June 6, 1967 A. MARZOCCHI ETAL 3,323,975

RESINOUS COATED GLASS FIBER YARN AND FABRIC WOVEN THEREFROM

Filed July 6, 1965 2 Sheets-Sheet 1

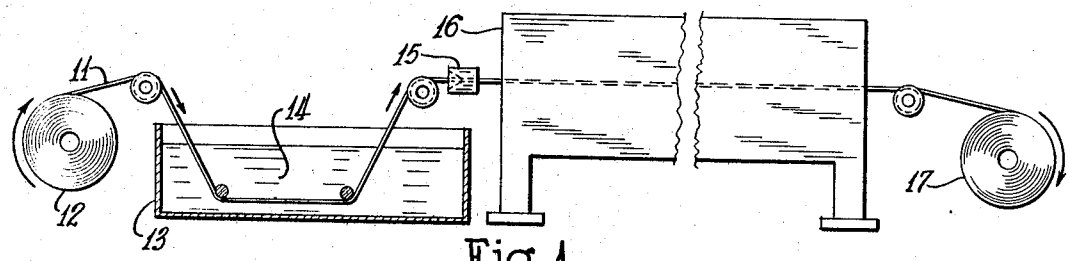

Fig. 1

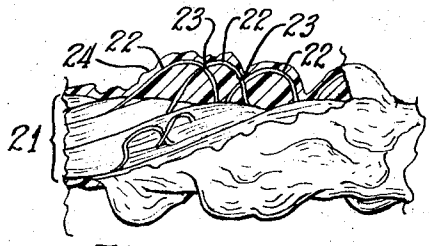

Fig. 2

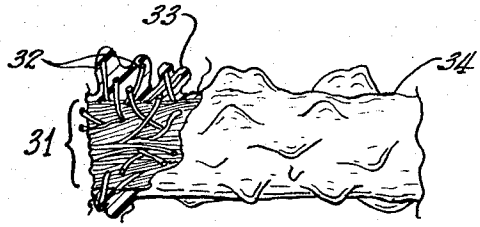

Fig. 3

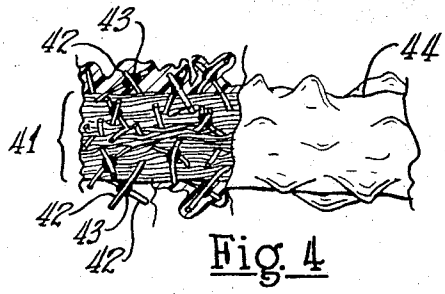

Fig. 4

INVENTORS
ALFRED MARZOCCHI &
JAMES M. O'FLAHAVAN DECEASED
BY LORRAINE C. O'FLAHAVAN, ADMINISTRATRIX

BY Staelin & Overman
ATTORNEYS

June 6, 1967 A. MARZOCCHI ETAL 3,323,975

RESINOUS COATED GLASS FIBER YARN AND FABRIC WOVEN THEREFROM

Filed July 6, 1965 2 Sheets-Sheet 2

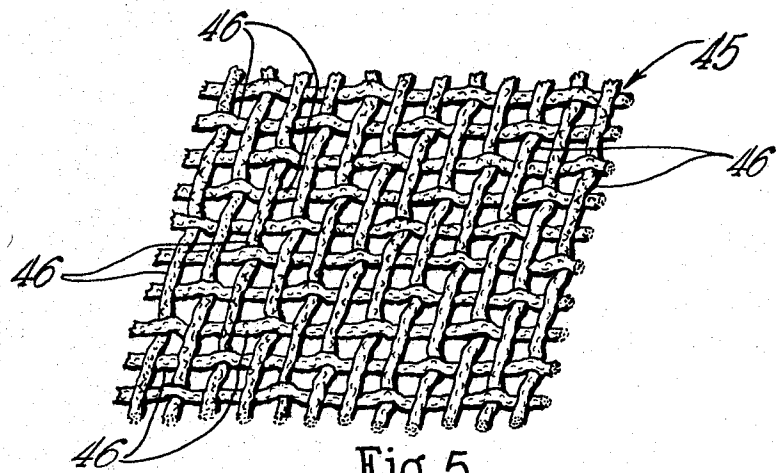

Fig. 5

INVENTORS
ALFRED MARZOCCHI &
JAMES M. O'FLAHAVAN, DECEASED,
BY LORRAINE C. O'FLAHAVAN,
ADMINISTRATRIX

BY Staelin & Overman
ATTORNEYS

United States Patent Office 3,323,975
Patented June 6, 1967

3,323,975

RESINOUS COATED GLASS FIBER YARN AND FABRIC WOVEN THEREFROM

Alfred Marzocchi, Cumberland, R.I., and James M. O'Flahavan, deceased, late of Manville, R.I., by Lorraine C. O'Flahavan, administratrix, West Chelmsford, Mass., assignors to Owens-Corning Fiberglas Corporation, Toledo, Ohio, a corporation of Delaware

Filed July 6, 1965, Ser. No. 469,942
8 Claims. (Cl. 161—85)

This application is a continuation-in-part of our copending application Ser. No. 110,261, filed May 15, 1961, now abandoned.

The present invention relates to coated yarns and particularly to fibrous glass yarns having laterally projecting filaments which are provided with a resinous coating.

Due to certain intrinsic characteristics of fibrous glass and an unfavorable consumer reaction or antipathy, fibrous glass fabrics have to date been restricted to the areas of decorative fenestration fabrics and crude fabrics employed in the reinforcement of synthetic resins. Consequently, such extensive fabric or textile areas as wearing apparel, upholstery fabrics, carpeting, industrial fabrics and the like have been closed to the fibrous glass industry.

The inherent impediments of limited flexibility and elongation as well as inadequate resistance to compressive forces and tensile stress or shock, have served to confine fibrous glass fabric applications to static or non-dynamic utilizations such as decorative fenestration fabrics, which are devoid of frequent flexing, stretching, compression or exposure to the application of sudden longitudinal stresses. The fact that glass fibers will break once a critical point of bending or flex is realized, has rendered them highly susceptible to attrition accruing from flexing and from lateral and longitudinal compression. At the same time, the inability of the fibers to align in order to mutually or unitedly assume a longitudinal stress results in damage due to stretching or the shock of suddenly applied longitudinal stresses. In the latter regard, individual fibers are compelled to assume the total force during the phase of non-alignment and are successively broken before the mutual tensile strength of the plurality of fibers may be realized. Naturally, such characteristics have precluded fibrous glass fabrics from applications such as wearing apparel, upholstery fabrics and the like, wherein flexing, stretching, compression and the application of sudden longitudinal stresses are common and frequent occurrences.

In addition, the tactile qualities of fibrous glass fabrics have evoked a negative response or antipathy from a consuming public which has become accustomed to the warm or dry feel of non-synthetic fibers such as wool or cotton. While this attitude has not proved a serious drawback in respect to applications such as drapery or curtain fabrics, it is significant in regard to utilizations involving frequent or prolonged bodily contact such as in wearing apparel or upholstery fabrics.

It is an object of the present invention to provide novel coated fibrous glass yarns which exhibit unusual qualities of flex, stretch, compression and tensile strengths, and highly desirable tactile qualities.

Another object is the provision of methods for the preparation of novel coated yarns.

These and other objects and advantages of the invention will hereinafter appear and for purposes of illustration, but not of limitation, the practice of the invention may be shown by the accompanying drawing in which:

FIGURE 1 is a schematic view of a coating technique and apparatus embodying the features of the invention;

FIGURE 2 is a perspective view with segments removed of a texturized yarn prepared in accordance with the invention;

FIGURE 3 is a perspective view with segments removed of a yarn having laterally projecting filaments, such as a staple yarn or an abraded continuous yarn, prepared in accordance with the invention;

FIGURE 4 is a perspective view with segments removed of a continuous yarn having short fiber lengths mechanically lodged and retained between the parallel glass fiber, which has been treated according to the invention, and

FIGURE 5 is a view of a fabric woven from the coated yarns.

The foregoing objects are achieved by means of a coated yarn comprising a central yarn or strand made up of fibers in a substantially parallel and close relationship, and laterally projecting fibers in the form of loops, whorls or straight fibers which are provided with a coating comprising a film-forming material. The resulting yarn has a nubby or nubbly surface covered with knobs formed of projecting fibers.

This structure and the method for its attainment are devised and employed to provide optimum qualities and to avoid previous product defects. In essence, the fibrous-resinous composite serves to provide a structure which resists the harmful effects of flexing, abrasion, compression and the application of tensile stresses while simultaneously imparting unusual extensibility and tactile qualities, and desirable bulk and coloration.

The resinous coating material simultaneously serves to provide a protective, abrasion resistant sheath about the individual filaments embodied in the yarn, a cushioning medium between the individual filaments and strands and a protective web, reinforced by the filaments projecting from the central yarn, about the entire yarn structure. The protective web which shields the entire yarn structure is characterized by unusual toughness and durability due to the reinforcement provided by the fibers which project laterally from the central yarn. In addition, such durability is enhanced due to the resilient or springy nature of the laterally projecting fibers. The resin increment which penetrates the individual fibers embodied in the central yarn is of lesser significance since it merely serves to provide a very thin protective film or sheath upon the fiber surfaces and to maintain, to some extent, the integrity of the core yarn. In fact, complete impregnation of the core yarn is undesirable since it may result in a stiff or rigid yarn of inferior processing and product properties. Excess coating material is preferably removed from the yarn. Impregnation may be completely avoided if the yarn is previously provided, such as during fiber attenuation or immediately prior or subsequent to plying, twisting or texturizing, with a protective binder or size composition which does not impart the aforementioned stiffness or rigidity, such as conventional starch, gelatin or resin based forming size compositions. In such case, the application of the coating materials of the invention is controlled to merely provide a coating which is primarily deposited upon the laterally projecting fibers or loops.

Both the radial and longitudinal compressibility of the resultant fibrous glass yarn or strand structures are considerably enhanced by the treatment of the invention. Resistance to the stresses of laterally applied compression is provided by the reinforced resinous web, as well as by the flexible, projecting filaments or loops which support the web surrounding the central yarn. In addition, resistance to longitudinal stresses or shock is provided by the cushioning resinous medium which serves to absorb sudden shocks and permits a period during which the fibers are allowed to align in order to mutually assume the force. Simultaneously, the cushioning medium allows radial compression and a consequent longitudinal elongation or extensibility.

Furthermore, a desirable, low density bulk is imparted

to the yarns by virute of the resinous coating and laterally projecting fibers or loops. The consequently increased yarn diameters also improve flexing qualities since the critical angle of flex is less likely to be experienced and a considerable degree of the flex stress is taken up by, and distributed throughout, the more elastic or resilient and spaced resinous web.

Another desirable aspect is the fact that the external resinous web provides a colorable medium in contrast to the non-receptive glass fiber surfaces which must be subjected to a finishing step in order to achieve dyeing or pigmentation. Alternatively, the resinous web provides a medium which is highly amenable to the incorporation of dyes or pigments.

Of possibly equal importance are the enhanced tactile qualities which are imparted to the yarns treated in accordance with the invention. A warm and dry feel which approximates the hand of non-synthetic yarns such as wool or cotton is achieved with the resinous web-fibrous core composite of the invention. While the reason for this divergency of tactile qualities is not immediately apparent, it is feasible that they accrue from the presence of the projecting filaments or loops within the resinous web or from the discontinuous nature of the yarn surface.

The advantages of the coated yarns of the invention over conventional resin coated yarns is apparent upon a consideration of the structure of the present yarns. Conventional yarns provided with a smooth resinous coating are first plagued by a stiffness or rigidity which serves to render them difficult to process and conducive to the formation of stiff, unyielding fabrics. Secondly, the continous resin surface which results is characterized by a cold, hard feel in contrast to the tactile stimuli evoked by non-synthetic fabrics. In addition, the locking or binding of the plural filaments into a fixed relationship renders the yarns prone to the harmful effects of compression, tensile stress and flexing, while depriving them of extensibility or elongation. The yarns of the present invention are nubby, flexible and warm to the touch.

The structures of the invention are readily prepared by passing the yarn provided with projecting filaments or loops through a bath comprising the film-forming material or a solution thereof, and then through a heat treatment which serves to cure or set the film-forming material. This preferred method is illustrated by FIGURE 1 wherein a yarn **11** provided with laterally projecting fibers or loops is withdrawn from a supply bobbin **12**, passed through a receptacle **13** wherein it is immersed in the film-forming coating material **14**, and through a die **15** which serves to remove excess coating material, then through an oven **16** maintained at a temperature adequate to cure the coating material and finally wound upon a take up reel **17**.

The fabrication of the structures of the invention is not limited to the specific apparatus illustrated by FIGURE 1 and the application of the coating may be achieved by conventional immersion, contact or spray methods such as rollers, pads, apron applicators, sprays and jets. In addition, heating means other than ovens may be substituted and the heating step may be completely omitted if coating materials capable of rapid drying at atmospheric conditions are employed.

FIGURES 2 through 4 depict various types of yarn structures prepared in accordance with the invention.

FIGURE 2 illustrates a texturized type of yarn such as that disclosed by U.S. 2,783,609 wherein yarns or strands are exposed to fluid turbulence to yield a structure characterized by a central yarn **21** and laterally projecting crunodal loops **22** but with coatings of the present invention. As shown, the coating materials serve to coat the projecting loops **22** and to form a resinous web **24** upon the loops **22** as well as depositing the coating material at the junctures or points of contact **23** of the loops **22**.

Another suitable yarn for coating in accordance with the present invention, is a staple yarn such as that disclosed by U.S. 2,133,238; 2,323,684 and 2,780,909. Coated staple yarns comprise a multitude of short or non-continuous fibers gathered and bonded into a single central yarn **31**, see FIGURE 3. The utilization of short fibers results in a structure characterized by a multitude of laterally projecting fiber ends **32** which are covered by a resinous web **34** and bonded together at their points of intersection **33**. A highly similar structure is yielded by abrading or breaking individual filaments in a textile strand or yarn comprising continuous fibers. In such instance, the abraded or fuzzy condition may be achieved by passing the strand in contact with an abrasive surface such as ground glass, and the structure comprises parallel fibers which are continuous except for the attrition or broken ends produced by such abrasion. Other methods of breaking filaments within a strand or yarn to provide laterally projecting broken ends include subjecting the strand to turbulence, mechanical attrition or picking.

Another suitable yarn form is depicted by FIGURE 4 wherein a central yarn **41** is provided with laterally projecting fibers **42** which are mechanically lodged between the filaments of the central yarn **41**. These projecting fibers **42** are also coated with a resinous web **44** and bonded together at their points of intersection **43**. The projecting fibers **42** may comprise cotton, glass, cellulosic materials and the like and may be deposited or lodged between the parallel fibers of the central yarn **41** by passing the yarn between two spaced rolls and simultaneously introducing a supply of the short fibers to the nip of the rolls. The rolling action serves to separate or spread apart the individual filaments embodied in the strand and the short fibers lodge between the parallel filaments to be retained when the strand is free of the compressive effect of the rollers, and to project laterally from the strand. While the short fibers may be readily dislodged during subsequent utilization, this is avoided by immediately subjecting the strand to the coating step of the invention. In addition, the short fibers may be adhered to or inter-felted with the central yarn by a method such as that disclosed by U.S. 2,132,702.

The strands amenable to the treatments of the invention are not restricted to glass or siliceous fibers, and organic fibers or organic fiber-glass fiber composites have proved highly satisfactory. In the case of the latter materials, organic fibrous yarns or strands are plied with fibrous glass strands and the bonding of the resinous coating and the strand structure is considerably enhanced by the compatibility of the organic fibers and the resinous coating. In addition, color values may be obtained by employing dyed or pigmented organic fibers and improved bonding may be attained by means of the fusion of the organic fibers.

The coating material employed may comprise an aqueous or non-aqueous solution of a film-forming composition, a hot melt or a solvent free material which is liquid at room temperature but which may be hardened by a subsequent chemical or thermal treatment. While vinyl polymers or copolymers are preferred, other representative but non-limitative examples of suitable materials include polyurethanes, the polymers and copolymers of acrylic and methacrylic acids and their esters, cellulose acetates, triacetates, acetate butyrates and nitrates, alkyl cellulose compounds, polyolefins, halogenated polyolefins, polyamides, styrene polymers and copolymers, polyesters and epoxy resins.

Other desirable but optional additives such as pigments, dyes, plasticizers, emulsifiers, lubricants and coupling agents which enhance resin to glass bonding, may also be employed.

Coating materials which have proved satisfactory are set forth in the following examples, quantities being expressed in percentages by weight:

EXAMPLE 1

Polyvinyl chloride	9.5
Cresyl diphenyl phosphate	8.5
Milled cotton fibers	2.0
Phthalocyanine green pigment dispersion	1.0
Tetrahydrofuran	70.0
Acetone	9.0

A mixture was prepared from the above ingredients by dissolving the polyvinyl chloride in the solvents, adding the phosphate plasticizer with agitation, and then adding the cotton fibers and pigment with further agitation.

A texturized fibrous glass yarn comprising 2 core strands and 1 effect strand was then impregnated with the mixture and cured by passage through a 30-foot-long oven maintained at 475° F., at a rate of 130 feet per minute.

EXAMPLE 2

	Percent
Polyurethane	5.4
Tetrahydrofuran	94.6

The above ingredients were admixed with agitation and applied to a staple fibrous glass yarn which was immersed therein. The coated yarn was then cured according to the method of Example 1.

EXAMPLE 3

	Percent
Ethyl acrylate-acrylic acid copolymer (aqueous emulsion, 46% solids)	6.1
Acetone	89.3
Milled cotton fibers	3.6
Cellulose acetate	1.0

The acetone and acrylic copolymer were first admixed with agitation and the remainder of the ingredients were then added with agitation. The resulting material was then applied to a texturized yarn comprising 8 plied fibrous glass strands and cured according to the method of Example 1.

EXAMPLE 4

The coating composition of Example 1, minus the pigment, was applied to a variety of organic fiber-fibrous glass composite, texturized 2/2 yarns comprising the following arrangements:

Corn yarns	Effect yarns
2 glass strands	1 glass strand, 1 regenerated cellulose strand.
2 glass strands	2 regenerated cellulose strands.
2 regenerated cellulose strands	1 glass strand, 1 regenerated cellulose strand.
2 regenerated cellulose strands	2 glass strands.
1 glass strand, 1 regenerated celluose strand	1 glass strand, 1 regenerated cellulose strand.
1 glass strand, 1 regenerated cellulose strand	2 glass strands.
1 glass strand, 1 regenerated cellulose strand	2 regenerated cellulose strands.

The yarns prepared according to Examples 1–4 all yielded structures exhibiting unusual qualities of extensibility or elongation, and resistance to attrition stemming from flexing, abrasion, compression and the application of longitudinal tensile stress. In addition, the tactile qualities of all of the yarns were characterized by an unusual warmth or dryness normally experienced only with non-synthetic yarns such as wool or cotton. Fabrics **45** woven from the yarns **46**, **46** produced no irritation or unpleasant sensations when placed in moving contact with the skin and exhibited unusual durability, stain resistance and aesthetic attributes when utilized to upholster office chairs and as covers for automobile seats, see FIGURE 5. The yarns also proved highly receptive to pigments and dyes incorporated in the coating materials and the color values derived from both adequate and aesthetically pleasing. In the case of the organic fiber-fibrous glass composites of Example 4, excellent color values were achieved when uncolored fibrous glass strands were plied with colored regenerated cellulose strands. The blending merely served to subdue the color imparted by the presence of the organic fibers, without yielding perceptible variegation.

It is apparent that novel textile strands exhibiting unusual tactile, strength and durability qualities, and methods for the preparation of such strands are provided by the present invention.

It is further obvious that various changes, alterations and substitutions may be made in the methods, materials and products of the invention, without departing from the spirit of the invention as defined by the following claims.

We claim:

1. A fibrous glass yarn having a central strand of generally parallel fibers, laterally projecting fibers forming a non-compacted, nubby layer of fibers depending from said central strand, and a continuous outer coating of resinous material on said yarn, said coating locking the laterally projecting fibers in the form of a nubby, non-compacted outer layer on said yarn.

2. The yarn of claim **1** wherein the laterally projecting fibers are discontinous filaments.

3. The yarn of claim **1** wherein the laterally projecting fibers are loops of continuous fibers.

4. An improved glass yarn comprising a plurality of generally parallel glass fibers which serve as a central core of the yarn, about said central core and projecting therefrom a plurality of non-parallel fibers arranged in non-compacted, individual loops and whorls that form a cushioning outer layer on said yarn, and a continuous outer coating of resinous material on said yarn, said resinous material locking said non-parallel fibers in non-compacted loops and whorls depending from the central core and all of the fibers as an integral yarn.

5. The glass yarn of claim **4** wherein the resinous coating material includes a dye for lending a color to said yarn.

6. A fabric woven from glass yarn comprising a plurality of generally parallel glass fibers which serve as a central core of the yarn and projecting from the central core fibers throughout their length, a plurality of groups of non-parallel fibers arranged in non-compacted, individual loops and whorls that form a cushioning outer layer on said yarn, and a substantially continuous outer coating of a resinous coating material to lock said groups of non-parallel fibers in non-compacted loops and whorls at the surface of the yarn and to lend integrity to the whole yarn, said fabric thereby having an improved hand.

7. The fabric of claim **6** wherein the resinous coating material includes a dye to color the fabric.

8. The fabric of claim **6** wherein the resinous coating material is polyvinyl chloride containing milled cotton fibers.

References Cited

UNITED STATES PATENTS

2,719,350	10/1955	Slayter et al.	28—1
2,975,503	3/1961	Bacon et al.	161—70
3,166,884	1/1965	Steiner et al.	57—140

ALEXANDER WYMAN, *Primary Examiner.*

G. D. MORRIS, *Assistant Examiner.*