Dec. 21, 1965 | L. REYNOLDS | 3,224,041

SPINNING APPARATUS

Filed Jan. 28, 1963 | 2 Sheets-Sheet 1

FIG. 1.

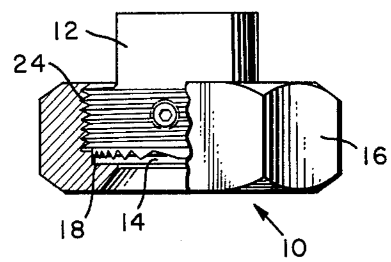
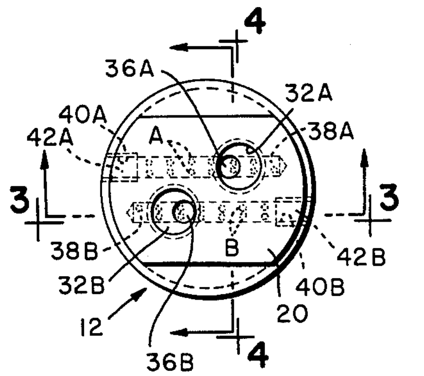


FIG. 2.



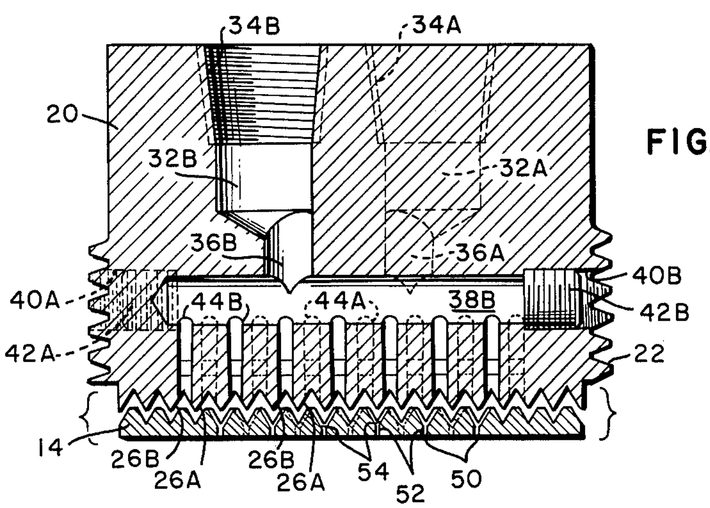


FIG. 3.

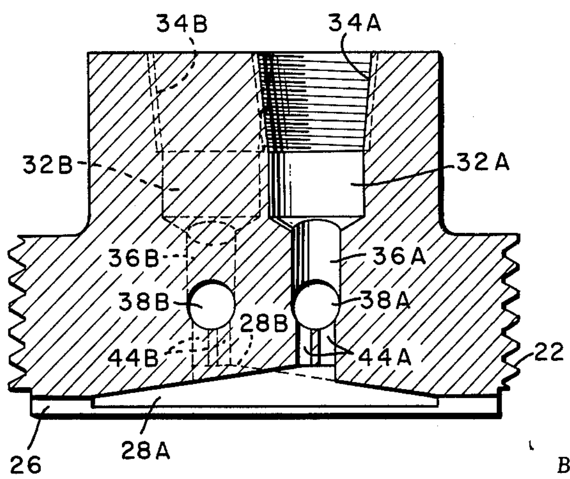


FIG. 4.

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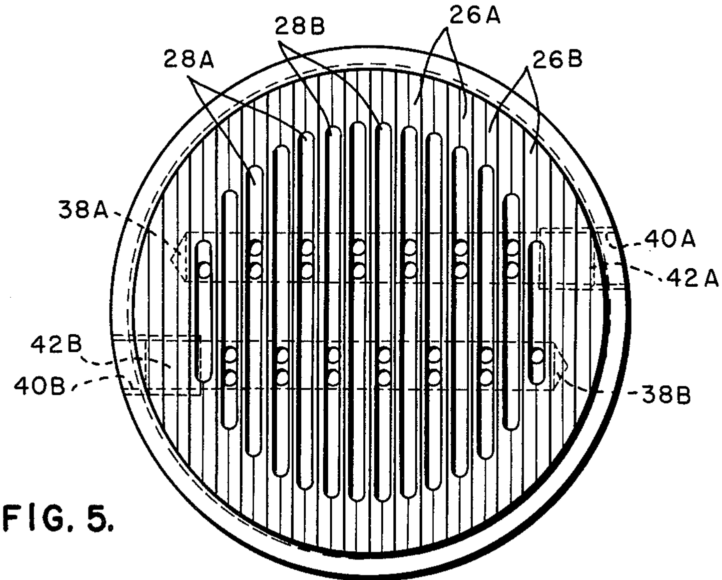

FIG. 5.

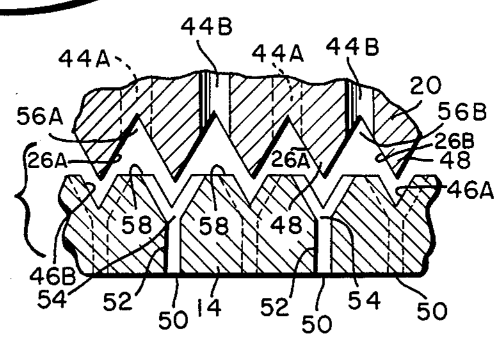

FIG. 7.

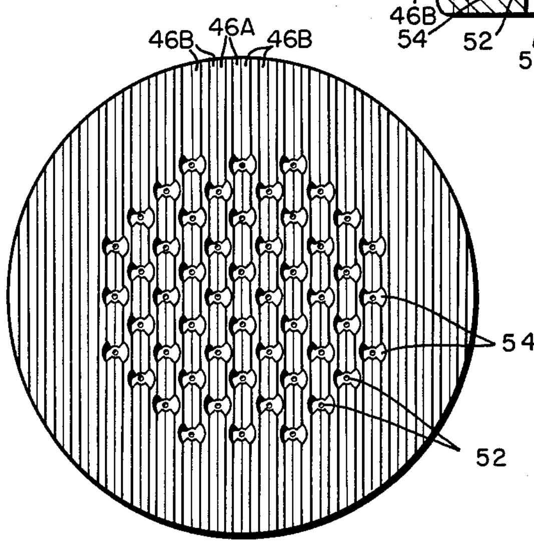

FIG. 6.

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SPINNING APPARATUS

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(Filed under Rule 47(b) and 35 U.S.C. 118)

This invention relates to apparatus for producing artificial fibers of composite character which exhibit a high degree of uniformity in component distribution within individual fibers. More particularly, this invention relates to an improved spinning apparatus for producing such fibers.

Where it is desired to incorporate the separate characteristics of two individual polymeric species into one filamentary structure, it is frequently advantageous to spin the two polymeric species in such a way that each species remains separate and distinct within a particular area of the fiber cross section. This is particularly true where the differences in properties of the two species are such as to produce a crimped fiber when the two species are spun in eccentric relationship to each other. For example, when two polymeric species having different shrinkage characteristics appear in eccentric relationship to each other in a single fiber, that fiber will develop a desirable spiral-type crimp when it is treated under conditions which cause the two components to undergo differential shrinkage.

Various embodiments of apparatus for producing composite or side-by-side fibers or filaments from two separate spinnable mediums which are capable of forming fibers on evaporation, coagulation, or cooling are described in the prior art. However, such apparatus has not proved to be satisfactory in providing fibers having a high degree of uniformity of distribution of the components making up the fiber cross section. Also, when a plurality of fibers is spun from a single spinneret, variations in the structure of the various fiber cross sections occur due to variations in the pressures at which the various spinnable mediums are supplied to a given spinneret orifice. In addition, it has been a common objection of presently available spinning apparatus that they are of such design as to severely limit the number of spinneret orifices that may be provided for. In attempting to overcome certain of these problems, there have been proposed intricately machined spinneret apparatus which have been found to be prohibitively costly in manufacture and to involve a mixing problem when the seperate spinnable mediums are subjected to a non-laminar flow prior to being joined and ejected through the spinneret orifices.

It is, therefore, an object of this invention to provide a spinning apparatus capable of producing multi-component fibers or filaments which have uniform distribution of the components across the fiber cross section. Another object of this invention is to provide apparatus capable of producing a plurality of multi-component fibers which have uniform distribution of such components over the cross section of each fiber. A further object of this invention is to provide a new and improved spinning apparatus so designed that it may be manufactured at significantly reduced cost, yet be capable of providing the intricate channeling and passageways necessary to spin multi-component filaments. Still a further object of this invention is to provide a spinning apparatus of such design as to render it capable of simple, rapid assembly and disassembly without sacrifice to the requirement of precise alignment of the various passageways formed therein.

According to the present invention, the foregoing and other objects are attained by providing a new and improved spinneret assembly basically comprising a feeder block and a spinneret plate, each of which has been so designed that, when placed in face-to-face relationship, there is defined particularly shaped passageways and

channels which are so interconnected as to provide multi-component filaments of heretofore unattainable quality, while at the same time providing for an increased number of spinneret orifices. This is accomplished by machining the component parts of the instant spinning apparatus to form complementary channels and passageways which would not be possible in an integral spinning block and which greatly simplifies the machining operations.

An understanding of the instant invention will be aided by reference to the accompanying drawings in which:

FIG. 1 is a partially sectionalized, assembled view of the spinning apparatus showing the interrelationship of the three basic components of such apparatus, viz. the feeders block, the spinneret and the nut retainer;

FIG. 2 is a top plan view of the feeder block as it appears in FIG. 1;

FIG. 3 is a cross-sectional view of the feeder block taken on line 3—3 of FIG. 2 with the spinneret plate shown in a position just short of operative engagement with the feeder block;

FIG. 4 is a cross-sectional view of the feeder block taken on line 4—4 of FIG. 2;

FIG. 5 is a bottom plan view of the feeder block shown in FIGS. 2–4 illustrating the various channels and passages formed therein;

FIG. 6 is an enlarged plan view of the spinneret plate shown in FIG. 1, the view being taken of that face of the spinneret plate which engages the portion of the feeder mechanism illustrated in FIG. 5, and

FIG. 7 is a detailed view of the interrelationship of the spinneret plate and feeder block when in operative position.

Referring now in detail to the drawings, FIG. 1 shows the spinneret assembly **10** in its fully assembled, operative condition, wherein the feeder block **12** and spinneret plate **14** are seen to be held in face-to-face, intermeshing engagement by means of a relatively large retainer nut **16**. The spinneret plate **14** is seen to rest upon an interior, annularly-shaped shoulder **18** and is secured thereagainst by threadably engaging the feeder block **12** with retainer nut **16** to an extent that will effect engagement of the channeled surfaces of the spinneret plate **14** and the feeder block **12**. At the outset, therefore, it will be appreciated that there has been provided a spinneret assembly comprising a minimum number of ruggedly designed parts susceptible of quick and precise alignment without the need for special tools. For a better understanding of the details of the component parts of the instant invention, attention is now directed to the showings of FIGS. 2–7.

Considering, first, the feeder block, shown in FIGS. 2–5, it is seen to comprise a cylindrically-shaped, integral body portion **20** provided with a circumferentially-extending, externally threaded portion **22** shaped to engage the internal threading **24** formed in retainer nut **16**. The bottom surface of feeder block **12**, which may be fabricated from any suitable material, preferably stainless steel, is machined to provide distribution channels **26A**, **26B**, which may be best viewed in plan in FIG. 5 and in elevation in FIG. 3. These distribution channels are illustrated in the drawings as being of V-shaped cross-sectional configuration, but it is to be emphasized that any similar configuration would be equally suitable, the only criteria being that they be so shaped as to mesh with similar channels formed in the spinneret plate in a fashion that will later be referred to in detail. These distribution channels **26A**, **26B** are formed to extend along chord-wise dimensions across substantially the entire bottom surface of the feeder block. Intermediate the extremities of these distribution channels and centered with respect thereto, there are formed distribution slots **28A** and **28B**, which slots may be viewed in elevation in FIG. 4 and in plan in FIG.

5. These distribution slots will vary in length and slope according to their location across the bottom face of the feeder block and their distance from their respective supply passages. For example, the slopes of these slots may be varied to compensate for pressure drops that may tend to occur as a spinnable medium is forced through the feeder block, which, if not controlled, would result in a cross-sectional variation of the filamentary components from filament to filament. The length of the slots will be varied according to the number of spinneret orifices they are intended to supply, the longer slots being nearer the center of the feeder block, as viewed in FIG. 5, where they feed the greater number of spinneret orifices.

A typical set of passage systems formed in feeder block 12 to supply distribution channels 26 by way of distribution slots 28A and 28B will now be described, but it is to be understood that numerous other passage systems may be readily devised to accomplish an equally satisfactory result, the primary consideration being given to the ease and economy of machining operations involved. One such set of passage systems which has been found particularly adaptable to simplified machining operations which would be easily reducible to mass production techniques, is illustrated in the drawings and may be best understood with reference to FIGS. 3 and 4. As there shown, main supply passages 32A, 32B are provided to communicate between an exterior surface of feeder block 12 and transversely extending distribution passages 38A, 38B. The main supply passages 32A, 32B are shaped to define enlarged upper main supply passages 34A, 34B and reduced lower main supply passages 36A, 36B. The enlarged upper main supply passages 34A, 34B are of sufficient size to accommodate sandpacks, screens, or other suitable filtering agents in the conventional manner, the lower ends 36A, 36B of the supply passages being reduced to compensate for the pressure drop across the filtering device. The distribution passages 38A, 38B are seen to extend at right angles to the main supply passages and transversely of the feeder block, preferably along a chord-wise dimension thereof. These distribution passages may be conveniently formed in the feeder block by drilling laterally inwardly across a substantial portion of the feeder block, threading the resulting lateral openings as at 40A, 40B to receive threaded plugs 42A, 42B. Along substantially the entire length of distribution passages 38A, 38B and extending vertically downward therefrom, as viewed in FIG. 3, there are provided pairs of feeder passages 44A, 44B, as best viewed in FIG. 4, which feeder passages provide fluid communication of the separate fluid mediums A and B between distribution passages 38A, 38B and distribution slots 28A, 28B.

As may now be readily understood, the feeder block above described as typical of one aspect of the present invention is seen to incorporate two discrete systems of passageways designed to convey separate spinnable mediums through supply passages 32, distribution passages 38 and feeder passages 44 to occupy distribution channels 26. The feeder passages 44A, 44B are staggered with respect to one another to feed the separate fluid mediums A and B to the alternate distribution channels 26A, 26B, respectively.

Attention is now directed to FIGS. 3 and 6 for a better understanding of the details of the spinneret plate 14. As there shown, the spinneret plate 14 may conveniently comprise a substantially planar disc, one face of which has been machined to provide feeder channels 46A, 46B, which feeder channels are shaped to receive in closely fitting fashion the outer extremities of protruding ridge portions 48 on feeder block 12. The manner of this engagement of the spinneret plate 14 with the bottom surface of feeder block 12 will be more fully related to hereinbelow. As will be appreciated from an insection of FIG. 6 of the drawings, a substantial number of spinneret orifices may be accommodated over a relatively large area of the spinneret plate.

Looking to the edgewise view of the spinneret plate shown in FIG. 3, it will be seen that the spinneret orifices 50 are placed in fluid communication with the lower regions of feeder channels 46A, 46B by way of orifice passages 52. At the juncture of the orifice passages 52 with the feeder channels 46A, 46B, there is provided an inverted cone-shaped merging chamber 54 which cooperates with the protruding rib portions 48 to define a chamber of such shape as will insure a gradual and laminar merging of the separate spinnable mediums introduced from either side of the protruding rib portions 48.

In FIG. 7, there is shown in enlarged detail the nature of the intermeshing engagement of the spinneret plate 14 with feeder block 12. It will be seen that, upon bringing the channeled surface of spinneret plate 14 into engagement with the channeled surface of feeder block 12, the protruding ridge portions 48 will fully occupy feeder channels 46A, 46B and, because of the somewhat greater depth of the distribution channels 26A, 26B, there will be defined manifold passages 56A, 56B, which manifold passages are bounded by the trough portions of distribution channels 26A, 26B and the flattened portions 58 intervening the feeder channels 46A, 46B of spinneret plate 14. At spaced points along the length of each feeder channel 46, there appears the previously referred to merging chambers 54, which chambers are seen to provide precisely controlled points of communication between manifold passages 56 and orifice passages 52. Flow from manifold passages 56 to orifice passages 52 is otherwise prevented by the intermeshing engagement of rib portions 48 with feeder channels 46.

In operation, with the spinneret assembly in its fully assembled condition, as depicted in FIG. 1, separate spinnable mediums are supplied to the main supply passages 32A, 32B, whence each medium will be conveyed to a separate distribution passage 38A, 38B, at which point the mediums will be distributed to staggered feeder passages 44A, 44B, which in turn feed alternating distribution slots 28A, 28B, respectively, to thereby supply adjacent distribution channels 26 with discrete spinnable mediums. At this point, the spinnable mediums will occupy the manifold passages 56A, 56B, as best shown in FIG. 7. At a point intermediate the manifold passages 56 and the spinneret orifices 50, a laminar merging of the heretofore discrete streams of the separate spinnable mediums A and B is effected, by way of heated channels 46A and 46B, by the previously described merging chambers 54 just prior to the ejection of the now conjugated mediums.

It will be appreciated that there has been herewith disclosed a significantly improved spinning apparatus having a novel and highly beneficial co-action among its interrelated parts which makes possible new economies in fabrication and which is capable of obtaining a high degree of quality in the end product without sacrifice to its ease of operation. It will be obvious that numerous modifications and variations of the present invention are possible without departing from the spirit of the above teachings. It is, therefore, to be understood that the invention may be practiced otherwise than as specifically described herein and is not to be otherwise limited than by the full and fair scope of the appended claims when construed in the light of the accompanying disclosure by one of recognized skill in the art appurtenant thereto.

What is claimed is:

1. An apparatus for use in spinning composite filaments comprising a feeder means, a spinneret means, and a holder means for maintaining said feeder means and spinneret means in operative engagement with one another, said spinneret means comprising a substantially planar disc having a plurality of spaced feeder channels of substantially V-shaped cross-section formed in one face of said disc to extend chordwise thereof, a flattened portion bridging the space between adjacent feeder channels, a plurality of orifice feeder passages communicating between the apex region of each of said feeder chan-

nels and the obverse face of said disc to thereby define a plurality of spinning orifices along said obverse face; said feeder means comprising an integral body portion having a substantially planar surface, a plurality of V-shaped distribution channels formed in said surface of a depth greater than the depth of said feeder channels, the upper portions of the walls of said distribution channels being so shaped as to mesh in substantially fluid-tight relationship with said feeder channels, whereby the apex regions of said distribution channels and said flattened portions intervening said feeder channels together define a plurality of manifold passages.

2. A spinning apparatus as defined in claim **1** wherein said feeder channels are slightly enlarged in their transverse dimension at the juncture of said feeder channels with said orifice passages to thereby define a precise region of laminar merger of at least two theretofore discrete streams of spinnable mediums at a point immediately upstream of the point of ejection of said mediums through said spinning orifices via said orifice feeder passages, the enlarged portions of said feeder channels constituting merging chambers which communicate between said orifice feeder passages and said manifold passages when said distribution and feeder channels are placed in intermeshing engagement.

3. A spinning apparatus as defined in claim **1** wherein said feeder means is further provided with at least two fluidly discrete systems of passageways communicating between the manifold passages within said distribution channels and separate points of supply, one of said systems of passageways communicating with alternate numbers of said manifold passages and the other of said systems of passageway communicating with the remainder of the manifold passages interposed between said alternate numbers of manifold passages.

4. A spinning apparatus as defined in claim **2** wherein each of said plurality of discrete systems of passageways comprises at least one supply passage communicating between a supply point exterior of said feeder means and an interior point thereof, at least one distribution passage communicating with said supply passage at said interior point, said distribution passage being spaced from said distribution channels and extending transverse thereto, a plurality of feeder passages communicating between said distribution passage and the apex regions of alternate numbers of said V-shaped distribution channels, whereby a spinnable medium may be fed through each of said supply, distribution and feeder passages to occupy alternate numbers of said distribution channels.

5. A spinning apparatus as defined in claim **3** wherein said feeder channels are slightly enlarged in their transverse dimension at the juncture of said feeder channels with said orifice passages to thereby define a precise region of laminar merger of at least two theretofore discrete streams of spinnable mediums at a point immediately upstream of the point of ejection of said mediums through said spinning orifices via said orifice feeder passages, the enlarged portions of said feeder channels communicating between said orifice feeder passages and said manifold passage when said distribution and feeder channels are placed in meshing engagement.

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