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(54) A method of making a two-ply tissue and a two-ply tissue product.

(57) A soft tissue product is made by forming a layered web with a crescent former, wherein the layer of the web (15) which is in contact with the felt (3) contains a substantial amount of short fibers, such as eucalyptus fibers. The tissue web is dried such that the opposite side of the web is pressed against the dryer (20) surface and creped. The resulting tissue web is plied together with another tissue web such that the layers (15) containing the substantial amount of short fibers become the outwardly facing layers of the two-ply tissue product.

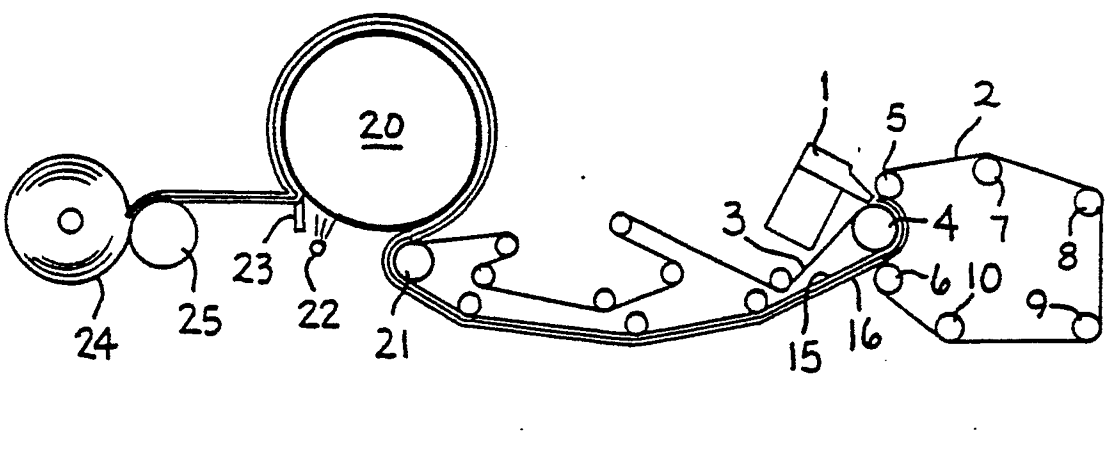

FIG. 1

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A METHOD OF MAKING A TWO-PLY TISSUE AND A TWO PLY TISSUE PRODUCT

The invention relates to a method of forming a two-ply tissue and a two-ply tissue product.

In the manufacture of tissue products such as facial and bathroom tissue, it is known to improve the softness of the tissue by incorporating hardwood fibers into the tissue furnish. This can be accomplished by using a blended furnish or by making a layered product in which the hardwood fibers are concentrated in the outer layers. An example of a layered tissue process and product is provided by U.S. Patent No. 4,300,981 to Carstens, in which a tissue web having 60% or more short fibers in the outer layer is disclosed. However, conventional wisdom in the tissue industry, as evidenced by Carstens, is that in order to obtain a softer, smoother tissue, it is preferred to use the dryer side of the tissue web as the outwardly facing surface of the final tissue product. This is because the dryer side of the tissue web (the side that is in contact with the dryer during drying and creping) experiences the greatest degree of debonding during creping and hence is traditionally viewed as the softer of the two sides of the tissue web. Hence commercially available layered prior art tissue is made by placing the hardwood layer against the dryer surface and positioning that layer as the outwardly facing surface of the final product. However, it has now been discovered that by producing a layered tissue web with a former commonly known in the industry as a crescent former, in which a tissue web is initially formed between a forming wire and a papermaking felt, a superior product can be made with a lesser amount of short fibers. In addition, such a process provides a number of process advantages which make it even more desirable. The invention provides a method of making a two-ply tissue product according to independent claim 1 and a two-ply facial tissue according to independent claims 8 and 9. Further features and advantages of the process and products are evident from the dependent claims, the following description and examples. The claims should be viewed as a first non-limiting approach of defining the invention in general terms.

In one aspect, the invention resides in a method for making a two-ply tissue product comprising: (a) depositing a stratified aqueous slurry of papermaking fibers between a forming wire and a felt to form a layered embryonic web, said embryonic web having a first layer of fibers comprising a substantial amount of short fibers in contacting relationship with the felt and a second layer of fibers, preferably of predominantly long fibers, which provides most of the strength of the resulting tissue web and which is in contacting relationship with the forming wire; (b) dewatering the web, preferably to a consistency of about 30 weight percent or greater; (c) adhering the dewatered web to the surface of a rotating drying cylinder and drying the web, wherein the second layer is in contacting relationship with the surface of the drying cylinder; (d) creping the dried web to form a tissue web; and (e) converting the tissue web into a two-ply tissue product wherein the first layer of the tissue web is positioned as an outwardly facing surface of the tissue product.

In another aspect, the invention resides in a two-ply tissue product made by the method described herein.

It has been found that the method of this invention offers a large number of advantages. First, the resulting product has surprising softness and is preferred by users relative to untreated commercially available tissues made in the conventional manner. In addition, forming the embryonic web with the second layer, which is preferably predominantly long fibers, in contact with the forming wire provides a filter and forming base for the short fibers of the first layer and results in higher fiber retention than forming with a substantial amount of short fibers against the forming wire. Also, applying a predominantly long fiber layer against the drying/creping cylinder reduces the amount of dust generated during creping, both in the tissue web and in the manufacturing environment. Further, by winding two of these plies together with the dryer (dustier) side inward to convert the plies into a two-ply tissue product, the dust level in the manufacturing and converting areas of the mill are further reduced. Furthermore, such a two-ply tissue product exhibits reduced lint in use because the dustier sides of each of the two tissue webs are plied together inwardly in the middle of the tissue product. This is a significant benefit to the user, for which lint is a common complaint when using tissues having a significant level of hardwood fibers.

For purposes herein, a tissue web is a web suitable for use as a facial or bath tissue and having a finished basis weight of from about 5 to about 15 pounds per 2880 square feet * per ply. Creped tissue web densities can be from about 0.1

*1 $lb./ft^2$ = 4.89 kg/m^2

to about 0.3 grams per cubic centimeter. Strengths in the machine direction can be from about 100 to about 1000 grams per inch * of width, preferably from about 200 to about 350 grams per inch of width. Tensile strengths in the cross-machine direction can be from about 50 to about 500 grams per inch of width, preferably from about 100 to about 250 grams per inch of width. Such webs are preferably made from natural cellulosic fiber sources such as hardwoods, softwoods, and nonwoody species, but can also contain significant amounts of synthetic fibers.

Figure 1 is a schematic flow diagram of the method of this invention.

Figure 2 is a schematic flow diagram of the converting step of this invention, depicting plying of two creped webs together such that the layers containing a substantial amount of short fibers are the outwardly facing surfaces of the final tissue product.

Referring to Figure 1, the invention will be described in greater detail. Shown is a multi-layered headbox 1 which can have one, two, or more internal dividers for separating different furnishes during formation of an embryonic web. Headboxes of this kind are well known in the paper industry and a wide variety of suitable designs are available. Not shown is the stock system for supplying the multi-layered headbox with different furnishes used to form the different layers within the tissue. In operation, the headbox deposits a stratified aqueous slurry of papermaking fibers between a forming wire 2 and a felt 3. Each of the strata consists of a fibrous slurry of different characteristics. The felt is wrapped around the forming roll 4. The forming wire is also partially wrapped around the forming roll, but to a lesser extent, and simultaneously spans the gap between the breast roll 5 and the wire take-off roll 6. Remaining rolls 7, 8, 9, and 10 provide means to properly adjust the tension of the forming wire. The relative positions of the forming roll, the breast roll, and the wire take-off roll must be adjusted to optimize the forming process.

The forming wire is characterized by a weave which provides immediate water drainage while providing adequate support for the fibers deposited thereon. Typically these fabrics are made of polyester or nylon and have a mesh of at least about 80 and a count of at least about 100. On the other hand, the felt is characterized by a fabric construction which absorbs or wicks away water from the embryonic web to assist in dewatering and which causes the embryonic web to adhere to the felt. Typically felts are made of a woven base with graded layers of batt needled into the base, with finished weights of from at least about 3.6 ounces per square foot * to about 5 ounces per square foot.

The layered embryonic web contains at least two layers or strata. The first layer 15, which is in contacting relationship with the felt, comprises a substantial amount of short fibers such as hardwood fibers. Suitably, the amount of short fibers constitutes at least 40 weight percent of the fiber content of the layer. Preferably, the amount of short fibers is from about 50 to about 60 weight percent of the layer, although amounts up to 100 percent can be used to further alter the surface characteristics of the web. Because of the presence of substantial amounts of short fibers which tend to form webs of low strength, the fiber composition of this first layer generally exhibits a handsheet TAPPI burst factor of about 15 meters^2 per gram^2, second layer 16, which is in contacting relationship with the forming wire, can be of any composition which provides sufficient strength to the resulting tissue web for its intended use and preferably consists predominantly (50 dry weight percent or greater) of long fibers such as softwood fibers. For purposes herein, short fibers are those which have an average length of from about 0.25 millimeters to about 1.50 millimeters and primarily include hardwood fibers, such as eucalyptus fibers. Long fibers are those which have an average length greater than about 1.50 millimeters and primarily include softwood fibers. The strength layer fiber composition exhibits a greater handsheet TAPPI burst factor than the layer 15, which preferably is about 30 meters squared per gram squared.

In the vicinity between the forming roll 4 and the wire take-off roll 6, the forming wire is passively disengaged from the embryonic web, which remains with the felt. The embryonic web is dewatered by the absorbent action of the felt as the felt carries the web to the rotating drying cylinder 20. Transfer of the dewatered web to the drying cylinder takes place at the pressure roll 21, which presses the dewatered web against the surface of the drying cylinder. The degree of hardness of the pressure roll can vary, although pressure rolls having a hardness of about 38 P&J (as measured on the Pusey and Jones scale) are preferred. Adhesion of the dewatered web to the drying cylinder is accomplished by the presence of moisture in the web and is preferably augmented by the presence of a creping adhesive, which is applied by a suitable spray device 22 as shown. The creping adhesive can be any creping adhesive which provides the appropriate level of adhesion for the particular web composition and basis weight. Such adhesives

*1 inch = 2.54 cm

*1 ounce = 28.35 gms 1 ft^2 = .09 m^2

are well known in the papermaking industry. Particular adhesives which have been found to work well are those based on polyvinyl alcohol. The web is then dried to about 5 weight percent moisture and is dislodged from the drying cylinder by contact with the doctor blade 23, which crepes the web. Because the second layer of the web (dryer side) is against the dryer surface, the formation of lint is minimized while the web is softened, particularly if the second layer primarily contains long fibers. The creped web is then wound onto a soft roll 24 with the aid of a reel drum 25.

Figure 2 illustrates a method of combining two of the layered webs made as described above to form a two-ply facial tissue in accordance with this invention. Shown are two soft rolls 24 being unwound and brought together in a nip formed between a first pair of steel calender rolls 31 and 32 followed by a second pair of steel calender rolls 33 and 34. The calendered webs are then crimped together between an anvil roll 35 and a crimper wheel 36. The crimped webs, now a two-ply basesheet, are then appropriately slit between an anvil roll 37 and a slitter roll 38 and wound onto a hardroll 40, from which the tissue web is further converted (folded, interfolded, packaged) into the final tissue product.

Examples

Example 1: Making the tissue web.

A tissue web was made as illustrated in Figures 1 and 2. More specifically, a layered headbox was used to form a two-layered embryonic web between the felt and the forming wire. The layer against the felt (first layer) consisted of 100 dry weight percent eucalyptus fibers provided as an aqueous slurry having a consistency of about 0.14 weight percent. The layer against the forming wire (second layer) consisted of 100 dry weight percent northern softwood kraft fibers provided as an aqueous slurry having a consistency of about 0.14 weight percent. The forming wire was an 84 mesh polyester fabric manufactured by Appleton Wire Company, Appleton, Wisconsin. The felt was a Yankee pick-up felt also manufactured by Appleton Wire Company. The embryonic layered web was dewatered to a consistency of about 40 weight percent before being transferred to a Yankee dryer with the second layer against the surface of the dryer. Transfer to the dryer was effected with a soft pressure roll having a hardness of about 38 P&J. A creping adhesive consisting of a mixture of polyvinyl alcohol, KYMENE, and Quaker release agent was used to enhance the adhesion of the web to the Yankee dryer. The web was creped at about 5 weight percent moisture and the resulting tissue web was wound onto a softroll.

Two softrolls of tissue webs, each made as described above, were plied together as described above in reference to Figure 2. The two-ply basesheet was converted into two-ply facial tissue having a finished basis weight of about 18.5 pounds per 2880 square feet * with the first layer of each ply positioned as the outwardly facing surface of the tissue product.

Example 2: Making the tissue web.

A two-ply facial tissue was made as described in Example 1, except the furnish of the layer against the felt (first layer) was about 50 dry weight percent eucalyptus fibers and about 50 dry weight percent northern softwood kraft fibers and was unrefined. The furnish of the layer against the forming wire (second layer) was the same, but was highly refined to provide sufficient strength. The finished basis weight of the two-ply facial tissue was about 19 pounds per 2880 square feet. *

Example 3: Making the tissue web.

A two-ply facial tissue was made as described in Example 1, except the furnish of the layer against the felt (first layer) was about 55 dry weight percent eucalyptus fibers and about 45 dry weight percent northern softwood kraft fibers and was unrefined. The furnish of the layer against the forming wire (second layer) was the same, but was highly refined to provide sufficient strength. The finished basis weight of the two-ply tissue product was about 19 pounds per 2880 square feet. *

Example 4: Consumer evaluations.

Two-ply facial tissues made as described in Examples 1 and 2 were placed with consumers in test cells of 100 subjects each. The consumers were given unidentified sample facial tissues to view and handle and were asked to determine which sample was softer. In the evaluations, tissue samples of Examples 1 and 2 were compared to a commercially-available two-ply facial tissue (PUFFS), each ply of which is layered and having an outer layer of about 100% eucalyptus fibers which during manufacture is positioned against the creping cylinder surface. In the test cells comparing facial tissues of Example 1 versus PUFFS, on average about 58 percent selected Example 1 as being softer, about 20 percent selected PUFFS as being softer, and about 22 percent had no preference. In the test cells comparing facial tissues of Example 2 versus PUFFS, on average about 54 percent selected Example 2 as being softer, about 39 percent selected PUFFS as being softer, and about 7 percent had no preference. In the test cells comparing facial tissues of Example 3 versus PUFFS, on average about 51 percent selected Example 3 as being softer, about 30 percent selected PUFFS as being softer, and about 19 percent had no preference. These results are statistically significant and illustrate that the method of this invention produces tissue products which are superior in softness, either with an equal percentage or with a lesser percentage of eucalyptus fibers in the outer layer of the tissue. This is not only an advantage from a product performance standpoint, but is also an advantage from an economic standpoint because of the relatively greater expense of eucalyptus fibers compared to softwood fibers.

Claims

1. A method of making a two-ply tissue product comprising:

(a) depositing a stratified aqueous slurry of papermaking fibers between a forming wire and a felt to form a layered embryonic web, said embryonic web having a first layer of fibers comprising a substantial amount of short fibers in contacting relationship with the felt and a second layer of fibers which provides most of the strength of the resulting tissue web and is in contacting relationship with the forming wire;

(b) dewatering the embryonic web;

(c) adhering the dewatered web to the surface drying means and drying the web, wherein the second layer is in contacting relationship with the surface of the drying means;

(d) creping the dried web to form a tissue web; and

(e) converting the tissue web into a two-ply tissue product wherein the first layer of the tissue web is positioned as an outwardly facing surface of the tissue product.

2. The method of Claim 1 wherein the drying means is a rotating drying cylinder.

3. The method of Claims 1 or 2 wherein the short fibers are hardwood fibers.

4. The method of one of Claims 1 to 3 wherein the hardwood fibers are eucalyptus fibers.

5. The method of one of Claims 1 to 4 wherein the second layer primarily comprises long fibers.

6. The method of one of Claims 1 to 5 wherein the first layer contains at least about 40 dry weight percent short fibers.

7. The method of Claim 6 wherein the amount of short fibers in the first layer is from about 50 to about 60, preferably 55 dry weight percent.

8. A two-ply tissue made by the method of one of the preceding claims.

9. A two-ply facial tissue obtainable by the method of one of the preceding claims.

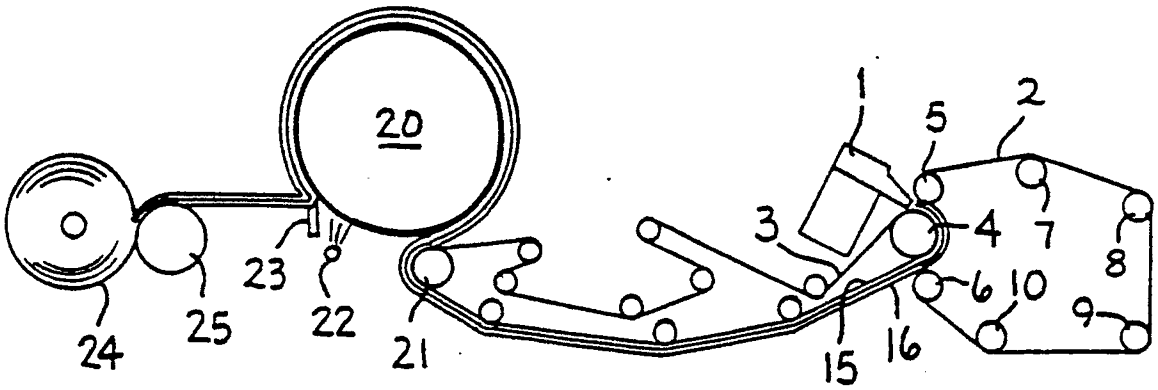
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FIG. 1

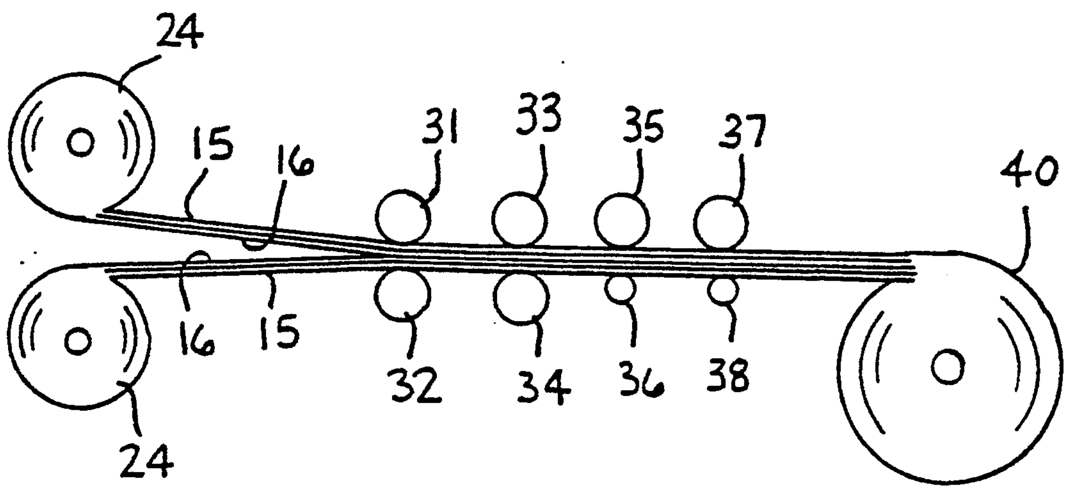
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FIG. 2

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EUROPEAN SEARCH REPORT

Application number

EP 90111901.6

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 5)
D,X	US - A - 4 300 981 (CARSTENS) * Fig. 42-45,20,21; claims 1,16,22,28 *	1,2	D 21 F 11/04 D 21 H 27/38
D,X	* Page 23, lines 48-52 *	3,4,6	
D,X	* Page 23, lines 56-60; claim 8 *	5	
D,X	* Page 31, lines 61-64 *	7	
D,X	* Page 31, line 47; claim 20 *	8,9	
A	EP - A1 - 0 003 377 (THE PROCTER & GAMBLE COMPANY) * Fig. 1; example 1 (pages 28ff); claims 8-11 *	1,2,3,4,5	

TECHNICAL FIELDS SEARCHED (Int Cl 5)

D 21 F 11/00
D 21 H 5/00
D 21 H 27/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	10-09-1990	KRUMPSCHMID

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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