APPARATUS FOR SPINNING COMPOSITE FIBERS

Filed Feb. 7, 1968 3 Sheets-Sheet 1

Fig. 1

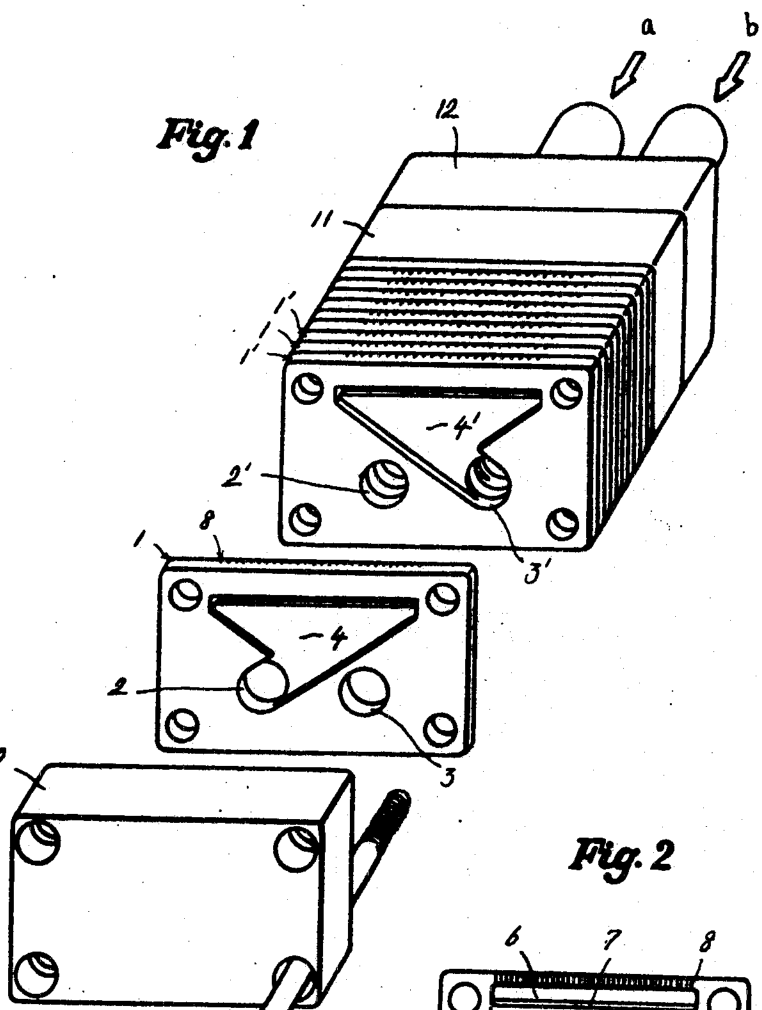

Fig. 2

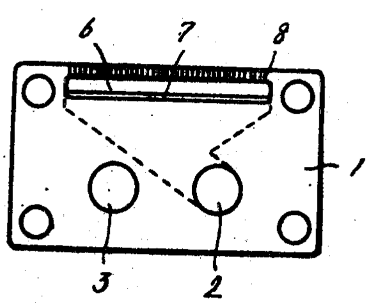

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Fig. 3

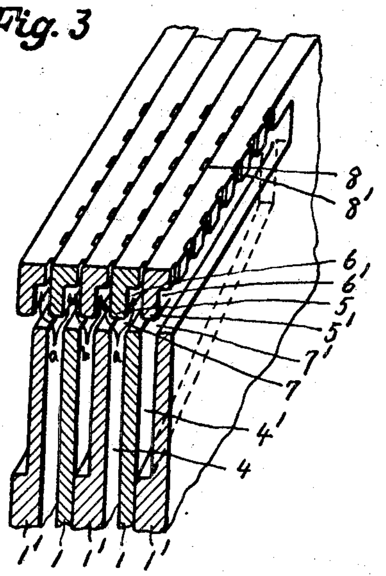

Fig. 4

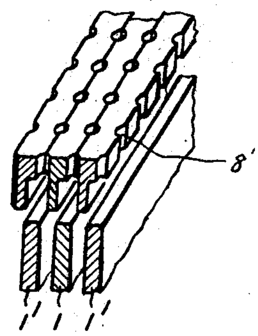

Fig. 5

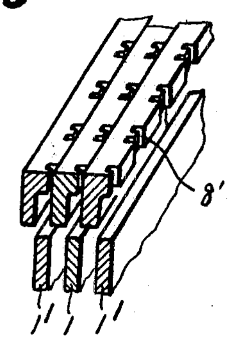

Fig. 6

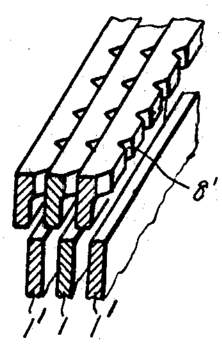

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Fig. 7

A B C D

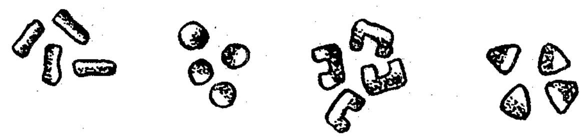


Fig. 8

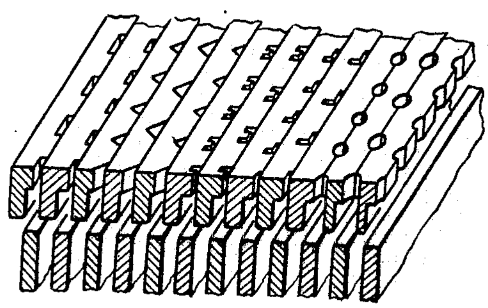


Fig. 9

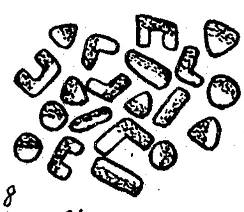
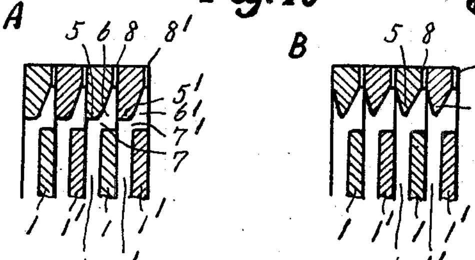


Fig. 10

A B



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APPARATUS FOR SPINNING COMPOSITE FIBERS

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Int. Cl. D01d 3/00

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ABSTRACT OF THE DISCLOSURE

A composite fiber spinning apparatus for extruding two different spinning solutions through common orifices to form conjugated or composite fibers is made up essentially of a series of plates clamped together to form a laminated structure. The two end plates function as front and rear closure plates. Each of the intermediate plates disposed between the end plates is provided with a pair of spaced bores extending therethrough in mutual alignment and in alignment with one of the two feed supply bores in the front closure plate, for feeding the two different spinning solutions. Each intermediate plate is also provided on one side thereof with a recess which is closed by the adjacent uninterrupted side of the adjacent plate. The recess of the first plate is in communication with one of the conduits formed by the two bores; the recess of the second plate is in communication with the other of the said bores. Each recess is also in communication with a back-side recess formed on its plate, through a flow through portion provided in each plate for this purpose. Each backside recess leads to nozzles formed at the top of the respective plates.

The present invention relates to a composite fiber spinning apparatus for extruding two different spinning solutions through common orifices to form so-called conjugated or composite fibers, each comprising the different components laminated along the entire length of the fiber and arranged in an eccentric relationship over the cross-section of the fiber.

Generally, a composite fiber spinning apparatus is adapted to cause two different spinning solutions to laminarily flow together just in front of orifices and then to be extruded through the orifices concurrently. A conventional spinning apparatus of this type is constituted by a spinning solution introducing part for guiding two different solutions to the vicinity of each orifice separately so as not to allow the solutions to be mixed together and then causing them to flow together just in front of the orifices, and a spinnerette part formed with orifices in positions corresponding to the junctions of the flows. With the apparatus of such structure, unless the junction of flows of two spinning solutions at the spinning solution introducing part is exactly aligned with the position of each orifice of the spinning head, this will result in a difference in the proportions of the spinning solutions, and therefor a uniform composite fiber cannot be obtained.

As a result, there arise various problems in manufacture and operation since the apparatus becomes complicated as compared with the ordinary single component spinning apparatus; for example, a high degree of working precision is required to establish alignment between the disposition of the spinning solution introducing part (at the junction of flows) and the disposition of the orifices of the spinnerette and positioning procedure for aligning the spinning solution introducing part with the spinnerette at the time of use is required.

2

It is known that like the ordinary single component fiber, by providing the composite fiber with irregular cross-sectional shape different from circle, such as, for example, rectangle and triangle, the composite fiber can be caused to possess special hand (touch) not obtainable with circular cross-sectional fiber. Irregular cross-sectional orifices, however, are extremely difficult to work as they require special working technique as compared with circular orifices, and a spinnerette having thousands of or tens of thousands of such irregular orifices used for wet spinning system will involve an enormous cost, so that in practice such irregular orifice spinnerettes are rarely employed at present.

There have been made some proposals that plates are stacked one upon another to form a spinning solution introducing part and orifices. However, they have various difficulties in that the plates are difficult to manufacture and the shape of the orifices is limited.

Therefore, it is an object of this invention to provide a novel spinning head for spinning composite fibers which does not contain any parts requiring special manufacturing technique as mentioned above but is constituted by parts capable of being easily produced with the usual technique and which is simple in structure from a viewpoint of mechanism.

The invention will be described in more detail with reference to the drawings, wherein FIG. 1 is an exploded perspective view of the main portion of the apparatus embodying this invention; FIG. 2 is a back view of one of the component plates constituting of the apparatus of FIG. 1; FIG. 3 is a fragmentary enlarged perspective view of portions of component plates adjacent orifices; FIGS. 4, 5 and 6 are perspective views similar to FIG. 3, but showing other forms of orifices of the spinning apparatus; FIG. 7A, 7B, 7C and 7D are cross-sections of composite fibers obtained by means of the orifices shown in FIGS. 3, 4, 5 and 6, respectively; FIG. 8 is a fragmental enlarged perspective view of portions adjacent orifices, showing an example in which orifices of various cross-sections are formed by using a single spinning head according to the present invention; FIG. 9 shows the cross-sections of composite fibers obtained by means of the spinning head shown in FIG. 8; and FIGS. 10A and 10B are fragmentary enlarged cross-sections of component plates showing embodiments of various shapes of back-side recesses and partitions.

Referring to the drawings, particularly FIG. 1, the composite spinning head of the invention is constructed by stacking a number of component plates **1** and **1′** alternately, which are clamped together in parallel relationship and uniformly between shutter plates **10** and **11** by means of clamping bolts **9** in order to prevent liquid from leaking through clearances between the stacked component plates. The component plates **1** and **1′** have cut-outs **2**, **3** and **2′**, **3′**, respectively. Each component plate **1** has on its front side a front-side recess **4** leading to the cut-out **2**, and similarly each component plate **1′** has on the front side a front-side recess **4′** leading to the cut-out **3′**. FIG. 2 is a view of such component plate **1** as seen from the backside thereof. As shown in FIG. 3, the component plates **1** and **1′** have back-side recesses **6** and **6′** on their back-side and grooves **8** and **8′** leading to the outer periphery. The front side recesses **4**, **4′** and the back-side recesses **6**, **6′** are connected with each other at locally portions, and at said connecting portions there are formed flow-through portions **7**, **7′** passing through the component plates. When the component plates **1** and **1′** are stacked and assembled, the cut-outs **2**, **3** and **2′**, **3′** define introduction passages for spinning solutions, the front-side recesses **4**, **4′** and back-side recesses **6**, **6′** define spinning solution branch flow passages, and the intermediate portions serve as partitions **5** and **5′**. Grooves **8** and **8′** are engaged with plane surfaces of adjacent component plates or with such grooves formed at opposed positions, thereby forming orifices.

Spinning solutions are supplied by a spinning solution supply part **12**, which supplies them at positions corresponding to the cut-outs **2**, **2'** and **3**, **3'**. One spinning solution *a* is passed through the spinning solution introducing passage defined by the cut-outs **2**, **2'** of the component plates **1**, **1'**, and through the spinning solution branch flow passages defined by the front-side recesses **4**, to reach the flow-through portions **7**, **7'**, and are divided into two streams entering the back-side recesses **6**, **6'**. Correspondingly, the other spinning solution *b* is passed through the spinning solution introducing passage defined by the cut-outs **3**, **3'** of the component plates, and through the spinning solution branch flow passages defined by the front-side recesses **4**, to reach the flow-through portions, and are divided into two streams as in the case of the spinning solution *a*. Thus the spinning solutions *a* and *b* join together in overlapped or back to back relation when flowing through the flow-together passages defined by the back-side recesses **6**, **6'**, and are finally discharged through the orifices.

The cross-section of the orifices may be rectangular, circular, ⊐-shaped, and triangular shapes shown in FIGS. 3, 4, 5 and 6, respectively, or may be of any other shape by suitably selecting the shape and size of the grooves **8**, **8'** of the component plates **1**, **1'**.

While the back-side recesses **6**, **6'** are shown as having sectional shapes out at right angles to the component plates as shown in FIGS. 3 to 6 and FIG. 7, they may be cut obliquely with respect to the component plates as shown in FIG. 10, or alternatively they may be of inverted Y-shape by obliquely cutting the partitions **5**, **5'** corresponding to the back-side recesses **6**, **6'**, thereby to reduce the spinning back-pressure.

FIGS. 7A, B, C and D respectively show the cross-sectional shapes of the composite fibers spun by means of the orifices having shapes shown in FIGS. 3, 4, 5 and 6.

While the component plates may be formed of any desired materials, the use of synthetic resin having a low thermal conductivity, preferably less than 5×10^{-3} cal.·cm.$^{-1}$·sec.$^{-1}$·deg.$^{-1}$· has advantages in that the low thermal conductivity thereof makes it unnecessary to use heat insulator and excludes the possibilities of causing irregularities in the temperature of the spinning solutions and of causing stagnation of the solutions, thereby assuring smoothness and uniformity of spinning operation. Further, if the composite plates are to be articles made of synthetic resin, the formation of only two metal molds allows mass-production and hence reduces the cost of manufacture greatly.

While the synthetic resins useful as the material of the component plates include polyamide resin, polycarbonate resin, polyether resin, heat-resistant polyvinyl chloride resin, phenol resin, epoxy resin, unsaturated polyester resin, etc., preferable ones are polycarbonate resin, polyether resin and epoxy resin, which are excellent in heat resistant, pressure- resistant and chemical-resistant properties. Any of the many commercially available resin materials—e.g. hexan, Zytel-42, Derlin, Epikote 1031, etc.—can be employed.

As mentioned above, the apparatus of the present invention is simple in structure and easy to produce. Moreover, irregular orifices can be obtained as easily as circular orifices, and as the characteristics of the stack system, the alteration of the number of the orifices can be easily attained by simply changing the number of the component plates. Further, owing to the integral structure of the spinning head main part and spinnerette, all the needs of the working technique for aligning the junction of flows at the spinning solution introducing part of the orifices of the spinnerette, of positioning at the time of use, and of the provision of attachment means and seals, are eliminated.

Further, as shown in FIGS. 8 and 9, there are various features that when it is desired to produce composite fibers of various cross-sectional shapes and are as in various proportions of the products by using a single spinning head, this object can be attained by altering the combination of the component plates.

What we claim is:

1. An apparatus for spinning composite fibers, which comprises component plates (**1**) having cut-outs (**2**) and (**3**), front-side recesses (**4**) leading to said cut-outs (**2**), back-side recesses (**6**) communicating with said front-side recesses (**4**) locally at flow-through sections (**7**), and spinning grooves (**8**) leading from said back-side recesses to the outer periphery, and component plates (**1'**) having cut-outs (**2'**) and (**3'**), front-side recesses (**4'**) leading to said cut-outs (**3'**), back-side recesses (**6'**) communicating with said front-side recesses locally at flow-through sections (**7'**), and spinning grooves (**8'**) leading from said back-side recesses to the outer periphery, said component plates (**1**), (**1'**) are stacked alternately so that passages defined by the front-side recesses (**4**) of the component plates (**1**) and the plane surfaces of the adjacent component plates (**1'**) communicate at flow-through portions (**7**) and (**7'**) with passages defined by the front-side recesses (**4'**) of the component plates (**1'**) and the plane surfaces of the component plates (**1**), and orifices are defined by the spinning grooves (**8**) and (**8'**) leading to passages defined by the back-side recesses (**6**) and (**6'**) of the component plates (**1**) and (**1'**) and the adjacent component plates (**1**) and (**1'**).

2. An apparatus as claimed in claim **1** wherein each component plate is made of a synthetic resin having a thermal conductivity less than 5×10^{-3} cal.·cm.$^{-1}$·sec.$^{-1}$·deg.$^{-1}$.

3. An apparatus as claimed in claim **2** wherein the synthetic resin is selected from polycarbonate, polyether, polyamide, phenolic resins, epoxy resins, thermally stable polyvinyl chloride and unsaturated polyester resins.

References Cited

UNITED STATES PATENTS

2,031,387	2/1936	Schwarz.
3,176,345	4/1965	Powell.
3,192,562	7/1965	Powell.
3,192,563	7/1965	Crompton.
3,204,290	9/1965	Crompton.
3,403,422	10/1968	Nakagawa et al.

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