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METHOD AND APPARATUS FOR PRODUCING FINE HOLLOW THREADS

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Fig. 1.

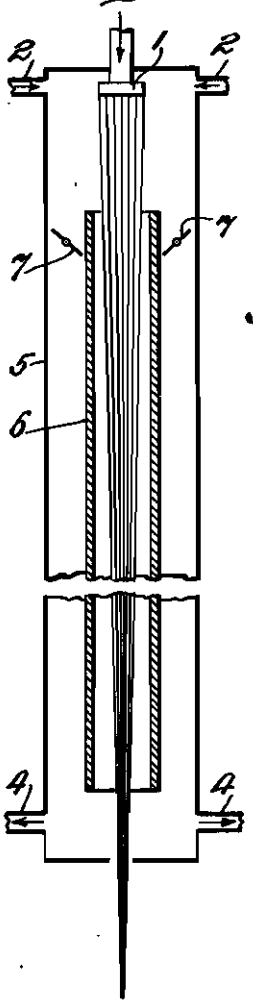


Fig. 2.

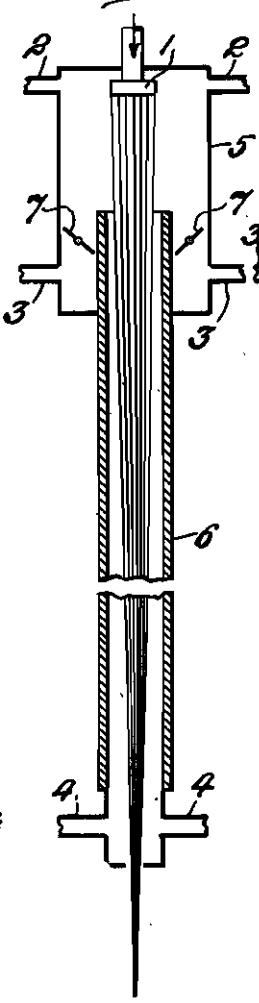


Fig. 3.

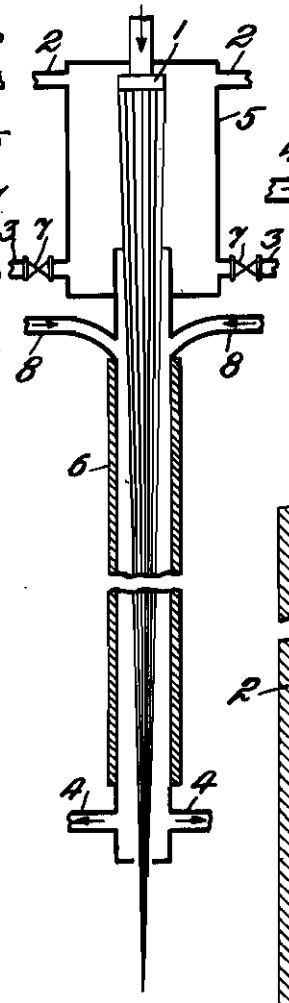
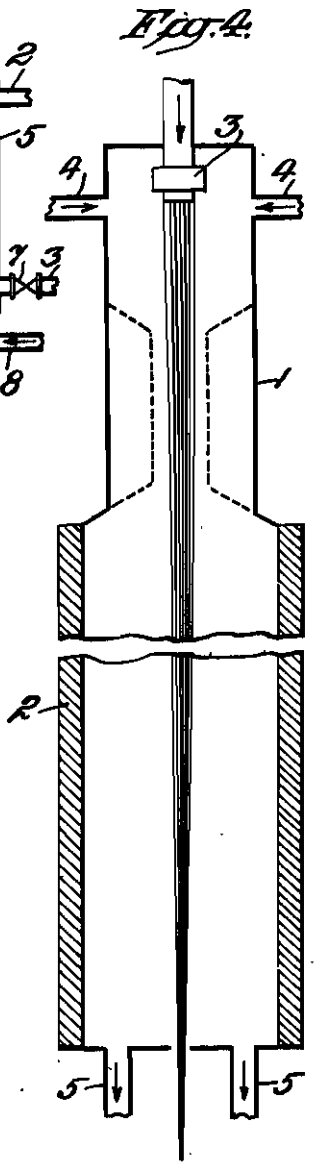


Fig. 4.



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METHOD AND APPARATUS FOR PRODUCING FINE HOLLOW THREADS

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Hollow filaments from solutions of acyl cellulose may be partially obtained according to the usual dry-spinning process if thereby the temperature of the drying gas is considerably raised above the boiling point of the solvent and if the speed of spinning is reduced. According to this method, it is not possible to obtain only hollow threads in a technically satisfying manner; on the other hand the speed of spinning must thereby be reduced in such a way that the production of hollow threads becomes uneconomical.

Now it has been found that it is necessary to apply quite determined temperatures and streaming conditions of the drying gas in order to obtain fine hollow threads with security by the usual speeds of spinning of 150 m and more pro minute. According to this invention the thread passes two steps of treatment. In the first step the thread is rapidly and partially freed from the solvent by a strong current of warm gas, the temperature of which does not considerably lie above the boiling point of the solvent. In this time the surface is solidified while the interior of the thread is still fluid and contains solvents. The drying gas thereby may stream in the direction of the thread or against it. Then the thread passes a second zone where the gas has a temperature lying considerably above the boiling point of the solvent. In this zone the thread forms hollow spaces by evaporating of the solvent in the interior of the thread, whereby the thread becomes tubelike. The raising of the temperature in the second zone may be executed in such a way that the walls of the room through which the threads pass are heated or by introducing hot gas into the room and so on. Two possibilities are given for the treatment of the thread in the second zone. This zone may be feeded by only a part of the drying gas which was applied in the first zone for instance by streaming off of a part of the drying gas from the first zone. But it is also possible to introduce the drying gas into the treating room in such a way the gas streams against the direction of the thread. In this case no drying gas from the first zone comes in the second zone. The room of treatment is suitably a narrow canal whereby the thread passes near the wall. The second possibility for the treatment of the thread in the second zone consists in diminishing the velocity of the drying gas in contrast to the velocity in the first zone. This is possible, if the second zone has a considerably higher diameter than the first zone. By this way a higher velocity of the drying gas in the first zone is attained. By this method in combination with the heating up of the second zone the threads only solidified on the surface by evaporating of the solvent in the first zone, blow up whereby hollow spaces respectively hollow filaments are formed. According to the invention fine hollow threads with 3–4 and fewer denier are formed by means of the usual speeds of spinning of 150 m pro minute and more. The hollow threads have a diameter which is about 3–4 times larger than that of complete threads of the same titre.

The apparatus used differs somewhat from the usual ones. Above all, they have a heatable canal being generally as long as the spinning cell and arranged in some distance from the spinnerette. The canal is heated by steam or electrical manner. It is also possible to blow hot gas into the canal in order to introduce additional heat into the interior of the canal. If, in the simplest case, the heated canal is arranged in some distance from the spinnerette, a part of the drying gas can stream off between the canal and the inner walls of the spinning cell and this part meets at the end of the canal again the drying gas which streams through the canal. The amount of the drying gas branched off is regulated by suitable devices like flaps or valves and the like. The Figs. I to III show in section an apparatus according to the invention. Essentially the apparatus consists of the spinnerette **1**, and the pipes **2**, **3** and **4** through which the drying gas enters respectively leaves. **6** is a narrow heatable canal through which the threads pass as near the walls as possible. Flaps or valves **7** are further arranged for regulating the movement of the gas in the interior of the spinning cell.

Fig. I shows in the interior of the spinning cell **5** a heatable canal **6** arranged in some distance below the spinnerette **1**. Between the spinning cell **5** and the canal **6** some flaps or valves **7** are fitted. The apparatus works as follows: A spinning solution nearly gelatinized enters the interior of the spinning cell **5** through the spinnerette **1**. Through the pipes **2** hot gas is blown into the spinning cell. In some distance from the nozzle the threads are then solidified on the surface whilst the interior of them is nearly fluid. A part of the drying gas enters the room between the spinning cell **5** and the canal **6** according to the position of the flaps **7** and meets at the end of the canal again that part of drying gas streaming through the canal. Thereby it is attained that the speed of streaming in the canal **6** be-

comes not too high for the formation of hollow threads, what would arrive if all the gas entering the spinning cell at 2 would pass the canal 6. When the threads are solidified on the surface, they pass the heated canal 6 whereby the solvents in the interior of the threads evaporate and tubelike hollow threads are formed.

Fig. II shows the spinning cell 5 and a heated canal 6 which enters the spinning cell at the bottom of the cell. At the lower parts of the spinning cell 5, pipes 3 are arranged through which the drying gas enters or leaves. By this arrangement the drying gas may enter the first zone from above through the pipes 2 or from below through the pipes 3 whereby the drying gas moves either in the direction of the forming thread or opposite to it. In this first zone the threads form a skin on the surface. The drying gas forming hollow spaces in the interior of the thread enters the heated canal 6 either from the spinning cell or through the pipes 4. The amount of this part of drying gas is considerably lower than the amount in the cell 5 solidifying the threads only on the surface.

The arrangement in accordance with Fig. III differs from that of Fig. II in such a way that pipes 6 for hot gas enter the upper part of the heated canal 6. By this way the heating of the interior of the canal is favoured and, if necessary, the evaporating of the solvent may be accelerated. The arrangement of hot gas-pipes according to Fig. III may also be applied in arrangements according to Figs. I and II.

In order to give the drying gas a lower speed in the second zone of the spinning cell than in the first one the lower part of the spinning cell is wider. Fig. IV shows schematically this kind of arrangement.

1 is a spinning cell the lower end 2 of which is widened and provided with a heating jacket. Instead of a heating jacket, a heating coil or other means may be applied for heating up the cell. 3 is the spinnerette and 4 and 5 are the pipes for entering or leaving drying gas. The spinning cell is suitably contracted between the upper and the lower part of the cell marked by an interrupted line in Fig. IV.

The apparatus is operating as follows: The spinning solution nearly gelatinized enters the upper part 1 of the spinning cell through the spinnerette 3. The drying gas entering the cell through the pipes 4 solidifies the thread on the surface and forms a skinlike coating. Then, the threads pass the lower part 2 of the spinning cell where the speed of the streaming gas is considerably lower because this part is wider. In this part of the apparatus heated up to a higher temperature by means of a heating jacket, the threads are blown up under formation of hollow spaces whereby hollow threads are formed. Highly heated gas may be blown into the spinning cell near the widening in order to increase the effect of heat in the lower parts 2 of the spinning cell.

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