April 2, 1946. M. A. CHAVANNES 2,397,838

METHOD OF AND APPARATUS FOR PRODUCING ELASTIC FABRICS

Filed March 30, 1940 4 Sheets-Sheet 1

FIG.1.

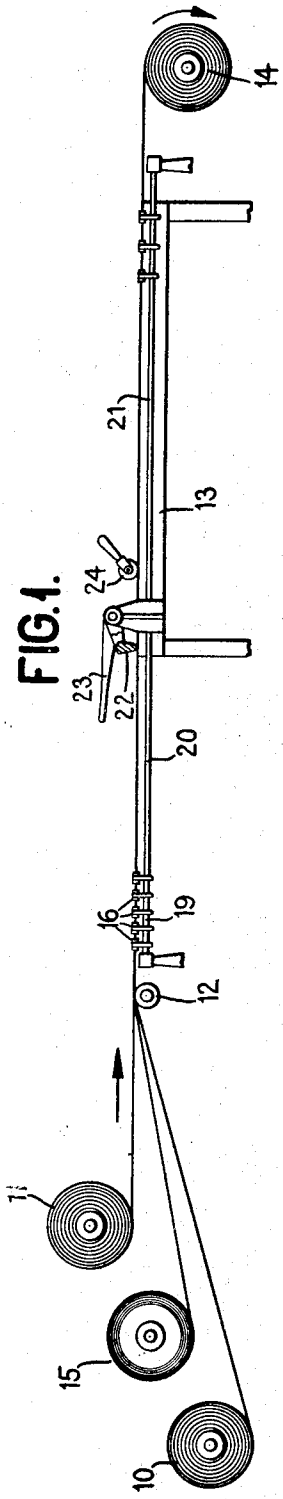


FIG.2.

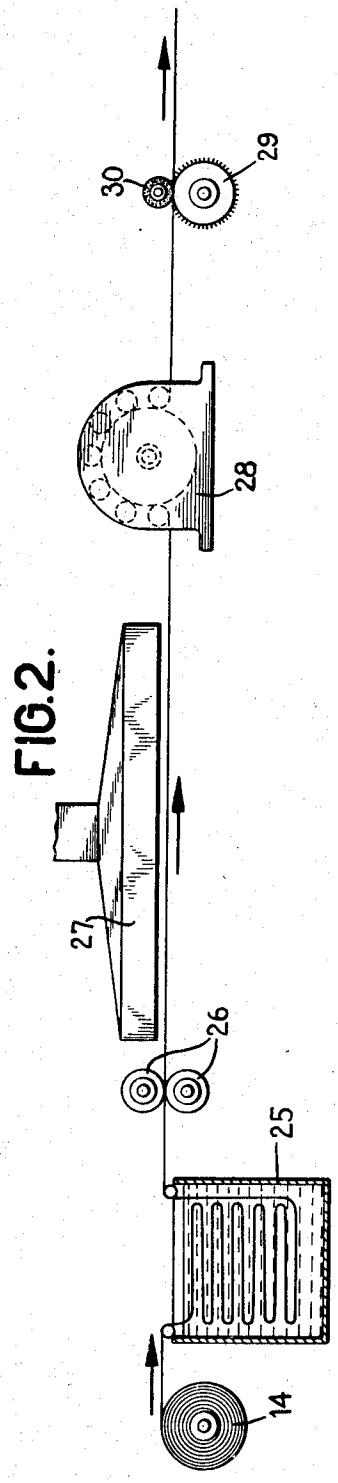
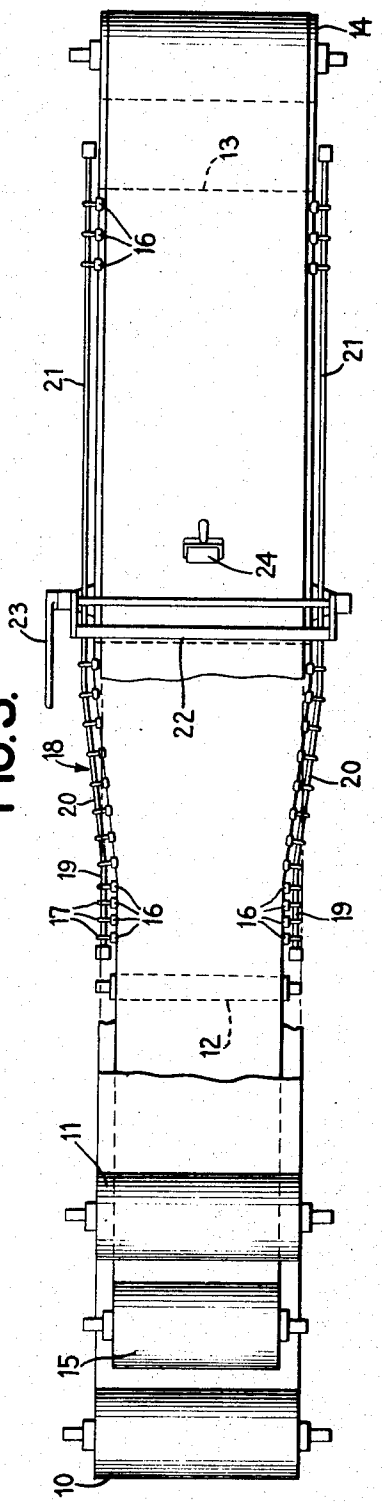


FIG.3.



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April 2, 1946. M. A. CHAVANNES 2,397,838

METHOD OF AND APPARATUS FOR PRODUCING ELASTIC FABRICS

Filed March 30, 1940 4 Sheets-Sheet 2

FIG. 4.

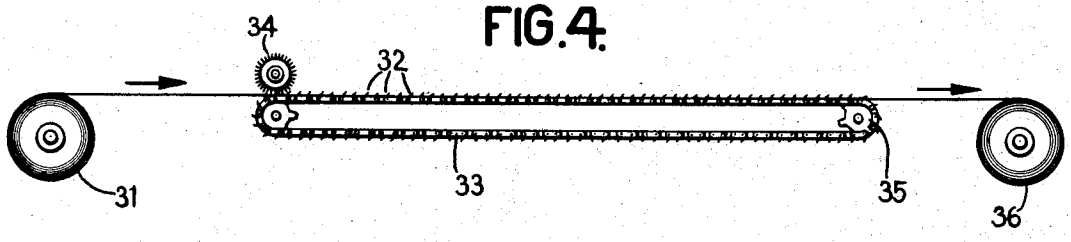


FIG. 5.

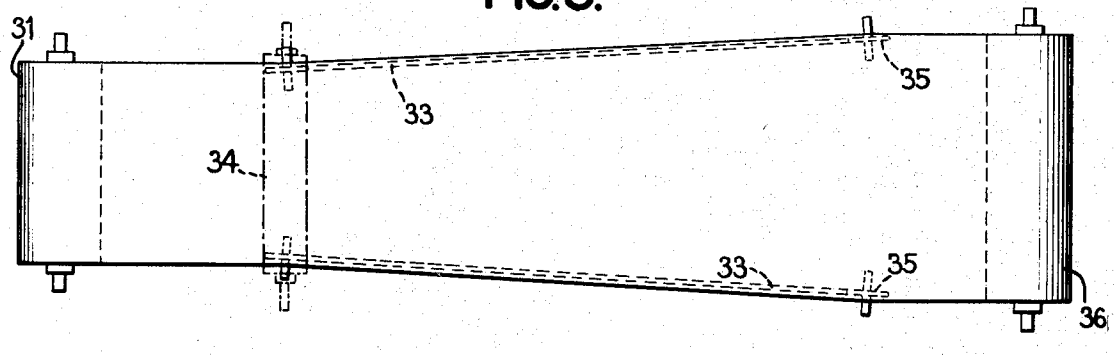


FIG. 6.

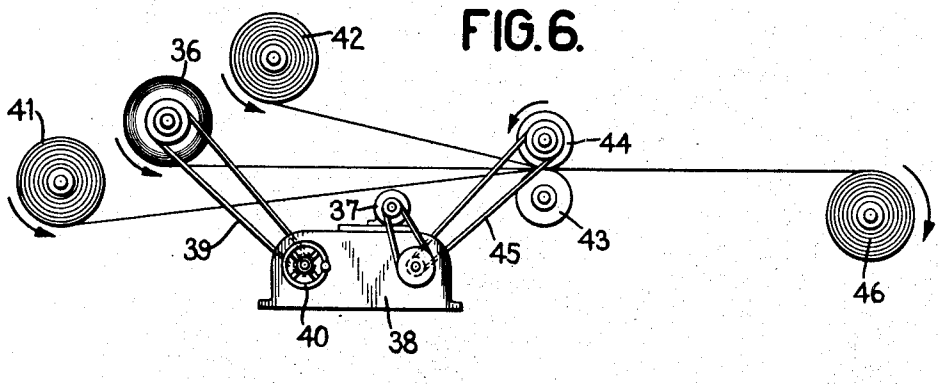
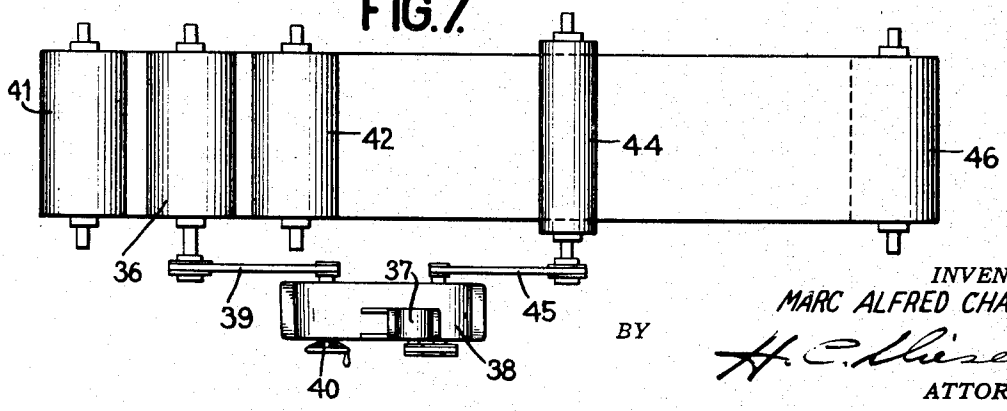


FIG. 7.



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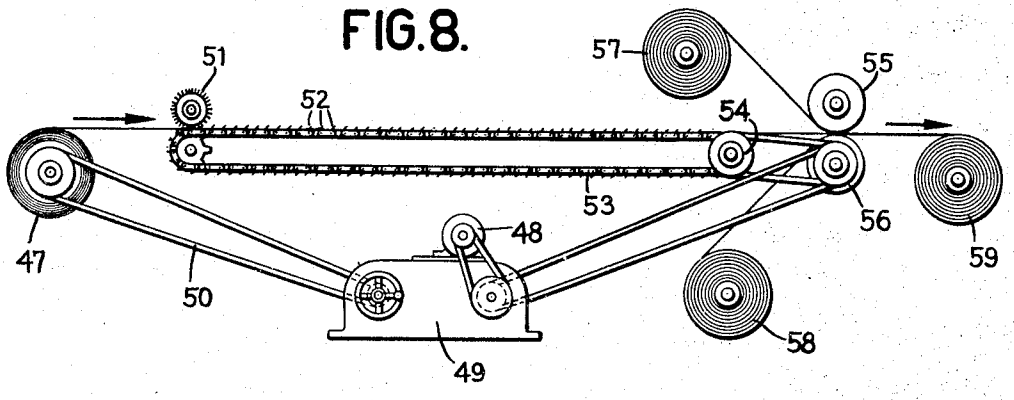
METHOD OF AND APPARATUS FOR PRODUCING ELASTIC FABRICS

Filed March 30, 1940 4 Sheets-Sheet 3

FIG.8.



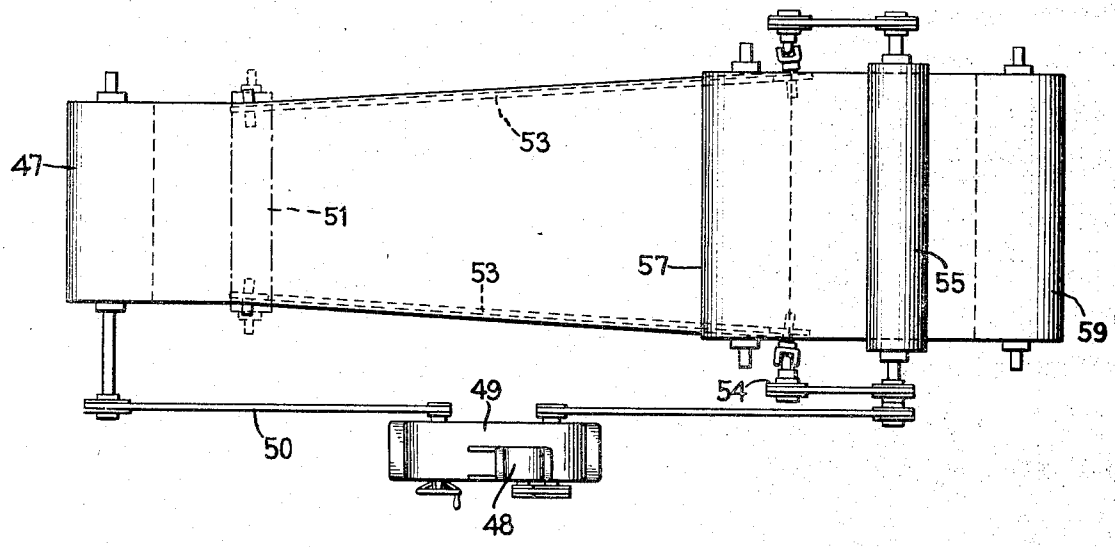


FIG.9.

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April 2, 1946. M. A. CHAVANNES 2,397,838

METHOD OF AND APPARATUS FOR PRODUCING ELASTIC FABRICS

Filed March 30, 1940 4 Sheets-Sheet 4

FIG. 10.

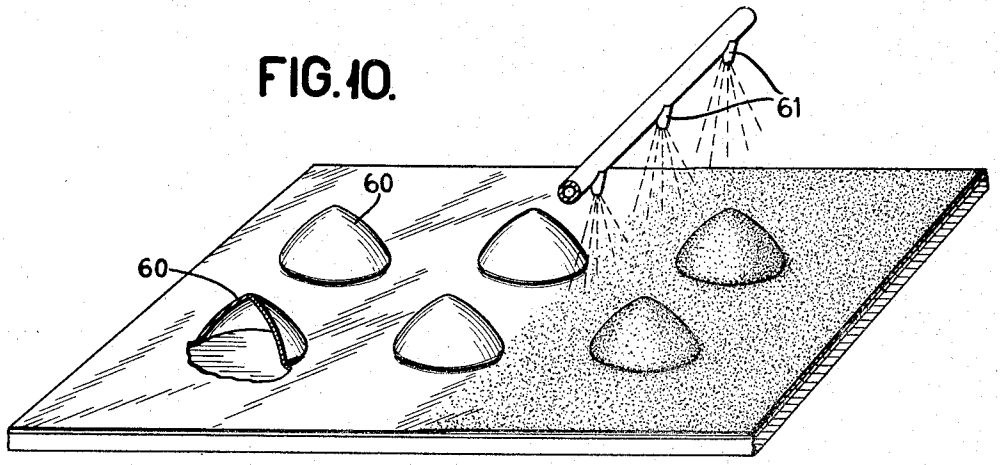


FIG. 11.

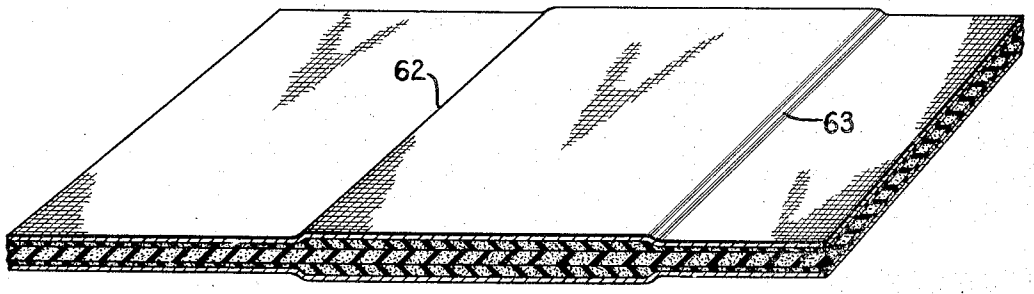
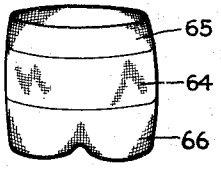


FIG. 12.



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Patented Apr. 2, 1946

2,397,838

UNITED STATES PATENT OFFICE

2,397,838

METHOD OF AND APPARATUS FOR PRODUCING ELASTIC FABRICS

Marc Alfred Chavannes, Genthod, Switzerland, assignor to American Ecla Corporation, Dover, Del., a corporation of Delaware

Application March 30, 1940, Serial No. 326,879

11 Claims. (Cl. 154—1)

This invention relates to improvements in methods and apparatus used in the production of elastic fabrics and to the products resulting from the use of such improved methods and apparatus. It is particularly applicable to the production of fabrics capable of stretching simultaneously in all directions in two dimensions, although some features are applicable also to the production of fabrics of other types.

In my prior applications Ser. No. 316,336, filed January 30, 1940, and Ser. No. 321,618, filed March 1, 1940, and in Schwartz application Ser. No. 112,972, filed November 27, 1936, and in applications by Schwartz and Chavannes Ser. No. 137,254, filed April 16, 1937, Ser. No. 157,504, filed August 5, 1937, Ser. No. 162,892, filed September 8, 1937, Ser. No. 197,935, filed March 24, 1938, and Ser. No. 214,916, filed June 21, 1938, various methods and apparatus have been disclosed by which elastic fabrics may be produced capable of stretching in one or all directions. Fabrics produced in accordance with these prior methods have received their elasticity from rubber latex sprayed upon the surfaces of stretchable, but non-elastic, base materials which are combined or united by the adhesive action of the latex. Various schemes have been suggested, moreover, for increasing the stretch of the resulting composite fabric in certain directions. However, it has not been possible in the production of these fabrics to impart a sufficient resistance to stretch, and accompanying restoring force or "kick," to render them suitable for certain corset purposes, and the like, without utilizing an excessive amount of the latex and producing an objectionably thick and heavy fabric. This is due to the fact that in applying the layers or coatings of rubber latex, according to these prior methods, it has not been possible to form the rubber into a homogeneous and continuous, flat film having the characteristics of a separate film of rubber, nor is it possible to place the rubber under initial tension. Rubber which is completely relaxed, i. e., under no initial tension, will offer little resistance to stretch at the outset but this resistance will increase as the extent of stretching of the rubber increases. If base materials or fabrics having unlimited stretchability could be used, the desired resistance to stretch could be obtained by stretching the composite fabric to the required extent in use. Thus, a girdle formed of the fabric could be made sufficiently small, when untensioned, to give the desired restraining forces upon stretching the same to apply it to the figure. But base fabrics suitable for the purpose are not ordinarily capable of stretching sufficiently to build up the desired restoring forces in this manner. Furthermore, it is desirable in many instances to provide a substantial restoring force without stretching the composite fabric to any great extent.

It has been an important object of the present invention to produce elastic fabrics having the outward appearance and feel of ordinary non-elastic fabrics and capable of producing predetermined, substantial restoring forces upon relatively little elongation from their normal, relaxed conditions. A more specific object has been to produce fabrics of the character mentioned, having elasticity in all directions in two dimensions; these may be designated "all-way stretch" fabrics. In connection with all types of elastic fabrics, it has been an object to provide regulated or controlled elasticity or resistance to stretch, throughout the range of stretchability of the fabrics.

An important feature of the invention is its applicability to the production of fabrics having the indicated elastic properties and having an infinite variety of outward appearances. By appropriate selection of the non-elastic base materials, employed in the production of the final, composite, elastic fabric, almost any desired outward appearance may be imparted to the finished fabric. It may, for example, present the appearance of velvet, or it may have a lace-like appearance, or it may present the effect of any other of a wide variety of non-elastic fabrics of woven or knit or other character.

A further feature of the invention is its adaptability for the production of elastic fabric having distinctly different stretch characteristics in different portions of an integral length of the fabric. By appropriate steps in the production of the multi-ply, elastic fabric, one section may be given a substantially greater resistance to stretch than another section without substantially altering the appearance of the fabric and without correspondingly modifying the weight or thickness of the fabric. This phase of the invention is of particular utility in the production of fabric for use in various types of body-confining or molding garments, such as girdles, corsets, brassières and the like.

Still another feature of the invention is its adaptability for the production of an integral length of elastic fabric which is substantially flat over most of its area, when extended to its normal length and width but not stretched, but has a series of pocket formations, or any other de-

sired configuration, in relief at selected points, under these conditions, without the necessity of employing folds or darts or seams of any character. This phase of the invention has a wide variety of applications. It is particularly advantageous for the production of fabrics for use in brassières, bathing suits, and the like, wherein extra fullness or special pocket formations, or some particular configurations, are desirable at various points.

Other objects, features and advantages of the invention will appear from the detailed description of several illustrative forms of the same which will now be given in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic view, in elevation, illustrating a method and means by which the improved, composite, elastic fabric may be produced.

Fig. 2 is a similar schematic view in elevation, illustrating certain steps and means employed in a subsequent stage of the improved method.

Fig. 3 is a plan view showing schematically the devices of Fig. 1.

Figs. 4 and 5 are schematic views, in elevation and plan, respectively, illustrating a modified method and means of performing certain steps of the improved method.

Figs. 6 and 7 are schematic views, in elevation and plan, respectively, illustrating a method and means of carrying out subsequent steps in the modified method.

Figs. 8 and 9 are schematic views, in elevation and plan, respectively, illustrating a further modification for carrying out certain steps of the improved process.

Fig. 10 is an isometric view illustrating, schematically, a step in the method by which a pocket formation is provided in the fabric.

Fig. 11 is an isometric view illustrating, schematically and on a greatly enlarged scale, a section of fabric, produced by the improved method, having greater elasticity or resistance to stretch in one portion than in another, and

Fig. 12 is an isometric view of a panty formed, in whole or in part, of the fabric of Fig. 11.

Briefly, the invention may be said to involve the uniting of one or more non-elastic base materials with a sheet or film of pre-vulcanized rubber, this sheet or film being under a desired tension in one or more dimensions at the time of its incorporation in the composite fabric.

The rubber film is preferably formed by spraying rubber latex upon an appropriate surface from which it may be readily stripped. The latex employed for this purpose may be of a prevulcanized type so that the film is vulcanized as it is formed or upon simple exposure to the atmosphere. However, if desired, the film may be formed of ordinary latex, with any of the common accelerators and vulcanizing agents, and then subjected to a later vulcanizing operation in a conventional manner. In any case the film may be formed by spraying a plurality of layers or coats of latex upon an appropriate surface or by applying the latex to such surface in any other convenient way.

In the preferred practice of the invention one face of each of a pair of base materials is preferably coated with a relatively light coating or series of coatings of rubber latex, sufficient to provide an effective bond with one surface of the rubber film which is subsequently inserted between the two base fabrics. Any of the methods and features set forth in the aforementioned, pending applications may be employed in the application of the coating or coatings of latex to the surfaces of the base materials. It will be understood that these base materials will be selected with the desired appearance of the final, composite fabric in view and with the desired stretch characteristics of the final, composite fabric in view. Preferably the latex coatings will be applied by a method and apparatus of the character set forth in the pending application Ser. No. 214,916. In the use of this method and apparatus I have found it desirable to subject each of the fabrics to a number of coating operations, i. e., a number of passages through the spraying zone, the number varying with the amount of rubber desired. Durirng these coating operations the sprays are preferably adjusted to apply between two and twenty grams per square meter for each coating or each passage of the fabrics through the spraying zone. The operation is preferably such that the sprayed latex will not penetrate deeply into the fabric but will simply become lodged on the high points of the coated side. Its presence will then not be apparent from the opposite side.

Referring now to Figs. 1 and 3, the base fabrics, having the rubber latex sprayed on one face of each, are carried in rolls 10 and 11. The arrangement is such that the inner or upper surface of the fabric taken from roll 10 is provided with the porous, adhesive coating, which has not yet been vulcanized and is still quite tacky, while the fabric taken from roll 11 has a similar coating, of either the same or different thickness or weight, on its outer or under surface. The fabrics taken from these rolls, which are supported in any suitable way by the frame of the machine, are brought together over a guide roller 12 and are then passed over the surface of a table 13 to a take-up roller 14.

Between the two webs or layers of base material, there is fed from a roll 15, suitably supported in the frame of the machine, the beforementioned web or thin sheet or film of rubber. This is passed over the guide roller 12 between the two base materials and continues in this relation over the table 13, on which the three layers or webs are adhesively combined or united in the manner to be explained. The rubber sheet or film may be of any suitable thickness, depending upon the strength and elasticity of the composite fabric desired. It may vary between .001 and .010 inch, although in certain cases it may be more or less than this. Its weight, in an unstretched condition, may appropriately vary between 100 and 300 grams per square meter, although it may, for special purposes, be either lighter or heavier than this.

The rubber film may be made in any known manner. It may be formed by spraying rubber latex upon a relatively smooth surface from which the sheet of rubber may readily be stripped. For this purpose a sheet or belt formed of cellulose acetate may suitably be employed as the deposition surface. This has been found to have the requisite smoothness of surface and will permit the rubber film to be readily stripped from it. The important considerations are that the surface, on which the film is formed, should be water-proof, smooth and of such nature as to enable the ready stripping of the rubber film from it. In the formation of the rubber film, the deposition surface, from which it is stripped, may be subjected to between 2 and 20 sprayings or coatings.

As shown in Fig. 3, the webs of base material

carried by the rolls 10 and 11 are preferably wider than the roll 15 of the rubber film. As the rubber film is passed over the guide roller 12, its longitudinal edges are attached, by appropriately stationed operators, to small clamps 16, which are adapted to grip the opposite edges of the rubber film at suitably spaced intervals. These clamps are provided with hooks or rings 17 slidably carried by guide rods 18. The portions 19 of these guide rods, adjacent the roller 12, are parallel and spaced only sufficiently to enable the clamps 16 to grip and hold the rubber film flat but without substantial tension. As the rubber film is attached to the series of clamps, in the manner indicated, the latter will be advanced along the rods 18, by operators stationed at the two sides of the apparatus, and as the clamps are moved along the divergent portions 20 of the rods, the rubber film will be stretched widthwise. This widthwise stretching of the rubber film may be to any extent desired, depending upon the amount of elasticity or "kick" desired in the final, composite fabric and depending upon other factors, such as the original thickness, strength and composition of the film, the nature of the base fabrics, etc. The widthwise stretching of the rubber film may appropriately be between 25 and 100% of its original width, although the film may be stretched to an even greater or to a less extent for certain purposes. Beyond the divergent portions of the rods 18 there are parallel portions 21 which serve to maintain the rubber film in the selected, stretched condition as it is carried over the table 13.

After a suitable section of the rubber film has been carried over the table 13, between the layers of base fabric, the three layers may be appropriately clamped against the top of the table, along a line adjacent the supply or receiving end, by means of a bar 22 operated in any suitable way, as by means of a lever 23. This arrangement is such as to retain one end of the sections of the three materials to be operated upon in fixed relation to the table while the three layers are otherwise still free. The forward end of the rubber film in the section beyond the bar 22, which may be, say, ten yards in length and which overlies the table 13, is now advanced an appropriate extent to stretch the film lengthwise to any desired percentage of its original length. This is accomplished by the operators stationed at the two sides of the table, who may slide the clamps along the section 21 of the rods and who may also pull the rubber film forwardly by gripping it intermediate its edges. After it has been stretched the desired extent, the forward end of the section of material overlying the table 13 may be clamped to the latter by a bar similar to the bar 22, or, if desired, the appropriate tension may be maintained on the rubber film by means of the take-up roller 14.

It will be understood that up to this stage in the process the base fabrics and the rubber film have not yet been united and only the rubber film has been stretched. The base fabrics are still in their normal, untensioned condition so that if a ten-yard length of the rubber film has been stretched to fifteen yards, fifteen-yard lengths of each of the base materials will be required to be united with the rubber film. The uniting of the three layers of the composite fabric may now be accomplished in any suitable way, as by pressing and rolling a hand-operated roller 24 against and over the upper surface of the base fabric 11. The roller may be readily operated in such a way as to avoid wrinkling or creasing the fabric and in this way an effective bond may be produced between the base fabrics and the rubber film.

After the three layers have been sufficiently bonded, the tension on the section of material over the table may be released by lifting the bar or bars 22 and by unclamping the members 16 from the edges of the rubber film. This will result in both a widthwise and lengthwise contraction of the fabric to a certain extent, although the rubber may not, in some cases, return to its original, unstretched dimension. The partially completed section of material may be rolled upon the take-up roller 14 and a new section of each of the three layers may be brought over the table 13 and the operation repeated until a composite fabric of appropriate length has been formed. At either this stage or at some subsequent stage the rubber film which extends beyond the edges of the base fabrics may be trimmed off and, if desired, a small strip of the base fabrics may be trimmed at each edge.

In the event that a sufficient bond between the rubber film and the base fabrics has not been effected by means of the hand-operated roller 24, the fabric on the roll 14 may subsequently be passed between a pair of pressure rolls, such as calender rolls or the like, adapted to squeeze the layers or plies of the fabric together under relatively high pressure. In this way the rubber film and base fabrics may be brought into intimate engagement.

It has been found that a considerably further contraction of the fabric may be brought about by wetting the same after the several plies or layers have been firmly united or combined and preferably, although not necessarily, before the sprayed latex on the base fabrics has been vulcanized. The wetting of the fabric appears to put the base materials and even the fibers themselves into a plastic condition, enabling the threads to adjust themselves readily and permitting the tensioned rubber film to bring about a further contraction both widthwise and lengthwise. However, it will be understood that even in the wet condition the fabric may not be contracted sufficiently to relieve the entire tension in the rubber film. A substantial portion of the pretensioning of the latter may remain, by appropriate selection of the base materials. This will be done when a substantial initial kick is desired. As a result of the contraction of the fabric, the threads or yarns of which it is formed will be brought more closely together than in the original base fabrics. Accordingly, the final, combined fabric will appear to be of a much finer texture, i. e., more closely woven or knit than the original base materials.

In Fig. 2 there is schematically illustrated the wetting, drying and vulcanizing operations to which the composite fabric on the roll 14 is subsequently subjected. This composite fabric may be passed through a bath of water, preferably plain water, in a tank 25. Any suitable means may be employed for insuring the thorough wetting of the fabric with a minimum of strain or tension. After thorough saturation, the fabric may be passed between a pair of squeeze rollers 26 for removing as much of the water as possible. At this stage the fabric will have contracted to its maximum extent. It may now be passed in any suitable way through any desired form of drying equipment. For example, it may be passed beneath a drying hood 27 arranged to blow a stream

of hot air upon and around the fabric and after it has been dried it may be passed through an appropriate vulcanizer 28. Here the sprayed latex previously applied to the surfaces of the base fabrics will be subjected to appropriate vulcanization. The rubber film, however, should not be affected because of the use of prevulcanized latex in the production of this film or because of its prior vulcanization in other ways. Accordingly, the vulcanizing conditions in the vulcanizer 28 should be such as not to over-cure the rubber in the film or otherwise detrimentally affect this film. The accelerators employed in the production of the rubber film should be of such a character as not to bring about over-curing of the rubber in the vulcanizer 28, or the accelerators used in the latex applied to the base fabrics should be of such character as not to require a temperature high enough or a heat treatment long enough to detrimentally affect the rubber film.

After passing through the vulcanizer the fabric may be subjected to a perforating operation of any appropriate type. This is, of course, only in the event that the final fabric is desired to be of a porous character, i. e., permeable to air. The fabric for this purpose may be passed between a pair of rollers 29 and 30, the latter serving to force the fabric over a series of fine needles carried by the roller or drum 29. If considerable porosity is desired, the fabric may be passed through several sets of rollers of this character. Other known means of producing the perforations may be employed, if desired, and this step might be carried out at some other stage in the process. After leaving the perforating rolls, the fabric may be subjected to any desired, final treatments and formed into bolts or other suitable lengths, ready for shipment and use.

Referring now to Figs. 4 to 7, inclusive, a different form of apparatus for carrying out the invention is schematically illustrated. A vulcanized rubber film, which may be formed in any of the ways previously explained, may be supplied from a roll 31 and, without imparting any substantial lengthwise tension thereto, it may be applied to the needles 32 of suitable conveyor chains 33 arranged at the opposite edges of the rubber film. A roller or brush 34 of suitable form may assist in attaching the rubber film to the needles 32 at the receiving end of the chains. These chains, as best illustrated in Fig. 5, may be arranged to diverge at any appropriate angle so that as the rubber film is carried along by the needles 32, it will be stretched widthwise to any desired extent. The angle between the chains may be made variable or adjustable, if desired. At the end 35 of the conveyor chains, which, it will be understood, are operated in any appropriate way by power from a motor or the like (not shown), the rubber will be withdrawn from the needles and wound upon a roller 36. This may be accomplished without applying any substantial lengthwise tension to the film and, due to the friction of the wrappings of the film on the roller 36, it will tend to retain its widthwise stretch and tension. Accordingly, by way of example, a rubber film, which may be a yard in width as taken from the roller 31, may be rolled up on the roller 36 at a width of, say, a yard and a half under a corresponding widthwise tension.

The roll 36 of the rubber film, thus tensioned in a widthwise direction, may now be placed upon an appropriate combining machine, the roll being suitably supported by frames (not shown) and adapted to be driven to feed the rubber film from the roll at any desired rate by means of a motor 37. Any suitable form of variable drive mechanism, such as indicated at 38, may be provided between the motor and the roll 36. For example, a drive of the well known Reeves type may be employed, a belt 39 being provided to take off power from this variable drive mechanism and transmit it to the roller 36. By appropriate adjustment of a hand wheel 40, any appropriate reduction in the drive may be effected between the motor 37 and the roll 36.

The base fabrics to be united with the rubber film fed from the roll 36 may be carried by rolls 41 and 42. These fabrics may be of any selected type of material, preferably capable of stretching to at least some extent in either one or both directions, i. e., widthwise and lengthwise, or being of sufficiently open construction to permit contraction in one or both dimensions. These base fabrics, in the rolls 41 and 42, will have been previously coated with latex, in the manner previously explained, on the surfaces which face toward the rubber film. The three layers of material, including both base fabrics and the intermediate rubber film, are passed between a pair of feed rollers 43 and 44, the latter of which is preferably driven by means of a belt or chain 45 connected with the drive mechanism 38. This arrangement is such that the rate of feed of the rollers 43 and 44 may be varied to any desired extent with relation to the rate of feed of the rubber film from the roll 36. Thus, if it is desired to impart a 50% lengthwise stretch to the rubber film as it is inserted between the two base fabrics, the ratio of the rate of feed of the rubber film from the roll 36 to the peripheral speed of the feed roller 44 should be two to three. In this way each yard of rubber film fed from the roll 36 will be combined with a yard and a half of each of the base fabrics drawn from the rolls 41 and 42. To avoid any substantial variation in the product, the supply roller 36 is preferably relatively large in diameter so that the wrappings of the rubber film about the roller will add little to the total diameter of the roll and will thus cause but slight variation in the rate of feed of the film from the roll. If desired, suitable compensation may be made for the reduction in the diameter of the roll as the film is fed from it.

As the two base fabrics and the intermediate rubber film are passed between the feed rollers 43 and 44, they are subjected to substantial pressure so that a firm bond will be effected between the several layers. This operation may, if desired, be followed by a calendering operation to improve the bond. The composite fabric may then be wound upon a roll 46 and subjected to the same subsequent treatments as explained in connection with the fabric produced by the first-described apparatus. This subsequent treatment may include a thorough wetting of the combined fabric, to render it plastic and thus induce a further contraction, and it may include the perforating step or steps and preparation of the fabric for shipment and final use.

Referring now to Figs. 8 and 9, a further modified form of apparatus for carrying out certain steps of the improved method is schematically illustrated. In this arrangement, the rubber film in unstretched and untensioned condition is carried by a roll 47, mounted on suitable frames (not shown) and adapted to be driven by a motor 48 through a variable drive mechanism 49, which may be of the same type as the drive mechanism

38 previously described. A belt 50 may serve to connect the drive mechanism with the roll 47.

As the rubber film is fed from the roll 47, it is applied by means of a brush or roller 51 to the pins or needles 52 of a pair of conveyor chains 53. These conveyor chains are arranged to diverge with respect to each other so as to produce the widthwise stretch of the rubber film as it is advanced from the receiving end, beneath the roll 51, toward the discharge end 54. Chains 53 are adapted to be driven by the motor 48, through the drive mechanism 49, at a speed differing from the rate of feed of the rubber film from the roller 47 in any relationship desired. Thus, if the film is to be given a 50% lengthwise stretch before it is combined with the non-elastic fabrics, it will be fed from the roller 47 at a rate which is only two-thirds of the rate at which it is advanced by the conveyor chains 53. With this arrangement, the film is subjected to a 50% stretch in its passage between the roller 47 and the point at which it is applied to the pins of the chains by means of the roller 51.

The film which has thus been stretched in a lengthwise direction is then subjected to a widthwise stretch by means of the chains as the latter advance the film toward the discharge end 54. From here it is passed between a pair of feed rollers 55 and 56, one or both of which may be driven at the same peripheral speed as the rate of advance of the conveyor chains. In this way the same lengthwise tension, initially imparted to the film, will be maintained as it is combined with the base fabrics taken from the rolls 57 and 58. It will be understood that these base fabrics may be of any of the types of stretchable, but non-elastic, materials previously explained and they will have an appropriate coating or coatings of latex upon the surfaces facing the rubber film so as to adapt them to be adhesively united therewith. A sufficient pressure or squeezing tension may be provided by the rollers 55 and 56 to firmly bond or unite the three layers as they are passed between these rollers. The combined or composite fabric may then be wound upon a roll 59 and subjected to any of the further treatments hereinbefore mentioned.

As a special feature of the invention, it has been found that the final combined fabric may be very simply and effectively provided with pocket formations or other desired configurations in relief at any desired points by a procedure which will now be explained. These pocket formations are in the nature of an extra fullness of the material or slack at the selected points, when the material is laid flat upon a table or the like. This slackness, or extra fullness or special formation, may be very neatly imparted to the composite fabric by simply forming the inserted film of rubber in such a way as to present the same fullness or pocket construction when not tensioned. Thus, as illustrated in Fig. 10, the rubber film may be formed upon a surface of cellulose acetate, or the like, having bumps or projections 60 of any suitable configuration and size so that as the film is formed by spraying a plurality of coats of latex from a nozzle or series of nozzles, 61, it will be given this particular configuration. It will be clear that when the film is subsequently stripped from the cellulose acetate backing, it will not lie flat but will have the extra fullness or pocket formation, or other form of the surface on which it is produced, at the points where the projections 60 were provided on the deposition surface. Or the desired configuration may be imparted to the rubber film by first forming a flat, unvulcanized film and then molding this into the desired form in the course of vulcanization.

Now, when the rubber film, formed in either of the ways just explained, is subjected to the widthwise and lengthwise stretching operations, previously explained, by any of the means or methods described, the extra fullness or pocket formation or other configuration will be eliminated and the rubber film under tension will become perfectly flat. However, due to the previous fullness or pocket formation of the rubber at the particular points, the tension upon the rubber in the areas formed over the projections 60 of the molding surface will be substantially less than the tension in the originally flat portions of the film and in some cases they may be substantially free of tension, i. e. if the film is simply stretched enough to flatten the projections.

Since the rubber film will be entirely flat while under tension, it may be combined with the two base fabrics, in any of the ways explained, without presenting any special difficulty. However, when the base fabrics and rubber film have been combined, and the tension is released upon the rubber film to the full extent permitted by the base fabrics, it will be found that the extra fullness or special formation will be imparted to the composite fabric. This extra fullness may not be to quite the same extent as in the original rubber film but it will be a substantial percentage of that original fullness. Due allowance for the possible difference should, of course, be made in the formation of the bumps 60 on the molding surfaces. In this way a continuous strip of elastic fabric may, for example, be formed with bust pockets provided at appropriate intervals to enable a series of brassière sections, or bathing suit sections, or the like to be cut therefrom.

In the production of the sheet or film of rubber, the thickness of varions portions or sections of the same may be varied, if desired, whether the sheet is simply flat or is provided with the projecting portions or pockets just described. This is in the event that extra strength and resistance to stretch or "kick" is desired in certain portions of the fabric which are to form, for example, some particular parts of garments or the like. This may readily be accomplished by protecting or shielding certain areas or portions of the surface on which the latex is being sprayed against the deposit of latex during any selected number of the spraying operations. For example, if the thickest portions of the film are to be made of such a weight as to require ten passages of the mold or deposition surface through the spraying zone, the entire area of the mold might be exposed for, say, five of these passages and then selected portions, which are to be thinner than the remaining portions of the film, may be covered with paper, or the like, to prevent the latex from being deposited on those selected portions during the subsequent passages of the mold or deposition surface through the spraying zone. In this way the selected areas which are covered or shielded by paper will be of only about half the thickness of the areas which have not been covered. Obviously, the shielding may be applied at any desired stage or stages in the formation of the rubber film.

It has been discovered, however, that a much greater variation in the elasticity or resistance to stretch of different portions of the final fabric may be produced by a variation in the quantity of latex sprayed upon different portions of the

base fabrics. It has been found, for example, that if a certain area of the base fabrics, such as that between the lines 62 and 63 of Figure 11 is given, say, eight coatings of latex, e. g., is passed through the spraying zone eight times, whereas other portions of the base fabric are permitted to receive only four of these coats, by being covered or shielded with paper or the like during the remaining four passages through the spraying zone, the composite fabric resulting from the combination of such base fabrics with a tensioned rubber film will have an elasticity or resistance to stretch in the region between the lines 62 and 63 that is many times the elasticity at other portions of the fabric. This is remarkable in view of the fact that the actual difference in the amount of rubber in the area between the lines 62 and 63, as compared with that in other portions of the composite fabric, will be relatively small. For example, if the rubber film weighs 150 grams per square yard, the coatings on the two base fabrics in the area between the lines 62 and 63 may be, say, eighty grams per square yard while the coatings on the base fabrics in other areas may be forty grams per square yard. In the composite fabric, then, the total rubber in the area between the lines 62 and 63 will be 230 grams per square yard whereas the total weight of rubber in other sections of the fabric will be 190 grams per square yard. Yet the elasticity, or resistance to stretch, of the section between the lines 62 and 63 may be three or four times, or even more, the resistance to stretch of other portions of the fabric. While I do not wish to limit myself to any theory as to how this remarkable result is brought about, it is possible that it is due to the fact that the rubber in the inserted film and the rubber in the latex applied to the coated base fabrics is in part subjected to tensile stresses and in part to shear stresses. When the greater amount of latex is applied to the base fabrics, there may be a correspondingly greater effect of the shear stresses, which may account for the abnormally increased resistance to stretch. Or the globules or droplets of latex on the base fabrics in adhering to the rubber film at spaced points may so modify its stretch characteristics as to produce this result.

It will be appreciated that fabric of the type indicated in Fig. 11, having different sections of different stretch characteristics, may be used to advantage in the production of various forms of garments and other articles. For example, panties, of the type shown in Fig. 12, may be formed with a band 64, spaced somewhat below the upper edge, of greater elasticity or resistance to stretch than the upper and lower portions 65 and 66. This will enable the intermediate portion 64 to exert a desired confining force upon the abdomen while the upper and lower portions of the garment may have a relatively easy resistance to stretch and interfere little with the comfort and ease of movement of the wearer. The section having greater resistance to stretch may, if desired, be provided only at the front of the garment or it may be provided at any other point desired.

While several embodiments of the invention have been disclosed in considerable detail, it will be understood that numerous variations may be made in the several methods of procedure, and in the form and arrangement of the apparatus for carrying out the improved methods, as well as in the character of the products resulting from these improved methods, without departing from the general principles and scope of the invention. The terms and expressions used herein have been used as terms of description and not of limitation. The term "textile base fabric" as used in the claims is intended to include knit, woven and other fabrics produced by the interengagement of threads or yarns. The term "extra fullness" as herein employed may be defined as the condition of the fabric resulting from the fact that the surface area of a particular portion when relaxed is greater than that of a plain surface bounded by the same periphery as said portion.

I claim:

1. A method of producing elastic fabric having the appearance and feel of non-elastic fabric which comprises forming a thin, vulcanized film of rubber, applying unvulcanized rubber latex to only one surface of each of a pair of textile base fabrics, stretching said rubber film, adhesively uniting said base fabrics by means of said latex to the opposite faces of said rubber film as the latter is held stretched, wetting the composite fabric so formed with water, and subsequently vulcanizing the latex.

2. A method of producing elastic fabric having substantially different resistance to stretch in different regions and the appearance and feel of non-elastic fabric which comprises forming a thin, vulcanized film of rubber, applying rubber latex to only one surface of each of a pair of textile base fabrics by spraying a plurality of successive light coats upon each of the same in such a manner as to prevent substantial penetration of the fabrics, varying the number of coats of latex sprayed upon different portions of at least one of said base fabrics, stretching said rubber film, and adhesively uniting said base fabrics by means of said latex to the opposite faces of said rubber film as the latter is held stretched.

3. A method of producing elastic fabric having the appearance and feel of non-elastic fabric which comprises forming a thin, vulcanized film of rubber, applying rubber latex to only one surface of each of a pair of textile base fabrics, stretching said rubber film and tensioning the same both widthwise and lengthwise and holding the same in stretched condition, varying the tensioning force imparted by said stretching to different portions of said rubber film, and adhesively uniting said base fabrics by means of said latex to the opposite faces of said rubber film as the latter is held stretched.

4. A method of producing elastic fabric having the appearance and feel of non-elastic fabric which comprises forming a thin, vulcanized film of rubber having integral portions of excess area forming pockets when the film is laid flat but not stretched, applying rubber latex to only one surface of each of a pair of textile base fabrics, stretching said rubber film and thereby eliminating said pockets, and adhesively uniting said base fabrics by means of said latex to the opposite faces of said rubber film as the latter is held stretched.

5. A method of producing elastic fabric having the appearance and feel of non-elastic fabric which comprises forming a thin, vulcanized film of rubber having integral slack portions of greater area than the plane area enclosed by the line of connection between said portions and the surrounding parts of the film when the latter is not under tension, applying rubber latex to only one surface of each of a pair of textile base fabrics, stretching said rubber film and thereby eliminat-

ing said slack portions, and adhesively uniting said base fabrics by means of said latex to the opposite faces of said rubber film as the latter is held stretched.

6. A method of producing elastic fabric which comprises forming a thin, vulcanizing rubber film having substantially flat portions and pocketed portions extending out of the general plane of said flat portions, and adhesively uniting therewith, by means of rubber latex, a non-elastic but stretchable textile base fabric, the rubber film being stretched in two dimensions in the plane of said substantially flat portions and held under tension while the base fabric is substantially unstretched during the uniting process.

7. A method of producing elastic fabric which comprises forming a thin, vulcanizing rubber film, applying rubber latex in variable amounts to one surface of a textile base fabric of stretchable but non-elastic material, said latex being applied in greater quantities at some portions of said surface than at others, and adhesively uniting said surface of the base fabric to a surface of said rubber film while the latter is tensioned in two directions and held under tension.

8. In apparatus of the class described means for feeding a thin rubber film, means for feeding non-elastic base fabrics in juxtaposition to the opposite faces of said rubber film, means for operating said feed means to supply said rubber film at a slower rate than said base fabrics, means for including devices arranged to grip the longitudinal edges of the film stretching said rubber film and holding the same tensioned in two dimensions between said base fabrics and independently thereof, and means for squeezing said base fabrics and tensioned rubber film together to unite the same.

9. In apparatus of the class described means for feeding a thin rubber film, means for feeding non-elastic base fabrics in juxtaposition to the opposite faces of said rubber film, means for operating said feed means to supply said rubber film at a slower rate than said base fabrics, said last recited means being adjustable to vary the relative speeds of operation of said feed means, means including devices arranged to grip the longitudinal edges of the film for stretching said rubber film and tensioning it in two dimensions between said base fabrics and independently thereof, and means for squeezing said base fabrics and tensioned rubber film together to unite the same.

10. In apparatus of the class described means for feeding a thin rubber film, means for feeding non-elastic base fabrics in juxtaposition to the opposite faces of said rubber film, means including devices arranged to grip the longitudinal edges of the film for stretching said rubber film in a widthwise direction, means for subsequently stretching said film in a lengthwise direction, said stretching means operating upon said film independently of said base fabrics, and means for squeezing said base fabrics and tensioned rubber film together to unite the same.

11. In apparatus of the class described means for feeding a thin rubber film, means for feeding non-elastic base fabrics in juxtaposition to the opposite faces of said rubber film, means for stretching said rubber film in a lengthwise direction, means including devices arranged to grip the longitudinal edges of the film for subsequently stretching said film in a widthwise direction, said stretching means operating upon said film independently of said base fabrics, and means for squeezing said base fabrics and tensioned rubber film together to unite the same.

MARC ALFRED CHAVANNES.