July 22, 1969 J. S. COBB, JR 3,456,292

SPINNERET

Filed March 30, 1967

Fig. 1.

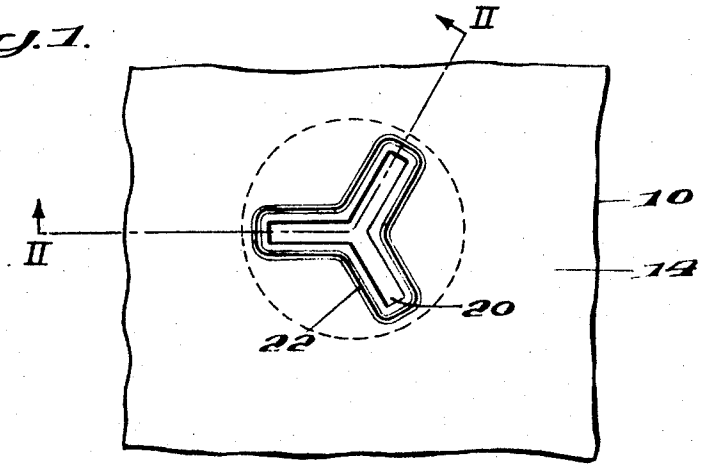


Fig. 2.

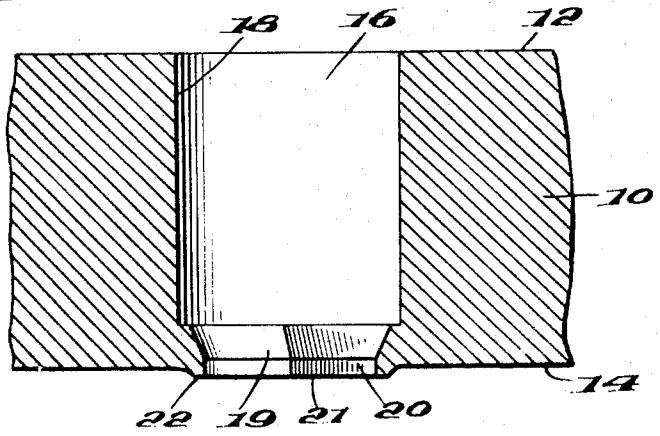
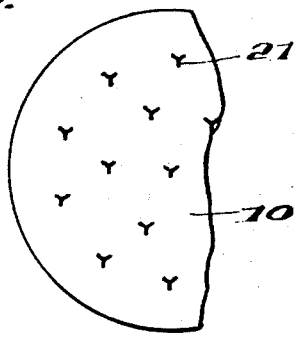


Fig. 3.



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SPINNERET

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U.S. Cl. 18—8 4 Claims

ABSTRACT OF THE DISCLOSURE

A raised portion of minute dimensions is left around the orifice of a spinneret capillary to facilitate effective removal of accumulated deposits.

This invention relates to the manufacture of artificial filaments and, more particularly, to an improvement in the apertured plates through which such filaments are extruded or spun.

During the formation of artificial filaments by extruding a molten filament-forming material through spinneret capillaries, a buildup of degraded material forms at the capillary exits. The normal procedure is to stop the spinning process periodically and to wipe the face of the spinneret with a stick to remove degraded polymer. Frequently, a lubricant is used to assist in this. However, unless the operator is extremely careful, it is quite unlikely that a good clean wipe is obtained 100% of the time. This either forces unscheduled wipes to be made which results in further down time and loss of production or makes it necessary to shorten the time between scheduled wipes.

The various objectives and advantages described herein have been achieved with a spinneret plate having a plurality of holes which extend through terminal cylindrical capillary lengths to odd-shaped orifices in its discharge face. Such a spinneret plate has been improved by provision of a raised portion on the discharge face at the rim of, conforming generally to and extending peripherally of the orifices. The raised portions have planar outer surfaces less than 0.0002 inch thick.

In the drawing, FIGURE 1 is a fragmentary enlarged view of the discharge face showing an odd-shaped capillary orifice, FIG. 2 is a sectional view taken on line II—II in FIG. 1 and FIG. 3 is another fragmentary view of the discharge face showing the hole pattern.

As shown in the drawing, spinneret plate **10** has an upstream face **12** and a discharge face **14**. Each through hole **16** has an entrance length **18**, a convergent intermediate length **19** and a cylindrical capillary length **20** which terminates in an odd-shaped exit orifice **21**.

In capillary length **20**, hole **16** is defined by planar walls substantially normal to face **14**. Length **20** and orifice **21** are in the form of three angularly disposed interconnected slots.

In operation, molten polymer is supplied to each entrance hole **18** under pressure and is forced through capillary length **20** below which the molten polymer is quenched and solidified to form a filament. Although the exact mechanism is not known, during melt spinning, degraded polymer builds up, around orifice **21**, on the downstream face **14**. After a certain time, this buildup causes the issuing filament to either deflect and curl onto face **14** and cause a broken filament or may cause some other form of nonproductive spinning. At this point, it is necessary for an operator to remove the degraded buildup. As noted above, this is usually accomplished with a wipe stick, a bladed tool with a sharp edge, which is scraped or drawn across the face of the spinneret.

Experience has shown that it is better to schedule periodic wipes and remove the degraded buildup before it causes a breakdown in the normal spinning. It is obvious that these scheduled wipes are expensive, not only in operator expense, but also in lost production. Consequently, every effort is made to increase the length of time between wipes and still have good, continuous spinning.

With raised portions **22**, a good clean wipe is achieved in the area immediately surrounding exit orifices **21**. It has been found that the height or thickness of the raised portions is an important factor. There must be sufficient thickness to insure that a clean wipe is obtained. However, if the raised portion is too large, the wipe stick is damaged or bounces from one raised portion to another and damages the spinneret. It has been found that if the raised portion **22** around an odd-shaped orifice is less than 0.0002 inch thick, there is no bumping whereas if the raised portion **22** is 0.00025 inch or higher, the consequences are ineffective wiping and damage to the parts. Bouncing or bumping of the wipe stick has been attributed at least in part to the irregular contours of odd-shaped orifices and probably would not present the same problems with round orifices. Experiments have shown that the preferred upper limit on raised portions **22** for nylon spinning is 0.0001 inch high.

In forming spinneret capillaries by the process of U.S. Patent 3,017,789, there is a punching step which leaves a protuberance on discharge face **14**. This protuberance conforms to the outline of orifice **21** and is removed by a polishing step. A planar surface on a raised portion **22** is obtained by stopping this polishing step before the protuberance is completely removed. When of the proper thickness, the raised portion extends through the periphery of an orifice and from its rim by a distance approximately equal to the slot width of the odd-shaped orifice. As shown in FIG. 1, it also conforms to the outline of orifice **21**.

In a spinneret plate where there are a large number of capillaries, it has been found that with the normal manufacturing tolerances encountered, a few of the raised portions will be completely removed before other raised portions are brought down to the maximum height permissible. Preferably, at least 90% of the capillaries have a measurable raised portion **22**. To be measurable with an interference microscope, the portion must have a thickness of at least 0.00001 inch.

The efficiency of wiping can be measured by tabulating the number of spinning breaks that occur between wipes or by the number of fully-wound packages that can be doffed between breaks. Another criterion is the spinning time permissible between wipes consistent with good spinning performance.

In comparative tests of known spinneret plates having planar discharge faces with other plates having raised portions ranging from 0.00003 to 0.00007 inch in thickness, the latter exhibited 53% fewer spinning breaks over a fifteen-day period in a first test, had 32% fewer breaks with a one-day wipe cycle than a control plate with a twelve-hour wipe cycle in a second test and permitted an average of 39.1 doffs between breaks whereas control plates gave only an average of 18.3 doffs between breaks in a third test. Using the same spinnerets, the third test was evaluated in a different manner in that the control spinnerets were wiped after every 10 doffs and the experimental spinnerets were wiped every 26 doffs. The experimental spinnerets had 48% fewer breaks than the control spinnerets.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. As an article of manufacture, a spinneret plate having a plurality of holes extending through cylindrical

capillary lengths to odd-shaped orifices in the discharge face, the improvement of which comprises a raised portion on said face at the rim of, conforming generally to the outline of and extending peripherally of at least 90% of the orifices, each raised portion having a planar surface and a thickness of less than 0.0002 inch.

2. The spinneret plate of claim **1** wherein said discharge face is planar except at the locations of said raised portions and wherein each raised portion has a thickness of at least 0.00001 inch.

3. The spinneret of claim **1** wherein said orifices and said capillary lengths are in the form of angularly disposed interconnected slots.

4. The spinneret of claim **3** wherein the raised portions have widths approximately equal to slot widths.

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