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W. O. SNELLING

1,713,679

METHOD OF MANUFACTURING HOLLOW RAYON FIBERS

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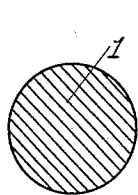


Fig. 1

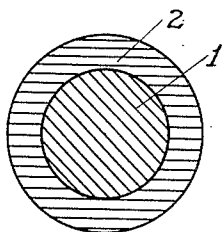


Fig. 2

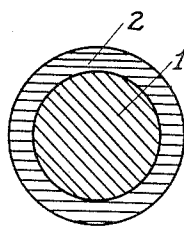


Fig. 3

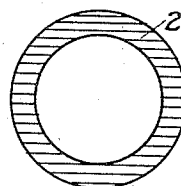


Fig. 4

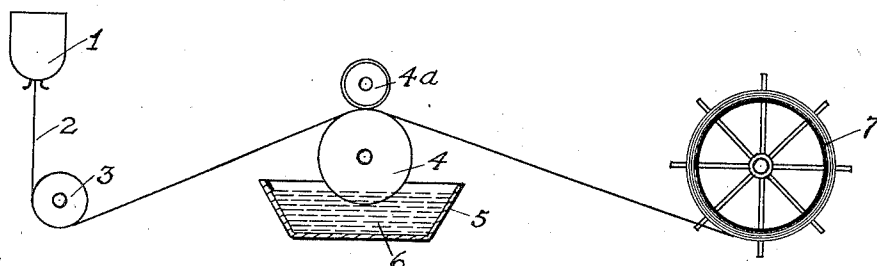


Fig. 5

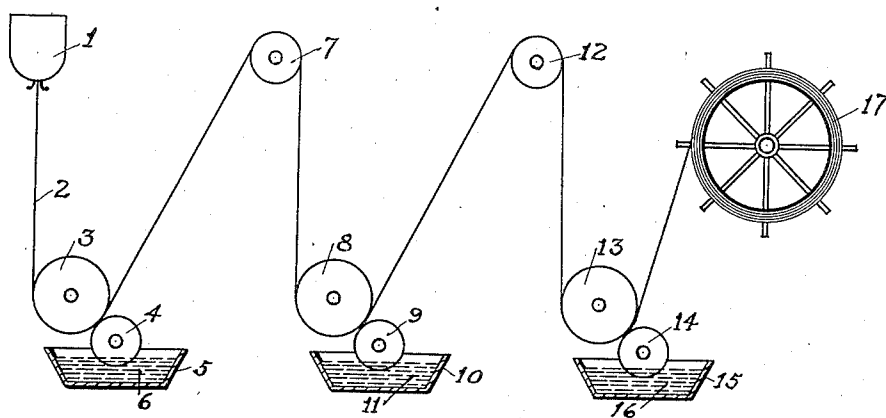


Fig. 6

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METHOD OF MANUFACTURING HOLLOW RAYON FIBERS.

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My invention relates to improvements in the manufacture of fibers of rayon or artificial silk and has as its principal object the providing of new and improved methods for obtaining textile fibers of hollow structure and great strength. The present application is in part a continuation of my co-pending application S. N. 29,309, filed May 11, 1925, and issued as Patent 1,631,071, May 31, 1927, in which I have described a closely related method of obtaining hollow fibers.

I have discovered that by preparing a preliminary fiber of any suitable material, such as melted sugar for example, and then coating such fiber with a nitrocellulose solution, a cupra-ammonia solution of cellulose or with viscose or any other suitable material, and subsequently dissolving in any suitable solvent the preliminary fiber after hardening or coagulating the coating layer, I can obtain textile fibers having many advantages over the solid fibers of rayon or artificial silk produced by methods at present known.

There are many materials which may be very readily drawn into filamentous or fiber form, but which do not have such properties of permanence as to make them of value in the preparation of textile fibers. Sugar at its melting point, for example, may be readily drawn into very thin fibers, but these fibers have relatively little strength, and soon deteriorate in moist air. Sulfur at certain temperatures is quite viscous and may similarly be drawn into thin fibers, but these fibers soon become brittle and lose their structural strength. Rosin and many resins may similarly be drawn into fibers at suitable temperatures, but these fibers also become fragile and brittle a short time after they have been formed. By my invention I employ any of the materials named, or many other materials such as glue, casein, and the like, as the base for a preliminary fiber and upon this preliminary fiber I build up a coating of a material having such characteristics of permanence and strength as makes it suitable for textile uses. After properly hardening or conditioning the coating or outer layer of my preliminary fiber, I dissolve the preliminary fiber in any suitable material, thus obtaining a permanent hollow fiber of nitrocellulose, cellulose or other suitable material.

In the drawing which forms a part of this

application Figure 1 is a cross-sectional view, on a greatly enlarged scale, through a fiber of sugar such as I may use in the practice of my invention, 1 representing the amorphous sugar forming the fiber. Figure 2 shows this fiber after it has received a coating of nitrocellulose solution but before the drying of the solvent, 1 again representing a cross-section through the amorphous sugar forming the fiber, while 2 represents the overlying coating. Figure 3 shows the same fiber shown in Figure 2, after the nitrocellulose has dried by loss of the initial solvent, 1 again representing a cross-section through the amorphous sugar forming the fiber, while 2 is a cross-section through the solid nitrocellulose coating. Figure 4 shows the hollow fiber which remains after the fiber shown in Figure 3 has been treated with water to dissolve the preliminary sugar fiber, leaving only the hollow tube of nitrocellulose 2.

In Figure 5 there is shown diagrammatically one form of apparatus suitable for the manufacture of hollow fibers in accordance with my present invention, while Figure 6 shows diagrammatically a slightly different form of apparatus for the same purpose.

In Figure 5, 1 represents a spinneret or spinning nozzle, from which a fiber 2 of melted sugar is continuously drawn, the spinneret nozzle being heated electrically or in any other convenient way to a temperature slightly above the melting point of sugar, at which temperature the melted sugar has excellent properties of fiber formation. The fiber 2 passes partially around a control pulley 3 and contacts with the surface of coating wheels 4 and 4^a. Coating wheel 4 contacts with a coating liquid 6 held in tank 5, the coating liquid being any suitable nitrocellulose solution as for example a solution of nitrocellulose in a solvent comprising methyl, ethyl, and amyl alcohols and propyl and amyl acetates with a suitable plasticizing agent such as dibutylphthalate. The periphery of the coating wheel 4 takes up a thin film of the coating liquid 6, and the fiber 2 upon coming in contact with the coating wheel takes up a portion of the coating material, the even distribution of the coating wheel being facilitated by contact with coating wheel 4^a, the surface of which is continually wet with the coating material by contact with the sur-

face of coating wheel 4. The coated fiber from coating wheels 4 and 4^a is continuously wound on reel 7 by a convenient motive power, the distance between coating wheel 4 and reel 7 being sufficient to permit of the substantially complete drying of the nitrocellulose film. The coated fiber is removed at intervals from reel 7 and is treated with water to dissolve out the interior preliminary fiber, after which the hollow fiber is dried and is then ready for use, or may be further treated by known methods for the purpose of denitrating the nitrocellulose to reduce the flammability of the fiber.

15 In Figure 6 a closely related process is shown diagrammatically, 1 being the spinneret and 2 being the fiber drawn from the spinneret. 3 and 4 are coating wheels, coating wheel 4 contacting with a coating fluid 20 6 held in tank 5, while coating wheel 3 serves the joint function of a pulley to modify the direction of the fiber, and as a secondary coating wheel obtaining coating agent by contact with primary coating wheel 4. 7 25 is a pulley for modifying the direction of motion of the fiber 2 while 8 and 9 are coating wheels, 10 is a tank and 11 is fluid in this tank. The fluid may be a coating liquid similar to that in tank 6, or it may be a 30 coating agent of different nature, where a composite fiber is desired. 12 is a control pulley, 13 and 14 are coating wheels, 15 is a tank containing water 16, and 17 is a reel for winding the finished fiber.

35 Although in the diagrammatic sketches I have shown the formation of a preliminary fiber of sugar, and a coating layer of nitrocellulose, it will be evident that the principle of my invention is broadly applicable 40 to the use of many materials as the preliminary fiber, and to many coating materials in the preparation of the final hollow fiber. As preliminary fibers I have successfully used sugar, rosin, sulfur, casein, glue and 45 many other materials, and still other materials may be used, and as coating materials, cellulose nitrate, cellulose acetate, cellulose xanthate, cupra-ammonium solutions of cellulose and many other like materials may 50 be used. In all cases it is essential that the preliminary fiber should be of a soluble material, and that the solvent used in dissolving this material should not dissolve the coated material. For preliminary fibers of 55 sugar I use water as my solvent, for preliminary fibers of rosin or resins I use alcohol as my solvent, and in all cases I select a solvent for my preliminary fiber which is without dissolving or other harmful action 60 on my coating material. When coating a preliminary fiber with cellulose xanthate or with cupra-ammonia solutions of cellulose, I may pass my fiber through a bath of any suitable coagulating or hardening material, 65 either before or after the dissolving out of

the preliminary fiber. Under certain circumstances I find it convenient instead of contacting my preliminary fiber with treating agent on the surface of a number of coating wheels to pass the preliminary fiber at 70 one or more stages in the process of making a composite fiber, through a mist of spray of a coating agent or a treating agent, the excess agent being collected and reused, and in a similar way I may coagulate or harden 75 the coating on my prepared fiber at any stage in its manufacture by the use of a gaseous or vaporous reagent, instead of using a coagulating bath of liquid material.

My present invention is limited to the contacting of a preliminary fiber with a film of 80 material on the surface of a suitable support in at least one operation of the process of making a hollow fiber, the broad process of making hollow fibers by the described process, but without the use of a support carrying only a surface film of a treating agent, being described and claimed in 85 said co-pending application S. N. 29,309. I have discovered that the use of a surface film only of a coating agent or of a modifying reagent gives fibers of somewhat more uniform nature than can be obtained by the complete immersion of the fiber in the coating agent or modifying reagent as described 90 in said application S. N. 29,309, and the purpose of the present application is to describe and claim this modification of my earlier process. With certain coating materials there is a tendency for the liquid to form a 100 series of small globules upon the fiber when the preliminary fiber is contacted with a large excess of the coating agent, while this tendency can be controlled by bringing the fiber to be treated into contact with a thin film 105 of the coating agent under conditions which prevent any excess of the coating agent being present. The coating agent (or treating reagent of any sort) may be held upon the surface of a support of any suitable nature, 110 either stationary or movable, but I find the best results to be obtained by the use of revolvable treating wheels as described, the coating surface of these wheels being of any desired material, and preferably of a 115 material readily "wetted" by the liquid coating agent, as under these conditions the obtaining of a uniform thin film is automatically adjusted. Stationary wipers or movable wiper wheels of controlled tension 120 may of course be employed to control the thickness of the film of treating agent held by the support, and in general the methods well known in the art may be applied in conjunction with the specific method of forming hollow fibers herein described. When 125 coating wheels are used to apply a coating material or a treating reagent to a preliminary fiber, the fiber may wrap around the coating wheel if desired or may contact 130

with the wheel over any desired portion of its periphery, according to the degree of contact desired.

As many modifications may be made in the described process without departing from the essential principles of the disclosure as herein made, no limitations should be placed upon my invention except such as are indicated in the appended claims.

I claim:

1. In the preparation of hollow fibers the process which comprises forming a preliminary fiber, contacting this fiber with a thin film of coating agent carried on a suitable support, transforming the liquid coating on the fiber to solid condition and dissolving the preliminary fiber.

2. In the preparation of hollow fibers the

process which comprises forming a preliminary fiber, contacting this fiber with a thin film of coating agent carried by a coating wheel, transforming the liquid coating on the fiber to solid condition and dissolving the preliminary fiber.

3. As a step in the preparation of hollow fibers the process which comprises contacting a fiber with a thin film of a liquid carried on a suitable support.

4. As a step in the preparation of hollow fibers the process which comprises contacting a fiber with a thin film of a liquid carried on a rotatable support.

In testimony whereof, I have hereunto subscribed my name this 17th day of May, 1927.

WALTER O. SNELLING.