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METHODS AND SOLUTIONS FOR TREATING FIBERS AND PRODUCTS RESULTING THEREFROM

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This invention relates to high quality felt hats having the richness of texture and feel of all-fur felt hats, to methods of making the same, and to solutions and methods of treating fibers therefor.

Heretofore cotton, rayon and other nonfelting fibers have sometimes been used to achieve ornamental effects in fur felt hats. However, only very small percentages of such nonfelting fibers could be used, inasmuch as such fibers have not been truly interfelted therewith.

There have also been efforts to make stratified hats from superposed hat bats, as for example, a fur-wool-fur sandwich hat bat. During the motion, heat and pressure working of such superposed hat bats, adverse reactions have taken place. In fact such grossly unsatisfactory hats are produced from such superposed hat bats that so far as could be determined no attempt has been made to industrially produce such hats notwithstanding the several old literature references thereto. There is a tendency for the superposed bats to separate from each other instead of thoroughly felt together. Even if the strata do not entirely separate, the superposed bats tend to blister, fall to pieces and/or grossly lack tensile strength.

It is an important object of the present invention to provide a method of making a high quality felt hat characterized by a dissimilar central layer disposed between and interfelted with two similar outer layers.

A further important object of certain embodiments of the present invention is to provide a method of felting mixtures comprising substantial amounts of fibers ordinarily classified as non-felting fibers.

A very important object is to enable the replacement of limited and now hard to obtain foreign furs with unlimited and readily available domestic fibers such as cotton for felt.

A further object is to provide a method of chemically treating fibers, and to provide new products resulting therefrom.

Additional objects are: to provide a felt having most of the desirable characteristics of an all-fur felt but including substantial amounts of other fibers such as fibers cheaper than fur; and to provide a method of making a high-quality fur-type hat on fur-hat making machinery at a substantially lower cost than heretofore.

An important feature of the present invention is the provision of a sandwich or composite felt including a dissimilar central layer disposed be-

tween and interfelted with two similar outer layers.

A further important feature of certain embodiments of the present invention is the provision of a sandwich felt having a central layer of cotton or other ordinarily nonfeltable fiber. A feature of one embodiment is the provision of a fur-felt hat, 20-70% of which consists of a central layer of cotton.

10 An additional important feature of the present invention is the provision of a process of interiorizing fibers, that is, a process of treating fibers to impart interior-seeking characteristics thereto. The fibers resulting from said treatment are also a feature of the present invention.

15 A further feature of certain embodiments of the invention is the provision of a felt having most of the desirable characteristics of an all-fur felt but including substantial amounts of other fibers.

20 A further feature is the provision of chemically treating fibers to impart potential cohesiveness, adhesiveness and/or potential segmentizability.

25 Another feature is the provision of unlike fibers initially completely mixed together and in the final product in well defined layers.

Other objects and features will be apparent from a reading of the detailed description and claims.

30 The present invention is not limited to the details described herein, for the invention is capable of other methods of operation. Therefore, the phraseology used is for the purpose of description and not of limitation.

SUMMARY OF METHOD OF MAKING HATS

40 According to the present invention a hat bat is prepared from a thoroughly mixed blend of interior-seeking fibers and exterior-seeking fibers (both prepared as described hereinafter). Particular attention is directed to this fact because it is believed that the prior art is totally lacking of any teaching of a method of making a sandwich felt which includes the step of starting with a uniformly mixed blend of fibers.

45 Especially satisfactory results are obtained by utilizing from 70 to 75 parts of exterior-seeking fibers and from 25 to 30 parts of interior-seeking fibers, on the basis of 100 parts by weight of the blend. However, up to 70 parts of interior-seeking fibers may be utilized if desired with the remainder exterior-seeking fibers. Although the present sandwich felts are preferably made from blends of only exterior-seeking fibers and in-

terior-seeking fibers, some uniformly dispersing fibers (prepared as described hereinafter) may be used, in which event, preferably not more than 30 parts of uniformly dispersing fibers are added to each 100 parts of the blended interior-seeking and exterior-seeking fibers.

The thoroughly mixed blend of interior-seeking fibers and exterior-seeking fibers may be sucked upon a cone and formed into a hat bat in the conventional manner and with conventional apparatus. During the conventional starting, hardening, shrinking and felting operations on this special hat bat, the motion, heat, moisture and pressure cause all or nearly all interior-seeking fibers to migrate to the interior or center of the felt, and cause all or nearly all exterior-seeking fibers to migrate toward the exterior. The migrations are not so complete as to destroy the intertwinning and interfelting between the interior-seeking fibers and the exterior-seeking fibers. Accordingly, the present invention is distinguishable from the previously described dividing superposed bats resulting from futile efforts to make hats from superposed hat bats having strata of dissimilar fibers.

The product resulting from the present invention is a sandwich or composite felt having a dissimilar central layer disposed between and interfelted with two similar outer layers. The existence of the sandwich structure can be proven in many ways. One of the most effective methods is to originally blend interior-seeking fibers dyed one color and exterior-seeking fibers dyed another color. Then the absence of strata in the originally formed hat bat and the presence of strata in the felted hat of the present invention can be recognized by an ordinary observer and/or established by color analysis. Cross-sectional cuts in the felted hat of the present invention clearly disclose the differently colored central layer; or, one of the outer layers of the felted hat can be removed by sandpapering or the like, thereby disclosing the differently colored central layer.

The central layers of the felted hats of the present invention are generally characterized by having significant amounts of short fibers, such as fibers from .1 mm. to 3 mm. The central layers of the felted hats of the present invention are also characterized by having clusters. These clusters include bunches of interior-seeking fibers securely cohered together. Under the microscope, the clusters appear to be the result of a plastic fusion of the circumferential surface of the interior-seeking fibers. The central layers of the present invention are distinguishable from the central layers of ordinary fur-felt not only because of the fragmentation and clustering discussed above but also by other physical and/or chemical characteristics. For example, the fibers of the central layer are ordinarily more friable and more cohesive than fibers of ordinary felt.

Inasmuch as the fibers are of small size and inasmuch as the art of interiorizing is new, the theory of operation is somewhat speculative. It should be noted that highly advantageous results (e. g. a sandwich felt from a thoroughly mixed blend) are attained regardless of the correctness of the theory of operation. The pressure working may be utilized alone, but the heat and moisture with the pressure helps.

PREPARATION OF INTERIOR-SEEKING (INTERIORISTIC) FIBERS

Several species of methods of preparing in-

terior-seeking fibers have been developed and proven satisfactory.

SPECIES I—THE ACID-CHLORITE TREATMENT

A method of imparting interior-seeking characteristics to fibers consists of the steps of: (1) optionally first cleaning the fiber; (2) subjecting the fiber to a strong acid, such as a 5-15% (desirably 10%) solution of technical (32%) hydrochloric acid or a solution of sulfuric acid, or the like; (3) subjecting the fiber to a 1-6% (desirably 3%) solution of a soluble chlorite, such as sodium chlorite (NaClO_2), potassium chlorite (KClO_2), and/or ammonium chlorite (NH_4ClO_2); and (4) drying the fiber. Although the control and results are not as satisfactory, it is possible to subject the fiber to a single bath including both the acid and the chlorite.

The timing, temperature, pressure and other operating conditions are not critical, but depend partly upon the nature of the fiber and other variables customarily encountered and solved by those skilled in the fiber-treatment art. The fibers are left in the acid long enough for the acid to penetrate into the fiber, but not long enough to adversely decompose the same. For example, cotton may be subjected to the acid for one minute at room temperature. Similarly, the fiber may be subjected to the chlorite for approximately one minute at room temperature. Temperatures substantially in excess of 212° F. are desirably avoided during the drying operation.

SPECIES II—THE ACID-ACTIVATOR TREATMENT

A less expensive and single bath treatment for interiorizing certain kinds of fibers consists of the steps of: (1) preferably cleaning the fibers; (2) subjecting the fibers to a solution consisting essentially of water, an acid and a cation activator; and (3) drying the fibers. A solution consisting of:

	Per cent
Water	84.84
Technical (32%) hydrochloric acid	15.00
Diethylene glycol	.15
Sapamine NS	.01

has been found satisfactory. Sapamine NS is a quarternary amine salt of diethyl, diaminoethyl, oleylamide hydro-acetate. Sapamine NS is sold by the Ciba Chemical Company of New York City. Other cation activators which have proven satisfactory include Onyxsan (a tertiary ammonium salt hydroacetate) sold by Onyx Chemical Company of Bayonne, New Jersey, and Ultramine A, sold by the Ultra Chemical Company of Paterson, New Jersey.

The operating conditions for Species II are in general as explained in connection with Species I; however, the fibers are desirably subjected to the single solution for one minute or less.

SPECIES III—THE ACID-PEROXIDE TREATMENT

Another method of interiorizing fibers consists of subjecting the fibers to a solution including an acid and an oxidizing agent. For example any of the following solutions may be used:

Example a	Cc
Hydrochloric acid	10X
Hydrogen peroxide	15X
Water	25X

Example b

Hydrochloric acid.....	Cc.
Hydrogen peroxide.....	50
Water.....	150
	300

Example c

Hydrochloric acid.....	Cc.
Hydrogen peroxide.....	100
Water.....	100
	300

Example d

Hydrochloric acid.....	Cc.
Hydrogen peroxide.....	100
Water.....	200
	200

Example e

Hydrochloric acid.....	Cc.
Hydrogen peroxide.....	100
Water.....	200
	200

The hydrochloric acid is technical (32%) acid, and the hydrogen peroxide is 100 volume peroxide. The fibers are desirably subjected to the solution for about two minutes.

OTHER SPECIES OF INTERIORIZING TREATMENTS

So far as has been thus far determined, the interiorizing solution appears to be characterized by its results upon the fibers, and particularly in that it: (1) swells the fibers; (2) imparts potential friability to the fiber, so that the dried fiber is relatively more easily segmented by crushing forces; (3) imparts potential cohesiveness to the fiber, so that when the dried fibers are moistened, they pack like a snowball; and (4) imparts potential adhesiveness and feltability to said fibers whereby they serve to hold the outer layers of material to the center strata. It should be noted that highly advantageous results (e. g. a sandwich felt from a thoroughly mixed blend) are achieved by the present invention regardless of the correctness of the theory of operation. The solution ordinarily includes such powerful hydrolyzing agents (e. g. acids or alkalies) that if the fibers were left in the solution for a prolonged period of time, they would be noticeably decomposed; however, according to the present invention, the fibers are subjected to the interiorizing solution for only a relatively short time. An example of an additional species is the method of treating fibers which consists in the steps of: (1) preferably cleaning the fibers; (2) subjecting the fibers to a strong acid (e. g. sulfuric acid, or 15% of technical hydrochloric acid, or the like) for about four or five minutes; and (3) drying the fibers.

According to the present invention, synthetic, vegetable, animal and/or other fibers may be subjected to the interiorizing treatment. In any event, the fibers are preferably about $\frac{1}{2}$ " to 3" (desirably $\frac{3}{4}$ "') long and about 10 to 30 (desirably 18) microns in diameter. Cellulose acetate fibers have been successfully interiorized and felted into the center of a sandwich felt. Other synthetic fibers, such as nylon, rayon, casein, rayon, soy rayon, other rayons, and other organic filaments capable of being chemically modified to form somewhat gelatinous surfaces may also be interiorized according to the present invention.

Cotton is one of the most important vegetable fibers. Because of the great difference in the price of hatter's fur and cotton, (and because of

the abundance and the continuous ready availability of cotton) it has long been recognized that it would be desirable to make a high quality hat having most of the characteristics of an all-fur hat but including substantial amounts of cotton. This desideration is particularly marked at times such as World Wars I and II when normally extensively used foreign (European and Australian) fur is available in costly and only limited amounts. However, until the development of the present invention, no industrially satisfactory method of making such a hat was available. According to certain embodiments of the present invention, cotton is subjected to an interiorizing solution. Species I and II are particularly satisfactory. Other vegetable fibers which may be interiorized according to the present invention include linen, Palco (a trade name designating a fiber sold by Pacific Lumber Co., San Francisco, California, and believed to be made from the Sequoia tree), or the like.

Among the animal fibers which may be interiorized according to the present invention, wool (e. g. virgin, reused and/or reclaimed wool) is of particular importance. Wool is desirably treated according to Species I or III, inasmuch as Species II tend to adversely attack the wool. Mohair, silk, lama and other animal fibers might also be interiorized according to the present invention.

PREPARATION OF EXTERIOR-SEEKING FIBERS

The preferred exterior-seeking fibers of the present invention are hatter's fur, prepared from clipped rabbit pelts, beaver pelts, hare pelts, and/or coney pelt. A conventional carroting solution and method are preferably used in the preparation of the fur for felting. It is believed that the tip-carroting of the fur and the treatment of the entire interioristic fiber may be a part of the explanation of the sandwich structure. The present invention relates particularly to the making of high quality fur-felt hats; however, other sandwich felts such as wool felt hats can be made according to the present invention (e. g. a raw wool-interiorized cotton-raw wool sandwich felt) are believed to be within the scope thereof.

PREPARATION OF UNIFORMLY-DISPERSING FIBERS

Prolon fibers (e. g. casein fibers) having an acid pH, a length preferably of approximately $\frac{1}{2}$ " to 1", and a diameter of 15 to 30 microns, may be used as uniformly-dispersing fibers (viz. mixed with the interioristic and exterioristic fibers to be thoroughly intermingled and dispersed with the same initially and also after the stratified product is formed).

THEORY OF OPERATION

The exact reason why the interiorized fibers of the present invention migrate in large part to the center of a felt is not known, notwithstanding the fact that considerable research has been devoted to seeking an explanation. It may be: (1) because the interiorized fibers develop a surface cohesiveness and/or gel condition relatively greater than that of the exterior-seeking fibers (which probably forms a coherently and tenacious mass which during working oozes or forces the exterioristic fibers toward the outer sections and surfaces of the mass); (2) because the interiorized fibers possess a friability and/or ability

to segmentize relatively greater than the exterior-seeking fibers (which probably causes the same to form a compact mass which in turn forces the noninterioristic treated fibers to the outer surfaces); or (3) for other reasons not known.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

Having thus described the invention, what is claimed as new is:

1. The method of making composite sandwich-type felt hats, including the steps of preparing exterioristic fibers for felting; chemically treating interioristic fibers to impart center-seeking characteristics thereto; forming a bat with said interioristic and exterioristic fibers in a thoroughly and completely intermingled state throughout the thickness of the bat; and subjecting said bat to a pressure working until said thoroughly intermingled state of said bat is changed into a state wherein the exterioristic fibers are segregated into two well defined outer layers and the interioristic fibers are caused to seek and form a well defined single layer between said outer layers yet thoroughly felted therewith.

2. The method of making composite sandwich-type felt hats, including the steps of preparing exterioristic fibers for felting; chemically treating with a strong acid certain fibers to impart thereto segmentizing and cohesive properties relative to said exterioristic fibers, to give them interioristic characteristics; forming a bat with said interioristic and exterioristic fibers in a thoroughly and completely intermingled state throughout the thickness of the bat; and subjecting said bat to a pressure working until said thoroughly intermingled state of said bat is changed into a state wherein the exterioristic fibers are segregated into two well defined outer layers and the interioristic fibers are caused to seek and form a well defined single layer between said outer layers yet thoroughly felted therewith.

3. The process of making a composite felt including the steps of chemically treating fibers to impart center-seeking characteristics thereto; conditioning fur fibers for felting; forming a bat with all of said fibers thoroughly and completely intermingled throughout the thickness thereof; and subjecting said bat to heat, moisture and pressure working until said fur fibers are in large part driven to the exterior of the felt and the other fibers are in large part driven to the center of the thickness of the felt.

4. The process of making a composite felt including the steps of subjecting fibers to an acid and an oxidizing agent to impart center-seeking characteristics thereto; carroting hatter's pelts; cutting carroted fur fibers from the pelts; preparing a bat with all of said fibers thoroughly and completely intermingled throughout the thickness thereof; and subjecting said bat to heat, moisture and pressure working until said fur fibers are in large part driven to the exterior of the felt and the other fibers are in large part driven to the center of the thickness of the felt.

5. The process of making a composite felt including the steps of chemically treating with a strong acid certain fibers to impart considerable friability and center-seeking properties thereto; conditioning different fibers with less friability for felting; forming a bat with all of said fibers thoroughly intermingled throughout the thickness of the bat; and subjecting said bat to a pressure working sufficiently to effect a shrinking

thereof and to cause the fibers of considerable friability to come together as a center stratum and to concurrently form surface strata of the less friable fibers thoroughly interfelted with the center stratum.

6. The process of making a composite felt including the steps of subjecting fibers to an acid to impart center-seeking characteristics thereto; carroting hatter's pelts; cutting carroted fur fibers from the pelts; preparing a bat with all of said fibers thoroughly and completely intermingled throughout the thickness thereof; and subjecting said bat to pressure working until said fur fibers are in large part driven to the exterior of the felt and the other fibers are in large part driven to the center of the thickness of the felt.

7. The process of making a composite felt which includes the steps of chemically treating fibers chosen from the class consisting of animal, vegetable, synthetic, wool, silk, cotton, linen, sequoia, rayon and cellulose acetate fibers to impart interior-seeking characteristics thereto; preparing fur fibers; preparing a bat with said interior-seeking fibers and said fur fibers thoroughly intermingled throughout the thickness of the bat; and subjecting said bat to pressure working until said fur fibers are in large part driven to the exterior of the felt and the interior-seeking fibers are in large part driven to the center of the thickness of the felt.

8. The process of making a composite felt which includes the steps of chemically treating fibers to impart interior-seeking characteristics thereto; preparing exterior-seeking fibers for felting; preparing uniformly-dispersing fibers; forming a bat with all of said fibers thoroughly and completely intermingled throughout the thickness thereof; and subjecting said bat to motion, heat, moisture and pressure working until said exterior fibers are in large part driven to the exterior of the felt and the interior-seeking fibers are in large part driven to the center of the thickness of the felt.

9. The process of making a composite felt including the steps of chemically treating certain fibers with a strong acid to impart considerable cohesive, adhesive and center-seeking properties thereto; preparing other fibers with less cohesive and adhesive properties for felting; forming a bat with all of said fibers thoroughly intermingled throughout the thickness of the bat; and subjecting said bat to a pressure working sufficiently to effect a shrinking thereof and to cause said fibers of considerable cohesive and adhesive properties to come together as a center stratum and to concurrently form surface strata of the less cohesive and adhesive fibers thoroughly interfelted with the center stratum.

10. The process of making a composite felt including the steps of chemically treating certain fibers with a strong acid to impart considerable surface gel-formation and center-seeking properties thereto; preparing other fibers with less gel-formation properties for felting; forming a bat with all of said fibers thoroughly intermingled throughout the thickness of the bat; and subjecting said bat to a pressure working sufficiently to effect a shrinking thereof and to cause said fibers of considerable surface gel-formation properties to come together as a center stratum and to concurrently form surface strata of the fibers having less surface gel-formation properties thoroughly interfelted with the center stratum.

11. The process of making a composite felt in

cluding the steps of chemically treating nonfur fibers to impart center-seeking characteristics thereto, thoroughly mixing carotated fur fibers with said chemically treated fibers, forming a bat with all of the fibers completely intermingling throughout the thickness thereof, and subjecting said bat to moisture, heat and pressure working until said fur fibers are in large part driven to the exterior of the felt and the other fibers are in large part driven to the center of the thickness of the felt.

12. The method of preparing a composite felt having three inseparable layers interfelted at their contacting faces, the outer layers being of animal fiber and the center layer being of cellulose fiber, the steps of treating the cellulose fibers with a strong acid to provide center-seeking characteristics thereto; and felting a mixed mass of said treated cellulose fibers and animal fibers to cause the center-seeking fibers to move to the center and the animal fibers to move to the exterior of the mass.

13. The method of preparing a composite felt having three inseparable layers interfelted at their contacting faces, the outer layers being of the same fiber and the center layer being of a different fiber, the steps of treating the fibers for the center layer with a strong acid and an oxidizing agent to provide center-seeking characteristics thereto; and felting a mixed mass of said treated fibers and the other fibers to cause the center-seeking fibers to move to the center and the other fibers to move to the exterior of the mass.

14. The method of preparing a composite felt having three inseparable layers interfelted at their contacting faces, the outer layers being of the same fiber and the center layer being of a different fiber, the steps of treating the fibers for the center layer with a strong acid and a soluble chlorite to provide center-seeking characteristics thereto, and felting a mixed mass of said treated fibers and the other fibers to cause the center-seeking fibers to move to the center and the other fibers to move to the exterior of the mass.

15. A sandwich felt comprising outer layers of similar fibers and an inner layer of chemically treated different fibers having interior-seeking characteristics when mixed with said first fibers, some of the fibers of each layer being intermingled and interfelted at the contacting

faces of the layers to provide a composite inseparable felt.

16. A sandwich felt comprising outer strata of fur fibers and an inner stratum of chemically treated cotton fibers having interior-seeking characteristics when mixed with said fur fibers, the fur and cotton fibers being intermingled and interfelted at the contacting faces of adjacent strata to provide a composite inseparable felt.

17. A sandwich felt comprising outer surface sections of fur fibers, and an inner section between said surface sections of chemically treated wool fibers having interior-seeking characteristics when mixed with said fur fibers, some of the fur and wool fibers being intermingled and interfelted at the contacting faces of adjacent sections to provide a composite inseparable felt.

18. A felt hat body having inner and outer surface sections of animal fibers, and an intermediate section between said surface sections of chemically treated non-fur fibers having interior-seeking characteristics when mixed with the animal fibers, some of the animal and non-fur fibers at the contacting faces of adjacent sections being intermingled and interfelted to provide a composite inseparable felt.

19. A felt hat body having inner and outer surface sections of fur fibers, and an intermediate section between said surface sections of chemically treated cotton fibers having interior-seeking characteristics when mixed with the fur fibers, some of the fur and cotton fibers at the contacting faces of adjacent sections being intermingled and interfelted to provide a composite inseparable felt.

20. A felt hat body having inner and outer surface sections of fur fibers, and an intermediate section between said surface sections of chemically treated wool fibers to provide interior-seeking characteristics when mixed with the fur fibers, some of the fur and wool fibers being intermingled and interfelted at the contacting faces of adjacent sections to provide a composite inseparable felt.

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