Sept. 20, 1966 F. V. F. PAUL 3,273,978

REINFORCING ELEMENT

Filed May 9, 1962

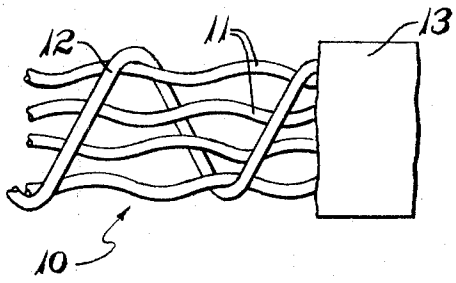


FIG. 1

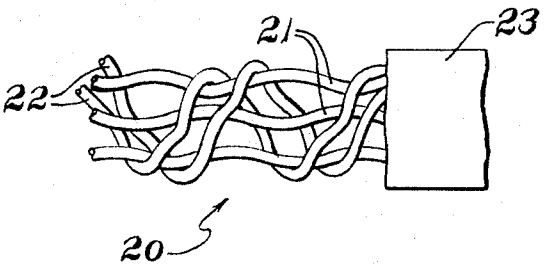


FIG. 2

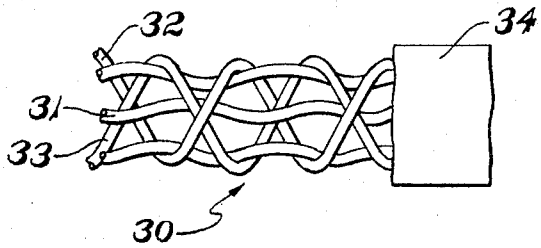


FIG. 3

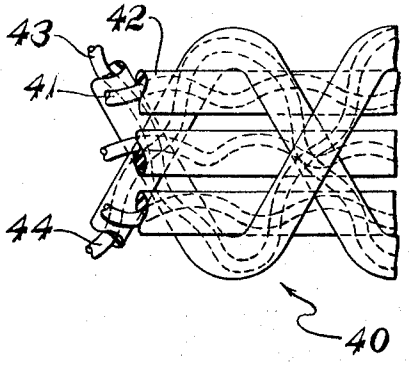


FIG. 4

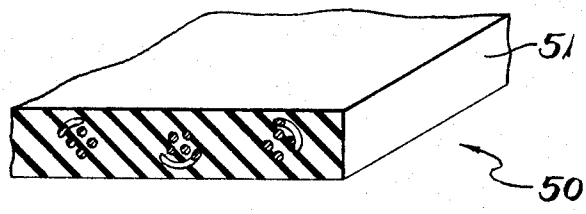


FIG. 5

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REINFORCING ELEMENT

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This invention relates to reinforcing elements for elastomeric articles and, more particularly, to such elements which are formed primarily of metallic wires.

The use of metallic wires to reinforce flexible articles of elastomeric material, such as tires, belts, hose and the like, provides such products with excellent qualities of resistance to flexing while retaining an adequate degree of suppleness without excessive cost. Unfortunately, however, wire reinforced elastomeric articles have frequently suffered from lack of extensibility longitudinally of the reinforcements. This has resulted in inadequate resistance to shock, such as impacts upon conveyor belts, abrupt changes in tension exerted on transmission belts, and other similar stresses. In an effort to overcome these defects, attempts have been made heretofore to provide the metal reinforcements as stranded or braided members formed of a plurality of separate filaments. While this has increased flexibility and provided some measure of extensibility, the results have not been equivalent to that possible with textile reinforcing elements.

The principal object of this invention is, therefore, the provision of an improved reinforcing element for elastomeric material, which element is formed of metallic filaments so formed and assembled as to provide better longitudinal elasticity than in conventional metallic cables.

This is achieved, in accordance with this invention, by constituting the reinforcing element or cable of a plurality of individual metallic filaments at least some of which have been previously deformed and are then twisted, stranded and/or cabled together in a manner which provides interstices between the filaments that are filled with elastomeric material during subsequent manufacturing operations in forming the elastomeric article in which the elements are incorporated or as a separate step prior to incorporation of the elements into such articles.

Other and further objects and advantages of the invention will be apparent from the following detailed description of the presently preferred embodiment, and certain modifications thereof, described with reference to the accompanying drawing, forming a part of this application, and in which:

FIG. 1 is a fragmentary view in side elevation of the presently preferred embodiment of a reinforcing element formed in accordance with this invention, the view being drawn to an enlarged scale with a portion of the rubber covering and filling of the element removed and with the individual filaments separated to more clearly illustrate the construction;

FIG. 2 is a view similar to FIG. 1 showing a modified form of the reinforcing element;

FIG. 3 is a view similar to FIG. 1 showing a still different embodiment of the invention;

FIG. 4 is a side elevational view to an enlarged scale of another embodiment of the invention in which the individual metallic filaments are separately covered with elastomer, the filaments being shown separated from each other with a portion of the covering of each removed to more clearly illustrate the construction; and

FIG. 5 is a fragmentary perspective view showing reinforcing elements of this invention incorporated in a rubber article.

The reinforcing element **10**, illustrated in FIG. 1, comprises an assembly of individual metallic filaments **11**

at least some of which are nonrectilinear and hence have an undulating form which may be achieved by a prior deformation into a sinusoidal or helicoidal configuration. In the illustrated embodiment, four such undulating filaments **11** are disposed in generally parallel relationship as a strand comprising the core of the element **10** and about this strand a filament **12** is helically wound. The filament **12** is preferably wire but may be nylon, rayon or other nonmetallic monofilament.

The undulations of the filaments **11** provide a large number of interstices or spaces within the element so that the result can be said to be a "loose" cable which is capable of substantial extension, i.e. as high as 10 percent, when subjected to tension. However, such a reinforcing element has a low modulus of elasticity or, in other words, would tend to "flow" under even small stresses and would not return to its original length when the tension was removed. However, when such a reinforcing element has been further treated in a manner to render it suitable for reinforcing elastomeric articles as, for example, by providing it with elastomeric material **13**, it behaves differently. Thus, the material **13**, which not only covers the element but also fills the empty spaces therein due to the effect of the pressure under which the material is applied and also the pressures during molding or vulcanization of the article in which the element is incorporated, increases the modulus of extension of the element. Thus, the extension of the reinforcing element, when under tension, is now elastic so that the original length of the element is again achieved when the tension is removed. That is to say, the elastomeric material **13** within the spaces between the filaments **11** elastically opposes the straightening or other displacements of these filaments when under tension. Hence, the improved reinforcing element is particularly suitable for use on vehicle tires, conveyor or power transmission belts, hose, or similar reinforced elastomeric articles.

The improved characteristics achieved with the reinforcing elements constructed from an assembly of undulating metallic filaments is not restricted to assembling of those elements in the manner indicated in FIG. 1. Thus, the number of filaments comprising the central strand or core can be varied and these can be held in generally parallel relationship by means other than a single helically wound filament. For example, as shown in FIG. 2, the reinforcing element **20** may comprise a plurality of undulating metallic filaments **21** disposed in generally parallel relationship as a central strand or core and retained in that relationship by a helical winding of undulating metallic filaments **22** of which two are here shown disposed in adjacent relationship. Such a reinforcing element possesses the same interstitial spaces between the filaments which are filled by the elastomer **23** with which the element is covered, either prior to or during incorporation in the elastomeric article which the element reinforces. This element, therefore, possesses the same elastic extensibility as characterizes the form of the reinforcing element shown in FIG. 1.

FIG. 3 shows a still different embodiment wherein the reinforcing element **30** has a plurality of undulating metallic filaments **31** disposed in generally parallel relationship as a central core or strand and provided with two helical wrappings or windings extending in opposite directions about the filaments **31**. The filaments **32** and **33**, which may be textile or metallic filaments, are wound in opposite directions around the filaments **31** and the assembly is covered with elastomeric material **34** which fills the interstices and provides elastic extensibility thereof.

The reinforcing element **40** shown in FIG. 4 comprises individual undulating metallic filaments **41** which are separately covered with elastomeric material **42**, as

by use of an extrusion die or the like, so that the said elastomeric material **42** forms a substantially cylindrical cover for each individual element. A plurality of these separately covered elements may then be disposed in generally parallel relationship as a central strand or core and helically wound by one or more similar undulating filaments of which too such filaments **43** and **44** are here shown as extending in opposite directions about the central strand.

FIG. 5 shows the manner in which the reinforcing elements, formed in accordance with this invention, are incorporated into an elastomeric article **50**. This may be achieved by disposing elements, such as **10**, **20**, **30** or **40**, in generally parallel relationship and applying a coating of elastomer **51** thereover, as for example, by calendering this material upon the elements. The elements may have themselves been previously individually coated with rubber or may be assembled in uncoated relationship prior to the calendering operation. In either case, the interstices between the individual filaments, such as **11** of the elements, which spaces were provided by the undulations therein, are filled by the elastomeric material so that the article **50** has elastic extensibility in the direction of length of the elements.

The undulations of the metallic filaments may be achieved in any known manner. One suitable method is to pass the wires between two toothed members similar to pinion gears which are slightly separated from one another so that the wire is given a permanent sinusoidal deformation. The wire may be guided in this passage between the toothed members by small grooves machined in the surfaces of the teeth which grooves have a diameter slightly in excess of that of the filament.

The desired undulations of the metallic filaments may also be effected by twisting, stranding or cabling together several filaments to a relatively short pitch, stabilizing them from untwisting and then separating them so that they are left in the generally helicoidal shape which they assumed during the twisting.

In addition to forming the reinforcing elements by disposing a plurality of the filaments generally parallel in the form of a central strand or core and winding or wrapping rectilinear or undulating filaments thereabout, it is also possible to twist, strand or cable together a plurality of metallic filaments which have been previously deformed with the pitch of the cabling or stranding being distinctly different from that of the undulations of the individual filaments. It is also within the purview of this invention to have the individual metallic filaments stranded or otherwise assembled before undulation and then simultaneously undulating the filaments while in the stranded relationship with the strands thereafter assembled together by winding or twisting. It will also be apparent that when the undulating filaments are provided with a helical winding this may comprise one or more cords of textile material instead of a filament of metal or of a textile substance. These and other modifications, which will be apparent to those skilled in the art, are all considered as encompassed within the ambit of the invention the scope of which is defined in the appended claims.

Having thus described the invention, I claim:

1. A reinforcing element for elastomeric articles comprising an assembly of a plurality of metallic filaments extending in generally parallel juxtaposed relationship with each filament having undulations transversely of its length and with at least some of the undulations of adjacent filaments noncoincident thereby providing interstices between adjacent filaments penetrable by elastomer, and at least one filament helically wrapped in spaced convolutions about said plurality of generally parallel filaments, the spacing of said convolutions being sufficient to permit penetration by elastomer.

2. A reinforcing element for elastomeric articles comprising a plurality of metallic filaments having individual undulations transversely of the length thereof and with the filaments disposed in generally parallel juxtaposed relationship, at least some of the undulations of adjacent filaments being noncoincident, and at least two elongated rectilinear members wound helically about said plurality of filaments in reverse directions and in spaced convolutions, the spacing between the convolutions being sufficient to permit penetration by elastomer.

3. A reinforcing element for elastomeric articles comprising a plurality of individual metallic filaments each provided with transverse undulations and separately covered by elastomer, the said filaments extending in generally parallel juxtaposed relationship, and at least one filament covered with elastomer wound in spaced convolutions helically about said plurality of parallel separately covered filaments.

4. A reinforcing element for elastomeric articles comprising an assembly of a plurality of metallic filaments extending in generally parallel juxtaposed relationship with each filament having undulations transversely of its length with at least some of the convolutions of adjacent filaments noncoincident thereby providing interstices between the filaments penetrable by elastomer to thereby provide elastic extensibility of the element, and at least one metallic filament having undulations transversely of its length twisted about said plurality of generally parallel filaments, the undulations of the last-mentioned filament being sufficient to permit penetration of elastomer to and between the said plurality of filaments.

5. A reinforced elastomeric article comprising a plurality of reinforcing elements extending in generally parallel juxtaposed relationship and united by elastomeric material, each of said elements comprising a plurality of metallic filaments extending in generally parallel relationship with each filament having undulations transversely of its length and with at least some of the undulations of adjacent filaments noncoincident, and at least one filament helically wrapped in spaced convolutions about said plurality of filaments, there being interstices between the said generally parallel filaments and the convolutions of said helically wrapped filament which are filled by the elastomer so that the article has elastic extensibility longitudinally of the reinforcing elements.

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