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ARTIFICIAL CELLULOSIC TUBULAR STRUCTURE

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FIG. 1.

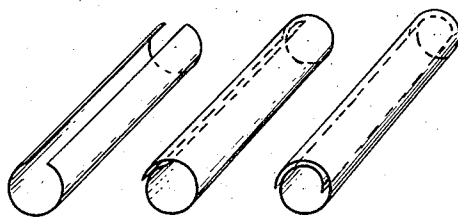
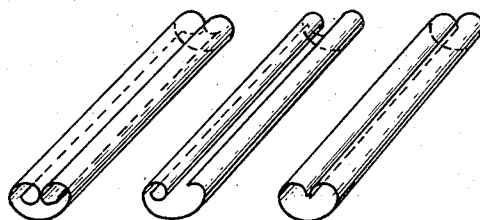


FIG. 2.

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ARTIFICIAL CELLULOSIC TUBULAR STRUCTURE

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16 Claims. (Cl. 93-94)

This invention relates to novel cellulosic products, and it pertains in particular to artificial cellulosic tubular structures.

Natural straw and natural horsehair constitute raw materials much used in the millinery industry, in the manufacture of braids, basket, etc. Artificial straw and artificial horsehair have been made according to various processes, to simulate the natural product and to improve upon the natural product.

It is an object of the present invention to produce novel tubular products comprising non-fibrous cellulosic material which products are capable of use, similarly to natural or artificial straw or horsehair in the various arts. Other objects will appear hereinafter.

The objects of the present invention are accomplished in general by producing strips comprising non-fibrous cellulosic material which curl transversely upon themselves by suitable treatment, thereby forming tubular articles having the general properties of straw, the longitudinal edges (i. e., the edges substantially parallel to the axis of the tube) of said tubular articles being substantially free.

Figures 1 and 2 are perspective views of tubular bands produced in accordance with this invention.

It is known that in the manufacture of non-fibrous films having a base of regenerated cellulose or cellulose derivative, e. g. cellulose acetate, glycol cellulose and other cellulose esters or ethers, particularly thin, flexible films such as are adapted for use as wrapping tissue, every effort is made to obtain film having uniform physical characteristics and particularly uniform flatness, the manufacturing processes being so carried out as to eliminate differences in characteristics between the opposite sides of the film. Thus where the film is composed of a single homogeneous material, the processing during manufacture is such that both sides of the film are acted upon uniformly, particularly during the drying of the film.

According to the present invention, on the contrary, thin films are produced in such a way that the opposite sides of the film have a sufficient difference, e. g. as regards shrinkage, that the films when in the form of narrow bands, can be made to roll upon themselves and thus to assume the form of narrow tubular, straw-like articles.

In carrying out the practice of the present invention it is preferred that a wide film be first produced under conditions which will confer on the film a tendency to roll on itself, the film being subsequently slit into narrow bands which will easily roll on themselves to form the narrow tubular straws. Any one of the following processes may be used to produce wide film which is subsequently slit or cut into the narrow strips:

1. Thin, regenerated cellulose film is produced

generally according to known processes for making regenerated cellulose wrapping tissue, e. g. having a thickness of 0.02 mm., except that during the drying operation the dryer rolls heated to a relatively hot temperature such as 100° C., contact one side of the film only, the tendency of the film to shrink transversely of the direction of travel of the film through the machine, i. e., the machine direction, being opposed by any suitable means, such as by holding the edges of the film during the drying operation.

When the wide film is subsequently slit into narrow bands, e. g. 6 mm. wide, the bands curl upon themselves to form tubes. This curling of the bands apparently takes place due to a varying tension set up on opposite sides of the film by drying the same at different temperatures on their opposite sides.

2. Two wide films having different shrinking capacities are glued together by the use of any suitable adhesive. Thus, a gel regenerated cellulose film, i. e., a regenerated cellulose film which has not yet been dried and which therefore contains a large amount of water, may be laminated with a dried regenerated cellulose film, or for that matter, with a regenerated cellulose film which has not been completely dried but which has a much less water content than the gel film, an adhesive being placed on one or both of the films prior to the lamination, the composite film then being dried. When the dried composite film is slit, the slit films roll on themselves to form tubes. The rolling tendency of the slit film will be much more marked if a transverse tension is imparted to the gel film, thereby increasing its width or opposing its tendency to shrink if applied during the film manufacturing operation, and the rolling tendency is further accentuated if the second film is dry when it is applied to the gel film. Similarly, films having a tendency to roll will be produced by gluing on to the gel film a layer of paper, fabric, thin metal foil or any other flexible material capable of shrinking less than the gel.

3. Portions of the same wide film, having different shrinking characteristics may be laminated together by means of an adhesive. For example, a film of wet regenerated cellulose manufactured according to known continuous processes for making regenerated cellulose wrapping tissue wherein considerable tension is imparted to the film in the machine direction, exhibits, in its middle portion, a tendency to shrink less transversely upon drying, than in its marginal portions. Therefore, if a band cut from the middle of the film is laminated to a band cut from the marginal portion, and the two portions are dried together, a film apt to roll will be obtained, since the opposite sides of the composite film have

shrunk differently, and thin strips slit therefrom will roll into the form of tubes.

It is known also that film has a less tendency to shrink in the machine direction than in the transverse direction so that a film having a tendency to roll will likewise be produced if two pieces of regenerated cellulose film which have not yet been dried, are glued together in such a way that the machine directions are at right angles to each other.

4. If one side of a thin regenerated cellulose film is treated with a material which modifies the properties of the treated side so as to cause one side to shrink more than the other, a tendency to roll will be imparted to the film so that thin strips cut therefrom will roll into tubular objects. Thus by applying to one side of a regenerated cellulose film a layer of concentrated zinc chloride solution, then preferably subjecting the treated film for some seconds to a temperature of 90-120° C., washing with much water and then drying, a film having a tendency to roll will be obtained and thin strips of such material will roll into tubular objects.

If other liquids capable of modifying the properties of the regenerated cellulose so as to produce a similar difference in shrinking characteristics in the opposite sides of the film, are applied for a short time to one side, the same general effect is obtained. This is the case with regenerated cellulose film, one side of which is treated with concentrated sulfuric acid, aqueous caustic soda solution, aqueous cuprammonium hydroxide solution, a concentrated aqueous solution of calcium thiocyanate, etc.

5. On a film of regenerated cellulose, a layer of material is deposited which has different shrinkage possibilities than that of the cellulose constituting the film when subsequently moistened. For example, if a uniform layer of a cellulose solution of any kind, for example viscose, is deposited on one side of a film, a product apt to roll is obtained.

A similar result is produced by depositing a layer of cellulosic solution containing cellulose dissolved in aqueous zinc chloride solution on a regenerated cellulose film as set forth in the next preceding paragraph; the action of heat on the film immediately after depositing the cellulose solution in zinc chloride, furthermore favors the phenomenon.

The deposit of a layer of cuprammonium solution of cellulose on such a film leads to the same result.

A deposit of various solutions, for example, lacquer adhering firmly to the films, on one side of the latter, is a means of creating the dissymmetry of properties which renders films apt to roll. For example, a layer of nitrocellulose deposited on a cellulose film produces rolling.

These various solutions may contain different materials such as opaque powders, colored or uncolored.

In order to manufacture tubes of small diameter from a film capable of rolling obtained by one of the foregoing processes, or by any other process, the material is cut into bands of suitable width; these bands are moistened more or less and then are dried while stretched longitudinally. During drying, the band rolls and forms a stable tube of variable diameter, according to the nature of the product, the degree of moistening, the thickness and width of the film and the nature of the previous treatment.

Furthermore, previously moistened film may be cut.

For example, if 6 mm. bands are cut from a film prepared according to paragraph 2 by means of two regenerated cellulose films, each 0.02 mm. thick, if these bands are moistened with pure water or water with an addition of glycerin, and they are then dried under longitudinal tension, tubes of 1 to 2 mm. diameter will be obtained.

Likewise if 2 mm. bands are cut from 0.02 mm. thick films of regenerated cellulose treated with zinc chloride, and they are treated as described in paragraph 4, tubes of a few tenths of a millimeter in diameter will be obtained.

Furthermore, it is evident that the two parts of the operation, that is, the preparation of the film and the rewetting and tensioning of narrow widths of the film, may at times be combined into one. This is the case when in order to carry out the first part, that is, the preparation of the film, bands are used, the width of which corresponds precisely to that of the narrow bands cut for carrying out the second part, that is, the rewetting and tensioning of narrow widths of the film. It is also the case when bands are cut during the first part of the operation before drying. In these two cases, the drying on cylinders which follows the first operation, as well as the moistening provided at the beginning of the second operation is avoided.

The tubes thus obtained may present very different appearances and may be modified and decorated to change their appearance and properties. For example, previously dyed or printed films and more or less opaque, dull or bright films may be used.

The films may also be dyed, printed, metallized, covered with various fibers or powders, or decorated by any known process, either during the operation producing rolling, during the course of cutting, just before humidifying, or even after humidifying.

When the tubes are formed, they may be subjected to treatments such as dyeing, metallizing, irisation, lacquering, coating with various materials, or mechanical treatment such as crushing to transform them into flat straws, or embossing.

It is also possible to glue on one side of films apt to roll a product such as a fabric, paper, thin sheet of metal or any other flexible surface, or to insert these products between two constituent films, in certain cases. In the latter case, ramie, cotton or similar products may also be inserted.

After coating with an adhesive, the finished tubes may be covered with various powders or textile fibers cut to a short length, for example, cotton, silk, wool fibers, etc.

During its formation, a thread of any material, such as metal, linen, hemp, etc., which would confer strength and new properties may be inserted into the tube.

The liquid used for moistening may be applied on one or both sides and contain products such as glycerin for softening the tube, glues such as gelatin or dextrine for gluing the parts which come into contact at the moment when the tube is formed, or in a word, products giving special properties. If, in particular, an agglutinant and products such as opaque powders, colors, powdered metals, etc., are added, transparent films may be transformed into opaque films and all kinds of new aspects may be produced.

During drying, a tube may assume either a perfectly circular form, such as that represented in Figure 1 of the attached drawing, the tube either remaining open or the edges overlapping more or less, or forms such as those represented in Figure 2 or the two edges roll equally or unequally, without being superposed.

Instead of wetting the cut bands to be transformed into tubes directly with an aqueous liquid, they may be subjected to the action of a humid atmosphere, for example, a jet of live steam.

Narrow tubular straws may also be made by slitting dried regenerated cellulose film such as that adapted for use as wrapping tissue and made according to known processes involving drying under tension, the slit film being treated on one side with a swelling agent such as water, and then being immediately and rapidly dried under a suitable longitudinal tension whereupon the narrow film curls transversely on itself. Thus if a band of regenerated cellulose having a width of 6 mm. and a thickness of 0.04 mm. is passed rapidly over a water moist pad and immediately dried under tension in the machine direction, tubular products are formed. The swelling agent chosen will ordinarily be one which disappears entirely during the drying of the film.

The various processes explained above relate particularly to films of regenerated cellulose but the same results are obtained with all films by means of operations of the same order based on the principles explained in the foregoing by adapting them to the nature of the film. Cellulose acetate films which, slightly moistened on one side with certain organic solvents, roll very much, may be cited. It is sufficient, for example, to moisten with acetone one side of a cellulose acetate film of a few mms. width and to allow this solvent to evaporate while keeping the film stretched, in order to obtain tubular products easily. One side of a cellulose acetate film may also be saponified partly by an alkali in such a way as to have on one side a more or less deacetylated surface which, after being moistened and dried, shrinks more than the opposite side composed of acetate.

The processes mentioned therefore apply to all films which may have the properties on one side modified in comparison with the other during manufacturing or subsequent thereto in such a way that they may have a tendency to roll under the action of a chemical or physical agent.

Generally speaking, this invention is concerned with making tubular straws from slit film having a width up to about 20 mm., the tubes being narrower than the slit film to the extent to which the film has rolled. Generally speaking, the thickness of the film contemplated by this invention may range from a fraction of a millimeter up to 1 millimeter. It will be understood that these limits may, however, be departed from to a substantial degree, if desired.

I claim:

1. A thin, flexible tube having the properties of millinery straw comprising a thin, flexible non-fibrous sheet rolled transversely upon itself, the free inner and outer longitudinal edges of said tube being movable relative to each other.

2. A thin, flexible tube having the properties of millinery straw comprising a thin flexible non-fibrous, cellulosic sheet rolled transversely upon itself, the free inner and outer longitudinal

edges of said tube being movable relative to each other.

3. A thin, flexible tube having the properties of millinery straw comprising a thin, flexible regenerated cellulose sheet rolled transversely on itself, the free inner and outer longitudinal edges of said tube being movable relative to each other.

4. A tube comprising a thin flexible sheet rolled transversely on itself, said sheet comprising regenerated cellulose on one side, and a material other than regenerated cellulose on the other side, the free inner and outer longitudinal edges of said tube being movable relative to each other.

5. A thin, flexible tube having the properties of millinery straw comprising a thin flexible sheet rolled transversely on itself, said sheet comprising an outer and an inner lamina, the free inner and outer longitudinal edges of said tube being movable relative to each other.

6. A tube comprising a thin flexible sheet rolled transversely on itself, said sheet comprising an outer and an inner lamina of regenerated cellulose, the free inner and outer longitudinal edges of said tube being movable relative to each other.

7. The process of making tubes which comprises treating a sheet of non-fibrous material on one side to impart to said side a greater tendency to shorten transversely whereby to cause said sheet to roll on itself.

8. The process of making tubes which comprises treating a sheet of non-fibrous cellulosic material on one side to impart to said side a greater tendency to shorten transversely whereby to cause said sheet to roll on itself.

9. The process of making tubes which comprises treating a sheet of regenerated cellulose on one side to impart to said side a greater tendency to shorten transversely whereby to cause said sheet to roll on itself.

10. The process of making tubes which comprises treating a wide film of regenerated cellulose whereby to impart to one side a greater tendency to shrink upon drying than the other side, drying said film, and dividing said film into narrow strips.

11. The process of making tubes which comprises treating a wide film of regenerated cellulose whereby to impart to one side a greater tendency to shrink upon drying than the other side, drying said film, and dividing said film into narrow strips, then wetting said strips and drying under tension.

12. The process of making tubes which comprises laminating a wet sheet of regenerated cellulose with a sheet of a material having a less tendency to shrink upon drying, drying the composite film whereby to impart to the film a tendency to roll upon itself, then making tubes from said film.

13. The process of claim 12, characterized in that the composite sheet is slit into narrow strips after lamination.

14. The process of claim 12, characterized in that said second sheet is regenerated cellulose.

15. The process of making tubes which comprises applying heat to a wet sheet of non-fibrous material from one side only whereby to cause said sheet to roll on itself.

16. The process of making tubes which comprises applying heat to a wet sheet of regenerated cellulose from one side only whereby to cause said sheet to roll on itself.

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