Sept. 7, 1937. W. W. ROWE 2,092,140

RESILIENT STRETCHABLE FABRIC

Filed April 26, 1933

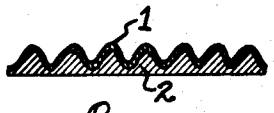


Fig. 1.

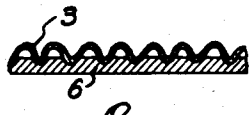


Fig. 2.

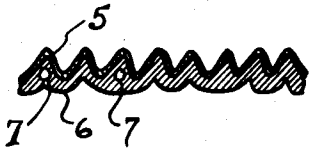


Fig. 3

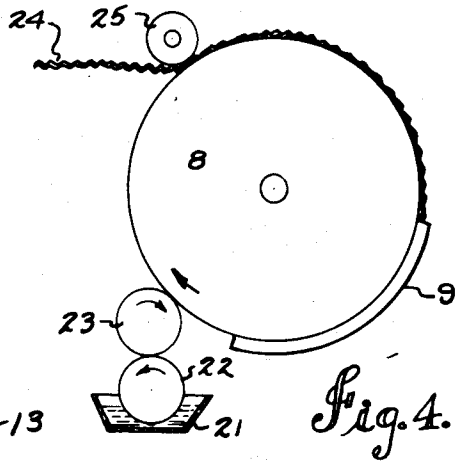


Fig. 4.

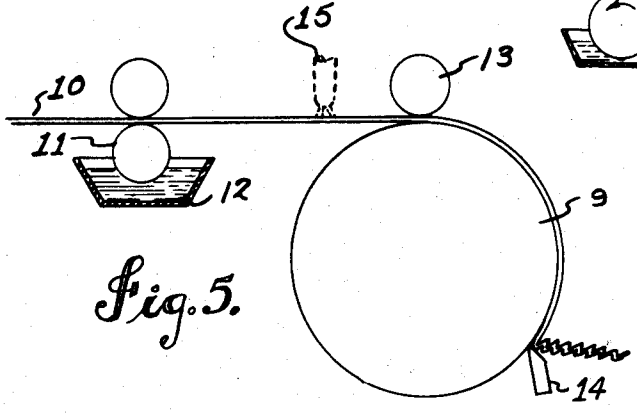


Fig. 5.

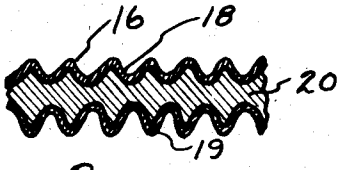


Fig. 7.

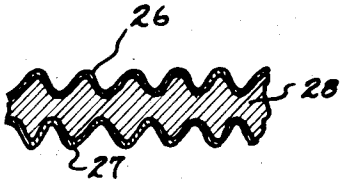


Fig. 6.

INVENTOR.
William Wallace Rowe
BY
Allen & Allen
ATTORNEYS.

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2,092,140

RESILIENT STRETCHABLE FABRIC

William Wallace Rowe, Cincinnati, Ohio, assignor to The Paper Service Company, Lockland, Ohio, a corporation of Ohio

Application April 26, 1933, Serial No. 668,105

8 Claims. (Cl. 154—55)

My invention is addressed to creped fabrics comprising part of an article of manufacture, namely, a stretchable fabric in which not only is resistance interposed to the removal of stretch, but also a resilient means opposes the removal of stretch and tends to restore the fabric to its original unstretched condition.

I have shown in my co-pending application Serial No. 668,106, filed April 26, 1933, Patent No. 2,069,778, that the interposition of a coating substance between non-conjointly creped layers of fabric is capable of very greatly resisting stresses tending to remove the stretch; and where a universally stretchable web is employed remarkable serviceability is secured in the resultant product. My present invention has to do with the use of coating substances, which, while distortable, are resilient and are not subject to a preponderant degree of permanent distortion under stress.

The primary objects of my invention will follow from what has been said. More specific objects relate to the production of novel fabrics in which stretching strains are resiliently resisted and to novel procedures in the manufacture of these.

The objects referred to and others which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, I accomplish in those certain constructions and arrangements of parts and in those procedures of which I shall now set forth exemplary embodiments, reference being had to the accompanying drawing.

In the drawing:

Figure 1 shows in section a sheet of creped paper having a coating of rubbery material which is substantially continuous with respect to the paper surface and extends fully within the crinkles thereof.

Fig. 2 shows in section a creped web having essentially a superficial coating of rubbery material, which does not extend down into the crinkles at all points.

Fig. 3 shows somewhat diagrammatically one result which may be secured when creping by means of rubbery material, or when employing a rubbery material which is adhesive to itself.

Fig. 4 shows a mechanism for forming a film of rubbery substance upon a creping cylinder which may be the second creping cylinder of a double creping mechanism.

Fig. 5 is a somewhat diagrammatic view of a machine for creping a fabric by means of a resilient coating, or for coating a fabric with a resilient substance prior to creping it.

Fig. 6 shows a combined fabric of creped layers joined by means of rubber derived from latex.

Fig. 7 shows in section two plies creped by means of a thermoplastic adhesive and joined together by means of a rubbery substance.

Primarily in the practice of my invention, I employ rubbery materials in connection with creped webs, usually of paper. My invention is not limited to any particular resilient coating or combining substance, but since rubber is the primary resilient gum commercially obtainable, I shall describe my invention in connection with the use of it, it being understood likewise that the rubber may be used with such other diluents or binder substances as may be desired. More particularly in some phases of my invention, I employ dispersions of rubber, whether naturally or artificially produced, and especially rubber latices, which may be used with or without vulcanizing or modifying agents as desired.

I am aware that attempts have been made in the past to combine rubber and creped paper, but such attempts have usually resulted in the removal of a great part of the stretchability in the paper and have been primarily for the purpose of securing a rubber coated product or the temporary or permanent adhesion of the coated material to other substances. No such result as I secure, has hitherto been obtained. It is one of my objects to produce the combination of a highly and universally stretchable creped fabric and a body of stretchable resilient material which must be likewise stretched when stretch is removed from the web, and novel types of coaction between the resilient material and the crinkles of the creped web. Another feature of my invention is the provision of novel ways of associating resilient and elastic materials with webs prior to, concurrently with, or after the creping of the web, so that the association of the materials does not ipso facto result in the removal of stretch from the web.

I have shown in Figure 1, a section through a creped web of paper or the like indicated at 1 and having a coating 2 of rubbery material. It will be noted that this coating extends well down into the crinkles of the creped web and is substantially continuous with respect to the surface thereof. A product of this general nature may be made by spraying, for example, a coating of rubbery material upon a pre-creped web, but may also be made by coating the web prior to or concurrently with the creping operation as will hereinafter be set forth, and then carrying on the creping operation prior to the setting of the coat-

ing. In this way, continuity of the coating is secured with respect to the surface of the web. The amount of the coating may be varied to control to what extent, if incompletely, the coating fills the valleys of the crepes, or whether or not there shall be an excess of the coating material forming a more or less smooth external coating. All of these factors will determine the resistance to the removal of stretch per unit weight of the coating material employed.

I have shown in Figure 2 another creped web of material **3**, having what is essentially a superficial coating of rubbery materials **4**, the primary characteristic of which is surface continuity rather than a penetration into the valleys of the crinkles. The rubbery body thus has to be more directly stretched rather than distorted when the creped web is stretched.

This product may conveniently be made by coating with rubber latex or other rubber suspension, a support to which the rubbery substance will not strongly adhere when set. Metal and glass form supports of this character as well as certain impervious web materials such as cellophane, glassine and parchment papers, cellulose acetate films and the like. The coating of rubber suspension may be allowed partially to set on the support and the creped web brought into contact with it. After the coating has completely set, the web and coating may be removed from the support.

It is characteristic of the products of Figs. 1 and 2 that there is in association with a creped sheet of paper, a rubber coating so disposed that it must be stretched when the paper is stretched. Not all coatings of rubbery substances have this property, and indeed so far as I am aware, a product of this character is novel with me. To illustrate the distinction let it be supposed that two sheets of plain paper are cemented together by means of rubber derived from latex in a uniform film. Afterwards the duplex sheet so produced is creped. In this operation the two layers of paper and the layer of rubber are conjointly creped, as will be clear, and when the combined product is stretched the crinkles come out of the rubber in the same way as they come out of the paper, and do not involve any substantial elongation of the rubber layer. Similarly the same phenomena may be observed in single layers of paper coated with rubber, as will be clear. The phase of my invention to which this application primarily relates contemplates the union of a creped sheet, having substantial stretchability, with a layer of resilient substance which must be elongated rather than distorted when the combined product is stretched. In its ordinary forms the product of my invention will be characterized either by a substantially continuous layer of unstretched rubber in union with creped paper having resident stretchability, or such a disposition of the rubbery substance that it ties across peaks of the crinkles in the creped paper so that it must be elongated when the paper is stretched. My invention, however, includes certain novel methods of creping paper in conjunction with or by means of a rubbery adhesive, as to which these product differentiations referred to are not a necessary limitation. It is to be pointed out also that when two layers of previously creped paper are cemented together by means of rubber or other resilient gum, such a combination tends to produce a disposition of the resilient gum to give the quality hereinabove referred to.

It is possible in the practice of my invention, to coat a web of paper with rubbery material and then crepe the web either before or after the coating has set. If the creping is carried on after the coating has set, the effect is one of creping the web and the rubber together, and if the rubber has lost its adhesive character by vulcanization or otherwise, it offers relatively less resistance to the removal of the stretch of the paper. However, if the rubber is unvulcanized or incompletely vulcanized, as the crinkles are forced against each other by the creping doctor, the coatings will adhere to each, at least at interspaced points, tying across the crests of the crinkles. This result is illustrated in Fig. 3, where a creped web **5** has a coating **6** of rubbery material which is substantially continuous as respects the paper surface, but ties across the crinkles as at **7**. It will be understood that Fig. 3 is a diagrammatic representation. The effect is produced by the crowding of the crinkles together by the creping doctor or knife during the crinkling operation, and while the coating substance is adhesive to itself at least, and the product may vary from one in which there are sporadic rubbery bridges across the peaks of the crinkles to one in which the ultimate result is very much like that shown in Fig. 1.

It is a characteristic of my invention that the rubbery material is imposed upon the web under circumstances not involving a removal of the stretch of the web during the imposition step. My result may be obtained either by applying the rubbery material to the web prior to the creping step, whether or not the rubbery material is in the form of a dispersion, or by applying dispersed and therefore initially substantially liquid rubbery materials to a precreped web.

In Fig. 5, I have shown a creping cylinder at **9** to which a web **10** is led. The web may be coated by means of a roll **11**, turning in a pan **12** of latex or the like and may be pressed against the surface of the cylinder **9** by means of a back-up roll **13**. The web is removed from the creping cylinder **9** and creped by means of the doctor **14**. Under these circumstances the latex may be employed as an adhesive to bind the paper to the creping cylinder **9** and to assist in the creping operation.

Instead or in addition, however, latex may be flowed or sprayed against the side of the web away from the cylinder as by the pipe **15** ahead of the back-up roll **13** and a result secured, although this method is productive in general of a light coating of rubber and comparatively less resistance to the removal of stretch.

With respect to a universally stretchable web, I prefer a creped product characterized by crossing sets of diagonally disposed creping crinkles, as set forth in the copending applications to William C. Kemp, Ser. No. 626,059, filed July 29, 1932, and Ser. No. 558,884, filed August 24, 1931. The process of Kemp contemplates in general two creping operations upon the web. In the preferred mechanism and process the paper is led to a first creping cylinder and removed therefrom by a knife which is diagonal to the direction of movement of the paper. It is preferably a knife of the band type, helically disposed about the periphery of the cylinder. After this first creping, the product is led to a second cylinder, to which it is caused to adhere, and from which it is removed by a second helical band knife again diagonally disposed to the path of movement of the paper, but in the opposite direction, so as to produce in the paper crossing sets of diagonal

crinkles. An operation involving a second creping of already creped paper complicates the problem of creping by means of the adhesive action of rubber. For the first creping operation the steps and mechanism illustrated in Fig. 5 are satisfactory. For the second operation, the problem of adhesion is rendered more difficult, both because of the crinkled surface of the paper and because the crinkling stiffens the paper and makes it difficult to crepe in the opposite direction. The paper having first been creped by means of rubber retains a rubber coating, but this rubber coating will be relatively non-adhesive to the second creping cylinder, both because it has dried, and because its surface is likely to be rough. It is again possible to recoat paper with rubber, but in order to form a good bond with the cylinder the paper must be led against the cylinder before the coating is dry. It is then necessary to dry the paper on the cylinder prior to its removal therefrom by means of the knife, if the proper cohesion in the coating is to be developed. This requires an inordinate length of time, since the paper is already sealed by one coating of rubber, and there is relatively little opportunity for the water to dry out of the coating interposed between an impervious layer of paper and an impervious cylinder. Moreover, to get good adhesion to the cylinder, such a coating of rubber would have to be fairly thick, i. e. preferably thick enough to fill up the rugosities of the already creped paper. This may entail the use of an uneconomical quantity of the rubbery substance, and increases the difficulty of creping becausing thickened areas of the rubber must be distorted.

To obviate these difficulties I make use of a procedure involving the formation of a thin film of rubber upon the second creping cylinder, and the drying of this coating on the cylinder prior to the application of the paper to the cylinder. Since the coating is applied wet to the cylinder it will adhere thereto satisfactorily. The dried layer of rubber on the cylinder will adhere strongly to the dried layer of rubber on the paper, and the creping step may be carried on satisfactorily without the use of a large excess of rubber.

The coating may be applied to the second cylinder by spraying, or the like, but I prefer to use such an apparatus as that shown diagrammatically in Fig. 4, where 8 indicates the second creping cylinder, and 9 the diagonal knife by which the paper is removed therefrom. 21 is a pan of latex in which a roll 22 turns and transfers a portion of the latex to coating roll 23. Arrows on the several rolls indicate their direction of movement, and it will be noticed that the coating roll 23 turns oppositely to the cylinder 8, wiping thereon a film of latex which may be accurately controlled as to thickness. The cylinder 8 may be heated if desired, or blasts of drying air applied against the film formed thereon to dry it prior to the application of the creped web 24 thereto. The web will ordinarily be pressed into contact with the cylinder by means of a rubber covered back-up roll 25.

In creping by means of rubber, where the water from the latex will enter the web, there is an advantage in removing the web from the underside of the cylinder where it can, if desired, be supported by a conveyor, or the like, while it is limp.

In all of the fabrics hitherto described, additional resistance may be secured by joining plies together. Where unvulcanized rubber coats both fabrics such juncture may readily be obtained merely by pressing the plies together. Fabrics having an external coating of rubbery materials, are particularly useful under many circumstances because of their impervious character and their so called non-skid surfaces. In Figure 6 I have shown in section webs of universally stretchable, non-conjointly creped paper 26 and 27, joined by means of a layer 28 of resilient substance.

I have also found that webs creped by means of a thermoplastic adhesive substance as set forth in my Reissue Patent No. 17,633 may be cemented by a latex or solutions or dispersions of rubber. I have shown in Figure 7 layers of creped paper 16 and 17 bearing relatively thin layers of asphalt or the like 18 and 19, cemented together by a layer 20 of rubbery material.

The resilient character of the coating substance coacts particularly well with a universally stretchable character in the web or webs employed, since the removal of stretch in one direction also has a result upon the stretchability in other directions. In this way unusually tough and resistant fabrics may be made. The resilient layer may be reinforced, if desired, by means which will resist but not destroy the universally stretchable character of the coating substance. Thus relatively short and heterogeneously arranged fibers may be embedded in the rubber, which is either a cementing agent between plies, or an external coating thereon. In the case of an external coating, fibers such as cotton or the like, caught in the resilient matrix, but projecting therefrom, will provide a desirable and attractive surface texture.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A web of creped fabric having a high resident stretchability and coated upon one side with a thermoplastic adhesive substance and a layer of rubbery substance in combination with said web, said layer of rubbery substance contacting said web upon the side opposite the coating of thermoplastic adhesive substance.

2. A web of creped fabric having a high resident and universal stretchability and coated upon one side at least with a thermoplastic adhesive substance and a layer of rubbery substance in combination with said web, said rubbery substance and said thermoplastic adhesive being in direct adhesive contact.

3. In combination a plurality of webs of creped paper having opposed surfaces coated with a bituminous adhesive substance and a coating of rubbery material interposed therebetween and serving to join said webs.

4. A universally stretchable paper having in combination therewith a coating of rubber, said rubber having in combination therewith short, heterogeneously arranged fibers, whereby the stretchability of the fabric in any given direction is controlled.

5. A composite fabric comprising a plurality of plies of universally stretchable creped paper joined together, at least one of said plies having in combination therewith a layer of rubbery substance, in which are embedded short, heterogeneously arranged fibers, whereby the stretchability of the fabric in any given direction is controlled.

6. An article comprising a plurality of webs of creped paper with a coating of thermoplastic adhesive extending into the crinkles thereof, said webs having the characteristics of paper creped by means of the positive adhesive action of said

thermoplastic adhesive, said webs being joined together by means of rubber, said rubber contacting at least one of said coatings of thermoplastic adhesive.

7. In combination, a creped web having high resident stretchability, and a substantially continuous coating of rubbery substance on said web which is substantially in coextensive contact with the surface of said web and of substantially uniform thickness throughout, portions of adjacent crinkles in said web being tied together by said coating.

8. In combination a plurality of webs having a high resident stretchability and in adhesive union with each other, each of said webs having a coating of bituminous substance thereon, and a layer of rubbery substance in combination with one of said webs, said layer of rubbery substance contacting said web upon the side opposite the coating of bituminous adhesive substance.

WILLIAM WALLACE ROWE.