

Feb. 21, 1967

L. H. MOTT

3,304,577

SPINNERETTE DISK FOR EXTRUSION OF SYNTHETIC POLYMER FIBERS

Filed June 18, 1965

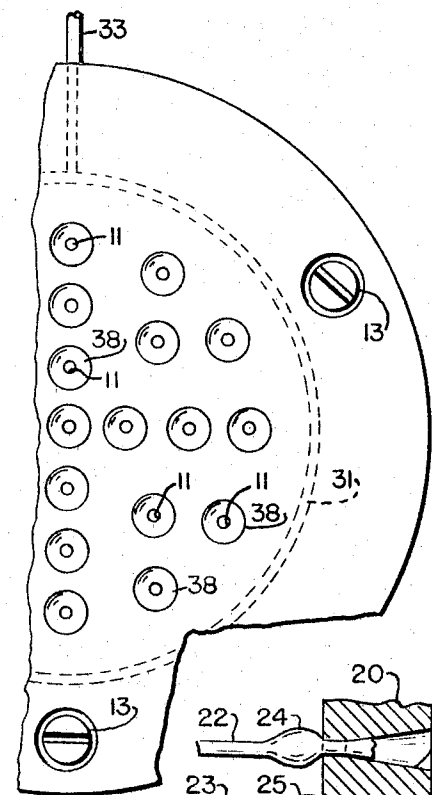
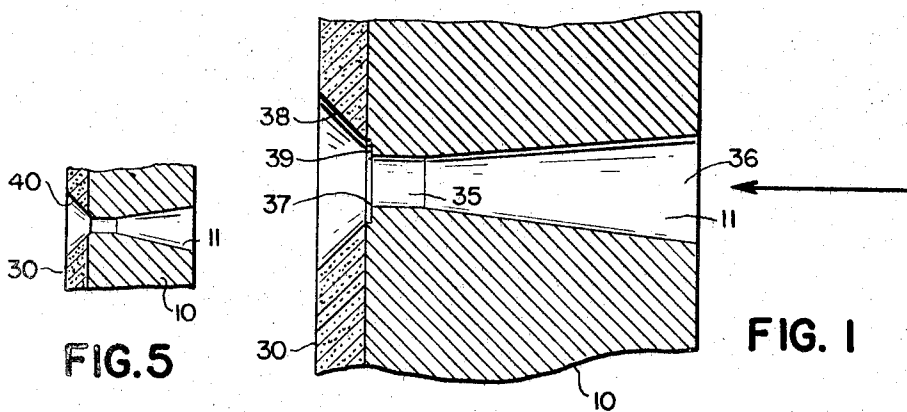


FIG. 3

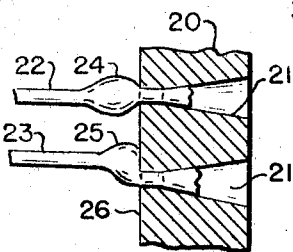


FIG. 4

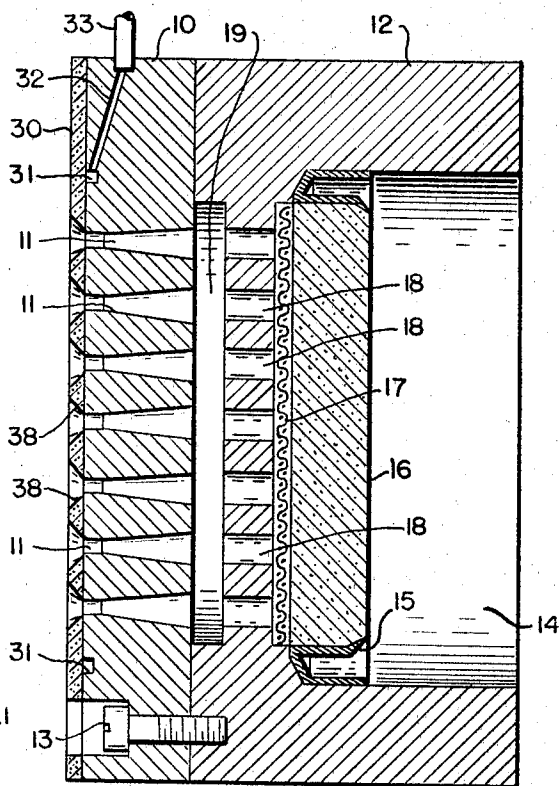


FIG. 2

INVENTOR:

LAMBERT H. MOTT

BY

Peter S. Taylor
ATTORNEY

3,304,577
**SPINNERETTE DISK FOR EXTRUSION OF
 SYNTHETIC POLYMER FIBERS**
 Lambert H. Mott, Farmington, Conn.
 (272 Huyshope Ave., Hartford, Conn. 06114)
 Filed June 18, 1965, Ser. No. 464,974
 3 Claims. (Cl. 18—8)

This invention relates in general to spinnerette assemblies for the extrusion of plastic fibers, and, more particularly, to a spinnerette assembly having a porous, lubricated downstream surface.

In the melt spinning of synthetic polymer fibers such as nylon, orlon, and the like, the synthetic polymer is melted and forced under high pressure, usually from 1500 to 5000 lbs. per square inch, through a spinnerette disk containing extrusion orifices. Since the extrusion pressures are high, as the individual fibers leave a sharp edged orifice on the downstream side of a spinnerette, there is a tendency for the high pressure to be relieved causing the "ballooning" or expansion of each fiber. This "ballooning" usually assumes a teardrop shape directly behind the extrusion orifice which tapers to the filament diameter. The expansion may be caused by entrained gases or it may be caused by fiber velocity considerations.

Probably caused by this "ballooning" is the result that fibers often "crawl" to one side of an orifice so that the center line of the fiber becomes offset from the center line of the orifice. This may cause a change in the rate of flow of a particular fiber and may cause premature contact between adjacent extruded fibers. This phenomenon causes changes in the extruded fibers which necessitates the shutting down of the apparatus to scrape the downstream face of the spinnerette assembly. A silicon oil lubricant may then be applied to the downstream face of the spinnerette and the extrusion process resumed.

Generally, the coagulation and creeping on the downstream side of an orifice occurs between two to six hours after the particular extrusion process has been started. Often, before the creeping is discovered, considerable material and time is lost.

It is, therefore, an object of this invention to provide a spinnerette assembly which may be operated for longer periods of time.

Another object of this invention is to provide a spinnerette assembly having a lubricated downstream surface which does not interfere with the spinning of synthetic polymer fibers.

A further object of this invention is to provide a spinnerette assembly which permits the more efficient and less costly spinning of synthetic polymer fibers.

Many other objects, advantages, and features of invention reside in the particular construction, combination and arrangement of parts involved in the embodiment of my invention and its practice otherwise as will be understood from the following description and accompanying drawing wherein:

FIGURE 1 is a longitudinal section through a fragment of a spinnerette disk containing an extrusion orifice according to my invention;

FIGURE 2 is a longitudinal section through a spinnerette assembly;

FIGURE 3 is a front view of a fragment of the spinnerette assembly shown in FIGURE 2;

FIGURE 4 is a longitudinal section through a fragment of a conventional spinnerette disk showing synthetic polymer fibers being extruded through two orifices; and

FIGURE 5 is a longitudinal section through a fragment of a spinnerette disk having an extrusion orifice formed according to a modification of this invention.

Referring to the drawing in detail, a spinnerette assembly, as shown in FIGURE 2, consists of a spinnerette disk 10 containing the filament extrusion orifices 11. The spinnerette disk 10 is secured to a mounting 12 by means of screws 13. Mounting 12 contains a large opening 14 through which the molten polymer is introduced at a high pressure and at a temperature usually over 300 degrees C. Fixed within opening 14 by means of a seal 15 is a porous filter element 16. Behind filter 16 is a distribution screen 17 and the apertures 18 which lead into the collection plenum chamber 19.

FIGURE 4 shows a fragment of a spinnerette disk 20 which could be mounted in the manner described. Spinnerette disk 20 is a conventional disk such as those which are now used to extrude filaments from .0005" to .020" in diameter. As molten polymer is forced through the extrusion orifices 21 to form the filaments 22 and 23, the filaments 22 and 23 will "balloon" to form a characteristic teardrop shape 24. As has been described, this teardrop shape may adhere to the front face 26 of a disk 20 to restrict flow and misalign filament 23 in the manner indicated by the reference numeral 25.

As shown in FIGURES 1 and 2, this invention provides a porous metal layer 30 which is bonded to and associated with the front surface of the spinnerette disk 10. The porous metal layer 30 is then thoroughly impregnated with a silicone oil. Surface tension spreads this oil so that the "ballooning" polymer will not stick to layer 30. Depending upon many factors, such as the plastic being extruded, the size of the filaments, extrusion pressures, etc., a single silicone oil impregnation of a porous metal layer 30 may prevent sticking of extruded filaments during the entire service life of a spinnerette assembly. However, under other circumstances, a circular channel 31 below the porous metal layer 30 may be fed through a channel 32 and a tube 33 to provide a continuing supply of a silicone oil lubricant.

As is further shown in FIGURE 1, the extrusion orifice 11 has a cylindrical front portion 35 and a funnel shaped rear portion 36. Depending upon a given plastic being extruded, the size of the filaments, and the conditions under which it is being extruded, the angle 37 formed at the front of spinnerette plate 10 where the filament leaves spinnerette 10 may be critical. If the angle 37 should be substantially 90 degrees, a conical opening 38 may be formed through the porous layer 30. A very shallow cylindrical cut 39 may then be further made into the spinnerette plate 10 to leave the desired 90 degree angle 37. If the distance between the porous metal layer 30 and the angle 37 is only a few thousandths of an inch or less, surface tension will draw the silicone oil lubricant across the cut 39.

As shown in FIGURE 5, where the edge angle of the extrusion orifice 11 is not critical, a conical aperture 40 may be formed at a desired angle to extend through the porous layer 30 into spinnerette disk 10 for a slight distance.

Spinnerette disk 10 may be fabricated by machining a suitable disk out of stainless steel, placing and compacting a stainless steel powder of a suitable grain size up to 70 microns on the face of the disk, and sintering the disk and the powder to form the spinnerette disk 10 and the porous metal layer 30. The extrusion orifice 11 and the conical opening 38 may then be machined. Since machining tends to close the porosity of a porous metal layer, at least the inner surface of each opening 38 must be etched with a suitable acid to again render it porous and permeable to the silicone oil with which the layer 30 is impregnated. If a continuous feed of silicone oil is required as shown in FIGURE 2, the spinnerette disk 10 would be fabricated and the circular channel 31 would be machined

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in its face. A separate disk of porous metal 30 would then be fabricated by compacting and sintering a metal powder. The disk 30 thus formed would then be placed on spinnerette disk 10 and be further sintered to bond the porous layer 30 to disk 10. The extrusion apertures 11 and the openings 38 would then be drilled or formed in the manner which has been described.

Stainless steel is an excellent material from which to fabricate the spinnerette disks 10 and the porous metal layer 30, however many other metals or combinations of metals may be used. In some cases it may be desirable to bond a porous metal layer 30 with a lower melting point to a spinnerette disk 10 to prevent distortion of the disk 10. Depending upon the size of the metal powder used to form the porous layer 30, this layer should be compacted so that the pore size varies from .5 to 30 microns in size. The pore size best suited to a given porous layer 30 depends on the filament being extruded, its size, and the silicone oil being used.

This invention provides a successful solution for the first time to a problem which has long plagued the melt spinning of synthetic polymer fibers.

While I have shown and described my invention in the best form known to me, it will nevertheless be understood that this is purely exemplary and that modifications may be made without departing from the spirit and scope of the invention except as it may be more limited in the appended claims wherein I claim:

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1. A spinnerette disk for the extrusion of synthetic polymer fibers therethrough, said disk being of metal, said disk having a downstream side, said disk containing a plurality of extrusion orifices, and a porous metal layer on the downstream side of said disk, said porous metal layer containing a substantially conical opening disposed about each extrusion orifice a slight distance away from each extrusion orifice, said porous metal layer containing a lubricant preventing the sticking of extruded polymer fibers to said spinnerette disk at least within said openings.

2. The combination according to claim 1 wherein said openings extend through said porous metal layer a short distance into said metal disk.

3. The combination according to claim 1 wherein said metal disk contains a shallow cut having a bottom parallel to the downstream side of said disk, each cut being at the bottom of an opening and extending about an extrusion orifice.

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WILLIAM J. STEPHENSON, *Primary Examiner.*