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ELASTIC THREAD AND ELASTIC FABRIC

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Fig:1

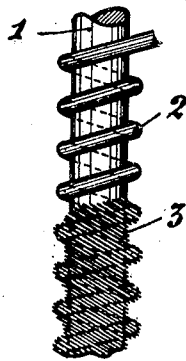


Fig:2

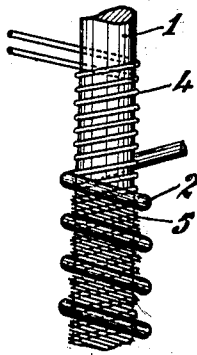


Fig:3

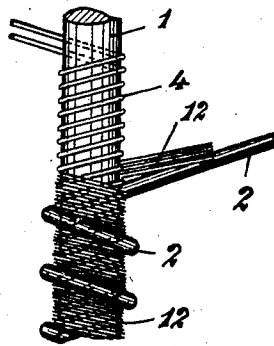


Fig:4

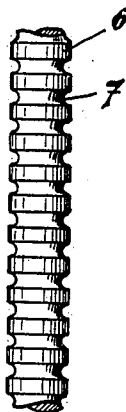


Fig:5

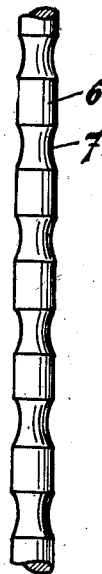


Fig:6

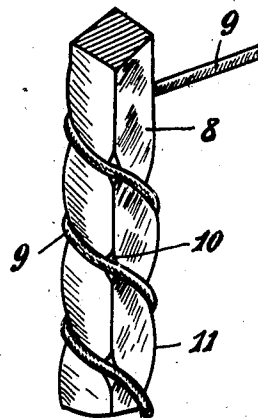
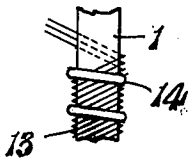


Fig:7

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UNITED STATES PATENT OFFICE

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ELASTIC THREAD AND ELASTIC FABRIC

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The present invention relates chiefly to elastic fabrics and more especially those which are made of at least two sets of threads. As it will result from the following description, the word fabric should be taken in its broadest meaning, including in a general manner any manufactured product obtained by a combination, according to a given system, of thread-like elements which cross one another. The invention is more especially, although not exclusively, applicable to open work fabrics generally made with an elastic warp of rubber threads suitably covered (these threads being round, square, etc.) and to close mesh fabrics the elastic warp of which is made, on the contrary, of bare rubber threads, suitably associated with and maintained by inextensible fibers, either in the direction of the warp or in the direction of the weft, or again in both directions. Besides, in the following specification, the words "warp" and "weft" can be interchanged, the reference to an elastic warp and a non-elastic weft being made merely in order to simplify the language in the description.

For the same reason, the word "rubber" will be used in a generic manner, designating not only rubber proper but any matter having equivalent qualities and in particular having a good elasticity corresponding to that of rubber proper.

In open work elastic fabrics, and especially when the threads of the two groups (warp and weft) have sections of the same order of magnitude, each weft thread is liable to slide at the point where it crosses each warp thread, with respect thereto (and inversely) when the fabric is subjected to stresses of a nature to cause such displacements of the threads. As a matter of fact, in opposition to what takes place for the elements constituting close mesh fabrics, the threads of these open work fabrics are not, as a rule, maintained at the cross points by the adjacent threads of the same kind, and in this case only mutual friction between threads of different natures tends to prevent relative sliding displacements. In many circumstances, this friction has proved to be insufficient. It is therefore interesting to be able to improve the interconnection of the threads at the crossing points without being compelled to modify the structure of the fabric.

This improvement is still more necessary in the case of extensible fabrics of the open work kind than in the case of inextensible open work fabrics because the successive elongations and reductions of length undergone by the rubber warp threads produce corresponding variations of section of the

threads which, in the case of reduction of section, facilitate the relative sliding of the threads.

In a general manner, the object of the present invention is to reduce as much as possible the two drawbacks above mentioned.

More specifically an object of the present invention is to provide threads of a particular kind the use of which permits of avoiding these drawbacks.

Another object of the invention is to provide elastic fabrics made with such threads and consequently avoiding the drawbacks above pointed out.

Still another object of the invention is to provide a method of manufacturing the fabrics in question.

The elastic threads according to the present invention are essentially characterized by the fact that they have, superficially, projections alternating, in the direction of the length, with hollows, these unequalities being of such an amplitude and at such intervals from one another that they are capable of preventing relative sliding movement of cross-threads contacting the improved elastic threads.

The elastic fabrics according to the present invention are also characterized by the fact that, among the groups of threads which constitute them, at least one of these groups includes, either exclusively or partly, threads of an elastic nature provided with unequalities as above mentioned, these threads being for instance warp threads. The amplitude of the unequalities and the interval from one to the other, in the longitudinal direction, are generally chosen in accordance with the size of the threads of the other group and the interval between these last mentioned threads, in such manner that the latter are supported by the threads of the first mentioned group in such manner as to prevent as far as possible, a relative sliding. However, in certain cases, this choice of a particular relation between the amplitude and the interval of the unequalities on the one hand and the size and interval of the threads of the second group on the other hand is not absolutely necessary; in some fabrics where weft threads are looped around or make a turn about the warp threads, said weft threads are nearly at right angles to the warp threads, and they always find on a portion of their loops around such warp threads a recessed portion into which they penetrate, provided, of course, that the amplitude and interval of the unequalities, without having to be too great, are however sufficient.

In order to obtain elastic threads having the

necessary superficial inequalities, I may, first, produce these inequalities by suitably modifying the covering of the threads, without imposing any particular condition to the longitudinal section of the rubber core of said threads. Thus, instead of trying to obtain, as it was the case up to now, in all covered threads, a surface as smooth as possible despite the various technical requirements which sometimes make this difficult to obtain, I can obtain very simply alternating projections and hollows of sufficient size by placing, on the surface of the elastic core, a helix of a thread sufficiently big, in point of fact bigger than the threads used up to the present time (which are strictly sufficient for maintaining the core in an already tensioned state at rest). The diameter and the rigidity of the thread of this helix are chosen in such manner that the helical thread forms on the rubber core a projection which is sufficient even if the helical thread penetrates slightly into the surface of said rubber core. For practical purposes, I may cover the core with a first ordinary covering the convolutions of which are in adjoining or nearly adjoining relation to each other, and I position thereover a thick thread in the form of an open spiral and (or) I cover the core having already received the helix of thick thread with an ordinary external covering. However, I preferably make use of this helix, which is of course very strong, in such manner that it constitutes, at least partly, the covering of the rubber core, or one of the coverings. When use is made of two coverings, an inner covering and an outer covering, and when they are treated differently and are such that it is chiefly one of them which limits the elongation of the elastic thread, it is this last mentioned covering which is preferably chosen for incorporating the helix therein. In this manner, I make sure that in the state of tension, this elongated helix will make the minimum angle with the axis of the core or even will be so deeply imbedded into the surface of the core as to project by less amount with respect to the general surface of the core, as it is well known in the art.

If the helix is to constitute the external part of the finished elastic thread, it can, in some cases in which it is not desired to obtain a very dense covering, constitute the whole of the external covering, or on the contrary, it may constitute it in combination with other threads which are thinner, for instance of ordinary size, and the convolutions of which are inserted between the convolutions of the big helix. In this case, it is the difference between the diameters of these two external covering threads which determines the importance of the projections. The efficiency of the big thread helix is of course greater if this helix is located above an external thread covering having substantially adjoining convolutions and if its pitch is greater than that of said thread covering. However, this necessitates the fitting of a third spindle on the thread covering machine.

If, on the contrary, the helix is in contact with the rubber, under an external thread covering, it can also constitute or not, by itself, the inner thread covering, but it is necessary to take into account its more or less accentuated sinking into the rubber core. But, on the other hand, the external thread covering is then made, in the usual manner, with fine thread, so that the relief of the helix is not materially attenuated and on the contrary the helix is still better anchored, without any risk of displacement along the rubber surface.

Instead of forming projections with the helix produced by a single big thread, I may, on the

contrary, form this helix with a plurality of parallel fine threads, placed simultaneously on the core by the thread covering machine, in such manner that they accumulate locally on the core (which is provided or not with a first uniform thread covering) in such manner as to form a spiral-shaped projection the spires of which are not in adjoining relation to one another.

Besides, in both cases, I may provide, instead of a single spiral, several spirals each constituted from a single thread or from a sheaf of threads, these spirals being analogous to the threads of a multi-thread screw.

The material constituting the big thread of the helix or of the equivalent sheaf of threads is not necessarily an unextensible material. Advantageously, in some cases, it can also be elastic, the thread or the sheaf of threads being either covered or not. For instance it is possible to obtain a better adhesion in this way. Furthermore, the normal stretching capability of the whole is not limited by the helix, especially when the latter is obtained by means of a third spindle, by placing this helix above the external thread covering and with a larger pitch.

The direction of winding of the helix on the warp thread may be chosen in accordance with the structure of the fabric to be obtained, in such manner as to correspond to the direction of the greater number of loops produced by the weft on the warp, when such loops exist. If, on the whole, the fabric includes as many right hand loops as left hand loops, it is generally unnecessary to bother with the direction of winding of the helix, except when the loops of inverse directions are located on different warp threads. If, on the contrary, it is on each thread that the weft threads are successively wound by forming loops in inverse directions, generally those in a certain direction will produce, according to the structure of the fabric, the best connection with the warp thread, by opposition with the other direction, and this will be sufficient in most cases for avoiding slipping.

The slight increase of the total section of the elastic thread will generally be without any disadvantageous consequence because the elimination of slipping permits, for a given section, of utilizing stronger threads which are stretched to a higher degree and better covered, the latter being, generally, more fully covered and therefore the less capable of being used as a consequence of the fact that their surface is nearly continuous, when the covering is made in the usual manner, for instance with ordinary cotton threads.

Especially for the manufacture of open work fabrics with covered elastic threads, it even suffices, in some cases, instead of making in advance an elastic thread having projections alternating with hollows in the longitudinal direction, of making the external covering of this thread in such manner that these projections may be produced, so to speak automatically, at the end of the manufacture of the fabric when the latter, removed from the frame, undergoes contraction or even only at the time of the use, when the causes above pointed out have a tendency to cause the weft thread to slip and, consequently, to compress the warp thread covering between its loops.

By way of example, I may make use, for constituting this external covering, of artificial silks or analogous threads (and even in some cases of silk, either raw or not) the fibers of which, of very great length, are assembled with a re-

duced, or even negligible, twist. As soon as they are helically placed on the core, in the thread covering machine, these fibers become flattened, distribute themselves so as to form a continuous and very thin layer and the threads are nearly exactly side by side with a thickness of only some elementary threads.

However, viscose such as it is manufactured at the present time should be excluded because the facility of winding it for covering a thread and the good slipping when weaving are at the cost of a certain lack of stability of the covered thread, due to the defective resistance of this material to water and moisture, in particular to perspiration. On the contrary, I may make use of acetate silk or any other analogous matter resisting moisture and which, in spite of its utilization in the untwisted state, is however capable of satisfactorily hooping the thread and giving it the necessary stability in service.

I thus obtain, owing to the retraction of the warp threads of the fabric, which contracts for the first time when leaving the frame, a true imbedding of the weft threads in the external covering of the warp threads, owing to the relative freedom of the elementary threads slipping on one another due to their smooth surface. In order to obtain this imbedding in a still better manner, I may take the maximum advantage of the period of distension of the covered threads, in which the covering is floating, as if it were released from the core. Instead of unwinding without precaution from the roll of fabric the part that has been recently made, I cause it to pass on a special roller permitting, through suitable means, for instance by means of jaws applied on the edges, of tensioning to the maximum degree, in the direction of the width, the fabric as it passes from one roller to the other, being distended in the longitudinal direction.

Once the fibers, temporarily malleable, have settled in position on the surface of the warp threads, imprisoning the bobbin threads passing among them and shaping themselves to the contour thereof, they tend subsequently to keep this position and they resist the actions urging the bobbin threads in the direction of the warp threads, by bearing upon one another and upon the surface of the core with which they are at least partly in contact.

Finally, it is possible to combine an inner covering, made either wholly or partly of a big helix, with an external covering of acetate silk.

Of course, the rubber that is utilised can, instead of a single thread, consist of a sheaf of elastic threads.

The invention is also applicable to open-work fabrics with multiple warp threads, that is to say in which each warp thread is constituted of several separate elementary threads covered individually. It suffices to choose accordingly the pitch of the helix on each individual thread. Besides the threads may be only provided therewith for some of them.

The invention further applies to dense and close-meshed fabrics made with elastic warp threads which may be covered or not. In fabrics of this kind, if such a thread breaks, the alternations of tension and lack of tension cause the two elements of which the thread is made to retract gradually, producing generally a characteristic sinuous line, and thus creating, in addition to a defect which is disagreeable to see, a line of reduced resistance.

In this case, it is the rubber thread itself

which, according to the present invention, is provided with superficial unequalities. The latter may be created by producing one or more spirals in relief or in hollow but the projections may be given the shape of rings alternating with grooves. These variations of section may be produced at the end of the manufacture of the thread by the provision of notches or the like, either annular or not, or even, in the case of threads of square section, by periodically notching the edges.

Said variations of section may, on the contrary, be produced during the manufacture; for instance in the case of a thread produced by drawing or in an analogous manner, by a quick and periodical change of the height of liquid above the holes through which the drawing takes place, or by quick modifications of its pressure, for instance by the application of vibrations. They can also be produced by providing projections in the grooves of a drum which, in the known manner, turns in a bath of liquid rubber, so as to take off from said bath matter which coagulates in the grooves and is subsequently removed in the form of coagulated threads, after about one half-revolution of the drum.

I may also, without making use of a thread which is wholly bare, compress the core, or merely the edges thereof, when they exist, locally and as deeply as possible, for instance by a single thread covering consisting of a single helix of fine and highly resistant thread, the spires of which do not adjoin one another, in such manner as to produce in the gum correlative recesses and projections sufficiently intensive for remaining when the thread undergoes a moderate elongation. I may consequently make use of threads of this kind when their elongation is limited inside the fabric under normal conditions of use of the fabric, or again is limited by auxiliary warp threads, inextensible and parallel to the direction of said elongation. Besides, a double covering may be constituted in such manner that its non-adjointing spires produce in the uncovered portions a diameter substantially greater than that of the covered portions, including the covering, even when the gum undergoes a moderate elongation.

In a more general manner, the invention can be applied to all kinds of fabrics, close or loose knitted, with or without meshes, making use, either as warp or as weft of elastic rubber threads which are either thread covered or not.

The invention also applies to the inextensible fabrics of the open mesh or net type, in particular to nets or laces and in this case it permits of avoiding deformations of the nets caused by the slipping of the threads of one group on the threads of the other group. It may only be necessary in this application to arrange that the projections utilized on the inextensible threads of one of the groups or on a part of the threads do not interfere too much, when weaving, with the setting in position of the threads of the other group.

With the elastic threads above described, such precautions are generally unnecessary because the threads are mostly employed on the frames in the stretched state, about as much as when covering the thread, and in this state the helix, made of a big thread or the like, has its pitch so much increased that it no longer opposes a material obstacle to weaving. Concerning the shaping of bare threads, the projections must be given a suitable angle, facilitating weaving as much as possible, when the thread is fully stretched.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawing, given merely by way of example, and in which:

5 Figs. 1 to 3 diagrammatically show three specific forms of covered rubber threads made in accordance with my invention.

Figs. 4 and 5 show two specific forms of naked rubber threads also in accordance with my invention.

10 Fig. 6 shows another form of rubber thread with an open-spiral cover thread wound thereabout.

Fig. 1 shows, on an enlarged scale, a portion of an elastic thread including a core 1 surrounded with a relatively big thread 2 which is arranged to form a helix with non-adjointing spires, the whole being embedded in the external covering 3 of fine thread, wound in the opposite direction.

15 In Fig. 2, the core 1 is provided with a first covering 4, which is surrounded by a big thread 2 having non-adjointing spires, and simultaneously by a covering 5 of fine thread, disposed between the spires of the big thread 2.

20 Fig. 3 shows a thread provided with the two usual coverings 4 and 12, the latter being covered by a big helix 2 of a different pitch.

Fig. 4 shows a thread 6 of bare rubber provided with peripheral grooves 7.

30 Fig. 5 shows the same thread in the elongated state, the grooves now making but a small angle with the thread itself, in such manner as to interfere as little as possible with the weaving.

Fig. 6 shows a rubber thread 8 of square section, which thread is surrounded by the non-adjointing spires of an inextensible thread 9 fitting in notches 10 or merely applied upon the unmodified thread under a tension such that a pronounced swelling takes place at 11 between two consecutive spires and the two grooves produced by them, respectively.

40 Figure 7 illustrates another embodiment of the invention in which the resilient core 1 is first wound with a layer of fine cover threads 13, and then a large cover thread 14 in spaced helical form is wound about the first layer and preferably in the opposite direction.

In a general manner, while I have, in the above

description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition, and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. An elastic thread which comprises a core 10 of elastic material; an innermost cover on the core; a coarse cover thread spirally wound about the innermost cover to form an outstanding open-spiral rib on the same; and a filling cover of fine thread positioned on the innermost cover to span, 15 in sunken relief, the interval between proximate convolutions of the outstanding rib.

2. An elastic thread which comprises a core of elastic material; an inner cover on the core, the outer surface of which is formed by convolutions 20 of fine thread wound in one direction; and a coarse cover thread exposed throughout its length, spirally wound over the outer surface of the inner cover, in a direction opposite to the aforesaid direction to form an outstanding open spiral rib 25 on the same.

3. An elastic thread which comprises a core of elastic material; at least one substantially even cover on the core, consisting of spirally wound fine cover threads; and a big thread wound in the 30 form of a continuous open spiral helix over the even cover, positioned outwardly with respect to any and all the fine cover threads in the even cover which it contacts, so as to be throughout in exposed operative position.

4. In an elastic thread having a plurality of covers arranged to provide local projections on the external surface of said thread, the combination of a core of elastic material with a cover of spirally wound fine threads, and a thick even rib which is 40 disposed on one side with respect to the cover of spirally wound fine threads, follows an open spiral line and produces an even, open spiral projection on the elastic thread surface, throughout the length of said thread.

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