

(19)



Europäisches Patentamt

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Office européen des brevets



(11)

EP 1 101 853 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

23.05.2001 Bulletin 2001/21

(51) Int Cl.7: **D04H 1/08**, D04H 1/10,
D04H 1/46

(21) Application number: **00660208.0**

(22) Date of filing: **17.11.2000**

(84) Designated Contracting States:

**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

Designated Extension States:

AL LT LV MK RO SI

(30) Priority: **22.11.1999 FI 992479**

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(54) **A method for preparing a product of angora fibre, a product made of angora fibre, and the use of a product made of angora fibre**

(57) The present invention relates to a method for preparing a felt product of fibres, of which at least some are angora fibres, and in which method the fibres are

formed into a planar sheet. The fibres are found to each other by mechanical binding and the produced non-woven fabric is then finished to a felt product.

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Description

[0001] The present invention relates to a method for preparing a felt product of fibres, of which at least some amount are angora fibres; a felt product comprising angora fibre; a non-woven fabric; and the use of a product containing angora fibre. In this application, angora fibre refers to fibre obtained from the angora rabbit.

[0002] A known method for manufacturing a felt product of animal fibres is felting. In felting, animal fibres, normally fibres obtained of sheep's wool, are treated with water, or with water and chemicals, and with mechanical processing in such a way that scales on the surface of the wool fibres adhere to each other, the fibre mat formed by the wool fibres shrinks, and a felt is produced. In addition to manual felting, felting can also be done by machine.

[0003] Before the felting, the wool fibres are carded in such a way that the fibres form a mat in which the fibres are substantially parallel. The carded wool is set in thin cross layers in the form of a workpiece to be felted and in a size larger than the finished workpiece. By means of water, or water and chemicals, and by means of mechanical processing, the wool is shrunk and formed into the desired shape of the product. The chemicals can be acids or bases. The felting time and the felting technique are selected according to the product to be manufactured. The rinsed, dried workpiece is finished in a way suitable for each product. The finished felt is dense, firm and strong. To manufacture a softer and more flexible felt, the time of mechanical processing is reduced, wherein the degree of shrinkage of the felt remains lower.

[0004] It is known that a felt can be made of angora fibre in blends with other fibres. The angora fibres and the blend fibres must be combined and mixed to each other before carding. The felt is made by the conventional felting technique, wherein the felt becomes thick, rigid and hard on its surface. Best felting results are obtained from baby wool, which refers to the hair of a young angora rabbit. The felting of baby wool is more successful than the felting of hair of older animals for the reason that baby wool is curly and contains only few long wool hairs. However, the thermal insulating capacity of a product made of baby wool and blend fibre is poorer than that of a product containing all the hair qualities obtained from the hair of the angora rabbit. Another disadvantage in the use of baby wool is that it is only obtained about 30 g per animal, and the quantity of available fibre is directly proportional to the production of the young. Therefore, the commercial utilization of felt made of baby wool / blend fibre does not seem possible, except for handicrafts in small batches.

[0005] The problem with angora fibre is that it does not bind to the felt but will come loose from it during use and/or maintenance. Particularly long wool hairs, which become wider in the plane towards the tip and make a so-called lancet at the tip of the hair, are incapable of

binding. Due to the poor binding, the manufacture of a felt product made of 100% angora fibre by the felting technique is not successful in providing a felt product of acceptable quality. Furthermore, the felting technique is relatively complicated, it produces a relatively rigid felt and the technique is slow. If the felting is done by machine, the angora fibre will come loose from the product even more easily than from a manually felted product. Furthermore, in machine felting, the fibre is subjected to heat, which affects the properties of the fibre.

[0006] The method according to the invention is characterized in that the fibres are bound to each other by mechanical binding and the produced non-woven fabric is then finished to form a felt product. The product according to the invention is characterized in that it is made by mechanically binding a planar sheet formed of fibres to a non-woven fabric and then finishing it to form a felt product. The non-woven fabric according to the invention is characterized in that it contains angora fibre up to 100 weight percent.

[0007] It is surprising that fibres bound to each other by mechanical binding, such as needling, do not substantially shed from the product when it is used and/or maintained, for example during washing, centrifugation or acts containing angora fibre in a blend, or the product is fully made of angora fibre. Fibre blends normally contain angora fibre at least 30 weight percent to manifest the special properties of angora fibre in the product. For example, the blends of 30/70% angora fibre / other fibre, 40/60% angora fibre / other fibre or 50/50% angora fibre / other fibre are well suited for use. Although the product is fully made of angora fibre, a high-quality felt product is obtained which is flexible and has a soft feel. The fibres adhere to the product so well that they do not shed during the use and/or during the maintenance of the product. This has not been possible with conventional felting techniques. The quantity of fibre required for manufacturing the felt product is smaller than when using the felting method, wherein a high-quality product with a comfortable feel can be made of a small quantity of fibre. The felt product can be made fully without harmful chemicals, such as antistatic agents or felting additives. Furthermore, the process of manufacturing the felt product is simple, does not load the environment and is applicable in large industrial scale. In the felt product, angora fibre can be used without sorting it in different qualities; that is, the different types of fur of the angora rabbit: long, medium-sized and baby wool, are all suitable as raw materials for the product, and also the long hair is well bound to the product. Also hair obtained from angora rabbits of all ages are suitable as raw material for the manufacture.

[0008] The angora fibres are obtained by shearing an angora rabbit. The rabbit is normally sheared when its hair has grown to the length of 60 to 80 mm. The fur consists of long, medium-sized and short wool hairs, each hair type comprising a specific quantity of air cavities. In the cross-section of the hair, long wool hair has

4 to 8 air cavities side by side, medium-sized hair has 2 or 3 air cavities side by side, and short wool hair has only one air cavity. The air cavities are follicular and discontinuous in the longitudinal direction of the fibre. Thanks to the air cavities, the hair of the angora rabbit is very light weight. The air cavities also affect the thermal insulation capacity of the hair, and it is the better, the more air cavities there are in the cross-section of the hair. The density of hair of the angora rabbit is 1.23 g/m², whereas the density of e.g. sheep's wool is 1.30 g/m². The quality of the fibres obtained from the fur is dependent on e.g. the age of the animal to be sheared. According to the age of the animal, the fur is called baby, teenage or adult wool, which all have slightly different properties.

[0009] Angora fibre charges electrically very strongly, wherein a product made of it can be used to alleviate articular and muscular diseases, such as rheumatic diseases. In addition to rheumatic diseases, products made of angora fibre can also alleviate e.g. sciatica, slipped discs in the back, pulmonary diseases, and bronchitis. Because angora fibre is very fine and has a smooth surface, it can be used in direct skin contact without causing irritation to the skin. The smooth surface and the very low friction coefficient of angora fibre is due to e.g. the fact that the scales on its surface are small and the fibre is relatively straight, i.e. it is not curly. The average diameter of angora fibre is 10 to 17 µm (average diameter of sheep's wool is 15 to 80 µm, depending on the quality).

[0010] Angora fibre has a very high thermal insulation capacity, at least 2 to 4 times and even 7 times as high as that of sheep's wool (in comparison between products of equal weight), depending on the number of air cavities in the fibre. Thus, its application is interesting in uses requiring a warm textile with a comfortable feel. The comfortable feel of the products made of angora fibre is increased by the windproof capacity of the products and the capacity of angora fibre to absorb moisture. Angora fibre can absorb moisture 60 wt-% of the weight of the dry fibre, without the product feeling damp. Thus, the feel on the skin is dry and warm in direct skin contact with a product made of angora fibre. Products made of angora fibre can be used without constraints in direct skin contact, because they do not cause skin irritation to persons with sensitive skin. As a natural fibre, angora fibre is also suitable for persons allergic to man-made fibres.

[0011] Uses for a felt product containing angora fibre include clothing and footwear, products for direct or indirect skin contact, and textiles for use in homes or public facilities.

[0012] work activities. Such uses include e.g. the clothing for persons working in cold rooms, the clothing for outdoor life, slipcovers for stools used by ice fishers, or a padding between a saddle and the furcoat of a horse. As clothing for persons working in cold rooms, one example to be mentioned is the clothing for persons

working in freezing plants. Clothing for outdoor life can be, for example, the clothing of ice fishers, hunters, nature photographers, horsemen and -women, or yachtsmen and -women under cold conditions. In addition to clothing, the felt product can be used in other products for personal use, such as sleeping bags.

[0013] Products to be worn in direct skin contact and/or on clothing, protecting different human body parts from cold, include e.g. warming garments for the shoulders, wrists, back, genital area, or knees. On one hand, the felt product is suitably flexible and elastic to be used for such purposes; on the other hand, it also remains well in its shape, wherein the felt product is for example not rolled in the same way as e.g. knitted products used for corresponding purposes. A warming garment for the back area is important e.g. for paralytic patients.

[0014] Warming pieces made of the felt product can be fixed to the clothing in a suitable way; for example, the garment can be provided with a pocket for the felt product in a suitable location, where it can be placed when necessary. It is also possible to make entire parts of garments of the felt products, for example warming linings for coats, or pieces of clothing. The felt product can be used in the same way as a fabric, i.e. products can be made of it by normal manufacturing techniques. Suitable uses of the felt product include e.g. thermal insulation layers in overalls for ice fishers, insoles in shoes, slippers, and thermal vests. The non-woven fabric obtained as an intermediate product in the manufacture of the felt product can also be utilized as a final product without treatment with water. Such uses include e.g. a thermal lining in a coat, wherein the non-woven fabric is placed between the outermost fabric and the lining fabric, or a blanket or a sleeping bag, in which the non-woven fabric containing angora fibre can be stitched between the two fabrics.

[0015] The felt product can also be used outside the body and the clothing as a product which feels warm and insulates heat well. Such uses include textiles used in homes or public facilities, for example covers, baby seats in prams, sledges, or the like, or seat covers for wheelchairs. Said seat covers for wheelchairs are a significant use, because they require a product with particular good thermal insulation properties and warm feel, as patients in wheelchairs often have impaired blood circulation.

[0016] The manufacture of the felt product is started in such a way that the angora fibres are stored under suitable moisture conditions before carding, to achieve a suitable moisture content in the fibres. The fibres are stored at a temperature of 15°C to 25°C, preferably at the temperature of 20°C, and relative humidity of 55 to 75 %, preferably at the relative humidity of 65 %, for about 2 days before the carding. Thus, the moisture content of the fibres is suitable so that the fibre can be carded without significant generation of static electricity and, on the other hand, the fibre is not so damp that it would affect the fluffiness of the product made of it, that is, the

fibres do not adhere to each other, but the carded mat remains fluffy, which is important in view of the feel and the thermal insulation capacity of the final product. It is advantageous to perform the carding at a suitably slow speed, which also affects the generation of static electricity. The fibres are carded under substantially the same conditions as under which the fibres were stored, to form an even fibre mat. The fibre mat can be carded for example twice to achieve evenness.

[0017] In the carding machine, the fibres are fed in between card wire cylinders, where they are formed into a fibre mat. In the fibre mat, the fibres are substantially in parallel. The fibre mat is bound to a non-woven fabric by mechanical binding, such as needling. In the needling, the needles of a needling plate in the needling machine, equipped with barbs, penetrate the fibre mat and draw fibre bundles in their barbs, binding the fibres to each other in the areas penetrated by the needles. The needles move up and down through the fibre mat as the fibre mat is arranged to move forward at a suitable rate. The needles can be above or underneath the fibre mat, or there can be needles on both sides of the fibre mat. The needles can have varying shapes and sizes, which has an effect on the properties of the non-woven fabric, for example the strength and appearance properties. To obtain good binding, the fibre mat is normally needled on both sides. To make a thicker product, the fibre mat can also be first needled on one side, double-folded or folded several times, and the product can then be needled on both sides.

[0018] The obtained non-woven fabric is treated with water and mechanical processing for example in a washing machine. The non-woven fabric is treated in water at the temperature of 25 to 40°C, preferably at 30°C, after which the product is lightly centrifuged. The non-woven fabric is thus fulled, and it forms a felt product. The felt product is finished by compressing it, when wet, by subjecting it to a high perpendicular pressure against a surface, e.g. by mangling. After this, the felt product is dried either in horizontal plane or by hanging.

[0019] The resulting soft, flexible felt product normally has a square mass ranging from 150 to 250 g/m², preferably from 180 to 220 g/m². The fibres obtained from hair of the angora rabbit can be dyed by a method known as such at a suitable manufacturing stage, with dyes suitable for dyeing wool fibres, such as acid dyes.

[0020] Angora fibre can also be used in a blend with other fibres to make a felt product. Suitable blend fibres include e.g. animal fibres, such as fibres obtained from sheep's wool and silk, but also other fibres suitable for the purpose can be used. The blend fibres are selected on the basis of the use and the properties required of the product. The different fibres can be mixed with each other either before the carding stage, or carded fibre mats made of different fibres can be combined with each other. The angora fibres do not necessarily need to be carded, but they can be suitably applied on the surface of another fibre product, or they can be placed between

two fibre products and then bound mechanically. An example of such a product is one in which an even layer of angora fibres is applied onto a non-woven fabric made of silk, and a second fabric of silk fibre is placed on top of the angora fibres. The product-forming layers are combined by needling and finished in a way presented in this application. Mechanically bound products of several layers are also possible.

[0021] The felt product can also be made of recycled raw materials, for example waste fibres from spinning mills, i.e. fibres which the spinning mill cannot utilize in its processes. Also recycled fibres, obtained by tearing a product in a disintegrator, can be utilized as raw material for the felt product. It is thus possible to utilize e.g. second-hand felt products according to the invention or products made of a non-woven fabric according to the invention, or shearings produced in connection with the manufacture of the products. According to the need, new fibres can also be added in the recycled fibre mass or between layers formed of recycled fibre mass.

[0022] The felt product can also be used in a layer structure in which the mechanically bound felt product constitutes at least one layer. Two or more layers can be combined by a suitable way of adhering, for example by glueing. Such a product with a sandwich structure can be e.g. a plate-like product which is used in the manufacture of insoles for footwear. The top layer constitutes a layer containing hair from the angora rabbit, coming against the bottom of a foot in the insole. The lower side of the product can be formed by a layer made of another fibre material, such as linen, cotton or a suitable fibre blend.

[0023] In the following, the invention will be described by means of examples:

Example 1.

[0024] Batches of fibre masses, in which the total fibre mass was 100 g, were weighed which contained, in a ratio of 50/50 wt-%, angora fibres and lambwool fibres which had been stored under suitable thermal and humidity conditions. Of the fibre batches, fibre mats were carded and needled to form a non-woven fabric by a needling machine in which the needle plate contained about 2000 needles in an area of 1.0 m x 0.3 m. The needles comprised 2 barbs each.

[0025] The obtained non-woven fabrics were treated in water without any chemicals at 30°C for about 30 minutes in such a way that the filling factor was about 1/3 of the net volume of the drum. During the treatment with water, the drum was arranged to rotate in cycles in such a way that it rotated 5 rotations per minute, and during the rotation cycle, the rotation speed was 55 rotations per minute. Thus, during the treatment with water, the drum rotated for about 5 to 6 seconds in a minute. After the treatment with water, the products were lightly centrifuged for 1 to 2 minutes at the rate of 375 rotations per minute. After this, the felt products were mangled to

compress and level out the products, and dried on a plane.

[0026] Felt products were obtained, whose square mass was 185 to 210 g/m² and whose thickness was 2.40 to 2.65 mm (thickness measurement according to standard SFS 3380). The properties were measured at the temperature of 20°C and relative humidity of 65 %.

Example 2.

[0027] The thermal insulation capacities of a felt product made of 100% angora fibre by the method according to the invention, and of a felt product made of 100 % sheep's wool by the felting technique, were compared with each other. The thickness of both felt products was substantially the same, and the test specimens were of equal size.

[0028] Identical bottles were filled with hot water having the temperature of 78°C. The bottles were wrapped in the felt products in the same way, and the temperature of the water contained in them was measured after one hour. The temperature of the water in the bottle protected with the felt product made of angora fibre was 50°C, and the temperature of the water in the bottle protected with the felt product made of sheep's wool was 38°C.

[0029] It should be noted that in this test, the size and the thickness of the test specimens were equal to each other, but the felt product made of sheep's wool had a greater square mass than the felt product made of angora fibre, due to the difference in the manufacturing techniques. To manufacture products of equal thickness by the felting technique always requires more fibre than the method of manufacturing a felt product according to the invention.

[0030] The invention is not restricted to the description above, but the invention may vary within the scope of the claims. The fibres can be bound to each other e.g. by needling with water, wherein the product is subjected to high-pressure water jets which cause binding of the fibre in the product. The steps in the process of manufacturing of the felt product can also be combined partly or wholly to a continuous process.

[0031] Carded fibre mats can be combined with each other to form cross webs, wherein the strength properties of the felt product are improved. Furthermore, e.g. an air stream can be used to make fibre mats of angora fibre, in which the fibres extend in random direction. In general, various techniques can be used at the carding stage, e.g. depending on the length of the fibres, because the fibre length may vary for example due to the shearing interval or the fact that a certain fibre length is particularly suitable for the product.

[0032] In fibre blends, it is possible to blend angora fibre with all natural fibres and man-made fibres suitable for the use, also including regenerated fibres. The fibre blends may also contain more than two fibre sorts.

[0033] The main idea in this invention is that a fibre mass containing angora fibre can be used to manufac-

ture, simply by an industrially applicable method, a fluffy and flexible felt product in which the fibres remain well attached during the wear and maintenance of the product.

Claims

1. A method for manufacturing a felt product of fibres, of which at least some amount are angora fibres, and in which method the fibres are formed into a planar structure, **characterized** in that the fibres are bound to each other by mechanical bonding and the produced non-woven fabric is then finished to a felt product.

2. The method according to claim 1, **characterized** in that the fibres are bound to each other by mechanical needling or water needling.

3. The method according to claim 1 or 2, **characterized** in that before the mechanical binding, the fibres having a suitable moisture content are carded into an even fibre mat.

4. The method according to any of the claims 1 to 3, **characterized** in that the mechanically bound non-woven fabric is finished by mechanical processing in water, to form a felt product.

5. The method according to claim 4, **characterized** in that the temperature of the water is 25°C to 40°C, preferably 30°C.

6. The method according to any of the preceding claims, **characterized** in that the felt product is compressed, when wet, by compressing it between two contact surfaces.

7. The method according to claim 6, **characterized** in that the felt product is compressed by mangling.

8. A felt product including angora fibre, **characterized** in that it is prepared by bonding a planar sheet formed of fibres mechanically into a non-woven fabric and finishing it then to a felt product.

9. The felt product according to claim 8, **characterized** in that it comprises angora fibre up to 100 weight percent. is flexible and fluffy.

11. A non-woven fabric, **characterized** in that it comprises angora fibre up to 100 weight percent.

12. The non-woven fabric according to claim 11, **characterized** in that the fibres are formed into a planar sheet and bound by mechanical bonding.

13. The use of a felt product according to any of the preceding claims 8 to 10 in the manufacture of clothing and footwear, in products which are in direct or indirect skin contact, and in the manufacture of textiles for use in homes or public facilities.

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14. The use of a non-woven fabric according to claim 11 or 12 in the manufacture of clothing and footwear, in products which are in direct or indirect skin contact, and in the manufacture of textiles for use in homes or public facilities.

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EUROPEAN SEARCH REPORT

Application Number
EP 00 66 0208

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		15 March 2001	V Beurden-Hopkins, S
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 00 66 0208

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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