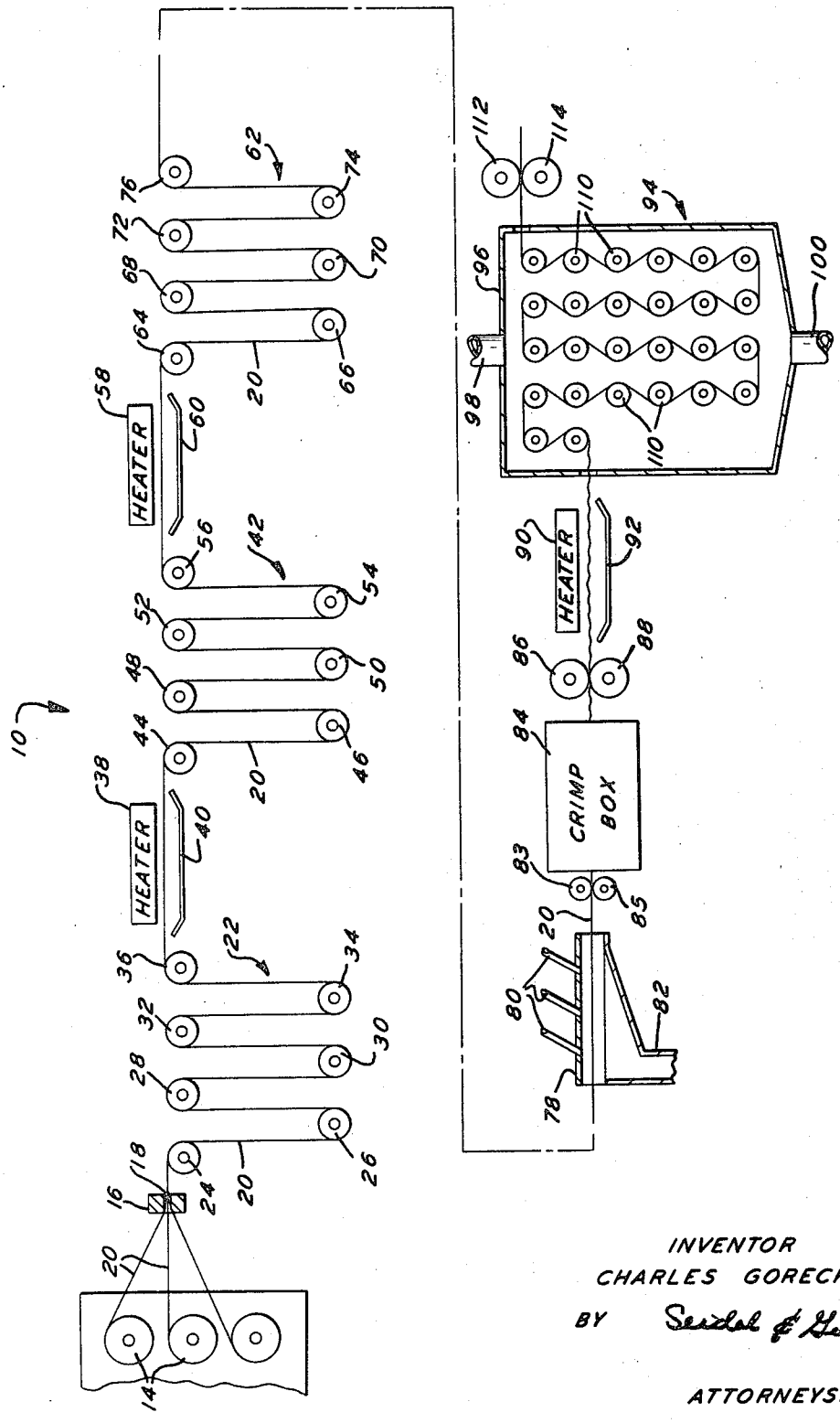
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APPARATUS FOR STRETCHING AND CRIMPING FIBERS

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APPARATUS FOR STRETCHING AND CRIMPING FIBERS

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ABSTRACT OF THE DISCLOSURE

Apparatus are disclosed for stretching and crimping synthetic fibers so that the crimp will have a sharp definition and the fibers will have a uniform dye index. The tow of fibers is alternately subjected to stretching and plasticizing, then crimped, and then the crimp is set in a steam chamber having idler rollers. The number of idler rollers used determines the time to which the fibers are exposed to the steam without reducing the speed of production.

This invention relates to apparatus for stretching and crimping fibers. More particularly, this invention relates to apparatus for stretching and crimping synthetic filament so as to impart desirable characteristics to filaments.

It is well known that many synthetic fibers obtain their desirable characteristics by imparting a stretch thereto. Depending upon the denier of the filaments, nylon, for example, should be stretched between four and seven times its original length so as to impart to it the desirable characteristics generally associated with nylon. Moreover, it is known that the desirable characteristics of nylon are further enhanced by placing a crimp in the fibers.

A substantial number of filaments or fibers is referred to as "tow." Apparatus for stretching a tow of filaments is called a tow stretcher. The apparatus of the present invention includes a tow stretcher, and for example, is designed to stretch a tow having up to 500,000 total drawn denier.

It has been found that certain qualities of a synthetic fiber are affected by the manner in which it is stretched and crimped. Thus, the process and the apparatus used for accomplishing the process may affect the dye index of the fiber whereby the finished product would have variations of color even though the fiber comes from the same batch. Further, the method and apparatus used to stretch and crimp the material effects the number of crimps per inch and the quality of the crimp. It, therefore, is a general object of the present invention to overcome these and other disadvantages in present methods and apparatus for stretching and crimping synthetic fibers.

It is an object of this invention to provide a novel apparatus for stretching and crimping of synthetic fibers.

It is another object of the present invention to provide a novel apparatus for stretching synthetic fibers.

It is yet another object of the present invention to provide a novel apparatus for crimping synthetic fibers.

It is still another object of the present invention to provide a novel apparatus for stretching a synthetic filament by successively increasing the amount of stretch from a predetermined amount to a desired amount by subjecting the filaments to a controlled amount of frictional drag.

It is a further object of the present invention to provide a novel apparatus for crimping synthetic fibers to get a crimp having a sharper definition.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

The drawing illustrates a schematic diagram of the apparatus of the present invention.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown a tow stretcher and crimper designated generally as **10**.

The apparatus **10** includes a creel stand **12** which rotatably supports a large number of unstretched synthetic filament packages commonly referred to as cheese. The filaments are drawn from the outer surface of the packages **14** and caused to pass through one of a plurality of holes **18** in a filament guide **16**.

The filament of tow **20**, which may be type 6 or type 66 nylon, are continuously drawn from the creel packages **14** through a first tow stretching apparatus designated generally as **22**. The tow stretcher **22** consists of a plurality of drag rollers **24**, **26** and **28** having a normal smooth finish or a sandblasted finish and a diameter of approximately fourteen inches. The drag rollers may be of the type disclosed in copending patent application Ser. No. 245,887 filed Dec. 19, 1962 and assigned to the same assignee as the present application. Thus, each of the drag rollers **24**, **26** and **28** may be provided with means whereby they may be selectively locked or allowed to rotate freely as the filament passes over them in contacting relation. The tow is generally in the form of a sheet or layer as it passes over the various rollers. Each drag roller is a cylindrical drum and may have a standard smooth finish such as a 100 or 125 finish.

From the drag roller **28**, the tow **20** passes around four driven rollers **30**, **32**, **34** and **36** in partial contact therewith. Each of the driven rollers **30–36** is rotating at the same speed. For example, the rollers **30–36** may be rotating at a velocity of 150–200 feet per minute. While the tow **20** is passing over the driven rollers, at least one of the drag rollers is locked or otherwise prevented from rotating so as to apply a frictional drag on the tow. This causes the tow to be stretched. The amount of stretch can be varied by unlocking or locking one or more of the drag rollers **24**, **26** and **28** thereby varying the frictional drag on the tow. It should also be noted that means may be provided for merely slowing down the drag rollers rather than completely locking them from any rotation.

From the driven roller **36** the tow **20** is next passed through a plasticizing means which may be in the form of a radiant heater **38**. A reflector **40** is associated with the radiant heater **38** to insure uniform heating of the tow **20**. If nylon is the product being stretched, then the temperature of the heater may be adjusted to heat the tow **20** to a temperature of from between 130° C. to 190° C. Alternative means for plasticizing the tow could be used. Thus, for example, a contact heater could be substituted for the radiant heater. However, the radiant heater is preferred as it permits better control and eliminates such problems as may arise if the heat source is defective in a contact heater.

From the plasticizing means, the tow **20** passes through a second tow stretcher **42**. The tow stretcher **42** is similar in construction to the tow stretcher **22**. Thus, it comprises selectively lockable drag rollers **44**, **46** and **48** together with driven rollers **50**, **52**, **54** and **56**. The tow stretcher **42** differs from the tow stretcher **22** in that the driven rollers **50–56** are rotated at a higher velocity than the driven rollers **30–36**. Thus, the driven rollers **50–56** may be rotated at a velocity of 350 to 550 feet per minute. The increased rotational speed compensates for the greater length produced by tow stretcher **22**, and it also is sufficient to stretch the tow **20**. Further, the drag rollers **44**, **46** and **48** may be water cooled. For nylon the drag rollers **44**, **46** and **48** are preferably cooled to a temperature of 50°–60° F.

The tow **20** passes from the second set of speed rollers through a plasticizing means which may be a radiant

heater **58** and reflector **60**. The radiant heater **58** operates at the same temperatures and in the same manner as the radiant heater **38**. Moreover, any of the alternative plasticizing means heretofore mentioned may be used.

From the radiant heater **58**, the tow **20** passes through a third tow stretcher **62**. The third tow stretcher **62** is similar in construction to tow stretchers **22** and **42**. Thus, tow stretcher **62** comprises drag rollers **64**, **66** and **68** together with driven rollers **70**, **72**, **74** and **76**. In tow stretcher **62** the driven rollers **70–76** are rotated at a velocity of 650 to 850 feet per minute. The speed selected is sufficient to prevent slack in the tow **20** and to stretch the tow **20**. Drag rollers **64**, **66** and **68** are also water cooled to a temperature of 50°–60° F.

As the denier of the filaments increases, an increasing number of drag rollers must be locked or slowed down.

Depending upon the number of drag rollers utilized, the surface finish of the drag rollers, diameter of the drag rollers and the type of filaments being stretched, anyone skilled in the art may easily ascertain by simple tests the number of drag rollers in each roller set of the tow stretcher which must be locked as the function of the denier of the filaments.

As shown schematically by the dotted line, the stretched tow passes from the third tow stretcher **62** to the steam plasticizer **78**. The steam plasticizer **78** has a funnel shape which groups the tow **20** in the form of a rope. A plurality of steam nozzles **80** are mounted on the steam plasticizer **78**. The steam nozzles **80** are connected to a source of steam. The bottom of the steam plasticizer **78** slopes downwardly into an outlet tube **82** for permitting condensed steam to escape from the plasticizer **82**.

From the steam plasticizer **78**, the tow passes through a crimp box **84**. The tow is pulled through the steam plasticizer and directed into the crimp box **84** by feed rolls **83** and **85** which gives a positive and controlled rate of feed into the crimp box **84**. The nip rollers **86** and **88** serve to control the discharge from the crimp box **84** and provide a positive feed to the heater **90**. The plasticizer **78** is adjusted to have a temperature of approximately 105° C. to 120° C.

From the nip rollers **86** and **88** the tow is pulled through a radiant heater **90** with a reflector **92**. The radiant heater **90** preheats the tow **20** for setting the crimp in the crimp setter **94**.

The crimp setter **94** comprises a steam chamber **96** having an inlet **98** and an outlet **100**. Steam is sent into the steam chamber **96** through inlet **98** at a temperature of approximately 245°–280° F. for setting type 6 nylon. The upper and lower limits of this range would be about 35–40° F. higher for type 66 nylon. Condensed steam escapes from the chamber **96** through outlet **100**. As used herein, the steam may be referred to as a fluid.

A plurality of idler rollers **110** are mounted in the chamber **96**. As shown, the tow **20** passes over the idler rollers **110** in partial contact therewith. The idler rollers serve to retain the tow **20** within the chamber **96** for a sufficient amount of time to permit the crimp to be set. Thus, although the illustrated diagram shows the tow **20** making partial contact with each of the idler rollers **110**, it should be obvious that if it is desired to lessen the amount of time which the tow **20** is within the chamber **96**, then it is only necessary to reduce the number of idler rollers with which the tow **20** makes contact.

The nip rollers **112** and **114** pull the tow **20** through the crimp setter **94**. The nip rollers **112** and **114** are rotated at a velocity sufficient to retain the tow **20** taut against the idler rollers. From the nip rollers **112** and **114**, the tow **20** may be collected in a container for packaging.

Using the apparatus and method described above, it has been found that the crimp in the fiber may have a sharper definition and more crimps per inch. The reason for this is believed to be because steam is applied to the

tow before the tow enters the crimp box **84**. It is believed that a more uniform steam penetration results therefrom Further, the use of a preheater **90** together with the steam in steam chamber **96** and the ability to control the amount of time that the material is within the chamber **96** results in a sharper crimp definition as and if desired. Moreover, it has been found that the use of a combination of tow stretchers and plasticizers in alternating relationship results in a more uniform dye index for any particular batch of fiber.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. Apparatus for stretching filaments comprising a first means for stretching filaments including a plurality of freely rotatable drag rollers, each drag roller being adapted to be selectively locked, a plurality of driven rollers adapted to pull the filaments around a portion of the drag rollers with a portion of the filament in contact with said driven rollers, a second and third means for stretching filaments similar to said first means, said first, second and third means being in successive operative relationship for stretching the filaments, the driven rollers of said second means and the driven rollers of said third means being adapted to be rotated at successively higher speeds relative to the driven rollers of said first means, the speeds of said second and third driven rollers increasing in the direction of travel of the filaments, a filament plasticizing means operatively located between said first and second and between said second and third filament stretching means, crimping means operatively associated with said third filament stretching means for crimping the filaments stretched thereby, said crimping means including a crimp setting means, said crimp setting means including a steam chamber, means to introduce steam into said chamber, and a plurality of idler rollers mounted within said chamber, and means for pulling said filament serially around a portion of a predetermined number of said idler rollers.

2. Apparatus in accordance with claim **1** wherein each said filament stretching means includes three drag rollers and four driven rollers.

3. Apparatus in accordance with claim **1** wherein a filament plasticizing means is operatively located between said filament stretching means and said crimping means.

4. Apparatus in accordance with claim **1** wherein said first-mentioned plasticizing means are radiant heaters each having a reflective shield positioned so that the tow of filaments may pass therebetween.

5. Apparatus in accordance with claim **1** including means for rotatably supporting a plurality of spools of filaments, and means for guiding the filaments into a tow so that the tow of filaments may be fed to said first-mentioned rollers.

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