Oct. 25, 1949. C. S. FRANCIS, JR 2,485,725

COATED ELASTIC FABRIC

Filed June 22, 1944

Fig. 1.

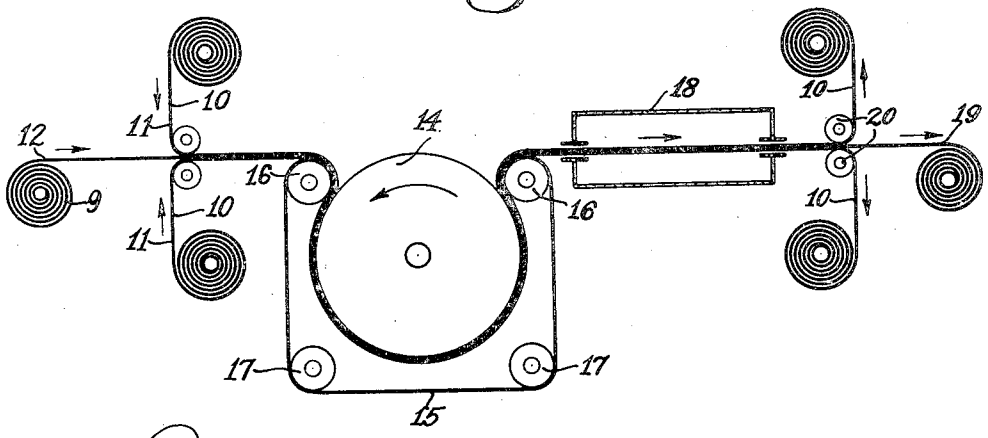


Fig. 2.

Fig. 3.

Fig. 4.

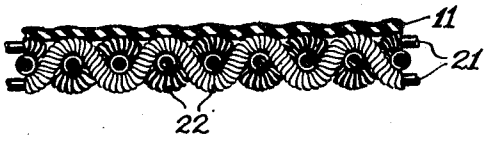
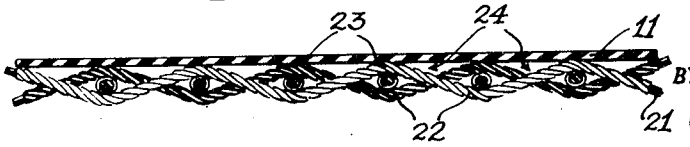


Fig. 5.



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COATED ELASTIC FABRIC

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6 Claims. (Cl. 154—48)

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This invention relates in general to elastic fabrics and in particular to coated elastic fabrics made by the use of thermoplastic transfers.

In the production of coated elastic fabrics for use in girdles, brassières, shoe fabrics, surgical bandages, gas masks and certain industrial uses, it is essential that both the total weight and the thickness of such sheet materials be maintained at an absolute minimum. However, such coated materials must meet the following stringent specifications:

(*a*) The fabric must be extremely light in weight;

(*b*) The fabric must be waterproof and water-repellent;

(*c*) The coating must not become tacky when folded and stored under pressure;

(*d*) The coating must not become brittle or inflexible at the lowest temperatures experienced in the arctic regions;

(*e*) In many cases, as in gas masks, it is desirable that the coating be impermeable and proof against the effects of both water vapor and gases.

It has been found that elastic fabrics made by conventional methods of coating elastic fabrics will not meet all of the above stringent requirements.

In one prior method an elastic fabric is coated with a solution of a film-forming material in a volatile solvent and the solvent then evaporated to deposit the material on the fabric. However, it invariably results that the first coating tends to penetrate and impregnate the yarns so that it is necessary with such a prior method to apply a plurality of coatings, as many as six or seven, in order to finally produce a film which is free of pin holds and relatively smooth. Such a method obviously results in the use of a large quantity of the coating material, the larger part of which is useless since it is lost in impregnating the yarns. Thus, when such solutions are applied to elastic fabrics containing covered elastic threads, the impregnation of the yarn results in the bonding of the textile covering to the elastic filament, thereby seriously affecting the natural elasticity of the elastic yarns and stiffening these yarns, and finally the solutions tend to bond the yarns to each other at their points of crossing, thus limiting the elasticity of the fabric as a whole. In another prior method the use of volatile solvents is avoided by preforming a relatively thick film of plastic material and calendering the same onto the surface of the fabric. However, it has been found that it is impossible to produce a film by calendering which has a thickness less than

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0.002". Even if films thinner than 0.002" could be produced by calendering, it would be impractical to apply them to the surface of elastic fabric because such films are not self-supporting and they could not be run through automatic calenders at a rate which would make the process commercial. When the thicker calendered films are applied to elastic fabrics, a bulky, thick product always results and it is frequently the case that the film, by reason of its greater thickness, tends to seriously diminish the elasticity of the fabric. In such cases the advantage of having elastic rubber threads in the fabric is lost.

Accordingly, it is a general object of the present invention to overcome present disadvantages residing in prior coated fabrics while providing coated fabrics with a thin continuous impervious coating.

Another general object of the invention is to provide a light-weight fabric which will have high tear resistance, high tensile strength and a substantial stretch while exhibiting a material recovery after being stretched.

A further specific object is to provide an elastic textile fabric with a thin continuous impervious coating.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

According to the present invention, an elastic textile fabric is coated without impregnating the yarns thereof by applying to one or both sides of the fabric a non-self-supporting continuous film of a thermoplastic elastomer, preferably less than .002" in thickness, supported on a temporary backing to which the film exhibits no permanent adhesion, applying heat and pressure to the assembled materials to cause the film to adhere to the surface portions only of the yarns and, preferably after cooling the article, separating the temporary backing sheet from the coated fabric.

The term "elastic fabric" as used in the specification and in the appended claims is intended to include the following: (*a*) Knitted fabrics, in which the elastic thread, (e. g. a rubber thread) either bare or covered with a textile covering, is actually knitted with elastic or non-elastic knitting yarns. In this case the rubber thread forms the loops in the fabric.

(*b*) Inlaid knitted fabrics, i. e. knitted fabrics in which the elastic thread is merely fed in between the non-elastic textile yarns. Thus, in a knitted fabric the elastic yarn would lie straight and run through the loops.

(*c*) Woven fabrics in which the warp and/or

weft yarns are elastic thread, either bare or covered.

The expression "open mesh fabric" as used in the specification and in the appended claims denotes a fabric having discrete and substantial spaces between the yarns in such a fabric, and may be an elastic fabric as defined above, or an ordinary fabric without rubber threads and formed by weaving, knitting, netting, crocheting or otherwise.

Some common varieties of open mesh fabrics are, for example, scrim, cheesecloth, bobinet, and crinoline. It is to be understood that the fabrics may be formed of natural or artificial textile fibres and mixtures thereof.

For a more complete understanding of the nature and objects of the present invention, reference should be had to the accompanying drawing in which

Fig. 1 is a diagrammatical representation in side elevation of means for carrying out one embodiment of the process of the invention;

Fig. 2 is a cross-section of another embodiment of the article comprising one layer of fabric coated on both sides with an elastic film;

Fig. 3 is a third embodiment of the article in which two layers of elastic fabric are united by means of an enclosed elastic film;

Fig. 4 is a cross-sectional view of one embodiment of the fabric of the invention in the unstretched condition; and

Fig. 5 is a cross-section of the fabric illustrated in Fig. 2 after stretching.

According to the present invention, the fabric is combined on one or both sides thereof with a continuous transfer film comprising, as the essential film-forming agent, a natural or synthetic elastomer. Thus, there may be used natural rubber or any of the synthetic or artificial rubbers possessing the elastic characteristics of natural rubber; for example, there may be used in the invention one of the synthetic elastomers given in the table below or any compatible mixture of such elastomers.

Structure	Remarks	Tensile Strength	Percentage Elongation
		Kg./cm.²	
Plasticized Polyvinyl Chloride (Koroseal).	plasticized 30%	270	170
	60%	70	500
Iso-butylene Polymer and Iso-butene Polymer (Vistanex).	"Vistanex" MM	20	1,000
	"Vistanex" HM	60	1,000
Butadiene Polymer (Buna).	Buna 85	175	600
	Buna 115	200	700
Copolymer of Butadiene and Iso-butylene (Butyl Rubber).	vulcanized carbon black compound.	260	1,000
Copolymer of Acrylonitrile and Butadiene (Perbunan, Perbunan Extra, Chemigum, Hycar).	vulcanized pure gum compound.	150	900
	vulcanized carbon black compound.	320	600
Chloroprene Polymer. Product removed when ½ polymerized (Neoprene).	unvulcanized	30	1,100
	vulcanized pure gum compound.	300	820
	vulcanized carbon black compound.	290	760
Copolymer of Butadiene and Styrene (Styrene Rubber).	vulcanized carbon black compound.	280	650

Of the various materials which may be employed for the transfer film, the synthetic elastomers as a class are preferred over all other materials. Thin films formed of a synthetic elastomer have the property of stretching and recovering after stretch. In accordance with this invention, these properties, inherent in the elastomers per se, are enhanced by the fact that the yarns of the fabric are not impregnated with the film but are bonded thereto only at the peak points of the fabric, which permits the yarns to recover their original shape after stress. Thus the finished product may be subjected to substantial stress and strain without permanent distortion or without permanent change in dimension, since after the stress is removed the synthetic elastomer film causes the fabric to return to its original structure and shape. Further, the synthetic elastomers contemplated by the invention are superior to natural rubber in their resistance to oils, greases, water vapor, and dry cleaning fluids.

To facilitate handling the transfer film which is so thin that it is not self-supporting, the film may be supported on a temporary backing. The temporary backing may be any drum, band or sheet material having a smooth surface to which the transfer film exhibits no permanent adhesion. When the transfer film is an organic hydrophobic material, the backing sheet is formed in whole or is coated with a hydrophilic material, such for example, as regenerated cellulose, an alkali-soluble water-insoluble cellulose ether, gelatine, casein, denitrated nitrocellulose, deacetylated chitin, zein, and the like; or with a thermosetting resin in the infusible state; or with a thermoplastic material which has a thermal softening point higher than the thermal tacking point of the synthetic elastomer, or a coated backing sheet in which the coating has a thermal softening point lower than the thermal tacking point of the transfer film. There may be used also backing sheets of fibrous material, such as papers, fabrics and felts which are coated with one of the above-mentioned materials to provide a smooth, non-porous surface to which the transfer film is applied. The natural or synthetic elastomer film has a thickness of not over .002", preferably between .001" and .002".

The transfer film may be formed on the temporary backing in any suitable manner, for example, by applying the thermoplastic material as a solution or molten mass to the backing surface by spraying, dipping, calendering, and the like. The invention also contemplates that the transfer film may be applied to a continuously moving backing surface, such as a drum, band or web, and transferred from such backing sheet at a point spaced from the point of application of the film thereto. The expression "temporary backing" as used in the following detailed description and in the appended claims is intended to include a backing in the form of a sheet, web, or an endless band, or a drum.

In producing the coated elastic fabric, one or both surfaces of the fabric are brought into contact with two non-self-supporting thermoplastic transfer films carried on a temporary backing, and the assembled materials then subjected to heat and pressure by suitable means whereupon the transfer film is rendered tacky and caused to adhere to the outer surface portions only of the yarns. Thereafter the assembled materials are preferably cooled and the backing sheets stripped off.

In one embodiment the elastic fabric is stretched prior to the transfer and the film is transferred thereto while the fabric is in its stretched condition after which the backing sheet is stripped off and the fabric allowed to relax.

There is shown in Fig. 1 one embodiment of

suitable means for carrying out the invention in which two backing sheets 10, each carrying an elastic transfer film 11 on one surface, are fed between the assembly rolls 13 so as to contact the film with a web 12 of elastic fabric supplied from the roll 9. The assembled sheets are then passed around the heated drum 14, being pressed against the drum by means of the blanket 15 which travels about the pressure rolls 16 and the tension rolls 17. Heat and pressure applied by the drum 14 and blanket 15 cause the transfer film to adhere to the raised surface portions of the yarns without impregnating the yarns. The stripping of the backing sheets from the product is facilitated if the composite sheet material is cooled prior to stripping, for example, by passing the composite sheet material through the cooling chamber 18. The backing sheets are stripped from the coated fabric in passing around the stripping rolls 20. The backing sheet 10 and the coated fabric 19 are wound up separately.

The product produced is shown in Fig. 2 and comprises a single layer of elastic fabric 12 coated on each side with a thin continuous elastic film 11. It is to be understood, however, that the fabric may be coated on one side only. Alternatively, there is shown in Fig. 3 a further embodiment of the article which comprises two layers of elastic fabric 12 united by and enclosing a single continuous elastic film 11. It is clear from these examples that the number and relation of the films and layers of fabric may be varied to produce articles of various types without transcending the scope of the present invention.

For a more detailed explanation of the features and characteristics of the present article reference should be had to the detailed drawings in Figs. 4 and 5. In Fig. 4 there is shown a single layer of elastic fabric in an unstretched condition. It should be noted that both the weft and warp yarns of the fabric comprise an elastic rubber core 21 covered with a spiral textile covering 22. In Fig. 4 the yarns are shown in a relaxed or unstretched condition. The thin continuous elastic film 11 is shown as bonded to the exposed or raised surfaces of the covered yarns and the material of the film does not penetrate the yarn structure to any substantial extent. Accordingly, the yarns of the fabric are not bonded to each other at their points of crossing so the yarns are free to move and slide one upon another to a substantial extent. When the fabric illustrated in Fig. 4 is stretched its structure is represented in Fig. 5. In this figure it will be noted that the yarns as a result of the stretching are slightly smaller in diameter and that the film has been stretched with the yarns, the film being bonded to the yarns at the raised exposed surfaces 23, but the film is free from attachment to the yarns in the spaces 24 between such points 23. It will thus be noted that the present invention provides a novel method of producing a coated elastic fabric without substantially altering the elastic characteristics of the fabric. The thin elastic film 11 follows the expansion and contraction of the fabric freely and the yarns of the fabric are not bonded to each other at their points of crossing. It would be impossible to produce an article such as that illustrated in Figs. 4 and 5 by the use of prior methods such as by coating the fabric with a solution of film-forming material in a volatile solvent because the solution would saturate the fabric, impregnate the yarns, and upon evaporation of the solvent the film-forming material would form a coating around each yarn and bond the yarns at their points of crossing. On the other hand, the present invention provides a method of producing an extremely lightweight fabric because the film 11, although it is extremely thin and non-self-supporting, is applied to the fabric in such a manner that it is not disrupted or broken by the transfer operation. Because the elastic film is extremely thin, preferably having a thickness less than .002 inch, it is capable of following the expansion and contraction of the fabric without interfering with or substantially modifying the elastic fibres of the fabric, and despite the fact that the film is anchored near to the raised surface of the yarns, it does not become detached when the fabric expands and contracts. When one attempts to calender a thick self-sustaining elastic film to an elastic fabric by prior methods there is always produced a product heavier, less flexible and less elastic than is produced by the present invention.

It is to be understood that many variations and alternatives are possible in the article and process of the invention. If desired, the transfer film which is applied to the one side may be dissimilar in chemical composition, color, thickness and other characteristics from the transfer film which is applied to the other side. Also, the natural or synthetic elastomer film may be applied to the elastic fabric in an unvulcanized condition and the vulcanization of the film can be effected during or after transfer.

By way of illustration but not by way of limiting the invention, there will be given the following specific examples:

Example I

An elastic webbing is made by coating one side of a knitted elastic fabric having elastic threads knitted in and forming the loops with a film of a synthetic elastomer comprising neoprene having a thickness of .002" supported on a smooth calendered paper by passing the fabric and the supported film through an apparatus of the type shown in Fig. 1, and stripping off the paper backing sheet. The coated fabric is highly elastic, flexible, waterproof, and resistant to oils and dry cleaning fluids. The film is bonded only to the exposed surfaces of the fabric, but it will not separate therefrom at temperatures below 0° F. and/or when boiled in water for an hour. The coated fabric has a tensile strength of between 2 to 4 times greater than the uncoated fabric. The film follows the expansion and contraction of the fabric without delamination.

Example II

A mass of polymerized butadiene (Buna rubber) is dissolved in a suitable solvent and applied to the surface of a sheet of glycerinated regenerated cellulose, after which the solvent is evaporated to leave a continuous extremely thin film of the synthetic elastomer on the cellophane. The coated cellophane and a woven fabric made of yarns comprising continuous filament elastic "Vinyon" (vinyl chloride-vinyl acetate copolymer) is passed through an apparatus similar to that shown in Fig. 1 above with the synthetic elastomer film in contact with the fabric and the layers subjected to sufficient heat and pressure to render the synthetic elastomer tacky and cause it to bond to the raised portions of the surface of the "Vinyon" fabric. In the pre-

ferred embodiment the temperature used is such that the surface of the "Vinyon" filaments is also rendered tacky, thus improving the anchorage between the fabric and the synthetic elastomer film.

Example III

To an elastic fabric containing rubber threads of the type disclosed in U. S. Patent No. 2,152,826, there is applied on one side a film having a thickness of 0.002" of polyvinyl butyral resin. The film is first formed on a sheet of cellophane as a temporary backing, and is then applied to the fabric at a temperature of 150° C. and 200 lbs. pressure to cause the film to adhere to the peaks of the fabric. There is thus produced a composite material in which the film, while continuous over the yarns, does not penetrate the spaces between the yarns. The strength of the bond between the fabric and the film, as well as the elasticity of the composite material, are particularly noticeable at low temperatures.

The coated elastic fabric of the present invention is applicable for a wide variety of uses where both water-repellency and elasticity are desirable, inter alia, as waterproof coverings such, for example, as shoe and overshoe material, baby panties, hospital sheeting, mattress covers, surgical gloves, waterproof beach bags, life vests, girdles and the like. Also for bathing caps, raincaps, glider covers, outdoor furniture covers and other articles requiring stretch and resistance to water. Owing to the light weight, elasticity and impermeability of the coated fabrics, they are particularly designed for balloon fabrics, parachute cloth, air and gas ducts, and the like.

Since certain changes in carrying out the above process, and certain modifications in the article which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What I claim as new and desire to secure by Letters Patent is:

1. As an article of manufacture, an elastic textile fabric having a non-self-sustaining continuous film of a thermoplastic elastomer thermally bonded to superficial portions of at least one surface of the fabric in such a manner that the points of crossing of the yarns in said fabric and the remainder of the fabric except for said superficial points are free of the film material, whereby the fabric is free to expand and to contract, said surface film having a thickness of not over .002" and being adapted to follow the movements of said fabric without rupture or separation therefrom.

2. As an article of manufacture, an elastic textile coated with a film comprising an elastomer and having a thickness of not over .002", said film being thermally united only to the raised surface of the yarns of said fabric, whereby the fabric is free to stretch and the film follows the expansion and contraction of the fabric without rupture or separation therefrom.

3. As an article of manufacture, an elastic textile fabric formed of elastomeric threads, and a non-self-sustaining continuous film of a thermoplastic elastomer thermally bonded only to superficial portions of at least one surface of the fabric in such a manner that the points of crossing of the yarns in said fabric and the remainder of the fabric except for said superficial points are free of the film material, said film having a thickness of not over 0.002 inch, whereby the fabric is free to expand and to contract and the film is adapted to follow the movements of said elastic fabric without rupture or separation therefrom.

4. The article of claim 3 in which the elastomeric threads are of rubber.

5. The article of claim 3 in which the elastomeric threads comprise elastic vinyl chloride-vinyl acetate copolymer filaments.

6. The article of claim 3 in which the elastomeric threads are of rubber having a textile covering and the film is bonded to the raised surfaces of the covering yarns but the material of the film does not penetrate the yarn structure to any substantial extent.

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