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SYNTHETIC FELTS

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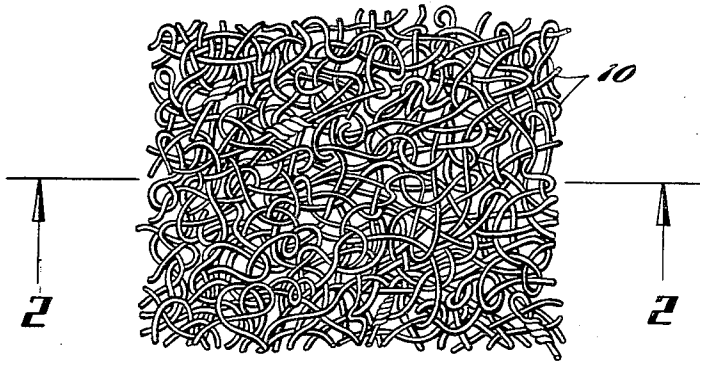


Fig. 1



Fig. 2

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SYNTHETIC FELTS

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1 Claim. (Cl. 28—79)

This invention relates to conformable, pliable, extensible felt-like materials composed primarily of synthetic fibers.

Hitherto many non-woven fabrics and sheet materials have been manufactured by assembling synthetic fibers in the form of loosely associated fibrous webs and stabilizing the fiber configurations by developing the coalescent properties of the synthetic fibers in some cases, and in others by adding adhesive bonding agents in the form of liquids, powders or potentially adhesive fibers. These non-woven materials however, have depended almost entirely on the positive adhesive bonding between the fibers for their integrity since the surfaces of the commercially available synthetic fibers are generally smooth and the fibers themselves essentially straight, precluding the surface frictional action and capacity for entaglement which is thought to provide the integrity in natural felts such as wool. As a result, these products lack flexibility and have extensibilities essentially the same as those of the cementitious substances used to hold them together. Further, even though such prior art materials have sometimes been characterized as "felts," they lack the bulk or thickness per unit weight, and the resilence and intimacy of fiber association of true felts.

For the first time in the art, to my knowledge, I have found it possible to provide true felts which can be composed entirely of synthetic fibers. By "true felts" I refer to nonwoven fibrous materials in whilch the fibers are held together by frictional interlocking and entanglement by virtue of artificially-induced kinks, bends, twists and curls in the fibers. Even though it may be desirable for some purposes to strengthen my synthetic felts by providing additional coherence in the form of adhesive bonds between and among the fibers, the basic felt-like properties of my materials are derived from the frictional interlocking and entanglement of the fibers independent of added or self-generated binder substances.

The synthetic felts of my invention are adapted to many of the uses for which wool felts are commonly employed as well as a wide variety of other uses depending on the chemical and physical properties of the synthetic fiber component. For instance, felts composed of fibers of regenerated cellulose are characterized by a softness, pliability, porosity, and absorbency that make them particularly well suited for use in the medical and surgical fields as bandages, sponges, dressings and the like. The network of interlocking fibers closely simulates the structural arrangement of the fibers of natural leather providing a base material combining substantial tensile strength, flexibility, and conformability which can be readily saturated, impregnated, and finished into articles strikingly similar to natural leather in physical properties as well as appearance.

Where absorbency is unnecessary or undesirable, as in seat coverings, rugs, rug backings, pot holders, shoe linings, insulation materials and the like, I may employ felts of a non-cellulosic nature, such as those composed of thermoplastic fibers. The exceptional conformability of my felts coupled with the tendency of the fibers to readjust to new configurations of entanglement when the original structure has been altered by deformation stresses enables them to be molded without rupture to many deep-drawn complicated shapes.

Among the many other applications for my novel products are battery separators, industrial filters, wiping clothes, pillow and mattress stuffing, and the like.

These and other characteristics of my invention will be more readily appreciated from the following description of an embodiment thereof selected for the purposes of illustration and shown in the accompanying drawings, in which:

Figure 1 is a plan view of a section of fabric in accordance with my invention.

Figure 2 is a cross section along line 2—2 of Figure 1.

To prepare my synthetic felts I ultilize synthetic fibers having latent, substantial, built-in potential energy of a curl-inducing nature, hereinafter abbreviated as "B. I. P. E." I assemble these fibers into a loosely associated fibrous sheet or body either by means of conventional textile machinery such as cards or garnets, by pneumatically distributing the fibers on a suitable supporting medium, or otherwise. I then subject the assembled fibrous body or sheet to the action of an energy-releasing agency, whereby the fibers writhe, gyrate, curl, loop, twist and bend, condensing and contracting the fibrous body as they entangle and interlock to form a synthetic felt as shown in Figures 1 and 2. On removal of the activating medium the fibers 10 of my felts are in a network or stable configuration of intermeshing random kinks, gyrations, bends, twists, writhes, and curls as shown in the drawings, such that the felt attains a high degree of resistance to forces tending to interrupt its continuity or structural coherence or to deform it from its contracted condition.

The pronounced B. I. P. E. of the synthetic fibers which is a pre-requisite to the practice of my invention may take various forms. It may exist in certain fibers commercially available because of non-homogeneity of composition, physical asymmetry or instability, or differential stresses implanted in the process of manufacture, or may be induced at a later stage by physical or chemical treatment. Whether inherent or induced in my synthetic fibers, the B. I. P. E. represents a form of stored or potential energy which can be released by appropriate thermal and/or chemical means to cause the fibers to gyrate, writhe, squirm, twist, bend, shortening in span, and in some cases in length. Because of the preparatory association of the fibers this motion is not wasted but results in an intercurling, interlocking and felting of the fibers. Whatever may be the exact explanation of the writhing and twisting of the fibers during their treatment to produce a felting action, such action comes as the result of what I have herein termed the built-in potential energy (B. I. P. E.), and this B. I. P. E. may be present in certain commercial fibers as hereinbefore referred to or may be produced in fibers during or after their manufacture as herein set forth.

Thermal creation of differential stresses within certain special fibers is one method of obtaining the built-in potential energy referred to above. For example, in the manufacture of certain calendered polyethylene sheet materials, the calender rolls are maintained at widely separated temperatures. It is believed that differential stresses and/or greatly varying crystalline conditions and arrangements are thus induced. At any rate, when monofilaments are cut from such polyethylene sheets, chopped into appropriate lengths (1¼", for instance), assembled in the form of a fibrous web, and subjected to temperatures of the order of 240° F., the stored energy is released and the fibers go through their felting motions. Slightly

higher temperatures may be employed if it is desired to produce some spot welding or fusion of the fibers to each other in addition to the felting action. Alternatively, a fiber-forming substance may be extruded or pulled through an orifice the circumferential temperatures of which are non-uniform, or otherwise in which the orifice produces unequal drafting effect upon the fiber, or in which radial asymmetry of structure is induced in the fiber. In these ways, for illustration, a fiber may be produced which under appropriate energy releasing agencies will curl and twist.

Mechanically-induced B. I. P. E. is further illustrated by the following example. A monofilament of Vinylite (a co-polymer of vinyl chloride and vinyl acetate commercially distributed by the Carbide and Carbon Company) was tightly twisted under tension and wound around a glass rod to prevent kinking. The rod with the monofilament wrapped around it was immersed in boiling water to set the twist in the Vinylite. The monofilament and rod were removed from the water and cooled. The monofilament was unwound from the glass rod, cut into convenient fiber lengths, and these lengths randomly distributed in a small container in sufficient quantity to fill the container. The container and intermingled fibers were then placed in an oven maintained at approximately 230° F. (any temperature above the boiling point of water and below the melting point of the fibers would be operative), whereupon the potential energy was released and the plastic memories of the fibers came into play so that they strove to reassume their original untwisted forms, writhing, contorting, interlooping and felting in the process.

B. I. P. E. may also exist in synthetic fibers as a result of non-homogeneous composition. For example, in the spinning of fibers of regenerated cellulose, different solutions or spinning dopes may be fed into a single spinneret to produce a fiber of non-homogeneous composition and properties. As a result, when such fibers are subjected to appropriate swelling agents, such as caustic alkali, the two fiber constituents swell and/or contract to a different degree causing random curling, interkinking of the fibers sufficient to felt them when they are so treated in the form of an associated fibrous body or sheet.

A commercially available fiber with B. I. P. E. is Fiber E (a regenerated cellulose fiber manufactured by the E. I. du Pont de Nemours Company). I have produced satisfactory felts from this fiber by the following techniques:

Example 1

Six-denier Fiber E filaments were cut into convenient fiber lengths and worked into the form of a fibrous sheet weighing 70 grams per square yard on a carding machine. The sheet was given a light press between nip rolls and floated in a bath of 20% NaOH at 23° C., for a period of about 120 seconds. The treated sheet was removed from the caustic, washed with water containing 10% NaCl, washed with plain water, neutralized with dilute acetic acid, again washed with water and dried on a steam can. An area contraction of 48.7%, based on the original dimensions of the untreated sheet, was observed. The product was soft and pliant to the touch and had a felt-like appearance.

Example 2

A fibrous sheet weighing 70 grams per square yard was prepared as in Example 1 and floated in a bath of 5% NaOH at 23° C. The material was washed and dried as in Example 1 resulting in an essentially similar product.

Example 3

A fibrous sheet was prepared and treated as in Example 2, except that the sodium chloride wash was omitted. The dried product was felt-like in appearance and properties and in addition had a pebbly texture suggesting particular utility as a base material for the manufacture of leather-like products.

The synthetic fibers of my novel felt-like materials may be composed of any fiber-forming substance which is capable of being spun, extruded, cut or otherwise fashioned into continuous filaments. Applicable fibers include those of regenerated cellulose such as viscose and Bemberg rayon, thermoplastic fibers, both cellulosic and non-cellulosic, examples of which are: cellulose acetate, cellulose propionate, cellulose butyrate, ethyl cellulose and benzyl cellulose. Fibers made of mixed esters such as cellulose acetate-propionate also are useful. Others of an entirely different chemical nature, however, may be employed, such as those made of vinyl polymers, for example, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, or vinyl copolymers, and those of the polyamide type, an important example of which is that commercially known as nylon. Fibers of the polyacrylate family are also useful.

I have chosen synthetic fibers as the raw materials for my felts because the B. I. P. E. necessary for the practice of my invention can be conveniently induced in the fibers during their manufacture or thereafter when the fiber substances are in easily handled continuous filament form. According to the general principles of my invention it is possible to produce a similar B. I. P. E. in natural fibers and to release the energy stored thereby when the fibers have been assembled in the form of associated fibrous sheets. However, the limited lengths of natural fibers and the practical difficulty of inducing differential stresses and the like in them make the practice of my invention with natural fibers commercially inexpedient except as they may be combined with synthetic materials to produce laminated fibers or the like having B. I. P. E.

Although it is essential that synthetic fibers having B. I. P. E. be employed in major proportion in the preparation of my products, natural fibers or synthetic fibers without this special energy may be utilized and combined therewith in minor proportions.

I claim:

A nonwoven fabric sheet composed essentially of unspun synthetic fibers held in a network relationship by the release of built-in potential energy of a curl and twist inducing nature, which results in fibers having artificially induced bends, twists, curls, writhes and gyrations which frictionally interlock to form a coherent fabric sheet structure which is primarily dependent for its integrity upon said interlock of said fibers.

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