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(54) **EXPANDABLE MATERIAL FOR USE IN A GARMENT**

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(57) **ABSTRACT**

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A protective garment having an expandable material incorporated therein is provided. The expandable material may be formed of a nonwoven fabric having a first fabric surface and a second fabric surface which is opposite the first fabric surface. A section of the fabric defines at least one region gathered into a plurality of successive pleats. Each pleat is made of an overlap in the fabric such that a portion of the first fabric surface is disposed adjacent to another portion of the first fabric surface. These two adjacent surfaces are affixed to one another. The entire region is selectively extensible by application of a tensile force to the region which causes the two surfaces to at least partially detach thus enabling the pleat to at least partially unfold.

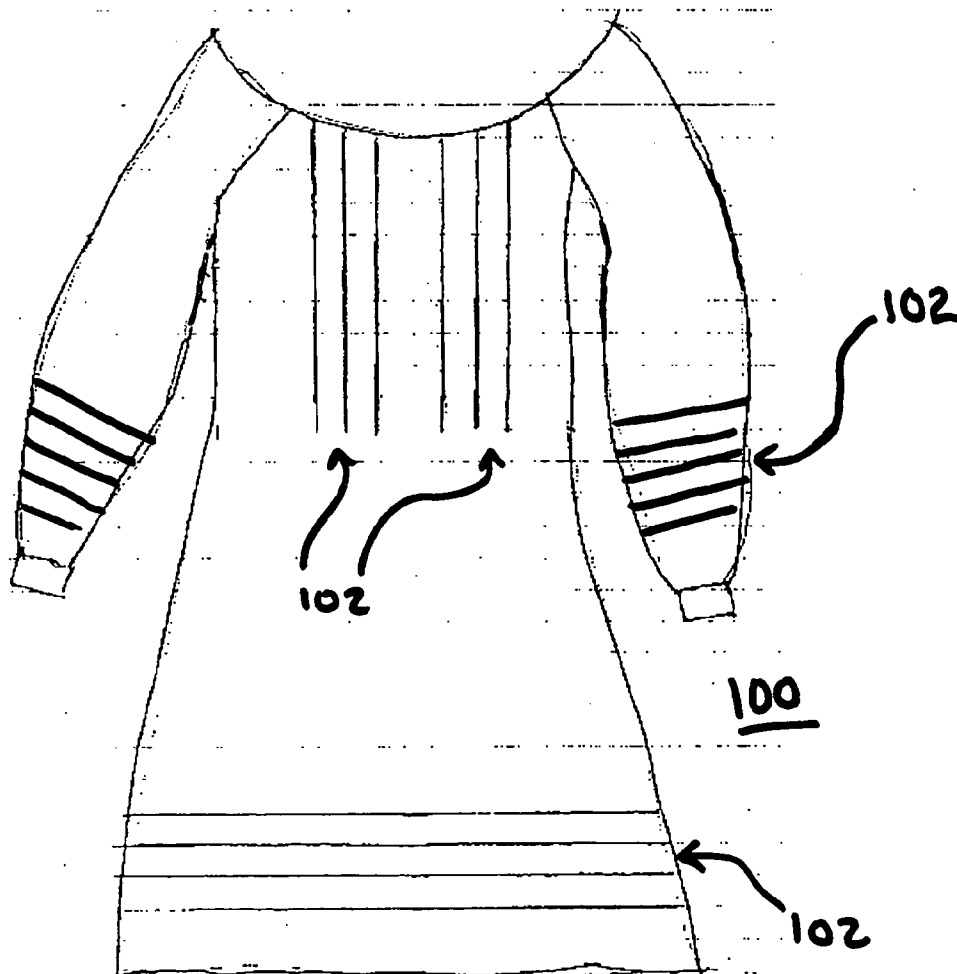
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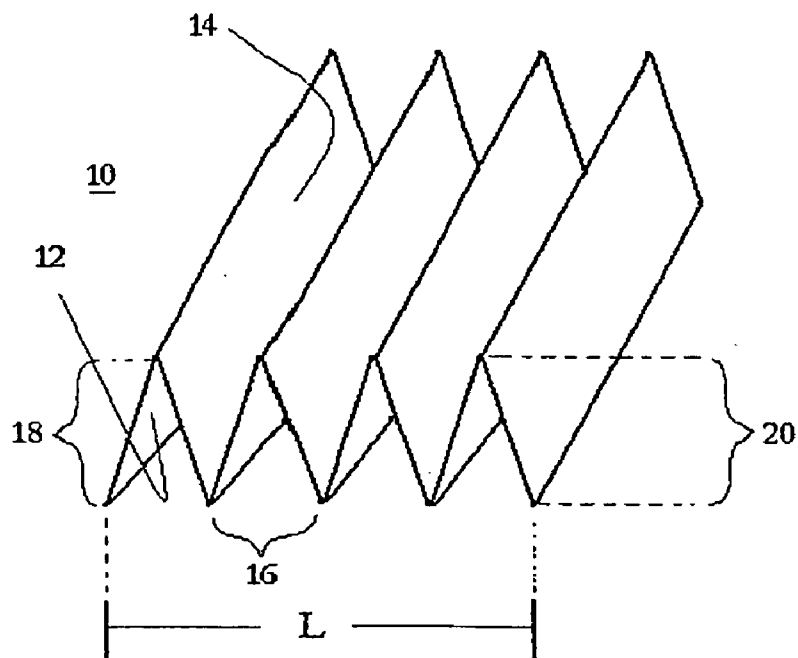


FIG. 1

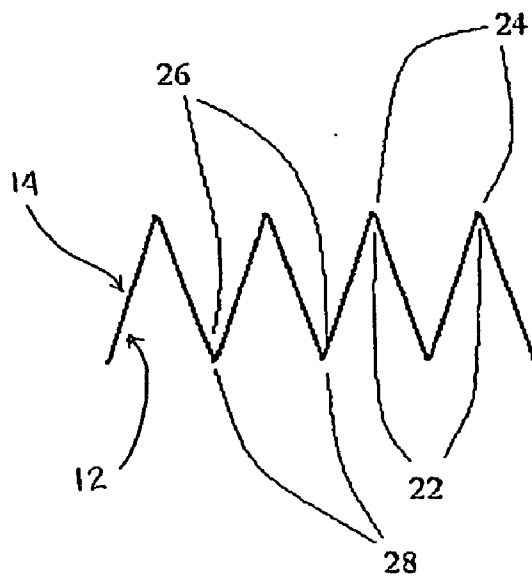


FIG. 2

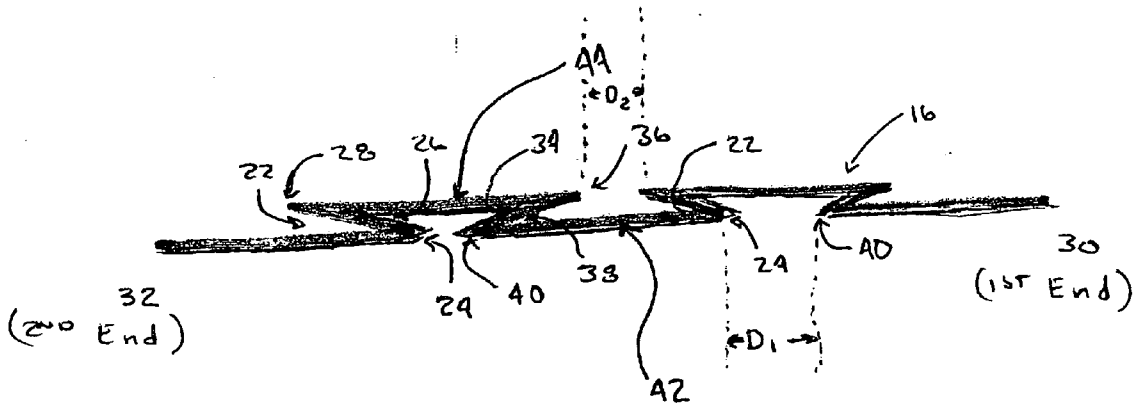


FIG. 3

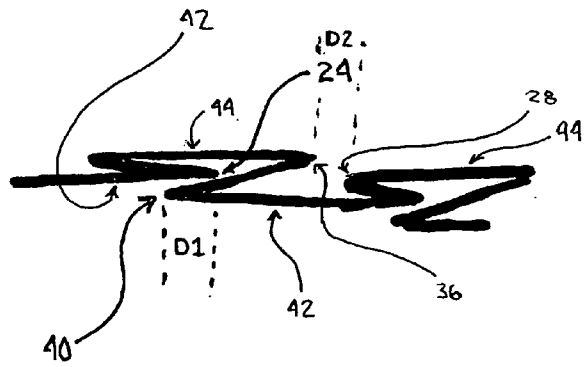


FIG. 4

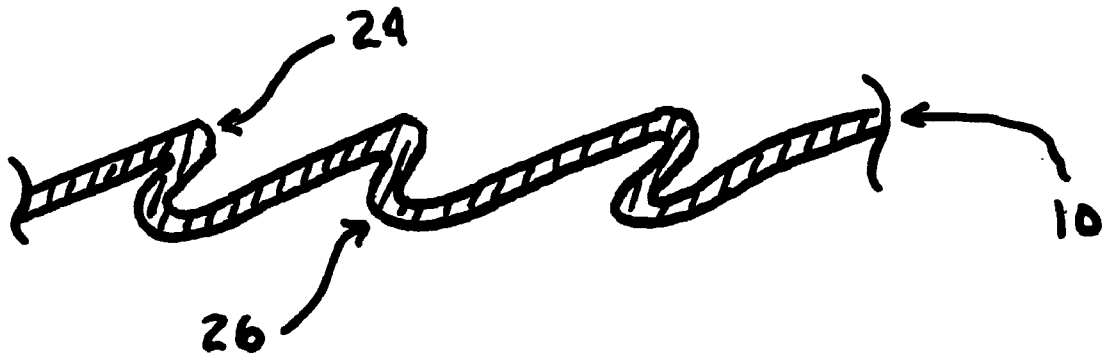


FIG. 5

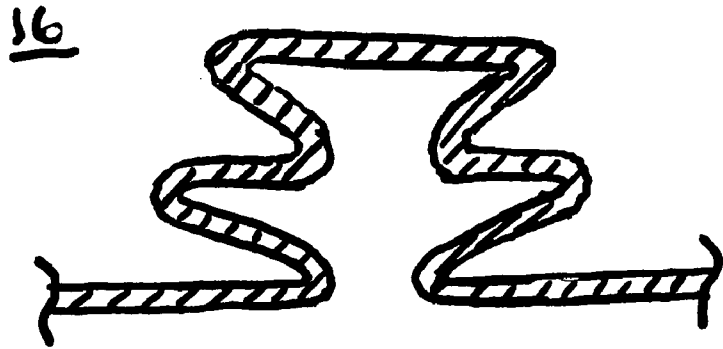


FIG. 6

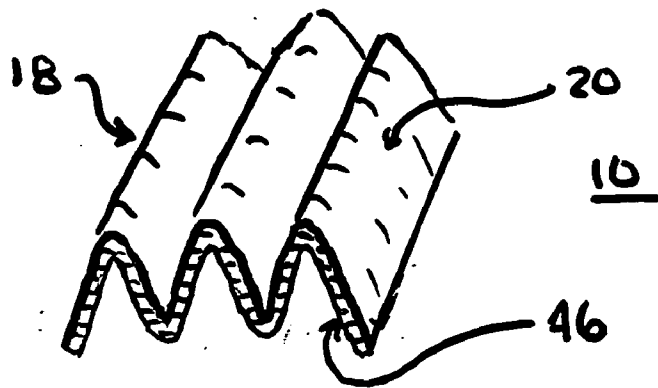


FIG. 7

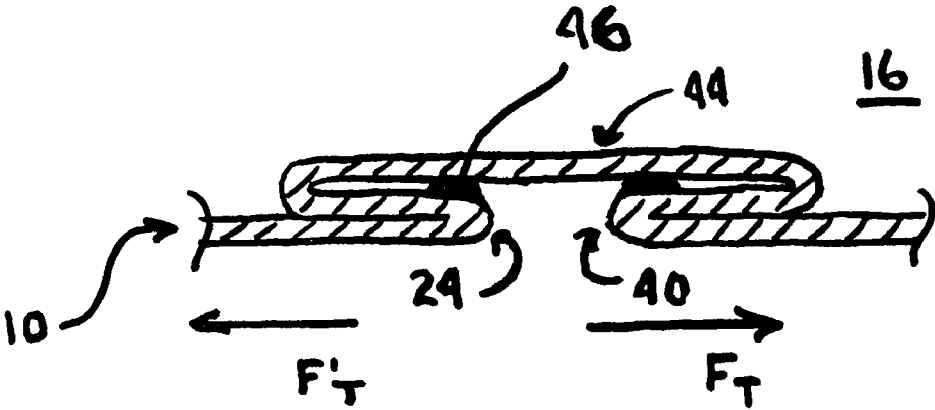


FIG. 8

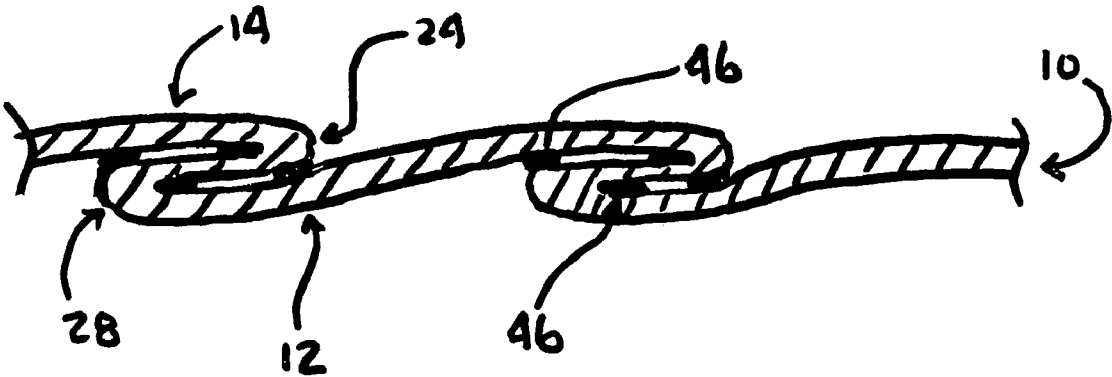


FIG. 9

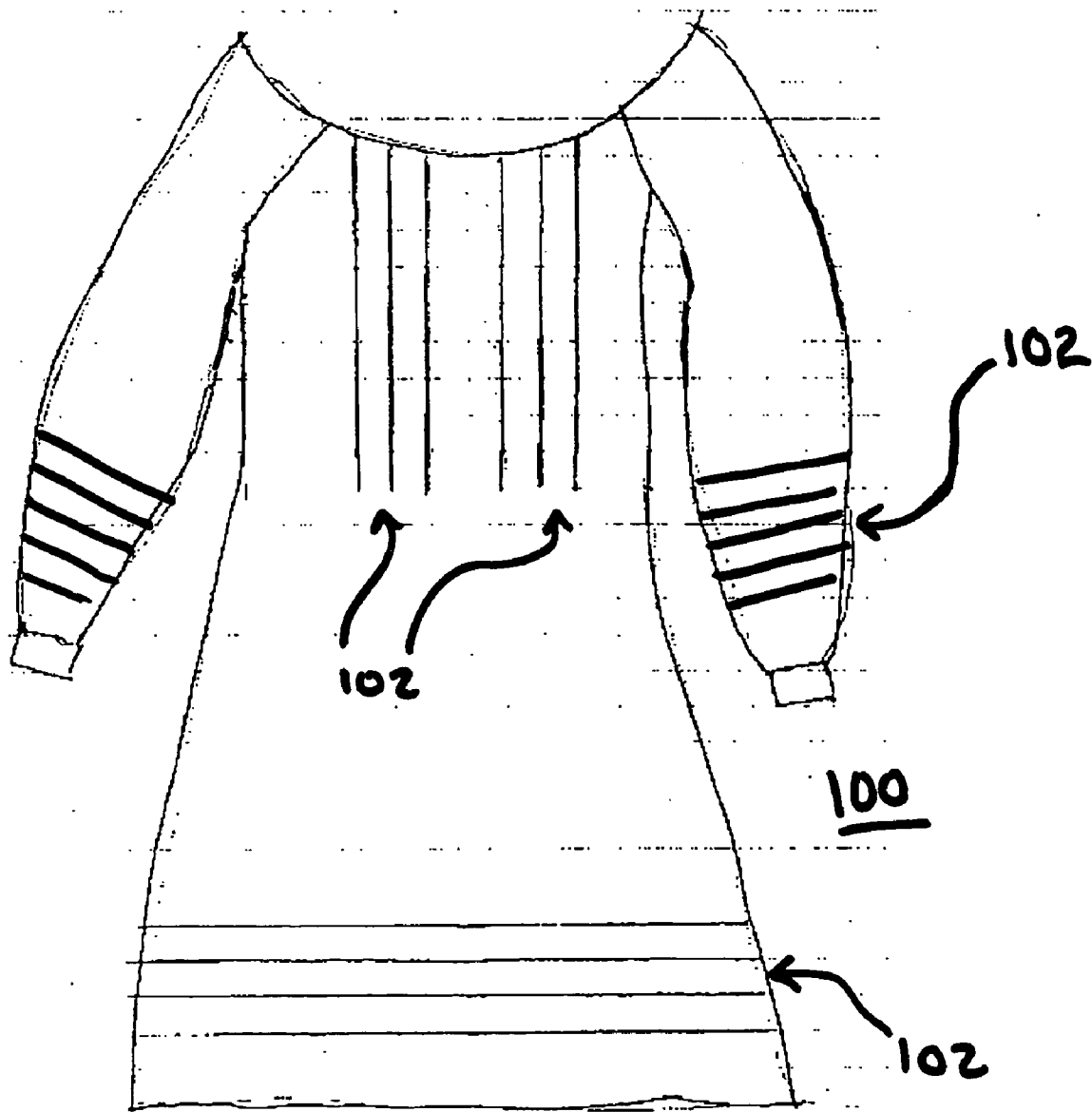


FIG. 10

## EXPANDABLE MATERIAL FOR USE IN A GARMENT

### BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to user adjustable or expandable materials for use in protective apparel or garments. More specifically, a user adjustable or expandable material for use in an adjustable protective garment is disclosed. A garment using such a material will be capable of providing some protection for an individual in a hazardous environment while permitting easy size adjustability. Protective apparel or garments, such as coveralls and gowns, designed to provide barrier protection to a wearer are well known in the art. Such protective garments are used in situations where isolation of a wearer from a particular environment is desirable, or it is desirable to inhibit or retard the passage of hazardous liquids and biological contaminants through the garment to the wearer.

[0002] For example, in the medical and health-care industry, particularly with surgical procedures, a primary concern is isolation of the medical practitioner from patient fluids such as blood, saliva, perspiration, etc. Protective garments rely on the barrier properties of the fabrics used in the garments, and on the construction and design of the garment. Openings or seams in the garments may be unsatisfactory, especially if the seams or openings are located in positions where they may be subjected to stress and/or direct contact with the hazardous substances.

[0003] Originally, surgical gowns were made of linen, the gowns being sterilized prior to use in the operating room. Linen gowns were not capable of preventing "strike-through" of various liquids encountered during surgical procedures. As a result, the wearer's clothes came into contact with blood and the like, and a path was established for the transmission of bacteria to and from the wearer of the gown. Additionally, linen gowns, due to their high cost, had to be used a number of times, thus necessitating laundering and sterilization between successive uses.

[0004] In an attempt to reduce strike-through of liquids and to eliminate the need for repeated laundering and sterilization, disposable gowns were made from fluid repellent nonwoven fabrics. These gowns reduced liquid strike-through for a limited time. However, due to the generally inextensible nature of these nonwoven fabric constructions typically they tend to have less ability to conform to the body than the previously used linens or knits. In order to accommodate for a range of body shapes and sizes, the gown is designed to be loose fitting especially in the chest region, sleeve length, and gown length. Making the gown loose fitting generally minimizes the possibility that the gown may otherwise be undesirably too tight in some area or areas. However, this creates the very obvious problem that the gown will be too big for some wearers. By making the gown oversize a wearer having body dimensions smaller than the maximum size contemplated by the gown is subject to areas or regions of the gown or sleeve that hang or are caused to hang loosely. This phenomenon is known as "blousing". Unfortunately blousing often occurs in or at regions which may be undesirable for the intended use of the gown. Such areas often include the chest region, sleeve area, and the overall length of the gown itself.

[0005] Moreover, many health care facilities purchase only the extra large size version of surgical gowns in order

to minimize the volume of different inventory they must maintain on site. In order to fit these gowns to an individual who may be smaller than that intended by the gown size, the typical wearer resorts to taping sections of the gown together to minimize blousing, for example, in the sleeve area or chest region as well as cutting portions of the gown away so as to shorten the overall length of the gown or shorten the sleeve length.

[0006] Thus, a need exists for an improvement in materials which may provide some degree of adjustability to an end user that may be incorporated into user worn protective apparel or garments. Such a material would be capable of being easily incorporated into the protective garment and would also be economically cost effective to implement and practice.

### SUMMARY OF THE INVENTION

[0007] Objects and advantages of the invention will be set forth in the following description, or may be obvious from the description, or may be learned through practice of the invention.

[0008] The present invention relates to a material that may be found useful in making a unique configuration of a protective garment, particularly a surgical gown, wherein regions of extensible material are selectively provided in the garment to provide for adjustability to accommodate various size wearers. The areas or regions containing extensible materials may be incorporated into the garment by the addition of a dedicated material having characteristics described herein or alternatively may be formed from the substrate material of the garment itself. In any event, the regions of extensibility are typically surrounded by the remaining material of which the garment is made, generally a nonextensible material and, thus, the regions of extensibility may be thought of as "islands" of extensible material strategically located throughout the gown.

[0009] It should be appreciated that, although the present invention has particular usefulness as a material capable of incorporation into a surgical gown, the invention is not limited in scope to surgical gowns or to the medical industry. The material according to the present invention has wide application and can be used in any instance wherein a user adjustable material is desirable in such garments as protective coveralls, gowns, robes, etc. As such, all such uses and garments are contemplated within the scope of the invention.

[0010] The garment, in form according to the invention may be a surgical gown having a conventional body configuration. That is, the garment may have a closed front portion made from a first panel of material and an open back portion defined by back panels that are attached to the first panel of material alongside the seams of the garment. In an alternate embodiment, the garment may have front and back portions formed from a single piece of material. As discussed in greater depth, the style and configuration of the garments of the present invention are not intended to be considered a limiting factor.

[0011] In an embodiment of the invention, a protective garment is provided having a garment body. The garment may be, for example, a surgical gown, a protective coverall, etc. Moreover, in one particular embodiment an expandable

garment is provided. The expandable garment may have a garment body with two sleeves attached. The garment body and sleeves may be formed of a nonwoven fabric having a first fabric surface and a second fabric surface which is opposite the first fabric surface. A section of the fabric defines at least one region gathered into a plurality of successive pleats. Each pleat is made of an overlap in the fabric such that a portion of the first fabric surface is disposed adjacent to another portion of the first fabric surface. These two adjacent surfaces are affixed to one another. The entire region is selectively extensible by application of a tensile force to the region which causes the two surfaces to at least partially detach thus enabling the pleat to at least partially unfold.

[0012] In a further embodiment, it may be desirable to place a plurality of such regions upon sections of the garment. Each region may be adapted to be independently lengthened to accommodate different size individuals. For example, the regions may be adapted to affect overall garment length, affect overall sleeve length, and to affect garment width. A releasable adhesive may be disposed upon at least one portion of the first fabric surface for affixing the surfaces together. Additionally, a releasable adhesive may also be disposed upon at least one portion of the second fabric surface for affixing adjacent pleats to one another. Such a garment may prove useful as medical apparel, surgical gowns, shirts, and/or coveralls.

[0013] In another embodiment, an extensible material for use in a garment is provided. Such a material may be configured as a fabric having a length, a first surface, and an opposing second surface. The fabric may contain at least one pleat transverse to the length. The pleat may be made by overlapping the fabric such that a first portion of the first surface is disposed adjacent to a second portion of the first surface and the first and second portions are removably affixed to one another until freed by application of a tensile force directed along the fabric length. Adjacent pleats may be removably affixed to one another until freed by application of the tensile force directed along the fabric length. The required tensile force may be applied by a wearer pulling on the material. The adhesive may be applied so that application of the tensile force results in an incremental release of the affixed portions or application of the tensile force may result in a smooth release of the affixed portions.

[0014] Embodiments of the protective garment according to the invention are described below in greater detail with reference to the appended figures.

#### BRIEF DESCRIPTION OF THE FIGURES

[0015] **FIG. 1** illustrates one embodiment of an exemplary section of an extensible material according to the present invention;

[0016] **FIG. 2** is an end view of the **FIG. 1** embodiment;

[0017] **FIGS. 3-6** depict alternative pleat configurations of an extensible material of the present invention;

[0018] **FIGS. 7-9** depict pleat embodiments with adhesive means depicted; and

[0019] **FIG. 10** depicts a surgical gown incorporating the material of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

[0020] Reference will now be made in detail to one or more embodiments of the invention, examples of which are graphically illustrated in the drawings. Each example and embodiment are provided by way of explanation of the invention, and not meant as a limitation of the invention. For example, features illustrated or described as part of one embodiment may be utilized with another embodiment to yield still a further embodiment. It is intended that the present invention include these and other modifications and variations.

[0021] **FIG. 1** illustrates an exemplary section of an extensible material **10** which may prove useful for incorporation into those garments where adjustability of portions of the garment to accommodate different size wearers is found especially desirable. An exemplary material **10** would have an initial length "L", a first surface **12**, and a second surface **14** disposed opposite the first surface **12**. A pleat **16** or a series of such pleats **16** would be formed into the material **10**. These pleats and the manner in which they are employed form the predominant means with which the material is extended. Each pleat **16** is created by folding the material **10** over upon itself so that a portion of one surface lies adjacent to another portion of the same surface. For example, the material **10** in this embodiment is overlapped in a direction that lies perpendicular to the length "L" of the material **10** so that for any one pleat, a first portion **18** of surface **12** is superposed with a second portion **20** of surface **12**.

[0022] Looking now to **FIG. 2**, a diagram of an exemplary pleat **16**, may be seen. In this configuration, each pleat **16** is formed by creasing or folding the material **10** such that a first crease **22** having a first peak **24** is formed. The peak **24** points in a direction away from the plane originally established by the first surface **12** prior to folding the material **10**. A second crease **26** is formed in the material **10** a desirable distance from the first crease **22** in a similar manner. This second crease **26** forms a second peak **28**, that points in a direction opposite that of the first peak **24**, i.e., second peak **28** points in a direction toward the plane originally established by the first surface **12** prior to folding the material **10**. As such, the crease **26** may also be considered a reverse fold of the first crease **22**. A series of these folds or creases **22** and **26** are alternately repeated in a pattern to form a plurality of pleats **16** until a desirable number of pleats are formed in the material **10**. Such an arrangement may take on the appearance of an accordion-like folding pattern where each pleat **16** may be identified as beginning with a crease **26** and ending with the next consecutive crease **26**. However, it is only a matter of semantics to identify a pleat in this manner, a pleat may also be considered to begin with a crease **22** and end with the next consecutive crease **22** if desired.

[0023] Turning to **FIG. 3**, an alternative pleat **16** is depicted. In this embodiment, each pleat **16** is formed by creasing or folding the material **10** so as to create the first crease **22** having the first peak **24**. However, in this embodiment the first peak **24** points generally toward a first end **30** of the material **10**. The second crease **26** is oppositely folded from the first crease **22** in a manner similar to the **FIG. 2** embodiment, however, the second peak **28** points in a direction opposite that of the first peak **24**. That is the second peak **28** points toward a second end **32** of the material **10**.



A third crease **34** is formed in the material **10**. The third crease has a third peak **36** that again points toward the first end **30** of the material **10**. A fourth crease **38** is also formed in the material **10**. The fourth crease **38** has a fourth peak **40** that points toward the second end **32** of the material **10**. As depicted, creases **22** and **38** have a section **42** of material **10** disposed therebetween, each section **42** begins and ends with peaks **24** and **40** respectively. Looking to successive sections **42**, it can be seen that the peak **24** of the first section **42** is located a distance "D1" from the peak **40** of the next consecutive section **42** of material **10**. In a similar fashion, creases **26** and **34** have a section **44** of material **10** disposed therebetween beginning and ending with peaks **28** and **36** respectively. Looking now to successive sections **44**, it can also be seen that the peak **28** of one section **44** is located a distance "D2" from the peak **36** of the next consecutive section **44** of material **10**. The dimensions D1 and D2 are not critical to the invention. These dimensions may be the same or they may differ with respect to each other. Moreover each D1 dimension may be different from any other D1 dimension and each D2 dimension may be different from any other D2 dimension.

[0024] In looking to FIG. 4, it may be seen that D1 as well as D2 may reflect a negative value or physically, an overlap of the material **10**. That is, FIG. 4 depicts the dimension D1 as reflecting the amount of overlap between peak **24** of the first section **42** and peak **40** of the next consecutive section **42** of material **10**. The dimension D2 in this FIG. continues to be represented as a positive value which corresponds to a separation between peaks **28** and **36** of two consecutive sections **44**. However, it should be understood that the dimension D2 may also represent a negative value or overlap. Likewise, the dimension D1 may be a positive value when the dimension D2 is a negative value. As should also be understood any combination of values between the dimensions D1 and D2 are possible. FIG. 4 is provided to depict one exemplary arrangement. Other arrangements are contemplated and one skilled in the art would understand such other arrangements resorting to this description in conjunction with FIGS. 3 and 4.

[0025] FIG. 5 depicts an alternative configuration similar to the FIG. 2 embodiment. In lieu of the accordion-fold arrangement depicted in FIG. 2 however, FIG. 5 depicts an overlapping of the peaks **24** and **28** similar to that shown in FIG. 4. FIG. 6 depicts still an alternative pleat **16**. This pleat **16** is similar to that shown in FIG. 4, however, there is an additional depth made up of additional creases. These are not labeled in the FIG., simply because the FIG. is meant to depict the many configurations of pleat which are available to choose depending upon how complex the manufacturer wishes to make the pleat as well as the length of material the manufacturer wishes to fold into a discrete area. As such, each crease and overlap in the material enables a greater total length of material to be folded into a smaller space. Nonetheless these FIGs. are intended to depict that each pleat **16** no matter its configuration begins with an arbitrarily identified starting crease and terminates at a subsequent crease. The specific crease at which the pleat terminates may be identified by looking to the entire repeat folding pattern in the material. Each repeat folding pattern may be thought of as constituting an individual crease.

[0026] Despite the specific form of the pleat **16**, each pleat is initially secured so as to prevent its being unfolded

without first subjecting it to the application of a predetermined tensile force acting thereon. In one embodiment, an adhesive such as that depicted as adhesive **46** in FIG. 7 is applied in strategic locations that serve to retain the pleat structure but will release upon application of a predetermined appropriate amount of force.

[0027] While it is contemplated that the adhesive **46** may be an organic solvent based adhesive or water based adhesive (e.g., latex adhesive) that can be printed, brushed or sprayed onto the pleat substrate, the coating of adhesive **46** may be in the form of a randomly scattered network of hot-melt adhesive taking on the visual characteristics of filaments and/or fibers which are typically produced by conventional hot-melt adhesive spray equipment. The coating of hot-melt adhesive **46** may also be applied in patterns such as, for example, semi-cycloidal patterns. For example, the adhesive **46** may be a hot-melt self adhesive material applied as generally described by U.S. Pat. No. 4,949,668 to Heindel, et al., which is hereby incorporated by reference. The coating of adhesive **46** may also be a coating of any suitable conventional commercially available hot-melt adhesive such as, for example, hot melt adhesives which may contain a blend of thermoplastic polymers (e.g., thermoplastic polyolefins), adhesive resins, and waxes.

[0028] Exemplary hot-melt adhesives which may be used include auto-adhesive 6631-117-1 and auto-adhesive 6631-114-4 available from the National Starch & Chemical Company, Adhesives Division, Bridgewater, N.J. Other adhesives **46** may be, for example, Hot Melt Adhesive H-9140 available from Findley Adhesives, Incorporated, Wauwatosa, Wis. These adhesives **46** may be blended with other materials such as, for example antioxidants, stabilizers, surfactants, flow promoters, particulates and materials added to enhance processability of the composition. Regardless, the adhesive **46** should be selected such that it is sufficiently tacky to retain the pleat structure until the force is applied, yet it should not be so tacky that it will stick to other surfaces, will be subject to transfer to other surfaces, or will readily stick to itself after its initial separation.

[0029] Looking in more detail to FIG. 7, the pleat structure of FIG. 2 is depicted with the adhesive **46** applied. As can be seen in FIG. 7, the adhesive **46** may be applied to the entire first surface **12**. Application of the adhesive **46** may be made to only one of the two adjacent portions **18** or **20**, however, application may be made to both portions **18** and **20** as appropriate. Looking next to FIG. 8, an enlarged view of an exemplary pleat **16** from the pleat structure of FIG. 3 is depicted. In this FIG., the adhesive **46** is shown as being applied to the material **10** upon those surfaces proximate to peaks **24** and/or **40** that are adjacent to and superposed with the section **44** to which they are associated. Looking to FIG. 8, it should be envisioned that application of a tensile force in the direction of the arrows "FT" or F'<sub>T</sub>" will result in the failure of an individual region of adhesive **46**. Continued application of force will result in the failure of other individual regions of adhesive **46**. As such, application of force on a material having individual regions of adhesive will create an intermittent or periodic release of individual regions of adhesive, whereas application of force to a region of adhesive that coats an entire surface as shown in FIG. 7 will be smooth and gradual in comparison. Thus far, the adhesive **46** has been described as being applied only to the first surface **12**. However, as depicted in FIG. 9, the adhe-

sive **46** may also be applied to the second surface **14**. These FIGs. are also intended to show variations upon where and how the adhesive **46** may be applied to the material so as to maintain the pleat structure until such time that sufficient tensile force is applied to the material **10** to unfold the pleat or pleats **16**. Other variations as well as combinations of those discussed above may also be found suitable and therefore are contemplated by this invention as well.

[0030] The present invention thus far has described a material **10** that may be found useful in making a unique configuration of protective garments, particularly surgical gowns **100** such as shown in FIG. 10, wherein regions **102** of the extensible material **10** are selectively provided in the garment so as to enable adjustability to accommodate various size wearers. These areas or regions **102** may be incorporated into the garment by the addition of a dedicated material having characteristics described above, or alternatively the regions **102** may be formed from the substrate material comprising the gown itself by incorporation of the appropriate folds thereby creating the creases. Selective application of the adhesive to maintain the initial integrity of the pleats may be accomplished in either situation. In any event, these regions **102** of extensibility are typically surrounded by the remaining material from which the garment is made. This material may be a nonextensible material such as a nonwoven substrate. In this case, the regions **102** of extensibility may be thought of as "islands" of extensible material strategically located in an otherwise nonextensible material comprising the gown **100**.

[0031] It should, however, be appreciated that any garment made in accordance with this invention, including the surgical gown **100** depicted, is not limited to any particular type of materials. Conventional materials for forming gowns are well known to those skilled in the art, and any such material may be used for a gown in accordance with the present invention. As such, the gown **100** may be made from a multitude of materials, including nonwoven materials suitable for disposable use. A material particularly well suited for use with the present invention is a three-layer nonwoven polypropylene material known as SMS. "SMS" is an acronym for Spunbond, Meltblown, Spunbond, the process by which the three layers are constructed and then laminated together. See for example U.S. Pat. No. 4,041,203 to Brock et al. One particular advantage is that the SMS material exhibits enhanced fluid barrier characteristics, making it desirable for use in a surgical setting. It should be noted, however, that other nonwovens as well as other materials including wovens, knits, films, foam/film laminates, and combinations thereof may be used in the construction of the present invention. Likewise, there are a number of elastomeric extensible materials used in the art that may serve adequately and would enhance the function of the extensible regions **102** used in the present invention. As such, it should be appreciated that the type of fabric or material used for the gown **100** is not a limiting factor of the invention.

[0032] Additionally, it should be appreciated that, although the present invention has particular usefulness as a material capable of incorporation into a surgical gown, the invention is not limited in scope to surgical gowns or to the medical industry. The material according to the present invention has wide application and can be used in any instance where a user adjustable material is desirable in such

garments as protective coveralls, gowns, robes, etc. Consequently, all such uses and garments are contemplated within the scope of the invention. The value of the material may be easily understood by drawing a comparison to the present state of the art with respect to the solution presented herein. Presently a wearer of a disposable garment is provided with a single predetermined size. Custom fitting of such garments is inherently impractical, therefore portions of the garment are often left long or loose to accommodate a larger percentage of wearer body shapes and sizes. Incorporation of the material described herein in certain areas, for example, in the garment arm sleeves, the garment leggings, at the chest and torso region, as well as those regions directed to total garment length provides a wearer with adjustability. The garment would initially appear to be foreshortened, however, by pulling or tugging on the garment at the appropriate region, i.e., providing the necessary tensile force, that region of material is extended by the partial or full unfolding of pleats contained in the region. This results in a lengthening of the garment at the specific region needed for proper fit for the wearer.

[0033] It should be appreciated by those skilled in the art that various modifications and variations can be made to the embodiments of the present invention described and illustrated herein without departing from the scope and spirit of the invention. The invention includes such modifications and variations coming within the meaning and range of equivalency of the appended claims.

What is claimed:

1. An expandable garment comprising a garment body having two sleeves attached thereto, the garment body and sleeves formed of a nonwoven fabric having a first fabric surface and a second fabric surface opposite the first fabric surface, a section of the fabric defining at least one region gathered into a plurality of successive pleats, each pleat comprising an overlap in the fabric such that a portion of the first fabric surface is disposed adjacent to another portion of the first fabric surface, the two adjacent surfaces affixed to one another, the region being selectively extensible by application of a tensile force to the region causing the two surfaces to at least partially detach enabling the pleat to at least partially unfold.

2. The garment of claim 1 comprising a plurality of regions disposed upon sections of the garment, each region adapted to be independently lengthened to accommodate different size individuals.

3. The garment of claim 1 wherein the region is adapted to affect overall garment length.

4. The garment of claim 1 wherein the region is adapted to affect overall sleeve length.

5. The garment of claim 1 wherein the region is adapted to affect overall sleeve width.

6. The garment of claim 1 wherein the region is adapted to affect garment width.

7. The garment of claim 1 comprising a releasable adhesive disposed upon at least one portion of the first fabric surface for affixing the surfaces together.

8. The garment of claim 1 comprising a releasable adhesive disposed upon at least one portion of the second fabric surface for affixing adjacent pleats to one another.

9. The garment of claim 1 wherein the garment is selected from a group consisting of medical apparel, surgical gowns, shirts, and coveralls.

**10.** An extensible material for use in a garment comprising a fabric having a length, a first surface, and an opposing second surface; the fabric containing at least one pleat transverse to the length made by overlapping the fabric such that a first portion of the first surface is disposed adjacent to a second portion of the first surface and the first and second portions are removably affixed to one another until freed by application of a tensile force directed along the fabric length.

**11.** The material of claim 10 comprising a releasable adhesive disposed upon at least one portion of the first surface for removably affixing the portions of the surfaces together.

**12.** The material of claim 10 wherein adjacent pleats are removably affixed to one another until freed by application of the tensile force directed along the fabric length.

**13.** The material of claim 10 comprising a releasable adhesive disposed upon at least one portion of the second surface for removably affixing portions of the second surfaces together.

**14.** The material of claim 10 wherein the tensile force is applied by a wearer pulling on the material.

**15.** The material of claim 10 wherein application of the tensile force results in an incremental release of the affixed portions.

**16.** The material of claim 10 wherein application of the tensile force results in a smooth release of the affixed portions.

**17.** The material of claim 10 wherein the pleat comprises an additional fold.

**18.** A surgical gown comprising the material of claim 10.

\* \* \* \* \*