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QUILTING AND CUSHIONING ARTICLE OF LOOSELY-ASSEMBLED, CRIMPED, CONTINUOUS SYNTHETIC ORGANIC FILAMENTS

Filed June 18, 1959

FIG. 1

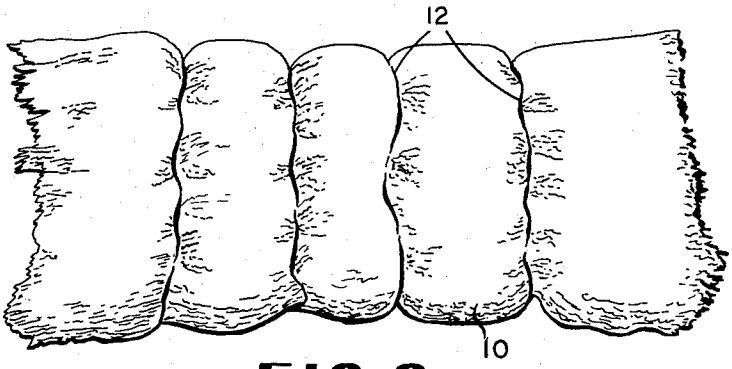


FIG. 2

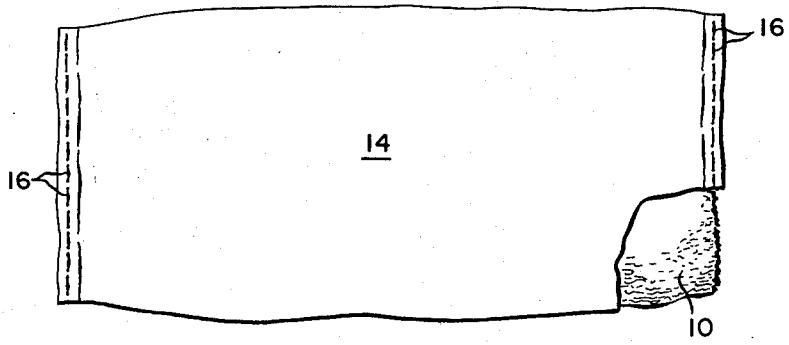
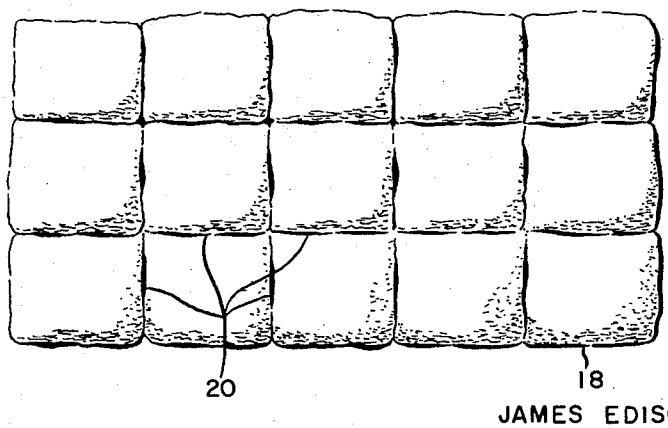


FIG. 3



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QUILTING AND CUSHIONING ARTICLE OF LOOSELY-ASSEMBLED, CRIMPED, CONTINUOUS SYNTHETIC ORGANIC FILAMENTS

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This invention relates to cushioning and insulating articles and more specifically to resilient and high-bulk materials suitable for filling such articles, and particularly to such materials comprising synthetic organic polymer filaments.

The characteristics most desired in filling materials for articles such as pillows, cushions, quilts, sleeping bags, insulating clothing, and the like are high bulk per unit weight combined with resiliency and the ability to return to their original high-bulk condition after the distortions and compressions resulting from service, packing, or cleaning. The filling materials should be soft and uniform with no tendency to develop aggregates or lumps. It is most desirable that the filling material be of such character that it does not tend to penetrate through the interstices of the fabrics used for covering such articles. Such "leakage" of filaments produces a surface on the article which is highly unpleasant to the user and results in loss of filling material. These characteristics must be maintained through long periods of service and through the necessary cleaning operations. The utility value of such a material after a given period of service is directly related to its continued ability to return to a high-bulk resilient condition on manipulation by hand.

Down, and selected feathers of waterfowl, have long been accepted as the best materials for filling such articles. Wool batts are useful for quilting. Batts of kapok and cotton, sometimes mixed with garnetted fabric or filament waste, are in common use but lack a desirable degree of resiliency. Cotton and wool batts are quilted for use in insulating clothing.

More recently, it has been found that certain synthetic filaments can serve as resilient filling materials. Filaments of cellulose acetate, of arcylic polymers, and of polyesters are used commercially. These are prepared in staple lengths and processed into the form of low density batts by using well-known carding or garnetting equipment to produce a web, and cross-lapping the web on an apron to build up the desired thickness of batt. Although superior to most other materials, such batts gradually compress or mat on repeated use and lose their ability to be refluffed to a high-bulk condition. They are particularly found wanting when subjected to cleaning and washing operations because of a pronounced tendency to form lumps which cannot be refluffed.

Such filling materials also have a strong tendency toward filament leakage through the casing fabric and this is particularly true if relatively large denier filaments are used to obtain improved resilience. To reduce this problem, expensive closely woven or specially finished casing fabrics have been devised. However, such fabrics are stiff, uncomfortable and not entirely successful since filament leakage persists, particularly during washing. These properties are very objectionable in quilts or sleeping bags, and particularly so in padded inner and outer clothing.

It is an object of this invention to provide a superior filling material for use in pillows, cushions, sleeping bags, quilts, insulating clothing, and similar articles

which has high bulk per unit weight and which maintains this condition through long periods of service of the cushioning or insulating article or the like.

It is a further object of this invention to provide such a cushioning article which is easily refluffed by simple manipulation even after washing.

A further object is to provide a filling material comprising continuous synthetic organic filaments which in a casing exhibits no filament leakage and thereby permits use of inexpensive loosely woven casing materials.

In the drawing, which illustrates specific embodiments of the invention,

FIGURE 1 is a plan view of a fluffy, resilient quilting and cushioning article of high bulk per unit weight composed of loosely-assembled, crimped, continuous synthetic organic filaments **10** stitched together in rows **12** athwart the filaments,

FIGURE 2 is a front view of a pillow, shown partially in cross-section, composed of loosely-assembled, crimped, continuous synthetic organic filaments **10** and a fabric covering **14** held in place by stitching **16** through the covering and filaments at the edges of the pillow, and

FIGURE 3 is a plan view of a quilted article formed by covering the article of FIGURE 1 on opposite faces with fabric **18** and stitching the assembly together along lines **20** outlining squares about 3 inches on a side.

According to this invention there is provided a filling material in the form of a batt of crimped continuous synthetic organic filaments, the individual filaments preferably being long enough to reach from one edge of the batt to the opposite edge. The filaments must contain a sufficient crimp density to provide the batt, when unloaded, with a bulk of at least 1.5 cubic feet per pound and preferably at least 3 cubic feet per pound. The individual filaments should each contain at least 6 crimps per inch and a crimp index of at least 20%. Filaments in the batt may be constrained to their relative positions in the batt by bonding spaced points along their lengths or by stitching, cementing, or other appropriate means, but at least 97% of the filament lengths must be free from bonding and bonding agents. The batt or batts of filaments may be attached to a casing or other covering sheet at appropriate points where desired.

The filaments preferred in the practice of this invention are those made from synthetic organic linear polymers such as nylon, polyacrylonitrile, copolymers of acrylonitrile with other olefinic unsaturated monomers and containing at least 85% by weight combined acrylonitrile and polyesters such as polyethylene terephthalate. Most suitable are filaments which combine a relatively high degree of resistance to bending, stretching, and torsion with the ability to recover substantially from such distortion. The advantages of this invention are also realized using synthetic filaments of regenerated cellulose or cellulose esters or of proteins, but these materials are adversely affected by humidity and repeated compression so that the full advantages of the invention are not attained with these materials.

Polyester filaments are outstanding in this invention because of their excellent resilience properties. The preferred polyesters used in this invention are linear terephthalate polyesters. These should be filament forming and have a relative viscosity of at least about 12. Such polymers may be represented in a more general way by the formula $HO—G—(OOC—A—COO—G)_y—OH$ where —G— and —A— are divalent organic radicals corresponding, respectively, to the radicals in the initial glycol, $G(OH)_2$, and to the initial dicarboxylic acid,

$$A(COOH)_2$$

and y is a whole number sufficiently large that the poly-

mer is of filament-forming molecular weight. At least about 75% of the —A— radicals must be terephthalate radicals and preferably at least about 75% of the —G— radicals are ethylene radicals. The terephthalate radical may be the sole dicarboxylate constituent of the recurring structural units, or up to about 25% of the recurring structural units may contain other dicarboxylic radicals, such as the adipate, sebacate, isophthalate, 5-(sodium sulfo)-isophthalate, bibenzoate, hexahydroterephthalate, diphenoxyethane-4,4'-dicarboxylate, or p,p'-sulfonylbibenzoate radicals, derived from the corresponding dicarboxylic acids or ester-forming derivatives thereof. Similarly, ethylene glycol may be the sole glycol constituent of the polyester, or another glycol may be used, such as tetramethylene glycol, hexamethylene glycol, decamethylene glycol, 2,2-dimethylpropanediol, trans-p-hexahydroxylylene glycol, diethylene glycol, bis-p-(β-hydroxyethoxy)benzene, bis-1,4-(β-hydroxyethoxy)-2,5-dichlorobenzene, or bis-[p-(β-hydroxyethoxy)phenyl]difluoromethane alone or in mixtures.

It is necessary for the practice of this invention to use crimped filaments and to maintain the kind and degree of crimp within defined ranges. In describing the preferred crimp, the symbol L represents the extended length of the filament under tension just sufficient to remove the crimp, while the symbol *l* represents the length of the filament under no tension and in the crimped condition. The symbol I represents the crimp index which is expressed in percentage and is defined by the equation

$$\frac{100\ (L-l)}{L}=I$$

For example, a filament having an extended length of two inches and a crimped length of one inch has a crimp index of

$$\frac{2-1}{2}$$

or 50%.

Filaments suitable for the practice of this invention must have a crimp index of at least 20% and preferably above 25%. If the crimp index is below 20%, the finished article is less bulky and firm and does not show the advantages of this invention. Increasing the crimp index from 25% to as high as 50% or more provides improved characteristics.

The number of crimp loops per unit of length is also important in the practice of this invention. The number of crimp loops per inch of length L should be not less than 6 nor greater than 10, and preferably should be between 7 and 9. Less than 6 loops per inch, even at a high crimp index, does not produce a resilient and high bulk material. If there are more than ten loops per inch, there is difficulty in processing.

The filaments used in this invention are continuous filaments having sufficient length in the crimped state to extend from one edge of the batt to the opposite edge although shorter lengths can be utilized where the filaments or tows of filaments are constrained in their relative positions in the batt by rows of stitching or bonding or the like. In a preferred embodiment, however, the individual filaments or tows utilized in preparing this invention will extend from one edge of the batt or other finished article to the opposite edge and in this embodiment no bonding or stitching of filaments are necessary. All of the filaments utilized in this invention are crimped continuous filaments and for best results the crimp should persist throughout the service life of the article prepared and should not be reduced by the mechanical action and cleaning processes inherent in such service. Understandably, of course, crimp retention varies from filament to filament depending upon the chemical charcteristics of these filaments, and for reasons of economy or because a particular product is designed for a short or long life under special conditions, filaments of lesser or greater crimp retention may be chosen. The advantages of the

bulky batts of the present invention are not limited to any particular filament composition so long as the essential characteristics of the crimped continuous filaments described above are met.

A preferred starting material for this invention is a continuous filament untwisted tow. For reasons of economy and ease of handling, it is preferred to use a tow of 1,000 to 500,000 denier but smaller or larger units may be used. The denier of the filaments may vary from about 1 denier to 20 denier depending on the properties desired in the finished article. Finer filaments produce a softer article, and coarser filaments, a firmer article. The individual filaments may be crimped by one of several methods, continuous or discontinuous, well known in the art. For instance, the tow may be forced by fluid or mechanical pressure into a receptacle where it is compressed and treated with hot air or steam. It may be passed through grooved rollers, or into a stuffer box in a continuous manner. An alternate method is to use the air jet tow opening and crimping device suggested by Mummery, U.S. Patent 2,379,824, and, if desired, to follow this with further compressing and setting steps to accentuate the crimp and make it more permanent. There are also crimping methods specific to certain kinds of filament or inherent in their method of manufacture. For example, certain filaments have the property of crimping spontaneously when stretched and relaxed, or when heated or treated with swelling agents. The particular method of crimping used is not critical so long as the crimp imparted to the filaments is sufficiently permanent for the end utility selected and sufficient bulk is provided.

It is best to avoid crimping methods which produce groups of filaments in which the crimp waves are closely parallel to or interlocked with one another, or produce a filament having crimp waves lying substantially in one or only a few places, since tows containing such filaments are difficult to open into high bulk structures. It is preferred to have the crimp waves randomly distributed around and along the main axis of the filament.

The opened tow of crimped continuous filaments may be assembled into batts in many ways. For instance, a suitable filling for a sleeping pillow may be prepared by winding one or more tows to a large bulky skein and shaping the skein to fit the pillow casing. Larger batts may be formed by laying a plurality of ends of opened tow side by side and manipulating to merge them together laterally by brushing, vibrating, or other means. This method may be made continuous by drawing a plurality of opened tows into substantially abutting or slightly overlapping arrangements and merging them into a continuous batt. Such a continuous batt is particularly useful in the manufacture of quilted products since it may be combined with the cover fabrics and fed continuously to the sewing machines which form the quilting. The quilted product is suitable for fabrication into sleeping bags or inner or outer garments.

If thicker batts are needed as for pillows, cushions, upholstery, and the like, a number of layers of opened tow may be combined. All the tows may be parallel in such a batt or they may be cross-lapped sufficiently to provide superposed discrete layers. Alternatively, thick batts may be made by forming continuously a sheet of opened tows, one or more tows thick, and folding and cross-lapping this sheet to obtain the desired number of layers. In this modification the superposed layers may have their tow directions parallel or disposed at any desired angles. This crossed relationship is often desirable in extended articles since it permits securing the tow ends at many points around the edges of the article.

Analogous to the preceding method is that of piddling one or more opened tows through oscillating or rotating guiding means onto a support or a moving apron to build up the desired batt in swirls or diagonal patterns.

In all of these methods the crimped filaments in the

tow are long and substantially continuous throughout all layers of the batt. They may be secured at spaced points and at the edges of the article, if desired, by stitching, taping, cementing, or other appropriate means. In quilted articles they are further secured by the stitching of the quilting. In articles which are not quilted and particularly in extended or very bulky articles it is often desirable to obtain more control over the long filaments by securing groups of filaments to their adjacent and neighboring filaments at spaced points throughout the batt. This is conveniently accomplished by loose stitching. Other ways are spraying limited areas with adhesive or swelling agents to obtain filament bonding. With thermoplastic filaments the local application of heat by hot fluids, infrared radiation, or other means produces bonding.

Where any form of bonding is used, the individual filaments must be 97% free of bonding agents or any similar material which would reduce the bulk or flexibility of the article. Preferably, any bonds or areas of attachment are scattered and staggered throughout the filling material so that they do not directly overlay each other. Their spacing will depend on the properties of the filaments, the shape and size of the articles, and the need for control. And bonding should not occur at points closer than 8 inches apart along a filament, and any stitching should be in rows athwart the filaments and spaced at least 8 inches apart. Preferably, any stitching will be loose and not compress the batt so that the bulk characteristics of the batt will be independent of the stitching.

Batts prepared as above are preferably rolled or folded to the desired shape for insertion in a fibrous casing. If a box edge is desired, as in furniture upholstery, it may be trimmed and the cut edge may be bound with a tape applied by sewing or cementing. Although it is not always necessary, it is preferred to secure the edges to the casing at several points.

The advantages of the continuous crimped filaments of this invention over conventional filling materials are shown in the following examples. In all examples the filaments contain at least 6 crimps per inch and have a crimp index of at least 20%.

Example I

A number of tows of crimped continuous polyethylene terephthalate filaments having a filament denier of 4.75 and eight crimps per inch of length are well opened and laid together in parallel relationship with slight overlapping to form a batt 45 inches wide and ½ inch thick, weighing 5 oz. per running yard. The batt is placed between two layers of taffeta fabric made from 50 denier continuous filament nylon yarn having 110 warp threads and 70 filling threads per inch, and the assembly is passed through a sewing machine and quilted in 3-inch squares. The product is a bulky, resilient material with a pleasant soft feel suitable for use in insulated clothing. Test specimens 18″ by 24″ are cut and their edges bound by stitching. These are washed and dried five times using automatic home laundry machines, refluffed by hand manipulation and examined. It is found that the samples have retained their loftiness and pleasant hand, no lumps or aggregates have formed, and no filament leakage through the covering fabric has occurred.

Another sample of the same polyethylene terephthalate crimped continuous filament tow is cut to staple filaments 2 in, in length. The staple filament is carded and crosslapped by conventional means. The resulting batt weighing 5 oz. per running yarn in 45 inches width is covered on both sides with an identical taffeta fabric to that mentioned above, quilted in the same way and sample pieces subjected to the same five washings and drying as above. It is found that the material is no longer uniform, lumps and aggregates have formed, and filament leakage is extensive and objectionable.

Example II

A number of tows of crimped continuous filaments of polyethylene terephthalate having a filament denier of 3.0 and containing 7.5 crimps per inch are assembled as in Example I to form a batt weighing 5 oz. per running yard in 45 inches width, covered with a taffeta fabric made from 70 denier nylon yarn having 110 warp ends and 70 filling ends per inch, and quilted as in Example I. Sample pieces are prepared and submitted to five laundering cycles as in Example I. It is found that the material is still uniformly bulky, resilient, and has a pleasant hand. No filament leakage occurs.

Another sample of the same polyethylene terephthalate tow is cut to staple filaments 1.5 inches long, formed as in Example I, into a batt weighing 5 oz. per running yard in 45 inches width, covered with another sample of the above nylon taffeta fabric and quilted. Sample pieces are laundered five times as in Example I. It is found that lumps have begun to form and that filament leakage is substantial, producing an objectionable surface.

Example III

Tows of crimped continuous filaments of an acrylonitrile copolymer having a filament denier of 4.5 and containing 8 crimps per inch are opened and assembled as in Example I to form a batt weighing 5 oz. per running yard in 45 inches width. This batt is covered with the taffeta fabric of Example II and quilted as in Example I. Sample pieces are laundered five times as in Example I. The material is slightly less bulky than that of Example I, but is uniform with no lumps or aggregates and there is no filament leakage.

Another identical acrylic filament tow is cut to staple filaments 1.5 inches in length, processed into a batt, fabric covered, and quilted as above. Samples are laundered five times as in Example I. The material is found to have lumps and aggregates and there is extensive filament leakage.

Example IV

Tows of continuous crimped nylon filaments having a filament denier of 3.0 and containing 12 crimps per inch are assembled into 45 inches wide batts weighing 5 oz. per running yard, covered with the taffeta fabric of Example II, and quilted as in Example I. Sample pieces are prepared and laundered five times as in Example I. It is found that the material has retained almost all its bulk and pleasant hand, is still uniform and free from aggregates, and that no filament leakage is evident.

Nylon tow of Example IV is cut to staple filaments 1.5 inches long, processed into batts weighing 5 oz. per running yard in 45 inches width, covered with taffeta fabric, and quilted as in Example I. Sample pieces are prepared and laundered 5 times as in Example I. It is observed that filament has started to form aggregates and there is a considerable degree of filament leakage.

Example V

A continuous filament tow of polyethylene terephthalate filaments having a high degree of crimp, individual filament denier of 4.4 and a tenacity of 2.7 grams per denier is opened by hand manipulation to separate the filaments to form a bulky product. The tow is then cut into 26 inch lengths which are stacked together in parallel relation to form a batt approximately 26″ by 19″ by 10″ weighing 1.15 pounds. This batt is inserted in a cotton fabric pillow tick 18″ by 25″. The ends of the pillow are compressed and a row of stitching through the tick and the filament batt is inserted at each end. The resulting pillow has a soft pleasing hand together with good bulk and load bearing capacity.

This pillow is used as a sleeping pillow for nine days and then washed. Its thickness is measured under a series of loads from 0.2 to 1.0 pound per square inch after one and nine days use and after washing. There is some loss

in bulk during use, but washing restores the pillow essentially to its condition after one day's use. There is no distortion, no lump formation, and no filament leakage.

Example VI

A tow of highly crimped continuous filaments of polyethylene terephthalate having a total denier of 50,000, individual filament denier of 4.0, and tenacity of 3.6 grams per denier is thoroughly opened by passage through an air jet. The bulky tow is wound under very light tension around two parallel bars spaced 27 inches apart to form a bulky skein about 20 inches wide weighing 1.25 pounds. Each end of the skein is laced with a cord to facilitate handling and after removal from the bars a strip of fabric 1½ inches wide is stitched to the filament batt across each end. This assembly is placed in a nylon fabric pillow tick approximately 20" by 25". The resulting pillow is bulky, resilient, and has a soft pleasant hand. After service as a sleeping pillow and washing, it is easily refluffed to its high bulk condition without lump formation and with no filament leakage.

Example VII

Sleeping pillows are made from commercially available tows of crimped continuous polyethylene terephthalate filaments, the filament denier being 3.0 and the tow denier 470,000. The well opened tows are laid in parallel arrangement with slight overlap to form a batt which is then rolled in the lengthwise direction of the tow to form a bulky "blank" weighing 1.5 pounds about 25 inches long in the filament direction and 20 inches wide. This "blank" is slipped into a fabric casing and secured to the casing at the ends by stitching. The pillows are lofty and have a pleasant soft feel. Sample pillows are washed in an agitator washing machine using full rinse cycles and dried in a tumble dryer. The laundered pillows show no loss in bulk, no distortion or lumps, and no filament leakage.

The crimped polyethylene terephthalate tow above is cut to staple filaments 2 inches long. The cut staple is carded and the web cross-lapped by conventional means to form a batt, which is rolled into a "blank" weighing 1.5 pounds and placed in a casing identical with that above. Sample pillows are laundered as aforesaid. The laundered pillows are distorted and contain lumps and aggregates which cannot be opened by hand manipulation or fluffing.

Example VIII

Sleeping pillows are made from tows of crimped continuous acrylic filaments, the filament denier being 4.5 and the total tow denier 470,000. The procedures, structure, weight and fabric casing are the same as in Example VII. These pillows are similar to those of Example VII but slightly less bulky. Sample pillows are laundered as in Example VII with some small loss in bulk, but no lumps are formed and there is no filament leakage.

Another sample of the same acrylic filament tow is cut to staple filament and processed into pillows in the same manner. The pillows are initially slightly bulkier than those above, but when laundered by the method of Example VII, these pillows are badly distorted with many lumpy areas.

Example IX

Tows of crimped continuous nylon filaments are processed into sleeping pillows as in Example VII, the filament denier being 3.0 and the total denier 450,000. The procedure, structure, weight, and fabric casing are those of Example VII. The pillows are similar to those of Example VIII. Sample pillows are laundered by the method of Example VII with some small loss of bulk, but no lumps are formed and there is no filament leakage.

Another sample of the same nylon tow is cut into staple filament and processed into pillows as in Example VII. Such pillows are slightly more bulky than those of Example IX but less bulky than that of Example VII. Sample pillows are laundered by the method of Example VII. This treatment causes substantial loss of bulk, distortion, and the formation of many lumps.

Example X

A well opened, highly crimped, continuous filament tow of polyethylene terephthalate having a total denier of 350,000, the individual filaments being of 3.0 denier, is stitched across its width at intervals of eight inches along its length. The width of the tow is slightly over five inches. Four such cross-stitched tows are assembled side by side with the rows of crosswise stitching in lengthwise register, and the rows of stitching across each tow secured to that of its adjacent tow or tows by further stitching. The product is a coherent batt about 20 inches wide which can be easily handled in long lengths and conveniently cut to required sizes. Four yards of this batt sheet are folded lengthwise at about 25" intervals to form a pillow blank which is placed in a pillow tick 20" by 25" and the ends of the blank secured to the casing by stitching. The pillow so produced has a soft pleasant hand and may be washed without loss in bulk or the formation of lumps.

Four ends of the same well opened tow are assembled side by side with a slight overlap. The sheet so formed is layed over a length of cotton cheese cloth and stitched to the cheese cloth at intervals. The rows of stitching run laterally across the sheet and are spaced 6 inches apart in the lengthwise direction. The product has dimensional stability and is easily handled through subsequent processing. Four yards of this combined sheet are folded lengthwise at about 25" intervals to form a pillow blank which is placed in a fabric pillow tick 20" by 25". The resulting pillow is lofty with a pleasant hand and particularly resistant to distortion and filament leakage during service and washing.

The advantages of the articles of this invention over those produced of conventional methods utilizing staple filaments are thought to result from the use of long continuous filaments extending throughout the batts. Securing of the filaments at the borders of the article and, if needed, at spaced points within the article positively prevents migration and aggregation of filaments to form lumps. If in the distortions which occur in use some tangling should occur, this can be removed by manipulating the filaments through applying tension and vibration to the edges of the article. It is believed that such action temporarily removes the crimp from the filaments to relieve entanglement. Such action is not possible with staple filament batts.

Cushioning and insulating articles made in accordance with this invention are substantially entirely free from filament leakage and retain through service and washing an extraordinary ability to be "refluffed" to a high bulk condition. These unusual properties are of great importance in determining service life and satisfaction.

In addition to the advantages in service, the present invention provides important advantages in materials and processes used. With filament leakage eliminated a wide choice in the fabrics used for coverings is available. This is particularly advantageous in articles of clothing where softness, drape, and other aesthetic qualities are of great importance. Furthermore, cheap and loosely woven fabrics are frequently satisfactory as coverings.

In processing filamentary material according to this invention, conventional procedures involving cutting filaments into staple length, opening, garnetting, or carding webs, and cross-lapping into batts are completely eliminated, together with breaking of filaments, loss of crimp, and formation of waste inherent in these operations. In fact, in operating this invention the combining of tows, covering or restraining with fabric, and the stitching or other bonding means can advantageously be done in a single continuous operation.

I claim:

1. A fluffy, resilient quilting and cushioning article of high bulk per unit weight composed of opened tows of crimped synthetic organic filaments loosely assembled into a batt and stitched together at opposite edges of the batt with the filaments extending substantially parallel to each other between the stitched edges, the individual filaments being continuous and unbonded between stitched portions, having 6 to 10 crimps per inch of length at a crimp index value of at least 20%, and having a free length between stitched portions of at least 3 inches sufficient to provide a bulk of 1.5 to 3 cubic feet per pound for the batt of parallel filaments.

2. The article defined in claim 1 wherein stitched portions are in rows athwart the filaments and spaced at least 8 inches apart in the batt.

3. A pillow which comprises the article defined in claim 2 with a fabric covering stitched to the edges of the batt.

4. A quilted article which comprises the article defined in claim 1 with fabric covering on opposite faces stitched together through the batt in lines outlining squares about 3 inches on a side.

5. The article defined in claim 1 wherein the filaments are polyethylene terephthalate.

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