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(54) **FLEXIBLE, ARC RESISTANT, FLUID REPELLANT, HIGH TEMPERATURE AND ABRASION RESISTANT, WRAPPABLE TEXTILE SLEEVE AND METHOD OF CONSTRUCTION THEREOF**

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(57) **ABSTRACT**

A wrappable sleeve has a wall including an interlaced layer providing an inner surface and an opposite outer surface extending widthwise between opposite edges and extending lengthwise between opposite ends. The opposite edges are wrappable about a central longitudinal axis to bound the elongate member within a cavity bounded by the inner surface. The interlaced layer is formed of yarns interlaced with one another, wherein a least some of the yarns include multi-filaments resistant to heat and monofilaments resistant to heat. The wall further includes a silicone-based coating adhered to the outer surface of the interlaced layer, and a closure member fixed along one of the opposite edges. The closure member has an adhesive surface configured to maintain the opposite edges of the wall in overlapping relation with one another.

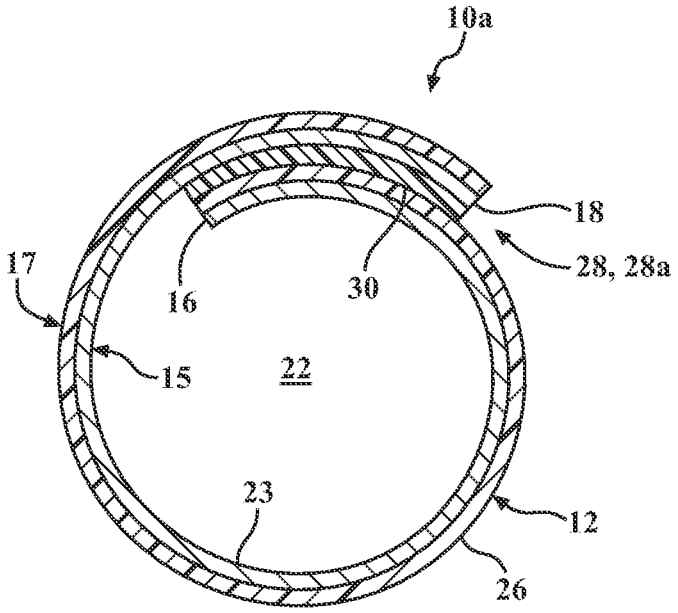
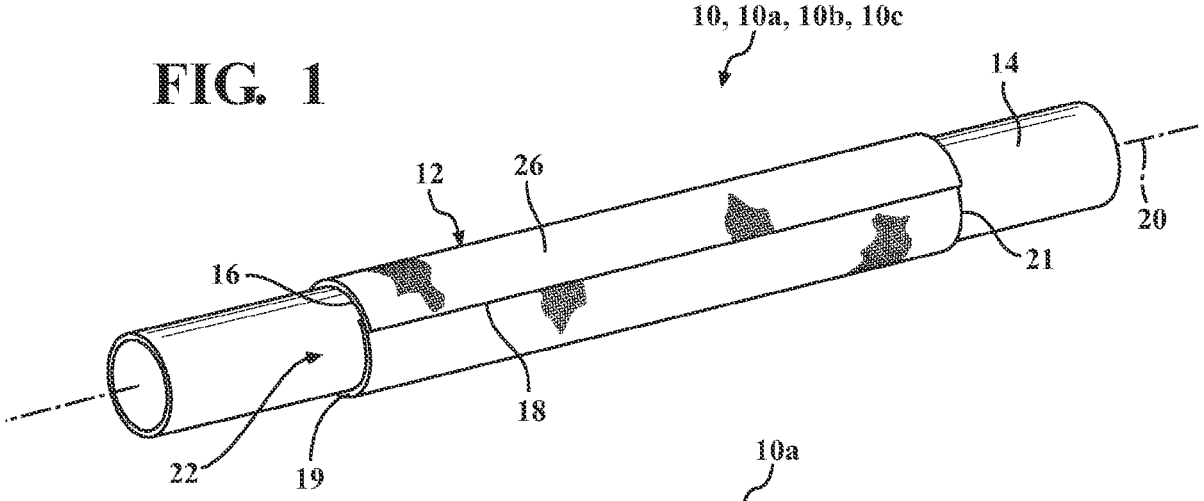


FIG. 1



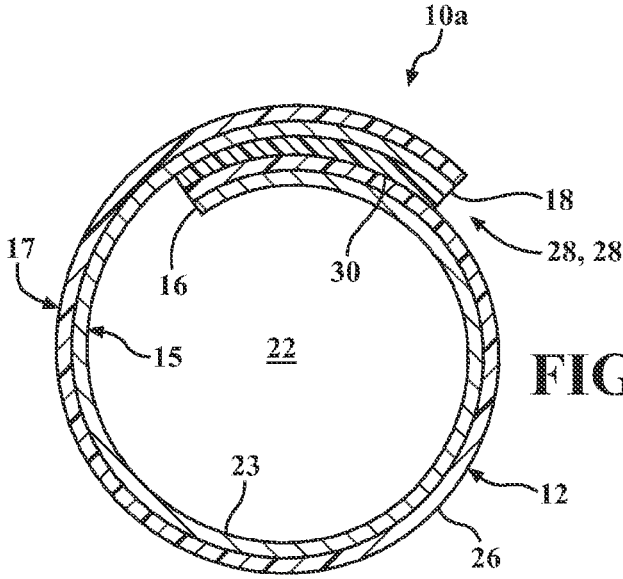


FIG. 2A

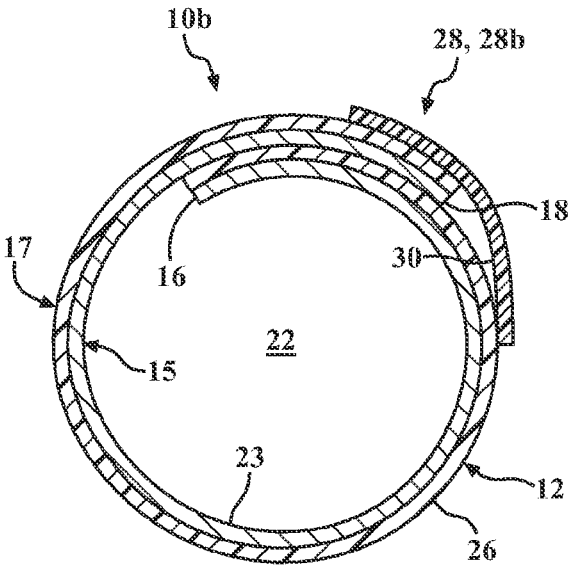


FIG. 2B

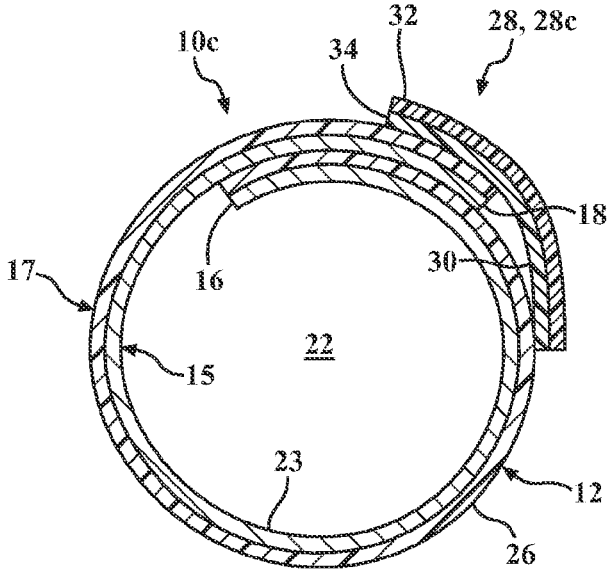


FIG. 2C

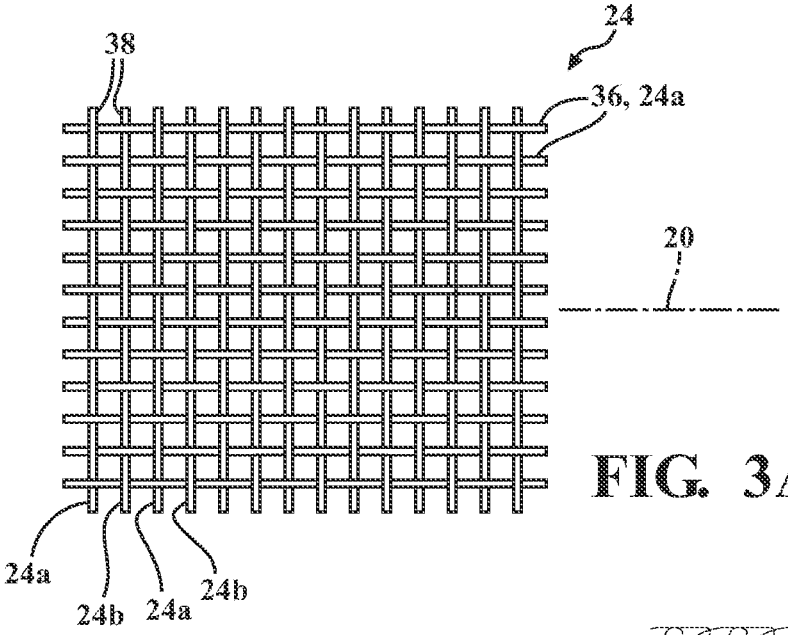


FIG. 3A

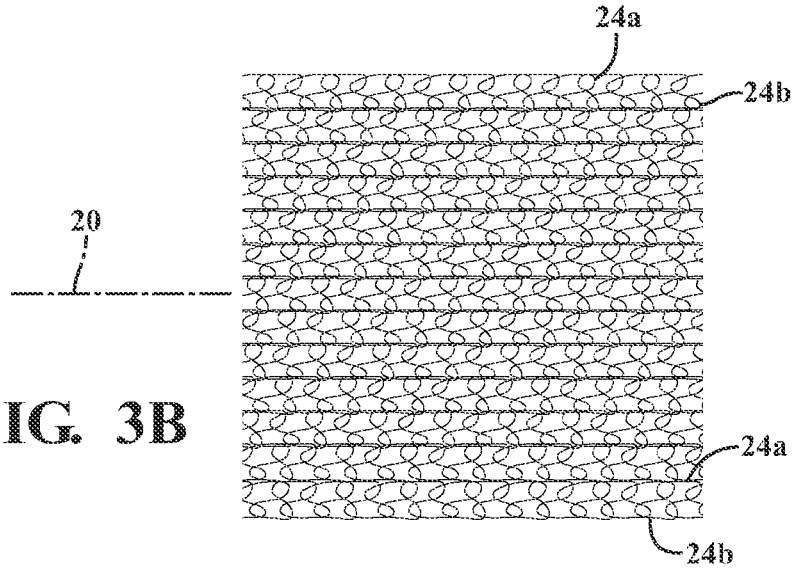


FIG. 3B

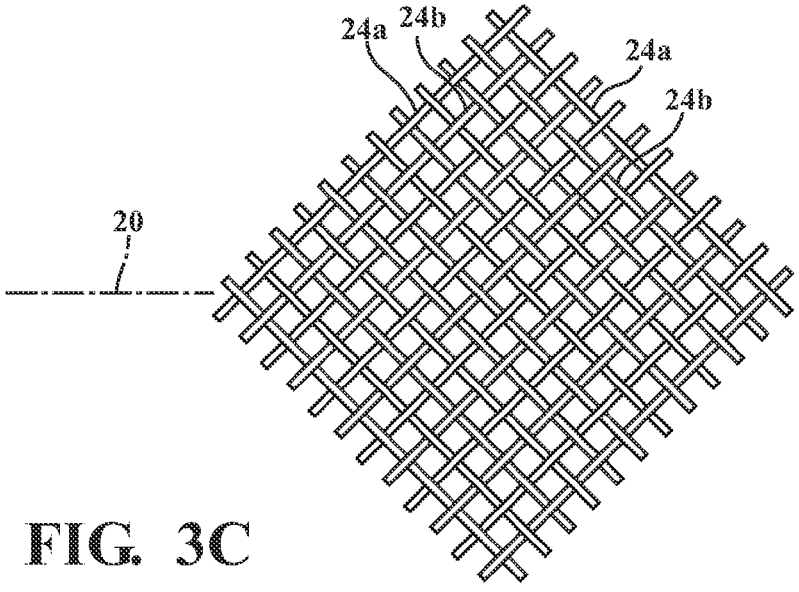


FIG. 3C

FLEXIBLE, ARC RESISTANT, FLUID REPELLANT, HIGH TEMPERATURE AND ABRASION RESISTANT, WRAPPABLE TEXTILE SLEEVE AND METHOD OF CONSTRUCTION THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 63/317,891, filed Mar. 8, 2022, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Technical Field

[0002] This invention relates generally to textile sleeves for protecting elongate members, and more particularly to flexible, wrappable textile sleeves having arc resistant, abrasion resistant, heat resistant and fluid repellent properties.

2. Related Art

[0003] It is known to contain and protect elongate members, such as wires and wire harnesses, for example, in circumferentially continuous, tubular textile sleeves to provide protection to the cables, wires, and hoses. However, these sleeves are generally challenging to assemble about elongate members to be protected due to their having a fixed cavity size and to having to be slipped axially over the elongate member to be protected. Further yet, in order to achieve the multiple, different types of desired protection, such as arc resistance, fluid resistance, abrasion resistance, heat resistance, known protective sleeves typically have multiple layers, with each of the layers being specifically provided for a different type of protection. Although the aforementioned multilayer sleeves may provide suitable protection against various environmental conditions, unfortunately they are bulky, having a thick, multilayered wall with different types of yarns being provided in each layer, thereby requiring an increased volume of space, and further, they tend to be relatively heavy and exhibit low flexibility. Further yet, having to include multiple layers can prove problematic in some applications, particularly applications requiring routing cables, wires or hoses through tight, winding areas, as well as applications having weight restrictions, such as aircraft and aerospace applications, for example.

SUMMARY OF THE INVENTION

[0004] One aspect of the invention provides a wrappable sleeve for routing and protecting an elongate member from arcing, exposure to abrasion, thermal conditions including high heat and fire, fluid (water/fuel) ingress, and other environmental conditions, such as contamination, and protects against fluid absorption into a wall of the sleeve is provided. The wrappable sleeve has a wall including an interlaced layer having an inner surface and an opposite outer surface extending widthwise between opposite edges and extending lengthwise between opposite ends. The opposite edges are configured to be wrapped about a central longitudinal axis to bound the elongate member within a cavity bounded by the inner surface. The interlaced layer is formed of yarns interlaced with one another, wherein a least some of the yarns include multifilaments resistant to heat and monofilaments resistant to heat. The wall further includes a silicone-based coating adhered to the outer surface of the interlaced layer, and a closure member is fixed along one of the opposite edges. The closure member has an adhesive surface configured for adhesion to an outer surface of the wall to maintain the opposite edges of the wall in overlapping relation with one another.

[0005] In accordance with another aspect of the invention, the yarns can including warp yarns extending generally parallel to the central longitudinal axis and weft yarns extending generally transversely to the central longitudinal axis, with the warp yarns being woven with the weft yarns.

[0006] In accordance with another aspect of the invention, the warp yarns can be provided entirely from multifilaments resistant to heat and the weft yarns can be provided including monofilaments resistant to heat.

[0007] In accordance with another aspect of the invention, the weft yarns can be provided including monofilaments resistant to heat and multifilaments resistant to heat.

[0008] In accordance with another aspect of the invention, the multifilaments resistant to heat can be provided as meta-aramid.

[0009] In accordance with another aspect of the invention, the warp multifilaments resistant to heat can be provided having a denier between about 100-3000 and the weft multifilaments resistant to heat can be provided having a denier between about 50-1000.

[0010] In accordance with another aspect of the invention, the monofilaments resistant to heat can be provided having a diameter between about 0.1-0.5 mm.

[0011] In accordance with another aspect of the invention, the monofilaments resistant to heat can be provided as PEEK.

[0012] In accordance with another aspect of the invention, the silicone-based coating can include at least one, or both of a flame retardant and a heat stabilizer.

[0013] In accordance with another aspect of the invention, the silicone-based coating has a thickness between about 0.1-3.0 mm.

[0014] In accordance with another aspect of the invention, the closure member can be provided as a silicone pressure sensitive adhesive.

[0015] In accordance with another aspect of the invention, the silicone pressure sensitive adhesive is configured for fixed adhesion to the inner surface of the interlaced layer and to an outer surface of the silicone-based coating.

[0016] In accordance with another aspect of the invention, the closure member can include a silicone amalgamating tape.

[0017] In accordance with another aspect of the invention, the closure member can include a silicone pressure sensitive adhesive bonded to the silicone amalgamating tape.

[0018] In accordance with another aspect of the invention, a method of constructing a wrappable sleeve for routing and protecting an elongate member from arcing, exposure to abrasion, thermal conditions including high heat and fire, fluid (water/fuel) ingress, and other environmental conditions, such as contamination, and to protect against fluid absorption into a wall of the wrappable sleeve, is provided. The method includes interlacing heat-resistant yarn to form an interlaced layer of a wrappable wall having opposite edges extending lengthwise between opposite ends, with

the opposite edges being configured to be wrapped about a central longitudinal axis to bound the elongate member within an enclosed cavity. The method further includes bonding a silicone-based coating on an outer surface of the interlaced layer. The method further includes fixing a closure member along one of the opposite edges, and providing the closure member having an adhesive surface configured for adhesion to an outer surface of the wall to maintain the opposite edges of the wall in overlapping relation with one another.

[0019] In accordance with another aspect of the invention, the method can further include interlacing the yarns with one another in a weaving process, a knitting process, or a braiding process. If woven, the method can further include weaving the yarns including warp yarns extending generally parallel to the central longitudinal axis, with the warp yarns being provided entirely as multifilaments resistant to heat, and weft yarns extending generally transversely to the warp yarns, with the weft yarns including monofilaments resistant to heat.

[0020] In accordance with another aspect of the invention, the method can further include providing the weft yarns including both monofilaments and multifilaments resistant to heat.

[0021] In accordance with another aspect of the invention, the method can further include providing the warp multifilaments having a denier between about 100-3000 and providing the weft multifilaments having a denier between about50-1000.

[0022] In accordance with another aspect of the invention, the method can further include providing the weft monofilaments having a diameter between about 0.1-0.5 mm.

[0023] In accordance with another aspect of the invention, the method can further include weaving the warp yarns and the weft yarns in one of a plain, twill, basket, or satin weave pattern.

[0024] In accordance with another aspect of the invention, the method can further include weaving the weft monofilaments and multifilaments in alternating relation with one another along the entirety of the length of the wall.

[0025] In accordance with another aspect of the invention, the method can further include providing the silicone-based coating having a thickness between about 0.1-3.0 mm.

[0026] In accordance with another aspect of the invention, the method can further include providing the silicone-based coating including at least one of a flame retardant and a heat stabilizer.

[0027] In accordance with another aspect of the invention, the method can further include providing the closure member including a silicone pressure sensitive adhesive.

[0028] In accordance with another aspect of the invention, the method can further include providing the silicone pressure sensitive adhesive being configured for fixed adhesion to the inner surface of the wall and to an outer surface of the wall.

[0029] In accordance with another aspect of the invention, the method can further include providing the closure member including a silicone amalgamating tape.

[0030] In accordance with another aspect of the invention, the method can further include providing the silicone amalgamating tape having a silicone pressure sensitive adhesive bonded thereto, with the silicone pressure sensitive adhesive being configured for adhesion to an outer surface of the silicone-based coating.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] 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:

[0032] FIG. **1** is schematic perspective view of a wrappable sleeve constructed in accordance with one aspect of the invention, with the wrappable sleeve shown wrapped about an elongate member to be protected therein;

[0033] FIGS. **2**A-**2**C are end views looking along a central longitudinal axis of the sleeve of FIG. **1** illustrating different embodiments of a closure member for maintaining opposite edges of the wrappable sleeve in fixed, overlapped relation with one another; and

[0034] FIGS. **3**A-**3**C illustrate different embodiments of an interlaced layer of the wrappable sleeve of FIG. **1**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0035] Referring in more detail to the drawings, FIGS. **1** and **2**A-**2**C show a schematic representation of a wrappable (shown wrapped in FIG. **1**) textile sleeve, referred to hereafter as sleeve **10***a*, **10***b*, **10***c*, constructed in accordance with different aspects of the invention, wherein sleeves **10***a*-**10***c* are discussed hereafter generically as sleeve **10**, unless otherwise specified. The sleeve **10** has a flexible, wrappable elongate wall **12** for routing and protecting an elongate member(s) **14**, such as a cable, wires, and pipe, for example, from exposure to arcing (electrical flow path through an air gap from a cable or wire to another conductor, such that energy of a cable or wire is contained inside the wall **12**, thereby preventing the release of energy from the sleeve **10**), abrasion, thermal conditions including high heat and fire, fluid absorption and ingress, e.g. water, oil, fuel, and the like, and other environmental conditions, such as contamination. The wall **12** can be constructed having any suitable size, including length and diameter. The wall **12** has an inner surface **15** and an opposite outer surface **17**, extending widthwise between opposite edges **16**, **18** and lengthwise between opposite ends **19**, **21**. The opposite edges **16**, **18** extend generally parallel to a central, longitudinal axis **20**, wherein the edges **16**, **18** are wrappable into overlapping relation with one another in "cigarette wrapped" fashion to fully enclose the elongate member **14** within a central cavity **22** bounded by the inner surface **15** of the sleeve **10**. The wall **12** has an inner, interlaced textile layer **23** formed of yarns **24** interlaced with one another in one of a woven (FIG. **3**A), knit (FIG. **3**B), or braided (FIG. **3**C) fashion, wherein a least some of the yarns **24** include multifilaments **24***a* resistant to heat, and monofilaments **24***b* resistant to heat, thereby allowing the sleeve **10** to withstand exposure to high heat and fire for a predetermined amount of time, including up to about 2 hours or more, while protecting the elongate member **14** against heat damage. A silicone-based coating **26** is adhered to the outer surface **17** of the interlaced textile layer **23**, shown as being adhered to the entirety of the outer surface **17**, wherein the silicone-based coating **26** enhances the aforementioned levels of protection to the elongate member **14**, particularly with regard to the prevention of arc and fluid absorption/ingress. A closure member **28** is fixed along one of the opposite edges (outer edge **18**),

and has an adhesive surface **30** configured for adhesion to an outer, outwardly facing surface of the silicone-based coating **26** of the wall **12** to maintain the opposite edges **16**, **18** of the wall **12** in overlapping relation with one another. Accordingly, the wall **12** and the closure member **28** seal off the cavity **22** against the ingress of fluid, thereby providing the aforementioned protections to the elongate member **14**.

[0036] The silicone-based coating **26** is a fluid impervious coating, thereby being impervious to water, fuel (e.g. kerosene), oil, and the like, to render the wall **12** fluid impervious as well as fluid repellant. As such, fluid is prevented from being absorbed by the interlaced layer **23**, thus, preventing water, fuel and the like from compromising the ability of the sleeve **10** to provide the desired levels of protection. The silicone-based coating **26** can include at least one or both of a flame retardant and a heat stabilizer, and can be provided having a thickness between about 0.1-3.0 mm, thereby contributing to the wall **12** having a narrow profile, thereby enhancing the flexibility and ability to be routed in relatively small, tight spaces.

[0037] As shown in FIG. **2**A, the closure member **28** can be provided as a silicone pressure sensitive adhesive (PSA) **28***a*. The silicone PSA **28***a* is shown configured for fixed adhesion to the inner surface **15** of the textile layer **23** and to an outer surface of the wall **12**, shown as being fixed to an outer surface of the silicone-based coating **26**. As such, the silicone PSA **28***a* is sandwiched between the inner surface **15** of the textile layer **23** and the outer surface of the silicone-based coating **26**. The silicone PSA **28***a* can be a double-sided PSA so as to be adhered to the inner surface **15** of the textile layer **23** during manufacture of the sleeve **10** and to the outer surface of the silicone-based coating **26** upon assembly of the sleeve **10** about the elongate member **14**. A release film (not shown) can be applied to the PSA surface configured to adhesion to the outer surface of the silicone-based coating **26**, thus allowing the release film to be peeled away, when desired, to wrap and fix the sleeve **10** about the elongate member **14**.

[0038] As shown in FIG. **2**B, the closure member **28** can be provided as a silicone amalgamating tape **28***b*. The silicone amalgamating tape **28***b* is shown configured for fixed adhesion to the outer surface of the silicone-based coating **26** adjacent the outer edge **18** and to the outer surface of the silicone-based coating **26** adjacent the inner edge **16**. As such, the silicone amalgamating tape **28***b* is exposed in its entirety about the outer surface of the silicone-based coating **26**. A release film(s) (not shown) can be applied to an inner surface of the silicone amalgamating tape **28***b*, as desired, with the release film being configured to be peeled away, when desired, during manufacture of the sleeve **10** and while wrapping and fixing the sleeve **10** about the elongate member **14**.

[0039] As shown in FIG. **2**C, the closure member **28***c* can be provided similarly as discussed above for the embodiment of FIG. **2**B, having a silicone amalgamating tape **32**, while also having an inner silicone PSA **34**, as discussed above for the embodiment of FIG. **2**A, bonded to an inner surface of the silicone amalgamating tape **32** and forming the adhesive surface **30**. The closure member **28***c* is shown adhered to the outer surface (surface facing radially outwardly relative to the central longitudinal axis **20**) of the silicone-based coating **26**, as discussed above for the embodiment of FIG. **2**B, and can include a release film(s), as desired.

[0040] The interlaced yarns **24**, in a preferred embodiment of FIG. **3**A, are woven, including warp yarns **36** extending generally parallel to the central longitudinal axis **20** and weft yarns **38** extending generally transversely to the central longitudinal axis **20**. The warp yarns **36** can be woven with the weft yarns **38** in any desired weave pattern, including a pain weave, twill weave, satin weave or basket weave, for example, with the plain weave pattern being preferred to provide a smooth, stable and uniform protection pattern, with the smoothness facilitating bonding of the silicone-base coating **26** to the outer surface **17**. The warp yarns **36** can be provided entirely from the multifilaments **24***a*, with the multifilaments **24***a* being resistant to heat (high temperature resistant) and the weft yarns can be provided including the monofilaments **24***b*, with the monofilaments **24***b* also being resistant to heat (high temperature resistant), while also having high abrasion resistance. Further yet, if desired to provide the wall **12** as being self-wrapping, the monofilaments **24***b* can be provided as being heat-settable, thereby be able to be heat-set to impart a heat-formed bias in the wall **12** to maintain the opposite edges **16**, **18** in overlapping relation with one another, absent an externally applied force sufficient to overcome the internal bias. Of course, the external force can be intentionally applied to spread the opposite edges **16**, **18** away from one another during installation of the sleeve **10** about the elongate member **14**, whereupon the externally applied force can be released to allow the bias to automatically return the opposite edges **16**, **18** into their overlapping relation. The weft yarns **38** can further include the multifilaments **24***a* being resistant to heat, with the weft monofilaments **24***b* and weft multifilaments **24***a* being provided in any desired ratio, and in one presently preferred embodiment, the weft monofilaments **24***b* and weft multifilaments **24***a* can be woven in alternating relation with one another in a 1:1 ratio.

[0041] The warp multifilaments **36**, **24***a* can be provided as meta-aramid having a denier between about 100-3000tex, and the weft multifilaments **38**, **24***a* can be provided having a denier between about 50-1000tex. The weft monofilaments **38**, **24***b* can be provided as PEEK having a diameter between about 0.1-0.5 mm. With the weft multifilaments **38**, **24***a* having a reduced effective diameter than the warp multifilaments **36**, **24***a*, an increased weave tightness and density can be achieved to provide enhance protection to the elongate member **14**.

[0042] In accordance with another aspect of the disclosure, with reference to FIGS. **3**B and **3**C, the textile sleeve **10***b*, **10***c*, respectively, can be knitted or braided with the aforementioned multifilaments **24***a* and monofilaments **24***b*. It is to be recognized that any desired combination of the multifilaments **24***a* and/or monofilaments **24***b* can be used to form the knitted or braided interlaced yarns **24**.

[0043] In accordance with another aspect of the invention, a method of constructing a textile sleeve **10***a*, **10***b*, **10***c* is provided. The method includes interlacing heat-resistant yarn **24** to form an interlaced layer **23** of a wall **12** having opposite edges **16**, **18** extending lengthwise between opposite ends **19**, **21**, with the opposite edges **16**, **18** being configured to be wrapped about a central longitudinal axis **20** to bound the elongate member **14** within an enclosed cavity **22**. The method further includes bonding a silicone-based coating **26** on an outer surface **17** of the interlaced layer **23**. The method further includes fixing a closure member **28***a*, **28***b*, **28***c* along one of the opposite edges **18**, and providing the

closure member **28***a*, **28***b*, **28***c* having an adhesive surface **30** configured for adhesion to an outer surface **17** of the wall **12** to maintain the opposite edges **16**, **18** of the wall **12** in overlapping relation with one another.

[0044] The method can further include interlacing the yarns **24** with one another in a weaving process, a knitting process, or a braiding process. If woven, the method can further include weaving the yarns including warp yarns **36** extending generally parallel to the central longitudinal axis **20**, with the warp yarns **36** being provided entirely as multifilaments **24***a* resistant to heat, and weft yarns **38** extending generally transversely to the warp yarns **36**, with the weft yarns **38** including monofilaments **24***b* resistant to heat.

[0045] In accordance with another aspect, the weft yarns **38** can further include both monofilaments **24***b* and multifilaments **24***a* resistant to heat.

[0046] The method can further include providing the warp multifilaments **36**, **24***a* having a denier between about 100-3000tex and providing the weft multifilaments **38**, **24***a* having a denier between about 50-1000tex.

[0047] The method can further include providing the weft monofilaments **24***b* having a diameter between about 0.1-0.5 mm.

[0048] Further yet, the method can include weaving the warp yarns **36** and the weft yarns **38** in one of a plain, twill, basket, or satin weave pattern.

[0049] The method can further include weaving the weft monofilaments **24***b* and weft multifilaments **24***a* in alternating relation with one another along the entirety of the length of the wall **12**, such that the monofilaments **24***b* and weft multifilaments **24***a* are provided in a 1:1 ratio.

[0050] The method can further include providing the silicone-based coating **26** having a thickness between about 0.1-3.0 mm, and in one exemplary embodiment, a thickness between about 0.1-1.00 mm.

[0051] The method can further include providing the silicone-based coating **26** including at least one of a flame retardant and a heat stabilizer, thereby allowing the sleeve to withstand exposure to high heat and fire for a predetermined amount of time, including up to about 2 hours, while protecting the elongate member therein against damage.

[0052] The method can further include providing the closure member **28** including a silicone pressure sensitive adhesive **30**.

[0053] The method can further include providing the silicone pressure sensitive adhesive **30** being configured for fixed adhesion to the inner surface **15** of the wall **12** and to an outer surface **17** of the wall **12**.

[0054] The method can further include providing the closure member **28** including a silicone amalgamating tape **32**.

[0055] The method can further include providing the silicone amalgamating tape **32** having a silicone pressure sensitive adhesive **34** bonded thereto, with the silicone pressure sensitive adhesive **34** being configured for adhesion to an outer surface of the silicone-based coating **26**.

[0056] Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is contemplated that all features of all claims and of all embodiments can be combined with each other, so long as such combinations would not contradict one another. 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 an elongate member, comprising:

a wall including an interlaced textile layer having an inner surface and an opposite outer surface extending widthwise between opposite edges and extending lengthwise between opposite ends, said opposite edges being configured to be wrapped about a central longitudinal axis to bound the elongate member within a cavity bounded by said inner surface, said interlaced textile layer being formed of yarns interlaced with one another, wherein a least some of said yarns include multifilaments resistant to heat and monofilaments resistant to heat;

a silicone-based coating adhered to said outer surface of said textile layer; and

a closure member fixed along one of said opposite edges, said closure member having an adhesive surface configured for adhesion to an outer surface of said wall to maintain said opposite edges of said wall in overlapping relation with one another.

2. The textile sleeve of claim **1**, wherein said yarns include warp yarns extending generally parallel to said central longitudinal axis and weft yarns extending generally transversely to said central longitudinal axis, said warp yarns being woven with said weft yarns.

3. The textile sleeve of claim **2**, wherein said warp yarns are provided entirely from said multifilaments resistant to heat and said weft yarns are provided including said monofilaments resistant to heat.

4. The textile sleeve of claim **3**, wherein said weft yarns are provided including said multifilaments resistant to heat.

5. The textile sleeve of claim **4**, wherein said multifilaments resistant to heat are provided as meta-aramid.

6. The textile sleeve of claim **4**, wherein said warp multifilaments resistant to heat are provided having a denier between about 100-3000dtex and said weft multifilaments resistant to heat are provided having a denier between about 50-1000dtex.

7. The textile sleeve of claim **6**, wherein said monofilaments resistant to heat are provided having a diameter between about 0.1-0.5 mm.

8. The textile sleeve of claim **5**, wherein said monofilaments resistant to heat are provided as PEEK.

9. The textile sleeve of claim **1**, wherein said silicone-based coating includes at least one of a flame retardant and a heat stabilizer.

10. The textile sleeve of claim **1**, wherein said silicone-based coating has a thickness between about 0.1-3.0 mm.

11. The textile sleeve of claim **1**, wherein said closure member is a silicone pressure sensitive adhesive.

12. The textile sleeve of claim **11**, wherein said silicone pressure sensitive adhesive is configured for fixed adhesion to said inner surface and to said outer surface of said wall.

13. The textile sleeve of claim **1**, wherein said closure member includes a silicone amalgamating tape.

14. The textile sleeve of claim **13**, wherein said closure member includes a silicone pressure sensitive adhesive bonded to said silicone amalgamating tape.

15. A method of constructing a textile sleeve for routing and protecting an elongate member against arcing, exposure to high temperatures and fire, abrasion, and fluid ingress, comprising:

interlacing heat-resistant yarn to form an interlaced textile layer of a wall having opposite edges extending lengthwise between opposite ends, with the opposite edges

being configured to be wrapped about a central longitudinal axis to bound the elongate member within an enclosed cavity;

bonding a silicone-based coating on an outer surface of the interlaced textile layer; and

fixing a closure member along one of the opposite edges, with the closure member having an adhesive surface configured for adhesion to an outer surface of the silicone-based coating to maintain the opposite edges in overlapping relation with one another.

16. The method of claim **12**, further including interlacing the yarns with one another in a weaving process.

17. The method of claim **16**, further including weaving the yarns including warp yarns extending generally parallel to the central longitudinal axis entirely from multifilaments resistant to heat and weft yarns extending generally transversely to the warp yarns including monofilaments.

18. The method of claim **17**, further including heat-setting the monofilaments to impart a heat-formed bias in the wall to maintain the opposite edges in overlapping relation with one another.

19. The method of claim **18**, further including weaving the weft yarns including multifilaments resistant to heat.

20. The method of claim **19**, further including providing the warp multifilaments resistant to heat having a denier between about 100-3000dtex and providing the weft multifilaments resistant to heat having a denier between about 50-1000dtex.

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