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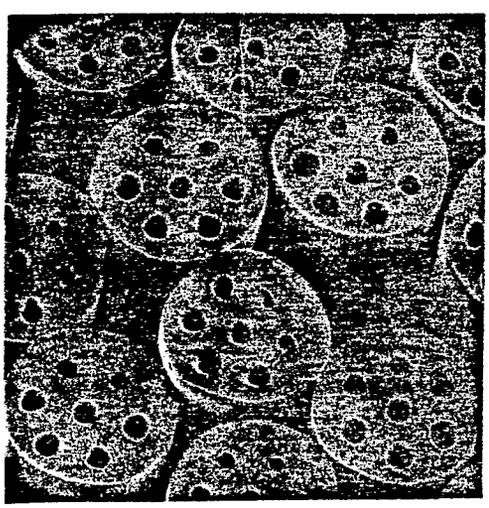
(54) New polyester fiberfill.

(57) New polyester fiberfill of round cross-section, but containing multiple peripheral voids around an axial void, and preferably seven such voids in a hexagonal packing arrangement, and processes for preparation and use, and articles filled with such new fiberfill.

F I G. 1



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EP 0 317 192 A1

NEW POLYESTER FIBERFILL

TECHNICAL FIELD

This invention concerns new polyester fiberfill containing multiple continuous voids along the length of the filaments, and processes for its preparation and its use, and articles filled with such new fiberfill.

BACKGROUND OF THE INVENTION

Polyester fiberfill (sometimes referred to as polyester fiberfilling material) has become well accepted as a reasonably inexpensive filling and/or insulating materials for pillows, cushions and other furnishing materials, including bedding materials, and in apparel, and is manufactured and used in large quantities commercially. Originally, as with other polyester fibers, solid fibers of round cross-section were used, being the least expensive fibers to make, and such solid round polyester fiberfill is still used commercially. Some twenty years ago, however, hollow polyester fiberfill was suggested and used, as disclosed, e.g. by Tolliver in U.S. Patent No. 3,772,137 and by Glanzstoff in GB Patent No. 1,168,759. Tolliver shows a single hollow core or central continuous longitudinal void. The preferred shape of the void was non-round in cross-section, but voids approximately circular in cross-section were also disclosed, and large quantities of hollow polyester fiberfill having single central voids of circular and of non-round cross-section have been manufactured and used because of their greater lightness (lower density), in contrast to solid fiberfill, and because of the improvement in insulating power, and for other aesthetic reasons. More recently, there has been provided an improved hollow polyester fiberfill, characterized by four equisized, equispaced, non-round voids around a solid axial core, the filament cross-section having a quadrilateral peripheral contour defined by four flattened sides and four rounded corners, in conjunction with a saw-toothed type of crimp configuration and a slickening agent, to provide high bulk and high bulk durability with improved softness more like that of natural down filling, as disclosed in EP-A-0 067 684.

Surprisingly, however, despite the improvements that have been available for several years from the various existing configurations that have been suggested and used commercially for polyester fiberfill having continuous longitudinal voids, the new improved polyester fiberfill, according to the present invention, provides advantages in contrast with each of the specific prior configurations, considered separately, as will be evident.

SUMMARY OF THE INVENTION

According to the invention, there is provided polyester fiberfill of denier per filament about 5 to about 20, and of essentially round peripheral cross-section, with at least 7 continuous voids of essentially circular cross-section along the length of the filaments, one such void being located essentially centrally, while the remaining voids are of essentially the same size as each other and are essentially equally spaced around the central void and from the central void and from the periphery of the filament. According to one embodiment, all voids are preferably of essentially the same size and essentially equally spaced from adjacent voids, and so constitute exactly 7 in number, in a hexagonal packing arrangement with a central void and 6 outer voids at the points of a hexagon, as will be particularly illustrated and discussed hereinafter.

It is also contemplated, however, that the central void may be somewhat larger in cross-section than the outer voids, which latter are substantially equisized and equispaced from each other, and are also equally spaced from the periphery of the central void, so as to provide the advantages of a larger central void; according to this embodiment, the outer voids are preferably symmetrically arranged and constitute an even number, especially 8, making a total of 9 voids with the central void.

The preferred total void content will generally be about 8 to about 25% (by area, measured on the cross-section of the polyester filaments, on average).

As in known in the art, and discussed hereinafter, the provision of crimp in polyester fiberfill is

extremely important in providing bulk, or loft, and with regard to its durability, and the crimp frequency is preferably about 4 to about 12 crimps per inch, corresponding approximately to about 1.5 to about 5 crimps per cm.

The fiberfill is preferably slickened with a durable slickener.

According to the invention, there are also provided processes for preparing such new polyester fiberfill and precursor filaments, as described hereinafter and filled furnishing and apparel articles that are filled with such new polyester fiberfill, including such articles filled with such new polyester fiberfill alone or blended with other filling materials.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a photomicrograph of cross-sections of typical polyester fiberfill filaments according to one embodiment of the present invention.

Figure 2 is an enlarged view of a spinneret orifice suitable for melt-spinning polyester fiberfill filaments as shown in Figure 1.

Figure 3 is a representation of a cross-section of another embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

I believe that the essential elements of the invention are the number and arrangement of the multiple continuous voids along the length of the round filaments, and contribute to improvements over those that have been suggested or used for polyester fiberfill hitherto. One can speculate that some, at least, of the advantages can be explained, in retrospect, by analogy with and comparison with prior art configurations/cross-sections, but this combination of elements is believed new, insofar as polyester fiberfill is concerned. I believe the round periphery is of importance. I believe that the location of a void centrally, i.e. axially, is important; polyester fiberfill according to the invention has this feature in common with the earlier suggestion by Tolliver; polyester fiberfill of my invention is, however, distinguished from Tolliver's configuration by the provision of multiple essentially parallel voids, whereas Tolliver provided only a single void. In contrast, EP-A-0-067 684 provided multiple essentially parallel voids (4 in number), and thereby derived certain improvements in comparison with the polyester fiberfill of Tolliver, containing only a single axially-located void; the polyester fiberfill of EP-A-0 067 684 is distinguished in several respects, namely being of essentially quadrilateral periphery cross-section, having a solid axial core and only 4 continuous parallel voids that are themselves non-round and only in the corners, or lobes, of the quadrilateral; as will be noted hereinafter, the polyester fiberfill of my invention makes possible an improvement in crimp configuration that is believed more difficult, and possibly even impractical to achieve with this prior art polyester fiberfill.

Although my invention is not limited by any theory of operation, or any speculated rationalization, in view of the many factors involved and a still imperfect understanding of the reasons for the improvements, one may speculate that the multiple voids with one central void of the configuration of the present invention provide better crush resistance, in the sense of permitting a higher stiffness for the same void content, and one can further speculate that, after crimping, the crimp configuration provides more rounded corners, as opposed to a more saw-toothed or sharp cornered crimp configuration such as may result from crimping prior configurations for polyester fiberfill having similar void content, and this (in association with the round peripheral cross-section) may account for better frictional properties and for greater durability during use. This could be especially true for the configuration shown in Figure 1, involving exactly 7 voids, that are equisized and equispaced from adjacent voids, in other words in a hexagonal packing arrangement, since I believe this is provide an optimum structure in this regard, being symmetrical, and presenting an optimum strength:weight (in the sense of lightness) relationship. However, for some applications, it may prove preferable to increase the size of the central void (in relation to the outer voids), and thereby derive some of the advantages of the large central void suggested by Tolliver, in association with a multi-void structure; in this regard, I believe that a symmetrical arrangement provides advantages; in other words, e.g., as shown in Figure 3, 8 equispaced outer voids 21 arranged around and equally spaced from a larger central void 22, making a total of 9 essentially parallel voids in a filament of essentially round peripheral cross-section 23, may provide certain advantages, it being understood that other arrangements of multiple voids around a

central void are possible, but will generally provide less symmetry than a hexagonal-packing arrangement.

In principle, the technology for melt-spinning hollow filaments from polyester and other synthetic polymers has long been known and disclosed in the art. H. Bohringer and F. Bolland presented a paper entitled "Development and Evaluation of Profiled Synthetic Fibers With and Without Hollow Core", Faserforschung und Textiltechnik 9, No. 10 (October, 1958) pages 405-416, and referred to several other publication therein. Although this publication was primarily addressed to providing nylon filaments, for use in making textile fabrics, e.g. by knitting, as opposed to polyester fiberfill for use as filling material, the same essential considerations apply insofar as preparation of hollow filaments are concerned. Nevertheless, although several multi-hole filaments are shown, with spinneret designs for obtaining such multi-hole filaments, this publication (in common with several others) did not disclose any way to make a configuration according to the present invention with a central void having a total of at least 7 voids, in an essentially round filament. Considerable difficulty and extensive experimentation was necessary to accomplish this task, and it was doubted by some that the task could be achieved in practice because, e.g., of the fineness of the filaments and voids and the well-known phenomenon of post-orifice bulging and because of the difficulty known as "kneeing". Nevertheless, this task was achieved as described hereinafter using a spinneret orifice design as shown in Figure 2, in which six orifices 11 are arranged (in the surface 12 of the spinneret) so that polymer will be extruded through each orifice and then coalesce to form a round filament with 7 voids essentially equi-sized and equi-spaced as shown in Figure 1. Although, in retrospect, this design does follow the general principles that have already been outlined in the art, as mentioned, considerable effort and experimentation was necessary before it was possible to achieve round multi-hole polyester filaments with a central void according to my invention.

Apart from the formation of the polyester filaments having the particular configuration acording to my invention, the various steps in the manufacture of the filaments, including preparation of the polymer, and the processing of the filaments, their conversion into staple fiber, and the handling of the fiberfill and its use as filling material in the preparation of articles such as pillows and other filled articles, such as cushions, or formation into quilts, including quilted articles, including garments, may be carried out according to known procedures, as described in the prior art referred to herein and elsewhere. As explained, poly(ethylene terephthalate) is generally preferred as the polyester polymer, on account of its commercial availability and cost, and a relative viscosity will be selected appropriately in conjunction with processing conditions, to provide the desired configuration that is the essence of the present invention. A chain-brancher may be used, as described, e.g. in copending EP-A-0 294 912 (Application No. 88301106.6)

As indicated, it has long been known and commercially practiced to "slicken" polyester fiberfill by use, e.g., of polysiloxane slickening agents, as taught for example by Hoffman U.S. Patent No. 3,271,189, Mead et al. in U.S. Patent No. 3,454,422, Ryan U.S. Patent No. 3,488,217, Salamon et al., U.S. Patent No. 4,146,674, and Takemoto Oil & Fat Co., Ltd., Japanese Published Patent Application 58-214,585 (1983). Polysiloxane and/or other slickening agents are used to improve the aesthetics of polyester fiberfill, and use of such slickener is preferred for some purposes according to the present invention. Non-silicone slickeners, as disclosed in copending EP-A-0 265 221, may prove advantageous for some purposes. Slickeners are preferably "cured", e.g. by heating, onto the filaments, so as to improve their durability, for most purposes.

In this regard, reference may be made to the following Example, which further illustrates my invention.

EXAMPLE

Filaments are spun from poly(ethylene terephthalate) of relative viscosity of 20.4 (as measured at 25° C for 80 mg of polymer in 10 ml of hexafluoroisopropanol containing 100 ppm of sulfuric acid) at a polymer temperature of 291-297° C at 900 ypm (823 mpm) through a spinneret with 288 capillaries with a throughput per capillary of 0.306 lbs./hr. (0.139 kg./hr.), using orifices as shown in Figure 2. The filaments are grouped together to form a rope (of 914,000 relaxed drawn denier). The rope is drawn in conventional manner, using a draw ration of 3.46X in hot, wet spray draw zone maintained at 90° C. The drawn filaments are crimped in a conventional stuffer box crimper of a cantilever type (3.5 in., 8.9 cm. size) and the crimped rope is relaxed in an oven at 180° C. A slickening finish containing a polyaminosiloxane is applied to the filaments to give about 0.32% (silicone solids) by weight on the fiber, and then conventional antistatic overlay finish of about 0.07% by weight. The fibers are cut in a conventional manner to a length of 3.0 in. (75 mm.). The fibers are found to have an average total void content of about 12.3% and a denier per filament of about 9. The fibers have a cross section as shown in Figure 1, containing seven continuous voids which are parallel, and substantially equal in size, six being substantially equi-spaced around the seventh which forms the center of

the fiber. The periphery of the fiber is round and smooth.

A sample (C) of similar denier is made similarly, except that it contains four parallel continuous voids with a solid axial core, and with an average total void content of 17.7%, and is crimped to about the same crimp frequency and bulk (at 0.2 psi) as the 7-hole fiber, for comparative purposes.

Various properties of the 7-hole Example (1) and of the 4-hole comparison (C) are measured, and are set out in the Table. It will be noted that the F-F friction (coefficient of fiber-to-fiber friction) is lower, and that the bulk at 0.001 psi is somewhat better, which are both advantageous and surprising.

Both the 7-hole fiberfill according to the invention and the 4-hole comparison are processed into 20 oz. rolled batting pillows. They have similar heights, as shown in the Table, but the 7-hole fiber pillow subjectively feels softer and more desirable, both when freshly made and after laboratory-stomping. The 7-hole fiber seems to give a slower recovery from compression, that is very desirable.

TABLE

Item	Crimp Per Inch	TBRM Bulk (in)		F-F Friction	Pillow Height (in)	
		.001 psi	.2 psi		New	Stomped
1- 7-hole	4.8	6.25	0.43	0.203	9.15	8.07
C- 4-hole	4.5	5.98	0.45	0.219	9.09	8.22

Claims

1. Polyester fiberfill of denier per filament about 5 to about 20, and of essentially round peripheral cross-section, with at least 7 continuous voids of essentially circular cross-section along the length of the filaments, one such void being located essentially centrally, while the remaining voids are of essentially the same size as each other and are essentially equally spaced around the central void and from the central void and from the periphery of the filament.

2. Polyester fiberfill according to Claim 1, wherein there are 7 such voids all of essentially the same size and essentially equally spaced from adjacent voids.

3. Polyester fiberfill according to Claim 1 or Claim 2, wherein the fiberfill is slickened with a durable slickener.

4. Polyester fiberfill according to any one of Claims 1 to 3, where the total void content is about 8 to about 25%.

5. Polyester fiberfill according to any one of Claims 1 to 4, wherein the fiberfill is crimped with a frequency of about 4 to about 12 crimps/inch.

6. An improved process for preparing polyester fiberfill, wherein the improvement is characterized by melt-spinning polyester into filaments of essentially round peripheral cross-section, with at least 7 continuous voids of essentially circular cross-section along the length of the filaments, one such void being located essentially centrally, while the remaining voids are of essentially the same size as each other and are essentially equally spaced around the central void and are essentially equally spaced from the central void.

7. A process for preparing slickened polyester fiberfill, comprising the steps of melt-spinning poly-(ethylene terephthalate) into filaments of essentially round peripheral cross-section, with at least 7 continuous voids of essentially circular cross-section along the length of the filaments, one such void being located essentially centrally, while the remaining voids are of essentially the same size as each other and are essentially equally spaced around the central void and are essentially equally spaced from the central void, processing such filaments in the form of a tow by drawing, applying a slickener, crimping and relaxing, and converting the filaments into staple fiber.

8. A process according to Claim 6 or 7, wherein the filaments contain 7 such voids of essentially circular cross-section along the length of the filaments, one such void being located essentially centrally, while the remaining voids are of essentially the same size as each other and are essentially equally spaced around the central void and are essentially equally spaced from the central void.

9. A batt consisting essentially of polyester fiberfill according to any one of Claims 1 to 5.

10. A filled furnishing or apparel article that is filled with polyester fiberfill according to any one of Claims 1 to 5.

FIG. 1

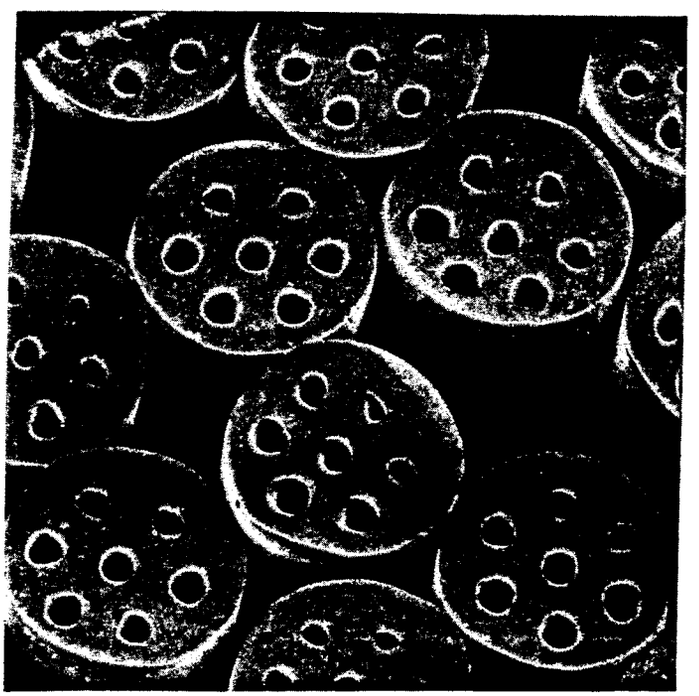

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FIG. 2

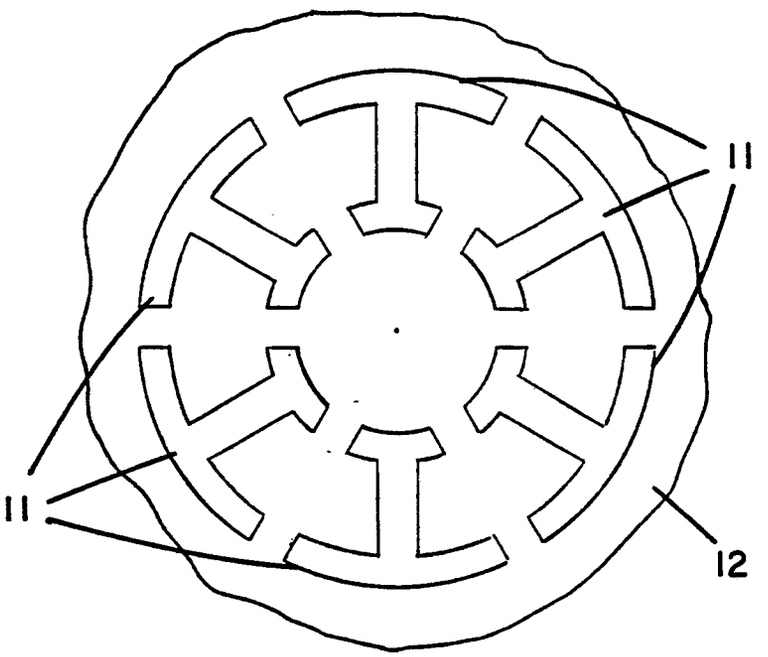
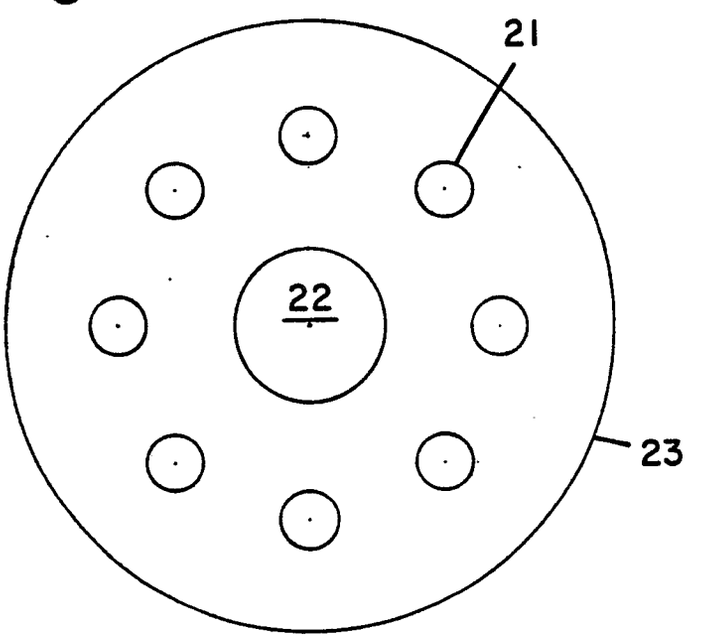


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 88 31 0642

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.4)
D,A	EP-A-0 067 684 (E.I. DU PONT DE NEMOURS)	1	D 01 D 5/24 D 01 F 6/62
A	US-A-3 834 251 (C.O. HAWKINS) * Figure 13 *	1	
A	US-A-3 405 424 (U. IMOBERSTEG et al.) * Figure 1 *	1	
A	US-A-4 020 229 (P.R. COX)		
A	DE-A-3 011 118 (AKZO)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

D 01 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20-01-1989	VAN GOETHEM G.A.J.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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