This invention relates to wires and to cables made of wires, and to the production of particular kinds of metallic wires and to cables made of these wires for use in reinforcing articles made of rubber, synthetic rubber or plastics, for example, heavy-duty vehicle tires, conveyor and power transmission belts, high-pressure hoses and the like.

It is known that in some cases of reinforcing the strength and rigidity of the elastic end product, a substantial rigidity and stiffness thereof is required, for example, in the breakers of heavy-duty tires. This can be obtained by using wires having a flat, rectangular section, the stiffness of which is determined by its moment of inertia. This, in turn, is determined by the proportion (n) of the height (h) and the breadth or width (b) of the section:

\[ n = \frac{h}{b} \quad (\text{FIG. 2}) \]

Flat wires presently are produced from round wires having a diameter (D) by either rolling or drawing (FIG. 1).

The moment of inertia of the desired flat wire is:

\[ I = \frac{bh^3}{12} \]

and preferably:

\[ n = \frac{h}{b} > 1 \]

The area of the section of the original round wire from which the flat wire is made, is:

\[ A = \pi D^2 / 4 = b \times h = n \times b^2 \]

Thus, one obtains an optimum value of the moment of inertia by substituting:

\[ I = \frac{bh^3}{12} = \frac{n}{12} (n^2 \times h^4) \]

\[ = \frac{n}{12} (\frac{\pi D^2}{4})^2 \]

\[ = \frac{5.12}{100} \times n \times D^3 \]

The inherent disadvantage of such a product is that the stiffness or rigidity principally appears in one direction, although it is desirable to have a product for the intended purposes which has stiffness properties in several directions.

Furthermore, in the case where a certain quantity or section of a rubber or plastic product has to be reinforced or stiffened by means of a steel wire or cable, there is no great mass and weight of such reinforcement desired, for various technical and commercial reasons. As may be seen from FIGS. 3 and 4, the zone (z) in the product, which is influenced by the reinforcement, varies with the shape of the reinforcing means. When a reinforcing wire or cable is applied, having the maximum admissible quantity, the zone (z'), as shown in FIG. 3, of influence is too small. If the same admissible quantity is put into a different shape, taking a larger zone, the zone (z') (FIG. 4) of influence becomes much larger.

In other words, what is desired is a wire or cable product which is capable of filling the product which has to be reinforced in a more efficient manner. This obviously is an improvement regarding both the technical and the commercial aspects of this invention which consists in such novel features, construction arrangements, combinations of parts and improvements as may be shown and described in connection with the device herein disclosed by way of example only and as illustrative of a preferred embodiment.

Objects and advantages of the invention will be set forth in part hereafter and in part will be obvious herefrom or may be learned by practicing the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

It is an object of the present invention to provide a device for reinforcing articles made of rubber or rubber-like or plastic materials.

A further object of the present invention is to provide a wire which has an improved stiffness in all directions for given tensile strength.

Another object of the present invention is to provide cables made of twisted flat wires.

Yet another object of the present invention is to provide new and improved means for reinforcing articles made of rubber, plastic or the like materials, which have a greater adhesivity than cables obtained with a round wire or with straight flat wires.

Furthermore, it is an object to provide cables for reinforcing articles made of rubber or the like elastic materials, which have more bulk for less weight.

A further object of the present invention is to provide an article of manufacture which is useful and practical and which can be produced easily and economically.

Another object of the present invention is to provide a method of producing cables of flat, twisted wires.

Various further and more specific purposes, features and advantages will clearly appear from the detailed description given below taken in connection with the accompanying drawings which form part of this specification and illustrate merely by way of example one embodiment of the article of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but such names are intended to be as generic in their application to similar parts as the art will permit. Like reference characters denote like parts in the several figures of the drawings, in which:

FIG. 1 illustrates schematically the forming of a flat wire from a round wire of a given diameter;

FIG. 2 shows the cross-section of a flat wire;

FIG. 3 illustrates the zone of reinforcing influence of a solid round wire in a surrounding body;

FIG. 4 illustrates the zone of reinforcing influence of a cable wire in a surrounding body, similar to FIG. 3;

FIG. 5 is the front face view of a twisted flat wire;

FIG. 6 is a side view of a flat wire, twisted about its own neutral axis;

FIG. 7 is a perspective view of a flat wire, spirally twisted around an imaginary inner cylinder; and

FIG. 8 is a schematic illustration of the method of making twisted, flat wires.

FIG. 9 is a view of two flat wires twisted upon one another;

FIG. 10 is a view of two flat wires, spirally twisted around the imaginary inner cylinder similar to FIG. 7.

Referring now in more detail to the drawing illust-
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Illustrating a preferred embodiment by which the invention may be realized, there is shown in FIG. 1 a round wire 11 having a diameter D, from which a flat wire 12 is rolled or drawn. FIG. 2 shows the cross-section of the resulting flat wire 12, having the long side l and the short side b.

FIGS. 3 and 4 illustrate the various sizes of the zones of the reinforcing influence of a solid round wire 13 and of a wound cabled wire 14, respectively, in a body of rubber, plastic or the like resilient or elastic material 15.

A cable or rope, according to the present invention, consists either of one or more flat wires 12 which is twisted about its own neutral axis, or which is spirally wound and twisted freely about an imaginary inner cylinder 16 (FIG. 7). It is obvious that several such twisted wires may be twisted around each other FIGS. 9 and 10 for forming a cable which has great bulk but has no great weight (cable not shown in the drawing). It also is obvious that such twisted wire and particularly such twisted cable will be "anchored" very firmly in a body made of rubber or the like material.

The method of twisting may be described and illustrated by reference to FIG. 8. The flat wire is twisted first beyond the elastic limit of the material of which it consists (at 17), then it is twisted in a rotating cabling head 18 and eventually gets a final winding at a rotating spool 19.

While the invention has been described and illustrated with respect to certain preferred examples which gives satisfactory results, it will be understood by those skilled in the art after understanding the principle of the invention, that various other changes and modifications may be made without departing from the spirit and scope of the invention and it is intended therefore in the appended claims to cover all such changes and modifications.

I claim:

1. A metallic rope for reinforcing an article made of rubber, plastic or the like material, comprising at least two spirally twisted wire elements, each of said elements having a flat rectangular section.

2. A metallic rope according to claim 1, wherein said elements are spirally wound upon one another, each of said elements having a flat, rectangular section.

3. A metallic rope according to claim 1, said elements being twisted around each other.

4. The method of making metallic ropes for reinforcing articles made of rubber, plastic or the like material, comprising the steps of spirally twisting wires, each having a flat, rectangular section, and then spirally twisting together a plurality of said spirally twisted wires.

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STANLEY N. GILREATH, Primary Examiner.
D. E. WATKINS, Assistant Examiner.