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(54) **FLEXIBLE, ABRASION RESISTANT TEXTILE SLEEVE AND METHOD OF CONSTRUCTION THEREOF**

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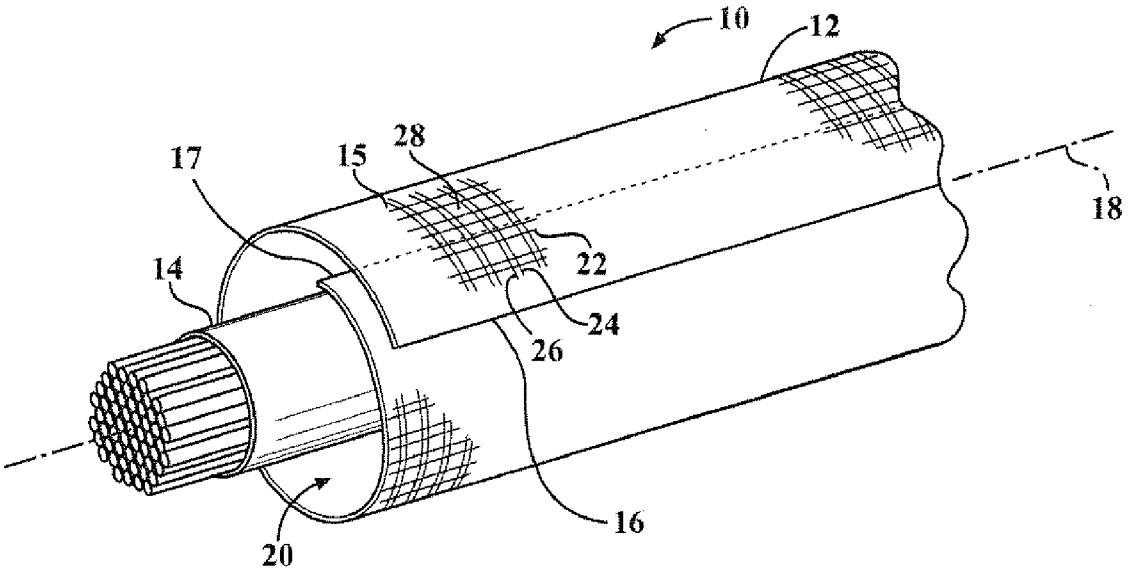
(57) **ABSTRACT**

A textile sleeve for routing and protecting elongate members and method of construction thereof is provided. The sleeve includes an elongate wall having opposite edges extending parallel to a central axis of the sleeve. The wall is woven with warp yams extending parallel to the axis and fill yarns extending transverse to the warp yams. The warp yarns are provided as monofilament yarns to provide abrasion resistance and the fill yams are provided as both monofilament yams to provide further abrasion resistance and multifilament yams to provide increased coverage, maintain flexibility, and to maintain the warp monofilaments in their intended position.



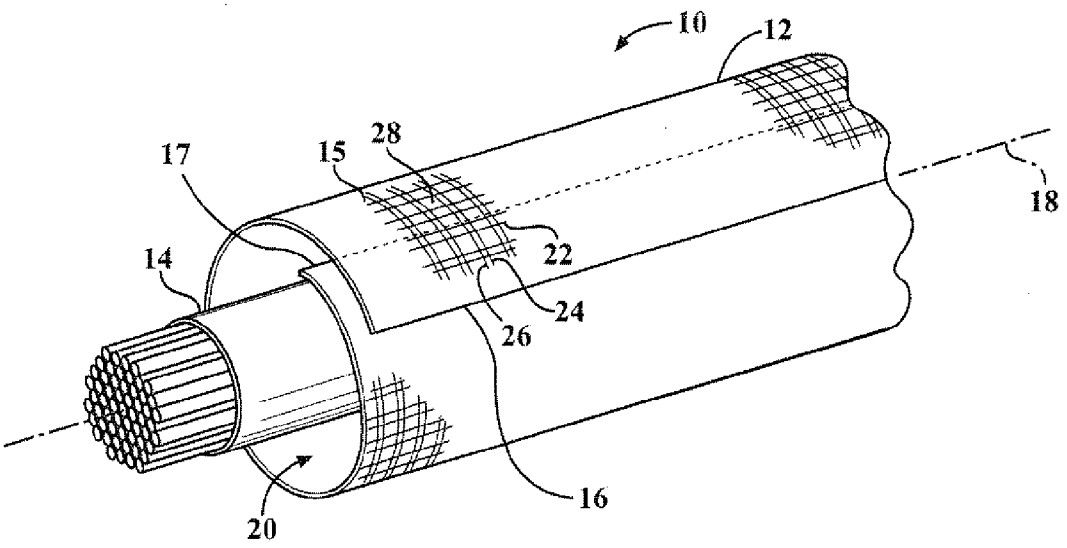
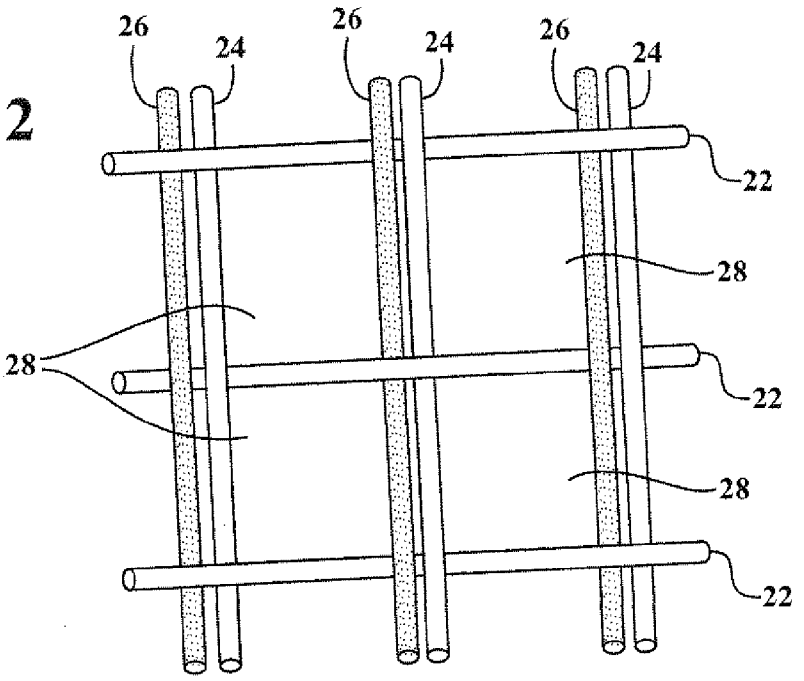


FIG. 1

FIG. 2



FLEXIBLE, ABRASION RESISTANT TEXTILE SLEEVE AND METHOD OF CONSTRUCTION THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 61/186,174, filed Jun. 11, 2009, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Technical Field

[0003] This invention relates generally to textile sleeves for protecting elongate members, and more particularly to woven sleeves. 2. Related Art

[0004] It is known to wrap wires and wire harnesses in protective sleeves, such as in automobiles, aircraft or aerospace craft, to provide protection to the wires against abrasion, fluid and thermal affects. In order to achieve the desired protection, the protective sleeve may have multiple layers, with some of the layers being specifically provided for different types of protection. For example, one layer may be provided for water resistance, e.g. a sheet of plastic material, while another layer may be provided for abrasion resistance, and yet another layer may be provided for protection against thermal conditions, e.g. a non-woven layer. Unfortunately, although the aforementioned multilayer sleeves may provide suitable protection against the various environmental conditions, they are typically bulky, thereby requiring an increased volume of space, being relatively heavy and exhibiting limited flexibility. This can prove detrimental in some applications, particularly applications requiring routing through tight, winding areas, and applications having weight restrictions, such as aircraft and aerospace applications, for example. In order to reduce the bulk and improve the flexibility of the sleeves, it is also known to use tightly woven multifilament and monofilament yams in both the warp and fill directions. However, having to use a tight weave typically comes at an increased cost.

SUMMARY OF THE INVENTION

[0005] One aspect of the invention provides a woven sleeve for routing and protecting elongate members from exposure to abrasion and other environmental conditions, such as contamination. The sleeve has a flexible, abrasion resistant, self-curling elongate wall constructed from woven monofilament and multifilament yarns. The wall has opposite edges extending generally parallel to a central axis of the sleeve, wherein the opposite edges are biased into a self-curled overlapping relation with one another. The wall is woven with warp monofilament yarns and fill monofilament and multifilament yams. The warp monofilament yarns provide the sleeve with abrasion resistance; the fill monofilament yams provide the self-curling bias to the wall, while also providing enhanced abrasion resistance, while the fill multifilament yarns provide further protection to the elongate members within the sleeve by inhibiting the ingress of contamination, debris and the like, while also providing the sleeve with enhanced flexibility and imparting friction on the warp monofilaments to maintain the warp monofilaments in their intended, as woven position.

[0006] In accordance with another aspect of the invention, the monofilament and multifilament fill yarns are dual inserted to provide pairs of the monofilament and multifilament yarns spaced axially from one another by interstices.

[0007] In accordance with another aspect of the invention, a method of constructing a textile sleeve is provided. The method includes weaving an elongate wall having opposite edges extending parallel to a central axis of the sleeve with the wall having warp yarns extending parallel to the axis and fill yams extending transverse to the warp yarns. Further, the method includes providing the warp yams as monofilament yams and the fill yams as monofilament yarns and multifilament yams.

[0008] In accordance with yet another aspect of the invention, the method includes dual inserting the monofilament and multifilament fill yams with the warp yarns and providing discrete pairs of the monofilament and multifilament fill yarns spaced axially along the central axis from one another.

[0009] A sleeve constructed in accordance with the invention not only provides enhanced protection to elongate members contained therein, but is also economical in manufacture.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] These and other aspects, features and advantages will become readily apparent to those skilled in the art in view of the following detailed description of presently preferred embodiments and best mode, appended claims, and accompanying drawings, in which:

[0011] FIG. **1** is schematic perspective view of a woven, self-wrapping sleeve constructed in accordance with one aspect of the invention carrying and protecting elongate members therein; and

[0012] FIG. **2** is an enlarged partial view of a wall of the sleeve of FIG. **1**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] Referring in more detail to the drawings, FIG. **1** shows schematic representation of a woven, self-wrapping textile sleeve, referred to hereafter as sleeve **10**, constructed in accordance with one aspect of the invention. The sleeve **10** has a self-wrapping elongate wall **12** for routing and protecting elongate members, such as wires or a wire harness **14**, for example, from exposure to abrasion and the ingress of contamination, debris and the like. The elongate wall **12** has opposite edges **16**, **17** extending generally parallel to a central, longitudinal axis **18**, wherein the edges **16**, **17** are preferably biased into overlapping relation with one another in "cigarette wrapped" fashion to fully enclose the elongate members **14** within a central cavity **20** of the sleeve. The cavity **20** is readily accessible along the full length of the longitudinal axis **18** so that the elongate members **14** can be readily disposed radially into the cavity **20**, and conversely, removed from the cavity **20**, such as during service. To provide protection to the elongate members **14** against abrasion, the wall **12** is woven with warp yarns **22** provided as monofilament yams and fill yarns **24** provided as monofilament yams, wherein the fill monofilament yams **24** provide additional, enhanced protection to the elongate members **14** against abrasion, while also providing the bias to self-curl the opposite edges **16**, **17** in overlapping relation with one another. The bias is imparted by heat-setting the fill monofilament yams **24** into their curled configuration about the central axis **18**. In addition to the fill monofilament yams **24**, the wall **12** has fill yams **26** provided as multifilament yarns. The

multifilament yarns **26** provide additional surface area coverage of the wall **12** to the elongate members **14** and inhibit ingress of contamination, debris, or the like into the cavity **20**, thereby providing enhanced protection to the elongate members **14**. In addition, the multifilament yarns **26** maintain the warp monofilaments **22** in place in their intended, as woven position by imparting friction on the warp monofilaments **22**, while providing the sleeve **10** with sufficient flexibility for routing around corners, for example.

[0014] Depending on the application needs, the wall **12** can be constructed having any suitable size, including length and diameter. When the wall **12** is in its self-wrapped tubular configuration, generally free from any externally applied forces, the edges **16**, **17** preferably overlap one another at least slightly to fully enclose the cavity **20**, and thus, provide enhanced protection to the wires **14** contained in the cavity **20**. The edges **16**, **17** are readily extendable away from one another under an externally applied force sufficient to overcome the bias imparted by the fill monofilament yarns **24** to at least partially open and expose the cavity **20**. Accordingly, the wires **14** can be readily disposed into the cavity **20** during assembly or removed from the cavity **20** during service. Upon releasing the externally applied force, the edges **16**, **17** return automatically to their natural, overlapping self-wrapped position under the bias imparted by the heat-set fill monofilament yarns **24**.

[0015] The monofilament yarns **22**, **24** can be provided as any suitable heat-settable polymeric material, such as polyphenylene sulfide (PPS) or polyethyleneterephthalate (PET), for example. In one exemplary sleeve embodiment, the monofilament yarns **22**, **24** were provided as PET having a diameter of about 0.22 mm. The wall **12** was formed having a width (dimension extending between the edges **16**, **17** with the wall **12** in a flattened state) of about 42 mm, and the number of ends of the warp monofilaments **22** was **48**. The fill monofilament yarns **24** and the fill multifilament yarns **26** were dual inserted having a pick per inch (PPI) of **10**, however, a PPI between about 8-12 is considered to be within a workable range. With such a low PPI, interstices **28** are formed within the wall **12**. Accordingly, the monofilament and multifilament fill yarns **24**, **26** provide discrete pairs of the circumferentially extending monofilament and multifilament fill yarns spaced axially along the central axis **18** from one another by the interstices **28** extending axially therebetween. The multifilament yarns **26** were provided having a denier of about **1250**. The yarns **22**, **24**, **26** were woven using a plain weave which resulted in the sleeve **10** having a wall thickness of about 0.6 mm. In yet another exemplary sleeve embodiment, the number of ends of the warp monofilaments **22** was **52**, with all other yarn factors remaining the same. It should be recognized that these yarn factors can be modified by one skilled in the art in dimension and number, while maintaining the warp yarns **22** as purely monofilaments and the fill yarns **24**, **26** as a combination of monofilaments and multifilaments, while remaining within the spirit and scope of the invention.

[0016] With the warp yarns **22** being provided as purely monofilaments, the abrasion resistance of the sleeve assembly **10** is enhanced. Further, with some of the fill yarns **24** being provided as monofilaments, additional protection against abrasion is provided. Further yet, with some of the fill yarns **26** being provided as multifilaments, added surface area coverage is provided to the wall **12** to the elongate members **14**, thereby further protecting the cavity **20** against ingress of contamination, and further, the multifilaments act to maintain the warp monofilaments **22** in their intended location, even under external abrasion force.

[0017] Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A textile sleeve for routing and protecting elongate members, comprising:

an elongate wall having opposite edges extending parallel to a central axis of the sleeve, said wall being woven with warp yarns extending parallel to said axis and fill yams extending transverse to said warp yarns, said warp yarns being provided as monofilament yarns and said fill yarns being provided as monofilament yams and multifilament yarns.

2. The textile sleeve of claim **1** wherein said monofilament and multifilament fill yams are dual inserted with said warp yarns to provide discrete pairs of said monofilament and multifilament fill yams spaced axially along said central axis from one another by interstices.

3. The textile sleeve of claim **2** wherein said fill yarns are woven having between about 8-12 picks per inch.

4. The textile sleeve of claim **1** wherein said monofilament fill yarns are heat set to bias the wall into a curled configuration about said central axis.

5. The textile sleeve of claim **5** wherein said opposite edges are biased by said monofilament fill yams in overlapping relation with one another.

6. The textile sleeve of claim **1** wherein said warp yams are provided solely as monofilament yarns.

7. A method of constructing a textile sleeve, comprising:

weaving an elongate wall having opposite edges extending parallel to a central axis of the sleeve with the wall being having warp yarns extending parallel to the axis and fill yams extending transverse to the warp yarns; and

providing the warp yams as monofilament yarns and the fill yams as monofilament yarns and multifilament yarns.

8. The method of claim **7** further including dual inserting the monofilament and multifilament fill yarns with the warp yarns to provide discrete pairs of the monofilament and multifilament fill yams spaced axially along the central axis from one another.

9. The method of claim **8** further including weaving the fill yams having between about 8-12 picks per inch.

10. The method of claim **7** further including heat-setting the monofilament fill yams to bias the wall into a curled configuration about the central axis.

11. The method of claim **10** further including biasing the opposite edges with the monofilament fill yams in overlapping relation with one another.

12. The method of claim **7** further including providing the warp yarns solely as monofilament yarns.

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