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71 Applicant: **LASSILA & TIKANOJA OY**
Urusvuorenkatu 2 P.O. Box 670
SF-20361 Turku 36(FI)

72 Inventor: **Servanto, Pekka**
Lehmustie 2 B
SF-20720 Turku(FI)
 Inventor: **Kiili, Esa**
Stoltinkatu 1 A 9
SF-20350 Turku(FI)

74 Representative: **Calderbank, Thomas Roger et al**
MEWBURN ELLIS & CO. 2/3 Cursitor Street
London EC4A 1BQ(GB)

54 **A lifting sling and a method for manufacturing it.**

57 The invention relates to an endless, flexible lifting sling which is fitted on the one hand around the load and on the other hand to the lifting device. The sling is made up of a load-bearing core (2) which is formed of one or several coils of thread, and of a tubular mantle (1), surrounding the core, the ends (3a, 3b) of the mantle having been (4) connected to each other.

The purpose of the invention is to provide a sling having a mantle which is smooth and without transverse folds which weaken the sling and hamper the use of the sling. This has been achieved by making the mantle (1) shorter than the core (2). The difference in length is preferably at least 2 % and may be up to 10 %.

The invention also relates to a couple of methods for the making of such a sling. One of the methods comprises a heat treatment in which, by means of suitably selected raw material, temperature and treatment period, a shorter length is obtained for the mantle (1) than for the core (2). According to the other method the sling is made of an already shorter mantle, in which case the mantle must have a greater break elongation value than has the core which, owing to its greater length, will have to stretch less.

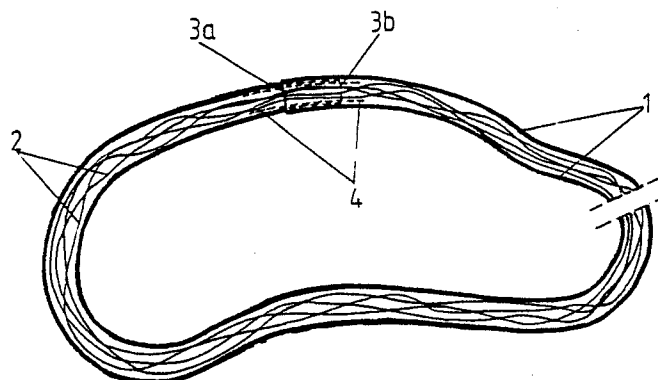


FIG. 1

A lifting sling and a method for manufacturing it

The present invention relates to the lifting sling defined in the preamble of the principal claim and to the methods for its manufacture, defined in the preamble of a claim.

A lifting sling such as this is endless and made from textile material, and it is intended on the one hand for being fitted around the article to be lifted and on the other hand for being fitted to the hoist. The lifting
 5 sling is made up of a loadbearing core which is made up of one or more coils of synthetic thread, film or synthetic split thread, and of a tubular coating loosely surrounding the core. The ends of the tubular coating are connected to one another. The coil of thread is made up of thread wound in several layers inside the coating.

Slings of this type are previously known. For example, from Finnish Patent 48 570 there is known a
 10 lifting sling of this type, the coating of which is a seamless tube. Owing to the method of manufacture, the coating of such a sling is longer than its core and forms transverse folds over the entire length.

From Swedish published application 14437/72 and Swedish lay-open print 368 241 there are known side-seamed lifting slings the coatings of which have a looser cross section than the cross section of the core, and in which it is possible for the coil or coils of thread in different layers to adjust their length and
 15 their position in the cross section of the sling so that the individual threads are strained evenly when the sling is loaded. In a side-seamed lifting sling the coating is longer than the core, since for unhampered seaming the coating must be longer than the core. In these slings, also, the coating therefore forms transverse folds, which may be highly detrimental during the use of the sling.

The object of the present invention is to provide a seamed or seamless lifting sling the coating of which
 20 is primarily smooth and does not form transverse folds along its length.

This is achieved according to the invention by giving the lifting sling the characteristics defined in the characterizing part of the principal claim and by manufacturing the sling in the manner defined in the characterizing parts of the claims.

The lifting sling according to the invention, having a coating or mantle shorter than the length of the
 25 core made up of the loadbearing coil of thread, provides the following advantages:

During lifting, the mantle does not form folds or wrinkles which are easily worn out. Thus a longer useful life of the sling is achieved.

For example in slip-knot lifting, no fold is formed at the lifting arm and the loop part of the sling; such a fold may prevent smooth sliding of the sling in the hoisting loop, in which case the lifting arm moves in the
 30 loop in jerks, and as a result there may be melting damage caused to the loadbearing coil of thread by friction.

Owing to its consistency, a smooth lifting sling, i.e. one without wrinkles in the coating, is easier to fit in a hook and also around the load to be lifted.

The slipperiness of the coating can be regulated by the manufacturing technique, and thus the optimum
 35 form in terms of the behavior of the lifting sling can be sought.

The sling according to the invention is formed most preferably by first making the core by winding one or more threads into a coil, the diameter of the coil being slightly greater than the diameter of the completed sling. The coating is fitted around this coil by bending an open coating band over the coil and by
 40 seaming the edges of the band to one another. Thereafter the ends of the band are passed one inside the other and secured together by, for example, longitudinal seams at both edges of the joint or in the middle of the joint. For unhampered joining of the ends of the coating, the coating must be slightly longer than the core.

When a seamless sling is being manufactured, a tubular coating is fitted over the coil; this is done by gathering a tube of suitable length on a bar, whereafter the necessary number of rounds of the thread or
 45 threads of the coil are passed through the gathered tube, whereafter the bar is removed and the ends of the tube are connected to each other. The produced sling corresponds to the state of the art of Finnish Patent 48570, and it has a core slightly longer than the coating or mantle, and it has transverse folds.

The stitched sling may thereafter be subjected to heat treatment for a few minutes, whereupon the mantle shrinks in length and width while the core does not shrink at all or shrinks considerably less, so that
 50 the length of the heat-treated mantle is at least 2 % shorter than the core. The shrinkage may be up to 10 %, but with this great a difference between the core and the mantle there easily arise problems with the ultimate strength on elongation.

Such a shrinkage ratio is achieved only through a suitable selection of the raw materials for the mantle and the core and by continuing the heat treatment for a precisely calculated period.

It is possible by the same manufacturing technique to make lifting slings according to the invention by

taking as a point of departure a pre-shrunk mantle, i.e. an already dyed mantle. In this case the mutual length ratio between the mantle and the core in the sling ready for use are the same as before the stitching of the sling.

When the initial material is an open mantle band which is seamed around the coil, the length of the coil is at least 2 % more than the completed sling and, furthermore, it is necessary to take into account the overlapping band parts in the area of the joint. When the side seam is being stitched, the coil of thread must be gathered by means of a machine over the entire length of the longitudinal seam.

When the initial material is a seamless, pre-shrunk mantle, a mantle or tube of a certain length is gathered on a bar, whereafter the thread or threads of the coil are passed through the tube in the suitable number of rounds of suitable length, in accordance with the technique of the said Patent 48570. In this case, also, a length at least 2 % greater is selected as the length of the coil, taking into account also the overlap in the area of the joint, whereby the desired difference in length is obtained between the mantle and the core.

When joining the ends of the mantle, the core must be gathered inside the mantle by means of a special tool so as to make the area of the joint smooth for the stitching stage.

The break elongation values and elastic properties of the mantle and the core must be such that in a loading situation the mantle is first capable of stretching to the straightened length of the core and additionally to the elongated length of the core, caused by the load, without the mantle being broken by this elongation. The mantle material must therefore be capable of stretching more than the core stretches. Sufficient elastic properties are indeed obtained for the mantle material in heat treatment, i.e. in general in the dyeing treatment, since after the dyeing the break elongation value of the core material will be approximately its break elongation plus the irreversible shrinkage caused by the dyeing.

In calculating the degree of shrinkage, it must be taken into account that the shrinkage measured after loading is something else than the shrinkage measured before the loading, because part of the shrinkage is irreversible. What is meant in speaking of shrinkage, and respectively the length difference between the mantle and the core, is the irreversible shrinkage, i.e. the shrinkage of the sling in the resting position, after loading. The degree of shrinkage is also affected by the structure of the mantle.

The raw materials of the core and the mantle may be of different materials or of the same material. When the same raw material is used, the material used for the core is, of course, treated so that it will not shrink at all or shrinks considerably less than the material used for the mantle.

Especially when a lifting sling is being made by the first-described method, i.e. so that the completed sling is subjected to a shrinking heat treatment, it is easier to use different raw materials for the mantle and the core. Among the available materials suitable for the purpose it is easy to find two compatible raw materials the shrinkage properties of which differ in a suitable manner. If the same raw material is used for both the mantle and the core, the material used for the core must be treated so that it does not shrink at all or shrinks considerably less than the material used for the mantle.

Materials suitable for mantle and/or core materials of lifting slings include various polyesters, polyamides and polypropylenes and polyethylenes. According to one international standard, the mantle material and the core material must be of the same raw material. For example, the compatible types listed below can be found among polyesters and polyamides. Their break elongation, shrinkage and strength values are as follows:

	Thread	Break elonga- tion	Heat treatment values	Shrinkage %	Ultimate strength
5	<hr/>				
	<u>Core thread</u>				
10	Polyester 1000-192 M112 P25	12.2	15 min 180 °C	9.8	7.28
15	Polyester 1000-192 E223 P341	15.6	15 min 189 °C	13.4	8.47
20	Polyester Type 710 Enka	16	5 min 180 °C	4	7.2
25	Polyester 855 T Enka	13.5	4 min 160 °C	5	8.3
30	Polyamide 66 155 HRS 940 dtex	23	15 min 190 °C	1.2	7.3
35	Polyamide 66 130 HR 940 dtex	16	5 min 160 °C	5	8.0
	<u>Mantle thread</u>				
40	Polyester 1000-96 E151 P37	24.5	15 min 180 °C	10	6.21
45	Polyester Type 730 (N) Enka	11	10 min 200 °C	22	7.0
50	Polyester Type 785 Celanese	12.5	4 min 200 °C	21	8.1
	Polyamide 6 540T 940 dtex	25	30 min 100 °C	11.5	7.4
55	The following preferred combinations are obtained of these types: 1. Core Polyester Enka 855 T Mantle Polyester Type 785 Celanese				

2. Core PA66 155 HRS

Mantle PA6 540 T

3. Core Polyester Type 710

Mantle Polyester 1000-96 E151 P37

5 HD polyester can also be used as mantle material, in which case polyester, polyamide or polypropylene can be used as core material.

Two examples are given below of the making of a lifting sling, the first one describing the heat treatment of a completed sling and the second the heat treatment of the coating band, i.e. before the making of the sling. In Example 1 the mantle material is polypropylene and the core material polyester (i.e. 10 a combination not in compliance with the standard), and in Example 2 the mantle material and the core material are both polyester, combination 1 in the Table.

Example 1

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A sling provided with a seamless polypropylene mantle, the mantle being for reasons of manufacturing technique slightly longer than the core, which is of polyester, was shrunk for 10 min at a temperature of 100 °C. The mantle shrank 4 %, of which 2 % remained as irreversible shrinkage after loading. When the treatment temperature was raised to 120 °C, the duration of the treatment being the same, the poly- 20 propylene shrank 8 %.

Example 2

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The break elongation value of Polyester 785 Celanese after heat treatment (dyeing) was approximately 32 % (12.5 + 21 %). The break elongation value of the core thread was 13.5 %. If the core thread stretched all the way to the breaking limit in a loading situation, the mantle would still have a stretching allowance of 20 % left.

The structure of a lifting sling according to the invention is described below in greater detail with 30 reference to the accompanying figures, in which

Figure 1 depicts a section of a seamless lifting sling according to the invention, and

Figure 2 depicts a part of the lifting sling according to Figure 1, in section and on a larger scale, as well as provided with a greater number of core threads.

In the figures, numeral 1 indicates the coating or mantle of the sling, 2 the individual threads 35 constituting the coil, 3a indicates the outer end of the mantle and 3b its inner end, and 4 the longitudinal seams connecting the ends 3a and 3b. For the sake of clarity, in the sling according to Figure 1, only a few rounds of one coil of thread are shown. The figure according to Figure 2 shows a greater number of rounds of the coil, although not the real number. The number of the rounds, of course, depends on the strength required.

40 Instead of heat treatment and shrinking, the lifting sling according to the invention can also be produced mechanically, i.e. by making, for example, the area of the joint of the tube elastic by producing the joining with the aid of resilient rubber means or the like, in which case the mantle and the core will stretch an equal degree in a loading situation.

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Claims

1. A lifting sling, intended for repeated use, the sling being endless and intended for being fitted on the one hand around the load to be lifted and on the other hand to the device which carries out the lifting, and 50 being made up of a core (2) formed of one or several loadbearing coils of thread and of a tubular textile mantle (1) surrounding the core, the ends of the mantle being connected (4) to each other, **characterized in** that the mantle (1) is shorter than the core (2).

2. A lifting sling according to Claim 1, **characterized in** that the mantle is at least approximately 2 % shorter than the core.

3. A lifting sling according to Claim 1 or 2, **characterized in** that the mantle is approximately 2-10 % 55 shorter than the core.

4. A lifting sling according to any of Claims 1-3, **characterized in** that the mantle is either seamless or provided with a side seam.

5. A lifting sling according to any of Claims 1-4, **characterized in** that the mantle (1) is of a textile material, for example polyethylene or polypropylene, which shrinks at an elevated temperature, and that the core (2) is of another synthetic thread, film or split thread, or that it is of the same synthetic thread, treated so as to be non-shrinking or less shrinking.

5 6. A method for manufacturing an endless lifting sling which is intended for being fitted on the one hand around the load to be lifted and on the other hand to the device carrying out the lifting, and which is made up of a load-bearing core (2) formed of one or several coils of thread, and of a mantle (1) of a textile material, surrounding the core, the method comprising the producing of a tubular mantle around the core and the connecting (4) of the ends of the tube, **characterized in** that the lifting sling is subjected to a heat
10 treatment in which, through a suitable selection of the raw materials, the temperature and the treatment period, the mantle (1) shrinks so that after the treatment it is shorter than the core (2).

7. A method according to Claim 6, **characterized in** that the parameters of the heat treatment are selected so that after the treatment the mantle is at least approximately 2 % shorter than the core.

8. A method according to Claim 6 or 7, **characterized in** that the parameters of the heat treatment are
15 selected so that after the treatment the mantle is approximately 2-10 % shorter than the core.

9. A method for the making of an endless lifting sling which is intended for being fitted on the one hand around the load to be lifted and on the other hand to the device carrying out the lifting, and which is made up of a load-bearing core (2) formed of one or several coils of thread, and of a mantle (1) of textile material, surrounding the core, the method comprising the producing of a tubular mantle around the core and the
20 connecting (4) of the ends of the tube, **characterized in** that the core is fitted to a coating band shorter than the core, which band is side seamed and its ends are connected, or that the core is formed in a coating tube shorter than the core and the ends of the tube are connected, and that the break elongation of the mantle material has by a previous heat treatment been made greater than the break elongation of the core material.

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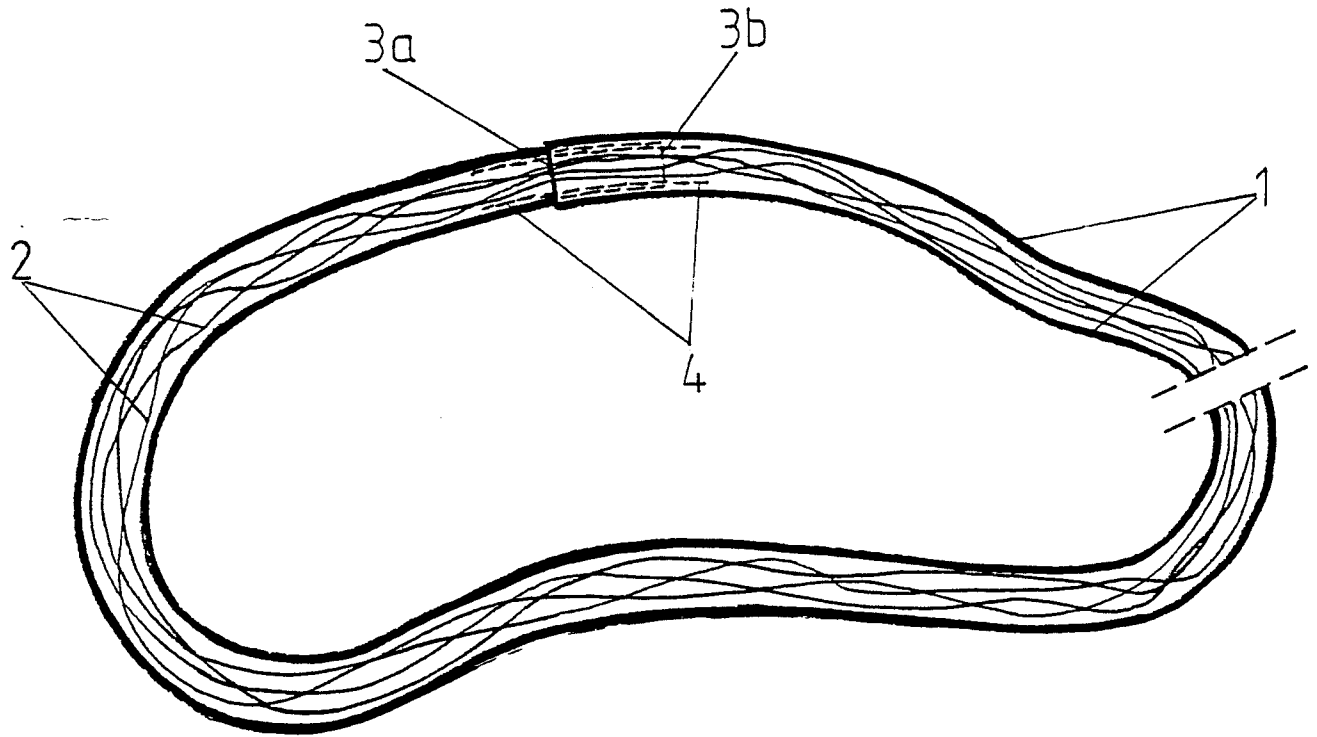


FIG. 1

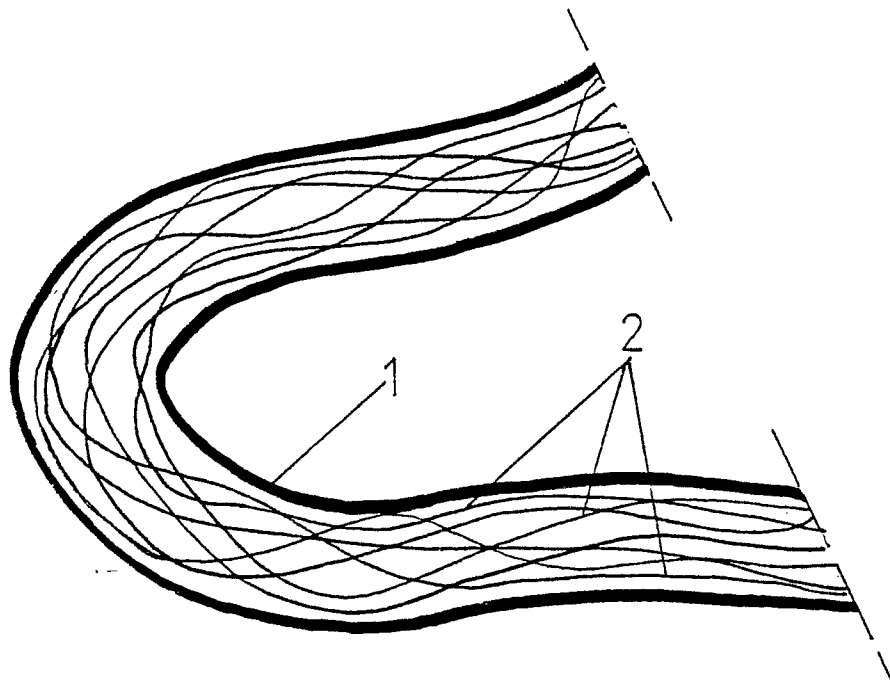


FIG. 2



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	EP-A-0 116 916 (SPANSET INTER AG) * page 5, lines 1-19; claim 9 * ---	1	B 66 C 1/18
A	GB-A-1 446 935 (AB SKEPPS- & FISKERITILLBEHOR) * figures 1, 2; claims 1, 2 * ---	1	
A	GB-A-1 325 207 (SPANSET INTER AG) * figures 1-4; claim 1 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 66 C 1/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 25-04-1988	Examiner KANAL P K
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			