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3,546,739

BICOMPONENT MANIFOLD

Filed Nov. 18, 1968

2 Sheets-Sheet 1

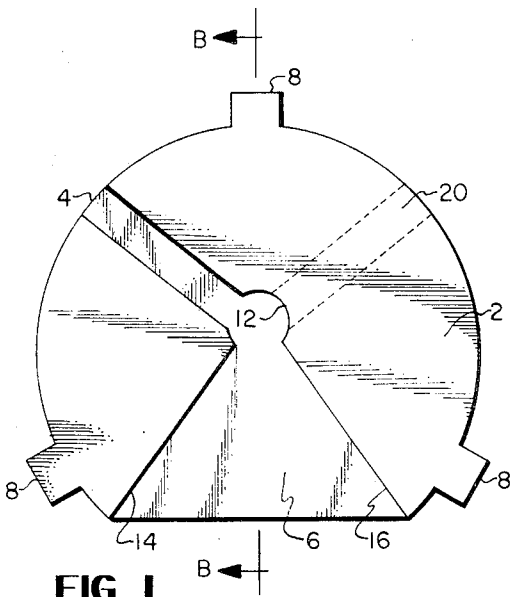


FIG. 1

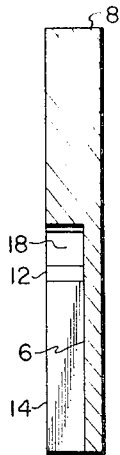


FIG. 2

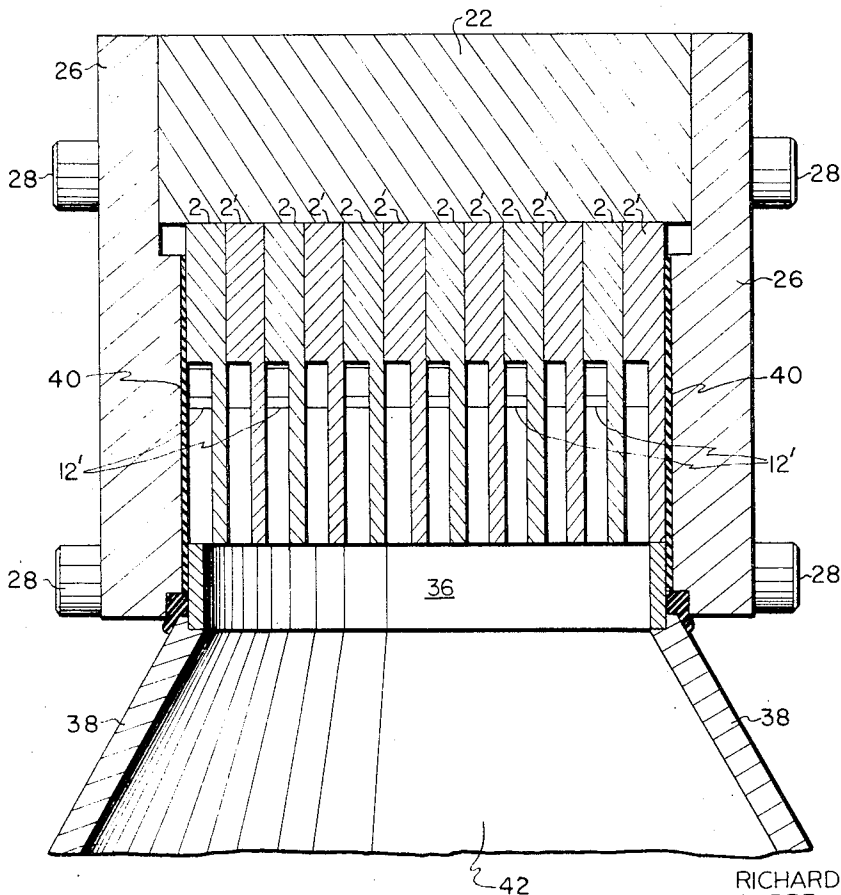


FIG. 4

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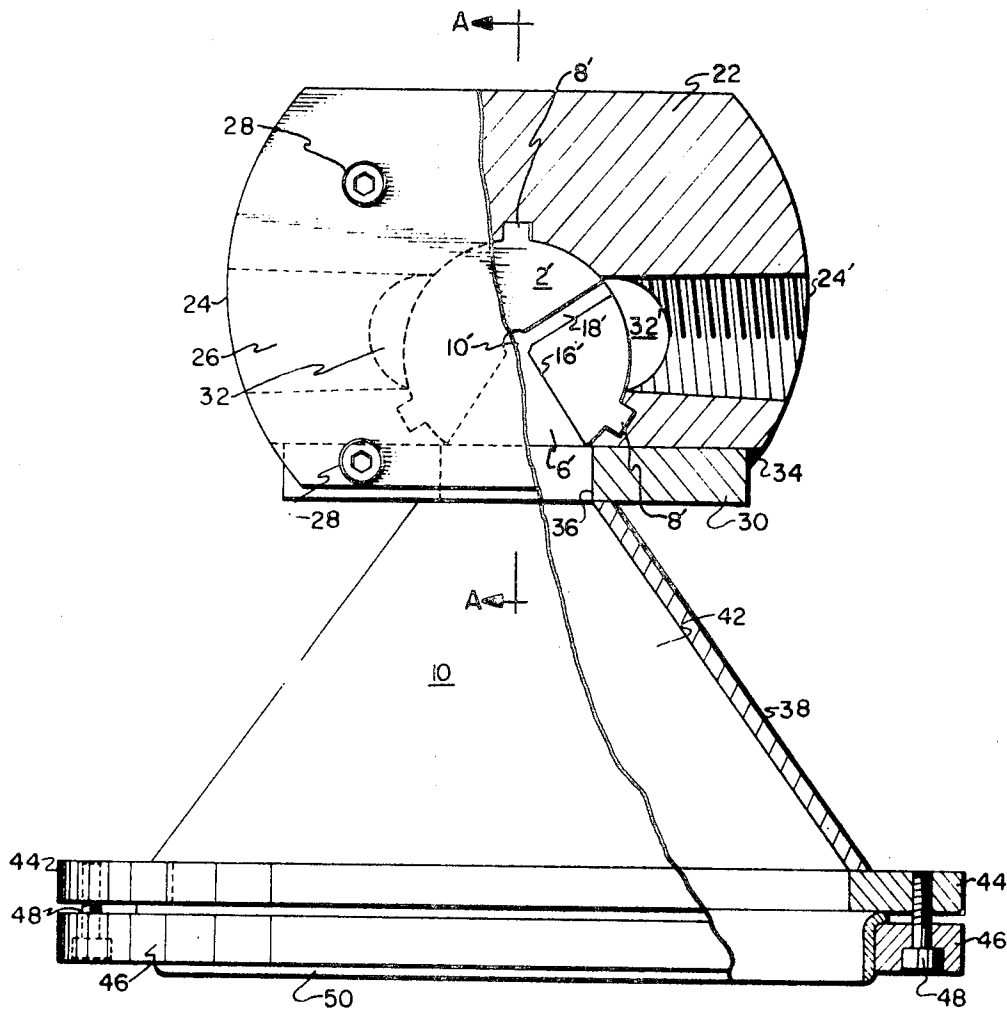


FIG. 3

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## BICOMPONENT MANIFOLD

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9 Claims

### ABSTRACT OF THE DISCLOSURE

A manifold adapted for use in spinning bicomponent fibers comprising a unit adapted to be inserted as a feed to a bar-type spinnerette comprising a plurality of removable juxtaposed disc-like elements, wherein alternate elements simultaneously feed alternate spinning solutions radially to said spinnerette and wherein the composite feed to said spinnerettes is a rectangular cross-section polymer solution comprising alternate layers of polymer solution.

This invention relates to devices for use in preparing bicomponent fibers having inherent crimping characteristics. More specifically, the invention relates to a manifold adapted for use with a bar-type spinnerette which provides a spinnerette feed comprising a rectangular cross-section polymer solution comprising alternate layers of polymer solution.

In view of the developments recently occurring in the field of textiles, and particularly bicomponent filaments utilized in the textile industry, it has been necessary to provide new spinning and polymer handling devices which will enable easy handling of polymer solutions used to produce the desired bicomponent filament.

Many devices have been utilized for feeding polymer solutions when a bicomponent filament tow is to be produced. Particularly successful have been mixers wherein a baffle system is provided to subject two or more polymer streams to a tortuous flow path. These devices serve to homogenize and laminate a polymer solution. They comprise units wherein the baffle system divides a main stream into a number of branches or partial streams displacing one partial stream with respect to adjacent partial streams while changing the cross-sectional shape thereof and combining the partial streams in groups corresponding to the original dividing factor. Thus, such devices generally take a feed comprising two or more polymer solutions and homogenize the individual melts while simultaneously forming a number of smaller volume streams, resulting in a product which comprises alternating layers of homogeneous polymer. Such devices are useful for homogenizing purposes but are generally bulky and inflexible and expensive to operate. They are by nature heavy, inflexible devices which can produce only a given number of alternating layers and can handle only a given volume of materials. Since these devices are bulky and inflexible, they are not adapted for use with spinnerettes which are generally small elements adapted to handle relatively small volumes of material. Thus, while it is known to form a number of layers of polymer from a single layer in-feed, this has not been adapted for use with filament spinnerettes.

The same principle of dividing and subjecting melts to a tortuous path has been utilized to some extent in spinnerettes, but the results have generally been unsatisfactory and expensive. Examples of such prior attempts at providing layered homogenous streams flowing to spinnerettes include utilizing a stack of components having progressively changing apertures so that a polymer flowing axially therethrough is subjected to reversal of flow

and a tortuous path which mixes or homogenizes the polymer. These devices generally provide the necessary mixing but are generally unsuitable for forming alternating layer polymer solutions.

A more recent development relates to the use of stacked elements such as disc-like elements wherein the apertures are of generally the same size but are at varying orientations. For example, concentric apertures are provided in one disc-like element, and the lower or next disc-like element will have concentric apertures arranged at a larger or smaller radius. Here, the tortuous flow path results in blending and mixing; however, it is generally difficult to provide clean and uniform flow through these devices since the resistance to axial flow is considerable. Modifications of these devices include the provision of spacer elements which block off part of the apertures in a given element, thereby enabling two polymer melts to be handled separately. However, it is found that the axial flow and the tortuous flow required for blending generally produce a device which requires considerable pressure to force a polymer therethrough. To handle such a high pressure system, bulky and heavy equipment is required, generally in the form of large steel housings and heavy components utilized as the disc-like elements.

Finally, one of the most recent developments in this art is described in U.S. Patent 3,308,503 which provides a manifold for a spinnerette using a number of disc-like elements. The device receives polymers and transforms them into layered solutions. The polymer in-flow is directed radially toward the center of the disc-like elements and the out-flow is in an axial direction. The resulting product is a circular cross-section element having alternating layers of concentric circles, each circle corresponding to an alternate polymer solution. This device reduces the above-noted deficiencies relating to excessive bulk and size of equipment; however, it produces an element having concentric circles or rectangles which is somewhat harder to handle when dealing with bicomponent fibers adapted to have different shrink characteristics. These fibers are preferably spun from a bar spinnerette which generally requires a rectangular cross-section solution feed comprising alternating layers of polymer. Another deficiency of this device is that it forms the concentric layers sequentially, thus producing flow resistance when the layers expand at different times, which promotes premature mixing of the solutions.

Accordingly, it is a primary object of the present invention to provide a manifold for a spinnerette which is adapted to provide blending of the polymer solutions fed thereto while producing a rectangular cross-section solution feed for a spinnerette.

Another object is to provide a manifold wherein a polymer solution is fed radially inwardly and is directed radically outwardly with respect to a plurality of feed elements.

Another object of the invention is to provide a manifold comprising a plurality of juxtaposed flow-directing elements adapted to receive polymer solutions and to simultaneously produce alternate layers of polymer solution.

Another object is to provide a manifold for a spinnerette which is adjustable by virtue of interchangeable feed elements which can vary the capacity of the device and the number of alternating layers produced in a rectangular cross-section polymer melt.

Still another object of the invention is to provide a manifold which is adapted to blend and integrally mix the components of a polymer stream which device has a low mass and is particularly adapted for use with bar-type spinnerettes.

Another object of the invention is to provide an improved manifold adapted to receive at least two polymer

solutions and to produce a rectangular cross-section polymer solution having alternating layers of polymer solution without preliminary intermixing of the layers.

These and other objects of the present invention will become apparent from a consideration of the hereinbelow described preferred embodiment. In the drawings, FIG. 1 represents a perspective view of a disc-like element of the present invention.

FIG. 2 represents a view partially in section taken along lines B—B of FIG. 1.

FIG. 3 represents a perspective view, partially in section, showing a manifold housing the disc-like elements of FIG. 1.

FIG. 4 is a sectional view taken along lines A—A of FIG. 3.

In accordance with the present invention, the above objects are achieved and the above-noted disadvantages are avoided by providing a manifold for a spinnerette which comprises a housing adapted to contain a plurality of juxtaposed, disc-like elements wherein each disc-like element is provided with an inlet, a radial flow path from said inlet toward the center of the disc, and an outlet directed away from the center of the disc-like element and toward the periphery thereof. A plurality of these elements are stacked in alternating sequence wherein alternating discs have an inlet spaced from that of the succeeding disc. It is thus possible to feed a first solution to a first point on the row of disc-like elements and a second solution to a second point on the row of disc-like elements, said feed points being spaced from each other. Since alternating layers or alternating discs have feed and flow paths spaced from the succeeding disc, only those alternating discs having an inlet aligned with the desired feed will transmit polymer through that disc. However, since all the discs have aligned outlets, the resulting solution will comprise alternating layers of polymers solutions. The layers are thus simultaneously formed without mixing with adjacent layers until they are out of the manifold. The polymer is fed from the aligned outlets through an expansion chamber to a spinnerette.

A preferred embodiment of the invention is disclosed in the drawings, and reference to the drawings, particularly FIG. 1, illustrates a disc-like component which is generally designated 2. The disc-like component shown is a "left hand feed" element having an inlet on the left side of center 10. An inlet 4 is connected to a radial flow path 18 leading to the center 10 of the disc and an outlet 6 leads radially from the center of the disc to the periphery thereof. Thus, polymer solution travels in at 4 along 18 to 10 and back out along element 6 making a turn of about 90°. The disc further comprises a plurality of knobs 8 which are adapted to be inserted into corresponding recesses in the manifold housing (FIG. 3), thereby maintaining the disc inlet 4 in alignment with a polymer reservoir provided in the manifold housing. The outlet 6 is seen to comprise a generally sector-shaped path which corresponds to a cut-out sector having an arc of approximately 90°. The arc defined by the outlet can vary from approximately 5° to approximately 180°, and it is generally found that an arc of approximately 72° is the optimum. The enlarged arc providing the outlet for the polymer allows expansion of the polymer and thereby allows mating of layers to be facilitated when they meet outside the manifold. As better seen in FIG. 2, each disc-like element comprises a substantially cylindrical element having cut-out portions to provide the radial flow path 18 and the axial outlet 6. The walls of the outlet 6 are designated 14 and 16, and the walls of the center portion 10 are designated 12. In some instances, a slot 20 may be provided on the reverse side of the disc in order to align and secure adjacent discs. In these cases, a raised portion (not shown) should be provided on the adjacent disc to align with the recess 20.

Turning to FIG. 3, the arrangement of discs within the

manifold housing is seen. A housing comprising a hollow conical base 38 is provided which serves as an expansion chamber for the layered polymer solution issuing from outlets 6 and 6' of juxtaposed elements 2 and 2'. Elements 2' are the "right hand feed" discs. The housing comprises a portion 22 having inlets 24 and 24' which is supported on the conical element 38 by a plate 30. A gasket 34 is provided to seal the junction of plate 30 and housing 22. Plate 30 has an aperture 36 in alignment with the outlets 6 and 6' of the disc elements. By combined reference to FIGS. 3 and 4, the manifold housing is seen to comprise the main body 22 which is supplied with end plates 26 secured by means of bolts 28 extending therethrough and sealed by gaskets 40 which line the cavity in housing 22. It will become more apparent later that the capacity and volume of the housing may be easily varied by removing one end plate and inserting additional disc elements 2 and 2', or removing some of the disc elements 2 and 2' which are then present. As mentioned earlier, knobs 8 and 8' on the disc elements are aligned in recesses within the cavity provide in body 22. This arrangement enables the discs to be held in a given orientation within the housing. An aperture 24' is threaded and forms a passage from a reservoir 32' to the inlet portions 4' of alternate discs 2'. As shown in phantom in FIG. 3, left hand feed discs 2 are aligned through aperture 24 and with reservoir 32. Thus, it is possible by screwing suitable hosing and feed lines into portions 24 and 24' of housing 22 to supply two different polymer solutions to the housing. Alternate discs will receive the polymer through channels 18 or 18' and conduct it radially to the center of the discs 10 and 10'. At this point, the cut-away sections 6 and 6' serve as radial outlets for the polymer. As the polymer travels outwardly from the aligned outlets 6 and 6', it passes through aperture 36 into hollow expansion chamber 42 which is defined within conical element 38. Since the outlets 6 and 6' of the alternate discs are aligned, it is apparent that the solution which issues from the housing will contain simultaneously formed alternate layers of polymers which are fed through inlets 24 and 24'. Since the outlets are substantially rectangular in shape at their widest point, the feed which issues from the manifold will comprise a generally rectangular cross-section element.

Referring to FIG. 4, the arrangement of discs is seen to comprise an alternate system wherein elements 2 which corresponds to left hand feed elements (shown in FIG. 1) and elements 2' corresponding to right hand feed elements (shown in FIG. 3) are juxtaposed in alternate sequence. The alternate discs will have inlets aligned with either 24 or 24'. Although the orientation of inlets 4 and 4' can vary within the limits defined by reservoirs 32 and 32', approximately 90° spacing is preferred in order to bleed any air trapped in the reservoirs or other parts of the housing. Since all the outlets 6 and 6' are aligned, all the polymer issues from the same point at the same time, and herein the alternate sequence and rectangular configuration of the spinnerette feed is achieved.

One of the chief advantages of this system is that the number of plates which can be utilized is variable. An additional advantage is that the volume or capacity of the unit can be varied also. The variation in number of layers is easily accomplished by inserting or removing discs 2 and 2'. The variation in capacity will inherently result, and it may be desirable in some instances to substitute or insert blank discs having no inlet which will reduce the capacity of the unit.

Though not shown in FIG. 3, the spinnerette is adapted to be disposed downstream adjacent to element 50. The housing 38 further comprises a pair of plates 44 and 46 secured by bolts 49 and a base plate 50. This base plate 50 can be aligned by suitable means with a spinnerette (not shown).

It should thus be apparent that the operation of the device provides an improved manifold which not only

causes reversal of flow in a flowing melt thereby blending and homogenizing the polymer solution, but also provides a substantially reduced resistance to flow. By providing radial flow, the reduced resistance enables the use of light weight elements particularly adapted to preparing a polymer feed to a bar spinnerette. More particularly, the light elements can be small units adapted for the production of bicomponent filaments having inherent crimp characteristics.

The following example is given by way of illustration, and it should be understood that the particular dimensions and materials utilized in this example should not limit the invention.

Six left and six right handed discs were molded of polypropylene having approximately one-inch diameters. These inserts were arranged in alternating layers in a manifold comprising a stainless steel body about 3" long and 2" wide. Two different polymer solutions of 10.5% solids in 60% zinc chloride solution were fed through 1/2" steel tubing to opposite sides of the manifold. After passing through the discs, the resulting polymer solution contained 12 alternating layers of polymer solution. The feed consists of one polymer containing 0.8% sulfur as SEMA (sulfo-ethyl methacrylate), 4.5% MA (methacrylate), with the remainder VCN (acrylonitrile), while the other polymer contained 0.2% sulfur as SEMA, 8% MA, with the remainder again being VCN. The layered polymer melt was then passed through the transition zone and then through a bar-type spinnerette having 13 rows, each row having 134 holes of approximately 165μ into a coagulating bath. The polymer solutions were initially at 70° C., and the bath temperatures ranged from 11° C. to 26° C. In view of the temperature differences, the two outside rows were allowed to spin monocomponent filaments of a somewhat lower denier. As seen in FIG. 4, one end of the juxtaposed discs has a disc 2 and the other end has a disc 2', so monocomponents can be achieved from these laminae of the polymer melt. The inner layers will contact spinnerette holes at a point so as to intersect interlaminar surfaces and result in bicomponent filaments. The fibers from the 11 center rows were designed to be 15 denier per filament and bicomponent in character. The polymer solutions were extruded into a coagulating bath comprising a 32.5% zinc chloride solution having a temperature ranging from 11° to 26° C. The extruded filaments were drawn from the bath at 18 feet/minute, washed, stretched 10 times, and autoclaved at 18 p.s.i.g. After dyeing and cross-sectioning, the resulting tow was formed of from 60-80% bicomponent fibers.

The manifold of this invention is adapted for use in spinning solutions or melts of cellulose acetates, polyvinyl chloride, polyvinylidene chloride, polyacrylonitrile, polyvinyl acetate, polycarbonates, polyesters, polyamides, polyurethanes, polyureas, and other polymers or copolymers of the above. If melts are used, the discs should be formed of heat resistant materials. Additives to affect the properties of the filaments can be used. Other carrier liquids can be used in place of zinc chloride, e.g. nitric acid.

From the above example and description of the preferred embodiment of apparatus, it should be apparent that the device of this invention is an improved apparatus adapted to make alternating layered polymer feeds. The device further may be used to form the layers simultaneously rather than sequentially which has been the practice in prior processes. By simultaneously forming the layers, better flow characteristics are derived when the polymer

flows through the transition zone and into the spinnerette, since more uniform expansion is achieved when the polymers pass through the transition zone wherein expansion occurs. By having uniform expansion, the adjacent layers of the melt fed to the spinnerette do not undergo distortions or disorientating influences.

Additional advantages are apparent from the above description insofar as the device of this invention by utilizing discs which are readily insertable into a cylindrical manifold will facilitate operation and speed changes in the processing equipment. Additionally, repairs are considerably facilitated due to the easy procedures involved in dismounting the apparatus. Furthermore, the disc being made of materials such as polypropylene and having no axial flow passages therethrough can be adapted to serve as gaskets and seals during polymer flow, i.e., the polymer flow from reservoir 32 through zone 42 is secure against possible leakage or seepage when the discs are firmly pressed together in the manifold housing. The device is particularly suited for use with a bar-type spinnerette which is, of course, particularly suited for use in spinning large tows. Circular spinnerettes have been used, but are limited in the number of holes which they contain and, accordingly, are limited in the size of the tows or number of filaments produced. Thus, economically in terms of production capacity, the invention comprises a substantial advance in the art.

Having described the invention in clear and concise terms, we claim:

1. A manifold for a filament spinnerette comprising a plurality of removable juxtaposed elements comprising disc-like means having an inlet and a radial in-flow path leading from said inlet to the center of the disc, and an outlet comprising a cut-away sector of that disc defining an arc of from approximately 5° to 180° whereby polymer out-flow occurs radially from the center of the disc.

2. The device of claim 1 wherein the arc is approximately 72°.

3. The device of claim 1 wherein the inlet is at the periphery of the disc.

4. The device of claim 1 wherein said discs are individually removable.

5. The device of claim 1 wherein alternate disc inlets are spaced at different peripheral points.

6. The device of claim 1 wherein the plurality is housed in a housing with a first series of inlets aligned with one reservoir and a second series of inlets formed by the alternate discs aligned with a second reservoir.

7. The device of claim 6 wherein polymer is fed radially to the inlet of the disc.

8. The device of claim 6 wherein the outlets of the disc element are all in alignment and are aligned with the inlet to a spinnerette.

9. The device of claim 1 wherein the flow path inwardly is a radially aligned channel in the disc element.

#### References Cited

##### UNITED STATES PATENTS

|           |        |          |      |
|-----------|--------|----------|------|
| 2,031,387 | 2/1936 | Schwarz  | 18—8 |
| 3,192,563 | 7/1965 | Crompton | 18—8 |
| 3,308,503 | 3/1967 | Fays     | 18—8 |

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259—4