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(54) **Title:** HOSIERY WITH GRADUATED COMPRESSION PANTY

(57) **Abstract:** Provided is a garment including hosiery which avoids the needs for a conventional waistband by providing a gradu-  
ated compression panty where the compression is gradually increased from the bottom of the panty where leg portions are attached  
to the top of the panty which corresponds approximately with the waist of the wearer.



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## **HOSIERY WITH GRADUATED COMPRESSION PANTY**

### **BACKGROUND OF THE INVENTION**

#### **Field of the Invention**

This invention relates to a hosiery garment that with a specially designed panty for comfortable wear without a conventional waistband.

#### **Summary of Related Art**

The primary function of a waistband is to hold up a garment. For this purpose in hosiery, a narrow band is knitted with a strong elastic yarn on top of the panty area. This conventional waistband may include an elastic band or a knitted in welt as described in U.S. Patent No. 6,276,176. All of these constructions generally form narrow, high compression bands at the waist. Because of the high compression, localized in a small area, hosiery with this type of conventional waistband is often uncomfortable to wear. Another deficiency of this type of construction is the rolling-over of the waistband.

### **SUMMARY OF THE INVENTION**

What is needed is a garment construction that for hosiery that does not have a conventional waistband and is comfortable to wear. In spite of the absence of a conventional waistband, the garment should not slide down and the top of the panty area should not roll over.

In one aspect, hosiery having leg portions and a panty portion exclude a conventional waistband which is replaced by a specifically designed, graduated compression panty. The compression is gradually increased from the bottom of the panty where leg portions are attached to the top of the panty which corresponds approximately with the waist of the wearer, but may fall below, at or above the waist. This graduated compression panty is selected from a single layer construction, a double layer construction, and a partial double layer construction. The panty portion includes a single layer, double layer, or partial double layer including graduated compression in a way that it provides sufficient compression to hold up the garment while preventing rolling-over.

## DETAILED DESCRIPTION

As used herein, the term "spandex" means a manufactured filament in which the filament-forming substance is a long chain synthetic polymer comprised of at least 85% by weight of a segmented polyurethane. A variety of different spandex compositions are useful with the pantyhose of some aspects such as polyether and co-polyether based spandex, among others. Specific examples of commercially available spandex yarns include those available under the tradenames LYCRA® 162B, LYCRA®163C, LYCRA®163A, LYCRA®178,C LYCRA®902C, and LYCRA®777C (especially useful for anti-laddering hosiery) available from INVISTA S.à.r.l. of Wichita, KS.

The terms "pantyhose" and "hosiery" are used interchangeably throughout this specification and are intended to include garments have at least a portion of a circular knit construction and including a panty portion which will typically fall from the around the waist of the wearer to the crotch, but may be extended to the upper thigh of the wearer.

The pantyhose may include any suitable combination of elastic or elastomeric yarns with hard yarns. The elastic or elastomeric yarn may be included in every course or in alternate courses (other constructions may be useful where patterned hosiery is desired). One suitable elastomeric yarn is spandex which may be used bare or covered. The covering may be single or doubled covered, air covered, air jet textured, entangled, core-spun, etc.

Examples of hard yarns include polyamide yarns such as nylon 6, nylon 6/6 (PA 66), nylon 10, nylon 12, nylon 6/10, nylon 6/12, and combinations thereof. The hard yarns may be flat or textured. The pantyhose may include yarns selected from polyamide covered spandex yarns and blends of polyamide covered spandex yarns with polyamide yarns.

The graduated compression of the panty can be accomplished by using yarns of varying and increasing linear density (decitex) as well as by varying and/or increasing the tension of the yarn during knitting. One apparatus to measure and control the tension of the yarn is a constant tension feeder (KTF) available from BTSR International S.p.A., Italy.

Suitable amounts spandex fiber may be about 10% to about 30% by total yarn weight, including about 12% to about 26%; and about 15% to about 22%.

The graduated compression panty is selected from a single layer construction, a full double layer construction, and a partial double layer construction. Each of these constructions excludes a waist band which is rendered unnecessary due to the graduated structure. The graduated compression is provided by a series of zones having a different level of compression that increases from the zones closest to the bottom (leg attachment area) to the top (waist

area). In the final construction of the garment, the top of the panty will have the highest level of compression. A suitable number of zones may be included from about 2 to about 10 zones, such as from about 3 to about 5 zones of differing compression level. This includes about 3 zones of different compression.

The differing zones of compression may differ by any suitable amount to provide the desired comfort while maintaining the ability to keep the panty portion in place on the wearer. The increased compression may be about 2 times to about 20 times greater from the bottom to the top areas. This includes from about 3 times to about 10 times greater, and about 4 times to about 9 times greater, depending on the overall compression level of the panty.

The percentage of the number of courses in each zone depends on the desired graduated compression and the total number of zones. Where there are three zones, the bottom zone may include about 10% to about 50% of the total number of courses in the panty, this includes from about 15% to about 40% and about 20% to about 30%, and about 15% to about 25%.

Three different constructions are described in further detail below:

**A full double layer panty:**

In this construction, a double layer is knitted in the panty area over the full length of the panty. This double layer can be provided by knitting in separate layers. The double layer panty may also be prepared by knitting a single layer which is then folded over and sewn in. This is accomplished by knitting a single layer which increases compression from a leg attachment point to a center point of highest compression then decreasing compression to a top portion. This top portion is folded over to meet the leg attachment portion such that a crease is made at the point of highest compression which will correspond approximately to the waist of the wearer. As completed, there is sufficient compression in the top part of the panty (corresponding approximately to the waist of the wearer) for holding up the garment, as well to prevent the rolling-down of the garment; compression in the panty area is increased by going from the bottom (leg attachment portions) to the top area (waist) of the panty. The increase in compression is achieved by a combination of yarn selection and knitting machine settings such as elastic yarn tension and stitch length.

**A partial double layer:**

As an alternative, a double layer is only knitted in the top part of the panty area, similarly to that described for the full double layer above. However, the area of this double layer is significantly bigger than the standard (double layer) waistband, which is the conventional waistband. The partial double layer may be from about 10% to about 50% of the total number

of courses in the panty, this includes from about 15% to about 40% and about 20% to about 30%. Also in this construction, compression in the panty area is increased by going from the bottom till the top area of the panty in order to provide sufficient compression in the top part of the panty for holding up the garment, as well to prevent the rolling-down of the garment. The increase in compression is achieved by a combination of yarn selection and knitting machine settings such as elastic yarn tension and stitch length.

A single layer:

Another alternative is a single layer graduated compression panty. This includes a graduated compression panty with lower compression at the bottom of the panty (leg attachment area) to a higher compression at the top (waist area). This construction includes multiple zones similar to the full double layer and partial double layer panty constructions while also avoiding the need for a conventional waistband, (i.e., a narrow band of higher compression at the top of the panty.) The increase in compression is achieved by a combination of yarn selection and knitting machine settings such as elastic yarn tension and stitch length.

The leg portions may include yarns that have the same denier (linear density), lighter denier or a heavier denier than yarns in panty portion. The leg portions (left and right) may have a construction selected from the group consisting of sheer, semi-opaque, and opaque. To further enhance comfort and reduce soreness during wear, leg portions may each may include an upper thigh portion where the upper thigh portion includes reinforcing yarns.

The construction of the leg portions may be any of a variety well-known in the art. These include full coverage from panty to toe, exposed toe, ankle length, knee length or any other desired length for the leg portion

The features and advantages of the present invention are more fully shown by the following examples which are provided for purposes of illustration, and are not to be construed as limiting the invention in any way.

EXAMPLES

**TEST METHODS**

The effects in wear (comfort, holding up and rolling over) were evaluated by a wear test with 14 participants. The power of the various zones was measured on an Instron the power a sample of 5 cm width.

Table						
Panty construction	(A) Double Layer	(B) Single Layer	(C) Partial Double Layer	(D) Double Layer	(E) Partial Double Layer	(F) Partial Double Layer
	$g^a - \% ^b - \#^c$	$g^a - \% ^b - \#^c$	$g^a - \% ^b - \#^c$	$g^a - \% ^b - \#^c$	$g^a - \% ^b - \#^c$	$g^a - \% ^b - \#^c$
Zone 1 (closest to leg)	1.0-26%-144	1.0-23%-67	1.0-18%-67	1.0-26%-144	1.0-23%-67	1.0-18%-67
Zone 2	2.0-48%-270	2.0-48%-270	2.0-28%-105	2.0-48%-270	2.0-27%-105	2.0-28%-105
Zone 3 (top)	4.0-27%-150	10.0-27%-150	10.0-27%-100	4.0-27%-150	9.0-40%-100	3.0-27%-100
Fold – waist area (top)						
Zone 3a (top)	4.0-27%-150	n/a	10.0-27%-100	4.0-27%-150	9.0-40%-100	3.0-27%-100
Zone 2a	2.0-48%-270	n/a	n/a	2.0-48%-270	n/a	n/a
Zone 1a (closest to leg)	1.0-26%-144	n/a	n/a	1.0-26%-144	n/a	n/a
a – grams – KTF settings b - % courses c – number of courses						

In the garment construction for the pantyhose in the table, each of zones 1 and 1a, 2, and 2a and 3 and 3a are adjacent. The panty yarns were for Example A: 20 dtex LYCRA® T777C fiber, SC 11f7 PA 66 flat, EC; for Example B, C, E and F: 45dtex LYCRA® T902C fiber, SC18/6 text. AC with 24/11/2 text. Bright; for Example D: 16dtex LYCRA® T178C fiber, 11f/7 PA 66 flat, EC. The leg yarns were for Example A: 20 dtex LYCRA® T777C fiber, SC 11f7 PA 66 flat, EC; for B and C: 20 dtex LYCRA® T777C fiber, SC 11f7 PA 66 flat EC; and for D, E, and F: 16 dtex LYCRA® T178C fiber, SC 11f7 PA 66, flat EC.

Each wearer reported that the hosiery was comfortable while avoiding rollover.

#### Example 1 for full double layer

A 16 dtex LYCRA® T178C fiber and 11f/7 PA66 are covered in a standard process. This composite yarn is knitted in every course hosiery. The graduated compression is achieved by variation of the knitting, as well the number of knitting rows for each zone.

Example 2 for full double layer

A 13 dtex LYCRA® T163A fiber and 11f/7 PA66 are covered in a standard process. The composite yarn is knitted in every course hosiery. The graduated compression is achieved by variation of the knitting, as well the number of knitting rows for each zone.

Example partly double layer:

A 13 dtex T163C and 17 dtex LYCRA® T175C and 11f/7 PA66 are covered in a standard process. The covered yarn with 13 dtex is knitted in every course hosiery in the top layer, the covered yarn with 17 dtex is knitted in every course hosiery in the mid and bottom layer. The graduated compression is achieved by variation of the knitting, as well the number of knitting rows for each zone.

While there have been described what are presently believed to be the preferred embodiments of the invention, those skilled in the art will realize that changes and modifications may be made thereto without departing from the spirit of the invention, and it is intended to include all such changes and modifications as fall within the true scope of the invention.

## Claims:

1. A garment comprising hosiery having leg portions, a panty portion, and excluding a conventional waistband comprising a graduated compression panty wherein the compression is gradually increased from the bottom of the panty where leg portions are attached to the top of the panty which corresponds approximately with the waist of the wearer.
2. The garment of claim 1, wherein the graduated compression panty is selected from a single layer construction, a full double layer construction, and a partial double layer construction.
3. The garment of claim 1, wherein said graduated compression of said panty portion provides sufficient compression to hold up the garment while preventing rolling-over.