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SPINNERET ASSEMBLY

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FIG. 1

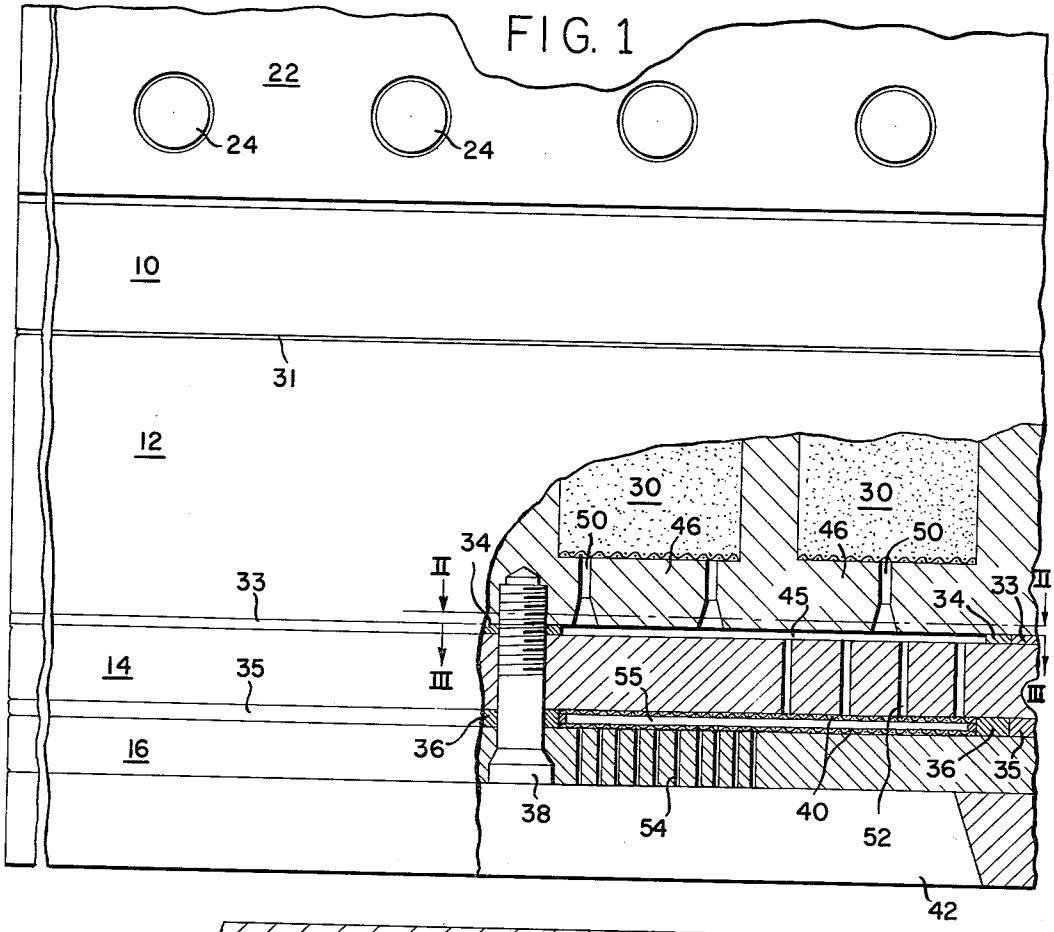
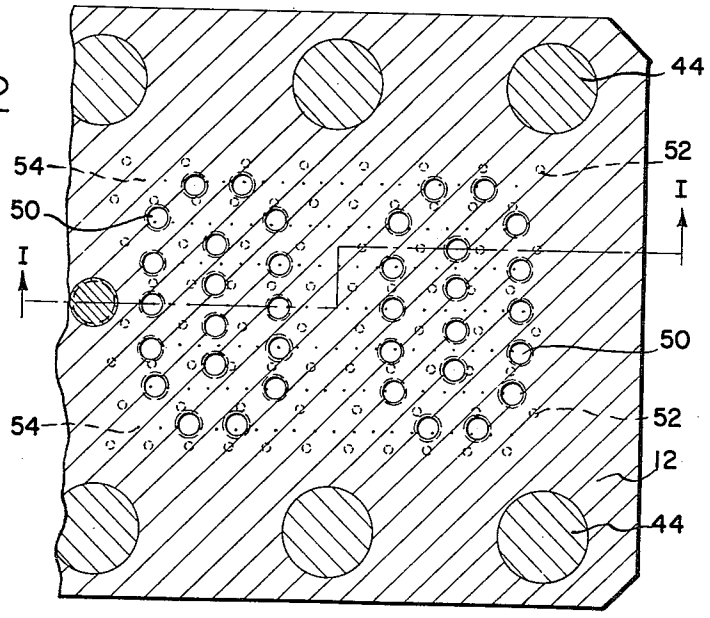


FIG. 2



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FIG. 3

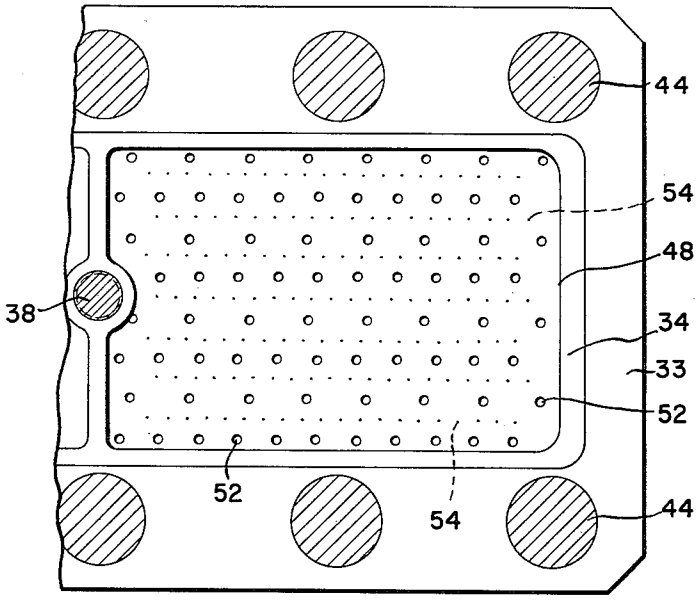
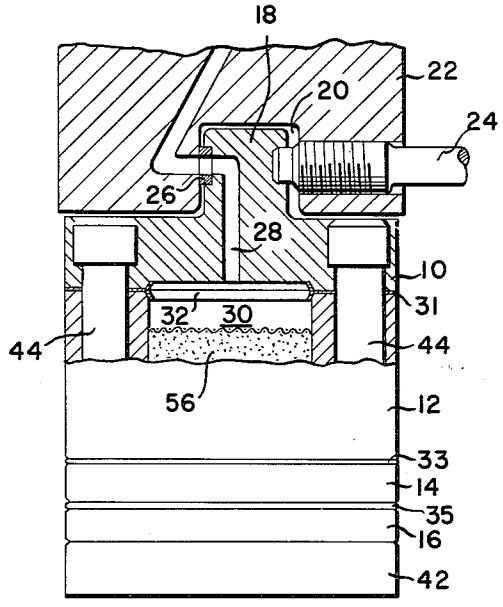


FIG. 4



United States Patent Office 3,050,774 Patented Aug. 28, 1962

3,050,774

SPINNERET ASSEMBLY

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Filed July 27, 1960, Ser. No. 45,569
4 Claims. (Cl. 18—8)

This invention relates generally to the production of spun filaments from molten organic compositions and, more particularly, to a spinneret assembly useful in the spinning process.

In the melt-spinning of organic, polymeric materials such as nylon, it is customary to pass the molten polymer through a sand filter prior to extrusion through a spinneret. Such an assembly, in which the spun filaments are quenched with air below the spinneret, has been disclosed by Graves in U.S. Pat. No. 2,266,363. This procedure is entirely satisfactory when only a relatively small number of filaments is being spun. However, difficulties in maintaining filament uniformity have been encountered when spinning a large number of filaments, as in the production of high denier industrial yarns or staple tows. There have been various attempts to overcome these difficulties, e.g., by distributing the polymer in a uniform manner and at a uniform pressure. One such attempt, which involves the use of a rectangular spinneret and a plural cavity filter, has been disclosed by McCormick et al. in U.S. Patent No. 2,969,561.

The most important object of the present invention is to improve the uniformity of melt-spun filaments.

A further important object of the invention is to provide for the uniform distribution of polymer to the individual holes in a spinneret and for the elimination of stagnation zones in the spinneret assembly. These and other objectives are accomplished in a spinneret assembly which has superimposed filter block, distribution plate and spinneret plate elements. The filter block element has two or more filtration cavities each of which has a perforated bottom wall. In the successive elements, the holes are more frequent, smaller in diameter and staggered relative to the holes in an adjacent element. The hole pattern in the distribution plate covers a larger area and extends peripherally beyond the other hole patterns.

Other objectives will become apparent in the following specification wherein reference is made to the accompanying drawings in which:

FIGURE 1 is a fragmentary side view of the spinneret assembly of the invention, parts having been broken away and shown in section (along irregular line I—I of FIG. 2) to reveal details of construction;

FIGS. 2 and 3 are fragmentary sectional views taken on lines II—II and III—III, respectively, of FIG. 1; and

FIG. 4 is an end view of the assembly shown in FIG. 1, parts having been broken away and shown in section to illustrate the manner in which the assembly is located with respect to a spinning machine.

The embodiment of the spinneret assembly which has been chosen for illustration includes a lid **10**, a filter block or sand holder **12**, a distribution plate **14** and a spinneret plate **16**. As best shown in FIG. 4, the lid **10** has an upstanding rib **18** which fits in a groove **20** in a spinning machine **22** and is held in place by a plurality of screws **24**. There is a screw **24**, a gasket **26** and a flow passage **28** for each cavity **30** of the assembly. Lid **10**, block **12** and plates **14**, **16** have spacers **31**, **33**, **35** located therebetween and are sealed by gaskets **32**, **34**, **36**. A fastener **38** extends through the plates and into block **12** to provide suitable support centrally of the assembly. The distribution zone **55** between plates **14**, **16** is fitted with a pair of screens **40** and the assembly, including a peripheral ring

member **42**, is held together by a plurality of through bolts **44**.

As illustrated, each pair of cavities **30** feeds into a zone **45** between the bottom wall **46** thereof and plate **14** which zone is defined by an opening **48** in gasket **34**. The individual cavities **30** are elliptical in cross section and discharge through an elliptical pattern of equi-dimensional holes **50** passing through the associated bottom wall **46**. Plate **14** is provided with a substantially rectangular hole pattern in which pattern the individual holes **52** are arranged in longitudinal rows and staggered transversely, i.e., with respect to the holes in adjacent rows. Equi-dimensional holes **52** have a diameter substantially less than the minimum diameter of holes **50**. In the assembled spinneret, holes **52** are also staggered with respect to holes **50** and their pattern extends peripherally beyond the pattern of holes **50**, as shown in FIG. 2. Plate **16** is similarly provided with a substantially rectangular pattern of equi-dimensional spinneret holes **54** which, with respect to the distribution holes **52**, are smaller in diameter and more frequent. The holes **54** are also arranged in longitudinal rows each of which lies substantially midway between two rows of distribution holes. It is apparent from FIG. 3 that the distribution hole pattern extends beyond the spinneret hole pattern in every direction.

The various hole patterns are arranged in such a manner that no distribution hole **52** or spinneret hole **54** is beneath another hole. The spinneret holes are equi-spaced and symmetrically staggered relative to the holes in the next adjacent row and, at the same time, are substantially equally spaced from the nearest distribution hole. The latter feature has been accomplished in part by varying the hole frequency in alternate rows of distribution holes **52**. The combination of these features with the successive decrease in hole diameter from element to element and the greater peripheral extent of the distribution hole pattern insures an increased pressure drop across the successive elements **12** (**46**), **14**, **16** and a substantially equal volumetric flow through each spinneret hole **54**.

In operation, equal volumes of molten polymer are pumped to the passages **28** and through the filter medium **56** in each cavity **30** in much the same manner as has been described in the McCormick et al. patent. There is thus a substantially uniform flow through each hole **50** to the zone **45** above distribution plate **14**. In view of the staggered relationship between the holes **50**, **52** and the location of certain holes **52** peripherally beyond the patterns of holes **50**, all of zone **45** is swept by the polymer, there is no possibility of stagnation in that zone and there is a substantially equal pressure drop through each hole **52**. The staggered relationship betweel holes **52**, **54** and the frequent location of holes **52** beyond the periphery of the spinneret hole pattern similarly insures an equal flow through each spinneret hole **54** and the elimination of any stagnation in the distribution zone **55** between plates **14**, **16**.

The illustrated filter block **12** has a total of four cavities **30**, only two of which have been shown in detail in FIGS. 1–3. It should be apparent, however, that each pair of cavities **30** discharges through the associated holes **50** to a single zone **45** which in turn discharges to a single zone **55** and that an identical flow arrangement is provided for the pair of cavities (not shown) located on the opposite side of screw **38**. It is equally apparent that additional pairs of cavities could be provided, depending on the construction of the particular spinning machine to which the assembly is to be connected.

As noted previously, the use of plural sand cavities for the purpose of obtaining a uniform flow of the polymer melt therethrough has been described by McCormick

et al. By incorporating the improvements disclosed herein, a uniform distribution and flow of polymer to each spinneret hole is insured and the possibility of stagnation areas is substantially eliminated. In actual tests, a substantial reduction in the number of spinning breaks per position per day and a reduction in the required number of pack changes were noted.

It is apparent that many changes and modifications may be made in the disclosed spinneret assembly without departing from the spirit of the present invention which is therefore intended to be limited only by the scope of the appended claims.

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

1. A spinneret assembly comprising superimposed filter block, distribution plate and spinneret plate elements, said elements being spaced to present zones therebetween, each element being provided with a pattern of spaced, substantially equi-dimensional flow holes, the holes in the successive elements being more frequent and smaller in diameter with the distribution hole pattern covering a larger area, extending peripherally beyond the other patterns, and being substantially conterminous with both zones, each distribution hole also being staggered with respect to the holes in the other elements, there being a uniform density of holes throughout the area of each pattern.

2. The spinneret assembly of claim 1 wherein the filter block element is provided with at least two filtration cavities each having a bottom wall in which a separate pattern of filter block holes is located, the distribution and spinneret hole patterns being uninterrupted, each distribution hole being communicable with each filter block hole.

3. A spinneret assembly comprising superimposed filter block, distribution plate and spinneret plate elements, said elements being spaced to present zones therebetween, each element being provided with a pattern of substantially equi-dimensional flow holes, the holes in the distribution and spinneret elements being arranged in parallel rows with each hole staggered relative to those of adjacent rows, each row of spinneret holes being located between two adjacent rows of distribution holes, said distribution hole pattern covering a larger area than the other patterns and being substantially conterminous with both zones.

4. A spinneret assembly comprising superimposed filter block, distribution plate and spinneret plate elements, said elements being spaced to present zones therebetween, said filter block element including at least two filtration cavities each having a bottom wall, each bottom wall and each plate being provided with a pattern of substantially equi-dimensional flow holes, the holes in the successive elements being more frequent, smaller in diameter and staggered relative to the holes in an adjacent element, the pattern of the distribution holes extending peripherally beyond the other patterns and being substantially conterminous with both zones, there being a substantially uniform density of holes throughout the area of each pattern.

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