May 22, 1951 W. L. WEBB 2,553,692

STAPLE FIBER SPINNERET

Filed July 3, 1948

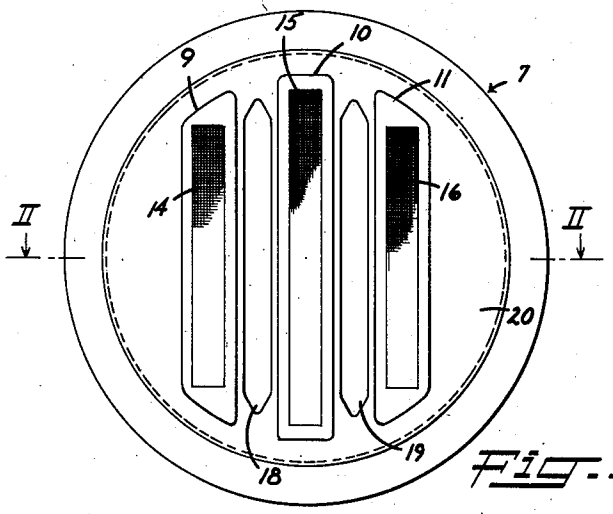

Fig. 1

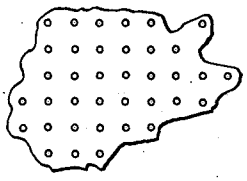

Fig. 3

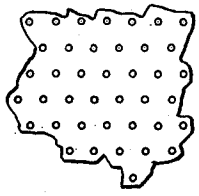

Fig. 4

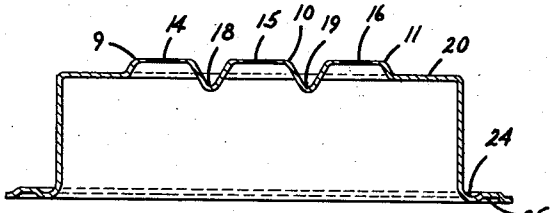

Fig. 2

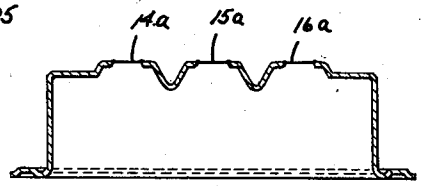

Fig. 6

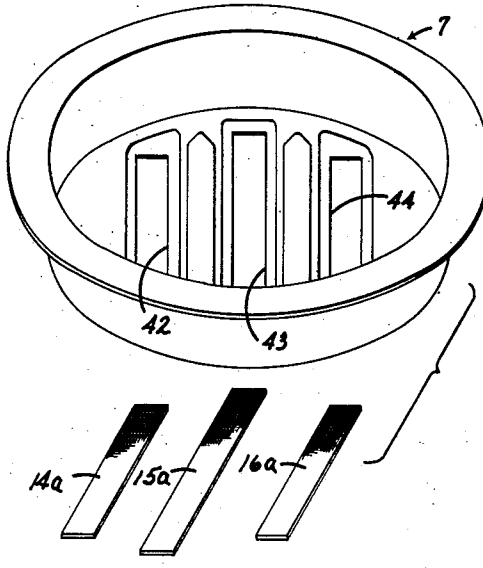

Fig. 5

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STAPLE FIBER SPINNERET

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12 Claims. (Cl. 18—8)

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This invention relates to the manufacturing of filamentary materials and is particularly concerned with spinnerets or spinning jets which may be used in relatively large sizes to extrude a large number of filaments at high speed.

Spinning jets used in the extrusion of artificial filaments take the form generally of a shallow cup having a number of very small apertures distributed over the bottom or the disc surface thereof. When secured to a rounder through which a spinning liquid is supplied, filaments are formed by passage of liquid through the orifices. The rate at which the filaments are formed will depend upon the pressure at which the liquid is supplied to the spinneret nozzle. The fineness of the orifices will determine the amount of pressure needed to maintain a given rate of extrusion. When the spinning is being conducted with jets of small diameter, such as the ½ inch jets commonly used in continuous spinning operations, the pressure needed to maintain a desired extrusion rate does not cause any great degree of strain on the jet but when the extrusion of filaments is obtained while using larger jets such as are needed in the production of staple rayon fiber wherein it is desired to extrude thousands of filaments from a single nozzle, the surface area of the jet is necessarily large and is subjected to considerable hydraulic pressure. In order to maintain desirable extrusion rates, pressures are readily developed which would distort a spinneret of simple construction. It is impractical to increase the thickness of the metal from which the spinneret or jet is constructed because of the difficulty of perforating the metal with closely spaced apertures, i. e., apertures spaced at 0.010 of an inch or less. Moreover, it is desirable to space the orifices as closely as possible in order to provide a jet of a minimum size so that excessive strain will be avoided. However, the more closely the orifices are spaced, the greater is the difficulty in obtaining efficient coagulation of the filaments in the region adjacent to the face of the jet because of poor distribution or circulation of the liquid coagulant.

It is an object therefore to provide a spinneret or jet for extruding artificial filaments having high structural resistance to bulging or other distortion. Another object is to provide a jet so constructed that coagulating solutions or other treating fluids may be readily circulated throughout the filaments as they leave the jet face. A further object is to provide a jet of a design which will accommodate a large number of orifices while keeping the size of the jet to a minimum. Still

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another object is to provide a jet having apertured sections which may be readily replaced by portions of apertured sheet material such as a screen formed by electrolytic deposition. A still further object is to provide a jet of which a large portion thereof comprises inexpensive materials and the more expensive portions are replaceable panels. Other objects, features and advantages will become apparent from the following description of the invention and the drawings illustrative thereof in which

Fig. 1 is a face view of a preferred spinneret according to the invention;

Fig. 2 is a sectional view of the spinneret illustrated in Fig. 1 and taken along line II—II;

Fig. 3 is greatly enlarged fragmentary view of a perforated section of a spinneret according to this invention;

Fig. 4 is another enlarged fragmentary view of a perforated section showing a modified arrangement of the apertures;

Fig. 5 is a perspective view showing a spinneret and detached apertured panels; and

Fig. 6 is a section illustrating the parts shown in Fig. 5 assembled.

The above stated objects and others ancillary thereto are accomplished by providing an extrusion jet or spinneret comprising a cup-shaped member of which the face is divided into apertured panels in alternate arrangement with grooved or corrugated sections the corrugations of the latter are parallel to the lengthwise direction of the panels and provide rigidity in the face of the jet or spinneret and improved liquid distribution along the filaments extruded therefrom. The panels and the grooved sections therebetween extend transversely of the spinneret face generally within a peripheral marginal section thereof. The apertured panels are preferably raised above the plane of the surrounding portions of the face. The corrugated or grooved sections and the peripheral sections of the spinneret are, as shown in the drawing, of greater thickness than the panels. The bottoms of the grooves lie in a plane which is substantially parallel to the panels of the jet preferably inwardly of all other portions of the face, in order to provide grooves of correspondingly increased depth.

Fig. 1 illustrates three panels 9, 10 and 11 of the jet 7 each of which contains a rectangular apertured area 14, 15 and 16 respectively. A grooved section 18 separates the panels 9 and 10; another grooved section 19 separates panels 10 and 11. The jet in order to be readily secured to a rounder, is provided with a flange portion 24.

It is provided with an annular groove 25 to give the flange rigidity and implement the securing and the sealing thereof within a nozzle assembly.

Flectional resistance is given to the jet by the protrusion of panels 9, 10 and 11 beyond the plane of the portion 20 of the jet face, and also by protrusion of the grooves 18 and 19 in an opposite direction from such plane. Consequently, the grooves have substantial depth and function mechanically as beam extending transversely of the portion 20. However, in addition to strengthening the jet, such grooves as 18 and 19 perform another very important function by channeling liquid coagulant into the filament-forming region. As newly formed filaments leave the face of the spinneret, they tend to pull liquid along with them and consequently produce currents in the liquid parallel to their direction of movement. As a result, liquid entering the filamentary bundle from a lateral region is impeded in its lateral movement to the interior filaments of the bundle by the rapid movement of the filaments being drawn away from the spinneret. Moreover, the liquid which does reach the interior filaments is less effective as a result of losing some of its reactivity while passing through the outer filaments of the bundle. The grooves 18 and 19 provide passageways inward or behind the plane of the surfaces from which the filaments are extruded. Liquid flows along these grooves from an exterior region to reach the interior filaments of the bundle without passing by or through the outer filaments thereof. A strong current is induced longitudinally along the grooves but laterally of the movement of the filaments as the freshly formed filaments pick up portions of the liquid when leaving the spinneret face. The grooves therefore effectively implement the distribution of liquid coagulant or other liquid at substantially uniform strength to all of the filaments leaving a spinneret.

The preferred arrangement for the apertures, in order to most effectively obtain the benefits of grooves such as 18 and 19, is in substantially rectangular panels separated by such grooves which extend substantially across the face of the spinneret; grooves which intersect other grooves are not desired since they disturb the flow behavior just described. So that liquids may penetrate or be carried to the most inward filaments being extruded from the apertures of a panel, it is preferred that the apertures be regularly spaced in straight uniformly spaced rows. In a preferred arrangement the rows of apertures are normal to the general direction of the grooves. In Fig. 3 apertures are shown arranged in a square pattern whereas in Fig. 4 the apertures form a pattern comprising many identical triangles in the same alignment. The apertures may take any pattern whereby straight passages are formed for liquid transfer.

Fig. 5 shows a jet similar in construction to that shown in Fig. 1 except that the apertured panels 14*a*, 15*a* and 16*a* are removable from the jet 7*a* and may, in fact, be of a different material. The replaceability of such panels is advantageous since by such an expedient, electrolytically formed screens, such as those formed by a process described in the Norris Patent No. 2,166,367, may be utilized as apertured sections for jets. Pieces of these screens shown detached in Fig. 5 as elements 14*a*, 15*a*, and 16*a*, but shown in attached position in Fig. 6 may be welded or otherwise secured in place along the edges of the apertures 42, 43 and 44 therefor. The screen is of a corrosion-resistant material such as that normally used in jets, and when viscose solution is the material to be extruded, the screens may be of a precious metal, such as gold, platinum, or gold, platinum and iridium alloys. The main body of the jet may be of a less expensive metal or other corrosion-resistant material. The use of less expensive jet body portions effects a large saving and is of special importance when using the larger sized jets.

Spinnerets of the design and construction herein described make possible the use of large spinnerets of the closely-spaced orifice type. In addition to the desirability of providing a large number of orifices to produce large filamentary bundles as in the manufacture of staple fiber, it is advantageous to make use of the closely-spaced orifice principle such as disclosed in application Serial No. 522,430, filed February 15 1944, now Patent No. 2,465,408 in order to obtain the benefits accruing thereto such as: less breakage of filaments at the spinneret, less clogging of the orifices, and improvement of the quality of the products obtained.

The diameter of the orifices or holes themselves is normally from 0.001 to 0.003 of an inch; the thickness of the perforated panels may preferably range from 0.005 to 0.025 of an inch; the center-to-center spacing of holes may preferably range between 0.005 to 0.025 of an inch. The thickness of the perforated panel is preferably no greater than the spacing of the holes from center to center and the width of the lands is at least as large as the diameter of the holes. Apertured panels such as described may be formed also by punching or drilling the apertures.

While a preferred embodiment has been described and shown it is to be understood that changes in shape, size, and rearrangement of details and parts such as come within the purview of the invention claimed, may be resorted to.

I claim:

1. A spinneret having a face comprising a plurality of spaced flat panels which are raised with respect to the other sections thereof, each of said panels comprising an apertured area, said areas being thinner than said other sections of the spinneret face and having a plurality of closely-spaced apertures extending therethrough.

2. A spinneret as defined in claim 1 wherein the apertures have a diameter in the range of 0.001 to 0.003 of an inch, and the apertured areas has a thickness in the range of 0.005 to 0.025 of an inch, and the distance from center-to-center of adjacent apertures is in the range of 0.0005 to 0.025 of an inch.

3. A spinneret as defined in claim 2 wherein the thickness of the apertured areas is no greater than the center-to-center spacing of the apertures and the distance between the peripheries of adjacent apertures is as large as the diameter of the apertures.

4. A spinneret for spinning large filamentary bundles having a face comprising a plurality of spaced flat panels which are raised with respect to the other sections thereof, said other sections comprising grooved sections between the panels, each of said panels comprising an apertured area, said areas being thinner than said other sections of the face and having a plurality of closely-spaced apertures extending therethrough.

5. A spinneret as defined in claim 4 wherein the apertures have a diameter in the range of 0.001 to 0.003 of an inch, and the apertured areas have a thickness in the range of 0.005 to 0.025 of

an inch, and the distance from center-to-center of adjacent apertures is in the range of 0.005 to 0.025 of an inch.

6. A spinneret as defined in claim 5 wherein the thickness of the apertured areas is no greater than the center-to-center spacing of the apertures and the distance between the peripheries of adjacent apertures is as large as the diameter of the apertures.

7. A spinneret for spinning large filamentary bundles having a face comprising a plurality of flat panels which are raised with respect to the other portions of the face, said panels having adjacent paralel sides and extending crosswise of the face continuously between peripheral portions thereof providing parallel liquid conducting passageways between the adjacent sides of the panels, each of the panels having an apertured area which is substantially thinner than the material constituting said other portions of the face, and a plurality of closely-spaced apertures extending through each of said panel areas.

8. A spinneret for spinning large filamentary bundles having a face comprising a plurality of flat panels which extend continuously between peripheral portions of the face and are raised with respect thereto, the adjacent sides of the panels being parallel and spaced, a grooved section between each pair of adjacent panels extending in a direction parallel to the sides thereof with the bottoms of the grooves lying in a plane which lies inwardly of said peripheral face portions to provide passageways for liquid between the panels, the material constituting the panels being substantially thinner than that constituting the remainder of the face, and a plurality of apertures extending through each panel.

9. A spinneret as defined in claim 8 wherein the apertures have a diameter in the range of 0.001 to 0.003 of an inch, and the panels have a thickness in the range of 0.005 to 0.025 of an inch, and the distance from center-to-center of adjacent apertures is in the range of 0.005 to 0.025 of an inch.

10. A spinneret as defined in claim 9 wherein the thickness of the panels is no greater than the center-to-center spacing of the apertures and the distance between the peripheries of adjacent apertures is as large as the diameter of the apertures.

11. A spinneret having a face comprising a plurality of cut-out sections of which the peripheries are raised with respect to the other portions of the face, removable panels fitting into, and secured within, the cut-out areas of the sections, said panels having a plurality of closely-spaced apertures extending therethrough and constituted of a material which is substantially thinner than that constituting the other portions of the spinneret face to enable closer spacing of the apertures than possible through the material of the face.

12. A spinneret having a face and a plurality of cut-out sections of which the peripheries are raised with respect to the other portions of the face, the adjacent sides of the sections being parallel and spaced to provide passage for liquid in a direction parallel to the plane, said sections extending continuously crosswise of the face between peripheral portions thereof, removable panels fitting into, and secured within, the cut-out areas of the sections, said panels having a plurality of closely-spaced apertures extending therethrough and being constituted of a material which is substantially thinner than that constituting the other portions of the spinneret face to enable closer spacing of the apertures than possible through the material of the face.

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