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COATED STRANDS AND PROCESS FOR MAKING THE SAME

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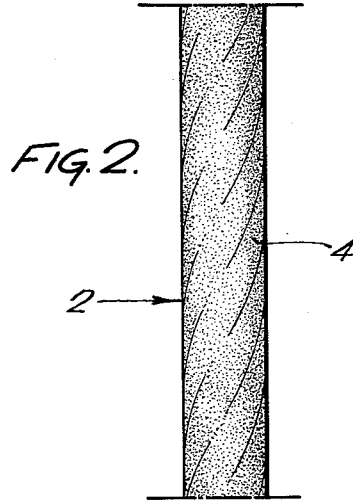
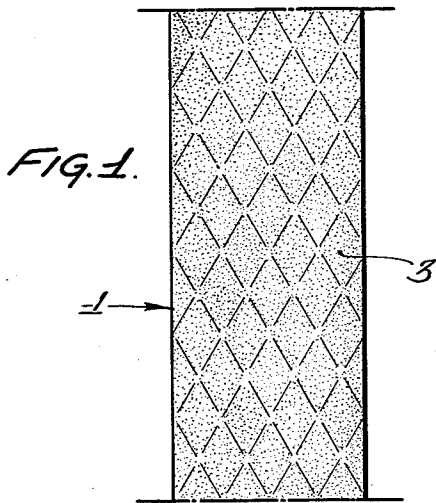


FIG. 3.

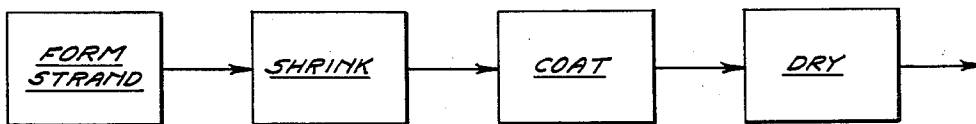
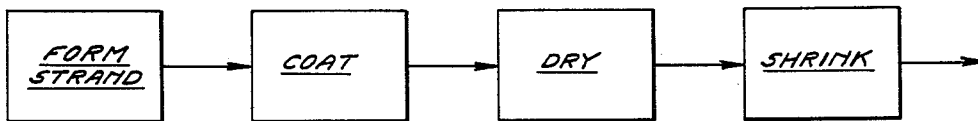


FIG. 4.



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COATED STRANDS AND PROCESS FOR MAKING THE SAME

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The present invention relates to new and useful improvements in strand material and in the process for forming such strand material.

The present invention is particularly directed to strands used at elevated temperatures under conditions wherein their strength must not be decreased and/or to strands which must be tied or secured without the danger of slippage. For example, these strands are used to tie motor windings and the like in place during the manufacture of a motor. In the manufacture of motors, after the windings are tied in place with the strand of the present invention, a finish is applied to the winding and the winding is subsequently baked in an oven for the purpose of curing the finish. There are several characteristics required in strands used for this and similar purposes which have not been present in strands prior to the present invention. These strands must be made of a relatively inert material which will not react with any atmosphere in which the motor is to be used and which will not deteriorate over a period of time. Additionally, these strands must possess a minimum amount of shrinkage at elevated temperatures, normally in the range of a few percent, so that when the motor is used at elevated temperatures or when the finish material applied to the motor windings is cured, the strands will not shrink and cut the motor windings. These strands must also possess relatively high strength at relatively high temperatures so that during use they will not become displaced. Furthermore, the strands must be formed of such a material or coated in such a manner that they may be tied in place securely without slipping.

With the foregoing in mind, a primary object of the present invention is to provide a novel strand or tape having the above characteristics which may be manufactured easily and cheaply and which is highly effective in use.

Another object of the present invention is to provide a novel method for making strand or tape material having the above characteristics which may be carried out easily and cheaply without the use of special expensive apparatus.

These and other objects of the present invention and the various features and details of the construction and operation thereof are hereinafter more fully set forth and described with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of one form of strand made in accordance with the present invention;

FIG. 2 is a plan view of a second form of strand made in accordance with the present invention;

FIG. 3 is a block diagram of the process used in forming the strand of the present invention; and

FIG. 4 is a block diagram of a modified process used in forming the strand of the present invention.

The strand material made in accordance with the present invention may comprise a series of continuous filaments gather or twisted into a yarn with the individual yarns loosely braided or twisted together to form a braided strand as indicated at 1 in FIG. 1 or twisted strand as indicated at 2 in FIG. 2 with the strands 1 and 2 subsequently having coatings 3 and 4, respectively, applied thereto. It is desirable in the braided form, that

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the yarns be loosely braided to form the strand. By loosely braided is meant a braid having in the neighborhood of twenty to thirty-five interlockings per inch.

The individual filaments of the strands must be formed of such material that they have a negligible loss in strength at elevated temperatures which may be in the neighborhood of 300 to 400° F. Filaments of this type, having the desired characteristics, for example, may be selected from the group consisting of a substantially linear polyester and a highly fluorinated fluorocarbon polymer including chlorofluorocarbons and perfluorocarbons. For example, the filaments may be a polyester of alkylene polyol with an aromatic polycarboxylic acid such as Mylar and Dacron (polyethylene terephthalate); or may, for example, be Teflon (tetrafluoroethylene resin manufactured by E. I. du Pont de Nemours & Company, or Kel-F, a polymer of trifluorochloroethylene, manufactured by M. W. Kellogg Co., all of which have the desired properties of being relatively inert and high strength at elevated temperatures.

These above materials in filament form, however, have the undesirable characteristic of considerable shrinkage at elevated temperatures. For example, Teflon shrinks as much as 18 to 20 percent and Dacron shrinks as much as 15 to 16 percent when maintained at elevated temperatures for a substantial period of time. With this shrinkage, if the material is used in its original condition, for example, to hold motor windings at elevated temperatures the material, during shrinkage, will cut or ruin the motor winding. Further, these materials are relatively smooth or slippery and may not easily be tied and maintained in a tied condition without slippage. To avoid these above disadvantages the materials must be preshrunk and must be coated to provide them with a surface having a high coefficient of friction.

In order to preshrink the material used in the strands the material in strand form is maintained at an elevated temperature for a predetermined period of time until it is substantially fully preshrunk. For example, Teflon may be maintained in a ventilated oven at a temperature in the neighborhood of 475° F. to 525° F. for a period of approximately five hours to obtain maximum shrinkage after which the material may be used at relatively high temperatures, for example, in the neighborhood of 400° F. without shrinkage deleteriously affecting its usage. During the shrinkage step of the process, strands of approximately 250 to 500 yards in length are loosely tied in skeins and spread out in an oven so that good air circulation may be had through the skeins. The oven is then raised to a temperature in the neighborhood of approximately 500° F. and maintained at this temperature for approximately five hours. After this the oven temperature is lowered slowly and the strand material is removed from the oven. The product of this step will be a strand of material having negligible residual shrinkage at the desired elevated temperature. Dacron may be preshrunk in the same manner limiting the maximum temperature to approximately 320° F., and maintaining the strands at this temperature for approximately three minutes.

It is also important that the strand of material be coated to provide the strand with a surface having the desired properties. This coating may be a latex or synthetic rubber material in a solution. An example of one coating material which has been found to be highly efficient and easy to apply is a solution of Butadiene Styrene in water with up to approximately 55 percent solids. Above this amount of solids the material is too thick and unworkable as a coating compound. The solution may be made more dilute than the above but with a more dilute solution a longer drying period is required to dry the coating material.

Preferably the coating is placed on the strand material so that it fills all of the interstices between the various filaments and yarns in the strand and provides a coating on the exterior surface of the strand in the neighborhood of 0.001 to 0.003 inch thick.

The coating material may be applied by any conventional process. One process which has been used successfully with the above described coated compound is passing the strand material through a bath of the coating solution and thereafter wiping the excess material off by passing the coated strand between a pair of wipers. Thereafter the coated strand is caused to pass through a drying zone and is maintained in the drying zone for a predetermined period of time. For example, the coated material may be maintained in the drying zone at approximately 125° F. for approximately two to three minutes to drive off the liquid with the maximum drying temperature being in the neighborhood of 200° F. If the temperature in the drying zone is too low or the drying time is too short, the final product will be relatively tacky and difficult to handle. Conversely, if the temperature in the drying zone is too hot or the drying time is too long, the product will be relatively hard and brittle. Accordingly, the drying temperature and time are dependent upon one another and also dependent upon the percentage of solids in the original coating solution.

In forming the strand of the present invention the forming process may be carried out as shown in either FIG. 3 or 4. For example, with reference to FIG. 3 the braided or twisted strand is first formed. Thereafter the strand is preshrunk as described above by maintaining the strand at an elevated temperature for a predetermined period of time. The shrunk strand is then coated with the desired coating material which may be a latex solution, and as the final step in the process, the coating material is dried. As opposed to the above process, the process of FIG. 4 may be used wherein the desired strand is formed and after formation is coated with the desired coating material. The coating material is then dried and the dried coated strand is then preshrunk by being maintained at an elevated temperature for a predetermined period of time. The temperature and time in this process may be exactly the same as that in the process described above with reference to FIG. 3.

Various examples of a strand made in accordance with the present invention are as follows:

Example 1

Filament	Teflon. 400 denier.
Strand	Braided—30 interlockings per inch. 10 yarns—60 filaments per yarn.
Shrinkage:	
Temperature	500° F.
Time	5 hours.
Percent	18%.
Coating:	
Material	Butadiene Styrene.
Solution liquid	Water.
Percent solids	50%.
Dried at	125° F.
Drying time	3 minutes.
Thickness	0.002 inch.

Example 2

Filament	Teflon. 400 denier.
Strand	Braided—34 interlockings per inch. 25 yarns—60 filaments per yarn.
Shrinkage:	
Temperature	500° F.
Time	5 hours.
Percent	18%.

Coating:	
Material	Butadiene Styrene.
Solution liquid	Water.
Percent solids	50%.
Dried at	125° F.
Drying time	3 minutes.
Thickness	0.003 inch.

Example 3

Filament	Teflon. 400 denier.
Strand	Twisted—10 turns per inch. 3 yarns—60 filaments per yarn.
Shrinkage:	
Temperature	525° F.
Time	4½ hours.
Percent	18%.
Coating:	
Material	Butadiene Styrene.
Solution liquid	Water.
Percent solids	50%.
Dried at	125° F.
Drying time	3 minutes.
Thickness	0.001 inch.

Example 4

Filament	Dacron. 40 denier.
Strand	Braided—35 interlockings per inch. 17 yarns—27 filaments.
Shrinkage:	
Temperature	300° F.
Time	3 minutes.
Percent	16%.
Coating:	
Material	Butadiene Styrene.
Solution liquid	Water.
Percent solids	50%.
Dried at	125° F.
Drying time	3 minutes.
Thickness	0.002 inch.

Example 5

Filament	Dacron. 70 denier.
Strand	Braided—30 interlockings per inch. 17 yarns—34 filaments.
Shrinkage:	
Temperature	300° F.
Time	2½ minutes.
Percent	13%.
Coating:	
Material	Butadiene Styrene.
Solution liquid	Water.
Percent solids	55%.
Dried at	125° F.
Drying time	2½ minutes.
Thickness	0.003 inch.

Example 6

Filament	Dacron. 220 denier.
Strand	Braided—21 interlockings per inch. 17 yarns—50 filaments.
Shrinkage:	
Temperature	300° F.
Time	3 minutes.
Percent	13%.

Coating:

Material ----- Butadiene styrene.
 Solution liquid . Water.
 Percent solids - 45%.
 Dried at ----- 140° F.
 Drying time -- 2 minutes.
 Thickness ---- 0.001 inch.

The final strands of all of the above examples were treated both by the process of FIG. 3 and by the process of FIG. 4. After the treating process all of the strands of the above examples had negligible residual shrinkage, high strength when tested after treatment at elevated temperatures, and were able to be handled easily and tied securely.

While particular embodiments of the present invention have been illustrated and described herein, it is not intended to limit the invention to such a disclosure and changes and modifications may be incorporated and embodied therein within the scope of the following claims.

I claim:

1. The process of forming strand material composed of a plurality of filaments having high strength and low residual shrinkage at elevated temperatures comprising the following steps: forming a plurality of yarns each composed of a plurality of continuous filaments, loosely combining said yarns together to form a continuous strand, maintaining said strand at an elevated temperature for a predetermined period of time to shrink said strand, completely coating said strand and filling the interstices between the filaments in the strand with a latex solution, and maintaining said coating at an elevated temperature for a predetermined period of time to dry said coating.

2. The process of claim 1 including the step of loosely braiding the yarns together to form said strand.

3. The process of claim 1 including the step of loosely twisting the yarns together to form said strand.

4. The process of claim 1 wherein said coating is maintained at an elevated temperature below approximately 200° F. for between approximately 2 to 3 minutes to dry said coating.

5. A preshrunk strand formed of a series of yarns each composed of a plurality of continuous filaments, said yarns being loosely combined to form said strand, the loosely combined yarns forming in said strand a plurality of interstices between the individual filaments and yarns of said strand, said filaments being formed of material selected from the group consisting of a substantially linear polyester and a highly fluorinated fluorocarbon polymer, said strand being preshrunk to provide a low residual shrinkage at elevated temperatures, and said strand having a coating of latex formed about its entire periphery with the latex bonded to the strand and mechanically interlocked with the yarns and filaments of the strand by completely filling the interstices between the yarns and filaments.

6. A preshrunk strand in accordance with claim 5 in which said yarns are loosely twisted together providing interstices between the individual filaments and yarns.

7. A preshrunk strand in accordance with claim 5 in which said yarns are loosely braided together providing interstices between the individual filaments and yarns, said braid having in the neighborhood of 20 to 35 interlockings per inch.

8. A preshrunk strand in accordance with claim 5 wherein said filaments are formed of a tetrafluoroethylene resin.

9. A preshrunk strand in accordance with claim 5 wherein said filaments are formed of polyethylene terephthalate.

10. A preshrunk strand in accordance with claim 5 wherein said coating composition comprises a water solution of Butadiene Styrene having less than 55% solids.

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