United States Patent [19]

Brindejonc de Treglode

[11] **3,718,945**

[45] **March 6, 1973**

[54] **SLINGS, TOW-ROPES AND THE LIKE**

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[22] Filed: **Oct. 8, 1970**

[21] Appl. No.: **79,205**

[30] **Foreign Application Priority Data**

Oct. 13, 1969 France....6935549
Sept. 16, 1970 France....7034193

[52] **U.S. Cl.**....**24/73,** 294/74
[51] **Int. Cl.**....**A44b 31/00,** B66c 1/12
[58] **Field of Search**...24/73 ES, 115 K, 122.3, 122.6; 294/30.5 TC, 74

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[57] **ABSTRACT**

A cargo sling, tow-rope or the like comprises two cables embedded in a continuous elastomeric sheath of generally elliptical cross-section, these cables being disposed substantially in the longitudinal plane containing the major axis of the ellipse and in a substantially symmetrical relationship with the longitudinal centerline of the sheath; the cables extend beyond the sheath on at least one end, their projecting extremities being interconnected to form a loop or to engage an attachment such as an extension cable or a coupling member. The cables may be provided with deformations inside the sheath, such as undulations or shoulders, to prevent relative longitudinal slippage. The sheath can be produced by extrusion about the juxtaposed cables.

6 Claims, 29 Drawing Figures

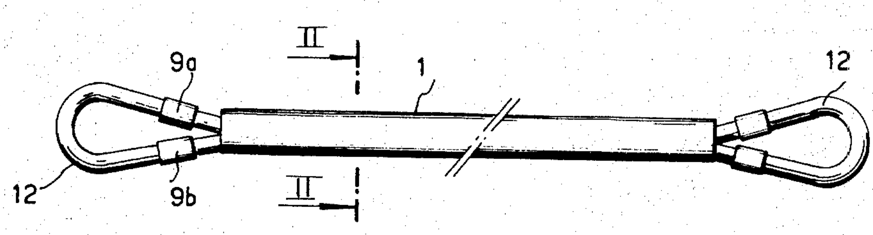


Fig-1

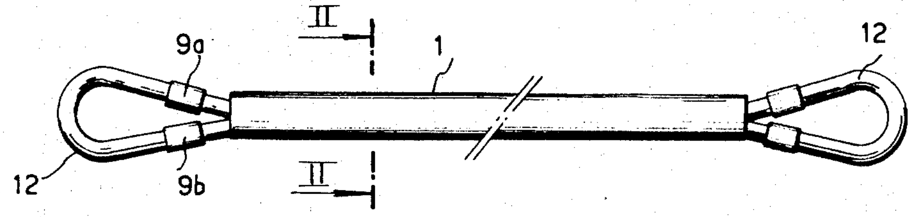


Fig-2

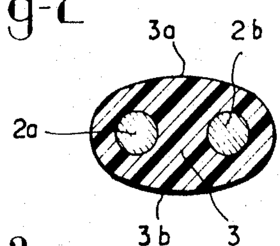
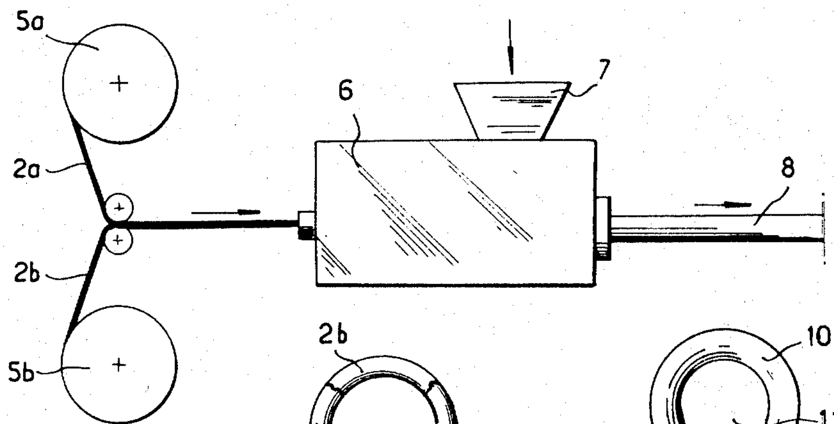


Fig-3



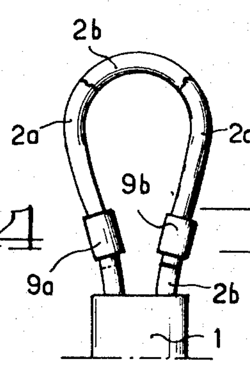


Fig-4

Fig-6

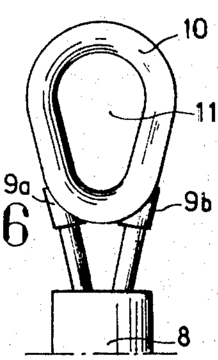


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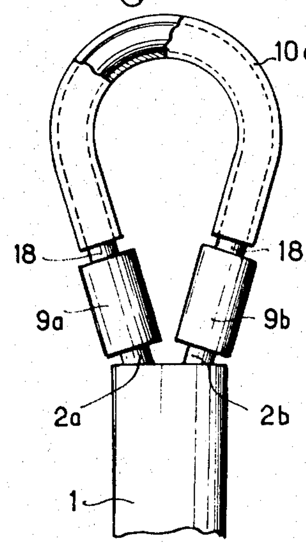
Fig-5



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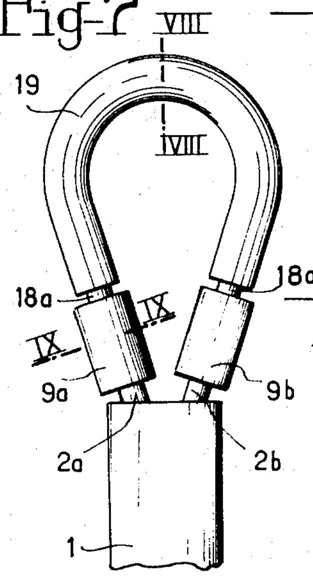

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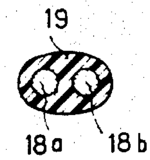

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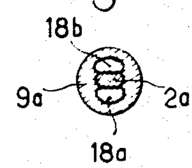

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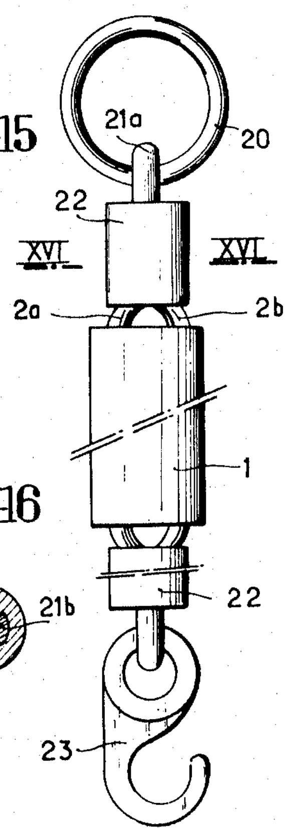

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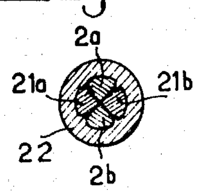

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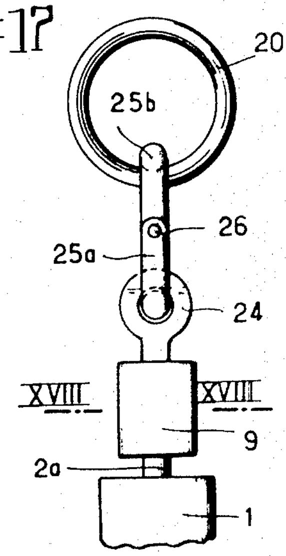

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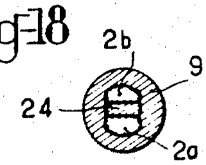

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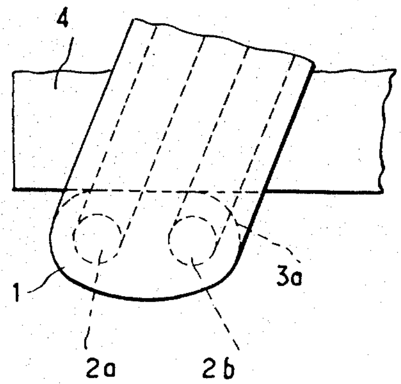
Fig-10



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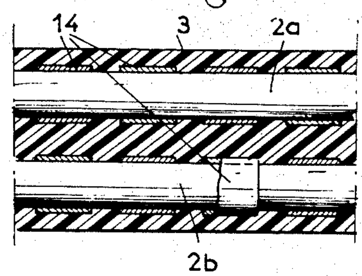

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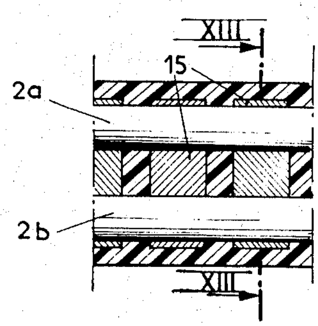

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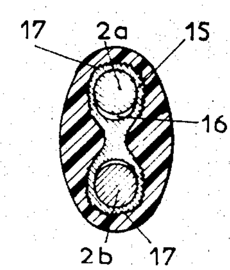

Fig-14

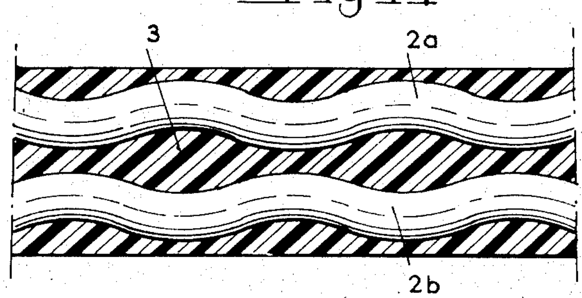

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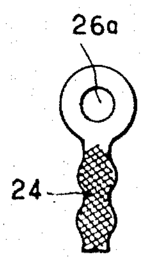
Fig-19



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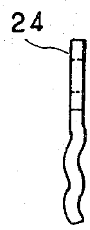

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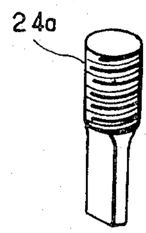

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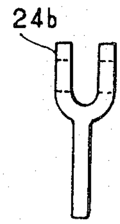

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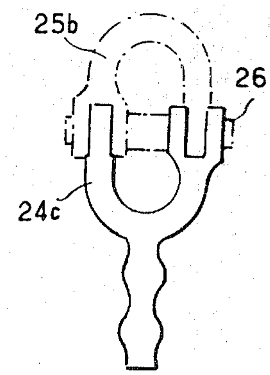

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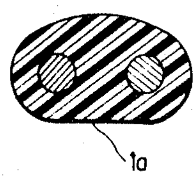

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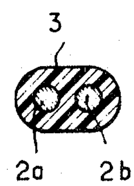

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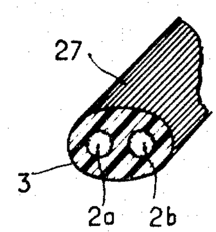

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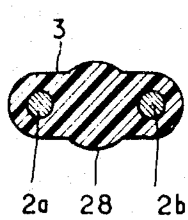

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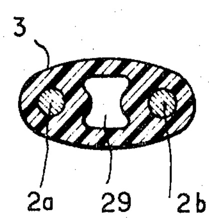

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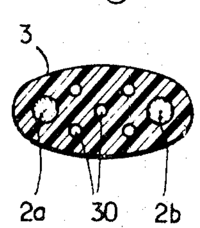

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SLINGS, TOW-ROPES AND THE LIKE

My present invention relates to cargo slings, tow-ropes and the like, hereinafter referred to for simplicity as slings.

At the present time it is known to use flat slings in the form of several metal cables embedded in rubber. However, such slings have the drawback that they operate under adverse conditions if their runs extend obliquely in relation to a load being carried, since the effort is then exerted along one edge of the sling so that the forces may have to be carried by a single cable, with the result that this particular cable fails.

Furthermore, such slings have hitherto been manufactured by passing a metal cable over pulleys or cylinders in order to form a series of parallel runs, which are then stretched and finally embedded together with the pulleys or cylinders in a rubber sheath which is subsequently vulcanized. This method is expensive, and is restricted to the production of slings of predetermined lengths, because a special mold is required for each length. The individual cables are spaced apart in the sheath so that the width of the sling becomes substantial for slings having a load rating above a given force, and the amount of rubber is much larger than that actually required to bind the cables together.

One object of the present invention is to provide an improved sling construction which overcomes these drawbacks.

The sling according to my invention comprises two cables embedded in an elastomeric sheath of generally elliptical cross-section, the cables being located substantially in the longitudinal plane containing the major axis of the ellipse and in a substantially symmetrical manner on either side of the longitudinal centerline of the sheath; the cables project from the sheath on at least one end, where they are connected together to form a loop or to engage an attachment.

Thanks to this arrangement, the sling can be disposed skew to the load being lifted without any ill effect, the resulting stresses being readily transmitted from one cable to the other. Furthermore, the contact between the sling and a load having a sharp corner is not limited to a linear zone but is spread over a relatively wide face owing to the compression of the enveloping material of the convex sheath, the contact area increasing with the load.

In addition, the area of contact between sling and load is not disposed opposite a cable, and this serves to prevent shear in the elastomeric material. If loading is such that one cable is located at the outside, it will be initially subjected to a higher force than the interior cable, but the two cables automatically adjust their positions on account of the loop formed by their ends, so that the part of the sling which is located beneath the load can reposition itself slightly until the forces to which the two cables are subjected balance one another. Finally, the rigidity of the sling is improved because of its convex cross-section, which makes it easier to push a cable beneath a load.

The sheath material may be rubber or polyvinylchloride. It may be transparent so that the cables can be seen and their condition inspected.

In a preferred method of manufacture, two cables are fed through an extruder in which an enveloping material is extruded around them to form a sheath which is relatively flexible and elastic in the cold condition, the assembly then being cut to provide any desired length of sling whereupon the cable ends are bared and interconnected to form a loop.

The invention will now be described with reference to the accompanying drawing in which:

FIG. 1 is an elevational view of one exemplary embodiment;

FIG. 2 is a sectional view on the line II—II of FIG. 1;

FIG. 3 is a schematic diagram illustrating a preferred method of manufacture;

FIG. 4 is a detail view of a loop formed at one of the ends of the sling shown in FIG. 1;

FIG. 5 is a detail view of a loop in one alternative exemplary embodiment;

FIG. 6 illustrates another exemplary embodiment;

FIG. 7 illustrates yet another exemplary embodiment;

FIG. 8 is a transverse section on the line VIII—VIII of FIG. 7;

FIG. 9 is a transverse section on the line IX—IX of FIG. 7;

FIG. 10 is a fragmentary view of a sling passing obliquely beneath a load;

FIG. 11 is a fragmentary longitudinal sectional view of another exemplary embodiment;

FIG. 12 is a view similar to that of FIG. 11, showing yet another exemplary embodiment;

FIG. 13 is a transverse sectional view on the line XIII—XIII of FIG. 12;

FIG. 14 is a fragmentary longitudinal sectional view showing the construction of yet another embodiment;

FIG. 15 is an elevational view of an exemplary embodiment provided with hook-and-eye terminations;

FIG. 16 is a section on the line XVI—XVI of FIG. 15;

FIG. 17 illustrates an alternative method of securing a ring to one end of a sling;

FIG. 18 is a section on the line XVIII—XVIII of FIG. 17;

FIGS. 19 to 23 illustrate various alternative linking strips suitable for use in constructing slings in accordance with the invention; and

FIGS. 24 to 29 are cross-sectional views of still further embodiments.

In the exemplary embodiment shown in FIGS. 1 and 2, a sling **1** is constituted by two metal cables *2a* and *2b* embedded in a continuous sheath **3** of elastomeric material.

The sheath has an elongate cross-section, and in this embodiment the two faces *3a* and *3b* flanking the major axis of the generally elliptical cross-section are convex. The cables *2a* and *2b* are preferably made of strands twisted in opposite directions in the two cables, in order to avoid any distortion of the sling when it forms a loop or knot. The cables are located substantially in the longitudinal plane containing the major axis of the cross-section of the sheath **3**, substantially symmetrically in relation to the longitudinal axis of the envelope. Their ends are bared and connected together to form loops **12**.

FIG. 3 shows a preferred method of manufacture of the sling **1**, the cables *2a* and *2b* being fed from two reels *5a* and *5b*, and passed into an extruder **6** at the same time that elastomeric material is fed into a hopper **7** of the extruder. In this fashion, an assembly **8** of sheathed cables is produced in a continuous fashion from the extruder, which can subsequently be stored until required, and from which the requisite length for any particular sling can be cut.

In order to form the loops **12** of the sling, the bared ends of the cables can be looped and joined together, at locations close to the end of the sheath, by two sleeves **9***a* and **9***b*, as shown in FIG. **4**. Alternatively, an auxiliary cable **18** can be used, which is curved back on itself, its ends being clamped by retaining sleeves **9***a* and **9***b* to respective extremities of the cables **2***a* and **2***b*, which in this case have been bared over a short length only, as shown in FIG. **5**.

Since the load on the sling during use is divided equally between the cables **2***a* and **2***b*, but is carried in full by the cable **18**, the latter preferably has a higher strength than that of either of the cables **2***a* and **2***b*. However, in certain cases it may be desirable that the weakest point of the sling be located in a loop, where it is easy to maintain serveillance, rather than at a point where the cables are embedded in the solid body of the sheath. In this case, the cable **18** may have the same strength as each of the cables **2***a* and **2***b*, or may even have a lower strength than they. The reverse case is equally possible, that is to say, the cable **18** may be stronger than the two cables **2***a* and **2***b* combined, if it is desired to ensure that any failure should take place beyond the loop.

If it is desired to fit a sliding attachment to form a running knot, the loop can be engaged in a "slip through" type of eyelet **10** which contains an elongate opening **11** whose length is grater than the external width of the eyelet, as shown in FIG. **6**. Preferably the two sleeves **9***a* and **9***b* are disposed inside the arms of the eyelet **10** in order to avoid an excessive rigid length. Alternatively, a half eyelet **10***a* can be used, as shown in FIG. **5**, to engage the auxiliary cable **18** but to limit the length of the rigid part.

Since it is frequently desirable to protect the loops, in a simple embodiment it is possible to form the auxiliary cable **18** from a section of sheathed cables similar to or identical with that used to make up the body of the sling.

Thus, in the embodiment shown in FIGS. **7** to **9**, the loop is formed by two extension cables **18***a* and **18***b* located in a sheath **19** which has two mutually opposed convex faces like the body **1** of the sling, albeit preferably of a smaller section. At each end, the cables **18***a* and **18***b* are fixed to the respective cable **2***a* or **2***b* by a respective sleeve **9***a* or **9***b*. The cables **18***a* and **18***b* can have the same strength as the cables **2***a* and **2***b*, or a lower strength in order to localize possible failures in the loop, or alternatively a higher strength if it is desired to guard against failures in the loop. In order to facilitate inspection of the loop, the sheath **19** is preferably made of a transparent material.

The sling just described does not twist, and retains its orientation, even after intensive use. This is due to the fact that when the sling is passed beneath a load, the cables **2***a* and **2***b* are not disposed vertically in relation to the point of contact but are spaced laterally to a small extent, on either side of the zone of contact. If the sling contained only one cable, this would not be the case and the cable could shear the elastomeric material of the sheath. In addition, in the sling described, the upper convex face **3***a* of the sling flattens under the effect of the load, and this tends to spread the two cables **2***a* and **2***b* slightly further apart whereas the tension developed in the cables tends to maintain the cables at their initial spacing, an equilibrium being thus established between these two forces.

When the sling is passed over two sharp edges of a load, the cables do not slide in relation to the sheath and the locations of the sharp edges of the load, thereby avoiding any risk of the envelope being sheared. Instead, the whole assembly slides over the sharp corners and the section of the sling which is defined between these sharp corners is urged against the bottom of the load.

In addition, if the sling is passed obliquely beneath a load, as shown in FIG. **10**, in such a manner that the rearward cable **2***a* is initially subjected to a larger force than the cable **2***b*, but the two cables adjust automatically thanks to the free loops over their ends, and the part of the sling located beneath the load deforms slightly until the forces to which the cables **2***a* and **2***b* are subjected are in balance.

The tension in the cables at a point in contact with a sharp angle during a lifting operation lead to the danger of producing shear in the sheath material. If it is desired to reduce this shear effect, the cables are advantageously bonded to the sheath.

The ratio between the height and the length of the elliptical cross-section can be selected in accordance with the desired application. This ratio can be small in the case where the load to be lifted is not fragile, or may be close to unity if it is necessary to place around the cables **2***a* and **2***b* a substantial quantity of enveloping material, as is the case, for example, if the load to be lifted has sharp angles or is fragile. On the other hand, in a sling having a given height and width, cables of different sizes can be used depending upon the strength which the sling is to have.

In order to reduce the possibility of a sling cable breaking at a sharp corner of a load, the cables can be provided with deformations in the form of closely spaced beads or fittings. FIG. **11** shows an embodiment of the invention in which individual fittings **14** are provided on each cable to form transverse shoulders preventing slippage relative to the sheath. FIGS. **12** and **13** illustrate an embodiment in which fittings **15** are provided which are common to the cable pair. In these latter Figures, the fitting **15** has two elongate holes **16** through each of which passes a cable, **2***a* or **2***b* respectively. The ends of the fitting are formed with external teeth **17**, in order to provide an improved bond between the fittings and the sheath material. The sling is otherwise designed in a manner hereinbefore described, the beads or fittings being slipped over the cables prior to extrusion.

FIG. **14** illustrates an embodiment in which the cables **2***a* and **2***b* are not straight but deformed to follow a serpentine path within the sheath, the undulations of one cable being symmetrical with respect to those of the other in relation to the longitudinal center-line of the sling. The sling can thus extend elastically at the same time that the enveloping sheath material located between the cables is compressed or stretched, thereby guarding against failure of the sling when it is subjected to a heavy shock load. The undulations or corrugations can extend over the whole of the length of the sling or over a part only. The pitch of the undulations in the two cables could also differ from one another, the amplitude of the undulations of larger pitch being smaller than that of the undulations of the other, so that the lengths of the serpentine portions of the two cables are substantially the same. The cables are preferably given the serpentine form prior to extrusion.

FIGS. **15** and **16** illustrate an exemplary embodiment of the invention in which one end of the sling **1** has been attached to a ring **20** through the medium of a stirrup link having two legs **21***a* and **21***b* which are attached to the cables **2***a* and **2***b* by a common sleeve **22**. The other end of the sling **1** has been connected in a similar manner to a hook **23**. The legs **21***a* and **21***b* of the stirrup link are preferably roughened in order to improve the connection between the link and the sleeve **22**.

FIGS. **17** and **18** illustrate an exemplary embodiment in which one of the ends of the sling **1** has been secured to a ring **20** by means of a flat anchor plate **24** and a composite link formed by two elements **25***a* and **25***b* interconnected by a pin **26**. The plate **24** has a hole **26***a* (FIG. **19**) receiving the element **25***a* of the composite link, the plate being secured to the cables **2***a* and **2***b* by a sleeve **9** which keeps it clamped between these two cables.

The major faces of the plate **24** can be keyed and/or given an undulation in the plane of the plate, as also shown in FIG. **19**, and/or currugated perpendicularly thereto, as shown in FIG. **20**.

Instead of being perforated at **26***a*, the anchor plate **24** may be formed integrally with a threaded portion **24***a* as shown in FIG. **21**, or a yoke **24***b* (FIG. **22**), or a chain link **24***c* (FIG. **23**). In this latter case, the attachment of the sling to a ring **20** is effected in a manner similar to that shown in FIG. **17**, by slipping a mating element **25***b* into the ring and attaching that element to the anchor plate by the pin **26**.

Alternative sheath cross-sections are shown in FIGS. **24** to **29**.

The sling can have one flat face **1***a* (FIG. **24**), or even or be of concave one (not shown), a flattened convex section (FIG. **25**). External striations or fluting **27** may be provided to improved its adhesion, as shown in FIG. **26**, or a central bead **28** as shown in FIG. **27**. Finally, one or more internal cavities **29** or **30** may be provided, as shown in FIGS. **28** and **29** respectively.

The cables **2***a* and **2***b* can be made of a natural or synthetic textile material instead of metal. As will be noted particularly from FIGS. **2** and **24–29**, the axes of cables **2***a*, **2***b* substantially coincide with the centers of curvature of the generally elliptical cross-section of the sheath **3** at opposite ends of its major axis.

The individual features described can be combined in various ways, and modified to form further embodiments of the invention.

What we claim as our invention and desire to secure by Letters Patent of the United States is:

1. A sling comprising two spacedly juxtaposed cables embedded in a continuous elastomeric sheath and provided with interconnected extremities projecting from said sheath and forming a pair of loops at opposite ends thereof, said sheath having a generally elliptical cross-section with the major axis of the ellipse substantially passing through the axes of said cables on opposite sides of the longitudinal centerline of the sheath and at substantially equal distances from said centerline, the axes of said cables substantially coinciding with the centers of curvature of said cross-section at opposite ends of said major axis.

2. A sling as defined in claim **1** wherein said cables are provided with deformations within said sheath for preventing relative longitudinal slippage between said sheath and said cables.

3. A sling as defined in claim **2** wherein said deformations are undulations of said cables.

4. A sling as defined in claim **3** wherein said undulations are mutually symmetrical.

5. A sling as defined in claim **2** wherein said deformations are longitudinally spaced fittings on said cables.

6. A sling as defined in claim **5** wherein said fittings are part of a set of transverse links interconnecting said cables within said sheath.

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