

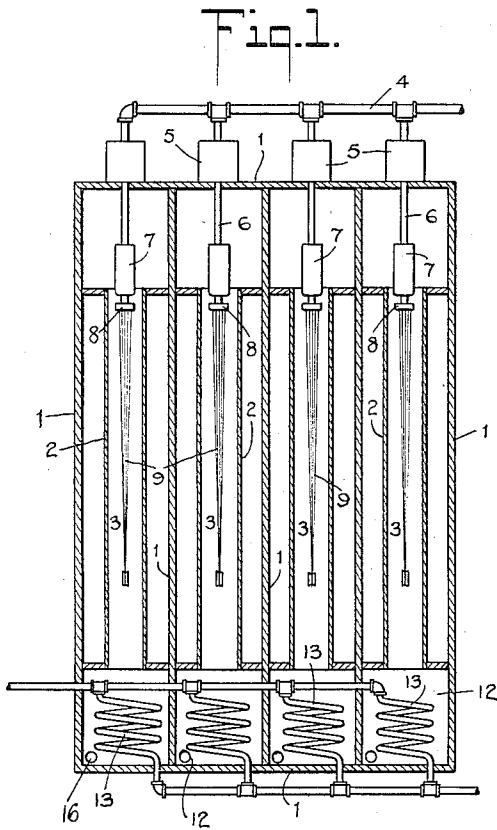
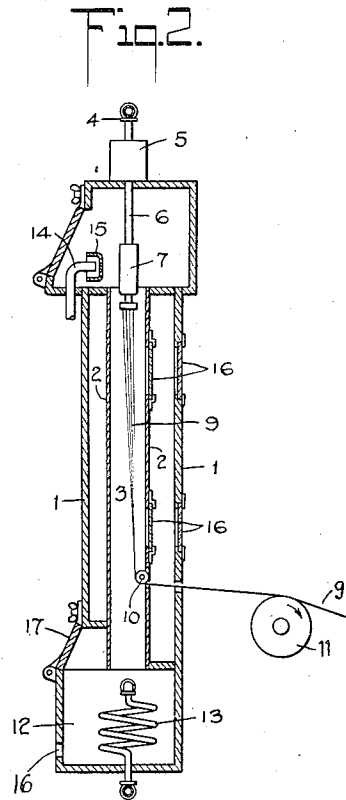
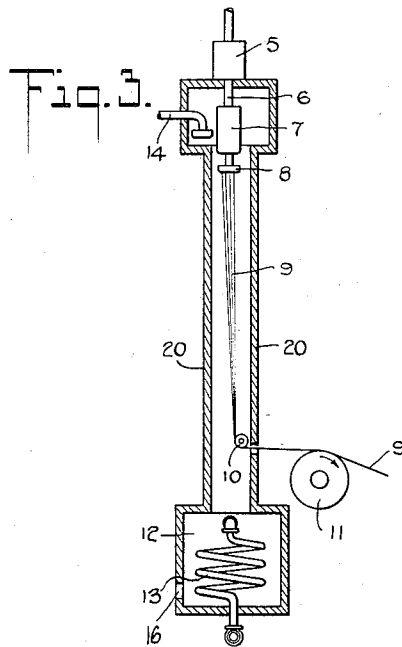
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METHOD OF AND APPARATUS FOR SPINNING

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METHOD OF AND APPARATUS FOR
SPINNING

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This invention relates to method of and apparatus for the manufacture of artificial filaments, such as yarns, bristles and the like, and relates more particularly to those methods where-
5 in a solution of a derivative of cellulose in a volatile solvent is extruded through orifices into a heated evaporative atmosphere, which methods are known as dry spinning.

An object of my invention is to obtain artificial
10 filaments or yarns containing organic derivatives of cellulose that have more uniform lustre than those previously made.

A further object of my invention is to provide process of and apparatus for the dry spinning of
15 artificial filaments of solutions of derivatives of cellulose in volatile solvents, wherein convection currents in the dry evaporative atmosphere are materially reduced.

A further object of my invention is to provide
20 process of and apparatus for dry spinning of artificial filaments from solutions of derivatives of cellulose in volatile solvents, wherein the cross-sectional area of the space wherein the threads of the solution of the derivative of cellulose are sub-
25 jected to the action of the heated evaporative atmosphere is materially reduced, thus increasing the speed of flow of the evaporative atmosphere. Other objects of my invention will appear from the following detailed description.

In the methods heretofore employed for the
30 dry spinning of artificial yarn from solutions of derivatives of cellulose in volatile solvents, such solutions are forced through the orifices of a spinneret into a spinning unit through which a
35 heated evaporative atmosphere flows. These spinning units are of comparatively large cross-sectional area, of 1 square foot or more.

The prior methods do not produce yarns of as
40 uniform lustre or other physical properties as may be desired. I have found that this is due to the fact that because of the comparatively large cross-sectional area of the spinning unit or cell, convection currents are set up by radiation losses and/or evaporation of the solvent from the spin-
45 ning solution, and that these convection currents cause variations in the temperature and the amount of solvent vapors contained in the drying atmosphere in the zone where evaporation of the volatile solvent from the solution is caused.
50 I have further found that the variation in the degree of saturation of the drying atmosphere causes variation in the lustre of the filaments or yarns that are produced. When spinning is per-
55 formed in a drying atmosphere having a high concentration of solvent vapors, filaments of high

lustre are produced; while spinning in a drying atmosphere of low concentration of solvent vapors produces filaments or yarns of low lustre. Thus if convection currents cause drying atmospheres of varying concentration of solvent to
5 come in contact with the spinning solution as it leaves the spinning jet, yarns or filaments of varying lustre will be formed. This variation also causes unevenness of pliability of the yarn.

I have found that if the cross-sectional area of
10 the spinning unit is reduced to $\frac{1}{2}$ or less of that of the spinning units previously employed, yarns or filaments of more uniform lustre or other properties may be produced.

In accordance with my invention I prepare
15 artificial filaments from solutions of organic derivatives of cellulose, for instance, in a suitable volatile solvent by extruding the same through the orifices of a spinning jet into a heated evaporative atmosphere contained in a spinning unit
20 of reduced cross-section. The filaments or yarns thus formed are then drawn off and wound onto a winding machine running at a uniform rate, which winding machine may also impart twist
25 to the filament, if desired. The filaments or yarns thus formed are of a high and uniform lustre and have other desirable uniform optical and physical properties.

Any suitable artificial filaments or yarns may
30 be produced by my invention. The filaments may be fine, say having deniers of less than 2 to 10 or more, to be used as such, or to be associated together to form yarns of various size. Heavier
35 filaments having deniers of 20 to 500 or more may also be made to be used as artificial bristles for brushes or artificial fur. Bands or ribbons may also be made by my invention to be used in making braids or as artificial straw.

Any suitable derivative of cellulose such as or-
40 ganic derivatives of cellulose may be employed which may be organic esters of cellulose and cellulose ethers. Examples of organic esters of cellulose are cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate, while
45 examples of cellulose ethers are ethyl cellulose, methyl cellulose and benzyl cellulose. Solutions of cellulose nitrate may also be spun in this manner, and if desired, the cellulose nitrate filaments
50 or yarns may then be denitrated in any suitable manner.

Any suitable solvent may be employed examples
of which are acetone, mixtures of chloroform and
ethyl alcohol or methyl alcohol, ethylene dichlo-
55 ride, methylene chloride or ether and alcohol, or

other suitable solvents or suitable mixtures of these.

As stated, the spinning unit into which the threads of the solution of the derivative of cellulose are extruded and through which a heated evaporative atmosphere flows, should be of reduced cross-section of $\frac{1}{2}$, $\frac{1}{3}$ or less of that heretofore employed.

Thus, the horizontal cross-section of the spinning unit or cell may be 12" x 4", (48 square inches) or 12" x 2", (24 square inches) especially if a plurality of spinning units, say four or more, are employed in one cabinet. The spinning units may be further reduced in size so that they have a cross-section of 2" x 6", (12 square inches), 3" x 6", (18 square inches), or 4" x 6", (24 square inches), especially in those cases where only two spinning units are employed in one cabinet. The size of the spinning unit may be further reduced so that it has a cross-sectional area of only 2" x 3", (6 square inches) or 3" x 3", (9 square inches), especially in cases where only one spinning unit is employed in the cabinet.

The evaporative atmosphere employed for volatilizing the solvent from the spinning solution may be any appropriate gas, such as air, hydrogen or a gas that does not support combustion such as nitrogen, carbon dioxide, etc. The evaporative atmosphere may be heated in any suitable manner, such as by heating coils or heating elements placed along the vertical walls of the spinning unit or cell. However, because of the restricted cross-section of the spinning unit, such coils or elements on the walls may tend to obstruct free passage of the artificial filaments or threads therethru. Therefore, I prefer to place heating coils or elements in the base of the spinning unit or else to preheat the evaporative atmosphere in a heater before it enters the spinning chamber, or both of these expedients may be employed, thus avoiding close proximity of the heating elements with the vertical walls of the spinning unit. Less desirably, the vertical walls of the spinning chamber may be jacketed and heating means such as steam may pass therethru, or electrical resistances may be placed therein.

In order further to explain my invention, reference is had to the accompanying drawing, wherein

Figure 1 is a vertical cross-section of a cabinet having four spinning units constructed in accordance with my invention.

Figure 2 is a cross-section along line 2—2, and Figure 3 is a vertical cross-section of a modification embodying my invention.

Referring to Figures 1 and 2, the walls of the spinning unit are indicated at 1 and are preferably lagged with heat insulating material. The space within these walls have a cross-sectional area substantially the same as that of spinning units heretofore employed, and therefore in order to restrict the effective cross-section of the drying zone, I provide the baffles 2 which define drying zone 3.

The spinning solution is introduced by the pipe 4 to the pump 5, which supplies a practically uniform amount of spinning solution per unit of time to the pipe 6 which leads to a candle 7 that contains a filtering medium, in order to filter out any trace of solid impurities that may be present in the spinning solution. The spinning solution from the candle 7 passes to the metal cap or jet 8 having a number of holes or orifices of required

size therein, which jet is situated in the upper part of the drying zone 3.

Upon extrusion of the spinning solution through the orifices of the jet 8, the fine threads of spinning solution lose at least part of their volatile solvents as vapors, and assume the form of tough filaments or threads 9 of predetermined size. These filaments pass under the guide roller 10 around the rotating roller 11 and pass to any suitable winding device (not shown). If desired, this winding device may also twist the filaments into a single thread and may be in the form of a cap spinning device.

To cause evaporation of the volatile solvent contained in the spinning solution extruded 15 through the orifices of the jet 6, a heated gas such as air, nitrogen, carbon dioxide or hydrogen is caused to flow up through the spinning unit. The gas may be heated prior to entry in the base of the spinning unit or the air may be heated by 20 steam coils 13 in the base 12 of the spinning unit. If desired, both of these methods of heating the evaporative gas may also be employed. The evaporative gas may be forced into the base of the spinning unit or it may be drawn up through 25 the same by suction supplied to the exhaust pipe 14 which is preferably supplied with a perforated cap 15, entry of the evaporative gas being effected by means of openings 16 in the bases of the spinning units.

To permit inspection of the interior of the cabinet, glass windows 6 are provided in the walls 1; and to permit access to the interior the doors 17 are provided.

In the modification shown in Figure 3, a spinning unit of restricted cross-sectional area is made by the walls 20 of the unit itself instead of having partitions provided in spinning units of standard size to restrict the cross-sectional area thereof as shown in Figures 1 and 2. Otherwise 40 the unit shown in Figure 3 is the same as that shown in Figures 1 and 2.

It will be thus seen that by my invention, the passage through which the drying evaporative atmosphere passes in contact with the artificial filaments or threads under formation is greatly restricted. This restriction causes a much greater linear velocity of gases and vapors for the given volume of evaporative gas that is necessary to effect suitable drying of the filaments under 50 formation. These factors cause great decrease of convection currents, and prevent periodic changes of saturation of solvent vapors around the critical zone of drying of the filaments, and as a result thereof, filaments or yarns having a 55 much greater uniformity with respect to luster, other optical or physical properties and affinity to dyes, both along the length of the same yarn and with respect to other yarns, are obtained.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention what I claim 65 and desire to obtain by Letters Patent is:

1. Method of forming artificial filaments of substantially uniform properties, which comprises extruding a solution of an organic derivative of cellulose in a volatile solvent through orifices immediately into a column of heated evaporative medium having a cross-section not substantially greater than the area occupied by the group of extruded filaments.

2. Method of forming artificial filaments of 75

substantially uniform properties, which comprises extruding a solution of cellulose acetate in a volatile solvent through orifices immediately into a column of heated evaporative medium having a cross-section not substantially greater than the area occupied by the group of extruded filaments.

3. In a device for spinning artificial filaments, the combination of a spinning unit comprising a spinning chamber, a jet through which a solution of a derivative of cellulose is adapted to be extruded in the form of filaments extending into and located within said spinning chamber, the cross-section of said spinning chamber being not substantially greater than the area of the jet, means for causing heated gas to pass through said spinning unit and means for drawing off the filaments.

4. In a device for spinning artificial filaments, the combination of a spinning unit comprising a spinning chamber, a jet through which a solution of a derivative of cellulose is adapted to be extruded in the form of filaments extending into and located within said spinning chamber, the cross-section of said spinning chamber being not substantially greater than the area of the jet, a heating element in the base of said spinning unit, means for causing a gas to flow in contact with said heating element and then through the spinning unit and means for drawing off the filaments.

5. In a device for spinning artificial filaments, the combination of a spinning unit comprising a spinning chamber, a jet through which a solution

of a derivative of cellulose is adapted to be extruded in the form of filaments extending into and located within said spinning chamber, the cross-section of said spinning chamber being not substantially greater than the area of the jet, means for causing heated gas to pass through said spinning unit and means for drawing off the filaments at a point along the length of said spinning chamber.

6. Method of forming artificial filaments of substantially uniform properties, which comprises extruding a solution of an organic derivative of cellulose in a volatile solvent through orifices immediately into a column of heated evaporative medium having a cross-section not substantially greater than the area occupied by the group of extruded filaments and withdrawing the filaments at a point intermediate the extremities of said column of heated evaporative medium.

7. In a device for spinning artificial filaments, the combination of a spinning unit comprising a spinning chamber, walls surrounding said spinning chamber to form a jacket around the same, a jet through which a solution of a derivative of cellulose is adapted to be extruded in the form of filaments extending into and located within said spinning chamber, the cross-section of said spinning chamber being not substantially greater than the area of the jet, means for causing heated gas to pass through said spinning unit and means for drawing off the filaments.

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