

UNITED STATES PATENT OFFICE.

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MANUFACTURE OF HOLLOW ARTIFICIAL TEXTILE FIBERS.

No Drawing. Application filed October 25, 1926, Serial No. 144,173, and in Great Britain November 11, 1925.

The manufacture of artificial fibers by the so-called "dry-spinning" method, that is, by extruding into an evaporating medium contained in a practically closed cell a solution of nitrocellulose, cellulose acetate or other cellulose derivative in a volatile solvent or solvent mixture, is a well-known operation which is practiced industrially. The cross-sections of filaments obtained by the above method may be of various shapes, for example, rounded or flat, and hereinafter the general term "full-shaped" will be used to define these ordinary dry-spun filaments in contrast to "hollow" dry-spun filaments, the manufacture of which is the object of the present invention.

It has now been found possible to obtain by the dry-spinning process hollow artificial filaments by employing the ordinary solutions of cellulose acetate, nitro-cellulose or other cellulose derivative commonly used for the manufacture of full-shaped filaments, without adding to said solutions any special compound.

Hereinafter the ordinary solutions referred to above will be described simply as "normal" solutions.

According to the present invention, hollow filaments are manufactured by the dry-spinning process from a normal solution of a cellulose derivative by maintaining in the zone of birth of the filaments a temperature substantially higher than the boiling point of the volatile solvent and by producing simultaneously on the filaments an active superficial evaporation by means of a suitable regulation of the rate of flow of the hot gaseous medium within the spinning cell. In carrying out the present process no addition of a gas-evolving body is required.

It was not possible to foretell that the evaporating conditions described above would lead to the production on an industrial scale of really hollow fibers. It was naturally to be expected that, in view of the violence of solvent vapours, a continuous filament would not be produced or in any case that the filament would not be continuously hollow along substantially its whole length. In fact, however, it has been proved that by following the process according to this invention a fiber is obtained whereof the

constituent filaments are substantially hollow throughout their length, and the fiber has a lustre comparable with that of ordinary artificial silk.

In order to maintain the steady working conditions necessary for an industrial process, care should be taken that the high temperature prevailing in the extrusion zone does not affect excessively the temperature, and therefore the viscosity, of the solution, which, prior to extrusion, is present in the spinning devices.

The evaporating conditions under which the process is carried out will vary with the volatile solvent employed, the temperature in the zone of birth of the filaments being always substantially higher than the boiling point of the solvent. For cellulose acetate solutions in acetone, a suitable temperature in the zone of birth of the filaments is 100-120° C. At temperatures between 90 and 100° C., the filaments contain a certain number of bubbles but the full benefits of a substantially hollow filament are not secured. Satisfactory results have been obtained from cellulose acetate solutions in acetone at a spinning temperature of 155° C., but as a general rule it will not be necessary or desirable to increase the temperature much above 120° C. With nitrocellulose solutions in alcohol-ether, satisfactory results have been obtained with temperatures ranging between 90 and 100° C.

The evaporating conditions will also vary with the other conditions of spinning, for example, the speed, the concentration of the solution and the size of the filaments, but it must be borne in mind that the two requirements hereinbefore specified, i. e., active evaporation creating immediately a hard envelope and high temperature producing the boiling of the remaining solvent, are simultaneously necessary.

Some examples according to the invention will be now described.

Example I.

In this example the spinning solution was a solution of cellulose acetate containing 25% of cellulose acetate in a mixture of acetone 80 parts and alcohol:20 parts. The solution was extruded through a nozzle pro-

vided with thirteen holes each having a diameter of 0.10 mm. The speed was 75 metres per minute and the size of each filament was 10 deniers. The temperature in the zone of birth of the filament was 110° C., and the rate of flow of the hot air circulating in the cell was 10,000 litres per hour. The filaments were found to be tubular, to have a gloss similar to that of full-shaped artificial silk, and to have a density of 0.9.

Example II.

In this example the flow of the circulating hot air was reduced to 3,200 litres per hour, but otherwise the spinning conditions were the same as in Example I. The filaments produced were no longer hollow but full-shaped. This example shows clearly the necessary influence of an immediate active superficial evaporation.

Example III.

In this case the spinning solution was nitrocellulose collodion prepared from 500 grms. nitrocellulose, 1000 ccs. alcohol, and 1700 ccs. ether. The solution was spun into hot air, the circulation of which was very active, through a monofil jet, orifice 0.12 mm., at a pressure of 5 atms. The temperature of the air was 92-99 C. and the speed of spinning, 41 metres per minute. The filaments produced according to this example were glossy, substantially hollow and had a density of 0.66.

What I claim and desire to secure by Letters Patent is:—

1. A dry-spinning process for the manufacture of hollow artificial fibers from a solution the base of which is a cellulose derivative, which consists in using a normal solution such as is commonly used for obtaining full-shaped filaments, spinning said solution into a hot gaseous medium at a temperature which is substantially higher than the boiling point of the solvent employed in the solution, and simultaneously submitting the filaments, as soon as extruded from the nozzles, to an active superficial evaporation by regulating the rate of flow of the hot gaseous medium in the spinning cell.

2. A dry-spinning process for the manufacture of hollow artificial fibers from a solution the base of which is a cellulose derivative, which consists in using a normal solution such as is commonly used for obtaining full-shaped filaments, spinning said solution in hot air at a temperature which is substantially higher than the boiling point of the solvent employed in the solution, and simultaneously submitting the filaments, as soon as extruded from the nozzles, to an active superficial evaporation by regulating the rate of flow of the hot air in the spinning cell.

In testimony whereof I have signed my name to this specification.

JOSEPH EDOUARD GUSTAVE LAHOUSSE.