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METHOD OF MANUFACTURE OF SLIDE FASTENERS

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The invention relates to method of manufacture of slide fasteners and methods for their manufacture, and more particularly to the tape component thereof.

It has been the practice in slide fastener manufacture to provide the tape with a predetermined inside curvature or concavity in order to compensate for the lengthening of the edge which occurs when the spaced fastener elements are clamped thereon. A flat fastener with equal length edges is desired, and if the edges of the tapes on which the fastener elements are clamped have thereby been made unduly long, the meshed elements of the fastener assume an undesirable "bumpy" condition. On the other hand, if the edges along which the fastener element are mounted are slightly on the short side, the tapes assume a slight "waviness" along the free or unscooped edges, a condition which is not undesirable, and some think it desirable. Thus for either reason a tape with an initial inside curvature is wanted.

Generally, there are two types of slide fastener tapes, "sewn" and "corded edge." In sewn tape, the thickened edge to receive the fastener elements or scoops is obtained by sewing two separate cords on opposite sides of a flat tape near one edge thereof. The fabrication of this type of tape requires special sewing machines, guides and tensioning devices. The desired predetermined concavity is obtained by placing the cords under greater tension than the tape during the sewing operation, so that subsequent to sewing, and with the release of tension, the tape acquires a concavity along the sewn edge. The amount of tension applied to the cords depends upon the tape and cord materials used, the size of the scoops to be applied, the number of elements per inch, etc., so that with different types and sizes of fasteners, it has been necessary to empirically determine the proper radii of curvature which will result in flat fasteners.

In corded edge tape, the thickened edge is obtained by incorporating a cord or cords in the edge as an integral part of the tape during the weaving, knitting or braiding thereof. Similarly to the sewn tapes, the prior art corded edge tapes have been made with a concavity along the corded edge, and a variety of methods have been suggested for obtaining this condition.

It has been proposed to place the cords at the edge under greater tension than the warp threads in the flat portion of the tape during the weaving operation, so that after weaving is completed, and the tape is released from tension, the cords at the edge will contract to a greater degree than the warps in the flat portion. Special attachments on the loom itself, as well as special auxiliary devices adjacent the loom have been used to provide the different linear dimensions in the selected areas of the tape. It has also been proposed to weave the tape with special warp, filler and cord arrangements in order to furnish the desired curvature. All of these corded edge constructions have necessitated special techniques and equipment, and exacting controls, so that the benefits which may have been realized from the elimination of

the sewing operation in the manufacture of sewn tape, were transposed into complications of operating and controlling the weaving, knitting or braiding machine. The difficulties of maintaining a suitable quality level for commercially reproducible production quantities of corded edge tape have resulted in their failure to supplant sewn tape to any appreciable degree, notwithstanding the apparent economic advantages of corded edge tape. The main difficulty has been the suitable curvature at the thickened edge upon which the fastener elements are mounted.

It has also been proposed to incorporate strands in the corded edge which have a greater coefficient of shrinkage when wetted or dyed than the strands of the body or flat portion of the tape, differentially shrinkable materials such as wool and cotton, or mercerized cotton and unmercerized cotton, being suggested. The idea was that after weaving, the dyeing or other wetting of the tape followed by drying would effect a contraction of the threads or strands in the corded edge portion to a greater degree than in the flat or body portion of the tape. This method, however, was found to be unsuitable, because later on ordinary laundering of a garment having a fastener made with such tape disturbs the proper linear dimension of the fastener.

It will be apparent from the foregoing discussion that a flat or non-bumpy slide fastener which also satisfies the requirements of being smooth-running, flexible, and linearly stable has been extremely difficult to obtain with corded edge tape. Also, whether using sewn or corded edge tape, it has been necessary that the tape possess the proper radius of curvature at the fastener element mounting edge initially, or before scooping. If sufficient compensation were not made for the lengthening of the tape edge which occurs upon scooping, the resulting bumpiness could not be corrected, and the fasteners had to be either scrapped or disposed of as sub-standard merchandise.

In accordance with the present invention, the slide fastener is flat, linearly stable, smooth-running and flexible. The process of manufacturing the tape, or the fastener of which it is a component, is simple and comparatively inexpensive. Although the greatest advantages of the invention are realized with corded edge tape, the invention is also applicable to sewn tape, for even with the latter type, the need for special tensioning devices is eliminated. Whereas, prior to the present invention nothing could be done to correct a "bumpy" chain or fastener, the present invention makes it possible to subsequently convert or correct such chain or fastener to a flat condition. Also, whereas it was previously necessary to impart a predetermined concavity to the tape edge initially, or before scooping, the present invention permits attainment of highly satisfactory fasteners by means of a simple treatment after the tape has been scooped, or when the product is in stringer, chain or fastener form.

The discussion up to this point, and aside from the other necessary qualities of a satisfactory slide fastener, has been in terms of preparing the edge to furnish a flat, as distinguished from a "bumpy" fastener. Another important aspect of the present invention resides in the fabrication of a flat, curvilinear fastener; that is, a fastener having its stringers contoured or curved in the plane of the tapes. Prior to the present invention, it was necessary to vary the distance between the fastener elements at the curved portion or portions of the stringers by the use of special attachments upon, and the manipulation of, the scoop machine. Such means for producing curved fasteners are illustrated in the patents to Sundback 1,434,857 and 2,001,591. The tape construction of the present invention makes it possible to achieve a substantially flat, linearly stabilized fastener having a

predetermined radius of curvature, without resorting to special scoop machine devices and techniques.

In accordance with the present invention, the tape is provided at a selected area, preferably at the fastener element mounting edge, with a cord or cords composed of a material capable of changing its linear dimension to controllably change the linear dimension of the tape, stringer, chain or fastener at the area where such cord is located. The controlled linear dimensional change is accomplished by a treatment of the tape, stringer, chain or fastener which does not appreciably impair the flexibility or tensile strength of the product. The treatment is accomplished under conditions which normally are not encountered in the end use of the fastener, including also laundering, ironing, and dry-cleaning of garments, so that the fastener is substantially linearly permanently stabilized or set.

Cord materials which have been found to be particularly suitable for the purposes of the present invention are the polyamides (nylon), polymers of acrylonitrile (Orlon or Acrilan), copolymers of acrylonitrile (Dynel), and polyesters (Dacron). Strands or cords of these materials when subjected to the treatment of the present invention, and without any tension thereon, will controllably shrink, or, if treated while under tension, will elongate to a fixed or set linear dimension. In most cases the rest of the tape is cotton.

Preferably, the controlled change in linear dimension of the cord material is accomplished by a heat treatment. While a temperature of 212° F. (using boiling water) will accomplish the desired linear change, it is preferred to carry out the heat treatment at a temperature which is substantially higher than the temperatures normally encountered in the end use of slide fasteners, including laundering. We find that further linear dimensional change will take place only if the activating temperature of treatment is exceeded.

In selecting these materials, an important characteristic is that their softening of melting point is not too low. There are many other synthetic fibre cords which will shrink when heated, but which become tacky at a temperature as low as 200° F. Such cords would not be desirable because of changes which would take place during laundering and ironing. However, ironing of a garment having a fastener made with our new tape will not disturb the linear dimension of the fastener. Preferably, our tape is subjected to a temperature between approximately 300 and 350° F. for approximately five minutes. Cord materials of the type mentioned above become tacky between approximately 450 and 480° F., and it is desired to keep the temperature sufficiently below this point to maintain the cord identity of the material, and in order not to materially affect the tensile strength and flexibility of the material or materials comprising the tape. Melting or fusing with the surrounding warps and fillers should be avoided. Thus the treatment temperature is preferably above 212° F. and below 450° F., and more preferably in the middle region therebetween and at or above ironing temperature, which may approach 300° F.

A cord material of the type described may be incorporated in the tape either as an integral part thereof during the weaving, knitting or braiding, or by sewing such cord material to a flat tape. If a corded edge tape of the woven variety is desired, any otherwise desirable weave may be use, and no provision need be made on the loom or in the weave pattern to impart a concavity to the tape edge as the tape comes off the loom. For example, a tape may be woven of cotton in accordance with the weave pattern disclosed in the patent to Jones 2,333,314, granted November 2, 1943, except that nylon (or Orlon, Dynel, Dacron, etc.) may be used for the anchor cord. For added flexibility, the nylon cord is preferably a multifilament yarn of either continuous filaments or staple. A suitable quantity of the tape is skeined and subjected to a temperature of between 300 to 350° F. for a period of five minutes. Upon cooling, the nylon cord shrinks, taking with it the tape edge, so that the tape assumes a concavity at the edge, which, for a given size of cord and tape width, furnishes a predetermined inside radius of curvature. After scooping and pull-up, the resulting chain is flat, and provides a smooth-running, flexible and strong fastener.

Instead of providing the linearly controlling cord as the anchor cord in the Jones weave pattern, the buffer cords, or both the buffer cords and the anchor cord may be of nylon, Orlon, Dacron, Dynel, etc.

In another form of the invention, a tape of the character described is scooped just after it comes off the loom, or before the described treatment, and a pair of the scooped tapes or stringers are pulled up to form chain. Since the tape edges are not shrunk before scooping, the resulting chain is quite "bumpy." The chain is then placed under longitudinal tension, as by securing same in a tenter frame. Since the scooped edges are longer than the remainder or flat portions of each of the tapes, the tension is applied to the flat portions and not to the scooped edges. The tensioned chain is then subjected to a heat treatment as hereinbefore described, whereupon the scooped or untensioned edges shrink until they substantially equal the length of the remaining restrained or tensioned portions of the tapes. The bumpiness disappears and the chain becomes flat.

When using this last type of treatment, the entire tape may be made of nylon, Dacron, Orlon, Acrilan, Dynel, or the like, instead of restricting the location of such material to the scooped edge. The tendency of the warps in the flat portion of each tape to shrink similarly to the cord or cords in the scooped edge is prevented by the tension applied to the flat portions, so that during the treatment the longer and untensioned scooped edges shrink to the point where the length across the entire width of the chain is substantially equalized.

In the case of a cotton tape, having a nylon or equivalent activatable cord or cords at the edge, if the treatment to obtain the concavity at the edge before scooping does not give a sufficient compensating radius of curvature, because, for example, the operator tending the oven removed the skein of tape too soon, so that after scooping and pull-up into chain form, the chain is slightly "bumpy," then placing the chain under tension, as described, and heating at a slightly higher temperature for a period of time will serve to convert it to flat chain.

For certain slide fastener applications, such as for trousers, it is desired that the tapes have a "waviness." The present invention permits this condition to be accomplished quite readily. Flat chain made with tape of the present invention is heated slightly beyond the activating temperature initially used upon the tape itself, or the chain, whereupon the scooped edges will shrink slightly further, and so impart a "waviness" to the unscooped or flat portions of the tape.

A straight, flat fastener made in accordance with any of the previously described processes, and whether made entirely of nylon, Dacron, Orlon, etc., or made of a combination of fibers including one of the aforementioned activatable materials in the scooped edges, may be made into a flat fastener which is curved or contoured to a desired radius of curvature in the plane of the tapes. Such fasteners are used, for example, around three sides of the rear cloth panel of a convertible automobile top, and such fasteners heretofore have been expensive to manufacture. With our invention this is accomplished by arranging flat chain, or a fastener, on the desired radius of curvature and maintaining same to such curvature in a plane by means of any suitable fixture or holding device. The chain or fastener is then subjected to a temperature the same as, or slightly in excess of, the temperature used to obtain the flat fastener. For example, if a 300° F. treatment for five minutes was used to make the

straight fastener, a treatment at about 325° F. for about the same period of time would be suitable. Upon cooling, the originally straight chain or fastener is found to be set to the predetermined radius of curvature.

When a portion of the straight fastener is arranged on the desired radius of curvature, the scooped edge of the outside stringer is stretched and the scooped edge of the inside stringer is relaxed. When heat is applied to the chain or fastener thus maintained, the tensioned edge is elongated and is set to an inside or concave radius of curvature, whereas the relaxed edge shrinks and is set to a corresponding outside or convex radius of curvature. The result is a smooth, flat fastener set to the desired radius of curvation. The invention takes advantage of the fact that heat can be used to both stretch and shrink the cord. If the cord is under tension it stretches. If the cord is free, it shrinks. In making the curved fastener it is convenient but not essential to start with a previously treated or flat fastener. An untreated or bumpy fastener may be used, but the holding fixture may then have to be somewhat more complex and elaborate, to insure both results, that is, removal of bumpiness and setting the curve.

It is believed that the described method of manufacturing tape, and slide fasteners, and the resulting products, as well as the advantages thereof, will be apparent from the foregoing detailed description.

Manufacture of tape with a sewn edge is simplified because there is no need to produce a curvature during the sewing operation. Similarly manufacture of a corded edge is simplified because there is no need to produce a curvature during the weaving or knitting or braiding of the tape. A corded edge is a more logical and convenient product than a sewn edge, but the latter heretofore has been preferred solely because of the enormous difficulty involved in attempting to curve a tape while making the tape with a corded edge, and when considered in this aspect, a most important advantage of the present invention is in making it practicable and economical to now employ a corded instead of a sewn edge.

In either case the ensuing procedure most nearly analogous to present practice is to treat the straight tape to shrink the cord material, thus curving the tape, following which the scoops are applied, thereby lengthening the shrunk edge, and so producing a flat stringer. If a wavy edge is desired the shrinkage of the cord material may be made somewhat greater than the elongation produced by mounting the scoops thereon.

Another advantage of the present invention is that the cord material may be treated after attachment of the scoops, and thus the fastener is subject to correction in the event of error. Specifically, if the elongation produced by attachment of the scoops should happen to exceed the preceding shrinkage, resulting in a bumpy chain or fastener, the difficulty may be cured by treating the chain or fastener to further shrink the cord material and thus eliminate the bumpiness.

Moreover, the entire treatment may be applied subsequent to scooping the tape. Thus straight tape, whether sewn or corded, but including the nylon or equivalent cord material, may be scooped, thus elongating the scooped edge. The stringers may then be heat treated, or more preferably two stringers are run together to form a chain which, of course, will be bumpy, and the chain is then heat treated to shrink the cord material and thereby eliminate the bumpiness. If a wavy tape edge is desired the treatment may be carried somewhat further in order to produce a little more shrinkage than would be needed for a flat fastener.

Another advantage of the present invention is that the heat treatment may be used to stretch the cord material as well as to shrink it, the difference depending on whether the material is under tension or is relaxed during the treatment. In consequence the invention may be used to produce a curved fastener which is contoured to a desired curvature while lying flat in the plane of the tapes. For this purpose it is merely necessary to secure the fastener in a suitable fixture which holds it in the desired curved shape, and to then heat treat the fastener, thus relatively stretching the cord material of the outer tape and shrinking the cord material of the inner tape, following which the fastener remains set in the desired curved condition.

Still another advantage of the invention is in making the foregoing possibilities available even when using a tape which does not have "differential" materials, such as cotton for the main web and nylon or equivalent for the cord material. The web as well as the cord material, or in other words, the entire tape, if desired, may be made of nylon or equivalent, and the desired results are obtainable because of the characteristic already mentioned whereby the same heat treatment may be used to either stretch or shrink the material, depending on whether or not it is under tension while being treated. Thus bumpiness can be removed by heat treating nylon tapes with the web portions but not the cord portions, under tension. Similarly curved fasteners may be produced, in which the outer and inner portions of even the flat part of the tape are differently stretched and shrunk.

As already explained, if the heat treatment is applied at a certain temperature, the material remains set even if again heated to temperatures lower than the treatment temperature. Thus by treating the cord material at a temperature higher than laundering and ironing temperatures, the set of the material is unchanged by subsequent laundering or ironing of garments using the slide fastener. Indeed the ironing temperature may even reach the treatment temperature without injurious result because of the time factor, that is, because the ironing period may be only a few seconds while the treatment time is a matter of, say, five minutes. A corrective treatment, for example to eliminate residual bumpiness, or to produce a curved fastener, may be applied by using a temperature a little higher than an earlier treatment temperature. Both treatment temperatures, however, are kept well below the temperature at which the nylon or equivalent cord material would become tacky, and that fact constitutes another important advantage of the invention, for if the cord material becomes tacky or is fused into the other materials of the tape, the tape and consequently the fastener loses strength and becomes stiff and unsatisfactory. There are a vast number of synthetic materials which we deem unsatisfactory for the present purpose, although they shrink under heat, because they become tacky at too low a temperature, in some cases only about 200° F.

In this specification the term "stringer" means scooped tape; the term "chain" means a pair of meshed stringers of indefinite length; and the term "fastener" means a pair of stringers of desired length equipped with end stops, etc. "Permanently stabilized" or "set" mean that the fastener is in such a condition that normal usage, including laundering, ironing and dry cleaning, will not affect the linear dimension.

The treatment employed is not necessarily limited to a heat treatment. For example, when the cord material is nylon the tape may be treated with cold acetic acid, specifically glacial acetic acid. This has a very slight plasticizing effect which is insufficient to lessen flexibility and strength and yet which causes shrinkage of the cord when it is relaxed or free of tension, and which affords stretching of the cord when it is under tension.

It will be apparent, therefore, that while we have shown and described our invention in several preferred forms, changes may be made without departing from the spirit of the invention as sought to be defined in the following claims. In the claims the expression "cord incorporated in an edge" is intended to include a sewn edge as well as a corded edge.

We claim:

1. A method of manufacture of slide fasteners, com-

prising the steps of providing a tape having a cord incorporated in an edge thereof, said cord being composed of a plastic material capable of changing its linear dimension when subjected to heat treatment and of being permanently set subsequent to treatment, and subjecting said tape to a heat treatment to cause the edge portion thereof to change its linear dimension while retaining the identity of said cord, said treatment being at a temperature higher than normally encountered in the use of slide fasteners including such tape so as to effect the permanent set of plastic material and to substantially permanently stabilize such fasteners, said temperature being lower than the temperature which will impair the strength and flexibility characteristics of the tape.

2. A method of manufacture of slide fasteners, comprising the steps of providing a tape having a cord incorporated in an edge thereof, said cord being composed of a plastic material capable of changing its linear dimension when subjected to heat treatment and of being permanently set subsequent to treatment, and subjecting said tape to a heat treatment to cause the edge portion thereof to change its linear dimension while retaining the identity of said cord, said treatment being at a temperature higher than normally encountered in the use of slide fasteners including such tape so as to effect the permanent set of said plastic material and to substantially permanently stabilize such fasteners, said temperature being lower than the temperature which will impair the strength and flexibility characteristics of the tape, said cord being composed of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile, and polyesters, and said temperature being between 300 and 350 degrees F.

3. A method of manufacturing a sliding clasp fastener which, at least in part, is curved in the general plane of the fastener stringers, comprising the steps of imparting a curvature to a stringer, in which a settable plastic material is incorporated, by deforming at least a part of the stringer, and causing the plastic material to set after the said stringer portion has been deformed, whereby to maintain the curvature imparted to the stringer by deformation.

4. A method as claimed in claim 3, wherein the stringer comprises threads made of the settable material.

5. In the manufacture of slide fasteners, the method set forth in claim 2, in which the tape provided in said method is made of cotton, except for the cord in the edge portion.

6. In the manufacture of slide fasteners, the method set forth in claim 2, in which the tape provided in said method is made entirely from a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile and polyesters.

7. In the manufacture of slide fasteners or the like, the method which includes providing chain comprising a pair of tapes, the tapes of which each include a flat portion and a fastener element mounting edge having a cord therein, said cord being composed of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile, and polyesters, applying longitudinal tension to the chain, whereby the flat portions of the tapes are under greater tension than the edge portions, subjecting said chain to a heat treatment to cause said edge portions to shrink relative to the flat portions until they are substantially equal to the length of the flat portions, the temperaure being higher than normally encountered in the use of slide fasteners made from such chain so that the fasteners are substantially permanently stabilized, and said temperature being lower than the temperature which will appreciably impair the strength and flexibility of the chain.

8. In the manufacture of slide fasteners or the like, the method which includes providing chain comprising a pair of tapes, the tapes of which each include a flat portion and a fastener element mounting edge having a cord therein, said cord being composed of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile, and polyesters, applying longitudinal tension to the chain, whereby the flat portions of the tapes are under greater tension than the edge portions, subjecting said chain to a temperature between approximately 300 to 350° F. to cause said edge portions to shrink relative to the flat portions until they are substantially equal to the length of the flat portions.

9. In the manufacture of slide fasteners or the like, the method set forth in claim 8, in which the tapes provided in said method are made of cotton, except for the defined cord material in the edge portions.

10. In the manufacture of slide fasteners or the like, the method set forth in claim 8, in which the tapes provided in said method are made entirely of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile, and polyesters.

11. A method of making a substantially flat, curvilinear slide fastener comprising providing a straight slide fastener or chain comprising a pair of tapes, the tapes of which each include in the fastener element mounting edge a cord composed of a material capable of changing its linear dimension, arranging the fastener or chain upon a desired radius of curvature, and while the fastener or chain is maintained on said radius of curvature, subjecting same to a treatment to cause the fastener or chain to be set to said radius of curvature.

12. A method of making a substantially flat, curvilinear slide fastener comprising providing a straight slide fastener or chain comprising a pair of tapes, the tapes of which each include in the fastener element mounting edge a cord composed of a material capable of changing its linear dimension when subjected to heat, arranging the fastener or chain upon a desired radius of curvature, and while the fastener or chain is maintained on said radius of curvature, subjecting same to a heat treatment to cause the fastener or chain to be set to said radius of curvature, the temperature being higher than normally encountered in the use of the slide fastener so that said fastener is substantially permanently stabilized to the set curved condition, and said temperature being lower than the temperature which will appreciably impair the strength and flexibility of the fastener.

13. A method of making a substantially flat, curvilinear slide fastener comprising providing a straight slide fastener or chain comprising a pair of tapes, the tapes of which each include in the fastener element mounting edge a cord composed of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile and polyesters, arranging the fastener or chain upon a desired radius of curvature, and while the fastener or chain is maintained on said radius of curvature, subjecting same to a treatment to cause the fastener or chain to be set to said radius of curvature, said treatment being carried out under conditions which normally are not encountered in the use of the slide fastener so that the fastener is substantially permanently stabilized to the set curved condition, the strength and flexibility of the fastener or chain being substantially unaffected by the treatment.

14. A method of making a substantially flat, curvilinear slide fastener comprising providing a straight slide fastener or chain comprising a pair of tapes, the tapes of which each include in the fastener element mounting edge a cord composed of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile and polyesters, arranging the fastener or chain upon a desired radius of curvature, and while the fastener or chain is maintained on said radius of curvature, subjecting same to a heat treatment to cause the fastener or chain to be set to said radius of curvature, the temperature being higher than normally encountered in the use of the slide fastener so that the fastener is substantially permanently stabilized to the set curved condi-

tion, and said temperature being lower than the temperature which will appreciably impair the strength and flexibility of the fastener.

15. A method of making a substantially flat, curvilinear slide fastener comprising providing a straight slide fastener or chain comprising a pair of tapes, the tapes of which each include in the fastener element mounting edge a cord composed of a material of the group consisting of polyamides, polymers of acrylonitrile, copolymers of acrylonitrile and polyesters, arranging the fastener or chain upon a desired radius of curvature, and while the fastener or chain is maintained on said radius of curvature, subjecting same to a temperature between approximately 300 and 350° F. to cause the fastener or chain to be set to said radius of curvature.

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