ELASTOMERIC TENSION MEMBER AND METHOD OF MAKING SAME

Filed Oct. 20, 1965

FIG. 1

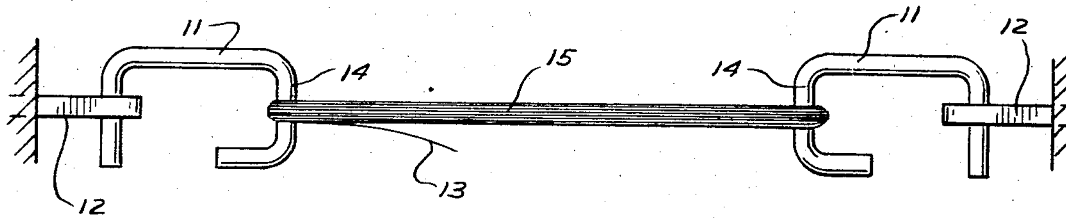


FIG. 2

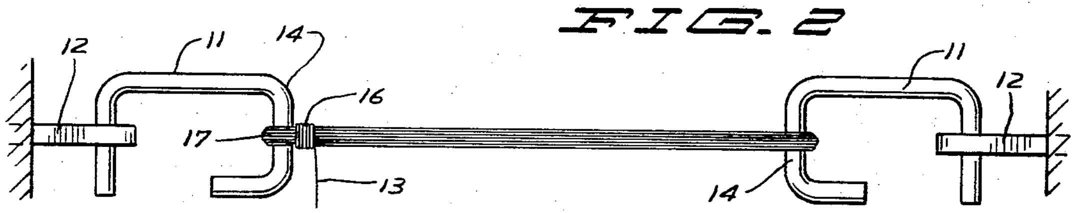
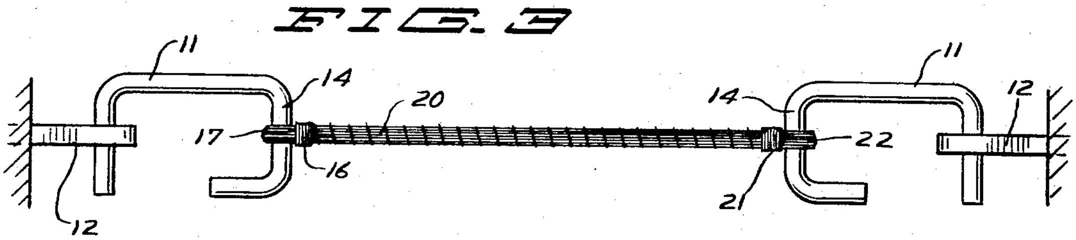


FIG. 3



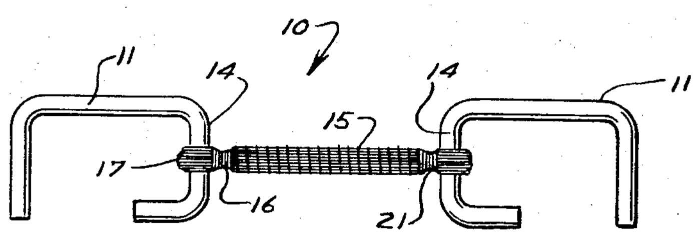


FIG. 4

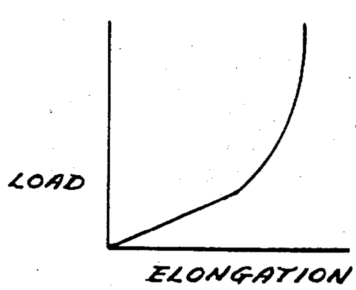


FIG. 5

INVENTORS
FRANK D. WERNER
PAUL S. PETERSEN
BY
Dugger, Johnson & Westman
ATTORNEYS

United States Patent Office 3,370,841
Patented Feb. 27, 1968

1

2

3,370,841
ELASTOMERIC TENSION MEMBER AND METHOD OF MAKING SAME

Frank D. Werner, Bloomington, and Paul S. Petersen, Minnetonka, Minn., assignors to Rosemount Engineering Company, Minneapolis, Minn., a corporation of Minnesota

Filed Oct. 20, 1965, Ser. No. 498,340
11 Claims. (Cl. 267—73)

ABSTRACT OF THE DISCLOSURE

A tension carrying member made up of multiple elastic strands that are fastened over at least one end clip, and wherein the strands are stressed over the end clip to a tension greater than that which it will encounter during service, and means are provided to maintain the strands in the portion where they pass over the end clip at this high tension at all times.

The present invention has relation to a tension carrying member made of elastomeric material.

At the present time there are many different types of tension carrying members using elastomeric material for carrying loads, and usually these are used much like small springs for resisting movement of a part or component from a rest position. If sufficient load is applied to the part or component to move it from its rest position, and then the load is removed, the tension carrying member will return the part to its rest position.

One usage of such members is in the ski boot art wherein an ankle cuff portion of the ski boot is pivoted to a lower portion. It has been found that the forward pivoting of this ankle cuff portion should be restrained in order to obtain satisfactory and comfortable skiing positions. It has further been found that the initial forward bending of the ankle should have only a low resistance and that the rate of resistance should go up rapidly as the ankle cuff is pivoted further. In other words, the amount of force necessary to pivot the ankle cuff a given number of degrees should at the forward extreme of its pivoting be much greater than that force required to pivot it the same number of degrees when it is near its rest or centered position.

Previously this has been attempted by the use of a plurality of load carrying members, some of which would carry the load initially and the additional one which would pick up load after the cuff had pivoted a certain amount. However, this resulted in a somewhat complex and expensive system.

The device of the present invention comprises a tension carrying member having fastening means at each end and with an elastomeric section made up of a plurality of discrete strands of a urethane rubber sold under the trademark Lycra. It has been found that this particular brand of urethane rubber can be stretched into its non-linear range (on a curve plotted as elongation versus load) repeatedly without damaging the tension members and without substantial change in the characteristics of the tension members.

The unit is made out of a plurality of discrete strands which are attached to the end hooks in a manner which prevents rubbing or chaffing of these hooks on the discrete strands thereby preventing early failure.

It is therefore an object of the present invention to present a tension carrying member which can be repeatedly stressed into its non-linear regions without failure.

It is a further object of the present invention to present a tension carrying member which can be easily manufactured out of a plurality of discrete strands of an elastomeric material.

It is another object of the present invention to present a tension carrying member which has a unique way of fastening load carrying end clips without failure at the fastening points during service.

It is a still further object of the present invention to present a method of making tension carrying members out of elastomeric strands.

Other objects are those inherent in the specification and drawings and will be apparent as the description proceeds.

In the drawings,

FIG. 1 is a side elevational view of an elastomeric tension member made according to the present invention during the initial stages of manufacture;

FIG. 2 is a side elevational view of the device of FIG. 1 showing a first end clip in the process of being attached to the tension carrying member;

FIG. 3 is a view of the device of FIG. 1 after it has been completed;

FIG. 4 is a side elevational view of an elastomeric tension carrying member made according to the present invention in its at rest position, and after being removed from the fixtures used during manufacturing; and

FIG. 5 is a schematic representation of the load verses elongation curve for a typical elastomeric strand utilized for making the device of the invention.

Referring to the drawings and the numerals of reference thereon, an elastomeric tension member in completed form, illustrated generally at **10** in FIG. 4, is made by supporting a pair of end clips **11**, **11** in suitable support members **12**, **12** and in spaced apart relationship. The distance between the hooks is further than the tension member will be stretched during usage. A single strand **13** of elastomeric material, for example a urethane rubber manufactured and sold under the trademark Lycra is held in a suitable manner (tied or wrapped) at one of the end clips **11** and is then elongated an amount greater than that which the tension member will be elongated during service, for example, approximately 400% of its at rest length, and in this elongated condition is wrapped back and forth over transverse pin portions **14**, **14** of the end clips **11**. The strand **13** is wrapped until the necessary number of strands are provided to carry the load that will be carried by the tension member during usage without breakage. This, of course, is determined by the loads which are to be carried and can vary for different applications. The strand of Lycra which is used is usually in the range of .003 to .010 inch in diameter, being very fine. While one strand only is shown as being wrapped around the end clips, a plurality of strands could be simultaneously wrapped around the end clips if desired.

The method of manufacture can be carried out on machines, for example by mounting the clips on a rotating member and holding the strand **13** under tension while it is wrapped in place. The clips would have to be designed to provide clearance for the transverse portion **14** to receive the strand.

Once the desired number of strands have been wrapped back and forth between the end pins, **14**, **14** to form a center section **15** (made up of all of the plurality of individual strands) the strand **13** is then wrapped tightly (elongated from its at rest length) around the center section **15** adjacent a first of the transverse end pins **14**. This is shown at **16** in FIG. 2. The strand **13** is wrapped very tightly around its center section to bind the individual strands making up the center section **15** tightly together and form a loop **17**. The strand **13** is wrapped at **16** a sufficient number of times to insure that the individual strands which make up the center section **15** will not slip when the unit is released from its supports. In other words, the loop portion **17** at the first end pin **14** will be held under the original wrapping tension over this end pin when the strand **13** has been properly wrapped at **16**.

When the section at **16** has been wrapped tightly enough to prevent the strands at the loop **17** from slipping, the strand **13** is then spiralled as at **20** along the length of the center section **15** back toward the opposite transverse pin **14**. The strand **13** is then wrapped as at **21** adjacent the center second transverse pin **14** until a loop **22** formed around this second pin is held tightly enough so that when the end clips are released the strands making up the loop **22** will not slip but will remain under the wrapping tension. The strand **13** is then tied off to prevent it from unravelling and the end clips **11**, **11** are released from the supports **12**. This makes the elastomeric tension carrying member as shown at **10** in FIG. 4.

The center section **15** will move to its at rest or unstressed position. The loops **17** and **22** will remain at a tension which is higher than the tension in the individual strands comprising the center section **15** during its maximum service. This means that the strands making up the loops **17** and **22** will not move substantially with respect to their cross pins **14**, **14** during use. This will prevent chaffing and rubbing of the individual strands on the end pins **14** during use and thereby increase the life of the elastomeric member because there will be no failure at the loop ends. The spiral winding of the strand **13** along the longitudinal length of the center section **15** not only holds the strands comprising this section together during use, but also adds to the strength of the center section.

The important thing is that the strand **13** is elongated greater than what it will be during service as it is wound onto the end clips **11**, **11** in the making of the tension carrying member.

In ski boot application, several of these tension carrying members will be utilized, and all of them can be the same length so that they can all pick up load immediately and when the ski boot cuff pivots forwardly the load necessary to cause additional pivoting will increase, in accordance with the curve shown in FIG. 5. The tension members will actually serve as a forward stop for movement when the members have been elongated to their limits.

While very simple end clips **11**, **11** have been shown for convenience of illustration, it is to be understood that any type of end clip can be used as long as it has the pins **14**, **14** for carrying the loops **17** and **22**. The windings **16** and **21** have to be tight enough to prevent the looped strands making up the loops **17** and **22** from slipping and losing their tension. The failure of a strand in the center section **15** will not result in failure of the entire member because the windings **16** and **21** prevent unravelling.

Lycra urethane rubber gives a tension member that is light in weight when compared to the energy it will store. Also it has a long life under high stresses and will survive a great number of stress cycles.

The term "stressing the material into its non-linear regions" relates to the curve of FIG. 5. At low loads the

load versus deflection curve goes at a straight line. However, as the load goes up the amount of deflection per pound of load decreases rapidly, causing the sharp rise shown. The outer end of the curve, where an increment increase in load no longer gives the same elongation as the previous increment of load is the non-linear region of the elastomer.

Although one specific binding has been shown, it is possible to use other bindings, for example separate cording or wire in place of the continuous filament shown at **16** and **21**. The elastomeric filament is wound first as shown in FIG. 1 and separate bindings applied adjacent clips **14**, **14**. Metal or plastic bands could also be used for this binding function.

What is claimed is:

1. A tension carrying member comprising a plurality of individual strands of an elastomeric material, and at least one end clip over which the strands are passed to form a loop, and means to maintain the stress level of the strands in the loop at a stress level greater than that which the strands will reach when loaded in service.

2. A tension carrying member comprising a pair of end clips, a single strand of an elastomeric material wrapped back and forth between said end clips and looped over portions of the end clips, the stress level on the portions of said strands forming the loops being greater than the stress level reached during service, and means to hold the strands forming the loops under such tension.

3. The combination as specified in claim **2** wherein the means for holding the looped portions are comprised as transversely extending strands of elastomeric material wrapped tightly around the strands forming the loops and at a position adjacent to the end clips, said transverse strands being wrapped when the loops are under greater tension than that which is reached in service.

4. A tension carrying member comprising a pair of end clips, a single strand of an elastomeric material looped a plurality of times around the pair of end clips, and means to hold the portions of the strand comprising the loops under a tension greater than that which is reached in service.

5. The combination as specified in claim **4** wherein the elastomeric material is Lycra urethane rubber.

6. The combination as specified in claim **4** wherein the elastomeric material in the loops is stressed into its non-linear portion of a curve made by plotting load on the strands versus elongation of the strands.

7. The combination as specified in claim **4** wherein the individual lengths of the strand between the end clips are held together with a spiralled over-wrapping of the strand from which the tension member is made.

8. A method of making a tension member comprising the steps of:

providing at least one end clip,

passing an individual elastomeric strand over said end clip a plurality of times under tension to form a multi-strand loop over a portion of the end clip, and

tightly wrapping the strand over the tensioned portions of the strands forming the loop in a manner to hold the loop under its initial tension.

9. A method of making an elastomeric tension member comprising the steps of:

providing two spaced apart end clips with transverse support portions,

wrapping a strand of elastomeric material between the end clips a plurality of times, and looping it over the transverse support portions to form a stressed elongated section between the end clips,

wrapping the strand around the elongated section adjacent a first end clip to hold the formed loop tightly,

spiralling the strand around the elongated section to the second end clip,

wrapping the strand tightly around the elongated section adjacent the second end clip, and

tying the strand to prevent it from unravelling.

10. The method as set forth in claim **9** wherein the elastomeric strand is stressed greater than it will be stressed during service while it is wrapped between the end clips, and the stress in the strands forming the loops remain at this level in the completed tension member.

11. The method as set forth in claim **10** wherein the strand is urethane rubber and is elongated substantially 400% of its at rest length during the wrapping between end clips.

References Cited

UNITED STATES PATENTS

1,822,135	9/1931	Fisher	267—63
1,923,926	8/1933	Faure-Roux	267—63
1,962,585	6/1934	Faure-Roux	267—63
2,751,218	6/1956	Pass	267—69

ARTHUR L. LA POINT, *Primary Examiner.*
R. M. WOHLFARTH, *Assistant Examiner.*