituting the stitching to one another along the length of the coupling element to form a nonseparable fastening means capable of withstanding high stress and even forming a substantially continuous member for guiding the slider, or the structure resulting from bonding the thermoplastic threads to a fillet disposed alongside the coupling element and stitched by the threads to the coupling element and the stringer tape, or the thermal welding of the threads of the stitching to one another, to the core passing through a helicoidal coupling element or to the coupling element itself, has the significant advantage that thread loops formed by loosening of the stitches or the woven fastening threads can be formed with use of the slide fastener and interfere with its movement along the coupling elements. Moreover, by avoiding such loops, it is possible to prevent localized separation of the coupling element from the stringer tape and/or dislocation of the coupling element in such manner as to prevent movement of the slider therealong. Another surprising advantage is the increase in the transverse strength of the slide fastener which can resist forces tending to separate the slide-fastener halves in the plane thereof to a greater extent than coupling elements attached with normal stitching techniques. When, for example, standard methods of measuring the transverse strength of a slide fastener, e.g. in terms of the force necessary to pull apart the closed slide fastener per unit length in a direction transverse thereto, are used, it is found that there is a minimum increase of 10% with the present improvement. In addition, the resistance of the slide fastener to washing and dry-cleaning stresses is increased. The thermal welding of the loops of the fastening stitches on or adjacent the coupling elements, which are composed of thermally fusible synthetic resin, can be carried out in various ways in accordance with the instant invention. For example, when the coupling element is provided with a core or fillet, a heating device may be used to fuse the stitches which comprises a number of relatively small localized heating elements spaced apart in accordance with the distribution of the threads and the welds which engages the slide-fastener half as it is displaced after stitching. A relatively simple technique involves the use of a radial heating device or a dielectric heater which fuses the free loops of the thread and forms from them thickenings or bulges, thereby shrinking the thread loops about the fillet or coupling element and produces a ridge along which the slider can ride. The threads are integrated with another and thermally fused to the coupling elements or core as may be desired. General heating techniques may be used, however, since the thickness of the threads is substantially less than that of the attaching cords or coupling elements so that the thermoplastic threads flow before the coupling elements and attaching cords have been heated sufficiently. The portions of the threads within the cords remain unaffected by the heat which cannot damage the coupling elements. When the coupling elements are composed of metal, inductive heating may be used to cause fusion and flowing of the threads at the locations at which they contact the metal element. Gas-flame heating may also be employed.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a perspective view of a slide fastener embodying the present invention;

FIG. 2 is a cross-scectional view along the line II—II of FIG. 1 showing the means for heating the threads in diagrammatic form and drawn to an enlarged scale;

FIG. 3 is a cross-sectional view similar to FIG. 2, illustrating another embodiment;

FIG. 4 is a cross-sectional view taken along the line IV—IV of FIG. 1;

FIG. 5 is a plan view drawn to an enlarged scale and with parts removed showing the relationship between the chain-stitch threads and the coupling elements;

FIG. 6 is a view similar to FIG. 5 showing the relationship of the coupling elements and attaching threads after thermal bonding;

FIG. 7 is a cross-sectional view similar to FIG. 4 illustrating another aspect of this invention; and

FIG. 8 is a view similar to FIG. 6 of another modification.

In FIG. 1 of the drawing, I show in diagrammatic form a slide fastener **10** which comprises a pair of slide-fastener halves **10***a* and **10***b* each having a respective stringer tape **2** of fabric and provided with a respective coupling element of the meandering or helicoidal type represented in **1**. The coupling elements may be composed of molecularly oriented synthetic resin and are attached to the stringer tapes **2** as described, for example, in connection with FIGS. 2 and 4–6. Flanking the coupling elements **1**, which may have the configuration illustrated in any of the aforementioned patents or application, are a pair of fillet cords **4** which protect the outer edges of the coupling elements and guide a conventional slider (not shown) therealong. While the present drawing illustrates stitching for retaining the coupling elements **1** on the stringer tapes **2**, it will be understood that the present invention also applies to systems in which the coupling elements **1** are woven into the fabric tapes, i.e. wherein the fabric tapes retain the coupling elements via threads from which these tapes are woven. The interweaving of flexible coupling elements of the character described into the fabric tapes is conventional in the art and need not be described in greater detail hereinafter except to note that the thermal fusion of the thermoplastic threads improves the anchorage of coupling elements to woven stringer tapes in which they are held by the interwoven threads. As shown in FIG. 2, however, the coupling elements **1** are retained on the stringer tapes **2** by stitching **3** through the cords **4** flanking these coupling elements which are here shown to be in their interengaged condition. In this embodiment, the threads **3** of the stitching along the left-hand slider half are thermally melted down and welded together to form thickenings **5***a* by a gas flame **11** from a torch **12** at the localities at which such thickenings are desired. In the system at the right-hand side of this slide fastener, the stitching threads **3** are thermally fused together and melted down by an infrared heater represented at **13** to form the thickenings or condensed portions **5***b* along the upper surface of the respective fillet cord **4**. The fillet cords **5** are here shown to be of thermally fusible thermoplastic material which merge with the threads **3** at the thickenings **5***a* or **5***b* and are integrated therewith. The stitching **3** may be a double-chain stitch, vamping stitch or the like having one or more loops bonded together by thermal welding as indicated previously. When a number of stitches are provided, it may be desirable to make use of nonthermally fusible threads for some of these loops and thermally fusible threads for others. For example, the thread loops of thread **3***a* in FIGS. 4–6 may be composed of cotton while the thermally condensed and fused thread loops are composed of the thermoplastic material (e.g. polyamide or polyester resin).

In the system of FIG. 3, the stitches **23** pass through cores **24** within the helicoidal coupling elements **21** on

the stringer tapes **22**. In this case, the thermal welding of the stitches **23** at **25** to fuse them together and form thickenings or condensed portions thereon, also thermally bonds the threads to the thermoplastic coupling elements **21** at the integrated interfaces **28**. It has been found that it is possible to eliminate the cores **24** and yet obtain a highly effective attachment of the coupling elements to the tape when the stitches **24** are fused to the coupling elements **21** at **25**, as represented in FIG. 3. Since the stitches are fused together as well, a relatively continuous seam is provided along the full length of the coupling element, which is practically unravelable and can serve to guide the slider.

In FIGS. 4–6, the relationship between the different stitches can be seen. In this embodiment, the upper thread **3***a* and the lower thread **3***b* attaching the couple elements **31** to the stringer tapes **32** are composed of cotton and thermoplastic material respectively, the stitch being illustrated at the left-hand side of FIG. 4 while, at the right-hand side of this figure, the tightened stitches are shown securing the core **34** within the helicoidal coupling elements. In accordance with conventional practice, the lower thread **3***b* forms the upper surfaces of the slide fastener and is heated (e.g. by the means illustrated in FIG. 7) to condense the threads **3***b* and form from the loops thereof the locking elements **6** which (compare FIGS. 5 and 6) are thermally bonded to the coupling elements **31** at **38** and retain the nonthermally fusible threads **3***a* in place. The locking elements **6** are here shown to be formed as eyes through which the threads **3***a* pass.

In the modification shown at FIG. 7, the thermally fusible threads **43***a* and **43***b* are both composed of thermoplastic material and form a chain stitch retaining the coupling element **41** on the tape **42**, a thermoplastic core **44** extending through the coupling element. Individual resistive heaters **49** carried by a support **49***a* and spaced apart in accordance with the spacing of the turns of the coupling element are brought into contact with the threads **43***a* and **43***b* and heat them to the flow condition, at which temperature the thermoplastic threads merge at **48** with the coupling elements, at **48***a* with the synthetic-resin core **44** and with each other at the thickened portion **48***b*. The support **49***a* is displaced by a drive **49***b* into and out of engagement with the slide fastener which is stepped in the direction of arrow **49***c*. In FIG. 8, I show an arrangement wherein synthetic-resin loops **46** are formed by thermal welding and condensation of one set of fastening threads and are bonded to the coupling elements at the upper surface thereof while anchoring the lower threads **53** which may pass through the tape and around the other shank of each coupling element to lock these threads in place.

The invention described and illustrated is believed to admit of many modifications within the ability of persons skilled in the art, all such modifications being considered within the spirit and scope of the appended claims.

I claim:

1. A slide-fastener structure comprising a stringer tape, a continuous-filament coupling element having a multiplicity of convolutions of thermoplastic material extending along an edge of said tape for mating interengagement with a complementary coupling element upon movement of a slider therealong, and means including a thermally fusible thread of a thermoplastic resin extending along said coupling elements for securing same to said tape and having a multiplicity of thread loops passing between said convolutions and in contact therewith, said thread loops being thermally welded unitarily with said convolutions at regions of contact therewith to hold said convolutions in place in the slide-fastener structure.

2. The slide-fastener structure defined in claim **1** wherein a plurality of thread loops secure said convolutions to said tape and the thread loops along each convolution are thermally fused to one another.

3. The slide-fastener structure defined in claim **1**, further comprising a continuous cord of thermoplastic material extending along said coupling elements and forming part of the means for securing same to said tape, said thread loops being thermally fused to said cord.

4. The slide-fastener structure defined in claim **3** wherein said cord flanks said coupling element.

5. The slide-fastener structure defined in claim **3** wherein said cord forms a core extending through said coupling element, said thread loops constituting a row of stitches securing said coupling element and said core to said tape.

6. The slide-fastener structure defined in claim **1** wherein the means for securing said coupling element to said tape includes thread of relatively nonfusible material interlinked with said thread of thermopolastic resin and locked thereby in place upon thermal fusion of the latter thread.

7. A slide-fastener structure comprising a stringer tape, a continuous coupling element having a multiplicity of convolutions extending along an edge of said tape for mating interengagement with a complementary coupling element upon movement of a slider therealong, and means including a thermally fusible thread of a thermoplastic resin extending along said coupling elements for securing same to said tape, said thread being thermally fused in place in the slide-fastener structure, said thread forming part of a double-chain stitch consisting of an upper thread and a lower thread, said lower thread being composed of thermally fusible material and being thermally fused so as to form locking elements in the form of annular eyelets retaining said upper thread.

8. A slide-fastener structure comprising a stringer tape, a continuous coupling element having a multiplicity of convolutions extending along an edge of said tape for mating interengagement with a complementary coupling element upon movement of a slider therealong, and means including a thermally fusible thread of a thermoplastic resin extending along said coupling elements for securing same to said tape and having a multiplicity of thread loops passing between said convolutions, said thread loops including two loops assigned to each convolution thermally welded unitarily together at regions of contact therewith to hold said convolutions.

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U.S. Cl. X.R.

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