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(54) **Apparatus and method for the continuous application of a repetitive adhesive pattern onto a stretch fabric**

Vorrichtung und Verfahren zum kontinuierlichen Auftragen eines Klebstoffs gemäss einem sich wiederholenden Muster auf eine elastische Warenbahn

Dispositif et procédé d'application en continu d'un motif répété d'adhésif sur un tissu étirable

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Description

[0001] The present invention relates to an apparatus and process for the continuous application of a repetitive adhesive pattern onto a stretch fabric with a high degree of accuracy. The stretch fabric produced in accordance with the present apparatus and process has found particular utility in providing additional reinforcement at desired areas of a woman's undergarment, such as panties, brassieres and pantyhose. Such additional reinforcement, or enhanced figure shaping, may typically be provided by restricting the ability of the garment to stretch at the stomach, buttocks or thigh regions of a panty or pantyhose, as well as the undercup and/or side panels of a brassiere. It is well known to provide such support by additional panels which are sewn to the main body fabric of the garment. Such sewing disadvantageously adds to the cost, stiffness and overall bulk of the garment, often times presenting the consumer with a garment of undesirable heaviness.

[0002] Recognizing the disadvantages of such supplemental sewn panels, applicant has developed highly desirable products in which the additional support is provided by an adhesively secured panel. Advantageously, the pattern of the adhesive is of a desired configuration and orientation such that it offers different magnitudes of resistance to stretch in its various directions. Hence, the characteristics, configuration, and orientation of the adhesive pattern will act in conjunction with the stretch characteristics of the fabrics to determine the additional support, for the figure shaping provided by the resultant garment. Such additional support is typically provided at the stomach region of a panty with the adhesive layer, as well as its laminate, offering greater resistance to stretch in the horizontal direction (around the body) than in the vertical direction.

[0003] One such arrangement for utilizing the characteristics and configuration of the adhesive layer as a factor in determining the laminate support is the subject of applicant's EP-B-0255101 entitled "Method and Apparatus For Providing Additional Support To Selected Portions of A Garment And Garment Produced Thereby", in which the additional support panel is adhesively secured to the main body panel. The adhesive securement is obtained by applying a desired pattern of a hot melt adhesive powder to the fabric of the support panel through a silk screen. The support panel is then heat cured and cut to its desired shape. The panel is then laminated to the main body fabric, with the powder adhesive being fused to and substantially confined between the two fabric layers so as to interconnect the fabric layers. The additional support provided by the reinforcement panel is predeterminedly controlled by the selected shape and configuration of the pattern and thickness of the adhesive layer in conjunction with the stretch characteristics of the fabrics.

[0004] Advantageously the fabrics can be selected such that the pattern of the adhesive layer is visible

through at least one of the fabrics (e.g. the reinforcement panel). Accordingly, the pattern of the adhesive layer, in addition to contributing to the requisite additional support, can be selected to provide a pleasing aesthetic presentation, which is imparted and delineated to the outer layer of one of the fabrics (without adhesive being present on the outer fabric layer) so as to provide further consumer enhancement of the product.

[0005] The product produced by the process of EP-B-0255101 has achieved substantial consumer acceptance and utility. However, the utilization of the silk screen for applying the powdered adhesive pattern limits the manufacturing speed, accuracy and overall efficiencies in the fabrication of the laminate and the resultant undergarments. It has also been experienced that the uniformity of the pattern applied through the silk screen is subject to variation, dependent upon such factors as humidity, particle size of the adhesive particles and the practical difficulty in repeatedly applying uniform pressure over the full extent of the silk screen. Further, this is a discontinuous process in which the textile fabric is stationary while the silk screen applies the adhesive powder thereto. Variations in the tensions of the fabric during subsequent applications of the adhesive screen will result in corresponding variations in the pattern. This can be particularly problematic where the pattern is in the form of the desired shape of the stomach panel, and must thereafter be die cut from the expanse of fabric. Slight variations in the tension of the fabric during the application of the adhesive pattern through the silk screen will result in corresponding variations in the size of the resultant pattern as the fabric is relaxed, and hence, lack of repeatability in subsequently die cut reinforcement panels.

[0006] Several of the potential problems and costs associated with the silk screen application of powdered adhesive at discrete and separated portions of the support fabric may be alleviated according to applicant's PCT Publication WO 94/23601 of October 27, 1994, and entitled "Fabric Laminate And Garments Incorporating Same." As disclosed therein, the support panel is adhesively secured to the body by an integral adhesive web. The web, while not having a definitive pattern, is characterized as offering different magnitudes of resistance to elongation when subjected to distortion in its different directions. The adhesive web is predeterminedly oriented within the laminate in accordance with its differential elongation characteristics such that the additional support provided by the support panel and the adhesive web is combinedly determined by the differential stretch characteristics of the adhesive web, the stretch characteristics of the fabrics, and their relative orientation. The adhesive web is in the form of a net-like film which may be readily cut to conform to the shape of the reinforcement panel, keeping in mind only its differential elongation characteristics so as to maintain the desired orientation with respect to the fabric layers. Inasmuch as the reinforcement layers are separately cut from their fabric

yard goods, this process does not require the separation of discrete panels on the reinforcement fabric, prior to cutting into individual panels, nor the high degree of accuracy previously demanded in cutting out the individual and separated panels of EP-B-0255101 which had been silk screened on the support fabric. While increasing the manufacturing efficiency, a disadvantage of this process is that the adhesive web, while exhibiting differential stretch characteristics, does not have the ability to provide the more substantial variations in support which can be achieved by the design and thickness of the specific pattern of the silk screen adhesive applique. That is, where the pattern had been applied through the silk screen, the design of the pattern may be changed to adjust the degree of control which is to be contributed by the adhesive layer. For example, where a higher degree of control is required, the pattern would be modified to provide a greater concentration of adhesive while still maintaining the requisite soft feel or "hand" of the fabric. Likewise different product applications of the support panel (as between a panty, pantyhose, or a brassiere) would typically require different degrees of support. This can be achieved by the selection of the reinforcement fabric in conjunction with varying the pattern and characteristics of the adhesive selected for the adhesive layer. Further, the adhesive web of this process does not present the enhanced aesthetics of a pattern visible at the outer surface of at least one of the laminate fabrics.

[0007] The prior art, in addition to applicant's aforementioned EP-B-0255101, WO-A-94/23601 or Applicant's EP-A-0734660 have suggested various other arrangements for applying a patterned layer to a substrate. However, such prior constructions do not disclose the inclusion of a tensionless feed for insuring that should a stretch fabric is used, the adhesive pattern will be accurately and repetitively applied as a continuous pattern. For example, Byrne US-A-3,228,408 applied a plastic reinforcement material to the fabric through a silk screen as a flowable paste which is intended to enter the fabric and embed the individual threads forming the fabric. Utilization of the silk screen naturally requires a discontinuous process.

[0008] Storti US-A-3,383,263 is directed to a method for preparing a fabric laminate by laminating two fabrics by means of regularly recurring spaced geometric units of substantially dry adhesive film sandwiched between the outer fabric surfaces, with the result laminate having a raised pattern portion as determined by the adhesive pattern.

[0009] Adachi US-A-3,497,415 forms a laminate including fabrics of different elasticity secured together with a conventional adhesive, such that the laminate characteristics are primarily determined by the elasticity of the two fabric layers.

[0010] Backes US-A-4,135,025 varies the stretch characteristics of a fabric by the selective insertion of different warp and weft threads into the fabric.

[0011] Additional composite elastomeric materials

are disclosed in Kasper et al US-A-3,489,154 and Vander Wielen US-A-4,720,415.

[0012] Various other apparatus and methods for continuously applying a layer of material to a substrate are disclosed in US-A-4,999,212, 5,196,063, 4,671,205, 5,053,254, 4,978,402, 4,612,874, 4,050,409 and 4,379,185, none of which have the ability to accurately apply a repetitive adhesive pattern onto a stretch fabric as does the instant invention.

[0013] DE-2313971 describes a device for the continuous printing of dyes onto a voluminous web-form material such as a carpet. The material to be printed is drawn around on a perforated drum on which the material is firmly and unshiftable held by suction so that accurate printing is possible, but the suction also assists the drawing-in of dye paste into the material. The material hangs in self-supporting loops before and after its passage on the drum.

[0014] The apparatus and process in accordance with the present invention advantageously permits the higher manufacturing speeds and efficiency of a continuous process, while readily permitting substantially variation in the characteristics and pattern of the adhesive reinforcement pattern applied to the stretch fabric in a highly accurate and repetitive manner. A particularly unique aspect of the present invention is the maintenance of the stretch fabric in a tensionless condition while the adhesive pattern is continually applied thereto, from about the outer circumferential surface of a seamless rotary printing member. The rotary printing member is advantageously a cylindrical screen, which has the desired regularly repeated pattern over its circumference. A liquid thermoplastic adhesive is continually supplied to the interior of the cylindrical screen and urged outward through the perforations of the screen at a desired rate by an interior doctor blade. As the screen rotates the stretch fabric traverses its outer printing surface after exiting from a tensionless feed. The tensionless feed, which is provided intermediate the stretch fabric source and the rotating printing member may typically be in the form of a J-frame scray or an endless belt, which will continuously store a desired length of the fabric in a non-taut, slack condition prior to being presented to the rotary printing surface of the screen cylinder. After application of the adhesive pattern, the stretch fabric will typically pass through an oven to dry the adhesive. After exiting the oven, the stretch fabric with the adhesive layer may then be wound on a storage roll, for subsequent transfer to the manufacturing location for forming the individual reinforcement panels, and fusing same to the body fabric of the garment. If desired, a tensionless feed may be interposed between the oven exit and the storage roll.

[0015] In accordance with a modified embodiment of our invention, after the adhesive pattern has been applied to the stretch fabric, a second stretch fabric (eg. typically the main body fabric of the undergarment) will be presented against the exposed surface of the adhe-

sive layer prior to presentation to the oven. In this embodiment, the oven will be at a higher temperature so as to fuse the layers together, instead of merely drying the adhesive. The second fabric will likewise pass through a tensionless feed means prior to lamination, with the resultant laminate may also pass through a tensionless feed means before the laminate is wound on a roll. Although various alternative tensionless feed means may be employed, a J-frame scray may be used at all three locations. The tensionless feed ensures a smooth laminate, devoid of wrinkles or bubbles, which might be present if either fabric was processed while under tension.

[0016] The adhesive pattern applied through the rotary screen may be readily changed by substituting different rotary screen within the rotary printing apparatus. One such screen, for which the present invention provides particular manufacturing efficiencies, includes individual and definitive areas of predetermined shape (eg. the front reinforcement panel of the panty), which are separated by relatively open areas. Peel strength of the laminate may be further controlled by selection of the adhesive and of doctor blade force. The maintenance of the stretch fabric in a tensionless state while this repetitive pattern is applied to the stretch fabric will enhance the uniformity, shape and spacing of the definitive areas. These definitive areas will then substantially be die cut from the expanse of the fabric and fused to the main body fabric of the resultant garment.

[0017] To further enhance the cost saving attendant to the present manufacturing apparatus and method, the adhesive pattern may be an all-over pattern over the expanse of the stretch fabric, without any intermediate open areas between definitive reinforcement areas, such as is the subject of applicant's EP-A-0734660, mentioned above. In either the all-over pattern, or the separated definitive patterns, the adhesive layer will advantageously be designed to have differential elongation, characterised as offering different magnitudes of resistance to elongation when the fabric laminate is subjected to distortion in selected differential directions. Hence, with the adhesive securement layer being predeterminedly oriented in accordance with its differential elongation and the stretch characteristics of the fabrics, the resistance to elongation offered by the fabric laminate will be determined by the pattern and orientation of the intermediate adhesive layer in conjunction with the stretch characteristics of the fabrics.

[0018] The adhesive is preferably a thermoplastic such that when the support panel is applied to the body fabric of the garment, the adhesive will, upon suitable temperature, be reactivated to securably adhere the support panel to the body fabric, to form a laminate. The adhesive will be confined to between the fabric layers so as to neither a) adversely affect the hand of the laminate, nor b) lock itself around the yarn of the fabric.

[0019] Advantageously, the degree of additional reinforcement, and hence figure control, provided by the ad-

hesive securement layer can be suitably adjusted by making variations in the pattern, the selection of the particular liquid adhesive, and doctor blade pressure against the interior of the screen.

[0020] Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a side view of a diagrammatic representation of a preferred form of the apparatus in accordance with the present invention.

Figure 2 is a perspective view of a portion of the apparatus shown in Figure 1, and more particularly, the tensionless presentation of the stretch fabric from its supply roll to the rotary printing member.

Figure 3 shows one form of the rotary printing screen which may be used in accordance with the apparatus of the present invention.

Figure 4 shows in plan view, the stretch fabric which has had the adhesive pattern applied thereto from the particular rotary screen printing member of Figure 3.

Figure 5 is a front view of a panty in which the stomach panel is reinforced utilizing the reinforcement panel fabricated on the apparatus shown in figures 1-4.

Figure 6 generally corresponds to Figure 2, but shows the utilization of a different pattern about the circumference of the rotary screen printer.

Figure 7 is a diagrammatic view of a modified apparatus, generally corresponding to that shown in Figure 7, but showing the addition of a second stretch fabric in the tensionless state to form a laminate.

Figure 8 is an elevation view of the layers forming the laminate formed in accordance with the instant invention and utilizing the rotary screen printer of Figure 6, with the body fabric being partially broken away to reveal the underlining support panel and applied adhesive securement layer.

Figure 9 is a cross sectional view of the laminate forming the layers shown in Figure 10 along the arrows 9-9.

Figure 10 is an elevation view of the laminate with the reinforcement panel including the adhesive of the all-over pattern of Figure 8, shown reduced and indicating the manner in which the individual stomach support panels may be cut out from the expanse of the laminate.

Figure 11 is an enlargement of a portion of Figure 10, showing the particular pattern of that adhesive layer in greater detail.

Figure 12 is an enlargement of a cross section of the stretch fabric (prior to the application of the additional stretch fabric to form the laminate) in which the adhesive has been applied, with a particular adjustment of the doctor blade force.

Figure 13 corresponds to Figure 12, with the doctor

blade force varied, all other conditions being the same.

Figure 14 is a front view of a panty in which the laminate of Figure 11 forms the stomach panel.

Figure 15 is a view corresponding to a portion of Figure 11 but showing a variation in the pattern of the adhesive securement layer.

Figures 16-20 depict further variations in the pattern of the adhesive securement layer.

Figure 21 is a front view of a pair of pantyhose which includes a stomach panel fabricated in accordance with the present invention.

Figure 22 is a front view of a brassiere which includes an undercup support panel fabricated in accordance with the present invention.

Figure 23 is an elevation view of the lower cup section of the brassiere shown in Figure 22.

Figure 24 is a modification of the apparatus shown in Figure 1, which utilizes an alternative form of the tensionless feed means at the input, and has dispensed with the output tensionless feed means.

Figure 25 shows in diagrammatic form, an alternative tensionless feed means which may be used in conjunction with the apparatus of the instant invention.

Examples

[0021] Referring initially to Figures 1 and 2, the apparatus 10 includes a supply roll 15 of stretch fabric 11 which is on axial reel 12, supported on fixture 13. The stretch fabric 11 will, after suitable application of an adhesive pattern thereto be laminated to the elastomeric main body fabric in the garment to provide selective reinforcement. Typically, this main body fabric will include an elastomeric yarn, such as Lycra to provide a desired degree of resistance to elongation. The magnitude of its resistance to elongation, which can be controlled by several factors, including the characteristics of the elastomeric yarn, is referred to as the modulus of the fabric. Stretch fabric 11 may also include an elastomeric yarn. However, for cost saving, fabric 11 may preferably be a non-elastomeric stretch fabric, wherein the stretch is achieved by the construction of the fabric as by a circular knit. Alternatively, fabric 12 could be woven with its yarn placed at an angle (e.g. 45°) with respect to the anticipated distorting force. This is referred to as bias stretch which occurs from the ability of the fabric construction to distort and permit elongation without the use of elastomeric yarn. Fabric 11 when it is assembled within the garment will have its primary direction of stretch in a desired direction.

[0022] A drive roller 14, actuated by a suitable motor (not shown) will unwind the fabric 11, in conjunction with backup roller 17, from supply roll 15 at a desired rate. While the fabric is being unwound, biased arm 16 extends across the surface of the fabric to provide a smooth and continuous unwinding of the stretch fabric.

[0023] Most importantly in accordance with the present invention, after the stretch fabric 11 is unwound by drive roller 14 and its complimentary back-up roller 17, the stretch fabric enters a tensionless feed means 20.

[0024] In the embodiment shown in this figure, the tensionless feed means 20 is in the form of a J-frame scray 22. Upon the initial feeding of the stretch fabric 11 from supply roll 15 a desired amount of fabric is loosely deposited within the J-frame 22, as shown by 11-1, such that the fabric 11 at the exit 24 of the J-frame will be in a tensionless state. A driven roller 30 which will be removing fabric 11 from the J-frame 22, at the same speed that roller 14 deposits the fabric therein is provided at the exit 24 of the J-frame. The stretch fabric 11 will then be in a tensionless state, as it is then presented to the rotary printing station 40.

[0025] Rotary printing station 40 includes a hollow rotary screen printer 42 and a backup roller 44 through which the fabric will pass for application of the desired adhesive pattern. The circumference of rotary screen printer 42 includes a substantial number of perforations over its circumference, arrayed to form the desired pattern. The particular pattern, as shown in greater detail in Figures 2-4 may include definitive first areas 44, of a generally all-over triangular configuration, which are separated by generally opened second areas 46. The generally triangular areas are configured to form the front panel of a panty, as typically shown in Figure 5. Alternatively, as shown in conjunction with Figures 6 and 8-20 a uniform all-over pattern maybe formed over the circumference of the cylinder, in which the individual elements will be arranged in successive generally horizontally and vertically extending rows.

[0026] A doctor blade 50 extends along the axis 52 of the rotating hollow printing screen cylinder 42 with its end 54 being applied against the interior surface of the cylinder 40. The pressure between end 54 and the interior circumference of the cylinder 40 may be predeterminedly adjusted. A source of liquid thermoplastic adhesive 60 pumps the adhesive through conduit 62 to the interior of printing cylinder 42, to form a continuous pool 64 of the liquid adhesive. Accordingly, as cylinder 42 rotates and the stretch fabric (which will be in a tensionless state) moves between its outer circumferential surface and backup roller 44, the perforate pattern about the cylinder circumference will deposit the corresponding pattern of adhesive on fabric 11 (as shown in Figure 6) as the doctor blade 50 forces the adhesive through the screen cylinder, in accordance with the controlled force of the doctor blade pressure.

[0027] The rotary printing assembly, utilizing the cylindrical screen printer 42 may be the Stork PD-III-c textile screen coater apparatus manufactured Stork Brabant BV of Boxmeer, Holland. Alternatively, the rotary printer may be a solid cylinder with the pattern engraved into its outer surface, as generally shown in applicant's, US-A-3,605,191. The thermoplastic adhesive applied

from source 60 is a preferably fast-drying adhesive, such as the 2P2 polyamide adhesive available from EMS GmbH Domat-EMS, Switzerland.

[0028] Fabric 11, in which the triangular areas 44 will ultimately form the reinforcement panel of a panty, as shown in Figure 5, may typically be a non-elastomeric circular knit 85/1Nm 100% cotton fabric. It is naturally understood however, that other adhesives and fabrics may be utilized, according to the desired configuration of the adhesive pattern applied to fabric 11, the associated fabric forming the laminate and the ultimate end product use.

[0029] The fabric 11 emerging from the rotary printing assembly 40 will then be transposed by roller assembly 66-68 to oven station 70. Rollers 66-68 are suitably construed so as not to disrupt the adhesive pattern applied to fabric 11, which may still be in a tacky state. Oven 70, which may typically be at about 360°F, dries the adhesive, after which the fabric will be rolled on storage roll 72, which rotates about its reel 74 and is supported on frame 76.

[0030] Advantageously, a tensionless feed, such as 80, is located between the exit end 71 of the oven and storage roller 72, to further insure that the fabric will be presented to roller 72 in a tensionless state, so as to maintain the accuracy of the pattern applied thereto with a high degree of repeatability.

[0031] The applied adhesive pattern, of in Figures 2-4, comprises individually spaced reinforcement panels 44 for subsequent bonding to the main body fabric of the panty. These individual panels must be die cut exactly about their perimeter, as shown by the dash lines 45 in Figure 4. Inasmuch as fabric 11 is a stretch fabric, any variation in the tension forces of the fabric between the application of the adhesive and its relaxed condition, as the stretch fabric 11 is passed through the printing station 40 will result in a variation in the pattern of the adhesive configuration applied thereto. Hence, when the fabric subsequently relaxes there will be an inexact duplication of the adhesive pattern, resulting in variations in the die cut product. Further, if the stretch fabric 11 is under tension as the adhesive pattern is applied thereto, the subsequent relaxation thereof can result in undesirable wrinkles or bubbles in the resultant fabric. Further, this could result in variation of the amount of adhesive being applied, resulting in inconsistent modulus, flex cracking, and an improper fit of the ultimate garment.

[0032] Accordingly, in order to maintain a high degree of accuracy and repeatability in the application of the adhesive pattern to the stretch fabric utilizing a continuous process with a rotary printing member such as rotary screen 42, it is important that the stretch fabric 11 be maintained in a tensionless state, as is provided by the instant invention. Any elongation of the stretch fabric 11 during the application of the adhesive pattern through screen 42 will disadvantageously affect the accuracy of the pattern.

[0033] The particular pattern 44 as shown in the screen configuration of Figures 2-4 will then be applied to the front panel 72 of panty 70 as shown in Figure 5. The reinforcement panel 44 is appropriately fused to the fabric 72 in a fusing station, which may include a fusing press of the general type described in aforementioned EP-B-0255101, in which the adhesive 44 is suitably thermally activated to provide a secure attachment between stretch fabric 11 of the reinforcement panel and stretch front panel 72 of the panty. Advantageously, the adhesive is confined between the textile fabrics without flowing into either the fabric and adversely affecting the fabric hand. As is well known in the art, the fusing dwell time, temperature and pressure will depend upon the fabrics, thickness of the adhesive, and the amount of resultant control being provided. The fabric forming front panel 72 of the panty may typically be a four bar Raschell-knit comprising 80% cotton 120/1Nm, 17% Lycra, 140 denier and 3% nylon (with the nylon being provided for the aesthetics of a spaced dot configuration over the surface of the fabric). The elastomeric properties and modulus of this fabric will naturally be obtained by its Lycra content. Advantageously, textile fabric 11, and/or the fabric of front panel 72 are selected such that the adhesive pattern 44 will be imparted and delineated to the outer layer of at least one of these fabrics (without the adhesive being present on the outer fabric layer) so as to provide a pleasing aesthetic presentation and further consumer enhancement of the product.

[0034] The pattern 44 of the applied adhesive is intentionally designed to have substantially less elongation in the horizontal direction, (e.g. around the body). Further, by virtue of the greater concentration of adhesive material at the central-most portion of pattern 42, its maximum resistance to stretch, and hence abdominal support, is preferably provided at the inner most section 44-1 of the pattern.

[0035] Panty 70 will typically also include side panels 74 and 76, and a back panel 78. However, panels 74, 76 and 78 may be combined into a single fabric piece which, for aesthetic reasons, may be formed of the same textile as front panel 72. A crotch section 80 is typically provided at the lower most portion of the garment. An elastic waistband 82 extends along the top of the garment. Another elastic band 84 sewn around the edges of the front, side and rear panels to provide a leg cut out, which also continues along the sides of the crotch piece 80.

[0036] While the panty construction shown in Figure 5, with the adhesive reinforcement pattern 44, has achieved significant consumer success, the manufacturing cost is increased because of the wasted fabric, such as shown by open areas 46 of Figure 4, which are usually discarded after the individual triangular reinforcement panels 44 are die cut from the fabric expanse. Further, the need to accurately die cut each of the panels 44, as shown by the lines 45 in Figure 4, tends to slow the manufacturing process, again adding to the prod-

uct's cost. Accordingly, as is the subject of aforementioned EP-A-0 734 660, an all-over adhesive pattern may be applied to the fabric 11, rather than the individual and definitive areas 44 which are spaced from each other by the open areas 46. The application of such a pattern is shown in Figure 6, which generally correspond to the rotary printing portion 40 of Figure 2 with like numbers used to indicate corresponding components. The perforate circumferential screen printing surface of drum 42-1 comprises an array of aligned individual elements, such as diamonds, which are arranged in successive, generally horizontally and vertically extending rows. The resultant pattern is designed to have differential elongation, characterized as offering different magnitudes of resistance to elongation when a laminate, containing such a reinforcement layer is subjected to distortion in different direction. To further enhance the manufacturing efficiencies utilizing the all-over adhesive pattern as shown in Figure 6, the expanse of fabric 11 with the adhesive pattern applied thereto may be laminated to its associated fabric (e.g. the main body fabric of the garment) before being die cut into individual panels. This can be done in a separate laminator after the roll 72 of adhesively printed textile fabric 11 is removed from the apparatus. Alternatively, and to further enhance the manufacturing efficiencies, the lamination to the additional fabric can be performed in the same apparatus, such as shown in 100 of Figure 7, wherein components corresponding to Figure 1 are designated by the same numerals. An additional source of the other fabric layer 102 is provided by roll 104 resting on fixture 106, and which is positively fed into the apparatus by drive spindle 108. Fabric 102 will also be a stretch fabric, and, may include an elastomeric yarn such as Lycra. In order to provide a smooth laminate fabric 130, the laminating portion 110 of the apparatus receives fabric 102 in a tensionless state. This could be provided by passing fabric 102 through a J-frame scray 112, generally corresponding to scray 22. Fabric 102, while in the tensionless state passes over rollers 114 and 116 and then downward, over roller 118, at which time it will be presented in opposed relationship to, and against, the just applied adhesive layer of fabric 11 emerging from the screen printer 42. The fabrics 11 and 102, with the printed adhesive layer of fabric 11 therebetween are then presented to complimentary laminating rollers 120, 122. The pressure of these rollers is suitably adjusted to join the fabrics together in their tensionless state, while maintaining the integrity of the adhesive pattern and not forcing the adhesive into either fabric. The laminate is then passed to oven 124, which will be at a suitable temperature for curing the adhesive. The laminate 130 exiting oven 124 is then advantageously presented to another J-frame scray 126, after which it is wound on roll 128. The laminate 130 thus formed, and utilizing the all-over adhesive pattern of rotary printing screen 42-1 as shown in Figure 6, is shown in Figures 8 and 9.

[0037] The fabric laminate 130 includes the main, or

body, fabric layer 102 of the garment. Fabric layer 102 is typically an elastomeric fabric including Lycra yarn to provide a desired degree of resistance to stretch, or modulus. If the laminate 130 forms a portion of the stomach panel of a panty, fabric layer 102 will have its primary elongation and modulus in the generally horizontal direction, as shown by the arrows 103.

[0038] The reinforcement panel is provided by the stretch fabric 11 upon which the adhesive securement layer 105 has been applied over its entire surface. While layer 11 may also be an elastomeric fabric, for cost saving, fabric 11 may be a non-elastomeric stretch fabric, wherein the stretch is achieved by the construction of the fabric as by circular knit. Stretch fabric 11, whether or not it includes elastomeric yarn will have primary elongation in one direction as shown by the arrows 11-1 of Figure 8, with there being a lesser degree of elongation, or give, in the direction orthogonal to that shown by those arrows.

[0039] The all-over pattern of the adhesive layer applied to the fabric of reinforcement panel 11 is, as shown in greater detail in Figures 10 and 11, in the form of a regularly repeated pattern generally coextensive with and uniformly presented over substantially the full extent of the fabric. The individual front stomach panels to be cut from the fabric are shown by the dash lines 12 in Figure 10. In the particular embodiment shown in Figures 6 and 8-11, the pattern comprises an array of aligned diamond shaped elements, indicated as 134 which are arranged in successive generally horizontally and vertically extending rows. The diamond shaped elements 134 are of uniform size throughout the extent of the pattern. The width of the sides 136 forming the diamond is shown as 130 in Figure 11, and is likewise uniform throughout the extent of the pattern. Each of the diamonds has a vertical length 138 and a lesser horizontal length 140. By virtue of the diamond pattern being oriented within the laminate such that the longer dimension 138 of the diamond is in the generally vertical direction the resistance to elongation offered by the diamond pattern of the adhesive securement layer will have a differential characteristic, exhibiting greater resistance to elongation in the horizontal direction than in the vertical direction.

[0040] The pattern of the adhesive securement layer also includes an array of closely-spaced discrete dots 142 of adhesive within each of the diamonds 134. These adhesive dots 142 provide enhanced securement of reinforcement layer 11 to the fabric 102. Further, the inclusion of such a closely-spaced array of adhesive elements 142 within the larger diamonds 134 precludes the laminate 130 from forming bubbles as it is stretched and released. This serves to maintain a smooth transition from the laminate's relaxed condition to its tensioned state without any unsightly bubble-type discontinuities in the smooth presentation of the laminated reinforcement panel.

[0041] Accordingly, when the laminated fabric panel

of Figure 8 is subjected to distorting forces it will offer greater resistance to stretch in the horizontal direction than in the vertical direction, with the modulus, the forces urging the panel towards its relaxed position, being obtained from the body fabric layer 102 and pattern of the adhesive securement layer. If desired, a further reduction in laminate elongation characteristics can be achieved if layer 11, which forms the control panel, is oriented 90° with respect to that shown in Figure 8.

[0042] Figures 12 and 13, which are an enlargement of a portion of the cross sectional view shown in Figure 9, but prior to the lamination of layer 102, depict the manner in which the strength of the lamination may be varied. The cross sectional configuration of the individual adhesive element forming the sides 136 and individual dots 142 of the pattern may be varied by suitable adjustment of the characteristics of the adhesives and force of doctor blade 150. Where the tops of the individual elements are essentially flat, as shown in Figure 12, there will be a greater force of adhesion to the additional fabric layer 102, than where the tops are somewhat arched, as shown in Figure 13. Hence, the laminate formed from the layers shown in Figure 12 will, all other conditions remaining the same, has a greater peel strength than that formed from Figure 13.

[0043] Reference is now made to Figure 14 which shows the front and rear views of a typical women's panty utilizing the laminate of Figures 8-11 for stomach control. The panty 150 is formed of a main body fabric panel which encircles the wearer's torso. This main body panel typically includes several fabric pieces, which are sewn together. Panty 150 includes a front panel 152, frontal side panels 154 and transitional lace panels 156. Side seams 158 connect panels 154 to a rear panel 160. A crotch section 162 is typically provided at the lowermost portion of the garment. An elastic waist band 164 extends along the top of the garment. Another elastic band 166 is sewn around the edges of panels 154 to provide the frontal portion of the leg cut-out, which is continued along the sides of the crotch piece 162 and lower edge of the rear panel 160. In the particular panty 150, fabric panels 154 and 160 are a single layer preferably formed of an elastomeric fabric which, as heretofore discussed, may include Lycra yarn. The front panel 152 is formed of the laminate 130 shown in Figures 8-11. Its outer layer corresponds to layer 102 of the laminate, and will typically be of the same fabric as panels 154 and 160, for appropriate aesthetic coordination. The laminate of front panel 152 has significantly less horizontal elongation than the single layer panels 154 and 160. That is, the placement of the laminate at the stomach panel provides the well-known type of stomach control to flatten the wearer's stomach and hence provide figure enhancement.

[0044] Figures 15-20 show various modifications that can be made to the pattern of the adhesive to appropriately adjust the resistance of the laminate to elongation, and hence the degree of control provided by the rein-

forcement panel, such as 152. In Figure 15 the generally uniform size and density of the dots 142 (as for example as shown in Figure 11) has been modified in that larger dots 142-1 extend across the horizontally displaced comers 136-1, 136-2 of each of the diamond shaped adhesive elements. As shown in Figure 15 there is a gradual reduction in the size of the adhesive dots and increase in the spacing between their horizontally adjacent rows, as shown by dots 142-2, 142-3, etc. displaced from the mid-section of the diamond. Alternatively, except for the enlarged dots of adhesive 142-1 across the horizontally opposed corners 136-1 and 136-2 of the diamond, all of the other adhesive dots within the diamond, while smaller than the dots 136-1, can be of uniform size. The increased amount of adhesive provided by enlarged adhesive dots 136-1 will further increase the resistance of the adhesive pattern shown in Figure 17 to horizontal elongation, thereby providing somewhat greater horizontal control. Such a pattern could be used where it is desired that the reinforcement panel provide increased control while still utilizing the same fabrics for the garment, size of reinforcement panel and adhesive thickness.

[0045] Figure 16 shows another variation in which horizontally extending lines 139 of adhesive extend from the opposed horizontal corners 136-1 and 136-2 of the diamond, towards the center of the diamond. Advantageously a gap X is provided at the central portion thereof. The horizontal lines of adhesive will likewise increase the resistance to horizontal stretch as provided by the adhesive pattern, thereby providing additional control. It has been determined that the inclusion of the gap X at the central portion of the horizontal adhesive lines prevents a bubbling of the fabric which, might otherwise occur if the stretch of the pattern is restrained across the entire span between comers 136-1 and 136-2, with respect to the remaining area of the diamond. The size of the diamond in Figure 16 is also shown as somewhat larger than the diamond in the pattern of Figure 11. Thus, with an existing geometric pattern of adhesive the degree of control can be adjusted by varying the size of the individual adhesive elements forming the pattern and/or supplemental adhesive elements placed within the main adhesive elements. This can be readily achieved by utilizing a different rotary printing screen 42-1 in the apparatus shown in Figure 6.

[0046] Figure 17 shows still another pattern, wherein the shape of its diamonds 150 has been modified so that there is less of a variation between the vertical dimension 151 and horizontal dimension 152. However, the horizontal dimension is still less than the vertical dimension, such that the pattern shown in Figure 17 will still be characterized as having a differential elongation which offers greater resistance to stretch in the horizontal direction than in the vertical direction. In addition, solid adhesive lines 154 extend across diametrically opposed horizontal comers of the diamonds 151. The tendency of this pattern to permit bubbling in the laminate

panel would depend on several factors, including the stretch characteristics of the fabrics forming the laminate. Should bubbling occur, a gap may advantageously be included at the enter of horizontal connecting bars 154, as typically shown by gap X of Figure 16. Discrete dots of adhesive, such as 142 of Figure 11, may also be included.

[0047] Figure 18 is still another configuration of the adhesive securement layer. It is a regularly repeated pattern which, like the prior patterns, will generally be coextensive with and uniformly presented over substantially the full extent of the reinforcement panel forming the fabric laminate. The array of aligned adhesive elements 156, rather than being diamond shaped, included elongate sides 157 between the upper and lower peaks 158 that would otherwise form the diamond. As in the other all-over patterns, the greater elongation of the individual elements 156 in the vertical direction would result in there being a differential elongation, with the pattern offering greater resistance to stretch in the horizontal than in the vertical direction. This pattern may also advantageously includes discrete dots within each of the individual elements 156 in order to provide a smooth and secure laminate. If desired, horizontal bars of additional adhesive, as shown in Figures 16 or 17, could be added.

[0048] Figure 19 shows still another arrangement of the individual elements forming the adhesive pattern. The individual elements are totally comprised of circular dots 160. They are arrayed such that the horizontal displacement 160-1 between adjacent circular dots 160 is less than the vertical displacement 160-2. Thus, the successive generally horizontally and vertically extending rows are established with there being greater spacing between the horizontal rows than the vertical rows. Hence, the pattern will offer greater resistance to stretch in the horizontal direction. While not shown, if desired, additional smaller discrete dots of adhesive can be added throughout the pattern to insure a smooth laminate.

[0049] Figure 20 shows still another variation of the pattern. For increased control, a second diamond adhesive element 136-3, is placed within each of the sides 136 of the diamonds, of the pattern typically shown in Figures 11 or 16.

[0050] It should however be understood that by changing the pattern about the circumference of cylinder 42-1 numerous other variations of patterns can be repeatedly applied over the extent of fabric 11 with a high degree of accuracy.

[0051] Figure 21 shows the manner in which the fabric produced by the present invention may be employed in conjunction with a pair of pantyhose 160. The pantyhose 160 comprises a panty portion 162, a pair of legs 164 integrally formed with the panty portion and depending therefrom, and a crotch piece 166. The yarn forming the panty 162 and leg sections 164 must have sufficient stretch properties in order that the garment may be expanded to closely confirm to the user's body conforming

abilities and provide a desired degree of figure control. For enhanced figure control an additional stomach support panel 168 is provided. Stomach panel 168 may be comprised of a non-elastomeric stretch fabric onto which a pattern of adhesive has been applied consistent with the teachings of the present invention. The selection of the fabric for the reinforcement panel, as well as the adhesive pattern may be suitably varied, from that employed for the panty of Figures 5 or 14, in order to properly allow for the necessary initial stretch of the fabric forming the panty and leg sections 162 and 164, as well as the desired degree of body-conforming stretch and constraint. In particular, in order for the pantyhose to initially conforming stretch and constraint. In particular, in order for the pantyhose to initially conform to the user's body, the fabrics utilized and the adhesive pattern applied to the reinforcement panel 166 will have to permit a greater degree of initial vertical stretch than would be required in the panties typically shown in Figures 5 or 14.

[0052] Reference is now made to Figure 22 which shows a brassiere 170 which utilizes the laminate produced by the present invention as an undercup support. Brassiere 170 includes a pair of cups 172 which are inwardly connected by a central platform 173. The outer sides of the cups are connected to side panels 174 which are typically connected to each other by closure means 175 and 176, which are commonly referred to as a hook and eye, and shoulder straps 177. Cups 172 shown in this particular brassiere are formed of two fabric pieces 178 and 179 which are seamed together at 171. Alternatively, the cups could each be moulded from a single piece of fabric, as is well known in the art. Figure 23 shows lower section 178, which includes the laminate produced by the present invention applied to its inside surface prior to assembly into brassiere 170. Lower cup section 178 includes the main fabric panel 183 to which the support panel 181 is laminated over at least a portion of its surface utilizing the adhesive securement layer produced in accordance with the present invention. Both fabrics 181 and 183 may be stretch fabrics. However, main fabric panel 183 of the brassiere cup 172 would typically not include elastomeric yarn. Fabrics 181 and 183 are suitably oriented within the brassiere 170, in conjunction with the orientation of the adhesive pattern used to secure the fabrics together, so that there is a sufficient restriction of the stretch of cup 172 along the portion of undercup section 178 which includes support panel 181. This is designed to provide the desired degree of underbust support. Advantageously, fabric 183 which forms the outer surface of cup section 178 is the same as the fabric which forms the upper cup section 179. For aesthetic purposes this may also be the same fabric used for side panels 174, except in those instances where it is desired that side panels 174 include an elastomeric yarn.

[0053] The laminate of the present invention may also be used for laminating a supportive control panel to oth-

er locations within a brassiere (not shown) such as the side panel 174 or underarm.

[0054] Reference is now made to Figure 24, which generally corresponds to Figure 1, but depicts a different embodiment of the tensionless feed. In Figure 24 components corresponding to that shown in Figure 1 are designated by the same reference numerals. The stretch fabric 11 emerging from its storage roll 15 is presented to a tensionless feed 190 which includes an endless belt 192. Belt 192 is driven by rollers 194, 196 at a speed suitably synchronized to the unwinding of the supply roll and rotary printing station 40, such that after a desired initial length of the fabric is placed on belt 192 in a loose, non-taut condition, substantially the same length will remain thereon as stretch fabric 11 is continuously withdrawn from the exit end 195 of tensionless feed 190 to rotary printing station 40. Depending on the particular stretch fabric employed, and the production rate, the tensionless feed means at the exit end of the oven 70 (such as is shown as 80 in Figure 1) may be dispensed with.

[0055] Figure 25 shows in diagrammatic form still another form of the tensionless feed means that can be provided intermediate the fabric source 15 and rotary printing station 40 so as to present the stretch fabric 11 in a tensionless condition between rotary screen 42 and its back up roll 44. Fabric supply roll 15 is on spool 12 which is a positive driver. The stretch fabric 11 as it emerges from supply roll 15 moves vertically upward and passes over a positive driver 200 which preferably broadens the stretch fabric 11 to remove wrinkles. Stretch fabric 11 is then presented to a subsequent positive driver 202 which changes the direction of fabric movement, with the stretch fabric then moving vertically downward. The stretch fabric then passes over a floating, or dancer, roller 204 before again changing direction of movement over positive driver 206. The dancer roller 24, is of a conventional type which will automatically move up or down to smooth out variations in the stretch fabric passing over its circumference. Fabric then passes over idler rollers 208 and 210 as it is driven by roller 212. As the stretch fabric 11 moves between rollers 210 and 212 its tension is measured by sensor 214. Feedback is provided by sensor 214 to the prior positive drives so as to appropriately adjust their speed if the fabric tension is incorrect. Before the fabric 11 is presented to the rotary printing station 40, it will pass by another tension measuring sensor 216, which typically is more sensitive than sensor 214, to appropriately fine tune adjust the speeds of the various drives, so as to insure that the fabric is presented to the adhesive printing station in a tensionless condition.

[0056] It should naturally be understood that various other tensionless drive assemblies may be utilized, dependent upon the particular stretch fabrics employed, characteristics of the rotary printing station, adhesive pattern and production speed.

Claims

1. Apparatus (10) for the continuous application of a repetitive pattern of a material onto a stretch fabric (11), comprising in combination:

a rotary printing member (42) having a regularly repeated pattern (44,46) over its circumference to provide a rotary printing surface;
a source means (60) for supplying said material to be applied to said rotary printing member (42);
a stretch fabric source means (15) for continuously supplying stretch fabric (11) to said rotary printing surface; and
application means (50) for transferring said material which is supplied to said rotary printing member (42) to the stretch fabric (11), as a regularly repeated and continuous pattern over the surface of the stretch fabric (11) as it contacts said rotary printing surface;

characterised in that the apparatus is for application of an adhesive pattern, said material being an adhesive; and

in that tensionless feed means (22,190,200-216) are provided intermediate said stretch fabric source means (15) and said rotary printing member (42) for maintaining the stretch fabric in a tensionless condition as it is presented to said rotary printing surface.

2. The apparatus of claim 1, wherein said rotary member (42) is in the form of a circumferential screen about an open cylinder, with said regularly repeated pattern provided by openings extending through said screen;
said rotary printing surface extending over the exterior circumference of said cylinder; and
said adhesive source means (60) supplies the adhesive to the open interior of said cylinder.
3. The apparatus of claim 1, wherein:

said rotary printing (42) member is a hollow cylinder having a perforate screen about its circumference, the perforations forming said regularly repeated pattern;
and which has
first drive means for rotating said hollow cylinder in a first direction;
a second drive means for activating said stretch fabric source means to supply stretch fabric in said first direction against the outer circumferential surface of said perforate screen;
said adhesive source means (60) supplying a liquid adhesive to the interior of said hollow cylinder;

said adhesive application means including a doctor blade (50) extending along the axis (52), and within the interior, of said hollow cylinder (42) to urge the adhesive through the pattern of the perforate screen circumference; said tensionless feed (22, 190, 200-216) presenting the stretch fabric (11) to the outer circumferential screen surface of said hollow cylinder while the stretch fabric (11) is in a tensionless condition; and printing means (44) for continuously urging the stretch fabric (11) against said outer circumferential screen surface as the stretch fabric (11) and hollow cylinder (42) are simultaneously moved in said first direction, such that the liquid adhesive is applied from the interior of the cylinder, through said perforate screen, to the stretch fabric (11) against said outer circumferential screen surface, while the stretch fabric (11) is in a non-taut, slack condition.

4. The apparatus of claim 2 wherein said adhesive application means is a doctor blade (50) extending along the axis (52), and within the interior, of said cylinder;

the stretch fabric (11) being continuously presented against the exterior rotary printing surface of said circumferential screen; and

said doctor blade (50) predeterminedly positioned to uniformly apply adhesive to the stretch fabric (11) through the pattern of openings of said circumferential screen.

5. The apparatus of any one of claims 1 to 4, wherein said regularly repeated pattern is in the form of an array of aligned elements arranged in successive generally axially and circumferentially extending rows.

6. The apparatus of claim 5 wherein said array comprises successive geometrically shaped areas, connected at their common sides to form generally axially and circumferentially extending rows of interconnected diamond shaped areas (134).

7. The apparatus of claim 6, wherein said array further includes a plurality of discrete dots (142) within each of said diamond shaped areas (134).

8. The apparatus of any one of claims 1 to 4 wherein said regularly repeated pattern is in the form of individual and definitive first areas (44) of predetermined shape, and open second areas (46) intermediate and separating said individual first areas, whereby the maintenance of the stretch fabric in a tensionless state while the repetitive adhesive pattern is applied provides accurate uniformity of the shape and spacing of said areas (44, 46).

9. The apparatus of any one of claims 1 to 8, wherein said adhesive application means (50) provides a liquid adhesive to said rotary printing member (42).

10. The apparatus of claim 9 wherein said adhesive is a polyamide adhesive.

11. The apparatus of any one of claims 1 to 10 wherein said adhesive application means (50) includes means for predeterminedly varying the thickness of adhesive applied to the surface of the stretch fabric.

12. The apparatus of claim 4, wherein said adhesive is a liquid thermoplastic; and

said adhesive application means includes means to adjust the force at which the doctor blade (50) applies the liquid adhesive to the stretch fabric.

13. The apparatus of any one of claims 1 to 12, wherein said adhesive application means (50) includes means for predeterminedly varying the thickness of adhesive applied to the surface of the stretch fabric; and

further including means for varying the cross section of at least a portion of the adhesive transferred to the stretch fabric.

14. The apparatus of any one of claims 1 to 13, wherein said fabric source means including a drive for continuously unwinding a roll (15) of stretch fabric (11) in a first direction, and presenting same to said tensionless feed means (22, 190);

said tensionless feed means positioned along said first direction, between said stretch fabric source means (15) and rotary printing member (42);

said tensionless feed means (22, 190) including a fabric storage fixture to provide a fabric storage area surface (22, 192) extending in said first direction; and

said fabric storage area adapted to continuously retain a length of stretch fabric (11-1) extending in said first direction which exceeds the length in said first direction of said fabric storage area, whereby the stretch fabric will be retained in said fabric storage fixture in a non-taut, slack, condition prior to being applied to said rotary printing surface (42).

15. The apparatus of claim 14, wherein said fabric storage fixture is a scray (22).

16. The apparatus of claim 15, wherein said scray is a J-Frame (22).

17. The apparatus of claim 14 wherein said fabric storage fixture includes an endless belt (192).

18. The apparatus of any one of claims 1, 2 or 4-13,

wherein said fabric source means includes a first drive (12) for continuously unwinding a roll (15) of stretch fabric (11) in a first direction, and presenting same to said tensionless feed means (200-216);

said tensionless feed means positioned along said first direction, between said stretch fabric source means (15) and said rotary printing member (42);

said tensionless feed means including a second drive (200), a fabric tension sensor (214), and a feedback between said fabric tension sensor and at least one of said drives for adjusting the speed of the movement of said fabric (11) in said first direction in response to the fabric tension at the input to said rotary printing member (42).

19. The apparatus of claim 18, wherein said tensionless feed (200-216), further includes smoothing means (200) for smoothing out wrinkles in the stretch fabric prior to presenting the stretch fabric to said rotary printing member (42).

20. The apparatus of any one of claims 1 to 19, further including;

a second stretch fabric source (104) means for providing a source of laminate stretch fabric (102);

a laminating means (120, 122) for continuously receiving i) the stretch fabric (11) from said rotary printing with the repetitive adhesive pattern applied thereto, and ii) the second stretch fabric (102), and laminating the stretch fabrics (11,102) together; and

a second tensionless feed means (112) intermediate second stretch fabric source means (104) and laminating means (120,122) for maintaining the second stretch fabric (102) in a tensionless condition as it is presented to said laminating means (120,122).

21. The apparatus of any one of claims 1 to 20 further including an oven (70,124) to cure the repetitive adhesive pattern applied to the stretch fabric (11).

22. A process for the continuous application of a repetitive pattern onto a stretch fabric (11), including the steps of:

providing a perforate hollow cylinder (42) having the regularly repeated pattern forming a screen about its circumference;

applying a liquid to the interior of the hollow cylinder (42);

urging the liquid outward of the screen to be uniformly present at a printing area of the outer cylindrical screen surface; and

presenting the stretch fabric (11) against the

printing area of the outer cylindrical surface as the cylinder (42) is rotated and the stretch fabric (11) moved in a first direction at a speed corresponding to the circumferential movement of the cylinder (42);

characterised in that the process is for application of an adhesive pattern, said liquid being an adhesive liquid, the stretch fabric being presented to the printing area in a tensionless condition.

23. The process of claim 22, wherein the presentation of the stretch fabric (11) in a tensionless state includes the step of passing the stretch fabric (11) through a scray (22) prior to being presented to the printing area of the outer cylindrical surface.

24. A process for making a stretch fabric laminate (130) which after carrying out the process in accordance with claim 22 or 23, includes the further step of:

presenting the stretch fabric (11) to a fabric laminator (120,122), simultaneously presenting a second stretch fabric (102) to the fabric laminator (120,122); and

laminating the stretch fabrics (11,102) together over their opposed surfaces by means of the adhesive pattern.

25. The process for making a stretch fabric laminate in accordance with claim 24, wherein the second stretch fabric (102) is presented to the laminator (120,122) in a tensionless condition.

Patentansprüche

1. Vorrichtung (10) zum kontinuierlichen Aufbringen eines sich wiederholenden Musters aus einem Material auf einen Stretchstoff (11), in Kombination umfassend:

ein rotierendes Druckelement (42), das ein sich regelmäßig wiederholendes Muster (44, 46) über seinen Umfang aufweist, wodurch eine rotierende Druckfläche bereitgestellt wird;

eine Zufuhreinrichtung (60), um das aufzutragende Material dem rotierenden Druckelement (42) zuzuführen;

eine Stretchstoff-Zufuhreinrichtung (15), um Stretchstoff (11) kontinuierlich der rotierenden Druckfläche zuzuführen; sowie

eine Aufbringungseinrichtung (50), um das Material, das dem rotierenden Druckelement (42) zugeführt wird, auf den Stretchstoff (11) als sich

regelmäßig wiederholendes und kontinuierliches Muster auf der Oberfläche des Stretchstoffes (11) zu übertragen, während sie die rotierende Druckfläche berührt;

dadurch gekennzeichnet, dass die Vorrichtung zum Aufbringen eines Klebermusters dient, wobei das Material ein Kleber ist, und dass Mittel zum zuglosen Zuführen (22, 190, 200-216) zwischen der Stretchstoff-Zufuhreinrichtung (15) und dem rotierenden Druckelement (42) vorgesehen sind, um den Stretchstoff in einem zuglosen Zustand zu halten, während er der rotierenden Druckfläche dargeboten wird.

2. Vorrichtung nach Anspruch 1, worin das rotierende Element (42) die Form eines Umfangssiebs um einen offenen Zylinder hat, wobei das sich regelmäßig wiederholende Muster durch Öffnungen entsteht, die sich durch das Sieb erstrecken; wobei sich die rotierende Druckfläche über den Außenumfang des Zylinders erstreckt; und die Kleber-Zufuhreinrichtung (60) den Kleber dem offenen Innenraum des Zylinders zuführt.

3. Vorrichtung nach Anspruch 1, worin:

das rotierende Druckelement (42) ein Hohlzylinder ist, der ein Perforationssieb um seinen Umfang aufweist, wobei die Perforationen das sich regelmäßig wiederholende Muster bilden,

und die aufweist:

eine erste Antriebseinrichtung, um den Hohlzylinder in eine erste Richtung zu drehen;

eine zweite Antriebseinrichtung, um die Stretchstoff-Zufuhreinrichtung zu aktivieren, um Stretchstoff in der ersten Richtung gegen die Außenumfangsfläche des Perforationssiebs zuzuführen;

wobei die Kleber-Zufuhreinrichtung (60) dem Innenraum des Hohlzylinders einen flüssigen Kleber zuführt;

wobei die Kleber-Aufbringungseinrichtung eine Rakel (50) umfasst, die sich die Achse (52) entlang und im Innenraum des Hohlzylinders (42) erstreckt, um den Kleber durch das Muster des Perforationssiebumfangs zu drängen;

wobei die zuglose Zuführung (22, 190, 200-216) den Stretchstoff (11) der Siebaußenumfangfläche des Hohlzylinders darbietet, während sich der Stretchstoff (11) in einem zuglosen Zustand befindet; und

eine Druckeinrichtung (44), die den Stretchstoff (11)

kontinuierlich gegen die Siebaußenumfangsfläche drängt, während der Stretchstoff (11) und der Hohlzylinder (42) gleichzeitig in die erste Richtung bewegt werden, so dass der flüssige Kleber vom Inneren des Zylinders aus durch das Perforationssieb hindurch auf den Stretchstoff (11) gegen die Siebaußenumfangsfläche aufgebracht wird, während sich der Stretchstoff (11) in einem nicht-straffen, schlaffen Zustand befindet.

4. Vorrichtung nach Anspruch 2, worin die Kleber-Aufbringungseinrichtung eine Rakel (50) ist, die sich die Achse (52) des Zylinders entlang und in seinem Inneren erstreckt, wobei der Stretchstoff (11) kontinuierlich gegen die rotierende Druckaußenfläche des Umfangssiebs dargeboten wird; und die Rakel (50) vorbestimmt so angeordnet ist, dass Kleber gleichmäßig durch das Muster von Öffnungen des Umfangssiebs hindurch auf den Stretchstoff (11) aufgebracht wird.
5. Vorrichtung nach einem der Ansprüche 1 bis 4, worin das sich regelmäßig wiederholende Muster die Form einer Anordnung aus ausgerichteten Elementen hat, die in aufeinanderfolgenden sich allgemein axial und den Umfang entlang erstreckenden Reihen angeordnet sind.
6. Vorrichtung nach Anspruch 5, worin die Anordnung aufeinanderfolgende geometrisch geformte Flächen umfasst, die an ihren gemeinsamen Seiten verbunden sind, um sich allgemein axial und den Umfang entlang erstreckende Reihen aus miteinander verbundenen rautenförmigen Flächen (134) zu bilden.
7. Vorrichtung nach Anspruch 6, worin die Anordnung weiters eine Vielzahl diskreter Punkte (142) innerhalb einer jeden der rautenförmigen Flächen (134) umfasst.
8. Vorrichtung nach einem der Ansprüche 1 bis 4, worin das sich regelmäßig wiederholende Muster die Form individueller und definitiver erster Flächen (44) mit vorbestimmter Gestalt, und offener zweiter Flächen (46) hat, die zwischen den individuellen ersten Flächen liegen und diese trennen, wodurch das Halten des Stretchstoffs in einem zuglosen Zustand, während das sich wiederholende Klebermuster aufgebracht wird, für präzise Gleichmäßigkeit der Gestalt und des Abstands der Flächen (44, 46) sorgt.
9. Vorrichtung nach einem der Ansprüche 1 bis 8, worin die Einrichtung (50) zum Aufbringen von Kleber das rotierende Druckelement (42) mit einem flüssigen Kleber versorgt.

10. Vorrichtung nach Anspruch 9, worin der Kleber ein Polyamidkleber ist.
11. Vorrichtung nach einem der Ansprüche 1 bis 10, worin die Einrichtung (50) zum Aufbringen von Kleber eine Einrichtung zum vorbestimmten Variieren der Dicke des auf die Oberfläche des Stretchstoffs aufgetragenen Klebers umfasst. 5
12. Vorrichtung nach Anspruch 4, worin der Kleber ein flüssiger Thermoplast ist; und die Einrichtung zum Aufbringen von Kleber eine Einrichtung zum Einstellen der Kraft umfasst, mit der die Rakel (50) den flüssigen Kleber auf den Stretchstoff aufbringt. 10 15
13. Vorrichtung nach einem der Ansprüche 1 bis 12, worin die Einrichtung (50) zum Aufbringen von Kleber eine Einrichtung zum vorbestimmten Variieren der Dicke des auf die Oberfläche des Stretchstoffs aufgetragenen Klebers umfasst; und weiters eine Einrichtung zum Variieren des Querschnitts zumindest eines Abschnitts des auf den Stretchstoff übertragenen Klebers umfasst. 20
14. Vorrichtung nach einem der Ansprüche 1 bis 13, worin die Stoff-Zufuhreinrichtung einen Antrieb umfasst, um eine Rolle (15) mit Stretchstoff (11) kontinuierlich in einer ersten Richtung abzuwickeln und sie der zuglosen Zuführungseinrichtung (22, 190) darzubieten; 30
die zuglose Zuführungseinrichtung entlang der ersten Richtung zwischen der Stretchstoff-Zufuhreinrichtung (15) und dem rotierenden Druckelement (42) angeordnet ist; 35
die zuglose Zuführungseinrichtung (22, 190) eine Stoffvorratshalterung umfasst, um eine Stoffvorratsbereichsfläche (22, 192) bereitzustellen, die sich in die erste Richtung erstreckt; und
der Stoffvorratsbereich dazu ausgebildet ist, kontinuierlich eine Stretchstofflänge (11-1) zurückzuhalten, die sich in die erste Richtung erstreckt, die über die Länge in der ersten Richtung des Stoffvorratsbereichs hinausgeht, wodurch der Stretchstoff in der Stoffvorratshalterung in einem nicht-straffen, schlaffen Zustand gehalten wird, bevor er auf die rotierende Druckfläche (42) aufgebracht wird. 40 45
15. Vorrichtung nach Anspruch 14, worin die Stoffvorratshalterung ein Fangkasten (22) ist. 50
16. Vorrichtung nach Anspruch 15, worin der Fangkasten ein J-Rahmen (22) ist.
17. Vorrichtung nach Anspruch 14, worin die Stoffvorratshalterung ein Endlosband (192) umfasst. 55
18. Vorrichtung nach einem der Ansprüche 1, 2 oder 4 bis 13, worin die Stoff-Zufuhreinrichtung einen ersten Antrieb (12) umfasst, um eine Rolle (15) mit Stretchstoff (11) kontinuierlich in eine erste Richtung abzuwickeln und ihn der zuglosen Zuführungseinrichtung (200-216) darzubieten; wobei die zuglose Zuführungseinrichtung entlang der ersten Richtung zwischen der Stretchstoff-Zufuhreinrichtung (15) und dem rotierenden Druckelement (42) angeordnet ist; wobei die zuglose Zuführungseinrichtung einen zweiten Antrieb (200), einen Stoffspannungssensor (214) und eine Rückkopplung zwischen dem Stoffspannungssensor und zumindest einem der Antriebe umfasst, um die Geschwindigkeit der Bewegung des Stoffs (11) in der ersten Richtung als Reaktion auf die Stoffspannung am Eingang zum rotierenden Druckelement (42) einzustellen.
19. Vorrichtung nach Anspruch 18, worin die zuglose Zuführung (200-216) weiters eine Glättungseinrichtung (200) umfasst, um Falten auszuglätten, bevor der Stretchstoff dem rotierenden Druckelement (42) dargeboten wird.
20. Vorrichtung nach einem der Ansprüche 1 bis 19, weiters umfassend:
eine zweite Stretchstoff-Zufuhreinrichtung (104), um eine Zufuhr für Laminat-Stretchstoff (102) bereitzustellen;
eine Laminierungseinrichtung (120, 122) zum kontinuierlichen Aufnehmen i) des Stretchstoffs (11) aus dem Rotationsdrucken, auf den das sich wiederholende Klebermuster aufgebracht ist, und ii) des zweiten Stretchstoffs (102) und zum Aneinanderlaminieren der Stretchstoffe (11, 102); sowie
eine zweite zuglose Zuführungseinrichtung (112) zwischen der zweiten Stretchstoff-Zufuhreinrichtung (104) und der Laminierungseinrichtung (120, 122), um den zweiten Stretchstoff (102) im zuglosen Zustand zu halten, wenn er dem Laminierungsmittel (120, 122) dargeboten wird.
21. Vorrichtung nach einem der Ansprüche 1 bis 20, die weiters einen Ofen (70, 124) umfasst, um das auf den Stretchstoff (11) aufgetragene sich wiederholende Muster zu härten.
22. Verfahren zum kontinuierlichen Aufbringen eines sich wiederholenden Musters auf einen Stretchstoff (11), folgende Schritte umfassend:
das Bereitstellen eines perforierten Hohlzylinders (42) mit einem sich regelmäßig wiederho-

lenden Muster, das ein Sieb um seinen Umfang herum bildet;

das Aufbringen einer Flüssigkeit auf die Innenfläche des Hohlzylinders (42);

das Drängen der Flüssigkeit aus dem Sieb heraus, so dass sie auf einem Druckbereich der äußeren Zylindersiebfläche gleichmäßig vorhanden ist; und

das Darbieten des Stretchstoffes (11) gegen den Druckbereich der Zylinderäußenfläche, während der Zylinder (42) gedreht wird und der Stretchstoff (11) mit einer Geschwindigkeit in eine erste Richtung bewegt wird, die der Umfangsbewegung des Zylinders (42) entspricht;

dadurch gekennzeichnet, dass das Verfahren zum Aufbringen eines Klebermusters dient, die Flüssigkeit ein flüssiger Kleber ist und der Stretchstoff dem Druckbereich in einem zuglosen Zustand dargeboten wird.

23. Verfahren nach Anspruch 22, worin das Darbieten des Stretchstoffs (11) in einem zuglosen Zustand den Schritt des Hindurchführens des Stretchstoffs (11) durch einen Fangkasten (22) umfasst, bevor er dem Druckbereich der Zylinderäußenfläche dargeboten wird.

24. Verfahren zur Herstellung eines Stretchstofflaminats (130), das nach der Durchführung des Verfahrens nach Anspruch 22 oder 23 weitere folgende Schritte umfasst:

das Darbieten des Stretchstoffs (11) einem Stoff-Laminator (120, 122), das gleichzeitige Darbieten eines zweiten Stretchstoffs (102) dem Stoff-Laminator (120, 122); und

das Aneinander-Laminieren der Stretchstoffe (11, 102) über ihre einander zugewandten Flächen durch das Klebermuster.

25. Verfahren zur Herstellung eines Stretchstofflaminats nach Anspruch 24, worin der zweite Stretchstoff (102) dem Laminator (120, 122) in einem zuglosen Zustand dargeboten wird.

Revendications

1. Appareil (10) pour l'application en continu d'un motif répété d'un matériau sur un tissu étirable (11), comprenant en combinaison :

un élément d'impression rotatif (42) présentant

un motif répété régulièrement (44, 46) sur sa circonférence pour réaliser une surface d'impression rotative ;

un moyen de source (60) pour appliquer ledit matériau à appliquer audit élément d'impression rotatif (42) ;

un moyen de source de tissu étirable (15) pour fournir continuellement du tissu étirable (11) à ladite surface d'impression rotative ; et

un moyen d'application (50) pour transférer ledit matériau qui est fourni audit élément d'impression rotatif (42) au tissu étirable (11), comme un motif répété régulièrement et continu sur la surface du tissu étirable (11) lorsqu'il vient en contact avec ladite surface d'impression rotative ;

caractérisé en ce que l'appareil est prévu pour l'application d'un motif d'adhésif, ledit matériau étant un adhésif ; et

en ce que des moyens d'amenée sans tension (22, 190, 200-216) sont prévus entre ledit moyen de source de tissu étirable (15) et ledit élément d'impression rotatif (42) pour maintenir le tissu étirable dans un état sans tension lorsqu'il est présenté à ladite surface d'impression rotative.

2. Appareil selon la revendication 1, où ledit élément rotatif (42) se présente sous la forme d'un écran circférentiel autour d'un cylindre ouvert, ledit motif répété régulièrement étant réalisé par des ouvertures s'étendant à travers ledit écran ; ladite surface d'impression rotative s'étendant sur la circonférence extérieure dudit cylindre ; et ledit moyen de source d'adhésif (60) fournit l'adhésif à l'intérieur ouvert dudit cylindre.

3. Appareil selon la revendication 1, où :

ledit élément d'impression rotatif (42) est un cylindre creux avec un écran perforé autour de sa circonférence, les perforations formant ledit motif répété régulièrement ; et qui comporte un premier moyen d'entraînement pour faire tourner ledit cylindre creux dans une première direction ;

un deuxième moyen d'entraînement pour activer ledit moyen de source de tissu étirable pour amener du tissu étirable dans ladite première direction contre la surface circonférentielle externe dudit écran perforé ;

ledit moyen de source d'adhésif (60) fournissant un adhésif liquide à l'intérieur dudit cylin-

dre creux ;

ledit moyen d'application d'adhésif comprenant une racle (50) s'étendant le long de l'axe (52) et dans l'intérieur dudit cylindre creux (42) pour solliciter l'adhésif à travers le motif de la circonférence de l'écran perforé ;

ladite amenée sans tension (22, 190, 200-216) présentant le tissu étirable (11) à la surface d'écran circonférentielle externe dudit cylindre creux pendant que le tissu étirable (11) se trouve dans un état sans tension ; et

un moyen d'impression (44) pour solliciter continuellement le tissu étirable (11) contre ladite surface d'écran circonférentielle externe lorsque le tissu étirable (11) et le cylindre creux (42) sont simultanément déplacés dans ladite première direction de telle sorte que l'adhésif liquide est appliqué depuis l'intérieur du cylindre, à travers ledit écran perforé, au tissu étirable (11) contre ladite surface d'écran circonférentielle externe pendant que le tissu étirable (11) se trouve dans un état mou, non tendu.

4. Appareil selon la revendication 2, où ledit moyen d'application d'adhésif est une racle (50) s'étendant le long de l'axe (52) et dans l'intérieur dudit cylindre ; le tissu étirable (11) étant présenté continuellement contre la surface d'impression rotative extérieure dudit écran circonférentielle ; et ladite racle (50) est positionnée d'une manière prédéterminée pour appliquer uniformément de l'adhésif au tissu étirable (11) à travers le motif d'ouvertures dudit écran circonférentiel.

5. Appareil selon l'une des revendications 1 à 4, où ledit motif répété régulièrement se présente sous la forme d'une rangée d'éléments alignés agencés selon des rangées successives s'étendant généralement axialement et circonférentiellement.

6. Appareil selon la revendication 5, où ladite rangée comprend des zones successives configurées d'une manière géométrique, reliées à leurs côtés communs pour former des rangées s'étendant généralement axialement et circonférentiellement de zones rhomboïdales interconnectées (134).

7. Appareil selon la revendication 6, où ladite rangée comprend en outre une pluralité de points discrets (142) dans chacune desdites zones rhomboïdales (134).

8. Appareil selon l'une des revendications 1 à 4, où ledit motif répété régulièrement se présente sous la forme de premières zones individuelles et définitives

(44) d'une forme prédéterminée et de deuxièmes zones ouvertes (46) se situant entre et séparant lesdites premières zones individuelles, par quoi le maintien du tissu étirable dans un état sans tension, pendant que le motif d'adhésif répété est appliqué, réalise une uniformité précise de la forme et de l'espacement desdites zones (44, 46).

9. Appareil selon l'une des revendications 1 à 8, où ledit moyen d'application d'adhésif (50) fournit un adhésif liquide audit élément d'impression rotatif (42).

10. Appareil selon la revendication 9, où ledit adhésif est un adhésif de polyamide.

11. Appareil selon l'une des revendications 1 à 10, où ledit moyen d'application d'adhésif (50) comporte un moyen pour faire varier d'une manière prédéterminée l'épaisseur de l'adhésif appliquée à la surface du tissu étirable.

12. Appareil selon la revendication 4, où ledit adhésif est un thermoplastique liquide ; et ledit moyen d'application d'adhésif comporte un moyen pour régler la force à laquelle la racle (50) applique l'adhésif liquide au tissu étirable.

13. Appareil selon l'une des revendications 1 à 12, où ledit moyen d'application d'adhésif (50) comporte un moyen pour faire varier d'une manière prédéterminée l'épaisseur de l'adhésif appliqué à la surface du tissu étirable ; et incluant en outre un moyen pour faire varier la section transversale d'au moins une portion de l'adhésif transféré au tissu étirable.

14. Appareil selon l'une des revendications 1 à 13, où ledit moyen de source de tissu comporte un entraînement pour dérouler continuellement un rouleau (15) de tissu étirable (11) dans une première direction et pour présenter celui-ci audit moyen d'amenée sans tension (22, 190) ; ledit moyen d'amenée sans tension étant positionné le long de ladite première direction, entre ledit moyen de source de tissu étirable (15) et l'élément d'impression rotatif (42) ; ledit moyen d'amenée sans tension (22, 190) comportant un appareil fixe de stockage de tissu pour réaliser une surface de zone de stockage du tissu (22, 192) s'étendant dans ladite première direction ; et ladite zone de stockage de tissu étant apte à retenir continuellement une longueur de tissu étirable (11-1) s'étendant dans ladite première direction qui dépasse la longueur dans ladite première direction de ladite zone de stockage du tissu, par quoi le tissu étirable sera retenu dans ledit appareil fixe de stockage de tissu dans un état mou, non tendu avant d'être appliqué à ladite surface d'impression rotative (42).

15. Appareil selon la revendication 14, où ledit appareil fixe de stockage de tissu est une cage (22).
16. Appareil selon la revendication 15, où ladite cage est un cadre J (22).
17. Appareil selon la revendication 14, où ledit appareil fixe de stockage de tissu comporte une courroie sans fin (192).
18. Appareil selon l'une des revendications 1, 2, 4-13, où ledit moyen de source de tissu comporte un premier entraînement (12) pour dérouler continuellement un rouleau (15) de tissu étirable (11) dans une première direction et pour présenter celui-ci audit moyen d'amenée sans tension (200-216) ; ledit moyen d'amenée sans tension étant positionné le long de ladite première direction entre ledit moyen de source de tissu étirable (15) et ledit élément d'impression rotatif (42) ; ledit moyen d'amenée sans tension comportant un deuxième entraînement (200), un détecteur de tension de tissu (214) et une réinjection entre ledit détecteur de tension de tissu et au moins l'un desdits entraînements pour régler la vitesse de déplacement dudit tissu (11) dans ladite première direction en réponse à la tension du tissu à l'entrée audit élément d'impression rotatif (42).
19. Appareil selon la revendication 18, où ladite amenée sans tension (200-216) comporte en outre un moyen de lissage (200) pour lisser des froissures dans le tissu étirable avant la présentation du tissu étirable audit élément d'impression rotatif (42).
20. Appareil selon l'une des revendications 1 à 19, comprenant en outre un deuxième moyen de source de tissu étirable (104) pour fournir une source de tissu étirable laminé (102) ; un moyen de laminage (120, 122) pour recevoir continuellement i) le tissu étirable (11) de ladite impression rotative avec le motif adhésif répété appliqué à celui-ci et ii) le deuxième tissu étirable (102), et pour laminier les tissus étirables (11, 102) ensemble ; et un deuxième moyen d'amenée sans tension (112) situé entre le deuxième moyen de source de tissu étirable (104) et le moyen de laminage (120, 122) pour maintenir le deuxième tissu étirable (102) dans un état sans tension lorsqu'il est présenté audit moyen de laminage (120, 122).
21. Appareil selon l'une des revendications 1 à 20, comportant en outre un four (70, 124) pour polymériser le motif adhésif répété appliqué au tissu étirable (11).
22. Procédé pour l'application continue d'un motif répété sur un tissu étirable (11) comprenant les étapes

consistant à :

prévoir un cylindre creux perforé (42) présentant le motif répété régulièrement formant un écran autour de sa circonférence ;

appliquer un liquide à l'intérieur du cylindre creux (42) ;

solliciter le liquide vers l'extérieur de l'écran pour être présent uniformément à une zone d'impression de la surface extérieure de l'écran cylindrique ; et

présenter le tissu étirable (11) à la zone d'impression de la surface cylindrique extérieure lorsque le cylindre (42) est entraîné en rotation et que le tissu étirable (11) est déplacé dans une première direction à une vitesse correspondant au mouvement circulaire du cylindre (42) ;

caractérisé en ce que le procédé est destiné à l'application d'un motif d'adhésif, ledit liquide étant un liquide d'adhésif, le tissu étirable étant présenté à la zone d'impression dans un état sans tension.

23. Procédé selon la revendication 22, où la présentation du tissu étirable (11) dans un état sans tension comprend l'étape consistant à faire passer le tissu étirable (11) à travers une cage (22) avant d'être présenté à la zone d'impression de la surface cylindrique extérieure.

24. Procédé de fabrication d'un laminé de tissus étirables (130), qui après avoir exécuté le procédé en accord avec la revendication 22 ou 23, comprend l'étape ultérieure consistant à :

présenter le tissu étirable (11) à un dispositif de laminage de tissu (120, 122) présentant simultanément un deuxième tissu étirable (102) au dispositif de laminage de tissus (120, 122) ; et

laminier les tissus étirables (11, 102) ensemble sur leurs surfaces opposées au moyen du motif d'adhésif.

25. Procédé de fabrication d'un laminé de tissus étirables en accord avec la revendication 24, où le deuxième tissu étirable (102) est présenté au dispositif de laminage (120, 122) dans un état sans tension.

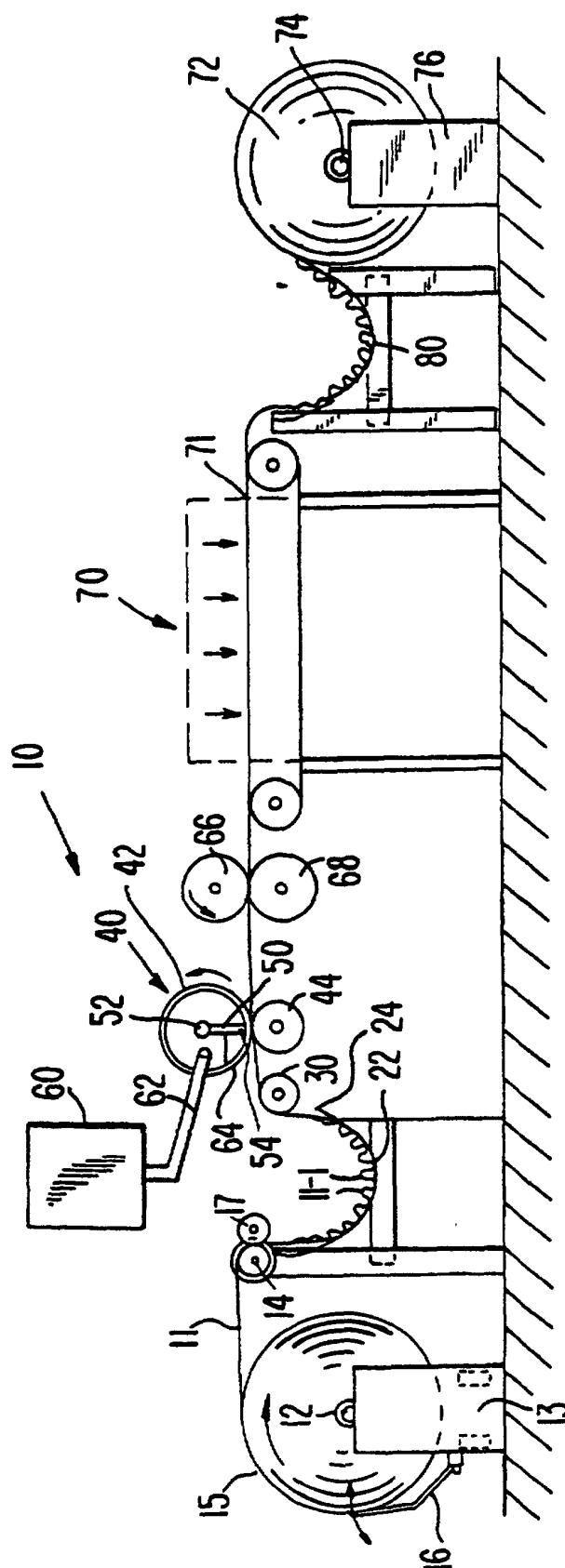
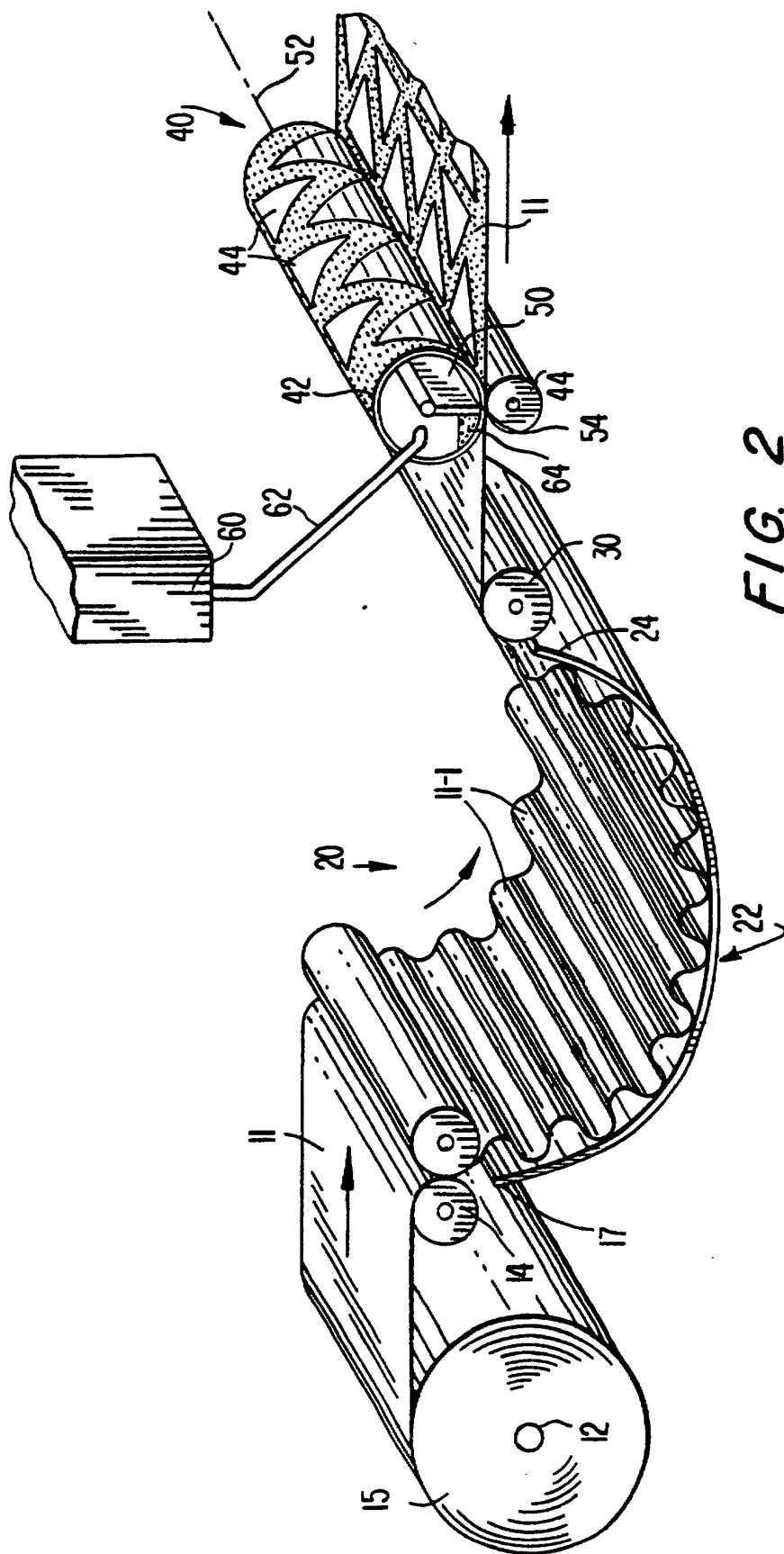


FIG. 1



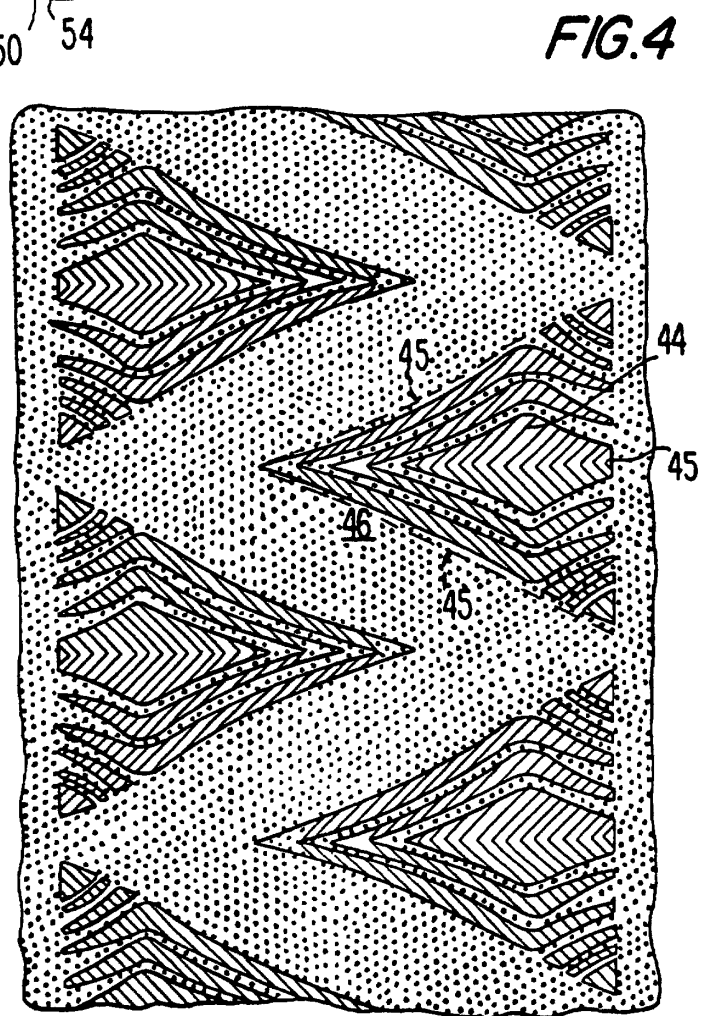
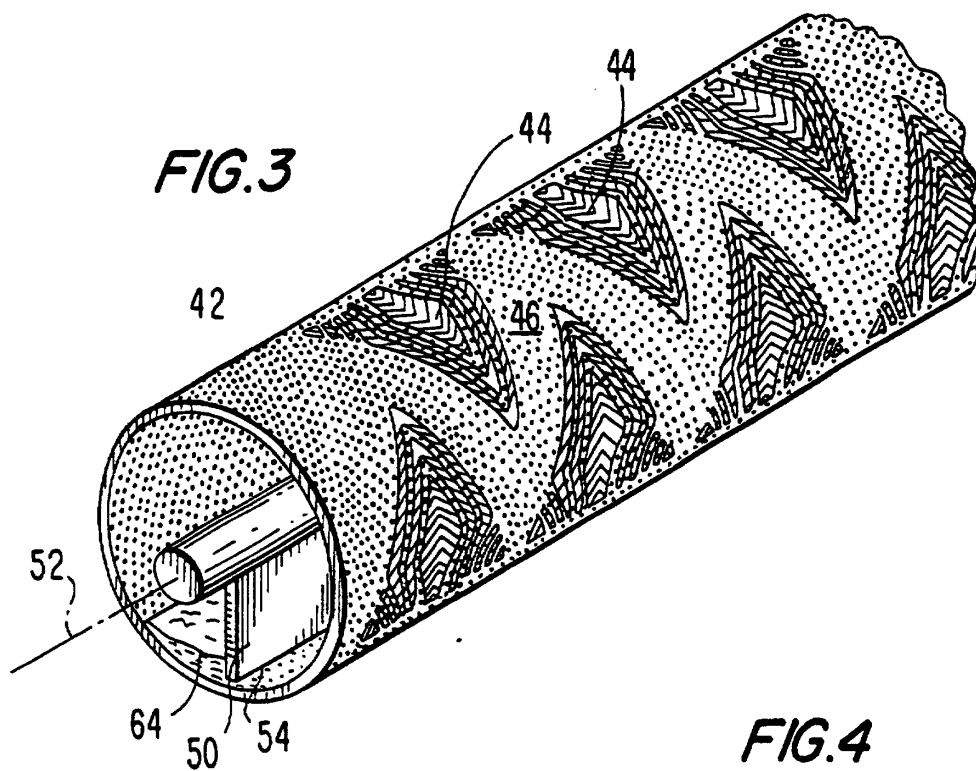


FIG. 5

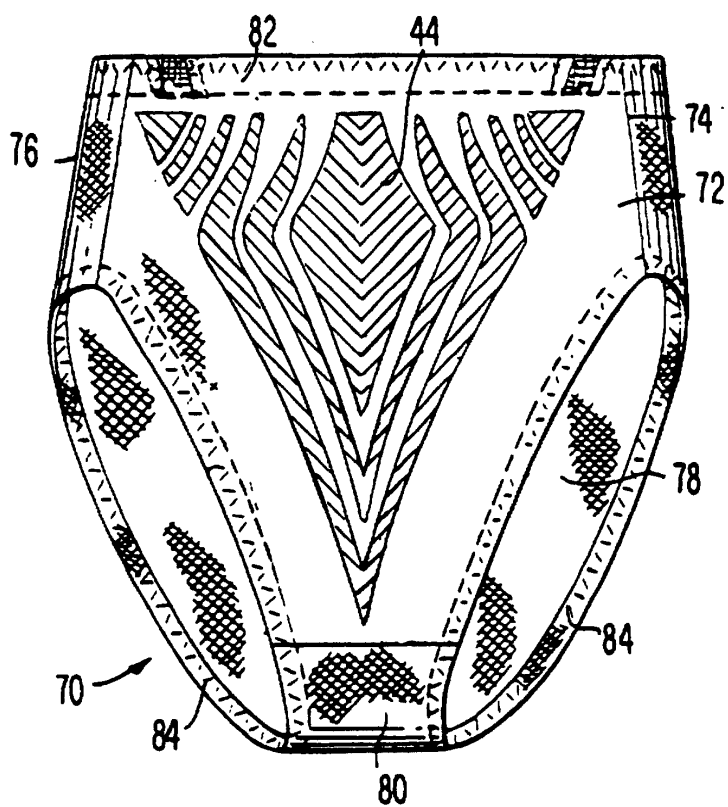
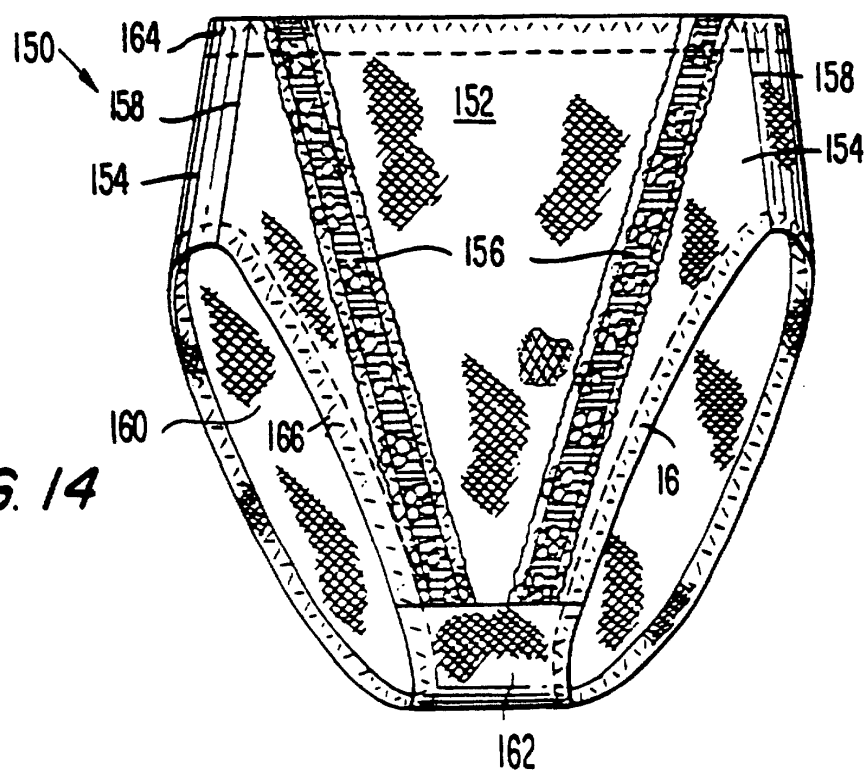


FIG. 14



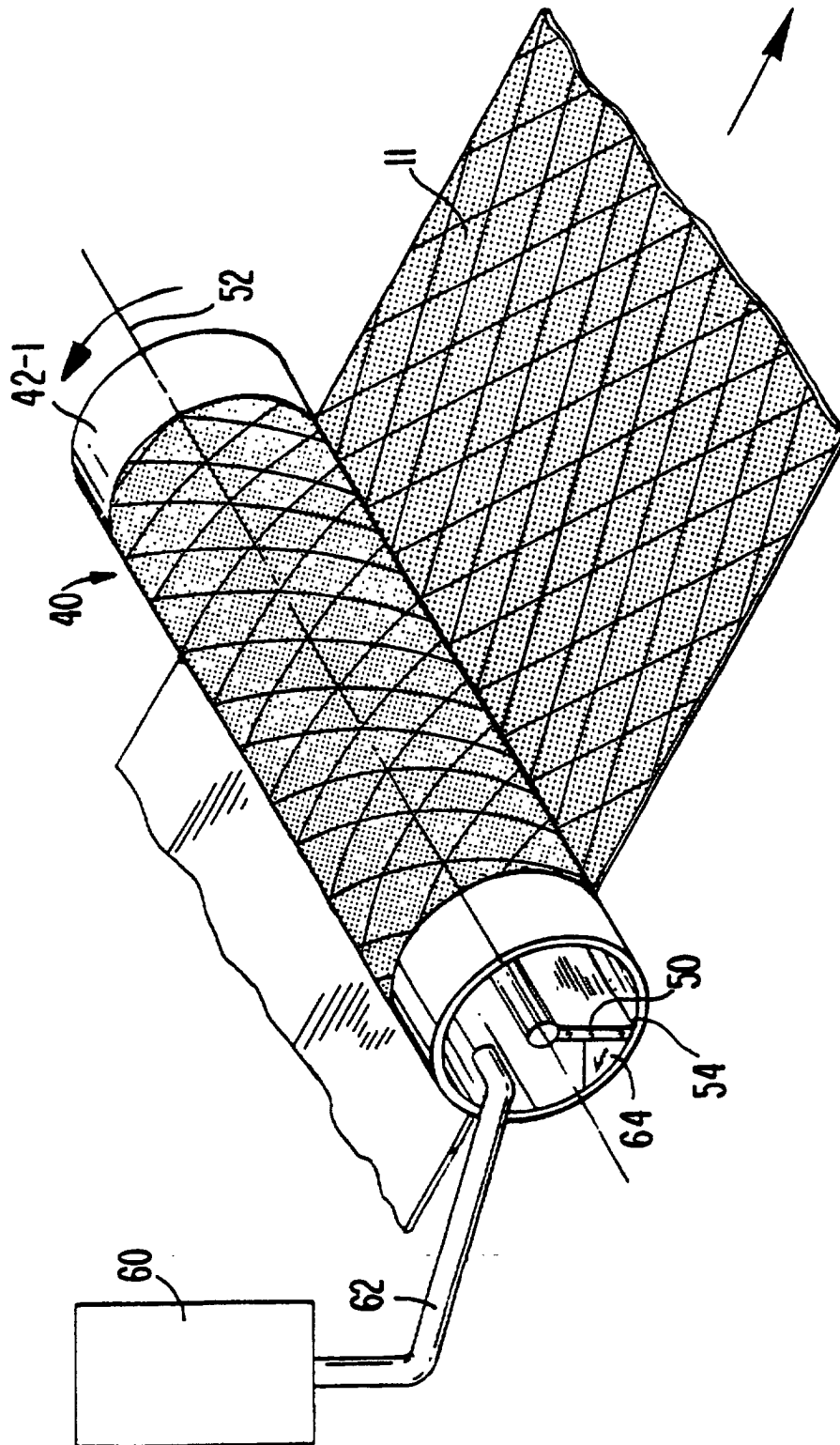


FIG. 6

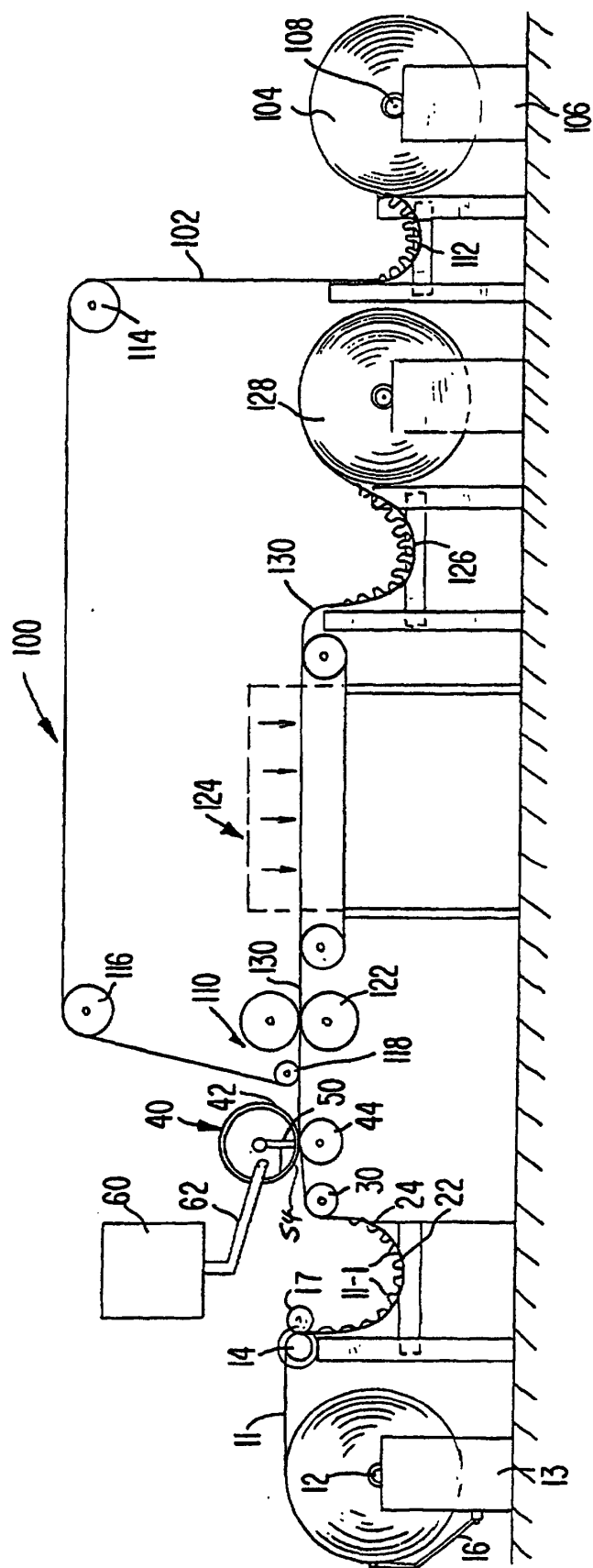


FIG. 7

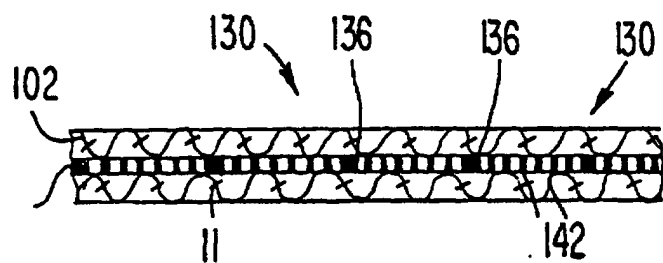
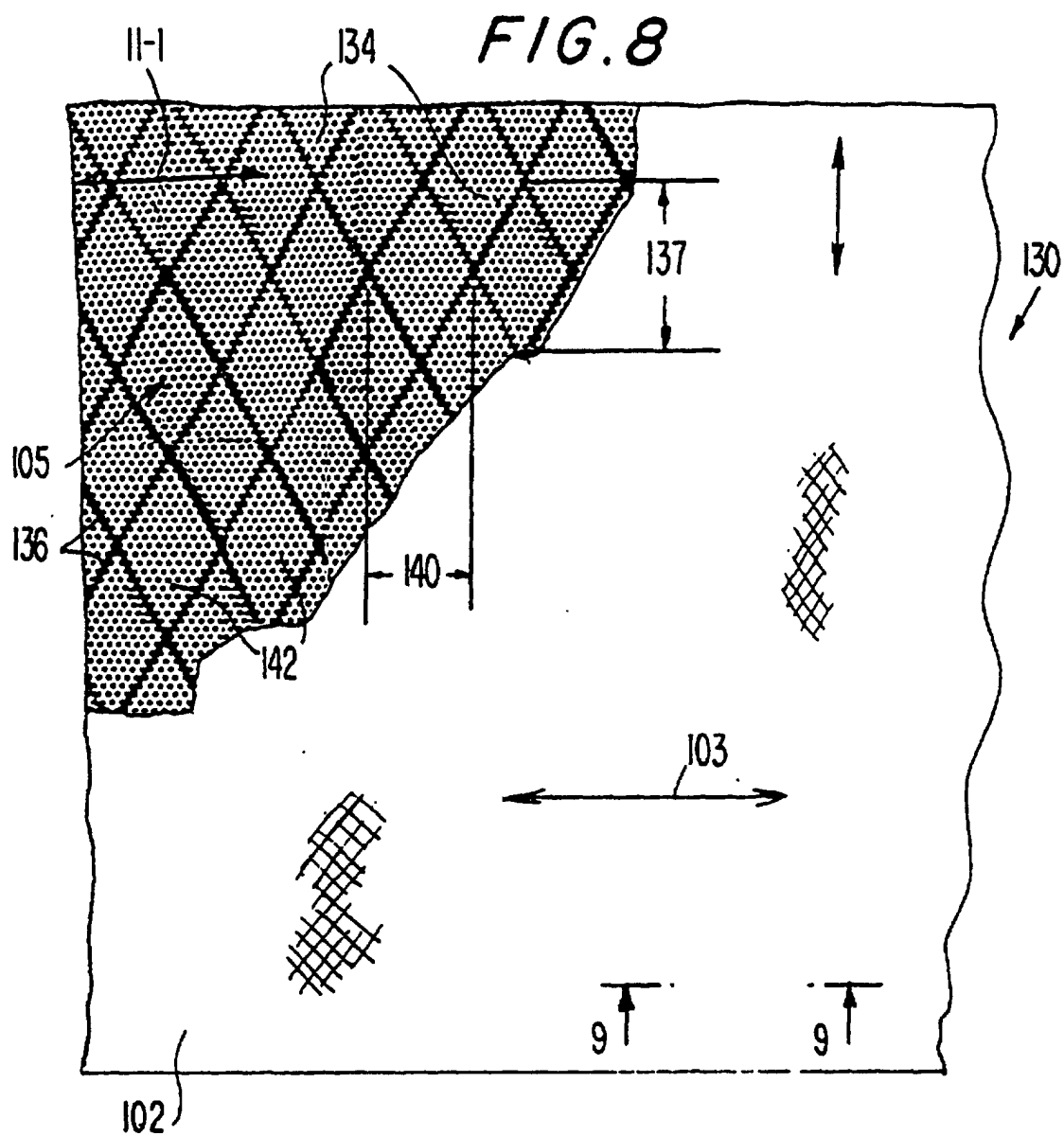


FIG. 9

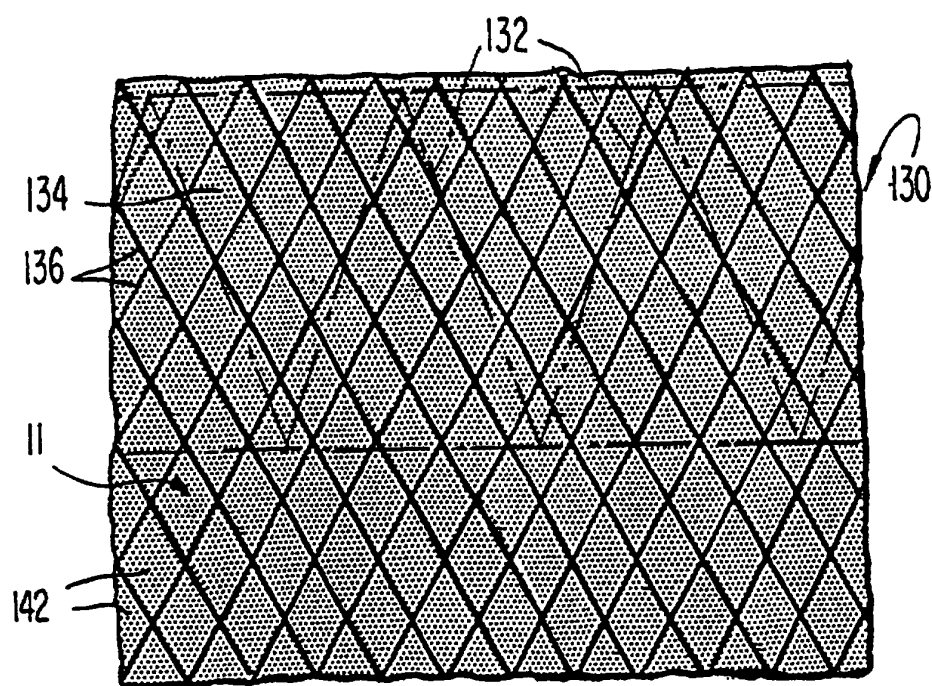


FIG. 10

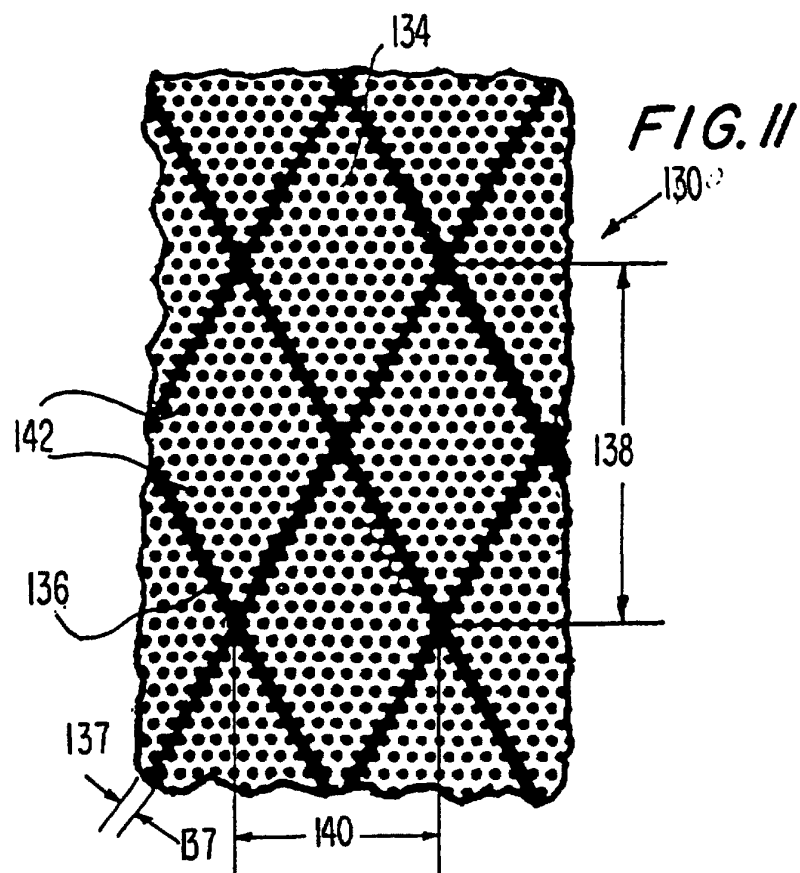


FIG. 11

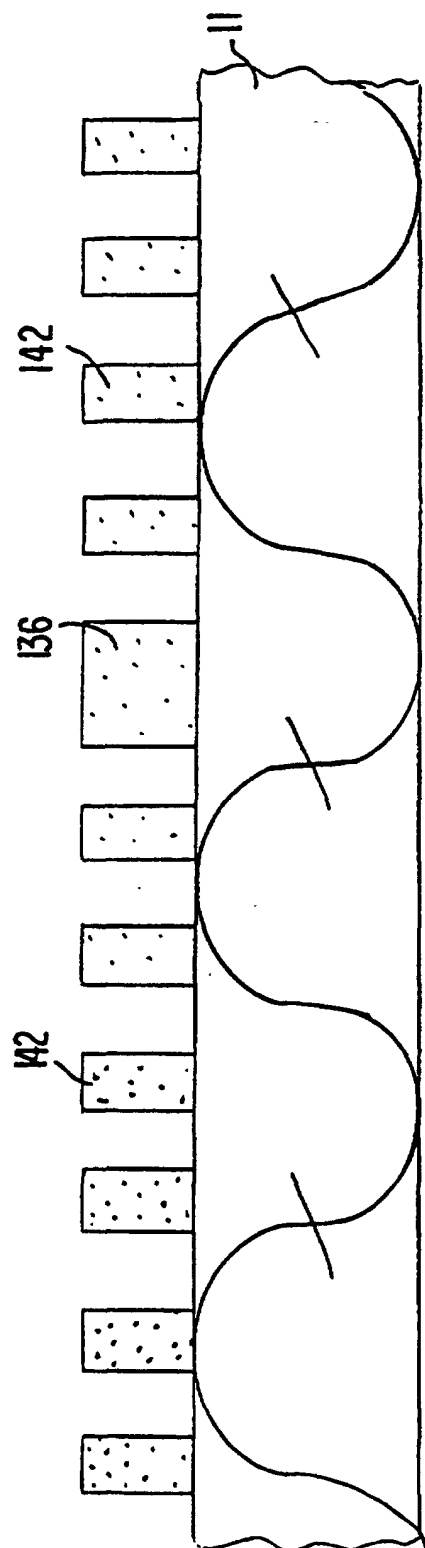


FIG. 12

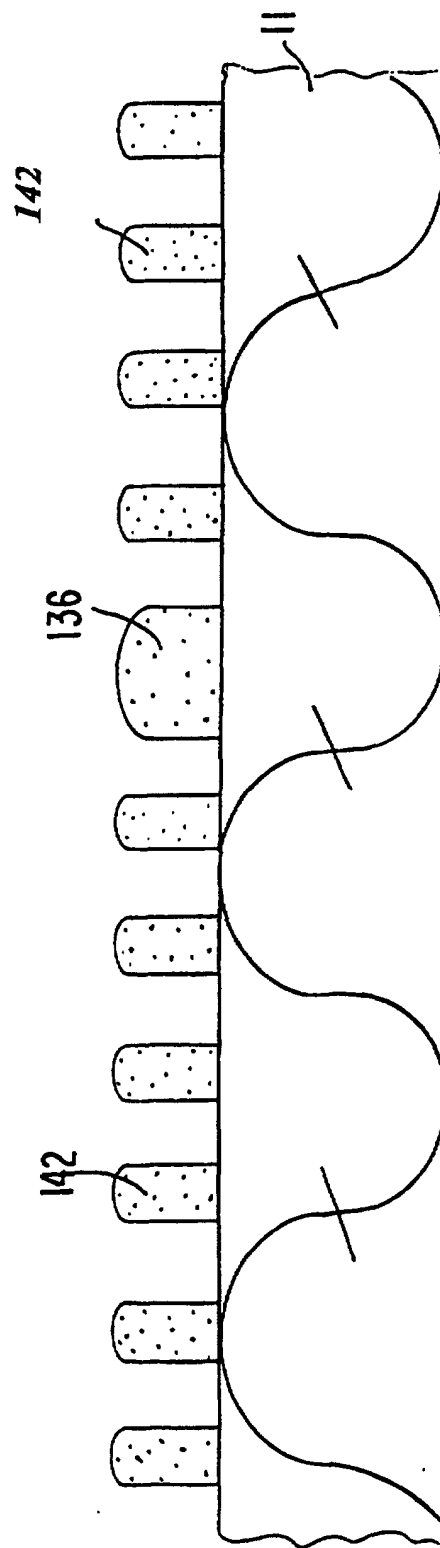
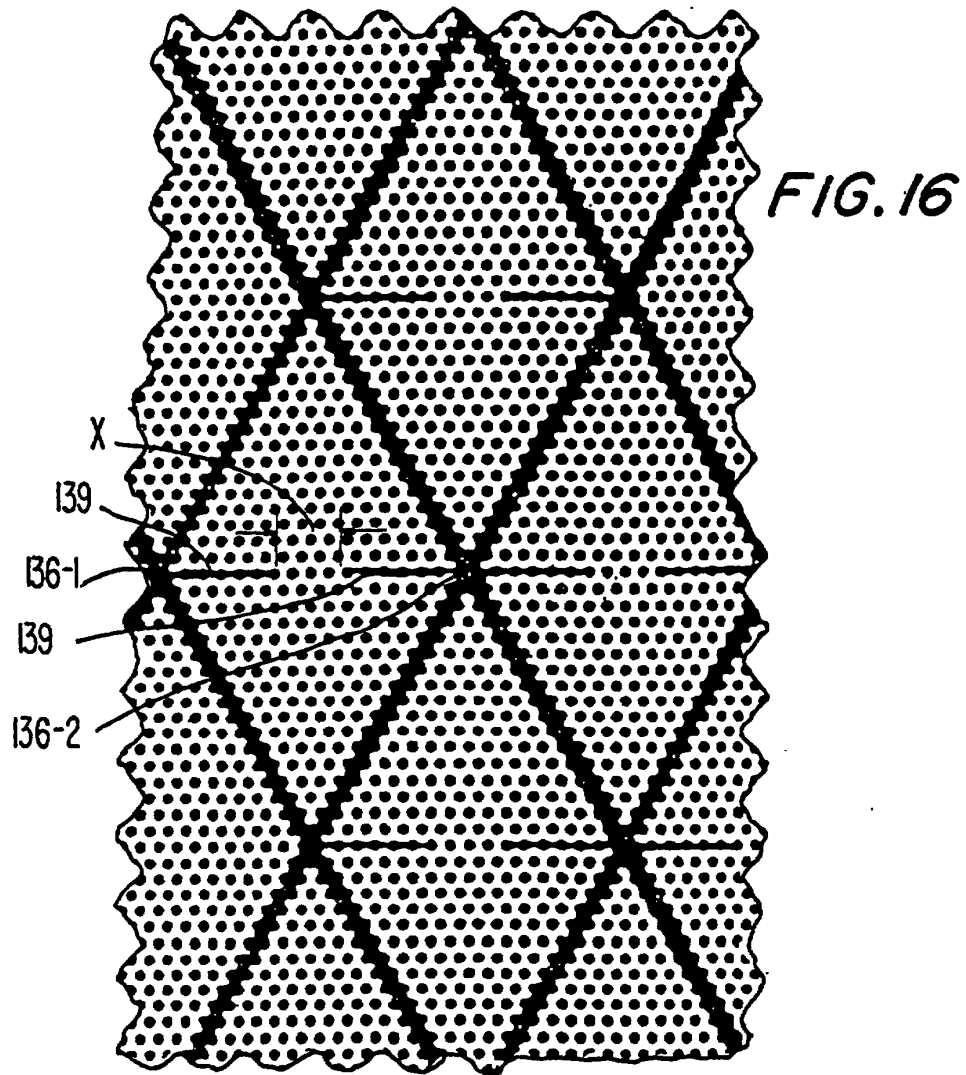
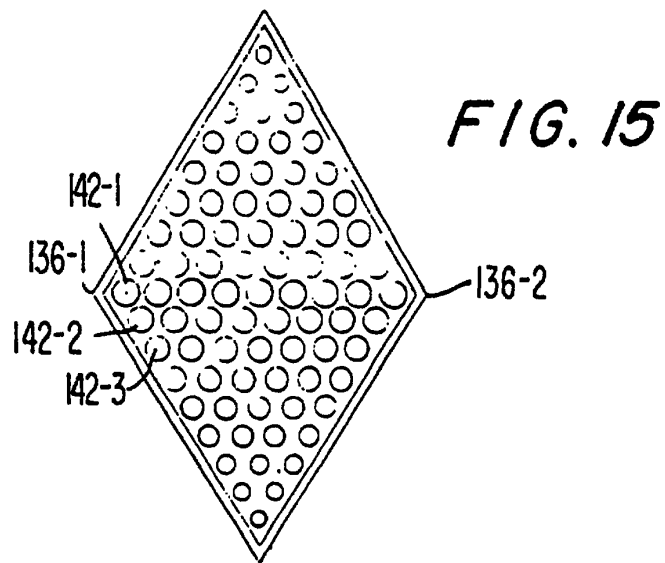


FIG. 13



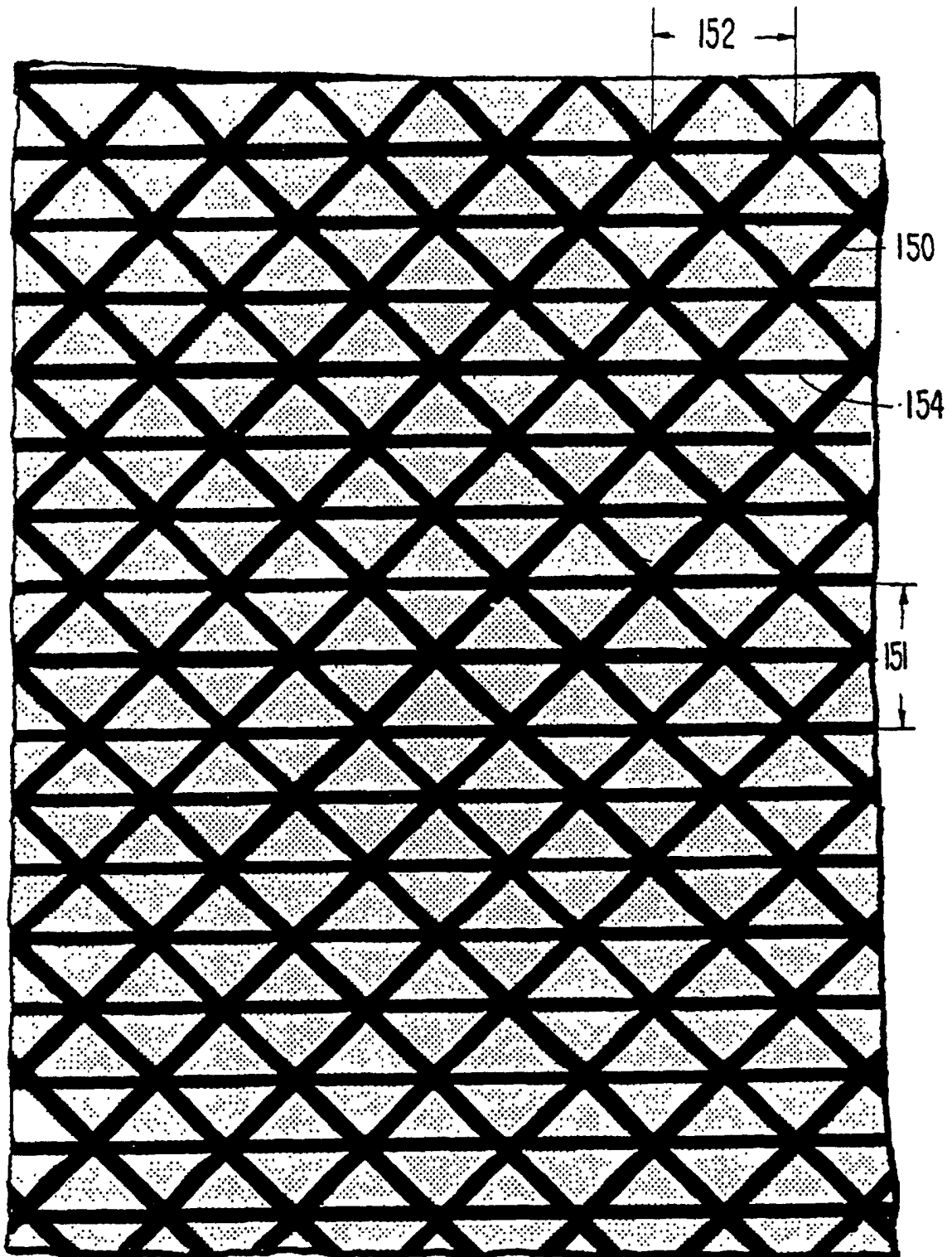


FIG. 17

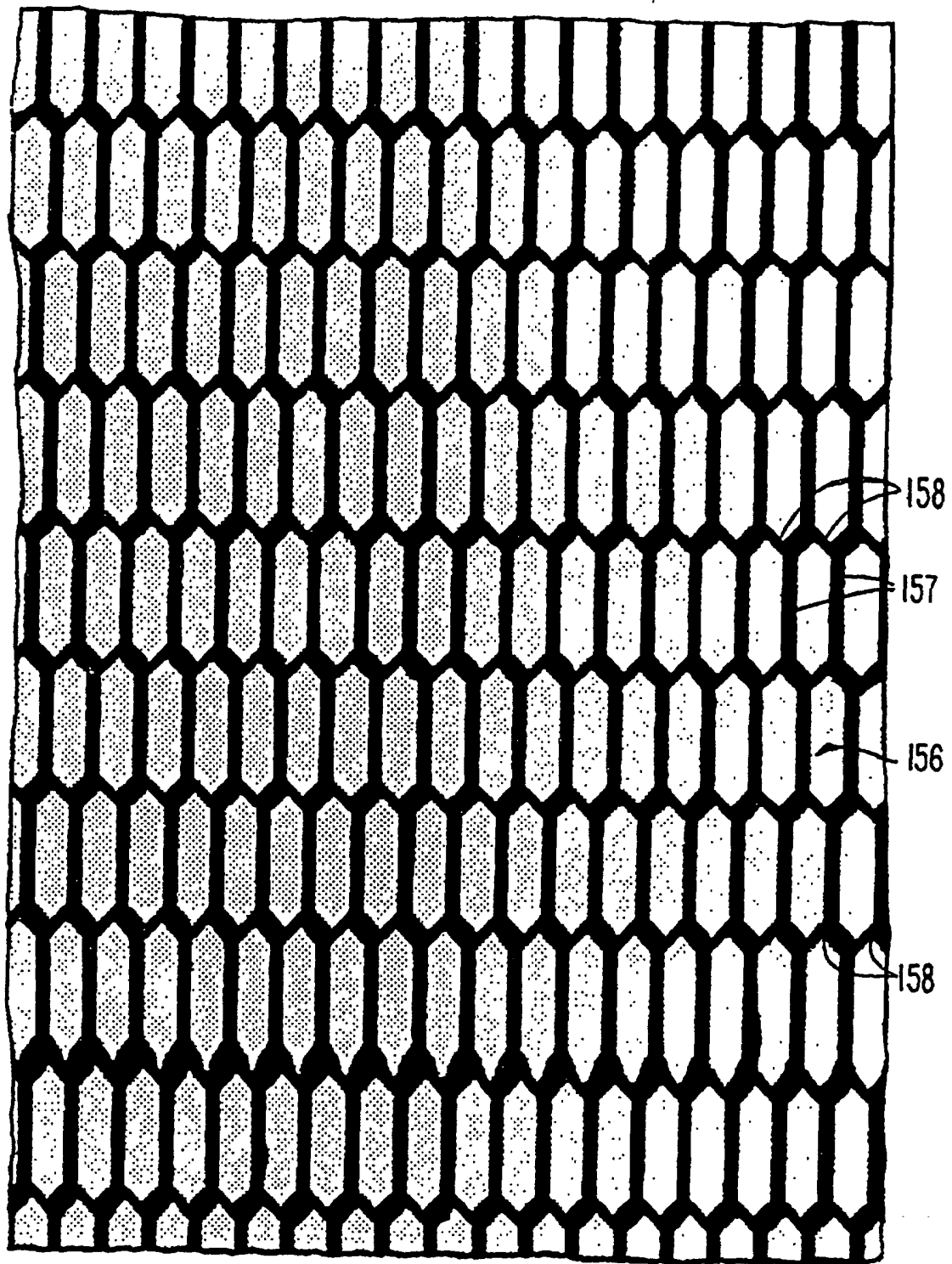


FIG. 18

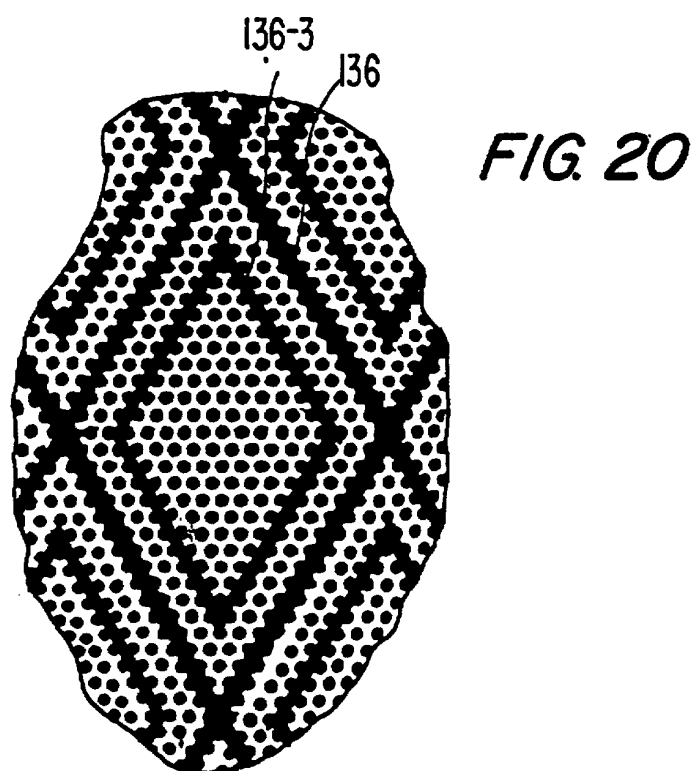
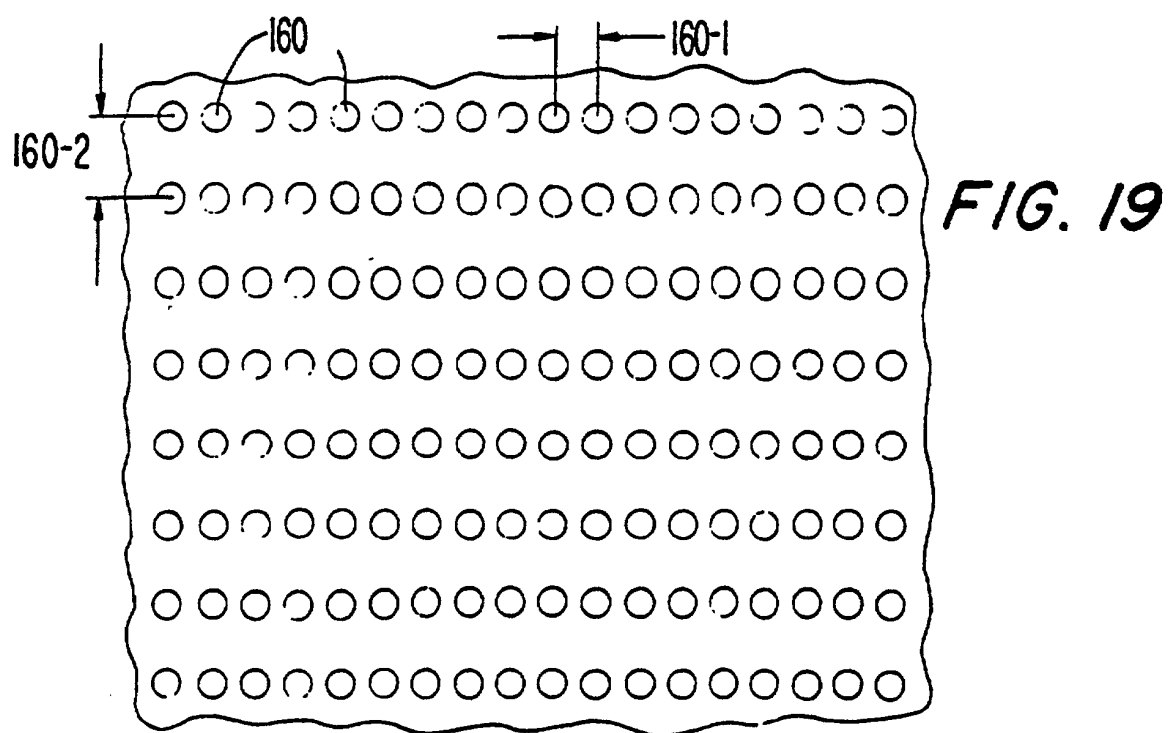
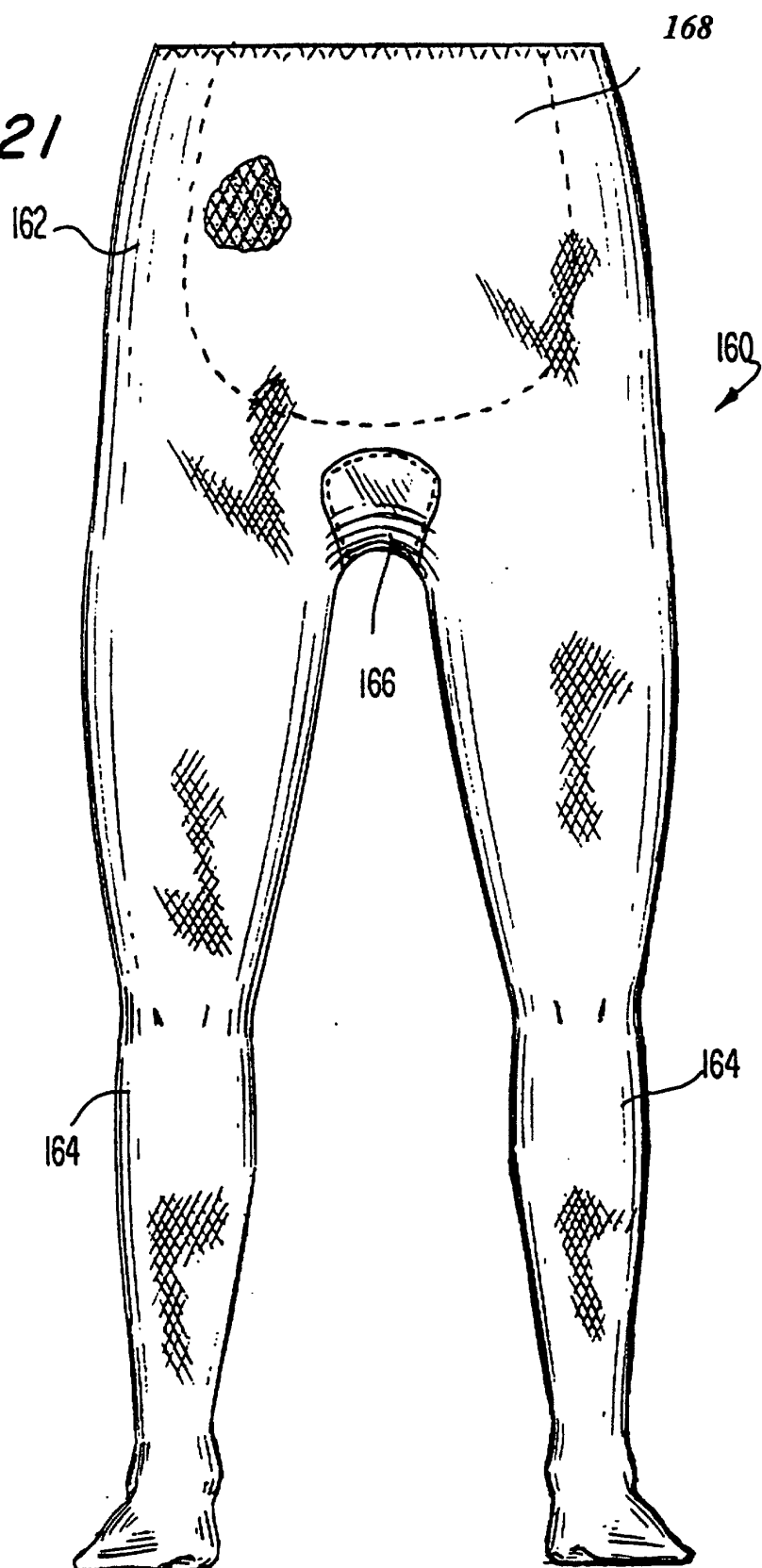
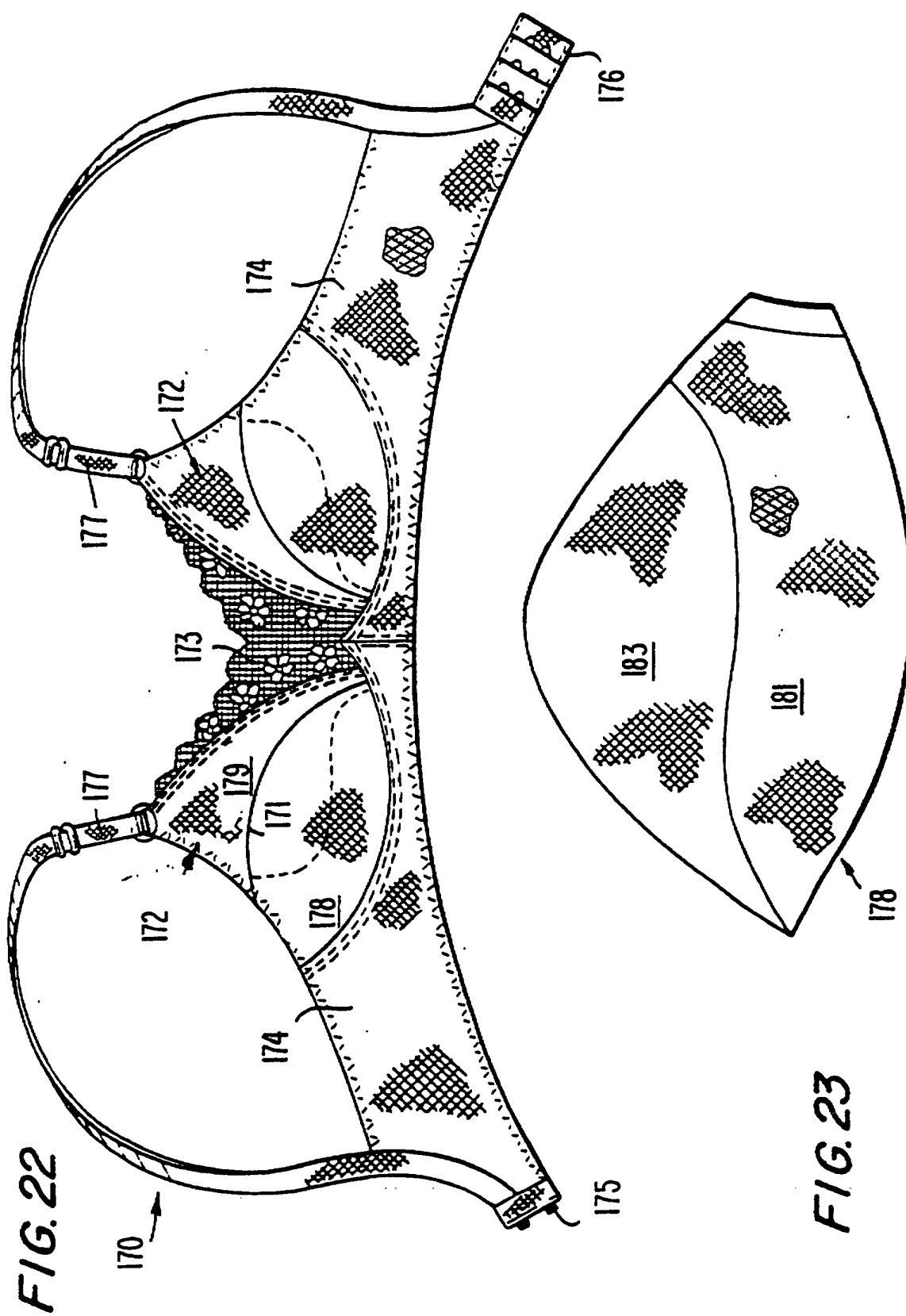


FIG. 21





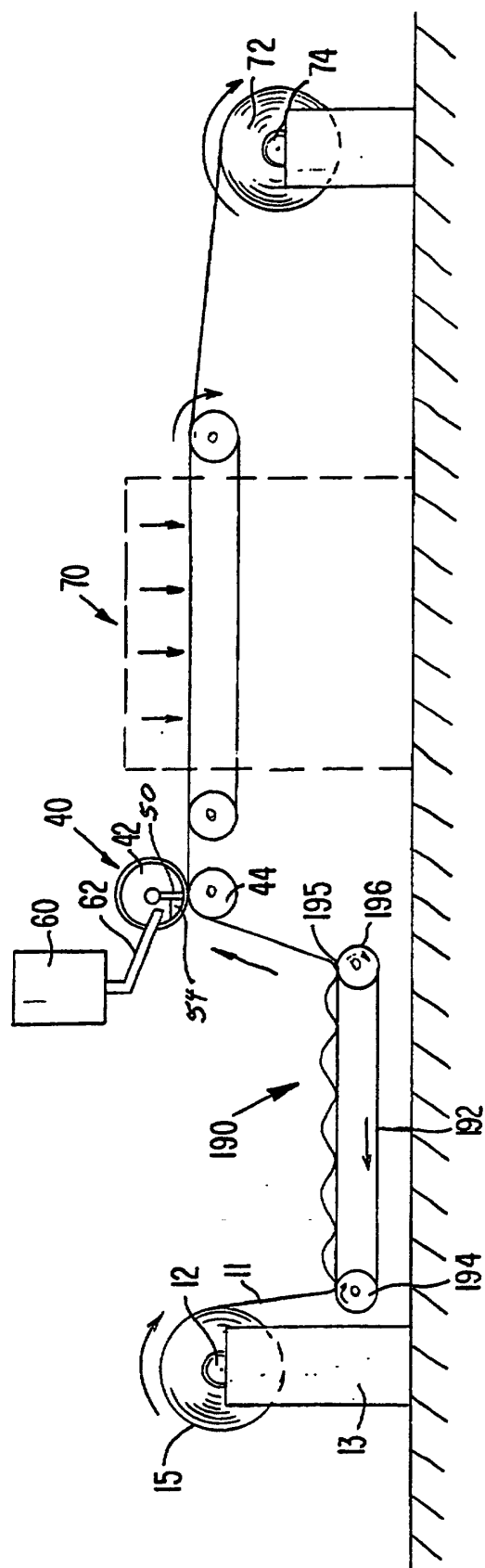


FIG. 24

