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MAKING SYNTHETIC FILAMENTS FROM FIBRILLATED FILM

Filed Aug 4, 1967

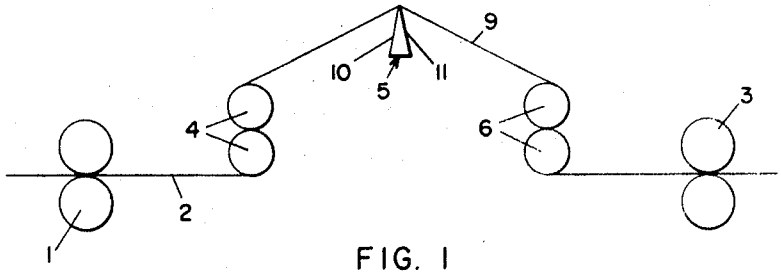


FIG. 1

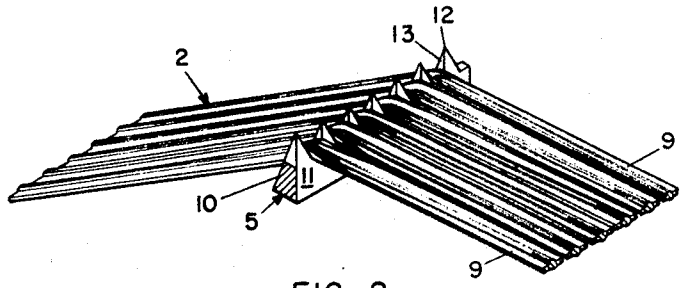


FIG. 2

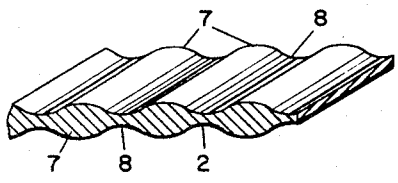


FIG. 3

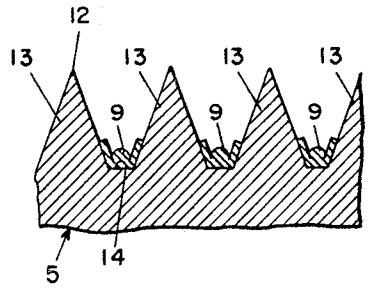


FIG. 4

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ABSTRACT OF THE DISCLOSURE

This invention relates to a process for making a yarn from a striated ribbon of thermoplastic material that is linearly oriented in the direction lengthwise of the striations by passing the ribbon over a serrated knife edge having the teeth thereof corresponding in gauge to that of the striations whereby the individual teeth penetrate the ribbon and split the same lengthwise along the webs of the striations as the ribbon is moved relatively to the knife edge, the ribbon being under tension and at an acute angle relative to the edge whereby a knife edge crimp is imparted thereto simultaneously with splitting.

The present invention relates to a process for making a synthetic yarn of thermoplastic material and particularly to a process for making such a yarn by fibrillation of a ribbon or a thin and narrow strip of a plastic film.

The objects of this invention are to provide a method for making a synthetic yarn from a thermoplastic material, which method will inexpensively produce uniformly high-quality yarn. A more specific object of this invention is to provide a method in accordance with the above in which the yarn is bulked or crimped simultaneously with the fibrillation thereof.

In accordance with this invention, the above objects have been achieved by advancing a linearly oriented striated ribbon under tension over a sharp serrated edge whereby the ribbon is split lengthwise along the striations to separate the same into individual filaments and simultaneously impart a knife-edge crimp to the filaments.

Further objects of this invention will be apparent from an understanding of the preferred embodiment of the invention hereinafter described with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of the process of the present invention.

FIG. 2 is a fragmentary perspective view of the separating element, together with the striated ribbon used in the process of FIG. 1 and illustrating the operation at the point of splitting.

FIG. 3 is a fragmentary sectional view of a striated plastic ribbon used in the process of FIG. 1.

FIG. 4 is an enlarged sectional view of the separating element used in the process of FIG. 1, together with the striated ribbon.

With reference to the drawings, there is illustrated a pair of feed rolls **1** for feeding a strip or ribbon of striated film **2** of plastic material such as polypropylene or other suitable fiber-forming material. The ribbon **2** is of indefinite length and is fed by the rolls **1** from a source (not shown). From the rolls **1**, the ribbon **2** is advanced by a pair of draw rolls **3** which are operated at a speed slightly greater than the speed of the feed rolls **1** to maintain a tension in the length of the ribbon **2** between the rolls **1** and **3**. The length of the ribbon **2** between the feed rolls **1** and draw rolls **3** passes around a pair of heated guide rolls **4**, over a separating element in the form of a block **5**, and around a pair of cooled guide rolls **6**.

The ribbon **2** is striated to provide a plurality of laterally spaced ribs **7** extending lengthwise of the ribbon, the adjacent pairs of which ribs are interconnected by webs **8**. More particularly, the ribbon **2** may be described as having a transverse cross section that varies continuously in thickness between a substantially constant minimum thickness at the webs **8** and a substantially constant maximum thickness at the ribs **7**. The ribbon **2** also has a substantially uniform transverse cross section lengthwise thereof, that is, the transverse cross section at any one point along the ribbon is substantially the same as the transverse cross section at any other point along the ribbon. The frequency of the ribs **7**, that is, the gauge or spacing from a point on one rib to the corresponding point on an adjacent rib, is substantially constant. Thus, the ribs **7** are of substantially uniform height and extend in substantially uniformly spaced parallel relation lengthwise of the ribbon.

The ribbon **2** is also highly oriented uniaxially or linearly in the direction lengthwise thereof so that there is an inherent transverse weakness whereby the ribbon can be readily separated by splitting lengthwise along the webs **8** into individual filaments **9** corresponding to the ribs **7**. Because of the high molecular orientation in the webs **8** and the increased thickness of material in the ribs **7**, there is an increased tendency for the ribbon to split uniformly along the webs **8**, or conversely, a reduced tendency for a split to migrate across a rib **7**.

The present invention is not limited in the manner in which the ribbon **2** is made but as an example of one method of making a suitable ribbon **2**, reference is made to the co-pending application of C. W. Kim, one of the present joint inventors, Serial No. 627,104, filed Mar. 30, 1967, which application is owned by the assignee of this application. Briefly, the method therein described comprises extruding a flat striated ribbon having a plurality of ribs with the adjacent pairs of ribs interconnected diametrically by webs. The number of ribs in the ribbon is made to correspond to the desired number of filaments in the yarn to be formed from the ribbon. The dimensions of the ribbon as extruded are determined by the desired dimensions of the final filaments and the draw ratios employed in the melt drawing and the orientation of the ribbon. As a specfic example, a polypropylene ribbon was extruded with ribs that were round and had a diameter of about 14 mils, with webs having a thickness of about 2 mils, and with a spacing of about 30 mils from a point on one rib to the corresponding point on the adjacent rib. The ribbon was melt drawn at a ratio of 4:1 and was subsequently oriented at a draw ratio of about 6:1. In the oriented ribbon, the ribs had a thickness of between 1.5 and 2.5 mils, the webs had a thickness of between 0.5 and 1.0 mil, and the spacing from a point on one rib to the corresponding point on the adjacent rib was about 10 mils.

One of the characteristics of a ribbon produced in the above manner is that the striations are substantially uniformly spaced through the mid-portion of the ribbon but are more closely spaced along the edges thereof. This is a result of the sides of the ribbon being pulled as the ribbon necks down during the melt draw. Normally, this will require that the edge portions of the ribbon be stripped off and discarded to obtain a ribbon in which the striations are substantially uniformly spaced across the width of the ribbon.

While the specific illustrated ribbon has both surfaces striated, it will be apparent that the striations could be confined to one surface thereof. Such single-surface striations have one flat face which can be passed over a feed roll for example, without crushing the ribs.

The block **5** is formed with side walls **10** and **11** that converge to form a relatively sharp yarn engaging edge **12** that is provided with a series of serrations **13** along the

length thereof. The frequency of the serrations **13**, that is, the distance from a point on one serration to the corresponding point on the adjacent serration, is made substantially equal to the frequency of the ribs **7**. The serrations **13** preferably have a height that is substantially greater than the thickness of the ribs **7** of the ribbon, for example, the height of the serrations **13** may be about 10 mils with a ribbon having ribs **7** that are about 2.5 mils in thickness.

In operation, the ribbon **2** is passed over the serrated edge **12** of the block **5** and is maintained under some tension so that the serrations **13** penetrate the webs **8** between adjacent ribs **7**. As the ribbon **2** is advanced, the serrations **13** continually separate the ribbon along the webs **8** to reduce it to individual filaments **9**. With the height of the serrations substantially greater than the thickness of the ribbon and with the ribbon under tension, there is very little opportunity for the ribbon to become disengaged so that, once engaged, splitting progresses uniformly along each web. Simultaneously with splitting the ribbon along the webs **8**, the filaments **9** have a knife-edge crimp imparted thereto by virtue of being scraped over the crimping edge **14** at the base of the serrations **13**. The tension in the ribbon **2** and the included angle of the ribbon, that is, the angle of the input lead of the ribbon **2** as it advances toward the block **5** relative to the output lead of the ribbon **2** as it leaves the block **5**, determine the force holding the ribbon **2** against the crimping edge **14**. From the standpoint of separation of the ribbon into filaments, a relatively low force is required and therefore a low tension in the ribbon and an included angle approaching 180° would be satisfactory. From the standpoint of crimp, a higher crimp level is obtained by increasing the tension in the ribbon and decreasing the included angle so that the ribbon is bent more sharply over the edge **14** and worked with more force over that edge. A crimp level of **8** to **10** crimps per inch was obtained with a ribbon made in accordance with the above described example by heating the rolls **4** to 140° C. and passing the ribbon at a rate of 10 feet per minute over the edge **14** at an included angle of 120° while maintaining a tension of 1 to 2 grams per denier on the ribbon. The primary purpose of heating the ribbon by the rolls **4** is to enhance and set the crimp. Knife-edge crimping can of course be imparted to the filaments without preheating the filaments and the crimp can be by subsequent heat treating.

What we claim and desire to protect by Letters Patent is:

1. A process for making a yarn of synthetic filaments of a thermoplastic material comprising preparing a striated ribbon characterized by a thickness that varies in transverse cross section at a uniform frequency between substantially constant minimum and maximum thicknesses and by a substantially uniform cross section lengthwise of the ribbon to provide a plurality of parallel ribs extending lengthwise of the ribbon with the adjacent pairs of said ribs interconnected by webs of reduced thickness, linearly orienting said ribbon in the direction lengthwise of said striations, and advancing said ribbon under tension at an acute angle relative to a linear and stationary sharp edge having serrations the frequency of which is substantially the same as the frequency of the striations whereby said ribbon is angled under tension as it is advanced over said edge and thereby split along said webs into individual filaments corresponding substantially to said ribs.

2. A process for making a crimped yarn in accordance with claim **1** wherein said ribbon is heated and has a knife-edge crimp imparted thereto simultaneously with said splitting.

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U.S. Cl. X.R.

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