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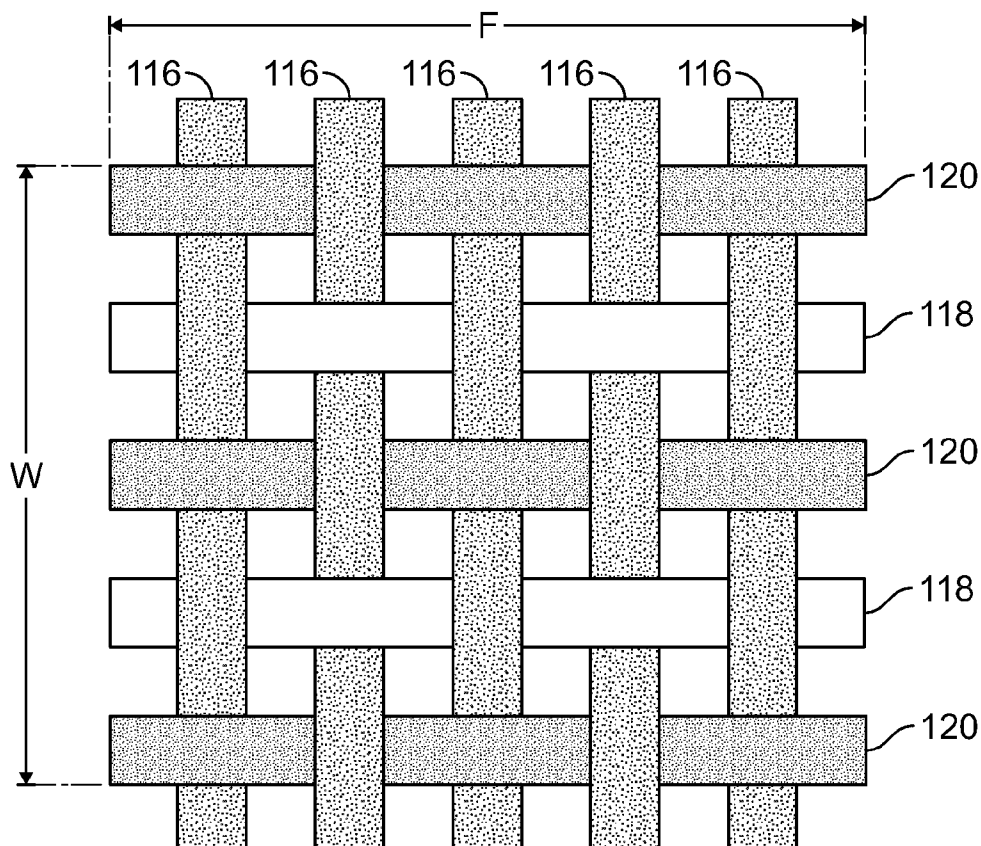
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**Ronner et al.**(10) **Pub. No.: US 2013/0115841 A1**(43) **Pub. Date: May 9, 2013**(54) **FABRIC MATERIAL**(71) Applicants: **David E. Ronner**, Berkeley Heights, NJ  
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(US); **Paul Lytle**, Victor, NY (US)(21) Appl. No.: **13/666,212**(22) Filed: **Nov. 1, 2012****Related U.S. Application Data**(60) Provisional application No. 61/555,581, filed on Nov.  
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(57)

**ABSTRACT**

A fabric material including a plurality of strands of a warp yarn positioned in a warp direction, a plurality of strands of a first filling yarn positioned in a filling direction, each being impregnated by silver ions, and a plurality of strands of a second filling yarn positioned in the filling direction, each being impregnated by copper ions. The strands of said warp yarn are woven with those of the first and second filling yarns to form a face side and a back side, and the strands of the first and second filling yarns are woven alternately relative to one another with the strands of said warp yarn in said filling direction. The fabric material may be a satin, plain or twill pattern, and can be used as a bed sheet having a low coefficient of friction, wickability, absorbency, and "cool to the touch" properties.

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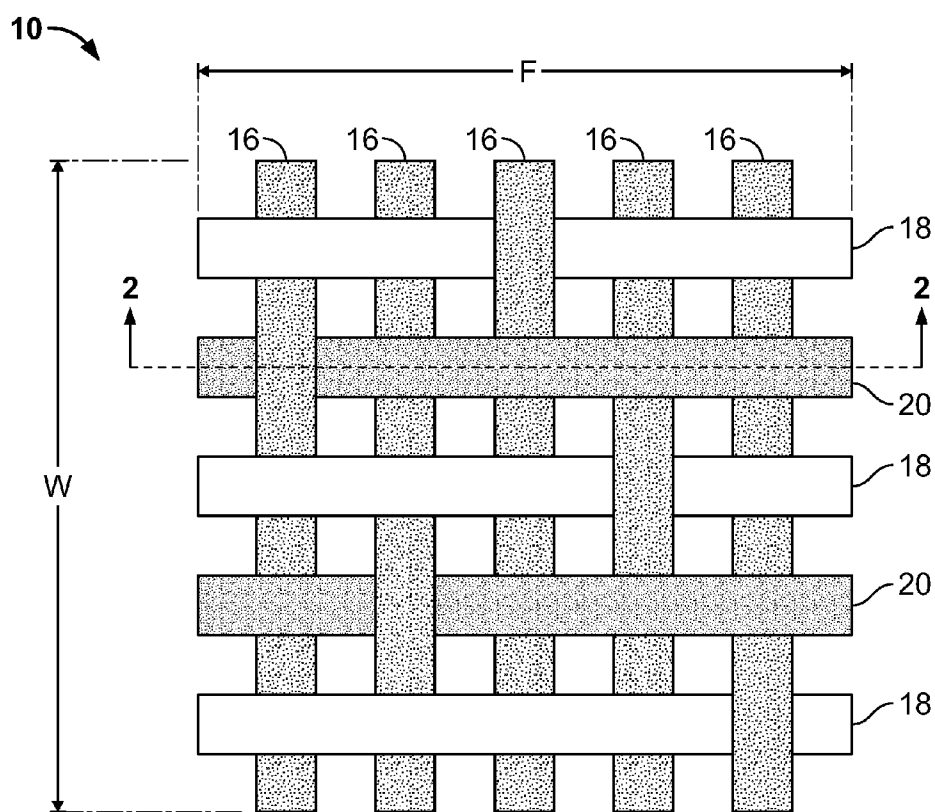


FIG. 1

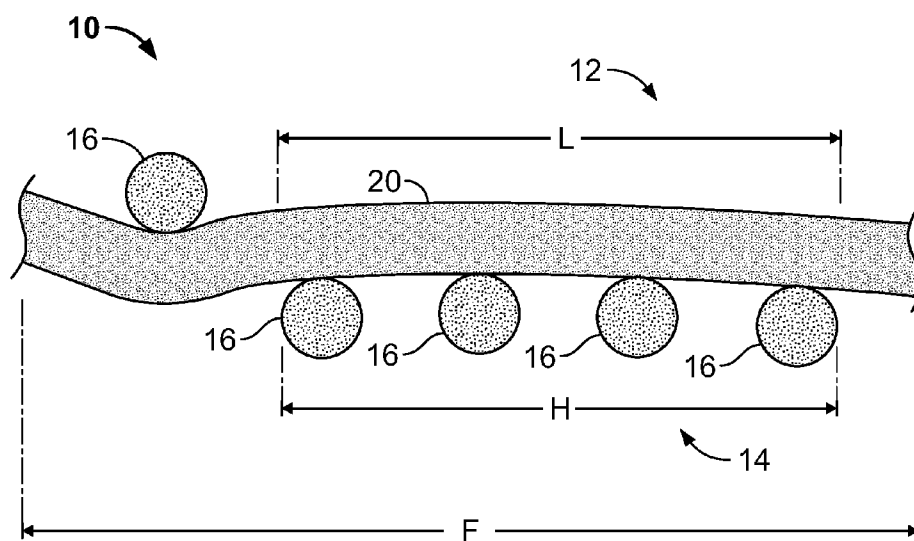


FIG. 2

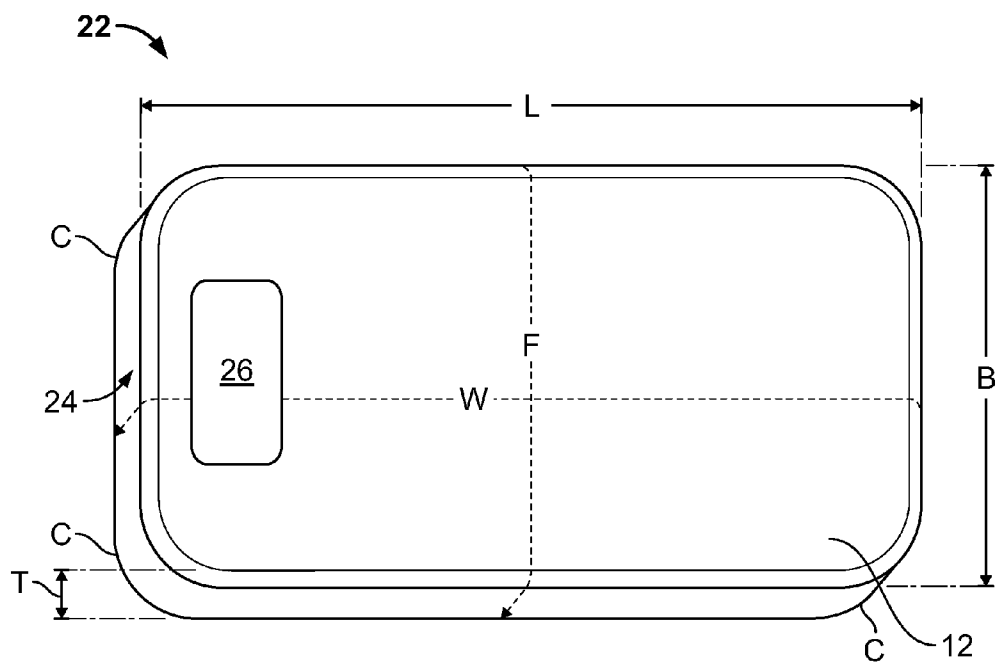


FIG. 3

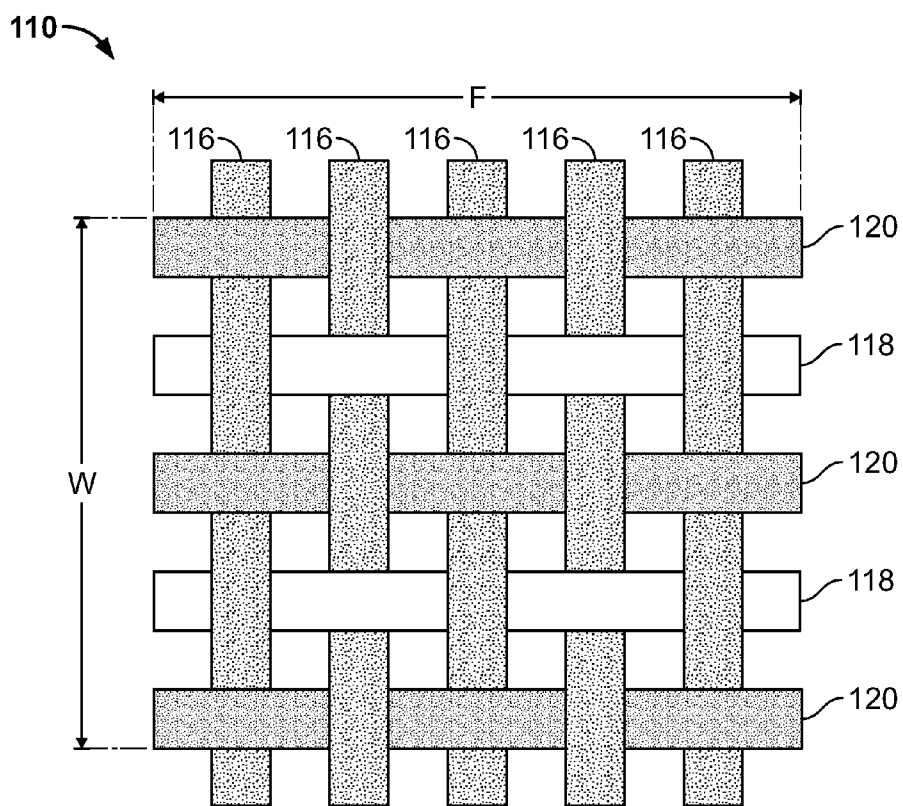


FIG. 4

## FABRIC MATERIAL

### CROSS-REFERENCE TO RELATED APPLICATION

**[0001]** The present application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/555,581 filed on Nov. 4, 2011 entitled FABRIC FOR BED SHEET, the disclosure of which is incorporated herein by reference in its entirety.

### FIELD OF THE INVENTION

**[0002]** The present invention relates to fabric material, and, more particularly, to fabric material having antimicrobial and healing properties, as well as a low coefficient of friction.

### BACKGROUND OF THE INVENTION

**[0003]** Products made from fabric materials, such as bed sheets and pillow cases used in hospitals, nursing homes and rehabilitation centers, are a potential source of bacterial colonization, skin irritation, and migration or worsening of skin infections. Bed sheets and pillow cases often produce irritated areas on a patient's skin as a result of friction caused by motion or lack of motion of the patient relative to the bed sheets and pillow cases. This skin irritation contributes to the formation of pressure ulcers. What is needed is a fabric material having antimicrobial properties, a low coefficient of friction, a "cool to the touch" feel, and moisture-wicking properties.

### SUMMARY OF THE INVENTION

**[0004]** In an embodiment, a fabric material including a plurality of strands of a warp yarn positioned in a warp direction; a plurality of strands of a first filling yarn positioned in a filling direction, each of the plurality of strands of the first filling yarn being impregnated by silver ions; and a plurality of strands of a second filling yarn positioned in the filling direction each of the plurality of strands of the second filling yarn being impregnated by copper ions, wherein the plurality of strands of the warp yarn are woven with the plurality of strands of the first filling yarn and the plurality of strands of the second filling yarn to form a face side and a back side opposite the face side, and wherein each of the plurality of strands of the first filling yarn and each of the plurality of strands of the second filling yarn are woven alternately relative to one another with the plurality of strands of the warp yarn in the filling direction.

**[0005]** In an embodiment, the fabric material includes a five-harness satin weave pattern. In an embodiment, the five-harness satin weave pattern is characterized by two of the plurality of strands of the first filling yarn and two of the plurality of strands of the second filling yarn floating over four of the plurality of strands of the warp yarn on the face side. In an embodiment, the five-harness satin weave pattern is characterized by four strands of the plurality of strands of the warp yarn underlying two strands of the plurality of strands of the first filling yarn and two strands of the plurality of strands of the second filling yarn on the back side. In an embodiment, the coefficient of friction of the face side in the filling direction is less than the coefficient of friction of the back side in the filling direction. In an embodiment, the plurality of strands of the warp yarn are made of filament rayon. In an embodiment, the plurality of strands of the first filling yarn are made from PLA polymer, and the plurality of strands

of the second filling yarn are made from PLA polymer. In an embodiment, the fabric material is antimicrobial, cool to the touch, and wickable. In all embodiment, the plurality of strands of the first filling yarn are made from nylon, and the plurality of strands of the second filling yarn are made from nylon. In an embodiment, the plurality of strands of the first filling yarn are made from polyester, and the plurality of strands of the second filling yarn are made from polyester.

**[0006]** In an embodiment, the fabric material is adapted to be used as a bed sheet. In an embodiment, the fabric material includes a plain weave pattern. In an embodiment, the plain weave pattern is characterized by five strands of the plurality of strands of the warp yarn in the warp direction, and five alternating strands of the plurality of strands of the first filling yarn and the plurality of strands of the second filling yarn in the filling direction. In an embodiment, the coefficient of friction of the face side is approximately equal to the coefficient of friction of the back side. In an embodiment, the fabric material is adapted to be used as a pillow case. In an embodiment, the fabric material includes a twill pattern.

**[0007]** In an embodiment, a method for making a fabric material includes the steps of weaving a plurality of strands of a warp yarn in a warp direction with a plurality of strands of a first filling yarn impregnated with silver ions in a filling direction and a plurality of strands of a second filling yarn impregnated with copper ions in the filling direction, wherein each of the plurality of strands of the first filling yarn and each of the plurality of strands of the second filling yarn are alternately woven with the plurality of strands of the warp yarn in the filling direction; scouring the fabric material to remove external matter; conditioning the fabric material in order to soften it; drying the fabric material; and calendaring the fabric material to smoothen it. In an embodiment, the conditioning step includes wet processing the fabric material using a cationic softener.

**[0008]** In an embodiment, the silver ion impregnated filling yarn and the copper ion impregnated filling yarn are manufactured separately and inserted alternately in the filling direction of the weave. In an embodiment, the silver and copper ions of the filling yarns provide antimicrobial and healing properties which are effective in combating the 2.5 growth and proliferation of harmful bacteria and fungus. With the silver and copper ions being inherently impregnated, they are resistant to being removed during repeated launderings of the fabric material, which enables the fabric's antimicrobial and healing properties to remain effective.

**[0009]** In an embodiment, the weave of the fabric material provides a low coefficient of friction on the face-side of the fabric, which inhibits irritation of a user's skin. In an embodiment, the rayon used in the warp direction of the weave possesses a low coefficient of friction that reduces the level of friction experienced by a user (such as a patient on a bed sheet) when he/she moves from side-to-side relative to the fabric. The reduced level of friction inhibits the formation of skin abrasions, which is one of the causes of pressure ulcers. In an embodiment, the fabric material includes a higher coefficient of friction on the back-side thereof versus the coefficient of friction on the face-side thereof. The higher coefficient on the back-side inhibits movement of the fabric material during movement by the user, when he/she moves from side-to-side thereon, thus reducing formation of wrinkles and creases that causes irregularity in the fabric's surface and creates additional friction points for the user.

**[0010]** In an embodiment, the fabric material is used for medical bed sheets, pillow cases, and other pressure ulcer related medical products. In an embodiment, the fabric material is absorbent and possesses a low coefficient of friction. In an embodiment, medical bed sheets that are fabricated from the fabric material provide patients comfort and pressure ulcer mitigation. Mitigation of patient pressure ulcers provides a benefit to the overall medical treatment and well being of the patient. In an embodiment, the low coefficient of friction on the face-side of the bed sheet greatly enhances rotation of disabled or sedentary patients by hospital staff. In an embodiment, the fabric material helps support a significantly enhanced ergonomic process in the hospital environment (e.g., it facilitates patient movement and rotations by hospital care giver staff). In an embodiment, the reduction in the required physical demands on care giver staff not only reduces lost time to injuries but also tends to increase the actual number of patient rotations completed by care givers. If patient rotations are easier to accomplish, care givers may be far more physically-able to complete timed rotations of the patients.

**[0011]** In other embodiments, the fabric can be used in connection with wearing apparel, boots, elbow pads, and other contact point protection shields.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** For a more complete understanding of the present invention, reference is made to the following detailed description of an exemplary embodiment considered in conjunction with the accompanying drawings, in which:

**[0013]** FIG. 1 is a diagrammatic plan view of a portion of a fabric material constructed in accordance with an embodiment of the present invention, the fabric material being woven with yarn provided in a warp direction and two different yarns alternately provided in a filling or weft direction;

**[0014]** FIG. 2 is a cross-sectional view, taken along the line 2-2 and looking in the direction of the arrows, of the fabric material shown in FIG. 1;

**[0015]** FIG. 3 is a top perspective view of a fitted bed sheet which is fitted on a mattress, the sheet being made from the fabric material shown in FIGS. 1 and 2; and

**[0016]** FIG. 4 is a diagrammatic plan view of a fabric material constructed in accordance with another embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0017]** Although the present invention can be used in conjunction with a fabric material for use with any type of sleeping or resting facility, it is particularly suitable for bed sheets used in hospitals, medical facilities, and nursing homes. Accordingly, the present invention will be described hereinafter in connection with bed sheets used in hospitals, medical facilities, and nursing homes. It should be understood, however, that the following description is only meant to be illustrative of the present invention and is not meant to limit the scope of the present invention, which also has applicability in other facilities (e.g., hotels, etc.) or for other products, such as pillow cases, wearing apparel and clothing, boots and other footwear, elbow and knee pads, and other fabric protective guards and shields.

**[0018]** FIGS. 1 and 2 illustrate a portion of a fabric material 10 constructed in accordance with an embodiment of the present invention. In embodiments to be described hereinbe-

low, the fabric material 10 is made from a plain weave, a twill weave, or a satin weave. In an embodiment, the fabric material 10 includes a face-side 12 and a back-side 14 opposite the face-side 12 (see FIG. 2). In an embodiment, the fabric material 10 is woven in a five-harness filling satin weave construction. FIG. 1 illustrates the face-side 12 of the fabric material 10, which shows one of a repeating pattern of a plurality of strands of warp yarn 16 which are provided in a warp direction, as indicated by arrows W, and one of a repeating pattern of a plurality of alternating strands of filling yarn 18 and filling yarn 20, which are provided in the filling or weft direction, as indicated by arrows F. In an embodiment, the repeating pattern of the plurality of strands of the warp yarn 16 is five (5) strands, as shown in FIGS. 1 and 2. In an embodiment, the repeating pattern of the plurality of alternating strands of the filling yarns 18, 20 are five (5) strands, as shown in FIG. 1. In an embodiment, the warp yarn 16 is made of filament rayon. In an embodiment, the filament rayon comprises ENKA® filament rayon. In an embodiment, the filament rayon has a low coefficient of friction, absorbency, wicking, and “cool to the touch” properties, and mitigates static electricity. In other embodiments, the filament rayon can be made by other manufacturers.

**[0019]** In an embodiment, the strands of the filling yarn 18 are made from a PLA (polylactic acid) polymer, nylon or a polyester yarn base that is inherently impregnated with silver ions (i.e., impregnated substantially equally throughout the entire yarn), while the strands of filling yarn 20 provided in the filling direction F are made from a PLA polymer, nylon or a polyester yarn base that is inherently impregnated with copper ions. In an embodiment, the PLA polymer is manufactured by Radici Fibers. In other embodiments, the PLA polymer can be made by other manufacturers. In an embodiment, the strands of the filling yarns 18, 20 are alternately inserted in the filling direction F (i.e., the filling yarn 20 is inserted in one pick, alternating with the filling yarn 18 in the next pick, and so on). In an embodiment, the silver and copper ions of the filling yarns 18, 20 include antimicrobial and healing properties which are described herein below.

**[0020]** In an embodiment, the filling yarn 18 is fabricated from fibers having inherent silver ions added to the base material of the master batch (e.g., PLA polymer, nylon or polyester yarn) of the fiber slurry in a process such as that disclosed in International Patent Publication Number WO 2006/084411 A1, published on Aug. 17, 2006 (the “’411 International Publication”), which is incorporated by reference herein in its entirety. Upon extrusion of the fiber, the silver ions are inherently part of the fiber. Likewise, the filling yarn 20 may be fabricated from fibers which have inherent copper ions added to the base material (e.g., PLA polymer, nylon or polyester yarn) of the master batch of the fiber slurry in the process disclosed in the ‘411 International Publication. Upon extrusion of the fiber, the copper ions are inherently part of the fiber.

**[0021]** In an embodiment, FIG. 2 illustrates the surface contours of the face-side 12 and the back-side 14 of the five-harness filling satin weave construction of the fabric material 10. In an embodiment, an arrow L indicates one of a repeated area of surface contours on the face-side 12, which contributes to a coefficient of friction in the filling direction F that is lower than the coefficient of friction in the filling direction F on the back-side 14 of the fabric material 10. More particularly, in an embodiment, on the face-side 12 of the fabric, an arrow L indicates one of a repeated area of surface

contours in which the two strands of the filling yarn **18** and the two strands of the filling yarn **20** float over (i.e., is not interwoven with) four strands of the warp yarn **16**, thereby minimizing the coefficient of friction on the face-side **12** in the filling direction F. In an embodiment, the rayon used in the warp direction W also contributes to the low coefficient of friction in the filling direction F. In an embodiment, on the back-side **14** of the fabric material **10**, an arrow H indicates one of a repeated area of surface contours in which the four strands of the warp yarn **16** underlie the two strands of the filling yarn **18** and the two strands of the filling yarn **20**, thereby maximizing the coefficient of friction on the back-side **14** in the filling direction F.

**[0022]** In an embodiment, the fabric **10** is woven in specific shapes and sizes to accommodate end use applications. For example, in an embodiment illustrated by FIG. 3, a fitted bed sheet **22**, which is made of the fabric material **10** and has fitted bottoms corners C, is shown fitted on a bed mattress **24**. In an embodiment, a pillow **26** is also shown positioned on the fitted bed sheet **22**. In an embodiment, the mattress **24** has a length indicated by the arrow L, a breadth indicated by the arrow B, and a thickness indicated by the arrow T. In an embodiment, the coefficient of friction in the filling direction F of the fabric material **10** reduces the level of friction that is experienced by a person (e.g., a patient) when he/she moves from side-to-side or is rotated by care giver staff on the face-side **12** of the fitted bed sheet **22**. In an embodiment, the reduced level of friction on the face-side **12** of the fabric material **10** inhibits the formation of skin abrasions on the skin of the person resting on the fitted bed sheet **22**, which is one of the causes of pressure ulcers. In an embodiment, the higher coefficient of friction of the back-side **14** of the fitted bed sheet **22** in the filling direction F serves to inhibit movement of the fitted bed sheet **22** relative to the mattress **24**, limiting the formation of wrinkles, creases or other characteristics that cause irritation points.

**[0023]** FIG. 4 depicts another embodiment of the present invention. Elements illustrated in FIG. 1, which correspond, either identically or substantially, to the elements described above with respect to the embodiment illustrated by FIGS. 1 and 2, have been designated by corresponding reference numerals increased by one hundred. Unless otherwise stated, the embodiment illustrated by FIG. 4 is constructed and assembled in the same basic manner as the embodiment illustrated by FIG. 4.

**[0024]** FIG. 4 illustrates a portion of a fabric material **110** constructed in accordance with another embodiment of the present invention. In an embodiment, the fabric material **110** is woven in a plain weave construction. In an embodiment, FIG. 4 illustrates the face-side of the material **110** which shows a repeating pattern of five (5) strands of warp yarn **116** in a warp direction, as indicated by the arrows W, and a repeating pattern of five (5) strands of alternating filling yarn **118** and filling yarn **120** in a filling or weft direction, as indicated by arrows F. In an embodiment, the strands of the filling yarn **116** provided in the warp W direction are made of filament rayon. In an embodiment, the strands of filling yarn **118** are made from a PLA polymer, nylon or a polyester yarn base that are inherently impregnated with silver ions, while the strands of the filling yarn **120** are made from PLA polymer, nylon or polyester yarn base that are inherently impregnated with copper ions and are alternately inserted in the filling direction F (i.e., the filling yarn **120** is inserted in one pick, alternating with the filling yarn **118** in the next pick, and

so on). Alternatively, in another embodiment, polyester or nylon yarn may be used as the base in the filling yarns **118**, **120**.

**[0025]** In an embodiment, the filling yarn **118** is fabricated from fibers that have inherent silver ions added to the base material of the master batch (e.g., PLA polymer, nylon or polyester yarn) of the fiber slurry in a process such as that which is disclosed in the '411 International Publication. Upon extrusion of the fiber, the silver ions are inherently part of the fiber. Likewise, the filling yarn **120** may be fabricated from fibers which have inherent copper ions added to the base material (e.g., PLA polymer, nylon or polyester yarn) of the master batch of the fiber slurry in the process disclosed in the '411 International Publication. Upon extrusion of the fiber, the copper ions are inherently part of the fiber.

**[0026]** In an embodiment, the fabric material **110** may be fabricated into pillow cases for covering, for example, the pillow **26** shown in FIG. 3, and a top sheet (not shown) for use with the fitted bed sheet fabric material **10** or **110**. In an embodiment, the plain weave of the fabric material **110** provides the same coefficient of friction on the face-side and the back-side. In an embodiment, the silver and copper ions of the filling yarns **118**, **120** have antimicrobial and healing properties which are equivalent to those provided by the five-harness filling satin weave of the fabric material **10**.

**[0027]** It should be appreciated that the present invention provides numerous advantages over the prior art discussed above. For instance, the fitted bed sheet **22** mitigates the formation of pressure ulcers and helps to heal existing pressure ulcers. More particularly, the fitted bed sheet **22** has a low coefficient of friction, and has antimicrobial agents that inhibit the development of micro-organisms, and has healing capabilities which are effective in reducing skin-born irritations. In an embodiment, the rayon used in the warp direction W possesses a low coefficient of friction and has significant absorption properties. In an embodiment, the absorption properties wick-away away moisture from the skin of the patient and contributes to the evaporation of moisture, which keeps the skin of the patient dry. This absorption prevents an environment conducive to bacterial growth and wicks odor-causing moisture from patients that are incontinent. In an embodiment, the rayon used in the warp yarn **16** in the warp direction W also has a natural cool feeling to the touch. This, in addition to its moisture wicking-action, assists in keeping the overall body temperature of the patient as cool as possible while resting or sleeping on the fitted bed sheet **22**. The fitted bed sheet **22** is also breathable and disposable at the end of its useful life. For instance, in an embodiment, if the fitted bed sheet **22** is constructed with rayon in the warp direction W, and PLA polymer, nylon or polyester yarn infused with copper and silver ions in the filling direction F, the material is 100% biodegradable. In another embodiment, if the fitted bed sheet **22** is constructed with rayon in the warp direction W and nylon or polyester infused with copper and silver ions in the filling direction F, it is compostable.

**[0028]** In an embodiment, silver ions, along with PLA polymer, nylon or polyester yarn, have antimicrobial properties which will inhibit the growth of bacteria on the surface of the fitted bed sheet **22** as well as on the skin of the patient, thereby minimizing or eliminating bacterial growth which is a contributing factor to the formation of pressure ulcers. Copper ions are known to be a healing agent. The combination of the silver ions and copper ions in the fitted bed sheet **22** provides both antimicrobial and healing properties. Because,

upon extrusion of the fiber, the silver ions are inherently part of the fiber of the filling yarn **18**, and the copper ions are part of the fiber of the filling yarn **20** (i.e., not just applied to their exterior surface), the antimicrobial and healing properties provided by the silver and copper ions will not wear away as the fitted bed sheet **22** is used and laundered over its useful life.

**[0029]** It should be noted that the present invention can have numerous modifications and variations. For instance, in an embodiment, the weave construction of the fabric material **10** may be provided with a float in the filling direction **F** which is less than 4 strands of warp yarn **16**. In an embodiment, the number of strands of the filling yarn **18** in the filling direction **F** may be greater or less than the number of strands of the filling yarn **20** in the filling direction **F**. In an embodiment, the strands in the filling direction may include only the filling yarn **18**. In an embodiment, the strands in the filling direction **F** may include only the filling yarn **20**. Examples of other weave construction that may be utilized in the fabric of the present invention (i.e., in addition to the 5-harness filling satin weave of the fabric material **10** and the plain weave of the material **110**) are twill weaves and sateen weaves. In an embodiment, the fabric materials **10**, **110** are scoured to remove any spin finish, oils, or foreign matter. In other embodiments, the addition of other conditioning substances, such as wet processing using cationic softeners, may also be applied to the fabric materials **10**, **110**. In an embodiment, the fabrics **10**, **110** are dried in a tenter frame and calendared to make the fabric materials **10**, **110** feel smoother. In other embodiments, the fabric materials **10**, **110** are inspected and rolled for subsequent processing of cutting according to end product specifications or applicable device dimensions.

**[0030]** It will be understood that the embodiment described herein is merely exemplary and that a person skilled in the art may make many variations and modifications without departing from the spirit and scope of the invention. For instance, all such variations and modifications, including those described hereinabove, are intended to be included within the scope of the invention and as defined in the appended claims.

What is claimed is:

1. A fabric material, comprising:
  - a plurality of strands of a warp yarn positioned in a warp direction;
  - a plurality of strands of a first filling yarn positioned in a filling direction, each of said plurality of strands of said first filling yarn being impregnated by silver ions; and
  - a plurality of strands of a second filling yarn positioned in said filling direction each of said plurality of strands of said second filling yarn being impregnated by copper ions,
 wherein said plurality of strands of said warp yarn are woven with said plurality of strands of said first filling yarn and said plurality of strands of said second filling yarn to form a face side and a back side opposite said face side, and
  - wherein each of said plurality of strands of said first filling yarn and each of said plurality of strands of said second filling yarn are woven alternately relative to one another with said plurality of strands of said warp yarn in said filling direction.
2. The fabric material of claim 1, wherein said fabric material includes a five-harness satin weave pattern.
3. The fabric material of claim 2, wherein said five-harness satin weave pattern is characterized by two of said plurality of

strands of said first filling yarn and two of said plurality of strands of said second filling yarn floating over four of said plurality of strands of said warp yarn on said face side.

4. The fabric material of claim 3, wherein said five-harness satin weave pattern is characterized by four strands of said plurality of strands of said warp yarn underlying two strands of said plurality of strands of said first filling yarn and two strands of said plurality of strands of said second filling yarn on said back side.

5. The fabric material of claim 4, wherein the coefficient of friction of said face side in said filling direction is less than the coefficient of friction of said back side in said filling direction.

6. The fabric material of claim 5, wherein said plurality of strands of said warp yarn are made of filament rayon.

7. The fabric material of claim 6, wherein said plurality of strands of said first filling yarn are made from PLA polymer, and said plurality of strands of said second filling yarn are made from PLA polymer.

8. The fabric material of claim 7, wherein said fabric material is antimicrobial, cool to the touch, and wickable.

9. The fabric material of claim 6, wherein said plurality of strands of said first filling yarn are made from nylon, and said plurality of strands of said second filling yarn are made from nylon.

10. The fabric material of claim 6, wherein said plurality of strands of said first filling yarn are made from polyester, and said plurality of strands of said second filling yarn are made from polyester.

11. The fabric material of claim 5, wherein said fabric material is adapted to be used as a bed sheet.

12. The fabric material of claim 1, wherein said fabric material includes a plain weave pattern.

13. The fabric material of claim 12, wherein the plain weave pattern is characterized by five strands of said plurality of strands of said warp yarn in said warp direction, and five alternating strands of said plurality of strands of said first filling yarn and said plurality of strands of said second filling yarn in said filling direction.

14. The fabric material of claim 13, wherein the coefficient of friction of said face side is approximately equal to the coefficient of friction of said back side.

15. The fabric material of claim 14, wherein said fabric material is adapted to be used as a pillow case.

16. The fabric material of claim 1, wherein said fabric material includes a twill pattern.

17. A method for making a fabric material, comprising the steps of:

weaving a plurality of strands of a warp yarn in a warp direction with a plurality of strands of a first filling yarn impregnated with silver ions in a filling direction and a plurality of strands of a second filling yarn impregnated with copper ions in said filling direction, wherein each of said plurality of strands of said first filling yarn and each of said plurality of strands of said second filling yarn are alternately woven with said plurality of strands of said warp yarn in said filling direction;

scouring said fabric material to remove external matter; conditioning said fabric material in order to soften it; drying said fabric material; and calendaring said fabric material to smoothen it.

18. The method of claim 17, wherein said conditioning step includes wet processing said fabric material using a cationic softener.