

BREATHABLE STAIN RESISTANT UNDERGARMENT FOR USE WITH AN ABSORBENT ARTICLE

CROSS-REFERENCE TO RELATED APPLICATION

This disclosure incorporates and has the priority of U.S. Provisional Patent Application Serial No. 60/019,102, filed on June 3, 1996 in the names of Lee, et al.

FIELD OF THE INVENTION

The present invention relates to undergarments, particularly to undergarments that can be used in conjunction with an absorbent article, and more particularly to undergarments a user can wear with a catamenial device during her menstrual period.

BACKGROUND OF THE INVENTION

As is known, disposable catamenial devices are commercially available in a wide variety of configurations for the specific purpose of absorbing and retaining menstrual fluids and other vaginal discharges. Unfortunately, such catamenial devices may leak menses along their periphery due to poor fit or improper placement. Such leakage frequently results in soiling of a wearer's undergarments, clothing and bedding.

To provide additional protection against leakage, it is known to use a washable and reusable garment, such as a menstrual short or panty, in combination with a disposable catamenial pad. For example, U.S. Patent 3,489,149, issued to Larson on January 13, 1970, discloses a washable menstrual panty having a small pocket in the crotch area for retaining a disposable catamenial pad. Since the menses must initially flow through a layer of material forming the pocket to reach the catamenial pad, removal of the soiled catamenial pad can be distasteful, difficult and unsanitary. While a new pad can be inserted into the pocket, the garment is already soiled and would typically be changed. Also, the pocket may not accommodate the varied sizes of catamenial devices currently on the market. Further, the layer of moisture resistant material described therein fails to provide ventilation or breathability in the crotch region with a resulting potential for wearer discomfort when such a panty is worn.

The art has also attempted to address leakage from a catamenial device by providing absorbent material in a region surrounding the device and means for positioning the catamenial device. For example, U.S. Patent 4,560,381, issued to Southwell on December 24, 1985, describes a mesh-like outer panty shell with a thick inner layer of absorbent material in the lower crotch area of the panty. The inner layer of absorbent material includes a depression for receiving and positioning a catamenial pad. An alternative embodiment includes a barrier film between the absorbent material and the panty shell. However, if the barrier film is present, the crotch portion will not be breathable (with resulting discomfort) and if the barrier film is absent, there is a risk of leakage.

In U.S. Patent 4,813,950, issued to Branch on March 21, 1989, a washable menstrual panty is disclosed as having an outer lining of spandex, soft tricot, etc. which provides a "skin tight or almost skin tight" fit and an inner lining of a microporous plastic film to prevent passage of menses therethrough while allowing passage of gasses. Similarly, existing Japanese-style menstrual shorts act like a girdle or a very tight fitting panty which holds a catamenial device in the wearer's pudendal region. Positioning of the catamenial device for such undergarments is achieved by the tightness of the menstrual short which, in turn, may cause discomfort to the wearer. Further, any leakage of menses along the periphery of the catamenial device could easily pass to outer garments because there is no provision for absorbing such leakage and wearer movement can create gapping in leg elastics.

A menstrual short panty having an elastic piece fixed to the front and rear of the crotch region in an elongated state is described in U.S. Patent 3,608,551, issued to Seijo on September 28, 1971. The elastic piece is said to keep a sanitary napkin raised and in contact with a wearer's body irrespective of her physical movements. The elastic piece is joined to the leg openings by an open mesh network and the crotch region underlies the network. While such a device may improve body contact, the risk of wearer discomfort is relatively high because the narrow elastic piece which provides all of the lifting would tend to force the sanitary napkin it supports into the axis of the vulvular cleft or the gluteal groove. Further, the Seijo device makes no provision to accommodate any liquids that may leak around the periphery of the sanitary napkin.

Disposable menstrual panties are also known. For example PCT Application WO 95/06451 published in the name of Kimberly-Clark Corporation on March 9, 1995 describes a disposable menstrual panty said to provide backup leakage

protection by way of an absorbent/barrier composite positioned in the crotch area of the panty. The menstrual panty described therein is also provided with circumferentially oriented elastics said to allow the panty to conform to various body types and builds. However, because they only encircle a wearer's waist and hip areas, such elastics provide no "z direction" (i.e. upward) biasing force to help maintain a catamenial device in contact with a wearer's pudendal region. As a result, there is a risk of leakage around the catamenial device and a resultant risk of soiled outer garments or bedding.

It is therefore an object of the present invention to provide an improved menstrual undergarment for use with a catamenial device which provides a biasing force to help insure close contact between the catamenial device and a wearer's pudendal region throughout the full range of wearer motions. It is a further object of the invention to provide a menstrual undergarment with a dual protection system wherein the crotch portion of the undergarment is liquid absorbent yet resists transport of liquids therethrough and the shell portion of the undergarment resists staining by bodily fluids such as menses. It is still a further object of the present invention to provide a menstrual undergarment that is breathable throughout both the body and the crotch portions.

These and various other objectives of the present invention will be more readily apparent when considered in reference to the following description and when taken in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

The present invention is directed to an undergarment to be worn in conjunction with an absorbent article. While the present invention is described in terms of an undergarment to be worn with a catamenial device by women during their normally occurring menstrual period, the invention is not limited to only such uses. In particular, the present invention is also suitable for use with absorbent articles designed to control other bodily fluids (e. g. adult incontinence devices, diaper inserts, and the like). In a preferred embodiment, the present invention is a legless, tubular knit undergarment which comprises a breathable, liquid resistant shell portion having an elasticized waist opening, an absorbent, preferably breathable, elastically extensible crotch portion, which also acts as a barrier to leakage, and a pair of elasticized leg openings.

The shell portion is liquid resistant because it is treated to be substantially hydrophobic. As a result bodily fluids, such as menses, are less likely to wet the shell portion than if the shell portion were untreated. Such hydrophobicity reduces the risk of staining. Further, pressure is required to force such bodily fluids through the structure of the shell portion reducing the risk of leakage with resulting soiling of outer garments or bedding. Preferably, the fibers comprising the shell portion are treated with a hydrophobic, surface active material, such as a fluorocarbon, to provide the requisite hydrophobicity.

The crotch portion has two layers: a liquid resistant barrier layer and an absorbent body layer. Liquid resistance is provided either by treatment with a hydrophobic, surface active material or by provision of a fluid resistant film laminate. Absorbency can be provided either by integral means, such as knitting absorbent materials into the crotch portion of the undergarment and subsequently treating the garment surface thereof to become liquid resistant, or by disposing an absorbent component onto a garment layer that is treated to be liquid resistant. The crotch portion is also preferably elastically extensible, more preferably the crotch portion is elastically extensible in both the longitudinal and transverse directions. This elastic extensibility provides a biasing force in the "z-direction" which helps maintain an absorbent article in contact with a wearer's body. For example, when used with a catamenial device, such a biasing force helps maintain the catamenial device in contact with the wearer's pudendal region throughout the full range of wearer motions.

Both the shell portion and the crotch portion are also preferably breathable for improved wearer comfort.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front view of a preferred embodiment of the menstrual undergarment of the present invention;

Figure 2 is a rear view of the menstrual undergarment shown in Figure 1;

Figure 3 is a plan view of the menstrual undergarment shown in Figure 1 that has been opened at the side seams, the elastic components being pulled flat;

Figure 4 shows, in a composite fashion and on a magnified scale, the loop structure of the preferred tubular knit fabric of the menstrual undergarment of the present invention;

Figure 5 is a cross sectional view of the menstrual undergarment of the present invention along line 4-4 of Figure 3;

Figure 6 is a cross sectional view, similar to Figure 5, of an alternative embodiment of the menstrual undergarment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As used herein, the term "catamenial device" refers to an absorbent article which is worn by females adjacent to the pudendal region for absorbing and containing bodily fluids, such as menstrual fluids and other vaginal discharges. Also as used herein, the term "disposable" refers to structures which are not intended to be laundered or otherwise restored or reused after use (i.e., they are intended to be discarded after a single use, and, preferably, to be recycled, composted or otherwise disposed of in an environmentally compatible manner). As used herein, the term "pudendal" refers to the externally visible female genitalia and is limited to the labia majora, the labia minora, the clitoris and the vaginal vestibule. In addition, the term "perineum" refers to the external region of the female's body between the anus and the pudendal region while the term "gluteal groove" refers to the crevice between the buttocks (gluteus maximi) extending upwardly from the perineum. As used herein, the terms "fluid", "liquid" and the like are intended to be interchangeable and refer to materials that are in a liquid state when they are at a temperature of about 100°F. It should be understood, however, that the present invention is also applicable for use not only with catamenial devices such as sanitary napkins, panty liners, and the like (including interlabial devices) but also other absorbent articles such as incontinence devices, diaper inserts, and the like.

General Description of the Undergarment

While, as noted above, the present invention is suitable for use with a wide variety of absorbent articles, it will be described in terms of a menstrual undergarment 20 which may be used in conjunction with a catamenial device 80. Figures 1 and 2 show front and rear views of the menstrual undergarment 20 of the present invention. As is shown in Figures 1 and 2, the menstrual undergarment 20 of

the present invention comprises a shell portion 30 and a crotch portion 40. The menstrual undergarment 20 has a front region 52, leg openings 34, a rear region 54, and a waist opening 33 having an elastic waistband 32 for maintaining the menstrual undergarment 20 on a wearer. The shell portion 30 and the crotch portion 40 cooperate to form the leg openings 34 which are also provided with leg elastics 35 to further provide a conforming fit and to seal the leg opening 34 against leakage of menses and other bodily fluids. Side seams 38A 38B join the front region 52 to the rear region 54. The menstrual undergarment 20 can be any style, for example "bikini", "tanga", "French cut", American style, or the like.

Figure 3 shows the menstrual undergarment of the present invention in a full flat out position wherein each of the side seams 38A, 38B has been opened and elastic components have been pulled flat. Figure 3 can also be considered to be a plan view of a blank for the menstrual undergarment 20. As can be seen from Figure 3, the menstrual undergarment 20 has a longitudinal centerline L and a transverse centerline T.

The menstrual undergarment 20 can comprise woven, nonwoven or knit fabrics. Preferably the menstrual undergarment 20 comprises a knit fabric. A particularly preferred knitting means involves first knitting a seamless tubular blank approximately half the final width of the menstrual undergarment 20. The tubular blank may be knit to have an hour glass shape so as to provide for the leg openings 34 in the finished menstrual undergarment 20 or, alternatively, portions of the opened tube may be cut away to provide for such leg openings 34. This preferred knitting means is described in greater detail in U.S. Patent 3,985,004, issued to Johnson, et al. on October 12, 1976, the disclosure of which is incorporated herein by reference. Figure 4 shows, in a composite fashion and on a magnified scale, the loop structure of the preferred tubular knit fabric of the menstrual undergarment 20 of the present invention. The knit pattern of the courses shown as 60 in Figure 4 corresponds to the knit pattern used for the shell portion 30. The courses shown as 64 correspond to the knit pattern used for the central region 45 of the crotch portion 40, and the courses shown as 62 correspond to a transitional pattern used for the remainder of the crotch 40. The floats, shown as F, F₁, and F₂, help provide the crotch portion 40 with an attractive ribbed appearance. These ribs also help direct the flow of any bodily fluids that may be deposited on the crotch portion 40 in the longitudinal direction.

The blank for the menstrual undergarment 20 is first knit in a tubular form. The tubular blank is then slit walewise and opened to form a flat blank for the menstrual

undergarment 20 having a shape similar to the plan view of the menstrual undergarment 20 that is shown in Figure 3. As is further shown in Figure 3, the blank for the menstrual undergarment has a front end edge 31F, a rear end edge 31R, front side edges 36A, 36B, and rear side edges 37A, 37B. The elastic waistband 32 may be formed by providing an elastic member, such as a LYCRA material, adjacent each distal end of a panty blank, C-folding each distal end of the blank about itself to form end edges 31F and 31R, and seaming the distal ends to the shell portion 30 to form the elastic waistband 32. Preferably, the elastic waistband 32 comprises a turned welt. The leg elastics 35 (described below) are joined to that portion of the side edges 36, 37 which will surround the leg openings 34 (i. e. form the periphery thereof). The blank for the menstrual undergarment 20 is then folded about the transverse centerline T and opposing portions of the side edges 36, 37 that lie between the leg opening 34 and the end edge 31 are joined to form side seams 38A, 38B completing the assembly of menstrual undergarment 20 (That is, the portion of side edge 36A that lies between the end of the leg elastic 35 that lies in the front region 52 and the end edge 31F is joined to the portion of side edge 37A that lies between the end of the leg elastic that lies in the rear region 54 and the end edge 31R to form seam 38A. Side edge 36B is joined to side edge 37B in a similar manner to form seam 38B).

Alternatively, portions of the tubular knit blank can be cut out to provide the leg openings 34. For example, a tubular blank can be flattened, such that, the interior faces thereof contact each other and a pair longitudinally oriented side edges are formed. Leg opening precursors can then be formed by cutting matching portions having a semi-circular, semi-elliptical, or other desired shape from transversely opposite side edges at regular intervals along the flattened blank. Undergarment blanks are then formed by transversely cutting the flattened tubular blank in a predetermined repeat pattern wherein a first transverse cut is made across the material that was not removed when the leg opening precursors were formed to create a crotch portion precursor and a second transverse cut is made across the full width of the flattened tubular blank forming the waist opening 33. The two ends formed by the first transverse cut are joined by a single transverse seam and, depending on the particular structure chosen for the crotch portion 40 (discussed below), a body layer 46 can be disposed on and joined to the inner surface of the panty blank or a barrier layer 48 can be disposed on and joined to the outer surface of the panty blank to complete the crotch portion 40. The menstrual undergarment 20 is then finished by disposing leg elastics 35 about the periphery of each leg opening 34

and joining the leg elastics 35 thereto and disposing the elastic waistband 32 about the periphery of the waist opening 33 and joining the elastic waistband 32 thereto.

The Shell Portion

As can be seen in Figures 1 and 2, the shell portion 30 is that portion of the menstrual undergarment 20 that is adapted to encircle a wearer's waist and hips. The shell portion 30 is provided with a waist opening 33 allowing entry into the menstrual undergarment 20. The waist opening is provided with an elastic waistband 32 allowing the menstrual undergarment 20 to fit a variety of sizes. As can be also seen in Figures 1 and 2, the shell portion also co-operates with the crotch portion 40 to define the leg openings 34 (discussed in detail below).

In the preferred embodiment of the present invention shown in Figures 1 to 3, the shell portion 30 is elastically extensible. Such elastic extensibility enables the menstrual undergarment 20 of the present invention to fit a variety of bodily shapes and sizes and provides good conformity to a wearer's body. An elastically extensible shell portion 30 further co-operates with the crotch portion 40 to provide a "z-direction" biasing force to the crotch portion 40 throughout the full range of wearer movement. Such a biasing force helps maintain a catamenial device 80 worn with the menstrual undergarment 20 in close bodily contact, particularly with a wearer's pudendal region. More preferably, such a biasing force directs the catamenial device 80 against the distal edges of a wearer's labia majora. Preferably, the shell portion 30 is constructed so as to provide a stretch modulus of between about 130 grams/inch (51 grams/cm) and about 160 grams/inch (63 grams/cm). More preferably the stretch modulus is between about 140 grams/inch (55 grams/cm) and about 150 grams/inch (59 grams/cm). A suitable method for measuring stretch modulus is described in the TEST METHODS section below.

In a particularly preferred embodiment of the present invention, the shell portion 30 is also liquid resistant. That is, the shell portion 30 resists the transport of aqueous liquids therethrough and, preferably, the flow of aqueous liquids thereon. More preferably, the shell portion 30 is liquid resistant because the shell portion 30 is hydrophobic to resist the flow of liquids thereon. As used herein, a surface is "hydrophobic" if it has a critical surface tension of less than about 35 dynes per centimeter or a surface can be made "hydrophobic" by treating that surface with a material having a critical surface tension of less than about 35 dynes per centimeter and a "hydrophilic" surface is one wherein water forms a contact angle of less than

about 89 degrees thereon. By having a hydrophobic surface, the shell portion 30 resists the transfer of any bodily fluids from the crotch portion 40, which is intended to absorb and contain any leakage around the periphery of a catamenial device 80 that may be disposed thereon (discussed below), to the shell portion 30.

In a particularly preferred embodiment, the shell portion 30 is breathable so the menstrual undergarment 20 is more comfortable to wear. As used herein, a material is "breathable" if the air permeability of the material is greater than about 25 cubic feet per minute per square meter (0.7 cubic meters per minute per square meter) when measured as described in the TEST METHODS section below. Preferably, the air permeability of the shell portion 30 is greater than about 220 cubic feet per minute per square meter (6.5 cubic meters per minute per square meter). More preferably, the air permeability of the shell portion 30 is greater than about 300 cubic feet per minute per square meter (8.5 cubic meters per minute per square meter).

The shell portion 30 can comprise any woven or nonwoven fabric having suitable feel, appearance, and surface properties. Preferably, the shell portion 30 comprises a woven or knit fabric. Fibers or yarns suitable for fabrication into the shell portion 30 include: polyolefin fibers, such as polyethylene or polypropylene fibers; nylon fibers; elastomeric fibers, such as LYCRA; and fibers of natural origin, such as cotton. Particularly preferred for the shell portion 30 of the menstrual undergarment 20 is stretch nylon available from DuPont of Wilmington, DE. Such yarns are more stretchable than the cotton yarns frequently used for women's undergarments. Preferably, such fibers are knit using means known to the art. More preferably, the yarns are wholly plain knit, as shown at 60 in Figure 4, to form the shell portion 30.

To provide liquid resistance to the shell portion 30 for the particularly preferred embodiment discussed above, the shell portion 30 can be treated using materials known to the art for providing such liquid resistance. Such materials include fatty acid or fatty alcohol derivatives, silicones, polyurethanes and fluorocarbons. Particularly preferred are fluorocarbon materials because of the low surface energy of fluorocarbon surfaces. For example, an all fluorocarbon surface has a critical surface tension of about 20 dynes per centimeter or less. Suitable fluorocarbon materials include those available from DuPont Specialty Chemicals, Wilmington, DE as ZONYL® and from 3M, Specialty Chemicals Division, St. Paul, MN. Particularly preferred are ZONYL® 6991 from DuPont and FC-280 from 3M.

Treating the shell portion 30 for liquid resistance as described above causes the shell portion 30 to resist the transport of liquids therethrough because such treatment lowers the surface energy of the shell portion 30 such that liquid transport is inhibited. See, for example, Adamson, A. W., Physical Chemistry of Surfaces 3rd Edition, John Wiley & Sons, New York, at 462 for a discussion of such behavior. As discussed therein, fabrics are made water repellent (i. e. liquid resistant) by providing them with a surface having a contact angle with water of greater than 90 degrees. Materials providing a surface having a contact angle with water that is greater than 90 degrees include fluorocarbon materials, silicone materials, and waxy coatings.

To treat the shell portion 30 for liquid resistance the following steps are suitable: 1) knit a blank as described above, 2) wash the blank to remove fiber finishes and the like, 3) treat the washed blank with the fluorocarbon material as the last step of the wash cycle according to the material supplier's instructions, 4) allow the blank to dry, 5) slit the blank, and 6) convert the slit blank into a finished panty as described above. This method treats the entire panty blank with the fluorocarbon material. Treating the entire blank to become liquid resistant means that absorbent material must be provided to the crotch portion 40 to insure the crotch portion 40 has sufficient absorbency (discussed in detail below). Alternatively, the fluorocarbon material can be selectively applied to only the shell portion 30 using means such as padding, spraying or other means familiar to the art to apply a solution (or emulsion or suspension) of the fluorocarbon material onto the shell portion 30 only and allowing the fluorocarbon material to dry thereon.

The Crotch Portion

As can be seen in Figures 1 to 3, the crotch portion 40 is that portion of the menstrual undergarment 20 that is disposed between a wearer's legs and extends toward the elastic waistband 32 at least to the vicinity of and preferably above a wearer's mons pubis in the front region 52 when the menstrual undergarment 20 is worn and at least in the vicinity of and preferably above the termination of a wearer's gluteal groove (i.e. the groove formed by the intersection of a wearer's gluteus maximi muscles) in the rear region 54. The crotch portion 40 provides support for a catamenial device 80 when the menstrual undergarment 20 is worn. The crotch portion 40 has a periphery 41, a front apex 43F, and a rear apex 43R. As used herein, the term "apex" is intended to refer to that position on the crotch portion 40 that is most distant from the intersection of the longitudinal centerline L and the transverse centerline T.

The crotch portion 40 is further provided with a central region 45 that is preferably knit with alternating courses having two yarns as shown at 64 in Figure 4. The remainder of the crotch portion 40 is preferably knit as is shown at 62 in Figure 4 which provides a transition between the knit pattern used for the shell portion 30 and the knit pattern used for the central region 45 of the crotch portion 40. Preferably, at least a portion of the yarns used to knit the crotch portion 40 comprise cotton yarns. More preferably, those courses having yarns that are floated, as at F, F₁, and F₂ in Figure 4, comprise cotton yarns.

As can be seen most clearly in Figure 3, the crotch portion preferably has a generally oval shape. Although other geometrical shapes, such as rectangular, are also suitable. More preferably such oval shape is symmetrical about the longitudinal centerline L and asymmetric about the transverse centerline T. This oval shape is sufficiently large to extend longitudinally beyond a catamenial device 80 that is disposed thereon such that any leakage past the ends of such a catamenial device 80 can be absorbed by the crotch portion 40. Specifically, the asymmetric shape shown in Figure 3 is preferred in order to insure that absorbent material (i. e. the body layer 46, 146 discussed below) is available for absorbing any leakage that may occur along a wearer's gluteal groove. Such absorbency properties are discussed in greater detail below. Preferably, the ratio of the distance between the transverse centerline T and front apex 43F to the distance between the transverse centerline T and front end edge 31F is at least about 0.4:1. More preferably, the front ratio is at least about 0.5:1. Similarly, the ratio of the distance between the transverse centerline T and rear apex 43R to the distance between the transverse centerline T and rear end edge 31R is at least about 0.6:1. More preferably the rear ratio is at least about 0.67:1. Also, the overall longitudinal length of the crotch portion 40 is preferably greater than about 50% of the longitudinal distance between the front end edge 31F and the rear end edge 31R when the menstrual undergarment 20 is in the flat out configuration shown in Figure 3.

The crotch portion 40 is soft and flexible so that it is not a source of discomfort for a wearer. Preferably, the crotch portion 40 is elastically extensible with a vector component in at least the transverse direction. More preferably, the crotch portion 40 is elastically extensible with vector components in both the longitudinal and transverse directions. Such elastic extensibility helps to provide a catamenial device 80 disposed on the crotch portion 40 with a uniform upward biasing force against the distal edges of the labia majora creating an improved seal therewith and reducing the potential for leakage around the periphery of the catamenial device 80. Preferably,

the stretch modulus in both the longitudinal and the transverse directions is equal to or less than the modulus of a wearer's skin so that the crotch portion will readily conform to the full range of wearer movements helping to insure that the menstrual undergarment 20 is comfortable to wear. That is, the stretch modulus of the crotch portion 40 is sufficiently low that the crotch portion 40 will stretch in response to wearer movement rather than causing the skin to move. More preferably the stretch modulus in at least one of the longitudinal and the transverse directions is equal to or less than about 300 grams/inch (118 grams/cm), still more preferably the stretch modulus of the crotch portion in both the longitudinal and transverse directions is equal to or less than about 180 grams/inch (71 grams/cm). A method to measure the stretch modulus of a material is described in the TEST METHODS section below.

An additional benefit of the soft, flexible crotch portion 40 of the present invention is that the Applicants have found the crotch portion 40 to be less noisy than menstrual undergarments having a nonelastic crotch portion as are typical of the art. Reduced noise provides additional discretion to a wearer when she is wearing such a menstrual undergarment 20. The elastically extensible crotch portions of the present invention are less noisy because they are less stiff and more cloth-like than a nonelastic crotch portion. It is well known in the art that stiffness and noise generation are closely related for a material. That is, stiffer materials are more noisy than less stiff materials when they are bent (e. g. by bodily movement). For example, when a crotch portion 40 of the present invention was evaluated for peak bending stiffness according to the CIRCULAR BEND PROCEDURE described in U.S. Patent 4,950,264, issued to Osborn on August 21, 1990 (the disclosure of which is incorporated herein by reference), the peak bending stiffness was lower than the measurement threshold of the apparatus. By comparison, the crotch portion of a commercially available menstrual undergarment (KOTEX® PERSONALS from Kimberly Clark Corp. of Neenah, WI), which is not treated to be elastically extensible, was found to have a peak bending stiffness of about 24 grams. Such a difference in stiffness suggests that the menstrual undergarment of the present invention will be less noisy, hence more discreet.

The crotch portion 40 preferably comprises a fluid resistant garment surface 42 and a hydrophilic body surface 44. Such a structure in the crotch portion 40 allows the menstrual undergarment 20 to absorb any bodily fluids that may leak around the periphery of any catamenial device 80 disposed thereon while, at the same time, resisting leakage of such absorbed fluids therethrough so staining of a wearer's clothing or bedding is minimized.

Figure 5 is a cross sectional view along section line 4-4 of Figure 3. Figure 5 shows one preferred embodiment of the crotch portion 40 aimed at providing the preferred combination of bi-directional elastic extensibility, a fluid resistant garment surface 42 and a hydrophilic body surface 44. The embodiment shown in Figure 5 comprises an absorbent body layer 46 and a fluid resistant barrier layer 48. At least a portion of the body layer 46 comprises the body surface 44 and at least a portion of the barrier layer 48 comprises the garment surface 42. The body layer 46 is soft and provides a comfortable tactile feel to those portions of a wearer's body which it contacts. The body layer 46 is also absorbent, so that any bodily fluids that may leak around the periphery of a catamenial device 80 that may be disposed thereon are contained within the menstrual undergarment 20. The barrier layer 48 resists penetration of any adsorbed fluids through the crotch portion 40 that may contact the garment surface 42 thereof to help prevent staining of garments, bedding and the like. At least one of the body layer 46 and the barrier layer 48 is elastically extensible in the transverse direction, preferably both the longitudinal and the transverse directions, to provide the crotch portion 40 with the requisite elastic extensibility. Preferably, both the body layer 46 and the barrier layer 48 are elastically extensible. If only one of the body layer 46 and the barrier layer 48 is elastically extensible, the yield value of the other element should be sufficiently low so as not to prevent the crotch portion 40 from responding to the full range of body movements.

In the embodiment shown in Figure 5, the body layer 46 comprises a knitted, cotton containing material. Preferably, the body layer 46 is knit concurrently with knitting the shell portion 30 of the menstrual undergarment 20 as is described above. More preferably, the crotch portion 40 is knit so as to provide the body layer 46 with longitudinally oriented rugosities or ribs whereby such ribs encourage longitudinally directed flow of any liquids that may be deposited on the body layer 46 by leakage around the periphery of the catamenial device 80. Such longitudinally directed flow helps utilize the absorbent capacity of the body layer 46 more fully helping to insure that localized areas thereof are not prematurely saturated. Such structures are described in additional detail in the above-mentioned U.S. Patent 3,985,004.

As also can be seen in Figure 5, the barrier layer 48 preferably comprises a laminate of a barrier film 47 and fabric outer layer 49. While a barrier layer 48 comprising only a barrier film 47 provides sufficient barrier properties to the crotch portion 40, the addition of the fabric outer layer 49 provides the menstrual undergarment with a pleasing clothlike feel and appearance. The barrier layer 48 is

extensible, preferably elastically extensible at least in the transverse direction and, more preferably, in both the longitudinal and transverse directions.

The barrier film 47 is substantially impervious to liquids (e.g., menses) and is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials may also be used. As used herein, the term "flexible" refers to materials which are compliant and will readily conform to the general shape and contours of the human body. The barrier film 47 prevents the exudates absorbed by the body layer 46 from wetting articles which contact the menstrual undergarment 20 such as pants, pajamas and bedding. The barrier film 47 may thus comprise a woven or nonwoven material, polymeric films such as thermoplastic films of polyethylene or polypropylene, or composite materials such as a film-coated nonwoven material. Preferably, the barrier film 47 is a polyethylene film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 mm (2.0 mils). Exemplary polyethylene films are manufactured by Clipay Corporation of Cincinnati, Ohio, under the designation P18-1401 and by Ethyl Corporation, Visqueen Division, of Terre Haute, Indiana, under the designation XP-39385. Particularly preferred is the microporous polyethylene film available from Clipay as code 950-92804. Such a microporous polyethylene film has the additional advantage of helping to make the crotch portion 40 breathable (discussed further below).

The fabric outer layer 49 provides an aesthetically pleasing, clothlike feel and appearance to the crotch portion 40 of the menstrual undergarment 20. The fabric outer layer 49 can comprise any woven or a nonwoven fabric having suitable feel and appearance. Preferably, the fabric outer layer 49 comprises a nonwoven fabric. There are a number of manufacturing techniques which may be used to manufacture the fabric outer layer 49. For example, the fabric outer layer 49 may be a nonwoven web of fibers spunbonded, carded, wet-laid, meltblown, hydroentangled, combinations of the above, or the like. Suitable materials for the fabric outer layer 49 include polyethylene, polypropylene, rayon, nylon, materials of natural origin, such as cotton, and other similar materials. A preferred fabric outer layer 49 comprises a spunbonded polyethylene nonwoven material having a basis weight of about 30 grams per square meter that is available from Corovin GmbH of Penne, Germany.

The barrier film 47 and the fabric outer layer 49 can be laminated to form the barrier layer 48 using means known to those skilled in the art. For example, polymer for forming the barrier film can be provided in molten form and extruded onto the fabric outer layer 49 forming the laminate of the barrier layer 48. The barrier film 47

and the fabric outer layer 49 can also be joined using adhesive means such as a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. Suitable adhesives are manufactured by Findley Adhesives Inc. of Wauwatosa, WI. Particularly preferred is the hot melt adhesive available from Findley under the designation 2120. The attachment means will preferably comprise an open pattern network of filaments of adhesive as is disclosed in U.S. Patent 4,573,986, which issued to Minetola et al. on March 4, 1986, more preferably several lines of adhesive filaments swirled into a spiral pattern such as is illustrated by the apparatus and methods shown in U.S. Patent 3,911,173 issued to Sprague, Jr. on October 7, 1975; U.S. Patent 4,785,996 issued to Ziecker, et al. on November 22, 1978; and U.S. Patent 4,842,666 issued to Werenicz on June 27, 1989. Each of these patents is incorporated herein by reference.

In order to insure breathability (discussed below) is not compromised by the means used to laminate the barrier film 47 and the fabric outer layer 49, the adhesive used for laminating the barrier film 47 and the fabric outer layer 49 is applied in a pattern that balances ply bond strength and air permeability. Particularly preferred is to apply the laminating adhesive in a lattice pattern which maximizes open area for breathability. The Applicants have found that an adhesive pattern which covers between about 10 percent and about 40 percent of the area of the crotch 40 provides a satisfactory balance of lamination strength and breathability. Preferably, the adhesive should cover between about 10 percent and about 30 percent of the area of the crotch portion 40. Alternatively, the attachment means may comprise heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art.

As is noted above, the crotch portion 40 is preferably elastically extensible in at least the transverse direction with a stretch modulus equal to or less than the modulus of a wearer's skin. Elastic extensibility can be provided to the crotch portion 40 by the body layer 46, the barrier layer 48 or a combination of the body layer 46 and the barrier layer 48. Preferably, elastic extensibility is provided to the crotch portion 40 by one of the body layer 46 or the barrier layer 48. In the preferred embodiment shown in Figure 5, elastic extensibility is provided by the body layer 46, specifically by the LYCRA component of the body layer 46. As can be seen in Figure 4, the knit patterns used for the crotch portion 40 (courses at 62 and 64) and the inclusion of LYCRA yarns therein combine to provide the crotch portion 40 with bi-directional elastic extensibility. That is, the LYCRA yarns are elastically extensible and the knit

patterns cause the LYCRA yarns to follow a path that has both longitudinal and transverse components.

As indicated above, a preferred structure for the crotch portion 40, as shown in Figure 5, calls for the body layer 46 to provide the elastic extensibility. This means that the stretch modulus of the barrier layer 48 should be lower than the stretch modulus of the body layer 46. One way to insure that the stretch modulus of the barrier layer 48 is lower than the stretch modulus of the body layer 46 in the transverse direction is to provide the barrier layer 48 with longitudinally oriented rugosities or ridges wherein the body layer 46 and the barrier layer 48 are joined so that the rugosities provide "slack", insuring that the stretch modulus of the body layer 46 is higher in the transverse direction. Such rugosities can be provided by incrementally stretching the laminate of the body layer 46 and the barrier layer 48 according to the method described in commonly assigned U.S. Patent 5,167,897, issued to Weber, et al. on December 1, 1992, the disclosure of which is incorporated herein by reference.

Alternatively, if bi-directional elastic extensibility is desired, the barrier layer 48 may comprise a structural elastic-like film (SELF) web. A SELF web is an extensible material that exhibits an elastic-like behavior in the direction of elongation without the use of added elastic materials. The SELF web includes a strainable network having at least two contiguous, distinct, and dissimilar regions. One of the regions is configured so that it will exhibit resistive forces in response to an applied axial elongation in a direction parallel to the predetermined axis before a substantial portion of the other region develops significant resistive forces to the applied elongation. At least one of the regions has a surface-pathlength which is greater than that of the other region as measured substantially parallel to the predetermined axis while the material is in an untensioned condition. The region exhibiting the longer surface-pathlength includes one or more deformations which extend beyond the plane of the other region. The SELF web exhibits at least two significantly different stages of controlled resistive force to elongation along at least one predetermined axis when subjected to an applied elongation in a direction parallel to the predetermined axis. The SELF web exhibits first resistive forces to the applied elongation until the elongation of the web is sufficient to cause a substantial portion of the region having the longer surface-pathlength to enter the plane of applied elongation, whereupon the SELF web exhibits second resistive forces to further elongation. The total resistive forces to elongation are higher than the first resistive forces to elongation provided by the first region. Thus, by:

- 1) controlling the area of the region having the shorter surface-pathlength such that the slope of the stress/strain curve describing the relationship between the first resistive forces and elongation (i. e. the stretch modulus) is less than the modulus of the body layer 46; and
- 2) controlling the pattern of the regions having the shorter surface-pathlength such that the first resistive forces have a vector component in both the longitudinal and the transverse directions (e. g. a chevron, or other diagonally oriented pattern);

a barrier layer 48 having a stretch modulus lower than the body layer 46 in both the longitudinal and the transverse directions can be provided. Alternatively, patterns that provide low modulus stretch in either the longitudinal or the transverse directions can also be used. SELF webs suitable for the present invention are more completely described in commonly assigned U. S. Patent 5,518,081 issued in the name of Chappell, et, al. on May 21, 1996, the disclosure of which is incorporated herein by reference.

The body layer 46 and the barrier layer 48 are joined at least about the periphery 41 to form the crotch portion 40. Preferably, in order to maximize body fit of the crotch portion 40, the body layer 46 and the barrier layer 48 are joined in the following manner: 1) the body layer 46 is stretched longitudinally about 25% and transversely between about 125% and about 150% and an adhesive material, such as material number 1524 available from 3M, Saint Paul, MN, is applied thereto in a pattern similar to that used to laminate the barrier film 47 and the fabric outer layer 49, 2) the barrier layer 48 is disposed on the adhesive treated body layer 46 and adhered thereto by the application of pressure (e. g. by a nip between a roll pair or the like). Alternatively, the attachment means may comprise heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art.

Figure 6 is a cross sectional view of an alternative preferred embodiment of the crotch portion 40 that is similar to Figure 5. The embodiment shown in Figure 6 also provides a crotch portion 40 with the preferred combination of bi-directional elastic extensibility, a fluid resistant garment surface 42 and a hydrophilic body surface 44. The crotch portion 40, as shown in Figure 6, comprises a body layer 146 and a barrier layer 148 wherein an absorbent body layer 146 is disposed on a barrier layer 148 which has been treated to provide the requisite fluid resistance. At least a portion

of the body layer 146 comprises the body surface 44 and at least a portion of the barrier layer 148 comprises the garment surface 42. The embodiment of the present invention shown in Figure 6 takes advantage of the simple method of treating a panty blank with a fluorocarbon material for providing liquid resistance to the shell portion 30 and the crotch portion 40 that is discussed above.

The body layer 146 of the embodiment of the present invention shown in Figure 6 is soft, absorbent, and breathable. The body layer 146 can comprise any woven or a nonwoven fabric having suitable feel and appearance. Preferably, the body layer 146 comprises a nonwoven or knit fabric. Fibers or yarns suitable for fabrication into the body layer 146 include: polyolefin fibers, such as polyethylene or polypropylene fibers, that have been treated to be hydrophilic; nylon fibers, acetate fibers, acrylic fibers, and rayon fibers (Since such fibers are of intermediate wettability—i.e. they have a critical surface tension of between about 40 dynes per centimeter and about 50 dynes per centimeter, they may require treatment with a surfactant for optimum utility as a component of the body layer 146); and fibers of natural origin, such as cotton. The body layer 146 can also comprise fibers or yarns having elastic extensibility, such as LYCRA, if such elastic extensibility is desired for the body layer 146. More preferably, the body layer 146 comprises a knit fabric having substantially the same knit pattern shown at 64 and 66 in Figure 4, wherein at least a portion of the fabric comprises cotton yarns.

As noted above, a panty blank can be treated to provide the crotch portion 40 with liquid resistance. That is, by treating a panty blank to become liquid resistant, the barrier layer 148 of the embodiment shown in Figure 6 is treated to be liquid resistant. Materials suitable for treating the barrier layer 148 for providing liquid resistance are substantially the same as those suitable for treating the shell portion 30 to provide liquid resistance. That is, suitable materials include fatty acid or fatty alcohol derivatives, silicones, polyurethanes and fluorocarbons. Particularly preferred are fluorocarbon materials such as the above mentioned materials from DuPont and 3M. Treating an entire panty blank to provide liquid resistance to both the shell portion 30 and the crotch portion 40 (i. e. the barrier layer 148) has been described above. Alternatively, the fluorocarbon material can be selectively applied to only the barrier layer 148 using means such as padding or spraying a solution (or emulsion or suspension) of the fluorocarbon material onto the barrier layer 148 and allowing the fluorocarbon material to dry thereon.

The body layer 146 and the barrier layer 148 are joined at least about the periphery 41 of the crotch portion 40 using means known to the art. For example, the body layer 146 can be stitched to the barrier layer about the periphery 41 of the crotch portion 40 or the body layer 146 and the barrier layer 148 can be adhesively joined. Preferably, the body layer 146 and the barrier layer 148 are stitched about the periphery 41 to form the crotch portion 40 of this alternative preferred embodiment.

Further, while elastically extensible crotch portions 40 having a fluid resistant garment surface 42 and a hydrophilic body surface 44 provide the desirable properties of leak resistance and wearer comfort, one particularly preferred embodiment of the present invention also contemplates providing breathability to the crotch portion 40 for improved comfort to a wearer. That is, the air permeability of the crotch portion 40 is greater than about 25 cubic feet per minute per square meter (0.7 cubic meters per minute per square meter). More preferably, the air permeability is greater than about 35 cubic feet per minute per square meter (1 cubic meter per minute per square meter). A material can be provided with both fluid resistance and air permeability by either treating an already fluid resistant material to become air permeable or treating an already air permeable material to become fluid resistant. For example, a fluid resistant film could be provided with apertures large enough to provide the requisite air permeability yet small enough to resist fluid transport therethrough (e. g. the microporous polyethylene film from Clopay discussed above) or an air permeable material could be treated to cause a surface thereof to become hydrophobic so fluid penetration therethrough is resisted without occluding any apertures which may provide air permeability (e. g. by treatment with a fluorochemical as discussed above).

Elasticized Leg Openings

As can be seen in Figures 1-4, the menstrual undergarment 20 of the present invention is also provided with a pair of elasticized leg openings 34. As noted above, the shell portion 30 and the crotch portion cooperate to define the periphery of each leg opening 34. This periphery is provided with a leg elastic 35 for elasticization of the opening 34. The leg elastics 35 both provide a seal against leakage of bodily fluids about the periphery of each leg opening and cooperate with the shell portion 30 and the crotch portion to provide a "z-direction" biasing force to the crotch portion 40 throughout the full range of wearer movement. That is, the shell portion 30, the crotch portion 40 and the leg elastics 35 cooperate to provide a catamenial device 80 that may be disposed on the crotch portion 40 with a uniform upward force against

the distal edges of a wearer's labia majora. As is shown most clearly in Figures 1 and 2, the high cut nature of the leg opening 34 also is designed to direct the contractive force of the leg elastics 35 in a more vertical direction than would be possible if a more circular shape would be used for the leg opening 34. Also, as shown most clearly in Figure 3, this high cut shape for the leg opening 34 allows the shell portion 30 to extend between the leg elastics 35 and the crotch portion 40 almost to the transverse centerline T. That part of the shell portion 30 that is disposed between the leg elastics 35 and the crotch portion 40 is particularly able to respond to wearer movements because the shell portion 30 has a lower stretch modulus than the crotch portion 40. As a result there is improved comfort because the shell portion 30 requires a lower force to stretch than the crotch portion 40. There is also a reduction in movement of any catamenial device 80 that may be attached to the crotch portion 40 because the shell portion 30 stretches in response to wearer movement rather than the crotch portion 40.

While the leg elastics 35 must provide a minimal contractive force help to seal the periphery of the leg opening 34 against leakage of bodily fluids, it is important that the contractive force not be so great as to cause discomfort to a wearer. The Applicants have found that a contractive force of at least about 20 grams is necessary to minimize the risk of gapping around the periphery of the leg opening 34. Preferably the contractive force should be at least about 40 grams. More preferably, the contractive force should be at least about 80 grams. Minimizing the stretch modulus over the range of expected elastic extensions during the wear cycle also minimizes the risk of wearer discomfort. That is, if the leg elastics are designed to provide a contractive force of about 80 grams at a typical in use extension, that force should not substantially increase for greater extensions that may either be due to a different wearer leg circumference or due to wearer movement. The Applicants have found that a stretch modulus for the leg elastics between about 540 grams/inch (213 grams/cm) and about 590 grams/inch (232 grams/cm) provides a good balance between maintaining leakage resistance and minimizing wearer discomfort. Preferably, the stretch modulus of the leg elastics is between about 550 grams/inch (216 grams/cm) and about 580 grams/inch (228 grams/cm). Methods for measuring elastic contractions and stretch modulus is given in the TEST METHODS section below.

The leg elastics 35 can be joined to the shell portion 30 and the crotch portion 40 about the periphery of the leg opening 34 using means known to those in the art. For example, the leg elastics 35 can be joined to the shell portion 30 and the crotch

portion 40 using adhesive means or by mechanical means, such as stitching. For the preferred knit menstrual undergarment 20 of the present invention, the leg elastics 35 are preferably joined to the shell portion 30 and the crotch portion 40 by stitching thereto.

Optional Features

The crotch portion 40 can optionally be provided with indicia to help a wearer optimally position a catamenial device 80 in the crotch portion 40. For example, such indicia can comprise markings on the leg elastics that would allow a wearer to properly locate any flaps that may be provided on a catamenial device 80 for use therewith. Alternatively, such indicia could comprise markings along the longitudinal centerline L that would allow a wearer to reliably position a catamenial device 80 each time a new device is disposed on the body surface 44 of the crotch portion 40.

The present invention also contemplates a containment system for control of bodily fluids wherein a menstrual undergarment 20 as described above and a catamenial device 80 act as a unit for control of menstrual flows. Using control of menses as an example, the catamenial device 80 could be made extensible, preferably elastically extensible, with a low modulus (comparable to that of a wearer's skin) further enhancing the body conformity properties of the menstrual undergarment 20 that are discussed above. Catamenial devices having such elastic extensibility are described in commonly assigned U. S. Patent application Serial No. 07/915,133, filed in the name of Osborn, et al. on July 23, 1992, now pending as U. S. Patent application Serial No. 08/503,895, filed on July 18, 1995 (allowed, no number assigned) and published as PCT application Serial No. WO 93/01785 on February 4, 1993 and in commonly assigned U. S. Patent application Serial No. 07/915,284, filed in the name of Osborn, et al. on July 23, 1992 and published as PCT application Serial No. WO 93/01786 on February 4, 1993, the disclosure of which is incorporated herein by reference. Other means whereby the menstrual undergarment 20 and the catamenial device co-operate to better control menstrual flow, such as providing complementary attachment means to the menstrual undergarment 20 and the catamenial device 80 are also contemplated.

It would also be obvious to one skilled in the art that other bodily fluids, such as urine and the like could be controlled using similar systems.

The menstrual undergarment 20 of the present invention is used by removing any release liner that may be provided to the catamenial device 80 and thereafter

placing the catamenial device 80 in the menstrual undergarment 20 on the body surface 44 thereof using sufficient pressure to insure that any releasable adhesive that may be provided is adhered thereto. If the catamenial device 80 is also provided with flaps, the user positions the catamenial device 80 so that such flaps drape over the edges of the elasticized leg openings 34 such that any flap attachment means that may be provided contact the crotch portion 40 on its garment surface 42. The wearer can then draw the menstrual undergarment 20 on in the conventional manner.

TEST METHODS

Air Permeability

Intent

This method is intended to measure the flow of air through a material at a defined pressure drop across the material.

Apparatus

Air permeability tester, available from Albany International Corporation of Albany NY.

Sample Preparation

1. Cut the sample into an approximate 4 inch X 4 inch (10 centimeter X 10 centimeter) square.

Method

Operate the air permeability tester according to the manufacturer's instructions. The following briefly summarizes the operating procedure described therein.

- 1) Mount the sample by stretching it sufficiently taut over the outer orifice plate to remove any distortions that may impede or distort the air flow. The sample is mounted such that the less open side, if the sample is determined to have such, faces toward the mounting plate.

- 2) Determine the appropriate inner orifice to provide the proper air flow for the sample being tested. Record the number of the orifice plate used for evaluating the sample.
- 3) Adjust the fan motor speed to provide a pressure drop of 0.5 inches of water (1.27 centimeters of water) across the inner orifice.
- 4) Record the pressure drop across the sample.

Calculation and Report

Using the tables provided by the manufacturer, the orifice plate number and the pressure drop across the sample, determine the air flow through the sample. Report the mean and standard deviation for each sample evaluated.

Stretch Modulus and Elastic Contractions

Intent

This method is intended to quantify a force comparable to the force exerted on a wearer's body by elastically extensible materials that may be used in an undergarment over an extension range comparable to that seen in the wear cycle of an undergarment.

Method

The method described in INDA (Association of Nonwoven Fabric Industry) Standard Test 110.1-92 is suitable. The following set up conditions are used:

Gage Length:	2 inches (5.08 centimeters)
Crosshead Speed:	10 inches/minute (25.4 centimeters/minute)
Tensile Testing Machine: and Load Cell	Appropriate for expected force range, a Model 5564, available from Instron Corporation, Canton, MA is suitable

Sample Width: 1 inch (2.54 centimeters) For samples less than 1 inch (2.54 centimeters) wide, measure the sample width and adjust the measured force by the ratio of 1 inch (2.54 centimeters) to the measured width.

Sample Size: At least three samples per material tested

Calculations

Force₂₅: Force at 25% elongation (grams/inch or grams/cm)

Force₅₀: Force at 50% elongation (grams/inch or grams/cm)

Elastic Contractions = Force₂₅

Stretch Modulus = (Force₅₀ - Force₂₅)/0.25

Report the mean and standard deviation for elastic contractions (leg elastics only) and for stretch modulus

The disclosures of all patents, patent applications (and any patents which issue thereon, as well as any corresponding published foreign patent applications), and publications mentioned throughout this description are hereby incorporated by reference herein. It is expressly not admitted, however, that any of the documents incorporated by reference herein teach or disclose the present invention.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.



WHAT IS CLAIMED IS:

1. A tubular knit undergarment for use with an absorbent article, said undergarment having a longitudinal centerline defining a longitudinal direction and a transverse centerline defining a transverse direction, said undergarment comprising:
 - a breathable, liquid resistant shell portion, said shell portion having an elasticized waist opening;
 - a crotch portion having a longitudinal length and comprising an absorbent body layer and a liquid resistant barrier layer, said crotch portion being elastically extensible in at least one of said longitudinal and said transverse directions; and
 - a pair of leg openings defined by said shell portion and said crotch portion, each of said leg openings having a periphery, said periphery of each of said leg openings being elasticized to provide a seal against liquid flow past said periphery.
2. An undergarment according to Claim 1 wherein said elasticized leg openings co-operate with said elastic extensibility of said crotch portion to provide a force to bias said absorbent article against a wearer's body.
3. An undergarment according to Claim 1 wherein said crotch portion is breathable.
4. An undergarment according to Claim 1 wherein said undergarment is legless.
5. An undergarment according to Claim 1 wherein said undergarment further comprises a front region and a rear region, said front and rear regions each having first and second transversely opposed longitudinal side edges, at least a portion of said first side edge of said front region being joined to said first side edge of said rear region and at least a portion of said second side edge of said front region being joined to said second side edge of said rear region by a pair of transversely opposed seams.



6. An undergarment according to Claim 5 wherein said undergarment has a longitudinal length and transverse end edges in each of said front and rear regions when said seams are opened and said undergarment is laid fully flat out in plan view, said longitudinal length of said crotch portion being greater than about 50% of said longitudinal length of said undergarment.
7. An undergarment according to Claim 6 wherein said crotch portion has an apex in said front region and an apex in said rear region and the distance along said longitudinal centerline between said apex in said rear region and said rear end edge is less than the distance along said longitudinal centerline between said apex in said front region and said front end edge.
8. An undergarment according to Claim 3 wherein at least a portion of said body layer comprises an absorbent cotton material and said barrier layer comprises an extensible laminate of a nonwoven web and a breathable film web.
9. An undergarment according to Claim 1 wherein at least a portion of said body layer comprises an absorbent cotton material and said barrier layer is treated with a material to increase the contact angle of liquids disposed thereon.
10. An undergarment according to Claim 9 wherein said cotton material is integrally knit into said crotch portion.
11. An undergarment according to Claim 1 wherein said crotch portion further comprises indicia to aid in proper placement of said catamenial device.
12. An undergarment according to Claim 1 wherein said crotch portion is elastically extensible in both of said longitudinal and said transverse directions.
13. An undergarment according to Claim 12 wherein at least a portion of said body layer comprises an absorbent cotton material and said barrier layer comprises an extensible laminate of a nonwoven web and a breathable film web.
14. An undergarment according to Claim 12 wherein at least a portion of said body layer comprises an absorbent cotton material and said barrier layer is treated with a material to increase the contact angle of liquids disposed thereon.
15. An undergarment according to Claim 1 wherein said undergarment is further provided with a front region and a rear region and said crotch portion is provided with a transversely oriented seam joining said front and rear regions.



16. An undergarment according to Claim 15 wherein said crotch portion has an apex in said front region and an apex in said rear region and the distance along said longitudinal centerline between said apex in said rear region and said waistband in said rear region is less than the distance along said longitudinal centerline between said apex in said front region and said waistband in said front region.
17. A legless, tubular knit undergarment for use with an absorbent article, said undergarment having a longitudinal centerline defining a longitudinal direction, a transverse centerline defining a transverse direction, a front region, and a rear region, said undergarment comprising:
 - a breathable, liquid resistant shell portion having an elasticized waist opening, wherein that part of said shell portion that is disposed of said front region has first and second transversely opposed longitudinal side edges and that part of said shell portion that is disposed of said rear region has first and second transversely opposed longitudinal side edges, at least a portion of said first side edge of said front region being joined to said first side edge of said rear region by a first seam and at least a portion of said second side edge of said front region being joined to said second side edge of said rear region by a second seam;
 - a breathable, liquid resistant crotch portion comprising an absorbent body layer and a liquid resistant barrier layer, said crotch portion being elastically extensible in said transverse direction; and
 - a pair of leg openings defined by said shell portion and said crotch portion, each of said leg openings having a periphery, said periphery being elasticized to provide a seal against liquid flow past said periphery, wherein said elasticized leg openings co-operate with said elastic extensibility of said crotch portion to provide force to bias said absorbent article against a wearer's body.
18. An undergarment according to Claim 17 wherein at least a portion of said body layer comprises an absorbent cotton material and said barrier layer comprises an extensible laminate of a nonwoven web and a breathable film web.



19. An undergarment according to Claim 17 wherein at least a portion of said body layer comprises an absorbent cotton material and said barrier layer is treated with a material to increase the contact angle of liquids disposed thereon.
20. An undergarment according to Claim 18 wherein said cotton material is integrally knit into said crotch portion.
21. An undergarment according to Claim 18 wherein said treatment material is selected from the group comprising: fluorocarbon materials, silicone materials, and waxy coatings.
22. A system for containment of bodily fluids, said system comprising:
 - a tubular knit undergarment, said undergarment having a longitudinal centerline defining a longitudinal direction and a transverse centerline defining a transverse direction, said undergarment comprising:
 - a breathable, liquid resistant shell portion, said shell portion having an elasticized waist opening;
 - a breathable crotch portion comprising an absorbent body layer having a body surface and a liquid resistant barrier layer, said crotch portion having a longitudinal length, a transverse width and being elastically extensible in at least one of said longitudinal and said transverse directions; and
 - a pair of leg openings defined by said shell portion and said crotch portion, each of said leg openings having a periphery, said periphery of each of said leg openings being elasticized to provide a seal against liquid flow past said periphery; and
 - an absorbent article disposed on said body surface.
23. A system for containment of bodily fluids according to Claim 22 wherein said elasticized leg openings co-operate with said elastic extensibility of said crotch portion to provide a force to bias said absorbent article against a wearer's body