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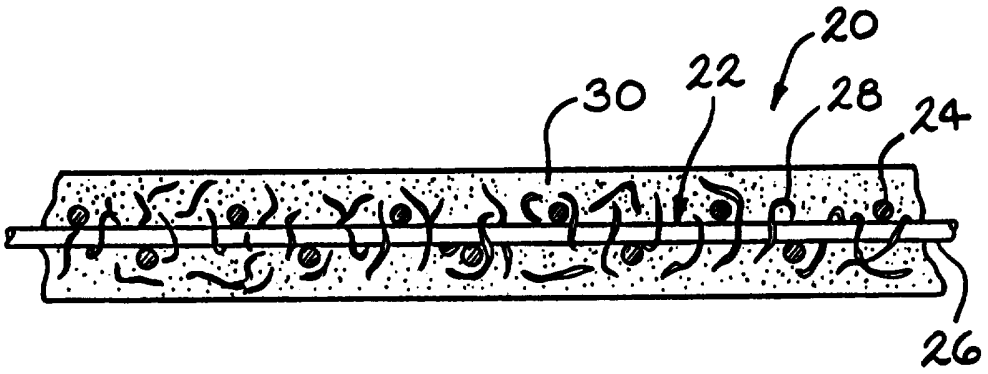

(57) Abstract

A conveyor belting (10, 20) having a broad spectrum antimicrobial agent associated therewith to inhibit bacterial growth and promote asepsis on the belting, is described. The antimicrobial agent may comprise a component of the polymeric mixture from which the synthetic yarns (12, 14, 24, 26) are made or the antimicrobial agent may be coated onto the yarns by drawing them through a bath comprising the antimicrobial agent, or by a spray coating technique and the like. Alternatively, the fabric for the belting may be made before the antimicrobial agent is associated therewith. Also, nonwoven bats of staple fibers may be woven to the fabric and the belting may be coated in an elastomeric admixture containing the antimicrobial agent. The belting of the present invention is particularly useful for conveying and transporting foods including food processing and food handling applications.

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BELTING HAVING ANTIMICROBIAL CHARACTERISTICS AND METHOD OF MANUFACTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to belting and methods of manufacture of belting. More particularly, the present invention relates to a conveyor belting having a broad spectrum antimicrobial agent associated therewith to inhibit bacterial growth and promote asepsis on the belting. The antimicrobial agent is preferably a chlorinated phenoxy incorporated into the polymeric material comprising the belting and it is released from the polymeric material over an extended period of time to inhibit bacterial growth and promote asepsis on the belting. Additionally, the antimicrobial agent is associated with the belting as a topical applicant sprayed or otherwise applied to the surface of the belting such as by drawing the belting through a bath of a synthetic polymeric admixture including the antimicrobial agent.

The belting of the present invention can comprise textile yarns formed of natural fibers, synthetic filaments or blends thereof and portions of the belting can be enveloped in an encapsulating material such as a matrix of polymeric material having the antimicrobial agent associated therewith. The belting of the present invention is particularly useful for conveying food grade products and articles intended for use in food processing.

2. Prior Art

Conveyor belting has been used extensively in the baking industry, in egg processing and other food related applications. For example, in the baking industry, raw dough is supported on conveyor belting and carried through the various processing steps to provide

a baked article that is further transported on the belting to the packaging operation. Another example, is the use of conveyor belting in collecting, sorting and packaging eggs.

Whenever conveyor belting comes into direct contact with foods including food processing and food handling applications, there is concern of bacteria, mold and fungus contaminating the food by contact with the belting. Similar concerns exist for belting used to transport articles that will subsequently be used to process and handle food grade products. There is therefore a need for a belting have associated therewith an antimicrobial agent that inhibits bacterial growth and promotes asepsis on the belting through extended wear, and that is safe for human contact. In that respect, the antimicrobial agent needs to be free of heavy metals, carcinogenic substances and any agents that are both harmful to the environment and are not suitable for human ingestion. As will be explained in detail presently, the conveyor belting of the present invention having the antimicrobial agent associated therewith meets this criteria.

The antimicrobial agent of the present invention has previously been provided as an additive incorporated into the elastomeric material in a pierced earring stand to disinfect the earring wires during storage (U.S. Patent No. 4,787,516 to Morrison); as a coating for metallic and non-metallic solid substrates (U.S. Patent No. 5,238,749 to Cueman et al.); and as a material incorporated into a surgical drape (U.S. Patent No. 5,069,907 to Mixon et al.). The disclosure of these patents are incorporated herein by reference. However, none of these prior art patents discloses the use of the present antimicrobial agent associated with a conveyor belting.

SUMMARY OF THE INVENTION

The present invention comprises a conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises: a plurality of substantially parallel textile yarns comprised of a polymeric material; and an antimicrobial agent associated with the textile yarns wherein the antimicrobial agent is provided as a topical applicant applied to an exposed surface of the textile yarns or is incorporated into the polymeric material thereof, the antimicrobial agent selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride, wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material comprising the yarns to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

Further, the present invention comprises a conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises: a plurality of substantially parallel textile yarns; a layer of fibrous material in the form of discrete staple fibers integrated with the yarns by entanglement of the staple fibers with the yarns and the staple fibers further being entangled together, the entanglements being of the character produced by a needling operation, wherein either or both the textile yarns and the staple fibers are comprised of a polymeric material; and an antimicrobial agent associated with either or both of the textile yarns and the staple fibers as a topical applicant applied to an

exposed surface thereof or incorporated into the polymeric material comprising the textile yarns and the staple fibers, wherein the antimicrobial agent is selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride and wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

Still further, the present invention comprises a conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises: a plurality of substantially parallel textile yarns;

an encapsulating material substantially enveloping the textile yarns, wherein either or both the textile yarns and the encapsulating material are comprised of a polymeric material; and

an antimicrobial agent associated with the textile yarns and the encapsulating material wherein the antimicrobial agent is provided as a topical applicant thereto or is incorporated into the polymeric material comprising the textile yarns and the encapsulating material to inhibit bacterial growth and promote asepsis on the belting, the antimicrobial agent being selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride, wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization

to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

Finally, the present invention comprises a method of manufacturing a conveyor belting having bacterial growth inhibiting and asepsis promoting characteristics, which comprises: providing a plurality of substantially parallel textile yarns comprising the belting, wherein the textile yarns are comprised of a polymeric material; and associating an antimicrobial agent with the textile yarns by applying the antimicrobial agent as a topical applicant applied to an exposed surface of the textile yarns or incorporating the antimicrobial agent into the polymeric material, wherein the antimicrobial agent is selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride and wherein with the antimicrobial agent incorporated into the polymeric material comprising the textile yarns, the antimicrobial agent exhibiting controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization, thereby continuously inhibiting bacterial growth and promoting asepsis on the exposed surface of the textile yarns comprising the belting.

These and other aspects of the present invention will become increasingly more apparent to those of ordinary skill in the art by reference to the following description and to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a plain weave belting 10 of the type intended to have associated therewith an antimicrobial agent according to the present invention.

Fig. 2 is a cross-sectional view along line 2-2 of Fig. 1.

Fig. 3 is a cross-sectioned, side elevational view of a portion of another type of conveyor belting 20 intended to have associated therewith the antimicrobial agent according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, Figs. 1 and 2 show an exemplary cloth that is useful in the manufacture of a belting 10 according to the present invention. It should be understood that the particular weave pattern of the cloth does not, in and of itself, constitute a part of the invention separate from the cloth having associated therewith an antimicrobial agent (not shown) that inhibits bacterial growth and promotes asepsis on the belting 10. In that regard, the belting 10 may be a woven or a knit cloth, or the belting may comprise non-woven cloths or batts.

The exemplary belting 10 shown in Figs. 1 and 2, comprises a plurality of lengthwise warp yarns 12 in a plain weave with crosswise weft yarns 14. The yarns 12, 14 may be selected from a wide variety of synthetic yarns such as polyester, polyamide and like resin materials acceptable for use in contact with edible substances. Some of the yarns, whether it be the warp yarns 12 or the weft yarns 14, may be natural fiber yarns. In that case, the yarns not made of a synthetic material are of a natural material such as cotton jute, wool, silk and blends thereof. Also, the yarns 12,14 need not necessarily be provided in a weave such as the exemplary weave shown, but they can be provided in a knitted cloth or in a non-woven form, as is well known to those skilled in the art.

Preferably, the present antimicrobial agent is incorporated into the polymeric mixture from which the various belting components are made. Thus, in the yarns formed of synthetic materials there is incorporated

therein an effective amount of an antimicrobial biocidal or biostatic substance, such as a chlorinated phenoxy. It is further within the scope of the present invention that in use, the belting 10 having the antimicrobial agent incorporated therein is resistant to growth of fungus, yeast, viruses, and Gram-positive and Gram-negative bacteria including Staph, E coli, Klebsiella and Salmonella. The antimicrobial biocidal or biostatic substance, which is non-toxic, and free of heavy metal, is preferably the chlorinated phenoxy 5-chloro-2-(2,4-dichlorophenoxy) phenol. An alternative antimicrobial agent is PHMB - polyhexamethlyene biguanide hydrochloride. These compounds are sold by the Microban Products Company, Huntsville, N.C. Other chemical components having known antimicrobial biocidal or biostatic characteristics may also be used in the present invention.

The preferred method of associating the antimicrobial agent with the belting 10 is to incorporate it into the synthetic polymeric material prior to forming the yarns 12,14. In that respect, the antimicrobial agent in powder form is added as a component to the mixture comprising the synthetic polymeric material and preferably comprises from between about 0.05 percent to about 2.0 percent, by weight, of the mixture. More preferably, the antimicrobial biocidal or biostatic agent is from between about 0.1 percent to about 1.0 percent, by weight, of the synthetic polymer into which it is incorporated. The resulting synthetic polymeric admixture is extruded or spun to provide threads containing the antimicrobial agent, which threads are then formed into the yarns 12,14. Such forming techniques are well known to those skilled in the art.

In use, the antimicrobial agent migrates through the polymeric material to the exposed surface thereof

from the amorphous zones of the polymer until equilibrium of the antimicrobial agent's internal vapor pressure is reached. If the antimicrobial substance on the surface of the coating is removed by friction or other means, more antimicrobial agent will move to the surface until the agent's internal vapor pressure is once again at equilibrium. It has been found that the antimicrobial agent incorporated into a belting according to the present invention can withstand temperatures of up to about 350°F without losing its biocidal and brostatic properties.

Another method of associating the antimicrobial agent with the yarns 12, 14 is by drawing the yarns through a saturation bath comprising the antimicrobial agent in solution to thereby coat the yarns 12, 14 before they are knitted or woven into the cloth 10. Of course, the natural fibers can also be drawn through the saturation tank to completely saturate them with the antimicrobial agent. Alternatively, the yarns 12, 14, whether synthetic or natural or a combination thereof, can be knitted or woven into the cloth 10 and the cloth itself drawn through the saturation bath having the antimicrobial agent present in the solution. In either case, an exemplary saturation bath can comprise about 96.9% water, about 0.1% of an antifoaming agent and about 3.0% of the antimicrobial agent.

Fig. 3 is an enlarged cross-sectioned side elevational view showing another embodiment of a belting 20 according to the present invention having the antimicrobial agent associated therewith. The belting 20 consists of a woven scrim 22 including lengthwise warp yarns 24 which are preferably synthetic textile yarns and crosswise weft yarns 26 which may be of a synthetic polymeric material or of natural fibers. Integrated with the scrim 22 is a distinct layer of a plurality of staple fibers 28 such as polyester fibers

needled to scrim 22. In that respect, discrete staple fibers 28 such as presented in a non-woven fibrous batt, are needled to the scrim 22. This forms a dense, fibrous layer (for illustration purposes, only a few fibers 28 are shown in Fig. 3) entangled with scrim 22. The batts may be of randomly oriented staple fibers such as synthetic polyamide, polyester, polyolefin, acrylic and like fibers including blends thereof and natural fibers such as cotton jute, wool, silk and blends thereof. Optionally, if desired, the fibers may be directionally oriented within the batts by methods known to the art. The fibrous batts are needled to only one side of the scrim 22 to form a layer of consolidated staple fibers 28, which through entanglement with the yarns 24,26 become integrated therewith, or fibrous batts are needled to both sides of the scrim 22 to produce a thicker needled cloth. The techniques of needling fibrous batts to cloths woven or knitted from textile yarns are well known and details need not be recited here.

The thrusly needled cloth can then be saturated with a plastisol formulation comprising the antimicrobial agent by drawing the fabric through a saturation bath. An exemplary bath comprises the antimicrobial agent in powder form added as a component to a mixture comprising from between about 0.05 percent to about 2.0 percent, by weight, of the mixture. More preferably, the antimicrobial brocidal or brostatic agent is from between about 0.1 percent to about 1.0 percent, by weight, of the saturation bath into which it is incorporated. An exemplary formulation for the saturation bath comprises about 47.0% dispersion grade PVC resin, about 48.0% polymeric ester plasticizer, about 2.0% TiO_2, about 0.4% chlorinated phenoxy, about 0.5% thermo-stabilizers and about 2.1% $CaCO_3$, by weight.

If desired, the scrim 22 and entangled staple fibers 28 are then completely encapsulated in a matrix of a polymeric elastomeric resin 30 having the present antimicrobial agent mixed therein. Preferably, the needled material is saturated with a liquid, non-cellular elastomer forming, synthetic, polymeric resin 30 containing the present antimicrobial agent. This may be carried out by dipping the cloth material into a bath of the liquid resin 30 incorporating the present antimicrobial agent. In that respect, the antimicrobial agent in powder form is added as a component to a mixture comprising the polymeric resin 30 with the antimicrobial agent present from between about 0.05% to about 2.0%, by weight of the mixture, and more preferably from between about 0.1% to about 1.0%, by weight. An exemplary formulation for the polymeric resin 30 comprises about 86% nitrial latex, about 0.5 NH_4OH, about 0.2% butyl zimate, about 0.3% sulfur, about 2.0% ZnO, about 10.0% TiO_2 and about 1.0% 5-chloro-2-(2,4-dichlorophenoxy) phenol, by weight.

It will be appreciated that a single dipping may suffice for saturating some materials, while multiple dippings with intermittent squeezing or partial drying steps may be required to fully saturate dense fibrous layers in other needled cloths.

A wide range of liquid resin saturants may be employed. Representative are the liquid precursors for polyurethane, polyvinyl chloride, neoprene, styrene-butadiene and like non-cellular polymeric resins. A particularly preferred liquid saturant are the liquid carboxylated acrylonitrile-butadiene latex resins. The acrylonitrile-butadiene copolymer elastomers formed from them are highly flexible, crack-resistant even at low temperatures and they form strong bonds with the textile components of the cloths comprising the conveyor belting 20 of the present invention. Liquid resins without

carriers and or solvents may be used. However, the latex employing a water carrier is advantageous. Liquid saturants employing organic solvents and carriers can also be employed as those skilled in the art will appreciate.

Desirably, the saturation of the needled cloth provides high loading of the antimicrobial agent containing polymer 30 to substantially penetrate the textile cloth so as to encapsulate the individual staple fibers 28 forming the consolidated layer and scrim 22 formed of the yarns 24 and 26. Advantageously, voids in the textile cloth are filled with the polymer 30 so that the polymeric material is distributed throughout the body of the conveyor belting. For a more detailed description of a belting made according to the exemplary one shown in Fig. 3, reference is made to U.S. Patent No. 4,154,335 to Burnett, which is assigned to the assignee of the present invention and incorporated herein by reference.

In use, the antimicrobial agent is released from the elastomeric material 30 over an extended period of time to inhibit viral and bacterial growth including the growth of fungus, yeast, viruses, and Gram-positive and Gram-negative bacteria including Staph, E coli, Klebsiella and Salmonella on the belting according to the present invention. Thus, as the surface layer of the belting materials having the antimicrobial agent incorporated therein wears away, the antimicrobial agent migrates through the polymeric resin 30 to the exposed surface thereof from the amorphous zones of the polymer until equilibrium of the antimicrobial agent's internal vapor pressure is established. That way, the belting 20 according to the present invention has a self-rejuvenation character that enables it to be subjected to extended usage without diminishing its biocidal and brostatic properties.

Those skilled in the art will appreciate that many modifications may be made to the above-described preferred embodiments without departing from the spirit and the scope of the invention. For example, the beltings according to the present invention may be coated with other materials having the present antimicrobial agent incorporated therein. For example, the individual yarns before they are woven or otherwise provided in the illustration cloths, may be coated with polyurethane, polyvinyl chloride, polytetrafluoroethylene, silicone rubber, and like polymer coatings having one or a combination of the above mentioned antimicrobial agents contained therein. The coating may be done by drawing the yarns through a bath or by spraying the yarns to provide the resulting belting with biocidal and biostatic characteristics.

Whether the vehicle for associating the antimicrobial agent with the present conveyor belting is the yarns formed into a woven, non-woven or knitted cloth, batts of staple fibers needled to a scrim or an encapsulating synthetic polymeric material, the antimicrobial agent present at the contact surface promotes asepsis on the belting. This makes the belting of the present invention having the antimicrobial agent incorporated therein particularly-well suited for use in many food handling applications, including poultry and egg, red meat, fruits and vegetables, and baking.

The belting of the present invention having the antimicrobial agent incorporated therein is illustrated further by the following examples.

EXAMPLE I

Beltings according to the present invention were manufactured from cloth woven having a single scrim and indicated as Belts A to C, drawn through a saturation

bath including water and an antifoaming agent and a chlorinated phenoxy additive. The chlorinated phenoxy additive comprised 5-chloro-2-(2,4-dichlorophenoxy) phenol present in the amounts by weight as listed in Table 1.

TABLE 1

Belt	% chlorinated phenoxy by weight	Zone of inhibition (mm) S. aureus	K. pneumoniae
A	untreated	no inhibition	
B	0.36	19 mm	13 mm
C	1.08	20 mm	15 mm
D	1.26	18 mm	12 mm
E	0.31	22 mm	21 mm

Belt samples measuring about 25 mm x 50 mm were then placed in a Petri dish containing either Staphylococcus aureus or Klebsiella pneumoniae in a nutrient broth and incubated at 37°C for 18 to 24 hours. The radius of the resulting zone of inhibition of growth extending outwardly about the perimeter of the various belt samples is listed in Table 1. The belt indicated as Belt A was not drawn through the antimicrobial saturation bath and it served as a control.

EXAMPLE II

Beltings according to the present invention were manufactured having a single scrim with a layer of consolidated staple fibers and indicated as Belts F to H. These belts were drawn through a saturation bath of water and an antifoaming agent and a chlorinated phenoxy additive. The chlorinated phenoxy additive comprised 5-chloro-2-(2,4-dichlorophenoxy) phenol present in the amounts, by weight, as listed in Table 2. Further, single scrim belting having a layer of consolidated staple fibers encapsulated in a matrix of an elastomeric resin and indicated as Belts I to K were made. The resin admixture included about 86.0% nitrial latrex, about 0.5% NH_4OH, about 0.2% butyl zimate, about 0.3% sulfur, about 2.0% ZnO, balance TiO_2 and chlorinated phenoxy,

amounts, by weight, as listed in Table 2. Further, single scrim belting having a layer of consolidated staple fibers encapsulated in a matrix of an elastomeric resin and indicated as Belts I to K were made. The resin admixture included about 86.0% nitrial latrex, about 0.5% NH_4OH, about 0.2% butyl zimate, about 0.3% sulfur, about 2.0% ZnO, balance TiO_2 and chlorinated phenoxy, by weight. The chlorinated phenoxy additive comprised 5-chloro-2-(2,4-dichlorophenoxy) phenol present in the amounts, by weight as listed in Table 2.

TABLE 2

Belt	% chlorinated phenoxy by weight	Zone of inhibition (mm) S. aureus	K. pneumoniae
F	untreated	no inhibition	
F, smooth side	untreated	no inhibition	
G	1.0%	2 mm	2 mm
G, smooth side	1.0%	2 mm	2 mm
H	2.0%	4 mm	3 mm
H, smooth side	2.0%	5 mm	4 mm
I	untreated	no inhibition	
I, smooth side	untreated	no inhibition	
J	0.625%	6 mm	7 mm
J, smooth side	0.625%	11 mm	7 mm
K	1.25%	11 mm	6 mm
K, smooth side	1.25%	16 mm	9 mm

Belt samples measuring about 25 mm x 50 mm were then placed in a Petri dish containing either Staphylococcus aureus or Klebsiella pneumoniae in a nutrient broth and incuabated at 37°C for 18 to 25 hours. The radius of the resulting zone of inhibition of growth extending outwardly about the perimeter of the various belt samples is listed in Table 2. For each belt, both the side of the belting having the staple fibers consolidated therewith and the smooth side of the scrim not have consolidated staple fibers are indicated.

From the following examples, it is readily apparent to those skilled in the art that the present invention accomplishes its states objects. However, it is intended that the foregoing description be only

illustrative of the present invention and that the present invention be only limited by the hereinafter appended claims.

What is claimed is:

1. A conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises:

a) a plurality of substantially parallel textile yarns comprised of a polymeric material; and

b) an antimicrobial agent associated with the textile yarns wherein the antimicrobial agent is provided as a topical applicant applied to an exposed surface of the textile yarns or is incorporated into the polymeric material thereof, the antimicrobial agent selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride, wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material comprising the yarns to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

2. The belting of claim 1 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

3. The belting of claim 1 wherein the textile yarns are incorporated as yarns in a cloth.

4. The belting of claim 2 wherein the textile yarns are warp yarns extending in a lengthwise direction of a knitted cloth.

5. The belting of claim 3 wherein the textile yarns are warp yarns extending in a lengthwise direction of a woven cloth.

6. The belting of claim 1 wherein the antimicrobial agent is present in the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

7. A conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises:

a) a plurality of substantially parallel textile yarns;

b) a layer of fibrous material in the form of discrete staple fibers integrated with the yarns by entanglement of the staple fibers with the yarns and the staple fibers further being entangled together, the entanglements being of the character produced by a needling operation, wherein either or both the textile yarns and the staple fibers are comprised of a polymeric material; and

c) an antimicrobial agent associated with either or both of the textile yarns and the staple fibers as a topical applicant applied to an exposed surface thereof or is incorporated into the polymeric material comprising the textile yarns and the staple fibers, wherein the antimicrobial agent is selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride and wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material to the exposed surface thereof when an imbalance

of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

8. The conveyor belting of claim 7 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

9. The conveyor belting of claim 7 wherein the textile yarns comprise warp yarns extending in a lengthwise direction of the belting and wherein a plurality of weft yarns extend perpendicular to the warp yarns to thereby form a woven or knitted cloth comprising the belting.

10. The conveyor belting of claim 8 wherein the weft yarns are comprised of the polymeric material having the antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

11. The conveyor belting of claim 7 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to one side of the cloth.

12. The conveyor belting of claim 7 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to each side of the cloth.

13. The conveyor belting of claim 7 wherein the textile yarns are comprised of polyester having the antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

14. The conveyor belting of claim 7 wherein the staple fibers are comprised of polyester having the

antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

15. The conveyor belting of claim 9 wherein a matrix of polymeric material substantially encapsulates both the cloth and the layer of fibrous material, the matrix of the polymeric material having the antimicrobial agent either applied as the topical applicant thereto or incorporated therein and wherein when the antimicrobial agent is incorporated into the matrix of polymeric material, the antimicrobial agent exhibits controlled migration through the matrix to an exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization.

16. The conveyor belting of claim 15 wherein the encapsulated fibrous material has an outer section provided with an abraded finish that serves to wear away a surface portion of the polymeric material to a generally uniform depth to expose end portions of the fibrous material.

17. The conveyor belting of claim 7 wherein the antimicrobial agent is present in the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

18. A conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises:

a) a plurality of substantially parallel textile yarns;

b) an encapsulating material substantially enveloping the textile yarns, wherein either or both the textile yarns and the

encapsulating material are comprised of a polymeric material; and

c) an antimicrobial agent associated with the textile yarns and the encapsulating material wherein the antimicrobial agent is provided as a topical applicant thereto or is incorporated into the polymeric material comprising either or both of the textile yarns and the encapsulating material to inhibit bacterial growth and promote asepsis on the belting, the antimicrobial agent being selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride, wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

19. The conveyor belting of claim 18 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

20. The conveyor belting of claim 18 wherein the textile yarns comprise warp yarns extending in a lengthwise direction of the belting and wherein a plurality of weft yarns extend perpendicular to the warp yarns to thereby form a woven or knitted cloth comprising the belting.

21. The conveyor belting of claim 20 wherein the weft yarns are comprised of the polymeric material having the

antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

22. The conveyor belting of claim 18 wherein a layer of fibrous material in the form of discrete staple fibers is integrated with the textile yarns by entanglement of the staple fibers with the yarns and the staple fibers further being entangled together, the entanglements being of the character produced by a needling operation and wherein the matrix of polymeric material having the antimicrobial agent associated therewith encapsulates both the textile yarns and the integrated staple fibers.

23. The conveyor belting of claim 22 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to one side of the cloth.

24. The conveyor belting of claim 22 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to each side of the cloth.

25. The conveyor belting of claim 22 wherein the staple fibers are comprised of polyester having the antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

26. The conveyor belting of claim 18 wherein the antimicrobial agent is present in the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

27. A conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises:

a) a plurality of substantially parallel warp yarns extending in a lengthwise direction of the belting;

b) a plurality of weft yarns extending perpendicular to the warp yarns to thereby form a woven or knitted cloth comprising the belting;

c) a layer of fibrous material in the form of discrete staple fibers integrated with the cloth by entanglement of the staple fibers with the yarns and the staple fibers further being entangled together, the entanglements being of the character produced by a needling operation, wherein at least one of the warp yarns, the weft yarns and the staple fibers are comprised of a polymeric material; and

d) an antimicrobial agent associated with at least one of the warp yarns, the weft yarns and the staple fibers as a topical applicant applied to the surface thereof or is incorporated into the polymeric material, the antimicrobial agent being selected from the group consisting of a chlorinated phenoxy and polyhexamethyl biguanide hydrochloride and wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

28. The conveyor belting of claim 27 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

29. The conveyor belting of claim 27 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to one side of the cloth.

30. The conveyor belting of claim 27 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to each side of the cloth.

31. The conveyor belting of claim 27 wherein the yarns are comprised of polyester having the antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

32. The conveyor belting of claim 27 wherein the staple fibers are comprised of polyester having the antimicrobial agent incorporated therein.

33. The conveyor belting of claim 27 wherein the antimicrobial agent is present in the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

34. A conveyor belting having antimicrobial characteristics that inhibit bacterial growth and promote asepsis on the belting, which comprises:

a) a plurality of substantially parallel warp yarns extending in a lengthwise direction of the belting;

b) a plurality of weft yarns extending perpendicular to the warp yarns to thereby form a woven or knitted cloth comprising the belting;

c) a layer of fibrous material in the form of discrete staple fibers integrated with the yarns by entanglement of the staple fibers with the yarns and the staple fibers further being entangled together, the entanglements being of the character produced by a needling operation;

d) an encapsulating material substantially enveloping the cloth including the layer of fibrous material integrated with the yarns, wherein at least one of the warp yarns, the weft yarns, the staple fibers and the encapsulating material are comprised of a polymeric material; and

e) an antimicrobial agent associated with at least one of the warp yarns, the weft yarns, the staple fibers and the encapsulating material as a topical applicant applied to an exposed surface thereof or is incorporated into the polymeric material, the antimicrobial agent being selected from the group consisting of a chlorinated phenoxy and polyhexamethyl biguanide hydrochloride and wherein when the antimicrobial agent is incorporated into the polymeric material, the antimicrobial agent exhibits controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization to thereby continuously inhibit bacterial growth and promote asepsis on the belting.

35. The conveyor belting of claim 34 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

36. The conveyor belting of claim 34 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to one side of the cloth.

37. The conveyor belting of claim 34 wherein the layer of fibrous material is produced by needling a batt of the staple fibers to each side of the cloth.

38. The conveyor belting of claim 34 wherein the yarns are comprised of polyester having the antimicrobial agent either applied as the topical applicant thereto or incorporated therein.

39. The conveyor belting of claim 34 wherein the staple fibers are comprised of polyester having the antimicrobial agent incorporated therein.

40. The conveyor belting of claim 34 wherein the encapsulated fibrous material has an outer section provided with an abraded finish that serves to wear away a surface portion of the polymeric material to a generally uniform depth to expose end portions of the fibrous material.

41. The conveyor belting of claim 34 wherein the antimicrobial agent is present in the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

42. A method of manufacturing a conveyor belting having bacterial growth inhibiting and asepsis promoting characteristics, which comprises:

a) providing a plurality of substantially parallel textile yarns comprising the belting, wherein the textile yarns are comprised of a polymeric material; and

b) associating an antimicrobial agent with the textile yarns by applying the antimicrobial agent as a topical applicant applied to an exposed surface of the textile yarns or incorporating the antimicrobial agent into the polymeric material, wherein the antimicrobial agent is selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride and wherein with the antimicrobial agent incorporated into the polymeric material comprising the textile yarns, the antimicrobial agent exhibiting controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization, thereby continuously inhibiting bacterial growth and promoting asepsis on the exposed surface of the textile yarns comprising the belting.

43. The method of claim 42 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

44. The method of claim 42 wherein incorporating the textile yarns as yarns in a cloth.

45. The method of claim 42 wherein incorporating the textile yarns as warp yarns extending in a lengthwise direction of a knitted cloth.

46. The method of claim 42 wherein incorporating the textile yarns as warp yarns extending in a lengthwise direction of a woven cloth.

47. The method of claim 42 wherein incorporating the antimicrobial agent into the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

48. A method of manufacturing a conveyor belting having bacterial growth inhibiting and asepsis promoting characteristics, which comprises:

a) providing a plurality of substantially parallel textile yarns;

b) integrating a layer of fibrous material in the form of discrete staple fibers with the textile yarns by entanglement of the staple fibers with the yarns and further entangling the staple fibers together, the entanglements being of the character produced by a needling operation wherein either or both the textile yarns and the staple fibers are comprised of a polymeric material; and

c) associating an antimicrobial agent with either or both the textile yarns and the staple fibers by applying the antimicrobial agent as a topical applicant applied to an exposed surface thereof or incorporating the antimicrobial agent into the polymeric material comprising either or both the textile yarns and the staple fibers, wherein the antimicrobial agent is selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride and wherein with the antimicrobial agent incorporated into the polymeric material comprising either or both the textile yarns and the staple fibers, the antimicrobial agent exhibiting controlled migration through the polymeric material to the exposed surface

thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization, thereby continuously inhibiting bacterial growth and promoting asepsis on the belting.

49. The method of claim 48 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

50. The method of claim 48 wherein incorporating the textile yarns as yarns in a cloth.

51. The method of claim 48 wherein incorporating the textile yarns as warp yarns extending in a lengthwise direction of a knitted cloth.

52. The method of claim 48 wherein incorporating the textile yarns as warp yarns extending in a lengthwise direction of a woven cloth.

53. The method of claim 48 wherein integrating the staple fibers with the textile yarns includes needling a batt of the staple fibers to one side of the cloth to provide the layer of fibrous material.

54. The method of claim 48 wherein integrating the staple fibers with the textile yarns includes needling a batt of the staple fibers to each side of the cloth to provide the layer of fibrous material.

55. The method of claim 48 wherein incorporating the antimicrobial agent into the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

56. A method of manufacturing a conveyor belting having bacterial growth inhibiting and asepsis promoting characteristics, which comprises:

a) providing a plurality of substantially parallel textile yarns;

b) enveloping the textile yarns in an encapsulating material, wherein either or both the textile yarns and the encapsulating material are comprised of a polymeric material; and

c) associating an antimicrobial agent with either or both the textile yarns and the encapsulating material by applying the antimicrobial agent as a topical applicant applied to an exposed surface thereof or incorporating the antimicrobial agent into the polymeric material comprising either or both of the textile yarns and the encapsulating material, wherein the antimicrobial agent is selected from the group consisting of a chlorinated phenoxy and polyhexamethylene biguanide hydrochloride and wherein with the antimicrobial agent incorporated into the polymeric material comprising either or both the textile yarns and the encapsulating material, the antimicrobial agent exhibiting controlled migration through the polymeric material to the exposed surface thereof when an imbalance of vapor pressure of the antimicrobial agent demands equalization, thereby continuously inhibiting bacterial growth and promoting asepsis on the belting.

57. The method of claim 56 wherein the chlorinated phenoxy is 5-chloro-2-(2,4-dichlorophenoxy) phenol.

58. The method of claim 56 wherein incorporating the textile yarns as yarns in a cloth.

59. The method of claim 56 wherein incorporating the textile yarns as warp yarns extending in a lengthwise direction of a knitted cloth.

60. The method of claim 56 wherein incorporating the textile yarns as warp yarns extending in a lengthwise direction of a woven cloth.

61. The method of claim 56 wherein incorporating the antimicrobial agent into the polymeric material in an amount of between about 0.05 percent to about 2.0 percent by weight of the mixture.

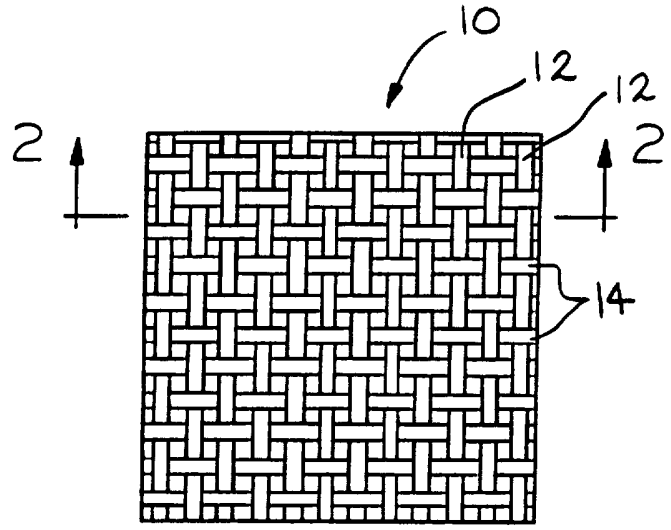

FIG. 1

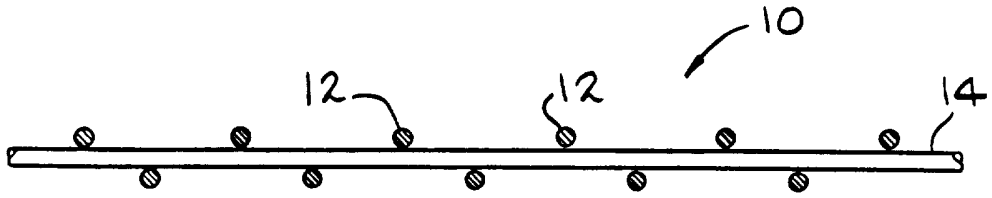

FIG. 2

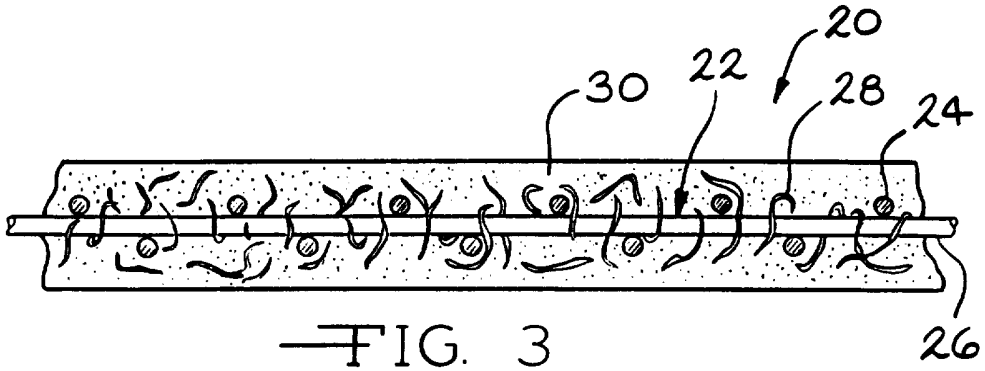

FIG. 3

INTERNATIONAL SEARCH REPORT

Int. ational application No.
PCT/US96/00417

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B65G 15/30
US CL :198/844.1

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)

U.S. : 198/844.1,'195,500,846,847,957

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 4,267,776 (Wilson et al) 21 April 1981 (21.04.81) ALL	1-61
A	US,A, 4,897,202 (King) 30 January 1990 (30.01.90) ALL	1-61
T	US,A, 5,495,935 (Zabron et al) 05 March 1996 (05.03.96) ALL	1-61

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
05 JUNE 1996	01.07.96
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Joseph E. Valenza Telephone No. (703) 308-1113

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