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(54) Apparatus and method for making two component continuous fibers or filaments by using flexible ducts

(57) An apparatus for making two-component continuous fibers or filaments comprises a pre-die plate (12) having first openings (26) therethrough a components (A) flows towards second openings (36) aligned with the first openings and provided through a die (10) opposite to the first pre-die (12). In order to overcome any disalignments of said first and second openings, without negatively affecting the flows of the two mentioned components, flexible ducts extending between the first and second openings are provided.

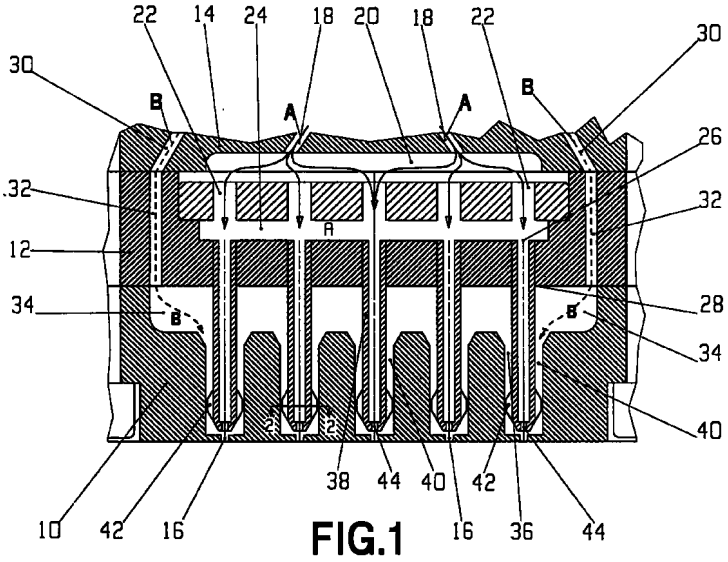

FIG.1

EP 0 995 822 A1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an apparatus and method for making a continuous fiber or filament and, more specifically, for forming a fiber including two discrete and different components.

[0002] Synthetic fibers, as is known, are conventionally made by extruding molten polymers through a plurality of very small openings of an extruding die.

[0003] Said synthetic fibers, as it is also known, can comprise two component polymers of different characteristics and physical properties. These fibers are the so-called "sheath-core" fibers which include a central component (the core) inside a further fiber component (the skin or sheath).

[0004] In forming these sheath-core fibers, it is very important to properly held the fiber core in the center of the fiber, since if the fiber core is offset from the fiber center, even if slightly, then the qualities and physical properties of the resulting fiber would be deleteriously affected.

[0005] A conventional method for forming the above mentioned sheath-core fibers provides for using a pre-die plate, including a first plurality of openings passing through said pre-die plate therealong one of the two components flows, as well as a further die including therethrough a second plurality of die openings therethrough the second component flows, which second component, after joining the first, is discharged through the corresponding openings of the die, with the above mentioned sheath-core pattern.

[0006] Thus, it should be apparent that the alignment between the first and second pluralities of openings through the pre-die plate and the die proper can be critical, since, if the first openings would be even slightly offset from the second openings, then the core component would not be centered with respect to the second component and the obtained fiber would have the above mentioned disadvantages.

[0007] Thus, as both the pre-die plate and die plate proper are provided with a plurality of disordered openings passing therethrough and having a very small size, then, it should be apparent that the involved tolerances would be very narrow. Thus, a small disalignment of the mentioned small openings would be anyhow possible.

[0008] Moreover, this problem is further greatly deleteriously aggravated by the fact that the fiber components must be held in a molten status as they are caused to flow through the two die plates. Then, the die plates will achieve a comparatively high temperature level (up to 350°C), considering the different melting points and degrees of the two components.

[0009] Since the die plate are conventionally made of a steel material, said high temperatures (and possible variations thereof) will cause the plate size to change, both by expanding and by contracting, and this variations can offset or displace opening sets of a plate from the respective openings of the other plate, thereby greatly and undesirably disaligning the two opening sets or series.

SUMMARY OF THE INVENTION

[0010] Accordingly, it would be desiderable to provide and apparatus and method, of simple and reliable nature, for compensating any possible disalignments of the openings of the two die plates, for allowing the fiber core component to be precisely centered with respect to the sheath component.

[0011] In order to achieve the above mentioned aim, according to the present invention is provided an apparatus for making continuous fibers or filaments, constituted by a first and second component polymers, said apparatus including a first plate having an inlet for receiving said first component polymer and a plurality of first openings therethrough said first component polymer flows to an outlet end of said openings. A second plate is oppositedly mounted with respect to said first plate, said second plate being provided with a plurality of second openings which are axially aligned with said plurality of said first openings of said first plate, said second plate being provided with a flow channel allowing said second polymeric component to flow through said second openings and exit from a respective end of the latter.

[0012] A plurality of flexible hollow ducts are axially assembled inside the mentioned second openings, one end of each said duct being arranged adjoining the outlet and of one of said first openings and the other end of each said flexible duct being arranged adjoining the outlet ends of said second openings. Said flexible ducts are provided, through their cross-section, with a surface having a less area than that of the corresponding surface of said second openings, said flexible ducts being provided with a flexibility or resilience so designed as to overcome any possible disalignments of said first and second openings, thereby preventing the proper flow directions of said two component polymers from changing.

[0013] In a preferred embodiment of the present invention, each said flexible duct is provided with centering means arranged at said other end of said ducts, said centering means extending outwardly and engaging on the walls of said second openings, thereby centering said other end of said flexible ducts with respect to said second openings, and thereby holding said other end in a position axially aligned with said second openings, even if said end of said flexible ducts is not axially aligned with said second openings.

[0014] Preferably, said flexible ducts are mounted in the first openings of said first plate, at their outlet end. Moreover, according to the mentioned preferred embodiment of the invention, said second plate is provided with die openings adjoining the outlet ends of said sec-

ond openings and communicating with said second openings, thereby allowing said second component to flow from said second openings into said die openings, said other end of each said flexible duct being provided with a discharging or outlet opening directing the flow of said first polymeric component to the corresponding die opening inside the flow of said second polymeric component, thereby providing a sheath-core type of fiber or filament.

[0015] The present invention also relates to a method for forming a continuous fiber or filament including two polymeric components, said method comprising the step of arranging a first top plate, provided in the inside thereof with a plurality of first openings, at a position immediately adjoining a second plate, in turn provided in its inside with a plurality of second openings and a plurality of die openings on the bottom surface thereof, said first and second openings being axially aligned. The method of the invention further comprises the step of arranging a plurality of flexible hollow ducts so that an end of each said duct communicates with each said first opening and thereby said flexible ducts extend in said second openings being axially aligned therewith, each said flexible duct having a cross section surface smaller than a corresponding surface of said second openings, to form with the latter a flow channel. Said method further comprises the steps of deforming said flexible ducts by bending said flexible ducts at their top end portions, thereby overcoming any possible disalignments or offset between said first and second openings.

[0016] The method further comprises the steps of providing a first path for the first polymeric component said first path extending through said first openings and through the inside of said flexible hollow ducts, to be discharged from the latter and through the die openings, as well as providing a second flow path for the second polymeric component said second flow path extending through said second openings and about the outer surfaces of said flexible ducts, to be discharged from said second openings and through said die openings, thereby encompassing the flow of said first polymeric component passing through said die openings, thereby forming a sheath-core type of fiber or filament.

[0017] In the preferred embodiment of the present invention, the method further comprises the steps of arranging the bottom ends of said flexible ducts in the corresponding bottom ends of said second openings, as well as of mechanically holding said bottom ends of said flexible ducts at centered position which are centered with respect to said second openings, in particular at a position axially aligned with said second openings and the corresponding die openings, even if the top ends of said flexible ducts are not axially aligned with said second openings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the drawings:

Figure 1 is a vertical cross-sectional view illustrating the apparatus for making two-component fibers or filaments according to the present invention;

Figure 2 is a cross-sectional detail substantially taken along the line II-II of Figure 1;

Figure 3 is a cross-sectional view illustrating a sheath-core type of fiber, having a core component centered with respect to the structure of said fiber; and

Figure 4 is a further cross-sectional view illustrating a sheath-core type of fiber having a core component offset or not centered with respect to the structure of the fiber.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] With reference to the accompanying drawings, Figure 1 is a schematic view, as cross-sectioned, of a preferred embodiment of the apparatus of the invention, specifically designed for making fibers or filaments.

[0020] The apparatus comprises a die plate 10, oppositedly arranged to and under a pre-die plate 12. A distributing or delivering system 14 for delivering molten polymers to said pre-die plate 12 is moreover provided.

[0021] According to the preferred embodiment of the invention as herein illustrated, a full die can be made by two rectangular die plates arranged in a mutual side-by-side arrangement, each rectangular component plate having a length from 1 to 6 meters or larger, and a width of about 300 mm. On the bottom surface of the die-plate 10 are provided a plurality of die openings 16, each die opening 16 being arranged at the center of 5 mm of surface of the bottom of the plate 10. In this connection it should be apparent that the given dimensions are merely indicative of a typical manner for carrying out the invention. Actually, different dimensions or size can be provided, depending on the desired application.

[0022] The delivery or distributing system 14, as schematically shown in Figure 1, comprises delivery channels 18, a first molten polymeric component A flows inside a chamber 20 and, hence, through a plurality of openings 22, to a second chamber 24. Then, the component A will vertically flow, downward, from the second chamber 24 through a plurality of vertically arranged openings 26, having a respective outlet end 28, on the bottom surface of the pre-die plate 12. The delivery system 14 comprises moreover a second plurality of ducts 30 therethrough a second molten polymeric component B flows toward the vertical openings 32 formed through the pre-die plate 12.

[0023] The die plate 10 is formed, on the top surface thereof, with a comparatively broad open chamber 34, receiving the component B from the openings 32 of

the pre-die plate 12. The bottom portion of the die plate 10 is provided with a plurality of vertically extending second openings 36, each of which communicates with the chamber 34 and the bottom end of which communicates with one of said die openings 16.

[0024] As the die plate 10 and pre-die plate 12 are assembled in their opposite positions shown in Figure 1, said first vertical openings 26 of the pre-die plate 12 will be generally axially aligned with the second vertical openings 36 of the die plate 10.

[0025] According to the present invention, a flexible hollow duct 38 is assembled on the bottom end of each said first openings 26 of the pre-die plate 12. The bottom ends of said flexible ducts 38 extend vertically in the second openings 36 of the die plate 10, being axially aligned therewith. The flexible ducts 38 are preferably formed by a thin stainless steel sheet element, adapted to provide suitably flexible ducts, as it will become more apparent hereinafter. In this connection, however, it should be apparent that said ducts 38 can be made of any other suitable material.

[0026] The bottom end of said flexible ducts 38 is provided with a cross-sectional surface smaller than the corresponding surface of the second openings 36. Thus, a flow channel 40 will be formed between the outer surface of the ducts 38 and inner surface of said vertical openings 36. Moreover, the bottom end of the ducts 38 is provided with a plurality of centering elements 42 outwardly directed, thereby engaging with the walls of the openings 36. Said elements 42 are so dimensioned that they will easily center the bottom end of the corresponding duct 38 on the bottom end of the respective vertical opening 36, thereby holding said bottom ends of said ducts 38 in axial alignment with said openings 36, even if the top ends of the ducts 38 are not axially aligned with said openings, as it will become more apparent hereinafter. Said centering elements 42 could anyhow have different configurations from the patterns shown in the figures, and they can comprise, for example, a polygonal cross-sectional or the like, having apex points engaging against the walls of the openings 36.

[0027] Each flexible duct 38 is provided, as shown, with an outlet or discharging opening 44 precisely arranged under the centering elements 42, thereby said opening will be arranged to direct the molten polymer flow from said openings towards the center of the adjoining die opening 16.

[0028] During the operation of the apparatus, the first molten polymeric component A, which in the figure is indicated by solid arrows, will flow in the pre-die plate 12 from the delivery ducts 18, where suitable filters (not shown) for filtering the molten component A could be provided. Said molten component A will accordingly vertically flow through the openings 22, then through the second chamber 24 and into the top ends of the first openings 26. Hence, the component A will downward flow through the inside of the flexible hollow ducts 38, to exit the openings 44 and entering the corresponding openings of the die 16, therethrough it will exit the die plate 10.

[0029] Contemporaneously, a second molten polymeric component B, which, in the figures, has been shown by dashed line arrows, will flow through the delivery ducts 30 in the direction of the vertical openings 32 of the pre-die plate 12. Then, the component B will arrive at the opening chamber 34 of the top end of the die-plate 10 and then it will downward flow through the channels 40 formed between the flexible hollow ducts 38 and second openings 36. The component B, in particular, will be collected on the bottom ends of the latter openings, to be discharged through the openings of the die 16 thereby encompassing the component A as it exits the discharging or outlet openings 44 of the ducts 38 and inside the openings of the die 16. Thus, as the two components A and B exit the die plate 10 through the openings 16, they will form a continuous sheath core type of fiber or filament, where the component A forms the fiber core and the component B will form the fiber skin or sheath.

[0030] From an examination of Figure 1, it should be apparent that the first openings 26 through the pre-die plate 12 must be axially aligned with the second openings 36 of the die plate 10, thereby providing a sheath-core fiber having the core thereof centered with respect to the skin and to the axis of said fiber. However, as discussed hereinabove, said openings 26 and 36 have a very small diameter, and, accordingly, even a very slight disalignment thereof would cause the fiber core to be offset from the center of the fiber, as shown in Figure 4, with a lot of deleterious consequences, as above discussed.

[0031] It should be moreover apparent that the continuous flow of the molten components A and B through the die plate 10 and pre-die plate 12 will heat these parts, to very high temperature, which, as frequently occurs, may cause the size of said plates 10 and 12 to change. However, considering the narrow tolerance range required for aligning the small openings 26 with the corresponding openings 36, these size variations can cause undesired disalignments between said openings.

[0032] Owing to the features of the present invention, said disalignments or offset of said openings can be overcome, without deleteriously affecting the centered relationship of the core component A and the skin or sheath component B. More specifically, since the top ends of the flexible hollow ducts 38 are arranged in the open chamber 34, then it can freely move inside said chamber if, for any reasons, the outlet ends 28 of the first openings 26 would be arranged disaligned from the second openings 36 of the die plate 10. Moreover, the provision of said centering elements 42 will assure that the bottom ends of the ducts 38 will be held centered both with respect to the openings 36, and in axial alignment with the die openings 16, in the case in which the

top ends of the flexible ducts 38 are deflected or deformed because of any possible disalignments of the openings 26 and 36.

[0033] Thus, a perfect centering or axial alignment of the openings 44 of the flexible ducts 38 and openings 16 of the die plate 10 will be assured. Accordingly, the ducts 38 will allow the two fiber components, formed in the die plate 10, to be always arranged with the core component A in the center of the two component fibers, as shown in Figure 3, even if the small openings 26 and 36 are disaligned, thereby preventing any generations of fibers having the core component A offset from the center of the fiber (Figure 4).

[0034] The continuous fibers or filaments made by the method and apparatus of the present invention are suitable, in particular, to be used as staple-fibers (cut-out fibers), spun-bonded fibers and non woven fabrics.

Claims

1. An apparatus for making continuous fibers or filaments formed by a first (A) and a second (B) components, said apparatus being characterized in that it comprises:

   (a) a first plate (12) having an inlet (18) for receiving said first polymeric component (A) and a plurality first openings (26) therethrough said first component (A) flows towards an outlet end (28) in said openings (26);

   (b) a second plate (10) oppositedly assembled to said first plate (12) and having a plurality of second openings (36) axially aligned with said plurality of said first openings (26) of said first plate (12), said second plate (12) being provided with a flow channel allowing the second polymeric component (B) to move downward towards said second opening (36) and exiting respective outlet ends of said second openings (36); and

   (c) a plurality of flexible hollow ducts (38) mounted with an axial arrangement in said plurality of said second openings (36), said ducts (38) having respective ends adjoining said outlet end (28) of one of said openings (26), the other ends of said ducts (38) being arranged adjoining the outlet ends of said second openings (36), said flexible duct (38) having a cross-section surface smaller than the corresponding surface of said second openings (36) and being sufficiently flexible to overcome any disalignments of said first openings (26) and said second openings (36), without negatively affecting the flows of said first and second polymeric components.

2. An apparatus according to Claim 1, wherein each of said flexible hollow duct (38) is provided with centering means (42) arranged at said other end of said ducts, said centering means outwardly extending to engage the walls of said second openings (36), and being so sized as to center said other ends of said ducts (38) in the corresponding second openings (36).

3. An apparatus according to Claim 1, wherein said centering means (42) are so sized that they hold the other end of each said flexible duct (38) axially aligned with the second openings (36), even if said end of said flexible duct is not axially aligned with said second openings.

4. An apparatus according to Claim 1, wherein said flexible ducts (38) are mounted in said first openings of said first plate (12) at their outlet ends (28).

5. An apparatus according to Claim 1, wherein said second plate (10) comprises die openings (16) adjoining said outlet ends of said second openings (36) and communicating with said second openings (36) to allow the second polymeric component (B) to flow from said second openings (36) into the corresponding die openings (16), said other end of each said flexible ducts (38) being provided with an outlet opening (44) directing the flow of said first polymeric component into the respective die opening (16), inside the flow of said second polymeric component (B).

6. An apparatus for making continuous fibers or filaments formed by a first (A) and a second (B) components, said apparatus being characterized in that it comprises:

   (a) a first plate (12) having an inlet (18) for receiving the first polymeric component (A) and a plurality of first openings (26) therethrough said first component (A) flows towards an outlet end (28) of said openings (26);
   (b) a second bottom plate (10) oppositedly assembled to said first top plate (12) and having a plurality of second openings (36) axially aligned with said plurality of first openings (26) of the first plate (12), said second plate (10) being provided with a plurality of die openings (16) arranged on the bottom surface of said second plate and communicating with said second openings (36), said second plate (10) being moreover provided with a flow channel (40) allowing said second polymeric component (B) to flow to said second openings (36) and exit, through a respective outlet end of each of said second openings (36), toward said die openings (16); and

(c) a plurality of flexible hollow ducts (38) mounted, at a respective end thereof, on said outlet end (28) of each of said first openings (26), and axially extending in said plurality of said second openings (36), the other end of each of said flexible ducts (38) being arranged adjoining said outlet end of said second openings (36), said flexible ducts (38) having a cross-section surface less than the corresponding surface of said second openings (36), as well as centering means (42) arranged at their other end, and extending outwardly, thereby engaging the walls of said second openings (36) said centering means being so sized as to center said other ends of said flexible ducts (38) in said second openings (36) and to hold said other end of each said duct (38) in a position axially aligned with the second openings (36), even if one end of said flexible duct (38) is not axially aligned with said second openings (36), each duct (38) being moreover provided with an outlet opening (44) directing the flow of said first component (A) into the die opening (16), inside the flow of said second polymeric component (B), said duct (38) being sufficiently flexible as to overcome any disalignment of said first openings (26) from said second openings (36), thereby overcoming any flow alterations of said first and second polymeric components through the top (12) and bottom (10) plates.

7. A method for forming a fiber or filament formed by two polymeric components, said method comprising the steps of:

(a) arranging a first top plate, provided with a plurality of first openings, at a position immediately adjoining a second bottom plate provided with a plurality of second openings and, on its bottom surface, with a plurality of die openings, said first and second openings being axially aligned;

(b) arranging a plurality of flexible hollow ducts so that one end of each said duct is communicated with each said first opening, each duct extending in said second openings and being axially aligned therewith, said duct being moreover provided with a cross section surface less than the corresponding cross section surface of said second openings, to form with said second openings a flow channel;

(c) flexing said flexible duct at a position adjoining the top end of said flexible duct, in order to overcome any possible axial disalignment of said first and second openings;

(d) providing a first flow path for the first polymeric component (A) extending through said first openings and inside the flexible hollow ducts, to be discharged from said flexible hollow ducts and from said die openings; and

(e) providing a second flow path for the second polymeric component (B) extending through said second openings and about the outer surface of said flexible ducts, in order to discharge said second polymeric component from said second openings and die openings, thereby encompassing said flow of said first polymeric component from said die openings.

8. A method according to Claim 7, comprising the steps of arranging the bottom ends of said flexible ducts on the bottom ends of said second openings; mechanically holding said bottom ends of said flexible ducts at a position centered with respect to said second openings; and mechanically holding said bottom ends of each said flexible duct at a position axially aligned with said second openings and die openings, even if the top ends of said flexible ducts are not axially aligned with said second openings.

9. Two-component continuous fibers and filaments made by a method and an apparatus according to the preceding claims, for use as staple fibers (cut out fibers) or for making non woven fabrics, spoon bonded and melt blown materials and the like.

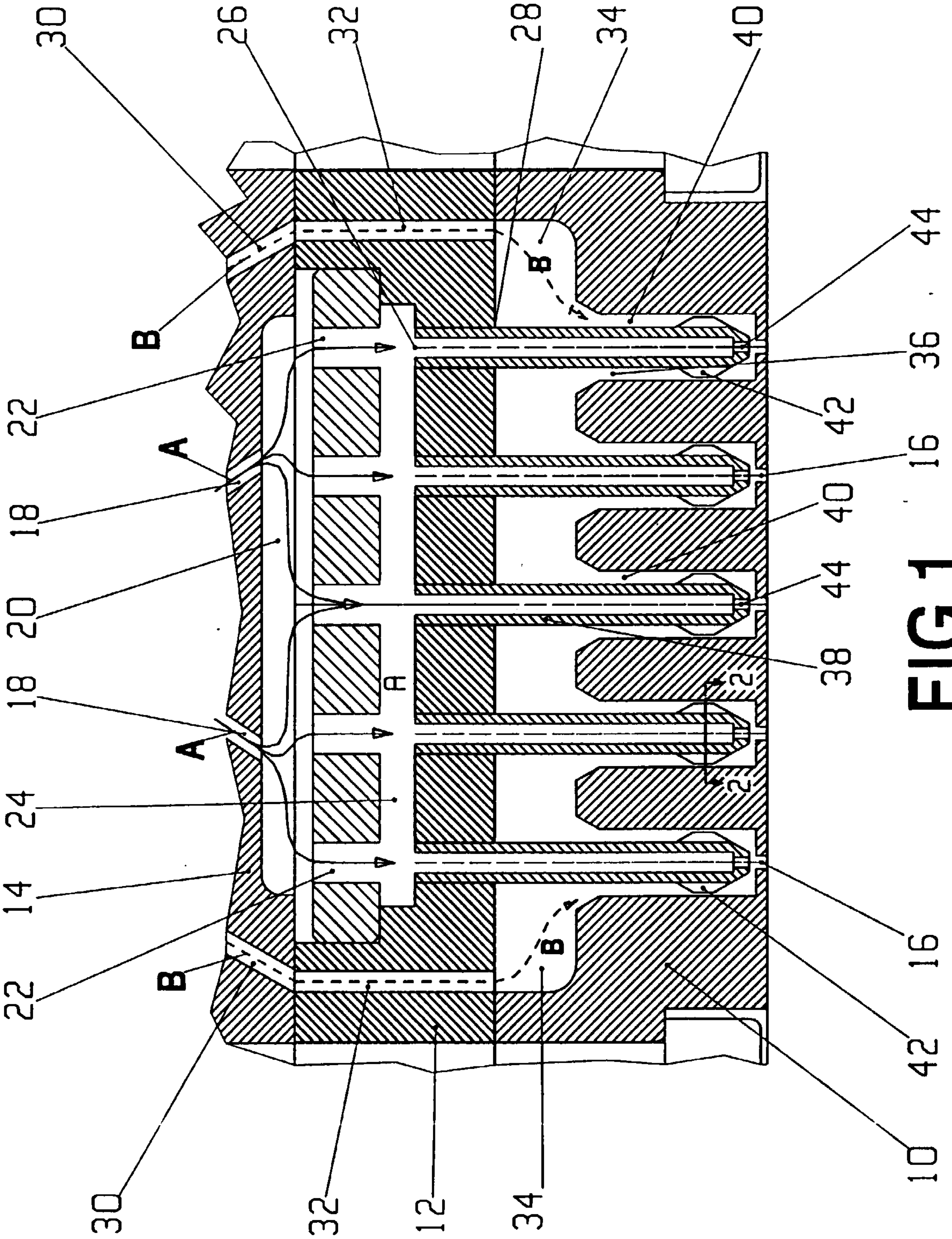
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FIG.1

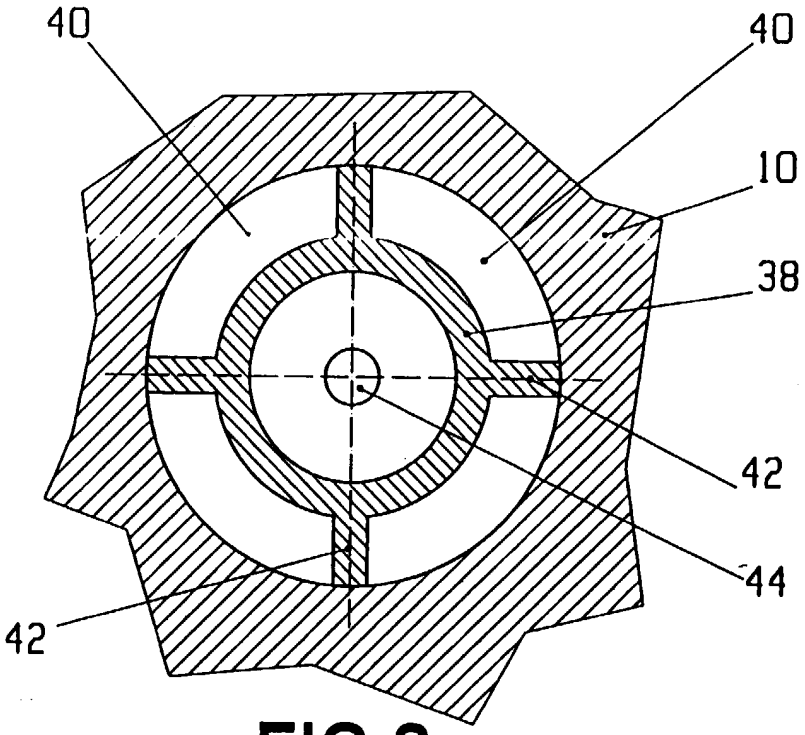

FIG.2

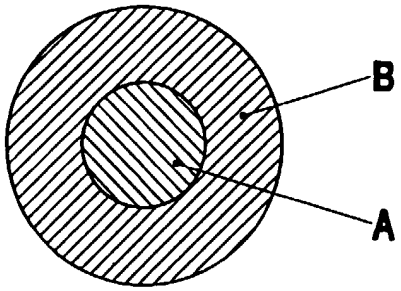

FIG.3

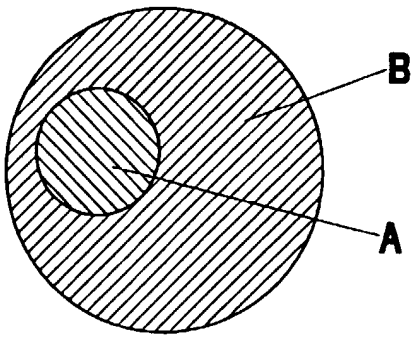

FIG.4

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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 3739

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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X Y	PATENT ABSTRACTS OF JAPAN vol. 016, no. 544 (C-1004), 13 November 1992 (1992-11-13) & JP 04 202806 A (KURARAY CO LTD), 23 July 1992 (1992-07-23) * abstract *	1,4,5, 7-9 2,3,6	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 January 2000	Tarrida Torrell, J

CATEGORY OF CITED DOCUMENTS

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