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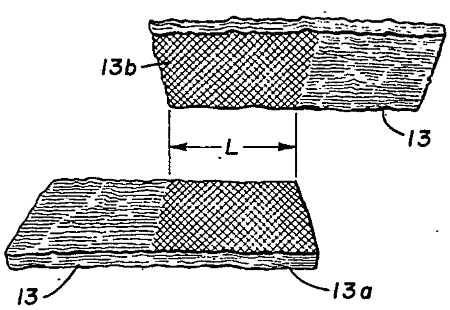
(54) **Method for splicing tows of filaments.**

(57) A method for splicing the ends of a pair of tows of filaments to be fed in succession through a zone where tension is applied to stretch the filaments in the tows, wherein a work-absorbing adhesive is applied to a portion of the filaments in the end of one of the tows and this portion of the tow is positioned in contact with the other tow in an overlapping relationship to form an adhesive bond between the tows. The adhesive is applied along a length of the tow which is a distance, in centimeters, of at least about 25 times the stretch to be applied to the tows and the tows are overlapped such that this length of adhesive contacts both tows. The adhesive has work-absorbing characteristics such that the bond elongates sufficiently to prevent breakage of the bond or the filaments as the tows are passed through the stretch zone under sufficient tension to apply a 1.6X stretch to acrylic filaments having a denier per filament (dpf) of 3 and a breaking tenacity of about 2.5 grams per denier.



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METHOD FOR SPLICING TOWS OF FILAMENTS

BACKGROUND OF THE INVENTION

a. Field of the Invention

This invention relates to methods for splicing tows of filaments to be stretched.

b. Description of the Prior Art

One of the problems facing manufacturers and users of tows of synthetic filaments is that the tows are not of infinite length but have a length which is determined by practical considerations such as tow size and the size of the carton in which the tow is packaged. Various machines are used to perform different operations on tow and, when one carton of tow is emptied, the next tow must usually be manually laced up through the machine by an operator. Normally, the operator merely ties the trailing end of one tow to the leading end of another, using a large knot which must be cut out when it reaches the machine processing the tow. This brings the next tow up to the machine, but it must still be manually laced up through the machine. This takes time and the use of the knot wastes product. This manual lace up also presents a risk of injury to the operator who must do it. It would be desirable to find a method of splicing tows such that the splice will pass through the processing equipment to save the time and labor involved in manually lacing up the tow.

Several methods of splicing tows are known but these are unsuccessful when the tow is to be passed through a machine which first stretches and then breaks the filaments making up the tow to form staple fibers. Such a stretch/break machine applies a tremendous tensile force to the tow in order to first stretch the filaments to their limit and then break them. Known tow splices will not survive tensile forces of this magnitude and usually fail at the location on the machine where the tow is first stretched. The operator must then manually lace the new tow through the machine. This wastes operator and machine time.

Attempts have been made to splice tows by overlapping the tows, placing fabric swatches on opposite side of the tows and then sewing back and forth across the swatches. In the stretch/break machine, such a splice breaks and the tows separate at the edge of the sewed portion while being stretched. It seems probable that damage done to the filaments by the needle used in sewing causes the break at this point.

The filaments in acrylic tows can be fused together by the application of heat, moisture and pressure or by use of ultra-sonic energy. This forms a hard, fused lump which secures the tows together. This type of splice breaks at the edge of the splice when the tows are passed through the stretch zone of a stretch/break machine. It is speculated that the tow breaks at this point because the filaments have been weakened at this point by the heat applied to form the bond.

Air-jets have been used to splice tows to form a strong bond between the tows by tangling the filaments. This type of splice will not withstand the forces which are necessary to stretch and break the filaments in a tow. The splice simply falls apart in the stretch zone and the two tows separate.

It is known to use certain latex types of glue to splice yarns. However, no significant tension is applied to these yarns and no stretching of the yarns is involved.

It is known to use various adhesives or glues to secure one article to another. However, it is not believed to be known that certain adhesives having certain work-absorbing characteristics can be used to splice two tows such that the work-absorbing characteristics of the adhesive will prevent separation of the tows when they are passed through a stretch zone.

SUMMARY OF THE INVENTION

A method for splicing the ends of a pair of tows of filaments to be fed in succession through a zone where tension is applied to stretch the filaments, wherein a work-absorbing adhesive is applied to a portion of the filaments in the end of one of the tows and the adhesive-bearing tow is positioned in contact with the other tow in an overlapping relationship to form an adhesive bond between the tows, the adhesive extending along the overlapped portion of the tows a distance, in centimeters of at least about 25 times the stretch to be applied to the tows. The adhesive has work-absorbing characteristics such that the bond elongates sufficiently to prevent breakage of the bond and the adhered portions of the filaments under sufficient tension to apply a 1.6X stretch to acrylic filaments having a denier per filament (dpf) of 3 and a breaking strength of about 2.5 grams per denier.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic side view of one type of machine used commercially for stretching and breaking tows of filaments to form staple fibers.

Figure 2 is a perspective view of the ends of a pair of tows to be joined, showing the area on one tow where the adhesive of this invention is placed.

Figure 3 is a perspective view showing the tows in overlapped relationship.

Figure 4 is a side view showing the manner in which the leading tow is folded back over the forward end of the trailing tow to form a second work-absorbing bond between the tows.

Figure 5 is a side view of the tows showing the positioning of the two tow ends in the splice.

DETAILED DESCRIPTION OF THE INVENTION

Referring now in detail to the drawing, there is shown in Figure 1 a schematic side view of a machine used commercially for stretch/breaking tows of acrylic and other filaments. The machine includes driven rolls 11 which are tightly nipped with idle rolls 12 to prevent slippage of a tow 13 made up of continuous filaments as the tow passes between the rolls 11 and 12. Each of the rolls 11 along the path of the tow 13 is driven at a higher peripheral speed than the preceding rolls in order to stretch and eventually break the tow of filaments into staple fibers. Reference number 16 denotes a first zone where sufficient tension is applied to the tow to stretch the continuous filaments in the tow to almost the breaking point. Zones 17-20 are break zones, where additional tension is applied to the tow to break the filaments to form staple fibers, the tow exiting from last roll 11 with the appearance of a bundle of continuous filaments but with all of the filaments being in the form of staple fibers. The tow 13 is fed into the machine over guides 21 and exits from the machine through a crimper 22 to be collected in a container 23. This machine is well known.

The present invention discloses a method for splicing the trailing end 13a of one tow 13 to the forward end of 13b of another tow 13 with a splice such that the trailing tow will be pulled through the machine to at least the first break zone, 17, without the tows separating. At this point, or in a subsequent break zone, the operator cuts out and discards the portions of the tows bearing adhesive and laces the new tow through the remainder of the machine. Manual lace-up through the long stretch zone is avoided.

In making the splice of the present invention, an adhesive is applied to one face of one of the tows 13 along a length, L, of the tow. This is illustrated by cross-hatching in Figure 2. The length, L, should be, in centimeters, at least about 25 times the amount the tows are to be stretched in the zone 16. For example, if the filaments in the tows are to be stretched 1.2X in the zone 16, then the length L should be at least about 30 centimeters. As used herein, the term "stretch" means the ratio of the length of the stretched tow leaving the zone 16 to the length of the unstretched tow entering the zone 16. The term "1.2X" means that the tow is stretched to a length 1.2 times its original length. Preferably, the length L is, in centimeters, at least about 35 times the stretch to be applied to the tows. It is also preferred that the adhesive be applied to both tows before they are brought into contact with each other.

The tows are then placed in overlapping relationship as shown in Figure 3 to bond portions of the filaments in each of the tows to portions of the filaments in the other tow. Because of the very large number of filaments in each of the tows 13, it is virtually impossible to bond all of the filaments in one tow to all of the filaments in the other tow. This process is successful where only a small fraction of the filaments in the tows are bonded together.

The adhesive applied to the tow has work-absorbing characteristics such that the adhesive will elongate under tension and allow one tow to slip past the other to thereby relieve tension in the tows and insure that those portions of the tows which are secured together by adhesive will not break and allow the two tows to separate. It is believed that the adhesive will absorb work not only by stretching of the adhesive under tension but also by allowing the filaments to slip through the adhesive. The term "elongation" as used herein is intended to include both stretching of the adhesive and the slipping of the filaments through the adhesive as the tows are stretched. Suitable adhesives include those which are applied as an aerosol, cures at room temperature to a non-tacky state in a few minutes, remains relatively soft even after complete curing and will elongate to allow the desired slippage of one tow relative to the other. Adhesives of this type elongate under tension, are known to those skilled in the art, and are normally used in applications such as securing heavy wall coverings to walls and securing upholstery fabric to foam pads.

Adhesives which cure to a hard state, such as the well known epoxy cements, are not suitable for use in this method for the reason that such adhesives do not have work-absorbing characteristics of the type necessary for splicing two tows as contemplated herein. Also, adhesives which cure to a hard state tend to damage the rubber covering of rolls used in stretch-break machines.

The suitability of an adhesive for use in the method of this invention may be determined by using the adhesive to splice two acrylic tows is described herein. The tows should be made up of acrylic filaments having a denier per filament of 3. A 4.5 meter length of the tows, including the splice, is then subjected to a tensile load sufficient to apply a 1.6X stretch to an unspliced tow of 3 dpf acrylic filaments. Such filaments will require a tensile load of about 2 grams per denier for this stretching. Any adhesive which is suitable will allow the tows to slip along each other in the splice and will not break and thereby allow the tows to separate.

The adhesive should cure, at room temperature and within a period of 15-20 minutes, to the point where it will not adhere to rubber rolls. Also, after the adhesive has stood several hours and is essentially completely cured, it should be softer than the rubber covers on the rolls of the stretch/break machine.

One might expect that the amount of adhesive to be used in this process would have to be carefully controlled. However, it has been found that such control is not necessary. The process will be successful even when only a small percentage of the filaments in the two tows are bonded together.

In the preferred embodiment of the invention, after the tows are placed in contact with each other as above described, additional adhesive is sprayed onto the exposed forward end 13b of the trailing tow as shown in Figure 3 and the leading tow is then folded back as shown in Figure 4 to enclose the forward end of the trailing tow in a fold in the first tow. This produces a second work-absorbing bond to better hold the tows together as they pass through the stretch zone.

The filaments are stretched almost to the breaking point in the zone 16 and some of them may actually break in this zone. Any breaking of the bonded filaments in the stretch zone is prevented by use of the adhesive specified herein, for the reason that elongation of the adhesive reduces tension on those bonded filaments. As the tows are observed in passing through the stretch zone, one can see one tow slipping relative to the other.

CLAIMS

1. A method for splicing tows of filaments to be stretched characterized in that the splicing is accomplished by:

a. applying a work-absorbing adhesive to a portion of the filaments in a first tow along a predetermined length of said tow, and

b. positioning a second tow in overlapping contact with the first tow to bring a portion of the filaments in said second tow into contact with said adhesive to form a bond securing said portions of filaments together, said bond having a length, in centimeters, of at least 25 times the stretch applied to the filaments, said adhesive having work-absorbing characteristics such that said bond will elongate sufficiently to prevent separation of tows under a tensile load sufficient to apply a stretch of 1.6X to acrylic filaments having a denier of 3 and a breaking tenacity of about 2.5 grams per denier.

2. A method of Claim 1, wherein the amount of tow overlap is, in centimeters, at least about 35 times the amount of stretch to be applied to said tows.

3. A method of Claim 1 or Claim 2, wherein the tows are in the form of flat ribbons, with the face of one tow being in contact with a face of the other tow with said bond being therebetween.

4. A method of Claim 3, wherein additional adhesive is applied to the exposed forward end of the second tow and the first tow is folded over said forward end to form a

second work-absorbing bond between said tows.

5. A method of any of Claims 1 to 4, wherein the adhesive will not adhere to rubber roll covers after standing at room temperature for a period of 15-20 minutes.

6. A method of Claim 5, wherein said adhesive has a hardness less than the hardness of said roll covers after said adhesive is fully cured.

7. A method of any of Claims 1 to 6, wherein said tensile load is about 2 grams per denier of said filaments.

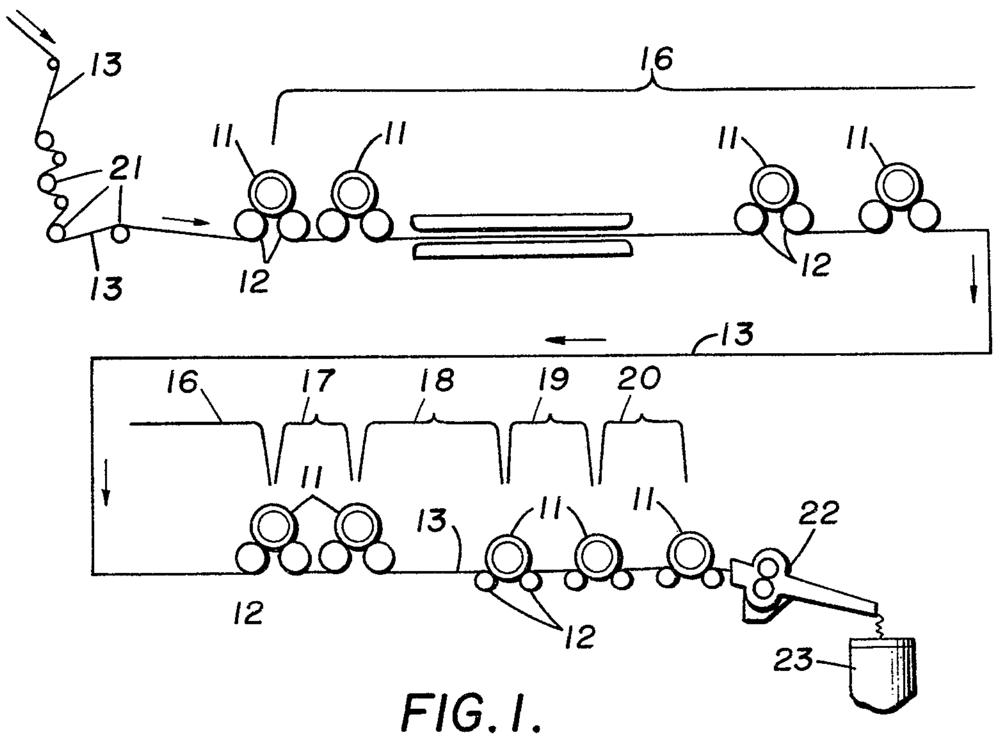
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FIG. 1.

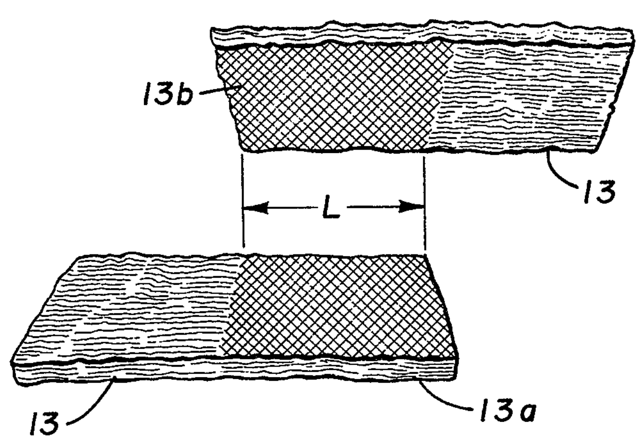
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FIG. 2.

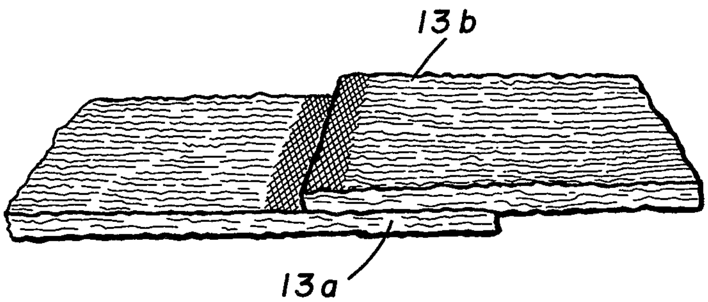

FIG. 3.

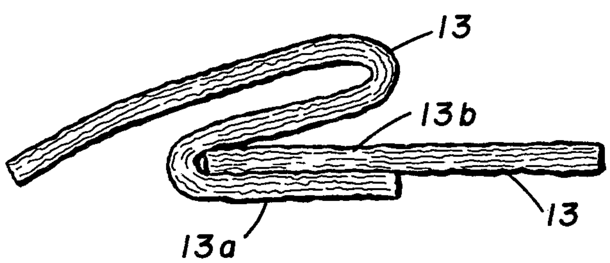

FIG. 4.

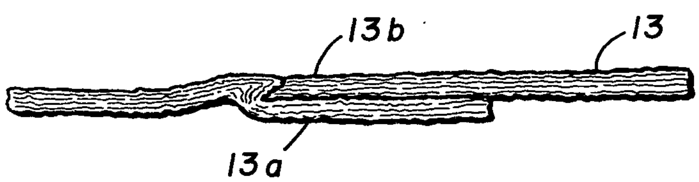

FIG. 5.

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EUROPEAN SEARCH REPORT

0043710

Application number
EP 81 30 3034

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 1 250 629 (IMPERIAL CHEMICAL INDUSTRIES) * Page 1, lines 85-95; page 2, lines 23-67; figures 1-3 * ---	1,3,4
	GB - A - 1 350 074 (COURTAULDS) * Page 1, lines 63-90; page 2 * ---	1
	US - A - 3 367 813 (DU PONT DE NEMOURS) * Column 2, lines 53-72; column 3, lines 1-46 * --------	1

CLASSIFICATION OF THE APPLICATION (Int. Cl.3)

B 65 H 69/02

TECHNICAL FIELDS SEARCHED (Int. Cl.3)

B 65 H 69/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25.08.1981	DEPRUN