United States Patent [19]

Bolliand et al.

[11] **3,848,295**

[45] **Nov. 19, 1974**

[54] **PROCESS OF MAKING A BULKED PADDING WEB**

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[22] Filed: **Feb. 5, 1973**

[21] Appl. No.: **329,544**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 161,627, July 12, 1971, Pat. No. 3,737,950.

[30] **Foreign Application Priority Data**

July 10, 1970 France 70.26734

[52] **U.S. Cl.** ..... **19/65 T**

[51] **Int. Cl.** **D01d 11/02**

[58] **Field of Search** ..... 19/65 T, 66 T; 28/71.3

[56] **References Cited**

UNITED STATES PATENTS

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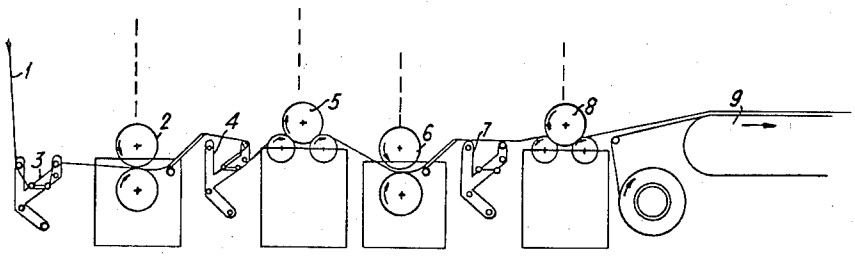
[57] **ABSTRACT**

Method for making padding web is disclosed, wherein uncut, highly crimped, tensioned tow is passed through a series of rollers. The rollers are arranged in at least two sets of pairs, the rollers of each pair rotating at different peripheral velocities. The ratio of peripheral velocities is higher for the upstream pair of rollers. The upper rollers of the two pairs rotates faster than the lower rollers thereof.

The padding web produced is suitable for stuffing articles such as bed covers, sleeping bags, anoraks, and the like.

8 Claims, 4 Drawing Figures



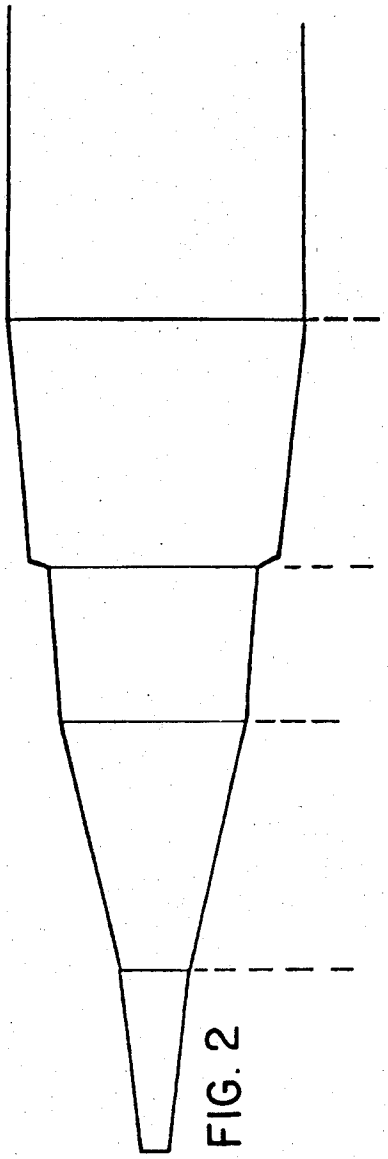


FIG. 2

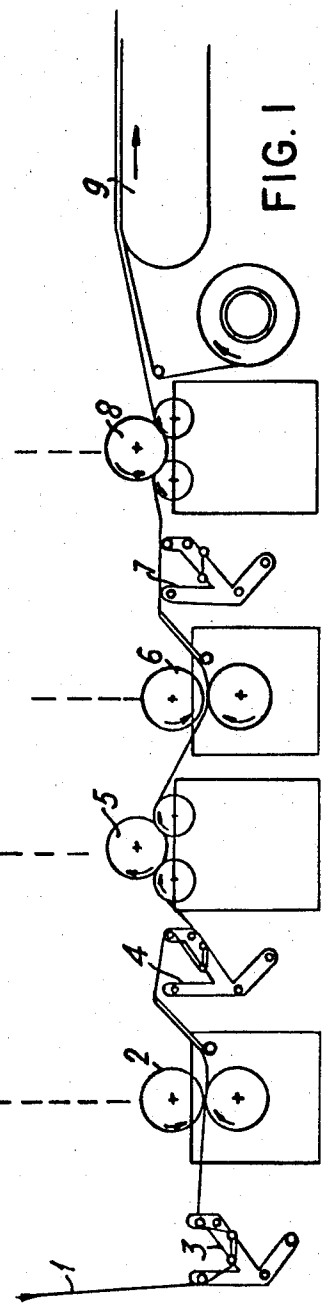


FIG. 1

FIG. 3

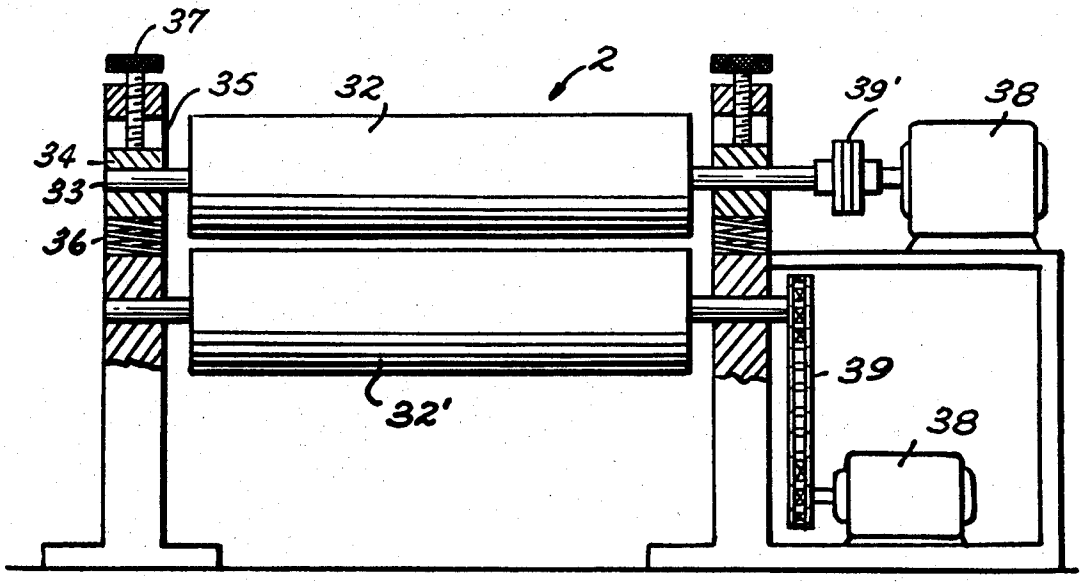
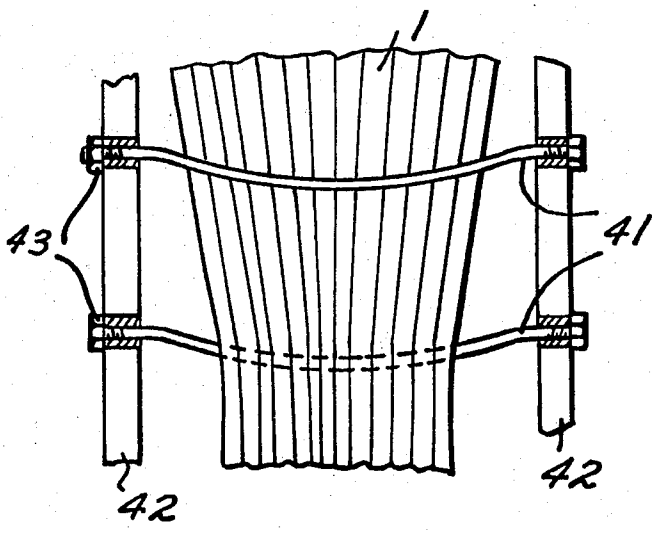


FIG. 4



PROCESS OF MAKING A BULKED PADDING WEB

This application is a continuation-in-part of our copending application, Ser. No. 161,627, filed July 12, 1971, now U.S. Pat. No. 3,737,950.

BACKGROUND OF THE INVENTION

The prior art has used natural materials, such as down, animal hair or feathers, for stuffing articles. However, such natural materials are expensive and have numerous practical disadvantages, particularly as regards cleaning. The prior art has proposed to use synthetic fibers for padding uses, with the fibers being used as such or in the form of flock or sheets. However, such synthetic fibers tend to agglomerate and to penetrate the coverings containing same after a certain time of usage, and especially, above all, after washings.

French Patent No. 1,418,403 describes a process of opening and spreading a tow of continuous crimped filaments, by passing the filaments between two rollers, at least one of which is grooved, with spreading of the filaments to 1.5 to 6 times the original width thereof on curved bars or on air spreaders.

French Patent No. 1,540,268 describes a process for making dense and wavy padding webs by passing tow between two rubbing rollers having different peripheral speeds. The mat obtained is heavily corrugated, generally with the corrugation fixed, by means of subsequent application of a resin. The end products produced by such a process have an irregular appearance, because the corrugations are readily apparent, and this appearance is unacceptable for certain applications, in particular for quilting. The products produced by this process are also too heavy to permit their use in light weight articles.

In order to avoid the visible corrugations produced using the process of the aforesaid French Patent No. 1,540,268, it has been proposed in U.S. Pat. application Ser. No. 32,778, filed Apr. 28, 1970, now U.S. Pat. No. 3,696,185, to produce mats having a relatively flat external surface by using two pairs of smooth rollers with the upper roller of the first pair of rollers having a higher peripheral speed that the lower roller of the pair, and the upper roller of the second pair of rollers having a lower peripheral speed that the lower roller of the pair. The mats obtained are of very high quality but practical disadvantages have been found in such a process, particularly as regards the regulation of the roller velocities and the feed rate.

SUMMARY OF THE INVENTION

The present process for making padding suitable for stuffing articles includes the steps of feeding tensioned tow through an upstream pair of parallel rollers comprising an upper upstream roller and a lower upstream roller, thereafter feeding said tow through a downstream pair of parallel rollers comprising an upper downstream roller and a lower downstream roller, wherein said downstream pair of rollers are substantially parallel to said upstream pair of rollers, while rotating each roller in the same direction, relative to the direction of travel of said tow, and at a different peripheral speed for each roller of each pair of rollers from the other roller of the pair, the upstream pair of rollers having a higher ratio of peripheral speeds than the downstream pair, and the upper rollers of the two pairs having a higher peripheral speed than the lower rollers. The process is practiced on apparatus which includes

an upstream pair of rollers comprising an upper upstream roller and a lower upstream roller, said rollers being parallel to one another, a downstream pair of rollers comprising an upper downstream roller and a lower downstream roller, said downstream rollers being parallel to one another and substantially parallel to said upstream rollers, feeding means to feed continuous filaments through said rollers in the direction from said upstream rollers to said downstream rollers, and rotating means to rotate each roller in the direction of movement of said filaments, with the periphery of each roller of each pair of rollers moving at a different speed from the other roller of the pair, the upstream pair of rollers having a higher ratio of peripheral speeds than the downstream pair of rollers, and the upper rollers of the two pairs having a higher peripheral speed than the lower rollers.

DESCRIPTION OF THE INVENTION

The present invention provides a method of making padding for stuffing articles comprising feeding tensioned tow through an upstream pair of rollers and then through a downstream pair of rollers, each pair of rollers having its respective rollers rotating at different peripheral speeds, the upstream pair of rollers having a higher ratio of peripheral speeds than the downstream pair of rollers, and the upper rollers of the two pairs of rollers rotating at a higher peripheral speed than the lower rollers. The padding produced by the present invention is generally readily compressible and slightly elastic, having a comparatively flat external surface. Such padding is highly suitable for stuffing articles such as quilts or other bed covers, sleeping bags, anoraks and the like. The continuous crimped tow used in the process or/and apparatus of this invention is a collection of a great number of continuous filaments with little, if any, twists or interlacing. Normally tows are merely intermediate products, which are later transformed to discontinuous fibers by cutting or crushing. In contrast, in the present invention, the starting tow is not cut. The tow will be heavily crimped, however, by known means, such as, for example, by means of a stuffing box.

The tow used may be of any synthetic textile filament, such as polyamides, including Nylon 6, Nylon 66, Nylon 610, Nylon 11, etc., polyolefins, such as polypropylene, vinyl polymers, acrylic polymers, polyester polymers and the like. Particularly good results have been achieved with polyester filaments, especially polyethylene terephalate.

The tow may be under a tension conventional in the art, such as, e.g., 1 to 5 kg, preferably 1.5 to 2.8 kg. The tow is preferably opened during processing according to the present invention, generally by a factor of about one to four times the original width of the tow. However, such opening may be unnecessary in certain cases, depending upon the specific tow used and the intended application of the padding.

The distance between the smooth rollers of each pair of rollers conveniently is adjustable. This distance between rollers depends mainly upon the thickness of the tow of continuous filaments, and the thickness of the desired padding mat. The spacing may conveniently vary, for example, between 0 and 1 mm, although greater spacing will be used in certain situations, i.e., up to 5 mm and even higher.

In a number of applications the padding produced by the present process will be treated with a thermosetting resin to enhance the cohesion of the resulting mat. Such treatment is known to the art, with the resin generally applied by spraying and then the resin-treated mat is subjected to a curing operation in order to cure the resin. In most instances, this curing operation will be a thermal treatment in a curing oven or the like, although chemical curing treatments may also be used, such as for instance, passing the treated mat through an atmosphere of steam or other gas or liquid.

It will be appreciated that the padding produced according to the present invention is obtained directly from tows without passing of the tow through carding machines. The padding webs of the present invention may be used, in certain applications, as a substitution for carding webs.

When used in the present specification the term "ratio of peripheral speeds" refers to the ratio of the peripheral speeds of the upper and lower rollers of a given pair of rollers, with the peripheral speed of the roller having the highest peripheral speed divided by the peripheral speed of the roller having the lowest peripheral speed. The two pairs of rollers have the upper rollers having the highest peripheral speed.

The continuous crimp tow feed rate may vary over a wide range but suitably would be from 10 to 25 meters/minute, preferably 12 to 15 meters/minute.

DESCRIPTION OF THE DRAWING

The invention will be more clearly understood with reference to the accompanying drawing wherein

FIG. 1 is a schematic diagram of the apparatus of the present invention and

FIG. 2 is a diagram illustrating the width of the tow at corresponding stages in the apparatus of FIG. 1.

FIG. 3 is a cross-sectional view of the upstream pair of smooth rollers 2 illustrating the means of rotation thereof, as well as the means for adjusting the gap between the rollers.

FIG. 4 is a view of the arched bar spreaders.

As shown in FIG. 1, a tow 1 of continuous, crimped filaments is removed from a storage bin (not shown) and continuously fed past arched bar spreaders and stretchers (not shown) and through the upstream pair of smooth rollers 2. The rollers rotate in opposite axial directions, but in the same direction relative to the direction of travel of the tow, i.e., both rollers travel in the direction of the tow. In other words, adjacent portions of the two rollers constituting each pair of rollers move in the same direction, which direction is from the upstream pair to the downstream pair. Spreader 3 located before the first pair of rollers 2 imparts a good, uniform appearance to the tow.

The axes of the first pair of smooth rollers 2 are parallel, and the adjustment between the rollers is adjustable. The rollers are adjusted to a separation which depends mainly upon the thickness of the tow and also upon the thickness of the padding mat. The surface of the smooth rollers 2 as well as the smooth rollers 6 is of a material having a high coefficient of friction, preferably rubber of 60°–70° shore hardness. The surface of the rollers may be of various other materials having similar high coefficient of friction as known to the art. The ratio of peripheral speeds of the upper and lower rollers of the upstream pair of rollers 2 is greater than 5, preferably between 5 and 10.

After passing between upstream pair of rollers 2, the tow then passes over spreader 4 comprising a series of arched bars, and then over holding rollers 5, which comprise 3 drums which serve to maintain the spread of the mat and control the mat tension. The tow then passes between the downstream pair of smooth rollers 6, which have a ratio of peripheral speeds of less than 5 and preferably between 3 and 5. The spacing of the downstream pair of rollers 6 is also adjustable and can be varied according to the thickness of the tow and of the desired mat.

Depending upon the desired width of the mat or padding web desired, the mat may be passed over an additional spreader 7 which consists of one or several arched bars. The mat is then passed into a set of holding rollers 8 and then to a moving belt 9. While on moving belt 9, the mat may be, if necessary, treated with a thermosetting resin, e.g., by spraying, with the resin-treated mat then being thermally treated to enhance the cohesion of the resulting mat or padding web.

The upstream pair of rollers 2 comprises an upper roller 32 and a lower roller 32'. The shaft 33 of upper roller 32 is supported by bearing 34 which rides in sleeve 35. Bearing 34 is urged upwardly by spring 36 and is adjustable by way of set screw 37. Roller 32' is driven by variable speed motor 38 through chain drive 39, and roller 32 is directly driven, through universal joint 39', by variable speed motor 38'.

The universal joint 39' is used because of the displacement of roller 32 during adjustment of the gap between rollers 32 and 32'. Two variable speed motors 38 and 38' are illustrated, and are greatly preferred, but it will be appreciated that in some instances one of the rollers may be driven by a constant speed motor. The transmission of power for motor 38 to roller 32' is preferably by way of a chain 39 rather than a belt drive in order to avoid slippage.

In FIG. 4 arched bars 41 are carried by rails 42. The tow 1 is illustrated passing over one bar 41 and under the next. The bars 41 are retained in rails 42 by adjusting nuts 43, which enable some rotational adjustment of the arched bars 41.

The process of the present invention produces a significant bulking or thickening of the resulting web, with the web density being controlled by various process parameters such as the relative speeds of the rollers and the coefficient of friction between the filaments and the roller surfaces. Thus, a web having significantly increased thickness, as compared to similar webs obtained by using conventional air spreaders, may be obtained.

While the process of the present invention is not to be limited to any particular theory or explanation, it is believed that the two faces of the web are caused to move at different speeds when passing through a pair of rollers. The face of the web which is in contact with the low speed roller will move at a speed which is proportional to the speed of that roller, while the other face of the web is moving at a greater speed which is proportional to the speed of the high speed roller with which it is in contact. It will be clear that the proportional nature of the web speed, as opposed to the actual roller speed, depends primarily on the coefficient of friction between the filaments of the web and the surface of the roller.

With the faces of the web moving at different speeds, one web face is essentially restrained as compared to

the other web face. In other words, there is a displacement of the filaments of the web face in contact with the high speed roller, as compared to the filaments of the other web face. As a result, undulations are formed in the filaments of the web face in contact with the high speed roller, and these undulations produce a bulking of the web. These undulations are significant for the web face in contact with the high speed roller, but there are practically no undulations on the other web face.

In addition to causing a web bulking, the frictional effect of the two rollers also results in filament separation and opening of the web. It is possible that, for given process conditions, the bulking produced by the rollers is too great, and/or that the web face containing the undulations is not plane enough. In this event, the web may be placed under tension by being passed through arched spreader bars and/or holding rollers **5.** This tension destroys a portion of the bulking effect, but the web opening is improved and the web faces are made more plane. The passage through the second pair of differential speed rollers produces additional separation and opening of filaments and results in an additional bulking effect. If desired, the web may then be again passed through arched spreader bars and/or holding rollers to obtain a web having relatively plane faces.

EXAMPLES

The invention will be understood more readily by reference to the following example; however, this example is intended to illustrate the invention and is not to be construed to limit the scope of the invention.

EXAMPLE 1

A polyethylene terephalate tow of crimped filaments of 110,000 dtex. about 6.7 dtex per strand, was fed to spreader **3** under a tension of 1.5 kg at a feed rate of 5 meters/minute. The tow, which had been spread to three times its original width, was then fed between the rollers of upstream pair of rollers **2,** with the upper roller being driven at a peripheral speed of 7.10 meters/minute and the lower roller at a speed of 1.40 meters/minute. The rollers were spaced 1/10 mm apart. The tow was then spread over four arched bars of spreader **4** and through the set of holding cylinders **5,** all of which cylinders or rollers revolved at a speed of 4.80 meters/minute. In the set of holding cylinders **5,** the width of the mat was 33 cm. Holding cylinders **5** served to control the tension for the passage of the mat between the rollers of downstream pair of rollers **6.**

The mat was passed between the smooth rolls of downstream pair of rollers **6,** with the upper roller thereof rotating at a peripheral velocity of 5 meters/minute and the lower roller rotating at a rate of 1.80 meters/minute. The downstream pair of rollers **6** were spaced 1/10 mm apart.

The surface of each roller of upstream pair of rollers **2** and downstream pair of rollers **6** was of rubber of 65° shore hardness.

The mat was then passed through holding rollers **8,** wherein the mat had a width of 51 cm. The mat was discharged on moving belt **9** at a rate of 4.50 meters/minute, having a weight about 22 grams per square meter.

The resulting mat is suitable for padding a variety of articles, such as anoraks and sleeping bags, for example. The padding web could also be used for thermal and acoustical insulation, as a coating support, or as a reinforcing element for plastic materials, laminants, etc. Depending upon the count (number of filaments) of the starting tow and the ultimate end use, the mat may be employed singly, or several mats may be superimposed, before or after the optional treatment with a thermosetting resin.

What is claimed is:

1. Method of making a bulked padding web, said method comprising the steps of

a. feeding tensional tow through an upstream pair of parallel rollers comprising an upper upstream roller and a lower upstream roller;

b. thereafter feeding said tow through a downstream pair of parallel rollers comprising an upper downstream roller and lower downstream roller, wherein said downstream pair of rollers are substantially parallel to said upstream pair of rollers; and

c. while rotating each roller in the same direction, relative to the direction of travel of said tow, and at a different peripheral speed for each roller of each pair of rollers from the other roller of the pair, the upstream pair of rollers having a higher ratio of peripheral speeds than the downstream pair, the ratio of peripheral speeds of said downstream rollers being less than 5, and the upper rollers having a higher peripheral speed than the lower rollers;

whereby a bulked padding web is obtained.

2. The method as claimed in claim **1,** wherein said ratio is between 3 and 5.

3. The method as claimed in claim **1,** wherein the ratio of peripheral speeds of the upstream pair of rollers is greater than 5.

4. The method as claimed in claim **3,** wherein said ratio is between 5 and 10.

5. The method as claimed in claim **1,** wherein the surfaces of said rollers are smooth.

6. The method as claimed in claim **1,** including the further step of passing the tow through a set of holding rollers after the tow passes through at least one of said pairs of rollers.

7. The method as claimed in claim **1,** further including the step of spreading the tow over arched bars prior to passing said tow through at least one of said pairs of rollers.

8. The method as claimed in claim **1,** wherein said tow comprises continuous crimped filaments of polyethylene terephthalate.

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