United States Patent

Woodall, Jr. et al.

[15] **3,669,157**

[45] **June 13, 1972**

[54] SHRINKABLE TUBULAR FABRIC

[72] Inventors: **Hubert C. Woodall, Jr.**, Winston Salem; **Horace L. Freeman**, Burlington; **Noah C. Goodman**, Winston Salem, all of N.C.

[73] Assignee: **Carolina Narrow Fabric Company**, Winston Salem, N.C.

[22] Filed: **June 1, 1970**

[21] Appl. No.: **41,997**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 502,028, Oct. 22, 1965, abandoned.

[52] **U.S. Cl.** **139/387**, 28/72, 138/123

[51] **Int. Cl.** **D03d 3/02**

[58] **Field of Search** ..... 139/387, 388, 389; 138/123–127; 66/171; 28/72, 72 FT

[56] **References Cited**

UNITED STATES PATENTS

3,096,560	7/1963	Liebig	28/72
3,242,554	3/1966	Raymond	139/387 UX
3,020,935	2/1962	Balis	139/388
910,891	1/1909	Atwood	139/388
2,474,375	6/1949	Shearer et al.	66/171
2,523,637	9/1950	Stanfield et al.	139/387 X
3,457,962	11/1965	Shobert	138/125
417,796	12/1889	Taft	139/387 X
1,747,715	2/1930	Hooper	139/388
173,615	2/1876	Gillespie	139/388

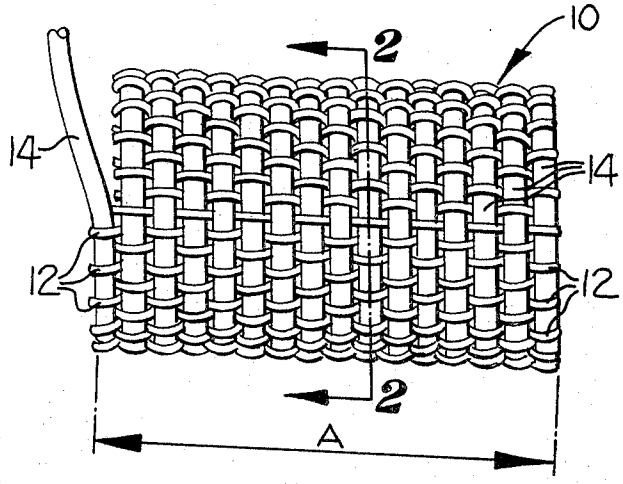
Primary Examiner—James Kee Chi

Attorney—Parrott, Bell, Seltzer, Park & Gibson

[57] **ABSTRACT**

A woven tubular fabric which is formed of a set of warp yarns extending longitudinally thereof and a filling yarn interwoven with the warp yarns and extending circularly around the tubular fabric. The filling yarn is heat shrinkable while the set of warp yarns is non-shrinkable so that the woven tubular fabric will shrink in a radial direction upon the application of heat, while the longitudinal dimension remains unchanged.

1 Claim, 4 Drawing Figures



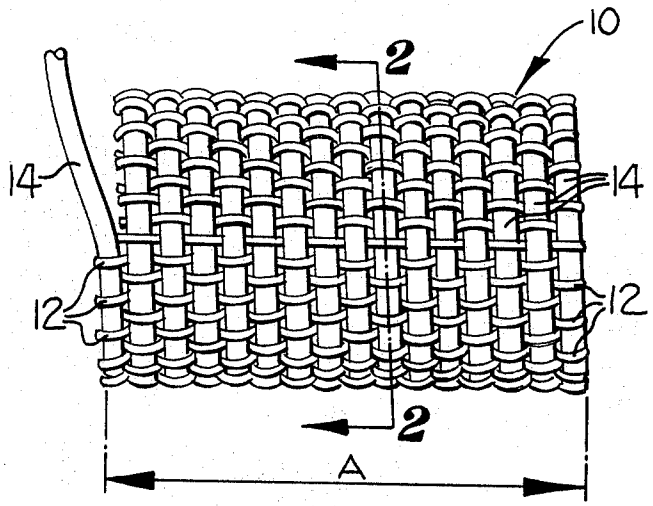


Fig-1

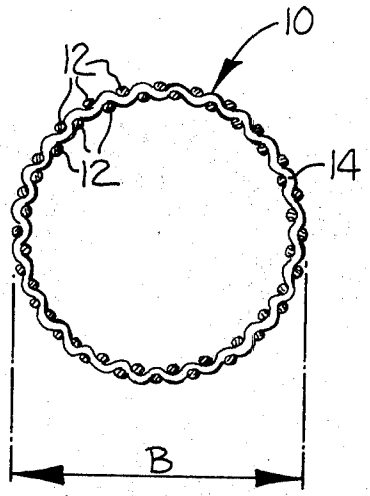


Fig-2

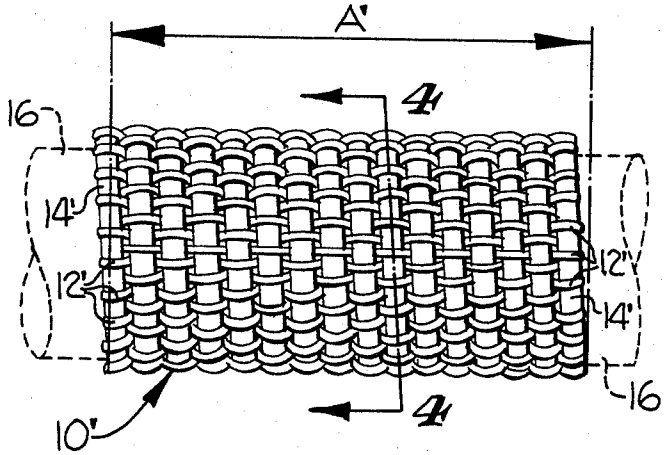


Fig-3

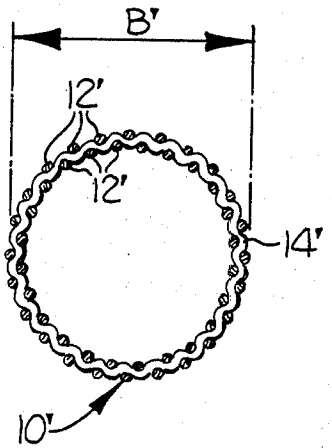


Fig-4

INVENTOR:
HUBERT C. WOODALL, JR.,
HORACE L. FREEMAN
and NOAH C. GOODMAN
BY Parrott, Bell, Seltzer, Park & Gibson
ATTORNEYS

SHRINKABLE TUBULAR FABRIC

This application is a continuation-in-part of application Ser. No. 502,028, filed Oct. 22, 1965 by the same inventors, now abandoned.

The present invention relates to an improved tubular fabric. More particularly, the invention relates to a tubular woven fabric which may be positioned about an elongated article and radially shrunk by the application of heat into a closely conforming relationship with the elongated article, while maintaining the longitudinal dimension of the fabric.

The tubular fabric of the present invention finds utility in a large number of applications. For example, the fabric may be utilized as a protective or insulating covering for an elongated article such as a pipe or wire, or it may be utilized as a component in a laminated article such as a glass fishing rod, plastic pipe or the like. In addition, the fabric may be used to form a relatively rigid hollow tubular article having independent uses.

It has previously been proposed to employ shrinkable yarns in a woven tubular fabric wherein shrinkage occurs in all directions (i.e., both longitudinally and radially) such that the tubular fabric may assume the contours of a mating irregularly shaped elongated article. However, shrinkage in all directions makes it difficult to insure that the resulting longitudinal length of a pre-cut tubular fabric will conform to that of the mating article since the fabric is unconstrained in the longitudinal direction and the degree of shrinkage is therefore difficult to control. Thus it is not possible to sell the fabric in precut standard lengths. In addition, shrinkage in all directions requires that a relatively large amount of the tubular fabric be utilized to cover a given article, and thus the cost of the tubular fabric is relatively high.

Accordingly, it is an object of the present invention to provide a tubular fabric capable of shrinkage in a radial direction while maintaining substantially the same longitudinal dimension.

It is a further object of this invention to provide a tubular fabric which may be easily positioned about an elongated article and radially shrunk into closely conforming relationship to protect or insulate the article.

It is another object of this invention to provide a versatile tubular fabric which may be employed as a covering, a tubing, or as a component in the construction of numerous elongated articles.

These and other objects and advantages of the present invention are achieved in the embodiment illustrated herein by the provision of a tubular woven fabric comprising a set of non-shrinkable warp yarns extending longitudinally of the fabric and heat-shrinkable filling yarn extending circularly about the fabric. The fabric is adapted to be positioned over an elongated article, and upon the application of heat will radially shrink into a closely conforming relationship while maintaining its longitudinal dimension substantially unchanged.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which

FIG. **1** is an enlarged side elevational view of a tubular fabric embodying the features of the present invention;

FIG. **2** is a sectional view taken substantially along the lines **2—2** of FIG. **1**;

FIG. **3** is a side elevational view illustrating the tubular fabric of FIG. **1** after it has been shrunk about an elongated article, such as a mandrel; and

FIG. **4** is a sectional view taken substantially along the lines **4—4** of FIG. **3**.

Referring to the drawings, a tubular woven fabric is illustrated generally at **10** in FIGS. **1** and **2**, and comprises a set of non-shrinkable warp yarns **12** extending longitudinally and substantially parallel to the axis of the fabric, and heat shrinkable filling yarn **14** extending circularly about the fabric and at substantially right angles to the warp yarns **12**.

In FIGS. **3** and **4**, a tubular fabric **10'** is illustrated which represents the fabric **10** after it has been subjected to sufficient heat to shrink the filling yarn and thereby reduce its diameter to that of an elongated article on which it has been placed, such as a mandrel, indicated in dotted lines at **16**. As will be apparent from the drawings, the longitudinal dimension A' of the fabric **10'** has not substantially changed from the corresponding dimension A of the fabric **10**, while the diameter B' thereof has been substantially reduced from the diameter B of the fabric **10**.

The particular number of warp of filling yarns employed in a particular fabric will depend on the desired end use. Thus while a single shrinkable filling yarn has been shown in the drawings, it will be recognized that a plurality of similar filling yarns could be employed in the fabric. In addition, it has been found that an increase in the number of warp yarns for a given diameter will reduce the amount of shrinkage of the filling yarn. Thus, if a large amount of shrinkage is intended, a relatively small number of warp yarns should be employed.

The non-shrinkable warp yarns **12** may consist of any material that will provide the insulating, chemical, or mechanical properties required for the desired end use, and which do not appreciably shrink when subjected to heat, water, or other chemical action. Typical of such fabric materials are glass, asbestos, ceramic, metal wire, and the like.

The filling yarn **14** preferably comprises a heat shrinkable polymeric material. Examples of such materials are polyesters, such as polyethylene terephthalate, acrylics such as polyacrylonitrile, nylon, and polyolefins such as polypropylene and polyethylene. Nylon is a synthetic linear polymer produced by the reaction of hexamethylene diamine with adipic acid, the molecule being entirely adiphatic and based on the formation of polyamides. The various polymeric materials exhibit a wide range of shrinkages in response to heat, and the particular one chosen should depend on the temperature at which shrinkage should take place, the desired percentage of shrinkage of the tube, and the required strength of the finished product. As typical examples of properties of these materials, polyester fibers shrink approximately 15–17 percent at 300° F., acrylic fibers shrink approximately 10–15 percent at 212° F., and polypropylene shrinks up to approximately 28 percent at 275° F.

In one embodiment of the present invention, the tubular fabric is utilized as a closely conforming protective or insulating covering for an elongated article such as a pipe, shaft, or wire. Coverings are commonly applied to the outer surface of such articles to provide electrical, chemical, or mechanical insulation or protection, and the tubular fabric of the present invention is ideally suited for such uses since it can be easily applied to the article and will result in a closely conforming, neat appearance. Also, the particular compositions of the fabric may be selected to include materials which contribute to the desired properties of the covering; for example, glass warp yarns could be utilized where a fire retardant covering is desirable.

To provide a substantially rigid tubular insulator or covering member for an elongated article such as an electrical component, the tubular fabric may be impregnated with a heat settable resin, such as a polyester or epoxy resin. The fabric is then placed loosely over the object to be covered, and heat is applied to shrink the filling yarns and cure or set the resin. Alternatively, a two step shrinking procedure may be employed wherein the resin impregnated fabric is first placed over a mandrel which is slightly larger in diameter than the diameter on which the tubular fabric is to be ultimately placed. Heat is then applied to shrink the filling yarns and partially cure or set the resin to produce a tubular fabric which is sufficiently rigid to retain the shape of the mandrel. In this condition, it is adapted for shipping in commerce as a preformed tubular cover or insulator of a diameter slightly greater than the diameter of the article on which the tubular fabric is to be placed. The user then places it over the article such as a wire or pipe which is ultimately to be covered and the filling yarn shrunk a second time by the application of heat to form a tight fit over the article. Further details of the process employing a

resin impregnated tubular fabric of this type may be obtained by reference to the U.S. Pat. to Wareham, No. 3,466,210.

The tubular fabric of this invention may also be utilized to form a hollow tubular article having independent uses. For example, if the warp yarns are fiber glass and the filling yarns are a heat shrinkable polymer, the fabric may be placed over a mandrel and, in a single heating operation the polymeric yarn shrunk to form a relatively rigid pipe-like article. Of course, the fabric could be impregnated with a heat settable resin or a suitable coating could be subsequently applied to the shrunken fabric to increase the rigidity of the resulting article. Such a fiber glass pipe may have many independent uses and applications, other than a covering for an elongated article.

The present invention may also be employed as a component in the construction of numerous elongated articles. For instance, the fabric could be filled with a lightweight material such as polystyrene foam and then subjected to a heating operation to shrink the filling yarns and thereby form a lightweight waterproof object which may serve as a water float. Further, the fabric may be shrunk about a bundle of fiber glass rods to form an elongated circular article such as a fiber glass fishing rod. Still further, the tubular fabric may serve as a strengthening component in a laminated elongated article such as a fiber glass pole-vaulting pole. In this latter case, the fact that the fabric of the invention will shrink into a closely conforming smooth covering is important, since the outer surface of the pole should be free from irregularities.

In still another embodiment of the present invention, the non-shrinkable warp yarns may be thin or fine metallic electrical conducting wires, such as silver, copper or aluminum. This embodiment would be particularly advantageous in an apparatus where it is necessary to run a very large number of electrical wires along the outer surface of an elongated member such as a shaft. In addition, non-metallic or insulating yarns could be alternated with the metallic wires in the warp so that the metallic wires are insulated from each other.

Typical applications of the tubular fabric have been discussed above. It should be evident however, that the fabric has an almost infinite number of potential uses. Also, the fabric may be made of any desired length or diameter depending on the desired end use. In addition, it will be evident that multiple layers of the tubular fabric could be sequentially applied over the elongated article to produce a covering or tubular article of substantial thickness.

In the drawings and specification there has been set forth a preferred embodiment of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A tubular woven fabric comprising a set of non-shrinkable warp yarns formed from material selected from the group consisting of glass, asbestos, ceramic and metal, said warp yarns extending longitudinally of the tubular fabric, and heat shrinkable polymeric filling yarn extending circularly around the tubular fabric and substantially at right angles to the warp yarns, whereby the corresponding circular dimension of the tubular fabric may be reduced by the application of heat to the fabric while the longitudinal dimension remains substantially unchanged.

* * * * *