

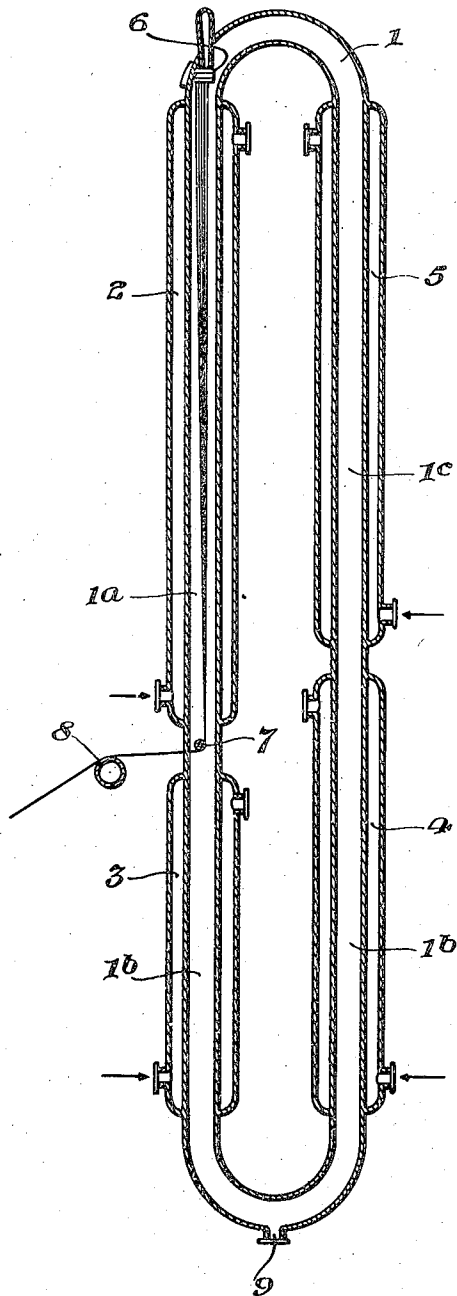
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APPARATUS AND METHOD OF DRY-SPINNING VINYL COMPOUNDS

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APPARATUS AND METHOD OF DRY
SPINNING VINYL COMPOUNDS

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The present invention relates to apparatus and process of dry-spinning solutions of vinyl polymers, which makes it possible to obtain remarkable results especially with relation to the stability of the spinning and the regularity in the quality of the products obtained.

This process is applicable to the manufacture of filaments, threads, fibres, artificial horse-hairs, straws, slivers, strips, sheets, ribbons, etc. It is characterised in that solely by reason of their movement the products in the course of spinning carry with them their evaporative atmosphere, consequently with a speed virtually the same as their own, in a closed circuit where this atmosphere undergoes after emergence of the said products a cooling which ensures the condensation of the solvent or solvents which have been evaporated.

The fact that the circulation of the evaporative medium is necessarily in harmony with the movement of the threads, filaments, etc., makes the process according to the invention particularly favourable to obtaining excellent stability in spinning. Furthermore the speed of the gaseous current being practically constant, this ensures a great regularity in the drying and in consequence in the dynamometric qualities of the threads. The vigorous cooling of the atmosphere in the circuit after the emergence of the filaments ensures that it retains only very little solvent vapour when it returns to the spinneret and thereby avoids the sticking together of the filaments, which would otherwise tend to be produced.

The process according to the present invention can be used with any suitable apparatus, but it naturally follows that this apparatus should not offer to the circulation of the evaporative atmosphere a resistance greater than the energy imparted to it by the threads, filaments, etc. This can be obtained by avoiding as far as possible any constrictions and any other sources of loss of impetus.

The process can be applied to all solutions which are capable of a dry-spinning process with vinyl polymers in all desired solvents, for example, to solutions of polyvinyl chloride in solvent mixtures containing carbon disulphide and also in tetrahydrofuran, glycolformal or other known solvents, to solutions of overchlorinated polyvinyl chloride in the same solvents as well as to the spinning of solutions of copolymers of vinyl chloride and vinyl acetate in various solvents, as for example, to the spinning of solutions of these products in acetone.

According to the process of the invention one obtains a very remarkable recovery of solvent with excellent yields even with very volatile solvents, while at the same time preserving a very remarkable stability of spinning, even when the filaments in the spinning chamber are very close together.

The evaporative atmosphere for carrying out the process according to the invention is generally formed by air; this can, however, be wholly or partially replaced by a different gaseous medium, for example, by carbon dioxide or nitrogen, etc. or any other gas adapted to reduce the risks of fire and explosion. Working in a closed circuit and the automatic circulation give conditions particularly favourable to such replacements. One can thus at the starting of the process displace the air out of the apparatus by the introduction of the chosen evaporative medium and when the spinning is once started and the circuit made practically airtight the introduction of the chosen evaporative atmosphere can be stopped.

The following examples are given to illustrate the process, but should not be considered as limitative. It is to be understood that the products manufactured according to the invention can contain various adjuvants such as dyes, loadings, pigments, plasticisers, etc. and that they can be subjected to any textile operations such as stretching, winding, cutting, curling, scraping, the application of a finishing dressing, sticking together, knitting, weaving, etc.

Example 1.—A solution formed of:

	Parts by weight
Polyvinyl chloride (polymerisation grade: 550)	30
Carbon disulphide.....	35
Acetone	35

is heated to a temperature of 75° C. and extruded through a spinneret containing 24 orifices each 0.08 mm. diameter into an evaporative chamber heated by a jacket or by the circulation of steam to 120° C. The evaporative chamber is connected with a cooling chamber and followed by a heating chamber, the whole of the apparatus being free from constrictions in such a way that the evaporative atmosphere surrounding the filaments is carried along by their movement and practically at the same speed. When the filaments leave the spinning cell which takes place through a lateral orifice just sufficient for their free passage, the atmosphere thus entrained follows on the contrary its own way passing into the cooling cham-

ber where it is cooled to -6°C . and then to a reheater where it is brought to 95°C . and it is then drawn again into the spinning cell by the movement induced by the fresh quantities of thread in circulation.

By regulating the flow of the spinning solution in a suitable manner one thus obtains at a speed of 170 metres per minute, a thread of 300 deniers of practically round cross-section which after stretching 360% in water at 97.5°C . has the following characteristics:

Titre of the thread: 75 deniers, 24 filaments
Tensile strength: 2.96 g. per denier
Elongation: 10%

By way of illustration there can be used for carrying out this example an apparatus such as that illustrated in the drawing. In this figure the apparatus is formed by the tube 1, of which the jackets 2 and 5 are heated by circulation of steam at 120°C . and the jackets 3 and 4 cooled by circulation of brine at -17°C . That portion of the tube 1 designated 1^a constitutes the evaporation chamber or spinning cell; the portions designated 1^b constitute the solvent condenser, and the portion designated 1^c constitutes the reheater.

The spinneret is shown by the Figure 6, the filaments formed are united by a guide roller 7, carried away by the roller 8 and then led to an arrangement for giving a coating and finishing dressing which is not shown in the drawing.

When starting and the conditions being such that the spinneret 6 delivers the dope into the cell 1^a while the filaments are not yet united on the guide roller 7 and conducted to the winding apparatus, the evaporative atmosphere remains stationary, but when the filaments are being regularly wound up and drawn along, they set the said atmosphere in motion in the direction of their movement and at practically the same speed. After emergence of the filaments, the atmosphere passes into the cooled part of the chamber, thereby causing the solvent mixture to condense and the condensed liquid emerges by the orifice 9 while the evaporative medium continues its circuit and passes into the part of the tube heated by the jacket 5 before returning to the spinneret.

Example 2.—As starting material there is used a commercial polymer obtained by the copolymerisation of vinyl chloride and vinyl acetate and entirely soluble in acetone containing 5% of water. A solution of 46% by weight of this polymer in acetone containing 2% of water is led to a heating head where it is brought to 75°C . and extruded through a spinneret having 260 orifices of 0.06 mm. each, into an evaporative cell heated by a jacket in which steam circulates at 130°C . This evaporative cell is connected with a cooling chamber followed by a heating chamber, the whole being without any constriction, so that, as in the preceding example, the atmosphere surrounding the filaments is carried along solely by their movement and practically at the same speed.

When the filaments leave the spinning chamber, the evaporative atmosphere follows its own course and passes into the cooling chamber where it is cooled to 0°C . and then into the heater where it is brought to 90°C . and it then returns to the cell in the neighbourhood of the spinneret.

By regulating the output of the pumps in a suitable manner one thus obtains with remark-

ably steady spinning a thread which is then stretched to 450% of its length while it is rendered plastic by passage through water at 95°C .

By regulating the rate of flow of the spinning solution, the speed of winding and the stretching in a suitable manner, there is obtained a thread of 300 deniers containing 260 filaments, possessing great smoothness and excellent dynamometric qualities.

Example 3.—By working as in Example 2 and using an acetone solution containing 45% of commercial over-chlorinated polyvinyl chloride containing about 64% of chlorine, there is obtained a thread of regular cross-section which can, if desired, be immediately stretched to more than 300%, while maintaining it at a temperature above its softening point.

The examples given above have been concerned with spinning operations in which the vinyl polymers are employed alone. It is obvious that the process is applicable also to the case where mixtures of such polymers are used or cases in which they are mixed with other materials, for example, with cellulosic derivatives.

What we claim and desire to secure by Letters Patent is:

1. A process of manufacturing products such as filaments and the like which consists in causing a solution of vinyl polymers in a volatile solvent to be extruded into an evaporative atmosphere substantially free from solvent vapor in a closed circuit, and moving the extruded filaments thereby to cause movement of the evaporative atmosphere at substantially the same speed and in the same direction as the filaments, causing the spun filaments to emerge from said evaporative atmosphere, and, after such emergence cooling the evaporative atmosphere thereby to ensure condensation of the solvent vapor contained therein.

2. Apparatus for manufacturing spun products such as filaments and the like, which comprises an endless tube forming a closed circuit including an evaporating chamber, a solvent condenser chamber and a heating chamber disposed in successive order and in unobstructed communication with each other, said evaporating chamber having an inlet for admitting material to be spun together with an evaporative atmosphere, means at the end of the evaporating chamber for directing spun filaments from said chamber, means disposed exteriorly of said solvent condenser chamber for cooling the same, and means disposed exteriorly of said heating chamber for heating the same, the organization being such that movement of the evaporative atmosphere around the entire circuit is induced and controlled entirely by movement of the filaments through the evaporating chamber.

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