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MANUFACTURE OF ARTIFICIAL MATERIALS

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Fig. 1.

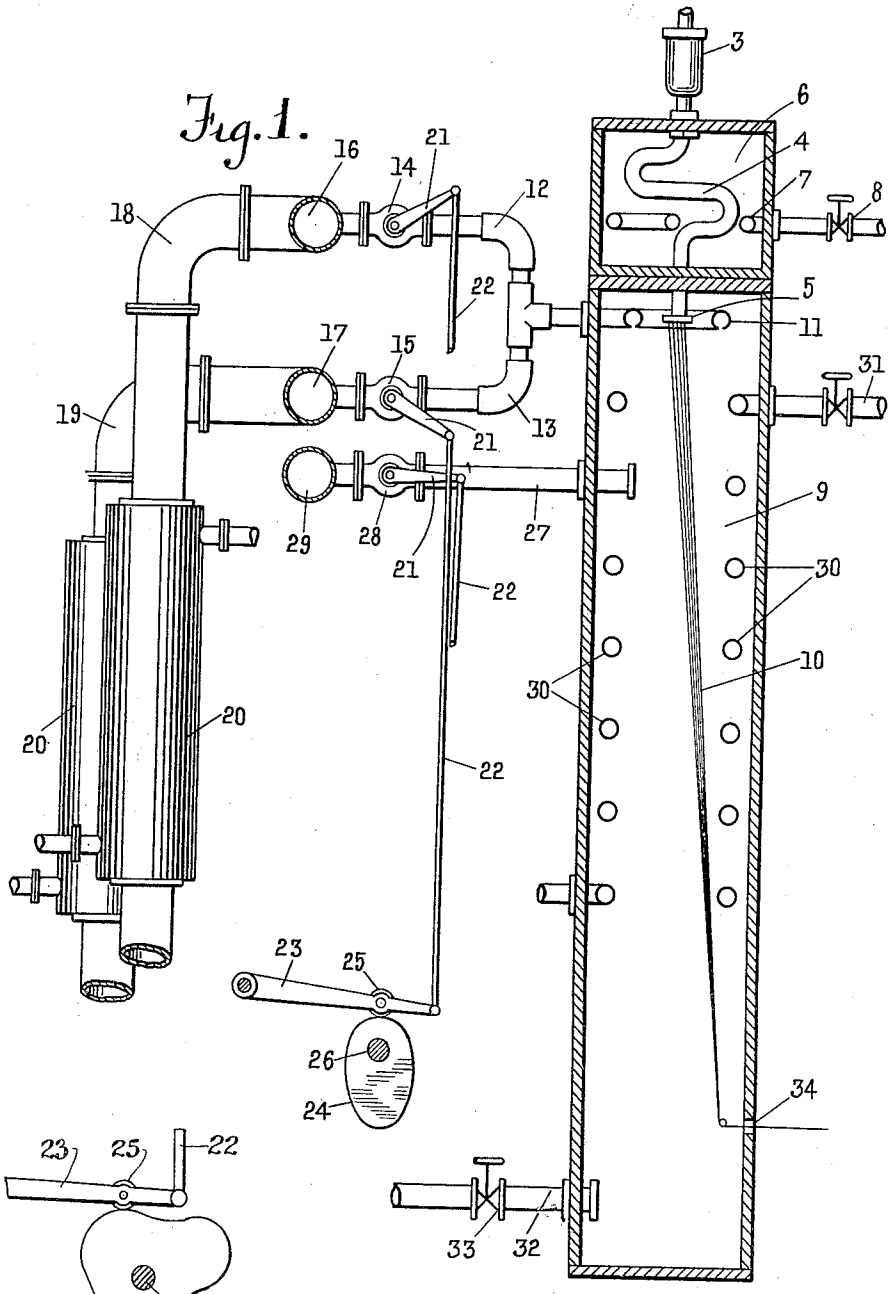


Fig. 2.

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MANUFACTURE OF ARTIFICIAL MATERIALS

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10 Claims. (Cl. 18—8)

This invention relates to the manufacture of artificial filaments, yarns, or threads (hereafter referred to as "filaments") and has for its object to produce filaments having useful novel characteristics, fabrics and articles made from or containing the novel filaments also being included within the scope of the invention. The invention is particularly concerned with the manufacture of artificial filaments from solutions of cellulose acetate or other organic derivatives of cellulose by the dry or evaporative method, i. e., by extruding the solutions into an evaporative medium by which the volatile solvents employed in the solutions are eliminated from the filaments.

In the spinning of filaments of cellulose acetate or other organic derivatives of cellulose, though the spinning orifices through which the filaments are extruded generally have a cross-section which is substantially circular, it is well known that the filaments produced may, according to the circumstances of the spinning operation, have a cross-section which is other than circular. For example, if the filaments are drawn from the jet other than perpendicularly to the jet face, a more or less flattened cross-section results. Such variations from the roundish cross-section are however more frequently met with as the result of the influence of the particular evaporative conditions under which the spinning solutions are extruded on the setting of the filaments. By a suitable choice of such conditions, filaments having any desired cross-section, varying from the "flat" to more or less completely round filaments, having either a smooth or an irregular surface, may be produced, as well as filaments of a more or less tubular or cellular structure.

The object of the invention is to produce filaments from solutions of cellulose acetate or other cellulose derivatives by the dry or evaporative method, the cross-sectional characteristics of which filaments exhibit a periodic variation along the length of the filaments, and according to the invention such periodic variation is effected by periodically varying one or more of the evaporative conditions under which the spinning solutions are extruded. Among the evaporative conditions which may be so adjusted, those most readily capable of variation during the spinning operation are (1) the temperature of the spinning solution, (2) the temperature of the evaporative atmosphere into which the filaments are extruded, (3) the relative proportions of solvent and evaporative medium in the evaporative atmosphere, and (4) the rate at which the evaporative atmosphere is carried from the spinning chamber, but, of course, the concentration and viscosity of the spinning solutions are also factors which determine the physical form of the filaments and variation in these factors is accompanied by corresponding changes in the form of the filaments spun from the spinning solution.

Any one or more of the conditions mentioned may be varied periodically during spinning to the same, or to a regularly or irregularly variable degree, at more or less frequent intervals of regular or irregular occurrence and regular or irregular duration, to produce a corresponding controlled irregularity in the cross-section of the filaments. By arranging for a periodic variation in at least two of the conditions, it is possible to produce filaments which exhibit at different intervals along their length a departure from a normal cross-section in more than one direction. Thus, for example, lengths of flattened cross-section may occur together with lengths of a cellular or tubular character in filaments otherwise of a roundish cross-section.

The spinning conditions employed in the production of the filaments may be such as would normally produce filaments having a roundish cross-section, variations in one or more of these conditions then resulting in a periodic departure from this roundish cross-section to some other cross-section or cross-sections. It is to be understood, however, that by appropriate choice of spinning conditions, the filaments produced need not exhibit a round cross-section except, if desired, as a variation at intervals between lengths of other cross-section determined by the conditions employed.

Periodic variation in the temperature of the spinning solution may be carried out in various ways, for example, by the provision of heating means arranged to bring the solution to any required temperature on its way to the spinning jet and capable of varying in temperature in accordance with the required variation in cross-section of the filaments. Preferably, in order to ensure that the temperature variations so imparted are not unduly influenced by other temperature conditions prevailing in the spinning cell, the heating means are arranged as near as possible to the spinning jet and may actually be incorporated in the jet. Any suitable means may be used to control the heating fluid or other medium employed so as to vary the temperature of the solution. Thus, where a fluid such as steam is employed, a valve may be actuated by mechanism operating at desired intervals to increase or decrease the flow of the fluid through

the heating means. Similarly, a switch or rheostat may be employed to vary the action of an electric heating element used as a heating device.

The temperature of the spinning solution may also be influenced by heating means arranged in the spinning cell so as to concentrate heat to a greater or lesser extent in the neighbourhood of the spinning jet. These means may also serve to vary the temperature of the evaporative atmosphere (hereafter referred to as "air") in the regions of the jet, which may further be introduced into the cell at any desired temperature, whether variable or constant.

For the variation in solvent concentration of the air in the spinning cell, means may be provided to introduce solvent vapour, alone or mixed with air or other gas at intervals into the cell in such proportions that any desired concentration of solvent vapour is maintained. Preferably, the solvent vapour is arranged in the vicinity of the spinning jet, slotted or perforated pipes or tubes such as those described in U. S. application S. No. 382,907 filed 2nd August, 1929 being particularly suitable for this purpose.

Instead of introducing solvent vapour at intervals, air or other gas may be introduced to reduce the concentration of solvent vapour in the cell by means such as those described above. The discharge of solvent vapour, air, or other gas, is preferably effected in symmetrical manner with respect to the filaments, but if it is immaterial whether all the filaments which are extruded simultaneously from one nozzle are treated uniformly, this precaution need not be taken.

Any suitable control device may be used to regulate the intervals at which the solvent vapour, air, or other gas is introduced, the duration of flow of vapour or gas and the amount of vapour or gas admitted. For example, one or more valves may be fitted in the supply pipe for the vapour and actuated as required by a suitable timing-mechanism operating in accordance with the periodic effect to be produced on the filaments.

In methods involving a periodic change of solvent vapour concentration, the filaments may be extruded into a more or less stagnant zone in the neighborhood of the spinning nozzle, the withdrawal of solvent-laden evaporative medium from this zone being at such a rate that the concentration of solvent vapour in the zone is maintained above the normal. The cross-section of the filaments is modified by introducing periodically into the zone air or other gaseous medium to reduce the concentration of solvent vapour to any desired extent, and for any desired duration, the interval between each introduction of air or other gas determining the lengths of the unmodified parts of the filaments.

The degree of concentration in the more or less stagnant zone may be chosen at an intermediate value, and the cross-section of the filaments may be modified by periodically introducing solvent vapour or air or other gas or solvent vapour and air or other gas alternately or in any desired sequence.

Variations in the rate at which the air flows through the spinning cell may result in corresponding variations in the cross-section of the filaments by their influence on the solvent vapour concentration as well as on the rate of evaporation of solvent from the filaments immediately on extrusion. The variation of the rate of air flow may be conveniently effected by means of a valve which regulates the suction outlet from the spinning cell.

The filaments produced according to the above methods may be collected in any suitable manner, as by winding or twisting and winding, and may be twisted or doubled with similar or other artificial filaments or with yarns, filaments, or threads of other filaments or fibres, such as cotton, silk, or wool. Yarns or threads made of or containing the filaments of intermittently varying cross-section may be formed into fabrics or articles by weaving, knitting, braiding, cording, or any other appropriate textile operations.

The invention will now be described in greater detail with reference to the accompanying drawing of which Figure 1 is a view of my improved apparatus, the spinning cell being in section to show the interior thereof, and Figure 2 is a detail view of an alternative form of cam, but it is to be understood that this description is given by way of example only and is in no respect limitative.

Spinning solution is supplied to a filter 3 and is passed thence through a coiled pipe 4 to a jet 5. In order to cause the temperature of the spinning solution to vary the coil 4 is enclosed in a bath 6 which contains a system of heating pipes 7 supplied with heating fluid through a valve 8. It will be seen that since the jet is so close to the bath 6 the temperature of the spinning solution will follow very closely that of the bath, which may be varied by varying the temperature of the heating fluid supplied to the pipes 7 or by manipulation of the valve 8.

The jet 5 is enclosed in a spinning cell 9, into which the filaments 10 are extruded, the cell being provided with an aperture 34 by which the filaments are removed. Surrounding the spinning jet 5 is an annular air jet 11 adapted to blow jets of air or other gases or vapours symmetrically round the bundle of filaments 10. The jet 11 is supplied from two pipes 12 and 13 provided with valves 14, 15, headers 16 and 17 preferably supplying a number of spinning cells each provided with such valves and supply pipes. Air or other gases are supplied to the headers 16 and 17 through main supply pipes 18, 19, which are provided with heaters 20. The gases in either or both of the pipes 18 and 19 may be loaded with acetone vapour or other vapours, and may be heated to any desired degree by the heaters 20. Solvent-laden air may conveniently be produced for introduction through the jet 11 in this manner by blowing air through a heated vessel containing a porous material, such as coke, saturated with a solvent such as acetone, and either or both of the heaters 18, 19, may be adapted for this purpose. The air leaves the vessel 18 or 19 more or less saturated with acetone vapour and is conducted to the spinning cell through the supply pipes 16, 17 leading to the spinning cell. The solvent may, however, be drawn in controlled amounts, through a jet into the air or other gases before or after heating by suitable aspirating means, the air or other gas being caused to vaporize the solvent and carry it to the spinning cell 9. It is preferred that one pipe, say 12 should supply gases laden with solvent vapour, and the other, gases not so laden, so that by suitable control, a mixture containing any desired and variable concentration of solvent vapour may be introduced by the jet 11.

Control of the valves 14 and 15 and thereby of the quantity and nature of the gases introduced

through the jet 11, is obtained by means of arms 21 operated by rods 22 which are attached at their lower ends to levers 23 operated by the action of one or more cams 24 against a bowl 25 on the lever 23. The several rods 22 connected with one spinning cabinet may be operated by cams on the same shaft 26 or by cams on different shafts rotating at the same or different speeds, and if by the same shaft, or at the same speed, the degree of opening of the valves at any moment, may be in the same phase, or in different phases, as desired. A cam 24' of irregular periphery may be used, if desired, to produce irregular control by valves 14 and 15.

The evaporative atmosphere is withdrawn from the cell by means of a pipe 27 leading to a valve 28, to a header 29. The valve 28 is controlled by an arm 21 and a rod 22 in the same way as the two valves 14 and 15. In this manner the rate of draw-off of the air in the cell is caused to vary, with due effect upon the cross-sectional characteristics of the filaments 10.

The cell is heated inside by means of heating pipes 30 supplied with heating fluid through a valve 31. The temperature of the heating fluid may be varied or the rate of its flow may be controlled by manipulation of the valve 31. The evaporative atmosphere is introduced into the cell through the pipe 32 and the valve 33. The air entering in this manner may also be heated intermittently or constantly, and in addition the rate of its flow may be caused to vary by means of the valve 33. Either the valve 31 or the valve 33, or both of them may be controlled by means similar to those described and illustrated with reference to the valves 14, 15 and 28.

In a similar manner, the valve 8, controlling the heating means 7 in connection with the bath 6 may be automatically controlled to open and close periodically by a device of the same kind. The bath 6 may be filled with any desired fluid as for example, air, or other gas, or a liquid, preferably having a relatively high coefficient of thermal conductivity with a low specific heat, so that it will take up and transmit rapidly the variations in temperature imparted by the pipes 7. Alternatively to the heating pipes 7 an electrical resistance may be used in connection with the bath 6, for heating purposes, and such a resistance may also be varied by control means similar to that applied to the valves 14, 15, and 28. Such an electrical resistance may be placed much more closely in association with the coiled supply pipe 4, or even with the jet 5. In this manner the temperature of the spinning solution extruded from the jet 5 may be caused to vary periodically, the effect of such variation being superposed on the variations induced in the filaments by the other means described.

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

1. Process for the production of artificial filaments from spinning solutions of cellulose derivatives by the dry or evaporative method, said process comprising periodically varying the evaporative conditions under which the spinning solution is extruded, whereby filaments are produced having cross-sectional characteristics periodically varying along their length.

2. Process according to claim 1, wherein a spinning solution of cellulose acetate is extruded.

3. Process according to claim 1, wherein the conditions influencing evaporation are periodically varied for intervals of regular occurrence or duration.

4. Process according to claim 1, wherein the conditions influencing evaporation are periodically varied for intervals of irregular occurrence or duration.

5. Process according to claim 1, wherein at least two of the conditions influencing evaporation are periodically varied so that each of the varied conditions exerts its own influence on the cross-section of different lengths of the filaments.

6. Dry-spinning apparatus for the production of artificial filaments of organic derivatives of cellulose, said apparatus comprising a chamber, a spinning jet within said chamber adapted to extrude a spinning solution, and means in connection with said chamber adapted automatically to vary periodically the evaporative conditions under which said spinning solution is extruded.

7. Apparatus according to claim 6, comprising automatic means for introducing evaporative gases into the cell in the neighborhood of the jet in periodically variable amounts.

8. Apparatus according to claim 6, comprising automatic means for introducing evaporative gases into the cell in the neighborhood of the jet, and means for automatically loading said gases to a periodically variable degree with vapors of material which is a solvent for the substance of the filaments.

9. Apparatus according to claim 6, comprising automatic means for introducing evaporative gases into the cell in the neighborhood of the jet in periodically variable amounts, and means for automatically loading said gases to a periodically variable degree with vapors of a material which is a solvent for the substance of the filaments.

10. Apparatus according to claim 6, comprising automatic means for periodically varying the rate of flow of evaporative atmosphere through the spinning cell.

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