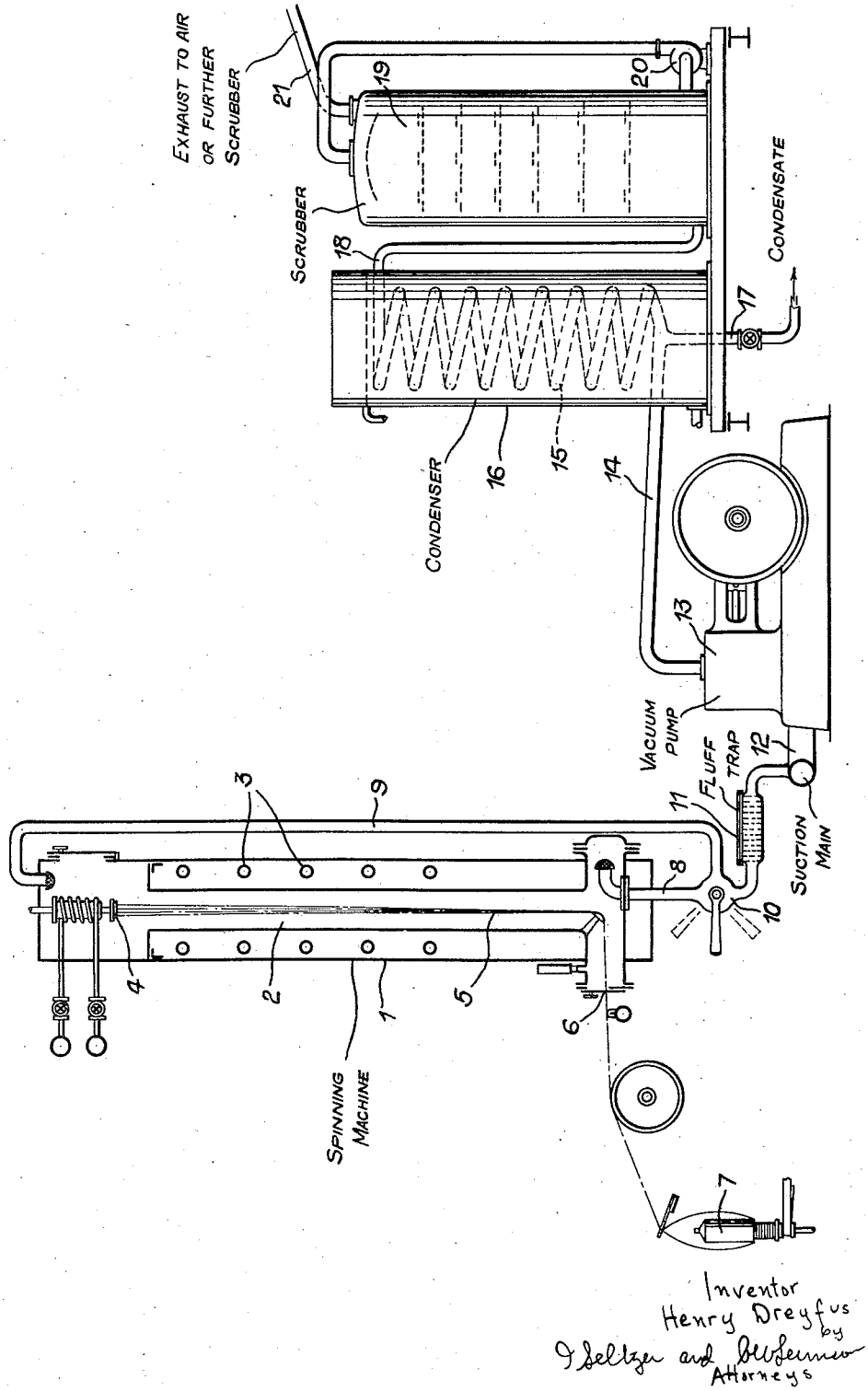
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MANUFACTURE OF ARTIFICIAL FILAMENTS AND THE LIKE

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MANUFACTURE OF ARTIFICIAL FILAMENTS AND THE LIKE

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5 Claims. (Cl. 18—54)

This invention relates to the manufacture of artificial silk or other filaments or threads or ribbons, tapes or straws or the like from solutions of cellulose derivatives, for example cellulose acetate or other cellulose esters or cellulose ethers by the dry-spinning method, that is to say, by extruding a spinning solution containing cellulose acetate or other cellulose derivative dissolved in a volatile solvent liquid through jets or spinnerets into a spinning chamber, and causing the resulting filaments or the like to set or solidify by evaporation of the volatile solvent liquid, after which the filaments or the like are withdrawn from the chamber and wound.

The application is in part a continuation of U. S. application Serial No. 375,150 filed 1st July, 1929.

One of the objects of the present invention is to increase the range of applicability of the dry-spinning method of producing artificial filaments or the like, both as regards the nature of the spinning solutions employed and as regards the character of the filaments or other materials produced therefrom. Other objects and advantages of the invention will be described hereinafter.

In the ordinary method of dry-spinning artificial filaments etc., the spinning solution is extruded into a chamber through which a current of air is caused to flow, the air carrying away from the chamber the solvent vapour extracted from the extruded filaments by the action of heat applied to the chamber and by the evaporative action of the air flowing past the extruded filaments. The air flow is created by connecting a number of chambers (cells) with an exhaust header in which a low suction of about 4–8 inches of water is maintained. This suction suffices to carry away the air from all the cells to the suction pump, and so to a solvent recovery plant. In each cell, however, the degree of suction is even much lower, practically the whole of the 4–8 inches being employed to give the difference of pressure necessary to produce a flow of air through the outlet, which acts as a throttle between the cell and the suction header. In fact, the suction inside the cells is usually of the order of 0.01 inch of water or less.

The atmosphere within the cell under these conditions is, therefore, air at a pressure not materially different from atmosphere, the air including the vapours of extracted solvent in a concentration that increases towards the outlet, though always low, the concentration of the vapour in the air extracted from the cell being about 1–2%.

According to the present invention, the setting or solidification of the filaments or the like in dry-spinning processes is effected by evaporation of the solvent liquid from the extruded filaments or the like in a sub-atmospheric pressure created by a suction of at least 5 inches of mercury. By the adoption of such a high degree of suction inside the spinning chamber, several advantages are obtained. In the first place, a better control is obtained over the cross-section of the filaments, an artificial thread which, if produced under ordinary dry-spinning conditions, would contain a large proportion of flat filaments, or filaments having flattened portions intermittently along their length, being found when spun into an atmosphere maintained at a high degree of suction to be free or substantially so from flat filaments.

Moreover, this advantage is obtained if, using a spinning solution of cellulose acetate dissolved in acetone (B. P. 58° C.), the temperature of the spinning chamber is reduced to the low figure of about 40° C., at which temperature in the ordinary process threads are likely to contain nothing but flat filaments. The invention therefore renders it possible to carry out the dry-spinning process at much lower temperatures than usual, without deterioration of the product and with considerable economy in the consumption of heating medium.

Apart from the chamber being heated to assist evaporation of the solvent, a small quantity of air or other evaporative medium may be admitted to the chamber, such quantity being, of course, insufficient to affect the ability of the suction plant to maintain the pressure sufficiently reduced. Where, however, a high degree of suction is to be maintained, in which connection it is to be noted that satisfactory production of artificial filaments can take place according to the invention with a degree of suction of 23 inches of mercury or higher, care should be taken to prevent the ingress of an undue quantity of air into the chamber (e. g. through the outlet opening leading the filaments to the winding device) under the very large difference of pressure existing between the inside of the chamber and the outside atmosphere. Very good results are obtained with the suction at about 15 inches of mercury (204 inches of water), filaments of good extensibility (22–28%) and of rather better tenacity than filaments spun by the ordinary process being produced, as well as the thread of filaments being of excellent commercial quality as regards its content of round (bulbous) cross-sectioned filaments.

It is also an advantage of the process that the solvent can be more easily recovered from the vapours drawn from the spinning chamber, the exhausting means delivering the extracted vapours to a suitable condensing plant, which may be followed by a scrubbing plant.

The invention will now be described in relation to the construction and operation of the apparatus shown in the accompanying drawing.

The spinning machine comprises a casing 1 containing a number of cylindrical cells 2 (of which one is shown in section in the drawing) heated by means of steam pipes 3, the number of pipes in service determining the temperature of the cells. A spinning jet 4 is located above the cell 2, the filaments 5 formed by extrusion of spinning solution, e. g. cellulose acetate dissolved in acetone, from the jet and elimination of solvent (acetone) from the solution in the cell passing through the outlet 6 to be wound as a thread by the cap-spinning device 7.

The interior of the cell 2 is freely connected by the pipes 8, 9, the cock 10, by means of which either of the pipes can be brought into action, and the fluff trap 11 to the suction main 12 leading to a vacuum pump 13. By reason of the free connection of the pump 13 with the cell 2, a high degree of vacuum, say 15 inches of mercury, is maintained inside the cell 2, so that the spinning solution is extruded into an atmosphere at a considerably reduced pressure.

The casing 1 and the cell 2 are made substantially air-tight, and the outlet 6 is formed with an opening just sufficient to allow the filaments to emerge, so that entry of air into the cell is reduced to a very small amount. Any air admitted is drawn through the cell by the applied suction and is led away along with the solvent vapours extracted from the filaments through the main 12.

The length of filament run from the jet 4 to the outlet 6 is sufficient to enable the extruded filaments to become set and to contain relatively little solvent when they leave the cell. The lustre of the product is controlled by the temperatures at which the spinning solution and the cell are maintained, and the cross-section of the filaments is caused to be round or bulbous by reason of the setting of the filaments taking place in vacuo.

Any waste filaments collecting within the spinning machine, e. g. during starting up the spinning operation, are prevented by the fluff trap 11 from reaching the suction main 12.

The pump 13 is connected by the pipe 14 to a coil 15 in a condenser 16, the location of the condenser on the exhaust side of the pump facilitating the condensation of the solvent (acetone) vapour withdrawn from the cell 2 by the pump, since the extraction of the solvent does not take place under the low-pressure conditions existing on the suction side of the pump. Condensate is withdrawn by the pipe 17 from the bottom of the coil 15.

The top of the coil 15 is connected by a pipe 18 to a scrubber 19 through which water is circulated by the pump 20 to remove uncondensed vapours. An exhaust pipe 21 leads from the top of the scrubber 19 to the atmosphere or to a further scrubber.

In starting up spinning, the cell 2 being initially under substantially atmospheric pressure, the cock 10 is adjusted to connect the pipe 8 with the suction main 12, so that the flow through the cell is downwards, i. e. in the same direction as the filaments 5. When the thread has been applied to the spinning device 7 and the outlet 6 closed until it just permits the passage of the thread, the cock 10 is turned to cut off the pipe 8 and open the pipe 9 to the suction main. The suction is then applied at the top of the apparatus near the jet 4 and remains so during continuance of spinning. In the third position of the cock 10, both pipes 8 and 9 are cut off to isolate the cell 2 when spinning is discontinued in that cell.

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

1. Process for the production of an artificial filamentary product comprising extruding a spinning solution containing a cellulose derivative dissolved in a volatile solvent liquid into a zone maintained at a sub-atmospheric pressure equivalent to a suction of at least 5 inches of mercury and withdrawing the filamentary product from the sub-atmospheric zone for collection after setting of the product by evaporation of the solvent liquid.

2. Process for the production of an artificial filamentary product comprising extruding a solution of cellulose acetate in a volatile solvent liquid into a heated zone maintained at a sub-atmospheric pressure equivalent to a suction of at least 5 inches of mercury and withdrawing the filamentary product from the heated sub-atmospheric zone for collection after setting of the product by evaporation of the solvent liquid.

3. Process for the production of an artificial filamentary product comprising extruding a spinning solution containing a cellulose derivative dissolved in a volatile solvent liquid into a zone maintained at a sub-atmospheric pressure equivalent to a suction of at least 5 inches of mercury, a slight flow of evaporative medium being provided through said zone, and withdrawing the filamentary product from the sub-atmospheric zone for collection after setting of the product by evaporation of the solvent liquid.

4. Process for the production of an artificial thread comprising extruding as a plurality of filamentary streams a spinning solution containing cellulose acetate dissolved in acetone into a zone maintained under a suction of about 15 inches of mercury and at a temperature of about 40° C., withdrawing the filaments from the zone after setting thereof by evaporation of the acetone, and collecting the filaments as a thread.

5. Process for the production of an artificial filamentary product comprising extruding a spinning solution containing a cellulose derivative dissolved in a volatile solvent liquid into a zone maintained at a sub-atmospheric pressure equivalent to a suction of at least 5 inches of mercury, withdrawing from the zone solvent vapour extracted from the extruded spinning solution by the sub-atmospheric pressure, and delivering the solvent vapour to a condenser at a higher pressure for recovery of the solvent by condensation.

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