Oct. 11, 1938. D. C. SIMPSON 2,132,702

COMBINED ASBESTOS AND GLASS FIBER YARN

Filed May 22, 1937

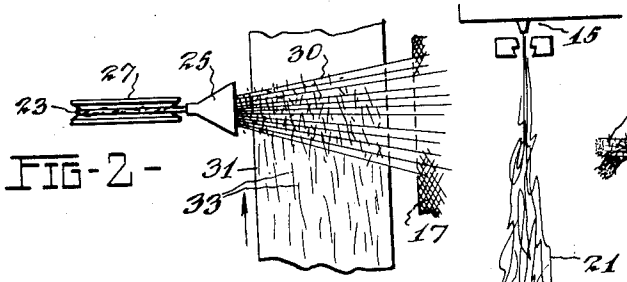


FIG-2-

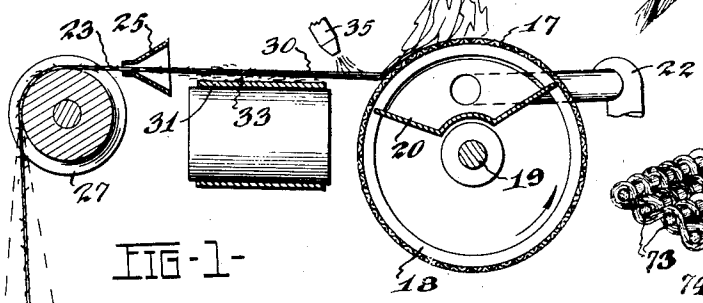
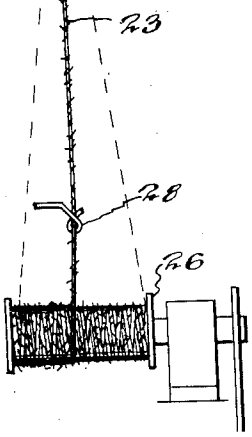


FIG-1-



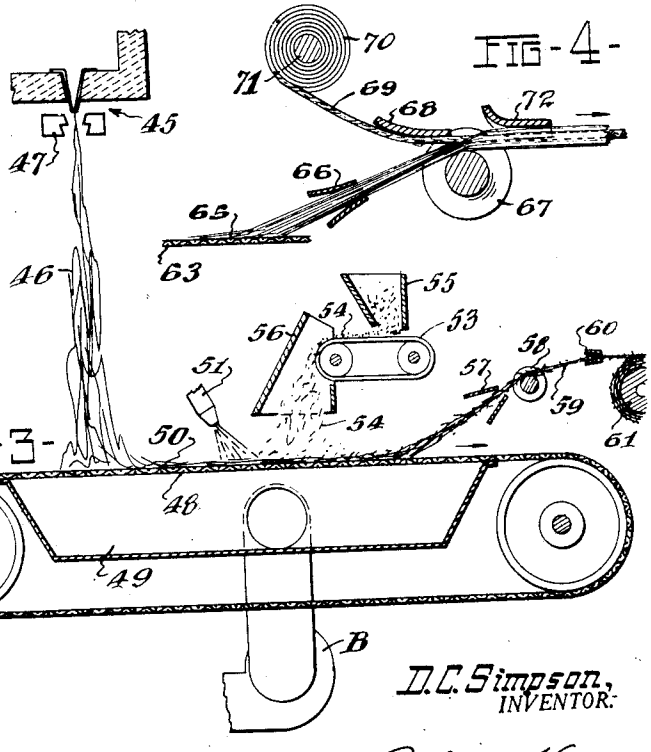


FIG-3-

FIG-4-

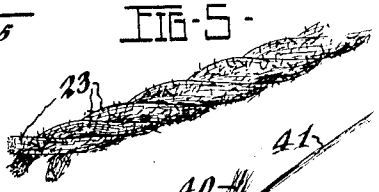


FIG-5-

FIG-6-

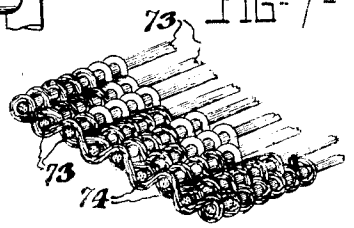


FIG-7-

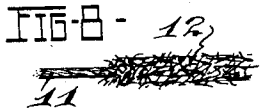


FIG-8-

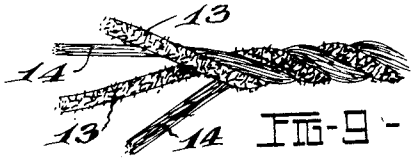


FIG-9-

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COMBINED ASBESTOS AND GLASS FIBER YARN

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14 Claims. (Cl. 117—53)

The present invention is a novel combination of asbestos and glass fibers for use in yarns, interwoven cloth, knitted articles, felts, or other fabricated articles, particularly adapted for electrical insulation, packing material, gaskets, friction elements, heat insulation, cements, fillers in fabricated boards, acoustical insulation, battery separators, and various other uses.

Both glass and asbestos fibers taken by themselves have inherent shortcomings which limit their application and use in industry and commerce. Asbestos, for example, is composed of relatively short and weak fibers which prevent them from being fabricated into strong yarns, cloth, and fabrics. Short asbestos fibers have not been fabricated into any type of yarn or fabric without the incorporation of organic fibers such as cotton, or the like, which serve to hold the short asbestos fibers together. Fine wires have also been used for this purpose. Both of these additional components, however, have definite shortcomings and disadvantages, as, for example, the admixture of organic cotton fibers or the like immediately brings down the temperature or fire resistance of the fabric to that of cotton. The incorporation of wires, on the other hand, prevents the use of the product as an electrical insulation. The use of metal wires or the like is also inferior from the point of view of pliability, flexibility, cost, ease of manufacture, and feltability between the metal wires and the asbestos.

Ordinary glass fibers also have serious shortcomings and limitations in their fabrication into woven fabrics. These limitations are generally traceable to the inherent nonstretchability of glass fibers, the stretchability being limited to one or two percent or so, according to the exact fiber diameter, the type of glass, and the perfection of the fiber. When a series of glass threads are fed into a conventional loom to form a warp, the sudden stresses and loads inherent in a loom are concentrated in the tightest threads which cannot carry the entire load themselves and, therefore, tend to break rather than stretch. Of course, whenever an end or thread breaks in a loom, the entire operation must be stopped and the broken end fed through again before the weaving may be resumed. A similar condition exists when ordinary glass yarns or threads are fed into the weft or filler of a fabric. Moreover, fabrics composed solely of glass fibers, especially if made particularly sheer or thin, have considerably less resistance to folding or creasing than ordinary fabrics. If the fabric is flexed to any degree, or creased, it tends to crack or break and fall apart. Merely reducing the diameter size of the glass fibers does not necessarily cure this condition because, as the fiber diameter is reduced, so is the radius of curvature around which the fibers have to be bent. That is to say, the fibers of the warp are bent around the fibers of the filler and if they are bent around a small enough radius of curvature, the fibers of the warp are cracked and broken. The same condition, of course, obtains when the fibers of the filler are bent around the fibers of the warp.

Another difficulty caused by the inherent nonstretchability of the glass fibers, is the concentration of stresses induced in the outermost fibers at a fold or flexure in the cloth. The glass fibers being more or less unyielding in and of themselves, prevent the load caused by a flexure or creasing from being distributed uniformly throughout the body of fibers to permit their full combined strength to be brought into play.

I have discovered that the above mentioned individual shortcomings of the asbestos and glass fibers may be overcome by a combination of the two, and that a superior product, having properties superior to any of the individual properties of the ingredients, may be produced by a combination of the two types of fibers.

An object of the invention is the provision of a fabric which is flexible, soft, strong, and completely fireproof, fire resisting, rot proof, and chemically resistant.

Another object of the invention is the provision of a fabric composed of inorganic fibers which may be fabricated into felt or interwoven tape suitable for electrical, heat and/or sound insulation.

Another object of the invention is to utilize the softness, pliability and yieldability more naturally inherent in the asbestos fibers in combination with glass fibers, which are much stronger and longer than the asbestos fibers. The individual glass fibers are sufficiently fine and long so that they may be intertwisted or interfelted with the asbestos fibers to form strong yarns which may be safely subjected to the rigors of a conventional loom. The asbestos fibers serve as cushions for the adjacent glass fibers to assist in the distribution of loads throughout the glass fibers, and to lend yieldability and pliability and strength to the final fabric.

In addition, if the glass fibers have been intertwisted or interfelted with the asbestos fibers, this arrangement will prevent the individual glass fibers from being laid out in straight lines, but, on the contrary, will permit them to assume heli-

cal, spiral, or undulating paths which serve to provide a marked increase in the stretchability and pliability for the yarn and fabric produced thereby.

As another feature in the present invention, it is to be noted that the asbestos fibers lying interjacent the glass fibers are softer and inhibit mutual scratching and breakage of the glass fibers as they are bent, flexed, or caused to move relative to one another.

Another feature of the present invention which may assist in the ultimate strength of the fabric composed of glass and asbestos fibers, is due to the fact that the asbestos material may be comparatively rough, and when composed of a mass of fine fibrous particles, may possess a number of outwardly projecting curled ends which assist in the interfelting and mutual seizure of the glass and asbestos fibers. Moreover, asbestos fibers appear to be more slippery and in this manner assist in distributing the stresses among the fibers more equally.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the drawing, in which:

Fig. 1 is an elevational diagrammatic view of an apparatus adapted to produce yarns composed of asbestos and glass fibers;

Fig. 2 is a fragmentary diagrammatic plan view of a portion of the apparatus illustrated in Fig. 1;

Fig. 3 is a fragmentary elevational diagrammatic view of another form of apparatus adapted to produce yarns composed of asbestos and glass fibers;

Fig. 4 is a fragmentary diagrammatical elevational view of a modified embodiment of the present invention; and

Figs. 5, 6, 7, 8 and 9 are fragmentary perspective views of yarns or fabrics which may be made in accordance with the present invention, and which will be explained more fully hereinafter.

In practicing the present invention, I may resort to various means and methods for combining asbestos and glass fibers into yarns and fabrics. I may also use various types of asbestos as, for example, short fibered asbestos which may be interfelted into a relatively hard yarn, and it is also possible to use longer fibered asbestos which may be carded and felted into a softer, more pliable type of yarn with the glass fibers. There are also various types of glass fibers which may be used, although I preferably use a fiber having a fine diameter, ranging in the neighborhood of about .0001 inch to about .0004 inch for softer, more pliable yarns and fabrics. Fibers having larger diameters ranging up to about one-thousandth of an inch may also be used for certain products. Fibers having diameters ranging from about .00015 to .00025 inch have excellent properties inasmuch as they are extremely flexible, and free from brash or skin irritation, and, at the same time, are not so fine that the cost or speed of manufacture is prohibitive. However, finer fibers than this, having even more flexibility and feltability, produce excellent fabrics when compounded with the asbestos fibers. The length of the glass fibers also is important, especially since the asbestos fibers are limited in length and of themselves limit the mass integrity and strength of the yarn. However, by using relatively long glass fibers, it is possible to produce yarns in which the principal tension loads are carried by the glass fibers and are distributed over a considerable length of these fibers. Accordingly, I preferably use glass fibers having average lengths at least about one inch and preferably many inches or feet, or even fibers which are theoretically unlimited in length, as may be produced by certain methods of manufacture.

In producing yarns of combined asbestos and glass fibers, it is possible to pick them apart and intermix them together with a carding machine which serves to straighten out and comb the fibers and intermingle them with one another from where they may be fabricated into intertwisted yarns in which the fibers are more or less interlaced and bound up with one another, the glass fibers providing the principal source of strength and fiber length, and the asbestos fibers providing the principal source of yieldability and softness, and serving to distribute the stresses placed in the yarn so that they may be carried more or less uniformly by the individual glass fibers.

If desired, certain binders and/or adhesives such as starches, asphalt, waxes, latex, rubber, gelatins, oils, synthetic resins, varnishes, shellacs, stearine, pitch, soaps, casein, cellulose derivatives, or the like, may be applied to the yarns in accordance with the particular purpose to which the yarns are to be put. The yarns may also be interwoven into fabrics having any desired construction, and the fabrics may be composed of any desired number of plys, also in accordance with the particular purpose to which it is to be put as, for example, brake lining, packing or gasketing material, clutch facings, electrical insulation, battery separators, or the like.

In compounding the fibers into yarns, I may first produce a thread of glass fibers. The fibers of such threads may be formed, for example, by the method and apparatus illustrated and described in the British Patent No. 482,085. If desired, the yarn formed of this type of glass fibers, which are substantially continuous, may then be coated with a suitable adhesive or binder material and then coated with asbestos fibers which are introduced and combined with the glass yarn by means of a doffer belt upon which the asbestos fibers lie. In order to more perfectly felt the asbestos fibers over the glass yarn, it is sometimes desirable to twist the glass yarn simultaneously as it is being drawn past the doffer belt. Various methods of this type of incorporation, when used with cotton fibers, have been illustrated and described, for example, in the Heany Patent Nos. 1,155,812, 1,155,813, and 1,071,676.

A yarn made in accordance with this method is illustrated in Fig. 8 in which reference character 11 designates a yarn composed of glass fibers having a covering 12 of intermatted asbestos fibers.

It is also possible to use for the yarn 11 a glass sliver composed of a multiplicity of glass fibers which are more or less mutually intermatted, and which lie predominantly parallel with one another although incompletely so, as illustrated and described in the French Patent No. 814,149. Such a sliver of glass fibers may be coated with an adhesive and have a body of asbestos fibers intermingled and interfelted therewith to produce a yarn in accordance with the present invention.

As illustrated in Fig. 9, I may also produce yarns composed of combined glass and asbestos fibers by intertwisting asbestos paper or felt 13 with threads 14 composed of fine, long, glass

fibers, here again the glass fibers serving to carry the load of the yarn as a whole, and the intertwisted asbestos strip of paper or felt serving to form a cushion for the glass yarn, which is ordinarily nonstretchable. When using such a combination for a friction element or fabric, it may be desirable to pull the glass threads so as to be embedded more or less into the intertwisted asbestos paper or felt, leaving the asbestos fibers exposed more predominantly on the outer surface of the yarn where it may serve as the primary friction element.

Another method of incorporating asbestos and glass fibers into yarns is illustrated in Fig. 6 and involves producing asbestos yarns or rovings **40** in the conventional manner and intertwisting these with the yarns **41** composed solely of glass fibers. Ordinarily, the asbestos yarns are not composed of pure asbestos fibers, especially if the asbestos is of the short fiber variety, in which case a small amount of organic fibers, such as cotton, wool, hemp, jute or the like, is incorporated therein in order to provide strength to the yarn during fabrication. In this event, the presence of the organic fibers does not hinder the temperature resistance of the finished fabric after it has been combined with the glass fibers, for in this event the glass fibers are present and may carry the tensile load even though the organic fibers may be burned out or otherwise destroyed as, for example, by acid, rotting, or the like. In other words, the use of the organic fibers is principally for the purpose of assisting the fabrication of the article rather than being present as a required element after the fabric has been completed.

As another method of incorporating asbestos fibers directly in with the glass fibers to produce a yarn, I may use the apparatus illustrated in Fig. 1 in which reference character **15** designates an apparatus for attenuating a multiplicity of glass fibers by gaseous mediums, such as steam, air, or the like. This apparatus **15** may be constructed and operated in accordance with the disclosure in the British patent applied for by Triggs, No. 428,720. Mounted under the forming apparatus **15** is a collecting device **16** composed of a traveling screen or perforated surface **17**, which may be mounted upon an open ended hollow drum **18**, revolving upon the shaft **19**. Extending into and mounted within the drum **18** and underneath the upper portion of the screen **17** is a suction chamber **20** adapted to draw the gases emanating from the forming apparatus **15** and serving to retain the fibers **21** in matted formation more firmly upon the screen **17**. A blower or other suction means **22** may also be provided in conjunction with the suction chamber **20** and serves to exhaust the gases from the chamber.

After the fibers have been arrested upon the belt or screen **17** in the form of a web **30**, they are drawn therefrom into sliver form or yarn **23** through the trumpet or guiding device **25**, and then over the rotating spool **26** where they are collected into a package. The roll **27** may be used in order to change the direction of the yarn **23**, although in practice this is unnecessary. A traversing eye or trumpet **28** may also be provided in order to traverse the yarn across the spool **26** and thus form a uniformly built up package.

Arranged under the web **30** of the fibers as they are being drawn into a sliver, is a doffer belt **31** leading from a suitable asbestos carding device (not shown) and conveying a multiplicity of asbestos fibers **33** arranged and combed in more or less parallel longitudinal position upon the belt **31**, whereby they may be introduced into the web **30** of glass fibers and incorporated therein to form a mutually interfelted product of combined glass and asbestos fibers. With this arrangement, it will be noted that prior to the incorporation of the asbestos fibers with the glass fibers, the latter are open and in an arrangement facilitating the incorporation of the asbestos fibers. From here the glass fibers are drawn or drafted into a more campact yarn **23**, the adjacent glass fibers being drawn together, closing up the intervening spaces, and permitting the interjacent asbestos fibers to be seized and interfelted therewith in a compact, mutually interfelted coherent yarn. This yarn **23** is then drawn through the trumpet **25** and wound upon the spool **26** from which it may be unwound and if desired, twisted into a more compact denser yarn.

If desired, a spray gun **35** may be provided at any suitable point as, for example, over the web **30**, in order to apply a suitable binder or adhesive to the fibers of the finished yarn.

If desired, the yarn of combined asbestos and glass fibers may also be drafted by suitable drafting means and a plurality of the yarns, drafted or not, may be intertwisted to form ply yarn such as the one illustrated in Fig. 5.

Referring now to Fig. 3, I have illustrated a modification of the apparatus shown in Figs. 1 and 2, the principal difference being that in the apparatus illustrated in Fig. 3 the asbestos fibers are distributed over the glass fibers as they lie in web form, prior to being drafted into a sliver. In the drawing, reference character **45** designates a glass filament or fiber forming apparatus adapted to produce a multiplicity of fine fibers **46** by means of a gaseous blast emanating from the blowers **47**. The gaseous blast carries the fibers downwardly and deposits them upon a perforated or foraminous screen belt **48** upon which the fibers accumulate in intermatted or web form. The gaseous blast passes directly through the screen belt **48** and into a suction chamber **49** which may be used to assist the deposition and retention of the fibers upon the belt **48**. A blower B, communicating with the chamber **49**, may also be provided in order to exhaust the gases from the suction chamber. As the fibers **46** lie upon the belt **48** in the form of a thin mat or web **50**, they may be sprayed, if desired, with a suitable adhesive or binder by means of an applicator **51** of any suitable design. In practice, the adhesive application may be made before or after deposition of the glass fibers into web form, or during the drafting operation into sliver form.

Mounted over the web **50** is a feeder **53** adapted to deposit a multiplicity of asbestos fibers **54** in a layer overlying and partially intermatted with the web **50**. The feeder **53** may be of any suitable type, as a vibrating belt or the like. A hopper **55** containing the asbestos may be mounted over the feeder **53**; and the hood or chute **56** may also be provided in order to assure the proper distribution and deposition of the asbestos fibers **54** upon the web **50**.

After the web **50** has been coated with asbestos fibers the mass is drawn up and collected through a trumpet **57** into a sliver form, the individual glass fibers tending to be interlaced and intermingled with the admixed asbestos fibers.

From the trumpet the slivers may then be passed over the diablo-shaped rolls **58** having a

V-shaped cross-section exposed to the sliver, adapted to fold the sliver and compact it more completely into the form of a strong, compact yarn. From here the yarn 69 may be passed through a traverse 60 and wound upon the spool 61 into the form of a package. The ultimate result again is a yarn composed of intermingled glass and asbestos fibers, which may be handled with any of the usual processes in the formation of intertwisted yarns, ply yarns, and interwoven fabrics.

Referring now to Fig. 4, I have illustrated another embodiment of the present invention, adapted to produce yarns of combined glass and asbestos fibers.

In the drawing, reference character 63 designates a traveling perforated surface, similar to the screen 17 of Fig. 1, or like the screen belt 48 of Fig. 3, upon which a web 66 of fine glass fibers has been arrested and collected. The web 65 is drawn into the form of a sliver through the trumpet 66 and then over a suitable folding device 67 which may be in the form of a diablo-shaped roll having a V-shaped, cardioid, or heart-shaped cross-section exposed to the sliver.

Mounted in conjunction with the roll 67 is a guide 68 arranged at the opening of the V and adapted to guide an asbestos roving, yarn, or thread 69 thereunder and into the partially open fold of the glass sliver. The sliver is advanced in semifolded form beneath a guide 72 of arcuate cross-section whereby the upstanding folds of the sliver may be closed over and around the central yarn to substantially surround the same. The roving or yarn 69 may be fed from a package 70 mounted upon the shaft 71, or the like.

The folding device performs the dual function of compacting the glass sliver, which more generally is in the form of a more or less flat ribbon, into a more nearly round, compact cross-section, and simultaneously incorporating the asbestos yarn or roving into the interior of the glass sliver. As a result a yarn is produced composed of combined glass and asbestos fibers having the characteristics above noted in connection with the present invention.

All of the yarns or threads produced by the various specific methods illustrated and described in the present application may be interwoven into the form of a fabric as illustrated, for example, in Fig. 7. The warp yarns 73 may be composed of the same type of yarns as the filler yarns 74, or, if desired, they may be of different varieties, combinations or permutations of any of the yarns illustrated herein. It is also to be noted that the warp yarns 73, if desired, may be composed wholly of asbestos, and the filler yarn 74 may be composed wholly of glass fibers, or, if desired, either one or both may be composed of combinations of the two.

Modifications and variations may be resorted to within the spirit and scope of the present invention.

I claim:

1. A fabricated body of combined long, fine glass fibers and intermixed asbestos fibers.

2. A yarn composed of asbestos fibers and intermixed long, fine glass fibers.

3. A yarn comprising asbestos fibers and intermixed long, fine glass fibers, said glass and asbestos fibers being intermatted with one another to provide mass integrity and strength to the yarn.

4. A yarn comprising asbestos fibers and intermixed long, fine glass fibers, said asbestos and glass fibers being intertwisted to form a strong, pliable yarn capable of yielding and elongating under stresses.

5. A yarn comprising asbestos fibers, intermixed long, fine glass fibers, said asbestos and glass fibers being intertwisted to form a strong, pliable yarn capable of yielding and elongating under stresses, and a binder incorporated throughout said yarn.

6. A sliver composed of long, attenuated, fine glass fibers lying predominantly but incompletely parallel and intermatted with one another, and asbestos fibers intermeshed with said glass fibers and dispersed throughout said sliver.

7. A sliver composed of long, attenuated, fine glass fibers lying predominantly but incompletely parallel and intermatted with one another, and asbestos fibers intermeshed with said glass fibers and dispersed throughout said sliver, said glass fibers having a diameter of not more than about .0003 inch.

8. A ply yarn comprising asbestos roving and threads composed of fine, long, attenuated glass fibers intertwisted with said roving.

9. A yarn comprising a thread of long, attenuated glass fibers, and a body of intermatted asbestos fibers overlying the surface of and coating said glass thread.

10. A yarn comprising a thread of long, attenuated glass fibers, a binder substance coating said glass threads, and a body of intermatted asbestos fibers overlying the surface of and coating said glass thread.

11. A ply yarn comprising a strip of asbestos paper, and a thread composed of long, attenuated glass fibers, said asbestos strip and said glass thread being intertwisted with one another to form said ply yarn.

12. A yarn comprising a sliver composed of an intermatted mass of long, fine, attenuated glass fibers lying predominantly parallel with one another longitudinally of said sliver, and a body of asbestos fibers, said sliver being in web form and folded over said body of asbestos fibers to form a covering therefor.

13. An interwoven fabric of yarns composed of asbestos fibers and combined long, fine attenuated glass fibers.

14. An interwoven fabric of yarns composed of asbestos fibers and combined long, fine, attenuated glass fibers, said yarns being impregnated with a binder substance.

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