United States Patent [19]

Glushko et al.

[11] **3,707,839**

[45] **Jan. 2, 1973**

[54] **METHOD OF MAKING A CLOSED LAYER OF SHAPED WIRE IN WIRE ROPES, ETC.**

[75] Inventors: **Mikhail Fedorovich Glushko; Viktor Klimentievich Skalatsky,** both of Odessa; **Ivan Timofeevich Skripnik,** Moscow, all of U.S.S.R.

[73] Assignee: **Odessky Politekhnichesky Institut,** Odessa, U.S.S.R.

[22] Filed: **Nov. 6, 1970**

[21] Appl. No.: **87,395**

[52] **U.S. Cl.** **57/161,** 29/505, 57/166

[51] **Int. Cl.** **D07b 5/10**

[58] **Field of Search** .....57/3, 6, 9, 13, 15, 34 R, 145, 57/146, 147, 148, 161, 166, 55; 29/505

[56] **References Cited**

UNITED STATES PATENTS

2,122,911	7/1937	Hunter et al.	57/161
1,996,689	4/1935	Rohs	57/166 X
3,130,536	4/1964	Peterson et al.	57/166 X
3,188,791	6/1965	Grimes et al.	57/161 X

FOREIGN PATENTS OR APPLICATIONS

637,571	5/1950	Great Britain	57/166

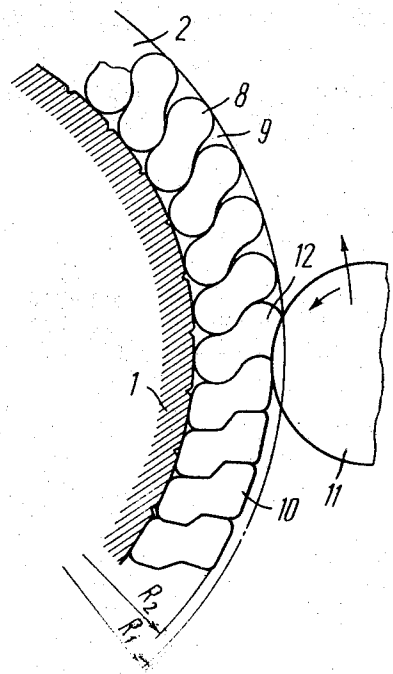
Primary Examiner—Werner H. Schroeder

Attorney—Holman & Stern

[57] **ABSTRACT**

The making of a closed layer from shaped wires on ropes, cables and similar products in which shaped wires are wound on a rope core and in concurrent plastic squeezing of these wires for redistributing their material and changing their profile so that they become reliably interlocked throughout the entire layer.

5 Claims, 7 Drawing Figures



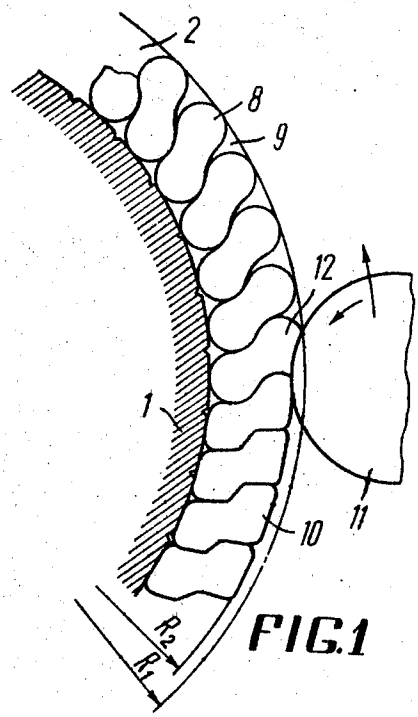


FIG. 1

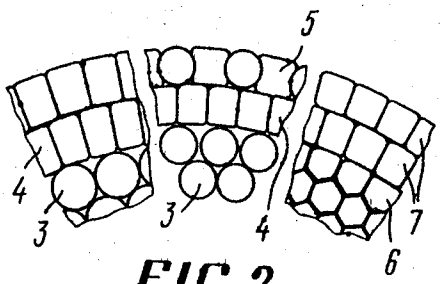


FIG. 2

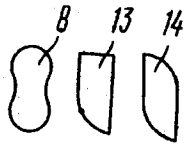


FIG. 3

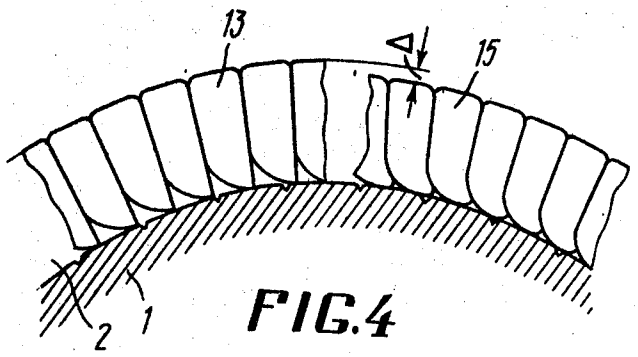


FIG. 4

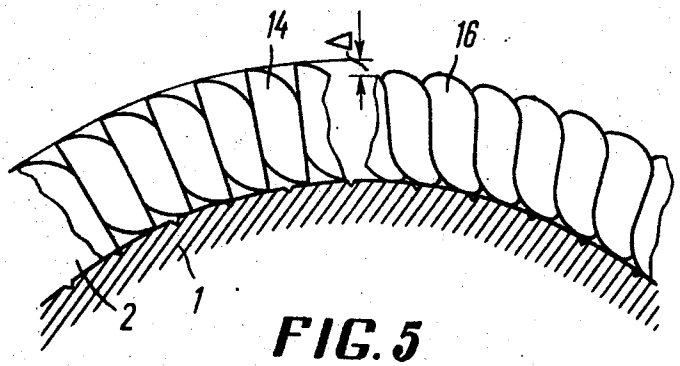


FIG. 5

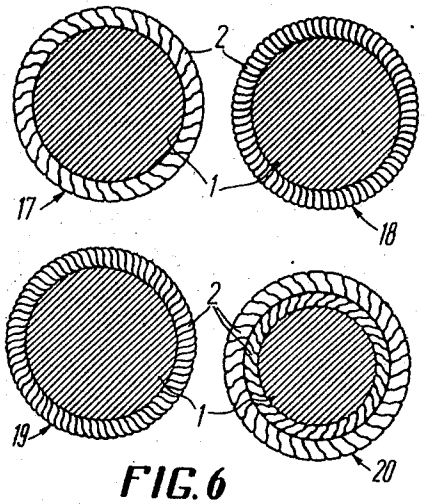


FIG. 6

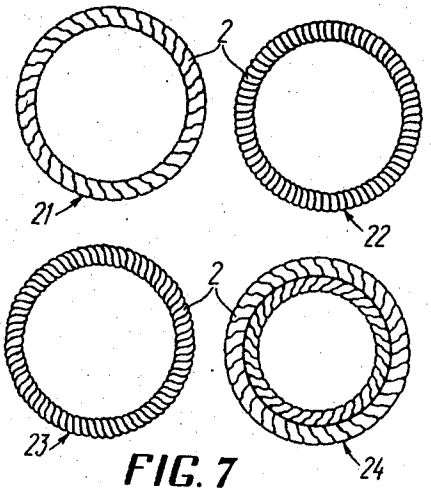


FIG. 7

METHOD OF MAKING A CLOSED LAYER OF SHAPED WIRE IN WIRE ROPES, ETC.

BACKGROUND OF THE INVENTION

The present invention relates to the rope and cable making industry and more specifically methods of making closed-surface ropes, cables and other similar products.

PRIOR ART

Known in the art are methods of making a closed outer layer on ropes and cables by twisting the layer from premanufactured shaped wires which become interlocked when wound on the core. The closed layer of ropes, cables and other similar products is made from three main types of shaped wire, namely those, having a Z-shaped, X-shaped and 8-shaped cross-section with one axis of symmetry in the cross-sectional plane.

The Z-shaped wire manufactured with sufficient accuracy, ensures the most reliable locking of all the wires in the layer and a maximum possible bearing surface of the rope and other similar products as compared with the wires of all the other known profiles intended for the same purpose.

Besides, because of the peculiarities of its profile, the Z-shaped wire is the most difficult to manufacture since it requires accurate calibration throughout its length so that the Z-shaped wire is difficult in manufacture and does not always meet the requirements of quality.

In the process of drawing or rolling of this wire, high pressures arise at the points at which the outline of the wire profile changes particularly sharply, with these pressures resulting in elongation at these points of the structural grains, and in increased hardness and stresses which may eventually lead to cracking.

In addition, while placing the Z-shaped wires into a closed layer, it is difficult to align the lower inside surface of the layer with the core surface which may lead, in operation, to untwisting of wires, waviness, spiral-coiling, separation of wires, protrusion of individual wires from the concentric row, and to other defects.

The X-shaped wire alternating with a round wire is capable of producing a closed layer of limited reliability. The closed layer consisting of a combination of these wire profiles is not very strong so that such ropes may be used only for a small bending ratio.

The 8-shaped wire whose profile is the simplest of those mentioned above is also used for making a closed layer with a limited reliability. Like the Z-shaped wire, the 8-shaped wire requires precise calibration and may develop the same defects as the Z-shaped one. The closed layer formed from the 8-shaped wires provides the smallest bearing surface area of the above-mentioned wire profiles.

In addition to the above-listed disadvantages inherent in the fabricated shaped wires used for making the closed layer of an article, account should be also taken of the disadvantages arising in the process of making the closed layer from these wires namely: a difficulty of ensuring a uniform tensioning of all the wires both inside the layer and throughout the section of the article. Different tensions result in the separation of wires and in other defects already stated.

An object of the present invention is to provide a method of making a reliably closed layer from comparatively simple wire profiles with a maximum possible bearing surface area and with equalized and minimized twisting stresses.

SUMMARY OF THE INVENTION

To accomplish this object, there is provided a method of making a closed layer from shaped wires in ropes, cables and other similar products in which the wires are laid on a core. A distinctive feature lies in the plastic squeezing of the wire layer during which the material of the wires is redistributed and their profile is changed so that they are interlocked along the entire length of the layer.

According to this method, the core for making the closed layer may be constituted by a removable mandrel.

For making a closed layer according to the method, we propose to utilize the 8-shaped wire with one or two axes of symmetry in its cross-sectional plane. The closed layer can also be made by using a wire with a single- or double-wedge-shaped profile.

If a rope, cable or any other similar article is made with more than one closed layer, each of the layers must be subjected to plastic squeezing in succession.

It is practicable that the cable, et cetera should have a closed layer made in accordance with the present method.

The method, based on the use of plastic squeezing of the layer of shaped wires leads to a redistribution of the twisting stresses in the wires, thereby ensuring one of the most vital characteristics of the article, i.e. its resistance to untwisting.

In the course of such a process, the lengths of unstressed wires become equalized, the service stresses are uniformly distributed between the wires, which fact has a positive effect on the general serviceability of the rope, making it more resistant to waviness, spiral-coiling and other structural defects.

Apart from these basic advantages of an operational nature, the article made in accordance with the method exhibits a number of manufacturing advantages. Since the wires in the layer are subjected to plastic squeezing after twisting, this allows to simplify, cheapen and intensify the manufacture of the shaped wire intended for making the closed layer. This method does not place heavy demands on the manufacturing accuracy of the profile of the wires to be used for making the closed layer because the final shaping of the wire profile takes place during squeezing. When a layer consisting of inaccurately machined wires is squeezed together, the surfaces of the adjacent wires become interlocked through the entire squeezed layer which cannot be attained by even the highest accuracy of the wire-manufacturing equipment and the resulting accuracy of the wire profile.

Thus, the present method makes it possible to simplify the manufacture of the wire-making equipment, to increase the allowances for the shape and dimensions of the wire, and to permit the introduction of a more advanced method, i.e. rolling of shaped wire intended for making the closed layer, including the rolling of fine-gauge wire.

The method also permits substantial simplification of the manufacture of the article in question, since its core can be made exclusively from round wires, and its closed layer from only one profile of shaped wire.

Squeezing will ensure deep plastic deformation of the round wire of the rope core and of the shaped wire of the closed layer to such a degree at which all the wires will be mutually interlocked by redistributing the material of the initial wires, the cross section of the article will be efficiently filled with the material, and its cylindrical bearing surface will be smooth, while the wires of the closed layer will be reliably interlocked.

The use of the 8-shaped wire with its biaxial symmetry simplifies and facilitates the processes of manufacture, winding, rewinding and feeding the wire into the rope-spinning machine because this wire may be fed in any position relative to its axis of symmetry.

The closed layer may be made from the shaped wires of other profiles including those which, unless squeezed, fail to ensure even the slightest degree of reliability.

To make the invention more apparent it will now be described in detail with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elementary diagram of making a closed layer from wires, having a 8-shaped section;

FIG. 2 illustrates approximate cross sections of the rope core;

FIG. 3 illustrates approximate cross sections of the initial elements used for making a closed layer;

FIG. 4 is a diagram of the formation of a closed layer from wires having a wedge-shaped cross-section;

FIG. 5 is a diagram of formation of a closed layer from wires having a double-wedge-shaped cross-section;

FIG. 6 illustrates approximate cross sections of ropes with a closed outer layer formed from different elements; and

FIG. 7 illustrates approximate cross sections of hollow articles with a closed outer layer, made on a hollow mandrel.

DETAILED DESCRIPTION OF THE INVENTION

A core 1 (FIG. 1) of the article, i.e. its part without a closed layer 2 is made by a conventional laying of round and shaped wires or by laying the round initial wires followed by their plastic squeezing in a bunch and or by successive layers. As a result of squeezing, the round wires of the rope core 1 acquire an interlocked shaped cross-section.

The cross section of the rope core 1 may take a form, several versions of which are shown in FIG. 2. Illustrated therein are parts of the cross sections of the rope core 1 made from round 3 and wedge-shaped wires 4 or from round wires 3, wedge-shaped and X-shaped wires 5 in combination with round wires 3, as well as from a plastic-squeezed strand 6 with initial wires 7 wound on the strand and then squeezed thereon as if on a mandrel.

In this case, each preceding layer together with the part of the article it encloses, serves as a kind of an auxiliary mandrel for squeezing the next layer. Both the strand 6 and the layers of wires 7 are laid from initially round wires.

Other constructions of the rope core 1 are also possible apart from those shown in FIG. 2. An important prerequisite is to ensure such a structure of one or more layers of the rope core 1 under the final closed layer 2 (FIG. 1) which allows the core to be used as a mandrel for the subsequent plastic squeezing of the closing wires wound thereon.

In particular, for making hollow products, the core 1 may be substituted for by a removable auxiliary mandrel.

The rope core 1 made by any one of the above-described methods is then covered with a layer of figure 8-shaped wires 8 (FIG. 3) or of wires approximating this profile. The wire 8 with a biaxial symmetry in its cross sectional plane should be preferred to the known figure 8-shaped wire with one axis of symmetry. Irrespective of what particular part of its two thicker parts is laid on the core 1 (FIG. 1), the wire 8 laid at a required pitch will ensure reliable interlocking of the sections which will be directed towards the rope core 1 during laying, and an adequate contact with the core 1.

During this process, guaranteed gaps 9 are formed between the thicker parts of the wires 8 on the external surface of the closed layer, with the gaps serving for the redistribution of the material of the wires and for changing the wire 8 of the 8-shaped or similar profile into the wire of or similar to the cross section identified 10.

The layer of wires 8 laid in a conventional manner is subjected to plastic squeezing by drawing, ball or roller burnishing, by rolling or by any other method of metal working by pressure.

Shown in FIG. 1 is a principle of realization of the present method of making the closed layer by plastic squeezing, accomplished by roller burnishing with one roller 11 being shown in FIG. 1.

As a result of plastic squeezing, the cross section of the wire 8 changes to shape 12, then to the shape 10, with the gaps 9 being diminished to the clearances of a required size. These clearances are ensured by the flexible recoil of both the layer 2 and, to a considerably larger extent, of the rope core 1.

Thus, after plastic squeezing, the article acquires a reliably closed layer which features high mechanical and operational properties while the diameter of the article is reduced to a certain extent $\Delta = R_1 - R_2$ in which R_1 and R_2 are the rope radii before and after plastic squeezing, respectively. The operation of plastic squeezing goes well with the process of laying so that both operations can be performed concurrently.

By utilizing the present invention, it is possible to make a closed layer 2 of the article from elements whose profile differs considerably from that of the figure 8-shaped wire. For example, such elements may be constituted by single-or double-wedge-shaped wires 13, 14 (FIG. 3).

After plastic squeezing, the elements 13, 14 are changed in shape to elements 15 and 16 (FIGS. 4,5). As can be seen from the figures, the wedge ends of the wires are deformed by plastic squeezing and ensure interlocking of wires in the closed layer 2.

If it becomes necessary to make a rope with more than one closed layer, each of the layers must be squeezed as described above, with each of the preceding layers functioning as a composite auxiliary mandrel on which the next layer is squeezed. The method can be used for manufacturing the products of various applications and shapes, such as ropes, cables, flexible metal hoses and their combinations.

The ropes may be made with different structures of the core **1** and with different structures and number of the closed layers **2**. Some of the possible versions are illustrated in FIG. **6**. A rope **17** whose closed layer **2** wound on the core **1** is made from the 8-shaped or similar wire **8** whose profile is changed by plastic squeezing into a Z-shaped or similar profile **10**.

The layer **2** of the ropes **18, 19** is made from wires **13, 14**, respectively having a wedge-shaped profile.

The rope **20** differs from the ropes **17, 18** and **19** in that it has two closed layers. This is only one of the possible embodiments of the wire rope with several layers.

In the cross sections of the ropes **17, 18, 19** and **20**, the area of the core is cross hatched in the drawings. The cables with one or more closed layers may look similar to the ropes **17, 18, 19** and **20**.

The hollow products **21, 22, 23, 24**, (FIG. **7**) look similar to the ropes and cables illustrated in FIG. **6**. Like ropes and cables, they may have one or more closed layers consisting of the above-described wire profiles. The function of the core in these products is performed by removable mandrels.

One type of the hollow products is flexible metal hoses.

We claim:

1. A method of manufacturing a closed layer on a core such as a wire rope, cable or similar product of wires having a non-round cross-sectional profile shaped to provide gaps between adjacent wires, said profile being selected in accordance with the definite configuration of the core and oriented in a definite manner with respect to the core, the method comprising the steps of applying a layer of wires of approximately the same hardness and essentially identical elongated cross-sectional profile onto the core at a required pitch with the one of the shorter dimensions bearing against the core said gaps being provided between the other shorter sides of adjacent wires, and subjecting the layer to plastic squeezing with the gaps serving for the redistribution of the material of the wires and for altering the profile thereof with at least the degree of interlocking of the wires over the layer being increased.

2. The method as claimed in claim **1** wherein a base for making the closed layer is constituted by a removable mandrel.

3. The method as claimed in claim **1** wherein the wires of the closed layer are of 8-shaped profile with one or two axes of symmetry in its cross-sectional plane, for increasing the degree of interlocking.

4. The method as claimed in claim **1** wherein the wires of the closed layer are of single- or double-wedge shaped profile, whereby the wires are mutually interlocked over the entire layer.

5. The method as claimed in claim **1** wherein the rope, cable or similar products with several closed layers are made by subjecting each closed layer in succession to plastic squeezing.

* * * * *