This invention relates to a new product and to processes for manufacturing the new product. In particular, it relates to divers fibres and to processes for imparting certain desirable character-
istics to fibres and other filamentous or filar

The great variety of fibres used in the textile arts may be considered, for our present purpose, as separable into two groups, namely felting and non-felting fibres, depending on whether they do or do not possess the property of felting; either in the manufacture of a felted cloth by applying the fulling and milling processes to a woven or knitted fabric, or in the manufacture of true felt in which the constituent fibres are moved from a loosely arranged layer into a closely intermingled, intermeshed, and interlocked relationship without recourse to spinning, weaving, or knitting. Thus, the felting property of the felting fibres enables them—under the repeated pressure, manipulation, flexing, and rubbing of the felting processes—to move from a more or less loose arrangement into the much closer, denser, and intertwined and interlocked felted positions in which they are given a permanent set. The felting property is limited to a relatively small group of fibres, such for example, as the wool of sheep and certain fur fibres of other animals; and varies widely in intensity.

The felting property is dependent on a number of interrelated factors such as the shape of the fibre, its diameter, length, density, plasticity, elasticity, and resilience, plus one essential and distinguishing characteristic, namely, the possession of an outer surface covering of a multitude of minute scales or serrations. The tips or edges of these scales project only slightly, but they point in the same direction, i.e., toward the tip of the fibre. They result in an obviously greater friction lengthwise of the fibre from tip to base, and thus provide a multiplicity of tiny fulcrum points which favor mono-directional motion under the action of the felting processes.

The partial destruction of these scales on fur, for example by chlorination, causes a corresponding loss in felting property. Similarly, when non-felting fibres are mixed with felting fibres and subjected to the felting processes, the non-felting fibres do not thoroughly interlock or intermesh with the felting fibres and consequently the resulting product is lacking in the complete characteristic qualities of felted material made entirely from felting fibres.

It is evident from the foregoing that the present arts of making felted fabrics and felt are lim-

It is evident from the foregoing that the present arts of making felted fabrics and felt are lim-

10

15

20

25

30

35

40

45

50

55
entirely new products, and new and novel results such as new color effects and new surface appearance and feel in old or well known products. Other objects, features, and advantages will appear hereinafter.

The term fibre as used herein is intended to include any filamentous material (whether it be short or long) such as cotton, wool, or linen thread, possibly impregnated with a stiffening agent or coated with a plastic such as cellulose acetate. Cotton, complete rayon, cellulose acetate, and other synthetic fibres of round, tubular, square or other irregular cross section. Further, it may include fibre such as animal fur and hair, for it is within the purview of the present invention to change the surface characteristics of fur and hair to improve its felting properties.

In the drawing:

Fig. 1 is a plan view of one form of fibre made in accordance with the present invention, having fabricated small semi-circular deformations.

Fig. 2 is a plan view of another form of fibre with fabricated annular deformations.

Fig. 3 is a plan view of a fibre with angularly disposed deformations.

Fig. 4 is a plan view of a flat fibre with fabricated deformations.

Fig. 4A is an end view of Fig. 4.

Fig. 5 is a plan view of another form of fibre.

Fig. 6 is a diagrammatic view of one form of apparatus for producing fibres according to the present invention.

Fig. 7 is a fragmentary detail of a modified form of cutter to be used with the apparatus shown in Fig. 6.

Fig. 8 is a diagrammatic view of a modified form of apparatus in which circular cutters are employed.

Fig. 9 is a diagrammatic view of another form of apparatus.

Fig. 10 is a detail of one form of cutter.

Fig. 10A is an end view of Fig. 10.

Fig. 11 is a detail of another form of cutter.

Fig. 11A is an end view of Fig. 11.

Fig. 12 is a detail of a bristle with duo-directional deformations made in accordance with the present invention.

Fig. 12A is an end view of Fig. 12.

Fig. 13 is a fragmentary detail view of the shaping and severing cutter, on an enlarged scale.

Fig. 14 is an enlarged fragmentary detail of the shaping and severing cutter in the operative position.

The present preferred form of new article provided by the present invention is disclosed in Fig. 1 and comprises a fibre 14, of cellulose acetate or other filamentous material, which originally had but limited or no felting properties, having minute modifications or deformations 15 fabricated on its outer surface, preferably pressed or cut thereon in large numbers in the form of minute projections and bars. The illustration in Fig. 1 is on a very much enlarged scale, and the deformations 15 thereon are also in general less in quantity and greater in proportional size than is most generally preferred, in order to more clearly illustrate the invention. As used herein the term fibre is intended to cover primarily a single filament as distinguished from a bundle of plurality of separate and distinct filaments. The deformations 15 on the fibre 14 have the characteristic of inching or causing the individual fibres to travel relative to each other as a loose mass thereof is worked by any usual pressing, felting, or milling process, and also to efficiently intermesh and interlock together in order to make a thoroughly felted body. Of particular importance, the present invention thus provides a normally non-felting fibre with structure for changing it into a fibre with felting properties, and also for changing a fibre with limited felting properties into one with extensive felting properties.

One form of apparatus 16 for producing the fibre 14 of Fig. 1 is illustrated diagrammatically in Fig. 6 and comprises a base member 17 having near its center a support 18 with a curved top 19 over which the fibre 14 may be passed. Movement of the fibre over the support 18 may be effected by hand or by any suitable mechanical driving means. For illustration, the present invention provides a fibre moving mechanism 20 including a play-off reel 21 detachably mounted on a stud 22 at the top of an upstanding standard 23 on one side of the support 18, and a take-up reel 24 similarly mounted on a shaft 25 at the top of an upstanding standard 26 on the opposite side of the apparatus. A crank 27 may be suitably secured to the shaft 25 in order to turn the take-up reel and pull the fibre from the play-off reel across the top of the support 18 and onto the take-up reel. However, in its place a belt and pulley connection 28 or any other type of driving connection may be associated with any suitable source of power in order to turn it automatically at an even rate of speed, if desired.

A deforming mechanism 30 is provided on this apparatus 16 for fabricating deformations 15 on the surface of the fibres 14 passed over the support 18 and includes a cutter 31 on a cutter carrier 32 which is pivotally mounted on a stud 33. The carrier is preferably provided with a spring 34 having an end engaging a pin 35 to normally urge the cutter 31 upwardly in order to have the cutting edge 36 thereof normally clear of the fibre 14 as it passes over the support 18. Movement of the cutter and carrier to an inoperative position is limited by a contact screw 37 carried by a bracket 38, suitably secured on a fibre or other insulating plate 39. Movement of the cutter toward the operative position, for cutting into the fibre 14, is limited by a similar regulating screw 40 carried by the fibre plate 39.

Oscillation or movement of the cutter 31 from the inoperative to the operative position for cutting bars or otherwise fabricating surface deformations 15 into the fibre may be accomplished by various means. In the present illustration, shown in Fig. 6, this is accomplished through the provision of an electro-magnetic mechanism 41 and by arranging the cutter carrier 32 to carry a vibrator armature 42. To this end an electro-magnet 43 is secured to an insulating strip 44 held to the base 17 by screws 45. It is energized by a battery 46 with one lead 47 extending to one end of the electro-magnet 43 and another lead 48 extending to the contact screw 37, thence through the cutter carrier 32 to a secondary lead 49 at the other end to the electro-magnet.

The cutter carrier 32 is provided with a soft iron armature 42 so that when the electro-magnets are energized, the cutter carrier 32 and cutter 31 will be quickly drawn toward the electro-magnet to an inoperative position against the regulating screw 40. As
the cutter carrier 32 is pulled away from the contact screw by electro-magnetic force to the regulating screw, the flow of current to the electro-magnet ceases and the carrier 32 becomes de-energized again and allows the carrier to be returned to the inoperative position by the spring 34. Through having a close relation between the contact screw 37 and the regulating screw, the carrier screw 32 is oscillated at a very high frequency. As the cutter carrier 32 passes through a great many deformations 15 during the passage of the fibre 14 over the support 18, and when they are farther apart, fewer deformations are fabricated in the fibre even though it is traveling at the same rate of speed. By adjusting the regulating screw 46, either very minute or large deformations may be fabricated in the fibre.

The fibre 14 may be run over the support 18 a number of times in order to form rows of deformations entirely around the periphery, as is indicated in Fig. 1, by changing the rolls 21 and 24 around on the standards 23 and 26, and by passing the fibre over the support 18 a number of times. An alternative and quicker method is to provide an auxiliary standard 50 with an auxiliary roller 51 adapted to take the fibre as it passes over the roller and return it through an opening 52 in the support 18 around an underlying curved surface 53 to be passed over the curved top 19 two or more times under the cutter 31, even though there is only one complete passage from the play-off reel to the take-up reel. If the cutter is of sufficient width and the fibre is passed around the curved surface 53 and top 19 enough times, the entire periphery of the fibre may be fabricated with deformations during only one such passage.

Similarly, a ribbon with warp and weft threads may be run through the mechanism, instead of a single thread. A complete article such as a ribbon with warp and weft threads may likewise have mono-directional surface deformations fabricated thereon.

Fig. 7 illustrates a modified form of cutter 31’ having a plurality of cutting teeth 36’ which, as shown, will fabricate four bars into the periphery of the fibre each time the carrier 32 is vibrated. If preferred, the cutting edges 36 and 36’ of the cutters 31’ or 31’ respectively may be angularly rather than transversely disposed relative to the path of travel of the fibre in order to form angularly disposed rather than transversely notched bars, or other deformations in the fibre similar to the deformations 17 in Fig. 3.

Fig. 8 illustrates another form of apparatus 54 adapted to fabricate mono-directional surface deformations 15 in the fibre, fibrous thread 14, or parallel band of such threads, differing from the form of apparatus shown in Fig. 6 and just described in detail mainly by the provision of circular cutter rolls 55 and 55 as distinguished from a reciprocating or oscillating cutter 31. The cutter roll 55 is mounted on a suitable shaft 57 in a standard 58 on a base 59 while the cooperating cutter 55 is similarly mounted on a shaft 60 adjustable and secured in a limited range of spacing relative to the cutter 55 through the provision of a slot 62 and holding screws 63.

Gears 64 and 65 on the shafts 57 and 60 mesh and coordinate drive the cutters 55 and 55 in a clockwise and counterclockwise direction respectively. The teeth 66 on the cutters 55 and 55 may be in the form of a calender resembling that used in the Schreinerberg process, of substantial width, and the gears 64 and 65 may be driven, for example, by a belt connection 67, or any other suitable driving means. The base 59 may be provided with a slot upon which the apparatus 54 may be moved and may be provided with a top guide 68 on a standard 70 to support and guide the uncut fibre.

By having the circular cutters 55 and 56 of the apparatus shown in Fig. 8 a substantial width it is possible to fabricate a large number of fibres 14 through this form of apparatus at one time to simultaneously form bars on two sides, and by having a plurality of such apparatus 54, one below the other, and with the cutters of each 55 an angle to the other, as will be understood readily by an ordinary mechanic, deformations may be simultaneously formed on more than two sides. Loose fur may also be passed between the rolls 55 and 56 to fabricate deformations 15 therein to impart or to improve its felting characteristics. Thus also, non-felting hair, as distinguished from felting fur, may be given felting properties.

As the cutters are rotated by the gears 64 and 65, successive teeth 66 engage the fibre 14 to fabricate mono-directional deformations 15 similar to the bars 12 and return it through the provision of guide bushings 68 and 68 having rectangular shaped bores in a round hole. This form of fibre may also be fabricated in the apparatus shown in Fig. 5 by merely providing a suitable channel, shown by dot-and-dash lines 73, in order to hold the thin edge 74 of the fibre 71 toward the cutters 31 or 31’.

In some instances it may be preferred to have a fibre 75 with complete or substantially complete annular shaped deformations 16 as shown in Fig. 2. It is felt that a fibre of this form will have some advantages or will improve the felting characteristics of a mass of fibres by providing felting deformations entirely about its periphery or a relatively continuous spiral. Thus, a barb on a cooperating hair, fur, or fibre is sure to find an annular barb on this fibre at very short intervals through its length. It will not ride over short or narrow smooth places between individual bars as might otherwise occur.

Figs. 9, 10, and 11 illustrate the present preferred apparatus 78 for fabricating fibres of the form shown in Fig. 2 and comprises a base 79 supporting cutter-carriers 80 and 81 on pivots 82 and 83 respectively. Cutters, like 84, of predetermined shape may be interchangeably connected to the carrier arms 80 and 81 by screws 85. Segments 86 and 87 secured to the shafts 82 and 83 insure coordinate movement of the cutters 84 both with movement of the fibre relative to a fibre 14 or to an inoperative or retracted position which these parts normally assume under the influence of springs 88 and 89. Contact screws 90 and 91 in insulating blocks 90’ and 91’ are provided to limit this retracted movement of the carriers 80 and 81 to the inoperative position.

Top and bottom guide bushings 92 and 93 insure a proper travel of the fibre 14 relative to the
cutters 84. Holes in these bushings are formed to accommodate and direct different sizes and different shapes of fibres to and from the cutters.

Electro-magnetic mechanisms 94 and 95 are provided to move the carrier arms 90 and 91 upwardly and thereby move the cutters 84 toward the fibre 14 or toward the operative cutting position. These magnets are, through an insulating plate 96, secured to an upper wall 79 of the base member 78 by suitable screws. Movement of the carrier arms 90 and 91 toward the operative position is limited by regulating screws 97 and 98.

Energy is transmitted to the electro-magnetic coils 89 and 100 through lines 101 and 102 extending from the armatures formed by the carriers 80 and 91 and to contact screws 90 and 91 and lines 101 and 102 to one side of a battery 103 while leads 104 and 105 extend from the electro-magnets to a switch 106 thence through a lead 107 to the other side of the battery. The gear segments 86 and 87 serve to insure coordinate movement of the cutters 84 both to and from the operative position and serves to dispense with one electro-magnet mechanism, if preferred.

Feed rolls 108 are provided on a standard 109 to feed the fibre 14 through the apparatus 54, although the cutters 84 in their movement toward the operative position may also be used for this purpose. These feed rollers may be rotated by a hand crank or by any suitable power means.

Plain cutters 84, as shown in Fig. 9, may be provided to fabricate deformations 15 on the periphery of the fibre 14 similar to the bars shown in Fig. 4. However, if preferred, these cutters may be replaced with a pair of cutters 110 as shown in Fig. 10 in order to form the annular deformations 76 in the fibre 75 as shown in Fig. 2. These cutters 110 are provided with conical shaped surfaces 113 and 114 having a diameter at its root similar to the diameter shown by dotted lines in Fig. 2 and flaring outwardly therefrom with a suitable rake or angle to form the annular deformations 76. These annular rings or deformations may be spaced any desired extent from each other along the length of the fibre.

Fig. 11 shows a similar pair of cutters 115 having angularly disposed teeth adapted to form the fibre 116 with angularly or spirally disposed deformations 117 as shown in Fig. 3.

In the formation of felt it is preferable to have the fibres of rather short length so that they interlock and intermesh better. Fig. 9 illustrates one mechanism 118 for cutting the fibres having deformations as hereinbefore described into any desired short length, comprising a fixed cutter 119 on the underside of the base 78 and a slidable cutter 120 adapted to be moved toward and from the stationary cutter in a suitable channel 121 by an eccentric 122 having a handle 123. If preferred, this movable cutter may be power driven in unison with the feed rolls 108 in order to have all of the fibres cut to the same length.

Preferably, the cutters 118 and 120 are provided with shaped walls 124 and adapted to cut the fibre ends to predetermined shapes. As shown, the walls are of a substantially conical shape adapted to form a pointed end 125 and a blunted end 126 to the individual fibres as they are chopped off. This is effected by a pressing and crushing action rather than a shearing action, as will be apparent by viewing the enlarged fragmentary detail views, Figs. 13 and 14, of the cutters. Points on the ends of the individual fibres opposite from the direction the deformations project, improve the felting operation or effect by facilitating the action of the fibres working down in the associated interval between the loose fur or fibres in the felt mass.

It should be particularly noted that by so pointing the fibres the present invention provides an improvement over natural fur for the reason that in natural fur the so-called scales lean toward the natural point of the fur and thereby tend to inch the butt or blunt end of a hair or fur down into the mass rather than the thin pointed end.

As shown in Fig. 3, the various fibres may be in the form of a usual Abrasion cotton or wool or other thread 127 with a coating 128 of acetate cellulose or other plastic material, with the latter adapted to receive and form the surface deformations. Or, as shown in Fig. 5, the entire fibre may be a fibrous thread 129 impregnated with starch or other stiffening agent so that it will hold its point 125 when cut to length and so that the mono-directional fibres 130 of the mass at the end, formed when crushing and separating individual fibres, will hold their shape substantially. Fig. 12 illustrates a fibre 131, with bars 15 and 15' extending in opposite directions, fabricated on the fibre. After felting, the coating may be dissolved away if so desired.

Thus, the present invention provides an important new article of manufacture comprising felting fibres made from normally non-felting fibres which may be used alone to produce a new form of felt mass or may be used in combination with the bars shown to produce new effects in hats or wearing apparel and many other articles. Not only is it possible to obtain new effects and new color combinations, but definite economies may be effected, for the novel fibres of the present invention may be produced at very little cost. The present invention conjointly provides a novel process and apparatus for producing the aforesaid novel fibres.

The fibres with fabricated deformations provided by the present invention may be used alone or with regular felting fibres to form felted hats, foot wear, sound absorbing pads, and many other commercial articles.

It is within the purview of this invention to provide deformation other than projections or bars on the various fibres; for example, the cutters 31 and 31' may be heated by the flame 134 of any suitably located burner 135 with a shield 137, or any other suitable heater, whereupon the point 36 or 36' burns a slot-like depression into the fibre to fabricate deformations which will not project from the fibre, but which will nevertheless provide deformations imparting felting characteristics to the fibre.

Other variations and modifications may be made within the scope of this invention, and portions of the improvements may be used without others.

Having thus described the present preferred forms of the invention, what is claimed as new and for which it is desired to obtain Letters Patent is:

1. A new article of manufacture consisting of a normally non-felting filament; and mono-directional surface projections on said filament, imparting felting characteristics thereto.

2. A new article of manufacture consisting of a normally non-felting filament; and tooth-like
projections extending uniformly from the outer surface of the filament, imparting felting characteristics thereto.

3. A new article of manufacture consisting of a single normally non-felting fibre; and barbs on said fibre extending lengthwise thereof, imparting felting characteristics thereto.

4. A new article of manufacture consisting of a fibre having fabricated annular projections thereon.

5. A new article of manufacture consisting of a fibre having fabricated mono-directional deformations thereon defining barbs extending lengthwise thereof.

6. A new article of manufacture consisting of a fibre with a fibrous thread core; a coating thereon; and mono-directional projections fabricated in the coating.

7. A new article of manufacture consisting of a normally non-felting fibre; surface deformations on said fibre defining barbs, imparting felting characteristics thereto; and a pointed end on said fibre.

8. The process of converting a non-felting fibre into a felting fibre, consisting of fabricating mono-directional definite projections on the periphery thereof.

9. The process of converting a single non-felting fibre into a felting fibre, consisting of fabricating barbs thereon.

10. The process of imparting felting characteristics to a normally non-felting fibre, consisting of fabricating mono-directional substantial barbs thereon extending lengthwise thereof.

11. The process of producing a felting fibre consisting in the steps of feeding a long filament; fabricating mono-directional projections thereon; and cutting the long filament to short predetermined lengths.

GEORGE S. RADFORD.