ABSTRACT: Producing filaments by drawing plastic film laterally, slitting the film into filaments and drawing the filaments longitudinally.
It is known to produce filaments by slitting or otherwise dividing plastics material sheets. In British Pat. specification No. 1,067,514 there is described a process in which drawable plastics material sheet is divided into filaments which are then drawn to decrease their denier. British Pat. specification No. 1,097,138 describes a modification of such a process.

According to a first aspect of the present invention, there is provided a method of producing filaments, including longitudinally dividing drawable plastics material film which has already been drawn laterally, to produce filaments, and then drawing the filaments longitudinally.

According to a second aspect of the present invention, there is provided apparatus for producing filaments, including means for drawing plastic film laterally to impart a substantial lateral stretch thereto, means for dividing said film longitudinally to provide longitudinally extended filaments, and means for drawing said filaments longitudinally to impart a substantial longitudinal stretch thereto.

According to a third aspect of the present invention, there is provided a filament which has been produced by the first aspect of the invention.

Using the invention, it is possible to produce very fine filaments. If undrawn cast film is slit, and the filaments are then drawn, the lateral contraction of each filament is usually proportional to the square root of the drawing ratio. However, if the film has been drawn laterally before slitting, the lateral contraction of each filament is much greater, decreasing the width to thickness ratio of the filament.

The drawn filaments produced in accordance with this invention can be wound on to a single rotary member in the manner described in British Pat. specification No. 1,067,514 and No. 1,097,138; thus a large number of filaments, suitable for preparing a warp, may be produced from the film and wound onto a single rotary member, and an even larger number of filaments may have been produced from the film in the first instance to allow some of the filaments to be cast out. Alternatively, the filaments produced in accordance with this invention may be for instance wound onto spindles or used for other purposes as explained hereafter; filaments in accordance with the invention are for example useful in core yarns.

The film slit is preferably unapertured, i.e. not provided with any pattern of holes or slits, until such time as it is divided in accordance with the invention.

The preferred plastics materials are polypropylene, polyethylene, nylon and polyester due to their drawing characteristics. The extent to which e.g. polypropylene filaments can be drawn longitudinally after slitting depends on the extent to which the polypropylene film was stretched longitudinally (if at all) before slitting. For instance, fine cast polypropylene film (say 60 gauge film) may be drawn longitudinally a little before it is chilled on a chill roll, causing a certain amount of polymer orientation. Maximum drawing ratios may vary from one film type to another depending on polymer types, extrusion techniques and stretching techniques. In the case of polypropylene, for example, these ratios may be between the limits of say 2:1 to 14:1, before fibrillation occurs although in the case of nylon the maximum encountered is 5:1. In this context, drawing ratios are such that fibrillation point is not reached in materials which can be fibrillated.

In general, the lateral drawing ratio is from 2:1 to 14:1; above 4:1 the effect of the initial lateral drawing becomes particularly noticeable. A particularly useful figure of the lateral drawing ratio for polypropylene for example is about 7:1 giving good mean results for commercial operations.

The filaments are preferably drawn longitudinally to a drawing ratio of 4:1 to 6:1 of type and variety, for the same reasons, though, as mentioned above, the film may already have been drawn longitudinally to a small extent before dividing, which would reduce the upper limit of the range of ratios. The useful value for commercial operation is about 5:1 or 6:1.
bears by gravity on a rubber-covered driving roller 16 which drives the rotary member 14 at a substantially constant peripheral velocity. The variable traverse comb 13 can be used to build up a package on the rotary member 14 which has conical ends, to prevent the end windings slipping; alternatively, the traverse of the comb 13 is gradually shortened as winding proceeds to build a number of pineapple cores.

As mentioned above, machinery for laterally stretching plastic films need not be described in detail. Nonetheless, the roll 2 of laterally stretched film could be replaced by suitable machinery for stretching unoriented film laterally.

British Pat. applications No. 45589/66 and 682/67 give details of ancillary equipment that may be used in association with the plant.

As shown in FIG. 22, the cutters of the cutter arrangement 4 are safety razor blades 16 which are clamped in position. In order to provide the blades 16, ordinary commercial safety razor blades are broken down the middle, along the line 17, and the ends of the blades are broken off at right angles to this line 17 in order to give sharp points at each corner of the blade. By providing these sharp points, no difficulties are met with on start-up.

On start-up, the film is threaded through to the rotary member 14, and the points of the blades are then inserted into the film to start slitting.

The blades 16 are split in half in order to facilitate insertion into the clamping arrangement. It will be noted that by reversing the blades, four different cutting edges can be used for each blade.

The blades 16 are clamped in position by annular spacers 18 through which is threaded a spindle 19; the spindle 19 carries a mounting bush 20 and a lock nut and washer arrangement 21.

In order to spread the wear along the length of each blade 16, the blades are slowly reciprocated up and down using an eccentric and slide arrangement, for instance with a period of 20 to 40 seconds. To this end, a slide member 22 is fixed to the bush 20, and the bush 20 is in turn keyed or pinned to the rod 19; the slide member 22 slides in a slidingway 23 shown dotted in FIG. 2, and in this way keeps the edges of the blade 16 at an attitude of about 45° to the film 1. An eccentric 24 is connected to the bush 20 by a connecting rod 25 in order to provide the reciprocating movement of the blade 16.

Suitable parameters for the apparatus are as follows:
1. Width at roll 2: 1100–2000 mm.
2. Width at rotary member 14; ±50 percent of width at roll 2.
3. Drawing ratios, i.e. longitudinal and lateral stretch in film in roll 2 and drawing ratio between the godet rolls 7, 9; discussed above.
4. Speed of filaments at rotary member 14; 220–440 m. per minute depending one type and variety of polymer.
5. Slitting width (distance between edges of adjacent blades 16); 0.8 mm. to 3 mm. or more.
6. Resistant width of filament at rotary member 14; 0.16 mm. upwards or even less.
7. The maximum number of filaments depends on machine width, slitting width, and number of film layers slit simultaneously. Thus for a 2,000 mm. machine fed with double layer film and employing a cutting head with a cutter pitch of 1 mm, the maximum number of filaments would be about 4000, allowing marginal waste for the edge tapes.
8. Film gauges; 12 to 120 micron.
9. Warp lengths; 2,000 to 40,000 meters.
10. Barrel diameter of rotary member 14; 300 mm.

These parameters are only given by way of example. The apparatus illustrated could be used with different parameters.

The methods described in the following examples could be carried out on the apparatus shown, but Example 1 illustrates the invention whereas Example 2 does not.

Example 1

In accordance with the invention, cast polypropylene film is given a lateral stretch of 600 percent (7:1 drawing ratio) and a longitudinal stretch of 40 percent (1.4:1 drawing ratio), the resulting stretched film weighing 85 gms. per square meter. The stretched film is then slit to give a large number of filaments 1.1 mm. wide. The slit filaments are then given longitudinal stretch of 400 percent (5:1 drawing ratio). The resulting filaments have a denier of 41 and a width of about 0.25 mm.

Example 2

Cast polypropylene film weighing 75 gms. per square meter was slit to provide 11 mm. wide filaments. The filaments were given a longitudinal stretch of 500 percent (6:1 drawing ratio). The resulting filaments had a denier of 36 but a width of about 0.6 mm.

It can be seen from a comparison of Examples 1 and 2 that the filaments produced in accordance with the invention will have much finer appearance than those of Example 2, being more nearly square in cross section.

1. A method of producing plastic filaments, comprising drawing plastic film laterally to impart a substantial lateral stretch thereto, dividing said film longitudinally to provide a plurality of longitudinally extending filaments, and drawing said filaments longitudinally to impart a substantial longitudinal stretch thereto whilst achieving a substantially exaggerated lateral contraction thereof.
2. A method as claimed in claim 1, wherein said plastic is polypropylene, polyethylene, nylon or polyester.
3. A method as claimed in claim 1, wherein said film is drawn laterally to a drawing ratio of from 2:1 to 14:1.
4. A method as claimed in claim 1, wherein said film is polypropylene and is drawn laterally to a drawing ratio of about 7:1.
5. A method as claimed in claim 1, wherein said filaments are drawn longitudinally to a drawing ratio of from 2:1 to 14:1.
6. A method as claimed in claim 1, wherein the total longitudinal drawing ratio, both before and after dividing into filaments, is from 4:1 to 12:1.
7. A method as claimed in claim 1, wherein the total longitudinal drawing ratio, both before and after dividing into filaments, is approximately equal to the drawing ratio to which the film is drawn laterally before dividing it into filaments.
8. A method as claimed in claim 1, wherein a large number of said filaments are produced from said film by said dividing and are wound onto one or more rotary members after said longitudinal drawing, to form warp or yarn packages side by side on the or each rotary member.
9. Apparatus for producing filaments, including means for drawing plastic film laterally to impart a substantial lateral stretch thereto, means for dividing said film longitudinally to provide a plurality of longitudinally extending filaments, and means for drawing said filaments longitudinally to impart a substantial longitudinal stretch thereto whilst achieving a substantially exaggerated lateral contraction thereof.
10. Apparatus as claimed in claim 9, and further comprising means for mounting one or more rotary members for winding on a large number of said longitudinally stretched filaments.