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(54) Title: HIP SURGERY UNDERGARMENT

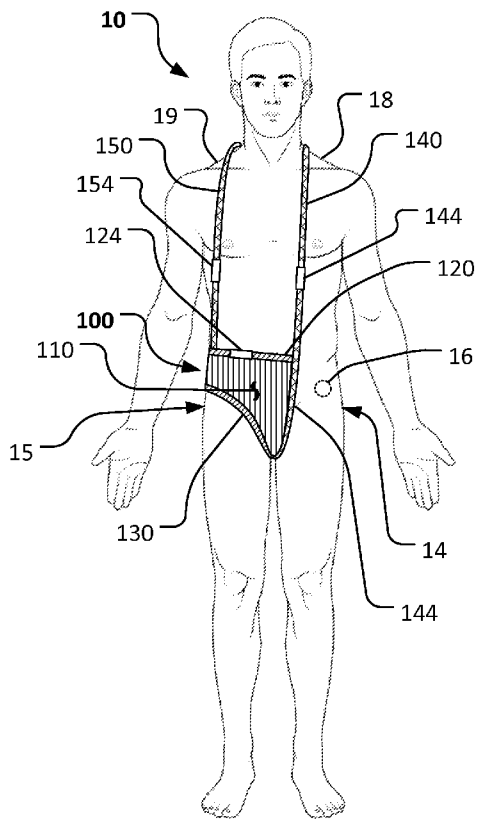


FIG. 1

(57) Abstract: Undergarments that are configured to be worn by a patient during a medical procedure is described. For example, this document provides undergarments that covers the patient's genitalia while leaving the patient's hip area unobstructed to facilitate a medical procedure that requires hip access.





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HIP SURGERY UNDERGARMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Serial No. 61/927,263, filed January 14, 2014. The disclosure of the prior application is
5 considered part of (and is incorporated by reference in) the disclosure of this application.

BACKGROUND

1. Technical Field

This document relates to an undergarment that is configured to be worn by a
10 patient during a medical procedure. For example, this document relates to an undergarment that covers the patient's genitalia while leaving the patient's hip area unobstructed to facilitate a medical procedure that requires hip access.

2. Background Information

15 The hip joint is one of the most important joints in the human body. It bears the body's weight and the force of the strong muscles of the hip and leg. The hip joint is also one of the most flexible joints and allows a greater range of motion than all other joints in the body except for the shoulder.

The hip joint is a ball-and-socket joint formed between the pelvis and the
20 femur. A cup-shaped structure on the pelvis, known as the acetabulum, forms the socket for the hip joint. The rounded head of the femur forms the ball of the joint. If a hip joint breaks in an accident or wears out in old age, a surgeon can replace it with a ball-and-socket joint made from metal and plastic and engineered in such a way that it will duplicate the motions of a human joint.

25 A hip labral tear involves the ring of soft elastic tissue called the labrum that follows the outside rim of the socket of the hip joint. The labrum acts like a socket to hold the ball at the top of the femur in place. Athletes who participate in such sports as ice hockey, soccer, football, golf, and ballet are at higher risk of developing a hip labral tear. Structural abnormalities of the hip also can lead to a hip labral tear.
30 Symptoms of a hip labral tear include hip pain or a "catching" sensation in the hip joint.

Using arthroscopic techniques, surgeons can remove loose fragments from within the joint and trim or repair a hip labral tear. Hip arthroscopy refers to the

viewing of the interior of the hip joint through an arthroscope, and the treatment of hip pathology through a minimally invasive approach. There are two widely used hip arthroscopy methods, one with the patient on their back (supine) and the other with the patient on their side (lateral decubitus).

5

SUMMARY

This document provides an undergarment that is configured to be worn by a patient during a medical procedure. For example, this document provides an undergarment that covers the patient's genitalia while leaving the patient's hip area unobstructed to facilitate a medical procedure that requires hip access.

In general, one aspect of this document features undergarments for a human patient. The undergarment is configured to be worn by the patient to cover the patient's genitalia while leaving one flank of the patient fully uncovered. Accordingly, the undergarment can be configured to not fully surround the patient's waist and hip areas.

Such an undergarment may optionally include one or more of the following features. In some embodiments, the undergarments provided herein include one and only one leg hole. In some such embodiments, the undergarments are configured to be worn by the patient such that one leg of the patient extends through the leg hole while the other leg of the patient is not surrounded by the undergarment. Optionally, a first support strap may be attached to a front side of the undergarment and to a backside of the undergarment. In some cases, the first support strap is configured to be worn over a first shoulder of the patient. The first support strap may include an adjustment that can adjust the length of the first support strap. In some embodiments, the undergarment also includes a second support strap. In some such embodiments, the second support strap can be attached to a side of the undergarment and to the first support strap. Optionally, the second support strap is configured to be worn over a second shoulder of the patient that is different than the first shoulder. The second support strap includes an adjustment that can adjust the length of the second support strap in some embodiments. Particular embodiments of the undergarment may include a partial waistband that may include an adjustment that can adjust the length of the partial waistband.

Further, the undergarments provided herein may optionally include one or more of the following features. In some embodiments, the undergarments provided

herein are reversible such that the undergarment can be worn in two ways. A first way of the two ways may leave a right flank of the patient fully uncovered, and a second way of the two ways may leave a left flank of the patient fully uncovered. In particular embodiments, the undergarment may be configured with crotch room for male genitalia. Optionally, the undergarment may be configured to be a disposable one-time-use item in some embodiments. In some embodiments, the undergarment is configured to be laundered and reusable. At least a portion of the undergarment may comprise an antibiotic agent, such as an antibiotic spray coating. In some embodiments, the undergarment includes a lead coating, liner, or insert. The undergarment may further comprise one or more elastic portions. Optionally, the undergarment may further comprise one or more semi-rigid support elements.

Particular embodiments of the subject matter described in this document can be implemented to realize one or more of the following advantages. In some embodiments, the undergarments provided herein can be worn by a patient to conceal the patient's genitalia during a medical procedure. As such, some patients may feel more at ease undergoing a medical procedure because of being able to maintain privacy and modesty. In some embodiments, the undergarments provided herein provide clear access to a patient's hip area, while concealing the patient's genitalia. As such, a medical procedure requiring hip access (e.g., a hip arthroscopy or hip replacement) can be performed without obstruction from the undergarment. In some embodiments, the undergarments provided herein are adjustable in size to provide a suitable fit for patients of differing body proportions. In some embodiments, the undergarments provided herein can be reversible. As such, the garments provided herein can be used for medical procedures requiring access to either the patient's right or left hip area. In some embodiments, the garments provided herein include an antibiotic coating to reduce the potential for infections. In some embodiments, a lead coating or liner is included in some portions of the undergarments described herein to provide patient protection.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention pertains. Although methods and materials similar or equivalent to those described herein can be used to practice the invention, suitable methods and materials are described herein. All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety. In

case of conflict, the present specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting.

5 The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description herein. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF THE DRAWINGS

10 Figure 1 is an anterior view of a patient wearing an example hip surgery undergarment in accordance with some embodiments provided herein.

Figure 2 is a posterior view of the patient wearing the hip surgery undergarment as shown in Figure 1.

15 Figure 3 is an anterior view of a patient wearing another example hip surgery undergarment in accordance with some embodiments provided herein.

Figure 4 is a posterior view of the patient wearing the hip surgery undergarment as shown in Figure 3.

Figure 5 is a perspective view of the hip surgery undergarment as shown in Figures 3 and 4.

20 Like reference numbers represent corresponding parts throughout.

DETAILED DESCRIPTION

This document provides an undergarment that is configured to be worn by a patient during a medical procedure. For example, this document provides an
25 undergarment that covers the patient's genitalia while leaving the patient's hip area unobstructed to facilitate a medical procedure that requires hip access.

In some embodiments, the undergarments provided herein include an antibiotic agent (e.g., a coating) to reduce the potential for infections. For example, in some embodiments triclosan (e.g., Microban®, a chlorinated aromatic compound with
30 antibacterial properties, as well as antifungal and antiviral properties) is coated on all or some portions of the undergarments provided herein. In some embodiments, other antibiotic coatings are additionally or alternatively included. In some embodiments, a lead coating, liner, or insert is included in some portions of the undergarments described herein to provide patient protection.

Referring to Figures 1 and 2, a patient 10 is shown wearing a hip surgery undergarment 100 in accordance with some embodiments provided herein.

Undergarment 100 can be worn by patient 10 during a medical procedure that requires unobstructed access to one of the patient's hips 14. The hip areas may also be referred to herein as flanks. While hip 14 is not covered by undergarment 100, 5 undergarment 100 covers the genitalia of patient 10. Therefore, patient 10 may advantageously maintain a preferable extent of privacy and modesty by wearing undergarment 100 during a medical procedure requiring unobstructed access to hip 14.

10 Undergarment 100 is well-suited for use during various types of medical procedures that require unobstructed access to an operating field in the area of hip 14. For example, undergarment 100 allows unobstructed access to an anterior superior iliac spine (ASIS) area 16 of hip 14. Such medical procedures can include, but are not limited to, total hip replacement, treatment of various types of hip fractures, hip 15 endoscopic procedures including arthroscopic surgery, hip examinations, imaging procedures, and other procedures requiring access to a flank of patient 10.

In some embodiments, undergarment 100 is a one-time-use disposable item. In some such embodiments, undergarment 100 can be made of materials including, but not limited to, cotton, polypropylene, polyethylene, latex, spandex, polyurethane, 20 and the like, and combinations thereof. In some embodiments, undergarment 100 can be laundered and reusable.

While patient 10 is depicted as a male, it should be understood that undergarment 100, or a slight variation thereof, can also be well-suited for use by females. For example, in some embodiments the male version of undergarment 100 25 provides additional crotch room for the male genitalia, which is not provided in the female version of undergarment 100. In some other embodiments, the undergarment 100 is a unisex design.

In the illustrated example, patient 10 is wearing undergarment 100 so as to expose left hip 14. However, it should be understood that undergarment 100 can also 30 be used so as to expose the opposite hip, i.e., right hip 15. In some embodiments, undergarment 100 can simply be turned inside out, and worn to cover left hip 14 while exposing right hip 15. That is, in some embodiments undergarment 100 is reversible such that it can be worn in either orientation (to cover left hip 14 or to cover right hip 15). In alternative embodiments, two versions of undergarment 100

can be provided. That is, a first version that covers right hip 15 (as shown) can be provided, and a second version (e.g., a mirror image of the shown first version) that covers left hip 14 can be provided.

Undergarment 100 can readily fit a range of different body sizes. In some
5 embodiments, undergarment 100 is adjustable (as will be described further below)
such that one version of undergarment 100 can fit a wide range of body sizes. In
other embodiments, different sizes (e.g., small, medium, large, extra-large, etc.) of
undergarment 100 can be provided to fit a range of different body sizes. In some
embodiments, undergarment 100 is provided in different sizes that also are adjustable.
10 In other words, undergarment 100 can be provided in sizes such as small, medium,
large, etc., in addition to being adjustable.

In the depicted embodiment, undergarment 100 includes a main body panel
110, an upper hem 120, a lower hem 130, a front-to-back strap 140, and a side strap
150. Main body panel 110 is bordered at the top by upper hem 120, and at the bottom
15 by lower hem 130. Main body panel 110 is bordered on the sides by a front side hem
142 and a backside hem 143. In some embodiments, front side hem 142 and backside
hem 143 are continuations of front-to-back strap 140. Main body panel 110 can be
attached to hems 120, 130, 142, and 143 using techniques such as stitching, heat
staking, adhering, and the like, and combinations of such techniques.

20 In some embodiments, upper hem 120 is an elastic member that acts as a
partial waistband of undergarment 100. In the depicted embodiment, upper hem 120
does not fully surround the waist of patient 10. In alternative embodiments, upper
hem 120 may surround the waist of patient 10. In some such embodiments, upper
hem 120 may include a detachment means (e.g., a snap, a tie, an adhesive tab, a hook
25 and loop fastener, etc.) that a clinician may use to open upper hem 120 to remove it
from the operating field as necessary.

In some embodiments, upper hem 120 may include one or more semi-rigid
support elements in portions of or all of upper hem 120. The support element(s) can
help ensure that upper hem 120 maintains its intended generally semi-circular shape
30 around a portion of the waist of patient 10. In some such embodiments, the semi-rigid
support element(s) can be malleable such that it can be conformed to the topography
of the anatomy of patient 10. Once formed to a desired shape, the malleable support
element(s) maintains the shape.

Upper hem 120 can optionally include an upper hem size adjustment 124 in some embodiments. Using upper hem size adjustment 124, patient 10 can customize the fit of main body panel 110 as desired, so as to essentially conform to the waist size of patient 10, for example. Upper hem size adjustment 124 can comprise a variety of
5 different types of adjustable arrangements. For example, in some embodiments upper hem size adjustment 124 is a strap and buckle that can be used to lengthen or shorten upper hem 120. In some embodiments, a series of snaps can be provided that can be selectively coupled to provide a customized fit of upper hem 120. In other
10 embodiments, upper hem size adjustment 124 can comprise a hook and loop closure, resealable adhesive tape, tie(s), and the like for customization of the fit of upper hem 120.

Lower hem 130 is attached to main body panel 110 and surrounds one leg of patient 10. Lower hem 130 can be elastic so that lower hem 130 conforms to the leg, while not being too tight so as to be uncomfortable or to constrict the circulation of
15 patient 10. Accordingly, in some embodiments lower hem 130 includes materials such as, but not limited to, stretch vinyl, spandex, nylon, and the like, and blends of such materials. Only one leg of patient 10 is surrounded by undergarment 100.

Undergarment 100 includes front-to-back strap 140. Front-to-back strap 140 extends from an anterior portion of upper hem 120, over a shoulder 18 of patient 10, and terminates at a posterior portion of upper hem 120. As such, front-to-back strap
20 140 can maintain the upper hem 120 at a desired position at or near the waistline of patient 10.

In some embodiments, front-to-back strap 140 can be elastic so as to adapt to different body proportions of patient 10. Optionally, front-to-back strap 140 can also
25 include a front-to-back strap adjustment 144. Front-to-back strap adjustment 144 can comprise a variety of different types of adjustable arrangements. For example, in some embodiments front-to-back strap adjustment 144 is a strap and buckle that can be used to lengthen or shorten front-to-back strap 140. In some embodiments, a series of snaps can be provided that can be selectively coupled to provide a customized fit of
30 front-to-back strap 140. In other embodiments, front-to-back strap adjustment 144 can comprise a hook and loop closure, resealable adhesive tape, tie(s), and the like for customization of the fit of front-to-back strap 140.

Undergarment 100 also optionally includes side strap 150. Side strap 150 can be configured in various manners. In the depicted embodiment, side strap 150

extends from upper hem 120 near hip 15 of patient 10, over a shoulder 19 of patient 10, and terminates in engagement with front-to-back strap 140. In some embodiments, the engagement between side strap 150 and front-to-back strap 140 is a fixed engagement. In some embodiments, the engagement between side strap 150 and front-to-back strap 140 is an adjustable engagement. For example, side strap 150 can terminate with a loop or a buckle that slidably engages with front-to-back strap 140. As such, side strap 150 can be moved in relation to front-to-back strap 140 to adjust the fit for different body proportions of patient 10.

In some embodiments, side strap 150 can be elastic. Optionally, side strap 150 can also include a side strap adjustment 154. Side strap adjustment 154 can comprise a variety of different types of adjustable arrangements. For example, in some embodiments side strap adjustment 154 is a strap and buckle that can be used to lengthen or shorten side strap 150. In some embodiments, a series of snaps can be provided that can be selectively coupled to provide a customized fit of side strap 150. In other embodiments, side strap adjustment 154 can comprise a hook and loop closure, resealable adhesive tape, tie(s), and the like for customization of the fit of side strap 150.

Optional side strap 150 can also be configured in other manners. For example, in some embodiments, side strap 150 can extend from upper hem 120 near an anterior portion of hip 15 of patient 10, over a shoulder 19 of patient 10, and terminate in engagement with upper hem 120 near a posterior portion of hip 15 of patient 10. In some such embodiments, side strap 150 can be optionally attached to front-to-back strap 140 using a conjoining strap (not shown) that can be located on the chest or back of patient 10 (or both). In some such configurations, the straps (i.e., straps 140, 150, and the conjoining strap) are configured similar to the manner commonly associated with pant suspenders.

Referring to Figures 3, 4, and 5, patient 10 is shown wearing a hip surgery undergarment 200 in accordance with some embodiments provided herein. As with undergarment 100 described above, undergarment 200 can be worn by patient 10 during a medical procedure that requires unobstructed access to one of the patient's hips 14. While hip 14 is not covered by undergarment 200, undergarment 200 covers the genitalia of patient 10. Therefore, patient 10 may advantageously maintain a preferable extent of privacy and modesty by wearing undergarment 200 during a medical procedure requiring unobstructed access to hip 14.

Undergarment 200 can be constructed and used in any of the manners and techniques that are described above in reference to undergarment 100.

In the depicted embodiment, undergarment 200 includes a main body panel 210 and a front-to-back strap 240. Front-to-back strap 240 extends from main body panel 210 and over shoulder 18 of patient 10. In the depicted embodiment, no side strap is included (such as the optional side strap 150 of undergarment 100).

In the depicted embodiment, distinct hem material portions are not included at the edges of main body panel 210. Rather, the material of main body panel 210 is merely terminated at its edges. In some embodiments, the material of main body panel 210 is terminated at its edges by heat-sealing, adhering, or sewing, and the like, and combinations thereof. In some embodiments, an elastic member is included at some or all of the edges of main body panel 210. In some embodiments, hems and/or hem portions are included at some or all of the edges of main body panel 210.

Undergarment 200 includes front-to-back strap 240. Front-to-back strap 240 extends from an anterior portion of main body panel 210, over a shoulder 18 of patient 10, and terminates at a posterior portion of main body panel 210. As such, front-to-back strap 240 can maintain main body panel 210 at a desired position on patient 10.

In some embodiments, front-to-back strap 240 can be elastic so as to adapt to different body proportions of patient 10. Optionally, front-to-back strap 240 can also include a front-to-back strap adjustment 244. Front-to-back strap adjustment 244 can comprise a variety of different types of adjustable arrangements. For example, in some embodiments front-to-back strap adjustment 244 is a strap and buckle that can be used to lengthen or shorten front-to-back strap 240. In some embodiments, a series of snaps can be provided that can be selectively coupled to provide a customized fit of front-to-back strap 240. In other embodiments, front-to-back strap adjustment 244 can comprise a hook and loop closure, resealable adhesive tape, tie(s), and the like for customization of the fit of front-to-back strap 240. In some embodiments, front-to-back strap adjustment 244 can be completely opened such that front-to-back strap 240 has two free ends, and then reclosed to configure front-to-back strap 240 as an essentially single continuous strap that extends between the anterior and posterior portions of main body panel 210.

Undergarment 200 also includes a waist size adjustment 224. Using waist size adjustment 224, patient 10 can customize the fit of main body panel 210 as desired, so

as to essentially conform to the waist size of patient 10, for example. Waist size adjustment 224 can comprise a variety of different types of adjustable arrangements. For example, in some embodiments waist size adjustment 224 is a strap and buckle that can be used to lengthen or shorten the waist size of main body panel 210. In
5 some embodiments, a series of snaps can be provided that can be selectively coupled to provide a customized fit of main body panel 210. In other embodiments, waist size adjustment 224 can comprise a hook and loop closure, resealable adhesive tape, tie(s), and the like for customization of the fit of main body panel 210. In some
10 embodiments, waist size adjustment 224 can be completely opened such that waist size adjustment 224 has two free ends, and then reclosed to configure waist size adjustment 224 as an essentially single continuous strap that extends between the anterior and posterior portions of main body panel 210.

In some embodiments, undergarment 200 may include one or more semi-rigid support elements in portions of undergarment 200. The support element(s) can help
15 ensure that undergarment 200 maintains its intended shape. In some such embodiments, the semi-rigid support element(s) can be malleable such that it can be conformed to the topography of the anatomy of patient 10. Once formed to a desired shape, the malleable support element(s) maintains the shape.

While this specification contains many specific implementation details, these
20 should not be construed as limitations on the scope of any invention or of what may be claimed, but rather as descriptions of features that may be specific to particular embodiments of particular inventions. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described
25 in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described herein as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a
30 subcombination or variation of a subcombination.

Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and

parallel processing may be advantageous. Moreover, the separation of various system modules and components in the embodiments described herein should not be understood as requiring such separation in all embodiments, and it should be understood that the described program components and systems can generally be
5 integrated together in a single product or packaged into multiple products.

Particular embodiments of the subject matter have been described. Other embodiments are within the scope of the following claims. For example, the actions recited in the claims can be performed in a different order and still achieve desirable results. As one example, the processes depicted in the accompanying figures do not
10 necessarily require the particular order shown, or sequential order, to achieve desirable results. In certain implementations, multitasking and parallel processing may be advantageous.

WHAT IS CLAIMED IS:

1. An undergarment for a human patient, the undergarment being configured to be worn by the patient to cover the patient's genitalia while leaving one flank of the patient fully uncovered, the undergarment being configured to not fully surround the patient's waist and hip areas.
2. The undergarment of claim 1 including one and only one leg hole whereby the undergarment is configured to be worn by the patient such that one leg of the patient extends through the leg hole while the other leg of the patient is not surrounded by the undergarment.
3. The undergarment of claim 2 including a first support strap that is attached to a front side of the undergarment and to a back side of the undergarment, wherein the first support strap is configured to be worn over a first shoulder of the patient.
4. The undergarment of claim 3, wherein the first support strap includes an adjustment that can adjust the length of the first support strap.
5. The undergarment of claim 3, including a second support strap that is attached to a side of the undergarment and to the first support strap, wherein the second support strap is configured to be worn over a second shoulder of the patient that is different than the first shoulder.
6. The undergarment of claim 5, wherein the second support strap includes an adjustment that can adjust the length of the second support strap.
7. The undergarment of claim 2, wherein a partial waistband of the undergarment includes an adjustment that can adjust the length of the partial waistband.

8. The undergarment of claim 1, wherein the undergarment is reversible such that the undergarment can be worn in two ways, wherein a first way of the two ways leaves a right flank of the patient fully uncovered, and wherein a second way of the two ways leaves a left flank of the patient fully uncovered.
9. The undergarment of claim 1, wherein the undergarment is configured with crotch room for male genitalia.
10. The undergarment of claim 1, wherein the undergarment is configured to be a disposable one-time-use item.
11. The undergarment of claim 1, wherein the undergarment is configured to be laundered and reusable.
12. The undergarment of claim 1, wherein at least a portion of the undergarment comprises an antibiotic agent.
13. The undergarment of claim 12, wherein the antibiotic agent is a coating.
14. The undergarment of claim 1, further comprising a lead coating, liner, or insert.
15. The undergarment of claim 1, further comprising one or more elastic portions.
16. The undergarment of claim 1, further comprising one or more semi-rigid support elements.

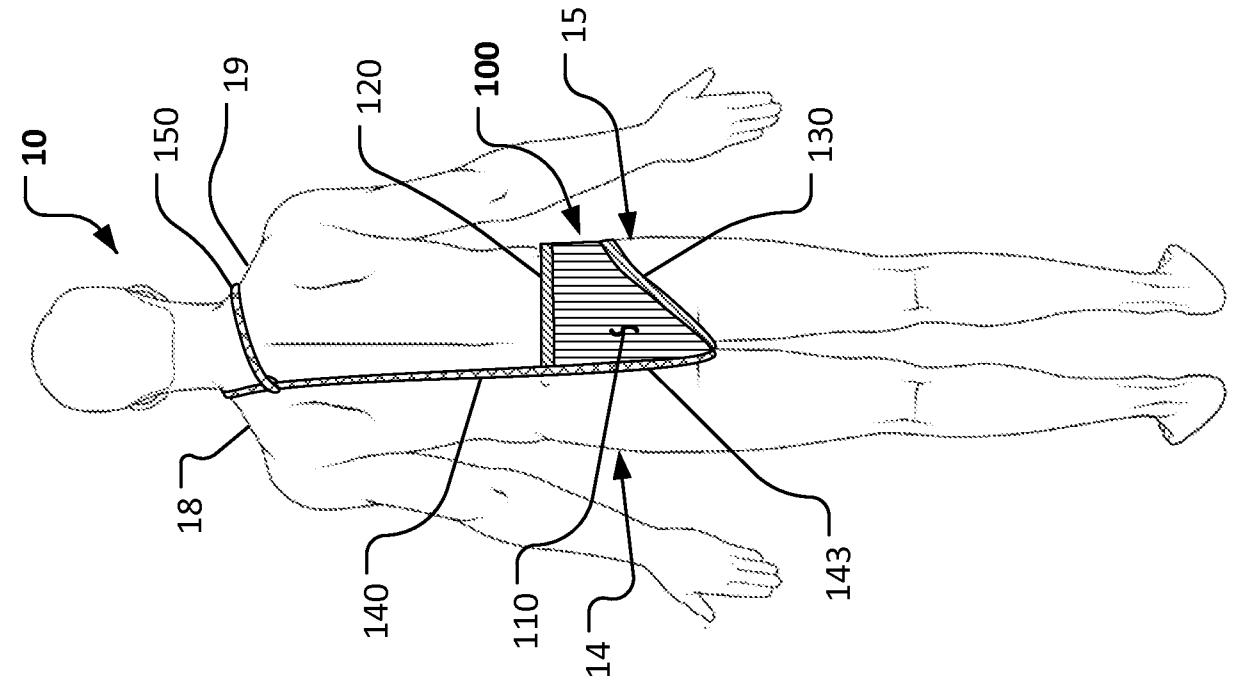


FIG. 1

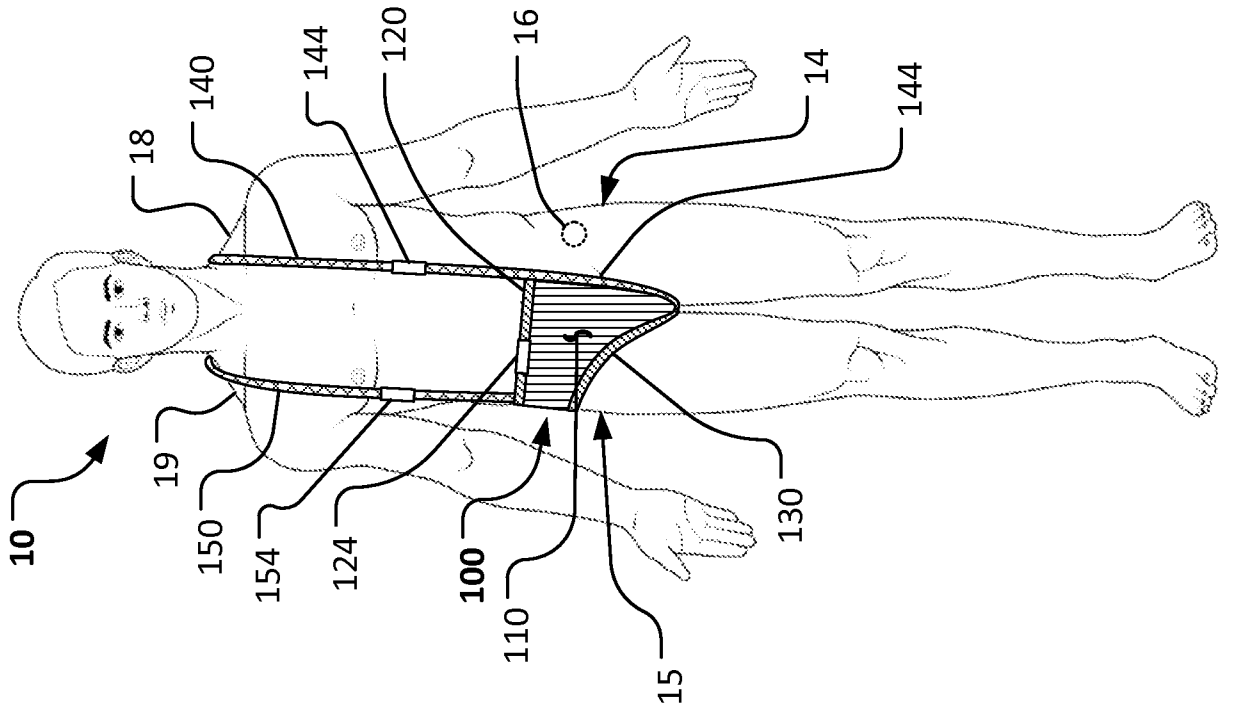


FIG. 2

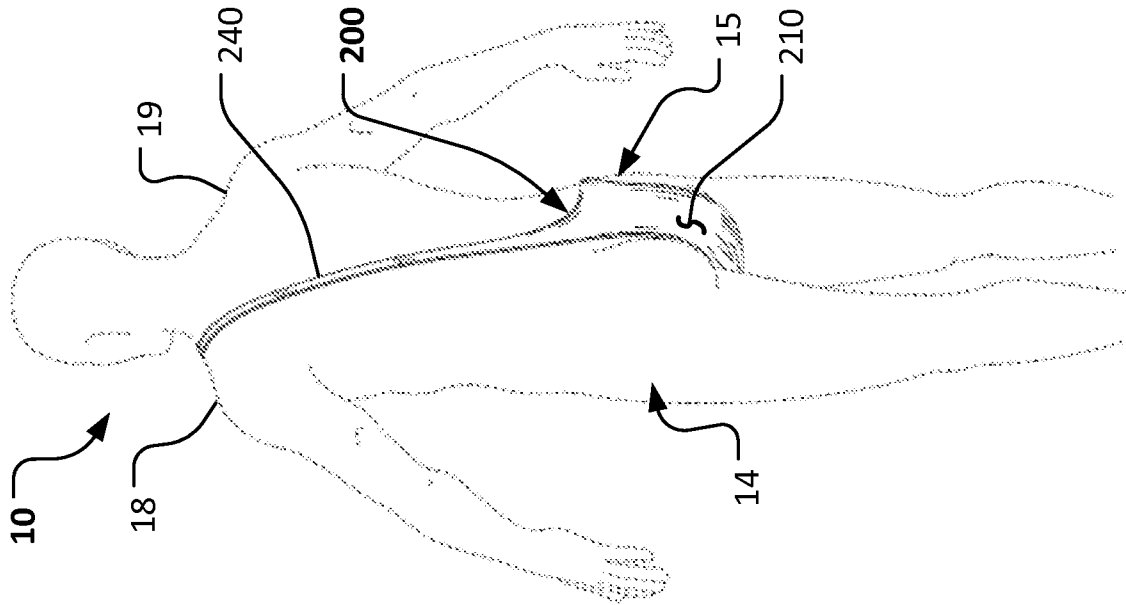


FIG. 4

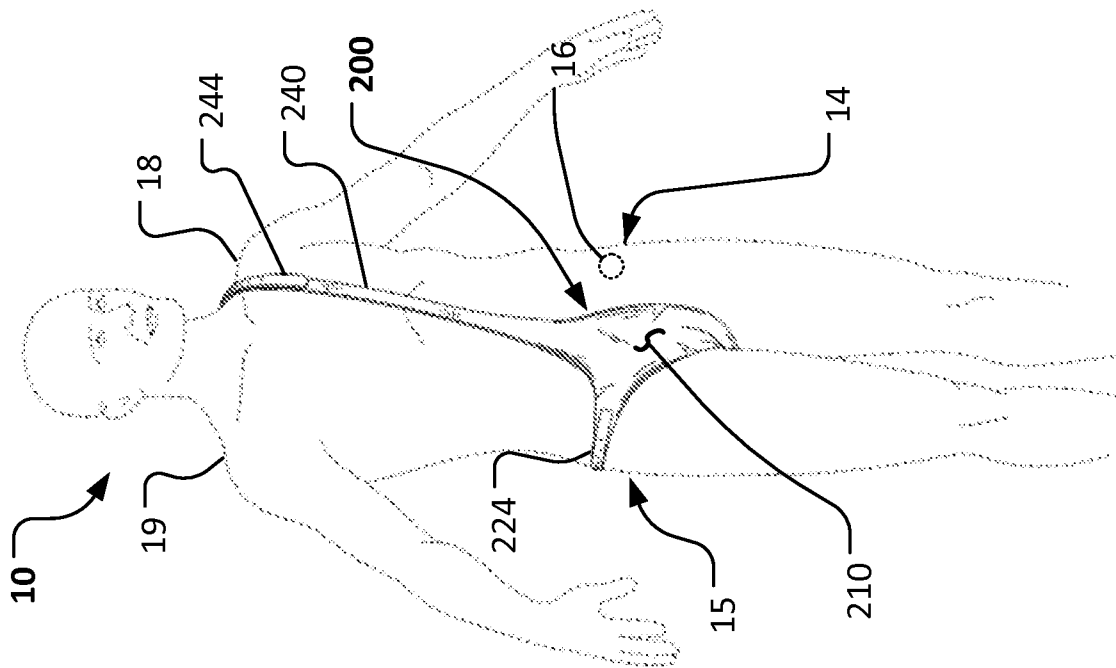


FIG. 3

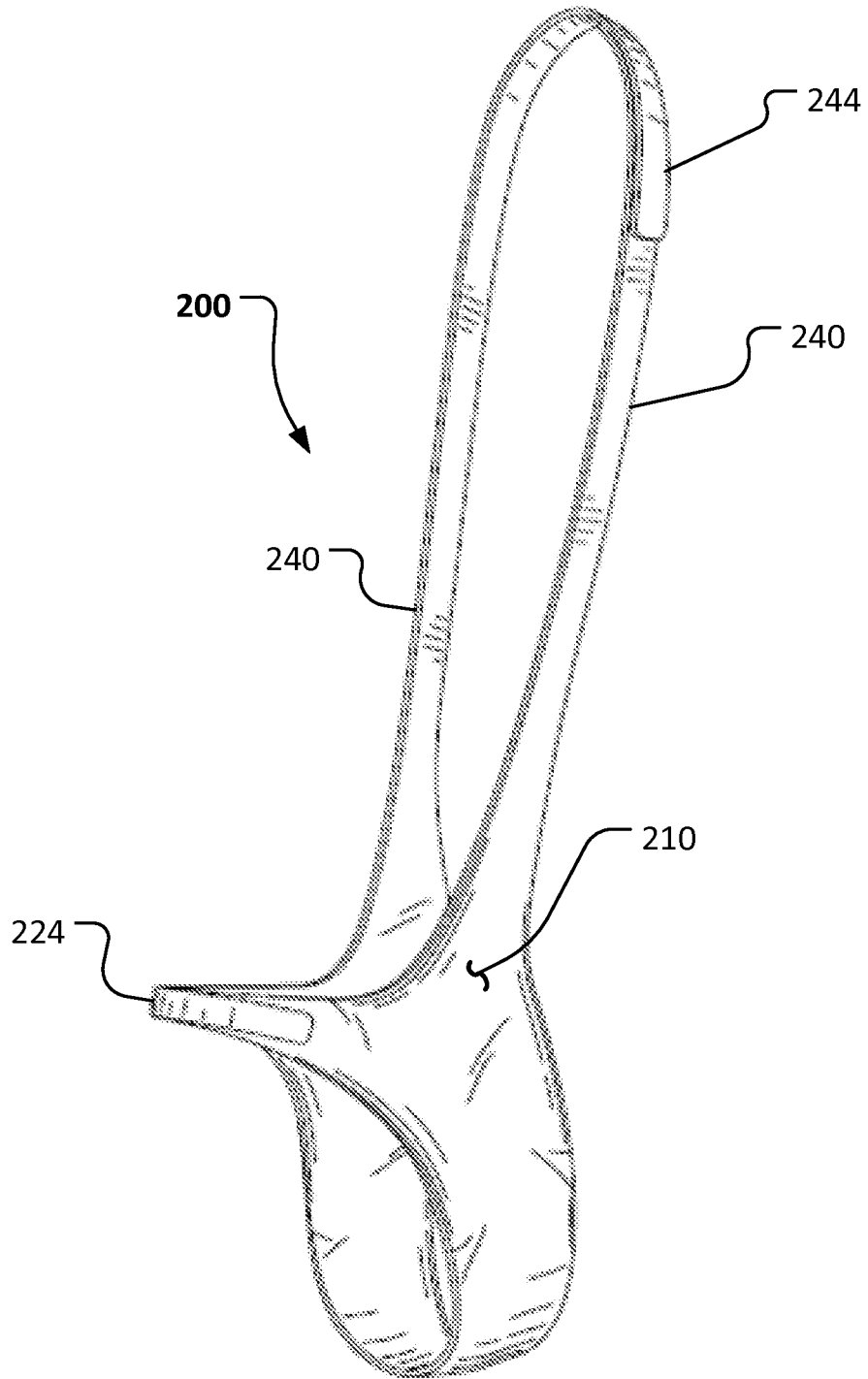


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/10639

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - A41B 9/00, 9/16, 13/12 (2014.01) CPC - A41B 9/00, 13/00, 13/12 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC(8) - A41B 9/00, 9/02, 9/04, 9/08, 9/12, 9/16, 13/00, 13/12 (2014.01) CPC - A41B 9/00, 9/001, 9/02, 9/04, 9/08, 9/12, 13/00, 13/12		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google; Google Scholar; ProQuest; Undergarment*, garment*, underwear*, apparel*, clothing*, robe*, patient*, genital*, crotch*, uncover*, expose*, bare*, show*, waist*, hip*, flank*, torso*, shield*, radiation*, antibiotic*, antimicrobial*, antibacterial*		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Summer will be hot: the new men's trend beyond discovery. Website [online]. Re:Public, 08 August 2013 [retrieved on 16 March 2015]. Retrieved from the Internet: <URL: http://republic.com.ua/article/28069-Leto-budet-jarkim-novyy-mujskoy-trend-za-granYu-otkrytosti.html >.	1-4, 7, 8-11
X --- Y	US 2012/0185992 A1 (BYRNES, L. A.) 26 July 2012; figures 2-3, 6; paragraphs [0017], [0020], [0023], [0028], and [0030]	1, 15 12-14, 16
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