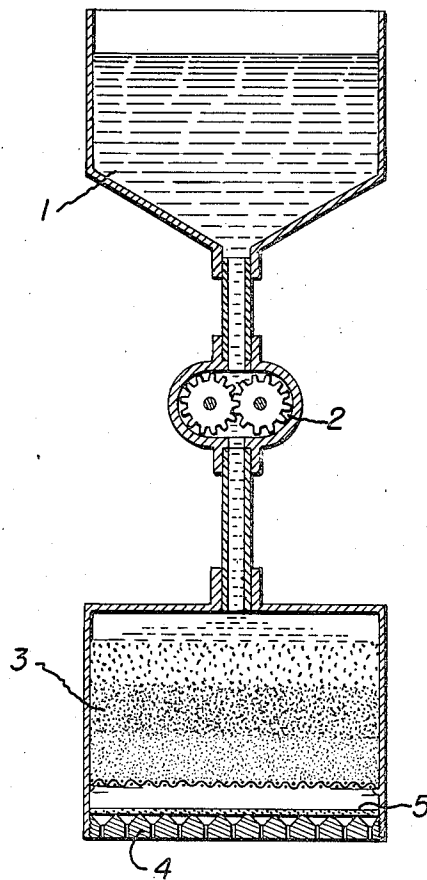


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METHOD AND MEANS FOR THE STARTING
OF SYNTHETIC YARN SPINNING
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METHOD AND MEANS FOR THE STARTING
OF SYNTHETIC YARN SPINNING

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1

This invention relates to the manufacture of artificial textile filaments, yarns and threads, and more particularly, to improvements in the dry- and melt-spinning of synthetic filament-forming materials.

In the past, in the melt- and dry-spinning of synthetic filament-forming materials, e. g. nylon, cellulose acetate, etc., considerable difficulty has been experienced, when starting up a spinning position, in obtaining uniform and equal extrusion through the orifices of the many-holed spinnerets used in the production of continuous filament yarns. Conventionally, the material to be spun is pumped from a melt pool or manifold supply system through a series of filters or sand packs, and then extruded through a spinneret into an evaporative and/or cooling atmosphere. The evaporative or cooling atmosphere is commonly contained in a tubular structure referred to as a spinning cell. In this cell, the filaments solidify by evaporation of the solvent, or in the case of melt-spun filaments, by cooling, to form the continuous filaments commonly used in the textile trade.

Each of these spinning positions must from time to time be shut down temporarily. This is frequently done for the purpose of cleaning the spinnerets, the various apertures of which may become clogged. Again, some part of the packing may fail and leakages occur. Also, the filters or spinning packs must be replaced at frequent intervals. Therefore, a type of preventative maintenance is usually followed whereby the various spinnerets are changed at regular intervals, each change, of course, necessitating a cessation of spinning from that particular position.

When the various parts have been cleaned or renewed and the position reassembled, pumping to the position to resume production of the continuous filaments is again started. A very considerable difficulty encountered in the start-up resides in the fact that as the pumping starts, the spinning solution or melt is not distributed evenly over the back face of the spinneret before extrusion starts. In other words, holes in one portion of the spinneret face start spinning before holes in the other portions and the last holes to spin quite frequently drip, i. e. do not pass a continuous stream of material, or are slow holes, i. e. an insufficient amount of material is extruded to form a suitable filament.

This difficulty is experienced with most spinnerets. However, it is especially troublesome in the case of very large spinnerets, i. e. 200-hole spinnerets and larger (3 to 5 inches in diameter),

2

of the type generally used to spin a tow for conversion into staple. It can be readily seen that when certain holes in a spinneret face either drip or do not spin at the same rate as the others, corrective steps must be immediately taken or else a non-uniform yarn bundle will result. The procedure usually followed is that of "wiping". In other words, the spinneret face is wiped clean in the hope that all the holes will commence spinning uniformly. Frequently, this must be done several times before spinning proceeds in the proper manner, and consequently entails a considerable loss of production as well as adding another operation.

A principal object of this invention, therefore, is to secure from the start of a dry- or melt-spinning operation simultaneous and uniform extrusions from all holes of multi-hole spinnerets.

Another object is to provide simple, inexpensive means for securing a satisfactory start-up of a conventional dry- or melt-spinning operation. Other objects will more clearly appear hereinafter.

These objects are realized by the present invention which, briefly stated, comprises providing the multi-hole spinneret, before the spinning operation is initiated, with a rupturable barrier placed in contact with the inner or outer face of the spinneret and sized to cover or close all of the holes of the spinneret whereby to permit back pressure to build up at the inner face of the spinneret and hence cause the spinning material to be distributed uniformly over the back face of the spinneret. Gradually, the back pressure reaches a point where the barrier ruptures at all spinneret holes simultaneously, thus insuring sufficient pressure for the immediate and uniform extrusion of spinning material through all of said holes.

The rupturable barrier utilized in accordance with the principles of this invention may be of any convenient film or foil which will withstand the operating temperatures encountered in the spinning head. As suitable examples of metals from which these rupturable barriers may be prepared, the following may be mentioned: aluminum, beryllium, chromium, copper, gold, iron, magnesium, nickel, platinum, zinc, etc., and various alloys thereof. In the case of materials that are spun at relatively low temperatures, suitable barriers may be prepared from various film-forming polymeric materials. As suitable examples, are films prepared from polyamides and polyesters, as well as various vinyl polymers such as polyacrylonitrile, vinylidene chloride, etc.

3

In addition, films prepared from cellulose esters and regenerated cellulose may be used for many such applications. However, for high temperature applications, e. g. such as those encountered in the melt spinning of polyamides, metallic barriers will normally be preferred.

The main requirement with regard to operativeness is that the foil should be thin enough so that it will rupture when the back pressure has reached that which is normally encountered in the spinning operation, thus insuring that abnormal back pressures are not built up. Suitable thicknesses for such foils may vary from 0.0001 inch to 0.01 inch, depending upon the material used in making the film. As a method for determining the correct thickness of the film to be used, the following equation serves to give a useful approximation:

$$t = \frac{PR}{\sigma}$$

wherein:

t =thickness of film or foil (inches)

P =operating back pressure (pounds per square inch)

R =radius of spinneret aperture (inches)

σ =tensile strength of film or foil at operating temperature (pounds per square inch)

Although the rupturable barrier may be placed at either the front or back face of the spinneret, in most instances, and particularly where a metal foil is to be used, it will be found most convenient to position the rupturable barrier over the back (inner) face of the spinneret. Alternatively a suitable barrier may be formed by coating the outer face of the spinneret with an appropriate film-former of the type hereinabove mentioned, or a barrier of film or foil may be cemented to the front face of the spinneret or secured thereon by any one of a number of conventional clamping expedients, e. g. a contractible band fitted around the outer side wall of the spinneret. In the case of the recessed type spinneret wherein a filter pack is placed directly against the back face of the spinneret, e. g. dry-spinning of cellulose acetate, the film or foil may be conveniently used across the polymer supply side of the filter pack. Here again, the primary purpose is served, i. e. the spinning material is distributed evenly over the area of the pack and spinneret, causing pack compression before the film bursts, thus insuring uniform extrusion.

The principles and practice of the invention are further illustrated by the following examples of preferred embodiments, reference being had to the accompanying drawing wherein is shown, diagrammatically, a typical system involving the use of the novel rupturable barrier of this invention. Legends in the description refer to like parts in the drawing.

Example I

A melt pool 1 containing molten polyhexamethylene adipamide is maintained in the vicinity of 280° C. The molten polymer is forced by a suitable pump 2 through a sand pack filter 3 to the spinneret 4. Across the back face of the spinneret, there is a rupturable barrier 5 comprising an aluminum foil 0.001 inch in thickness. The spinneret itself is a 70-hole spinneret 3 inches in diameter, each hole being 0.007 inch in diameter. The aluminum foil barrier causes the back pressure within the pack and polymer supply line to build up until it is sufficient to rupture

4

the aluminum foil at each point of non-support, i. e. the individual spinneret holes. When the pressure is sufficient to do this, holes are burst in the foil by the back pressure and uniform extrusion through all the holes of the spinneret occurs. Using the process of this invention with this type spinneret in the spinning of 3 denier per filament staple, fifteen out of twenty successful starts were achieved. For comparison, when the start-up procedure was tried without using a rupturable barrier, it was only possible to achieve twenty successful starts out of forty-three tries.

Example II

In a procedure, as in Example I, a 0.001 inch thick aluminum foil is used in the starting up of a spinneret 4¾ inches in diameter containing 200 holes, each 0.007 inch in diameter, for the spinning of 1½ denier per filament staple. Using the same procedure as outlined in Example I, three successful starts out of four tries are achieved using the aluminum foil. For comparative purposes, without the use of aluminum foil, only one successful start out of five tries is obtained.

Example III

This same procedure is repeated using the apparatus described in Example II, but substituting in the place of the aluminum foil 0.00025 inch thick nickel foil. Here again, a considerable improvement in start-up performance is achieved. Out of ten tries, seven successful start-ups are obtained. For comparison, without the use of the foil, in ten tries only five successful start-ups are realized.

As many apparently widely different embodiments can be made without departing from the spirit and scope of my invention, it is to be understood that said invention is not limited in any way except as set forth in the appended claims.

I claim:

1. In the process of spinning filaments, yarns and threads of synthetic filament-forming materials wherein a spinning composition comprising synthetic filament-forming material is extruded through a multi-hole spinneret into a gaseous atmosphere, the improvement which comprises covering the holes of the spinneret, prior to spinning, with a rupturable barrier of sufficient thickness to prevent the extrusion of spinning composition through the holes of said spinneret only until the pressure of spinning composition over the inner face of the spinneret has reached the level customarily encountered in the spinning operation, at which point the barrier ruptures at substantially all holes of the spinneret simultaneously to permit extrusion of spinning composition therethrough, and thereafter forcing spinning composition into said spinneret whereby to rupture said barrier and initiate spinning.

2. In the process of spinning filaments, yarns and threads of synthetic filament-forming materials wherein a spinning composition comprising synthetic filament-forming material is extruded through a multi-hole spinneret into a gaseous atmosphere, the improvement which comprises covering the inner face of the spinneret, prior to spinning, with a rupturable barrier of sufficient thickness to prevent the extrusion of spinning composition through the holes of the spinneret only until the pressure of spinning composition over the inner face of the spinneret has reached the level ordinarily encountered in the

5

spinning operation, at which point the barrier ruptures at substantially all the holes of the spinneret to permit extrusion of spinning composition therethrough, and thereafter forcing spinning composition into said spinneret whereby to rupture said barrier and initiate spinning. 5

3. A multi-hole spinneret, the holes of which are covered by a rupturable barrier of a thickness to prevent spinning solution from passing through said holes only until the back pressure in said spinneret reaches the level ordinarily encountered in the normal operation of said spinneret. 10

4. A multi-hole spinneret, the inner face of which is substantially covered with an impervious barrier whereby to close the holes of said spinneret, said barrier being of a thickness to prevent 15

6

spinning solution from passing through the holes of the spinneret only until the back pressure in said spinneret reaches the level ordinarily encountered in the normal operation of said spinneret, at which point said barrier will rupture at said holes.

5. The apparatus of claim 4 wherein the barrier is a metal foil.

6. The apparatus of claim 4 wherein the barrier is aluminum foil. 10

7. A multi-hole spinneret, the inner face of which is covered with metal foil of from 0.0001 inch to 0.1 inch in thickness.

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No references cited.