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METHOD OF MAKING MULTI-BREAK FABRIC

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*Fig. 1.*

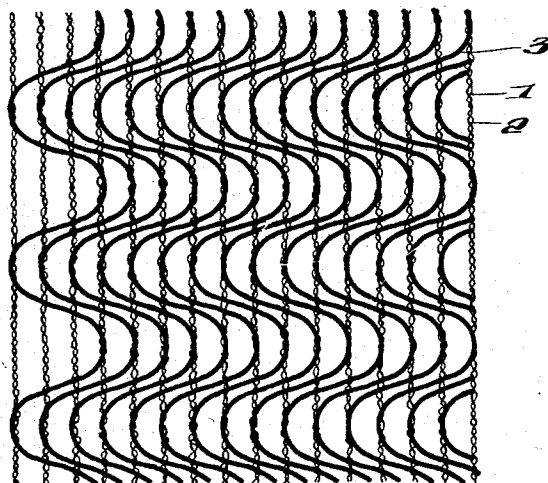
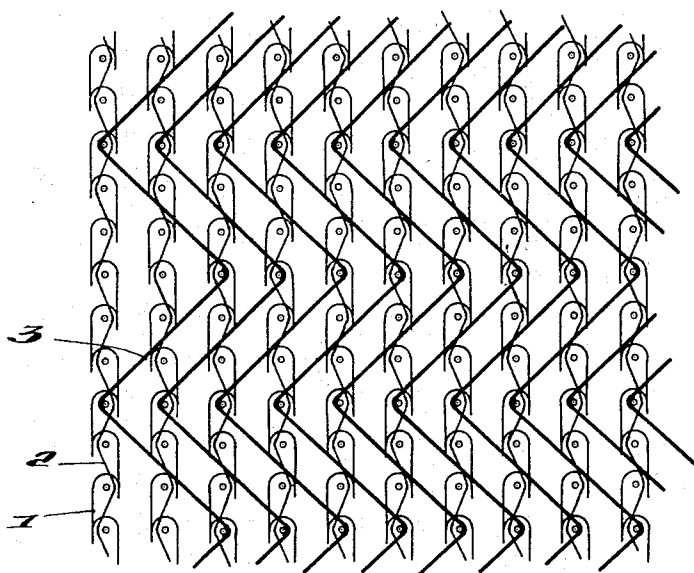


*Fig. 2.*



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## METHOD OF MAKING MULTI-BREAK FABRIC

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3 Claims. (Cl. 28—74)

The present invention is a division of application Serial No. 129,081, filed August 3, 1961, and relates to a system of fibers having controlled strength and stretch characteristics. More specifically the present invention provides an arrangement of fibers such as glass fibers which are disposed in a predetermined pattern so as to constitute a mat or fabric having a predictable stretch and strength characteristic in all or in predetermined directions.

It is well known that many fibers, both organic and inorganic have characteristics which make such fibers desirable for incorporation as reinforcement in impregnated or laminated materials. Metal fibers, for example, have high strength but low elasticity characteristics. The present invention provides a fabric and method of forming an elastic material using nonelastic reinforcement. While glass fibers are used in the specific example given herein it will be recognized that other fibers possess similar characteristics and could be used in like manner.

Glass fibers have many desirable characteristics for certain purposes. They possess good electrical insulating properties, high strength to weight ratio, high thermal resistivity and are resistant to oils, acids and corrosive atmospheres. Glass fibers do not, however, possess any appreciable elasticity and hence, fabric woven from such fibers will not stretch in order to conform to shapes having, for example, double curvatures. This characteristic presents a problem when fabrics are made up of woven glass fiber impregnated with rubber or any other material. Such fabrics, if not biased, are unusually strong and possess good electrical insulating characteristics but do not conform to shapes having curvatures requiring stretchability.

It is also desirable to provide a material in the form of a mat or fabric providing a "multi-break" material which will give or break certain fibers on initial tension and will maintain its continuity through the medium of a second set of fibers until a predetermined percent of elongation is reached whereupon a third set of fibers is relied upon for strength and continuity. In this manner material may be fabricated having predictable stretch characteristics in which an initial impact will cause the material to give by breaking a certain set of fibers but in which the impact will be contained by a high strength, controlled elasticity final set of fibers. Additional sets of fibers may be provided if desired.

Materials have been designed heretofore utilizing woven glass fiber impregnated with rubber or other suitable compound. In order to give such materials some degree of stretchability the glass fiber fabric is inserted on the bias. This type of material has a degree of flexibility but the fabric usually must be spliced along its length because of the bias fabric, also the width of the fabric decreases appreciably when the material is elongated.

According to the present invention there is provided a mat or fabric comprising a first system of glass fiber yarns which are arranged in a curved pattern with a second system of warp yarns knitted to retain the glass fiber yarns in their predetermined pattern within the mat or fabric. The third warp yarn system may be of a different material containing less geometric extensibility and different

strength characteristics than the fibers used in the first system. The elongation of the fabric can be controlled during impregnation or coating and when the material must be stretched to conform to a desired shape certain of the warp yarns will break to permit the material to assume the desired configuration. The ultimate strength of the material is not adversely affected by this breaking of certain warp yarns since the glass fibers forming the first system and constituting the principal strength of the reinforcement are still present in continuous form. Furthermore, the warp yarns, while broken and not continuous over great lengths of the fabric, are present and do add to the overall strength of a coated or impregnated material. Thus, the present invention provides a means whereby the desirable characteristics of glass fibers may be incorporated in a material having the additional desirable characteristic of stretchability at the desired time.

The present invention finds application as a laminating media where it is desirable that the fabric give slightly under an initial impact but that the ultimate strength of the material be high to prevent penetration by the impacting object. The formability of the invention lends itself to products having double curvatures.

An object of the present invention is to provide a fabric or mat having multiple break characteristics.

Another object of the present invention is to provide a fabric or mat having a plurality of systems of fibers including glass fibers, the various systems of fibers having varying strength and elastic characteristics so that one set of fibers yields under a predetermined tension without adversely affecting the ultimate strength of the material.

Still another object of the present invention is to provide an insulating material having a plurality of systems of fibers impregnated or coated therein, including glass fibers, the material being stretchable by virtue of breaking one or more sets of fibers, the glass fibers forming the ultimate strength of the reinforcement remaining in continuous form.

Other objects and many of the attendant advantages of the present invention will become more fully apparent upon consideration of the following detailed specification in connection with the accompanying drawings wherein:

FIG. 1 is a plan view of one embodiment of a fabric according to the present invention and,

FIG. 2 is a knitting diagram of the fabric shown in FIG. 1.

The present invention comprises a plurality of individual systems of fibers which are arranged in a predetermined pattern so as to constitute a mat of set pattern and having controlled strength and elongation characteristics.

A fabric according to one embodiment of the invention, is shown in FIG. 1. It can be seen that this fabric is composed of warp yarns 1 and 2 which form a support for the sinusoidally curved yarns 3.

The particular fabric shown is made on a warp knitting machine and the knitting diagram for this particular fabric is shown in FIG. 2. It can be seen that the yarn 1 is knitted, being wrapped around the needles alternately in opposite directions. The yarn 2 is passed on either side of the needle in each course. The yarn 3 is laid in the warp yarns and is shifted laterally in each course in alternate directions so as to have a sinusoidal form as shown. In the particular example disclosed the yarn 1 is 40 denier polyester, the yarn 3 is 150/2/2 glass fiber and the yarn 2 is 900/1/2 glass fiber. The fabric disclosed in FIG. 1 may be impregnated with a material such as a silicone rubber when used as a tape. Since the fibers are of a controlled thickness and the pattern

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of fibers is generally uniform throughout the length of the fabric, the tape will be of uniform thickness throughout. When such a material is wrapped around an irregularly shaped object, the yarn 2 will initially break for the reason that, in the particular fabric disclosed, these fibers are glass and in this design have a straighter configuration whereas the fibers 1 are of polyester and possess greater elasticity. Thus, the yarns 2 comprise a first system of fibers which break to give the reinforced material a degree of elasticity. If greater extensibility is required than is derived from a breaking of the yarns 2, the yarns 1 of polyester may also break and the reinforced tape may be stretched until the fibers 3 are extending substantially longitudinally of the tape. The strength characteristics of the impregnated material are not adversely affected by the breaking of the warp yarns since these yarns are still in the tape and the ultimate strength of the tape is based on the presence of the glass fibers 3.

It should be recognized that the specific pattern of the fabric may be varied to suit varying operational requirements. It is possible to utilize yarns of different size and materials in place of the yarns 1 and 2. The glass fiber yarns 3 may be arranged in any suitable pattern and it is only necessary that these yarns be supported by the knitted warp yarns and be disposed in a pattern to give the resulting fabric the desired ultimate strength and extensibility characteristics.

It will be noted that none of the yarns in this disclosed embodiment extend across the entire width of the material. This prevents wicking occurring across the width of any fabric so constructed and where slit or coated it does not destroy the integrity of the material.

It is also possible to construct a fabric in accordance with the present invention wherein the yarns used to retain the ultimate strength fibers in place during manufacture of the impregnated material may be subsequently removed from the material. That is to say, the yarns 1 and 2 which retain the yarns 3 in a predetermined pattern may be made of a material which by subsequent chemical treatment will be dissolved so that the fabricated material will contain only the yarns 3. It is also within the realm of the present invention to thermally fuse the warp yarn after the material is impregnated so as to provide a material having substantial elasticity and possessing the strength characteristics of tape reinforced with glass fibers.

It is also possible according to the present invention to break the yarns 2 by passing the impregnated tape between a pair of differential rollers, the second pair being driven at a greater speed than the first pair so that the tape is tensioned therebetween. This controlled tension will break the yarns 2 and give the tape the desired degree of elasticity.

It can be seen that the present invention provides a

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fabric in the nature of a mat wherein the strength and elongation characteristics are controlled and readily predictable. According to this general embodiment one or more systems of warp yarns are used to retain one or more sinusoidally or otherwise disposed systems of glass fibers in place and these retaining systems break under tension, thereby providing the material with a certain elasticity and the ability to conform to shapes requiring stretch in more than one direction. The remaining unbroken yarns provide the ultimate strength of the material and these yarns are maintained in continuous form up to the ultimate strength points of the material.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. What is claimed as new and desired to be secured by Letters Patent is:

We claim:

1. The method of forming a stretchable tape comprising the steps of forming a fabric having glass fibers forming a first system of yarns extending in a sinuous curved pattern warpwise of the fabric, a second system of glass fiber yarns extending warpwise and a third system of yarns knitted to retain said first and second system of yarns to produce a nonstretchable fabric, impregnating the nonstretchable fabric with elastic material, passing the impregnated fabric through a first set of differential rollers at a predetermined rate, passing the fabric through a second set of friction rollers at a greater rate to tension the impregnated fabric and break the second system of glass fiber yarns, whereby the first system of yarns may be extended to extend in a substantially straight line warpwise of the fabric.

2. The method of forming a stretchable tape having glass fiber yarns therein as reinforcement comprising the steps of forming a fabric having a first system of glass fiber yarns extending in a generally zig-zag pattern in the fabric, said glass fiber yarns providing a non-elastic fiber reinforcement, the fabric being formed with a second system of knitted fibers, impregnating the fabric with an elastic material, disrupting the second system of knitted fibers, permitting the first system of glass fiber yarns and elastic impregnant to elongate with the glass fiber yarns extending in a substantially straight line.

3. The method according to claim 2, wherein the disrupting step is achieved thermally.

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